BULL RUN

Dry Fly Ash
Bottom Ash - From Pond

BULL RUN

Dry Fly Ash

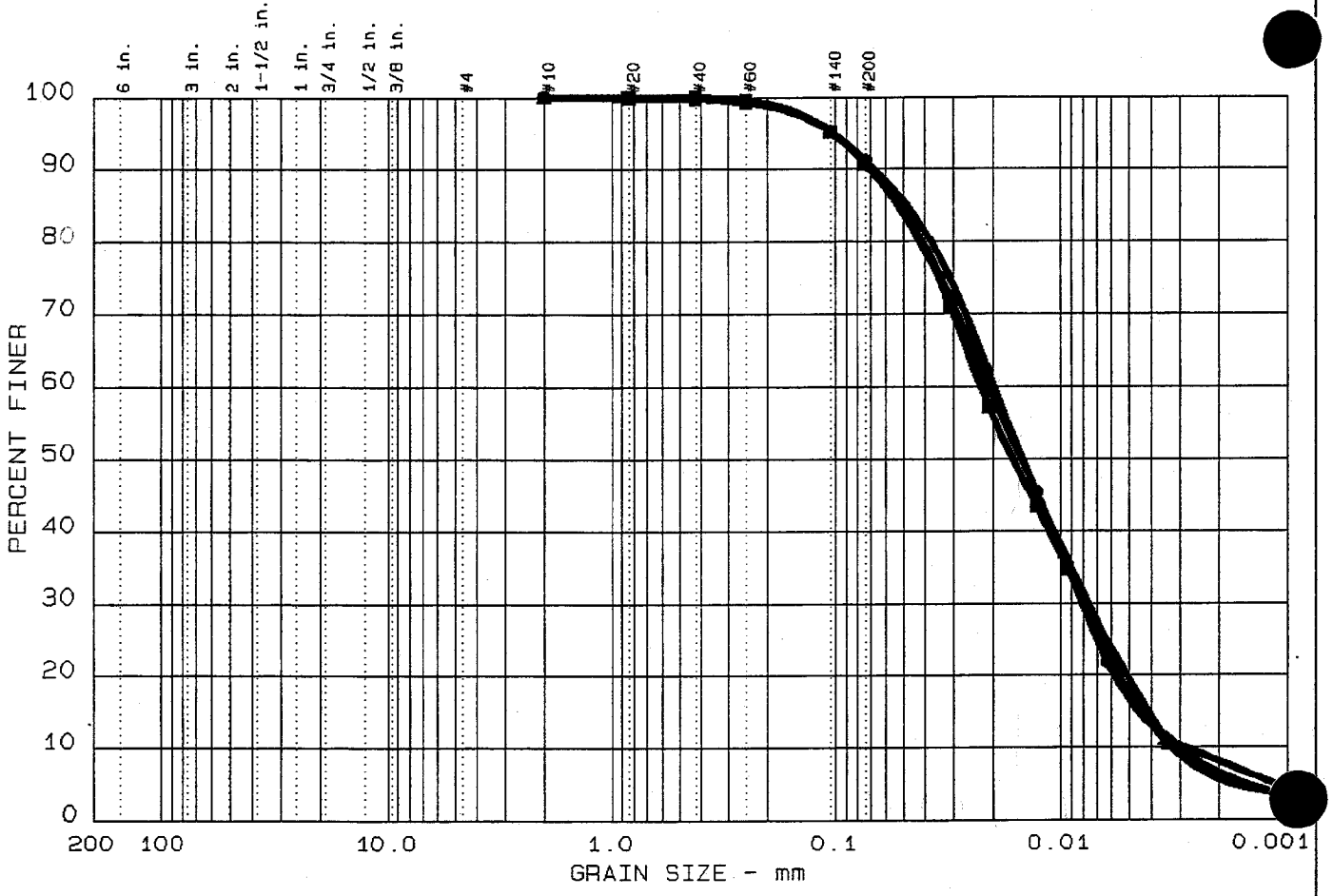
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - BULL RUN
DRY FLY ASH

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	0.0 91.2 16.6	0.0 91.2 19.5	0.0 90.7 17.5
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.36	2.28	2.37
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	ML A-4(0.0)	ML A-4(0.0)	ML A-4(0.0)
				Composite Sample	
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %		91.6 17.4	
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %		95.7 15.1	
			Result	**Dry Density, pcf**	**Moisture Content, %**
Consolidation	ASTM D2435	Compression Index C_c	0.04	84.8	17.4
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	4.0E-5	87.7	19.7
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ',degrees	0.31 27.7	87.6	19.6
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	1.12 21.2	87.6	19.6
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	1.36 27.4	80.9	17.9
California Bearing Ratio	ASTM D 1883	CBR, %	2	87.6	18.6
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,370	86.4	17.6
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,500	89.3	15.6
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm		690	
pH of Soil	AASHTO T 289	pH		8.4	
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg		4630	
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg		<10	

brf-fa.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	8.8	74.6	16.6
▲	5	0.0	0.0	8.8	71.7	19.5
■	3	0.0	0.0	9.3	73.2	17.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP			0.01	0.008	0.0046	0.0031	1.00	6.8
▲	NL	NP			0.01	0.008	0.0041	0.0027	1.06	7.2
■	NL	NP			0.02	0.008	0.0044	0.0033	0.87	6.9

	MATERIAL DESCRIPTION	USCS	AASHTO
●		ML	A-4 (0.0)
▲		ML	A-4 (0.0)
■		ML	A-4 (0.0)

Project No.: 5810860101
Project: TVA - Bull Run
● Location: Dry Fly Ash A & B
▲ Location: Dry Fly Ash C & D
■ Location: Dry Fly Ash E & F
Date: July 18, 1995

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

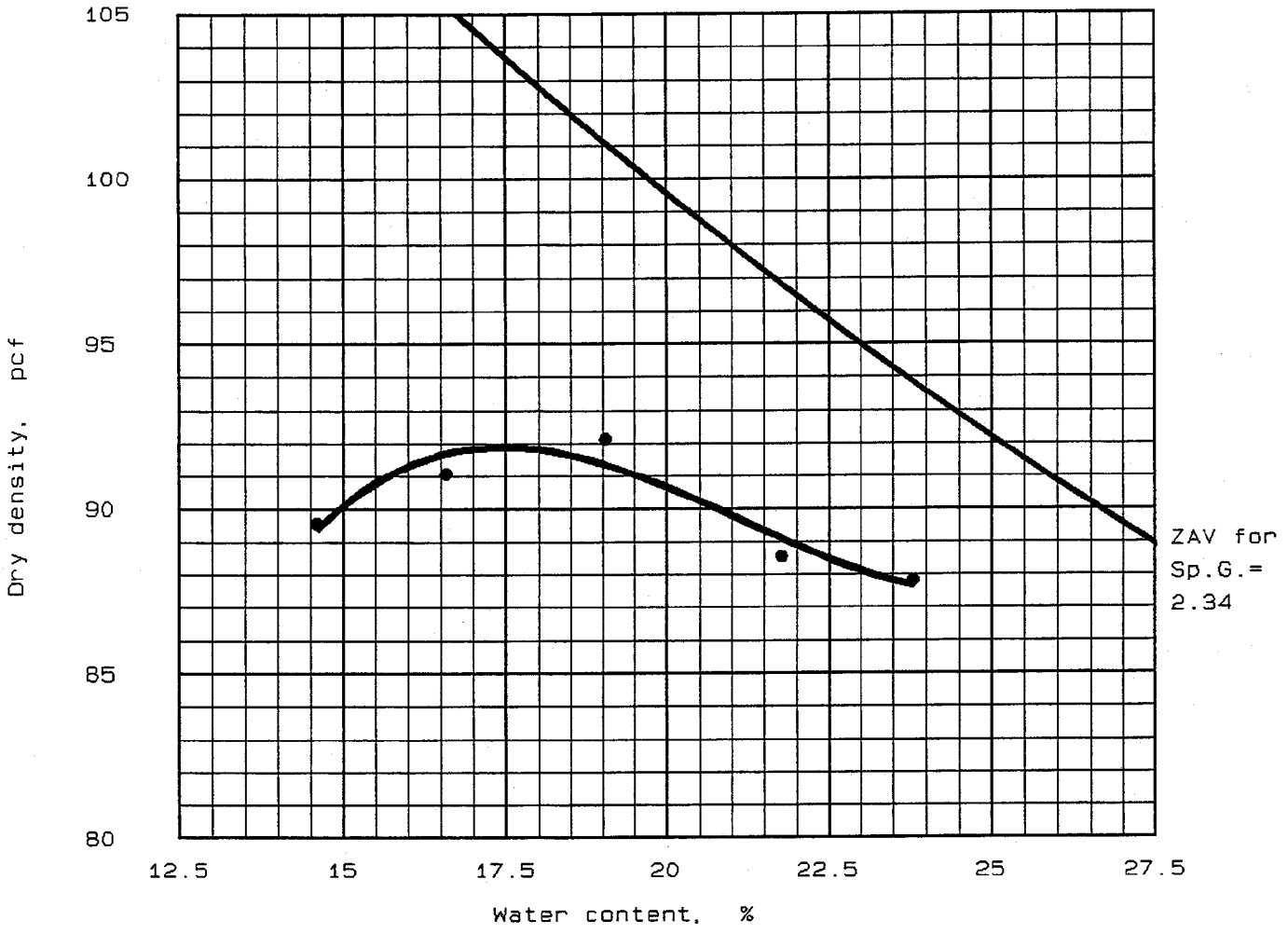
Remarks:

Tested by: JCR

Reviewed by: HS

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4 (0.0)		2.34	NL	NP	0 %	91.0 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 17.4 % Maximum dry density = 91.9 pcf	

Project No.: 5810860101
Project: TVA - Bull Run
Location: Dry Fly Ash

Date: July 25, 1995

Remarks:

Tested by: CLG

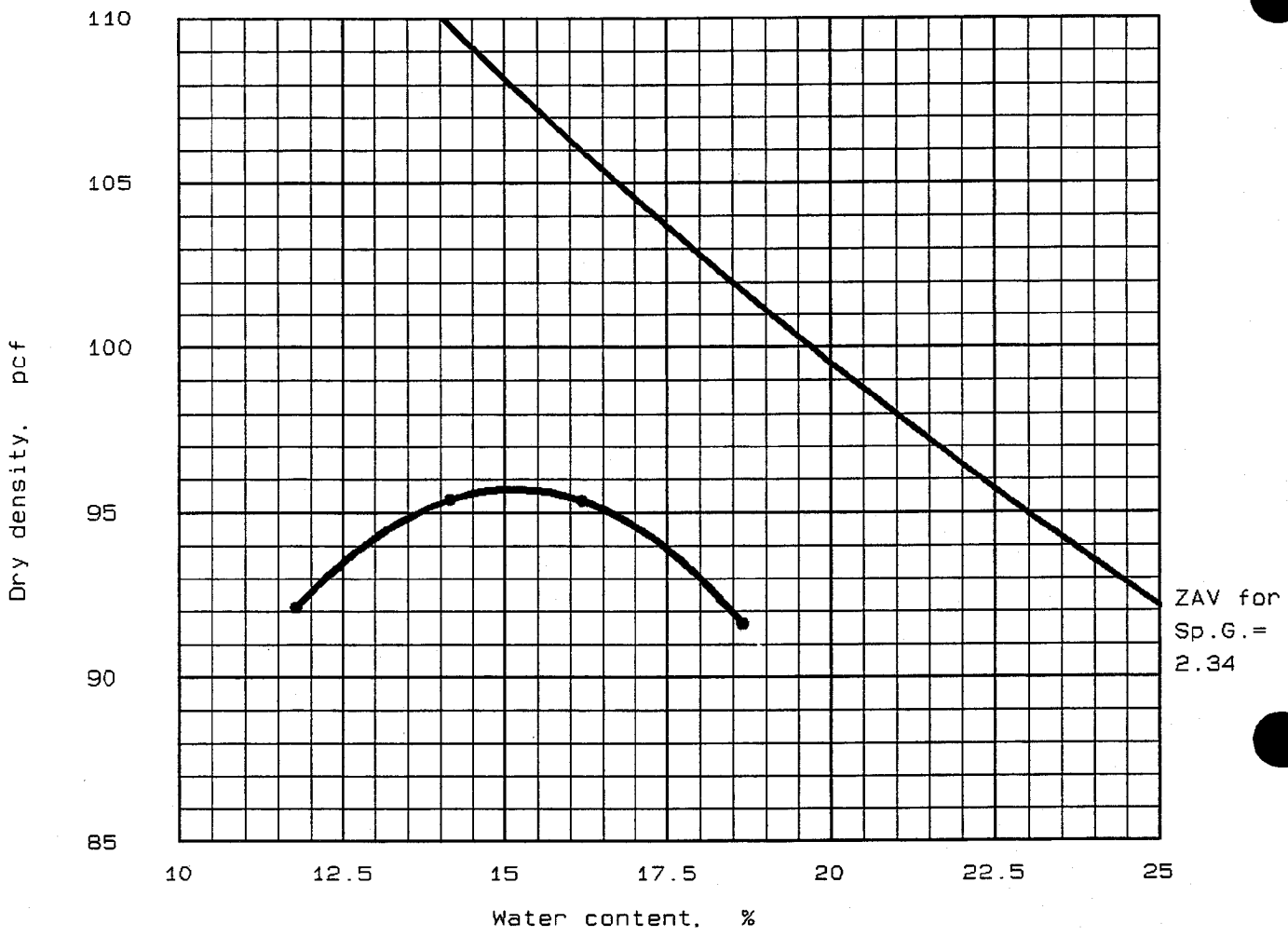
Reviewed by: RLB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4 (0.0)		2.34	NL	NP	0 %	91.0 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 15.1 % Maximum dry density = 95.7 pcf	

Project No.: 5810860101
Project: TVA - Bull Run
Location: Dry Fly Ash

Date: July 25, 1995

Remarks:

Tested by: CLG

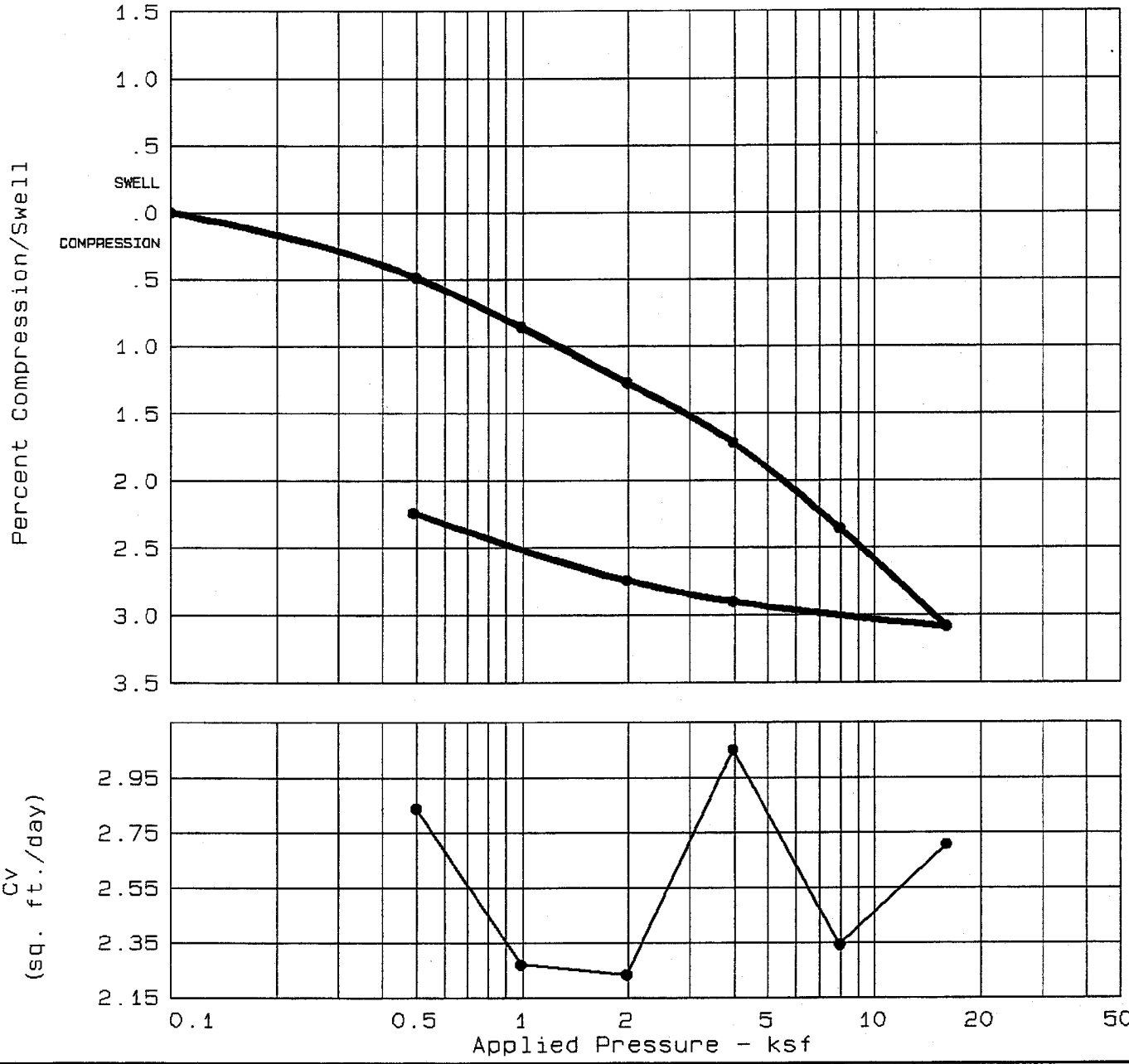
Reviewed by: RLB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Density	LL	PI	Sp.Gr.	Precons. press.	C_c	e_o
56.8 %	17.4	84.8	NL	NP	2.337	4.56	0.04	0.7170

