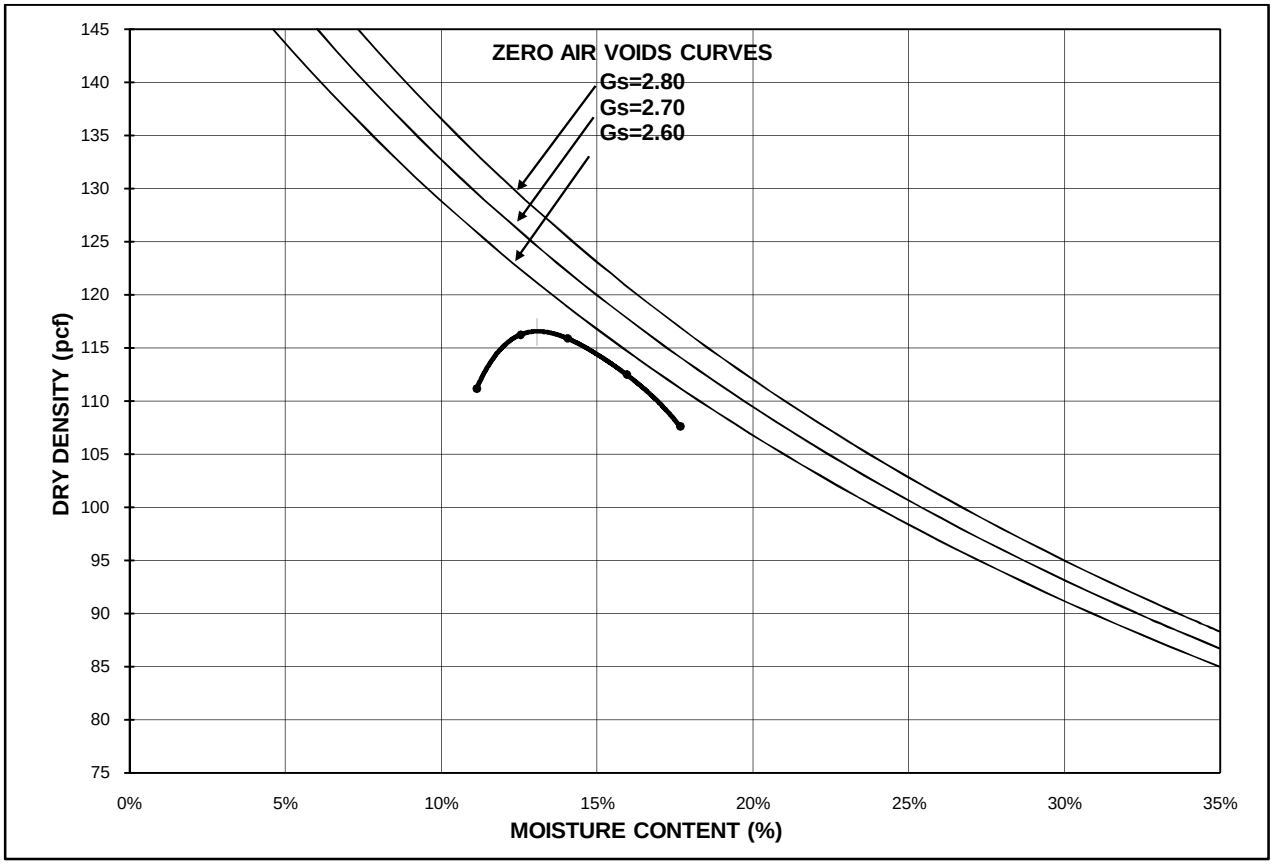
APPENDIX C-2

COMPACTION TESTING

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694.0001**
SAMPLE ID: **GA-TP-01** DEPTH: **5-10'** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	111.2	11.1%
2	116.2	12.6%
3	115.9	14.1%
4	112.5	16.0%
5	107.6	17.7%

Maximum Dry Density (pcf)	**116.5**
Optimum Moisture (%)	**13.1**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	--
% Passing #4 sieve	**100.0**
% Passing 3/8" sieve	**100.0**
% Passing 3/4" sieve	**100.0**

DESCRIPTION Yellowish red silty sand

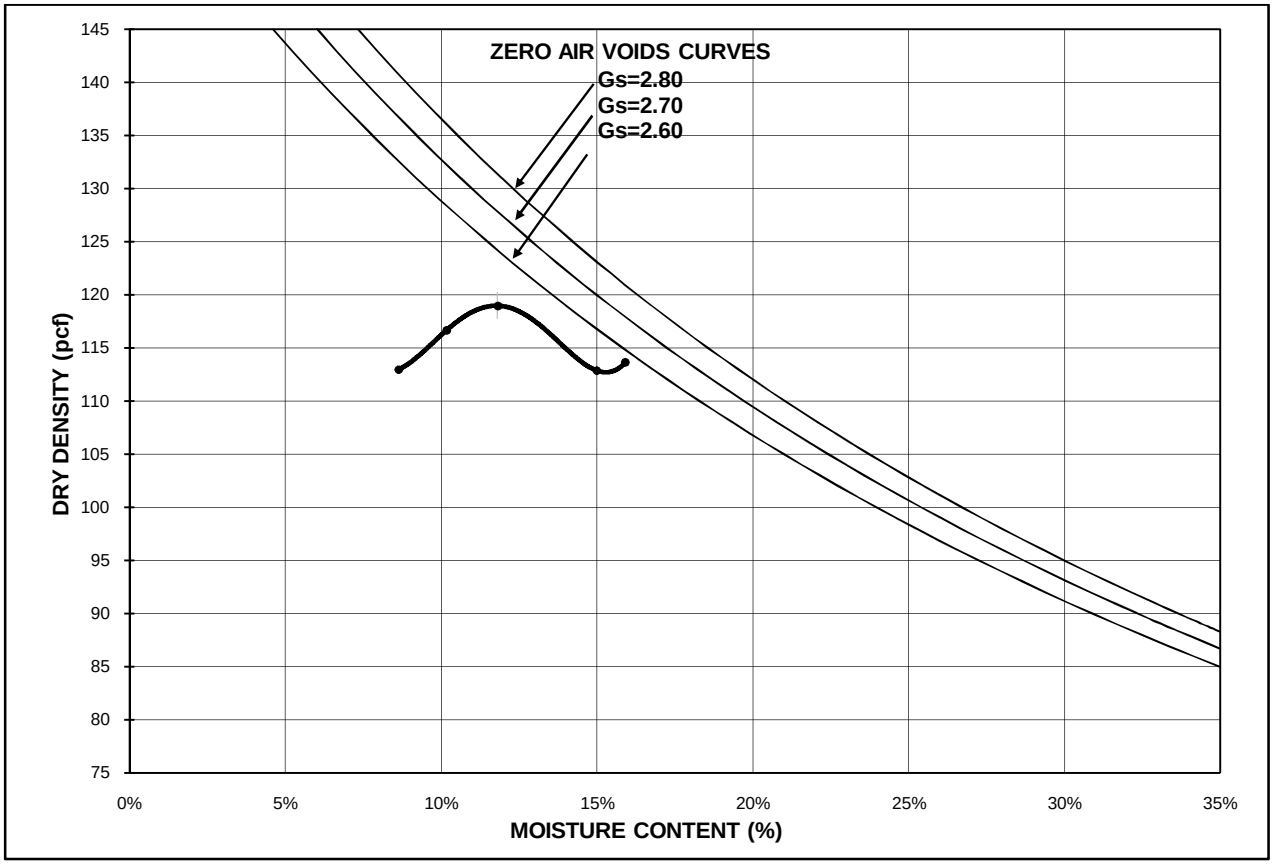
USCS SM

TECH	DS
DATE	11/14/07
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694**
SAMPLE ID: **GA-TP-2** DEPTH: **2-6** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	113.0	8.6%
2	116.7	10.2%
3	119.0	11.8%
4	113.7	15.9%
5	112.9	15.0%

Maximum Dry Density (pcf)	**119.0**
Optimum Moisture (%)	**11.8**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	**0.0%**
% Passing #4 sieve	**98.0**
% Passing 3/8" sieve	**98.4**
% Passing 3/4" sieve	**99.1**

DESCRIPTION Yellowish red silty sand

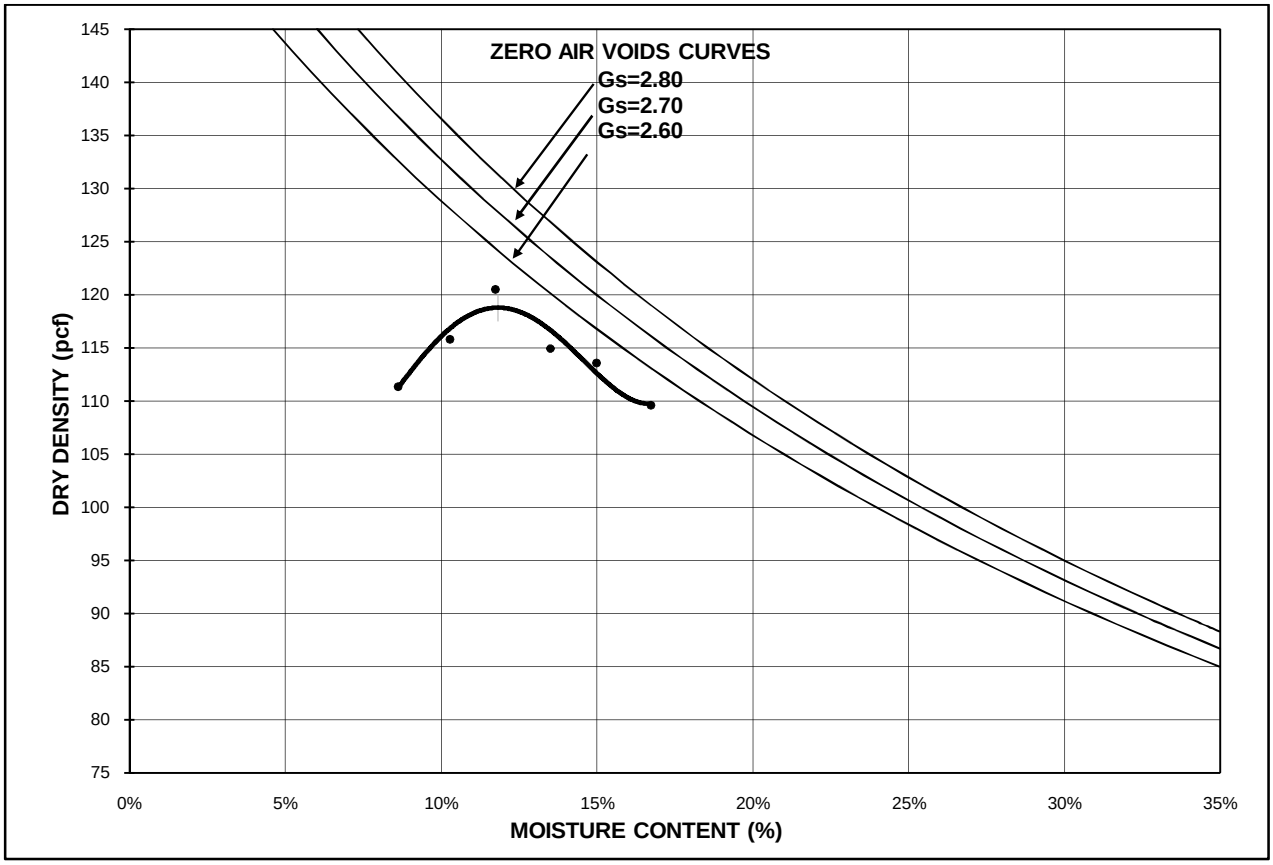
USCS SM

TECH	DS
DATE	12/21/07
REVIEW	CA

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694**
SAMPLE ID: **GA-TP-3** DEPTH: **4-9** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	111.3	8.6%
2	115.8	10.3%
3	120.5	11.7%
4	114.9	13.5%
5	113.6	15.0%
6	109.6	16.7%

Maximum Dry Density (pcf)	**118.8**
Optimum Moisture (%)	**11.8**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	**0.0%**
% Passing #4 sieve	**98.0**
% Passing 3/8" sieve	**98.5**
% Passing 3/4" sieve	**99.1**

DESCRIPTION Strong brown silty sand

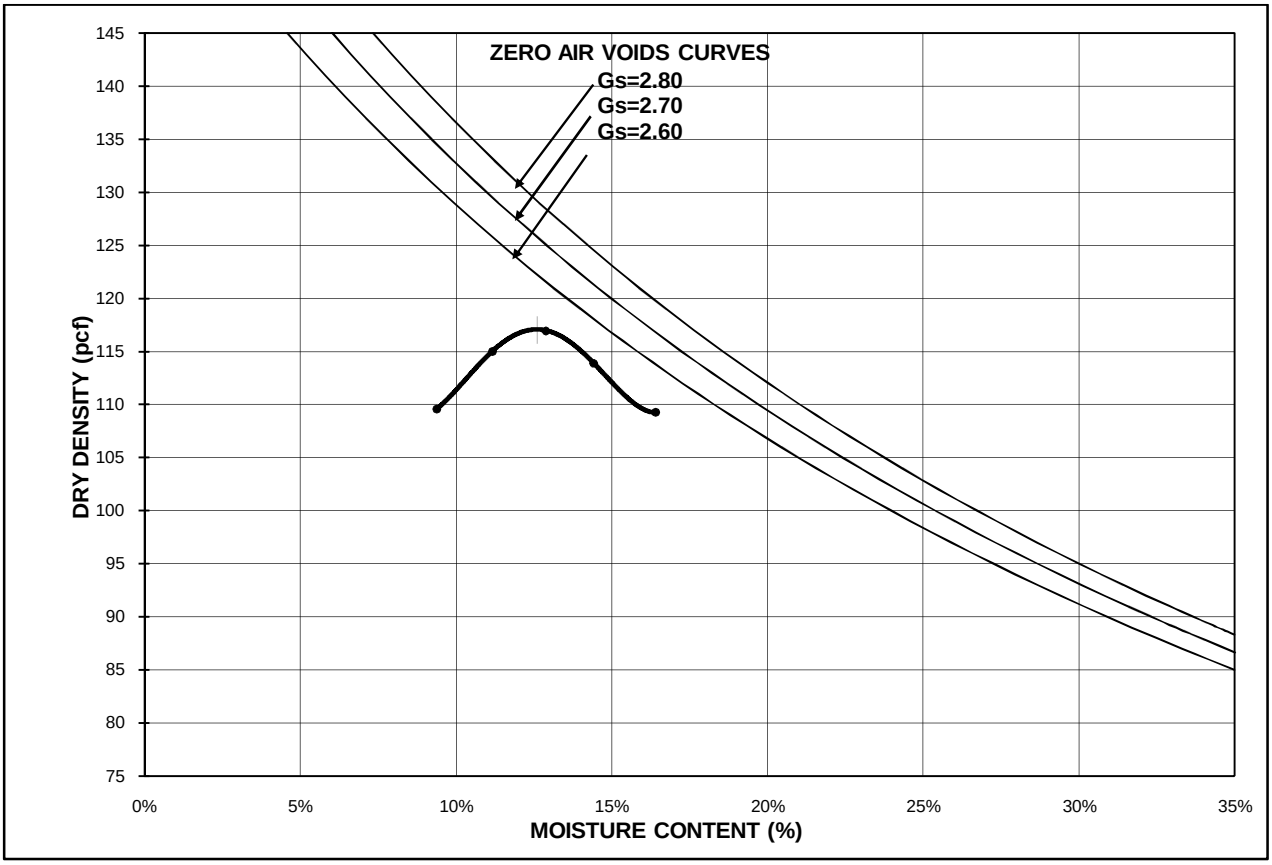
USCS SM

TECH	TES
DATE	12/20/07
REVIEW	CA

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694**
SAMPLE ID: **GA-TP-4** DEPTH: **2-5** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	109.6	9.4%
2	115.0	11.2%
3	117.0	12.9%
4	113.9	14.4%
5	109.2	16.4%

Maximum Dry Density (pcf)	**117.0**
Optimum Moisture (%)	**12.6**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	**0.0%**
% Passing #4 sieve	**99.5**
% Passing 3/8" sieve	**99.7**
% Passing 3/4" sieve	**100.0**

DESCRIPTION Light reddish brown silty, clayey sand

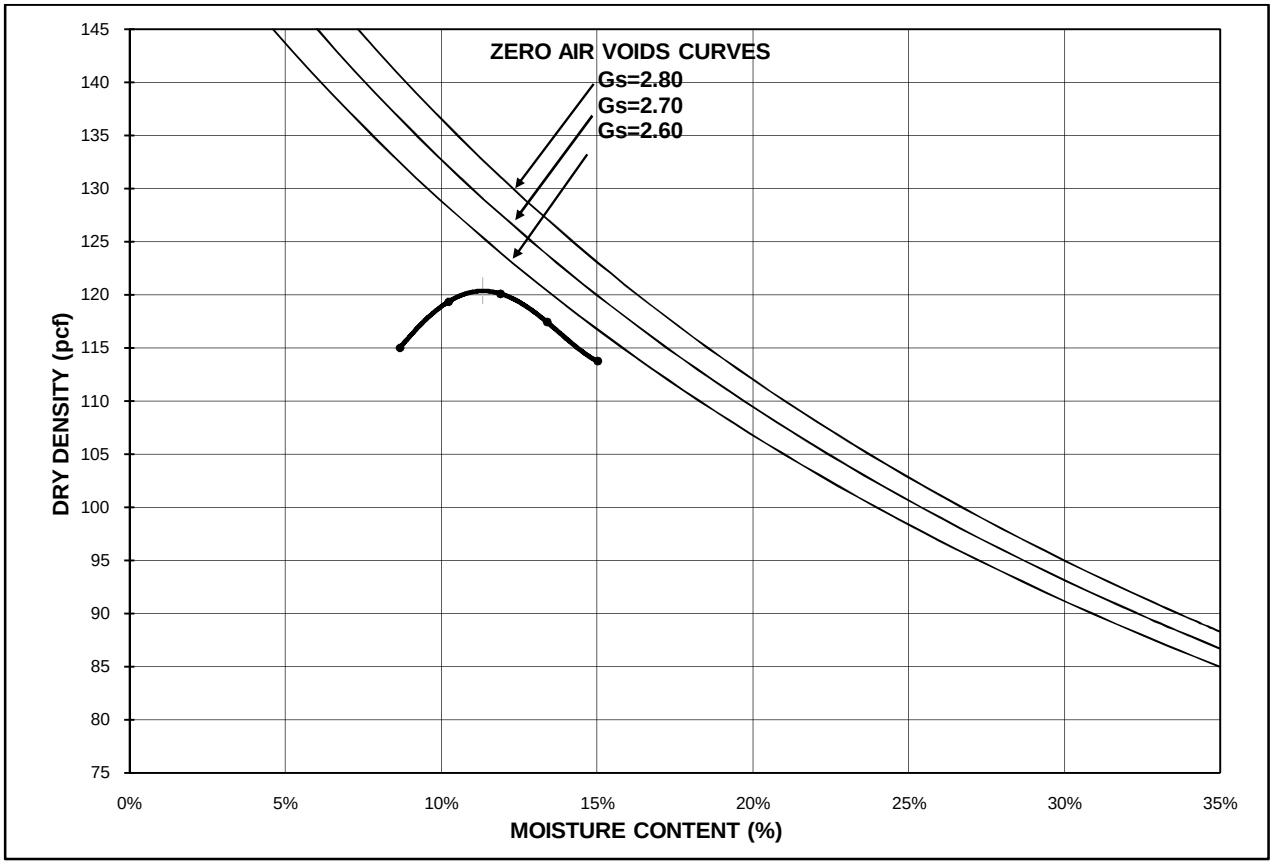
USCS SC-SM

TECH	DS
DATE	12/21/07
REVIEW	CA

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694**
SAMPLE ID: **GA-TP-4** DEPTH: **5-10** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	115.0	8.7%
2	119.3	10.2%
3	120.1	11.9%
4	117.4	13.4%
5	113.7	15.0%

Maximum Dry Density (pcf)	**120.4**
Optimum Moisture (%)	**11.3**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	**0.0%**
% Passing #4 sieve	**96.8**
% Passing 3/8" sieve	**98.5**
% Passing 3/4" sieve	**99.5**

DESCRIPTION Yellowish red silty sand

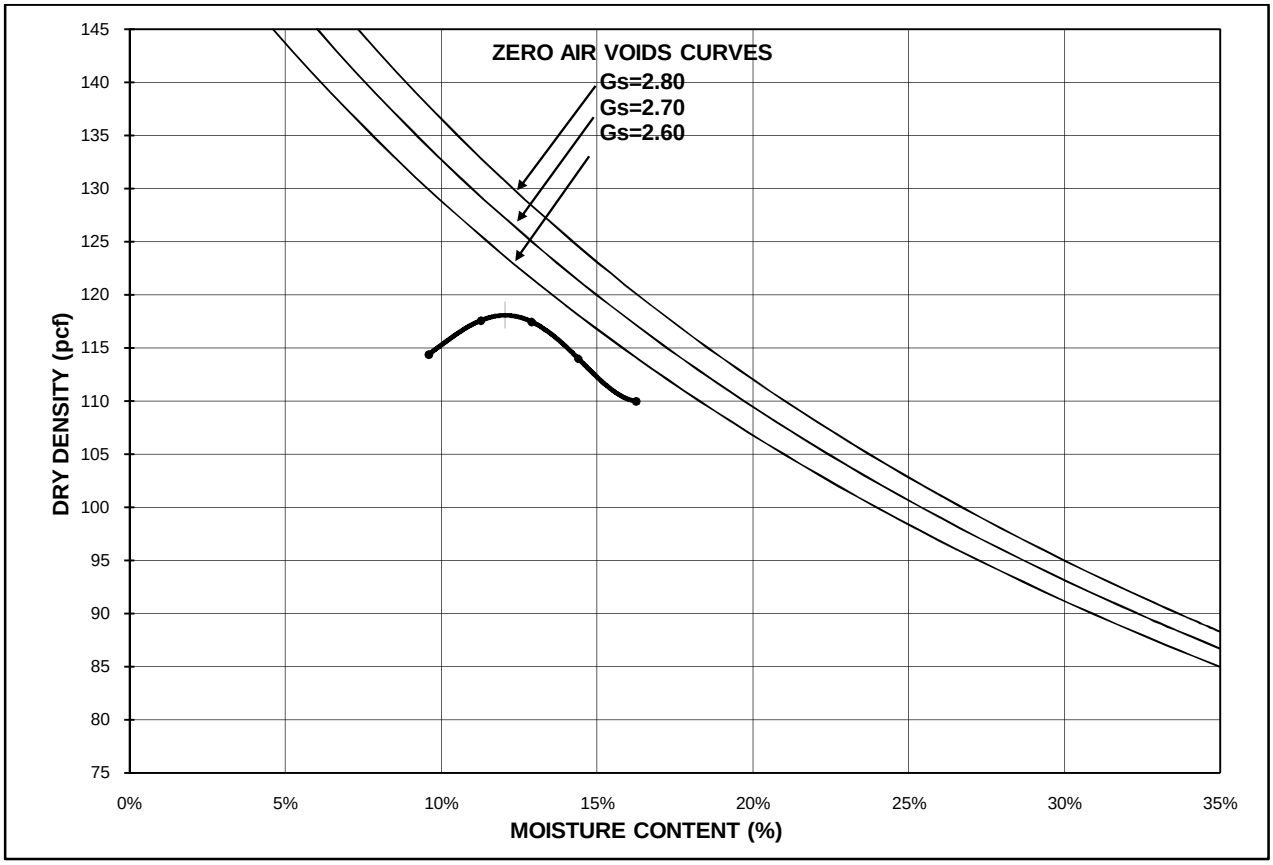
USCS SM

TECH	DS
DATE	12/21/07
REVIEW	CA

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694.0001**
SAMPLE ID: **GA-TP-05** DEPTH: **0-9.5** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	114.4	9.6%
2	117.6	11.3%
3	117.5	12.9%
4	114.0	14.4%
5	110.0	16.3%

Maximum Dry Density (pcf)	**118.1**
Optimum Moisture (%)	**12.0**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	--
% Passing #4 sieve	**100.0**
% Passing 3/8" sieve	**100.0**
% Passing 3/4" sieve	**100.0**

DESCRIPTION Strong brown silty sand

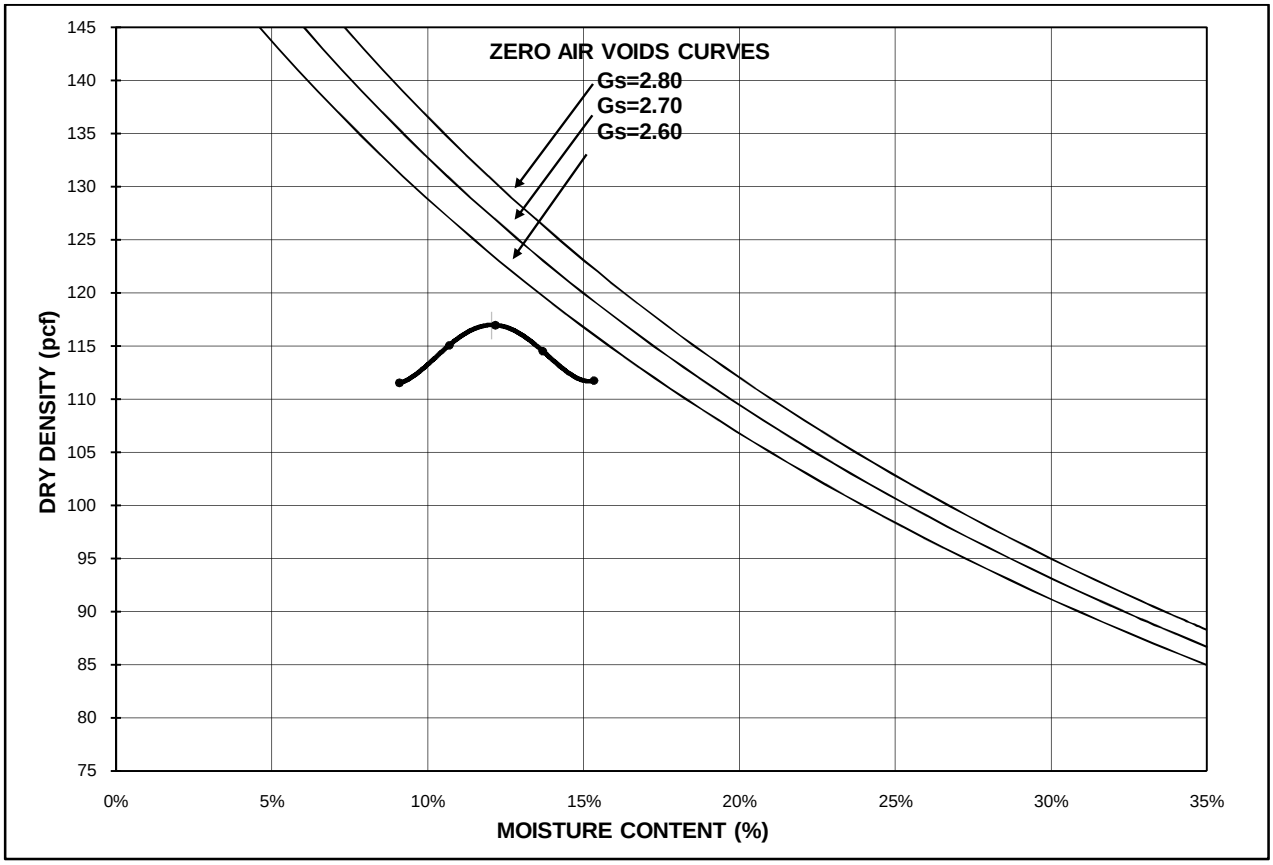
USCS SM

TECH	DCS
DATE	11/29/07
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694**
SAMPLE ID: **GA-TP-07** DEPTH: **1.5-9** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	111.5	9.1%
2	115.1	10.7%
3	117.0	12.2%
4	114.5	13.7%
5	111.7	15.3%

Maximum Dry Density (pcf)	**116.9**
Optimum Moisture (%)	**12.1**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	--
% Passing #4 sieve	**99.0**
% Passing 3/8" sieve	**99.4**
% Passing 3/4" sieve	**99.8**

DESCRIPTION Brown silty sand

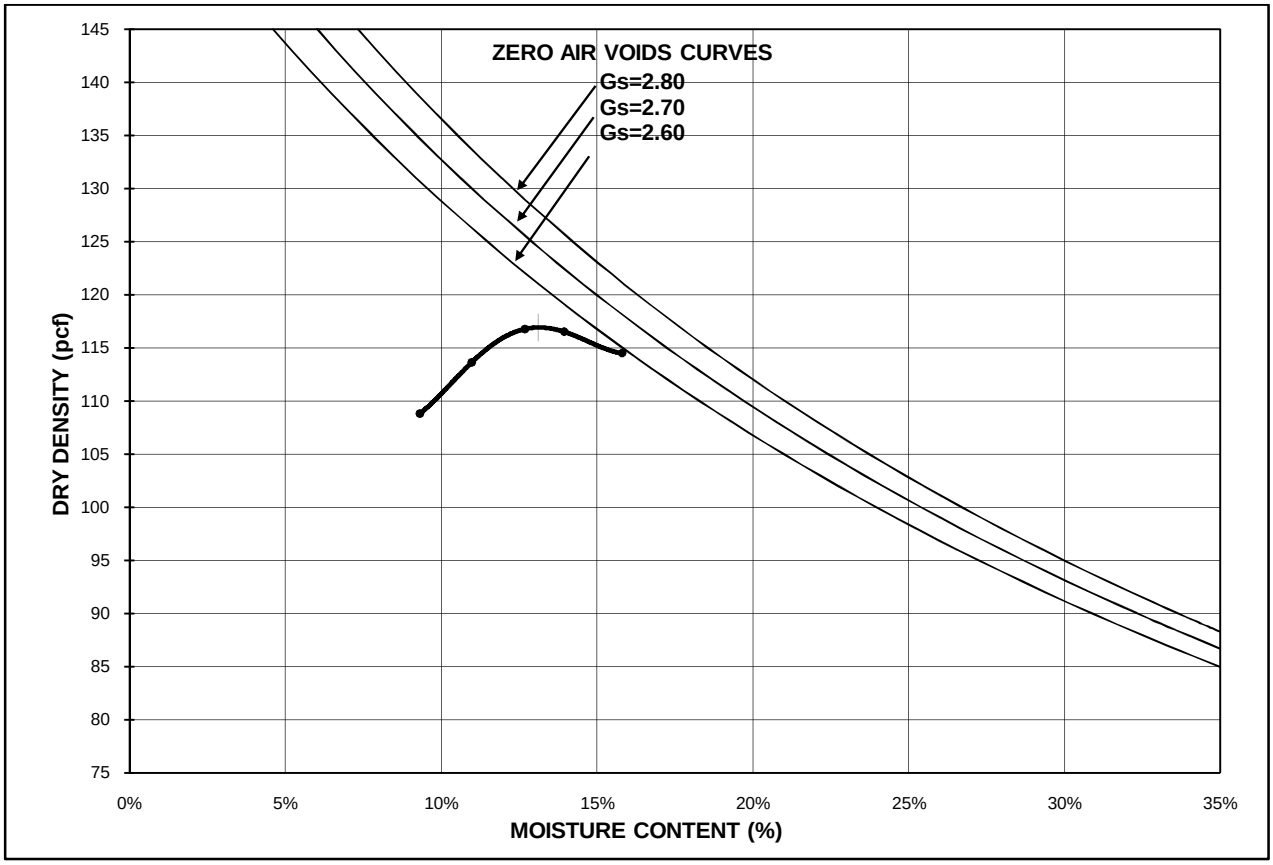
USCS SM

TECH	DCS
DATE	11/29/07
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
ASTM D 698 Method A

Mechanical	Standard	Wet Method

PROJECT NAME: **Energy Fuels/Geotech Pinon Ridge**
PROJECT NUMBER: **073-81694.0001**
SAMPLE ID: **GA-TP-09** DEPTH: **1-11** SAMPLE TYPE: **Pail**



