

July 25, 2008



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Intuition & Logic  
450 North New Ballas Road, Suite 246N  
St. Louis, MO 63141

Attention: Mr. Matt Harper

Re: Results of Dispersive Soils Analysis  
Little Salt Creek Watershed Master Plan  
Lincoln, Nebraska  
Terracon Project No. A3085016

Dear Mr. Harper:

Terracon Consultants, Inc (Terracon) appreciates the opportunity to provide engineering services for Intuition & Logic on the above referenced project. Terracon has performed field sampling and laboratory testing for the proejct, the results of which are presented in and attached to this report.

#### **A. PROJECT INFORMATION**

Terracon understands that Intuition & Logic is assisting the City of Lincoln and the Lower Platte South Natural Resources District (NRD) with the development of a watershed master plan with the purpose of allowing planning and design engineers the ability to evaluate and manage changes in the watershed. The watershed master plan takes into account factors such as stormwater quantity and quality, channel stability, and economic and environmental issues. Terracon's role in the current stage of development is to assist Intuition & Logic with soil sampling and analysis at various locations along the Little Salt Creek. A summary of field activities, boring locations, and soil analytical results follows:

#### **B. FIELD ACTIVITIES**

Terracon conducted soil sampling activities on July 9<sup>th</sup>, 2008. In general, Terracon collected soil samples from approximately two feet below grade to five feet below grade as discussed with Intuition & Logic prior to the sampling event. During sampling activities, Terracon collected two types of soil samples at each of the nine client-selected sampling locations. The soil located in the upper approximately two feet below grade to three feet below grade was placed into a plastic bag, while the soil collected from approximately three feet below grade to five feet below

grade was collected in-situ using a Shelby tube sampler. The samples were tagged for identification, sealed, and transported to our laboratory for tests and further observations.

In general, soil samples were collected at the top of bank at locations depicted on Intuition & Logic supplied aerial photographs. A diagram of depicting the general location of the borings is attached to this report as Figure 1. After the samples were collected, Terracon placed an orange painted lathe at the boring location for future reference. The locations of borings B-5 and B-6 were moved approximately 30-40 feet away from the top of bank, to within the Waverly Road right-of-way, because of the presence of concrete (or other rubble) presumably associated with the wing walls of the Waverly Road bridge over the Little Salt Creek.

### **C. Soils Analysis**

In an effort to determine if soils located at the boring locations depicted on the attached Figure 1 were dispersive, Terracon conducted pinhole dispersion tests on a portion of each soil sample. The results of these tests are summarized on the attached Table 1.

In addition to the analysis for dispersive clays, Terracon also performed laboratory tests to measure moisture content, dry density, Atterberg limits, and grain size distribution. The laboratory tests were conducted on soils obtained from the Shelby tube samples. The results of these tests are also summarized on the attached Table 1 with the exception of the grain size analysis which are presented graphically on the grain size distribution curves.

### **D. GENERAL COMMENTS**

The test results presented in this report are based upon the data obtained from the widely-spaced borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until further testing is performed, or during or after construction. If variations appear, we should be immediately notified so that further evaluations can be provided.

This report is prepared for the exclusive use of Intuition & Logic for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. No warranties, either express or implied, are intended or made. In the event any changes in the nature or location of observed conditions as outlined in this report are found, this report cannot be considered valid unless these changes are reviewed and the opinions and conclusions of this report are modified or verified in writing by Terracon.

Soil Sampling and Analysis  
Little Salt Creek Watershed  
Project No. 05085016  
July 25, 2008

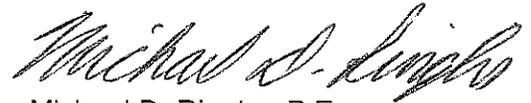
Terracon

We appreciate the opportunity to provide the field sampling and laboratory testing services for this project. Please contact us if you have any questions regarding this letter, the attached laboratory test results, or if we may be of further service.

Sincerely,  
**TERRACON CONSULTANTS, INC.**



Michael Henry, E.I.  
Environmental Engineer



Michael D. Ringler, P.E.  
Geotechnical Engineer

MDH/MDR:mdh/tmc

Copies to: Addressee (2)