TEST RESULTS

Compression Index = 0.04

MATERIAL DESCRIPTION

Class: USCS: ML

Project No.: 5810860101
Project: TVA - Bull Run
Location: Dry Fly Ash

Date: 06/29/95

Remarks:

Tested by: AdK
Reviewed by: [illegible]

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No._____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Bull Run*	Test Date	*05/19/95*
Material (Source)	*Dry Fly Ash*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*19.7*
Wet Unit Weight, pcf:	*105.0*
Dry Unit Weight, pcf:	*87.7*
Compaction, %:	*95.8*
Hydraulic Conductivity, cm/sec. @20 °C:	***4.0E-05***

.600.04
.00040

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Bull Run	Test Date	05/19/95
Material (Source)	Dry Fly Ash	Reviewed By	RLB
		Review Date	09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	5.600	Location 1	2.880	Dry Soil+Pan, grams	840.25
Location 2	5.600	Location 2	2.880	Pan Weight, grams	0.00
Location3	5.600	Location 3	2.880		
Average	5.600	Average	2.880	Moisture Content, %	19.7
		Wet Soil + Tare, grams	1005.80	Wet Unit Wt, pcf	105.0
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	87.7

Chamber Pressure, psi	47
Back Pressure, psi	33
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				1457	0.0	20.0	123.81	103.81	4.1E-05	21	4.0E-05
				1462	0.0	20.0	123.81	103.81	4.1E-05	21	4.0E-05
				1459	0.0	20.0	123.81	103.81	4.1E-05	21	4.0E-05

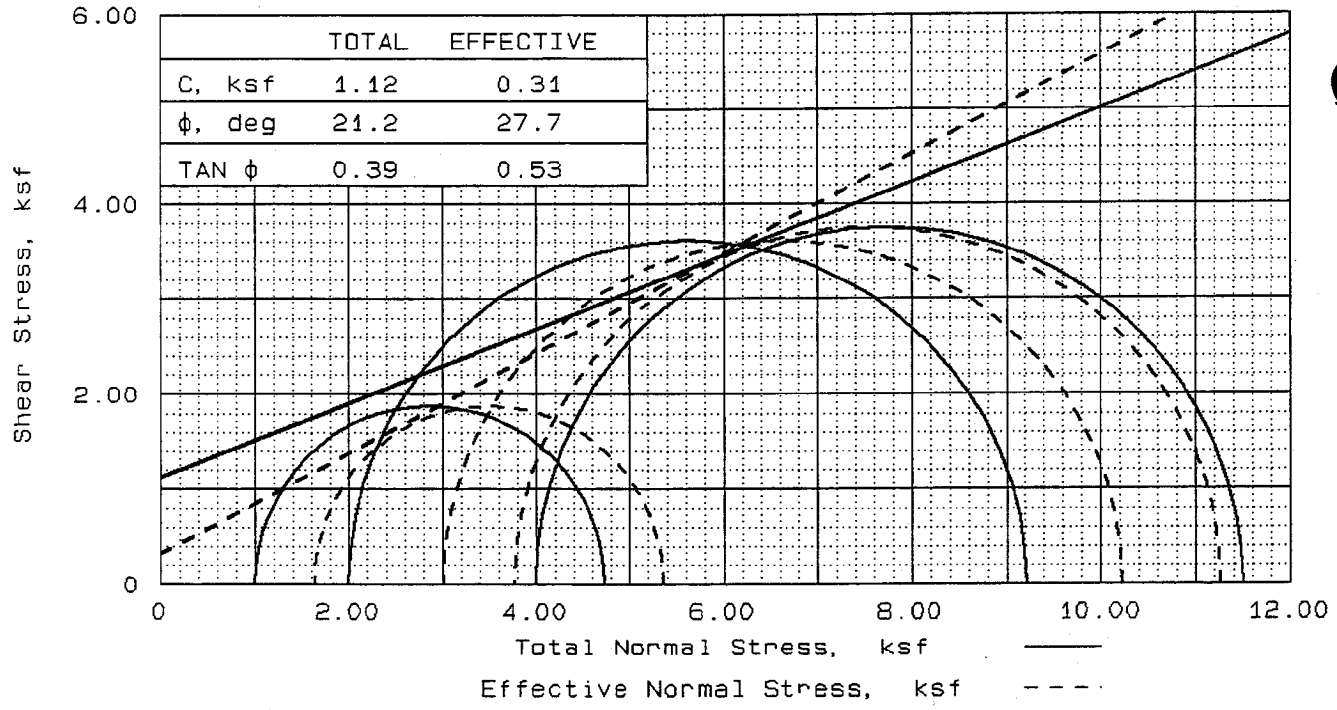
No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	91.6	95.8	Vertical

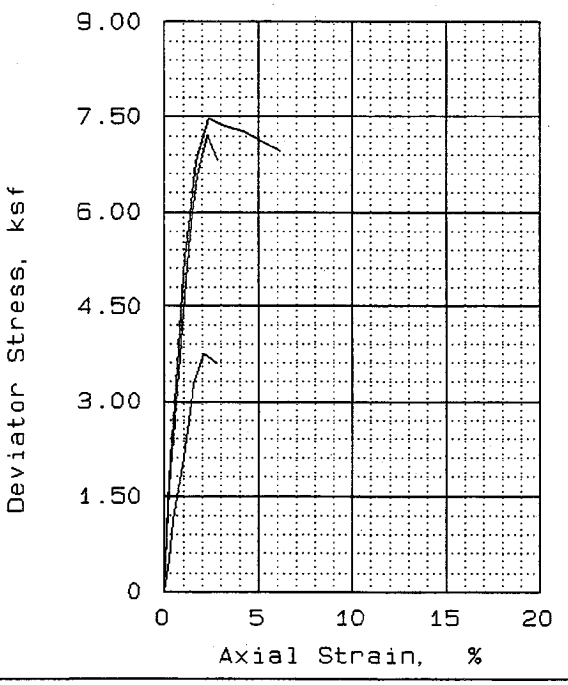
Avg. k at 20 °C 4.0E-05 cm/sec

a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 1.00 cm²
A = 42.028 cm²
L = 14.224 cm





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	19.6	19.7	19.6
	DRY DENSITY, pcf	87.3	87.7	87.9
	SATURATION, %	68.2	69.3	69.2
	VOID RATIO	0.673	0.665	0.663
	DIAMETER, in	2.88	2.88	2.88
	HEIGHT, in	5.60	5.60	5.60
AT TEST	WATER CONTENT, %	27.9	27.8	28.0
	DRY DENSITY, pcf	88.3	88.5	88.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.654	0.651	0.655
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.57	5.59	5.60
BACK PRESSURE, ksf		4.80	4.75	4.75
CELL PRESSURE, ksf		8.79	6.75	5.75
FAILURE STRESS, ksf		7.50	7.21	3.74
PORE PRESSURE, ksf		5.03	3.74	4.12
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		11.26	10.22	5.37
$\bar{\sigma}_3$ FAILURE, ksf		3.77	3.01	1.63

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.34
REMARKS: Tested by: HB

Reviewed by: RLB

FIG. NO.

CLIENT:

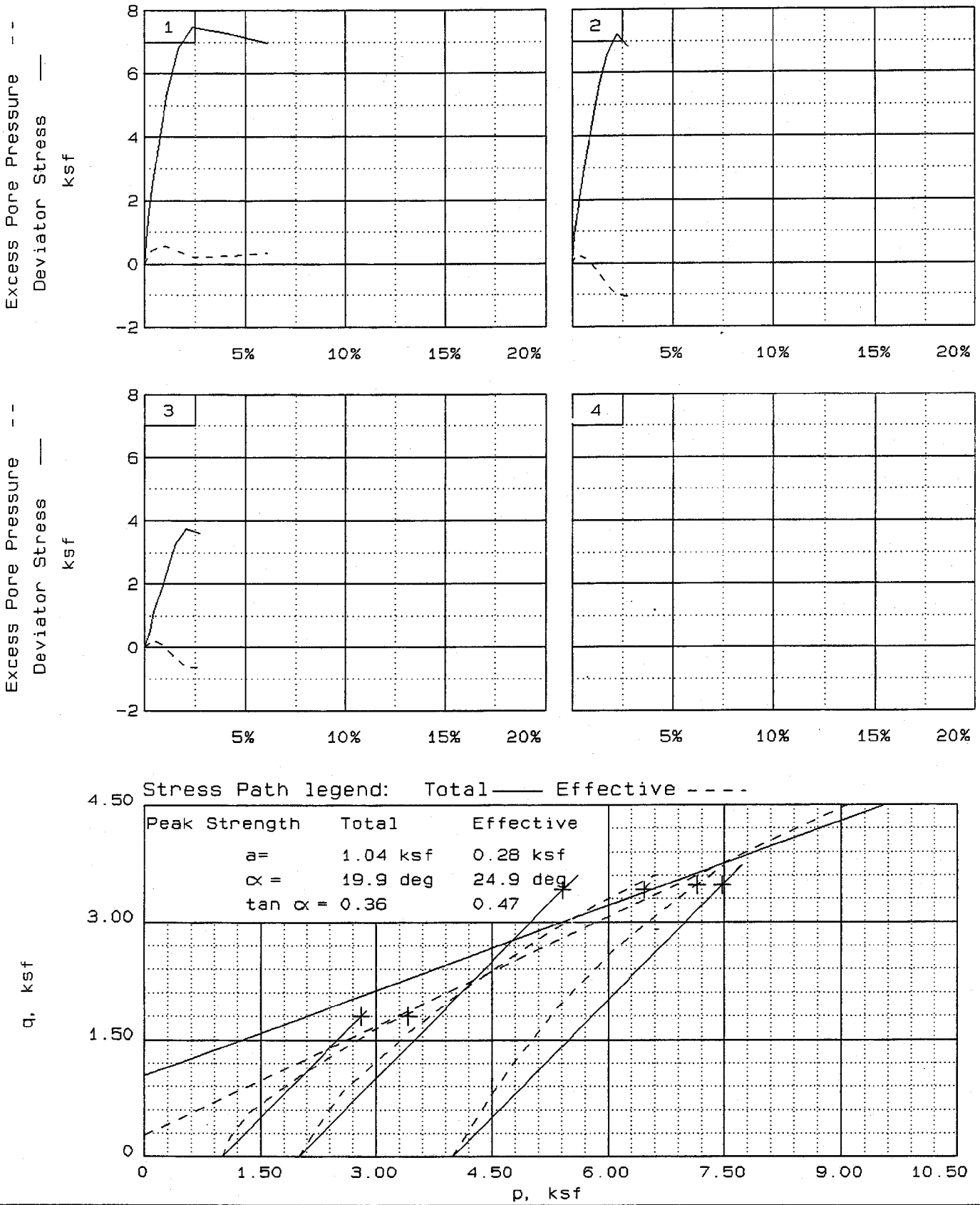
PROJECT: TVA - Bull Run

SAMPLE LOCATION: Dry Fly Ash

PROJ. NO.: 5810860101 DATE: July 27, 1995

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

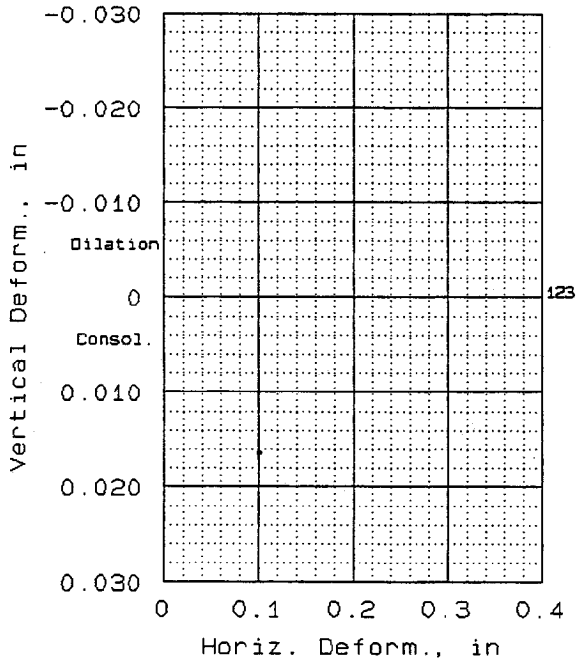


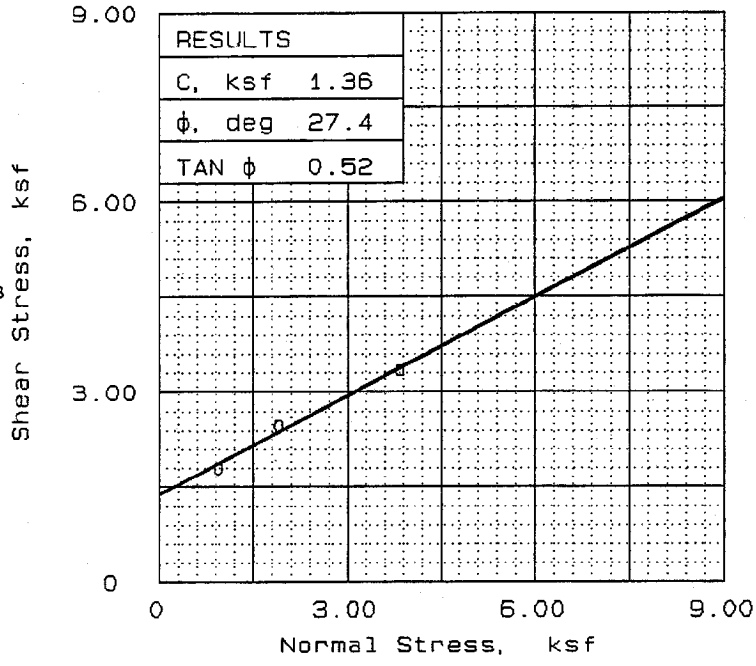
Client:

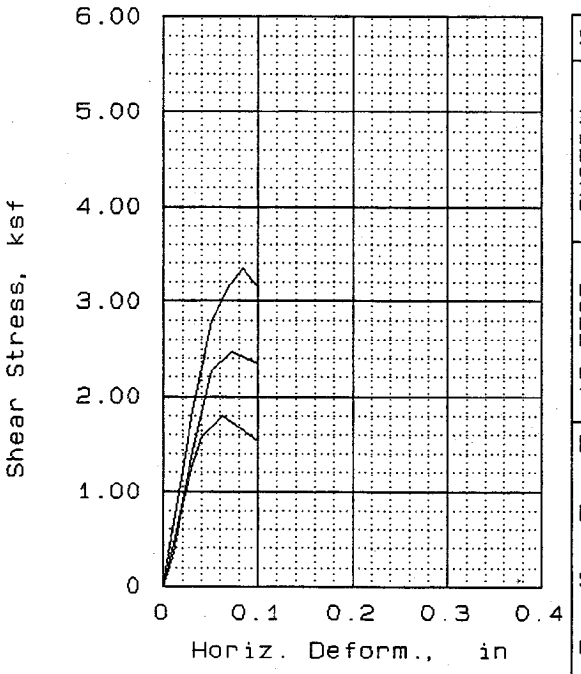
Project: TVA - Bull Run

Location: Dry Fly Ash

File: 8601C Project No.: 5810860101 Page 2/2 Fig. No. ____







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	17.9	18.1	17.6
	DRY DENSITY, pcf	81.1	80.4	81.3
	SATURATION, %	52.3	51.8	51.8
	VOID RATIO	0.802	0.817	0.796
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	17.9	18.1	17.6
	DRY DENSITY, pcf	81.1	80.4	81.3
	SATURATION, %	52.3	51.8	51.8
	VOID RATIO	0.802	0.817	0.796
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
NORMAL STRESS, ksf		0.97	1.94	3.88
MAX. SHEAR, ksf		1.80	2.47	3.34
STRAIN RATE, %/min.		0.500	0.500	0.500
ULT. SHEAR, ksf				

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION:

