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3/13/14 Carmen Johnson

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DIVISION OF SOLID WASTE MANAGEMENT
DATE 8/9/95 BY

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WASH. CNTY C&D
94-04 BINDER 2 OF 2

CONSTRUCTION PLAN REPORT

FOR

WASHINGTON COUNTY

CONSTRUCTION AND DEMOLITION
WASTE LANDFILL AND TIRE MONOFILL

Binder 2 of 2

RECEIVED
AUG 7 1995
SOLID WASTE MANAGEMENT
FAYETTEVILLE REGIONAL OFFICE

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AUG - 4 1995
ON

Prepared by:

Diehl & Phillips, P.A.
Consulting Engineers
219 E. Chatham Street
Cary, NC 27511
919-467-9972

NORTH CAROLINA PROFESSIONAL SEAL 13371 ENGINEER ALAN R. KEITH

6/11/95

Revised 8/3/95

CONSTRUCTION PLAN REPORT

FOR

WASHINGTON COUNTY

CONSTRUCTION AND DEMOLITION
WASTE LANDFILL AND TIRE MONOFILL

Prepared by:

Diehl & Phillips, P.A.
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219 E. Chatham Street
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6/12/95

Revised 8/3/95

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

The County of Washington contracted with Diehl & Phillips, P.A. to complete construction plans for a construction and demolition waste (C&D) landfill and a tire monofill. The landfill will be constructed on County-owned land at the end of NCSR 1363 off NC 308 between Plymouth and Roper, NC. The site is adjacent to the closed Washington County Sanitary Landfill. The site has been approved for use as a C&D landfill and tire monofill by the North Carolina Division of Solid Waste Management. A copy of the site application approval letter is enclosed in the Appendix.

The proposed C&D landfill will be constructed above ground using dikes. The dikes for the initial construction will consist of processed silica (PS) or alum mud which is stockpiled on the closed sanitary landfill site and in the unused south berm of the existing landfill. Information regarding the PS is included in the Appendix. The closed sanitary landfill utilized the PS for dikes which enclosed a vertical expansion of the sanitary landfill.

Cover material will be excavated from the land surrounding the C&D landfill and the tire monofill. A 200-foot buffer will be maintained between the landfill/monofill and the property line. A 50-foot buffer will be maintained between the landfill/monofill, borrow areas and wetlands. Wetlands on the site have been delineated according to U.S. Army Corps of Engineers criteria.

The proposed landfill/monofill will use the existing truck scales, office and maintenance building at the entrance to the facility. Access to the landfill/monofill is controlled by an existing lockable gate at the end of NCSR 1363. The exiting gate is the only vehicle access to the site.

A tire cutter will be used to slice tires prior to disposal in the tire monofill. A temporary shed will be erected over the tire cutter next to a proposed temporary tire stockpile area. No commingling of tires and C&D waste is proposed.

2.0 SITE DATA

The proposed Washington County C&D landfill and tire monofill will serve the residents of Washington County, North Carolina (1995 population estimated at 14,450). The following is data regarding the landfill:

Owner: County of Washington, North Carolina
Washington County Courthouse
PO Box 1007, Plymouth, NC 27962
919-793-5823
Fax: 919-793-9788

Operator: Norman Furlough, Landfill Superintendent
Washington County Landfill
NCSR 1363, Roper, NC
PO Box 1007, Plymouth, NC 27962
919-793-5615

Equipment Available:	One (1) caterpillar 953 tracked loader, one (1) Caterpillar D8 bulldozer, one (1) dragline, one (1) tandem dump truck, one (1) tractor with implements, one (1) pick-up truck, one (1) tire slicer
Landfill Operator:	One (1) full time and Landfill Superintendent
Size of Tract:	71 acres total

Total Available Volume of Phase 1 C&D Area:

335,000 Cu Ft or 12,400 Cu Yds

Total Available Volume of Phase 1 Tire Monofill:

140,00 Cu Ft or 5,185 Cu Yds

Estimated Annual C&D Waste Receipt:	750 Tons
Estimated Annual Tires Receipt:	220 Tons
Projected Life of Phase 1 Facility:	5 Years

3.0 PROPOSED CONSTRUCTION

The landfill/monofill is proposed to be constructed above ground to provide adequate buffer between waste and groundwater. Minor grading will be required to provide positive drainage from active landfilling areas. The accompanying plans indicate proposed grading and site development.

Processed silica (PS) stockpiled on the existing closed sanitary landfill site and in the unused berm will be moved into the landfill/monofill area using the County's dump truck, placed and compacted to form the Phase 1 berms. A long berm along the north edge of the landfill and three short berms perpendicular to the north berm are proposed to form the Phase 1 operational areas. A 15-foot high berm with 2:1 outer slopes, 1.5:1 inner slopes and a 10-foot wide top are proposed. The PS will be placed in lifts 6 to 9 inches in thickness and compacted using the County's tracked equipment. The above methods were used to successfully construct several thousand linear feet of berms for the sanitary landfill vertical expansion. The existing berms are stable with no known slope failures to date. Slope stability data related to the PS is included in the Appendix. Earthwork calculations are included in Section 4.0.

Expansion of the landfill for future phases would be accomplished by extension of the short berms and construction of the southern berm. This would be accomplished by using PS in the existing unused southern berm constructed for the sanitary landfill vertical expansion.

Landfilling will begin against the center berm and proceed east and west in lifts approximately 5-feet high. Interim cover will be placed on the waste cells as required by Solid Waste Management Rules. Six inches of interim cover is proposed to be placed weekly or when the

active area reaches 1/2 acre (150' X 150') in size. A total of three lifts of waste would carry the waste to the top of the berm. Landfilling according to permit requirements will continue until the first phase is filled. Depending upon permitting, the landfill would be closed or additional phases constructed following Phase 1.

Closure of the landfill would be accomplished by installing a final 2-foot thick cap on the waste per Solid Waste Management Rules. Grading of the working face at the end of the landfilling for positive drainage would be performed prior to capping.

At this time there are no proposed uses for the landfill site after closure except storage of County-owned equipment, recycle goods stockpiling and/or temporary storage, and vehicle maintenance at the existing maintenance building. The area immediately surrounding the landfill will not be used. The site will be left as open land.

4.0 EARTHWORK CALCULATIONS

Berm Construction:

Berm Area: 545 Sq.Ft./Linear foot for 15' High Berm

North Berm: 510 LF X 545 SF/LF = 277,950 CF

$\frac{2 \text{ X } 545 \text{ SF/LF}}{2}$ X 30 LF = 16,350 CF

Total Volume of North Berm: 294,300 CF = 10,900 CY

East and West Berm:
2 X 70 LF X 545 SF/LF = 76,300 CF = 2,825 CY

Middle Berm: 70 LF X 488 SF/LF = 34,160 CF = 1,265 CY

Total Volume Phase 1 Berms: 14,990 CY

Interim Cover:

C&D Waste:

750 Tn/Yr X 2000 Lbs/Tn = $\frac{1,500,000 \text{ Lbs/Yr}}{600 \text{ Lbs/CY}}$ = 2,500 CY/Yr

Assume waste placed in three lifts totaling 13' in height, 20' wide

2500 CY = $\frac{67,500 \text{ CF}}{13'}$ = $\frac{5,192 \text{ SF}}{20'}$ = 260' Long Working Area

Annual area to be covered =
260' X 20' X 2' Thick = 10,400 CF = 385 CY

Total Annual Interim Cover for C&D = 385 CY

Tires Waste:

220 Tn/Yr X 2000 Lbs/Tn = $\frac{440{,}000 \text{ Lbs/Yr}}{300 \text{ Lbs/CY}}$ = 1,467 CY/Yr

Assume tires placed in three lifts totaling 13' in height, 20' wide

1467 CY = $\frac{39{,}600 \text{ CF}}{13'}$ = $\frac{3{,}046 \text{ SF}}{20'}$ = 152' Long Working Area

Annual area to be covered =
152' X 20' X 2' Thick = 6,080 CF = 225 CY

Total Annual Interim Cover for Tires = 225 CY
Total Annual Interim Cover for C&D = 385 CY

Total Annual Interim Cover for Waste = 610 CY

Total Phase 1 Interim Cover Requirements = 3,050 CY

Final Cap:

Phase 1 Cap:

510' X 100' X 2' = $\frac{102{,}000 \text{ CF}}{27}$ = 3,778 CY

Total Cover Requirement for Phase 1 = 6,830 CY

Available Cover (See Appendix)

Cover available from area west of disposal area:	1,864 CY
Cover available from area south of disposal area:	7,030 CY
Cover available for future phases:	15,483 CY

5.0 SOLID WASTE MANAGEMENT COMPLIANCE DATA

The proposed landfill/monofill will be constructed and operated according to North Carolina Division of Solid Waste Management Rules (Rules). The following describes compliance with Section .0503(2) of the Rules:

a. Explosive gas shall be monitored and/or vented according to the requirements of the Rules.
b. Access to the site is limited to a single vehicular access point which is at the landfill office and can be closed using a lockable gate.
c. Surface water discharge shall be covered under general National Pollutant Discharge Elimination System (NPDES) permitting for landfills. The Division of Environmental Management has stated that C&D landfills and tire monofills are exempt from NPDES permits.

d. A groundwater monitoring plans has been developed for this facility by S&ME, Inc. A copy of the plans in included in the Appendix. Monitoring wells for the proposed facility are shown on the construction plans.

e. Open burning is not proposed at the site. Accidental fires would be controlled by landfill personnel using grading equipment or if necessary, by local volunteer fire departments.

f. A 200-foot buffer is provided between the site property line and disposal and borrow areas.
A 50-foot buffer is provided between wetland areas and disposal and borrow areas.
No private dwellings or wells are within 500 feet of the disposal area.
No streams or rivers are located on the site.

g. A sedimentation and erosion control plan will be submitted to the North Carolina Division of Land Resources with the construction plans. No work will take place without approval by the Division of Land Resources.

APPENDIX

* NOTE: REFER TO CONSTRUCTION PLAN REPORT DATED JUNE 15, 1995 FOR THIS SECTION, BINDER 1 OF 2

NORTH CAROLINA DIVISION OF SOLID WASTE MANAGEMENT
SITE APPLICATION APPROVAL LETTER

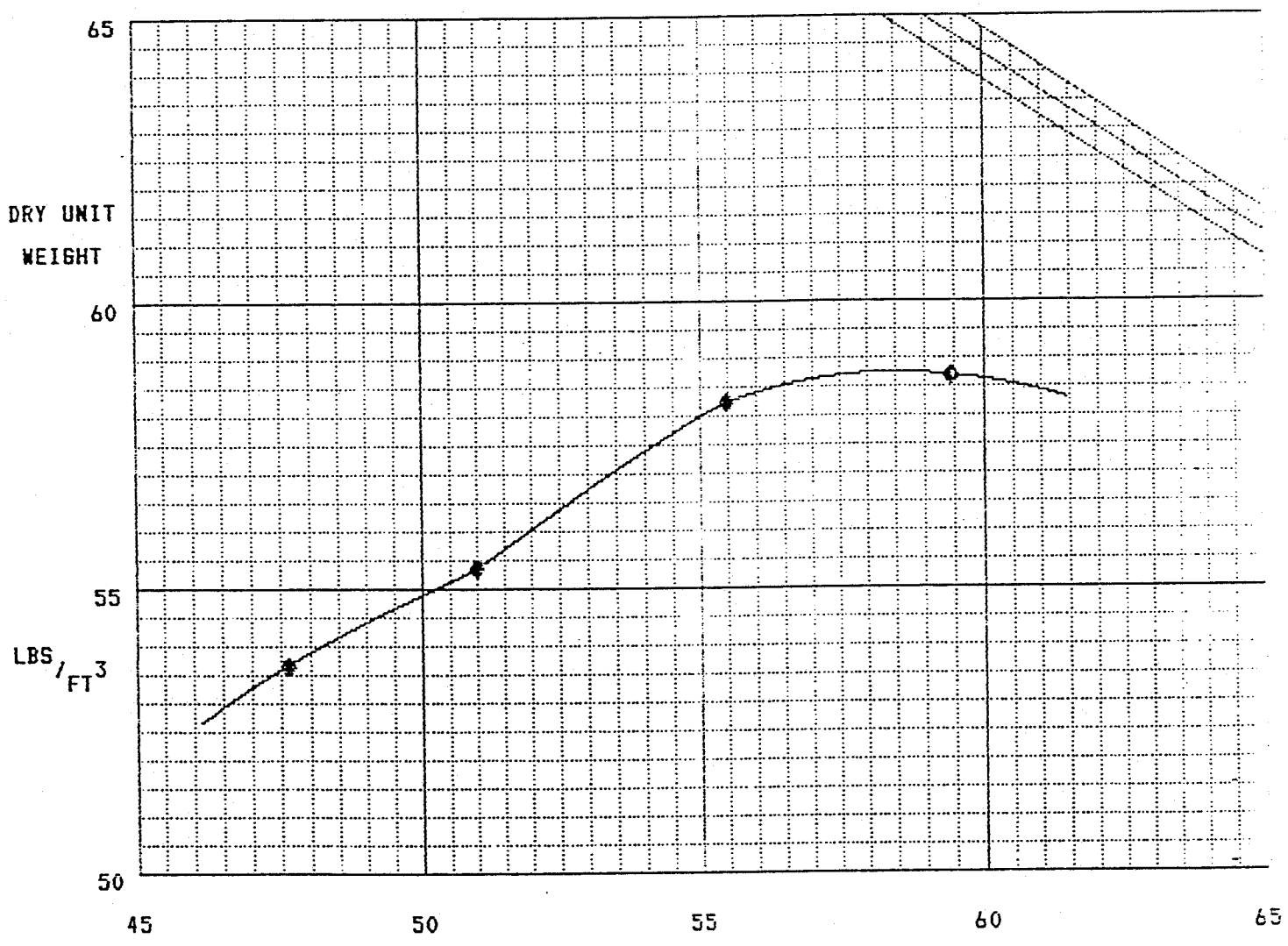
LAW ENGINEERING

STANDARD PROCTOR REPORT
ASTM D-698A

DATE: JANUARY 31, 1991
PROJECT NUMBER: WASHINGTON COUNTY LANDFILL
PROJECT NAME: J-6356
CLIENT: DIEHL & PHILLIPS
SAMPLE NUMBER: 3
FIELD MOISTURE:

SOIL DESCRIPTION:
ALUM MUD
PROPOSED USE:
LANDFILL BERM
SOURCE LOCATION:
WEYERHAEUSER CO.; PLYMOUTH, NC

MOISTURE - DENSITY RELATIONSHIP



OPTIMUM MOISTURE CONTENT 58.5 MAXIMUM DRY DENSITY 58.7

Bob Teel

LAW ENGINEERING

REPORT OF COEFFICIENT OF PERMEABILITY

CLIENT: County of Washington
c/o Diehl & Phillips

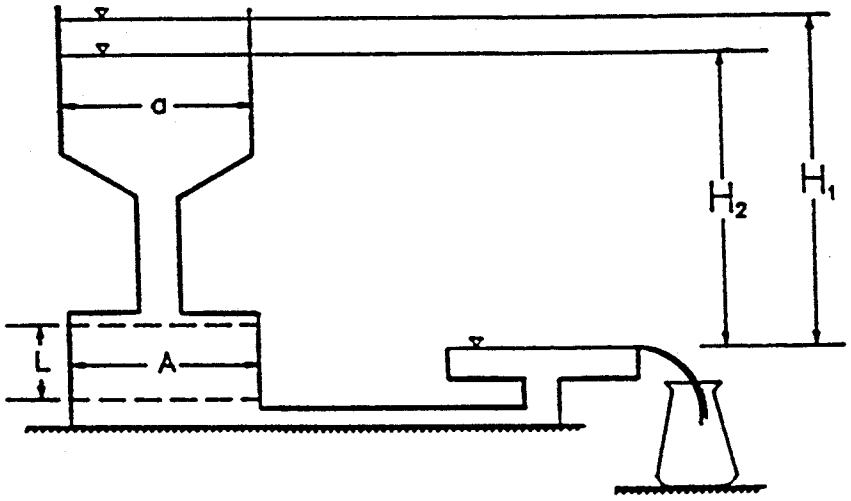
DATE: February 6, 1991

PROJECT: Washington Co. Landfill

JOB NO.: J-6356

Bag #3, Remolded
Unsaturated

$$K = \frac{2.3al}{At} \times \log_{10} H_1/H_2$$



a = 1.27 cm^2

l = 5.50 cm

A = 42.12 cm^2

t = as shown

H_1= 102.23 cm

H_2= as shown

K = as shown

t (sec)	H_2 (cm)	K (cm/sec)
60	100.01	8.422×10^{-5}
600	96.84	1.213×10^{-5}
13,920	71.12	2.071×10^{-6}

LAW ENGINEERING

REPORT OF COEFFICIENT OF PERMEABILITY

CLIENT: County of Washington
c/o Diehl & Phillips

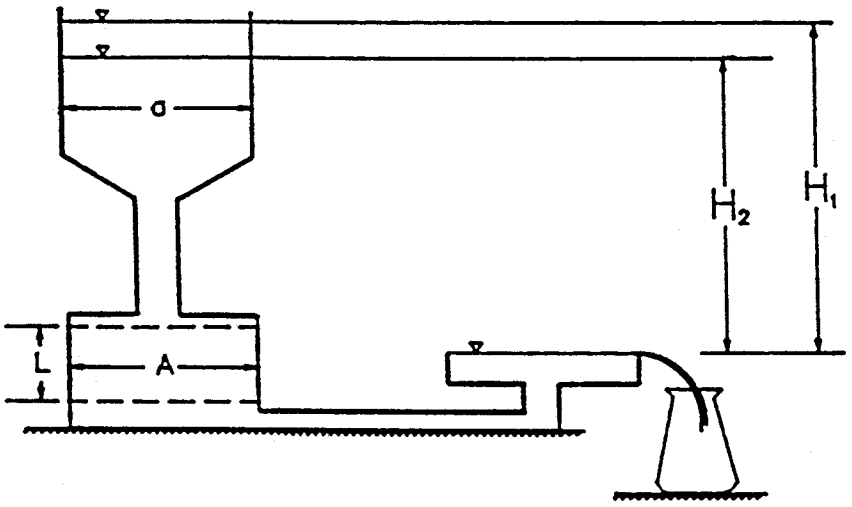
DATE: February 6, 1991

PROJECT: Washington Co. Landfill

JOB NO.: J-6356

Bag #3, Remolded
Saturated

$$K = \frac{2.3al}{At} \times \log_{10} H_1/H_2$$



a = 1.27 cm^2

l = 5.50 cm

A = 40.67 cm^2

t = 1740 sec

H_1= 100.33 cm

H_2= 97.79 cm

$K = 2.53 \times 10^{-6}$ cm/sec

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:21 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356
Client: WASHINGTON COUNTY
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - SATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 1