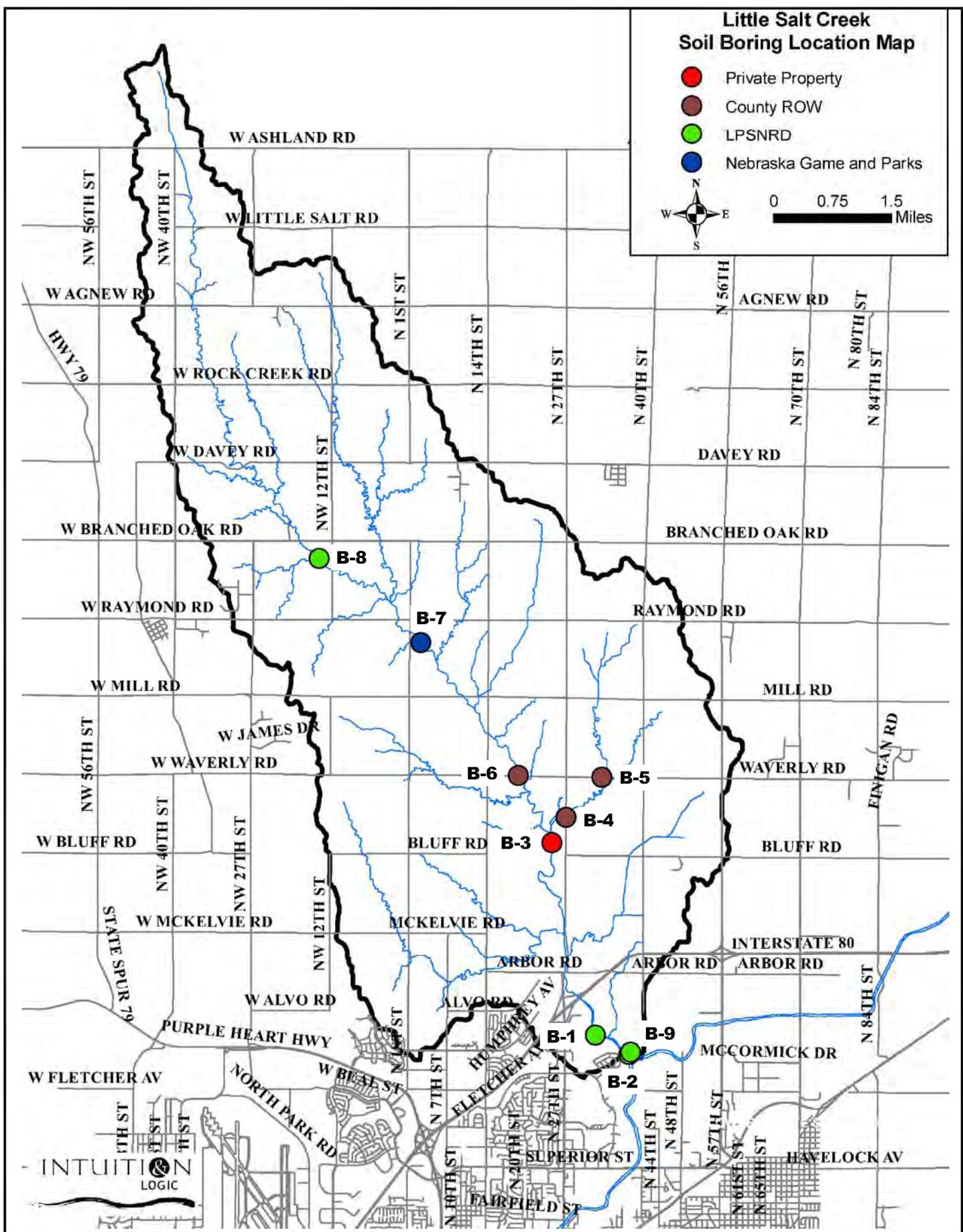
Attachments

### Little Salt Creek Soil Boring Location Map

- Private Property
- County ROW
- LPSNRD
- Nebraska Game and Parks



0 0.75 1.5  
Miles



Project Mng:	MDH
Drawn By:	PAI
Checked By:	MDH
Approved By:	BAL

Project No.	A3085016
Scale:	AS SHOWN
File No.	A3085016C01
Date:	JULY 2008

**Terracon**  
Consulting Engineers and Scientists

2211 SOUTH 156TH CIRCLE OMAHA, NE 68130-2506  
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BORING LOCATION DIAGRAM

LITTLE SALT CREEK WATERSHED MASTER PLAN

LINCOLN, LANCASTER COUNTY NEBRASKA

FIG. No.