COMPACTION POINTS		
Specimen Number	Dry Density (pcf)	Moisture Content (%)
1	108.8	9.3%
2	113.6	11.0%
3	116.8	12.7%
4	116.5	13.9%
5	114.5	15.8%

Maximum Dry Density (pcf)	**116.9**
Optimum Moisture (%)	**13.1**
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	
As-Received Moisture Content	--
% Passing #4 sieve	**100.0**
% Passing 3/8" sieve	**100.0**
% Passing 3/4" sieve	**100.0**

DESCRIPTION Reddish brown silty sand

USCS SM

TECH	DS
DATE	11/21/07
REVIEW	MB

APPENDIX C-3

CONSOLIDATION / COLLAPSE TESTING

TABLE C-3-1
ENERGY FUELS/GEOTECH PINON RIDGE
SUMMARY OF CONSOLIDATION/COLLAPSE TESTING DATA

Undisturbed (In-Situ) Samples:

Sample ID	GA-BH-03		GA-BH-08		GA-BH-08		GA-BH-16	
Depth (ft.)	19.75-20		9.75-10		44.75-45		54.3-54.7	
Loading Step	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation
1	0.00	0.06	0.00	0.09	0.00	0.00	0.00	0.03
2	0.25	0.39	0.25	0.53	0.25	0.09	0.25	0.43
3	0.50	0.64	0.50	0.71	0.50	0.32	0.50	0.90
4	1.00	1.03	1.00	1.05	1.00	0.68	1.00	1.63
5	2.00	1.60	2.00	1.71	2.00	1.74	2.00	2.63
6	2.00	8.40	2.00	8.08	4.00	3.49	4.00	3.73
7	4.00	9.97	4.00	9.10	4.00	8.61	4.00	7.70
8	8.00	12.31	8.00	10.56	8.00	10.93	8.00	8.61
9	-	-	-	-	16.00	13.78	16.00	10.02
10	-	-	-	-	-	-	-	-
% Collapse		*6.8*		*6.4*		*5.1*		*4.0*

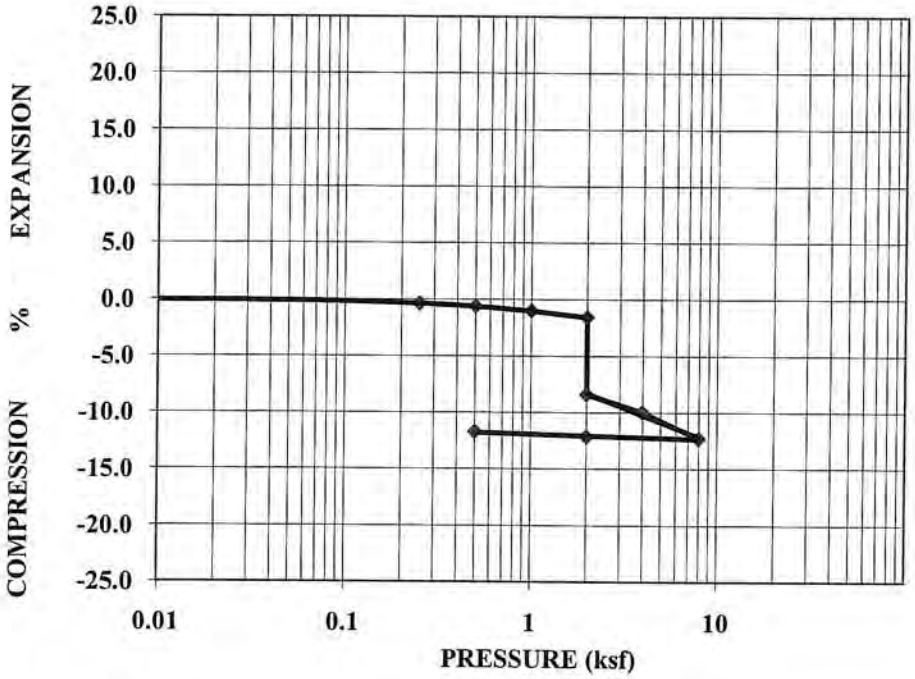
Sample ID	GA-BH-40		GA-BH-48		GA-BH-48		GA-BH-41	
Depth (ft.)	34.7-35		5.7-6		15.7-16		24.7-25	
Loading Step	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation
1	0.00	0.01	0.00	0.04	0.00	0.03	0.00	0.00
2	0.25	0.37	0.25	0.29	0.25	0.56	0.10	0.06
3	0.50	0.79	0.50	0.69	0.50	1.10	0.25	0.20
4	1.00	1.68	1.00	0.84	1.00	1.29	0.50	0.63
5	2.00	2.83	2.00	1.11	2.00	2.10	1.00	0.76
6	4.00	3.99	4.00	1.73	4.00	3.45	2.00	1.31
7	8.00	5.29	8.00	2.11	8.00	4.16	4.00	2.32
8	8.00	9.20	8.00	18.81	8.00	12.66	4.00	7.23
9	16.00	10.02	16.00	21.72	16.00	14.51	8.0	8.29
10	32.00	11.31	32.00	24.31	32.00	16.42	16.0	9.62
11	-	-	-	-	-	-	4.0	9.46
12	-	-	-	-	-	-	1.00	9.29
13	-	-	-	-	-	-	0.25	9.12
14	-	-	-	-	-	-	-	-
% Collapse		*3.9*		*16.7*		*8.5*		*4.9*

Sample ID	GA-BH-41		GA-BH-41		GA-BH-42		GA-BH-42	
Depth (ft.)	29.3-29.7		34.3-34.7		5.75-6		40.25-40.5	
Loading Step	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation	Load (ksf)	% Consolidation
1	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.09
2	0.10	0.01	0.1	0.11	0.10	0.18	0.10	0.64
3	0.25	0.01	0.25	0.30	0.25	0.38	0.25	1.02
4	0.50	0.21	0.5	0.89	0.5	0.90	0.50	1.81
5	1.00	0.43	1.0	1.16	1.0	1.14	1.00	2.02
6	2.00	0.92	2.0	1.99	2.0	2.07	2.00	3.03
7	4.00	1.93	4.0	2.40	2.0	8.50	4.00	4.55
8	4.00	9.55	4.0	11.59	4.0	10.11	4.00	12.95
9	8.0	11.31	8.0	13.48	8.0	11.46	8.0	13.90
10	16.0	13.40	16.0	15.88	2.0	11.39	16.0	15.23
11	4.0	13.16	4.0	15.68	0.5	11.21	4.0	15.03
12	1.00	12.78	1.0	15.41	0.00	10.54	1.00	14.83
13	0.25	12.38	0.25	15.04	-	-	0.25	14.63
14	-	-	-	-	-	-	-	-
% Collapse		*7.6*		*9.2*		*6.4*		*8.4*

Remolded Soil Samples:

Sample ID	GA-TP-9	
Depth (ft.)	Remolded sample	
Loading Step	Load (ksf)	% Consolidation
1	0.00	0.08
2	0.25	0.80
3	0.50	1.15
4	1.00	2.16
5	2.00	2.39
6	4.00	2.88
7	8.00	3.66
8	8.00	5.39
9	16.00	7.06
10	32.00	9.51
11	8.00	9.17
12	2.00	8.76
13	0.50	8.28
14	0.00	7.05
% Collapse		*1.7*

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

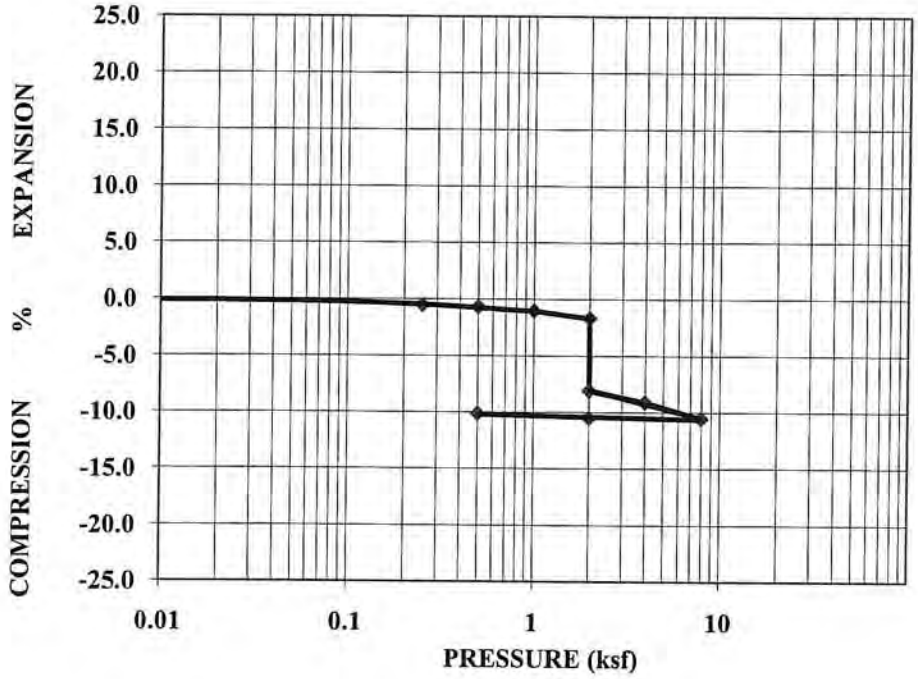


SAMPLE #:	GA-BH-03 19.75-20'
DESCRIPTION:	Yellowish red sandy lean clay (CL)

		DATE	11/20/2007
Job Name	Energy Fuels/Geotech Pinon Ridge	TECH	MKS
Job Number	073-81694.0001	REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

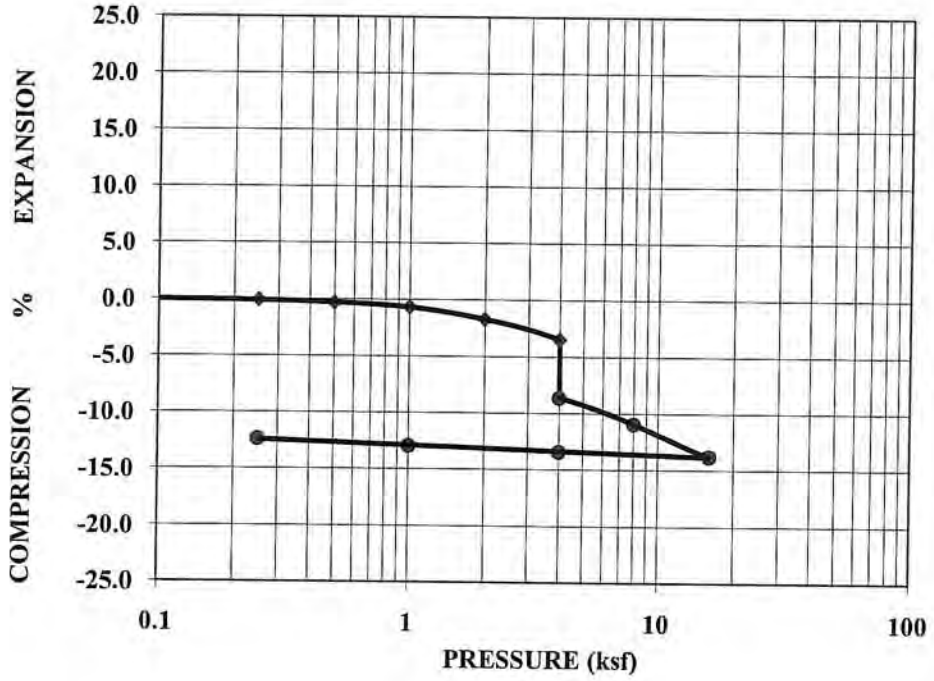


SAMPLE #:	**GA-BH-08 9.75-10'**
DESCRIPTION:	**Reddish brown silty sand (SM)**

Job Name	**Energy Fuels/Geotech Pinon Ridge**	DATE	11/20/2007
Job Number	**073-81694.0001**	TECH	MKS
		REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

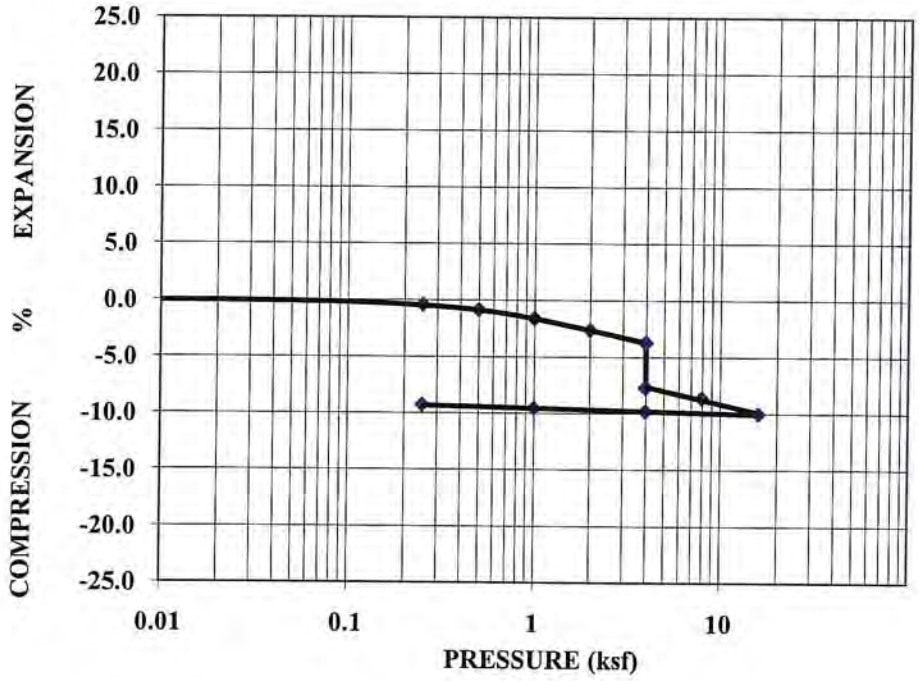


SAMPLE #:	GA-BH-08 44.75-45'
DESCRIPTION:	Brown sandy silt (ML)

Job Name	Energy Fuels/Geotech Pinon Ridge	DATE	11/28/2007
Job Number	073-81694.0001	TECH	MKS
		REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

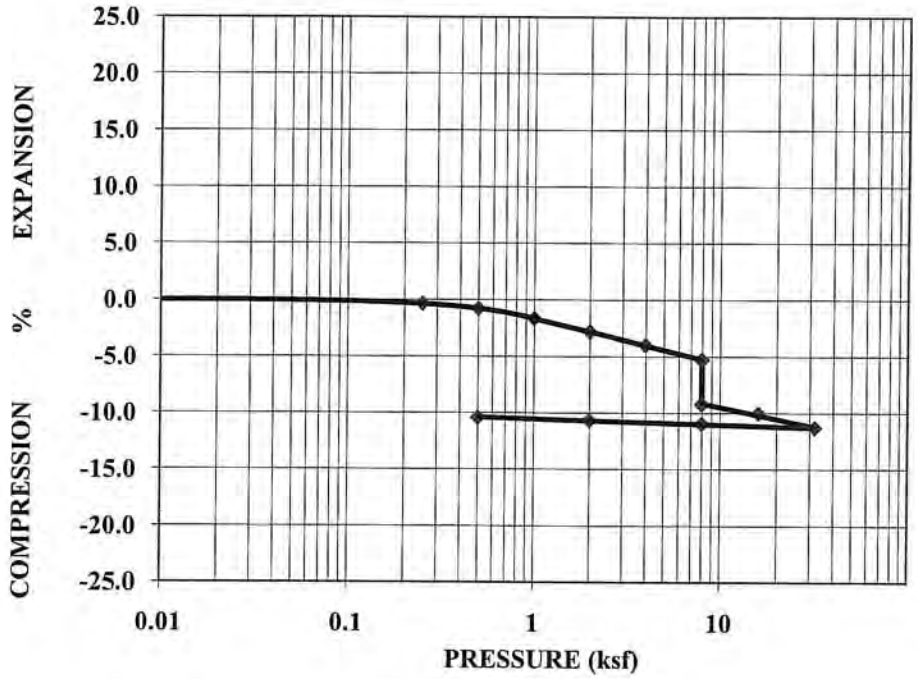


SAMPLE #:	**GA-BH-16 54.3-54.7'**
DESCRIPTION:	**Reddish brown silty sand (SM)**

Job Name	**Energy Fuels/Geotech Pinon Ridge**	DATE	11/20/2007
Job Number	**073-81694.0001**	TECH	MKS
		REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

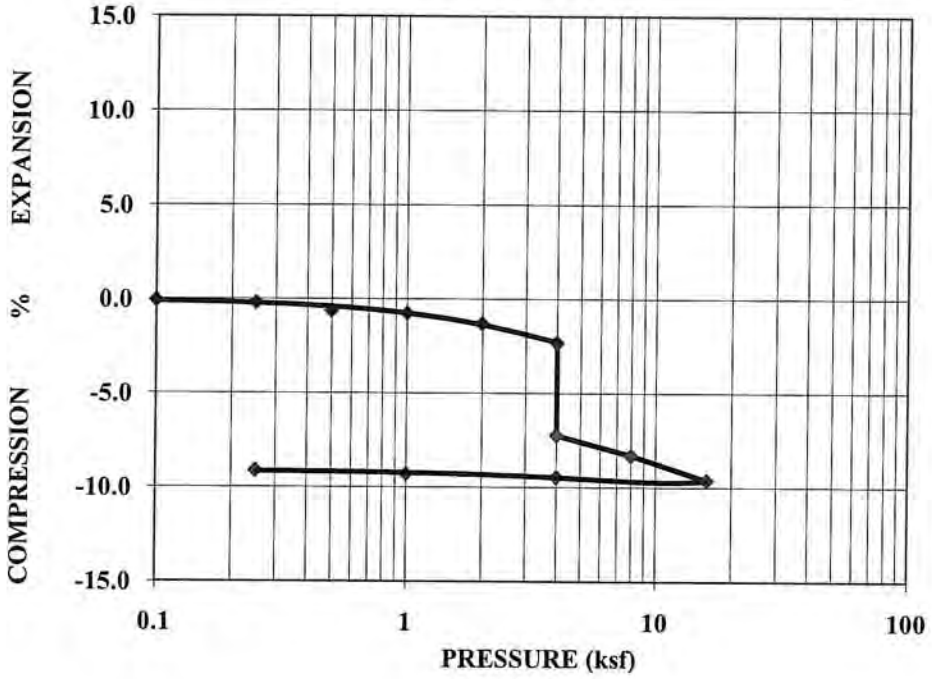


SAMPLE #:	GA-BH-40 34.7-35'
DESCRIPTION:	Yellowish red silty or clayey sand (no Atterbergs conducted)

		DATE	11/20/2007
Job Name	Energy Fuels/Geotech Pinon Ridge	TECH	MKS
Job Number	073-81694.0001	REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

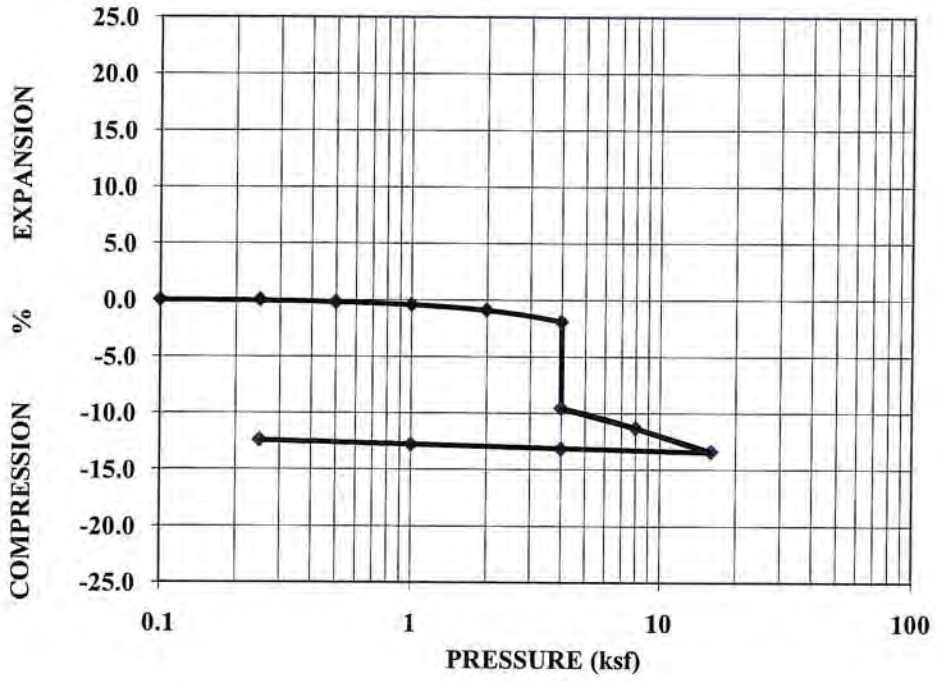


SAMPLE #:	**GA-BH-41 24.7-25'**
DESCRIPTION:	**Light reddish brown silty sand (SM)**
NOTE:	**0 loads will not plot on log graphs**
Job Name	**EFR/Pinon Rdige**
Job Number	**073-81694**

DATE	12/18/2007
TECH	MKS
REVIEW	REVIEW

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS



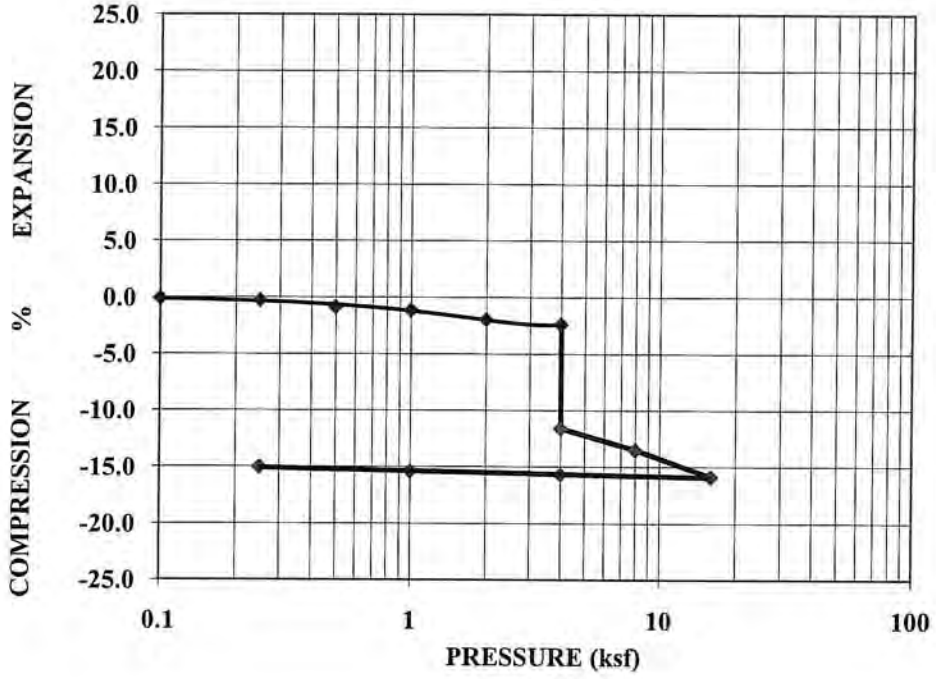
SAMPLE #:	GA-BH-41 29.3-29.7'
DESCRIPTION:	Light brown sandy silty clay (CL-ML)
NOTE:	0 loads will not plot on log graphs

Job Name	EFR/Pinon Rdige
Job Number	073-81694

DATE	12/18/2007
TECH	MKS
REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS



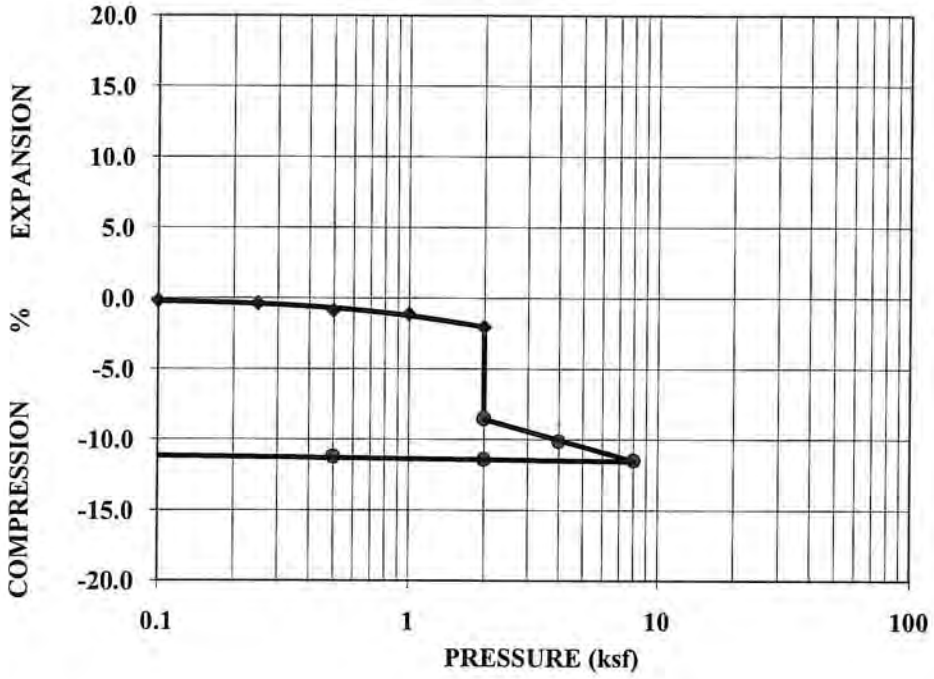
SAMPLE #:	GA-BH-41 34.3-34.7'
DESCRIPTION:	Light brown sandy silt (ML)
NOTE:	0 loads will not plot on log graphs

Job Name	EFR/Pinon Rdige
Job Number	073-81694

DATE	12/18/2007
TECH	MKS
REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS



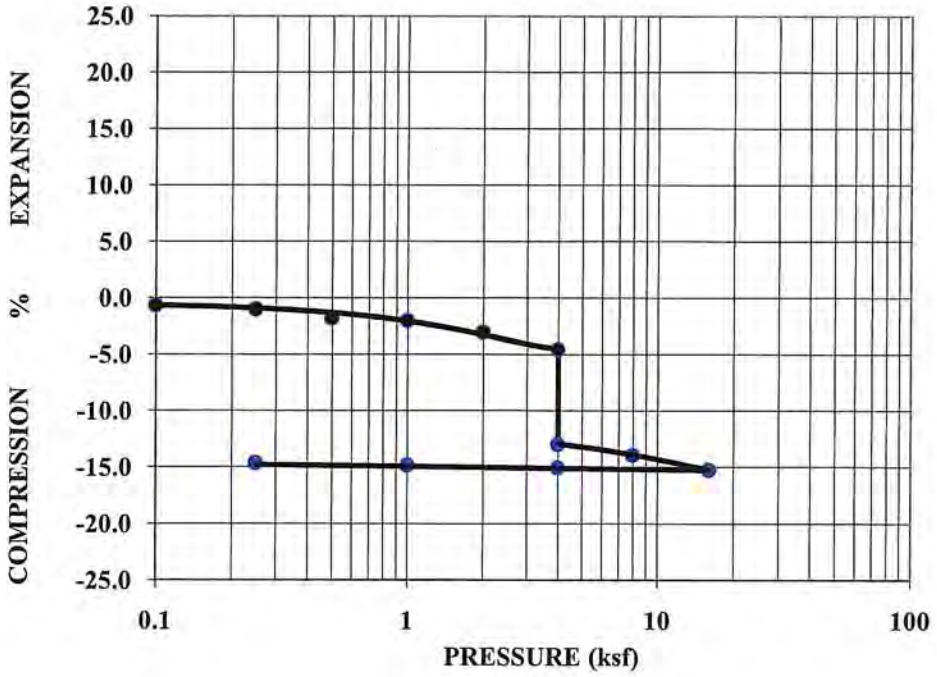
SAMPLE #:	GA-BH-42 5.75-6'
DESCRIPTION:	Brown silty sand (SM)
NOTE:	0 loads will not plot on log graphs

Job Name	EFR/Pinon Rdige
Job Number	073-81694

DATE	12/18/2007
TECH	MKS
REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS



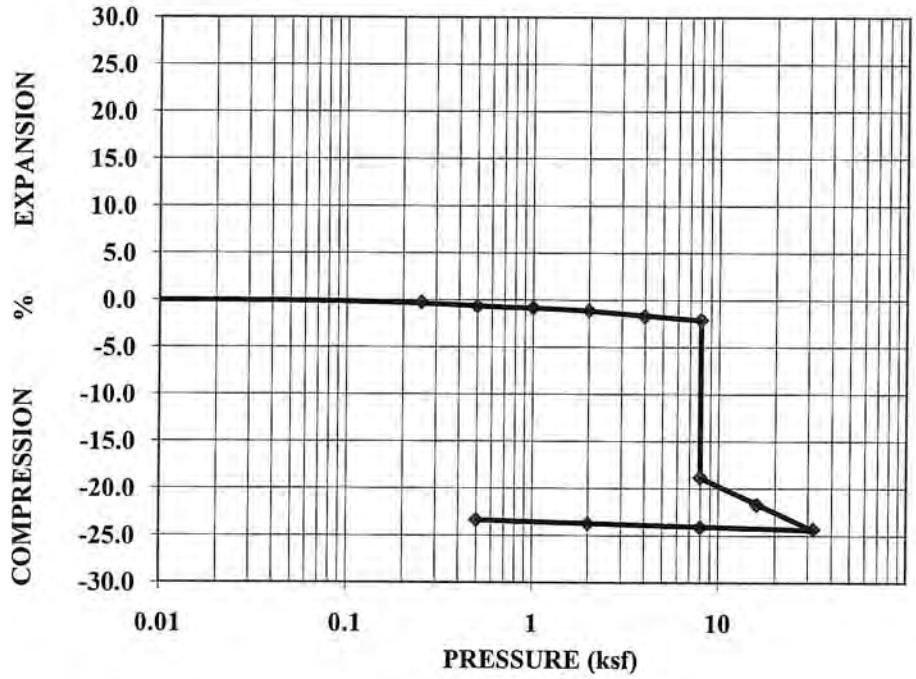
SAMPLE #:	GA-BH-42 40.25-40.5'
DESCRIPTION:	Strong brown silty sand (SM)
NOTE:	0 loads will not plot on log graphs

Job Name	EFR/Pinon Rdige
Job Number	073-81694

DATE	12/18/2007
TECH	MKS
REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

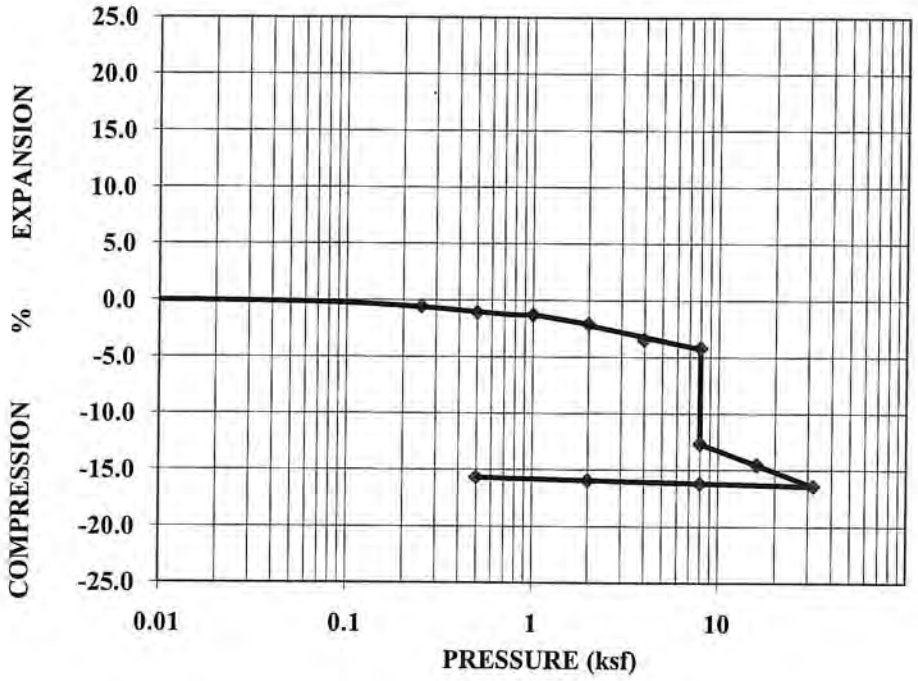


SAMPLE #:	GA-BH-48 5.7-6'
DESCRIPTION:	Yellowish red sandy lean clay (CL)