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 2.34

REMARKS: Tested by: KL

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: TVA - Bull Run

SAMPLE LOCATION: Dry Fly Ash

PROJ. NO.: 5810860101 DATE: August 23, 1995

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

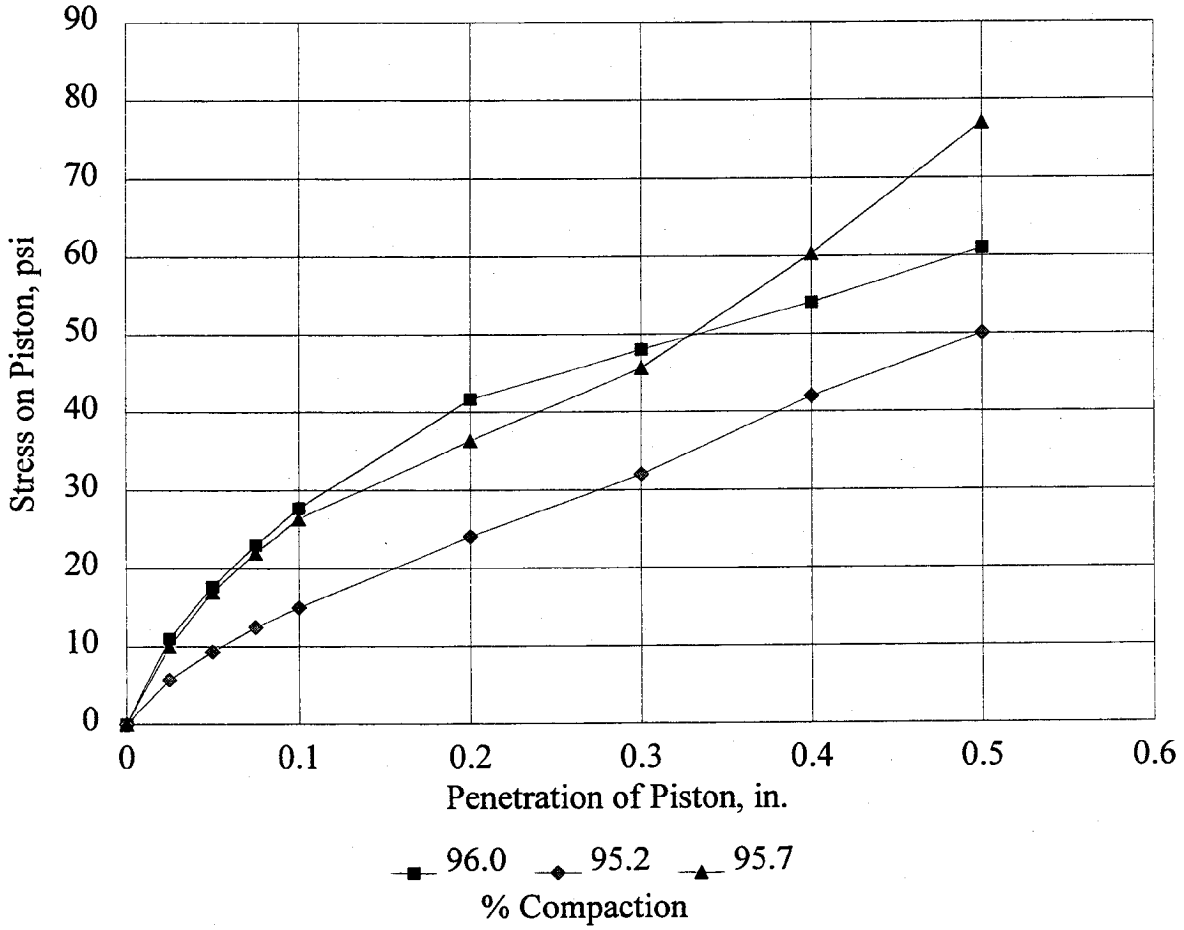
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Bull Run	**Test Date**	
Material (Source)	Dry Fly Ash	**Reviewed By**	RLB
		Review Date	08/23/95

Compaction, %	96.0	95.2	95.7
Before Soak Dry Density, pcf	88.0	87.2	87.7
Before Soak Moisture Content,	18.6	18.6	18.5
After Soak Dry Density, pcf	84.7	84.5	84.2
After Soak Moisture Content, %	28.6	30.0	29.1
CBR @ 0.1 in.	2.8	1.5	2.6
CBR @ 0.2 in.	2.8	1.6	2.4



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE
MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Bull Run	
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash	
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content	
4.	*MATERIAL TYPE* (Type 1 or Type 2)		2
5.	*TEST INFORMATION*		
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)		N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)		N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)		15
6.	*SPECIMEN INFO .:*		
	SPECIMEN DIAM., inch		
	TOP		2.86
	MIDDLE		2.85
	BOTTOM		2.86
	AVERAGE		2.86
	MEMBRANE THICKNESS (1), inch		0.01
	MEMBRANE THICKNESS (2), inch		0.01
	NET DIAM., inch		2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch		6.10
	HEIGHT OF CAP AND BASE, inch		0.00
	INITIAL LENGTH, L_0 , inch		6.10
	INITIAL AREA, A_0 , in^2		6.30
	INITIAL VOLUME $A_0 L_0$, in^3		38.46
7.	*SOIL SPECIMEN WEIGHT* :		
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams		1026.28
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams		0.00
	WEIGHT OF WET SOIL USED , grams		1026.28
8.	*SOIL PROPERTIES .:*		
	IN SITU MOISTURE CONTENT (NUCLEAR), %		N/A
	IN SITU WET DENSITY (NUCLEAR), pcf		N/A
	or		
	OPTIMUM MOISTURE CONTENT, %		17.4
	MAX. DRY DENSITY, pcf		91.6
	95 % MAX. DRY DENSITY, pcf		87.0
9.	*SPECIMEN PROPERTIES:*		
	COMPACTION MOISTURE CONTENT, %		17.6
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %		17.2
	COMPACTION DRY DENSITY, γ_d pcf		86.4
10.	*QUICK SHEAR TEST*		
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)		Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi		27.9
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)		Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)		
	(a) *CODE*	0 0 0 0 0 0	
	(b) *NOTE*		
12.	*TEST DATE*		07-10-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Burdham 9/5/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-17-1995

$$M_R = K1\,(S_C)^{K2}(1+S_3)^{K5}$$

K1 =	1,977
K2 =	0.13522
K5 =	0.76648
R^2 =	0.96

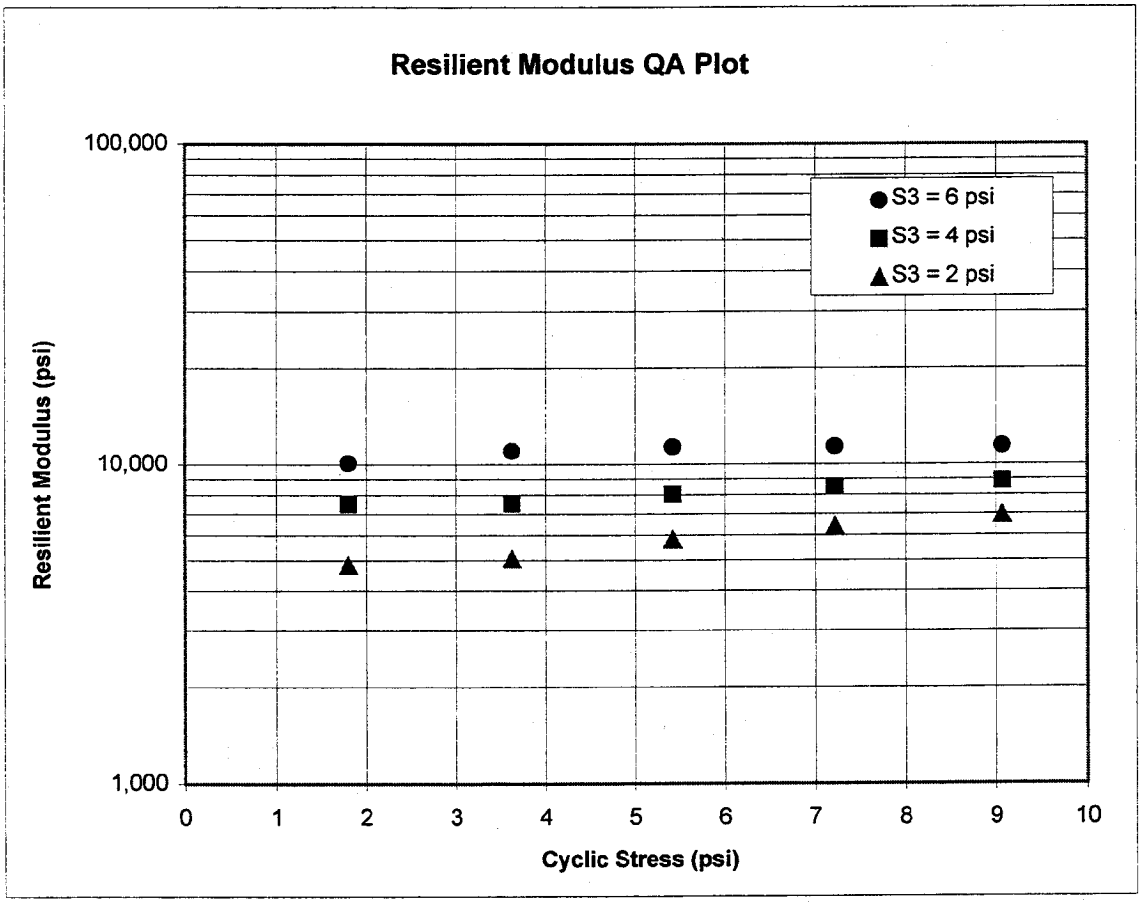
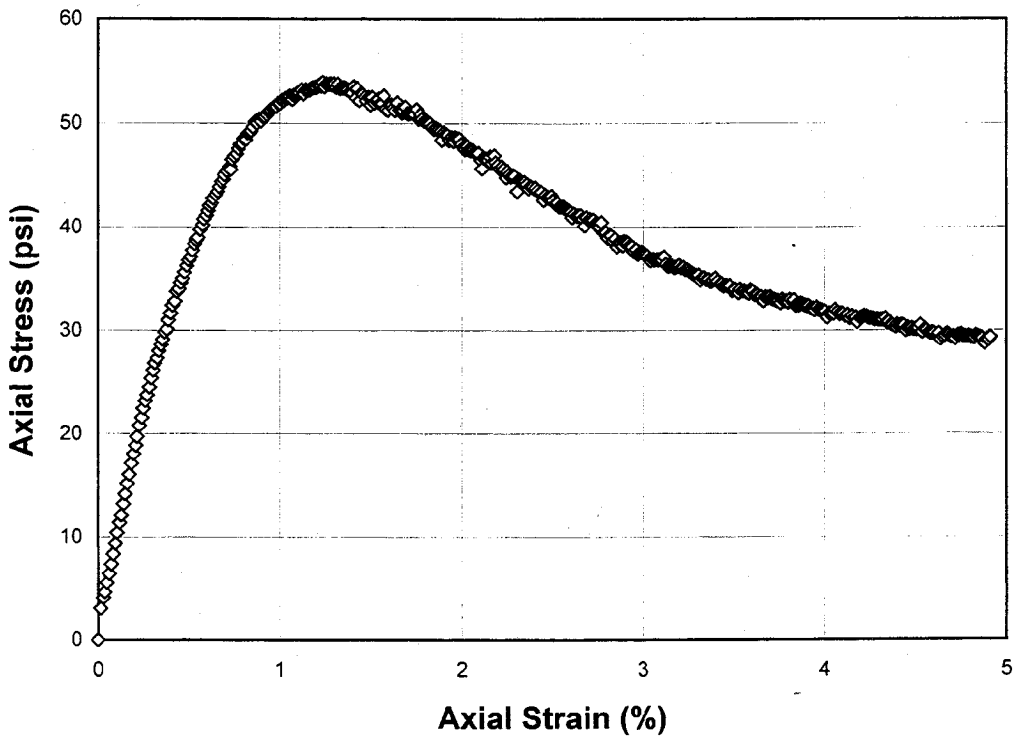


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-17-1995



PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1. *MATERIAL SOURCE:* Bull Run
2. *MATERIAL DESCRIPTION:* Dry Fly Ash
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-10-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _	_ _ _ _
SEQUENCE 1	6.0	2.0	1	8.4	7.1	1.4	1.3	1.1	0.2	0.00079	0.00077	0.00078	0.00013	8,760
			2	8.4	7.0	1.3	1.3	1.1	0.2	0.00080	0.00077	0.00078	0.00013	8,703
			3	8.4	7.0	1.3	1.3	1.1	0.2	0.00078	0.00075	0.00077	0.00013	8,874
			4	8.4	7.1	1.4	1.3	1.1	0.2	0.00080	0.00079	0.00079	0.00013	8,598
			5	8.4	7.0	1.3	1.3	1.1	0.2	0.00078	0.00075	0.00077	0.00013	8,874
	COLUMN AVERAGE			8.4	7.0	1.3	1.3	1.1	0.2	0.00079	0.00077	0.00078	0.00013	8,762
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	118

Source: Bull Run Description: Dry Fly Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	15.6	14.1	1.5	2.5	2.2	0.2	0.00162	0.00161	0.00162	0.00027	8,424
			2	15.5	14.1	1.5	2.5	2.2	0.2	0.00160	0.00158	0.00159	0.00026	8,539
			3	15.5	14.1	1.5	2.5	2.2	0.2	0.00162	0.00160	0.00161	0.00026	8,456
			4	15.6	14.1	1.5	2.5	2.2	0.2	0.00161	0.00158	0.00160	0.00026	8,554
			5	15.5	14.0	1.5	2.5	2.2	0.2	0.00162	0.00160	0.00161	0.00026	8,452
	COLUMN AVERAGE			15.6	14.1	1.5	2.5	2.2	0.2	0.00161	0.00160	0.00160	0.00026	8,485
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	58
SEQUENCE 3	6.0	6.0	1	23.6	21.3	2.2	3.7	3.4	0.4	0.00252	0.00256	0.00254	0.00042	8,139
			2	23.6	21.4	2.2	3.7	3.4	0.4	0.00254	0.00258	0.00256	0.00042	8,075
			3	23.6	21.3	2.2	3.7	3.4	0.4	0.00254	0.00258	0.00256	0.00042	8,065
			4	23.6	21.4	2.2	3.7	3.4	0.4	0.00251	0.00256	0.00253	0.00042	8,160
			5	23.5	21.3	2.2	3.7	3.4	0.4	0.00254	0.00257	0.00256	0.00042	8,063
	COLUMN AVERAGE			23.6	21.3	2.2	3.7	3.4	0.4	0.00253	0.00257	0.00255	0.00042	8,100
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	46
SEQUENCE 4	6.0	8.0	1	31.2	28.2	3.0	4.9	4.5	0.5	0.00367	0.00373	0.00370	0.00061	7,368
			2	31.2	28.2	3.0	4.9	4.5	0.5	0.00368	0.00374	0.00371	0.00061	7,340
			3	31.2	28.2	3.0	5.0	4.5	0.5	0.00369	0.00377	0.00373	0.00061	7,327
			4	31.2	28.2	3.0	4.9	4.5	0.5	0.00368	0.00376	0.00372	0.00061	7,340
			5	31.2	28.2	3.0	5.0	4.5	0.5	0.00367	0.00372	0.00370	0.00061	7,392
	COLUMN AVERAGE			31.2	28.2	3.0	4.9	4.5	0.5	0.00368	0.00375	0.00371	0.00061	7,353
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	26

Source: Bull Run Description: Dry Fly Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	39.1	35.2	3.9	6.2	5.6	0.6	0.00504	0.00513	0.00509	0.00083	6,706
			2	39.1	35.2	3.9	6.2	5.6	0.6	0.00501	0.00513	0.00507	0.00083	6,727
			3	39.2	35.3	3.9	6.2	5.6	0.6	0.00502	0.00514	0.00508	0.00083	6,722
			4	39.1	35.2	3.9	6.2	5.6	0.6	0.00506	0.00515	0.00510	0.00084	6,675
			5	39.1	35.2	3.9	6.2	5.6	0.6	0.00502	0.00511	0.00506	0.00083	6,732
	COLUMN AVERAGE			39.1	35.2	3.9	6.2	5.6	0.6	0.00503	0.00513	0.00508	0.00083	6,712
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	23
SEQUENCE 6	4.0	2.0	1	8.7	7.0	1.7	1.4	1.1	0.3	0.00094	0.00091	0.00092	0.00015	7,337
			2	8.7	7.0	1.7	1.4	1.1	0.3	0.00093	0.00091	0.00092	0.00015	7,386
			3	8.7	7.0	1.7	1.4	1.1	0.3	0.00094	0.00091	0.00092	0.00015	7,376
			4	8.7	7.0	1.7	1.4	1.1	0.3	0.00094	0.00091	0.00093	0.00015	7,324
			5	8.7	7.0	1.7	1.4	1.1	0.3	0.00093	0.00091	0.00092	0.00015	7,415
	COLUMN AVERAGE			8.7	7.0	1.7	1.4	1.1	0.3	0.00093	0.00091	0.00092	0.00015	7,368
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	37
SEQUENCE 7	4.0	4.0	1	15.7	14.1	1.7	2.5	2.2	0.3	0.00204	0.00206	0.00205	0.00034	6,642
			2	15.7	14.1	1.7	2.5	2.2	0.3	0.00205	0.00205	0.00205	0.00034	6,644
			3	15.8	14.1	1.6	2.5	2.2	0.3	0.00205	0.00205	0.00205	0.00034	6,661
			4	15.8	14.1	1.7	2.5	2.2	0.3	0.00205	0.00206	0.00206	0.00034	6,637
			5	15.8	14.1	1.6	2.5	2.2	0.3	0.00204	0.00205	0.00205	0.00034	6,665
	COLUMN AVERAGE			15.7	14.1	1.7	2.5	2.2	0.3	0.00205	0.00206	0.00205	0.00034	6,650
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	12

