

GALLATIN

Dry Fly Ash (Unit 2 Hoppers)
Bottom Ash - From Pond



GALLATIN

Dry Fly Ash (Unit 2 Hoppers)

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)

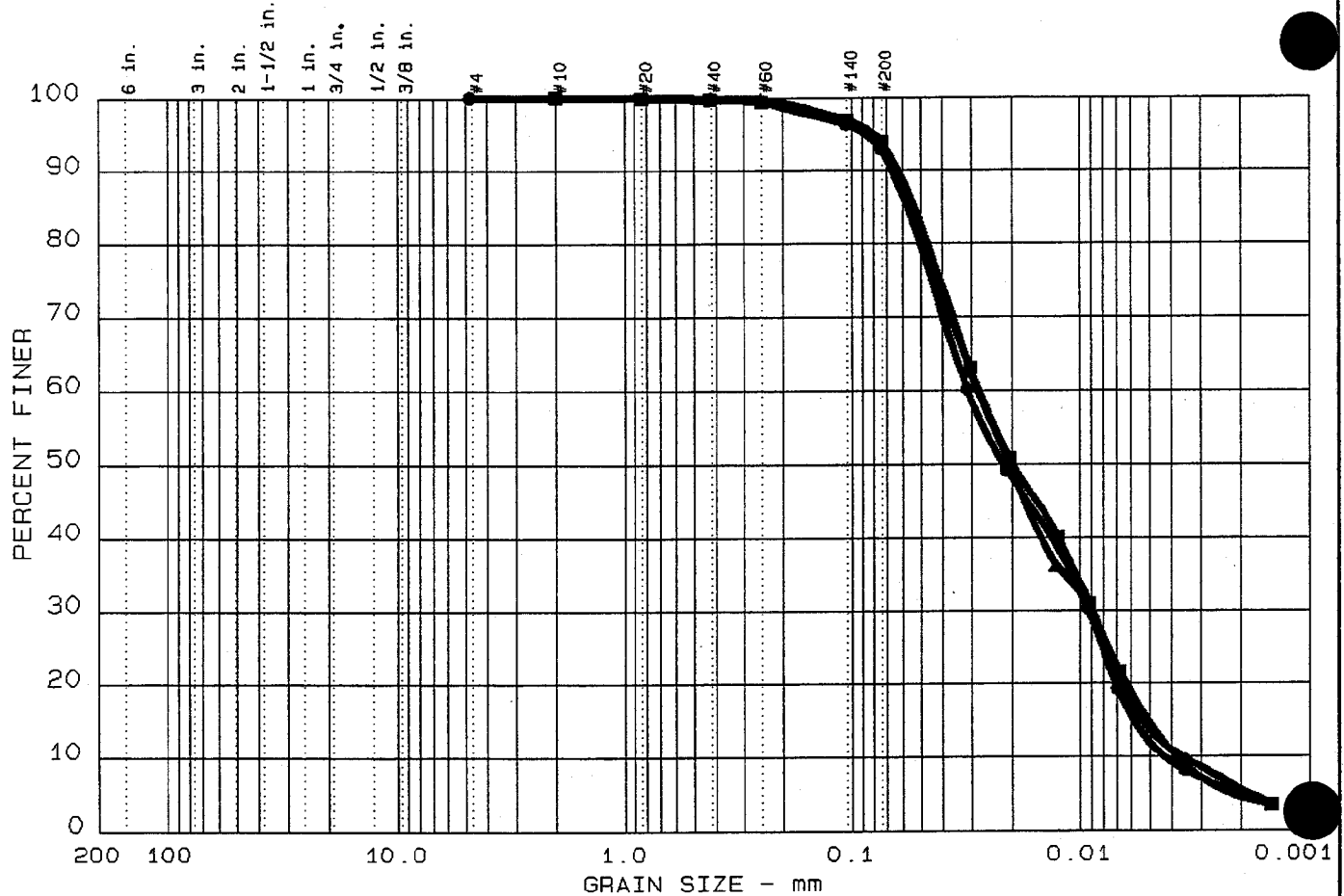


**TVA - GALLATIN
DRY FLY ASH (UNIT 2 HOPPERS)**

| Description | Test Method | Property | Sample 1 | Sample 2 | Sample 3 |
|--|--------------|--|---------------|-------------------------|----------------------------|
| Grain Size | ASTM D 422 | Percent Retained on the #4 Sieve | 0.0 | 0.0 | 0.0 |
| | | Percent Passing the #200 Sieve | 94.2 | 95.2 | 95.5 |
| | | Percent Passing the 0.005 mm Sieve | 12.0 | 13.8 | 14.8 |
| Atterberg Limits | ASTM D 4318 | Liquid Limit | NL | NL | NL |
| | | Plastic Limit | NP | NP | NP |
| | | Plasticity Index | N/A | N/A | N/A |
| Specific Gravity | ASTM D 854 | Specific Gravity at 20°C | 2.37 | 2.40 | 2.39 |
| Classification | ASTM D 2487 | Unified Soil Classification System (USCS) | ML | ML | ML |
| | AASHTO M 145 | AASHTO Classification | A-4(0.0) | A-4(0.0) | A-4(0.0) |
| Composite Sample | | | | | |
| Moisture-Density Relations (Standard Effort) | ASTM D 698 | Maximum Dry Density, pcf | 86.6 | | |
| | | Optimum Moisture Content, % | 21.4 | | |
| Moisture-Density Relations (Modified Effort) | ASTM D 1557 | Maximum Dry Density, pcf | 88.9 | | |
| | | Optimum Moisture Content, % | 18.8 | | |
| | | | Result | Dry Density, pcf | Moisture Content, % |
| Consolidation | ASTM D2435 | Compression Index C_c | 0.05 | 79.6 | 21.2 |
| Hydraulic Conductivity | ASTM D 5084 | Hydraulic Conductivity, cm/sec | 7.7E-5 | 82.1 | 21.0 |
| Triaxial Shear Strength Consolidated-Undrained (CU) | ASTM D4767 | Effective Stress, Cohesion, c', ksf | 0.00 | 82.2 | 21.0 |
| | | Effective Stress, Internal Friction Angle, ϕ' , degrees | 31.7 | | |
| | | Total Stress, Cohesion, c, ksf | 0.57 | 82.2 | 21.0 |
| | | Total Stress, Internal Friction Angle, ϕ , degrees | 26.2 | | |
| Direct Shear Strength | ASTM D 3080 | Cohesion, c, ksf | 1.37 | 76.7 | 21.0 |
| | | Internal Friction Angle, ϕ , degrees | 34.5 | | |
| California Bearing Ratio | ASTM D 1883 | CBR, % | 2 | 84.8 | 21.6 |
| Resilient Modulus (Standard Compactive Effort) | SHRP P46 | Resilient Modulus at 4psi axial stress and 4psi confining pressure | 4,598 | 79.8 | 21.9 |
| Resilient Modulus (Modified Compactive Effort) | SHRP P46 | Resilient Modulus at 4psi axial stress and 4psi confining pressure | 5,671 | 81.8 | 18.2 |
| Soil Resistivity | AASHTO T 288 | Minimum Resistivity, Ohm-cm | 420 | | |
| pH of Soil | AASHTO T 289 | pH | 10.6 | | |
| Water Soluble Sulfate Ion | AASHTO T 290 | Sulfate Ion Content, mg/kg | 5800 | | |
| Water Soluble Chloride Ion | AASHTO T 290 | Chloride Ion Content, mg/kg | <10 | | |

gaf-fa.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



| Test | % +3" | % GRAVEL | % SAND | % SILT | % CLAY |
|------|-------|----------|--------|--------|--------|
| ● 6 | 0.0 | 0.0 | 7.1 | 81.1 | 11.8 |
| ▲ 7 | 0.0 | 0.0 | 6.3 | 80.2 | 13.5 |
| ■ 8 | 0.0 | 0.0 | 6.0 | 79.4 | 14.6 |

| | LL | PI | D85 | D60 | D50 | D30 | D15 | D10 | C _c | C _u |
|---|----|----|-----|-----|------|-------|--------|--------|----------------|----------------|
| ● | NL | NP | | | 0.02 | 0.009 | 0.0059 | 0.0043 | 0.64 | 7.2 |
| ▲ | NL | NP | | | 0.02 | 0.009 | 0.0054 | 0.0036 | 0.79 | 7.8 |
| ■ | NL | NP | | | 0.02 | 0.009 | 0.0051 | 0.0038 | 0.76 | 7.3 |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|----------------------|------------------|-----------|
| | ● Unit 2 Hoppers | ML |
| ▲ Unit 2 Hoppers | ML | A-4 (0.0) |
| ■ Unit 2 Hoppers | ML | A-4 (0.0) |

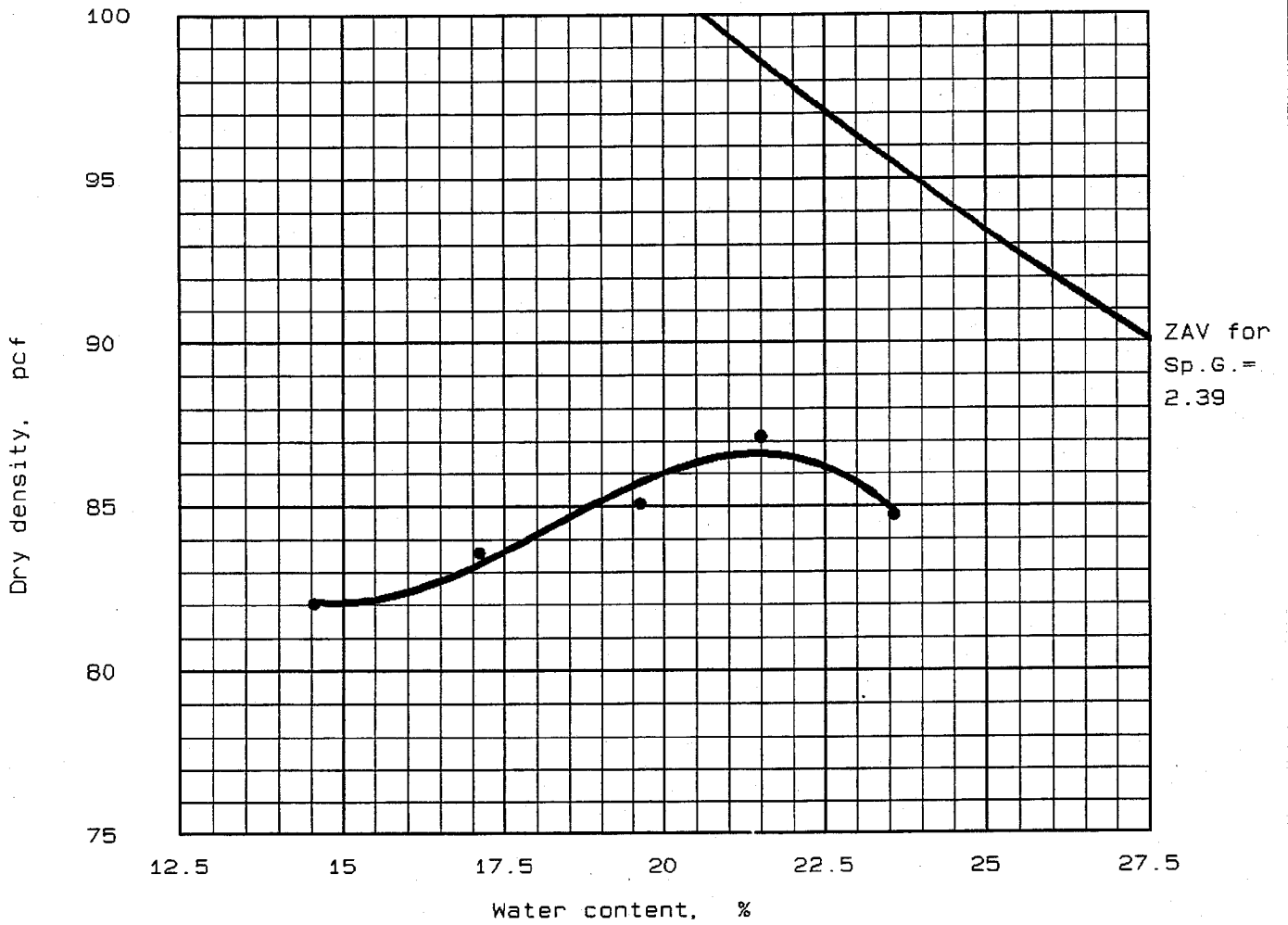
Project No.: 5810860101
 Project: TVA - Gallatin
 ● Location: Dry Fly Ash A & B
 ▲ Location: Dry Fly Ash C & D
 ■ Location: Dry Fly Ash E & F
 Date: July 18, 1995

Remarks:
 Tested by: *JCL*
 Reviewed by: *HS*

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor. ASTM D 698. Method A

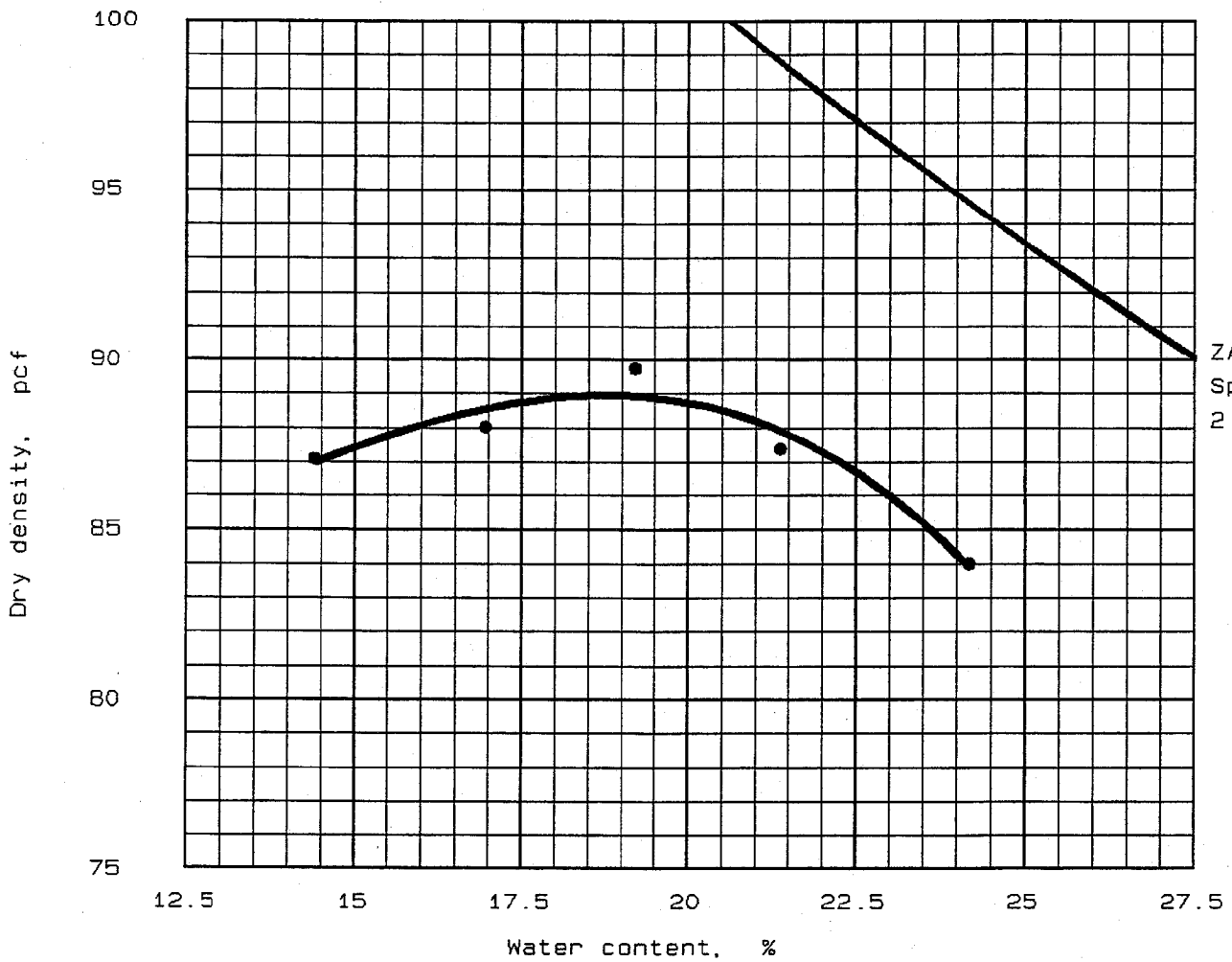
| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|----------------|----------------|-----------|----------------|-------|-----|----|-------------|---------------|
| | USCS | AASHTO | | | | | | |
| | ML | A-4 (0.0) | .017 % | 2.39 | .NL | NP | 0 % | 94.9 % |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|----------------------|
| Optimum moisture = 21.4 % Maximum dry density = 86.6 pcf | |

| | |
|--|--|
| Project No.: 5810850101 Project: TVA - Gallatin Location: Dry Fly Ash Unit 2 Hoppers Date: July 25, 1995 | Remarks: Tested by: <i>JCR/EM</i> Reviewed by: <i>HS</i> |
|--|--|

| | |
|---|------------------|
| 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) | .017 % | 2.39 | NL | NP | 0 % | 94.9 % |

| TEST RESULTS | MATERIAL DESCRIPTION |
|--------------|----------------------|
|--------------|----------------------|

Optimum moisture = 18.8 %
 Maximum dry density = 88.9 pcf

Remarks:

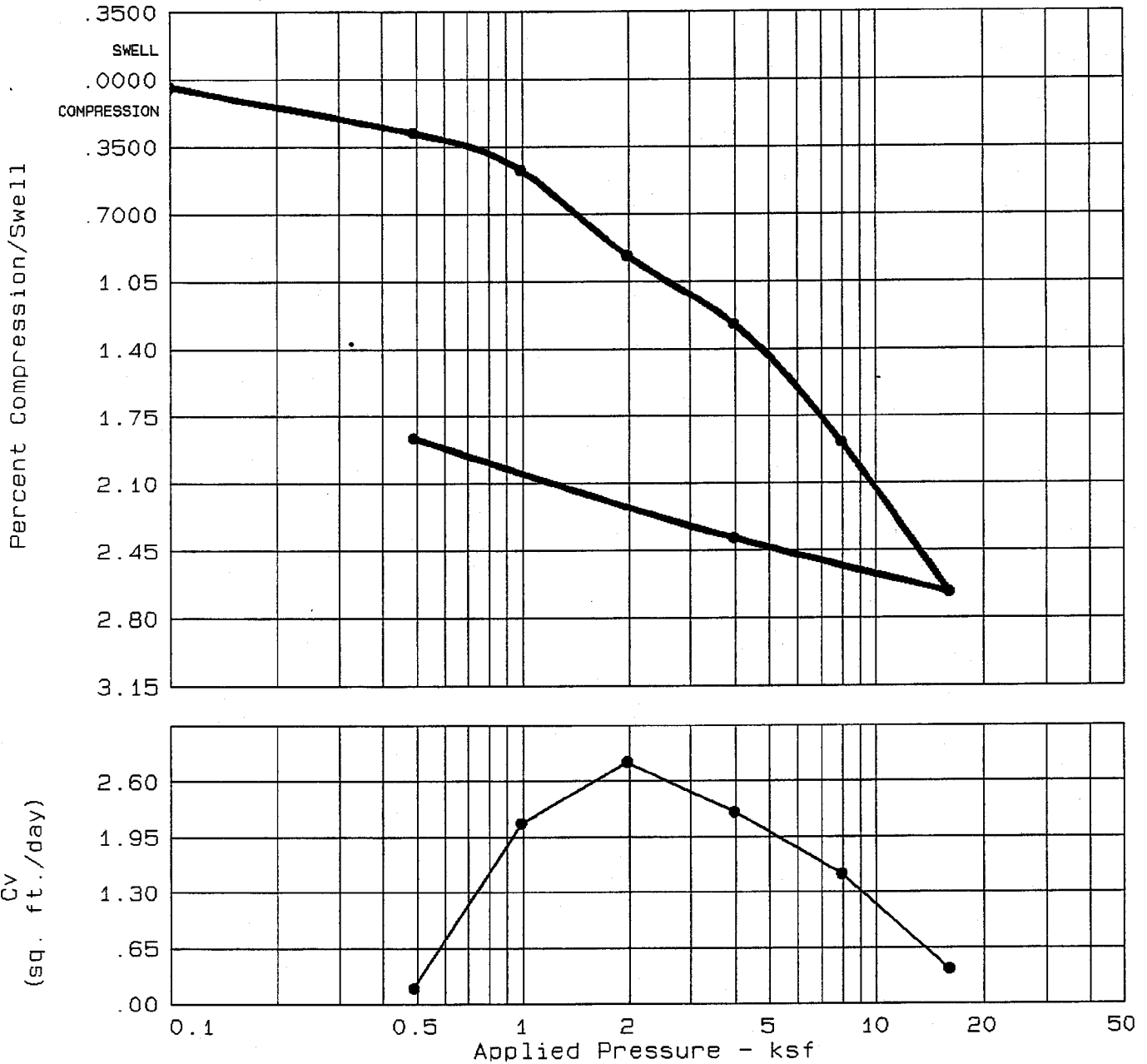
Project No.: 5810860101
 Project: TVA - Gallatin
 Location: Dry Fly Ash
 Unit 2 Hoppers
 Date: July 25, 1995