Sample No. 1 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	1.48	1.36	
Height change, in		0.09	
Height, in	3.00	2.91	
Weight, grams	122.2		
Water volume change, cc		5.33	
Moisture, %	58.8	51.9	58.8
Dry density, pcf	56.8	69.7	
Saturation, %	81.5	100.0	
Void ratio	1.912	1.375	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.1657 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.670 % per minute
Consolidation cell pressure = 15 psi
Consolidation back pressure = 10 psi
Consolidation effective confining stress = 5 psi
Peak deviator stress = 11.72 psi at reading no. 5
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	20.0	0.0	0.0	0.00	5.00	5.00	1.00	10.0	5.00	0.00
1	0.0300	0.015	26.0	1.0	0.5	0.68	5.00	5.68	1.14	10.0	5.34	0.34
2	0.0450	0.030	60.0	6.6	1.0	4.54	5.00	9.54	1.91	10.0	7.27	2.27
3	0.0600	0.045	97.0	12.8	1.5	8.69	4.80	13.49	2.81	10.2	9.14	4.34
4	0.0750	0.060	114.0	15.6	2.1	10.55	4.60	15.15	3.29	10.4	9.87	5.27
5	0.0900	0.075	125.0	17.4	2.6	11.72	4.50	16.22	3.60	10.5	10.36	5.86

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:21 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356
Client: WASHINGTON COUNTY
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - SATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 1

Sample No. 2 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	1.48	1.38	
Height change, in		0.08	
Height, in	3.00	2.93	
Weight, grams	122.2		
Water volume change, cc		2.41	
Moisture, %	58.8	55.7	58.8
Dry density, pcf	56.8	66.8	
Saturation, %	81.5	100.0	
Void ratio	1.912	1.475	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.1657 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.670 % per minute
Consolidation cell pressure = 20 psi
Consolidation back pressure = 10 psi
Consolidation effective confining stress = 10 psi
Peak deviator stress = 23.59 psi at reading no. 4
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	34.0	0.0	0.0	0.00	10.00	10.00	1.00	10.0	10.00	0.00
1	0.0300	0.015	120.0	14.3	0.5	9.45	9.50	18.95	1.99	10.5	14.23	4.73
2	0.0450	0.030	190.0	25.8	1.0	17.06	9.00	26.06	2.90	11.0	17.53	8.53
3	0.0600	0.045	229.0	32.3	1.5	21.21	8.80	30.01	3.41	11.2	19.41	10.61
4	0.0750	0.060	252.0	36.1	2.1	23.59	8.60	32.19	3.74	11.4	20.39	11.79

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:21 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356
Client: WASHINGTON COUNTY
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - SATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 1

Sample No. 3 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	1.48	1.44	
Height change, in		0.34	
Height, in	3.00	2.66	
Weight, grams	122.2		
Water volume change, cc		2.91	
Moisture, %	58.8	55.0	58.8
Dry density, pcf	56.8	67.3	
Saturation, %	81.5	100.0	
Void ratio	1.912	1.458	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.1657 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.670 % per minute
Consolidation cell pressure = 30 psi
Consolidation back pressure = 10 psi
Consolidation effective confining stress = 20 psi
Peak deviator stress = 37.93 psi at reading no. 6
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	145.0	0.0	0.0	0.00	19.50	19.50	1.00	10.5	19.50	0.00
1	0.0300	0.015	288.0	23.7	0.6	14.39	18.70	33.09	1.77	11.3	25.89	7.19
2	0.0450	0.030	400.0	42.3	1.1	25.51	18.00	43.51	2.42	12.0	30.75	12.75
3	0.0600	0.045	463.0	52.7	1.7	31.63	17.50	49.13	2.81	12.5	33.31	15.81
4	0.0750	0.060	500.0	58.8	2.3	35.11	17.10	52.21	3.05	12.9	34.65	17.55
5	0.0900	0.075	525.0	63.0	2.8	37.36	16.90	54.26	3.21	13.1	35.58	18.68

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
6	0.1050	0.090	533.0	64.3	3.4	37.93	16.70	54.63	3.27	13.3	35.66	18.96
7	0.1200	0.105	525.0	63.0	3.9	36.93	16.70	53.63	3.21	13.3	35.16	18.46
8	0.1500	0.135	500.0	58.8	5.1	34.09	16.80	50.89	3.03	13.2	33.85	17.05
9	0.1800	0.165	493.0	57.7	6.2	33.02	16.70	49.72	2.98	13.3	33.21	16.51
10	0.2100	0.195	496.0	58.2	7.3	32.91	16.60	49.51	2.98	13.4	33.05	16.45
11	0.2500	0.235	500.0	58.8	8.8	32.74	16.50	49.24	2.98	13.5	32.87	16.37
12	0.2700	0.255	499.0	58.7	9.6	32.38	16.50	48.88	2.96	13.5	32.69	16.19
13	0.3000	0.285	491.0	57.3	10.7	31.25	16.40	47.65	2.91	13.6	32.03	15.63
14	0.3400	0.325	492.0	57.5	12.2	30.82	16.40	47.22	2.88	13.6	31.81	15.41

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:22 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356
Client: WASHINGTON COUNTY
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - SATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 1

Sample No. 4 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

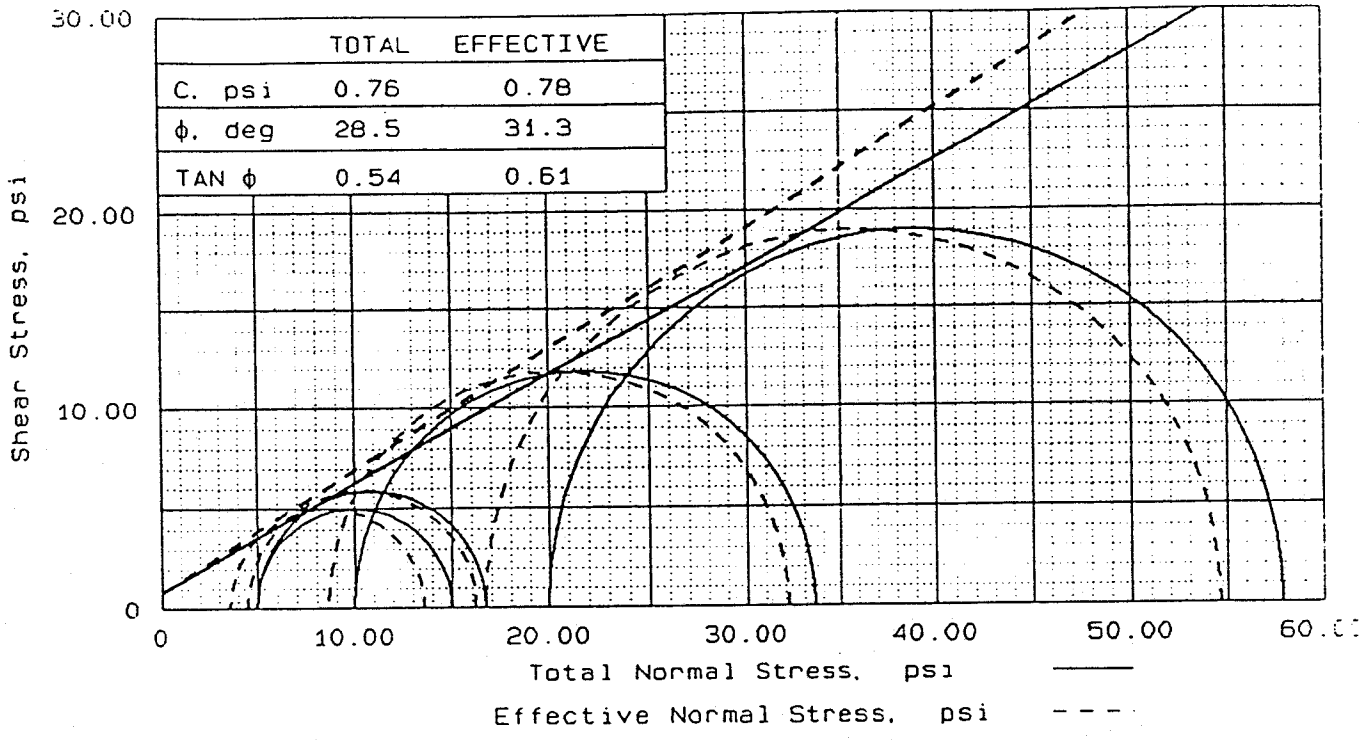
Sample Parameters	Before Test	At Testing	After Test
Diameter, in	1.48	1.27	
Height change, in		0.21	
Height, in	3.00	2.79	
Weight, grams	122.2		
Water volume change, cc		16.13	
Moisture, %	58.8	37.8	58.8
Dry density, pcf	56.8	82.6	
Saturation, %	81.5	100.0	
Void ratio	1.912	1.003	

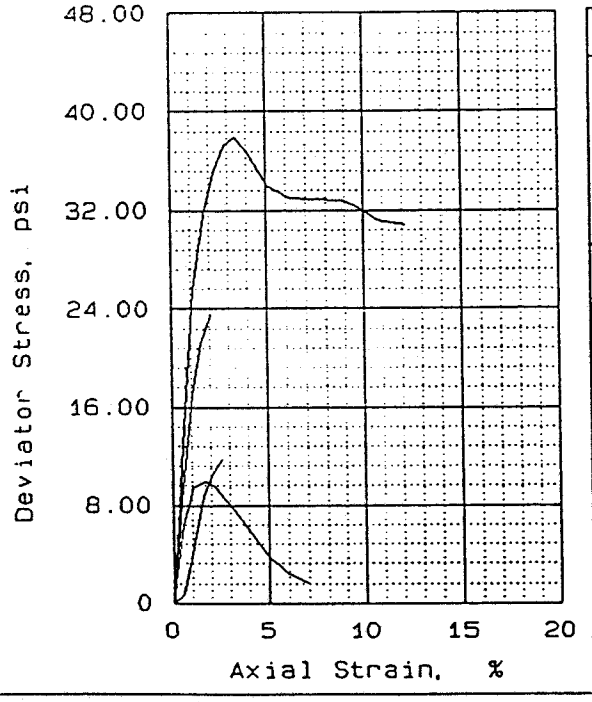
Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.1657 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.670 % per minute
Consolidation cell pressure = 26 psi
Consolidation back pressure = 21 psi
Consolidation effective confining stress = 5 psi
Peak deviator stress = 9.99 psi at reading no. 3
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	25.0	0.0	0.0	0.00	4.20	4.20	1.00	21.8	4.20	0.00
1	0.0300	0.015	74.0	8.1	0.5	6.35	3.50	9.85	2.81	22.5	6.67	3.17
2	0.0450	0.030	98.0	12.1	1.1	9.40	3.50	12.90	3.69	22.5	8.20	4.70
3	0.0600	0.045	103.0	12.9	1.6	9.99	3.60	13.59	3.78	22.4	8.60	5.00
4	0.0750	0.060	100.0	12.4	2.2	9.56	3.60	13.16	3.65	22.4	8.38	4.78
5	0.0900	0.075	92.0	11.1	2.7	8.49	3.60	12.09	3.36	22.4	7.85	4.25

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
6	0.1050	0.090	85.0	9.9	3.2	7.56	3.50	11.06	3.16	22.5	7.28	3.78
7	0.1200	0.105	76.0	8.5	3.8	6.39	3.50	9.89	2.83	22.5	6.70	3.20
8	0.1500	0.135	57.0	5.3	4.8	3.97	3.10	7.07	2.28	22.9	5.08	1.98
9	0.1800	0.165	45.0	3.3	5.9	2.45	2.90	5.35	1.84	23.1	4.13	1.23
10	0.2100	0.195	38.0	2.2	7.0	1.57	2.80	4.37	1.56	23.2	3.59	0.79





SAMPLE NO.		1	2	3	4
INITIAL	WATER CONTENT, %	58.8	58.8	58.8	58.8
	DRY DENSITY, pcf	56.8	56.8	56.8	56.8
	SATURATION, %	81.5	81.5	81.5	81.5
	VOID RATIO	1.912	1.912	1.912	1.912
	DIAMETER, in	1.48	1.48	1.48	1.48
	HEIGHT, in	3.00	3.00	3.00	3.00
AT TEST	WATER CONTENT, %	51.9	55.7	55.0	37.8
	DRY DENSITY, pcf	69.7	66.8	67.3	82.5
	SATURATION, %	100.0	100.0	100.0	100.0
	VOID RATIO	1.375	1.475	1.458	1.003
	DIAMETER, in	1.36	1.38	1.44	1.27
	HEIGHT, in	2.91	2.93	2.66	2.79
BACK PRESSURE, psi		10.00	10.00	10.00	21.00
CELL PRESSURE, psi		15.00	20.00	30.00	26.00
FAILURE STRESS, psi		11.72	23.59	37.93	9.99
PORE PRESSURE, psi		10.50	11.40	13.30	22.40
STRAIN RATE, %/min.		0.670	0.670	0.670	0.670
ULTIMATE STRESS, psi					
PORE PRESSURE, psi					
$\bar{\sigma}_1$ FAILURE, psi		16.22	32.19	54.63	13.59
$\bar{\sigma}_3$ FAILURE, psi		4.5	8.6	16.7	3.6

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: ALUM MUD

LL= 65 PL= 59 PI= 6.0
SPECIFIC GRAVITY= 2.65
REMARKS:

FIG. NO. 1

CLIENT: WASHINGTON COUNTY

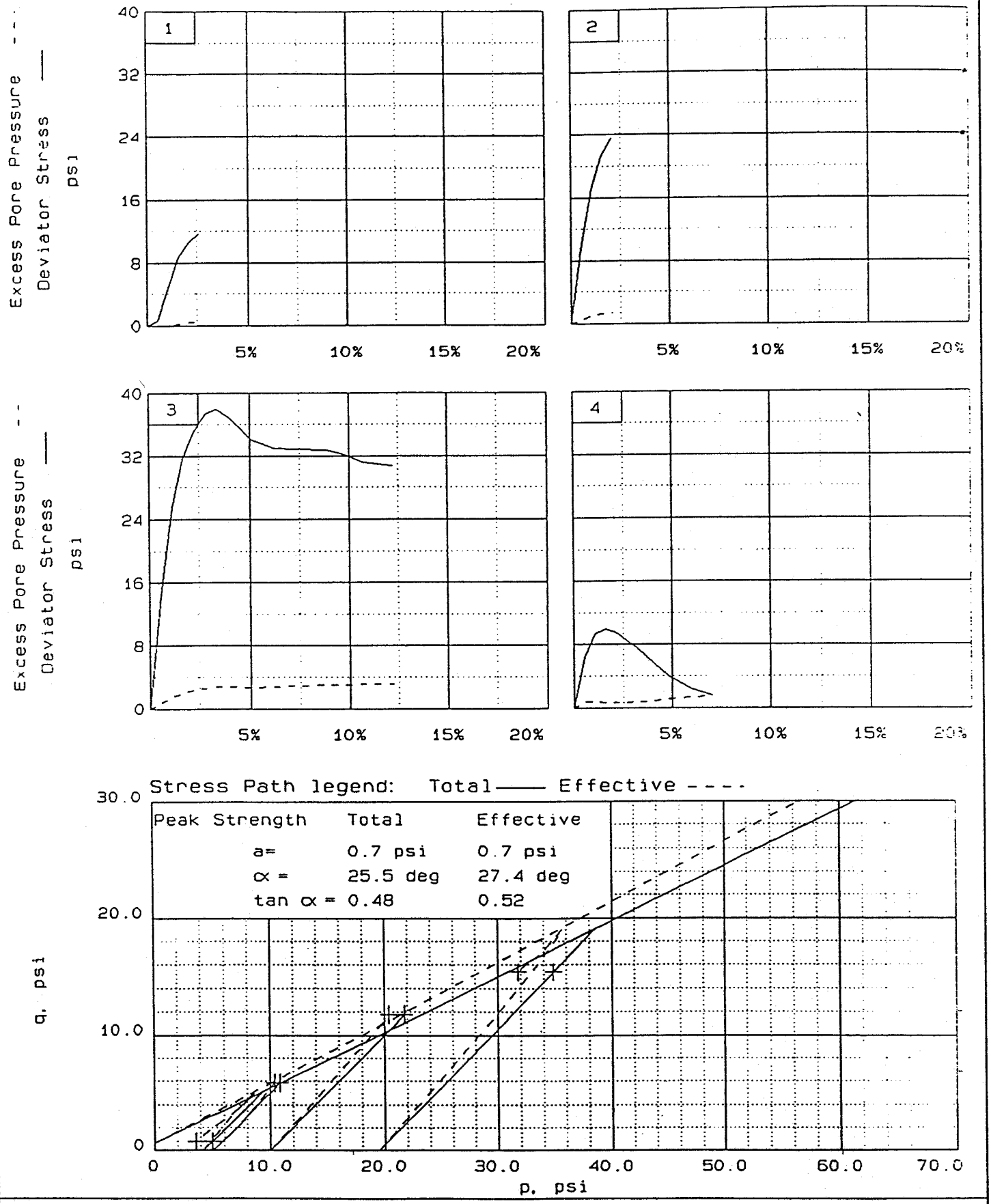
PROJECT: WASHINGTON COUNTY LANDFILL

SAMPLE LOCATION: BAG 1 - SATURATED

PROJ. NO.: J-6356 DATE: 2/14/91

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING



Client: WASHINGTON COUNTY

Project: WASHINGTON COUNTY LANDFILL

Location: BAG 1 - SATURATED

File: 6356 Project No.: J-6356 Page 2/2 Fig. No. 1

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:38 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356DRY
Client:
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - UNSATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 2

Sample No. 1 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.83	2.73	
Height change, in		0.33	
Height, in	5.59	5.26	
Weight, grams	827.1		
Water volume change, cc		0.00	
Moisture, %	58.8	58.8	58.8
Dry density, pcf	56.4	64.7	
Saturation, %	80.7	100.0	
Void ratio	1.932	1.558	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.68 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 1.500 % per minute
Consolidation cell pressure = 20 psi
Consolidation back pressure = 0 psi
Consolidation effective confining stress = 20 psi
Peak deviator stress = 55.79 psi at reading no. 13
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	40.0	0.0	0.0	0.00	20.00	20.00	1.00	0.0	20.00	0.00
1	0.0300	0.015	140.0	68.0	0.3	11.62	20.00	31.62	1.58	0.0	25.81	5.81
2	0.0450	0.030	230.0	129.2	0.6	22.02	20.00	42.02	2.10	0.0	31.01	11.01
3	0.0600	0.045	309.0	182.9	0.9	31.09	19.90	50.99	2.56	0.1	35.45	15.55
4	0.0750	0.060	371.0	225.1	1.1	38.15	19.60	57.75	2.95	0.4	38.67	19.07
5	0.0900	0.075	411.0	252.3	1.4	42.63	19.50	62.13	3.19	0.5	40.82	21.32