		DATE	11/16/2007
Job Name	Energy Fuels/Geotech Pinon Ridge	TECH	MKS
Job Number	073-81694.0001	REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS

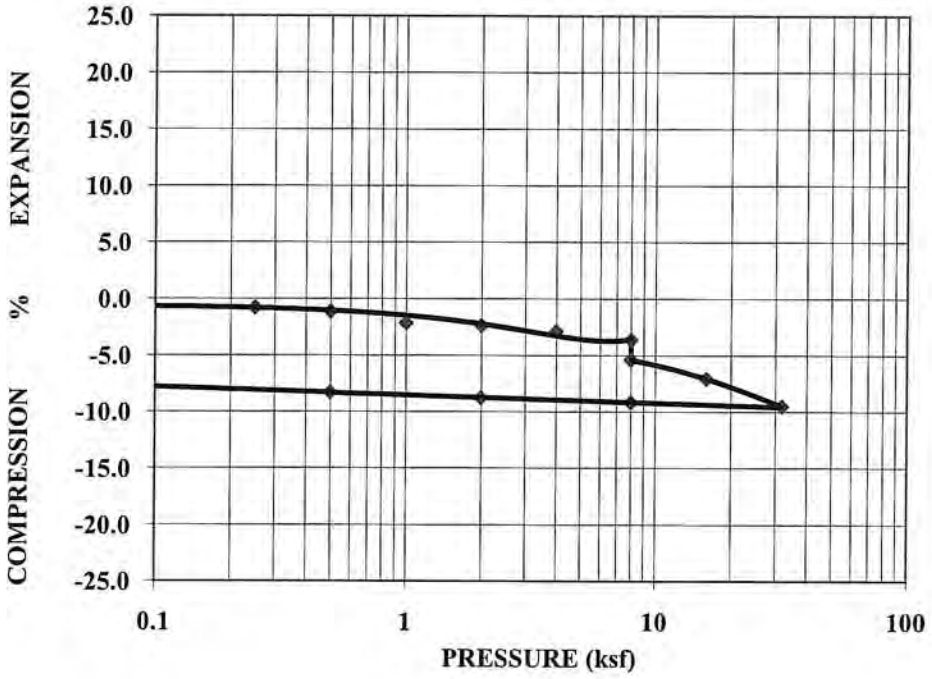


SAMPLE #:	GA-BH-48 15.7-16'
DESCRIPTION:	Strong brown sandy silty clay (CL-ML)

		DATE	11/16/2007
Job Name	Energy Fuels/Geotech Pinon Ridge	TECH	MKS
Job Number	073-81694.0001	REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL SWELL-CONSOLIDATION TEST RESULTS



SAMPLE #:	GA-TP-9 1-11'
DESCRIPTION:	Remolded - Reddish brown silty sand (SM)
NOTE:	0 loads will not plot on log graphs

Job Name	Energy Fuels/Geotech Pinon Ridge	DATE	1/3/2008
Job Number	073-81694.0001	TECH	MKS/CA
		REVIEW	MB

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

APPENDIX C-4

PERMEABILITY TESTING

TABLE C-4-1

SUMMARY OF UNDISTURBED FLEXIBLE-WALL PERMEABILITY TEST RESULTS

Boring Number	Sample Depth (ft)	Sample Length (cm)	Sample Diameter (cm)	Sample Dry Density (pcf)	Initial Moisture (%)	Effective Stress (psi)	Back Pressure (psi)	Gradient	Average Permeability (cm/sec)
GA-BH-08	44.5-44.75	6.05	4.93	73.2	13.5	15	85	2	3.4×10^{-5}
GA-BH-47	2-3.5	15.95	7.30	89.9	1.7	10	90	1	5.9×10^{-4}
GA-BH-42	10-11	15.4	7.30	83.8	3.1	10	90	1	4.5×10^{-4}

TABLE C-4-2

SUMMARY OF REMOLDED FLEXIBLE-WALL PERMEABILITY TEST RESULTS

Sample Number	Sample Length (cm)	Sample Diameter (cm)	Sample Dry Density (pcf)	Maximum Dry Density (pcf)	Compaction (%)	Initial Moisture (%)	Optimum Moisture (%)	Effective Stress (psi)	Back Pressure (psi)	Gradient	Average Permeability (cm/sec)
GA-TP-02 @ 2' - 6'	9.45	7..27	100.8	119.0	84.7	10.7	11.8	10	90	2	7.0×10^{-5}
GA-TP-02 @ 2' - 6' with 3% added Bentonite	9.41	7.30	100.7	119.0	84.6	10.3	11.5	10	90	2	4.2×10^{-6}
GA-TP-03 @ 4' - 9'	9.61	7.18	101.3	118.8	85.3	10.2	11.8	10	90	2	8.2×10^{-5}
GA-TP-03 @ 4' - 9' with 3% added Bentonite	9.41	7.26	101.3	118.8	85.3	10.7	11.8	10	90	11	3.2×10^{-6}
GA-TP-07 @ 1.5' - 9'	15.48	7.30	110.6	116.9	94.6	12.1	12.1	10	90	1	1.3×10^{-4}
GA-TP-04 @ 5' -10'	9.40	7.27	115.5	120.4	95.9	11.3	11.3	10	90	3	1.2×10^{-5}
GA-TP-04 @ 5' -10' with 1% added Bentonite	9.39	7.26	116.2	120.4	96.5	11.6	11.3	10	90	16	2.2×10^{-6}
GA-TP-04 @ 5' -10' with 3% added Bentonite	9.42	7.29	114.8	120.4	95.3	10.3	11.3	10	90	17	8.1×10^{-7}
GA-TP-09 @ 1' -11'	9.43	7.28	100.6	100.0	100.6	9.8	10.0	10	90	2	1.7×10^{-5}
GA-TP-09 @ 1-11' with 3% added Bentonite	9.40	7.29	100.4	100.0	100.4	9.3	10.0	10	90	15	2.3×10^{-6}
GA-TP-05 @ 0 -9.5'	9.34	7.28	113.7	118.1	96.3	11.7	12.0	10	90	7	4.9×10^{-6}
GA-TP-05 @ 0-9.5' with 1% added Bentonite	9.36	7.27	113.7	118.1	96.3	11.8	12.0	10	90	4	7.4×10^{-7}
GA-TP-05 @ 0-9.5' with 3% added Bentonite	9.37	7.29	113.3	118.1	95.9	11.5	12.0	10	90	6	5.4×10^{-7}

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-BH-08	Depth	44.5-44.75
SAMPLE TYPE	Brass Liner		

BOARD #	8
CELL #	--
Flow Pump Speed	5
Technician	BDM

COMMENTS
1. Water used as permeant
2. Specific gravity is assumed
3. Initial dimensions and weights are approximated
4. Sample was dry, extruded directly into membrane

Sample Data, Initial			
Height, cm	6.05	B-Value, f	97.0
Diameter, cm	4.93	Cell Pres.	100.0
Area, cm²	19.09	Bot. Pres.	85.0
Volume, cm³	115.49	Top Pres.	85.0
Mass, g	153.79	Tot. B.P.	85.0
Moisture Content, %	13.5	Head, max.	13
Dry Density, pcf	73.2	Head, min.	13
Spec. Gravity	2.70	Max. Grad.	2.15
Volume Solids, cm³	50.17	Min. Grad.	2.15
Volume Voids, cm³	65.32		
Void Ratio	1.30		
Saturation, %	28.1%		

Sample Data, Final	
Height, cm	5.83
Diameter, cm	4.66
Area, cm²	17.06
Volume, cm³	99.43
Mass, g	182.53
Moisture Content,%	38.0
Dry Density, pcf	83.0
Volume Solids, cm³	49.00
Volume Voids, cm³	50.43
Void Ratio	1.03
Saturation, %	99.6%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	52.69	281.0
Wt Soil & Tare, f	g	49.36	231.11
Wt Tare	g	24.76	99.60
Wt Moisture Lost	g	3.33	49.93
Wt Dry Soil	g	24.60	131.51
Water Content	%	13.5%	38.0%

DESCRIPTION
--

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
12/4/07	9:45											
12/4/07	10:00	15	20.7	5	1	13	6.05	19.09	2.15	1.4E-03	7.3E-05	3.4E-05

PERMEABILITY REPORTED AS ** 3.4E-05 cm/sec **

DATE 12/4/2007
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694		
SAMPLE ID	GA-BH-42	Depth	10-11'
SAMPLE TYPE	Shelby Tube		

BOARD #	1
CELL #	TX2
Flow Pump Speed	1
Technician	BDM

COMMENTS
1. Water used as permeant
2. Specific gravity is assumed

Sample Data, Initial			
Height, cm	15.40	B-Value, f	95.0
Diameter, cm	7.30	Cell Pres.	100.0
Area, cm²	41.85	Bot. Pres.	90.0
Volume, cm³	644.55	Top Pres.	90.0
Mass, g	892.90	Tot. B.P.	90.0
Moisture Content, %	3.1	Head, max.	23
Dry Density, pcf	83.8	Head, min.	23
Spec. Gravity	2.70	Max. Grad.	1.49
Volume Solids, cm³	320.76	Min. Grad.	1.49
Volume Voids, cm³	323.79		
Void Ratio	1.01		
Saturation, %	8.3%		

Sample Data, Final	
Height, cm	--
Diameter, cm	--
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	--
Moisture Content,%	#VALUE!
Dry Density, pcf	#VALUE!
Volume Solids, cm³	#VALUE!
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	--	--
Wt Soil & Tare, f	g	--	--
Wt Tare	g	--	--
Wt Moisture Lost	g	#VALUE!	#VALUE!
Wt Dry Soil	g	#VALUE!	#VALUE!
Water Content	%	3.1%	#VALUE!

DESCRIPTION
Light brown silty sand.

Flow Pump Rate 2.80E-02 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/8/08	13:00											
2/8/08	13:15	15	20.7	1	1	23	15.40	41.85	1.49	2.8E-02	6.7E-04	4.5E-04

PERMEABILITY REPORTED AS ** 4.5E-04 cm/sec **

DATE 2/8/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694		
SAMPLE ID	GA-BH-47	Depth	2-3.5
SAMPLE TYPE	Brass Liner		

BOARD #	7
CELL #	TX3
Flow Pump Speed	1
Technician	BDM

COMMENTS
1. Water used as permeant
2. Specific gravity is assumed

Sample Data, Initial			
Height, cm	15.95	B-Value, f	92.0
Diameter, cm	7.30	Cell Pres.	100.0
Area, cm²	41.85	Bot. Pres.	90.0
Volume, cm³	667.57	Top Pres.	90.0
Mass, g	978.40	Tot. B.P.	90.0
Moisture Content, %	1.7	Head, max.	18
Dry Density, pcf	89.9	Head, min.	18
Spec. Gravity	2.70	Max. Grad.	1.13
Volume Solids, cm³	356.24	Min. Grad.	1.13
Volume Voids, cm³	311.33		
Void Ratio	0.87		
Saturation, %	5.3%		

Sample Data, Final	
Height, cm	--
Diameter, cm	--
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	--
Moisture Content,%	#VALUE!
Dry Density, pcf	#VALUE!
Volume Solids, cm³	#VALUE!
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	75.56	--
Wt Soil & Tare, f	g	74.71	--
Wt Tare	g	25.33	--
Wt Moisture Lost	g	0.85	#VALUE!
Wt Dry Soil	g	49.38	#VALUE!
Water Content	%	1.7%	#VALUE!

DESCRIPTION
Light brown silty sand.

Flow Pump Rate 2.80E-02 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/6/08	13:00											
2/6/08	13:15	15	20.7	1	1	18	15.95	41.85	1.13	2.8E-02	6.7E-04	5.9E-04

PERMEABILITY REPORTED AS ** 5.9E-04 cm/sec **

DATE 2/6/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-02	Depth	2'-6'
SAMPLE TYPE	Remold		

BOARD #	5
CELL #	5
Flow Pump Speed	3
Technician	BDM/LE

COMMENTS
1. The sample was remolded to 85.3% of the Maximum Dry Density and -1.1% of OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.45	B-Value, f	95.0
Diameter, cm	7.27	Cell Pres.	100.0
Area, cm²	41.51	Bot. Pres.	90.0
Volume, cm³	392.27	Top Pres.	90.0
Mass, g	701.00	Tot. B.P.	10.0
Moisture Content, %	10.7	Head, max.	18
Dry Density, pcf	100.8	Head, min.	18
Spec. Gravity	2.70	Max. Grad.	1.90
Volume Solids, cm³	234.61	Min. Grad.	1.90
Volume Voids, cm³	157.67		
Void Ratio	0.67		
Saturation, %	42.9%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	NOTE 1
Volume, cm³	NOTE 1
Mass, g	NA
Moisture Content,%	18.6
Dry Density, pcf	NOTE 1
Volume Solids, cm³	NOTE 1
Volume Voids, cm³	NOTE 1
Void Ratio	NOTE 1
Saturation, %	NOTE 1

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	187.54	855.50
Wt Soil & Tare, f	g	172.18	737.03
Wt Tare	g	28.17	98.40
Wt Moisture Lost	g	15.36	118.47
Wt Dry Soil	g	144.01	638.63
Water Content	%	10.7%	18.6%

DESCRIPTION

Yellowish red silty sand (SM)

Notes: (1) Sample was too soft to take final measurements accurately.

Flow Pump Rate 5.50E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/4/08	9:45											
2/4/08	10:00	15	20.7	3	1	18	9.45	41.51	1.90	5.5E-03	1.3E-04	7.0E-05

PERMEABILITY REPORTED AS ** 7.0E-05 cm/sec **

DATE 2/4/2008

REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694 Phase 2		
SAMPLE ID	GA-TP-02	Depth	2'-6'
SAMPLE TYPE	Remold with 3% added bentonite.		

BOARD #	5
CELL #	5
Flow Pump Speed	7
Technician	LE

COMMENTS
1. The sample was remolded to 84.6% of the Maximum Dry Density and -1.5% of OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.41	B-Value, f	96.0
Diameter, cm	7.30	Cell Pres.	100.0
Area, cm²	41.85	Bot. Pres.	90.0
Volume, cm³	393.84	Top Pres.	90.0
Mass, g	701.06	Tot. B.P.	10.0
Moisture Content, %	10.3	Head, max.	16
Dry Density, pcf	100.7	Head, min.	14
Spec. Gravity	2.70	Max. Grad.	1.70
Volume Solids, cm³	235.38	Min. Grad.	1.49
Volume Voids, cm³	158.46		
Void Ratio	0.67		
Saturation, %	41.4%		

Sample Data, Final	
Height, cm	9.12
Diameter, cm	7.00
Area, cm²	38.48
Volume, cm³	350.98
Mass, g	755.70
Moisture Content,%	17.9
Dry Density, pcf	113.9
Volume Solids, cm³	237.33
Volume Voids, cm³	113.65
Void Ratio	0.48
Saturation, %	101.1%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	125.00	839.90
Wt Soil & Tare, f	g	115.98	725.05
Wt Tare	g	28.50	84.53
Wt Moisture Lost	g	9.02	114.85
Wt Dry Soil	g	87.48	640.52
Water Content	%	10.3%	17.9%

DESCRIPTION
Yellowish red silty sand (SM). 3% added bentonite.

Flow Pump Rate 2.80E-04 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/8/08	12:45											
2/8/08	13:00	15	20.7	7	1	14	9.41	41.85	1.49	2.8E-04	6.7E-06	4.5E-06
2/8/08	13:15	30	20.7	7	1	16	9.41	41.85	1.70	2.8E-04	6.7E-06	3.9E-06
2/8/08	13:30	45	20.7	7	1	16	9.41	41.85	1.70	2.8E-04	6.7E-06	3.9E-06
2/8/08	13:45	60	20.7	7	1	15	9.41	41.85	1.59	2.8E-04	6.7E-06	4.2E-06
2/8/08	14:00	75	20.7	7	1	15	9.41	41.85	1.59	2.8E-04	6.7E-06	4.2E-06

PERMEABILITY REPORTED AS ** 4.2E-06 cm/sec **

DATE 2/8/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-03	Depth	4'-9'
SAMPLE TYPE	Remold		

BOARD #	2
CELL #	BB
Flow Pump Speed	3
Technician	BDM/LE

COMMENTS
1. The sample was remolded to 85.3% of the Maximum Dry Density and -1.6% of OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.61	B-Value, f	95.0
Diameter, cm	7.18	Cell Pres.	100.0
Area, cm²	40.49	Bot. Pres.	90.0
Volume, cm³	389.10	Top Pres.	90.0
Mass, g	696.60	Tot. B.P.	10.0
Moisture Content, %	10.2	Head, max.	16
Dry Density, pcf	101.3	Head, min.	16
Spec. Gravity	2.70	Max. Grad.	1.66
Volume Solids, cm³	234.03	Min. Grad.	1.66
Volume Voids, cm³	155.07		
Void Ratio	0.66		
Saturation, %	41.7%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	NOTE 1
Volume, cm³	NOTE 1
Mass, g	NA
Moisture Content,%	20.5
Dry Density, pcf	NOTE 1
Volume Solids, cm³	NOTE 1
Volume Voids, cm³	NOTE 1
Void Ratio	NOTE 1
Saturation, %	NOTE 1

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	179.03	860.00
Wt Soil & Tare, f	g	165.03	731.00
Wt Tare	g	28.32	100.92
Wt Moisture Lost	g	14.00	129.00
Wt Dry Soil	g	136.71	630.08
Water Content	%	10.2%	20.5%

DESCRIPTION

Strong brown silty sand (SM)

Notes: (1) Sample was too soft to take final measurements accurately.

Flow Pump Rate 5.50E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/1/08	9:45											
2/1/08	10:00	15	20.7	3	1	16	9.61	40.49	1.66	5.5E-03	1.4E-04	8.2E-05

PERMEABILITY REPORTED AS ** 8.2E-05 cm/sec **

DATE 2/1/2008

REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Piñon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-03	Depth	4'-9'
SAMPLE TYPE	Remolded with 3% Bentonite		

BOARD #	5
CELL #	5
Flow Pump Speed	5
Technician	LE

COMMENTS
1. The sample was remolded to 85.3% of the Maximum Dry Density and -1.1% of OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed
4. Sample was too soft to take final measurements accurately.

Sample Data, Initial			
Height, cm	9.41	B-Value, f	95.0
Diameter, cm	7.26	Cell Pres.	100.0
Area, cm²	41.40	Bot. Pres.	90.0
Volume, cm³	389.54	Top Pres.	90.0
Mass, g	700.60	Tot. B.P.	10.0
Moisture Content, %	10.7	Head, max.	101
Dry Density, pcf	101.3	Head, min.	97
Spec. Gravity	2.70	Max. Grad.	10.73
Volume Solids, cm³	234.30	Min. Grad.	10.31
Volume Voids, cm³	155.24		
Void Ratio	0.66		
Saturation, %	43.8%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	765.17
Moisture Content,%	20.4
Dry Density, pcf	#VALUE!
Volume Solids, cm³	235.37
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	180.71	848.90
Wt Soil & Tare, f	g	166.02	719.27
Wt Tare	g	29.31	84.03
Wt Moisture Lost	g	14.69	129.63
Wt Dry Soil	g	136.71	635.24
Water Content	%	10.7%	20.4%

DESCRIPTION
Strong brown silty sand (SM)

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/18/08	10:35											
2/18/08	10:45	10	20.7	5	1	97	9.41	41.40	10.31	1.4E-03	3.4E-05	3.3E-06
2/18/08	11:00	25	20.7	5	1	101	9.41	41.40	10.73	1.4E-03	3.4E-05	3.2E-06
2/18/08	11:15	40	20.7	5	1	99	9.41	41.40	10.52	1.4E-03	3.4E-05	3.2E-06

PERMEABILITY REPORTED AS ** 3.2E-06 cm/sec **

DATE 2/18/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-04	Depth	5-10'
SAMPLE TYPE	Remold		

BOARD #	1
CELL #	7
Flow Pump Speed	5
Technician	BDM/LE

COMMENTS
1. The sample was remolded to 95.9% of the Maximum Dry Density and at OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.40	B-Value, f	96.0
Diameter, cm	7.27	Cell Pres.	100.0
Area, cm²	41.51	Bot. Pres.	90.0
Volume, cm³	390.20	Top Pres.	90.0
Mass, g	804.10	Tot. B.P.	10.0
Moisture Content, %	11.3	Head, max.	26
Dry Density, pcf	115.5	Head, min.	25
Spec. Gravity	2.70	Max. Grad.	2.77
Volume Solids, cm³	267.54	Min. Grad.	2.66
Volume Voids, cm³	122.66		
Void Ratio	0.46		
Saturation, %	66.6%		

Sample Data, Final	
Height, cm	8.98
Diameter, cm	7.27
Area, cm²	41.51
Volume, cm³	372.76
Mass, g	833.10
Moisture Content,%	15.7
Dry Density, pcf	120.6
Volume Solids, cm³	266.76
Volume Voids, cm³	106.01
Void Ratio	0.40
Saturation, %	106.5%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	178.00	932.90
Wt Soil & Tare, f	g	162.72	820.10
Wt Tare	g	27.67	100.20
Wt Moisture Lost	g	15.28	112.80
Wt Dry Soil	g	135.05	719.90
Water Content	%	11.3%	15.7%

DESCRIPTION
Yellowish red silty sand (SM)

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/15/08	8:30											
2/15/08	8:35	5	20.7	5	1	25	9.40	41.51	2.66	1.4E-03	3.4E-05	1.3E-05
	8:40	10	20.7	5	1	25	9.40	41.51	2.66	1.4E-03	3.4E-05	1.3E-05
	8:45	15	20.7	5	1	26	9.40	41.51	2.77	1.4E-03	3.4E-05	1.2E-05
	8:50	20	20.7	5	1	26	9.40	41.51	2.77	1.4E-03	3.4E-05	1.2E-05

PERMEABILITY REPORTED AS ** 1.2E-05 cm/sec **

DATE 2/15/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-04	Depth	5-10'
SAMPLE TYPE	Remolded with 1% Bentonite		

BOARD #	4
CELL #	CC
Flow Pump Speed	5
Technician	LE

COMMENTS
1. The sample was remolded to 96.5% of the Maximum Dry Density and at +0.3% OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed
4. Sample was too soft to take final measurements accurately.

Sample Data, Initial			
Height, cm	9.39	B-Value, f	97.0
Diameter, cm	7.26	Cell Pres.	100.0
Area, cm²	41.40	Bot. Pres.	90.0
Volume, cm³	388.71	Top Pres.	90.0
Mass, g	807.78	Tot. B.P.	10.0
Moisture Content, %	11.6	Head, max.	148
Dry Density, pcf	116.2	Head, min.	135
Spec. Gravity	2.70	Max. Grad.	15.76
Volume Solids, cm³	268.18	Min. Grad.	14.38
Volume Voids, cm³	120.54		
Void Ratio	0.45		
Saturation, %	69.4%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	837.80
Moisture Content,%	15.6
Dry Density, pcf	#VALUE!
Volume Solids, cm³	268.51
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	185.35	922.80
Wt Soil & Tare, f	g	169.07	810.00
Wt Tare	g	28.24	85.23
Wt Moisture Lost	g	16.28	112.80
Wt Dry Soil	g	140.83	724.77
Water Content	%	11.6%	15.6%

DESCRIPTION
Yellowish red silty sand (SM)

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/18/08	9:40											
2/18/08	9:45	5	20.7	5	1	135	9.39	41.40	14.38	1.4E-03	3.4E-05	2.4E-06
2/18/08	10:00	20	20.7	5	1	146	9.39	41.40	15.55	1.4E-03	3.4E-05	2.2E-06
2/18/08	10:15	35	20.7	5	1	148	9.39	41.40	15.76	1.4E-03	3.4E-05	2.1E-06

PERMEABILITY REPORTED AS ** 2.2E-06 cm/sec **

DATE 2/18/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-04	Depth	5-10'
SAMPLE TYPE	Remolded with 3% Bentonite		

BOARD #	1
CELL #	7
Flow Pump Speed	6
Technician	LE

COMMENTS
1. The sample was remolded to 95.3% of the Maximum Dry Density and at -1.0% OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed
4. Sample was too soft to take final measurements accurately.

Sample Data, Initial			
Height, cm	9.42	B-Value, f	95.0
Diameter, cm	7.29	Cell Pres.	100.0
Area, cm²	41.74	Bot. Pres.	90.0
Volume, cm³	393.18	Top Pres.	90.0
Mass, g	797.90	Tot. B.P.	10.0
Moisture Content, %	10.3	Head, max.	159
Dry Density, pcf	114.8	Head, min.	150
Spec. Gravity	2.70	Max. Grad.	16.88
Volume Solids, cm³	267.90	Min. Grad.	15.92
Volume Voids, cm³	125.28		
Void Ratio	0.47		
Saturation, %	59.5%		

Sample Data, Final	
Height, cm	9.49
Diameter, cm	7.32
Area, cm²	42.08
Volume, cm³	399.37
Mass, g	841.20
Moisture Content,%	15.7
Dry Density, pcf	113.6
Volume Solids, cm³	269.28
Volume Voids, cm³	130.10
Void Ratio	0.48
Saturation, %	87.7%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	177.61	923.80
Wt Soil & Tare, f	g	163.69	809.70
Wt Tare	g	28.65	82.99
Wt Moisture Lost	g	13.92	114.10
Wt Dry Soil	g	135.04	726.71
Water Content	%	10.3%	15.7%

DESCRIPTION
Yellowish red silty sand (SM)

Flow Pump Rate 5.50E-04 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/21/08	12:45											
2/21/08	13:15	30	20.7	6	1	150	9.42	41.74	15.92	5.5E-04	1.3E-05	8.3E-07
2/21/08	13:30	45	20.7	6	1	151	9.42	41.74	16.03	5.5E-04	1.3E-05	8.2E-07
2/21/08	13:45	60	20.7	6	1	159	9.42	41.74	16.88	5.5E-04	1.3E-05	7.8E-07
2/21/08	14:00	75	20.7	6	1	157	9.42	41.74	16.67	5.5E-04	1.3E-05	7.9E-07

PERMEABILITY REPORTED AS ** 8.1E-07 cm/sec **

DATE 2/21/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-05	Depth	0'-9.5'
SAMPLE TYPE	Remold		

BOARD #	2
CELL #	BB
Flow Pump Speed	5
Technician	LE

COMMENTS
1. The sample was remolded to 96.3% of the Maximum Dry Density and at -0.3% OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.34	B-Value, f	95.0
Diameter, cm	7.28	Cell Pres.	100.0
Area, cm²	41.62	Bot. Pres.	90.0
Volume, cm³	388.78	Top Pres.	90.0
Mass, g	791.30	Tot. B.P.	10.0
Moisture Content, %	11.7	Head, max.	66
Dry Density, pcf	113.7	Head, min.	62
Spec. Gravity	2.70	Max. Grad.	7.07
Volume Solids, cm³	262.39	Min. Grad.	6.64
Volume Voids, cm³	126.39		
Void Ratio	0.48		
Saturation, %	65.6%		

Sample Data, Final	
Height, cm	9.23
Diameter, cm	7.28
Area, cm²	41.62
Volume, cm³	384.20
Mass, g	824.20
Moisture Content,%	15.7
Dry Density, pcf	115.7
Volume Solids, cm³	263.84
Volume Voids, cm³	120.35
Void Ratio	0.46
Saturation, %	92.9%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	177.35	909.00
Wt Soil & Tare, f	g	161.81	797.22
Wt Tare	g	28.93	85.13
Wt Moisture Lost	g	15.54	111.78
Wt Dry Soil	g	132.88	712.09
Water Content	%	11.7%	15.7%

DESCRIPTION
Strong brown silty sand (SM)

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/20/08	13:30											
2/20/08	13:35	5	20.7	5	1	62	9.34	41.62	6.64	1.4E-03	3.4E-05	5.1E-06
2/20/08	13:45	15	20.7	5	1	63	9.34	41.62	6.75	1.4E-03	3.4E-05	5.0E-06
2/20/08	13:55	25	20.7	5	1	65	9.34	41.62	6.96	1.4E-03	3.4E-05	4.8E-06
2/20/08	14:05	35	20.7	5	1	66	9.34	41.62	7.07	1.4E-03	3.4E-05	4.8E-06

PERMEABILITY REPORTED AS ** 4.9E-06 cm/sec **

DATE 2/20/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-05	Depth	0'-9.5'
SAMPLE TYPE	Remolded with 1% Bentonite		

BOARD #	5
CELL #	5
Flow Pump Speed	8
Technician	LE

COMMENTS
1. The sample was remolded to 96.3% of the Maximum Dry Density and at -0.2% OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.36	B-Value, f	99.0
Diameter, cm	7.27	Cell Pres.	100.0
Area, cm²	41.51	Bot. Pres.	90.0
Volume, cm³	388.54	Top Pres.	90.0
Mass, g	791.70	Tot. B.P.	10.0
Moisture Content, %	11.8	Head, max.	44
Dry Density, pcf	113.7	Head, min.	42
Spec. Gravity	2.70	Max. Grad.	4.70
Volume Solids, cm³	262.21	Min. Grad.	4.49
Volume Voids, cm³	126.33		
Void Ratio	0.48		
Saturation, %	66.3%		

Sample Data, Final	
Height, cm	9.36
Diameter, cm	7.27
Area, cm²	41.51
Volume, cm³	388.54
Mass, g	825.10
Moisture Content,%	16.1
Dry Density, pcf	114.1
Volume Solids, cm³	263.20
Volume Voids, cm³	125.34
Void Ratio	0.48
Saturation, %	91.3%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	172.04	910.00
Wt Soil & Tare, f	g	156.59	795.56
Wt Tare	g	25.95	85.12
Wt Moisture Lost	g	15.45	114.44
Wt Dry Soil	g	130.64	710.44
Water Content	%	11.8%	16.1%

DESCRIPTION
Strong brown silty sand (SM)

Flow Pump Rate 1.40E-04 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/21/08	9:25											
2/21/08	9:45	20	20.7	8	1	43	9.36	41.51	4.59	1.4E-04	3.4E-06	7.3E-07
2/21/08	10:00	35	20.7	8	1	42	9.36	41.51	4.49	1.4E-04	3.4E-06	7.5E-07
2/21/08	10:15	50	20.7	8	1	42	9.36	41.51	4.49	1.4E-04	3.4E-06	7.5E-07
2/21/08	10:30	65	20.7	8	1	44	9.36	41.51	4.70	1.4E-04	3.4E-06	7.2E-07

PERMEABILITY REPORTED AS ** 7.4E-07 cm/sec **

DATE 2/21/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-05	Depth	0'-9.5'
SAMPLE TYPE	Remolded with 3% Bentonite		

BOARD #	4
CELL #	8
Flow Pump Speed	8
Technician	LE

COMMENTS
1. The sample was remolded to 95.9% of the Maximum Dry Density and at -0.5% OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.37	B-Value, f	95.0
Diameter, cm	7.29	Cell Pres.	100.0
Area, cm²	41.74	Bot. Pres.	90.0
Volume, cm³	391.10	Top Pres.	90.0
Mass, g	791.70	Tot. B.P.	10.0
Moisture Content, %	11.5	Head, max.	61
Dry Density, pcf	113.3	Head, min.	57
Spec. Gravity	2.70	Max. Grad.	6.51
Volume Solids, cm³	262.95	Min. Grad.	6.08
Volume Voids, cm³	128.15		
Void Ratio	0.49		
Saturation, %	63.8%		

Sample Data, Final	
Height, cm	9.32
Diameter, cm	7.28
Area, cm²	41.62
Volume, cm³	387.94
Mass, g	828.10
Moisture Content,%	16.2
Dry Density, pcf	114.6
Volume Solids, cm³	263.89
Volume Voids, cm³	124.05
Void Ratio	0.47
Saturation, %	93.2%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	178.11	911.70
Wt Soil & Tare, f	g	162.41	796.14
Wt Tare	g	26.04	83.89
Wt Moisture Lost	g	15.70	115.56
Wt Dry Soil	g	136.37	712.25
Water Content	%	11.5%	16.2%

DESCRIPTION
Strong brown silty sand (SM)

Flow Pump Rate 1.40E-04 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/25/08	13:40											
2/25/08	14:00	20	20.7	8	1	58	9.37	41.74	6.19	1.4E-04	3.4E-06	5.4E-07
2/25/08	14:15	35	20.7	8	1	57	9.37	41.74	6.08	1.4E-04	3.4E-06	5.5E-07
2/25/08	14:30	50	20.7	8	1	59	9.37	41.74	6.30	1.4E-04	3.4E-06	5.3E-07
2/25/08	14:45	65	20.7	8	1	61	9.37	41.74	6.51	1.4E-04	3.4E-06	5.2E-07

PERMEABILITY REPORTED AS ** 5.4E-07 cm/sec **

DATE 2/25/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Pinon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-07	Depth	1.5-9
SAMPLE TYPE	Remold		

BOARD #	--
CELL #	--
Flow Pump Speed	3
Technician	BDM

COMMENTS
1. The sample was remolded to 94.7% of the Maximum Dry Density and 0.0% of OPT MC (using ASTM D 698).
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	15.48	B-Value, f	97.0
Diameter, cm	7.30	Cell Pres.	100.0
Area, cm²	41.85	Bot. Pres.	90.0
Volume, cm³	647.90	Top Pres.	90.0
Mass, g	1287.70	Tot. B.P.	90.0
Moisture Content, %	12.1	Head, max.	16
Dry Density, pcf	110.7	Head, min.	16
Spec. Gravity	2.70	Max. Grad.	1.03
Volume Solids, cm³	425.52	Min. Grad.	1.03
Volume Voids, cm³	222.38		
Void Ratio	0.52		
Saturation, %	62.4%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	NA
Moisture Content,%	14.5
Dry Density, pcf	#VALUE!
Volume Solids, cm³	#VALUE!
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	227.04	728.10
Wt Soil & Tare, f	g	206.08	648.80
Wt Tare	g	32.59	101.96
Wt Moisture Lost	g	20.96	79.30
Wt Dry Soil	g	173.49	546.84
Water Content	%	12.1%	14.5%

DESCRIPTION
Brown silty sand (SM)

Flow Pump Rate 5.50E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient))	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
1/24/08	9:45											
1/24/08	10:00	15	20.7	3	1	16	15.48	41.85	1.03	5.5E-03	1.3E-04	1.3E-04

PERMEABILITY REPORTED AS ** 1.3E-04 cm/sec **

DATE 1/24/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Piñon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-09	Depth	1'-11'
SAMPLE TYPE	Remold		

BOARD #	5
CELL #	5
Flow Pump Speed	5
Technician	LE

COMMENTS
1. The sample was remolded to 100.6% of the Maximum Dry Density and -0.2% of OPT MC.
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.43	B-Value, f	91.0
Diameter, cm	7.28	Cell Pres.	100.0
Area, cm²	41.62	Bot. Pres.	90.0
Volume, cm³	392.52	Top Pres.	90.0
Mass, g	694.80	Tot. B.P.	10.0
Moisture Content, %	9.8	Head, max.	19
Dry Density, pcf	100.6	Head, min.	19
Spec. Gravity	2.70	Max. Grad.	2.01
Volume Solids, cm³	234.46	Min. Grad.	2.01
Volume Voids, cm³	158.06		
Void Ratio	0.67		
Saturation, %	39.1%		

Sample Data, Final	
Height, cm	NA
Diameter, cm	NA
Area, cm²	#VALUE!
Volume, cm³	#VALUE!
Mass, g	758.80
Moisture Content,%	19.5
Dry Density, pcf	#VALUE!
Volume Solids, cm³	235.12
Volume Voids, cm³	#VALUE!
Void Ratio	#VALUE!
Saturation, %	#VALUE!