Tested by: *JCE*
 Reviewed by: *HA*

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 ₀ |
|--------------------|------------------|-------------|----|----|---------|-----------------|----------------|----------------|
| 57.6 % | 21.2 | 79.6 | NL | NP | 2.399 | 4.89 | 0.05 | 0.8805 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|--|---|
| Compression Index = 0.05 | Class: USCS: ML Remarks: |
| Project No.: 5810860101 Project: TVA - Gallatin Location: Dry Fly Ash Unit 2 Hoppers Date: July 24, 1995 | Tested by: <i>AdK</i> Reviewed by: <i>HS</i> |
| CONSOLIDATION TEST REPORT LAW ENGINEERING, INC. | Fig. No. _____ |

HYDRAULIC CONDUCTIVITY



Project No. **5810860101**
Project Name **TVA - Gallatin**
Material (Source) **Dry Fly Ash**
(Unit 2 Hoppers)

Tested By **HEJ**
Test Date **06/05/95**
Reviewed By **RLB**
Review Date **09/06/95**

ASTM D5084 - Falling Head

| | |
|---|-----------------|
| Sample Type: | <i>Remolded</i> |
| Sample Orientation: | <i>Vertical</i> |
| Initial Water Content, %: | <i>21.0</i> |
| Wet Unit Weight, pcf: | <i>99.4</i> |
| Dry Unit Weight, pcf: | <i>82.1</i> |
| Compaction, %: | <i>94.8</i> |
| Hydraulic Conductivity, cm/sec. @20 °C: | <i>7.7E-05</i> |

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

Job Number 5810860101 Tested By HEJ
 Project Name TVA - Gallatin Test Date 06/05/95
 Material (Source) Dry Fly Ash Reviewed By RLB
 (Unit 2 Hoppers) Review Date 09/06/95

LAW ENGINEERING

Sample Data

| Length, in | Diameter, in | | Pan No. |
|------------|--------------|------------|---------------------|
| | Location 1 | Location 2 | |
| Location 1 | 6.000 | 2.830 | Dry Soil+Pan, grams |
| Location 2 | 6.000 | 2.830 | Pan Weight, grams |
| Location 3 | 6.000 | 2.830 | |
| Average | 6.000 | 2.830 | Moisture Content, % |
| | | 984.65 | Wet Unit Wt, pcf |
| | | 0.00 | Dry Unit Wt, pcf |

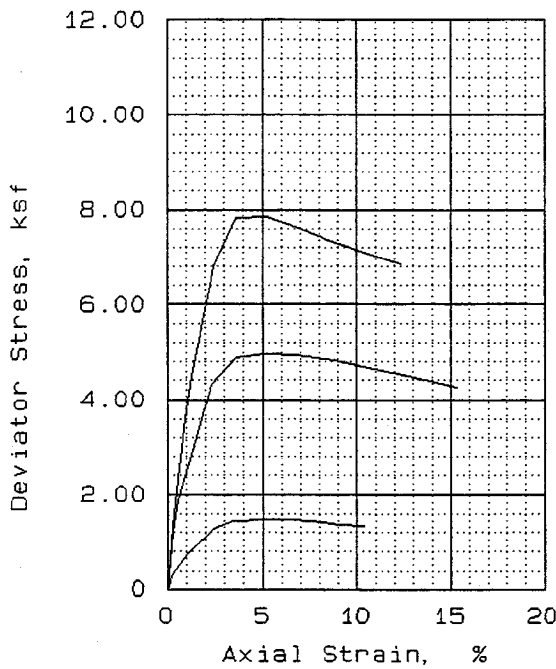
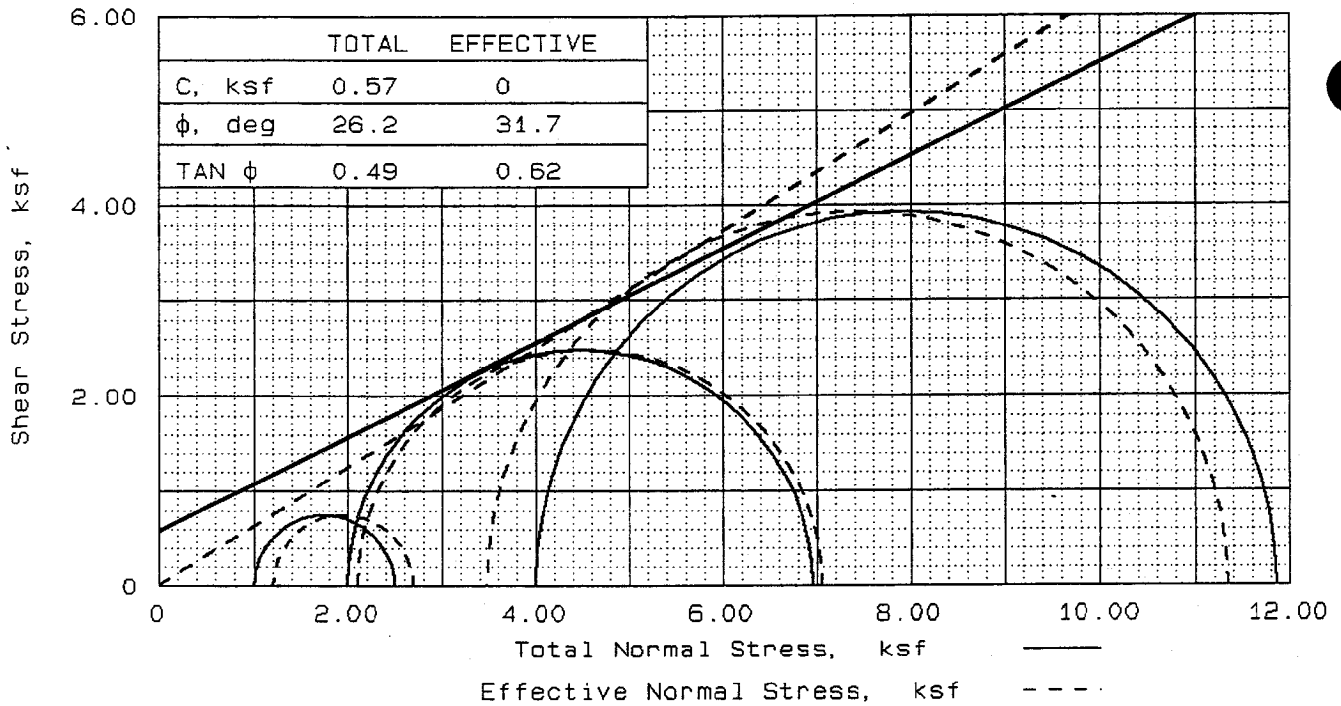
Chamber Pressure, psi 47
 Back Pressure, psi 33
 Confining Pressure, psi 14

| Date | Date | Time | Time | Time | Division | H ₀ | H _f | k | Temp | k |
|-------|--------|-------|--------|-------|----------|----------------|----------------|---------|------|---------|
| Start | Finish | Start | Finish | (sec) | Start | (cm) | (cm) | cm/sec | (°C) | cm/sec |
| | | | | 900 | 0.0 | 127.87 | 105.37 | 8.1E-05 | 21 | 7.9E-05 |
| | | | | 915 | 0.0 | 127.87 | 105.87 | 7.7E-05 | 21 | 7.6E-05 |
| | | | | 1007 | 0.0 | 127.87 | 103.87 | 7.8E-05 | 21 | 7.6E-05 |

| No. of Trial | Sample Type | Max. Density (pcf) | Compaction % | Sample Orientation |
|--------------|-------------|--------------------|--------------|--------------------|
| 3 | Remolded | 86.6 | 94.8 | Vertical |

Avg. k at 20 °C 7.7E-05 cm/sec

a = area of burette in cm² a = 1.00 cm²
 L = length of sample in cm A = 40.582 cm²
 A = area of sample in cm² L = 15.24 cm
 H₀ = initial head in cm
 H_f = final head in cm
 t = time in seconds



| SAMPLE NO. | | 1 | 2 | 3 |
|-------------------------------|------------------|-------|-------|-------|
| INITIAL | WATER CONTENT, % | 21.1 | 21.0 | 21.0 |
| | DRY DENSITY, pcf | 82.2 | 82.1 | 82.2 |
| | SATURATION, % | 61.9 | 61.5 | 61.5 |
| | VOID RATIO | 0.816 | 0.817 | 0.816 |
| | DIAMETER, in | 2.83 | 2.83 | 2.83 |
| | HEIGHT, in | 6.00 | 6.00 | 6.00 |
| AT TEST | WATER CONTENT, % | 33.3 | 32.8 | 32.3 |
| | DRY DENSITY, pcf | 83.0 | 83.6 | 84.2 |
| | SATURATION, % | 100.0 | 100.0 | 100.0 |
| | VOID RATIO | 0.797 | 0.785 | 0.771 |
| | DIAMETER, in | 2.83 | 2.81 | 2.80 |
| | HEIGHT, in | 5.95 | 5.98 | 5.96 |
| BACK PRESSURE, ksf | | 3.61 | 3.56 | 3.57 |
| CELL PRESSURE, ksf | | 4.61 | 5.56 | 7.57 |
| FAILURE STRESS, ksf | | 1.49 | 4.96 | 7.86 |
| PORE PRESSURE, ksf | | 3.41 | 3.46 | 4.09 |
| STRAIN RATE, %/min. | | 0.100 | 0.100 | 0.100 |
| ULTIMATE STRESS, ksf | | | | |
| PORE PRESSURE, ksf | | | | |
| $\bar{\sigma}_1$ FAILURE, ksf | | 2.69 | 7.06 | 11.34 |
| $\bar{\sigma}_3$ FAILURE, ksf | | 1.2 | 2.1 | 3.48 |

TYPE OF TEST:
CU with pore pressures

SAMPLE TYPE: Remolded
DESCRIPTION:

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 2.39

REMARKS: Tested by: *HD*

Reviewed by: *RUB*

FIG. NO.

CLIENT:

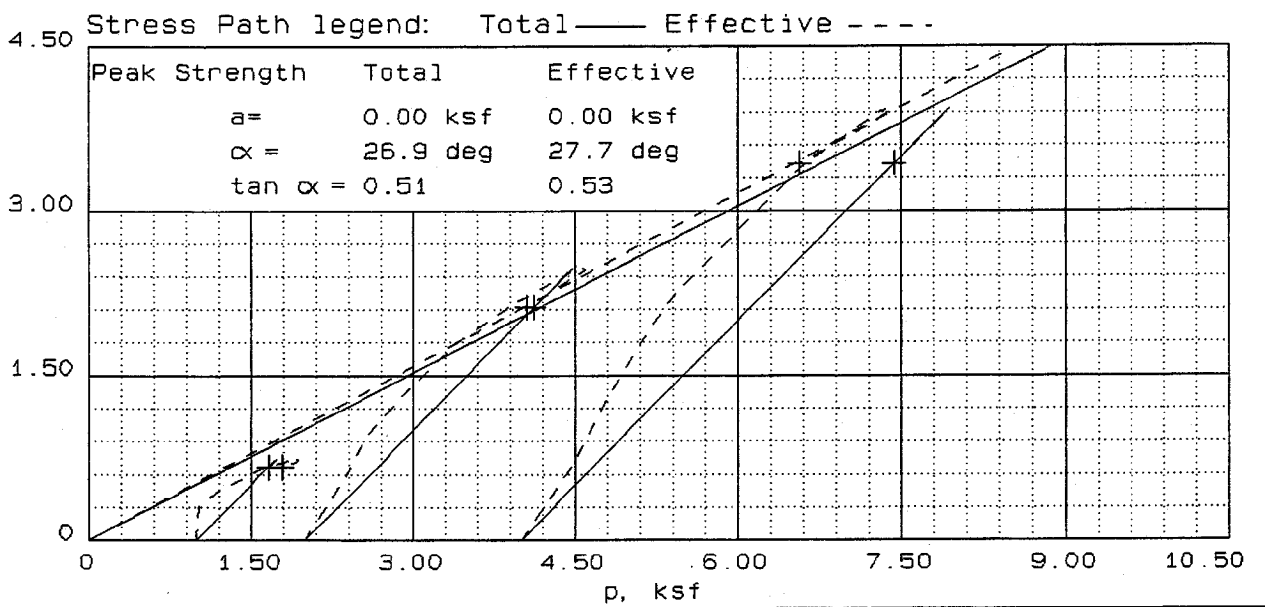
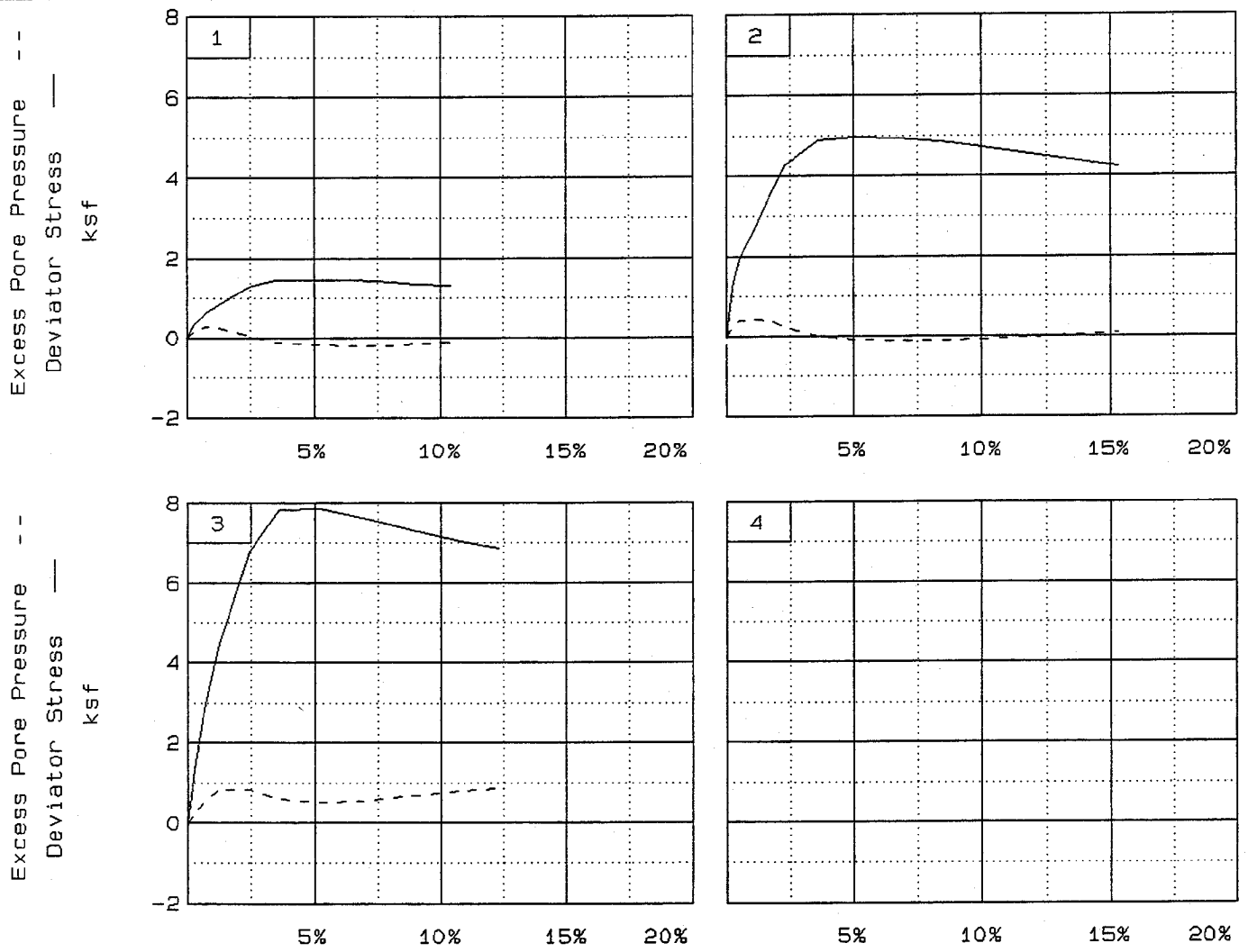
PROJECT: TVA - Gallatin

SAMPLE LOCATION: Dry Fly Ash
Unit 2 Hoppers

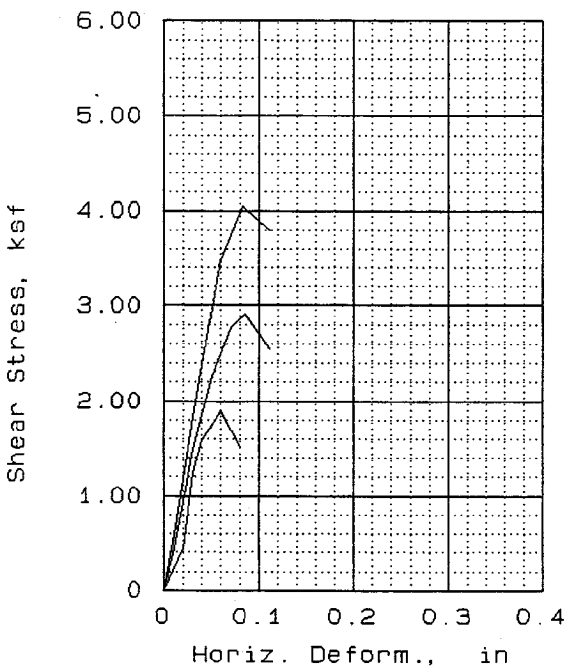
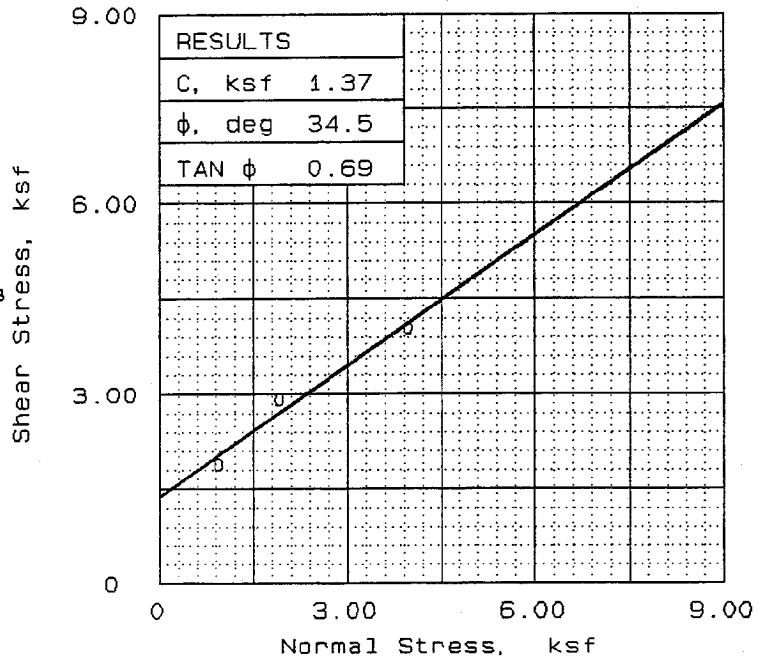
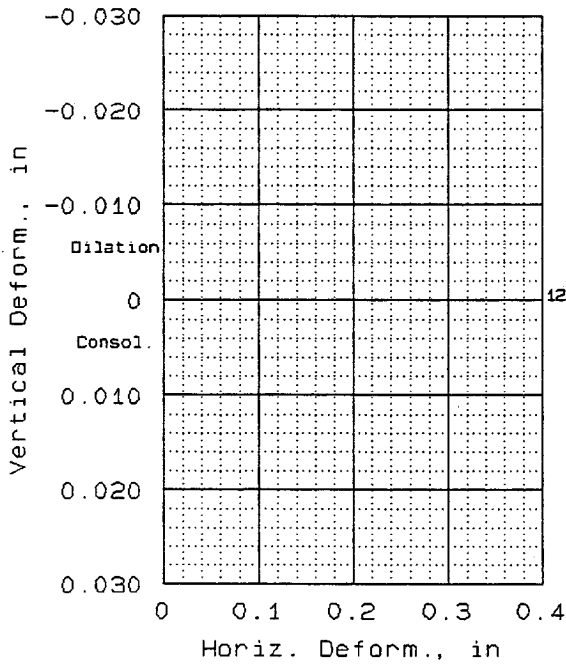
PROJ. NO.: 5810860101 DATE: August 23, 1995

TRIAxIAL COMPRESSION TEST

LAW ENGINEERING, INC.