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
6	0.1050	0.090	441.0	272.7	1.7	45.95	19.50	65.45	3.36	0.5	42.47	22.97
7	0.1200	0.105	462.0	287.0	2.0	48.21	19.40	67.61	3.49	0.6	43.51	24.11
8	0.1500	0.135	491.0	306.7	2.6	51.23	19.20	70.43	3.67	0.8	44.81	25.61
9	0.1900	0.175	515.0	323.0	3.3	53.53	19.00	72.53	3.82	1.0	45.77	26.77
10	0.2200	0.205	526.0	330.5	3.9	54.45	19.00	73.45	3.87	1.0	46.22	27.22
11	0.2400	0.225	531.0	333.9	4.3	54.79	19.00	73.79	3.88	1.0	46.39	27.39
12	0.2700	0.255	541.0	340.7	4.8	55.57	18.90	74.47	3.94	1.1	46.69	27.79
13	0.3000	0.285	546.0	344.1	5.4	55.79	18.90	74.69	3.95	1.1	46.80	27.90
14	0.3300	0.315	549.0	346.1	6.0	55.78	18.90	74.68	3.95	1.1	46.79	27.89

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:41 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356DRY
Client:
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - UNSATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 2

Sample No. 2 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.83	2.79	
Height change, in		0.09	
Height, in	5.59	5.51	
Weight, grams	827.1		
Moisture, %	58.8	58.8	58.8
Dry density, pcf	56.4	59.1	
Saturation, %	80.7	86.6	
Void ratio	1.932	1.799	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.68 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 1.500 % per minute
Consolidation cell pressure = 10 psi
Consolidation back pressure = 0 psi
Consolidation effective confining stress = 10 psi
Peak deviator stress = 22.46 psi at reading no. 5
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	85.0	0.0	0.0	0.00	10.00	10.00	1.00	0.0	10.00	0.00
1	0.0300	0.015	151.0	44.9	0.3	7.34	10.00	17.34	1.73	0.0	13.67	3.67
2	0.0450	0.030	211.0	85.7	0.5	13.97	9.90	23.87	2.41	0.1	16.89	6.99
3	0.0600	0.045	250.0	112.2	0.8	18.25	9.90	28.15	2.84	0.1	19.02	9.12
4	0.0750	0.060	277.0	130.6	1.1	21.17	9.80	30.97	3.16	0.2	20.39	10.59
5	0.0850	0.070	289.0	138.7	1.3	22.46	9.80	32.26	3.29	0.2	21.03	11.23

TRIAXIAL COMPRESSION TEST 2-14-1991
CU with pore pressures 1:41 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356DRY
Client:
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - UNSATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 2

Sample No. 2 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.83	2.79	
Height change, in		0.09	
Height, in	5.59	5.51	
Weight, grams	827.1		
Moisture, %	58.8	58.8	58.8
Dry density, pcf	56.4	59.1	
Saturation, %	80.7	86.6	
Void ratio	1.932	1.799	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.68 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 1.500 % per minute
Consolidation cell pressure = 10 psi
Consolidation back pressure = 0 psi
Consolidation effective confining stress = 10 psi
Peak deviator stress = 22.46 psi at reading no. 5
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	85.0	0.0	0.0	0.00	10.00	10.00	1.00	0.0	10.00	0.00
1	0.0300	0.015	151.0	44.9	0.3	7.34	10.00	17.34	1.73	0.0	13.67	3.67
2	0.0450	0.030	211.0	85.7	0.5	13.97	9.90	23.87	2.41	0.1	16.89	6.99
3	0.0600	0.045	250.0	112.2	0.8	18.25	9.90	28.15	2.84	0.1	19.02	9.12
4	0.0750	0.060	277.0	130.6	1.1	21.17	9.80	30.97	3.16	0.2	20.39	10.59
5	0.0850	0.070	289.0	138.7	1.3	22.46	9.80	32.26	3.29	0.2	21.03	11.23

TRIAXIAL COMPRESSION TEST 2-14-1991
CU with pore pressures 1:43 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356DRY
Client:
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - UNSATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 2

Sample No. 3 Data

Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.83	2.78	
Height change, in		0.11	
Height, in	5.59	5.49	
Weight, grams	827.1		
Moisture, %	58.8	58.8	58.8
Dry density, pcf	56.4	59.8	
Saturation, %	80.7	88.1	
Void ratio	1.932	1.769	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.68 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 1.500 % per minute
Consolidation cell pressure = 5 psi
Consolidation back pressure = 0 psi
Consolidation effective confining stress = 5 psi
Peak deviator stress = 15.25 psi at reading no. 6
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	64.0	0.0	0.0	0.00	5.00	5.00	1.00	0.0	5.00	0.00
1	0.0300	0.015	110.0	31.3	0.3	5.15	5.00	10.15	2.03	0.0	7.58	2.58
2	0.0450	0.030	145.0	55.1	0.5	9.05	5.00	14.05	2.81	0.0	9.52	4.52
3	0.0600	0.045	172.0	73.4	0.8	12.03	5.00	17.03	3.41	0.0	11.02	6.02
4	0.0750	0.060	188.0	84.3	1.1	13.78	5.00	18.78	3.76	0.0	11.89	6.89
5	0.0900	0.075	196.0	89.8	1.4	14.62	5.00	19.62	3.92	0.0	12.31	7.31
6	0.1050	0.090	202.0	93.8	1.6	15.25	5.00	20.25	4.05	0.0	12.62	7.62

TRIAXIAL COMPRESSION TEST
CU with pore pressures

2-14-1991
1:47 pm

Project Data

Project No.: J-6356 Date: 2/14/91 Data file: 6356DRY
Client:
Project: WASHINGTON COUNTY LANDFILL
Sample location: BAG 1 - UNSATURATED
Sample description: ALUM MUD
Remarks:
Fig No. 2

Sample No. 4 Data

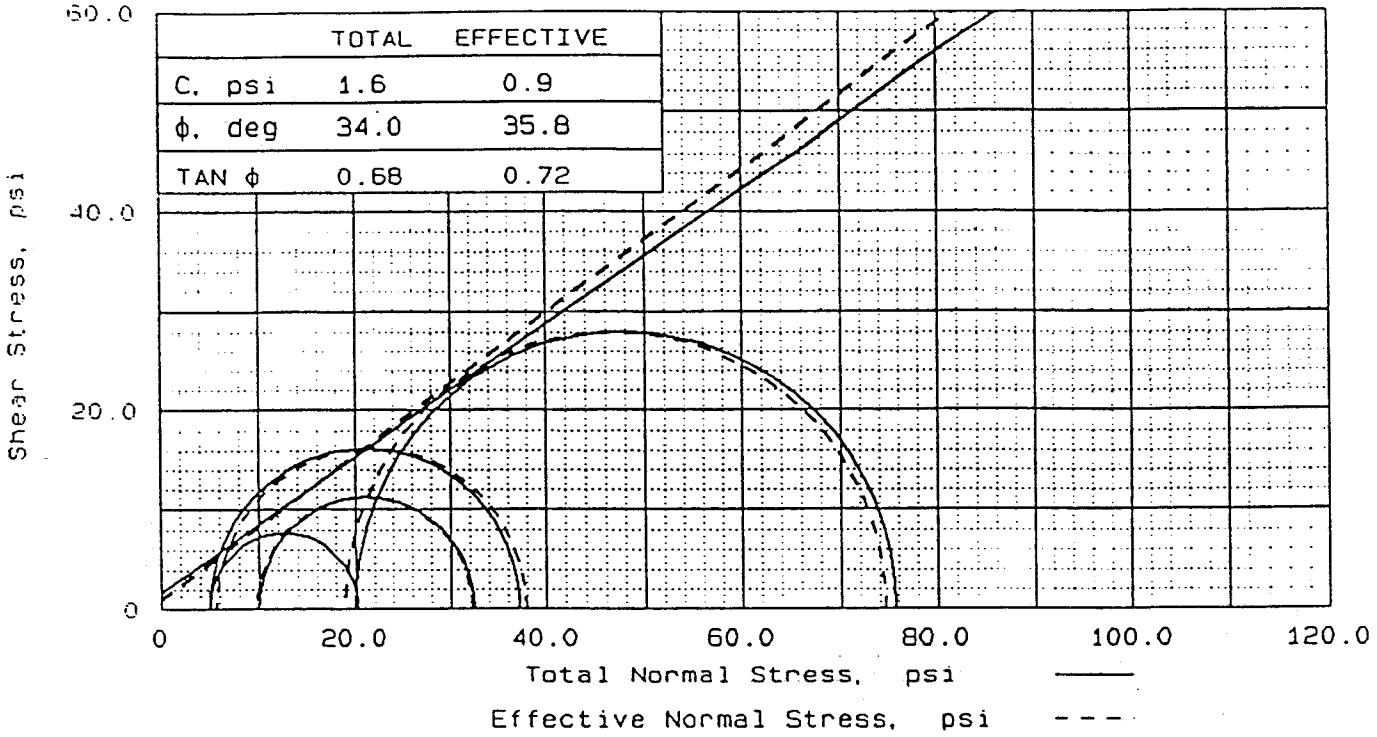
Type of sample:
Specific Gravity= 2.65 LL= 65 PL= 59 PI= 6

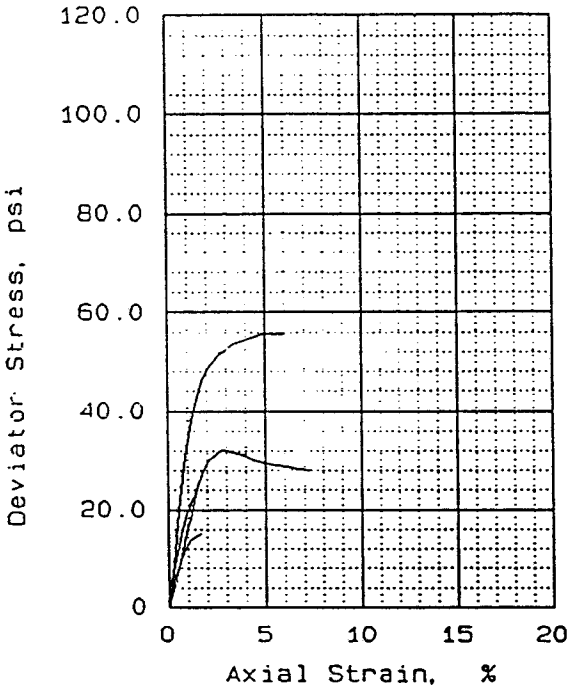
Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.83	2.63	
Height change, in		0.39	
Height, in	5.59	5.20	
Weight, grams	827.1		
Moisture, %	58.8	58.8	58.8
Dry density, pcf	56.4	70.5	
Saturation, %	80.7	115.7	
Void ratio	1.932	1.347	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.68 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 1.500 % per minute
Consolidation cell pressure = 5 psi
Consolidation back pressure = 0 psi
Consolidation effective confining stress = 5 psi
Peak deviator stress = 32.24 psi at reading no. 9
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress psi	Effective Stresses Minor psi	Effective Stresses Major psi	Effective Stresses 1:3 Ratio	Pore Pres. psi	P psi	Q psi
0	0.0150	0.000	40.0	0.0	0.0	0.00	5.00	5.00	1.00	0.0	5.00	0.00
1	0.0300	0.015	75.0	23.8	0.3	4.38	5.00	9.38	1.88	0.0	7.19	2.19
2	0.0450	0.030	115.0	51.0	0.6	9.37	5.00	14.37	2.87	0.0	9.68	4.68
3	0.0600	0.045	156.0	78.9	0.9	14.45	5.10	19.55	3.83	-0.1	12.32	7.22
4	0.0750	0.060	195.0	105.4	1.2	19.25	5.20	24.45	4.70	-0.2	14.82	9.62
5	0.0900	0.075	236.0	133.3	1.4	24.27	5.20	29.47	5.67	-0.2	17.33	12.13
6	0.1050	0.090	261.0	150.3	1.7	27.28	5.20	32.48	6.25	-0.2	18.84	13.64





SAMPLE NO.		1	2	3	4
INITIAL	WATER CONTENT, %	58.8	58.8	58.8	58.8
	DRY DENSITY, pcf	56.4	56.4	56.4	56.4
	SATURATION, %	80.7	80.7	80.7	80.7
	VOID RATIO	1.932	1.932	1.932	1.932
	DIAMETER, in	2.83	2.83	2.83	2.83
	HEIGHT, in	5.59	5.59	5.59	5.59
AT TEST	WATER CONTENT, %	58.8	58.8	58.8	58.8
	DRY DENSITY, pcf	64.7	59.1	59.8	70.5
	SATURATION, %	100.0	86.6	88.1	115.7
	VOID RATIO	1.558	1.799	1.769	1.347
	DIAMETER, in	2.73	2.79	2.78	2.63
	HEIGHT, in	5.26	5.51	5.49	5.20
BACK PRESSURE, psi		0.0	0.0	0.0	0.0
CELL PRESSURE, psi		20.0	10.0	5.0	5.0
FAILURE STRESS, psi		55.8	22.5	15.2	32.2
PORE PRESSURE, psi		1.1	0.2	0.0	-0.7
STRAIN RATE, %/min.		1.500	1.500	1.500	1.500
ULTIMATE STRESS, psi					
PORE PRESSURE, psi					
$\bar{\sigma}_1$ FAILURE, psi		74.7	32.3	20.2	37.9
$\bar{\sigma}_3$ FAILURE, psi		18.9	9.8	5	5.7

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: ALUM MUD

LL= 65 PL= 59 PI= 6.0
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT:

PROJECT: WASHINGTON COUNTY LANDFILL

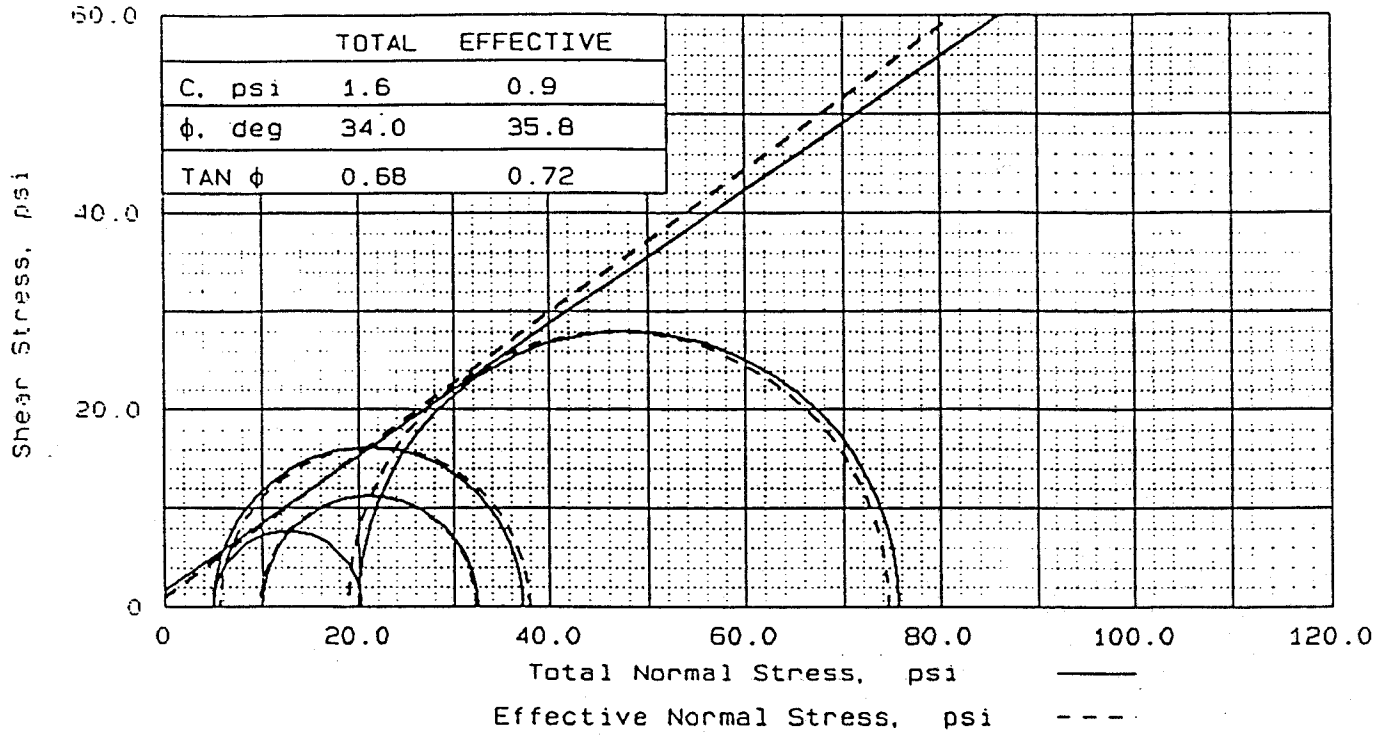
SAMPLE LOCATION: BAG 1 - UNSATURATED

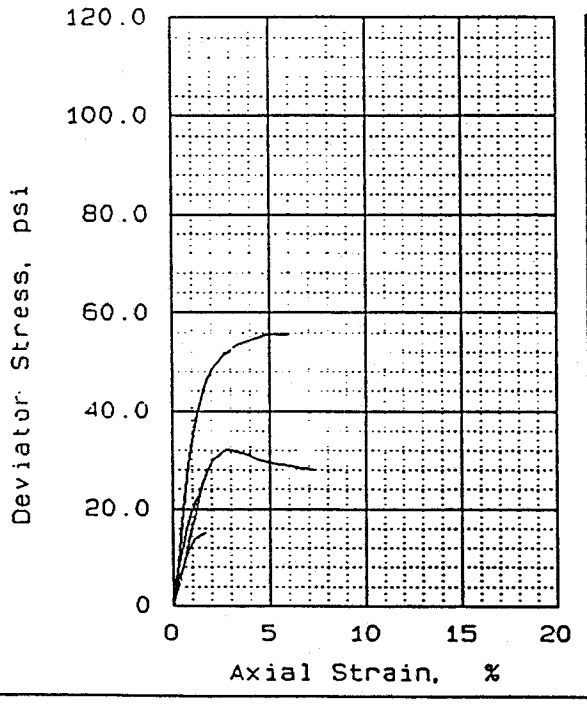
PROJ. NO.: J-6356 DATE: 2/14/91

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING

FIG. NO. 2





SAMPLE NO.		1	2	3	4
INITIAL	WATER CONTENT, %	58.8	58.8	58.8	58.8
	DRY DENSITY, pcf	56.4	56.4	56.4	56.4
	SATURATION, %	80.7	80.7	80.7	80.7
	VOID RATIO	1.932	1.932	1.932	1.932
	DIAMETER, in	2.83	2.83	2.83	2.83
	HEIGHT, in	5.59	5.59	5.59	5.59
AT TEST	WATER CONTENT, %	58.8	58.8	58.8	58.8
	DRY DENSITY, pcf	64.7	59.1	59.8	70.5
	SATURATION, %	100.0	86.6	88.1	115.7
	VOID RATIO	1.558	1.799	1.769	1.347
	DIAMETER, in	2.73	2.79	2.78	2.63
	HEIGHT, in	5.26	5.51	5.49	5.20
BACK PRESSURE, psi		0.0	0.0	0.0	0.0
CELL PRESSURE, psi		20.0	10.0	5.0	5.0
FAILURE STRESS, psi		55.8	22.5	15.2	32.2
PORE PRESSURE, psi		1.1	0.2	0.0	-0.7
STRAIN RATE, %/min.		1.500	1.500	1.500	1.500
ULTIMATE STRESS, psi					
PORE PRESSURE, psi					
$\bar{\sigma}_1$ FAILURE, psi		74.7	32.3	20.2	37.9
$\bar{\sigma}_3$ FAILURE, psi		18.9	9.8	5	5.7