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	76.22	842.10
Wt Soil & Tare, f	g	70.86	718.08
Wt Tare	g	15.91	83.00
Wt Moisture Lost	g	5.36	124.02
Wt Dry Soil	g	54.95	635.08
Water Content	%	9.8%	19.5%

DESCRIPTION
--

Flow Pump Rate 1.40E-03 cm³/sec

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/27/08	10:30											
2/27/08	10:40	10	20.7	5	1	19	9.43	41.62	2.01	1.4E-03	3.4E-05	1.7E-05
2/27/08	10:45	15	20.7	5	1	19	9.43	41.62	2.01	1.4E-03	3.4E-05	1.7E-05
2/27/08	10:50	20	20.7	5	1	19	9.43	41.62	2.01	1.4E-03	3.4E-05	1.7E-05
2/27/08	10:55	25	20.7	5	1	19	9.43	41.62	2.01	1.4E-03	3.4E-05	1.7E-05

PERMEABILITY REPORTED AS ** 1.7E-05 cm/sec **

DATE 2/27/2008
REVIEW MB

FLOW PUMP #1

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	Energy Fuels/Geotech Piñon Ridge		
PROJECT NUMBER	073-81694.0001		
SAMPLE ID	GA-TP-09	Depth	1'-11'
SAMPLE TYPE	Remolded with 3% Bentonite		

BOARD #	1
CELL #	7
Flow Pump Speed	5
Technician	LE

COMMENTS
1. The sample was remolded to 100.4% of the Maximum Dry Density and -0.7% of OPT MC.
2. Water used as permeant
3. Specific gravity is assumed

Sample Data, Initial			
Height, cm	9.40	B-Value, f	95.0
Diameter, cm	7.29	Cell Pres.	100.0
Area, cm²	41.74	Bot. Pres.	90.0
Volume, cm³	392.35	Top Pres.	90.0
Mass, g	690.10	Tot. B.P.	10.0
Moisture Content, %	9.3	Head, max.	141
Dry Density, pcf	100.4	Head, min.	137
Spec. Gravity	2.70	Max. Grad.	15.00
Volume Solids, cm³	233.92	Min. Grad.	14.57
Volume Voids, cm³	158.43		
Void Ratio	0.68		
Saturation, %	36.9%		

Sample Data, Final	
Height, cm	9.24
Diameter, cm	7.32
Area, cm²	42.08
Volume, cm³	388.85
Mass, g	760.27
Moisture Content,%	20.4
Dry Density, pcf	101.3
Volume Solids, cm³	233.83
Volume Voids, cm³	155.02
Void Ratio	0.66
Saturation, %	83.2%

WATER CONTENTS		Trimmings Initial	Sample Final
Wt Soil & Tare, i	g	164.49	843.90
Wt Soil & Tare, f	g	153.43	715.02
Wt Tare	g	34.08	83.93
Wt Moisture Lost	g	11.06	128.88
Wt Dry Soil	g	119.35	631.09
Water Content	%	9.3%	20.4%

Flow Pump Rate 1.40E-03 cm³/sec

DESCRIPTION
--

DATE/TIME		dt (min)	TEMP (°C)	Speed (1-12)	Speed Coeff.	ΔH (cm)	L (cm)	A (cm²)	i (Gradient)	q (cm³/sec)	v (cm/sec)	Permeability (cm/sec)
2/27/08	12:15											
2/27/08	12:35	20	20.7	5	1	138	9.40	41.74	14.68	1.4E-03	3.4E-05	2.3E-06
2/27/08	12:45	30	20.7	5	1	141	9.40	41.74	15.00	1.4E-03	3.4E-05	2.2E-06
2/27/08	12:55	40	20.7	5	1	137	9.40	41.74	14.57	1.4E-03	3.4E-05	2.3E-06

PERMEABILITY REPORTED AS ** 2.3E-06 cm/sec **

DATE 2/27/2008
REVIEW MB

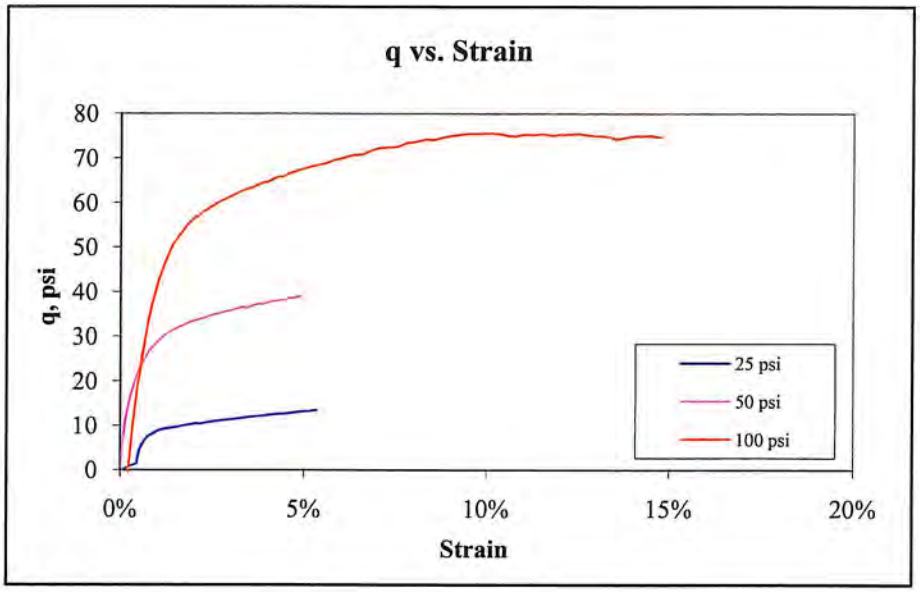
APPENDIX C-5

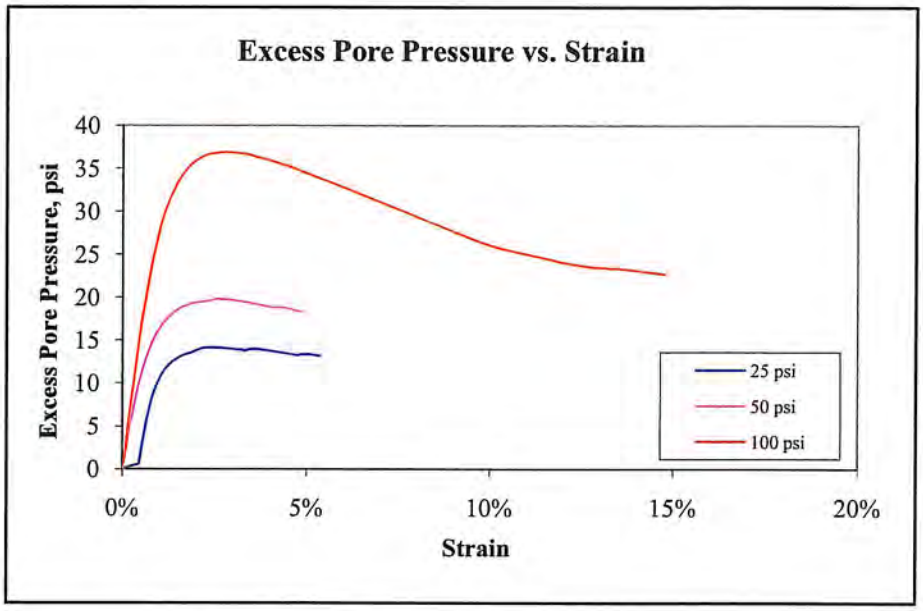
TRIAXIAL TESTING

Sample # = GATP 7 @ 1.5-9			Sample # = GATP 7 @ 1.5-9			Sample # = GATP 7 @ 1.5-9		
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	15.48	cm	Length =	15.52	cm	Length =	15.52	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	1287.70	g	Wet Weight =	1300.20	g	Wet Weight =	1300.20	g
Area =	41.9	cm^2	Area =	41.9	cm^2	Area =	41.9	cm^2
Sample Area =	6.49	in^2	Sample Area =	6.49	in^2	Sample Area =	6.49	in^2
Volume =	647.9	cm^3	Volume =	649.6	cm^3	Volume =	649.6	cm^3
Moisture Content =	12.1%		Moisture Content =	13.2%		Moisture Content =	13.2%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	1148.71	g	Dry Weight of Solids =	1148.59	g	Dry Weight of Solids =	1148.59	g
Wet Unit Weight =	1.99	g/cm^3	Wet Unit Weight =	2.00	g/cm^3	Wet Unit Weight =	2.00	g/cm^3
Dry Unit Weight =	1.77	g/cm^3	Dry Unit Weight =	1.77	g/cm^3	Dry Unit Weight =	1.77	g/cm^3
Wet Unit Weight =	124.0	pcf	Wet Unit Weight =	124.9	pcf	Wet Unit Weight =	124.9	pcf
Dry Unit Weight =	110.6	pcf	Dry Unit Weight =	110.3	pcf	Dry Unit Weight =	110.3	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	150	psi
Back Pressure =	75	psi	Back Pressure =	50	psi	Back Pressure =	50	psi
Confining Pressure =	25	psi	Confining Pressure =	50	psi	Confining Pressure =	100	psi

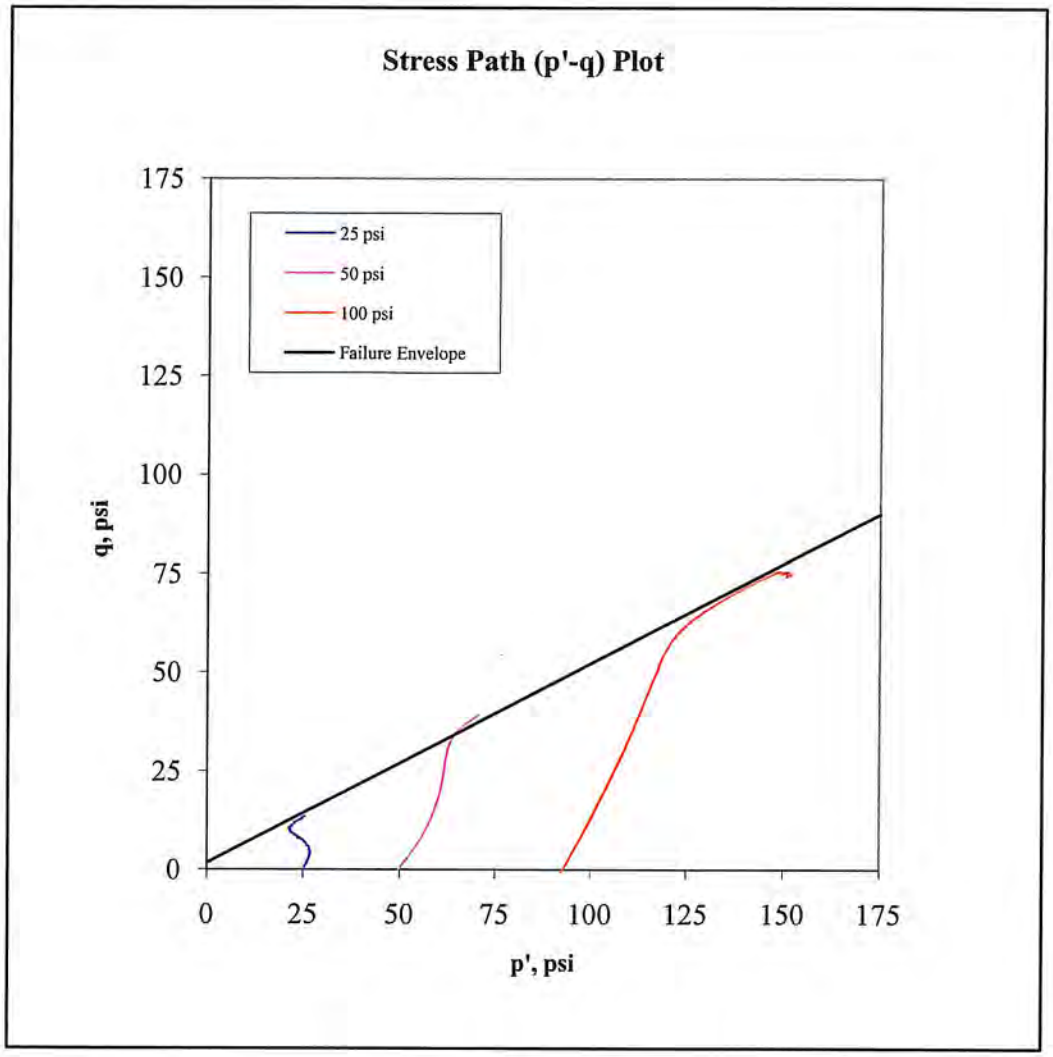
Notes: Sample consisted of sand with some clay.
Sample was remolded at approximately 95% of the maximum dry density and at the optimum moisture content (ASTM D 698).
Failure defined as the maximum principal stress ratio.
Rate of strain = 5% per hour and t_{50} = 2 min.

Golder Associates, Inc. Denver, Colorado	Title: TRIAXIAL SHEAR TEST REPORT SAMPLE DATA AND CALCULATIONS				
Job Short Title: EFR/Pinon Ridge					
Sample Number: GATP 7 @ 1.5-9	Reviewed: JEO	Date: 1/28/08	Job Number: 073-81694.001	Figure: 1	





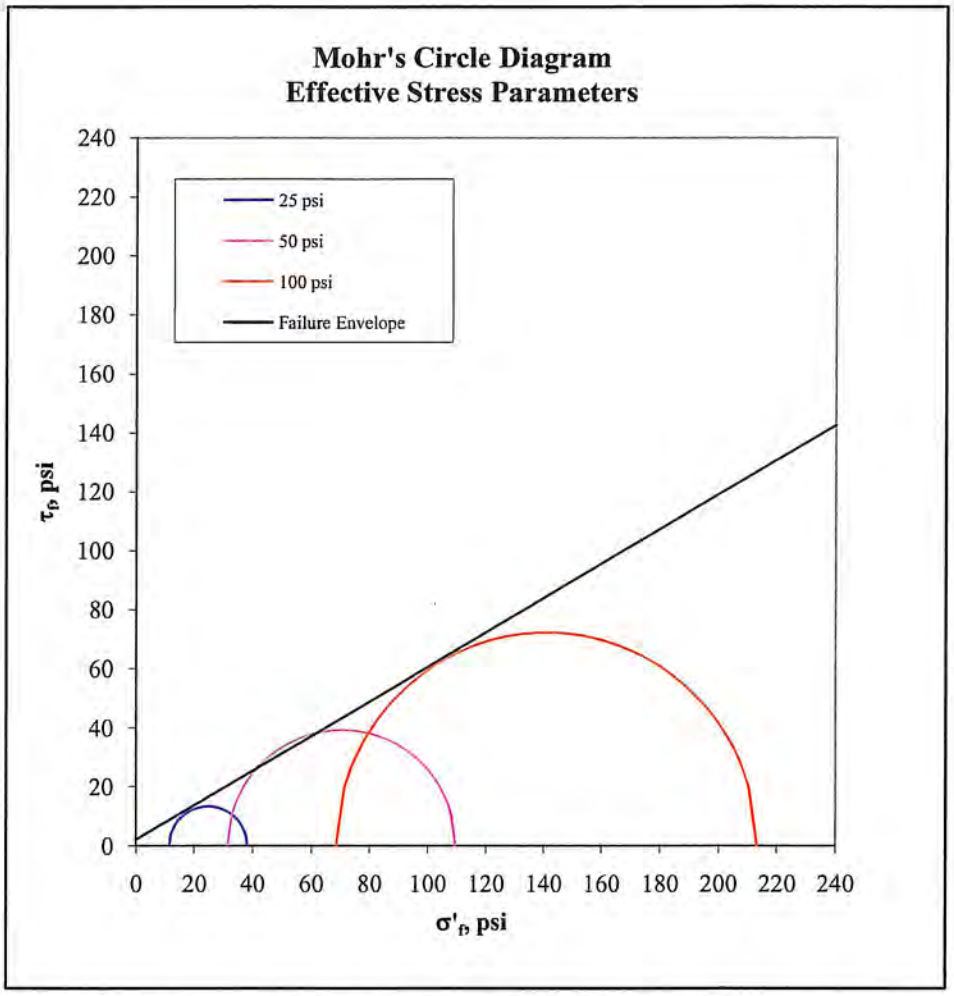
Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA q AND EXCESS PORE PRESSURE PLOTS			
Job Short Title: EFR/Pinon Ridge				
Sample Number: GATP 7 @ 1.5-9	Reviewed: JEO	Date: 1/28/08	Job Number: 073-81694.001	Figure: 2



Stress Path Parameters

ψ' = 26.8 degrees
a' = 1.7 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: EFR/Pinon Ridge				
Sample Number: GATP 7 @ 1.5-9	Reviewed: JEO	Date: 1/28/08	Job Number: 073-81694.001	Figure: 3



Effective Stress Shear Strength Parameters

$\phi' =$ 30.3 degrees
c' = 2.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA MOHR'S CIRCLE DIAGRAM			
Job Short Title: EFR/Pinon Ridge				
Sample Number: GATP 7 @ 1.5-9	Reviewed: JEO	Date: 1/28/08	Job Number: 073-81694.001	Figure: 4

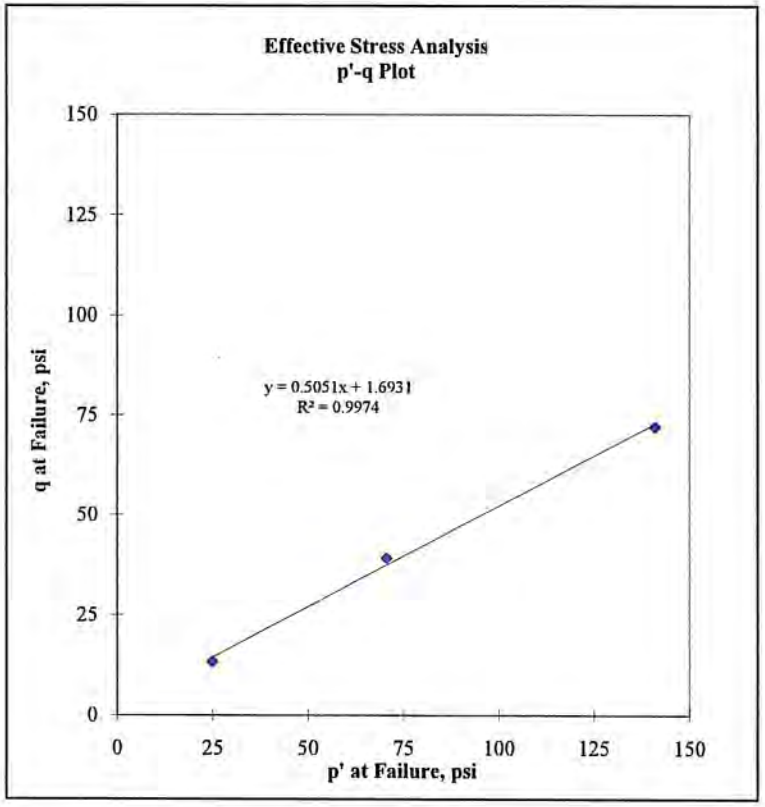
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **EFR/Pinon Ridge**
Project Number: **073-81694.001**

Sample Number	GATP 7 @ 1.5-9
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	24.9	13.2
2	70.6	39.1
3	140.9	72.2

tan(ψ') = **0.51**
a' = **1.7** **psi**

ϕ' = **30.3** **degrees**
c' = **2.0** **psi**



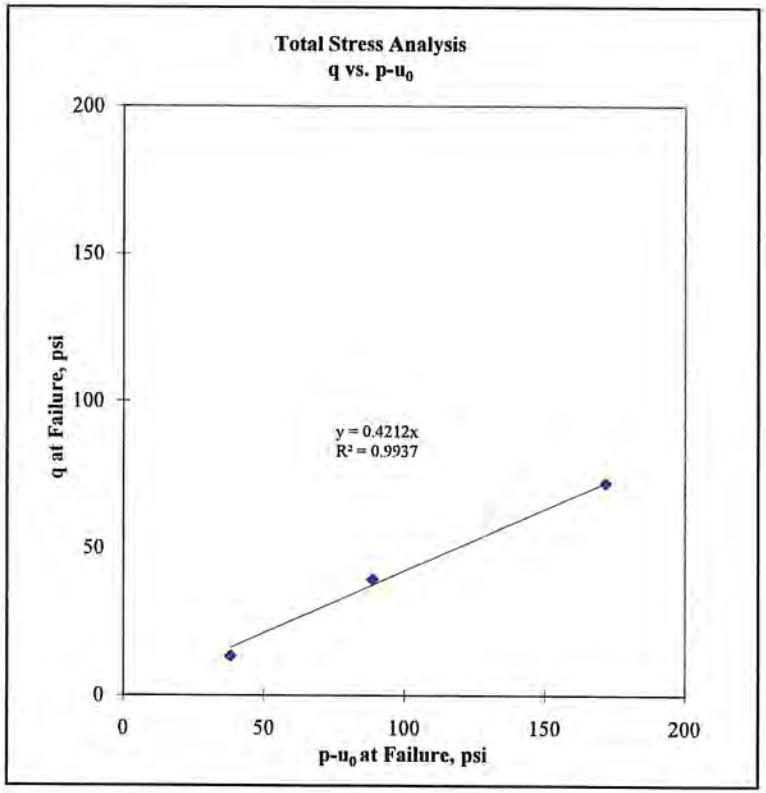
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **EFR/Pinon Ridge**
Project Number: **073-81694.001**

Sample Number	GATP 7 @ 1.5-9
Total Stress Analysis	

Point Number	$p\text{-}u_o$ (psi)	q (psi)
1	38.2	13.2
2	88.8	39.1
3	171.9	72.2

$\tan(\psi)$ = 0.42
a = 0.0 psi

ϕ = 24.9 degrees
c = 0.0 psi



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **EFR/Pinon Ridge**
Project Number: **073-81694.001**

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:

c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \quad p' = \frac{\sigma'_1 + \sigma'_3}{2} \quad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:

q = maximum shear stress

p', p = mean effective and total stresses

σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:

a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

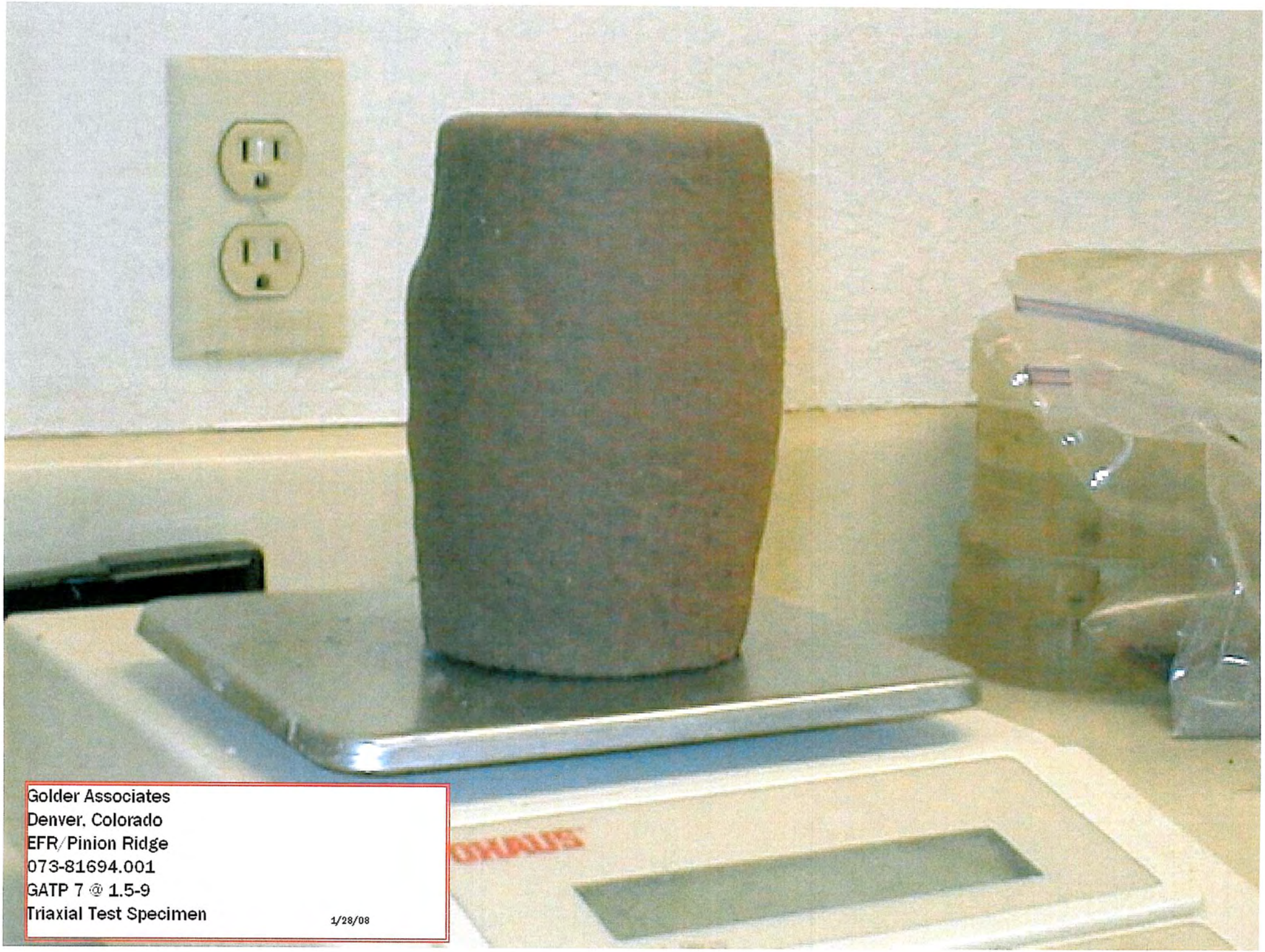
$p - u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

The relationships between ψ' and ϕ' and a' and c' are as follows:

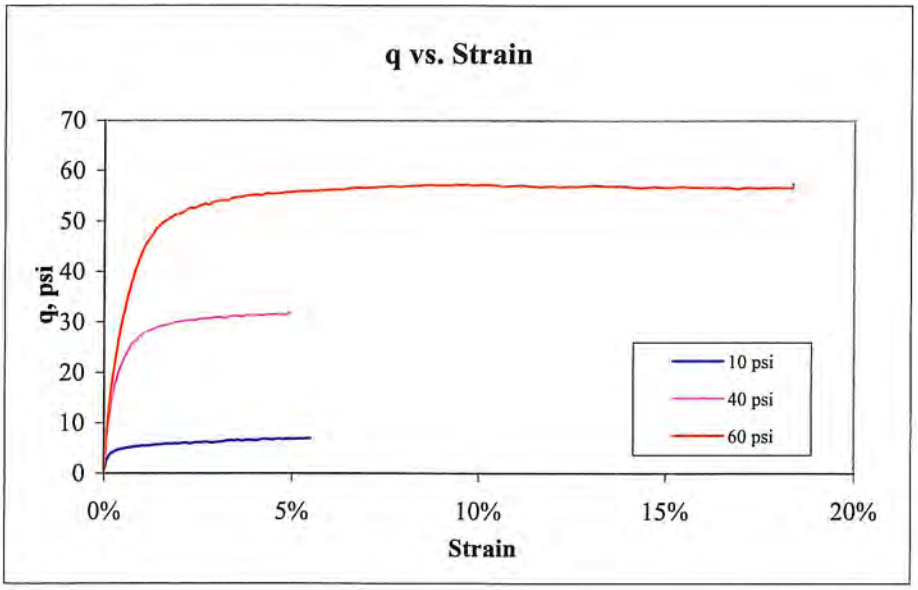
$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$