1

**TABLE 1**  
**SUMMARY OF RESULTS OF SELECT SOILS ANALYSIS**

Little Salt Creek Watershed Master Plan  
Lincoln, Nebraska  
Terracon Project No. A3085016

Sample Designation and Depth, ft.	Moisture Content %	Dry Density pcf	Dispersive Classification	Atterberg Limits			Unified Symbol
				LL	PL	PI	
B-1, 3-5	34	82	ND2	55	20	35	CH
B-2, 3-5	19	105	SD or ND3	22	19	3	ML
B-3, 3-5	8	89	ND2	34	20	14	CL
B-4, 3-5	21	103	ND3 or SD	35	20	15	CL
B-5, 3-5	22	104	ND1	45	18	27	CL
B-6, 3-5	21	110	ND3	NP	NP	NP	ML
B-7, 3-5	33	88	ND2	48	20	28	CL
B-8, 3-5	28	94	ND3	33	22	11	ML
B-9, 3-5	12	107	ND2	45	21	24	CL

Notes:

Soil samples were collected on July 9, 2008

Sample depths given refer to feet below grade

Dispersive classification was determined using the pinhole test (ASTM 4647, Method A)

pcf - pounds per cubic foot

ND1, ND2 - Nondispersive clay with very slight to no colloidal erosion under 380mm (15 inches) or 1020mm (40 inches) head (ND1 less dispersive than ND2)

ND3, ND4 - Slightly to moderately dispersive clays that erode slowly under 50mm (2 inches) or 180mm (7 inches) head.

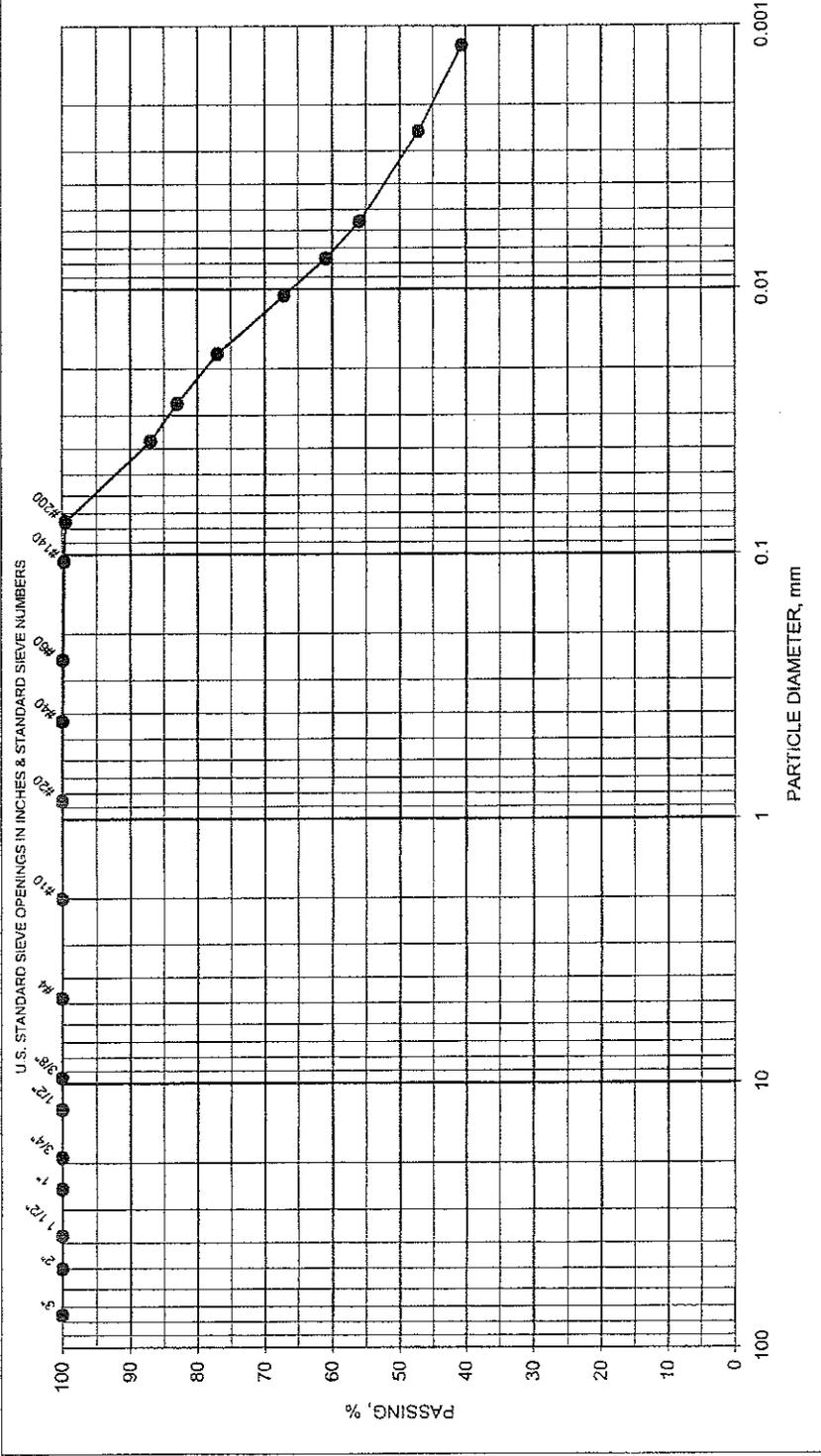
SD - Slightly dispersive clays that erode slowly under 180mm head