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: ALUM MUD

LL= 65 PL= 59 PI= 6.0
SPECIFIC GRAVITY= 2.65
REMARKS:

FIG. NO. 2

CLIENT:

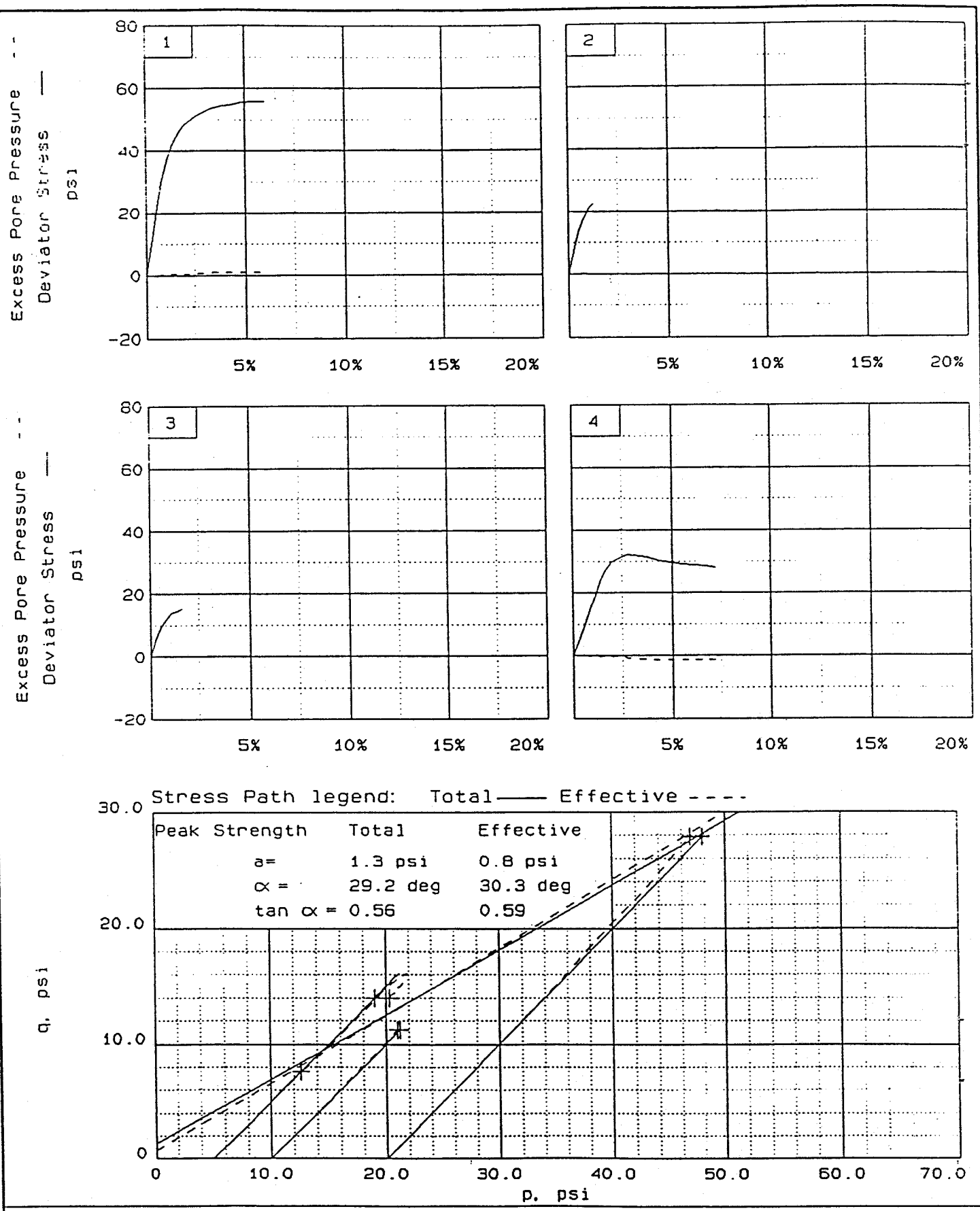
PROJECT: WASHINGTON COUNTY LANDFILL

SAMPLE LOCATION: BAG 1 - UNSATURATED

PROJ. NO.: J-6356 DATE: 2/14/91

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING



Client:

Project: WASHINGTON COUNTY LANDFILL

Location: BAG 1 - UNSATURATED

File: 6356DRY Project No.: J-6356 Page 2/2 Fig. No. 2

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	2/21/91
Time of Run:	9:30
Run By:	FSM
Input Data Filename:	A:GARBAGE1.IN
Output Filename:	A:GARBAGE1.OUT

PROBLEM DESCRIPTION WASHINGTON CO. LANDFILL

BOUNDARY COORDINATES

5 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	20.00	50.00	20.00	3
2	50.00	20.00	95.00	35.00	2
3	95.00	35.00	110.00	35.00	2
4	110.00	35.00	132.00	43.00	1
5	132.00	43.00	180.00	43.00	1
6	110.00	35.00	125.00	20.00	2
7	50.00	20.00	125.00	20.00	3
8	125.00	20.00	140.00	5.00	3
9	.00	5.00	140.00	5.00	4
10	140.00	5.00	180.00	5.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	75.0	75.0	100.0	10.0	.00	.0	1
2	56.0	56.0	100.0	28.5	.00	.0	2
3	120.0	120.0	.0	32.0	.00	.0	3
4	100.0	100.0	.0	28.0	.00	.0	4

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	15.00
2	180.00	15.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 50.00 ft.

Each Surface Terminates Between X = 95.00 ft.
and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

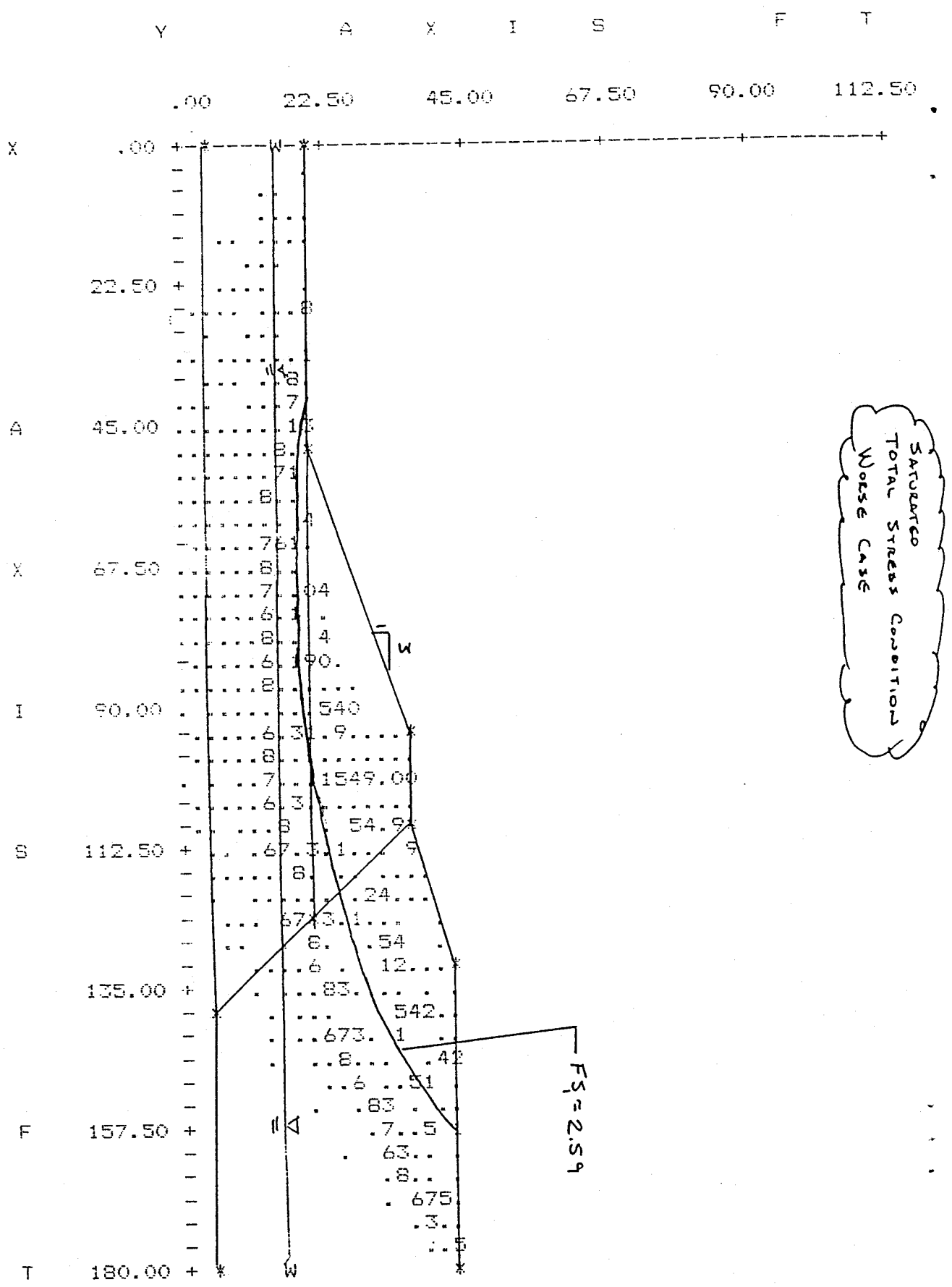
10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	20.00
2	43.26	18.77
3	53.23	18.06
4	63.23	17.86
5	73.23	18.19
6	83.19	19.04


Y A X I S F T
.00
22.50
45.00
67.50
90.00
112.50
X .00
22.50
A 45.00
X 67.50
I 90.00
S 112.50
135.00
F 157.50
T 180.00
1549.00
FS = 2.59
Saturated
Total Stress Condition
Worse Case

** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	2/21/91
Time of Run:	9:45
Run By:	FSM
Input Data Filename:	A:GARBAGE2.IN
Output Filename:	A:GARBAGE2.OUT

PROBLEM DESCRIPTION WASHINGTON CO. LANDFILL

BOUNDARY COORDINATES

5 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	20.00	65.00	20.00	3
2	65.00	20.00	95.00	35.00	2
3	95.00	35.00	110.00	35.00	2
4	110.00	35.00	132.00	43.00	1
5	132.00	43.00	180.00	43.00	1
6	110.00	35.00	125.00	20.00	2
7	50.00	20.00	125.00	20.00	3
8	125.00	20.00	140.00	5.00	3
9	.00	5.00	140.00	5.00	4
10	140.00	5.00	180.00	5.00	4

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	75.0	75.0	100.0	10.0	.00	.0	1
2	56.0	56.0	100.0	28.5	.00	.0	2
3	120.0	120.0	.0	32.0	.00	.0	3
4	100.0	100.0	.0	28.0	.00	.0	4

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	15.00
2	180.00	15.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 65.00 ft.

Each Surface Terminates Between X = 95.00 ft.
and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.00	20.00
2	74.85	18.25
3	84.80	17.31
4	94.80	17.18
5	104.78	17.88
6	114.66	19.40
7	124.38	21.71

9	143.11	28.71
10	151.98	33.32
11	160.44	38.65
12	166.23	43.00

Circle Center At X = 91.3 ; Y = 139.0 and Radius, 121.9

*** 2.315 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.78	20.00
2	67.67	18.53
3	77.63	17.65
4	87.63	17.35
5	97.62	17.63
6	107.58	18.50
7	117.48	19.95
8	127.27	21.97
9	136.93	24.56
10	146.42	27.71
11	155.71	31.41
12	164.77	35.65
13	173.57	40.41
14	177.75	43.00

Circle Center At X = 87.8 ; Y = 188.4 and Radius, 171.1

*** 2.391 ***

1

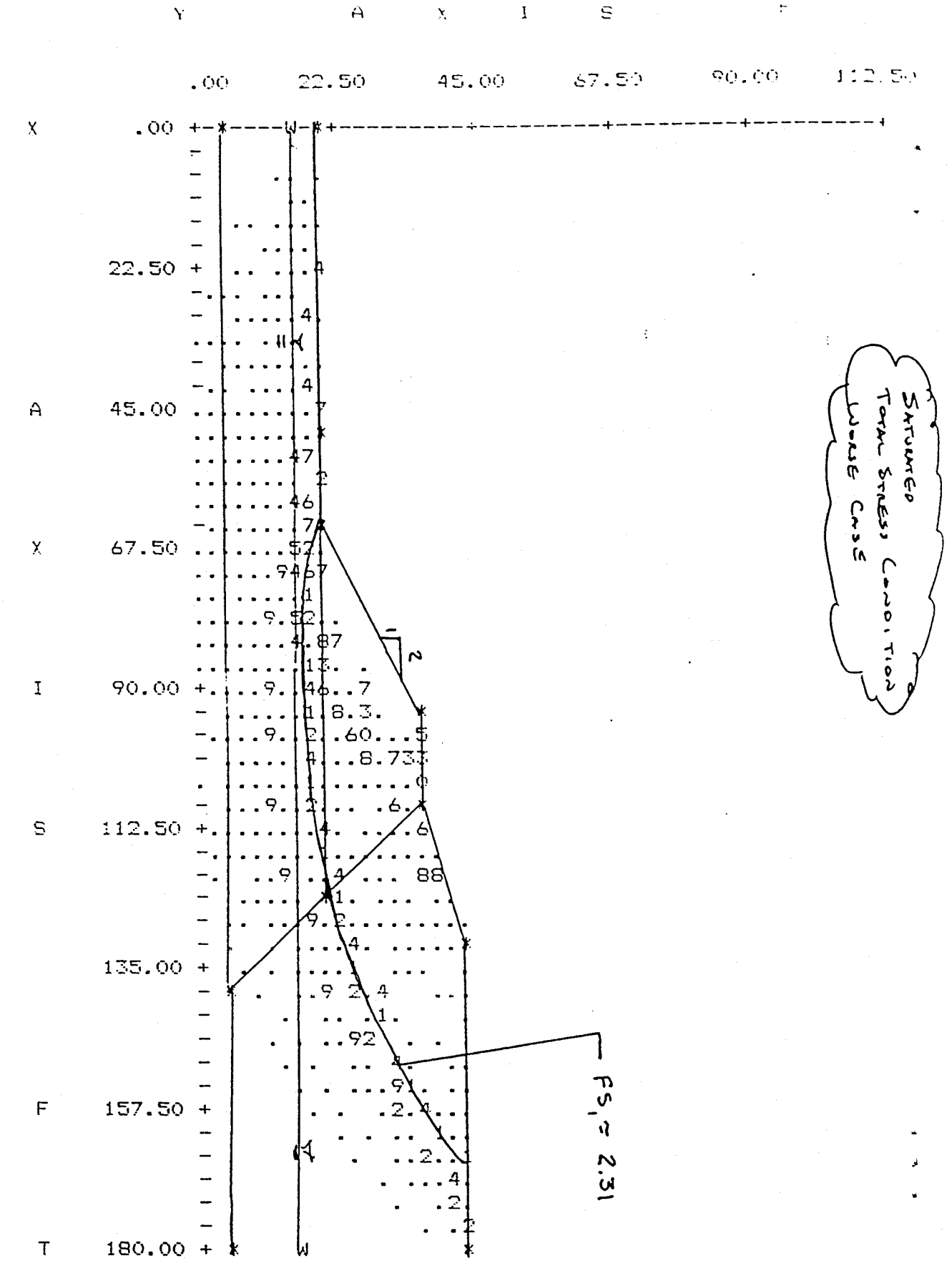
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.78	20.00
2	67.50	17.64
3	77.49	18.02
4	87.01	21.08
5	95.34	26.62
6	101.85	34.21
7	102.22	35.00

Circle Center At X = 71.2 ; Y = 54.0 and Radius, 36.5

*** 2.468 ***

Failure Surface Specified By 17 Coordinate Points


Y AXIS F
.00
22.50
45.00
67.50
90.00
112.50
X .00
22.50
A 45.00
X 67.50
I 90.00
S 112.50
135.00
F 157.50
T 180.00
1
2
FS = 2.31
Saturated
Total Stress Condition
Worse Case

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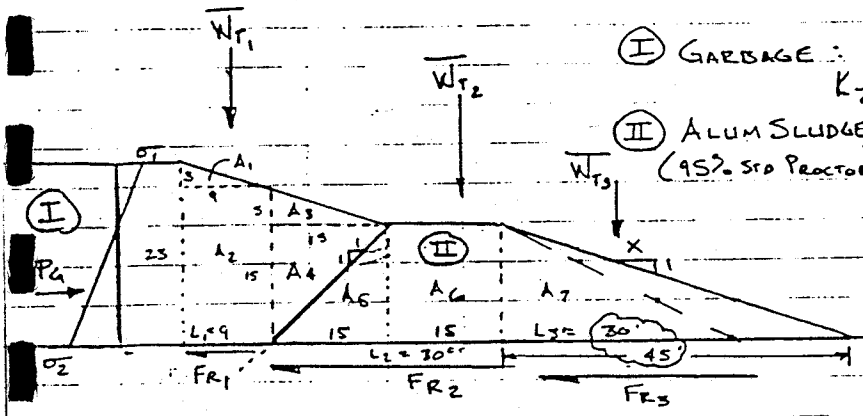
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS
3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

JOB NO. J6356 SHEET 1 OF 2
JOB NAME WASHINGTON Co LANDFILL
SUBJECT SLIDING WEDGE ANALYSIS
BY DEM DATE 2/25/91
CHECKED BY _____ DATE _____



(I) GARBAGE: $\phi_G = 10°$; $C_G = 100$ PSF ; 75 PCF $= \gamma_G$
$K_{a_G} = \tan^2(45 - \phi/2) = 0.704$

(II) ALUM SLUDGE: $\phi_T = 28.5°$; $C_T = 100$ PSF; 56 PCF $= \gamma_{AS}$
(95% STD PROCTOR) $\phi' = 31.3°$; $C' = 100$ PSF; 56 PCF $= \gamma_{AS}$

$A_1 = 3(9)/2 = 13.5\ FT^2$; $W_{T_1} = A_1 \gamma_G = (13.5)(75) = 1012\ ^{lb}/_{FT}$

$A_2 = 9(15) = 135\ FT^2$; $W_{T_2} = A_2 \gamma_G = (135)(75) = 10{,}125\ ^{lb}/_{FT}$

$A_3 = 5(15)/2 = 37.5\ FT^2$; $W_{T_3} = A_3 \gamma_G = (37.5)(75) = 2{,}812\ ^{lb}/_{FT}$