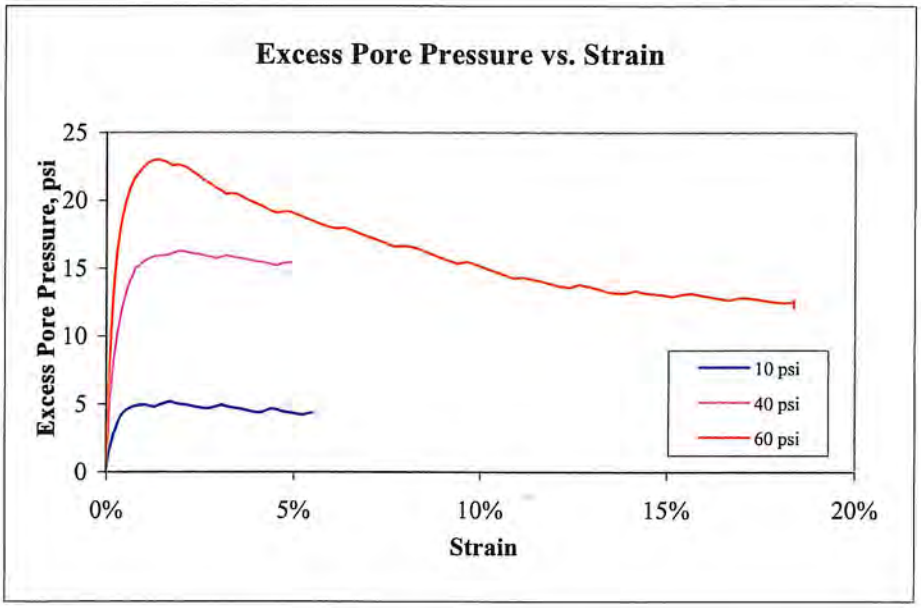

Golder Associates
Denver, Colorado
EFR/Pinion Ridge
073-81694.001
GATP 7 @ 1.5-9
Triaxial Test Specimen
1/28/08

Sample # = GATP 9 @ 1-11			Sample # = GATP 9 @ 1-11			Sample # = GATP 9 @ 1-11		
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	15.52	cm	Length =	15.52	cm	Length =	15.52	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	1300.20	g	Wet Weight =	1300.20	g	Wet Weight =	1300.20	g
Area =	41.9	cm^2	Area =	41.9	cm^2	Area =	41.9	cm^2
Sample Area =	6.49	in^2	Sample Area =	6.49	in^2	Sample Area =	6.49	in^2
Volume =	649.6	cm^3	Volume =	649.6	cm^3	Volume =	649.6	cm^3
Moisture Content =	13.2%		Moisture Content =	13.2%		Moisture Content =	13.2%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	1148.59	g	Dry Weight of Solids =	1148.59	g	Dry Weight of Solids =	1148.59	g
Wet Unit Weight =	2.00	g/cm^3	Wet Unit Weight =	2.00	g/cm^3	Wet Unit Weight =	2.00	g/cm^3
Dry Unit Weight =	1.77	g/cm^3	Dry Unit Weight =	1.77	g/cm^3	Dry Unit Weight =	1.77	g/cm^3
Wet Unit Weight =	124.9	pcf	Wet Unit Weight =	124.9	pcf	Wet Unit Weight =	124.9	pcf
Dry Unit Weight =	110.3	pcf	Dry Unit Weight =	110.3	pcf	Dry Unit Weight =	110.3	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	100	psi
Back Pressure =	90	psi	Back Pressure =	60	psi	Back Pressure =	40	psi
Confining Pressure =	10	psi	Confining Pressure =	40	psi	Confining Pressure =	60	psi

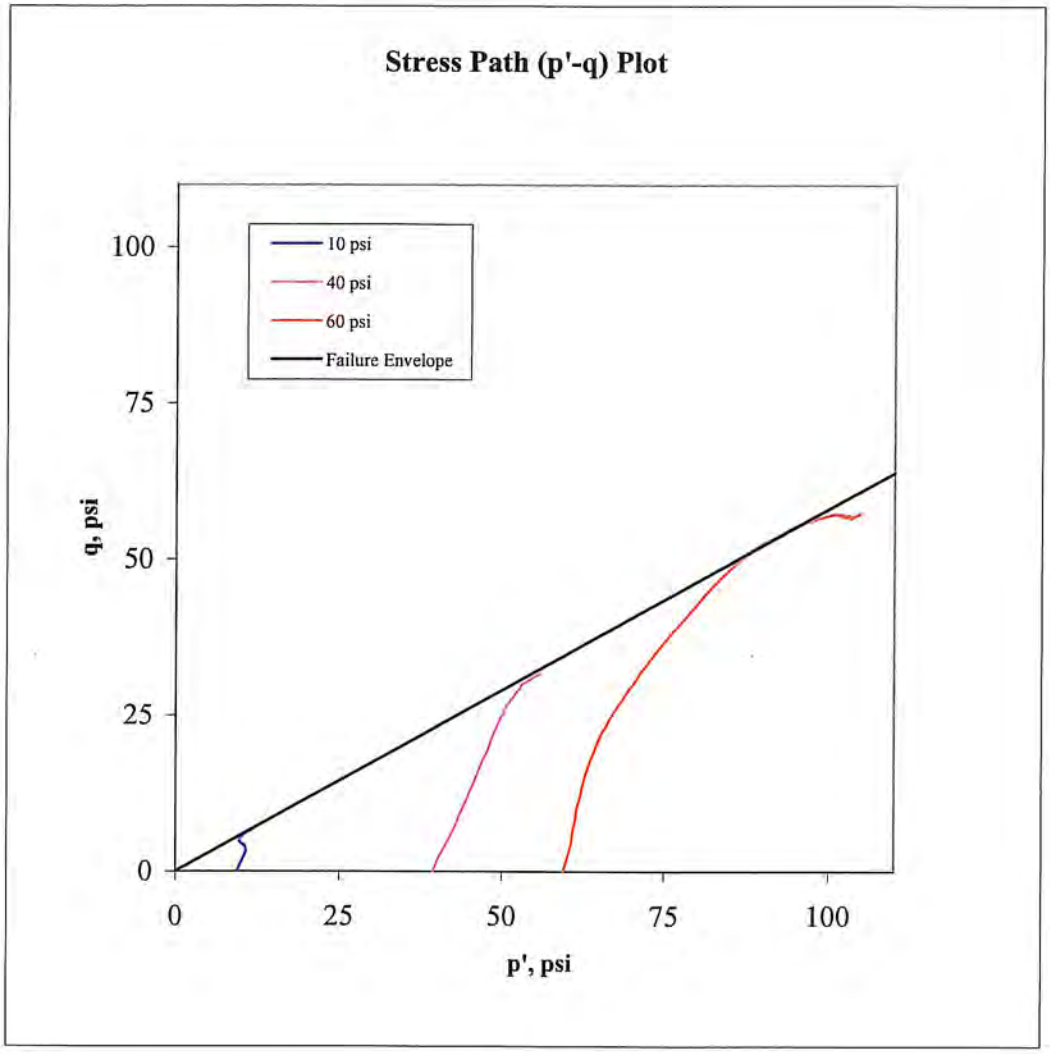
Notes: Sample consisted of sand with some clay.
Sample was remolded at approximately 95% of the maximum dry density and at the optimum moisture (ASTM D 698).
Failure defined as the maximum principal stress ratio.
Rate of strain = 5% per hour and t_{50} = 0.25 min.

Golder Associates, Inc. Denver, Colorado	Title: TRIAXIAL SHEAR TEST REPORT SAMPLE DATA AND CALCULATIONS				
Job Short Title: EFR/Pinion Ridge					
Sample Number: GATP 9 @ 1-11	Reviewed: JEO	Date: 1/18/08	Job Number: 073-81694.001	Figure: 1	





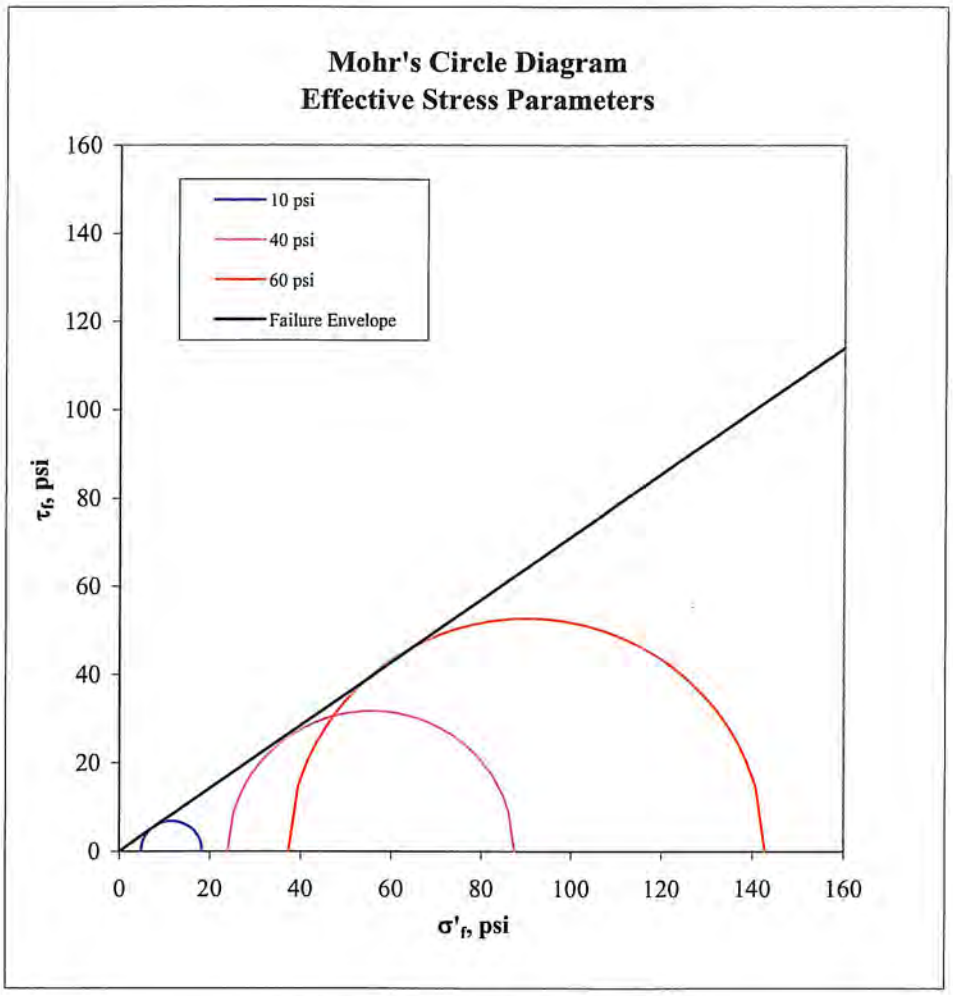
Golder Associates, Inc. **Denver, Colorado**	**Title:** **C-U TRIAXIAL SHEAR DATA** **q AND EXCESS PORE PRESSURE PLOTS**			
Job Short Title: EFR/Pinion Ridge				
Sample Number: **GATP 9 @ 1-11**	**Reviewed:** **JEO**	**Date:** **1/18/08**	**Job Number:** **073-81694.001**	**Figure:** **2**



Stress Path Parameters

ψ' = 30.1 degrees
a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: EFR/Pinion Ridge				
Sample Number: GATP 9 @ 1-11	Reviewed: JEO	Date: 1/18/08	Job Number: 073-81694.001	Figure: 3



Effective Stress Shear Strength Parameters

ϕ' = 35.5 degrees
c' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA MOHR'S CIRCLE DIAGRAM			
Job Short Title: EFR/Pinion Ridge				
Sample Number: GATP 9 @ 1-11	Reviewed: JEO	Date: 1/18/08	Job Number: 073-81694.001	Figure: 4

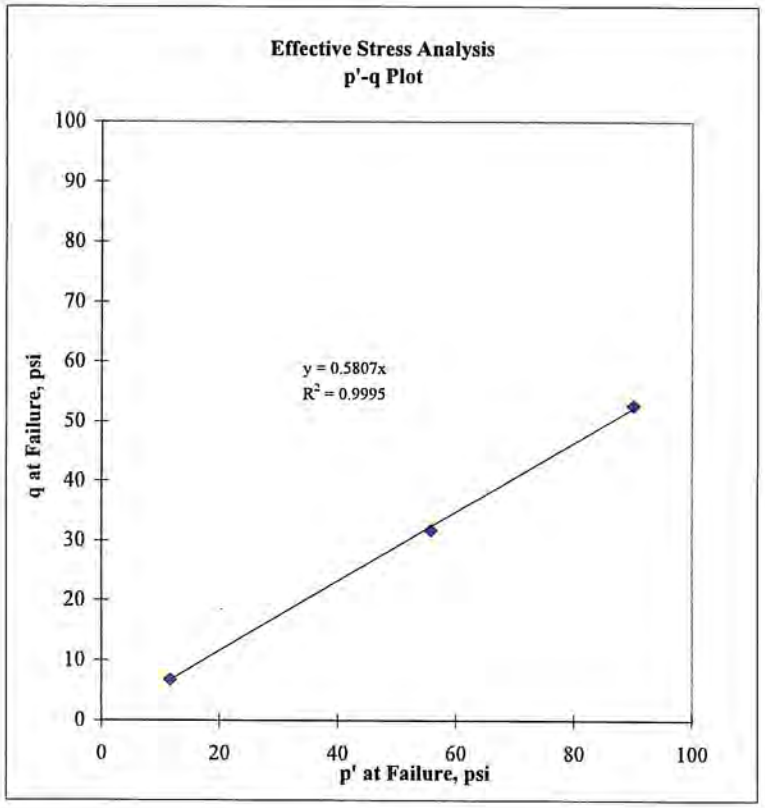
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **EFR/Pinion Ridge**
Project Number: **073-81694.001**

Sample Number	GATP 9 @ 1-11
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	11.6	6.8
2	55.7	31.7
3	90.1	52.7

tan(ψ') = **0.58**
a' = **0.0** **psi**

ϕ' = **35.5** **degrees**
c' = **0.0** **psi**

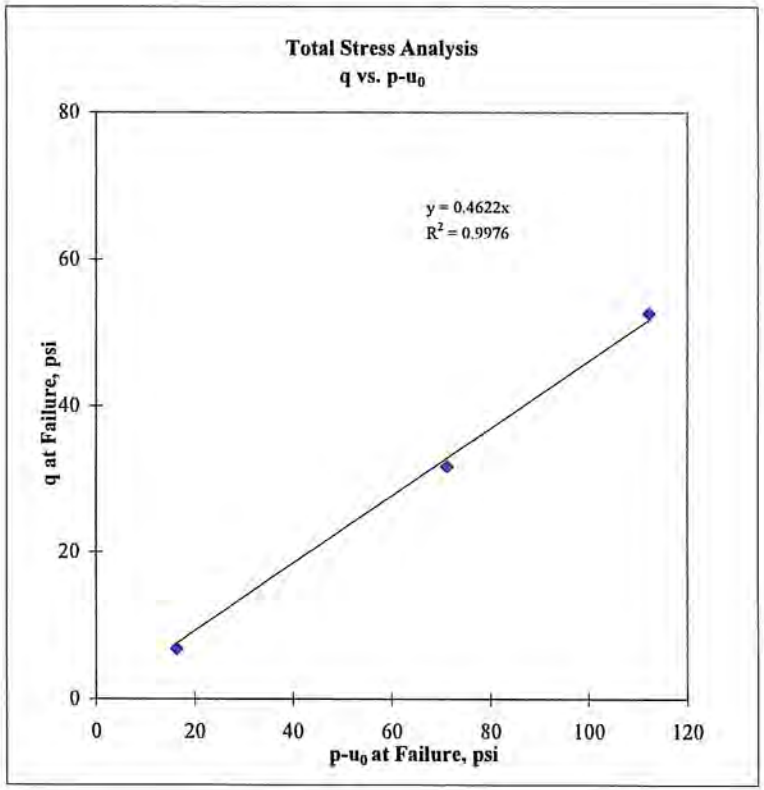


Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **EFR/Pinion Ridge**
Project Number: **073-81694.001**

Sample Number	GATP 9 @ 1-11
Total Stress Analysis	

Point Number	$p-u_o$ (psi)	q (psi)
1	16.3	6.8
2	71.2	31.7
3	112.2	52.7

tan(ψ) =	**0.46**	
a =	**0.0**	**psi**
ϕ =	**27.5**	**degrees**
c =	**0.0**	**psi**



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: EFR/Pinion Ridge
Project Number: 073-81694.001

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:

c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \quad p' = \frac{\sigma'_1 + \sigma'_3}{2} \quad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:

q = maximum shear stress

p', p = mean effective and total stresses

σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:

a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

$p - u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

The relationships between ψ' and ϕ' and a' and c' are as follows:

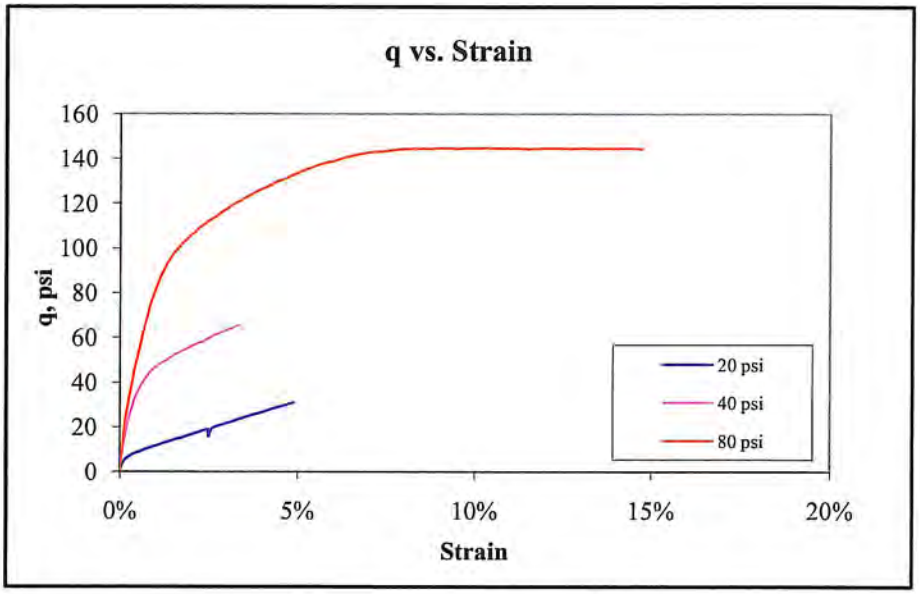
$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$

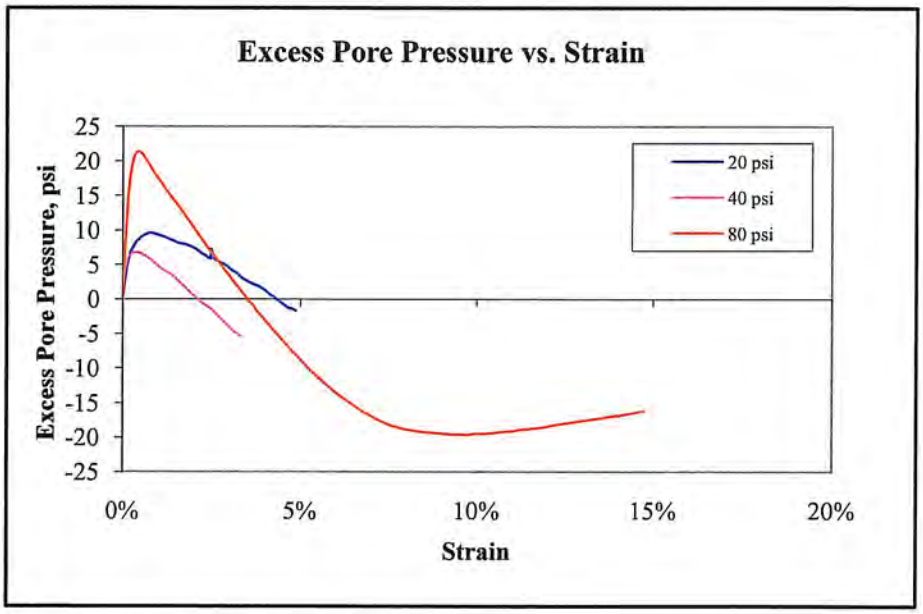
Golder Associates
Denver, Co
EFR/Pinon Ridge
073-81694.001
GATP 9 @ 1-11 Ft

Sample # =	GABH 42		Sample # =	GABH 42		Sample # =	GABH 42	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	15.40	cm	Length =	15.40	cm	Length =	15.40	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	892.90	g	Wet Weight =	892.90	g	Wet Weight =	892.90	g
Area =	41.9	cm^2	Area =	41.9	cm^2	Area =	41.9	cm^2
Sample Area =	6.49	in^2	Sample Area =	6.49	in^2	Sample Area =	6.49	in^2
Volume =	644.5	cm^3	Volume =	644.5	cm^3	Volume =	644.5	cm^3
Moisture Content =	3.1%		Moisture Content =	3.1%		Moisture Content =	3.1%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	866.05	g	Dry Weight of Solids =	866.05	g	Dry Weight of Solids =	866.05	g
Wet Unit Weight =	1.39	g/cm^3	Wet Unit Weight =	1.39	g/cm^3	Wet Unit Weight =	1.39	g/cm^3
Dry Unit Weight =	1.34	g/cm^3	Dry Unit Weight =	1.34	g/cm^3	Dry Unit Weight =	1.34	g/cm^3
Wet Unit Weight =	86.4	pcf	Wet Unit Weight =	86.4	pcf	Wet Unit Weight =	86.4	pcf
Dry Unit Weight =	83.8	pcf	Dry Unit Weight =	83.8	pcf	Dry Unit Weight =	83.8	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	140	psi
Back Pressure =	80	psi	Back Pressure =	60	psi	Back Pressure =	60	psi
Confining Pressure =	20	psi	Confining Pressure =	40	psi	Confining Pressure =	80	psi

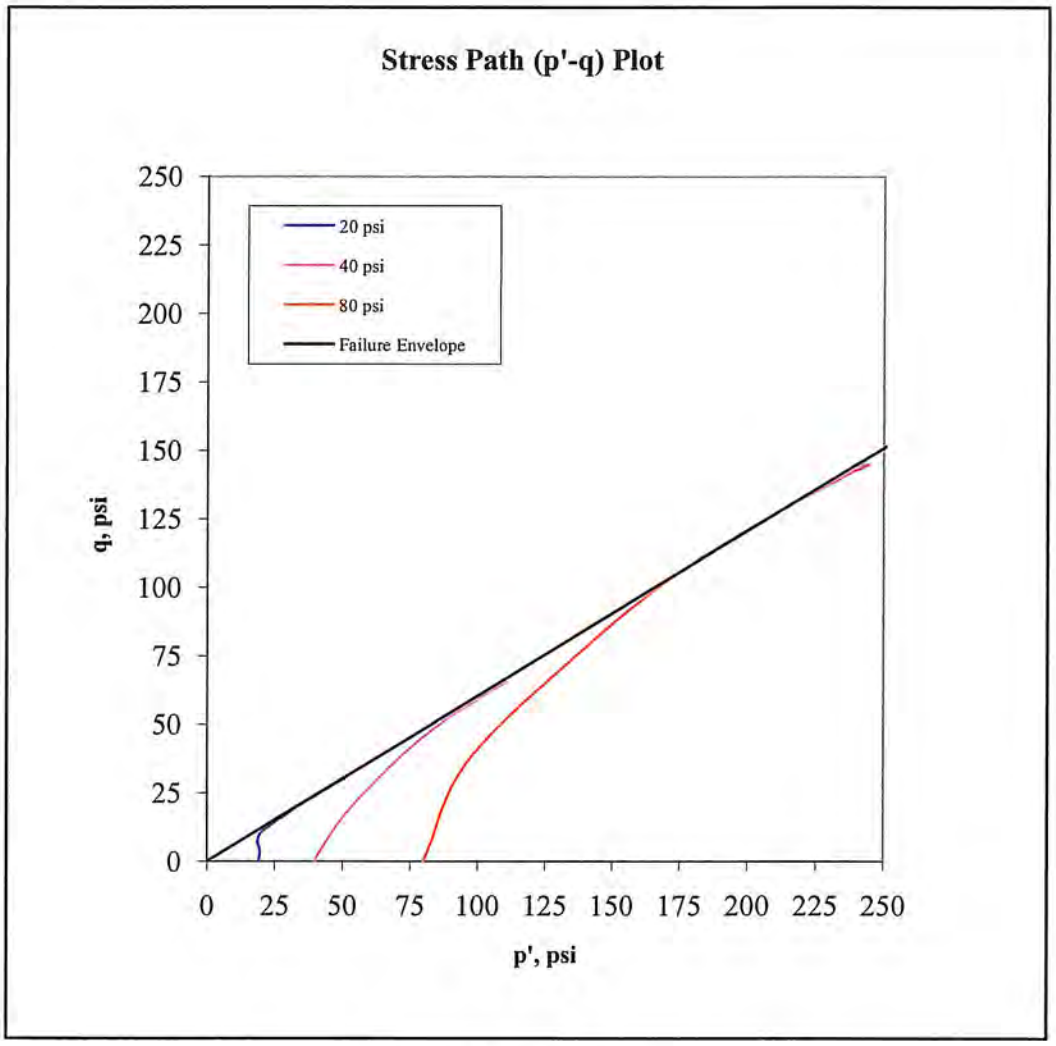
Notes: Sample described as: light brown silty sand.
Specimen was from an undisturbed Shelby tube sample. The soil was loose and was extruded directly into a streched membrane.
Failure was defined as the maximum principal stress ratio.
Rate of strain was 5% per hour.
Test was a staged triaxial test.

Golder Associates, Inc. **Denver, Colorado**	**Title:** **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**				
Job Short Title: Energy Fuels/Geotech Piñon Ridge					
Sample Number: **GABH 42 @ 10-11'**	**Reviewed:** **JEO**	**Date:** **2/14/08**	**Job Number:** **073-81694**	**Figure:** **1**	





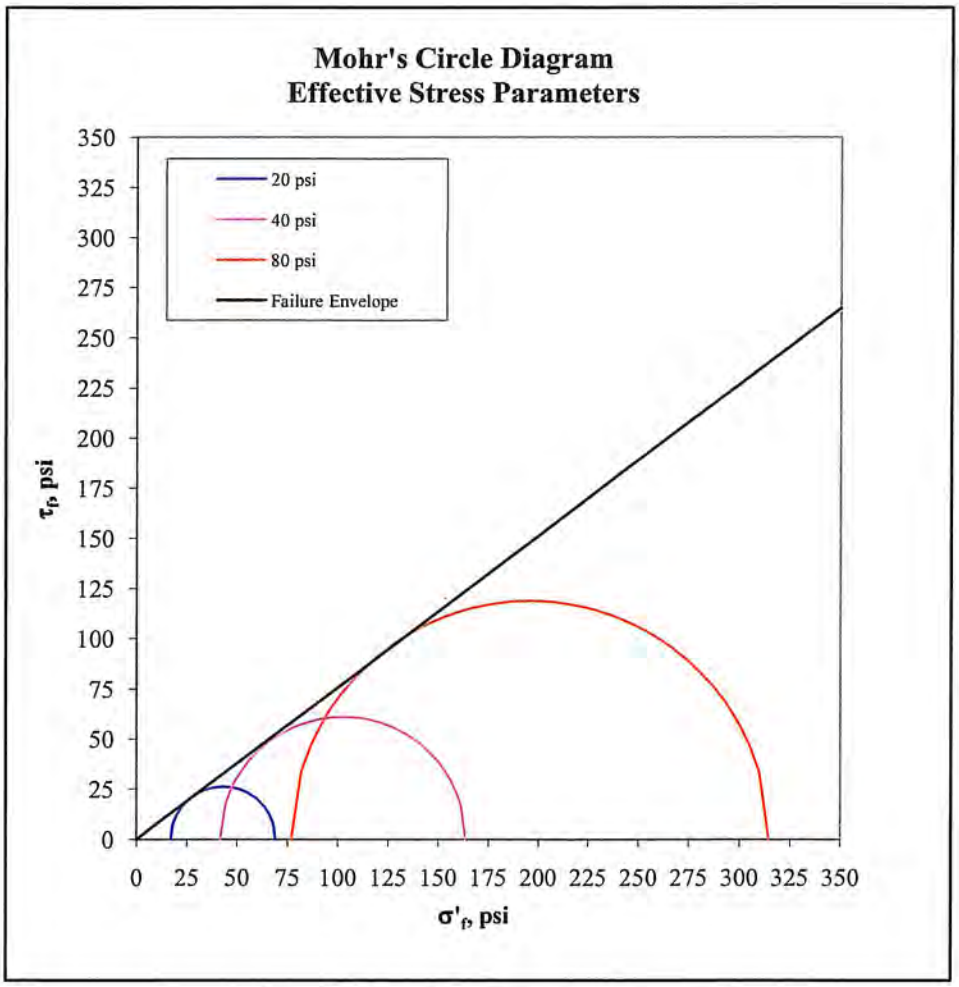
Golder Associates, Inc. **Denver, Colorado**	**Title:** **C-U TRIAXIAL SHEAR DATA** **q AND EXCESS PORE PRESSURE PLOTS**			
Job Short Title: Energy Fuels/Geotech Piñon Ridge				
Sample Number: **GABH 42 @ 10-11'**	**Reviewed:** **JEO**	**Date:** **2/14/08**	**Job Number:** **073-81694**	**Figure:** **2**



Stress Path Parameters

ψ' = 31.1 degrees
a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: Energy Fuels/Geotech Piñon Ridge				
Sample Number: GABH 42 @ 10-11'	Reviewed: JEO	Date: 2/14/08	Job Number: 073-81694	Figure: 3



Effective Stress Shear Strength Parameters

ϕ' = 37.1 degrees
c' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA MOHR'S CIRCLE DIAGRAM			
Job Short Title: Energy Fuels/Geotech Piñon Ridge				
Sample Number: GABH 42 @ 10-11'	Reviewed: JEO	Date: 2/14/08	Job Number: 073-81694	Figure: 4

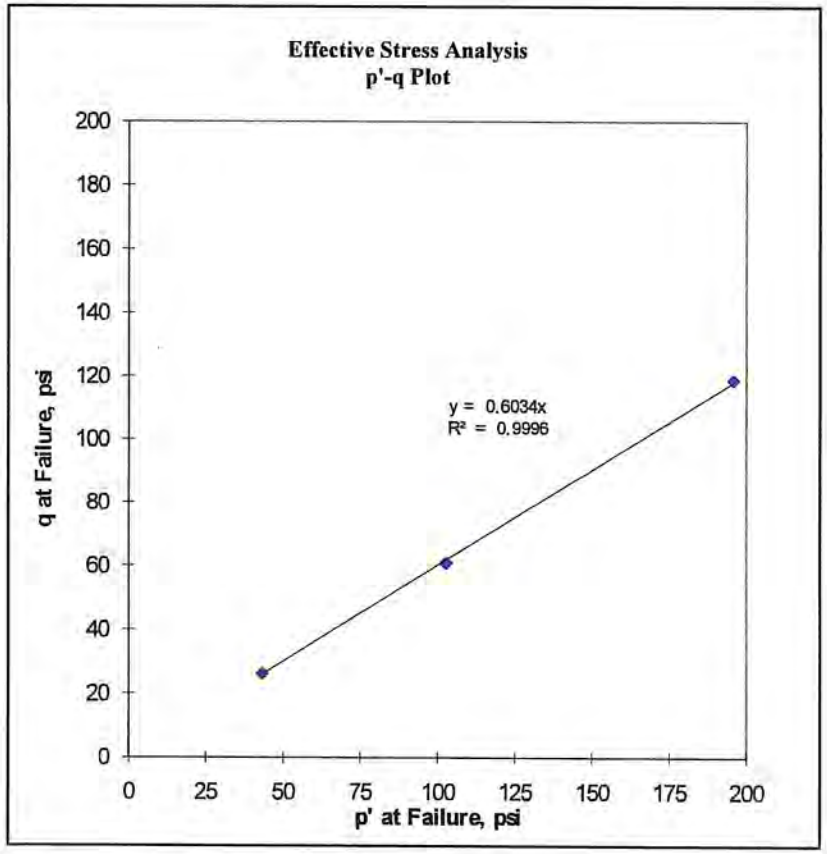
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Piñon Ridge**
Project Number: **073-81694**