CH - Fat clay

ML - Silt

CL - Lean clay

NP - Non-plastic



GRAIN SIZE DISTRIBUTION CURVE

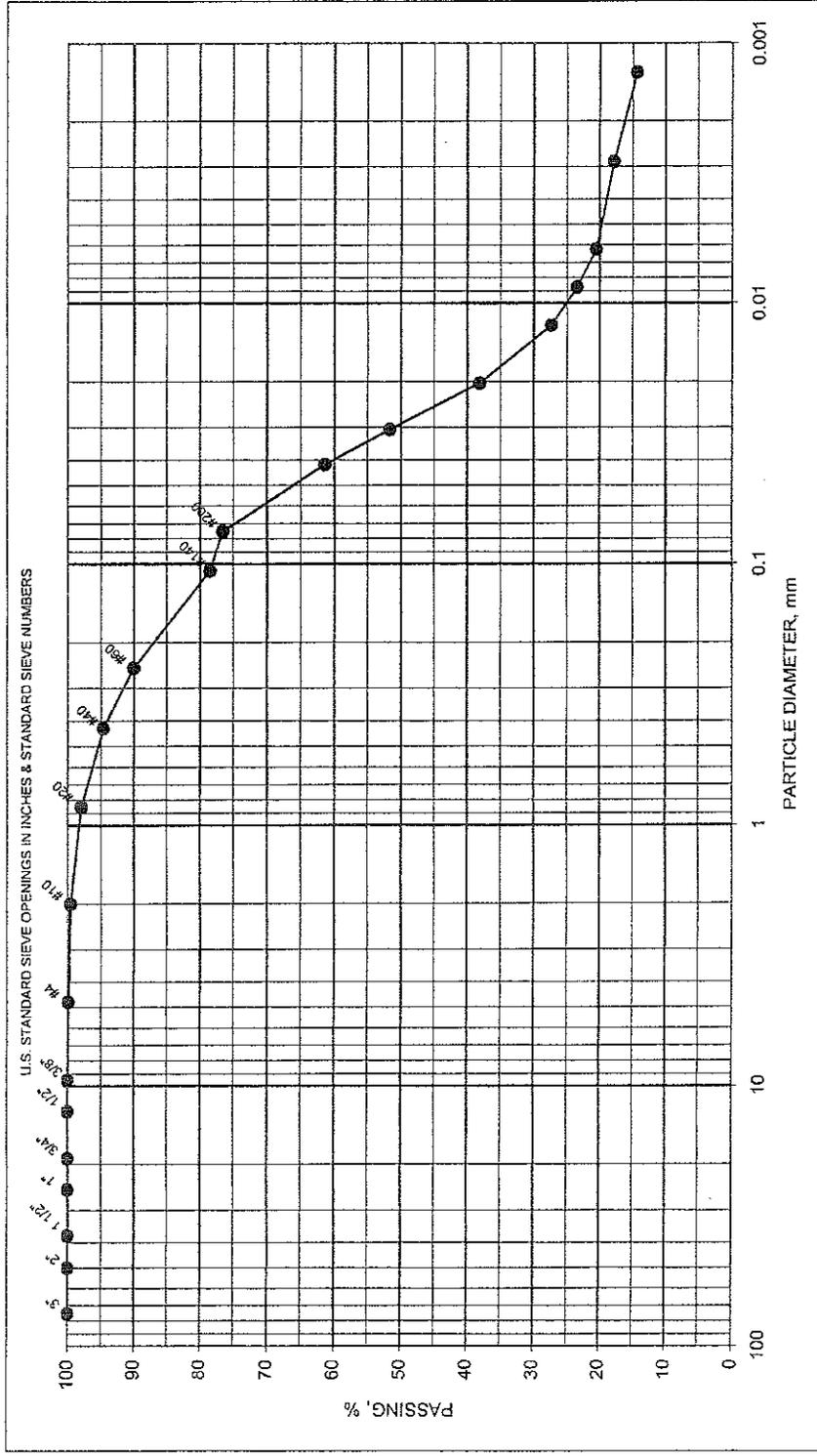
BORING ID	SAMPLE ID	DEPTH, feet	SPECIMEN DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS
B-1	1	2.9 TO 4.9	FAT CLAY, DARK BROWN TRACE LIGHT GRAYISH BROWN	CH	34.4	LL 55 PL 20 PI 35