Source: Bull Run Description: Dry Fly Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	23.4	21.2	2.2	3.7	3.4	0.4	0.00341	0.00345	0.00343	0.00056	5,971
			2	23.4	21.2	2.2	3.7	3.4	0.3	0.00341	0.00345	0.00343	0.00056	5,966
			3	23.4	21.2	2.2	3.7	3.4	0.4	0.00340	0.00345	0.00342	0.00056	5,994
			4	23.4	21.2	2.2	3.7	3.4	0.4	0.00342	0.00345	0.00343	0.00056	5,973
			5	23.4	21.2	2.2	3.7	3.4	0.3	0.00343	0.00345	0.00344	0.00056	5,978
	COLUMN AVERAGE			23.4	21.2	2.2	3.7	3.4	0.4	0.00341	0.00345	0.00343	0.00056	5,977
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	11
SEQUENCE 9	4.0	8.0	1	31.3	28.3	3.0	5.0	4.5	0.5	0.00477	0.00485	0.00481	0.00079	5,701
			2	31.3	28.4	3.0	5.0	4.5	0.5	0.00475	0.00482	0.00478	0.00078	5,739
			3	31.4	28.4	3.0	5.0	4.5	0.5	0.00474	0.00483	0.00478	0.00078	5,743
			4	31.4	28.4	3.0	5.0	4.5	0.5	0.00477	0.00484	0.00480	0.00079	5,723
			5	31.3	28.3	3.0	5.0	4.5	0.5	0.00477	0.00485	0.00481	0.00079	5,695
	COLUMN AVERAGE			31.3	28.4	3.0	5.0	4.5	0.5	0.00476	0.00484	0.00480	0.00079	5,720
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	22
SEQUENCE 10	4.0	10.0	1	39.0	35.5	3.4	6.2	5.6	0.5	0.00609	0.00621	0.00615	0.00101	5,594
			2	38.6	35.2	3.4	6.1	5.6	0.5	0.00610	0.00617	0.00613	0.00101	5,556
			3	38.7	35.3	3.4	6.1	5.6	0.5	0.00609	0.00620	0.00614	0.00101	5,566
			4	38.9	35.5	3.4	6.2	5.6	0.5	0.00607	0.00614	0.00611	0.00100	5,634
			5	38.6	34.9	3.6	6.1	5.5	0.6	0.00604	0.00613	0.00608	0.00100	5,553
	COLUMN AVERAGE			38.8	35.3	3.5	6.1	5.6	0.5	0.00608	0.00617	0.00612	0.00100	5,581
	STANDARD DEV.			0.2	0.3	0.1	0.0	0.0	0.0	0.00002	0.00004	0.00003	0.00000	34

Source: Bull Run Description: Dry Fly Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	8.8	7.1	1.7	1.4	1.1	0.3	0.00111	0.00109	0.00110	0.00018	6,210
			2	9.0	7.2	1.8	1.4	1.1	0.3	0.00116	0.00114	0.00115	0.00019	6,067
			3	8.7	7.0	1.7	1.4	1.1	0.3	0.00112	0.00110	0.00111	0.00018	6,065
			4	8.8	7.1	1.7	1.4	1.1	0.3	0.00115	0.00114	0.00115	0.00019	5,972
			5	8.7	6.9	1.7	1.4	1.1	0.3	0.00112	0.00112	0.00112	0.00018	5,985
	COLUMN AVERAGE			8.8	7.1	1.7	1.4	1.1	0.3	0.00114	0.00112	0.00113	0.00018	6,060
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	95
SEQUENCE 12	2.0	4.0	1	15.9	13.9	2.0	2.5	2.2	0.3	0.00267	0.00267	0.00267	0.00044	5,051
			2	15.9	14.0	1.9	2.5	2.2	0.3	0.00265	0.00263	0.00264	0.00043	5,131
			3	16.0	14.0	2.0	2.5	2.2	0.3	0.00263	0.00264	0.00264	0.00043	5,137
			4	15.9	13.9	2.0	2.5	2.2	0.3	0.00264	0.00265	0.00264	0.00043	5,092
			5	15.9	13.9	2.0	2.5	2.2	0.3	0.00265	0.00265	0.00265	0.00043	5,084
	COLUMN AVERAGE			15.9	13.9	2.0	2.5	2.2	0.3	0.00265	0.00265	0.00265	0.00043	5,099
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	35
SEQUENCE 13	2.0	6.0	1	23.3	21.1	2.1	3.7	3.3	0.3	0.00437	0.00441	0.00439	0.00072	4,657
			2	23.2	21.0	2.1	3.7	3.3	0.3	0.00438	0.00443	0.00440	0.00072	4,628
			3	23.2	21.1	2.1	3.7	3.3	0.3	0.00440	0.00441	0.00440	0.00072	4,628
			4	23.1	21.0	2.1	3.7	3.3	0.3	0.00442	0.00443	0.00442	0.00073	4,585
			5	23.3	21.1	2.1	3.7	3.3	0.3	0.00440	0.00445	0.00442	0.00072	4,621
	COLUMN AVERAGE			23.2	21.1	2.1	3.7	3.3	0.3	0.00439	0.00442	0.00441	0.00072	4,624
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00001	0.00000	26

Source: Bull Run Description: Dry Fly Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	31.1	28.1	2.9	4.9	4.5	0.5	0.00604	0.00608	0.00606	0.00099	4,492
			2	31.1	28.2	2.9	4.9	4.5	0.5	0.00601	0.00608	0.00605	0.00099	4,506
			3	31.0	28.1	2.9	4.9	4.5	0.5	0.00600	0.00605	0.00603	0.00099	4,507
			4	31.0	28.1	2.9	4.9	4.5	0.5	0.00600	0.00609	0.00604	0.00099	4,504
			5	31.0	28.1	2.9	4.9	4.5	0.5	0.00601	0.00607	0.00604	0.00099	4,501
	COLUMN AVERAGE			31.1	28.1	2.9	4.9	4.5	0.5	0.00601	0.00607	0.00604	0.00099	4,502
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	6
SEQUENCE 15	2.0	10.0	1	38.8	35.1	3.7	6.2	5.6	0.6	0.00753	0.00760	0.00757	0.00124	4,487
			2	38.7	35.0	3.7	6.1	5.6	0.6	0.00752	0.00761	0.00756	0.00124	4,482
			3	38.7	35.0	3.7	6.1	5.6	0.6	0.00754	0.00765	0.00760	0.00125	4,459
			4	38.7	34.9	3.7	6.1	5.5	0.6	0.00755	0.00765	0.00760	0.00125	4,452
			5	38.7	35.0	3.7	6.1	5.6	0.6	0.00751	0.00763	0.00757	0.00124	4,476
	COLUMN AVERAGE			38.7	35.0	3.7	6.1	5.6	0.6	0.00753	0.00763	0.00758	0.00124	4,471
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	15

SUBMITTED BY, DATE

RJ Bradham 9/5/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-10-1995

$$M_R = K1\,(S_C)^{K2}(1+S_3)^{K5}$$

K1 =	3,225
K2 =	-0.17750
K5 =	0.54531
R^2 =	0.97

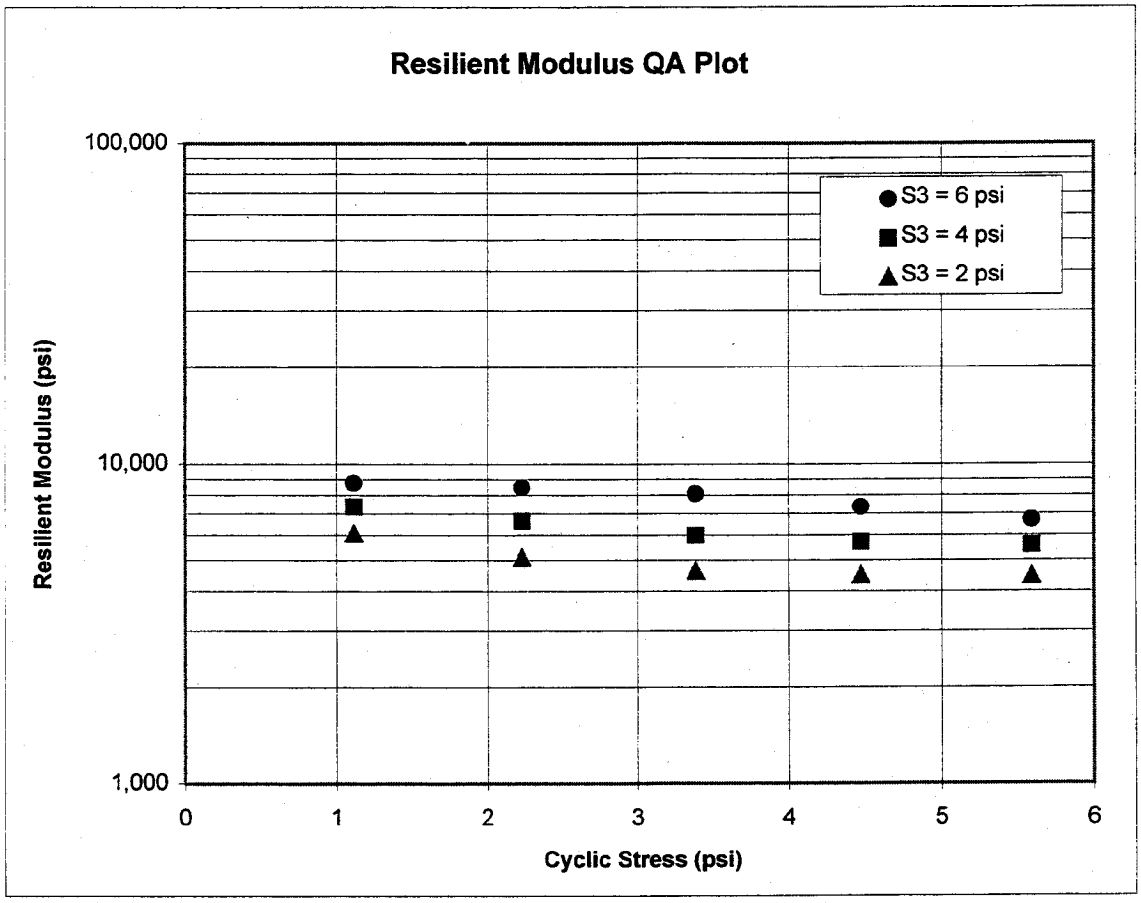
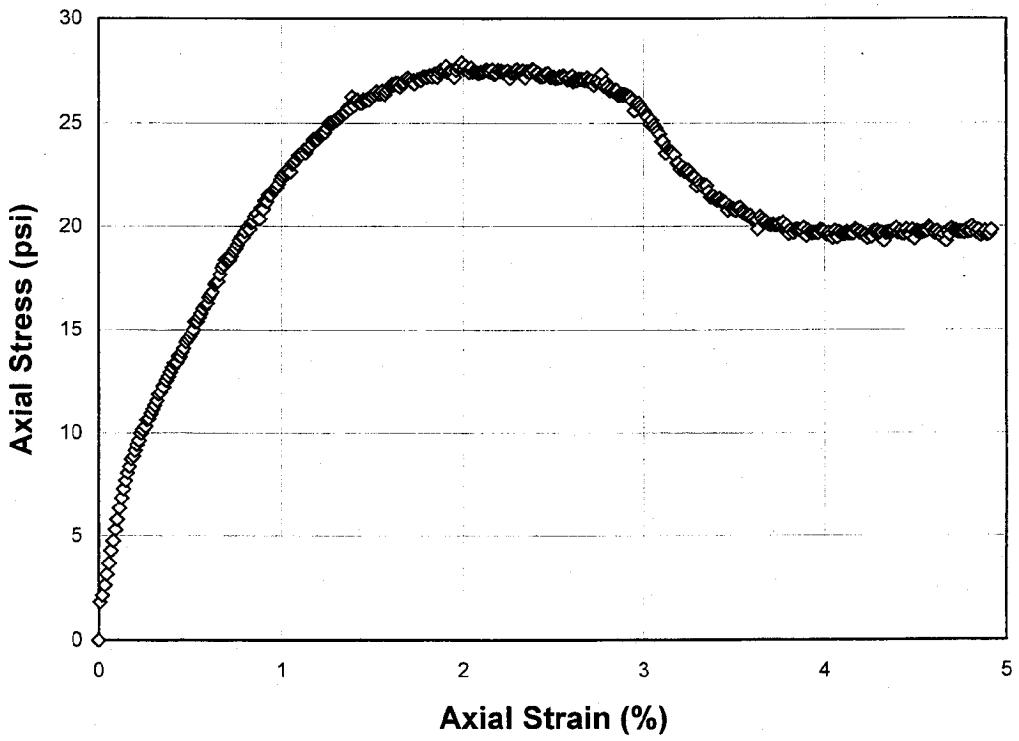


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-10-1995



LABORATORY MATERIAL HANDLING AND TESTING

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.:*	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.87
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.13
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0, inch	6.13
	INITIAL AREA, A_0, in^2	6.32
	INITIAL VOLUME A_0L_0, in^3	38.78
7.	*SOIL SPECIMEN WEIGHT:*	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1052.00
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1052.00
8.	*SOIL PROPERTIES.:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	15.1
	MAX. DRY DENSITY, pcf	95.7
	95 % MAX. DRY DENSITY, pcf	90.9
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	15.6
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	15.7
	COMPACTION DRY DENSITY, γ_d pcf	89.3
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	30.8
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	06-29-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

Richard S. Bruchman 7/23/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1. *MATERIAL SOURCE:* Bull Run
2. *MATERIAL DESCRIPTION:* Dry Fly Ash
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 06-29-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.8	11.5	1.3	2.0	1.8	0.2	0.00170	0.00175	0.00173	0.00028	6,471
			2	12.8	11.5	1.3	2.0	1.8	0.2	0.00171	0.00176	0.00173	0.00028	6,471
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00169	0.00174	0.00172	0.00028	6,492
			4	12.8	11.6	1.3	2.0	1.8	0.2	0.00169	0.00174	0.00172	0.00028	6,537
			5	12.8	11.5	1.3	2.0	1.8	0.2	0.00169	0.00174	0.00171	0.00028	6,532
	COLUMN AVERAGE			12.8	11.5	1.3	2.0	1.8	0.2	0.00170	0.00175	0.00172	0.00028	6,500
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	32

Source: Bull Run Description: Dry Fly Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.3	22.9	2.4	4.0	3.6	0.4	0.00289	0.00299	0.00294	0.00048	7,542
			2	25.3	22.9	2.4	4.0	3.6	0.4	0.00288	0.00299	0.00294	0.00048	7,560
			3	25.3	22.9	2.4	4.0	3.6	0.4	0.00288	0.00299	0.00293	0.00048	7,570
			4	25.3	22.9	2.4	4.0	3.6	0.4	0.00288	0.00299	0.00293	0.00048	7,584
			5	25.3	22.9	2.4	4.0	3.6	0.4	0.00285	0.00298	0.00292	0.00048	7,628
	COLUMN AVERAGE			25.3	22.9	2.4	4.0	3.6	0.4	0.00288	0.00299	0.00293	0.00048	7,577
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	32
SEQUENCE 3	6.0	6.0	1	37.8	34.2	3.7	6.0	5.4	0.6	0.00459	0.00474	0.00467	0.00076	7,108
			2	37.9	34.2	3.7	6.0	5.4	0.6	0.00460	0.00474	0.00467	0.00076	7,113
			3	37.7	34.1	3.7	6.0	5.4	0.6	0.00459	0.00473	0.00466	0.00076	7,096
			4	37.9	34.2	3.7	6.0	5.4	0.6	0.00462	0.00476	0.00469	0.00076	7,082
			5	37.9	34.3	3.7	6.0	5.4	0.6	0.00464	0.00477	0.00471	0.00077	7,068
	COLUMN AVERAGE			37.9	34.2	3.7	6.0	5.4	0.6	0.00461	0.00475	0.00468	0.00076	7,093
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	19
SEQUENCE 4	6.0	8.0	1	50.7	46.2	4.6	8.0	7.3	0.7	0.00649	0.00669	0.00659	0.00107	6,796
			2	50.8	46.2	4.6	8.0	7.3	0.7	0.00647	0.00665	0.00656	0.00107	6,833
			3	50.5	45.9	4.6	8.0	7.3	0.7	0.00646	0.00663	0.00654	0.00107	6,812
			4	50.5	45.9	4.6	8.0	7.3	0.7	0.00646	0.00661	0.00654	0.00107	6,818
			5	50.5	45.9	4.6	8.0	7.3	0.7	0.00645	0.00662	0.00654	0.00107	6,813
	COLUMN AVERAGE			50.6	46.0	4.6	8.0	7.3	0.7	0.00647	0.00664	0.00655	0.00107	6,814
	STANDARD DEV.			0.1	0.2	0.0	0.0	0.0	0.0	0.00002	0.00003	0.00002	0.00000	13