Client:
 Project: TVA - Gallatin
 Location: Dry Fly Ash Unit 2 Hoppers
 File: 8601E Project No.: 5810860101 Page 2/2 Fig. No. _____



| SAMPLE NO. | | 1 | 2 | 3 |
|---------------------|------------------|-------|-------|-------|
| INITIAL | WATER CONTENT, % | 21.4 | 21.0 | 20.7 |
| | DRY DENSITY, pcf | 75.9 | 77.1 | 77.1 |
| | SATURATION, % | 53.0 | 53.7 | 53.0 |
| | VOID RATIO | 0.966 | 0.935 | 0.935 |
| | DIAMETER, in | 2.50 | 2.50 | 2.50 |
| | HEIGHT, in | 0.81 | 0.81 | 0.81 |
| AT TEST | WATER CONTENT, % | 21.4 | 21.0 | 20.7 |
| | DRY DENSITY, pcf | 75.9 | 77.1 | 77.1 |
| | SATURATION, % | 53.0 | 53.7 | 53.0 |
| | VOID RATIO | 0.966 | 0.935 | 0.935 |
| | DIAMETER, in | 2.50 | 2.50 | 2.50 |
| | HEIGHT, in | 0.81 | 0.81 | 0.81 |
| NORMAL STRESS, ksf | | 0.97 | 1.94 | 3.99 |
| MAX. SHEAR, ksf | | 1.89 | 2.92 | 4.04 |
| 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= 2.39
 REMARKS: Tested by: *AD*

Reviewed by: *RUB*

FIG. NO.

CLIENT:

PROJECT: TVA - Gallatin

SAMPLE LOCATION: Dry Fly Ash
 Unit 2 Hoppers

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

DIRECT SHEAR TEST
LAW ENGINEERING, INC.

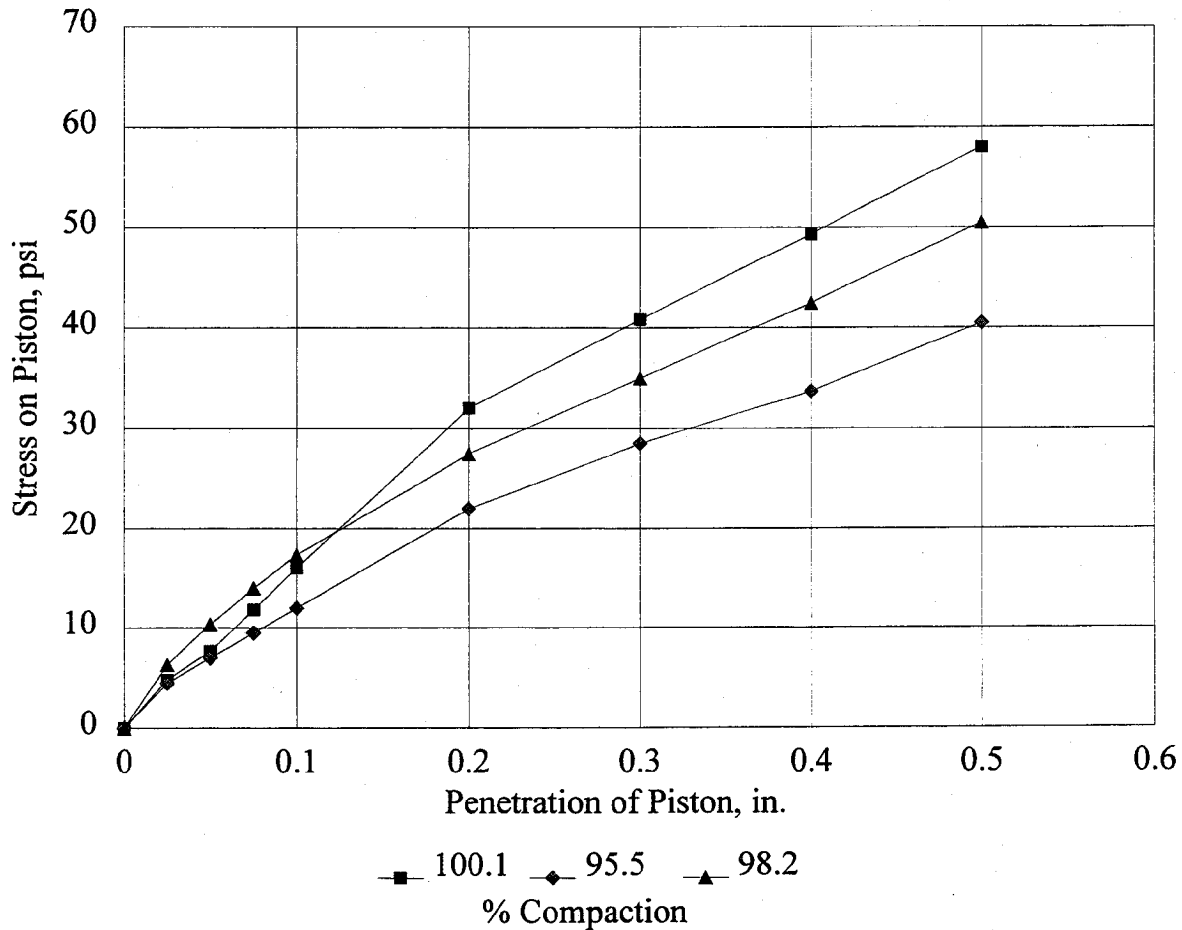
California Bearing Ratio (ASTM D1883-92)



Project No. 5810860101
 Project Name TVA - Gallatin
 Material (Source) Dry fly Ash (Unit 2 Hoppers)

Tested By EM
 Test Date 07/21/95
 Reviewed By RLB
 Review Date 08/16/95

| | | | |
|--------------------------------|-------|------|------|
| Compaction, % | 100.1 | 95.5 | 98.2 |
| Before Soak Dry Density, pcf | 86.7 | 82.7 | 85.1 |
| Before Soak Moisture Content, | 21.0 | 22.0 | 21.7 |
| After Soak Dry Density, pcf | 82.7 | 78.5 | 80.7 |
| After Soak Moisture Content, % | 33.5 | 35.2 | 34.3 |
| CBR @ 0.1 in. | 1.6 | 1.2 | 1.7 |
| CBR @ 0.2 in. | 2.1 | 1.5 | 1.8 |



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

SHEET NO 1 OF 2

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: | <u>Gallatin</u> | |
| 2. | MATERIAL DESCRIPTION: | <u>Dry Fly Ash (Unit 2 Hoppers)</u> | |
| 3. | REMODELING 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 | | 2.87 |
| | 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 | | 6.12 |
| | HEIGHT OF CAP AND BASE, inch | | 0.00 |
| | INITIAL LENGTH, L ₀ , inch | | 6.12 |
| | INITIAL AREA, A ₀ , in ² | | 6.34 |
| | INITIAL VOLUME A ₀ L ₀ , in ³ | | 38.82 |
| 7. | SOIL SPECIMEN WEIGHT: | | |
| | INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams | | 992.30 |
| | FINAL WEIGHT OF CONTAINER AND WET SOIL, grams | | 0.00 |
| | WEIGHT OF WET SOIL USED, grams | | 992.30 |
| 8. | SOIL PROPERTIES.: | | |
| | IN SITU MOISTURE CONTENT (NUCLEAR), % | | N/A |
| | IN SITU WET DENSITY (NUCLEAR), pcf | | N/A |
| | or | | |
| | OPTIMUM MOISTURE CONTENT, % | | 21.4 |
| | MAX. DRY DENSITY, pcf | | 86.6 |
| | 95 % MAX. DRY DENSITY, pcf | | 82.3 |
| 9. | SPECIMEN PROPERTIES: | | |
| | COMPACTION MOISTURE CONTENT, % | | 21.9 |
| | MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, % | | 21.9 |
| | COMPACTION DRY DENSITY, γ _d pcf | | 79.8 |
| 10. | QUICK SHEAR TEST | | |
| | STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO) | | Y |
| | TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi | | 26.5 |
| | 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 | | 07-28-1995 |

GENERAL REMARKS:

SUBMITTED BY, DATE

RT Buchanan 9/5/95
 LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
 LAW PROJECT NO.: 5810860101
 1. MATERIAL SOURCE: Gallatin
 2. MATERIAL DESCRIPTION: Dry Fly Ash (Unit 2 Hoppers)
 3. REMOLDING TARGETS: 95% Standard Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 07-28-1995
 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 _{cylic} | c ₁ | P _{max} | P _{cylic} | P _{contact} | S _{max} | S _{cylic} | 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 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00159 | 0.00159 | 0.00159 | 0.00026 | 6,909 |
| | | | 2 | 12.6 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00159 | 0.00161 | 0.00160 | 0.00026 | 6,870 |
| | | | 3 | 12.6 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00156 | 0.00158 | 0.00157 | 0.00026 | 7,022 |
| | | | 4 | 12.6 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00159 | 0.00161 | 0.00160 | 0.00026 | 6,866 |
| | | | 5 | 12.6 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00157 | 0.00158 | 0.00157 | 0.00026 | 6,989 |
| COLUMN AVERAGE | | | | 12.6 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00158 | 0.00159 | 0.00159 | 0.00026 | 6,931 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00001 | 0.00000 | 70 |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Standard Dry Density at Optimum Moisture Content | | | | |
|------------------|----------------|---|------|------|------|-----|-----|-----|---------|---------|---------|--|---------|-------|--|--|
| SEQUENCE 2 | 6.0 | 4.0 | 1 | 25.5 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00341 | 0.00343 | 0.00342 | 0.00056 | 6,505 | | |
| | | | 2 | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00341 | 0.00342 | 0.00341 | 0.00056 | 6,503 | | |
| | | | 3 | 25.5 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00342 | 0.00340 | 0.00341 | 0.00056 | 6,535 | | |
| | | | 4 | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00343 | 0.00340 | 0.00341 | 0.00056 | 6,503 | | |
| | | | 5 | 25.5 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00344 | 0.00340 | 0.00342 | 0.00056 | 6,524 | | |
| | COLUMN AVERAGE | | 25.5 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00342 | 0.00341 | 0.00342 | 0.00056 | 6,514 | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00001 | 0.00000 | 15 | | |
| SEQUENCE 3 | 6.0 | 6.0 | 1 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00566 | 0.00561 | 0.00563 | 0.00092 | 5,872 | | |
| | | | 2 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00568 | 0.00562 | 0.00565 | 0.00092 | 5,859 | | |
| | | | 3 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00571 | 0.00564 | 0.00567 | 0.00093 | 5,842 | | |
| | | | 4 | 38.0 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00570 | 0.00566 | 0.00568 | 0.00093 | 5,840 | | |
| | | | 5 | 38.0 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00566 | 0.00564 | 0.00565 | 0.00092 | 5,868 | | |
| | COLUMN AVERAGE | | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00568 | 0.00563 | 0.00566 | 0.00092 | 5,856 | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00002 | 0.00000 | 15 | | |
| SEQUENCE 4 | 6.0 | 8.0 | 1 | 50.4 | 45.4 | 5.0 | 7.9 | 7.2 | 0.8 | 0.00791 | 0.00783 | 0.00787 | 0.00129 | 5,567 | | |
| | | | 2 | 50.4 | 45.5 | 5.0 | 8.0 | 7.2 | 0.8 | 0.00794 | 0.00786 | 0.00790 | 0.00129 | 5,557 | | |
| | | | 3 | 50.4 | 45.4 | 5.0 | 7.9 | 7.2 | 0.8 | 0.00794 | 0.00788 | 0.00791 | 0.00129 | 5,543 | | |
| | | | 4 | 50.5 | 45.5 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00791 | 0.00785 | 0.00788 | 0.00129 | 5,576 | | |
| | | | 5 | 50.5 | 45.6 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00792 | 0.00785 | 0.00788 | 0.00129 | 5,581 | | |
| | COLUMN AVERAGE | | 50.4 | 45.5 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00792 | 0.00785 | 0.00789 | 0.00129 | 5,565 | | | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00002 | 0.00000 | 15 | | |

| Source: | Gallatin | Description: | Dry Fly Ash (Unit 2 Hoppers) | 95% Standard Dry Density at Optimum Moisture Content | | | | | | | | | | |
|------------|----------|--------------|------------------------------|--|------|-----|------|-----|-----|---------|---------|---------|---------|-------|
| SEQUENCE 5 | 6.0 | 10.0 | 1 | 63.2 | 57.5 | 5.7 | 10.0 | 9.1 | 0.9 | 0.01005 | 0.00996 | 0.01001 | 0.00163 | 5,544 |
| | | | 2 | 63.1 | 57.3 | 5.8 | 9.9 | 9.0 | 0.9 | 0.01004 | 0.00996 | 0.01000 | 0.00163 | 5,533 |
| | | | 3 | 63.1 | 57.3 | 5.7 | 9.9 | 9.0 | 0.9 | 0.01001 | 0.00991 | 0.00996 | 0.00163 | 5,554 |
| | | | 4 | 63.1 | 57.4 | 5.7 | 10.0 | 9.0 | 0.9 | 0.01006 | 0.00996 | 0.01001 | 0.00163 | 5,534 |
| | | | 5 | 63.1 | 57.4 | 5.7 | 9.9 | 9.0 | 0.9 | 0.01002 | 0.00994 | 0.00998 | 0.00163 | 5,546 |
| | | | | 63.1 | 57.4 | 5.7 | 10.0 | 9.0 | 0.9 | 0.01003 | 0.00995 | 0.00999 | 0.00163 | 5,542 |
| | | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00002 | 0.00000 | 9 |
| SEQUENCE 6 | 4.0 | 2.0 | 1 | 13.1 | 11.5 | 1.5 | 2.1 | 1.8 | 0.2 | 0.00201 | 0.00201 | 0.00201 | 0.00033 | 5,536 |
| | | | 2 | 13.1 | 11.6 | 1.5 | 2.1 | 1.8 | 0.2 | 0.00204 | 0.00201 | 0.00203 | 0.00033 | 5,524 |
| | | | 3 | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.2 | 0.00200 | 0.00199 | 0.00200 | 0.00033 | 5,580 |
| | | | 4 | 13.1 | 11.6 | 1.5 | 2.1 | 1.8 | 0.2 | 0.00198 | 0.00198 | 0.00198 | 0.00032 | 5,640 |
| | | | 5 | 13.1 | 11.5 | 1.5 | 2.1 | 1.8 | 0.2 | 0.00199 | 0.00196 | 0.00197 | 0.00032 | 5,650 |
| | | | | 13.1 | 11.6 | 1.5 | 2.1 | 1.8 | 0.2 | 0.00200 | 0.00199 | 0.00200 | 0.00033 | 5,586 |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00003 | 0.00002 | 0.00002 | 0.00000 | 58 |
| SEQUENCE 7 | 4.0 | 4.0 | 1 | 25.0 | 22.8 | 2.2 | 3.9 | 3.6 | 0.4 | 0.00465 | 0.00461 | 0.00463 | 0.00076 | 4,751 |
| | | | 2 | 25.0 | 22.7 | 2.2 | 3.9 | 3.6 | 0.4 | 0.00468 | 0.00462 | 0.00465 | 0.00076 | 4,718 |
| | | | 3 | 25.0 | 22.8 | 2.2 | 3.9 | 3.6 | 0.3 | 0.00468 | 0.00463 | 0.00466 | 0.00076 | 4,720 |
| | | | 4 | 25.0 | 22.8 | 2.2 | 3.9 | 3.6 | 0.4 | 0.00465 | 0.00465 | 0.00465 | 0.00076 | 4,728 |
| | | | 5 | 24.9 | 22.6 | 2.2 | 3.9 | 3.6 | 0.4 | 0.00466 | 0.00462 | 0.00464 | 0.00076 | 4,712 |
| | | | | 25.0 | 22.7 | 2.2 | 3.9 | 3.6 | 0.4 | 0.00466 | 0.00463 | 0.00465 | 0.00076 | 4,726 |
| | | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 15 |

| Source: | Gallatin | Description: | Dry Fly Ash (Unit 2 Hoppers) | 95% Standard 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 | 0.00735 | 0.00728 | 0.00732 | 0.00120 | 4,525 |
| | | | 2 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00737 | 0.00731 | 0.00734 | 0.00120 | 4,505 |
| | | | 3 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00733 | 0.00728 | 0.00731 | 0.00119 | 4,524 |
| | | | 4 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00737 | 0.00728 | 0.00733 | 0.00120 | 4,502 |
| | | | 5 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00734 | 0.00728 | 0.00731 | 0.00119 | 4,519 |
| | | COLUMN AVERAGE | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00735 | 0.00729 | 0.00732 | 0.00120 | 4,515 | |
| | | STANDARD DEV. | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00001 | 0.00001 | 0.00000 | 11 | |
| SEQUENCE 9 | 4.0 | 8.0 | 1 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00954 | 0.00944 | 0.00949 | 0.00155 | 4,677 |
| | | | 2 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00956 | 0.00946 | 0.00951 | 0.00155 | 4,667 |
| | | | 3 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00954 | 0.00947 | 0.00951 | 0.00155 | 4,670 |
| | | | 4 | 50.9 | 46.0 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00956 | 0.00944 | 0.00950 | 0.00155 | 4,671 |
| | | | 5 | 50.8 | 45.9 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00955 | 0.00945 | 0.00950 | 0.00155 | 4,666 |
| | | COLUMN AVERAGE | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00955 | 0.00945 | 0.00950 | 0.00155 | 4,670 | |
| | | STANDARD DEV. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 4 | |
| SEQUENCE 10 | 4.0 | 10.0 | 1 | 63.2 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01150 | 0.01145 | 0.01147 | 0.00187 | 4,802 |
| | | | 2 | 63.3 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01153 | 0.01139 | 0.01146 | 0.00187 | 4,809 |
| | | | 3 | 63.2 | 57.0 | 6.1 | 10.0 | 9.0 | 1.0 | 0.01153 | 0.01138 | 0.01146 | 0.00187 | 4,803 |
| | | | 4 | 63.1 | 57.0 | 6.1 | 10.0 | 9.0 | 1.0 | 0.01149 | 0.01146 | 0.01147 | 0.00187 | 4,794 |
| | | | 5 | 63.2 | 57.0 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01149 | 0.01139 | 0.01144 | 0.00187 | 4,811 |
| | | COLUMN AVERAGE | 63.2 | 57.0 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01151 | 0.01141 | 0.01146 | 0.00187 | 4,804 | |
| | | STANDARD DEV. | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00004 | 0.00001 | 0.00000 | 7 | |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Standard Dry Density at Optimum Moisture Content | | | | |
|------------------|----------------|---|------|------|-----|-----|-----|-----|---------|---------|---------|--|-------|--|--|--|
| SEQUENCE 11 | 2.0 | 1 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00247 | 0.00246 | 0.00246 | 0.00040 | 4,452 | | | |
| | | 2 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00246 | 0.00246 | 0.00246 | 0.00040 | 4,462 | | | |
| | | 3 | 13.4 | 11.3 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00245 | 0.00244 | 0.00245 | 0.00040 | 4,466 | | | |
| | | 4 | 13.4 | 11.4 | 2.1 | 2.1 | 1.8 | 0.3 | 0.00245 | 0.00243 | 0.00244 | 0.00040 | 4,496 | | | |
| | | 5 | 13.4 | 11.3 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00244 | 0.00244 | 0.00244 | 0.00040 | 4,479 | | | |
| | COLUMN AVERAGE | | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00245 | 0.00245 | 0.00245 | 0.00040 | 4,471 | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 17 | | | |
| SEQUENCE 12 | 2.0 | 1 | 24.6 | 22.3 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00573 | 0.00568 | 0.00570 | 0.00093 | 3,768 | | | |
| | | 2 | 24.5 | 22.2 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00575 | 0.00569 | 0.00572 | 0.00093 | 3,742 | | | |
| | | 3 | 24.6 | 22.2 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00575 | 0.00570 | 0.00573 | 0.00094 | 3,749 | | | |
| | | 4 | 24.6 | 22.2 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00573 | 0.00568 | 0.00570 | 0.00093 | 3,761 | | | |
| | | 5 | 24.5 | 22.2 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00574 | 0.00568 | 0.00571 | 0.00093 | 3,758 | | | |
| | COLUMN AVERAGE | | 24.5 | 22.2 | 2.3 | 3.9 | 3.5 | 0.4 | 0.00574 | 0.00568 | 0.00571 | 0.00093 | 3,755 | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 10 | | | |
| SEQUENCE 13 | 2.0 | 1 | 37.3 | 33.7 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00880 | 0.00870 | 0.00875 | 0.00143 | 3,717 | | | |
| | | 2 | 37.2 | 33.7 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00876 | 0.00869 | 0.00872 | 0.00143 | 3,725 | | | |
| | | 3 | 37.2 | 33.6 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00880 | 0.00871 | 0.00875 | 0.00143 | 3,704 | | | |
| | | 4 | 37.3 | 33.7 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00882 | 0.00871 | 0.00876 | 0.00143 | 3,708 | | | |
| | | 5 | 37.3 | 33.7 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00878 | 0.00870 | 0.00874 | 0.00143 | 3,727 | | | |
| | COLUMN AVERAGE | | 37.3 | 33.7 | 3.6 | 5.9 | 5.3 | 0.6 | 0.00879 | 0.00870 | 0.00875 | 0.00143 | 3,716 | | | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00001 | 0.00002 | 0.00000 | 10 | | | |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | 95% Standard Dry Density at Optimum Moisture Content | | | | | | | |
|------------------|----------------|---|---|------|------|-----|--|-----|-----|---------|---------|---------|---------|-------|
| SEQUENCE 14 | 2.0 | 8.0 | 1 | 50.5 | 45.6 | 4.9 | 8.0 | 7.2 | 0.8 | 0.01112 | 0.01099 | 0.01106 | 0.00181 | 3,981 |
| | | | 2 | 50.4 | 45.5 | 4.9 | 7.9 | 7.2 | 0.8 | 0.01112 | 0.01101 | 0.01107 | 0.00181 | 3,988 |
| | | | 3 | 50.3 | 45.5 | 4.9 | 7.9 | 7.2 | 0.8 | 0.01114 | 0.01102 | 0.01108 | 0.00181 | 3,959 |
| | | | 4 | 50.1 | 45.3 | 4.9 | 7.9 | 7.1 | 0.8 | 0.01114 | 0.01100 | 0.01107 | 0.00181 | 3,945 |
| | | | 5 | 50.2 | 45.3 | 4.9 | 7.9 | 7.1 | 0.8 | 0.01109 | 0.01099 | 0.01104 | 0.00180 | 3,963 |
| | COLUMN AVERAGE | | | 50.3 | 45.4 | 4.9 | 7.9 | 7.2 | 0.8 | 0.01112 | 0.01100 | 0.01106 | 0.00181 | 3,963 |
| | STANDARD DEV. | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00001 | 0.00002 | 0.00000 | 13 |
| SEQUENCE 15 | 2.0 | 10.0 | 1 | 63.0 | 56.9 | 6.1 | 9.9 | 9.0 | 1.0 | 0.01322 | 0.01310 | 0.01316 | 0.00215 | 4,170 |
| | | | 2 | 63.0 | 56.9 | 6.1 | 9.9 | 9.0 | 1.0 | 0.01321 | 0.01308 | 0.01315 | 0.00215 | 4,179 |
| | | | 3 | 63.1 | 56.9 | 6.1 | 9.9 | 9.0 | 1.0 | 0.01322 | 0.01308 | 0.01315 | 0.00215 | 4,180 |
| | | | 4 | 63.1 | 56.9 | 6.1 | 9.9 | 9.0 | 1.0 | 0.01323 | 0.01310 | 0.01317 | 0.00215 | 4,172 |
| | | | 5 | 63.2 | 57.1 | 6.1 | 10.0 | 9.0 | 1.0 | 0.01321 | 0.01309 | 0.01315 | 0.00215 | 4,188 |
| | COLUMN AVERAGE | | | 63.1 | 56.9 | 6.1 | 9.9 | 9.0 | 1.0 | 0.01322 | 0.01309 | 0.01316 | 0.00215 | 4,178 |
| | STANDARD DEV. | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 7 |