Sample Number	GABH 42 @ 10-11'
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	43.3	26.1
2	102.7	60.9
3	195.8	118.8

tan(ψ') = 0.60
a' = 0.0 psi

ϕ' = 37.1 degrees
c' = 0.0 psi



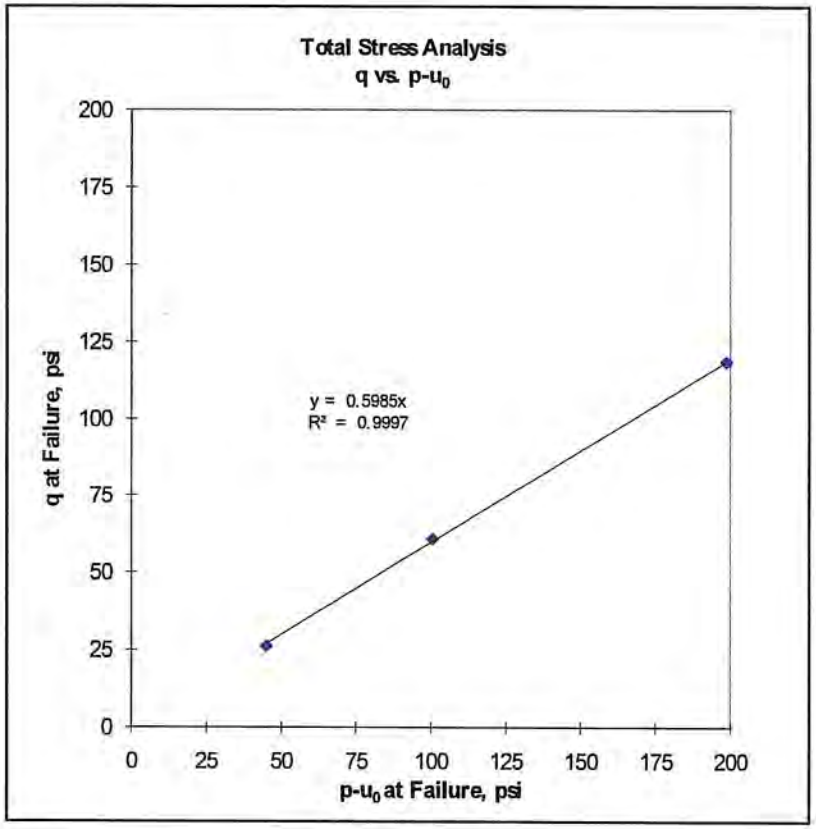
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Piñon Ridge**
Project Number: **073-81694**

Sample Number	GABH 42 @ 10-11'
Total Stress Analysis	

Point Number	$p-u_o$ (psi)	q (psi)
1	45.1	26.1
2	100.5	60.9
3	198.7	118.8

$\tan(\psi)$ = 0.60
a = 0.0 psi

ϕ = 36.8 degrees
c = 0.0 psi



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Piñon Ridge**
Project Number: **073-81694**

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:

c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \qquad p' = \frac{\sigma'_1 + \sigma'_3}{2} \qquad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:

q = maximum shear stress

p', p = mean effective and total stresses

σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:

a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

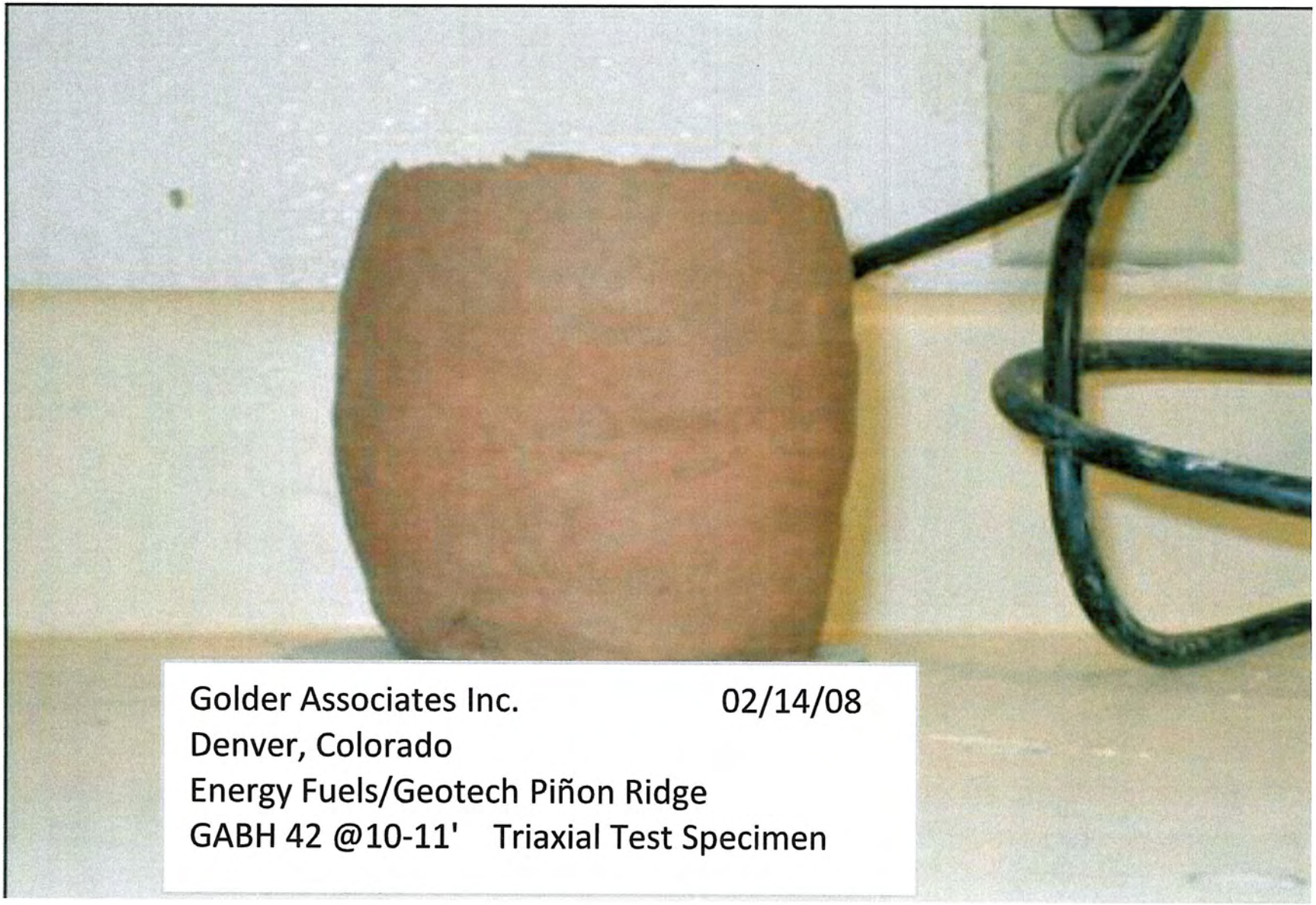
$p - u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

The relationships between ψ' and ϕ' and a' and c' are as follows:

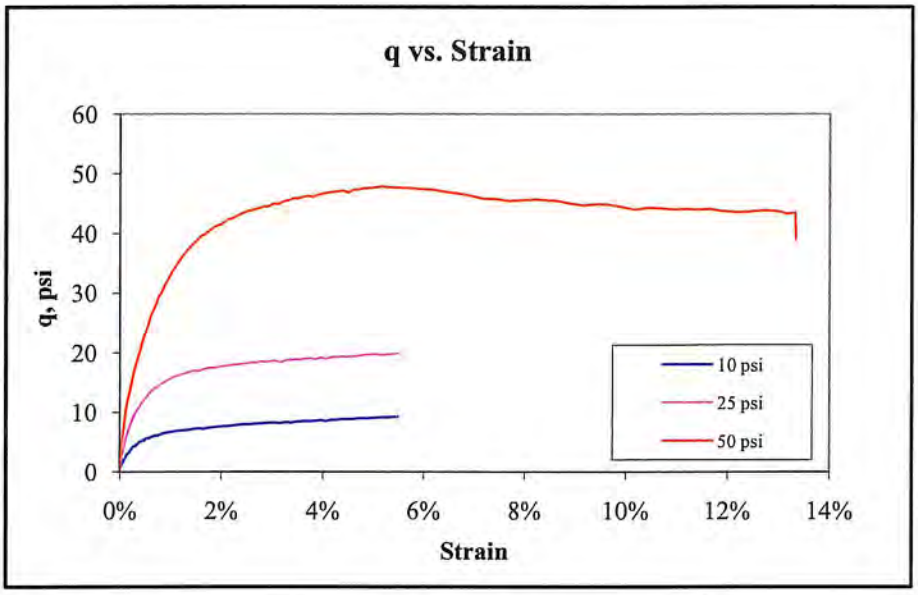
$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$

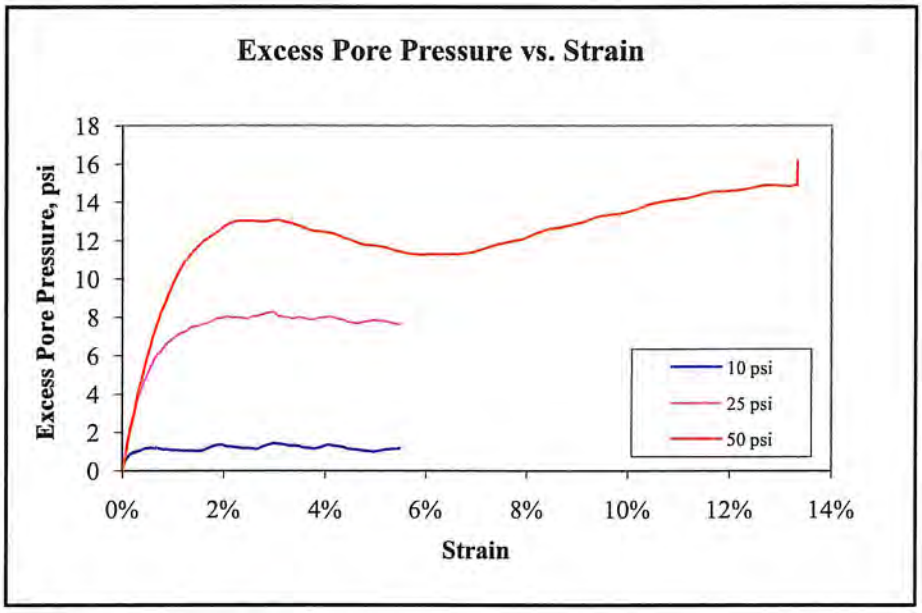

Golder Associates Inc. 02/14/08
Denver, Colorado
Energy Fuels/Geotech Piñon Ridge
GABH 42 @10-11' Triaxial Test Specimen

Sample # =	GABH 47		Sample # =	GABH 47		Sample # =	GABH 47	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	15.95	cm	Length =	15.95	cm	Length =	15.95	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	978.40	g	Wet Weight =	978.40	g	Wet Weight =	978.40	g
Area =	41.9	cm^2	Area =	41.9	cm^2	Area =	41.9	cm^2
Sample Area =	6.49	in^2	Sample Area =	6.49	in^2	Sample Area =	6.49	in^2
Volume =	667.5	cm^3	Volume =	667.5	cm^3	Volume =	667.5	cm^3
Moisture Content =	1.7%		Moisture Content =	1.7%		Moisture Content =	1.7%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	962.05	g	Dry Weight of Solids =	962.05	g	Dry Weight of Solids =	962.05	g
Wet Unit Weight =	1.47	g/cm^3	Wet Unit Weight =	1.47	g/cm^3	Wet Unit Weight =	1.47	g/cm^3
Dry Unit Weight =	1.44	g/cm^3	Dry Unit Weight =	1.44	g/cm^3	Dry Unit Weight =	1.44	g/cm^3
Wet Unit Weight =	91.5	pcf	Wet Unit Weight =	91.5	pcf	Wet Unit Weight =	91.5	pcf
Dry Unit Weight =	89.9	pcf	Dry Unit Weight =	89.9	pcf	Dry Unit Weight =	89.9	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	100	psi
Back Pressure =	90	psi	Back Pressure =	75	psi	Back Pressure =	50	psi
Confining Pressure =	10	psi	Confining Pressure =	25	psi	Confining Pressure =	50	psi

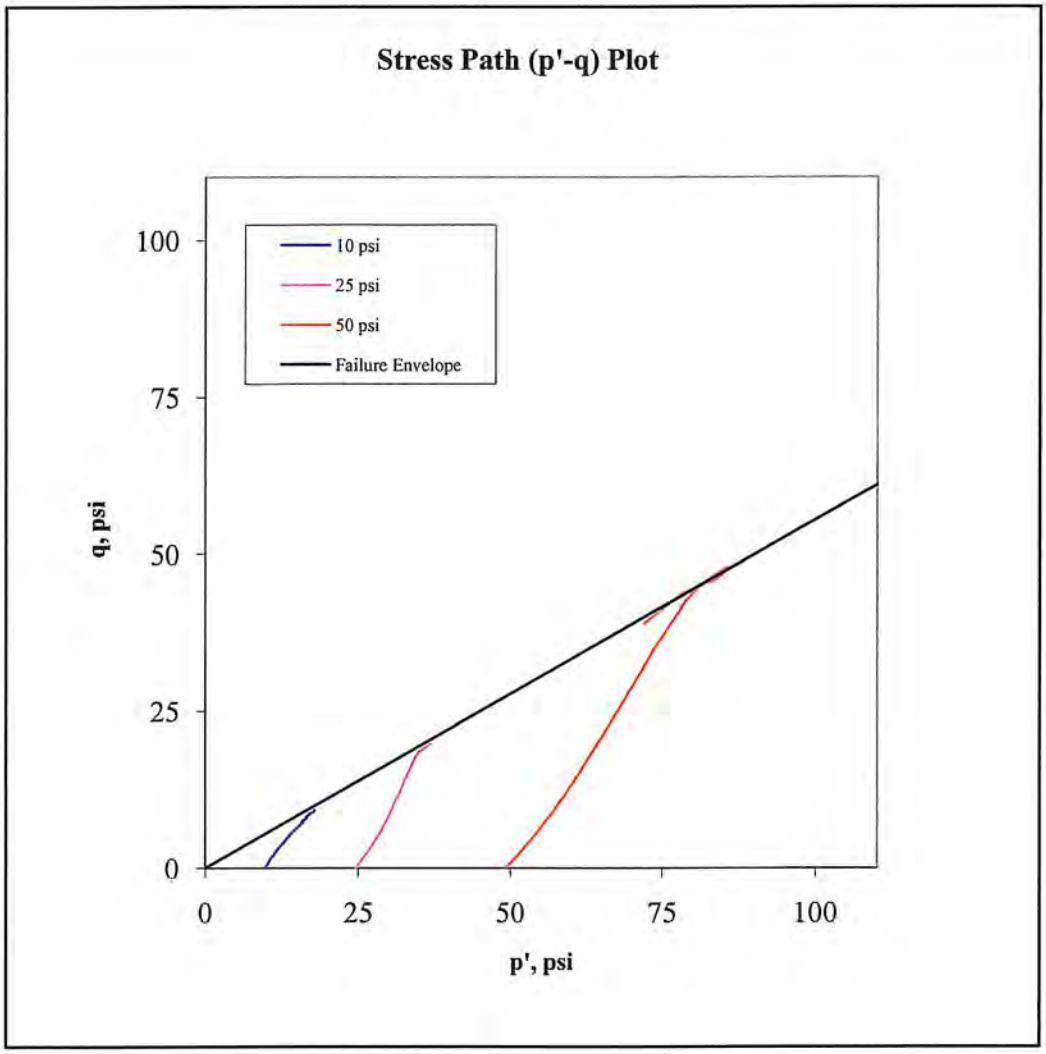
Notes: Sample described as: light brown silty sand.
Specimen was from an undisturbed Shelby tube sample. The soil was loose and was extruded directly into a streched membrane.
Failure was defined as the maximum principal stress ratio.
Rate of strain was 5% per hour.
Test was a staged triaxial test. The back pressure line developed a leak during consolidation, possibly causing the requested effective stress to be exceeded momentarily.

Golder Associates, Inc. **Denver, Colorado**	**Title:** **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**				
Job Short Title: Energy Fuels/Geotech Pinon Ridge					
Sample Number: **GABH 47 @ 2-3.5'**	**Reviewed:** **JEO**	**Date:** **2/11/08**	**Job Number:** **073-81694**	**Figure:** **1**	





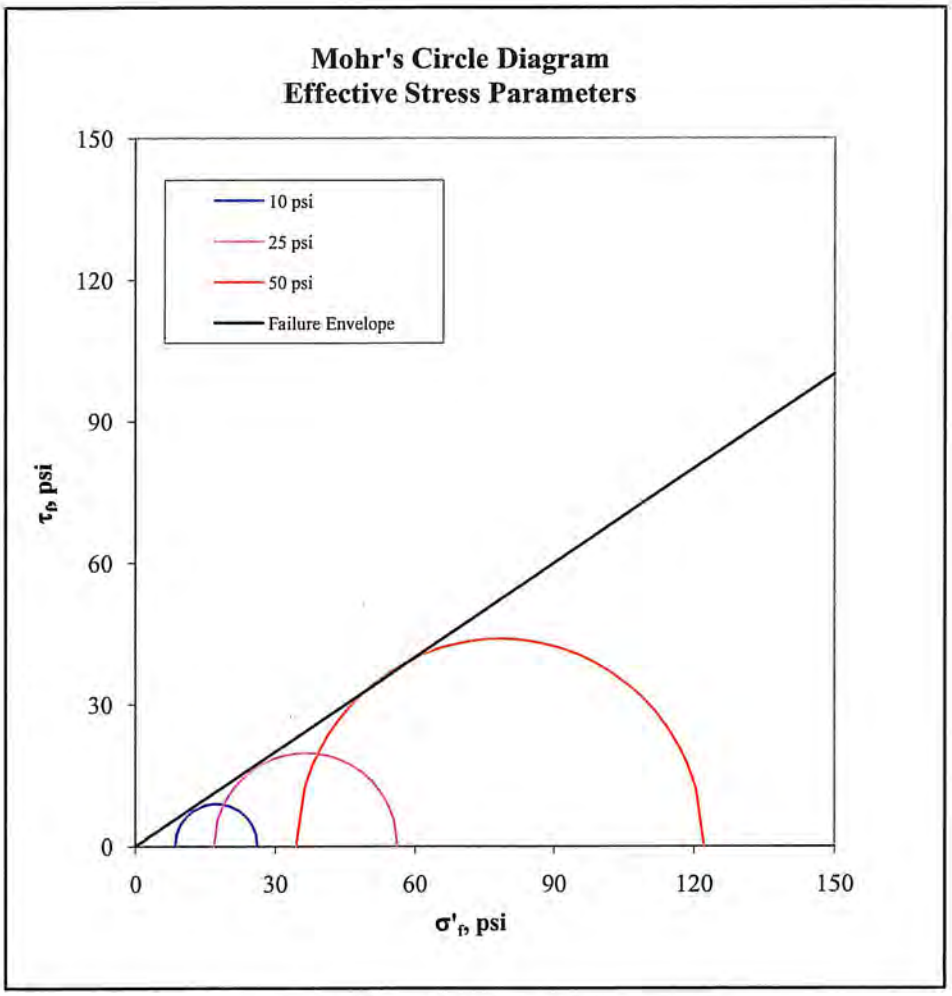
Golder Associates, Inc. **Denver, Colorado**	**Title:** **C-U TRIAXIAL SHEAR DATA** **q AND EXCESS PORE PRESSURE PLOTS**			
Job Short Title: Energy Fuels/Geotech Pinon Ridge				
Sample Number: **GABH 47 @ 2-3.5'**	**Reviewed:** **JEO**	**Date:** **2/11/08**	**Job Number:** **073-81694**	**Figure:** **2**



Stress Path Parameters

ψ' = 29.0 degrees
a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: Energy Fuels/Geotech Pinon Ridge				
Sample Number: GABH 47 @ 2-3.5'	Reviewed: JEO	Date: 2/11/08	Job Number: 073-81694	Figure: 3



Effective Stress Shear Strength Parameters

$\phi' =$ 33.7 degrees
c' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA MOHR'S CIRCLE DIAGRAM			
Job Short Title: Energy Fuels/Geotech Pinon Ridge				
Sample Number: GABH 47 @ 2-3.5'	Reviewed: JEO	Date: 2/11/08	Job Number: 073-81694	Figure: 4

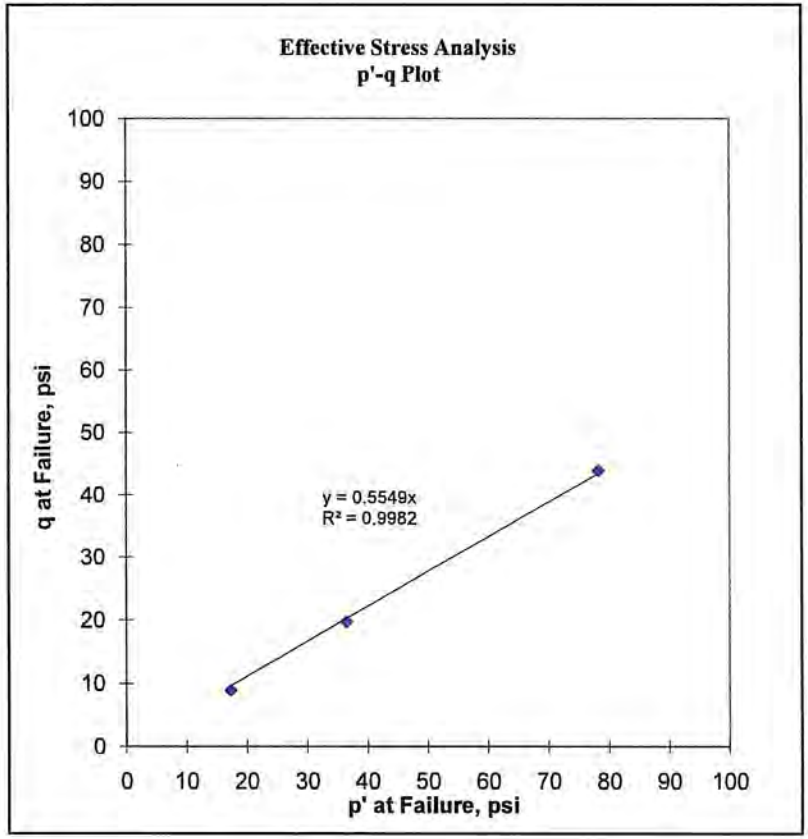
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Pinon Ridge**
Project Number: **073-81694**

Sample Number	GABH 47 @ 2-3.5'
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	17.3	8.8
2	36.5	19.7
3	78.3	43.9

tan(ψ') = **0.55**
a' = **0.0** **psi**

ϕ' = **33.7** **degrees**
c' = **0.0** **psi**

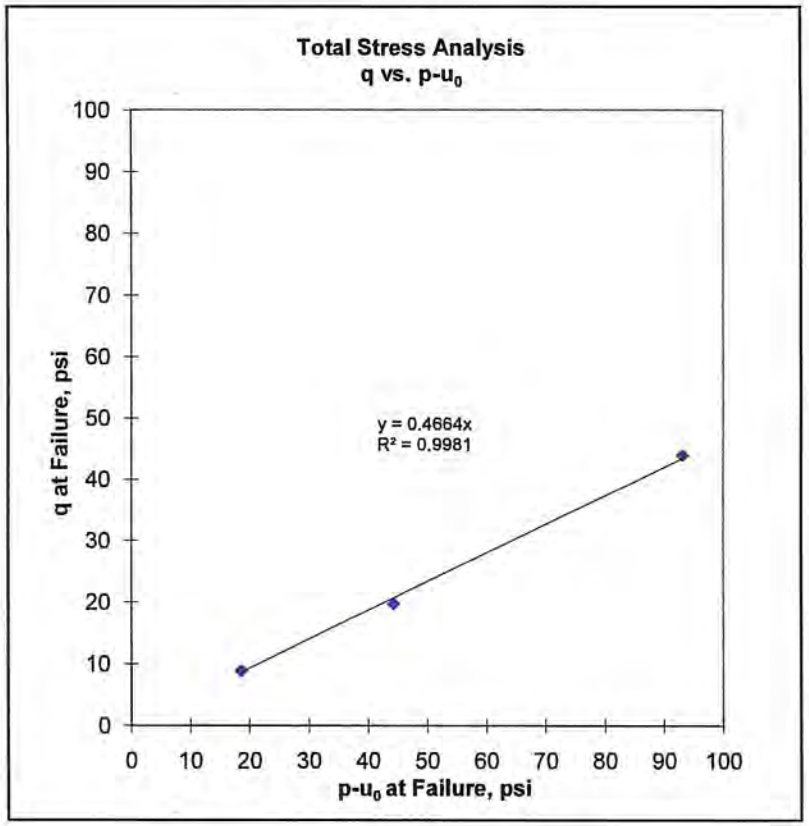


Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Pinon Ridge**
Project Number: **073-81694**

Sample Number	GABH 47 @ 2-3.5'
Total Stress Analysis	

Point Number	$p-u_o$ (psi)	q (psi)
1	18.6	8.8
2	44.3	19.7
3	93.1	43.9

tan(ψ) =	**0.47**	
a =	**0.0**	**psi**
ϕ =	**27.8**	**degrees**
c =	**0.0**	**psi**



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **Energy Fuels/Geotech Pinon Ridge**
Project Number: **073-81694**

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:
c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \quad p' = \frac{\sigma'_1 + \sigma'_3}{2} \quad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = maximum shear stress

p', p = mean effective and total stresses
σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:
a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

$p - u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

The relationships between ψ' and ϕ' and a' and c' are as follows:

$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$

APPENDIX C-6

INTERFACE SHEAR STRENGTH TESTING

FEBRUARY 2008

073-81694

SUMMARY OF DIRECT SHEAR TEST RESULTS

ENERGY FUELS
GEOTECH PINON RIDGE
COLORADO

SAMPLE DESIGNATION	Reference Value	1 GM vs GC	2 GM vs GCL	3 CLT GCL vs SOIL	4 DN GCL vs SOIL	5 ST GCL vs GM	- - -	- - -	- - -	- - -
DIRECT SHEAR										
Friction Angle (°)										
Peak	-	21.2	20.0	25.1	35.5	23.2	-	-	-	-
Residual @ 3 in	-	14.8	13.1	13.3	30.5	12.7	-	-	-	-
Adhesion (psi)										
Peak	-	7.7	1.7	1.7	0.0	4.9	-	-	-	-
Residual @ 3 in	-	0.0	0.8	5.9	2.6	1.7	-	-	-	-
ASTM D5321										
ASTM D6243										

NOTE: The test results relate only to the samples and laboratory conditions tested. GAI neither accepts responsibility for nor makes claim as to the final use and purpose of the material.