Source: Bull Run Description: Dry Fly Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.4	57.3	6.1	10.0	9.1	1.0	0.00819	0.00845	0.00832	0.00136	6,684
			2	63.6	57.5	6.1	10.1	9.1	1.0	0.00818	0.00845	0.00832	0.00136	6,706
			3	63.4	57.3	6.1	10.0	9.1	1.0	0.00816	0.00842	0.00829	0.00135	6,709
			4	63.5	57.4	6.1	10.0	9.1	1.0	0.00820	0.00846	0.00833	0.00136	6,680
			5	63.4	57.3	6.1	10.0	9.1	1.0	0.00819	0.00846	0.00833	0.00136	6,673
	COLUMN AVERAGE			63.5	57.3	6.1	10.0	9.1	1.0	0.00819	0.00845	0.00832	0.00136	6,690
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	16
SEQUENCE 6	4.0	2.0	1	13.2	11.6	1.6	2.1	1.8	0.3	0.00181	0.00189	0.00185	0.00030	6,089
			2	13.1	11.5	1.6	2.1	1.8	0.3	0.00180	0.00186	0.00183	0.00030	6,097
			3	13.2	11.6	1.6	2.1	1.8	0.3	0.00180	0.00185	0.00182	0.00030	6,154
			4	13.1	11.5	1.6	2.1	1.8	0.3	0.00180	0.00187	0.00184	0.00030	6,059
			5	13.2	11.6	1.6	2.1	1.8	0.3	0.00177	0.00185	0.00181	0.00030	6,204
	COLUMN AVERAGE			13.2	11.5	1.6	2.1	1.8	0.3	0.00180	0.00186	0.00183	0.00030	6,121
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00002	0.00000	58
SEQUENCE 7	4.0	4.0	1	25.2	22.8	2.4	4.0	3.6	0.4	0.00375	0.00388	0.00382	0.00062	5,790
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00374	0.00386	0.00380	0.00062	5,815
			3	25.1	22.8	2.4	4.0	3.6	0.4	0.00373	0.00385	0.00379	0.00062	5,833
			4	25.1	22.7	2.4	4.0	3.6	0.4	0.00373	0.00386	0.00380	0.00062	5,812
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00371	0.00385	0.00378	0.00062	5,837
	COLUMN AVERAGE			25.1	22.8	2.4	4.0	3.6	0.4	0.00373	0.00386	0.00380	0.00062	5,817
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	19

Source: Bull Run Description: Dry Fly Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.9	34.2	3.6	6.0	5.4	0.6	0.00585	0.00603	0.00594	0.00097	5,596
			2	38.0	34.4	3.6	6.0	5.4	0.6	0.00586	0.00603	0.00594	0.00097	5,611
			3	37.9	34.3	3.6	6.0	5.4	0.6	0.00584	0.00601	0.00592	0.00097	5,616
			4	38.0	34.3	3.6	6.0	5.4	0.6	0.00587	0.00603	0.00595	0.00097	5,599
			5	38.0	34.3	3.6	6.0	5.4	0.6	0.00584	0.00601	0.00593	0.00097	5,622
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00585	0.00602	0.00594	0.00097	5,609
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11
SEQUENCE 9	4.0	8.0	1	50.9	46.0	4.8	8.0	7.3	0.8	0.00769	0.00790	0.00779	0.00127	5,729
			2	50.9	46.1	4.9	8.1	7.3	0.8	0.00770	0.00792	0.00781	0.00127	5,722
			3	50.8	46.0	4.9	8.0	7.3	0.8	0.00771	0.00791	0.00781	0.00127	5,712
			4	50.8	45.9	4.9	8.0	7.3	0.8	0.00769	0.00792	0.00781	0.00127	5,713
			5	50.8	46.0	4.9	8.0	7.3	0.8	0.00769	0.00790	0.00779	0.00127	5,725
	COLUMN AVERAGE			50.8	46.0	4.9	8.0	7.3	0.8	0.00770	0.00791	0.00780	0.00127	5,720
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	7
SEQUENCE 10	4.0	10.0	1	63.4	57.3	6.1	10.0	9.1	1.0	0.00936	0.00959	0.00947	0.00154	5,874
			2	63.3	57.2	6.1	10.0	9.1	1.0	0.00932	0.00955	0.00944	0.00154	5,888
			3	63.3	57.2	6.1	10.0	9.0	1.0	0.00936	0.00958	0.00947	0.00154	5,863
			4	63.4	57.3	6.1	10.0	9.1	1.0	0.00935	0.00959	0.00947	0.00154	5,873
			5	63.4	57.3	6.1	10.0	9.1	1.0	0.00933	0.00958	0.00946	0.00154	5,878
	COLUMN AVERAGE			63.4	57.3	6.1	10.0	9.1	1.0	0.00934	0.00958	0.00946	0.00154	5,875
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	9

Source: Bull Run Description: Dry Fly Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.5	11.5	2.0	2.1	1.8	0.3	0.00206	0.00215	0.00211	0.00034	5,291
			2	13.4	11.4	2.0	2.1	1.8	0.3	0.00206	0.00214	0.00210	0.00034	5,276
			3	13.5	11.4	2.0	2.1	1.8	0.3	0.00205	0.00216	0.00211	0.00034	5,275
			4	13.5	11.5	2.0	2.1	1.8	0.3	0.00205	0.00215	0.00210	0.00034	5,292
			5	13.4	11.5	2.0	2.1	1.8	0.3	0.00208	0.00213	0.00210	0.00034	5,284
	COLUMN AVERAGE			13.5	11.5	2.0	2.1	1.8	0.3	0.00206	0.00215	0.00210	0.00034	5,284
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	8
SEQUENCE 12	2.0	4.0	1	25.3	22.9	2.3	4.0	3.6	0.4	0.00454	0.00470	0.00462	0.00075	4,813
			2	25.2	22.8	2.3	4.0	3.6	0.4	0.00458	0.00474	0.00466	0.00076	4,757
			3	25.2	22.8	2.4	4.0	3.6	0.4	0.00456	0.00471	0.00463	0.00076	4,779
			4	25.0	22.7	2.3	4.0	3.6	0.4	0.00459	0.00473	0.00466	0.00076	4,731
			5	25.1	22.8	2.4	4.0	3.6	0.4	0.00456	0.00470	0.00463	0.00075	4,774
	COLUMN AVERAGE			25.2	22.8	2.3	4.0	3.6	0.4	0.00457	0.00472	0.00464	0.00076	4,771
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	30
SEQUENCE 13	2.0	6.0	1	37.8	34.2	3.6	6.0	5.4	0.6	0.00707	0.00722	0.00714	0.00116	4,651
			2	37.9	34.3	3.6	6.0	5.4	0.6	0.00702	0.00720	0.00711	0.00116	4,680
			3	37.9	34.3	3.6	6.0	5.4	0.6	0.00706	0.00722	0.00714	0.00116	4,664
			4	37.9	34.3	3.6	6.0	5.4	0.6	0.00702	0.00719	0.00710	0.00116	4,683
			5	37.9	34.3	3.6	6.0	5.4	0.6	0.00705	0.00721	0.00713	0.00116	4,663
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00704	0.00721	0.00713	0.00116	4,669
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00002	0.00000	13

Source: Bull Run Description: Dry Fly Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.8	45.9	4.9	8.0	7.3	0.8	0.00897	0.00920	0.00908	0.00148	4,903
			2	50.8	46.0	4.8	8.0	7.3	0.8	0.00899	0.00919	0.00909	0.00148	4,907
			3	50.8	45.9	4.9	8.0	7.3	0.8	0.00899	0.00919	0.00909	0.00148	4,900
			4	50.8	45.9	4.9	8.0	7.3	0.8	0.00899	0.00921	0.00910	0.00148	4,894
			5	50.9	46.0	4.9	8.0	7.3	0.8	0.00899	0.00921	0.00910	0.00148	4,904
	COLUMN AVERAGE			50.8	45.9	4.9	8.0	7.3	0.8	0.00899	0.00920	0.00909	0.00148	4,902
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 15	2.0	10.0	1	63.5	57.4	6.1	10.0	9.1	1.0	0.01066	0.01089	0.01077	0.00176	5,166
			2	63.6	57.5	6.1	10.1	9.1	1.0	0.01063	0.01085	0.01074	0.00175	5,195
			3	63.6	57.5	6.1	10.1	9.1	1.0	0.01065	0.01088	0.01076	0.00175	5,183
			4	63.6	57.5	6.1	10.1	9.1	1.0	0.01065	0.01088	0.01076	0.00175	5,184
			5	63.6	57.5	6.1	10.1	9.1	1.0	0.01060	0.01086	0.01073	0.00175	5,197
	COLUMN AVERAGE			63.6	57.5	6.1	10.1	9.1	1.0	0.01064	0.01087	0.01075	0.00175	5,185
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	12

SUBMITTED BY, DATE

Richard J. Boudreau 7/23/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	06-29-1995

$$M_R = K1\,(S_C)^{K2}(1+S_3)^{K5}$$

K1 =	3,283
K2 =	-0.01625
K5 =	0.38843
R^2 =	0.89

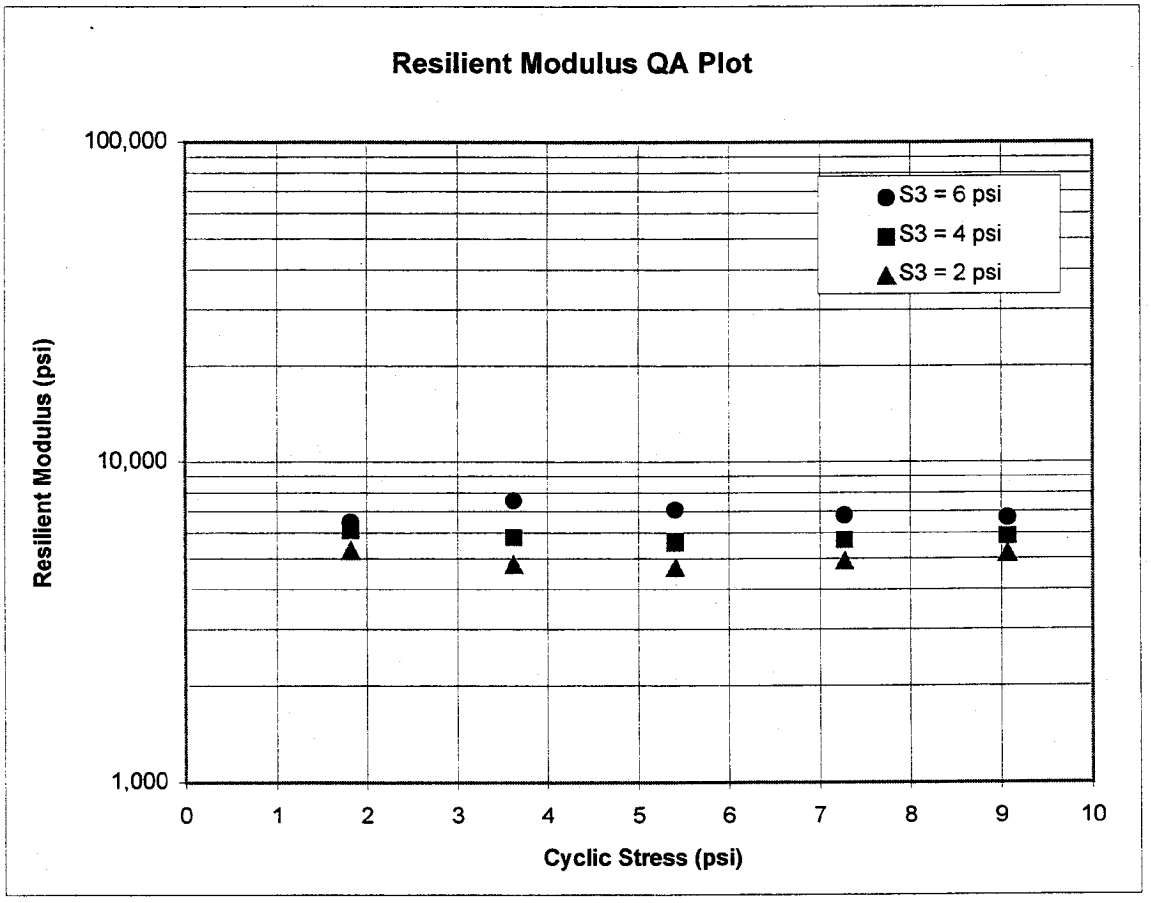
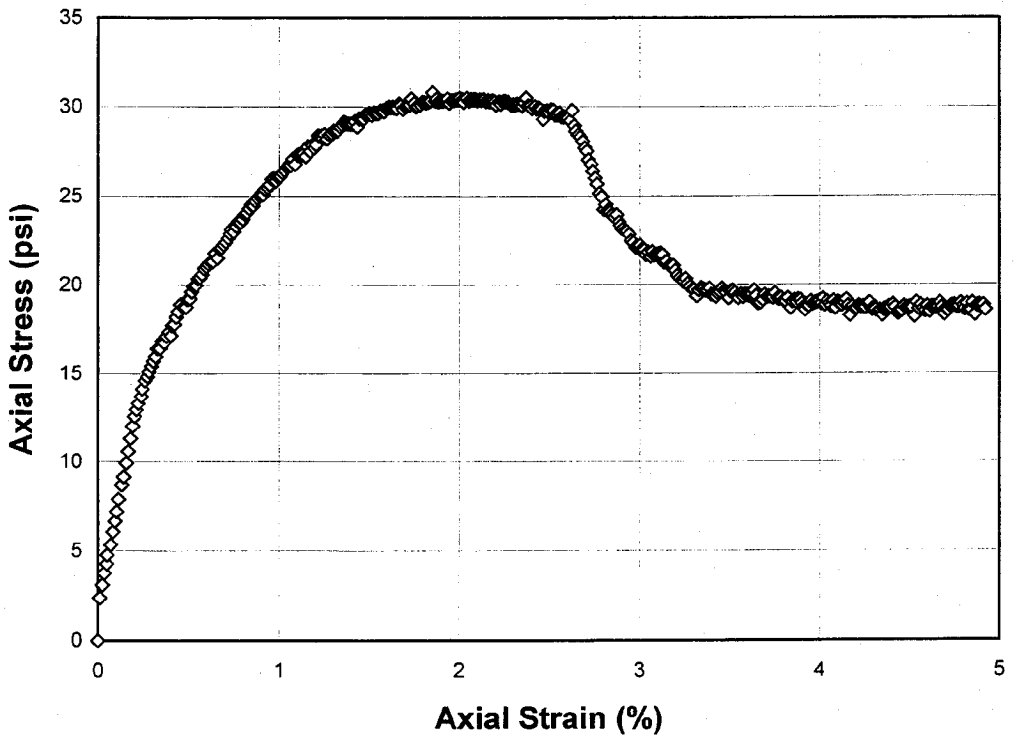


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	06-29-1995



BULL RUN

Bottom Ash - From Pond

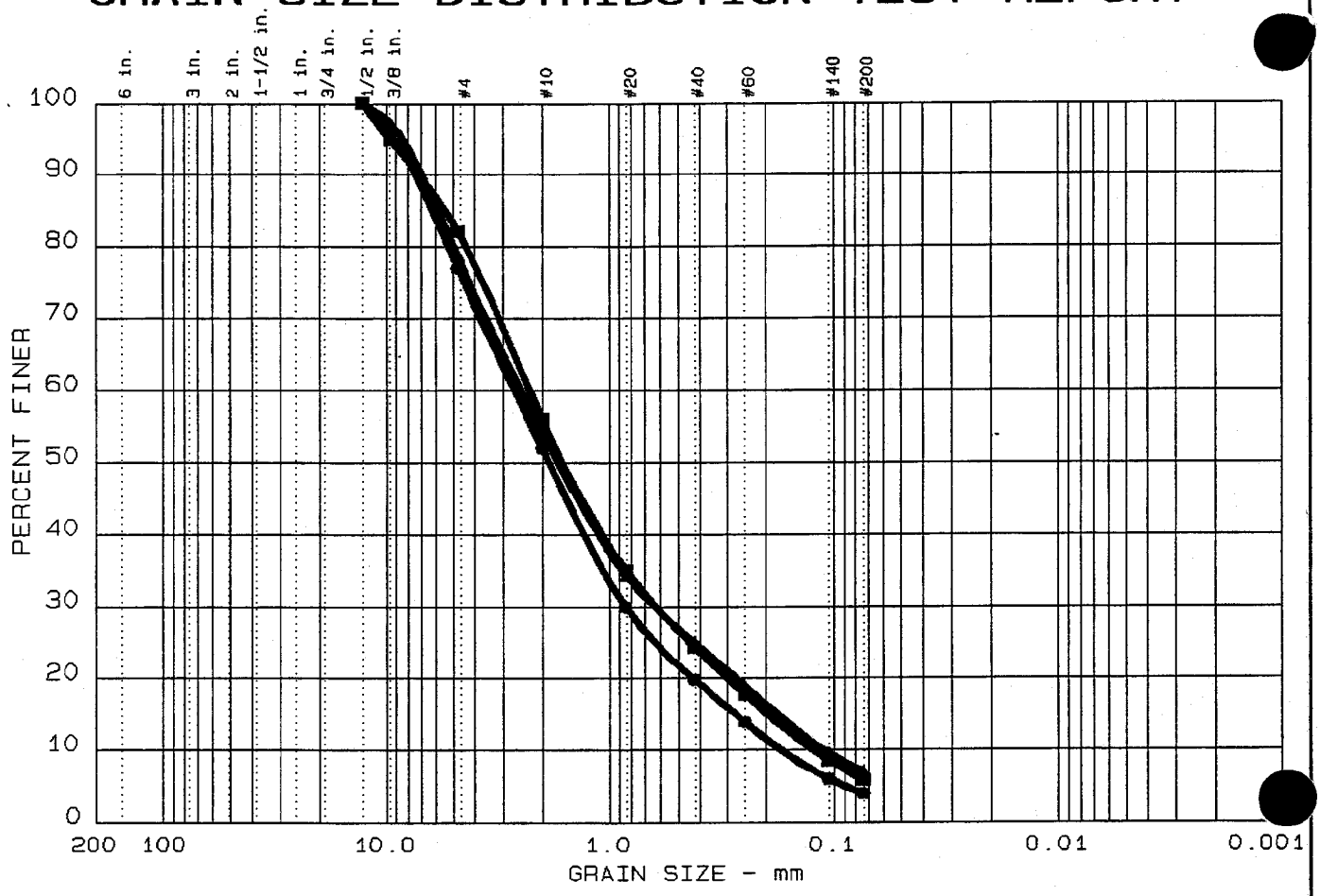
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Relative Density Test
Hydraulic Conductivity - Constant Head (2 Pages)
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - BULL RUN
BOTTOM ASH - FROM POND