SUBMITTED BY, DATE

R. J. Anderson 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: Gallatin
 2. MATERIAL DESCRIPTION: Bottom Ash
 3. REMOLDING TARGETS: 95% Modified Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 08-23-1995

$$M_R = K_1 (S_C)^{K_2} (1+S_3)^{K_5}$$

K1 = 2,427
 K2 = 0.20416
 K5 = 0.61364
 R² = 0.97

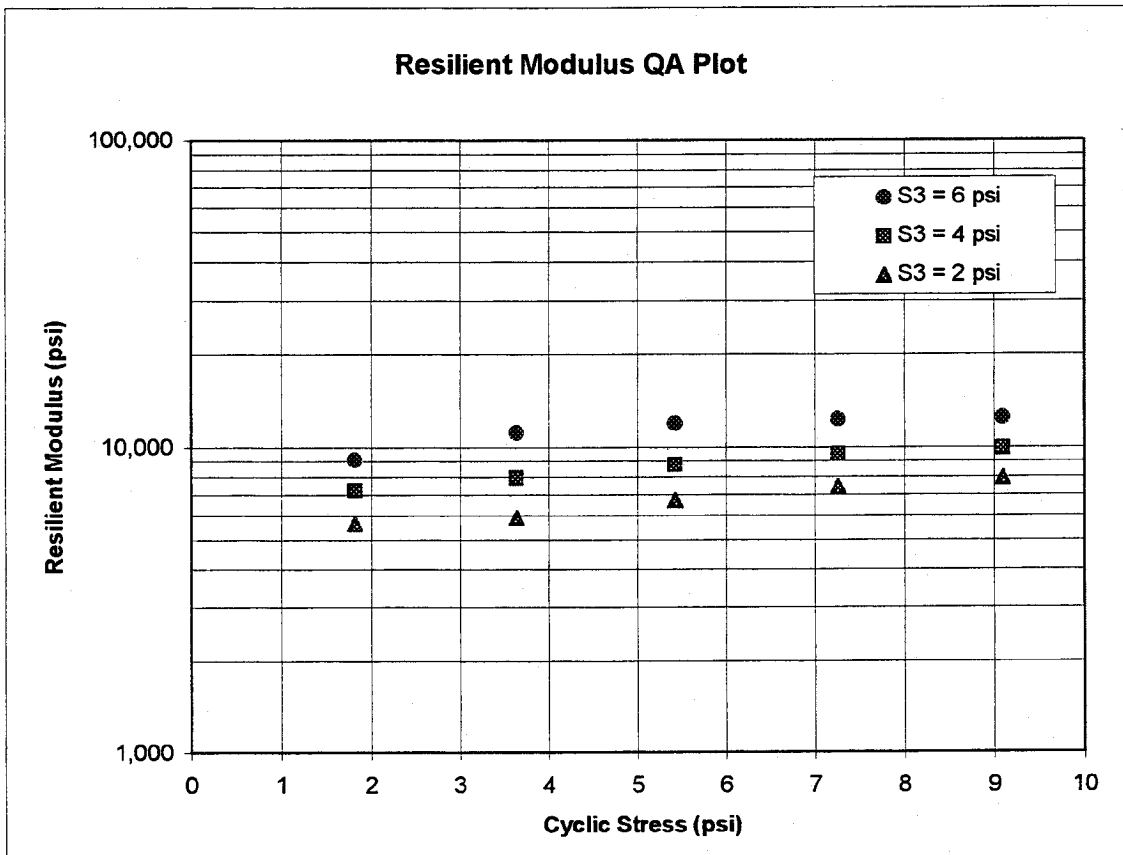


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. MATERIAL SOURCE: Gallatin
2. MATERIAL DESCRIPTION: Bottom Ash
3. REMOLDING TARGETS: 95% Modified Dry Density at Optimum Moisture Content
4. MATERIAL TYPE: 2
5. TEST DATE: 08-23-1995

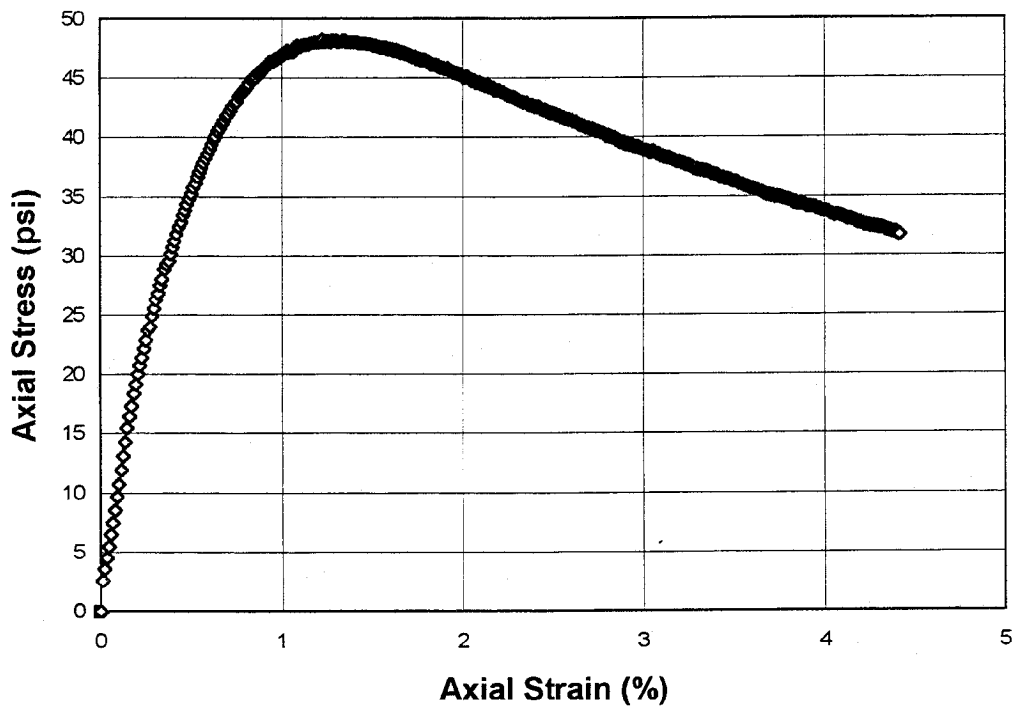
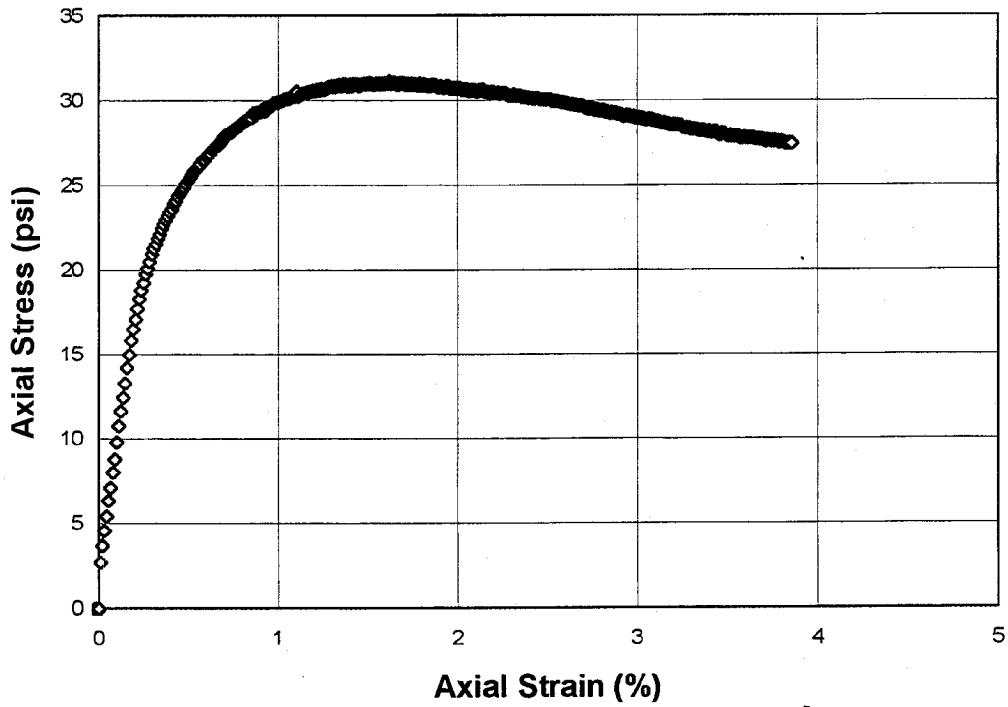


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. MATERIAL SOURCE: Gallatin
2. MATERIAL DESCRIPTION: Bottom Ash
3. REMOLDING TARGETS: 95% Standard Dry Density at Optimum Moisture Content
4. MATERIAL TYPE: 2
5. TEST DATE: 08-23-1995



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

SHEET NO 1 OF 2

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: | Gallatin | | |
| 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 | | | 2.86 |
| | 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 | | | 6.06 |
| | HEIGHT OF CAP AND BASE, inch | | | 0.00 |
| | INITIAL LENGTH, L ₀ , inch | | | 6.06 |
| | INITIAL AREA, A ₀ , in ² | | | 6.31 |
| | INITIAL VOLUME A ₀ L ₀ , in ³ | | | 38.23 |
| 7. | SOIL SPECIMEN WEIGHT: | | | |
| | INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams | | | 1747.40 |
| | FINAL WEIGHT OF CONTAINER AND WET SOIL, grams | | | 600.50 |
| | WEIGHT OF WET SOIL USED, grams | | | 1146.90 |
| 8. | SOIL PROPERTIES.: | | | |
| | IN SITU MOISTURE CONTENT (NUCLEAR), % | | | N/A |
| | IN SITU WET DENSITY (NUCLEAR), pcf | | | N/A |
| | or | | | |
| | OPTIMUM MOISTURE CONTENT, % | | | 20.9 |
| | MAX. DRY DENSITY, pcf | | | 102.5 |
| | 95 % MAX. DRY DENSITY, pcf | | | 97.4 |
| 9. | SPECIMEN PROPERTIES: | | | |
| | COMPACTION MOISTURE CONTENT, % | | | 18.3 |
| | MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, % | | | 18.3 |
| | COMPACTION DRY DENSITY, γ _d pcf | | | 96.5 |
| 10. | QUICK SHEAR TEST | | | |
| | STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO) | | | Y |
| | TRIAxIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi | | | 48.3 |
| | SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO) | | | Y |
| 11. | COMMENTS (Section 10.4 of Protocol P46) | | | |
| | (a) CODE | 0 | 0 | 0 |
| | (b) NOTE | 0 | 0 | 0 |
| 12. | TEST DATE | | | 08-23-1995 |

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Anderson 9/10/95
 LABORATORY MANAGER

Source: Gallatin Description: Bottom Ash

95% Modified Dry Density at Optimum Moisture Content

| SEQUENCE 2 | 6.0 | | 4.0 | | 1 | 25.4 | 23.0 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00205 | 0.00191 | 0.00198 | 0.00033 | 11.166 | | | | |
|----------------|----------------|------|------|------|-----|------|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|---------|---------|--------|
| | 2 | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00206 | 0.00193 | 0.00200 | 0.00033 | 11.084 | | | | | | | | |
| SEQUENCE 3 | 6.0 | | 4.0 | | 3 | 25.3 | 22.9 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00205 | 0.00193 | 0.00199 | 0.00033 | 11.084 | | | | |
| | 4 | 25.3 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00206 | 0.00192 | 0.00199 | 0.00033 | 11.084 | | | | | | | | |
| SEQUENCE 4 | 6.0 | | 4.0 | | 5 | 25.3 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00203 | 0.00193 | 0.00198 | 0.00033 | 11.143 | | | | |
| | COLUMN AVERAGE | 25.3 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00205 | 0.00192 | 0.00199 | 0.00033 | 11.112 | | | | | | | | |
| STANDARD DEV. | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.00001 | | 0.00001 | | 40 | | | | |
| SEQUENCE 3 | 6.0 | | 4.0 | | 1 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00281 | 0.00272 | 0.00277 | 0.00046 | 11.872 | | | | |
| | 2 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00281 | 0.00273 | 0.00277 | 0.00046 | 11.878 | | | | | | | | |
| | 3 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00281 | 0.00272 | 0.00277 | 0.00046 | 11.899 | | | | | | | | |
| | 4 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00281 | 0.00273 | 0.00277 | 0.00046 | 11.897 | | | | | | | | |
| | 5 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00281 | 0.00272 | 0.00277 | 0.00046 | 11.920 | | | | | | | | |
| COLUMN AVERAGE | | 37.9 | | 34.3 | | 3.6 | | 6.0 | | 5.4 | | 0.6 | | 0.00281 | | 0.00273 | | 0.00277 | 0.00046 | 11.893 |
| STANDARD DEV. | | 0.1 | | 0.1 | | 0.0 | | 0.0 | | 0.0 | | 0.00000 | | 0.00001 | | 0.00000 | | 19 | | |
| SEQUENCE 4 | 6.0 | | 8.0 | | 1 | 50.7 | 45.8 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00364 | 0.00354 | 0.00359 | 0.00059 | 12.270 | | | | |
| | 2 | 50.7 | 45.9 | 4.8 | 8.0 | 7.3 | 0.8 | 0.00364 | 0.00356 | 0.00360 | 0.00059 | 12.253 | | | | | | | | |
| | 3 | 50.6 | 45.8 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00363 | 0.00354 | 0.00358 | 0.00059 | 12.276 | | | | | | | | |
| | 4 | 50.7 | 45.8 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00364 | 0.00356 | 0.00360 | 0.00059 | 12.232 | | | | | | | | |
| | 5 | 50.6 | 45.8 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00364 | 0.00355 | 0.00360 | 0.00059 | 12.229 | | | | | | | | |
| COLUMN AVERAGE | | 50.7 | | 45.8 | | 4.9 | | 8.0 | | 7.3 | | 0.8 | | 0.00364 | | 0.00355 | | 0.00359 | 0.00059 | 12.252 |
| STANDARD DEV. | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.00001 | | 0.00001 | | 0.00001 | | 22 | | |

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
 LAW PROJECT NO.: 5810860101
 1. MATERIAL SOURCE: Gallatin
 2. MATERIAL DESCRIPTION: Bottom Ash
 3. REMOLDING TARGETS: 95% Modified Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 08-23-1995
 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 | Recov. Def. LVDT | Average Recov Def. LVDT 1 and 2 | Resilient Strain | Resilient Modulus |
| DESIGNATION | S ₃ | S _{yclic} | C ₁ | P _{max} | P _{yclic} | P _{contact} | S _{max} | S _{yclic} | S _{contact} | H ₁ | H ₂ | H _{avg} | ε _r | M _r |
| 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 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00127 | 0.00116 | 0.00122 | 0.00020 | 9,059 |
| | | | 2 | 12.7 | 11.4 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00126 | 0.00116 | 0.00121 | 0.00020 | 9,073 |
| | | | 3 | 12.7 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00127 | 0.00116 | 0.00121 | 0.00020 | 9,095 |
| | | | 4 | 12.7 | 11.5 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00127 | 0.00116 | 0.00121 | 0.00020 | 9,066 |
| | | 5 | 12.8 | 11.5 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00128 | 0.00116 | 0.00122 | 0.00020 | 9,031 | |
| COLUMN AVERAGE | | | | 12.7 | 11.5 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00127 | 0.00116 | 0.00122 | 0.00020 | 9,065 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 23 |

Source: Gallatin Description: Bottom Ash

95% Modified Dry Density at Optimum Moisture Content

| SEQUENCE 8 | 4.0 | 6.0 | Description: Bottom Ash | | | | | | | | | | | | |
|-------------|----------------|------|-------------------------|------|------|-----|------|-----|-----|---------|---------|---------|---------|-------|----|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| | | | 38.2 | 34.6 | 34.6 | 36 | 6.1 | 5.5 | 0.6 | 0.00384 | 0.00374 | 0.00379 | 0.00063 | 8.781 | |
| | | | 38.2 | 34.6 | 34.6 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00384 | 0.00375 | 0.00379 | 0.00063 | 8.776 | |
| | | | 38.2 | 34.6 | 34.6 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00384 | 0.00377 | 0.00380 | 0.00063 | 8.748 | |
| | | | 38.2 | 34.6 | 34.6 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00384 | 0.00375 | 0.00380 | 0.00063 | 8.750 | |
| | | | 38.2 | 34.6 | 34.6 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00386 | 0.00376 | 0.00381 | 0.00063 | 8.741 | |
| | COLUMN AVERAGE | | 38.2 | 34.6 | 34.6 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00384 | 0.00375 | 0.00380 | 0.00063 | 8.759 | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 18 | |
| SEQUENCE 9 | 4.0 | 8.0 | 51.1 | 46.2 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00475 | 0.00465 | 0.00470 | 0.00078 | 9.450 | |
| | | | 51.0 | 46.2 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00475 | 0.00464 | 0.00469 | 0.00077 | 9.451 | |
| | | | 51.1 | 46.2 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00475 | 0.00463 | 0.00469 | 0.00077 | 9.463 | |
| | | | 51.0 | 46.2 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00474 | 0.00462 | 0.00468 | 0.00077 | 9.484 | |
| | | | 51.0 | 46.1 | 46.1 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00474 | 0.00463 | 0.00469 | 0.00077 | 9.465 | |
| | COLUMN AVERAGE | | 51.0 | 46.2 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00474 | 0.00464 | 0.00469 | 0.00077 | 9.463 | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 13 | |
| SEQUENCE 10 | 4.0 | 10.0 | 63.6 | 57.5 | 57.5 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00569 | 0.00552 | 0.00560 | 0.00092 | 9.866 | |
| | | | 63.7 | 57.6 | 57.6 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00568 | 0.00552 | 0.00560 | 0.00092 | 9.882 | |
| | | | 63.7 | 57.7 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00569 | 0.00554 | 0.00561 | 0.00093 | 9.873 | |
| | | | 63.8 | 57.7 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00570 | 0.00555 | 0.00562 | 0.00093 | 9.860 | |
| | | | 63.8 | 57.7 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00568 | 0.00552 | 0.00560 | 0.00092 | 9.898 | |
| | COLUMN AVERAGE | | 63.7 | 57.6 | 57.6 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00569 | 0.00553 | 0.00561 | 0.00093 | 9.876 | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 15 | |