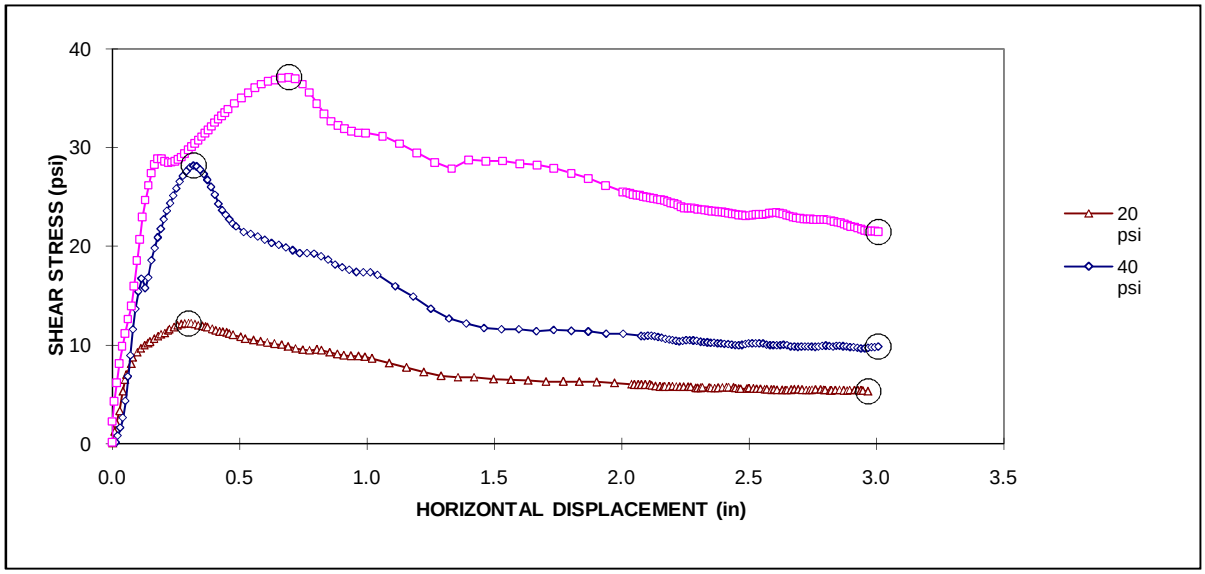
FEBRUARY 2008 073-81694

DIRECT SHEAR TEST RESULTS

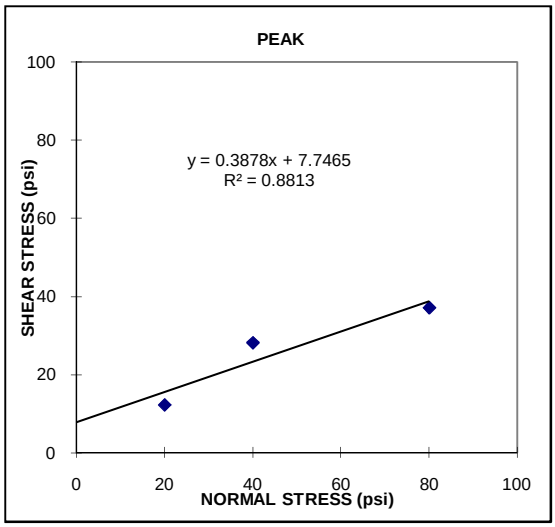
ASTM D5321

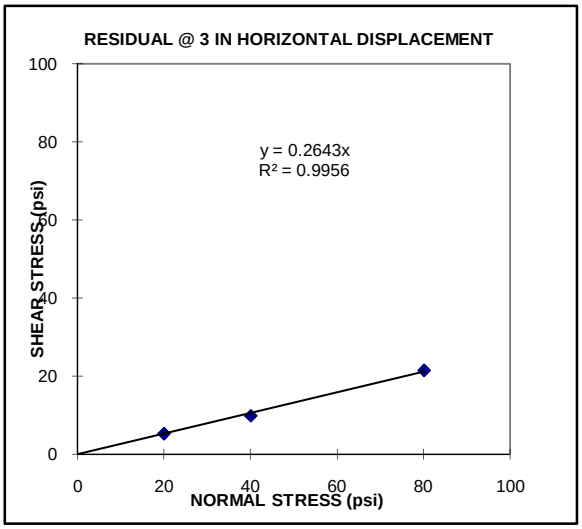
PROJECT NAME: ENERGY FUELS/GEOTECH PINON RIDGE/CO
SAMPLE NUMBER: 1 (GM vs GC)

INTERFACE TESTED: 60 mil TEXTURED HDPE GEOMEMBRANE vs TEXDRAIN 250 DS 6 GEOCOMPOSITE
TEST CONDITIONS: INTERFACES WETTED, CONSOLIDATED 15 min AT NORMAL LOAD
SHEAR RATE: 0.2 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psi)	Shear Stress Peak[1] (psi)	Shear Stress Residual (psi)	Peak Friction Angle	Peak Adhesion[2] (psi)	Residual Friction Angle	Residual Adhesion[2] (psi)
20	12.2	5.3				
40	28.2	9.9	21.2	7.7	14.8	0.0
80	37.1	21.5				





Observations After Test

20 psi: Shearing occurred at the interface between the Geomembrane and the Geocomposite
40 psi: Shearing occurred at the interface between the Geomembrane and the Geocomposite
80 psi: Shearing occurred at the interface between the Geomembrane and the Geocomposite

(1) The peak shear stresses for 20, 40, and 80 psi normal stresses were chosen at 0.300, 0.319, and 0.693 in horizontal displacements, respectively.
(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

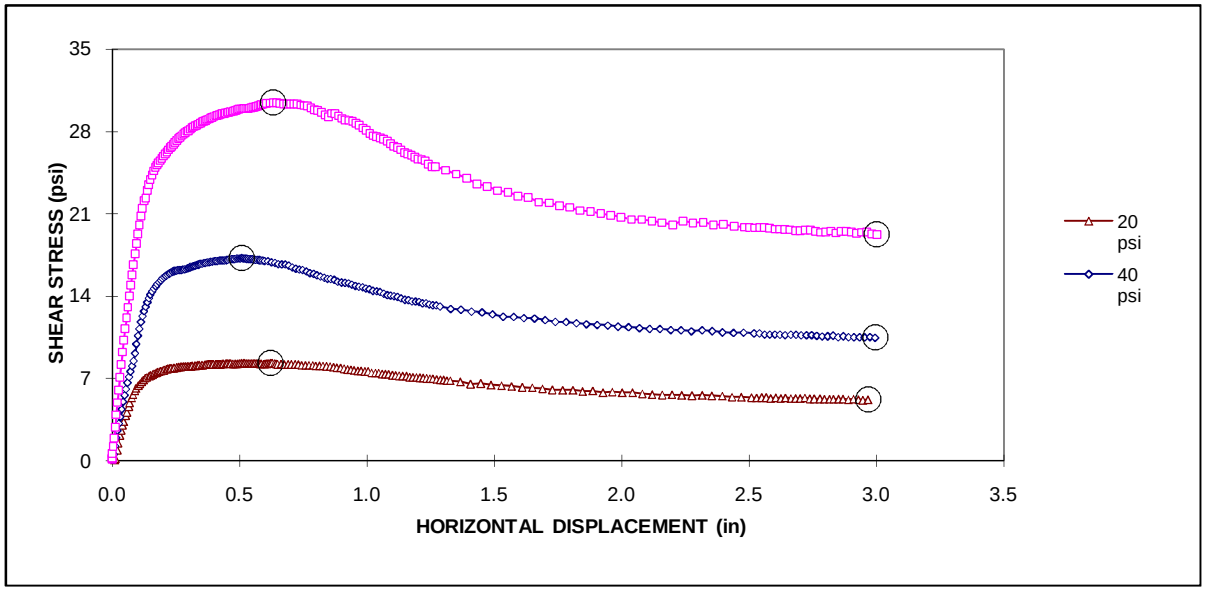
FEBRUARY 2008 073-81694

DIRECT SHEAR TEST RESULTS

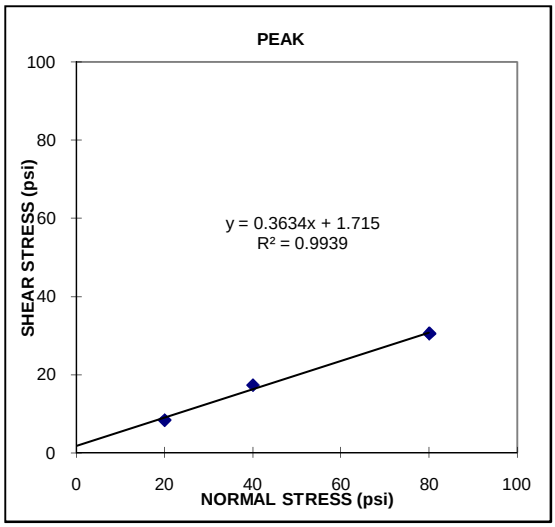
ASTM D6243

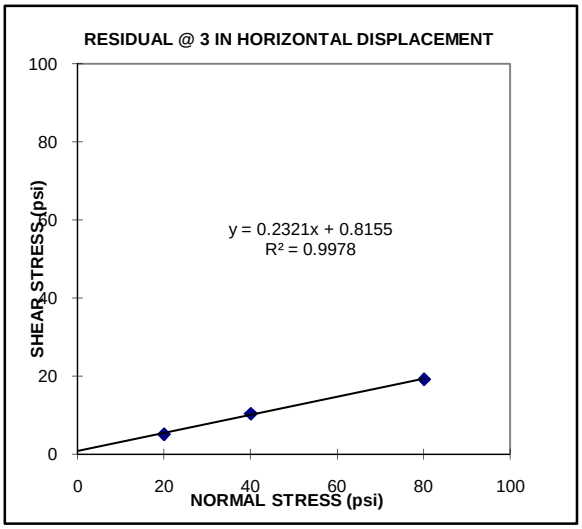
PROJECT NAME: ENERGY FUELS/GEOTECH PINON RIDGE/CO
SAMPLE NUMBER: 2 (GM vs GCL)

INTERFACE TESTED: 60 mil TEXTURED HDPE GEOMEMBRANE vs CETCO BENTOMAT CLT GCL (clay side against Geomembrane)
TEST CONDITIONS: INTERFACES WETTED, CONSOLIDATED 15 min AT NORMAL LOAD
SHEAR RATE: 0.04 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psi)	Shear Stress Peak[1] (psi)	Shear Stress Residual (psi)	Peak Friction Angle	Peak Adhesion[2] (psi)	Residual Friction Angle	Residual Adhesion[2] (psi)
20	8.3	5.2				
40	17.2	10.5	20.0	1.7	13.1	0.8
80	30.5	19.3				





Observations After Test

20 psi: Shearing occurred at the interface between the Geomembrane and the GCL
40 psi: Shearing occurred at the interface between the Geomembrane and the GCL
80 psi: Shearing occurred at the interface between the Geomembrane and the GCL

(1) The peak shear stresses for 20, 40, and 80 psi normal stresses were chosen at 0.622, 0.508, and 0.632 in horizontal displacements, respectively.
(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

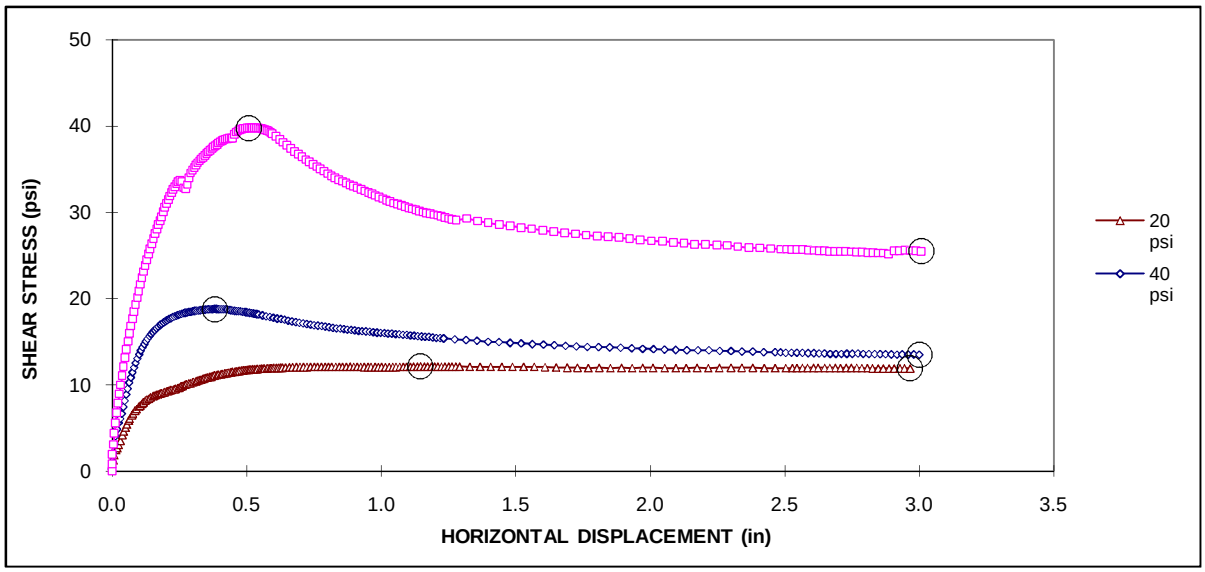
FEBRUARY 2008 073-81694

DIRECT SHEAR TEST RESULTS

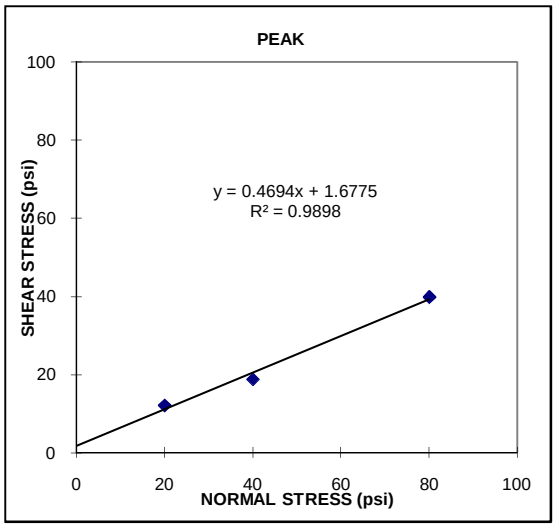
ASTM D6243

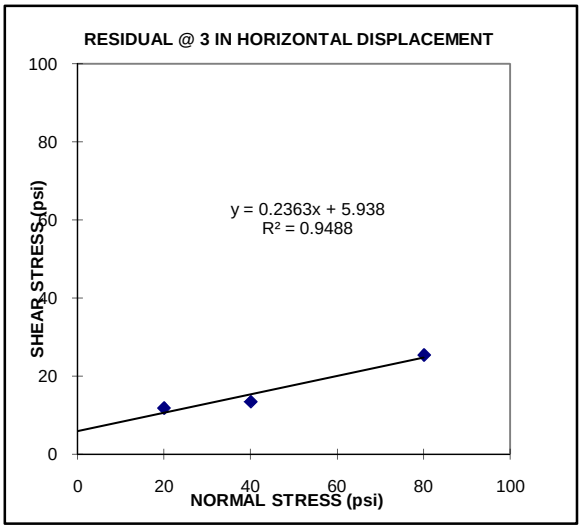
PROJECT NAME: ENERGY FUELS/GEOTECH PINON RIDGE/CO
SAMPLE NUMBER: 3 (CLT GCL vs SOIL)

INTERFACE TESTED: CETCO BENTOMAT CLT GCL (laminated HDPE side against Soil) vs SOIL (GA-TP-7 (1.5'-9'))
SOIL CONDITIONS: REMOLDED TO 95% OF THE MAX DRY DENSITY OF 116.9 pcf AT A MOISTURE OF 12.1 +/- 0.5%
TEST CONDITIONS: INTERFACES WETTED, CONSOLIDATED 12 hours AT NORMAL LOAD
SHEAR RATE: 0.04 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psi)	Shear Stress Peak[1] (psi)	Shear Stress Residual (psi)	Peak Friction Angle	Peak Adhesion[2] (psi)	Residual Friction Angle	Residual Adhesion[2] (psi)
20	12.2	11.9				
40	18.8	13.5	25.1	1.7	13.3	5.9
80	39.8	25.5				





Observations After Test

20 psi: Shearing occurred at the interface between the GCL and the Soil
40 psi: Shearing occurred at the interface between the GCL and the Soil
80 psi: Shearing occurred at the interface between the GCL and the Soil

(1) The peak shear stresses for 20, 40, and 80 psi normal stresses were chosen at 1.145, 0.381, and 0.508 in horizontal displacements, respectively.
(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

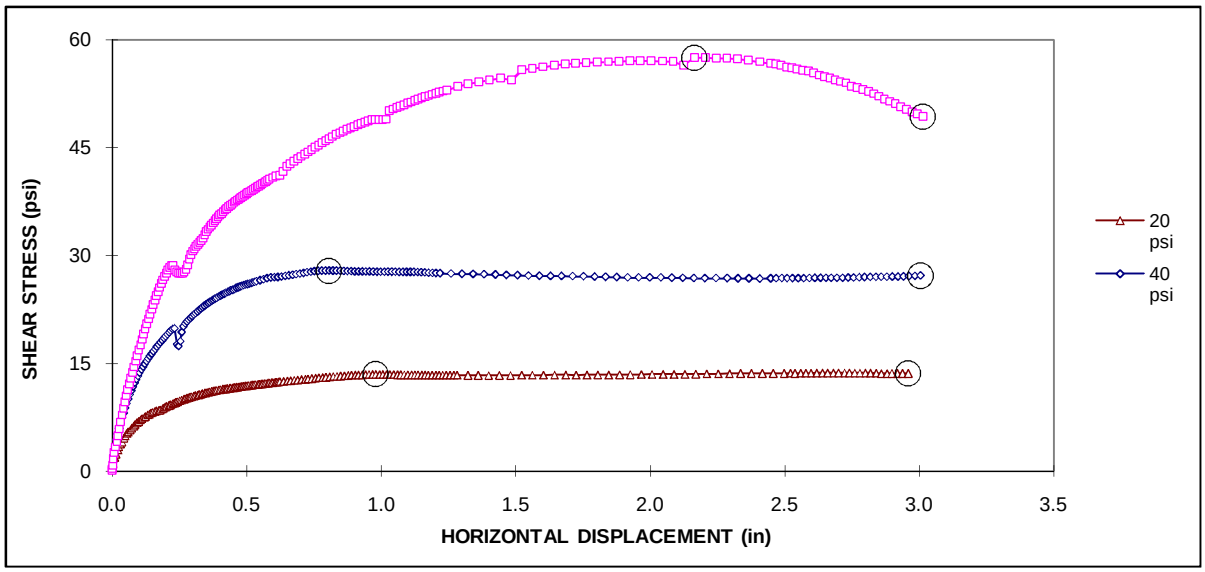
FEBRUARY 2008 073-81694

DIRECT SHEAR TEST RESULTS

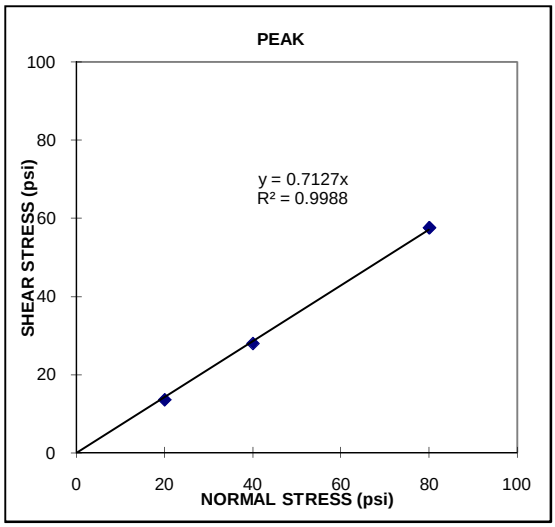
ASTM D6243

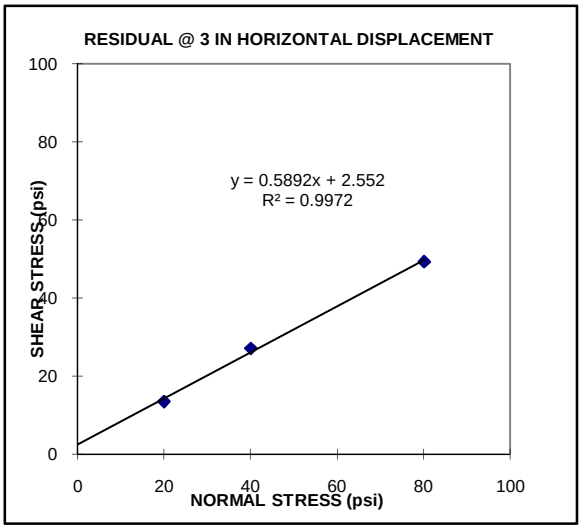
PROJECT NAME: ENERGY FUELS/GEOTECH PINON RIDGE/CO
SAMPLE NUMBER: 4 (DN GCL vs SOIL)

INTERFACE TESTED: CETCO BENTOMAT DN GCL (white nonwoven side against Soil) vs SOIL (GA-TP-7 (1.5'-9'))
SOIL CONDITIONS: REMOLDED TO 95% OF THE MAX DRY DENSITY OF 116.9 pcf AT A MOISTURE OF 12.1 +/- 0.5%
TEST CONDITIONS: INTERFACES WETTED, CONSOLIDATED 12 hours AT NORMAL LOAD
SHEAR RATE: 0.04 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psi)	Shear Stress Peak[1] (psi)	Shear Stress Residual (psi)	Peak Friction Angle	Peak Adhesion[2] (psi)	Residual Friction Angle	Residual Adhesion[2] (psi)
20	13.5	13.6				
40	27.9	27.2	35.5	0.0	30.5	2.6
80	57.5	49.3				





Observations After Test

20 psi: Shearing occurred at the interface between the GCL and the Soil
40 psi: Shearing occurred at the interface between the GCL and the Soil
80 psi: Shearing occurred within the Soil

(1) The peak shear stresses for 20, 40, and 80 psi normal stresses were chosen at 0.980, 0.806, and 2.164 in horizontal displacements, respectively, which may not represent the maximum shear stresses.
(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

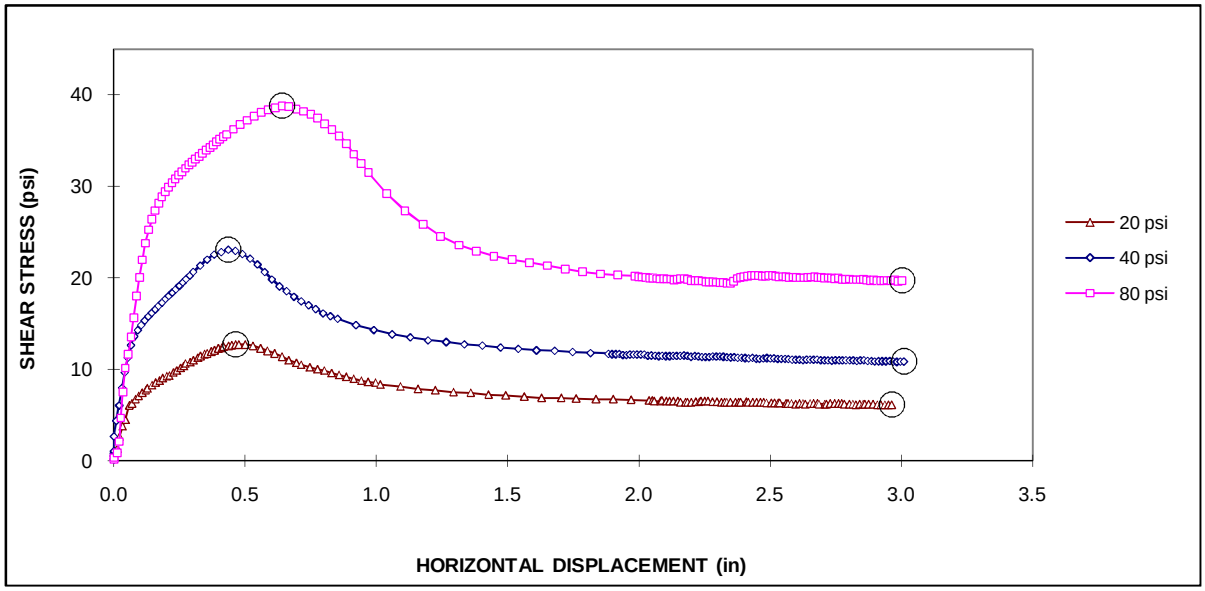
FEBRUARY 2008 073-81694

DIRECT SHEAR TEST RESULTS

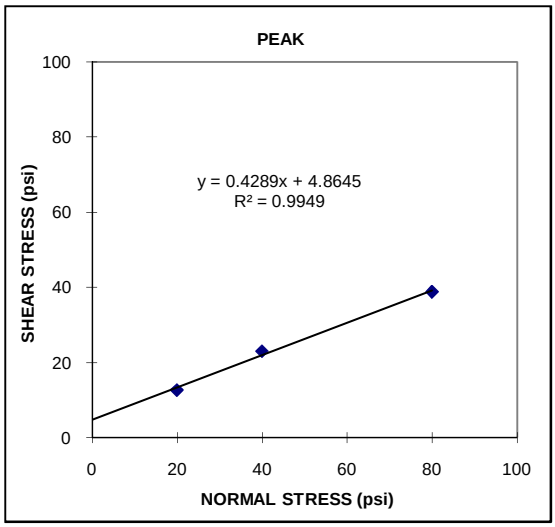
ASTM D6243

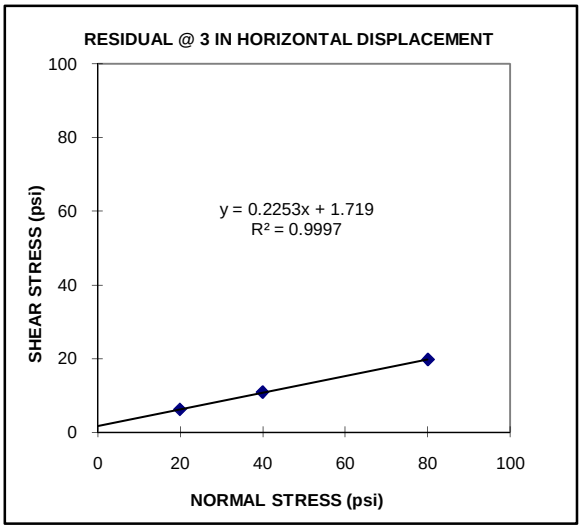
PROJECT NAME: ENERGY FUELS/GEOTECH PINON RIDGE/CO
SAMPLE NUMBER: 5 (GM vs GCL)

INTERFACE TESTED: 60 mil TEXTURED HDPE GEOMEMBRANE vs CETCO BENTOMAT ST GCL (woven side against Geomembrane)
TEST CONDITIONS: INTERFACES WETTED, CONSOLIDATED 15 min AT NORMAL LOAD
SHEAR RATE: 0.2 in/min
SUBSTRATE: TEXTURED RIGID PLATES



Normal Stress (psi)	Shear Stress Peak[1] (psi)	Shear Stress Residual (psi)	Peak Friction Angle	Peak Adhesion[2] (psi)	Residual Friction Angle	Residual Adhesion[2] (psi)
20	12.7	6.1				
40	23.1	10.9	23.2	4.9	12.7	1.7
80	38.8	19.7				





Observations After Test

20 psi: Shearing occurred at the interface between the Geomembrane and the GCL
40 psi: Shearing occurred at the interface between the Geomembrane and the GCL
80 psi: Shearing occurred at the interface between the Geomembrane and the GCL

(1) The peak shear stresses for 20, 40, and 80 psi normal stresses were chosen at 0.464, 0.436, and 0.641 in horizontal displacements, respectively.
(2) The adhesion value is based on the "best-fit" line which may not show true adhesion.

APPENDIX C-7

SOIL-WATER CHARACTERISTIC CURVE TESTING

HYDRAULIC PROPERTIES OF SOILS TP-2, TP-3, AND TP-9

by

C.H. Benson and X. Wang

Geo Engineering Report No. 08-05

Geotechnics Laboratory

Geo Engineering Program
Dept. of Civil and Environmental Engineering
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26 February 2008

1. SCOPE

This report describes results of laboratory tests conducted to determine hydraulic properties for three soil samples: TP-2, TP-3, and TP-9. Hydraulic conductivity and SWCC tests were conducted on all three soil samples.

2. METHODS

Test specimens for the hydraulic conductivity and SWCC tests were prepared from disturbed bucket samples provided by the requestor. Specimens were prepared at a water content of 10% and at a dry unit weight of 100 pcf, as specified by the requestor.

Saturated hydraulic conductivity of each specimen was measured in a flexible-wall permeameter following the methods in ASTM D 5084. The backpressure was set at 40 psi and the hydraulic gradient was approximately 10. The effective stress was set at 5.0 psi.

The wet end of the SWCC was measured using a pressure plate extractor following Method B in ASTM D 6836. A chilled mirror hygrometer (Method D in ASTM D 6836) was used to complete the dry end of the SWCC after the pressure plate test was complete. SWCCs were prepared by combining data from the pressure plate and chilled mirror hygrometer tests as described in D 6836. van Genuchten's equation was fit to the SWCC data:

$$\frac{\theta - \theta_r}{\theta_s - \theta_r} = \left[\frac{1}{1 + (\alpha\psi)^n} \right]^m \tag{1}$$

where θ is volumetric water content, θ_r is residual water content, θ_s is saturated volumetric water content, ψ is matric suction, and α, m, and n are fitting parameters. Equation 1 was fit to the data using a non-linear least-squares optimization procedure with the constraint $m = 1\text{-}n^{-1}$.

3. RESULTS

Data from the hydraulic conductivity and SWCC tests are tabulated in the appendix. The saturated hydraulic conductivities (K_s) and the van Genuchten parameters for the SWCCs are summarized in Table 1.

Table 2. Summary of van Genuchten parameters.

Sample	K_s (cm/s)	θ_r	θ_s	α (1/kPa)	n
TP-2	1.8×10^{-4}	0.00	0.39	0.216	1.24
TP-3	1.8×10^{-4}	0.02	0.41	0.195	1.32
TP-9	2.7×10^{-5}	0.00	0.40	0.231	1.23

APPENDIX:

DATA SHEETS

Hydraulic Conductivity Test

ASTM D 5084 - 00

Sample I.D.	TP-2		Test Date :	1/23/08	
Cell Pressure =	45.7	psi	Diameter of Sample, D =	15.2	cm
Inflow Pressure =	41.4	psi	Length of Sample, L =	9.6	cm
Outflow Pressre =	40.0	psi	Area of Sample, A =	182.41	cm^2
Pressure Difference =	1.4	psi	Sample Volume, V =	1756.0	cm^3
Effective Stress =	5.0	psi	a_{in} =	1	cm^2
Hydraulic Gradient, i =	9.9		a_{out} =	1	cm^2
Weight of wet sample =	2948.4	(g)	Sample Water Content =	9.2	(%)
Wet Density =	1.7	g/cm^3	Dry Density =	1.54	g/cm^3

96.1

$$K_s = \frac{a_{in} * a_{out}}{(a_{in} + a_{out})} \frac{L}{A * \Delta t} Ln\left\{\frac{(\Delta H_1)}{(\Delta H_2)}\right\}$$

Can #	WT of Can	WT of Can + Wet Soil	WT of Can + Dry Soil	Water Content
	(g)	(g)	(g)	(%)

Date, Time	Inflow	OutFlow	Δt	H	Time	K	Q_{out} / Q_{in}	Q_{in}	Q_{out}
			(sec)	(cm)	(min)	(cm/sec)			
0:00:00	0.0	24.2	0.0	24.2	0.0				
0:00:10	5.0	19.2	10.0	14.2	0.2	2.31E-04	1.0	5	5
0:00:41	15.0	9.5	31.0	-5.5	0.7	1.69E-04	1.0	10	9.7
0:01:17	24.0	0.5	36.0	-23.5	1.3	1.65E-04	1.0	9	9
0:00:00	0.0	24.5	0.0	24.5	1.3				
0:00:17	7.0	17.5	17.0	10.5	1.6	1.94E-04	1.0	7	7
0:00:42	15.0	9.8	25.0	-5.2	2.0	1.70E-04	1.0	8	7.7
0:01:13	23.0	1.4	31.0	-21.6	2.5	1.72E-04	1.1	8	8.4
0:00:00	0.0	24.5	0.0	24.5	2.5				
0:00:27	9.0	15.2	27.0	6.2	3.0	1.63E-04	1.0	9	9.3
0:00:49	17.0	7.2	22.0	-9.8	3.3	2.07E-04	1.0	8	8
0:01:21	24.0	0.4	32.0	-23.6	3.9	1.46E-04	1.0	7	6.8
0:00:00	0.0	24.5	0.0	24.5	3.9				
0:00:15	6.0	18.2	15.0	12.2	4.1	1.91E-04	1.1	6	6.3
0:00:36	13.0	11.3	21.0	-1.7	4.5	1.75E-04	1.0	7	6.9
0:00:56	19.0	5.4	20.0	-13.6	4.8	1.80E-04	1.0	6	5.9
0:01:17	24.0	0.4	21.0	-23.6	5.1	1.65E-04	1.0	5	5
0:00:00	0.0	24.7	0.0	24.7	5.1				
0:00:12	5.0	19.5	12.0	14.5	5.3	1.96E-04	1.0	5	5.2
0:00:26	10.0	14.8	14.0	4.8	5.6	1.75E-04	0.9	5	4.7
0:00:42	15.0	9.9	16.0	-5.1	5.8	1.72E-04	1.0	5	4.9
0:01:00	20.0	4.9	18.0	-15.1	6.1	1.73E-04	1.0	5	5
0:01:17	24.0	0.7	17.0	-23.3	6.4	1.68E-04	1.1	4	4.2
0:00:00	0.0	24.5	0.0	24.5	6.4				
0:00:13	5.0	19.0	13.0	14.0	6.6	1.87E-04	1.1	5	5.5
0:00:27	10.0	13.8	14.0	3.8	6.9	1.85E-04	1.0	5	5.2
0:00:43	15.0	8.9	16.0	-6.1	7.1	1.74E-04	1.0	5	4.9
0:01:01	20.0	4.9	18.0	-15.1	7.4	1.57E-04	0.8	5	4
0:01:17	24.0	0.0	16.0	-24.0	7.7	1.95E-04	1.2	4	4.9
0:00:00	0.0	24.5	0.0	24.5	7.7				
0:00:20	8.0	16.5	20.0	8.5	8.0	1.90E-04	1.0	8	8
0:00:45	16.0	8.5	25.0	-7.5	8.5	1.77E-04	1.0	8	8
0:01:16	24.0	0.5	31.0	-23.5	9.0	1.72E-04	1.0	8	8
0:00:00	0.0	24.5	0.0	24.5	9.0				
0:00:23	8.0	16.0	23.0	8.0	9.4	1.71E-04	1.1	8	8.5
0:00:46	16.0	8.0	23.0	-8.0	9.7	1.94E-04	1.0	8	8
0:01:17	24.0	0.0	31.0	-24.0	10.3	1.73E-04	1.0	8	8

K (cm/s) = 1.79E-04

Hydraulic Conductivity Test

ASTM D 5084 - 00

Sample I.D.	TP-3		Test Date :	1/23/08	
Cell Pressure =	45.8	psi	Diameter of Sample, D =	15.2	cm
Inflow Pressure =	41.6	psi	Length of Sample, L =	11.2	cm
Outflow Pressre =	40.0	psi	Area of Sample, A =	182.41	cm^2
Pressure Difference =	1.6	psi	Sample Volume, V =	2043.3	cm^3
Effective Stress =	5.0	psi	a_{in} =	1	cm^2
Hydraulic Gradient, i =	10.0		a_{out} =	1	cm^2
Weight of wet sample =	3492.7	(g)	Sample Water Content =	11.3	(%)
Wet Density =	1.7	g/cm^3	Dry Density =	1.54	g/cm^3

95.9

$$K_s = \frac{a_{in} * a_{out}}{(a_{in} + a_{out})} \frac{L}{A * \Delta t} Ln\left\{\frac{(\Delta H_1)}{(\Delta H_2)}\right\}$$

Can #	WT of Can	WT of Can + Wet Soil	WT of Can + Dry Soil	Water Content
	(g)	(g)	(g)	(%)