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve	23.0 4.0	21.3 6.9	17.9 5.9
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.31	2.29	2.35
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	SW A-1-b	SW-SM A-1-b	SW-SM A-1-b
			Composite Sample		
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %	91.9 22.6		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	98.7 18.5		
Relative Density	ASTM D 4254 ASTM D 4253	Minimum Dry Density, pcf Maximum Dry Density (Dry Method), pcf	73.9 92.1		
			Result	Dry Density, pcf	Moisture Content, %
Hydraulic Conductivity	ASTM D 2434	Hydraulic Conductivity, cm/sec	1.8E-2	81.6	0.0
Angle of Repose	LAW TP6	Angle of Repose, degrees	32.4	73.9	0.0
California Bearing Ratio	ASTM D 1883	CBR, %	35	81.3	22.3
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	6,378	87.2	19.7
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	6,901	92.7	17.2
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	7,300		
pH of Soil	AASHTO T 289	pH	7.2		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	370		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

brf-ba.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	23.0	73.0	4.0	
▲	7	0.0	21.3	71.8	6.9	
■	8	0.0	17.9	76.2	5.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP	6.17	2.66	1.86	0.840	0.2751	0.1716	1.55	15.5
▲	NL	NP	5.80	2.49	1.70	0.633	0.1764	0.1100	1.46	22.6
■	NL	NP	5.37	2.26	1.62	0.623	0.1970	0.1229	1.39	18.4

	MATERIAL DESCRIPTION	USCS	AASHTO
●		SW	A-1-b
▲		SW-SM	A-1-b
■		SW-SM	A-1-b

Project No.: 5810860101
Project: TVA - Bull Run
● Location: Bottom Ash A & B
▲ Location: Bottom Ash C & D
■ Location: Bottom Ash E & F
Date: July 18, 1995

Remarks:

Tested by: JCG

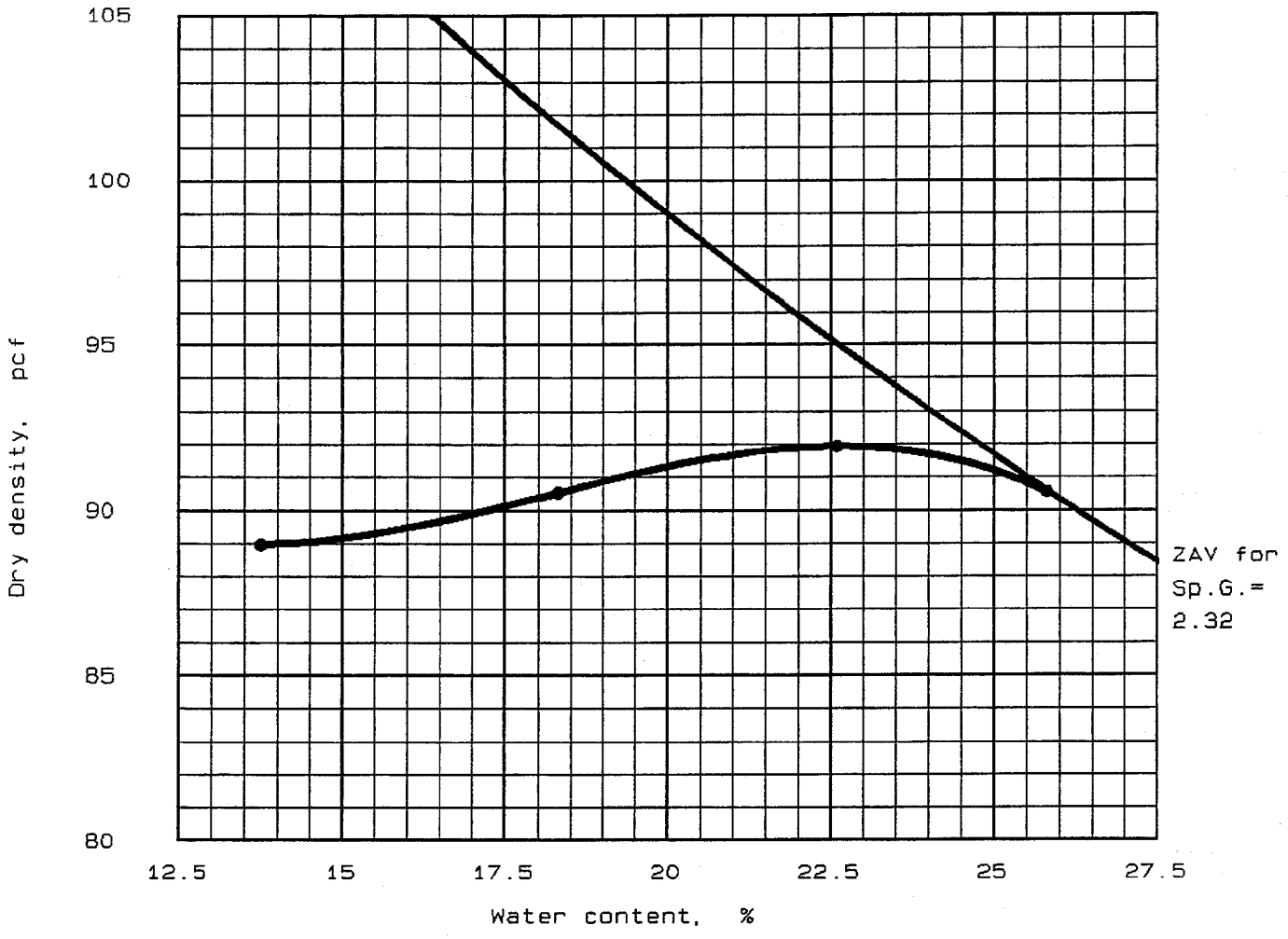
Reviewed by: [illegible]

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SW-SM (SW)	A-1-b	6.60 %	2.32	NL	NP	20.7 %	5.6 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 22.6 % Maximum dry density = 91.9 pcf	

Project No.: 5810860101
Project: TVA - Bull Run
Location: Bottom Ash

Date: July 25, 1995

Remarks:

Tested by: CLG

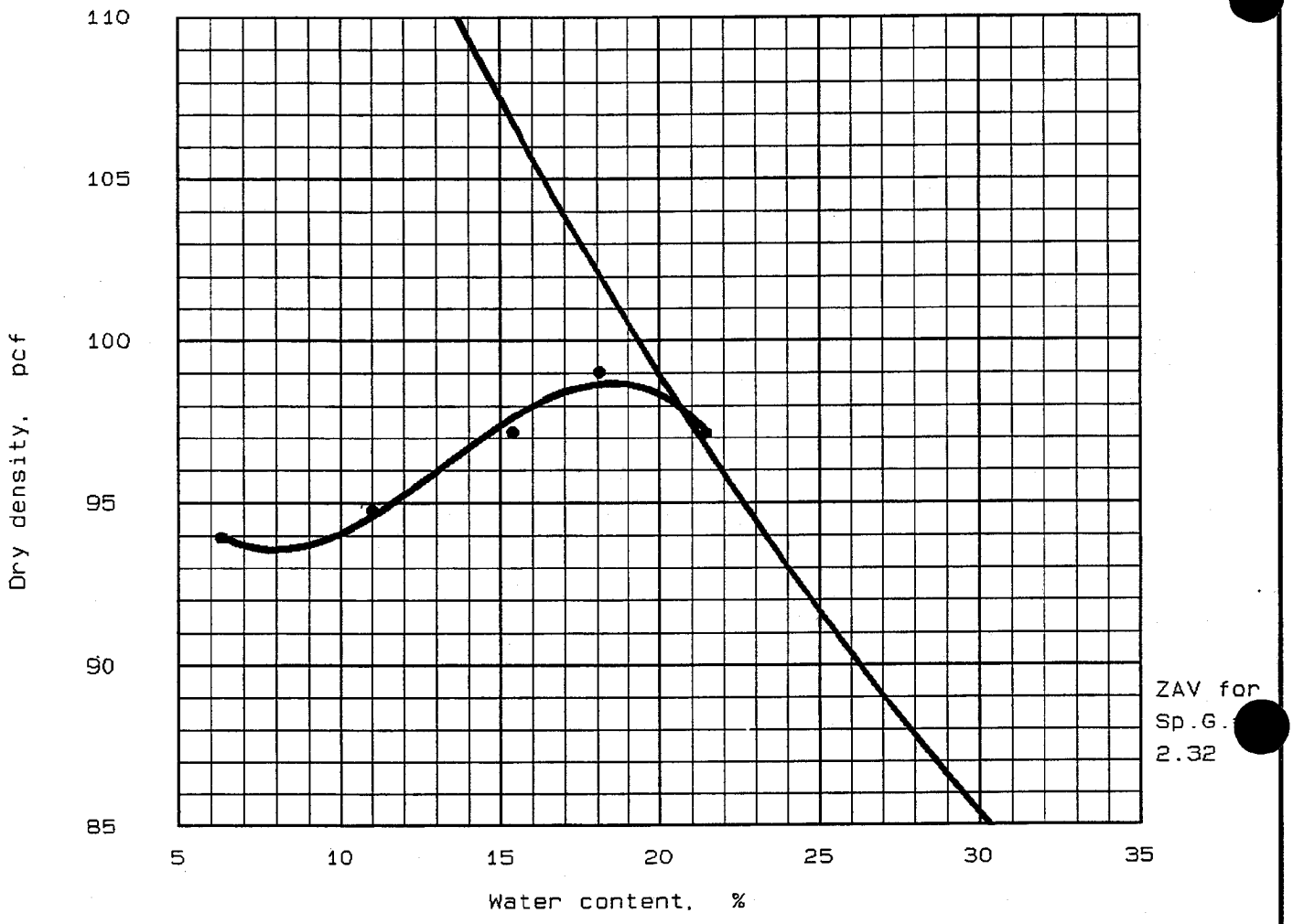
Reviewed by: RLB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SW-SM (SW)	A-1-b	6.60 %	2.32	NL	NP	20.7 %	5.6 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 18.5 % Maximum dry density = 98.7 pcf	

Project No.: 5810860101
Project: TVA - Bull Run
Location: Bottom Ash

Date: July 25, 1995

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Remarks:

Tested by: CLG

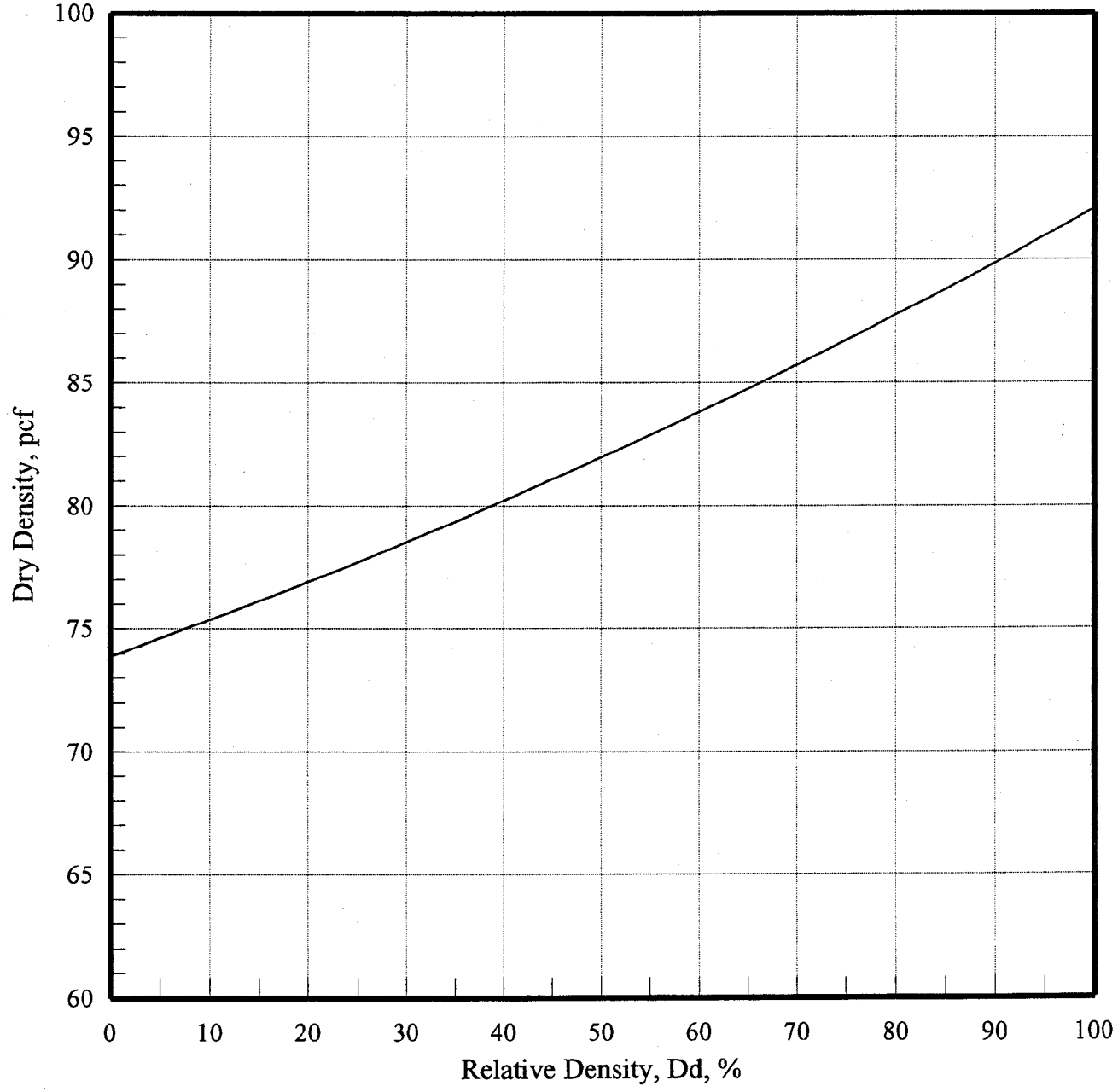
Reviewed by: RLB

Figure No. _____

Relative Density Test

TVA - Bull Run, Bottom Ash

Law Project No. 5810860101



HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*DMJ*
Project Name	*TVA - Bull Run*	Test Date	*08/16/95*
Material	*Bottom Ash*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D2434-68 Constant Head Permeability

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*0.0*
Wet Unit Weight, pcf:	*81.6*
Dry Unit Weight, pcf:	*81.6*
Compaction, %:	*88.8*
Hydraulic Conductivity, cm/sec. @20° C:	***1.8E-02***

PERMEABILITY TEST - Constant Head
(ASTM D2434 - 68)

LAW ENGINEERING

Project No. 5810860101
Project Name TVA - Bull Run
Material Bottom Ash

Tested By DMJ
Test Date 08/16/95
Reviewed By RLB
Review Date 09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	5.325	Location 1	2.858	Wet Soil + Pan, grams	741.30
Location 2	5.323	Location 2	2.875	Dry Soil+Pan, grams	741.30
Location3	5.427	Location 3	2.868	Pan Weight, grams	0.00
Average	5.358	Average	2.867	Moisture Content, %	0.0
		Sample wet weight, grams	741.30	Wet Unit Wt, pcf	81.6
		Membrane, Cap weight, grams	0.00	Dry Unit Wt, pcf	81.6

Time (sec)	Q (cm^3)	H (cm)	k (cm/sec)	Temp ° C	k (cm/sec at 20° C)	i (cm/cm)
600	170.00	4.83	1.9E-02	20.0	1.9E-02	0.35
1200	310.00	4.83	1.7E-02	20.0	1.8E-02	0.35

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
2	Remolded	91.9	88.8	Vertical

L = length of sample in cm
A = area of sample in cm^2
H = constant head in cm
t = time in seconds