Source: Gallatin

Description: Bottom Ash

95% Modified Dry Density at Optimum Moisture Content

| | | | | | | | | | | | | | | |
|----------------|-----|------|---|------|------|-----|------|-----|-----|---------|---------|---------|---------|--------|
| SEQUENCE 5 | 6.0 | 10.0 | 1 | 63.5 | 57.4 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00449 | 0.00439 | 0.00444 | 0.00073 | 12.434 |
| | | | 2 | 63.5 | 57.4 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00450 | 0.00437 | 0.00443 | 0.00073 | 12.450 |
| | | | 3 | 63.6 | 57.4 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00449 | 0.00436 | 0.00442 | 0.00073 | 12.478 |
| | | | 4 | 63.5 | 57.3 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00451 | 0.00438 | 0.00444 | 0.00073 | 12.400 |
| | | | 5 | 63.5 | 57.4 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00451 | 0.00438 | 0.00444 | 0.00073 | 12.406 |
| COLUMN AVERAGE | | | | 63.5 | 57.4 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00450 | 0.00437 | 0.00444 | 0.00073 | 12.434 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 32 |
| SEQUENCE 6 | 4.0 | 2.0 | 1 | 13.1 | 11.4 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00155 | 0.00146 | 0.00150 | 0.00025 | 7.309 |
| | | | 2 | 13.1 | 11.4 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00156 | 0.00148 | 0.00152 | 0.00025 | 7.222 |
| | | | 3 | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00156 | 0.00150 | 0.00153 | 0.00025 | 7.213 |
| | | | 4 | 13.1 | 11.5 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00158 | 0.00148 | 0.00153 | 0.00025 | 7.200 |
| | | | 5 | 13.1 | 11.4 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00155 | 0.00148 | 0.00151 | 0.00025 | 7.240 |
| COLUMN AVERAGE | | | | 13.1 | 11.4 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00156 | 0.00148 | 0.00152 | 0.00025 | 7.237 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00001 | 0.00000 | 43 |
| SEQUENCE 7 | 4.0 | 4.0 | 1 | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00283 | 0.00276 | 0.00279 | 0.00046 | 7.936 |
| | | | 2 | 25.4 | 23.0 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00283 | 0.00276 | 0.00280 | 0.00046 | 7.918 |
| | | | 3 | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00283 | 0.00276 | 0.00280 | 0.00046 | 7.903 |
| | | | 4 | 25.4 | 23.0 | 2.4 | 4.0 | 3.7 | 0.4 | 0.00282 | 0.00276 | 0.00279 | 0.00046 | 7.936 |
| | | | 5 | 25.5 | 23.2 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00282 | 0.00276 | 0.00279 | 0.00046 | 7.976 |
| COLUMN AVERAGE | | | | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00283 | 0.00276 | 0.00279 | 0.00046 | 7.934 |
| STANDARD DEV. | | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 27 |

Source: Gallatin Description: Bottom Ash

95% Modified Dry Density at Optimum Moisture Content

| SEQUENCE 14 | 2.0 | 8.0 | 95% Modified Dry Density at Optimum Moisture Content | | | | | | | | | | | |
|-------------|-----|-----|--|------|-----|------|-----|-----|---------|---------|---------|---------|-------|----|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | | | 51.3 | 46.5 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00610 | 0.00596 | 0.00603 | 0.00099 | 7.411 | |
| | | | 51.3 | 46.5 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00609 | 0.00594 | 0.00602 | 0.00099 | 7.427 | |
| | | | 51.2 | 46.4 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00608 | 0.00594 | 0.00601 | 0.00099 | 7.427 | |
| | | | 51.2 | 46.4 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00611 | 0.00593 | 0.00602 | 0.00099 | 7.406 | |
| | | | 51.2 | 46.4 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00610 | 0.00596 | 0.00603 | 0.00099 | 7.402 | |
| | | | 51.3 | 46.4 | 4.8 | 8.1 | 7.4 | 0.8 | 0.00610 | 0.00595 | 0.00602 | 0.00099 | 7.415 | |
| | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 12 | |
| | | | 63.7 | 57.6 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00707 | 0.00686 | 0.00697 | 0.00115 | 7.949 | |
| | | | 63.7 | 57.6 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00707 | 0.00685 | 0.00696 | 0.00115 | 7.958 | |
| | | | 63.7 | 57.6 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00708 | 0.00687 | 0.00697 | 0.00115 | 7.947 | |
| | | | 63.7 | 57.7 | 6.0 | 10.1 | 9.1 | 1.0 | 0.00708 | 0.00687 | 0.00698 | 0.00115 | 7.950 | |
| | | | 63.8 | 57.7 | 6.1 | 10.1 | 9.2 | 1.0 | 0.00707 | 0.00687 | 0.00697 | 0.00115 | 7.959 | |
| | | | 63.7 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00707 | 0.00686 | 0.00697 | 0.00115 | 7.952 | |
| | | | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 5 | |

SUBMITTED BY, DATE
R. R. Anderson 9/10/95
 LABORATORY MANAGER

Source: Gallatin

Description: Bottom Ash

95% Modified Dry Density at Optimum Moisture Content

| SEQUENCE 11 | 2.0 | 2.0 | 1 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00197 | 0.00192 | 0.00195 | 0.00032 | 5.630 |
|-------------|----------------|-----|---|------|------|-----|-----|-----|-----|---------|---------|---------|---------|-------|
| | | | 2 | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00197 | 0.00192 | 0.00194 | 0.00032 | 5.662 |
| | | | 3 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00192 | 0.00194 | 0.00032 | 5.630 |
| | | | 4 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00197 | 0.00193 | 0.00195 | 0.00032 | 5.618 |
| | | | 5 | 13.5 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00192 | 0.00194 | 0.00032 | 5.653 |
| | COLUMN AVERAGE | | | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00192 | 0.00194 | 0.00032 | 5.639 |
| | 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 | 25.7 | 23.3 | 2.3 | 4.1 | 3.7 | 0.4 | 0.00385 | 0.00376 | 0.00381 | 0.00063 | 5.893 |
| | | | 2 | 25.6 | 23.3 | 2.3 | 4.1 | 3.7 | 0.4 | 0.00384 | 0.00378 | 0.00381 | 0.00063 | 5.881 |
| | | | 3 | 25.7 | 23.3 | 2.3 | 4.1 | 3.7 | 0.4 | 0.00384 | 0.00378 | 0.00381 | 0.00063 | 5.884 |
| | | | 4 | 25.7 | 23.3 | 2.4 | 4.1 | 3.7 | 0.4 | 0.00387 | 0.00377 | 0.00382 | 0.00063 | 5.867 |
| | | | 5 | 25.8 | 23.4 | 2.4 | 4.1 | 3.7 | 0.4 | 0.00386 | 0.00378 | 0.00382 | 0.00063 | 5.888 |
| | COLUMN AVERAGE | | | 25.7 | 23.3 | 2.3 | 4.1 | 3.7 | 0.4 | 0.00385 | 0.00377 | 0.00381 | 0.00063 | 5.883 |
| | STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 10 |
| SEQUENCE 13 | 2.0 | 6.0 | 1 | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00507 | 0.00497 | 0.00502 | 0.00083 | 6.716 |
| | | | 2 | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00508 | 0.00499 | 0.00503 | 0.00083 | 6.705 |
| | | | 3 | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00507 | 0.00498 | 0.00503 | 0.00083 | 6.707 |
| | | | 4 | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00507 | 0.00495 | 0.00501 | 0.00083 | 6.730 |
| | | | 5 | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00507 | 0.00495 | 0.00501 | 0.00083 | 6.733 |
| | COLUMN AVERAGE | | | 38.7 | 35.1 | 3.6 | 6.1 | 5.6 | 0.6 | 0.00507 | 0.00497 | 0.00502 | 0.00083 | 6.718 |
| | STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 | 0.00001 | 0.00001 | 0.00000 | 13 |

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: Gallatin
 2. MATERIAL DESCRIPTION: Dry Fly Ash (Unit 2 Hoppers)
 3. REMOLDING TARGETS: 95% Standard Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 07-28-1995

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

K1 = 2,713
 K2 = -0.09930
 K5 = 0.47991
 R² = 0.90

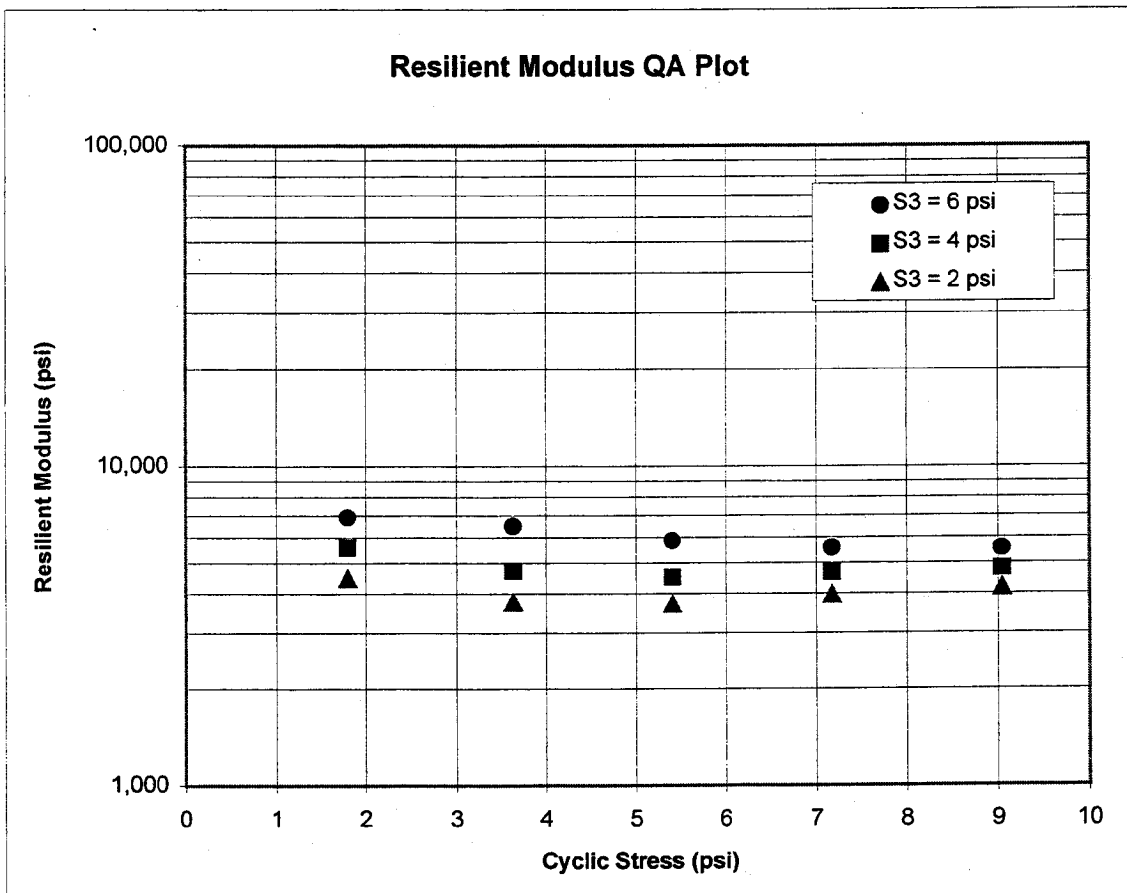
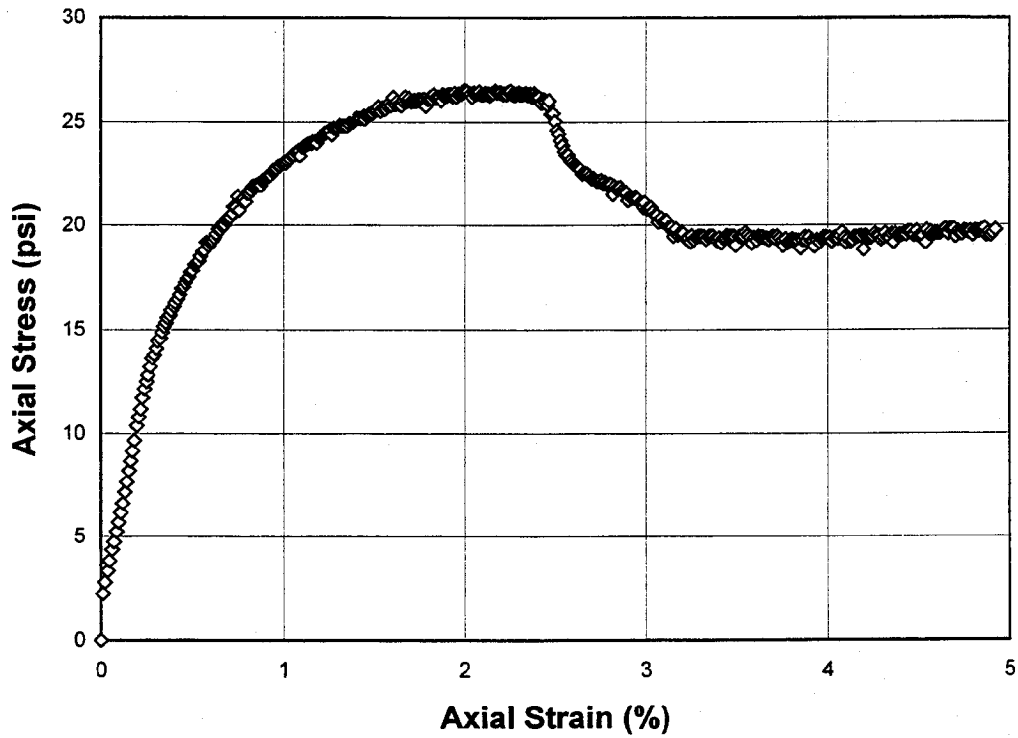


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Gallatin
2. *MATERIAL DESCRIPTION:* Dry Fly Ash (Unit 2 Hoppers)
3. *REMOULDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-28-1995



**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**

SHEET NO 1 OF 2

**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: | <u>Gallatin</u> | |
| 2. | MATERIAL DESCRIPTION: | <u>Dry Fly Ash (Unit 2 Hoppers)</u> | |
| 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 | | 2.86 |
| | 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 | | 6.15 |
| | HEIGHT OF CAP AND BASE, inch | | 0.00 |
| | INITIAL LENGTH, L ₀ , inch | | 6.15 |
| | INITIAL AREA, A ₀ , in ² | | 6.32 |
| | INITIAL VOLUME A ₀ L ₀ , in ³ | | 38.82 |
| 7. | SOIL SPECIMEN WEIGHT: | | |
| | INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams | | 986.30 |
| | FINAL WEIGHT OF CONTAINER AND WET SOIL, grams | | 0.00 |
| | WEIGHT OF WET SOIL USED, grams | | 986.30 |
| 8. | SOIL PROPERTIES.: | | |
| | IN SITU MOISTURE CONTENT (NUCLEAR), % | | N/A |
| | IN SITU WET DENSITY (NUCLEAR), pcf | | N/A |
| | or | | |
| | OPTIMUM MOISTURE CONTENT, % | | 18.8 |
| | MAX. DRY DENSITY, pcf | | 88.9 |
| | 95 % MAX. DRY DENSITY, pcf | | 84.5 |
| 9. | SPECIMEN PROPERTIES: | | |
| | COMPACTION MOISTURE CONTENT, % | | 18.2 |
| | MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, % | | 18.2 |
| | COMPACTION DRY DENSITY, γ _d pcf | | 81.8 |
| 10. | QUICK SHEAR TEST | | |
| | STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO) | | Y |
| | TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi | | 30.5 |
| | 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 | | 07-28-1995 |

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Bouchem 9/5/95
LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
 LAW PROJECT NO.: 5810860101
 1. MATERIAL SOURCE: Gallatin
 2. MATERIAL DESCRIPTION: Dry Fly Ash (Unit 2 Hoppers)
 3. REMOLDING TARGETS: 95% Modified Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 07-28-1995
 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 _j | S _{axial} | 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 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00131 | 0.00130 | 0.00131 | 0.00021 | 8,547 |
| | | | 2 | 12.7 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00132 | 0.00132 | 0.00132 | 0.00022 | 8,443 |
| | | | 3 | 12.6 | 11.5 | 1.1 | 2.0 | 1.8 | 0.2 | 0.00131 | 0.00132 | 0.00132 | 0.00021 | 8,469 |
| | | | 4 | 12.6 | 11.5 | 1.1 | 2.0 | 1.8 | 0.2 | 0.00129 | 0.00131 | 0.00130 | 0.00021 | 8,585 |
| | | | 5 | 12.6 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00132 | 0.00133 | 0.00132 | 0.00022 | 8,443 |
| COLUMN AVERAGE | | | | 12.6 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00131 | 0.00132 | 0.00131 | 0.00021 | 8,498 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 65 |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Modified 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 | 0.00281 | 0.00282 | 0.00281 | 0.00046 | 7,897 | | |
| | | | 2 | 25.1 | 22.8 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00282 | 0.00281 | 0.00281 | 0.00046 | 7,899 | | |
| | | | 3 | 25.2 | 22.9 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00282 | 0.00282 | 0.00282 | 0.00046 | 7,892 | | |
| | | | 4 | 25.1 | 22.8 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00279 | 0.00282 | 0.00280 | 0.00046 | 7,911 | | |
| | | | 5 | 25.1 | 22.8 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00278 | 0.00279 | 0.00278 | 0.00045 | 7,987 | | |
| | COLUMN AVERAGE | | | 25.1 | 22.8 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00280 | 0.00281 | 0.00281 | 0.00046 | 7,917 | | |
| | STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00001 | 0.00001 | 0.00000 | 40 | | |
| SEQUENCE 3 | 6.0 | 6.0 | 1 | 37.9 | 34.3 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00473 | 0.00476 | 0.00475 | 0.00077 | 7,029 | | |
| | | | 2 | 37.9 | 34.2 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00473 | 0.00477 | 0.00475 | 0.00077 | 7,016 | | |
| | | | 3 | 37.8 | 34.2 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00471 | 0.00475 | 0.00473 | 0.00077 | 7,033 | | |
| | | | 4 | 37.7 | 34.1 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00470 | 0.00473 | 0.00472 | 0.00077 | 7,031 | | |
| | | | 5 | 37.8 | 34.1 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00472 | 0.00474 | 0.00473 | 0.00077 | 7,022 | | |
| | COLUMN AVERAGE | | | 37.8 | 34.2 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00472 | 0.00475 | 0.00473 | 0.00077 | 7,026 | | |
| | STANDARD DEV. | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 7 | | |
| SEQUENCE 4 | 6.0 | 8.0 | 1 | 50.4 | 45.5 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00663 | 0.00666 | 0.00664 | 0.00108 | 6,659 | | |
| | | | 2 | 50.4 | 45.5 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00663 | 0.00666 | 0.00664 | 0.00108 | 6,660 | | |
| | | | 3 | 50.4 | 45.5 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00661 | 0.00669 | 0.00665 | 0.00108 | 6,652 | | |
| | | | 4 | 50.4 | 45.4 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00663 | 0.00669 | 0.00666 | 0.00108 | 6,639 | | |
| | | | 5 | 50.4 | 45.4 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00663 | 0.00669 | 0.00666 | 0.00108 | 6,643 | | |
| | COLUMN AVERAGE | | | 50.4 | 45.4 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00663 | 0.00668 | 0.00665 | 0.00108 | 6,651 | | |
| | STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00001 | 0.00000 | 9 | | |