$A_4 = 15(15)/2 = 112.5\ FT^2$; $W_{T_4} = A_4 \gamma_G = (112.5)(75) = 8{,}437\ ^{lb}/_{FT}$

$A_5 = 15(15)/2 = 112.5\ FT^2$; $W_{T_5} = A_5 \gamma_{AS} = (112.5)(56) = 6{,}300\ ^{lb}/_{FT}$

$A_6 = 15(15) = 225\ FT^2$; $W_{T_6} = A_6 \gamma_{AS} = (225)(56) = 12{,}600\ ^{lb}/_{FT}$

$A_7 = (X(15))\,15/2 = 112.5X\ FT^2$; $W_{T_7} = A_7 \gamma_{AS} = (112.5X)(56) = 6300X\ ^{lb}/_{FT}$

$F_{R_1} = W_{T_1} \tan\phi_G + C_G L_1 = (W_{T_1} + W_{T_2}) \tan 10° + (100)(9) = (1012 + 10{,}125)\tan 10° + 900 = 2864\ ^{lb}/_{FT}$ ←

$F_{R_2} = W_{T_2} \tan\phi + C L_2 = (W_{T_3} + W_{T_4} + W_{T_5} + W_{T_6})\tan\phi + 100(30) = [30{,}149 \tan\phi + 3000]\ ^{lb}/_{FT}$ ←
(2812, 8437, 6300, 12,600)

$F_{R_3} = W_{T_3} \tan\phi + C L_3 = W_{T_7} \tan\phi + 100((X)15) = (6300X)\tan\phi + 1500X$ ←
(W_{T_7} = 6300X)

$F_R = F_{R_1} + F_{R_2} + F_{R_3} = 2864 + 30{,}149 \tan\phi + 3000 + (6300X)\tan\phi + 1500X$ ←

$F_R = 1500X + (30{,}149 + 6300X)\tan\phi + 5864\ ^{lb}/_{FT}$ ←

$\sigma_T = K_{a_G} \gamma_G Z - 2C_G\sqrt{K_{a_G}} = (0.704)(75)(0) - 2(100)\sqrt{0.704} = 52.8(0) - 168 = -168$ PSF ←

$\sigma_2 = 52.8(23) - 168 = 1047$ PSF →

$P_G = (\sigma_T + \sigma_2)\,23/2 = (-168 + 1047)\,23/2 = 10{,}104\ ^{lb}/_{FT}$ →

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RALEIGH, NC 27619
919-876-0416

JOB NO. J6356 SHEET 2 OF 2

JOB NAME WASHINGTON CO. LANDFILL

SUBJECT SLIDING WEDGE ANALYSIS

BY DEM DATE 2/25/91

CHECKED BY _____ DATE _____

$$FS_{SLIDING} \simeq \frac{F_R}{P_G} \simeq \frac{1500X + (30,149 + 6300X)\tan\phi + 5864}{10,104} = FS$$

2(H) : 1(V) $\Rightarrow$ $X = 2$

$$FS_{2:1} \simeq \frac{3000 + (42,749)\tan\phi + 5864}{10,104} \simeq \frac{42,749\tan\phi + 8864}{10,104}$$

3(H) : 1(V) $\Rightarrow$ $X = 3$

$$FS_{3:1} \simeq \frac{4500 + (49,049)\tan\phi + 5864}{10,104} \simeq \frac{49,049\tan\phi + 10,364}{10,104}$$

TYPE OF ANALYSIS	FACTOR OF SAFETY (SLIDING)	
	$FS_{2:1}$	$FS_{3:1}$
TOTAL $\phi_T = 28.5°$	3.17	3.66
EFFECTIVE $\phi' = 31.3°$	3.45	3.98

LAW ENGINEERING

GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS

March 5, 1991

Diehl & Phillips
219 East Chatham Street
Cary, North Carolina 27511

Attention: Mr. Alen Keith

SUBJECT: REPORT OF GEOTECHNICAL SERVICES
AND LABORATORY TESTING - WASHINGTON COUNTY LANDFILL
WASHINGTON COUNTY LANDFILL DIKE & COVER MATERIAL
PLYMOUTH, NORTH CAROLINA
LAW ENGINEERING JOB NO. J47291-6356

Dear Mr. Keith:

Based on our telephone conversations of March 1,1991 regarding the potential volume change of the material placed for the dike and the permeability of the saturated and unsaturated permeabilities of the material at optimum moisture content in our report dated February 27, 1991. We have the following clarifications and recommendations.

To minimize potential shrinkage of the material placed in the dike, the material should be placed below the optimum moisture content (i.e., 58%±) and closer to the shrinkage limit (47%±). This may require additional compaction effort in order to achieve 95% of the standard maximum dry density.

The unsaturated permeability of the material to be used as a cover was approximately $2x10^{-5}$ cm/sec at 95% of the standard Proctor maximum dry density at an optimum moisture content of approximately 59%±. However as the material becomes saturated with time, it will become less permeable as shown by our laboratory testing. The permeability of the cover material noted on Page 3 of our report notes the moderately impervious nature of the material as $K=2x10^{-5}$ cm/sec. However, in its saturated state the material yields a permeability coefficient of $K=2x10^{-6}$ cm/sec.

3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

We are available to discuss our recommendations with you and to provide additional studies or services necessary to complete the project. We have enjoyed assisting you and look forward to serving as your consultant on the remainder of this project and on future projects.

Very truly yours,

LAW ENGINEERING

David E. Miller, P.E.
Geotechnical Project Engineer

Barney C. Hale, P.E.
Senior Geotechnical Engineer

DEM/BCH/pap

GROUND WATER MONITORING PLAN

WATER QUALITY MONITORING PLAN
WASHINGTON COUNTY C&D LANDFILL
AND TIRE MONOFILL
WASHINGTON COUNTY, NORTH CAROLINA
S&ME, INC. PROJECT NO. 1054-95-294

Prepared for:

Diehl and Phillips
219 East Chatham Street
Cary, North Carolina

Prepared By:

S&ME Inc.
3100 Spring Forest Road
Raleigh, North Carolina 27604

August 1995

S&ME

August 1, 1995

Diehl and Phillips
219 East Chatham Street
Cary, North Carolina 27511

Attention: Mr. Alan Keith

Reference: Water Quality Monitoring Plan
Washington County C&D Landfill and Tire Monofill
Washington County, North Carolina
S&ME Project No: 1054-95-294

Dear Mr. Keith:

S&ME, Inc. has completed the Water Monitoring Plan for the proposed Washington County C&D Landfill and Tire Monofill to be constructed adjacent to the existing Washington County sanitary landfill, located off of N.C. Highway 308, east of Plymouth, North Carolina.

The Monitoring Plan, when implemented as outlined, should be effective in providing early detection of a release of hazardous constituents so as to be protective of public health and the environment.

Abandonment of the piezometers installed during the site suitability study must be performed under the supervision of a Licensed Geologist, in accordance with North Carolina Well Abandonment Regulations (15A NCAC 2C, Rule .0113(a)(2)).

S&ME, Inc. 3100 Spring Forest Road, Raleigh, North Carolina 27604, (919) 872-2660, Fax (919) 790-9827
Mailing address: P.O. Box 58069, Raleigh, North Carolina 27658-8069

Printed on Recycled Paper

We appreciate the opportunity to assist you with this phase of this project. Please call us at 919-872-2660 if you have any questions regarding the information contained within this report or if we can be of additional service.

Very truly yours,

S&ME INC.

Walter J. Beckwith, P.G.
NC Registration No. 584

Ernest F. Parker, Jr., P.E.
NC Registration No. 7950

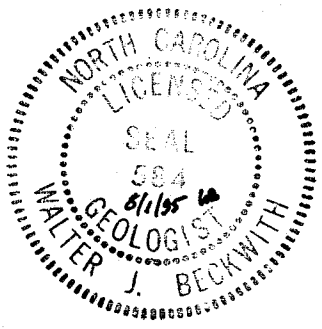


TABLE OF CONTENTS

APPENDICES

FIGURES

WATER QUALITY MONITORING PLAN

1.0 BACKGROUND

1.1 PLAN OVERVIEW

A Water Quality Monitoring Plan for the proposed Washington County Construction and Demolition (C&D) Landfill and Tire Monofill is a requirement of North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR), Division of Solid Waste Management Rule 15A NCAC 13B, Section 0.0504(1)(g)(iv). The purpose of the Water Quality Monitoring Plan is to protect human health and the environment by monitoring the quality of surface water and groundwater in the uppermost aquifer in the immediate vicinity of the facility to determine if a release of hazardous constituents has occurred from the landfill.

The information generated during the implementation of this plan will be used to assist the NCDEHNR Solid Waste Section and the operator of the Washington County C&D landfill in the evaluation of possible impacts to surface water and groundwater quality during the (active and post-closure) life of the landfill.

The following Plan includes sections describing:

- current site conditions,
- existing monitoring points or data,
- basis for new well installation,
- well design, construction and maintenance,
- sampling and analytical procedures,
- reporting and evaluation of the data.

All implemented procedures will be performed in accordance with NCDEHNR Solid Waste Section rules, guidelines, and policies.

1.2 CURRENT SITE CONDITIONS

The 71 acre site, proposed for construction of the C&D debris landfill, is located immediately east of the existing (and now closed) Washington County sanitary landfill. The existing facilities are located in northern Washington County, north of N.C. Highway 308, between the towns of Plymouth and Roper, North Carolina. The site is bounded to the north by the wooded wetland fringe of the Roanoke River. It is bounded to the east and south by privately owned, wooded, undeveloped property.

Approximately 25 percent of the site has previously been used as a source of borrow soils, both by the landfill for cover material, and previously, by the North Carolina Department of Transportation during the improvements to US Highway 64 near Plymouth, N.C. This area has been graded to the water table.

The remaining undisturbed portions of the site are elevated slightly above the surrounding land surface and covered with a thick stand of immature hardwoods and underbrush. With the exception of the site boundary adjoining the existing landfill, the land adjacent to the site boundaries is poorly drained and heavily wooded.

1.3 REVIEW OF SITE HYDROGEOLOGY

The following paragraphs summarize the hydrogeological conditions present at the site. They are included to support the basis for screen placement discussed in Section 2.2.

A more detailed discussion of site conditions can be found in the Geologic and Hydrologic Report for the Washington County C&D Landfill (S&ME, 1994).

1.3.1 Geology

Washington County is located within the Tidewater region of the Coastal Plain Physiographic Province of North Carolina. The Tidewater region is characterized by flat to subdued topography and in many areas, poorly drained soils. The Coastal Plain Region has formed through deposition of an eastward thickening wedge of sediments on crystalline bedrock. The sediments consist of interbedded sands and clays, limestone, sandstone and calcareous clays.

Surficial soils in the region consist of a series of undivided deposits of fine grained sands with interbedded clays. The undivided deposits have a thickness of between 30 and 50 feet. The Yorktown formation is present beneath the surficial deposits. The Yorktown formation typically consists of gray clayey sands and silty clays with interbedded sands and shell material. In the Plymouth, N.C. area, the Yorktown extends to a depth of approximately 95 to 100 feet.

1.3.2 Site Lithology

Soil test borings drilled at the site for the site suitability study encountered four stratigraphic units. The units consist of 20 to 28 feet of (1) relatively clean sand containing an interbedded (2) gray silty clay, overlain in undisturbed areas with a veneer of organic topsoil. The sand is fine grained near the ground surface, coarsening with depth, to medium to coarse sand with small (pea) gravel at the base of the unit. The

interbedded clay, found in 5 of the 7 borings, contains varying amounts of silt and sand, and is discontinuous across the site. It ranges between 1 and 11 feet in thickness.

The near-surface sands rest on (3) fine grained sandy and silty soils that are characteristically darker in color and contain some finely divided decayed organic matter. Typically, this unit is comprised of finely laminated silt and very fine sand that contain lenses of silty to clean fine sand and silty clay. This unit is underlain by (4) clay and clayey silt of the Yorktown formation that was encountered in one boring at a depth of 48 feet.

1.3.3 Hydraulic Conductivity of the Surficial Aquifer

Hydraulic conductivity values were determined during the suitability study performed by S&ME, Inc., in 1994 for the four lithologic units present at the site. Based on estimates provided by aquifer tests and soil particle size distributions, the upper sands have an approximate hydraulic conductivity value of 2×10^{-2} cm/sec. The interbedded clay has an approximate hydraulic conductivity value of 5×10^{-6} cm/sec. The underlying silts and clays have an approximate hydraulic conductivity value of 2×10^{-5} cm/sec.

1.3.4 Groundwater Movement

Groundwater flow occurs generally to the north toward the swampy floodplain of the Roanoke River. Some mounding of groundwater occurs in the northwestern corner of the site due to surface water run-off (and subsequent infiltration) and seepage from the adjacent sanitary landfill. The effect of this groundwater mounding is to "push"

groundwater flow toward the north-central property area and create a discharge area where former borrow excavations have lowered the ground surface.

Based on the groundwater flow gradients, annual groundwater (Darcey) velocities range from approximately 240 feet to greater than 10,000 feet in the upper sands. Velocities in the clay are on the order of 3 feet per year or less. This value is of likely minor importance as the clays are discontinuous. Groundwater tends to move around the clay lenses because of the higher seepage rates of the surrounding sand. Velocities within the deeper soils are lower, ranging from less than 1 ft/yr in the silts and clays to approximately 240 feet per year in the sand interbeds present in the deeper soils.

The surficial sands are the most permeable strata within the surficial aquifer. The deeper fine grained soils tend to act as barriers to the downward movement of groundwater. The monitor wells described in the following sections will monitor the surficial sand strata.

1.4 REVIEW OF EXISTING SITE MONITORING

1.4.1 Number and Location of Existing Monitor Wells

There are no existing monitor wells located within the area to be permitted for the C&D Landfill. There are four existing monitor wells located around the closed sanitary landfill. Two of these wells (MW-1 and MW-2) are located in close proximity of the west boundary. These wells are currently being used for monitoring of the closed landfill. They are located too far away from the proposed C&D Landfill to effectively be used as monitoring points.

Eleven piezometers were installed at the C&D site during the early spring 1994 to determine water levels around the proposed landfill.

1.4.2 Existing Monitor Well and Piezometer Construction

The existing shallow wells in the vicinity of the closed landfill are constructed of 2-inch PVC well casing and screen, installed so that the screens intersect the water table.

The temporary piezometers were installed to determine stabilized groundwater levels across the site and to perform in-situ permeability testing of the surficial aquifer. Four deep piezometers were installed in borings, B-1, B-2, B-4 and B-5, at the completion of drilling. Seven shallow piezometers were installed in shallow off-set borings located adjacent to the soil test borings.

The piezometers were constructed of 1.25" and 2.0" Schedule 40, PVC, flush threaded casing and .010" slotted screen. Ten foot (10') screen lengths were utilized for the shallow piezometers. Five foot (5') screen lengths were used for the deep piezometers.

The piezometers were installed to obtain water level data for the site. Their construction does not allow their use as monitor wells. As such, they will require abandonment prior to construction. The wells should be redrilled using hollow stem augers. The augers will be advanced to the bottom of the piezometer screen. The remaining borehole will be filled with cement-bentonite grout using a tremie pipe installed through the augers.

1.4.3 Surface Water and Groundwater Analytical Data

S&ME has not been provided with, or is aware of any existing analytical data for surface water or groundwater from the C&D site. The existing monitor wells around the sanitary landfill have been sampled periodically in conjunction with its former operation. These wells are located some distance from the proposed C&D site. Analytical data from these wells may not be representative of site conditions at the C&D landfill site.

2.0 GROUNDWATER MONITORING PLAN

The proposed monitoring well locations were selected to allow the detection of changes in groundwater quality at the site. The spacing and locations of the wells were selected based on existing site features and estimated groundwater flow directions.

2.1 BASIS FOR THE LOCATION AND NUMBER OF PLANNED MONITOR WELLS

Our interpretation of groundwater flow regimes suggests groundwater flow occurs in a northerly direction from the south boundary toward the Roanoke River, where it discharges onto the floodplain north of the site. Along the western edge of the site, there is an eastward flow component due to the higher groundwater head in the vicinity of the closed sanitary landfill.

The proposed monitoring network consists of three downgradient monitor wells (C&D-1, C&D-2, and C&D-3) and one upgradient monitor well (C&D-4). The new well locations were selected for characterization of groundwater quality both upgradient and downgradient of the proposed C&D landfill.

The downgradient wells, C&D-1 through C&D-3 are located within the buffer area, approximately 100 to 125 feet from the proposed waste boundary to allow detection of any groundwater impact prior to it's reaching the site's northern boundary. The wells are located closer to the waste boundary to move them to higher ground surface elevations, as they are in a flood prone area.

Similarly, the upgradient monitor well, C&D-4 is located in the central eastern portion of the property, approximately 250 feet upgradient of the area designated on Figure 1, as "Future Phases".

The proposed monitor well locations for the landfill are also shown on Sheet 1 of the Construction Plans. Sheet 1 also shows the location of two of the existing monitor wells (also identified as MW-1 and MW-2) part of the monitoring system for the existing sanitary landfill. For this reason it is desirable to renumber the proposed wells using a different prefix, for example, C&D in lieu of MW, to eliminate confusion in reviewing analytical data generated for the two adjacent sites. MW-1 through 4 would then pertain to the closed landfill site and C&D-1 through C&D-4 would pertain to the C&D Site.

Groundwater equipotential (contour) lines and groundwater flow direction for the surficial aquifer, based on our interpretation of groundwater levels measured in the piezometers on February 22, 1994 are also shown on Figure 1 to illustrate the relationship between the well locations and groundwater flow directions.

In addition to construction of the four proposed wells, it may be desirable to leave four of the existing shallow piezometers (B-1,B-2, B-4, and B-5) in-place to be used to determine groundwater levels in the vicinity of the landfill. All of the other piezometers should be properly abandoned prior to construction.

2.2 TYPICAL MONITORING WELL DESIGN, CONSTRUCTION AND MAINTENANCE

The four planned monitoring wells, C&D-1 through C&D-4, will be installed as Type II wells, constructed in accordance with the North Carolina Well Construction Standards

(15A NCAC 2C .0108) and the requirements of the North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities.

The Division typically requires monitor well screen placement such that seasonal water level variations will fall within the screened interval of the well. For sites such as this site, that exhibit a shallow depth to the water table, the Division recommends screen placement at a minimum depth of five feet.

Seasonal high groundwater levels are on the order of 2.5 to 3 feet below the existing ground surface within the areas proposed for location of the monitor wells. For the new wells, the top of screen will be positioned 5 feet below grade in order to allow sufficient room for construction of a well seal.

Typical monitoring well construction details for Type II wells are shown on Figure 2. It is estimated that each of the four wells will be screened between 5 and 20 feet. Final screened intervals may be adjusted slightly in the field depending on site conditions encountered during the drilling of the boreholes as described below.