A = 41.65 cm^2
L = 13.61 cm

Avg. k at 20° C 1.8E-02 cm/sec

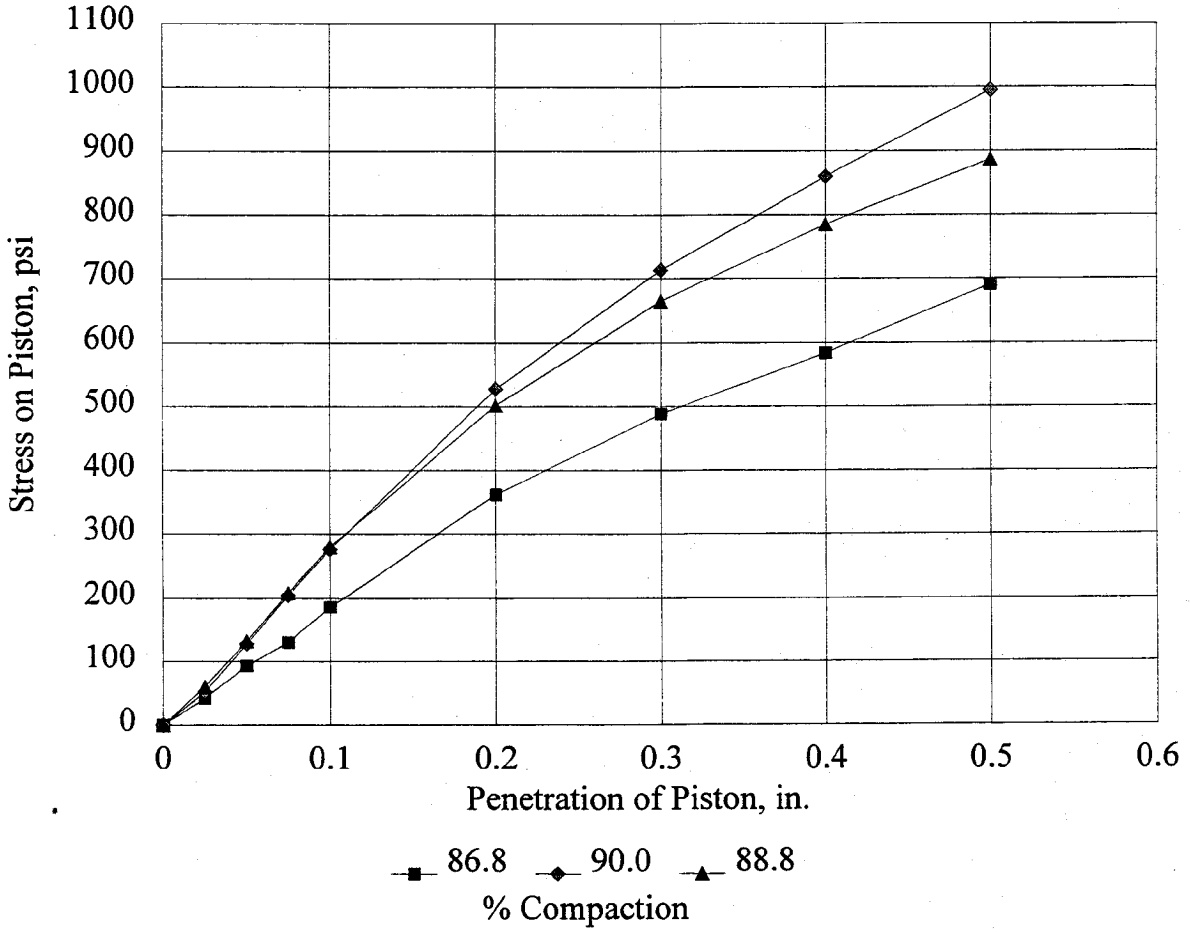
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Bull Run	**Test Date**	07/17/95
Material (Source)	Bottom Ash	**Reviewed By**	RLB
		Review Date	08/23/95

Compaction, %	86.8	90.0	88.8
Before Soak Dry Density, pcf	79.7	82.7	81.6
Before Soak Moisture Content,	19.9	22.4	21.6
After Soak Dry Density, pcf	80.4	83.2	82.1
After Soak Moisture Content, %	24.5	23.9	23.6
CBR @ 0.1 in.	18.6	27.6	28.0
CBR @ 0.2 in.	24.1	35.2	33.5



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.*:	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.86
	BOTTOM	2.86
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.07
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.07
	INITIAL AREA, A_0 , in^2	6.29
	INITIAL VOLUME A_0L_0 , in^3	38.18
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1046.64
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1046.64
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	22.6
	MAX. DRY DENSITY, pcf	91.9
	95 % MAX. DRY DENSITY, pcf	87.3
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	19.7
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	19.7
	COMPACTION DRY DENSITY, γ_d pcf	87.2
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	39.6
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-17-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Bondurant 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Bull Run
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-17-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	._ _ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.6	11.4	1.3	2.0	1.8	0.2	0.00119	0.00116	0.00118	0.00019	9,344
			2	12.6	11.3	1.3	2.0	1.8	0.2	0.00118	0.00116	0.00117	0.00019	9,368
			3	12.7	11.4	1.3	2.0	1.8	0.2	0.00118	0.00118	0.00118	0.00019	9,387
			4	12.6	11.4	1.3	2.0	1.8	0.2	0.00119	0.00116	0.00117	0.00019	9,374
			5	12.7	11.4	1.3	2.0	1.8	0.2	0.00117	0.00115	0.00116	0.00019	9,494
	COLUMN AVERAGE			12.7	11.4	1.3	2.0	1.8	0.2	0.00118	0.00116	0.00117	0.00019	9,393
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	59

Source: Bull Run Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.1	22.8	2.3	4.0	3.6	0.4	0.00217	0.00211	0.00214	0.00035	10,307
			2	25.2	22.9	2.3	4.0	3.6	0.4	0.00217	0.00212	0.00215	0.00035	10,301
			3	25.2	22.9	2.3	4.0	3.6	0.4	0.00215	0.00212	0.00214	0.00035	10,348
			4	25.2	22.9	2.3	4.0	3.6	0.4	0.00217	0.00212	0.00215	0.00035	10,299
			5	25.2	22.9	2.3	4.0	3.6	0.4	0.00216	0.00213	0.00214	0.00035	10,314
	COLUMN AVERAGE			25.1	22.9	2.3	4.0	3.6	0.4	0.00216	0.00212	0.00214	0.00035	10,314
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	20
SEQUENCE 3	6.0	6.0	1	37.6	34.1	3.6	6.0	5.4	0.6	0.00316	0.00310	0.00313	0.00051	10,518
			2	37.6	34.0	3.6	6.0	5.4	0.6	0.00317	0.00308	0.00313	0.00051	10,507
			3	37.7	34.2	3.6	6.0	5.4	0.6	0.00315	0.00310	0.00313	0.00051	10,558
			4	37.7	34.1	3.6	6.0	5.4	0.6	0.00316	0.00309	0.00313	0.00051	10,529
			5	37.6	33.9	3.6	6.0	5.4	0.6	0.00315	0.00309	0.00312	0.00051	10,495
	COLUMN AVERAGE			37.6	34.1	3.6	6.0	5.4	0.6	0.00316	0.00309	0.00313	0.00051	10,521
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	24
SEQUENCE 4	6.0	8.0	1	50.3	45.5	4.9	8.0	7.2	0.8	0.00420	0.00413	0.00417	0.00069	10,536
			2	50.4	45.5	4.9	8.0	7.2	0.8	0.00421	0.00414	0.00418	0.00069	10,521
			3	50.4	45.5	4.9	8.0	7.2	0.8	0.00420	0.00414	0.00417	0.00069	10,529
			4	50.3	45.4	4.9	8.0	7.2	0.8	0.00420	0.00413	0.00417	0.00069	10,537
			5	50.5	45.6	4.9	8.0	7.3	0.8	0.00421	0.00415	0.00418	0.00069	10,532
	COLUMN AVERAGE			50.4	45.5	4.9	8.0	7.2	0.8	0.00421	0.00414	0.00417	0.00069	10,531
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	7

Source: Bull Run Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.1	56.9	6.1	10.0	9.1	1.0	0.00524	0.00522	0.00523	0.00086	10,514
			2	63.1	57.0	6.1	10.0	9.1	1.0	0.00525	0.00523	0.00524	0.00086	10,501
			3	63.3	57.1	6.1	10.1	9.1	1.0	0.00525	0.00522	0.00523	0.00086	10,544
			4	63.2	57.0	6.2	10.0	9.1	1.0	0.00524	0.00523	0.00524	0.00086	10,514
			5	63.2	57.0	6.2	10.0	9.1	1.0	0.00525	0.00524	0.00525	0.00086	10,498
	COLUMN AVERAGE			63.2	57.0	6.1	10.0	9.1	1.0	0.00525	0.00523	0.00524	0.00086	10,514
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	18
SEQUENCE 6	4.0	2.0	1	13.2	11.5	1.7	2.1	1.8	0.3	0.00160	0.00156	0.00158	0.00026	7,054
			2	13.1	11.4	1.7	2.1	1.8	0.3	0.00159	0.00156	0.00157	0.00026	7,030
			3	13.1	11.4	1.7	2.1	1.8	0.3	0.00159	0.00153	0.00156	0.00026	7,074
			4	13.1	11.4	1.7	2.1	1.8	0.3	0.00158	0.00154	0.00156	0.00026	7,058
			5	13.1	11.4	1.7	2.1	1.8	0.3	0.00159	0.00155	0.00157	0.00026	7,037
	COLUMN AVERAGE			13.1	11.4	1.7	2.1	1.8	0.3	0.00159	0.00155	0.00157	0.00026	7,051
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 7	4.0	4.0	1	25.2	22.9	2.3	4.0	3.6	0.4	0.00313	0.00308	0.00310	0.00051	7,121
			2	25.3	22.9	2.4	4.0	3.6	0.4	0.00312	0.00308	0.00310	0.00051	7,146
			3	25.2	22.8	2.3	4.0	3.6	0.4	0.00312	0.00308	0.00310	0.00051	7,118
			4	25.2	22.8	2.4	4.0	3.6	0.4	0.00311	0.00308	0.00310	0.00051	7,123
			5	25.2	22.8	2.3	4.0	3.6	0.4	0.00312	0.00308	0.00310	0.00051	7,117
	COLUMN AVERAGE			25.2	22.9	2.3	4.0	3.6	0.4	0.00312	0.00308	0.00310	0.00051	7,125
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	12

Source: Bull Run Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.1	34.5	3.6	6.1	5.5	0.6	0.00442	0.00441	0.00442	0.00073	7,554
			2	38.1	34.6	3.5	6.1	5.5	0.6	0.00441	0.00441	0.00441	0.00073	7,563
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00442	0.00439	0.00440	0.00073	7,540
			4	38.0	34.5	3.6	6.0	5.5	0.6	0.00444	0.00441	0.00442	0.00073	7,527
			5	38.0	34.5	3.5	6.0	5.5	0.6	0.00443	0.00442	0.00443	0.00073	7,525
	COLUMN AVERAGE			38.0	34.5	3.6	6.1	5.5	0.6	0.00442	0.00441	0.00442	0.00073	7,542
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 9	4.0	8.0	1	50.7	45.8	4.9	8.1	7.3	0.8	0.00570	0.00568	0.00569	0.00094	7,772
			2	50.6	45.7	4.9	8.0	7.3	0.8	0.00569	0.00568	0.00568	0.00094	7,760
			3	50.7	45.8	4.9	8.1	7.3	0.8	0.00570	0.00569	0.00569	0.00094	7,774
			4	50.7	45.8	4.9	8.1	7.3	0.8	0.00573	0.00569	0.00571	0.00094	7,752
			5	50.7	45.8	4.9	8.1	7.3	0.8	0.00573	0.00570	0.00571	0.00094	7,745
	COLUMN AVERAGE			50.7	45.8	4.9	8.1	7.3	0.8	0.00571	0.00569	0.00570	0.00094	7,760
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	12
SEQUENCE 10	4.0	10.0	1	63.2	57.0	6.2	10.0	9.1	1.0	0.00680	0.00685	0.00683	0.00112	8,064
			2	63.2	57.1	6.2	10.1	9.1	1.0	0.00684	0.00686	0.00685	0.00113	8,050
			3	63.4	57.2	6.2	10.1	9.1	1.0	0.00684	0.00687	0.00686	0.00113	8,059
			4	63.3	57.1	6.2	10.1	9.1	1.0	0.00684	0.00689	0.00687	0.00113	8,033
			5	63.2	57.1	6.1	10.1	9.1	1.0	0.00684	0.00687	0.00686	0.00113	8,042
	COLUMN AVERAGE			63.3	57.1	6.2	10.1	9.1	1.0	0.00683	0.00687	0.00685	0.00113	8,049
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00001	0.00000	12

Source: Bull Run Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.2	2.1	2.1	1.8	0.3	0.00237	0.00233	0.00235	0.00039	4,609
			2	13.3	11.2	2.1	2.1	1.8	0.3	0.00236	0.00233	0.00234	0.00039	4,615
			3	13.3	11.2	2.1	2.1	1.8	0.3	0.00236	0.00233	0.00235	0.00039	4,623
			4	13.4	11.3	2.1	2.1	1.8	0.3	0.00235	0.00233	0.00234	0.00039	4,652
			5	13.3	11.2	2.1	2.1	1.8	0.3	0.00237	0.00233	0.00235	0.00039	4,607
	COLUMN AVERAGE			13.3	11.2	2.1	2.1	1.8	0.3	0.00236	0.00233	0.00235	0.00039	4,621
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	18
SEQUENCE 12	2.0	4.0	1	24.8	22.4	2.4	3.9	3.6	0.4	0.00463	0.00459	0.00461	0.00076	4,702
			2	24.9	22.5	2.4	4.0	3.6	0.4	0.00462	0.00460	0.00461	0.00076	4,711
			3	25.1	22.7	2.4	4.0	3.6	0.4	0.00461	0.00461	0.00461	0.00076	4,749
			4	24.9	22.6	2.4	4.0	3.6	0.4	0.00463	0.00461	0.00462	0.00076	4,717
			5	24.9	22.5	2.4	4.0	3.6	0.4	0.00461	0.00460	0.00460	0.00076	4,721
	COLUMN AVERAGE			24.9	22.5	2.4	4.0	3.6	0.4	0.00462	0.00460	0.00461	0.00076	4,720
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	18
SEQUENCE 13	2.0	6.0	1	37.6	34.0	3.6	6.0	5.4	0.6	0.00623	0.00627	0.00625	0.00103	5,251
			2	37.4	33.9	3.6	6.0	5.4	0.6	0.00621	0.00627	0.00624	0.00103	5,245
			3	37.5	33.9	3.6	6.0	5.4	0.6	0.00621	0.00628	0.00624	0.00103	5,250
			4	37.6	34.0	3.6	6.0	5.4	0.6	0.00623	0.00626	0.00625	0.00103	5,254
			5	37.5	33.9	3.6	6.0	5.4	0.6	0.00625	0.00628	0.00626	0.00103	5,235
	COLUMN AVERAGE			37.5	33.9	3.6	6.0	5.4	0.6	0.00622	0.00627	0.00625	0.00103	5,247
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	7

Source: Bull Run Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.3	45.6	4.8	8.0	7.2	0.8	0.00763	0.00773	0.00768	0.00126	5,730
			2	50.3	45.5	4.8	8.0	7.2	0.8	0.00765	0.00773	0.00769	0.00127	5,716
			3	50.3	45.6	4.8	8.0	7.2	0.8	0.00764	0.00778	0.00771	0.00127	5,709
			4	50.3	45.6	4.8	8.0	7.2	0.8	0.00763	0.00777	0.00770	0.00127	5,713
			5	50.2	45.5	4.8	8.0	7.2	0.8	0.00764	0.00778	0.00771	0.00127	5,694
	COLUMN AVERAGE			50.3	45.5	4.8	8.0	7.2	0.8	0.00764	0.00776	0.00770	0.00127	5,712
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00003	0.00001	0.00000	13
SEQUENCE 15	2.0	10.0	1	62.7	56.6	6.1	10.0	9.0	1.0	0.00889	0.00906	0.00897	0.00148	6,092
			2	62.7	56.6	6.1	10.0	9.0	1.0	0.00887	0.00908	0.00898	0.00148	6,093
			3	62.7	56.6	6.1	10.0	9.0	1.0	0.00889	0.00907	0.00898	0.00148	6,095
			4	62.7	56.6	6.1	10.0	9.0	1.0	0.00887	0.00909	0.00898	0.00148	6,090
			5	62.7	56.6	6.1	10.0	9.0	1.0	0.00886	0.00907	0.00897	0.00148	6,098
	COLUMN AVERAGE			62.7	56.6	6.1	10.0	9.0	1.0	0.00888	0.00907	0.00897	0.00148	6,094
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	3