| Source: | Gallatin | Description: | Dry Fly Ash (Unit 2 Hoppers) | 95% Modified Dry Density at Optimum Moisture Content | | | | | | | | | | |
|------------|----------|--------------|------------------------------|--|------|-----|------|-----|-----|---------|---------|---------|---------|-------|
| SEQUENCE 5 | 6.0 | 10.0 | 1 | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00835 | 0.00838 | 0.00837 | 0.00136 | 6,621 |
| | | | 2 | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00837 | 0.00838 | 0.00838 | 0.00136 | 6,611 |
| | | | 3 | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00837 | 0.00840 | 0.00838 | 0.00136 | 6,609 |
| | | | 4 | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00837 | 0.00840 | 0.00838 | 0.00136 | 6,606 |
| | | | 5 | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00837 | 0.00840 | 0.00838 | 0.00136 | 6,610 |
| | | | | 63.1 | 56.9 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00837 | 0.00839 | 0.00838 | 0.00136 | 6,611 |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 6 |
| SEQUENCE 6 | 4.0 | 2.0 | 1 | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00158 | 0.00162 | 0.00160 | 0.00026 | 7,031 |
| | | | 2 | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00157 | 0.00162 | 0.00160 | 0.00026 | 7,002 |
| | | | 3 | 13.2 | 11.6 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00160 | 0.00166 | 0.00163 | 0.00026 | 6,959 |
| | | | 4 | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00159 | 0.00162 | 0.00160 | 0.00026 | 6,964 |
| | | | 5 | 13.0 | 11.4 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00159 | 0.00164 | 0.00161 | 0.00026 | 6,898 |
| | | | | 13.1 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00159 | 0.00163 | 0.00161 | 0.00026 | 6,971 |
| | | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00001 | 0.00000 | 50 |
| SEQUENCE 7 | 4.0 | 4.0 | 1 | 25.3 | 23.0 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00377 | 0.00380 | 0.00378 | 0.00062 | 5,926 |
| | | | 2 | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00377 | 0.00380 | 0.00378 | 0.00062 | 5,940 |
| | | | 3 | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00377 | 0.00382 | 0.00380 | 0.00062 | 5,920 |
| | | | 4 | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00378 | 0.00380 | 0.00379 | 0.00062 | 5,931 |
| | | | 5 | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00378 | 0.00379 | 0.00379 | 0.00062 | 5,931 |
| | | | | 25.4 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00377 | 0.00380 | 0.00379 | 0.00062 | 5,930 |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 7 |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Modified Dry Density at Optimum Moisture Content | | | | |
|------------------|-----|---|----------------|------|------|------|------|------|-----|---------|---------|--|---------|---------|-------|--|
| SEQUENCE 8 | 4.0 | 6.0 | 1 | 37.7 | 34.0 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00600 | 0.00605 | 0.00603 | 0.00098 | 5,494 | | |
| | | | 2 | 37.7 | 34.1 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00601 | 0.00605 | 0.00603 | 0.00098 | 5,496 | | |
| | | | 3 | 37.7 | 34.0 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00599 | 0.00604 | 0.00601 | 0.00098 | 5,501 | | |
| | | | 4 | 37.7 | 34.0 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00602 | 0.00605 | 0.00604 | 0.00098 | 5,487 | | |
| | | | 5 | 37.7 | 34.0 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00601 | 0.00606 | 0.00604 | 0.00098 | 5,486 | | |
| | | | COLUMN AVERAGE | | 37.7 | 34.0 | 3.7 | 6.0 | 5.4 | 0.6 | 0.00601 | 0.00605 | 0.00603 | 0.00098 | 5,493 | |
| | | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 6 | | |
| SEQUENCE 9 | 4.0 | 8.0 | 1 | 50.7 | 45.8 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00794 | 0.00795 | 0.00794 | 0.00129 | 5,611 | | |
| | | | 2 | 50.6 | 45.6 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00790 | 0.00793 | 0.00792 | 0.00129 | 5,612 | | |
| | | | 3 | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00792 | 0.00796 | 0.00794 | 0.00129 | 5,602 | | |
| | | | 4 | 50.7 | 45.8 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00792 | 0.00795 | 0.00794 | 0.00129 | 5,610 | | |
| | | | 5 | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00789 | 0.00793 | 0.00791 | 0.00129 | 5,624 | | |
| | | | COLUMN AVERAGE | | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00792 | 0.00794 | 0.00793 | 0.00129 | 5,612 | |
| | | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00001 | 0.00002 | 0.00000 | 8 | | |
| SEQUENCE 10 | 4.0 | 10.0 | 1 | 63.5 | 57.3 | 6.2 | 10.1 | 9.1 | 1.0 | 0.00959 | 0.00964 | 0.00962 | 0.00156 | 5,800 | | |
| | | | 2 | 63.4 | 57.2 | 6.2 | 10.0 | 9.1 | 1.0 | 0.00959 | 0.00963 | 0.00961 | 0.00156 | 5,795 | | |
| | | | 3 | 63.4 | 57.2 | 6.2 | 10.0 | 9.1 | 1.0 | 0.00958 | 0.00966 | 0.00962 | 0.00156 | 5,788 | | |
| | | | 4 | 63.3 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00957 | 0.00964 | 0.00961 | 0.00156 | 5,786 | | |
| | | | 5 | 63.3 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.00958 | 0.00962 | 0.00960 | 0.00156 | 5,790 | | |
| | | | COLUMN AVERAGE | | 63.4 | 57.2 | 6.2 | 10.0 | 9.1 | 1.0 | 0.00958 | 0.00964 | 0.00961 | 0.00156 | 5,792 | |
| | | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 5 | | |

| Source: Gallatin | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Modified Dry Density at Optimum Moisture Content | | | | | | | | | |
|------------------|---|-----|------|------|------|-----|-----|-----|-----|---------|--|---------|---------|-------|--|--|--|--|--|--|
| SEQUENCE 11 | 2.0 | 2.0 | 11.4 | 13.5 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00199 | 0.00197 | 0.00032 | 5,639 | | | | | | |
| | | | 11.4 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00199 | 0.00197 | 0.00032 | 5,603 | | | | | | |
| | | | 11.4 | 13.5 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00198 | 0.00197 | 0.00032 | 5,649 | | | | | | |
| | | | 11.4 | 13.5 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00195 | 0.00198 | 0.00196 | 0.00032 | 5,668 | | | | | | |
| | | | 11.4 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00197 | 0.00200 | 0.00199 | 0.00032 | 5,607 | | | | | | |
| | COLUMN AVERAGE | | 11.4 | 13.4 | 11.4 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00196 | 0.00199 | 0.00197 | 0.00032 | 5,633 | | | | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 28 | | | | | | |
| SEQUENCE 12 | 2.0 | 4.0 | 22.5 | 24.8 | 22.5 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00464 | 0.00467 | 0.00466 | 0.00076 | 4,705 | | | | | | |
| | | | 22.6 | 24.9 | 22.6 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00463 | 0.00469 | 0.00466 | 0.00076 | 4,709 | | | | | | |
| | | | 22.6 | 24.9 | 22.6 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00464 | 0.00468 | 0.00466 | 0.00076 | 4,709 | | | | | | |
| | | | 22.6 | 24.9 | 22.6 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00465 | 0.00469 | 0.00467 | 0.00076 | 4,713 | | | | | | |
| | | | 22.6 | 24.9 | 22.6 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00467 | 0.00469 | 0.00468 | 0.00076 | 4,703 | | | | | | |
| | COLUMN AVERAGE | | 22.6 | 24.9 | 22.6 | 2.3 | 3.9 | 3.6 | 0.4 | 0.00465 | 0.00468 | 0.00467 | 0.00076 | 4,708 | | | | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 4 | | | | | | |
| SEQUENCE 13 | 2.0 | 6.0 | 34.1 | 37.7 | 34.1 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00721 | 0.00724 | 0.00722 | 0.00118 | 4,595 | | | | | | |
| | | | 34.1 | 37.7 | 34.1 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00721 | 0.00725 | 0.00723 | 0.00118 | 4,594 | | | | | | |
| | | | 34.3 | 37.9 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00723 | 0.00727 | 0.00725 | 0.00118 | 4,600 | | | | | | |
| | | | 34.2 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00724 | 0.00728 | 0.00726 | 0.00118 | 4,593 | | | | | | |
| | | | 34.1 | 37.7 | 34.1 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00724 | 0.00728 | 0.00726 | 0.00118 | 4,580 | | | | | | |
| | COLUMN AVERAGE | | 34.2 | 37.8 | 34.2 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00723 | 0.00726 | 0.00724 | 0.00118 | 4,593 | | | | | | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00002 | 0.00000 | 8 | | | | | | |

| Source: Gallatin | | Description: Dry Fly Ash (Unit 2 Hoppers) | | | | | | | | | | 95% Modified Dry Density at Optimum Moisture Content | | | | | | | | | |
|------------------|-----|---|---|------|------|-----|------|-----|-----|---------|---------|--|---------|-------|--|--|--|--|--|--|--|
| SEQUENCE 14 | 2.0 | 8.0 | 1 | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00925 | 0.00929 | 0.00927 | 0.00151 | 4,801 | | | | | | | |
| | | | 2 | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00922 | 0.00927 | 0.00924 | 0.00150 | 4,815 | | | | | | | |
| | | | 3 | 50.5 | 45.6 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00921 | 0.00925 | 0.00923 | 0.00150 | 4,811 | | | | | | | |
| | | | 4 | 50.5 | 45.7 | 4.8 | 8.0 | 7.2 | 0.8 | 0.00926 | 0.00928 | 0.00927 | 0.00151 | 4,798 | | | | | | | |
| | | | 5 | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00924 | 0.00928 | 0.00926 | 0.00151 | 4,804 | | | | | | | |
| | | | | 50.6 | 45.7 | 4.9 | 8.0 | 7.2 | 0.8 | 0.00924 | 0.00927 | 0.00925 | 0.00151 | 4,806 | | | | | | | |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00002 | 0.00000 | 7 | | | | | | | |
| SEQUENCE 15 | 2.0 | 10.0 | 1 | 63.2 | 57.0 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01092 | 0.01100 | 0.01096 | 0.00178 | 5,065 | | | | | | | |
| | | | 2 | 63.3 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01091 | 0.01096 | 0.01094 | 0.00178 | 5,081 | | | | | | | |
| | | | 3 | 63.3 | 57.1 | 6.1 | 10.0 | 9.0 | 1.0 | 0.01093 | 0.01097 | 0.01095 | 0.00178 | 5,080 | | | | | | | |
| | | | 4 | 63.2 | 57.0 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01093 | 0.01098 | 0.01096 | 0.00178 | 5,065 | | | | | | | |
| | | | 5 | 63.2 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01095 | 0.01099 | 0.01097 | 0.00178 | 5,063 | | | | | | | |
| | | | | 63.2 | 57.1 | 6.2 | 10.0 | 9.0 | 1.0 | 0.01093 | 0.01098 | 0.01095 | 0.00178 | 5,071 | | | | | | | |
| | | | | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00002 | 0.00001 | 0.00000 | 9 | | | | | | | |

SUBMITTED BY, DATE

RS Buchanan 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: Gallatin
 2. MATERIAL DESCRIPTION: Dry Fly Ash (Unit 2 Hoppers)
 3. REMOLDING TARGETS: 95% Modified Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 07-28-1995

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

$$K1 = \frac{3,602}{\quad}$$

$$K2 = \frac{-0.12389}{\quad}$$

$$K5 = \frac{0.45133}{\quad}$$

$$R^2 = \frac{0.90}{\quad}$$

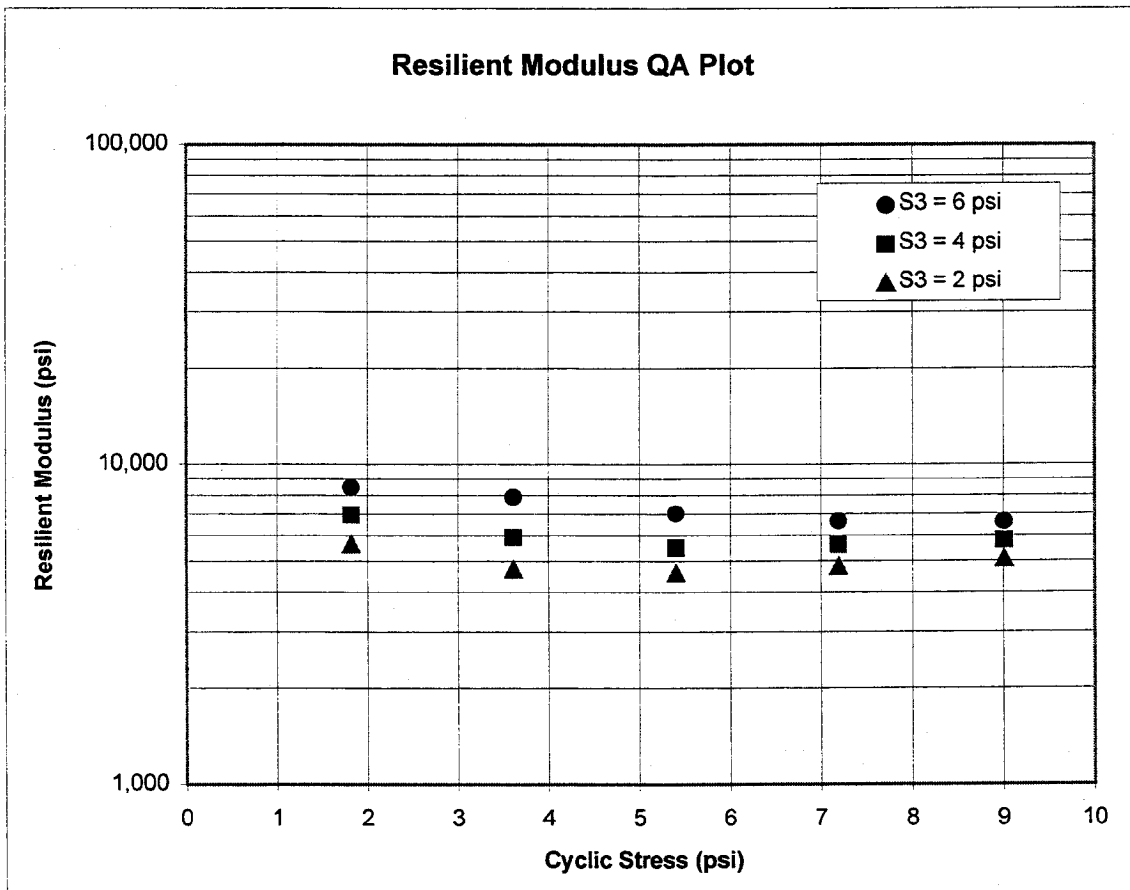
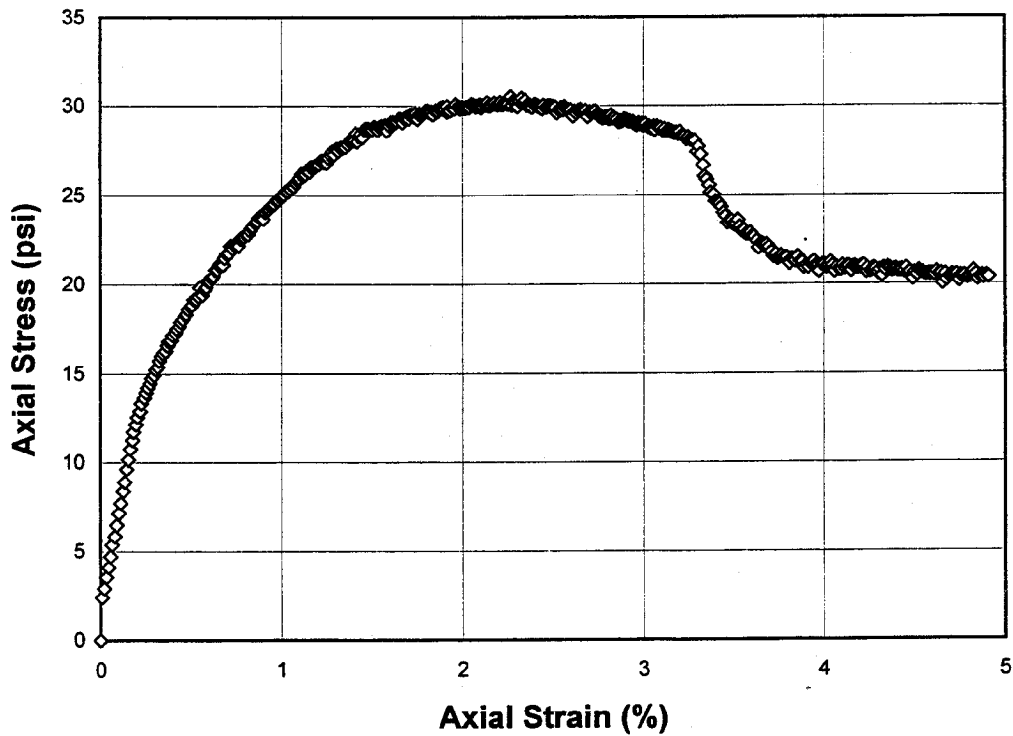


FIGURE 2 - Quick Shear Stress vs Strain

| | |
|---------------------------------|--|
| <i>PROJECT NAME:</i> | <u>TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study</u> |
| <i>LAW PROJECT NO.:</i> | <u>5810860101</u> |
| 1. <i>MATERIAL SOURCE:</i> | <u>Gallatin</u> |
| 2. <i>MATERIAL DESCRIPTION:</i> | Dry Fly Ash (Unit 2 Hoppers) |
| 3. <i>REMOLDING TARGETS:</i> | 95% Modified Dry Density at Optimum Moisture Content |
| 4. <i>MATERIAL TYPE</i> | 2 |
| 5. <i>TEST DATE</i> | 07-28-1995 |





GALLATIN

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)