The wells should be constructed by a qualified and experienced drilling contractor licensed in North Carolina. All equipment used for drilling and completion of the wells will be properly cleaned (decontaminated) before drilling and monitoring well installation. At a minimum, the cleaning will consist of high pressure hot-water cleaning of the downhole drilling equipment prior to performing each boring.

In order to obtain additional subsurface information at strategic locations, soil test borings will be performed at each of the well locations. Soil sampling will be performed,

using split-barrel sampling procedures on no more than 5-foot intervals during the advancement of the boring.

Following the completion of each borehole, the project engineer or geologist will confirm the screened interval for the monitoring well based on-site specific conditions. It is the intent that the highly permeable surficial sands be the zone monitored.

The wells will be constructed of 2-inch diameter Schedule 40 PVC flush threaded casing (ASTM F-480 or equivalent) and .010-inch slotted screen. All well construction materials will be thoroughly cleaned prior to installation or will be installed directly from factory-sealed packaging.

The proposed monitoring wells must be installed during site construction so that an initial sampling can be performed prior to landfilling.

The wells will be constructed according to the following general criteria:

1. The screen length is to be 15 feet, located so that the top of the screen is approximately 5 feet below the ground surface.

2. The annular space between the borehole wall and the well screen will be backfilled with clean, washed sand properly sized to the formation material. The sand pack shall be placed up to a level approximately one foot above the screen. The hollow-stem augers or temporary casing, if used, will be incrementally withdrawn while the filter pack is placed. The filter pack level will be frequently sounded until the desired depth of filter pack is obtained.

3. A one foot pelletized bentonite seal will be placed above the filter pack. The bentonite will be hydrated with clean water for a minimum of 2 hours. The bentonite pellets will be carefully tamped into a wet, cohesive clay mass before placement of the grout seal. Care will be taken so that the augers or temporary steel casing is withdrawn above the top of the pellets to prohibit the bentonite pellet seal from sticking to the augers or casing.

4. Grouting of the remaining annular space above the bentonite seal will be performed only after hydration of the bentonite. The remaining space will be filled with a cement grout from the top of the bentonite seal to approximately one foot below the ground surface. After grouting, no work is permitted on the well for a minimum of 24 hours while the grout hydrates.

5. The casing for each well and piezometer will be extended approximately 2.5 feet above grade and capped with a vented PVC cap. As the downgradient wells are located within a flood prone area, the PVC casings should be extended above the ground surface to slightly above +8.0 msl. This is the 100 year flood level. If this requires that the well casings are greater than 3 feet above the existing ground surface, there the ground surface should be built up above the well to facilitate sampling. A 4-inch square, or larger, steel protective casing with a lockable cover will be placed over the well's riser pipe. The protective casing will be embedded into the grout so that the top of the casing is elevated slightly above the inner well casing. The protective casing will be sealed and immobilized in concrete placed around the outside of the protective casing. A 1/4-inch diameter drain hole will be drilled in the protective casing 3 to 6 inches above the concrete pad to prohibit

7. The location, installation methods and construction details may be modified depending on field conditions, such as the presence of a significant thickness of clay within the surficial sand, etc. Any modifications will be discussed with NC Solid Waste Section prior to any revisions in construction of the wells or piezometers.

8. Following well installation, the wells will be developed in order to remove clay, silt, sand and other fines that may have been introduced into the formation or sand pack during the drilling and well installation process. Well development will also establish equilibrium of the well with the aquifer. Well development will be performed as soon as possible after well construction and will continue until the suspended solids are removed from the well and turbidity is minimized. Alternate pumping and surging cycles will be used to develop the wells.

9. Prior to initial well sampling, the highest point on the top of the PVC casing for each well shall be surveyed by a North Carolina registered land surveyor. The casing elevation shall be tied into the site benchmark in order to calculate the elevation of the groundwater surface. The wells shall also be surveyed for horizontal control. Locations shall be referenced to the North Carolina Plane Coordinate System.

10. The wells and surrounding area shall be maintained in such a way to allow access to the wells for sampling and to maintain the integrity of the wells. Each monitoring well shall be accessible by at least a four-wheel drive vehicle. Brush and weeds shall be cleared from around the wells (minimum of 10-foot radius).

11. For additional well protection, barricades are recommended to be constructed around the wells. A series of concrete filled steel posts embedded into concrete can be utilized. Alternatively, any design that offers reasonable protection to the well can be used. The barricades and well protective casings shall be painted with a high visibility color paint.

12. Surface water run-off controls shall be provided, where necessary, to prohibit erosion of or undermining of the concrete pads.

13. The well head, including protective casing, locking cap, lock and concrete pads shall be monitored for their integrity. Any repairs should be performed as needed.

2.3 WELL PERFORMANCE TESTING

Hydraulic conductivity tests shall be performed on each new well prior to the initial sampling event to allow the estimation of groundwater flow rate in the vicinity of each well, using the updated estimated hydraulic gradients at the site. The tests shall be performed by the removal of a quantity of water from the well, measuring the well response and calculation of Hydraulic Conductivity using an appropriate numerical analysis method.

3.0 SAMPLING AND ANALYSIS PLAN (SAP)

The following sampling and analysis plan includes provisions for obtaining both groundwater and surface water data. This plan applies to the four proposed monitor wells to be constructed around the C&D Landfill. The sampling requirements for the existing wells associated with the closed sanitary landfill are addressed in a separate plan.

3.1 GROUNDWATER SAMPLING

Groundwater samples will be collected from the four proposed monitor wells. The primary objectives during the collection of groundwater samples for analysis are to obtain a representative groundwater sample and to prevent the sample from being altered or contaminated during withdrawal from the well or during sample preparation.

3.1.1 Determination of Groundwater Levels

Prior to the well evacuation for every sampling event, the depth to water and total well depth will be determined with the use of an electronic water level indicator. All measurements will be recorded to the nearest 0.01 foot. The water level will be measured by turning the instrument on and slowly lowering the instrument probe into the well until the water level indicator contacts the water activating an audible alarm or indicator light. The depth to the water from the highest point on the well casing will be measured and recorded. The probe will then be lowered to the bottom of the well. The total depth will be recorded. The amount of water within the well casing will be

calculated by subtracting the depth to the water surface from the total depth of the well, and multiplying the difference by the cross-sectional area inside the well casing.

3.1.2 Well Purging, Sampling and Quality Control Procedures

Special procedures are often necessary for sampling monitoring wells based on their yield. For the purpose of this plan, a high-yield well will be defined as a well that cannot be drawn down more than 20 percent of the water column by bailing or pumping by hand. A moderate-yield well can be drawn down more than 20 percent, however, it cannot be evacuated to dryness. A low-yield well can be evacuated to dryness and requires a minimum of a few hours to a day to fully recover.

The range of hydraulic conductivity values suggests that monitor wells screened in the uppermost aquifer would provide high to moderate yields. For moderate to high-yield wells, a minimum of 3 to 5 times the volume of water standing in the well will be removed prior to sampling.

For low-yield wells, a minimum of 1.5 well volumes will be removed if evacuated to dryness; for example, a 2-inch diameter (I.D.) pipe (Schedule 40) has 0.1632 gallons per foot of pipe length. Therefore, five times the volume of a 2-inch diameter well having a seven-foot water column would be equal to 5.7 gallons (0.1632 gal/ft x 7 ft. x 5 volumes). All wells will be purged using either clean teflon bailers or decontaminated or dedicated pumps.

It is desirable to have the analytical laboratory prepare and supply the sample containers in a protective cooler or transpack. Delivery of the empty containers by the laboratory

to the sampler will be noted on the Chain of Custody. The same Chain of Custody will remain with the containers until they are delivered to the laboratory for testing.

The wells will be sampled utilizing teflon bailers previously cleaned in a laboratory in accordance with procedures from the North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities. Each bailer shall be cleaned, air-dried and wrapped in aluminum foil in the laboratory prior to shipment to the field. Following sampling, the bailers shall be returned to the laboratory for cleaning and storage. A separate laboratory cleaned bailer is required for each monitoring well. Field cleaning of sampling bailers will not be allowed.

The bailer line should consist of either (1) teflon coated wire (2) single strand stainless steel wire (3) other monofilament line or (4) nylon rope. In order to avoid contamination, new bailer line should be used at each well, for each sampling event.

During sample collection, the bailer will be slowly lowered into the water column until full, then slowly retrieved. The sample containers will be filled by slowly pouring the sample from the bailer directly into the sample container without the bailer contacting the well's outer casing, sample bottle or ground. The sample will be handled in a way to minimize aeration. For the volatile organic containers, no air bubbles or "head-space" will be allowed in the containers.

A complete set of precleaned and pre-labeled sample bottles will be removed from the cooler, prior to lowering the bailer in the well, or turning on the pump to collect the sample. Once collected, a portion of the sample from the bailer or pump (for each well) will be transferred into a fresh container. Preservatives will be added as necessary (in

accordance with EPA Methods SW-846) to the sample bottles either by the laboratory or in the field immediately prior to sampling. One trip blank prepared by the laboratory will be analyzed for each sampling event. Equipment blanks are not recommended since the sampling equipment will be either laboratory cleaned or disposable.

Because water samples are analyzed for various parameters, several types of containers are required. The sample collection will proceed as follows: Volatile organics (VOCs) will be collected first in 40 ml glass vials with Teflon lined septum caps. The vials will be filled completely with no headspace. Samples to be analyzed for inorganic constituents (metals) will be collected next. The containers are most often plastic cubes or bottles that have acid placed in the container as a preservative. These containers should not be rinsed prior to filling.

After transferring the sample to the container, it will be sealed and placed in a chilled cooler or transpack pending completion of the sampling event and delivery of all of the samples to the laboratory. Finally, the well will be capped and secured. The samples will be shipped or delivered to the laboratory on the day of collection.

3.1.3 Sampling Frequency

Groundwater monitoring will be performed at the C&D facility semi-annually. The first semi-annual sampling event will be performed during construction of the landfill, prior to waste placement. Subsequent sampling events will be scheduled with one sampling event occurring between the months of October and December and the second event occurring between April and June.

3.1.4 Field Analysis Procedures

During groundwater purging and sampling, temperature, specific conductance and Ph of the groundwater shall be measured and recorded. The instruments shall be calibrated at the beginning and end of each sampling day in accordance with the manufacturer's specifications.

3.1.5 Field Reporting Requirements

The sample collector will record all pertinent information regarding the purging and sampling of monitoring wells in a field or log book. The information will include at a minimum the following:

1. Sampling date and time
2. Collector's name
3. Site name and location
4. Well identification number
5. Water level measured from top of casing to the water surface
6. Total well depth measured from top of casing to the water surface
7. Well casing inside diameter
8. Well casing volume
9. Total volume of water removed during purging
10. Times that purging was initiated and completed
11. Sample pH, temperature, and specific conductance
12. Sample volume, container type, preservatives
13. Analytical methods for each sample

14. Sample observations, i.e., color and turbidity
15. Weather conditions at the time of sampling
16. Additional comments regarding the sampling event or sample.

The field data shall be recorded and retained in the operating record files. The data shall also be submitted to the appropriate State agencies.

3.1.6 Laboratory Analysis Parameters

Laboratory analytical parameters listed in *Sampling and Analysis Requirements for Construction and Demolition Landfills*, issued by the NC Solid Waste Section (included as Appendix 1), shall be verified prior to each sampling event. The listed parameters shall be analyzed for all samples. Trip Blanks shall be analyzed for volatile organics only.

Sample analyses shall be performed by a North Carolina Division of Environmental Management "certified" laboratory. All data shall be subjected to a strict quality assurance and quality control protocols. Only analytical methods that are acceptable to the Solid Waste Management Division shall be used by the laboratory selected to perform the analyses. Acceptable analytical methods shall be those methods described in *Sampling and Analysis Requirements for Construction and Demolition Landfills* (Appendix I). The list of parameters includes 8 inorganic constituents and 47 organic constituents.

3.1.7 Data Evaluation and Reporting

Routine monitoring of the analytical data will be performed to determine if contamination may be occurring. All analytical reports shall be completed with referenced analytical methodologies, laboratory quality assurance-quality control (QA/QC) documentation, field logs, analysis request forms, Chain-of-Custody forms, and parameter concentrations. All groundwater quality monitoring data shall be compared to the North Carolina Groundwater Standards, 15A NCAC 2L .0202, where applicable.

Results of the groundwater analyses shall be evaluated to determine if evidence of contamination exists between the "background" (upgradient) well samples and the "compliance" (downgradient) well samples.

Within 14 days of receiving the analytical data, the operator will submit a report to the Division. The report will include field observations relating to condition of monitoring wells, field data, sampling methodologies, chain-of-custody records, QA/QC data, information on groundwater flow direction, constituents that exceed groundwater standards for each well and any other pertinent information related to the sampling event.

If the operator determines that there is an exceedance of state standards for any constituent listed in Appendix I, the operator will:

- Resample the well(s) within 30 days to confirm the water quality data, and if the data is verified proceed with the following:

- Report to the Division and place a notice in the operating record, within 14 days of confirmation, indicating the constituents exceeding background levels; and either:
    - Demonstrate that a source other than the landfill unit caused contamination or that an error in sampling, analysis or evaluation occurred; or
    - Establish an assessment monitoring program within 90 days that meets the approval of the Division of Solid Waste Management.

3.2 SURFACE WATER MONITORING PLAN

Current regulations require monitoring of surface water quality both upgradient and downgradient of the landfill. Surface water runoff from the landfill is expected to be minimal due to the proposed erosion controls, site grades, and the sandy surface soils. Most of the precipitation falling on the landfill site will infiltrate the ground surface.

The site borders the Roanoke River floodplain, where wet and swampy conditions exist. Surface water samples will have to be obtained from standing water bodies within the swamp areas off-site to the north and from a marsh area on-site as there are no free flowing streams adjacent to the site. Upon review of the draft plan, the Division has agreed that a downgradient sampling point would likely not provide useful information about water qualities. Surface water sampling will be performed at one location upgradient of the site.

3.2.1 Monitoring Station Locations

The actual sampling point should be in an area of minimal turbulence and aeration. The sampling point should not be located at a constriction (where a creek narrows),

immediately upstream or downstream of a confluence with a tributary, nor immediately upstream or downstream of any structure.

The sampling point should be marked with a permanent reference point so that subsequent sampling events will obtain samples from the same location in order to maximize repeatability. One suggested upgradient sampling point is shown on Figure 1.

It is important that the surface water samples not contain any sediment. Thus, selection of potential sample locations will take into account potential low-flow conditions that may be present in the proposed sample areas during the fall months of the year.

3.2.2 Surface Water Sampling Procedures

The following sampling procedures are referenced from *EPA Standard Operating Procedures*, Section 4.8 and *North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities*, 1987.

To the extent possible, a single grab sample will be taken at mid-depth, at the center of the channel, in an area that exhibits the greatest degree of cross-sectional homogeneity. Direct dipping of the sample container is the most desirable method of collection but a laboratory cleaned teflon bailer or dipper may be used. The sample container should be rinsed with the water to be sampled prior to filling the container unless preservatives have been added. The sample container, bailer or dipper shall be lowered to the desired depth in the water and the sampling device or container removed. Care should be taken not to allow sediment or other debris to get in or on the sample container.

After the sample has been collected, the sample container should be lifted from the water or the sample should be poured directly into the sample container (if sample container not used to collect sample). About one-half inch of air space should be left in the container and the uncontaminated cap placed on the container. The containers for volatile organic samples shall be filled to the top without bubbles or headspace. The containers will be placed in protective cooler with ice for shipping.

3.2.3 Stormwater Sampling (NPDES Permit Requirements)

Surface water generated from precipitation falling on the landfill expansion area will be diverted to sediment basins or sediment traps prior to discharge into the stream or drainage features. Storm water sampling will not be required as C&D landfills are exempt from NPDES Stormwater sampling requirements unless they accept industrial or trade wastes.

3.2.4 Quality Control and Reporting Requirements

A primary concern during collection of surface water samples is to prevent sample alteration or contamination by sediment or other debris that may affect the analytical results. A set of sample bottles that have been precleaned in the laboratory and are pre-labeled will be removed from the cooler and the surface water sample poured into a fresh container. Preservatives will be added as necessary to the sample bottles at the laboratory or immediately prior to samples being placed in them. The sample bottles will then be securely placed into a precleaned cooler and a chain-of-custody form completed and placed with the samples.

The surface water sampling frequency, field analysis procedures, laboratory analysis parameters, field reporting requirements, data assessment, evaluation and reporting of the data and results shall be the same as that of the groundwater samples (Section 3.1). One surface water sampling event is required for the baseline sampling prior to landfilling. After the landfill opens, surface water sampling will be required on a semi-annual basis.

REFERENCES

Geologic and Hydrologic report, Proposed Washington County C&D Landfill, Washington County, North Carolina, N.C., S&ME Project No. 1054-94-119, April 1994

APPENDIX I

Sampling and Analysis Requirements for C&D Landfills,
January 1995,NC Solid Waste Section

SAMPLING AND ANALYSIS REQUIREMENTS
CONSTRUCTION AND DEMOLITION LANDFILLS
N.C. SOLID WASTE SECTION

LAB CERTIFICATION REQUIREMENTS:
The Solid Waste Section now requires water quality sample analysis by a laboratory certified by the Division of Environmental Management for groundwater analysis (15A NCAC 2H .0800). The laboratories used for water quality analysis for Solid Waste Section facilities shall be certified under the Division of Environmental Management (DEM) Certification program for the approved methods and at the approved levels of certification.

SAMPLING ANALYTICAL METHODS AND REPORTING LIMITS:
Each parameter on the following constituent list shall be certified at the designated level and an appropriately certified method used for the sample analysis. The data shall be reported at the specified Practical Quantitation Limit (PQL).

Parameter	Certification by DEM	PQL in ppb
Arsenic	Metals, Group I - low level	10
Barium	Barium (20)	500
Cadmium	Metals, Group I - low level	1
Chromium	Metals, Group I - low level	10
Lead	Metals, Group I - low level	10
Mercury	Mercury (21)	1
Selenium	Metals, Group I - low level	20
Silver	Metals, Group II - low level	10

Volatile Organic Compounds
For the parameters and PQLs required for volatile organic compound analysis, refer to the next page of this attachment. For volatile organic analysis the laboratory shall be certified for an SW-846 GC/MS Method (8240 or 8260). The recommended method of analysis is EPA Method 8260.

SAMPLING AND ANALYSIS:
In addition to sampling for the constituents referenced above, all sampling should also include field testing of pH, temperature, and specific conductivity. EPA requires analysis for total metals. No filtering of samples is allowed. The 3030C preparation method for metals analysis is not allowed.