Date, Time	Inflow	OutFlow	Δt	H	Time	K	Q_{out} / Q_{in}	Q_{in}	Q_{out}
			(sec)	(cm)	(min)	(cm/sec)			
0:00:00	0.0	24.5	0.0	24.5	0.0				
0:00:11	5.0	20.0	11.0	15.0	0.2	2.01E-04	0.9	5	4.5
0:00:24	10.0	15.0	13.0	5.0	0.4	1.93E-04	1.0	5	5
0:00:39	15.0	10.5	15.0	-4.5	0.7	1.73E-04	0.9	5	4.5
0:00:57	20.0	5.0	18.0	-15.0	1.0	1.74E-04	1.1	5	5.5
0:01:12	24.0	1.0	15.0	-23.0	1.2	1.75E-04	1.0	4	4
0:00:00	0.0	24.5	0.0	24.5	1.2				
0:00:18	7.0	17.5	18.0	10.5	1.5	1.84E-04	1.0	7	7
0:00:37	14.0	11.0	19.0	-3.0	1.8	1.88E-04	0.9	7	6.5
0:00:57	20.0	5.0	20.0	-15.0	2.2	1.78E-04	1.0	6	6
0:01:13	24.0	0.5	16.0	-23.5	2.4	1.75E-04	1.1	4	4.5
0:00:00	0.0	24.5	0.0	24.5	2.4				
0:00:21	8.0	16.5	21.0	8.5	2.8	1.82E-04	1.0	8	8
0:00:43	15.0	9.5	22.0	-5.5	3.1	1.72E-04	1.0	7	7
0:01:17	24.0	0.5	34.0	-23.5	3.7	1.66E-04	1.0	9	9
0:00:00	0.0	24.5	0.0	24.5	3.7				
0:00:17	6.0	18.5	17.0	12.5	4.0	1.66E-04	1.0	6	6
0:00:29	11.0	13.5	12.0	2.5	4.2	2.13E-04	1.0	5	5
0:00:48	17.0	7.5	19.0	-9.5	4.5	1.78E-04	1.0	6	6
0:01:15	24.0	0.5	27.0	-23.5	5.0	1.66E-04	1.0	7	7
0:00:00	0.0	24.5	0.0	24.5	5.0				
0:00:17	7.0	17.5	17.0	10.5	5.2	1.95E-04	1.0	7	7
0:00:38	14.0	10.5	21.0	-3.5	5.6	1.77E-04	1.0	7	7
0:00:58	20.0	4.5	20.0	-15.5	5.9	1.79E-04	1.0	6	6
0:01:15	24.0	0.5	17.0	-23.5	6.2	1.55E-04	1.0	4	4
0:00:00	0.0	24.5	0.0	24.5	6.2				
0:00:14	6.0	18.5	14.0	12.5	6.4	2.01E-04	1.0	6	6
0:00:31	12.0	12.5	17.0	0.5	6.7	1.82E-04	1.0	6	6
0:00:51	18.0	6.5	20.0	-11.5	7.1	1.72E-04	1.0	6	6
0:01:14	24.0	0.6	23.0	-23.4	7.4	1.67E-04	1.0	6	5.9
0:00:00	0.0	24.5	0.0	24.5	7.4				
0:00:14	5.0	19.5	14.0	14.5	7.7	1.66E-04	1.0	5	5
0:00:25	10.0	14.5	11.0	4.5	7.9	2.29E-04	1.0	5	5
0:00:40	15.0	9.5	15.0	-5.5	8.1	1.83E-04	1.0	5	5
0:00:58	20.0	4.5	18.0	-15.5	8.4	1.67E-04	1.0	5	5
0:01:13	24.0	0.5	15.0	-23.5	8.7	1.76E-04	1.0	4	4
0:00:00	0.0	24.5	0.0	24.5	8.7				
0:00:11	5.0	19.5	11.0	14.5	8.8	2.12E-04	1.0	5	5
0:00:25	10.0	14.5	14.0	4.5	9.1	1.80E-04	1.0	5	5
0:00:40	15.0	9.5	15.0	-5.5	9.3	1.83E-04	1.0	5	5
0:00:57	20.0	4.5	17.0	-15.5	9.6	1.77E-04	1.0	5	5
0:01:13	24.0	0.5	16.0	-23.5	9.9	1.65E-04	1.0	4	4

K (cm/s) = 1.75E-04

Hydraulic Conductivity Test

ASTM D 5084 - 00

Sample I.D.	TP-9		Test Date :	1/23/08	
Cell Pressure =	45.7	psi	Diameter of Sample, D =	15.2	cm
Inflow Pressure =	41.4	psi	Length of Sample, L =	9.5	cm
Outflow Pressre =	40.0	psi	Area of Sample, A =	182.41	cm^2
Pressure Difference =	1.4	psi	Sample Volume, V =	1728.2	cm^3
Effective Stress =	5.0	psi	a_{in} =	1	cm^2
Hydraulic Gradient, i =	10.0		a_{out} =	1	cm^2
Weight of wet sample =	2948.4	(g)	Sample Water Content =	11.0	(%)
Wet Density =	1.7	g/cm^3	Dry Density =	1.54	g/cm^3

96.0

$$K_s = \frac{a_{in} * a_{out}}{(a_{in} + a_{out})} \frac{L}{A * \Delta t} Ln\left\{\frac{(\Delta H_1)}{(\Delta H_2)}\right\}$$

Can #	WT of Can	WT of Can + Wet Soil	WT of Can + Dry Soil	Water Content
	(g)	(g)	(g)	(%)
				10.00

Date, Time	Inflow	OutFlow	Δt	H	Time	K	Q_{out} / Q_{in}	Q_{in}	Q_{out}
			(sec)	(cm)	(min)	(cm/sec)			
0:00:00	0.0	24.5	0.0	24.5	0.0				
0:01:06	5.0	20.9	66.0	15.9	1.1	2.94E-05	0.7	5	3.6
0:02:38	10.0	15.5	92.0	5.5	2.6	2.78E-05	1.1	5	5.4
0:04:19	15.0	11.0	101.0	-4.0	4.3	2.55E-05	0.9	5	4.5
0:06:15	20.0	6.1	116.0	-13.9	6.3	2.58E-05	1.0	5	4.9
0:08:01	24.0	2.0	106.0	-22.0	8.0	2.58E-05	1.0	4	4.1
0:00:00	0.0	24.4	0.0	24.4	8.0				
0:01:19	5.0	19.4	79.0	14.4	9.3	2.88E-05	1.0	5	5
0:02:52	10.0	14.5	93.0	4.5	10.9	2.65E-05	1.0	5	4.9
0:04:39	15.0	9.5	107.0	-5.5	12.7	2.57E-05	1.0	5	5
0:06:40	20.0	4.5	121.0	-15.5	14.7	2.54E-05	1.0	5	5
0:08:30	24.0	0.6	110.0	-23.4	16.5	2.47E-05	1.0	4	3.9
0:00:00	0.0	24.5	0.0	24.5	16.5				
0:01:58	7.0	17.4	118.0	10.4	18.5	2.76E-05	1.0	7	7.1
0:04:17	14.0	10.5	139.0	-3.5	20.8	2.64E-05	1.0	7	6.9
0:06:14	19.0	5.6	117.0	-13.4	22.8	2.54E-05	1.0	5	4.9
0:08:30	24.0	0.6	136.0	-23.4	25.0	2.50E-05	1.0	5	5
0:00:00	5.0	19.4	0.0	14.4	25.0				
0:01:27	10.0	14.5	87.0	4.5	26.5	2.83E-05	1.0	5	4.9
0:03:13	15.0	9.5	106.0	-5.5	28.2	2.60E-05	1.0	5	5
0:04:49	19.0	5.6	96.0	-13.4	29.8	2.50E-05	1.0	4	3.9
0:07:05	24.0	0.7	136.0	-23.3	32.1	2.47E-05	1.0	5	4.9
0:00:00	0.0	24.5	0.0	24.5	32.1				
0:01:24	5.0	19.3	84.0	14.3	33.5	2.76E-05	1.0	5	5.2
0:03:01	10.0	14.7	97.0	4.7	35.1	2.46E-05	0.9	5	4.6
0:04:47	15.0	9.5	106.0	-5.5	36.9	2.65E-05	1.0	5	5.2
0:06:24	19.0	5.5	97.0	-13.5	38.5	2.51E-05	1.0	4	4
0:08:24	24.0	0.5	120.0	-23.5	40.5	2.83E-05	1.0	5	5
					K (cm/s) =	**2.66E-05**			

Pressure Plate Extractor Test

ASTM D 6836 - 02 (Method B)

Sample I.D.	**TP-2**		**Test Date**	
WT of Sample Ring =	70.79	g		
WT of Sample Ring + Soil =	248.98	g		
Water Content =	10.0	%		
Diameter of Sample Ring, D =	2.86	in		
Height of Sample Ring, L =	1.0	in		
Volume, V =	3.72E-03	ft^3	105.3	cm^3
Dry Unit Weight =	96.06	pcf	1.54	Mg/m^3
Water WT =	16.20	g		
Solid WT =	161.99	g		
Add Water for saturation =	24.82	g	Sr	91.59
Saturated Water Content =	25.32	%		
Tube Area, A =	0.19	cm^2		

Applied Pressure	**Reading**	**Water out from soil sample**	**Suction**	**Water Content**	**Volumetric Water Content**
(psi)	**(cm)**	**(cc)**	**(kPa)**		
0	8.6	0.000	0.001	0.253	0.390
0.5	21	2.356	3.449	0.239	0.367
1	32	4.446	6.897	0.226	0.348
2	72.5	12.141	13.794	0.178	0.274
4	100.2	17.404	27.588	0.146	0.224
7	114.5	20.121	48.279	0.129	0.199
15	125.5	22.211	103.455	0.116	0.179
30	133.5	23.731	206.910	0.107	0.164
60	141	25.156	413.820	0.098	0.151
		Activity Meter Test	970.00	0.082	0.126
			8230.00	0.034	0.053
			44600.00	0.018	0.028

Activity Meter Test

Suction	Wt of Can	Wt of Can + Wet Soil	Wt of Can + Dry Soil	Gravimetric Water Content	Volumetric Water Content
(Mpa)	(g)	(g)	(g)	(%)	(%)
44.6	7.8013	16.3729	16.2173	0.018	0.028
8.23	7.6012	15.2926	15.0378	0.034	0.053
0.97	8.2742	14.8554	14.357	0.082	0.126

Fit van Genuchten Eqn to SWCC Data

van Genuchten Eqn

$$\Theta = \frac{\theta - \theta_r}{\theta_s - \theta_r} = \left[\frac{1}{1+(\alpha\psi)^n}\right]^m$$

θ_r =	0.0000
θ_s =	0.3898
α =	0.2160
n =	1.2433
m =	0.1957

FOR GRAPHING

Suction (kPa)	VWC
0.001	0.3898
0.025	0.3897
0.05	0.3895
0.075	0.3894
0.1	0.3892
0.25	0.3878
0.5	0.3852
0.75	0.3823
1	0.3794
1.5	0.3734
2	0.3675
3	0.3563
4	0.3462
5	0.3371
6	0.3290
7	0.3216
8	0.3149
9	0.3089
10	0.3033
15	0.2811
20	0.2651
30	0.2429
40	0.2277
50	0.2163
60	0.2073
70	0.2000
80	0.1938
90	0.1884
100	0.1838
500	0.1247
1000	0.1054
5000	0.0712
10000	0.0602
25000	0.0482
5.00E+04	0.0407
1.00E+05	0.0344
5.00E+05	0.0232
7.50E+05	0.0210
1.00E+06	0.0196

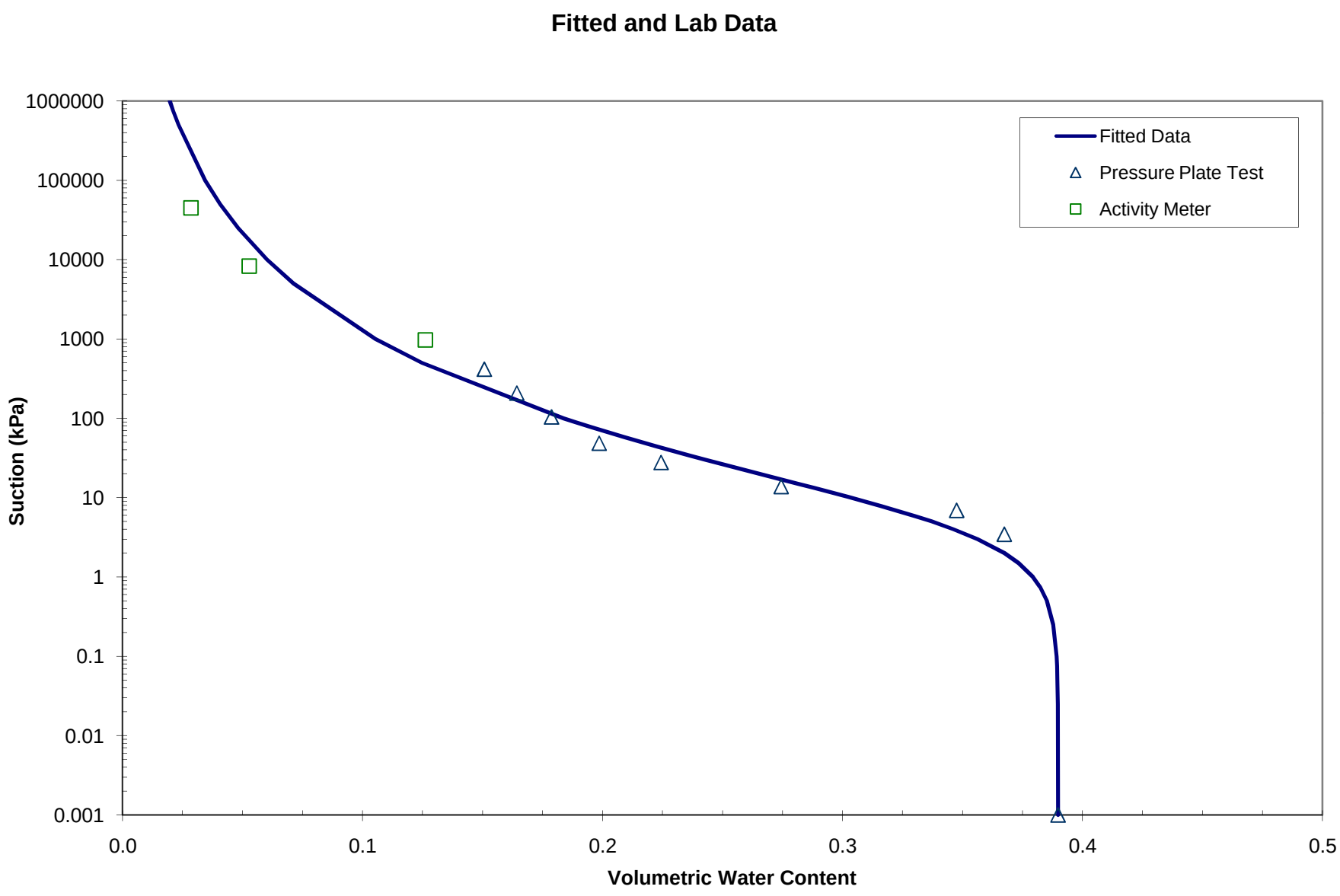
FOR FITTING

Applied Suction (kPa)	Measured VWC	Predicted VWC	ΔWC (%)	$(\Delta WC)^2$
0.001	0.390	0.3898	0.000	0.000
3.45	0.367	0.3516	0.016	0.000
6.90	0.348	0.3223	0.025	0.001
13.79	0.274	0.2858	-0.011	0.000
27.59	0.224	0.2474	-0.023	0.001
48.28	0.199	0.2181	-0.019	0.000
103.46	0.179	0.1823	-0.004	0.000
206.91	0.164	0.1544	0.010	0.000
413.82	0.151	0.1305	0.020	0.000
970.00	0.126	0.1062	0.020	0.000
8230.00	0.053	0.0631	-0.010	0.000
44600.00	0.028	0.0418	-0.013	0.000

Residual =	0.000260741

press plate data (FROM PAGE 2)

water activity meter data (FROM PAGE 2)


Fitted and Lab Data
Fitted Data
Pressure Plate Test
Activity Meter
Suction (kPa)
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100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0
0.1
0.2
0.3
0.4
0.5
Volumetric Water Content

Pressure Plate Extractor Test

ASTM D 6836 - 02 (Method B)

Sample I.D.		**TP-3**	**Test Date**	
WT of Sample Ring =	69.36	g		
WT of Sample Ring + Soil =	247.55	g		
Water Content =	10.0	%		
Diameter of Sample Ring, D =	2.86	in		
Height of Sample Ring, L =	1.0	in		
Volume, V =	3.72E-03	ft^3	105.3	cm^3
Dry Unit Weight =	96.06	pcf	1.54	Mg/m^3
Water WT =	16.20	g		
Solid WT =	161.99	g		
Add Water for saturation =	27.45	g	Sr	97.46
Saturated Water Content =	26.95	%		
Tube Area, A =	0.19	cm^2		

Applied Pressure	**Reading**	**Water out from soil sample**	**Suction**	**Water Content**	**Volumetric Water Content**
(psi)	**(cm)**	**(cc)**	**(kPa)**		
0	9.3	0.000	0.001	0.269	0.415
0.5	23.6	2.717	3.449	0.253	0.389
1	31.7	4.256	6.897	0.243	0.374
2	93	15.903	13.794	0.171	0.264
4	116	20.273	27.588	0.144	0.222
7	128.4	22.629	48.279	0.130	0.200
15	141.6	25.137	103.455	0.114	0.176
30	154	27.493	206.910	0.100	0.154
60	161	28.823	413.820	0.092	0.141
		Activity Meter Test	1860.00	0.056	0.086
			11700.00	0.036	0.055
			68300.00	0.019	0.029

Activity Meter Test

Suction	Wt of Can	Wt of Can + Wet Soil	Wt of Can + Dry Soil	Gravimetric Water Content	Volumetric Water Content
(Mpa)	(g)	(g)	(g)	(%)	(%)
68.3	7.7057	15.5469	15.4016	0.019	0.029
11.7	7.7604	13.7088	13.5028	0.036	0.055
1.86	8.0128	13.8743	13.5653	0.056	0.086

Fit van Genuchten Eqn to SWCC Data

van Genuchten Eqn

$$\Theta = \frac{\theta - \theta_r}{\theta_s - \theta_r} = \left[\frac{1}{1+(\alpha\psi)^n}\right]^m$$

θ_r =	0.0233
θ_s =	0.4148
α =	0.1954
n =	1.3205
m =	0.2427

FOR GRAPHING

Suction (kPa)	VWC
0.001	0.4148
0.025	0.4147
0.05	0.4146
0.075	0.4144
0.1	0.4143
0.25	0.4131
0.5	0.4105
0.75	0.4076
1	0.4045
1.5	0.3980
2	0.3914
3	0.3785
4	0.3664
5	0.3554
6	0.3454
7	0.3364
8	0.3281
9	0.3206
10	0.3137
15	0.2865
20	0.2670
30	0.2405
40	0.2227
50	0.2097
60	0.1995
70	0.1913
80	0.1845
90	0.1786
100	0.1736
500	0.1134
1000	0.0954
5000	0.0664
10000	0.0578
25000	0.0490
5.00E+04	0.0439
1.00E+05	0.0398
5.00E+05	0.0331
7.50E+05	0.0319
1.00E+06	0.0312

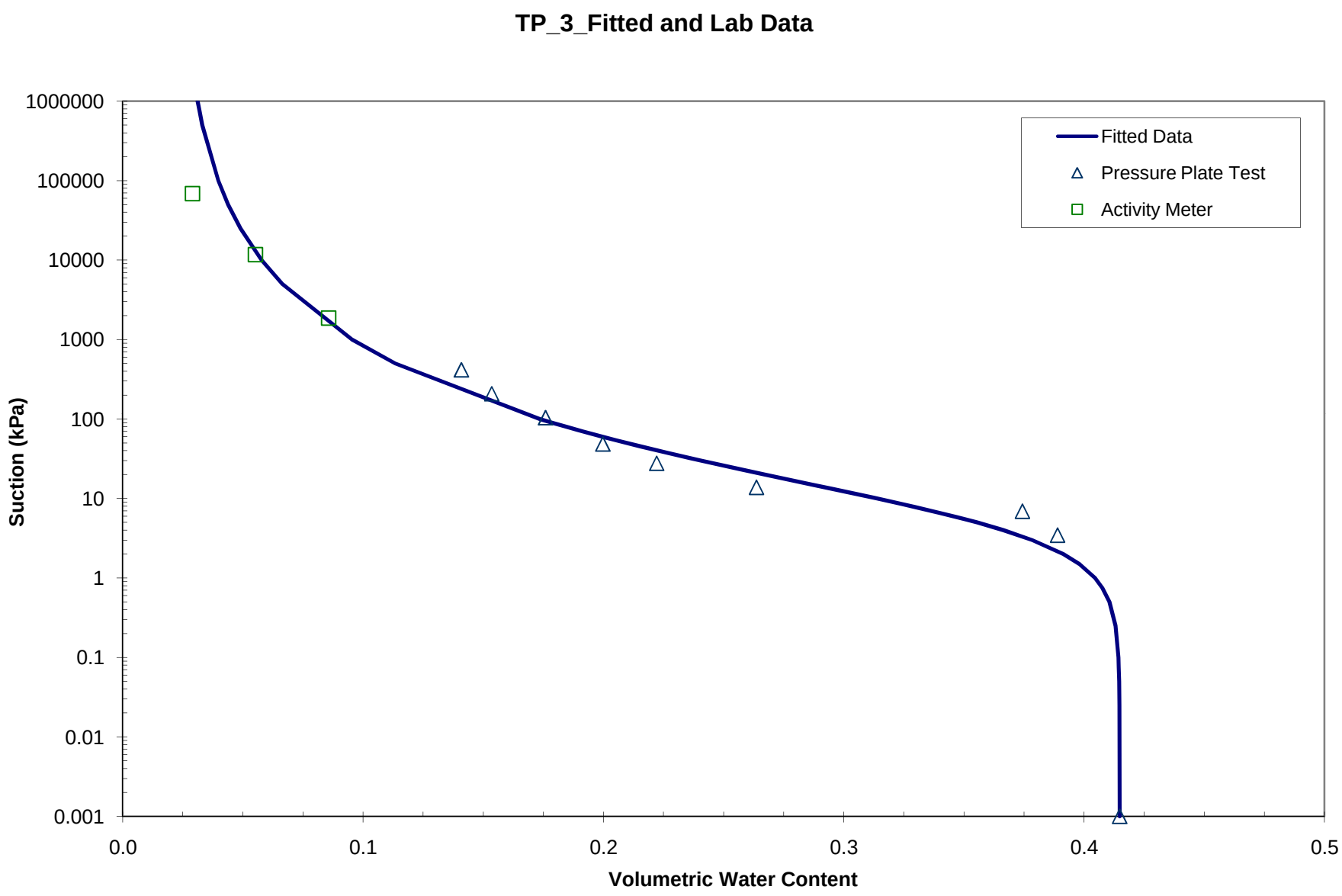
FOR FITTING

Applied Suction (kPa)	Measured VWC	Predicted VWC	ΔWC (%)	$(\Delta WC)^2$
0.001	0.415	0.4148	0.000	0.000
3.45	0.389	0.3729	0.016	0.000
6.90	0.374	0.3373	0.037	0.001
13.79	0.264	0.2922	-0.028	0.001
27.59	0.222	0.2458	-0.024	0.001
48.28	0.200	0.2117	-0.012	0.000
103.46	0.176	0.1720	0.004	0.000
206.91	0.154	0.1427	0.011	0.000
413.82	0.141	0.1190	0.022	0.000
1860.00	0.086	0.0824	0.003	0.000
11700.00	0.055	0.0561	-0.001	0.000
68300.00	0.029	0.0419	-0.013	0.000

Residual =	0.000328165

press plate data (FROM PAGE 2)

water activity meter data (FROM PAGE 2)


TP_3_Fitted and Lab Data
Fitted Data
Pressure Plate Test
Activity Meter
Suction (kPa)
1000000
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0
0.1
0.2
0.3
0.4
0.5
Volumetric Water Content

Pressure Plate Extractor Test

ASTM D 6836 - 02 (Method B)

Sample I.D.		**TP-9**	**Test Date**	
WT of Sample Ring =	69.67	g		
WT of Sample Ring + Soil =	247.86	g		
Water Content =	10.0	%		
Diameter of Sample Ring, D =	2.86	in		
Height of Sample Ring, L =	1.0	in		
Volume, V =	3.72E-03	ft^3	105.3	cm^3
Dry Unit Weight =	96.06	pcf	1.54	Mg/m^3
Water WT =	16.20	g		
Solid WT =	161.99	g		
Add Water for saturation =	26.14	g	Sr	94.54
Saturated Water Content =	26.14	%		
Tube Area, A =	0.19	cm^2		

Applied Pressure	**Reading**	**Water out from soil sample**	**Suction**	**Water Content**	**Volumetric Water Content**
(psi)	**(cm)**	**(cc)**	**(kPa)**		
0	8.4	0.000	0.001	0.261	0.402
0.5	20.8	2.356	3.449	0.247	0.380
1	36.1	5.263	6.897	0.229	0.352
2	80	13.604	13.794	0.177	0.273
4	100	17.404	27.588	0.154	0.237
7	109.4	19.190	48.279	0.143	0.220
15	119.5	21.109	103.455	0.131	0.202
30	129	22.914	206.910	0.120	0.185
60	139	24.814	413.820	0.108	0.167
		Activity Meter Test	3220.00	0.060	0.092
			32800.00	0.028	0.043
			83400.00	0.012	0.019

Activity Meter Test

Suction	Wt of Can	Wt of Can + Wet Soil	Wt of Can + Dry Soil	Gravimetric Water Content	Volumetric Water Content
(Mpa)	(g)	(g)	(g)	(%)	(%)
83.4	7.6594	15.2199	15.1281	0.012	0.019
32.8	7.9063	16.5648	16.328	0.028	0.043
3.22	8.0119	15.3013	14.8882	0.060	0.092

Fit van Genuchten Eqn to SWCC Data

van Genuchten Eqn

$$\Theta = \frac{\theta - \theta_r}{\theta_s - \theta_r} = \left[\frac{1}{1+(\alpha\psi)^n}\right]^m$$

θ_r =	0.0000
θ_s =	0.4024
α =	0.2308
n =	1.2274
m =	0.1853

FOR GRAPHING

Suction (kPa)	VWC
0.001	0.4023
0.025	0.4022
0.05	0.4020
0.075	0.4018
0.1	0.4016
0.25	0.4001
0.5	0.3973
0.75	0.3942
1	0.3911
1.5	0.3848
2	0.3787
3	0.3672
4	0.3570
5	0.3479
6	0.3397
7	0.3324
8	0.3258
9	0.3198
10	0.3143
15	0.2925
20	0.2767
30	0.2549
40	0.2399
50	0.2286
60	0.2197
70	0.2124
80	0.2062
90	0.2009
100	0.1963
500	0.1366
1000	0.1167
5000	0.0809
10000	0.0691
25000	0.0561
5.00E+04	0.0479
1.00E+05	0.0409
5.00E+05	0.0284
7.50E+05	0.0259
1.00E+06	0.0243

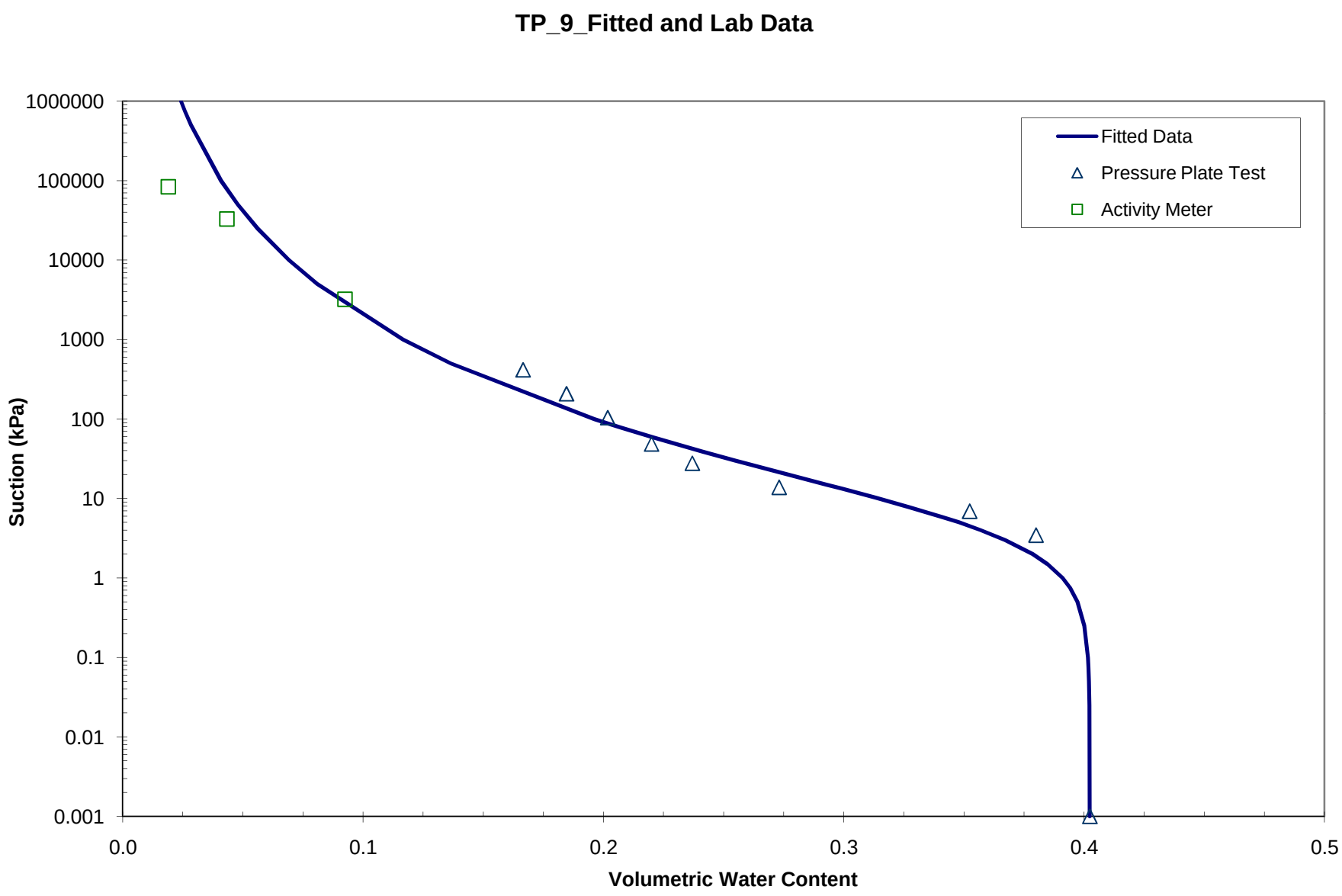
FOR FITTING

Applied Suction (kPa)	Measured VWC	Predicted VWC	ΔWC (%)	$(\Delta WC)^2$
0.001	0.402	0.4023	0.000	0.000
3.45	0.380	0.3625	0.017	0.000
6.90	0.352	0.3331	0.019	0.000
13.79	0.273	0.2970	-0.024	0.001
27.59	0.237	0.2593	-0.022	0.001
48.28	0.220	0.2304	-0.010	0.000
103.46	0.202	0.1948	0.007	0.000
206.91	0.185	0.1667	0.018	0.000
413.82	0.167	0.1425	0.024	0.001
3220.00	0.092	0.0894	0.003	0.000
32800.00	0.043	0.0528	-0.009	0.000
83400.00	0.019	0.0427	-0.024	0.001

Residual =	0.000288518

press plate data (FROM PAGE 2)

water activity meter data (FROM PAGE 2)


TP_9_Fitted and Lab Data
Fitted Data
Pressure Plate Test
Activity Meter
Suction (kPa)
1000000
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0
0.1
0.2
0.3
0.4
0.5
Volumetric Water Content