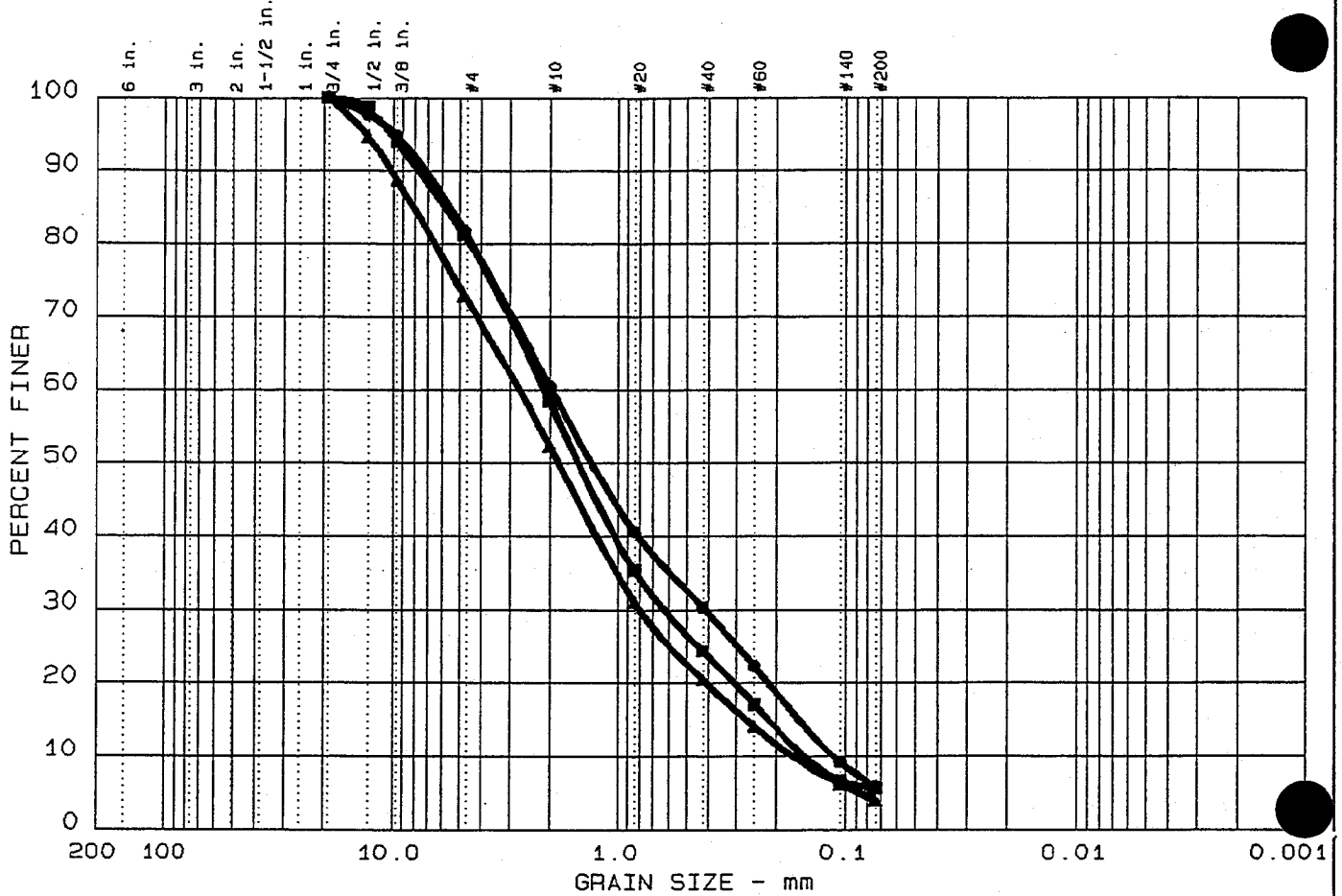


**TVA - GALLATIN
BOTTOM ASH - FROM POND**

| Description | Test Method | Property | Sample 1 | Sample 2 | Sample 3 |
|---|--------------|---|---------------|-------------------------|----------------------------|
| Grain Size | ASTM D 422 | Percent Retained on the #4 Sieve | 18.2 | 27.0 | 18.8 |
| | | Percent Passing the #200 Sieve | 5.9 | 4.0 | 5.6 |
| Atterberg Limits | ASTM D 4318 | Liquid Limit | NL | NL | NL |
| | | Plastic Limit | NP | NP | NP |
| | | Plasticity Index | N/A | N/A | N/A |
| Specific Gravity | ASTM D 854 | Specific Gravity at 20°C | 2.56 | 2.57 | 2.52 |
| Classification | ASTM D 2487 | Unified Soil Classification System (USCS) | SP-SM | SW | SW-SM |
| | AASHTO M 145 | AASHTO Classification | A-1-b | A-1-b | A-1-b |
| Composite Sample | | | | | |
| Moisture-Density Relations (Standard Effort) | ASTM D 698 | Maximum Dry Density, pcf | 92.0 | | |
| | | Optimum Moisture Content, % | 25.5 | | |
| Moisture-Density Relations (Modified Effort) | ASTM D 1557 | Maximum Dry Density, pcf | 102.5 | | |
| | | Optimum Moisture Content, % | 20.9 | | |
| Relative Density | ASTM D 4254 | Minimum Dry Density, pcf | 71.3 | | |
| | ASTM D 4253 | Maximum Dry Density (Dry Method), pcf | 90.7 | | |
| Hydraulic Conductivity | ASTM D 2434 | Hydraulic Conductivity, cm/sec | Result | Dry Density, pcf | Moisture Content, % |
| | | | 2.9E-2 | 82.7 | 0.0 |
| Angle of Repose | LAW TP6 | Angle of Repose, degrees | 31.8 | 71.3 | 0.0 |
| California Bearing Ratio | ASTM D 1883 | CBR, % | 30 | 86.2 | 24.4 |
| Resilient Modulus (Standard Compactive Effort) | SHRP P46 | Resilient Modulus at 4psi axial stress and 4psi confining pressure | 6,545 | 88.0 | 22.7 |
| Resilient Modulus (Modified Compactive Effort) | SHRP P46 | Resilient Modulus at 4psi axial stress and 4psi confining pressure | 7,541 | 96.5 | 18.3 |
| Soil Resistivity | AASHTO T 288 | Minimum Resistivity, Ohm-cm | 1,600 | | |
| pH of Soil | AASHTO T 289 | pH | 2.8 | | |
| Water Soluble Sulfate Ion | AASHTO T 290 | Sulfate Ion Content, mg/kg | 1660 | | |
| Water Soluble Chloride Ion | AASHTO T 290 | Chloride Ion Content, mg/kg | <10 | | |

gaf-ba.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



| Test | % +3" | % GRAVEL | % SAND | % SILT | % CLAY |
|------|-------|----------|--------|--------|--------|
| ● 9 | 0.0 | 18.2 | 75.9 | 5.9 | |
| ▲ 10 | 0.0 | 27.0 | 69.0 | 4.0 | |
| ■ 11 | 0.0 | 18.8 | 75.6 | 5.6 | |

| | LL | PI | D ₈₅ | D ₆₀ | D ₅₀ | D ₃₀ | D ₁₅ | D ₁₀ | C _c | C _u |
|---|----|----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
| ● | NL | NP | 5.50 | 1.95 | 1.30 | 0.412 | 0.1585 | 0.1109 | 0.79 | 17.6 |
| ▲ | NL | NP | 8.04 | 2.72 | 1.82 | 0.794 | 0.2692 | 0.1679 | 1.38 | 16.2 |
| ■ | NL | NP | 5.75 | 2.11 | 1.50 | 0.624 | 0.2163 | 0.1496 | 1.23 | 14.1 |

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

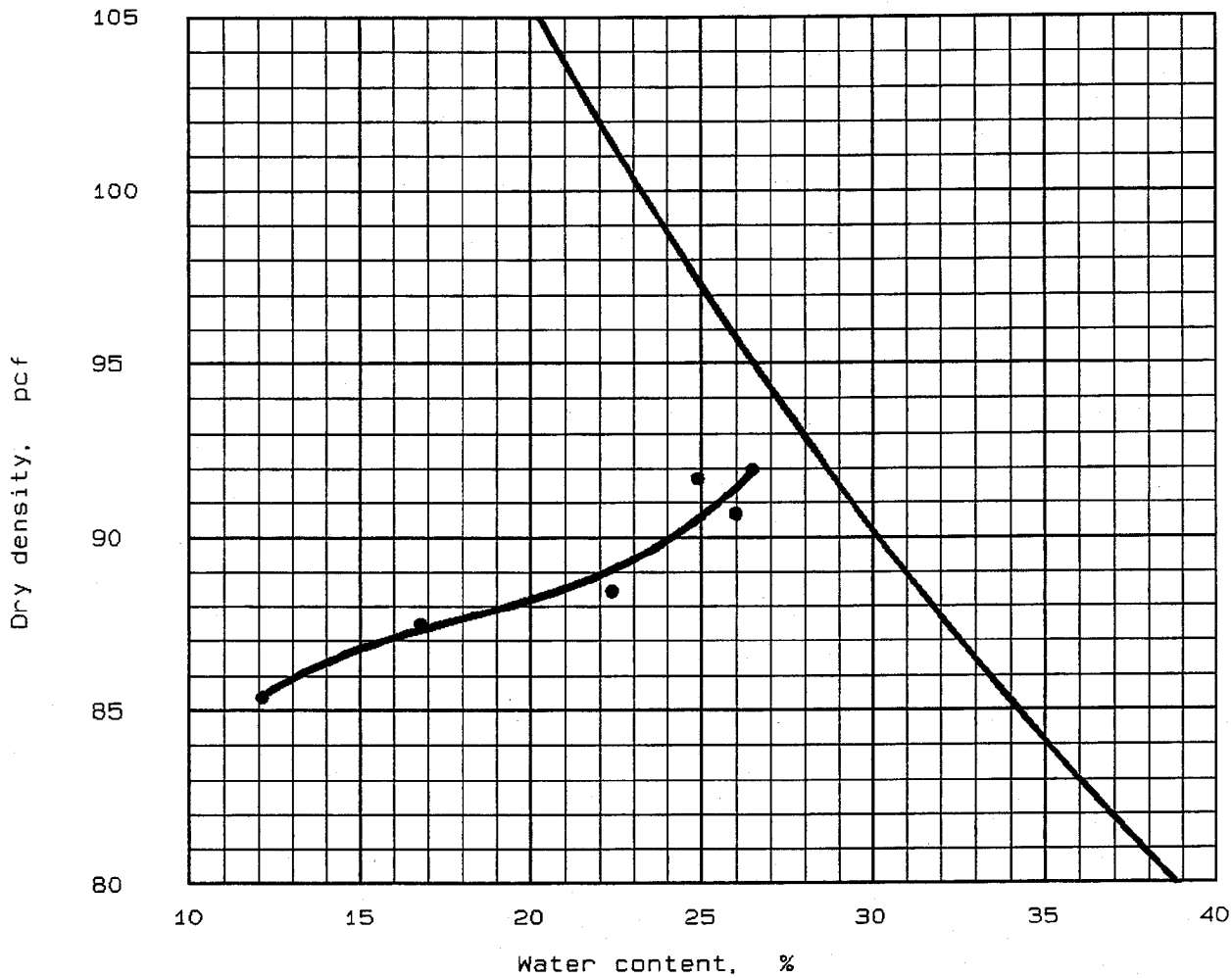
Project No.: 5810860101
 Project: TVA - Gallatin
 ● Location: Bottom Ash A & B
 ▲ Location: Bottom Ash C & D
 ■ Location: Bottom Ash E & F
 Date: July 18, 1995

Remarks:
 Tested by: JCE
 Reviewed by: HS

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

MOISTURE-DENSITY RELATIONSHIP



ZAV for
Sp.G. =
2.55

"Standard" Proctor, ASTM D 698, Method A

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|----------------|----------------|--------|----------------|-------|----|----|-------------|---------------|
| | USCS | AASHTO | | | | | | |
| | SP-SM/SW/SWSM | A-1-b | 12.2 % | 2.55 | NL | NP | 21.3 % | 5.17 % |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|----------------------|
| Optimum moisture = 25.5 % Maximum dry density = 92.0 pcf | |

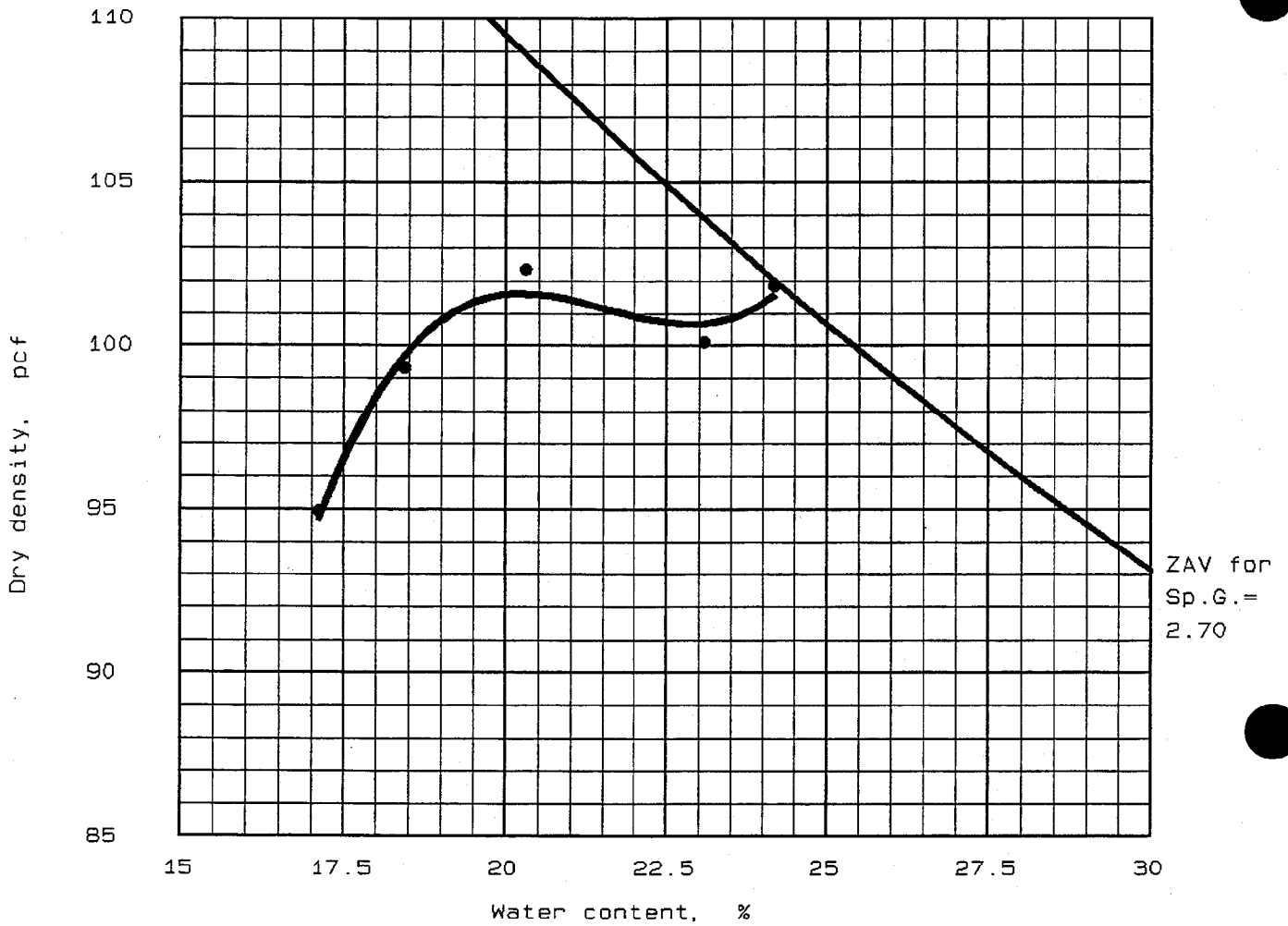
Project No.: 5810860101
 Project: TVA - Gallatin
 Location: Bottom Ash
 Date: July 25, 1995

Remarks:
 Tested by: *JCB*
 Reviewed by: *AK*

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 | | | | | | |
| | SP-SM/SW/SWSM | A-1-b | 12.2 % | 2.70 | NL | NP | 21.3 % | 5.7 % |

| TEST RESULTS | MATERIAL DESCRIPTION |
|--|----------------------|
| Optimum moisture = 20.2 % Maximum dry density = 101.6 pcf | |

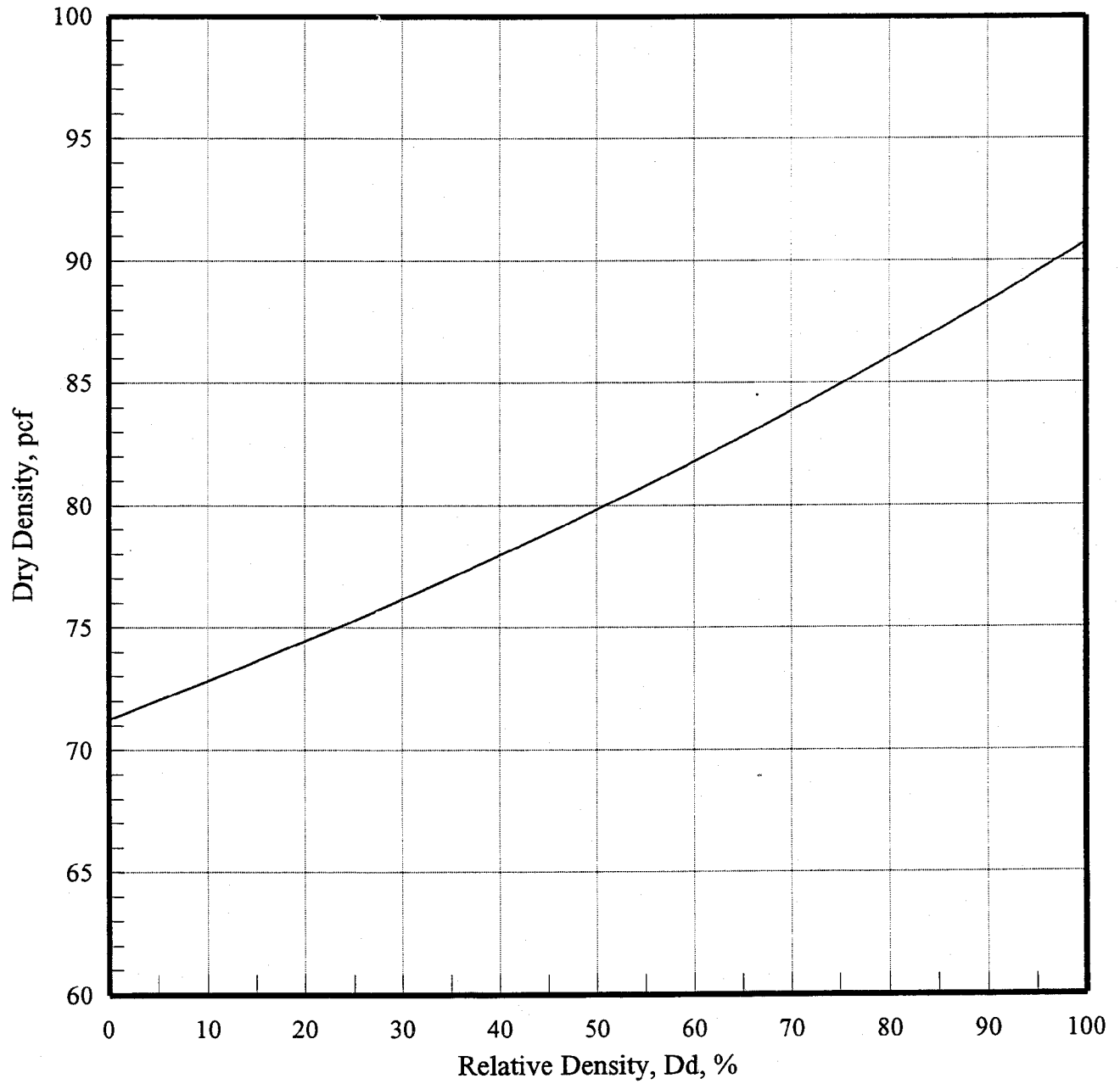
| | |
|---|---|
| Project No.: 5810860101 Project: TVA - Gallatin Location: Bottom Ash Date: July 25, 1995 | Remarks: Tested by: <i>JCB</i> Reviewed by: <i>HS</i> |
|---|---|

| | |
|---|------------------|
| MOISTURE-DENSITY RELATIONSHIP LAW ENGINEERING, INC. | Figure No. _____ |
|---|------------------|

Relative Density Test

TVA - Gallatin, Bottom Ash

Law Project No. 5810860101



HYDRAULIC CONDUCTIVITY



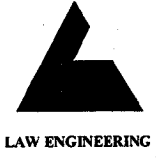
Project No. **5810860101**
Project Name **TVA - Gallatin**
Material **Bottom Ash**

Tested By **JCR**
Test Date **08/17/95**
Reviewed By **RLB**
Review Date **09/06/95**

ASTM D2434-68 Constant Head Permeability

| | |
|--|-----------------------|
| Sample Type: | <i>Remolded</i> |
| Sample Orientation: | <i>Vertical</i> |
| Initial Water Content, %: | <i>0.0</i> |
| Wet Unit Weight, pcf: | <i>82.7</i> |
| Dry Unit Weight, pcf: | <i>82.7</i> |
| Compaction, %: | <i>89.9</i> |
| Hydraulic Conductivity, cm/sec. @20° C: | <i>2.9E-02</i> |

PERMEABILITY TEST - Constant Head
(ASTM D2434 - 68)



Project No. 5810860101
 Project Name TVA - Gallatin
 Material Bottom Ash

Tested By JCR
 Test Date 08/17/95
 Reviewed By RLB
 Review Date 09/06/95

Sample Data

| Length, in | | Diameter, in | | Pan No. | | |
|------------|-------|--------------|-----------------------------|-----------------------|------------------|------|
| Location 1 | 5.294 | Location 1 | 2.858 | Wet Soil + Pan, grams | 742.10 | |
| Location 2 | 5.292 | Location 2 | 2.875 | Dry Soil+Pan, grams | 742.10 | |
| Location 3 | 5.303 | Location 3 | 2.868 | Pan Weight, grams | 0.00 | |
| Average | 5.296 | Average | 2.867 | Moisture Content, % | 0.0 | |
| | | | Sample wet weight, grams | 742.10 | Wet Unit Wt, pcf | 82.7 |
| | | | Membrane, Cap weight, grams | 0.00 | Dry Unit Wt, pcf | 82.7 |

| Time (sec) | Q (cm ³) | H (cm) | k (cm/sec) | Temp ° C | k (cm/sec at 20° C) | i (cm/cm) |
|------------|----------------------|--------|------------|----------|---------------------|-----------|
| 600 | 300.00 | 5.08 | 3.2E-02 | 20.0 | 3.2E-02 | 0.38 |
| 1200 | 550.00 | 5.08 | 2.9E-02 | 20.0 | 2.9E-02 | 0.38 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| No. of Trials | Sample Type | Max. Density (pcf) | Compaction % | Sample Orientation |
|---------------|-------------|--------------------|--------------|--------------------|
| 2 | Remolded | 92.0 | 89.9 | Vertical |

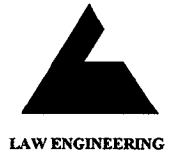
L = length of sample in cm
 A = area of sample in cm²