January 1995

VOLATILE ORGANIC COMPOUNDS

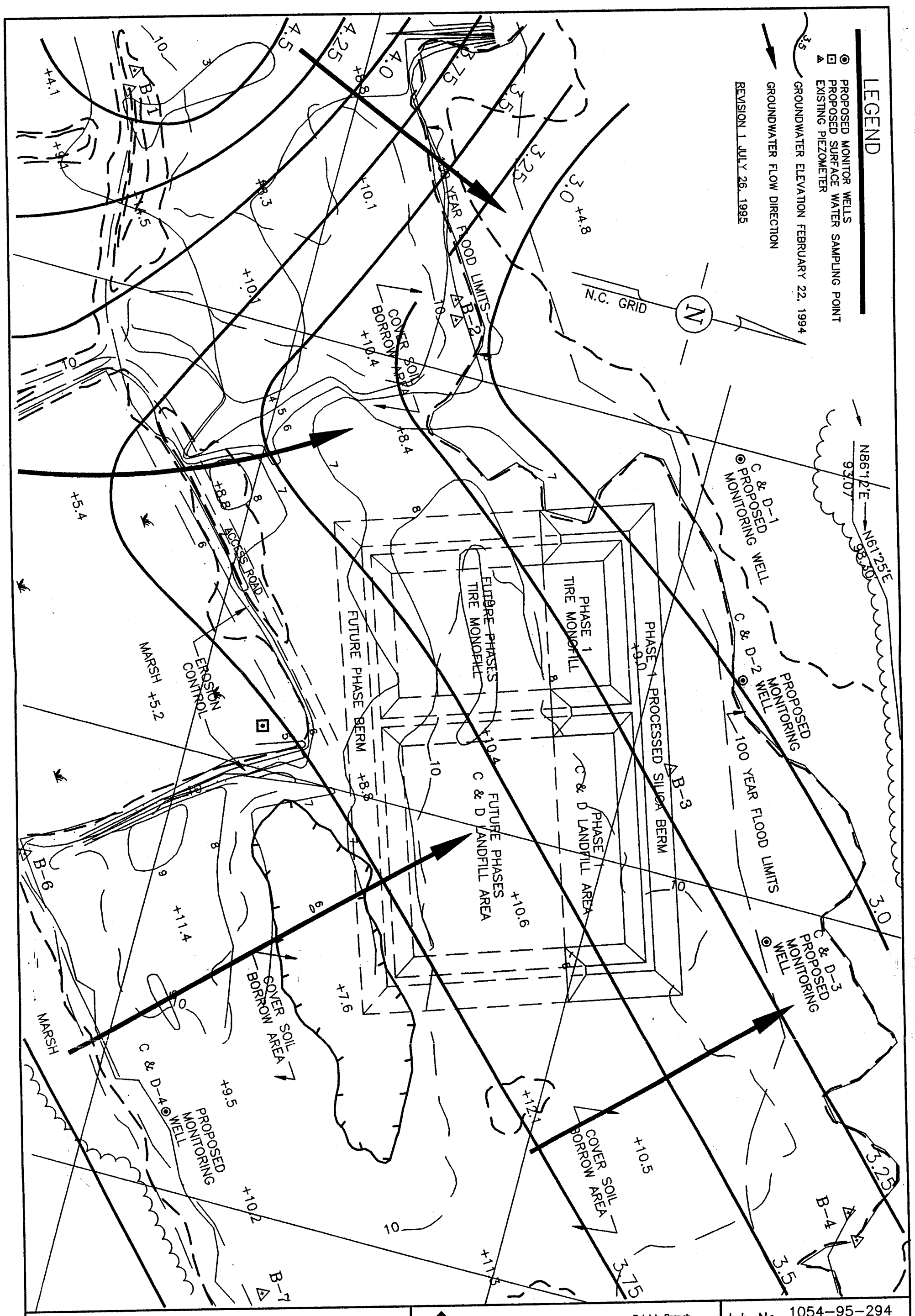
ORGANIC CONSTITUENT	PQL (UG/L)	ORGANIC CONSTITUENT	PQL (UG/L)
(16) ACETONE	100	(40) T-1,3-DICHLOROPROPENE	10
(17) ACRYLONITRILE	200	(41) ETHYLBENZENE	5
(18) BENZENE	5	(42) METHYL BUTYL KETONE	50
(19) BROMOCHLOROMETHANE	5	(43) METHYL BROMIDE	10
(20) BROMODICHLOROMETHANE	5	(44) METHYL CHLORIDE	10
(21) BROMOFORM	5	(45) METHYLENE BROMIDE	10
(22) CARBON DISULFIDE	100	(46) METHYLENE CHLORIDE	10
(23) CARBON TETRACHLORIDE	10	(47) MEK: 2-BUTANONE	100
(24) CHLOROBENZENE	5	(48) METHYL IODIDE	10
(25) CHLOROETHANE	10	(49) METHYL ISOBUTYL KETONE	100
(26) CHLOROFORM	5	(50) STYRENE	10
(27) CHLORODIBROMOMETHANE	5	(51) 1,1,1,2-TETRACHLOROETHANE	5
(28) DBCP	25	(52) 1,1,2,2-TETRACHLOROETHANE	5
(29) ETHYLENE DIBROMIDE	5	(53) TETRACHLOROETHYLENE	5
(30) O-DICHLOROBENZENE	5	(54) TOLUENE	5
(31) P-DICHLOROBENZENE	5	(55) 1,1,1,-TRICHLOROETHANE	5
(32) T-1,4-DICHLORO-2-BUTENE	100	(56) 1,1,2-TRICHLOROETHANE	5
(33) 1,1-DICHLOROETHANE	5	(57) TRICHLOROETHYLENE	5
(34) ETHYLENE DICHLORIDE	5	(58) CFC-11	5
(35) VINYLIDENE CHLORIDE	5	(59) 1,2,3-TRICHLOROPROPANE	15
(36) CIS-1,2-DICHLOROETHENE	5	(60) VINYL ACETATE	50
(37) T-1,2-DICHLOROETHENE	5	(61) VINYL CHLORIDE	10
(38) PROPYLENE DICHLORIDE	5	(62) XYLENES	5
(39) CIS-1,3-DICHLOROPROPENE	10		

ALSO KNOWN AS: (21)-TRIBROMOMETHANE, (25)-ETHYL CHLORIDE, (26)-TRICHLOROMETHANE, (27)-DIBROMOCHLOROMETHANE, (28)-1,2-DIBROMO-3-CHLOROPROPANE, (29)-1,2-DIBROMOETHANE, (30)-1,2-DICHLOROBENZENE, (31)-1,4-DICHLOROBENZENE, (33)-ETHYLIDENE CHLORIDE, (34)-1,2-DICHLOROETHANE, (35)-1,1-DICHLOROETHENE (ETHYLENE), (36)-CIS-1,2-DICHLOROETHYLENE, (37)-TRANS-1,2-DICHLOROETHYLENE, (38)-1,2-DICHLOROPROPANE, (42)-2-HEXANONE, (43)-BROMOMETHANE, (44)-CHLOROMETHANE, (45)-DIBROMOMETHANE, (46)-DICHLOROMETHANE, (47)-METHYL ETHYL KETONE, (48)-IODOMETHANE, (49)-4-METHYL-2-PENTANONE, (53)-TETRACHLOROETHENE, PERCHLOROETHYLENE, (55)-METHYLCHLOROFORM, (57)-TRICHLOROETHENE, (58)-TRICHLOROFLUOROMETHANE

•••END•••

FIGURE 1

Site Monitoring Plan



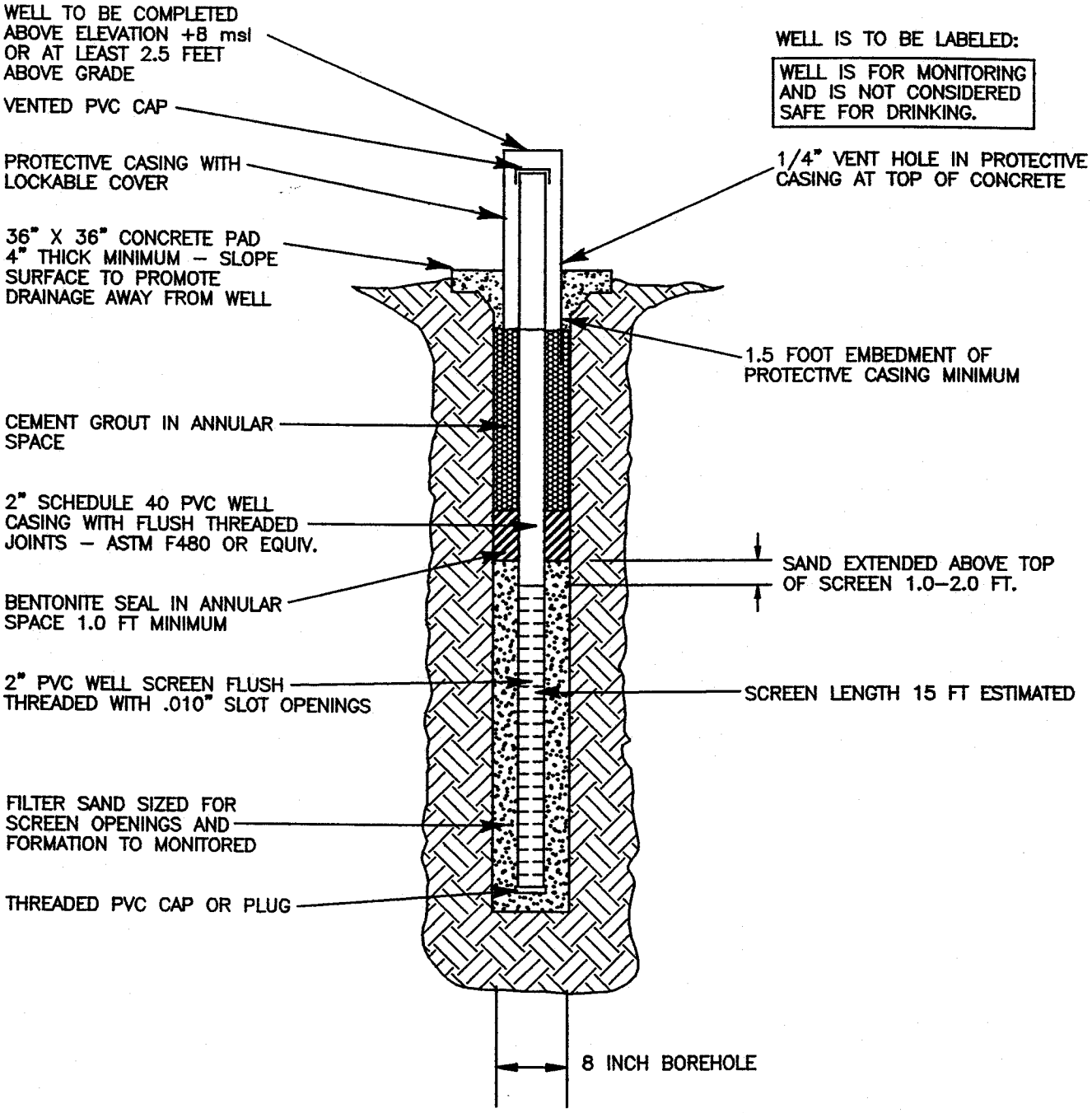
WASHINGTON COUNTY
WASTE LANDFILL/TIRE MONOFILL
PROPOSED MONITORING PLAN
WASHINGTON COUNTY, NORTH CAROLINA

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING
Raleigh Branch
3100 Spring Forest Road
P.O. Box 58069
Raleigh, N.C. 27658-8069
(919) 872-2660
Fax (919) 790-9827

Job No. 1054-95-294
Scale: 1" = 100'
Fig No. 1

Figure 2

Schematic of Well Construction



SCHEMATIC OF PROPOSED MONITOR WELL CONSTRUCTION

WASHINGTON COUNTY
C & D LANDFILL/TIRE MONOFILL
WATER QUALITY MONITORING PLAN
WASHINGTON COUNTY, N.C.

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ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

Job No. 1054–95–294
Scale: None
Fig No. 2

S&ME

February 1, 1995

Received
FEB 1995
Solid Waste
Section

Diehl and Phillips, P.A.
Consulting Engineers
219 E. Chatham Street
Cary, N.C. 27511

Attention: Mr. Alan Keith

Reference: Washington County C&D Landfill
Washington County, N.C.
S&ME Inc. Project No. 1054-94-119

Dear Mr. Keith,

We have reviewed the comments dated January 17, 1995, from Mr. Jim Bateson with the Solid Waste Management Division. One of the comments stated "Rule .0504(1)(c)(E) requires that (II) volume percent water, and (III) porosity values for each hydrological unit within 50 feet of the surface be provided. These need to be submitted." We have prepared the following response to address the volume percent water and porosity for each hydrological unit within 50 feet of the surface at this site.

Four hydrological units exist at the site within 50 feet of the ground surface. The units consist of a surficial sand, and interbedded clay, an organic clayey silt and a basal silty clay unit (the Yorktown Formation).

Due to the difficulty in obtaining in-situ samples of granular soils using a thin wall sampler, samples of the surficial sands were not obtained during the investigation. Additional moisture content determinations were not performed as the soils below a depth of about 6 feet were assumed to be fully saturated. The table on page 2 shows values of porosity and corresponding moisture content recommended for characterization of the units

S&ME, Inc. 3100 Spring Forest Road, Raleigh, North Carolina 27604, (919) 872-2660, Fax (919) 790-9827
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present at the site. The values have been obtained from literature sources, from laboratory tests performed on site soils, and similar off-site soils from a site located several miles west of the landfill, in Plymouth, North Carolina.

Hydrologic Unit	Estimated Porosity (in Percent)	Estimated Volumetric Moisture Content (in percent)
Upper Sands	38 [1]	10 [5] for the unsaturated zone 37 [6] for the saturated zone
Clay Interbeds	35.2 [2]	32.5 [2]
Gray Organic Silt	40 [3]	39 [6]
Silty Clay (Yorktown Formation)	47.0 [4]	46.3 [4]

Notes:

(1) Range of 25 to 50 percent for sands (Freeze and Cherry, 1979)

(2) Actual value from laboratory tests on site soils (S&ME, April 1994)

(3) Range of 35 to 50 percent for silts (Freeze and Cherry, 1979)

(4) Actual value from laboratory tests on off-site, Yorktown soils. (S&ME, June 1994). Porosity of clay estimated to range between 40 to 70 percent (Freeze and Cherry, 1979)

(5) Based on the value of porosity minus the specific yield. Specific yield estimated to range between 10 to 30 percent for sand. (Driscoll, 1986)

(6) Based on a saturation of approximately 98 percent.

Driscoll, F.G., 1986, Groundwater and Wells, Johnson Filtration Systems Inc., St. Paul, Minnesota 55112, page 67

Freeze, R.A., and Cherry, J.A., 1979, Groundwater, Prentice Hall, Inc., Englewood Cliffs, N.J. 07632, page 37

Should additional representative values be required to confirm the estimates shown above, they can be obtained from analysis of soil samples obtained during installation of the permanent monitor wells. This information should be submitted to the Division in order that they may complete their review of the site application.

Please call me at 872-2660 if you have any questions or require any additional information. S&ME appreciates the opportunity to be of service to you on this project.

Sincerely,

S&ME, Inc.

Walter J. Beckwith, P.G.
Senior Project Geologist

Ann M. Borden, P.G.
Environmental Manager

...\94119WC\SiteAppl.ltr

S&ME

July 28, 1995

Diehl and Phillips, P.A.
219 East Chatham Street
Cary, North Carolina 27511

Attention: Mr. Alan Keith

Reference: Response to NCDEHNR Letter of July 3, 1995
Washington County C&D Landfill
Washington County, North Carolina
S&ME Project No: 1054-95-294

Dear Mr. Keith:

We have reviewed the letter from Jim Bateson to Jim Barber with the North Carolina Department of Environment, Health, and Natural Resources, Division of Solid Waste Management (the Division), dated July 3, 1995. This letter contains a response to each of the four points raised in the letter. A copy of the July 3, 1995 letter is attached. The Water Quality Monitoring Plan has been amended to incorporate the responses.

The following paragraphs briefly outline our response to each of the four items of the Division's letter

1). There are three wells in Washington County, North Carolina that are in the US Geological Survey's (USGS) groundwater data collection network. These wells are maintained by the USGS to provide continuous hydrologic data. Two of the wells are located near Phelps lake. The third well (NC-158) is located on NCSR

1101, approximately 5 miles south of Plymouth, North Carolina. This well is screened in the surficial aquifer, as are the shallow piezometers at the site. Figure 1 shows the location of NC-158 and other USGS wells in the Coastal Plain of North Carolina. Figure 2 shows the hydrograph for well NC-158. A listing of actual daily measurements from the well for the period of October 1993 to September, 1994 are shown in the Appendix. The listing shows the seasonal high water level for the period occurred on March 3, 1994, when the depth to the water surface was 0.52 feet below land surface.

The bottom portion of Figure 1 shows hydrograph data for most of the period from 1987 through September 1994. Visual examination of the data shows water levels were slightly higher in the spring of 1993 and 1994 than the six preceding years.

Based on the only long term hydrograph data available for the site area, the short term water level data obtained at the site on February 14, and 22, 1994 should be suitable for design of the landfill. The period monitored at the landfill is representative of groundwater conditions in the area for the last seven years.

2) The downgradient wells CD-1, CD-2, and CD-3 have been moved closer to the waste boundary so the wells will be located on higher ground. The new locations will be adequate to properly monitor the shallow aquifer downgradient of the landfill. The well casings should be elevated above the land surface. The inner PVC riser should extended to elevation 8 feet above sea level (the 100 year flood level) or 2.5 feet above grade which ever is higher. If the well casings are greater than three feet above the ground surface, the wells will be difficult to sample. If

this is the case, it would be desirable to elevate the ground surface locally around the well to facilitate sampling.

3). The surface water monitoring point north of the landfill has been deleted from the plan.

4). The construction documents or operational plan should specify that the existing piezometers require abandonment. The Division requires the wells be redrilled with hollow stem augers and the resulting borehole must be filled with cement-bentonite grout introduced through the augers with a tremie pipe.

We trust this response sufficiently addresses the Division's letter. These comments have been incorporated into the Water Quality Monitoring Plan. Three copies are attached. Please call me at 872-2660 if you have any questions or require additional information.

Sincerely,

S&ME, INC.