SUBMITTED BY, DATE

RS Boudreau 9/5/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-17-1995

$$M_R = K1\ (S_C)^{K2}(1+S_3)^{K5}$$

K1 =	1,857
K2 =	0.10936
K5 =	0.78070
R^2 =	0.98

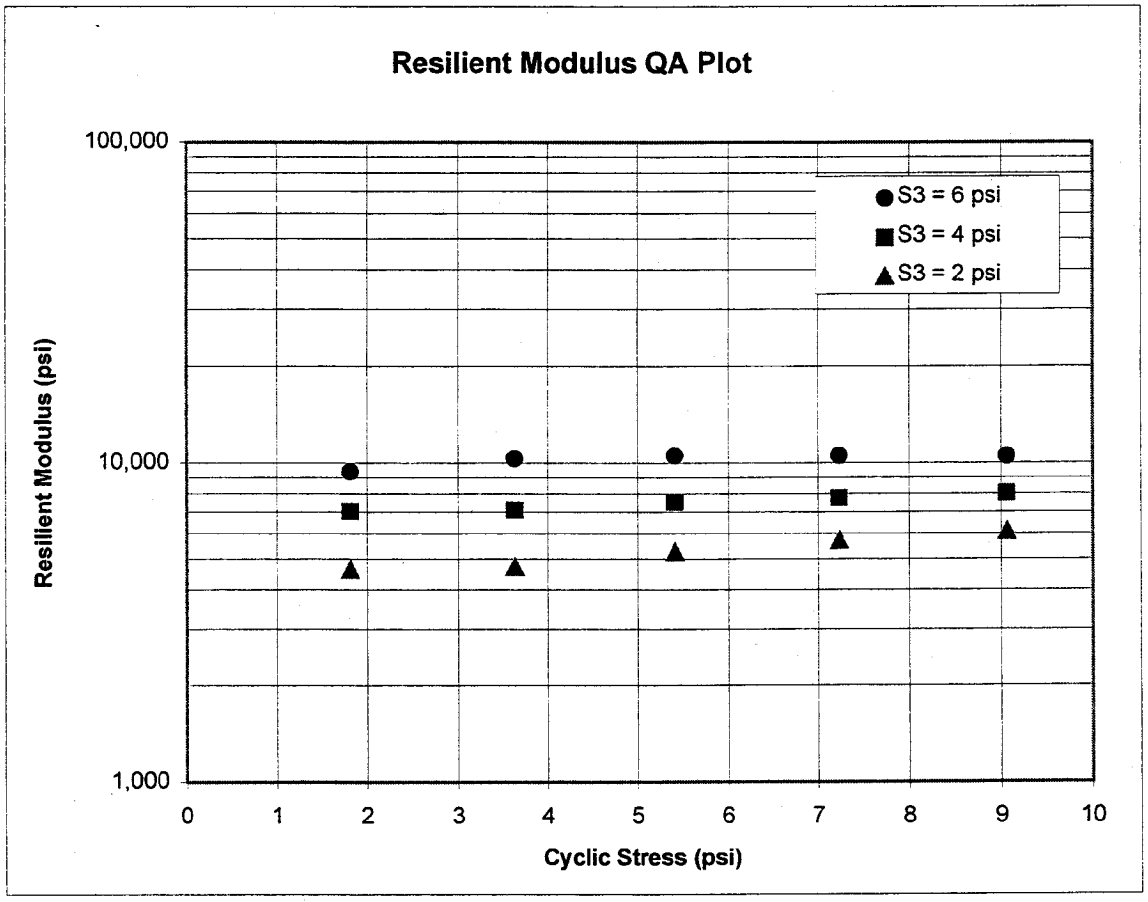
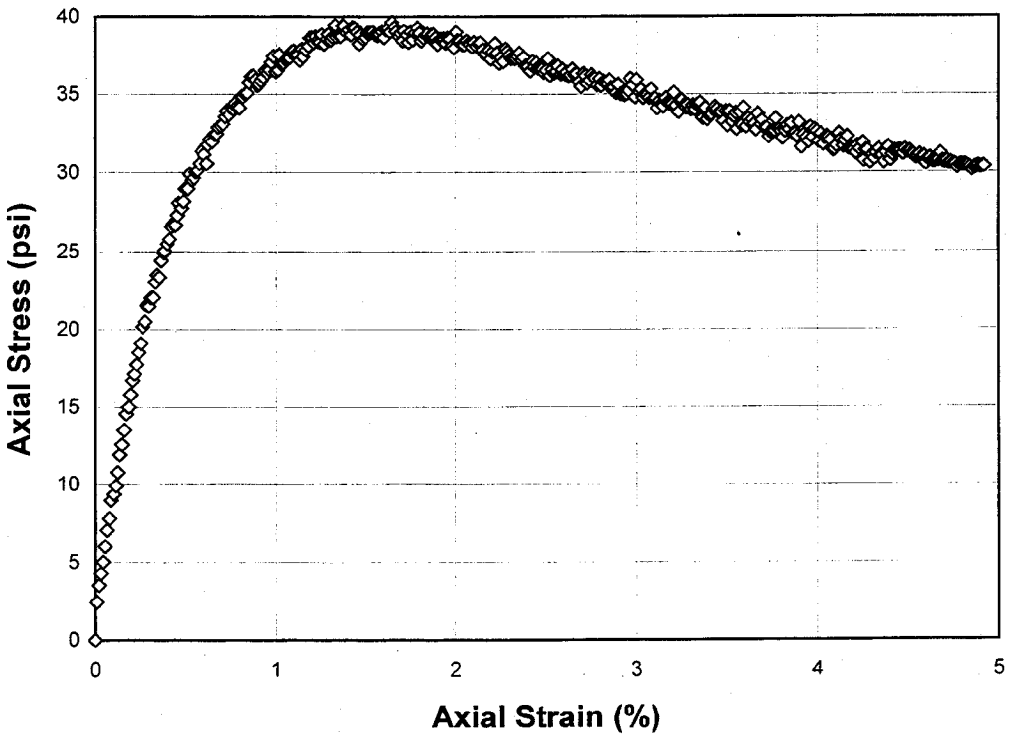


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-17-1995



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE
MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Bull Run
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.*:	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.86
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.08
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.08
	INITIAL AREA, A_0 , in^2	6.30
	INITIAL VOLUME $A_0 L_0$, in^3	38.27
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1092.53
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1092.53
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	18.5
	MAX. DRY DENSITY, pcf	98.7
	95 % MAX. DRY DENSITY, pcf	93.8
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	17.2
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	17.2
	COMPACTION DRY DENSITY, γ_d pcf	92.7
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	53.9
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-17-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

Michael S. Bourdeau 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Bull Run
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-17-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	___.__	___.__	_	_____.__	___.__	___.__	___.__	___.__	__.__	_.______	_.______	_.______	_.______	____.
SEQUENCE 1	6.0	2.0	1	12.7	11.5	1.2	2.0	1.8	0.2	0.00105	0.00114	0.00110	0.00018	10,118
			2	12.6	11.3	1.3	2.0	1.8	0.2	0.00104	0.00112	0.00108	0.00018	10,086
			3	12.7	11.4	1.3	2.0	1.8	0.2	0.00105	0.00112	0.00108	0.00018	10,215
			4	12.5	11.3	1.3	2.0	1.8	0.2	0.00103	0.00112	0.00107	0.00018	10,114
			5	12.7	11.4	1.3	2.0	1.8	0.2	0.00105	0.00114	0.00109	0.00018	10,049
	COLUMN AVERAGE			12.6	11.4	1.3	2.0	1.8	0.2	0.00104	0.00113	0.00108	0.00018	10,116
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	61

Source: Bull Run Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.2	22.8	2.4	4.0	3.6	0.4	0.00193	0.00205	0.00199	0.00033	11,043
			2	25.2	22.9	2.4	4.0	3.6	0.4	0.00194	0.00205	0.00199	0.00033	11,068
			3	25.3	22.9	2.4	4.0	3.6	0.4	0.00193	0.00206	0.00200	0.00033	11,067
			4	25.2	22.8	2.4	4.0	3.6	0.4	0.00192	0.00205	0.00199	0.00033	11,072
			5	25.2	22.8	2.4	4.0	3.6	0.4	0.00194	0.00207	0.00200	0.00033	11,001
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00193	0.00206	0.00199	0.00033	11,050
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	30
SEQUENCE 3	6.0	6.0	1	37.8	34.2	3.6	6.0	5.4	0.6	0.00279	0.00299	0.00289	0.00048	11,402
			2	37.9	34.2	3.6	6.0	5.4	0.6	0.00283	0.00298	0.00291	0.00048	11,358
			3	37.7	34.1	3.6	6.0	5.4	0.6	0.00281	0.00300	0.00290	0.00048	11,337
			4	37.8	34.1	3.6	6.0	5.4	0.6	0.00281	0.00299	0.00290	0.00048	11,354
			5	37.8	34.1	3.6	6.0	5.4	0.6	0.00281	0.00298	0.00289	0.00048	11,372
	COLUMN AVERAGE			37.8	34.1	3.6	6.0	5.4	0.6	0.00281	0.00299	0.00290	0.00048	11,365
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	24
SEQUENCE 4	6.0	8.0	1	50.4	45.5	4.9	8.0	7.2	0.8	0.00376	0.00396	0.00386	0.00063	11,382
			2	50.4	45.5	4.9	8.0	7.2	0.8	0.00375	0.00394	0.00385	0.00063	11,418
			3	50.4	45.5	4.9	8.0	7.2	0.8	0.00375	0.00395	0.00385	0.00063	11,403
			4	50.4	45.5	4.9	8.0	7.2	0.8	0.00374	0.00397	0.00386	0.00063	11,372
			5	50.4	45.5	4.9	8.0	7.2	0.8	0.00374	0.00395	0.00385	0.00063	11,406
	COLUMN AVERAGE			50.4	45.5	4.9	8.0	7.2	0.8	0.00375	0.00395	0.00385	0.00063	11,396
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	18

Source: Bull Run Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.2	57.0	6.1	10.0	9.1	1.0	0.00472	0.00491	0.00482	0.00079	11,423
			2	63.4	57.2	6.1	10.1	9.1	1.0	0.00470	0.00492	0.00481	0.00079	11,473
			3	63.3	57.2	6.1	10.0	9.1	1.0	0.00470	0.00495	0.00482	0.00079	11,436
			4	63.3	57.2	6.1	10.0	9.1	1.0	0.00468	0.00493	0.00481	0.00079	11,466
			5	63.2	57.2	6.1	10.0	9.1	1.0	0.00470	0.00495	0.00483	0.00079	11,420
	COLUMN AVERAGE			63.3	57.1	6.1	10.0	9.1	1.0	0.00470	0.00493	0.00482	0.00079	11,443
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	25
SEQUENCE 6	4.0	2.0	1	13.1	11.4	1.7	2.1	1.8	0.3	0.00140	0.00153	0.00146	0.00024	7,518
			2	12.9	11.3	1.7	2.1	1.8	0.3	0.00140	0.00148	0.00144	0.00024	7,524
			3	13.1	11.4	1.7	2.1	1.8	0.3	0.00142	0.00150	0.00146	0.00024	7,549
			4	13.0	11.3	1.7	2.1	1.8	0.3	0.00141	0.00148	0.00145	0.00024	7,519
			5	13.0	11.4	1.6	2.1	1.8	0.3	0.00140	0.00150	0.00145	0.00024	7,576
	COLUMN AVERAGE			13.0	11.3	1.7	2.1	1.8	0.3	0.00141	0.00150	0.00145	0.00024	7,537
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	25
SEQUENCE 7	4.0	4.0	1	25.2	22.8	2.4	4.0	3.6	0.4	0.00283	0.00301	0.00292	0.00048	7,555
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00282	0.00300	0.00291	0.00048	7,561
			3	25.1	22.8	2.3	4.0	3.6	0.4	0.00281	0.00299	0.00290	0.00048	7,583
			4	25.1	22.8	2.3	4.0	3.6	0.4	0.00285	0.00299	0.00292	0.00048	7,515
			5	25.2	22.8	2.3	4.0	3.6	0.4	0.00284	0.00300	0.00292	0.00048	7,541
	COLUMN AVERAGE			25.2	22.8	2.3	4.0	3.6	0.4	0.00283	0.00300	0.00291	0.00048	7,551
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	25

Source: Bull Run Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00398	0.00422	0.00410	0.00068	8,063
			2	38.1	34.5	3.6	6.0	5.5	0.6	0.00400	0.00423	0.00412	0.00068	8,077
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00400	0.00422	0.00411	0.00068	8,059
			4	37.9	34.3	3.6	6.0	5.5	0.6	0.00399	0.00422	0.00410	0.00068	8,072
			5	38.1	34.5	3.6	6.0	5.5	0.6	0.00399	0.00422	0.00411	0.00068	8,094
	COLUMN AVERAGE			38.0	34.4	3.6	6.0	5.5	0.6	0.00399	0.00422	0.00411	0.00068	8,073
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	14
SEQUENCE 9	4.0	8.0	1	50.8	45.9	4.9	8.1	7.3	0.8	0.00507	0.00533	0.00520	0.00086	8,522
			2	50.6	45.7	4.9	8.0	7.3	0.8	0.00507	0.00533	0.00520	0.00086	8,485
			3	50.7	45.8	4.9	8.0	7.3	0.8	0.00506	0.00532	0.00519	0.00085	8,520
			4	50.7	45.8	4.9	8.0	7.3	0.8	0.00509	0.00533	0.00521	0.00086	8,484
			5	50.7	45.8	4.9	8.0	7.3	0.8	0.00507	0.00534	0.00520	0.00086	8,486
	COLUMN AVERAGE			50.7	45.8	4.9	8.0	7.3	0.8	0.00507	0.00533	0.00520	0.00086	8,499
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	20
SEQUENCE 10	4.0	10.0	1	63.3	57.3	6.1	10.1	9.1	1.0	0.00611	0.00637	0.00624	0.00103	8,852
			2	63.5	57.4	6.1	10.1	9.1	1.0	0.00612	0.00637	0.00624	0.00103	8,875
			3	63.5	57.4	6.1	10.1	9.1	1.0	0.00613	0.00638	0.00625	0.00103	8,858
			4	63.3	57.3	6.1	10.1	9.1	1.0	0.00612	0.00638	0.00625	0.00103	8,837
			5	63.5	57.4	6.0	10.1	9.1	1.0	0.00613	0.00638	0.00626	0.00103	8,854
	COLUMN AVERAGE			63.4	57.4	6.1	10.1	9.1	1.0	0.00612	0.00637	0.00625	0.00103	8,855
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	14

Source: Bull Run Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.2	2.1	2.1	1.8	0.3	0.00219	0.00228	0.00223	0.00037	4,841
			2	13.2	11.1	2.1	2.1	1.8	0.3	0.00218	0.00228	0.00223	0.00037	4,817
			3	13.2	11.1	2.1	2.1	1.8	0.3	0.00217	0.00228	0.00223	0.00037	4,804
			4	13.1	11.1	2.1	2.1	1.8	0.3	0.00215	0.00226	0.00221	0.00036	4,830
			5	13.1	11.0	2.1	2.1	1.8	0.3	0.00218	0.00228	0.00223	0.00037	4,774
	COLUMN AVERAGE			13.2	11.1	2.1	2.1	1.8	0.3	0.00217	0.00228	0.00223	0.00037	4,813
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	26
SEQUENCE 12	2.0	4.0	1	25.2	22.8	2.4	4.0	3.6	0.4	0.00425	0.00442	0.00434	0.00071	5,081
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00423	0.00446	0.00435	0.00072	5,066
			3	25.1	22.8	2.4	4.0	3.6	0.4	0.00427	0.00445	0.00436	0.00072	5,036
			4	25.1	22.8	2.4	4.0	3.6	0.4	0.00426	0.00444	0.00435	0.00072	5,047
			5	25.1	22.8	2.4	4.0	3.6	0.4	0.00427	0.00444	0.00435	0.00072	5,043
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00425	0.00444	0.00435	0.00072	5,054
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	19
SEQUENCE 13	2.0	6.0	1	38.2	34.6	3.6	6.1	5.5	0.6	0.00565	0.00588	0.00576	0.00095	5,795
			2	38.1	34.5	3.6	6.1	5.5	0.6	0.00564	0.00587	0.00575	0.00095	5,787
			3	38.2	34.7	3.6	6.1	5.5	0.6	0.00565	0.00587	0.00576	0.00095	5,801
			4	38.1	34.6	3.6	6.1	5.5	0.6	0.00565	0.00586	0.00576	0.00095	5,791
			5	38.2	34.6	3.6	6.1	5.5	0.6	0.00566	0.00589	0.00577	0.00095	5,789
	COLUMN AVERAGE			38.2	34.6	3.6	6.1	5.5	0.6	0.00565	0.00587	0.00576	0.00095	5,793
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6

Source: Bull Run Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.8	46.0	4.8	8.1	7.3	0.8	0.00685	0.00709	0.00697	0.00115	6,367
			2	50.8	46.0	4.8	8.1	7.3	0.8	0.00680	0.00711	0.00695	0.00114	6,377
			3	50.7	45.8	4.9	8.0	7.3	0.8	0.00680	0.00710	0.00695	0.00114	6,365
			4	50.8	46.0	4.8	8.1	7.3	0.8	0.00684	0.00710	0.00697	0.00115	6,369
			5	50.7	45.8	4.8	8.0	7.3	0.8	0.00684	0.00710	0.00697	0.00115	6,341
	COLUMN AVERAGE			50.8	45.9	4.8	8.1	7.3	0.8	0.00682	0.00710	0.00696	0.00115	6,364
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00003	0.00001	0.00001	0.00000	14
SEQUENCE 15	2.0	10.0	1	63.6	57.4	6.1	10.1	9.1	1.0	0.00787	0.00810	0.00798	0.00131	6,940
			2	63.5	57.4	6.1	10.1	9.1	1.0	0.00787	0.00810	0.00799	0.00131	6,929
			3	63.4	57.3	6.1	10.1	9.1	1.0	0.00785	0.00811	0.00798	0.00131	6,927
			4	63.4	57.3	6.1	10.1	9.1	1.0	0.00784	0.00812	0.00798	0.00131	6,922
			5	63.4	57.3	6.1	10.1	9.1	1.0	0.00783	0.00813	0.00798	0.00131	6,930
	COLUMN AVERAGE			63.4	57.3	6.1	10.1	9.1	1.0	0.00785	0.00811	0.00798	0.00131	6,929
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00000	0.00000	7

SUBMITTED BY, DATE

RS Boudreau 9/5/95

LABORATORY MANAGER