H = constant head in cm
 t = time in seconds

A = $\frac{41.65}{L} \text{ cm}^2$
 L = $\frac{13.453}{A} \text{ cm}$

Avg. k at 20° C 2.9E-02 cm/sec

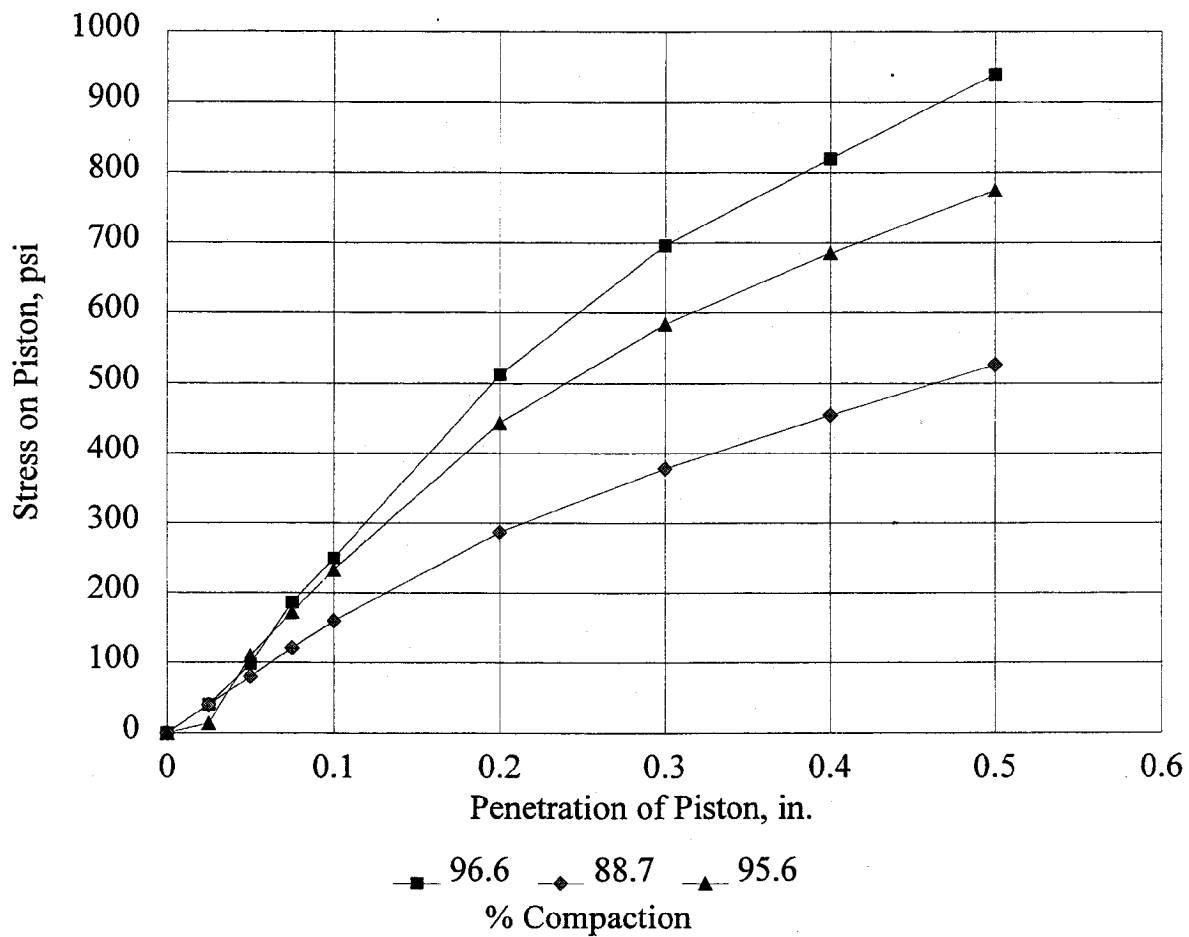
California Bearing Ratio
(ASTM D1883-92)



Project No. 5810860101
 Project Name TVA - Gallatin
 Material (Source) Bottom Ash

Tested By EM
 Test Date 07/24/95
 Reviewed By RLB
 Review Date 08/11/95

| | | | |
|---------------------------------|------|------|------|
| Compaction, % | 96.6 | 88.7 | 95.6 |
| Before Soak Dry Density, pcf | 88.9 | 81.6 | 88.0 |
| Before Soak Moisture Content, % | 24.2 | 27.9 | 21.2 |
| After Soak Dry Density, pcf | 89.1 | 81.8 | 88.2 |
| After Soak Moisture Content, % | 23.3 | 24.4 | 24.5 |
| CBR @ 0.1 in. | 25.0 | 16.0 | 23.3 |
| CBR @ 0.2 in. | 34.1 | 19.1 | 29.6 |



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: | Gallatin | | | | | | |
| 2. | MATERIAL DESCRIPTION: | Bottom Ash | | | | | | |
| 3. | REMOULDING 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 | | | | | | | 2.87 |
| | BOTTOM | | | | | | | 2.87 |
| | 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 | | | | | | | 6.05 |
| | HEIGHT OF CAP AND BASE, inch | | | | | | | 0.00 |
| | INITIAL LENGTH, L ₀ , inch | | | | | | | 6.05 |
| | INITIAL AREA, A ₀ , in ² | | | | | | | 6.33 |
| | INITIAL VOLUME A ₀ L ₀ , in ³ | | | | | | | 38.25 |
| 7. | SOIL SPECIMEN WEIGHT: | | | | | | | |
| | INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams | | | | | | | 1810.50 |
| | FINAL WEIGHT OF CONTAINER AND WET SOIL, grams | | | | | | | 725.60 |
| | WEIGHT OF WET SOIL USED, grams | | | | | | | 1084.90 |
| 8. | SOIL PROPERTIES : | | | | | | | |
| | IN SITU MOISTURE CONTENT (NUCLEAR), % | | | | | | | N/A |
| | IN SITU WET DENSITY (NUCLEAR), pcf | | | | | | | N/A |
| | or | | | | | | | |
| | OPTIMUM MOISTURE CONTENT, % | | | | | | | 25.5 |
| | MAX. DRY DENSITY, pcf | | | | | | | 92.0 |
| | 95 % MAX. DRY DENSITY, pcf | | | | | | | 87.4 |
| 9. | SPECIMEN PROPERTIES: | | | | | | | |
| | COMPACTION MOISTURE CONTENT, % | | | | | | | 22.7 |
| | MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, % | | | | | | | 22.7 |
| | COMPACTION DRY DENSITY, γ _d pcf | | | | | | | 88.0 |
| 10. | QUICK SHEAR TEST | | | | | | | |
| | STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO) | | | | | | | Y |
| | TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi | | | | | | | 31.1 |
| | 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 | | | | | | | 08-23-1995 |

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Bouchard 9/10/95
 LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
 LAW PROJECT NO.: 5810860101
 1. MATERIAL SOURCE: Gallatin
 2. MATERIAL DESCRIPTION: Bottom Ash
 3. REMOLDING TARGETS: 95% Standard Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 08-23-1995
 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 _r | M _r |
| 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 | 0.00136 | 0.00139 | 0.00138 | 0.00023 | 7,976 |
| | | | 2 | 12.7 | 11.5 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00136 | 0.00139 | 0.00137 | 0.00023 | 7,970 |
| | | | 3 | 12.7 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00135 | 0.00139 | 0.00137 | 0.00023 | 7,970 |
| | | | 4 | 12.7 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00135 | 0.00139 | 0.00137 | 0.00023 | 7,954 |
| | | | 5 | 12.7 | 11.5 | 1.3 | 2.0 | 1.8 | 0.2 | 0.00135 | 0.00139 | 0.00137 | 0.00023 | 7,991 |
| COLUMN AVERAGE | | | | 12.7 | 11.4 | 1.2 | 2.0 | 1.8 | 0.2 | 0.00135 | 0.00139 | 0.00137 | 0.00023 | 7,972 |
| STANDARD DEV. | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 13 |

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

| | | | | | | | | | | | | | | |
|------------|----------------|-----|------|------|------|-----|-----|-----|---------|---------|---------|---------|---------|--------|
| SEQUENCE 2 | 6.0 | 4.0 | 1 | 25.6 | 23.3 | 2.4 | 4.1 | 3.7 | 0.4 | 0.00233 | 0.00229 | 0.00231 | 0.00038 | 9,618 |
| | | | 2 | 25.6 | 23.2 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00233 | 0.00229 | 0.00231 | 0.00038 | 9,611 |
| | | | 3 | 25.7 | 23.3 | 2.4 | 4.1 | 3.7 | 0.4 | 0.00232 | 0.00228 | 0.00230 | 0.00038 | 9,664 |
| | | | 4 | 25.6 | 23.2 | 2.4 | 4.0 | 3.7 | 0.4 | 0.00232 | 0.00230 | 0.00231 | 0.00038 | 9,599 |
| | | | 5 | 25.6 | 23.3 | 2.4 | 4.0 | 3.7 | 0.4 | 0.00233 | 0.00229 | 0.00231 | 0.00038 | 9,613 |
| | COLUMN AVERAGE | | 25.6 | 23.2 | 2.4 | 4.0 | 3.7 | 0.4 | 0.00233 | 0.00229 | 0.00231 | 0.00038 | 9,621 | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 25 |
| SEQUENCE 3 | 6.0 | 6.0 | 1 | 38.0 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00321 | 0.00310 | 0.00315 | 0.00052 | 10,409 |
| | | | 2 | 38.0 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00321 | 0.00309 | 0.00315 | 0.00052 | 10,414 |
| | | | 3 | 38.0 | 34.3 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00322 | 0.00309 | 0.00315 | 0.00052 | 10,403 |
| | | | 4 | 38.1 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00322 | 0.00310 | 0.00316 | 0.00052 | 10,410 |
| | | | 5 | 38.0 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00322 | 0.00310 | 0.00316 | 0.00052 | 10,407 |
| | COLUMN AVERAGE | | 38.0 | 34.4 | 3.6 | 6.0 | 5.4 | 0.6 | 0.00321 | 0.00310 | 0.00316 | 0.00052 | 10,408 | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 4 |
| SEQUENCE 4 | 6.0 | 8.0 | 1 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00412 | 0.00400 | 0.00406 | 0.00067 | 10,845 |
| | | | 2 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00412 | 0.00399 | 0.00405 | 0.00067 | 10,856 |
| | | | 3 | 51.0 | 46.1 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00411 | 0.00400 | 0.00405 | 0.00067 | 10,867 |
| | | | 4 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00413 | 0.00400 | 0.00406 | 0.00067 | 10,816 |
| | | | 5 | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00412 | 0.00398 | 0.00405 | 0.00067 | 10,861 |
| | COLUMN AVERAGE | | 50.9 | 46.0 | 4.9 | 8.0 | 7.3 | 0.8 | 0.00412 | 0.00399 | 0.00406 | 0.00067 | 10,849 | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 20 |

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

| | | | | | | | | | | | | | | |
|----------------|-----|------|------|------|------|------|------|-----|---------|---------|---------|---------|---------|--------|
| SEQUENCE 5 | 6.0 | 10.0 | 1 | 63.9 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00502 | 0.00489 | 0.00495 | 0.00082 | 11,142 |
| | | | 2 | 63.9 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00504 | 0.00488 | 0.00496 | 0.00082 | 11,130 |
| | | | 3 | 63.9 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00502 | 0.00493 | 0.00497 | 0.00082 | 11,096 |
| | | | 4 | 63.8 | 57.7 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00505 | 0.00488 | 0.00496 | 0.00082 | 11,105 |
| | | | 5 | 64.0 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00501 | 0.00492 | 0.00496 | 0.00082 | 11,130 |
| COLUMN AVERAGE | | | 63.9 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00503 | 0.00490 | 0.00496 | 0.00082 | 11,121 | |
| STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00002 | 0.00002 | 0.00001 | 0.00000 | 19 | |

| | | | | | | | | | | | | | | |
|----------------|-----|-----|------|------|------|-----|-----|-----|---------|---------|---------|---------|---------|-------|
| SEQUENCE 6 | 4.0 | 2.0 | 1 | 13.2 | 11.6 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00172 | 0.00175 | 0.00173 | 0.00029 | 6,381 |
| | | | 2 | 13.2 | 11.6 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00171 | 0.00175 | 0.00173 | 0.00029 | 6,408 |
| | | | 3 | 13.2 | 11.5 | 1.7 | 2.1 | 1.8 | 0.3 | 0.00171 | 0.00175 | 0.00173 | 0.00029 | 6,381 |
| | | | 4 | 13.2 | 11.5 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00171 | 0.00175 | 0.00173 | 0.00029 | 6,387 |
| | | | 5 | 13.2 | 11.6 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00171 | 0.00175 | 0.00173 | 0.00029 | 6,381 |
| COLUMN AVERAGE | | | 13.2 | 11.6 | 1.6 | 2.1 | 1.8 | 0.3 | 0.00171 | 0.00175 | 0.00173 | 0.00029 | 6,388 | |
| STANDARD DEV. | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 12 | |

| | | | | | | | | | | | | | | |
|----------------|-----|-----|------|------|------|-----|-----|-----|---------|---------|---------|---------|---------|-------|
| SEQUENCE 7 | 4.0 | 4.0 | 1 | 25.3 | 23.0 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00316 | 0.00315 | 0.00316 | 0.00052 | 6,959 |
| | | | 2 | 25.3 | 22.9 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00317 | 0.00315 | 0.00316 | 0.00052 | 6,945 |
| | | | 3 | 25.3 | 23.0 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00317 | 0.00316 | 0.00316 | 0.00052 | 6,954 |
| | | | 4 | 25.4 | 23.1 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00319 | 0.00315 | 0.00317 | 0.00052 | 6,949 |
| | | | 5 | 25.5 | 23.1 | 2.3 | 4.0 | 3.7 | 0.4 | 0.00319 | 0.00318 | 0.00319 | 0.00053 | 6,934 |
| COLUMN AVERAGE | | | 25.4 | 23.0 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00317 | 0.00316 | 0.00317 | 0.00052 | 6,948 | |
| STANDARD DEV. | | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 9 | |

| Source: Gallatin | | Description: Bottom Ash | | | | | 95% Standard Dry Density at Optimum Moisture Content | | | | | | | | | |
|------------------|----------------|-------------------------|------|------|------|------|--|-----|---------|---------|---------|---------|---------|-------|--|--|
| SEQUENCE 8 | 4.0 | 6.0 | 1 | 38.6 | 35.0 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00422 | 0.00415 | 0.00419 | 0.00069 | 7,975 | | |
| | | | 2 | 38.6 | 35.0 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00423 | 0.00415 | 0.00419 | 0.00069 | 7,989 | | |
| | | | 3 | 38.6 | 35.0 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00422 | 0.00416 | 0.00419 | 0.00069 | 7,971 | | |
| | | | 4 | 38.4 | 34.8 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00422 | 0.00416 | 0.00419 | 0.00069 | 7,928 | | |
| | | | 5 | 38.3 | 34.7 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00422 | 0.00416 | 0.00419 | 0.00069 | 7,926 | | |
| | COLUMN AVERAGE | | 38.5 | 34.9 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00422 | 0.00416 | 0.00419 | 0.00069 | 7,958 | | | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 29 | | | |
| SEQUENCE 9 | 4.0 | 8.0 | 1 | 51.1 | 46.3 | 4.8 | 8.1 | 7.3 | 0.8 | 0.00522 | 0.00514 | 0.00518 | 0.00086 | 8,541 | | |
| | | | 2 | 51.0 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00521 | 0.00514 | 0.00517 | 0.00086 | 8,529 | | |
| | | | 3 | 51.0 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00520 | 0.00514 | 0.00517 | 0.00086 | 8,529 | | |
| | | | 4 | 51.1 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00521 | 0.00514 | 0.00518 | 0.00086 | 8,532 | | |
| | | | 5 | 51.2 | 46.3 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00522 | 0.00514 | 0.00518 | 0.00086 | 8,541 | | |
| | COLUMN AVERAGE | | 51.1 | 46.2 | 4.9 | 8.1 | 7.3 | 0.8 | 0.00521 | 0.00514 | 0.00518 | 0.00086 | 8,534 | | | |
| | STANDARD DEV. | | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 6 | | | |
| SEQUENCE 10 | 4.0 | 10.0 | 1 | 63.9 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00630 | 0.00619 | 0.00624 | 0.00103 | 8,845 | | |
| | | | 2 | 64.0 | 57.9 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00631 | 0.00620 | 0.00625 | 0.00103 | 8,846 | | |
| | | | 3 | 64.0 | 57.9 | 6.1 | 10.1 | 9.2 | 1.0 | 0.00630 | 0.00619 | 0.00625 | 0.00103 | 8,858 | | |
| | | | 4 | 64.1 | 57.9 | 6.1 | 10.1 | 9.2 | 1.0 | 0.00630 | 0.00620 | 0.00625 | 0.00103 | 8,852 | | |
| | | | 5 | 64.0 | 57.8 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00630 | 0.00619 | 0.00624 | 0.00103 | 8,850 | | |
| | COLUMN AVERAGE | | 64.0 | 57.9 | 6.1 | 10.1 | 9.1 | 1.0 | 0.00630 | 0.00619 | 0.00625 | 0.00103 | 8,850 | | | |
| | STANDARD DEV. | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00000 | 0.00001 | 0.00000 | 0.00000 | 5 | | | |

| Source: | Gallatin | Description: Bottom Ash | | | | | | | | | | 95% Standard Dry Density at Optimum Moisture Content | | | | | | | | | |
|-------------|----------------|-------------------------|------|------|-----|-----|-----|---------|---------|---------|---------|--|-------|--|--|--|--|--|--|--|--|
| SEQUENCE 11 | 2.0 | 1 | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00228 | 0.00235 | 0.00231 | 0.00038 | 4,737 | | | | | | | | |
| | | 2 | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00226 | 0.00235 | 0.00231 | 0.00038 | 4,756 | | | | | | | | |
| | | 3 | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00228 | 0.00235 | 0.00232 | 0.00038 | 4,732 | | | | | | | | |
| | | 4 | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00227 | 0.00234 | 0.00231 | 0.00038 | 4,754 | | | | | | | | |
| | | 5 | 13.6 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00228 | 0.00235 | 0.00231 | 0.00038 | 4,760 | | | | | | | | |
| | COLUMN AVERAGE | 13.5 | 11.5 | 2.0 | 2.1 | 1.8 | 0.3 | 0.00227 | 0.00235 | 0.00231 | 0.00038 | 4,748 | | | | | | | | | |
| | STANDARD DEV. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 13 | | | | | | | | | |
| SEQUENCE 12 | 2.0 | 1 | 25.4 | 23.1 | 2.3 | 4.0 | 3.6 | 0.4 | 0.00429 | 0.00435 | 0.00432 | 0.00071 | 5,098 | | | | | | | | |
| | | 2 | 25.4 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00430 | 0.00435 | 0.00433 | 0.00072 | 5,094 | | | | | | | | |
| | | 3 | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00429 | 0.00434 | 0.00432 | 0.00071 | 5,098 | | | | | | | | |
| | | 4 | 25.5 | 23.1 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00428 | 0.00436 | 0.00432 | 0.00071 | 5,106 | | | | | | | | |
| | | 5 | 25.3 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00429 | 0.00434 | 0.00432 | 0.00071 | 5,081 | | | | | | | | |
| | COLUMN AVERAGE | 25.4 | 23.0 | 2.4 | 4.0 | 3.6 | 0.4 | 0.00429 | 0.00435 | 0.00432 | 0.00071 | 5,095 | | | | | | | | | |
| | STANDARD DEV. | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 9 | | | | | | | | | |
| SEQUENCE 13 | 2.0 | 1 | 38.3 | 34.7 | 3.6 | 6.0 | 5.5 | 0.6 | 0.00561 | 0.00562 | 0.00561 | 0.00093 | 5,909 | | | | | | | | |
| | | 2 | 38.4 | 34.8 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00561 | 0.00562 | 0.00561 | 0.00093 | 5,921 | | | | | | | | |
| | | 3 | 38.4 | 34.8 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00561 | 0.00563 | 0.00562 | 0.00093 | 5,917 | | | | | | | | |
| | | 4 | 38.5 | 34.9 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00562 | 0.00561 | 0.00561 | 0.00093 | 5,932 | | | | | | | | |
| | | 5 | 38.4 | 34.8 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00562 | 0.00561 | 0.00561 | 0.00093 | 5,930 | | | | | | | | |
| | COLUMN AVERAGE | 38.4 | 34.8 | 3.6 | 6.1 | 5.5 | 0.6 | 0.00561 | 0.00562 | 0.00562 | 0.00093 | 5,922 | | | | | | | | | |
| | STANDARD DEV. | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 10 | | | | | | | | | |

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: Gallatin
 2. MATERIAL DESCRIPTION: Bottom Ash
 3. REMOLDING TARGETS: 95% Standard Dry Density at Optimum Moisture Content
 4. MATERIAL TYPE: 2
 5. TEST DATE: 08-23-1995

$$M_R = K_1 (S_C)^{K_2} (1+S_3)^{K_5}$$

K1 = 1,972
 K2 = 0.20995
 K5 = 0.65540
 R² = 0.99