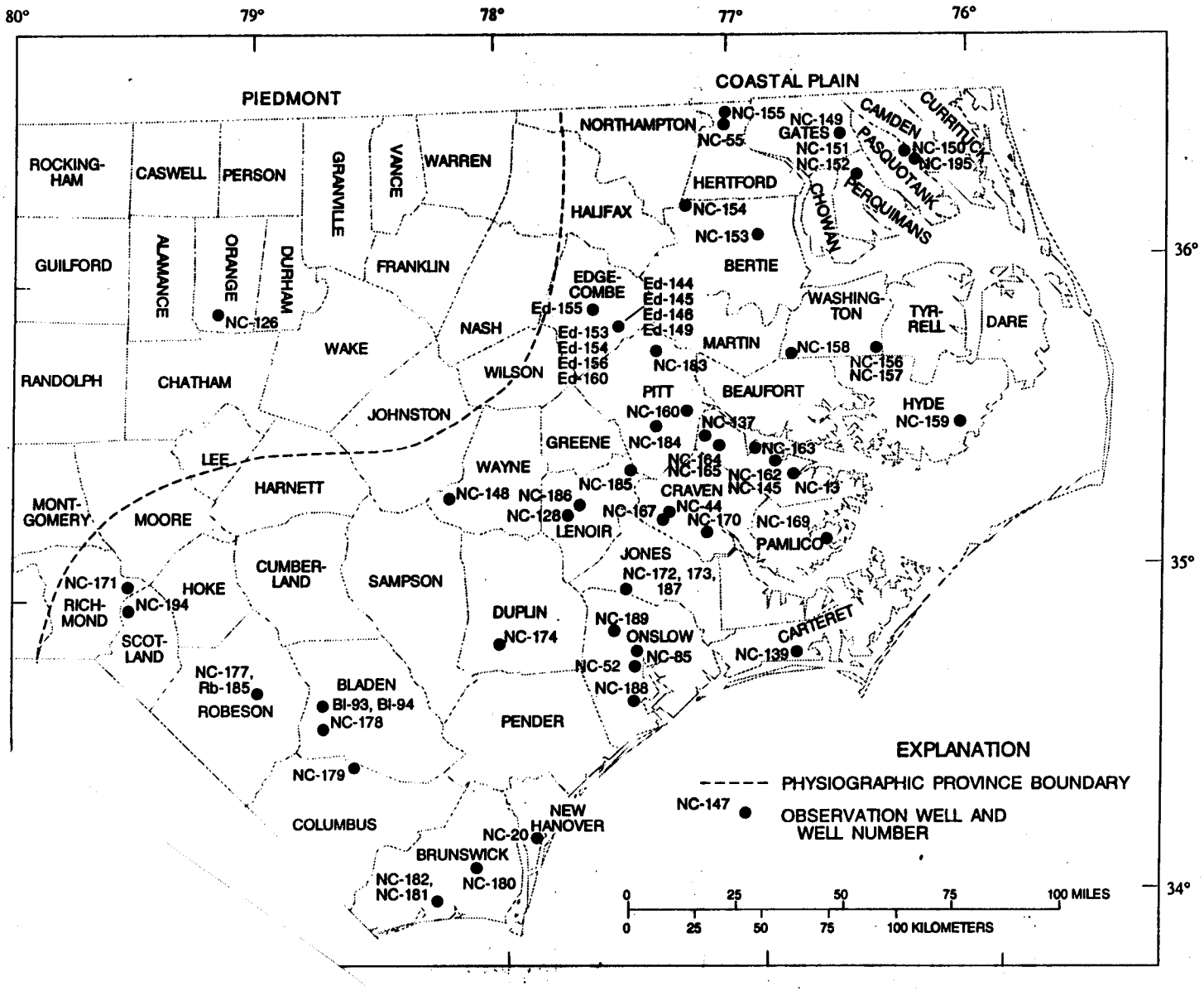
Walter J. Beckwith, P.G.
Senior Project Geologist

Ann M. Borden, P.G.
Environmental Manager

K:\..\95294WC\RESPNS.ltr

REFERENCES

Smith, D.G., George, E.D., Breton, P.L., 1995, U.S. Geological Survey Water Data Report NC-94-2, USGS and NCDEHNR, Raleigh, N.C., 166 p

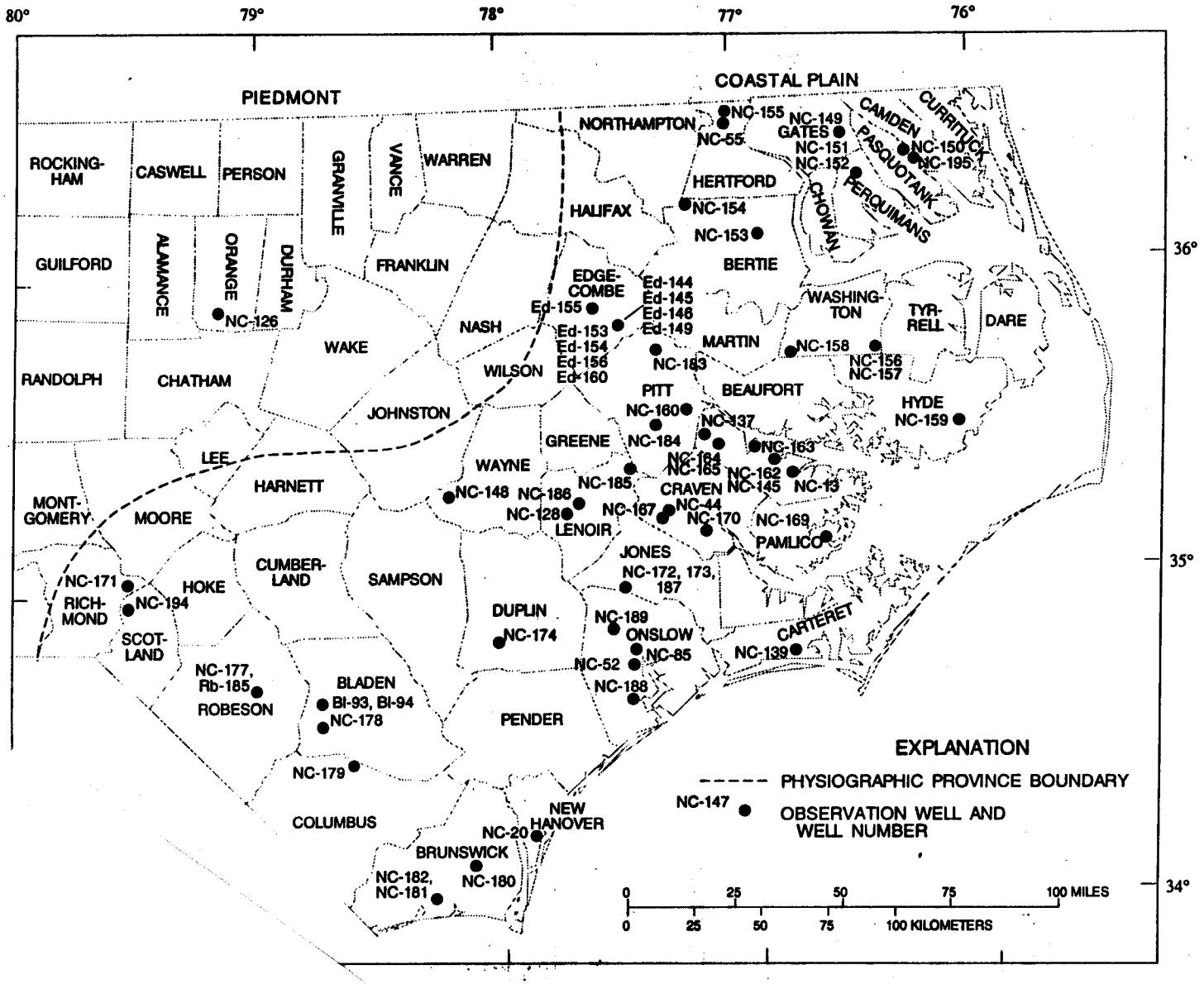


Source: U.S. Geological Survey, Water Data Report NC-94-Volume 2, Page 27

Location of USGS Observation Wells
Washington County C&D Landfill
Washington County, North Carolina

S&ME, INC.
Raleigh Branch Office
3100 Spring Forest Road
Raleigh, North Carolina 27604

PROJECT NO.:	**1054-95-294**
SCALE:	**As Shown**
FIGURE:	**1**



Source: U.S. Geological Survey, Water Data Report NC-94-Volume 2, Page 27

Location of USGS Observation Wells
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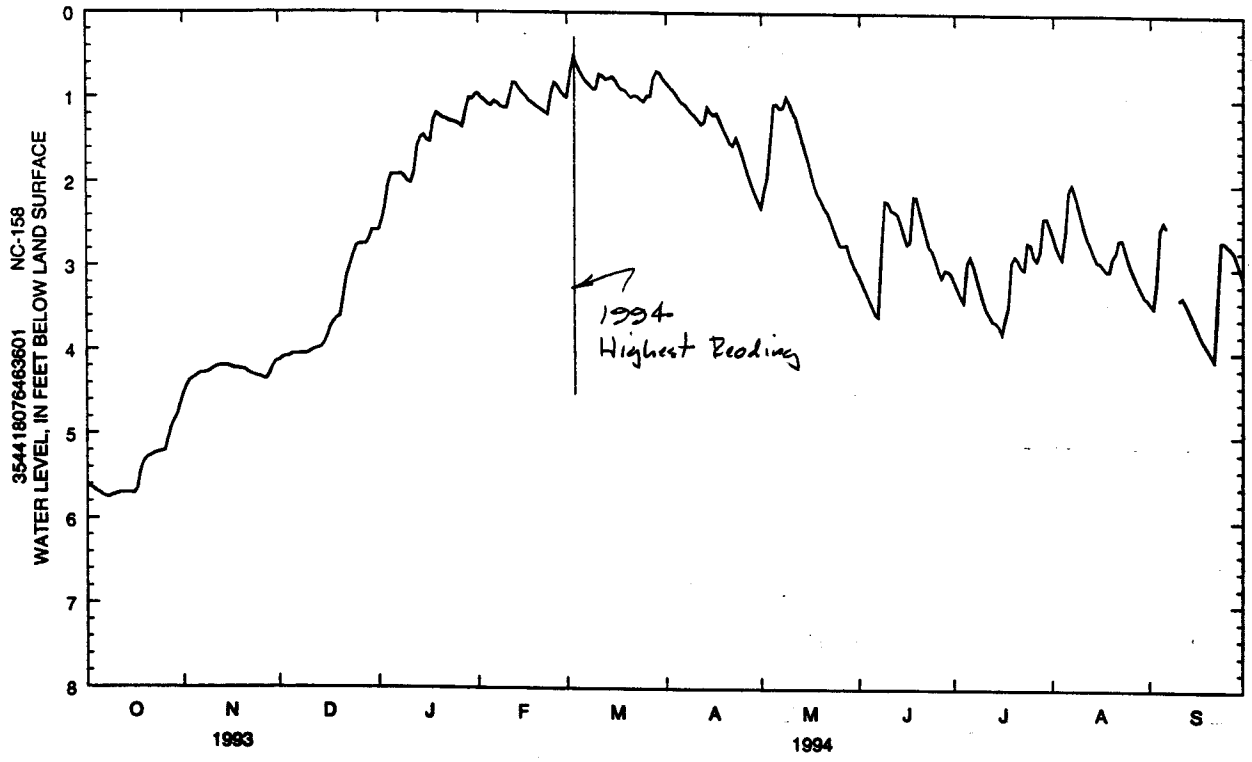
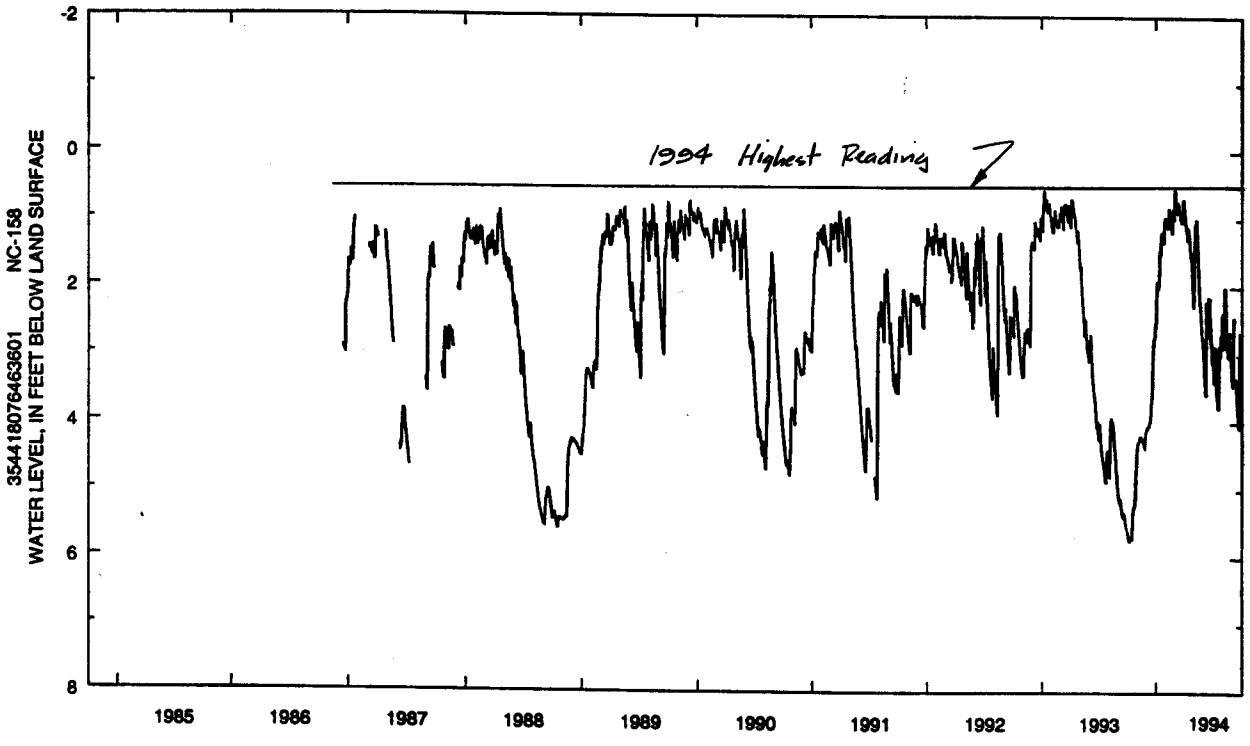
PROJECT NO.:	1054-95-294
SCALE:	As Shown
FIGURE:	1





Source: U.S. Geological Survey Water Data Report NC-94-2, Volume 2, page 157

Well Hydrograph for NC-158 **Washington C&D Landfill** **Washington County, N.C.**	**S&ME, INC.** Raleigh Branch Office 3100 Spring Forest Road Raleigh, North Carolina 27604 (919) 872-2660	**SCALE:** No Scale **PROJECT NO:** 1054-95-294 **FIGURE NO:** 2

APPENDIX I

WASHINGTON COUNTY--Continued

354418076463601. Local number, NC-158.

LOCATION.--Lat 35°44'18", long 76°46'36", Hydrologic Unit 03020104, 2.4 mi west of State Highway 32 on Secondary Road 1101. Owner: U.S. Geological Survey.

AQUIFER.--Surficial aquifer of post-Miocene age.

WELL CHARACTERISTICS.--Drilled observation well, drilled to 15 ft, diameter 4 in., cased to 10 ft, screened interval from 10 to 15 ft.

INSTRUMENTATION.--Digital recorder with a 60-minute punch interval.

DATUM.--Land-surface datum is 35 ft above sea level (from topographic map). Measuring point: Top of instrument shelf, 2.49 ft above land-surface datum.

REMARKS.--Well is part of climatic-effects network.

PERIOD OF RECORD.--December 1986 to current year.

EXTREMES FOR PERIOD OF RECORD.--Highest water level recorded, 0.50 ft below land-surface datum, Mar. 2, 3, 1994; lowest water level recorded, 5.76 ft below land-surface datum, Oct. 7, 8, 1993.

WATER LEVEL, IN FEET BELOW LAND SURFACE DATUM, WATER YEAR OCTOBER 1993 TO SEPTEMBER 1994

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.61	4.52	4.14	2.58	.96	1.00	.82	2.30	3.11	3.17	2.61	3.41
2	5.63	4.44	4.11	2.46	1.01	.72	.87	2.09	3.20	3.26	2.72	3.46
3	5.65	4.37	4.09	2.29	1.04	.52	.91	1.95	3.29	3.35	2.82	3.14
4	5.68	4.35	4.09	2.02	1.08	.62	.95	1.53	3.38	3.41	2.89	2.52
5	5.70	4.32	4.06	1.92	1.10	.70	1.02	1.08	3.47	2.95	2.60	2.44
6	5.73	4.29	4.06	1.92	1.05	.77	1.06	1.07	3.56	2.87	2.08	2.50
7	5.75	4.28	4.06	1.92	1.07	.82	1.08	1.12	3.59	2.97	2.00	---
8	5.75	4.28	4.06	1.91	1.11	.85	1.13	1.11	2.77	3.11	2.11	---
9	5.73	4.27	4.05	1.95	1.12	.90	1.18	.99	2.21	3.25	2.24	---
10	5.72	4.24	4.05	2.00	1.13	.90	1.21	1.06	2.23	3.39	2.38	3.36
11	5.71	4.22	4.02	2.02	.99	.73	1.26	1.15	2.32	3.50	2.53	3.33
12	5.70	4.20	4.00	1.89	.83	.75	1.31	1.23	2.34	3.57	2.64	3.40
13	5.70	4.20	3.99	1.59	.84	.79	1.28	1.35	2.37	3.64	2.73	3.49
14	5.70	4.20	3.98	1.48	.90	.78	1.11	1.49	2.48	3.65	2.83	3.57
15	5.70	4.20	3.93	1.45	.95	.76	1.17	1.62	2.61	3.70	2.92	3.66
16	5.71	4.21	3.84	1.51	.99	.80	1.20	1.75	2.73	3.79	2.93	3.74
17	5.65	4.23	3.74	1.53	1.04	.87	1.18	1.91	2.70	3.61	2.98	3.83
18	5.44	4.23	3.67	1.27	1.06	.91	1.27	2.05	2.16	3.46	3.03	3.89
19	5.34	4.24	3.63	1.19	1.09	.92	1.36	2.15	2.17	2.93	3.03	3.95
20	5.29	4.24	3.61	1.22	1.12	.96	1.44	2.22	2.33	2.86	2.87	4.02
21	5.27	4.27	3.38	1.25	1.14	1.00	1.53	2.30	2.48	2.91	2.81	4.08
22	5.25	4.29	3.13	1.26	1.17	.98	1.56	2.36	2.62	3.00	2.66	3.36
23	5.23	4.31	3.01	1.28	1.20	.99	1.47	2.45	2.76	3.02	2.65	2.67
24	5.22	4.32	2.88	1.29	.96	1.03	1.55	2.55	2.80	2.70	2.78	2.67
25	5.21	4.33	2.77	1.30	.83	1.05	1.68	2.66	2.91	2.72	2.90	2.71
26	5.20	4.35	2.75	1.32	.86	.98	1.80	2.75	3.04	2.86	3.01	2.74
27	5.05	4.36	2.75	1.35	.93	.98	1.92	2.75	3.12	2.91	3.10	2.79
28	4.92	4.29	2.75	1.16	.98	.78	2.03	2.74	3.03	2.80	3.18	2.88
29	4.84	4.20	2.69	1.01	---	.69	2.13	2.87	3.04	2.41	3.26	3.00
30	4.77	4.15	2.58	1.03	---	.71	2.22	2.97	3.08	2.40	3.33	3.11
31	4.64	---	2.58	.97	---	.78	---	3.04	---	2.50	3.36	---

WTR YR 1994 MEAN 2.67 HIGH .52 LOW 5.75