PROJECT LITTLE SALT CREEK WATERSHED

JOB NO. A3085016 DATE 7/18/2008







SPECIFIC GRAVITY 2.70  
ASSUMED

GRAIN SIZE DISTRIBUTION CURVE

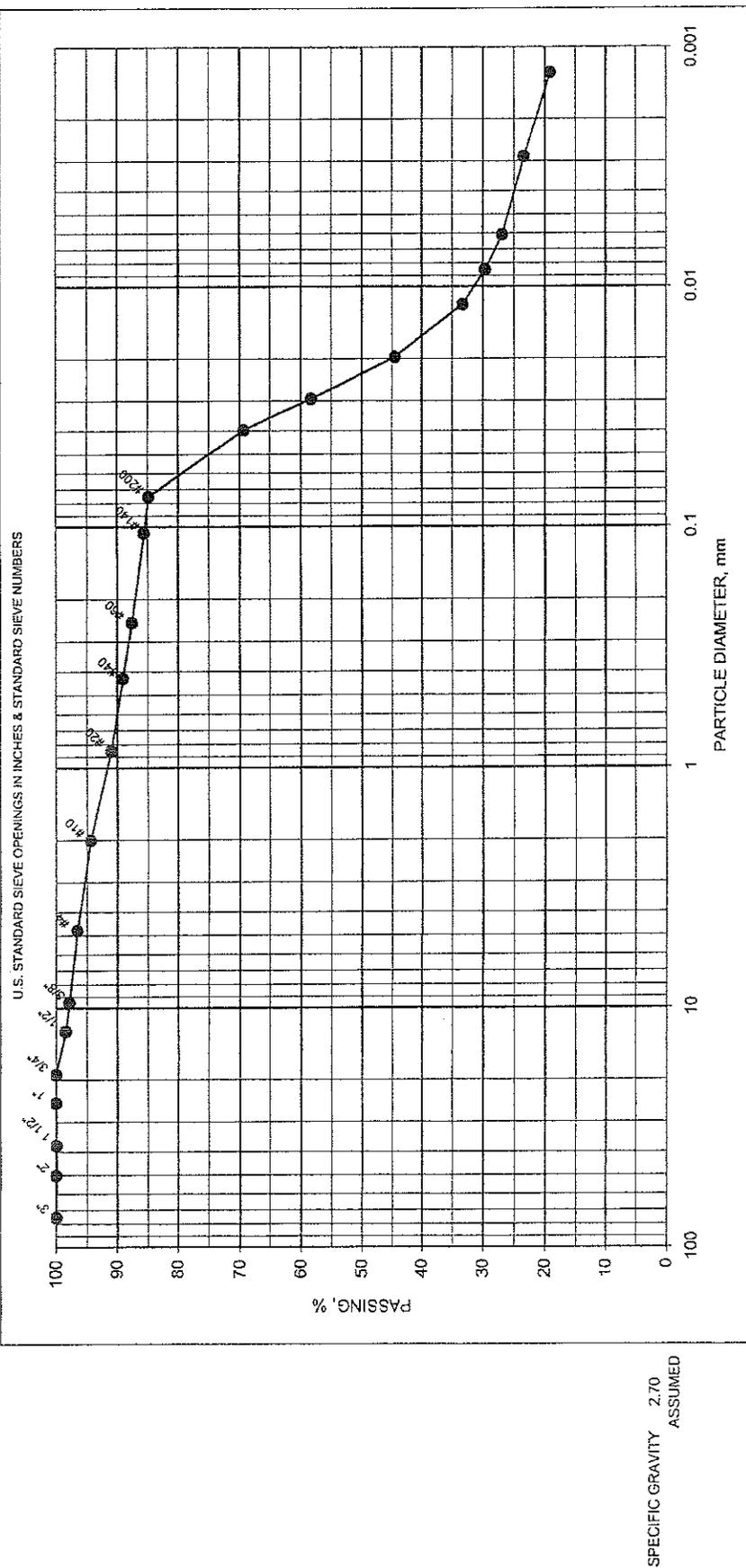
BORING ID	SAMPLE ID	DEPTH, feet	SPECIMEN DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL PL PI
B-3	1	3 TO 5	LEAN CLAY WITH SAND, DARK BROWN	CL	8.4	34 20 14

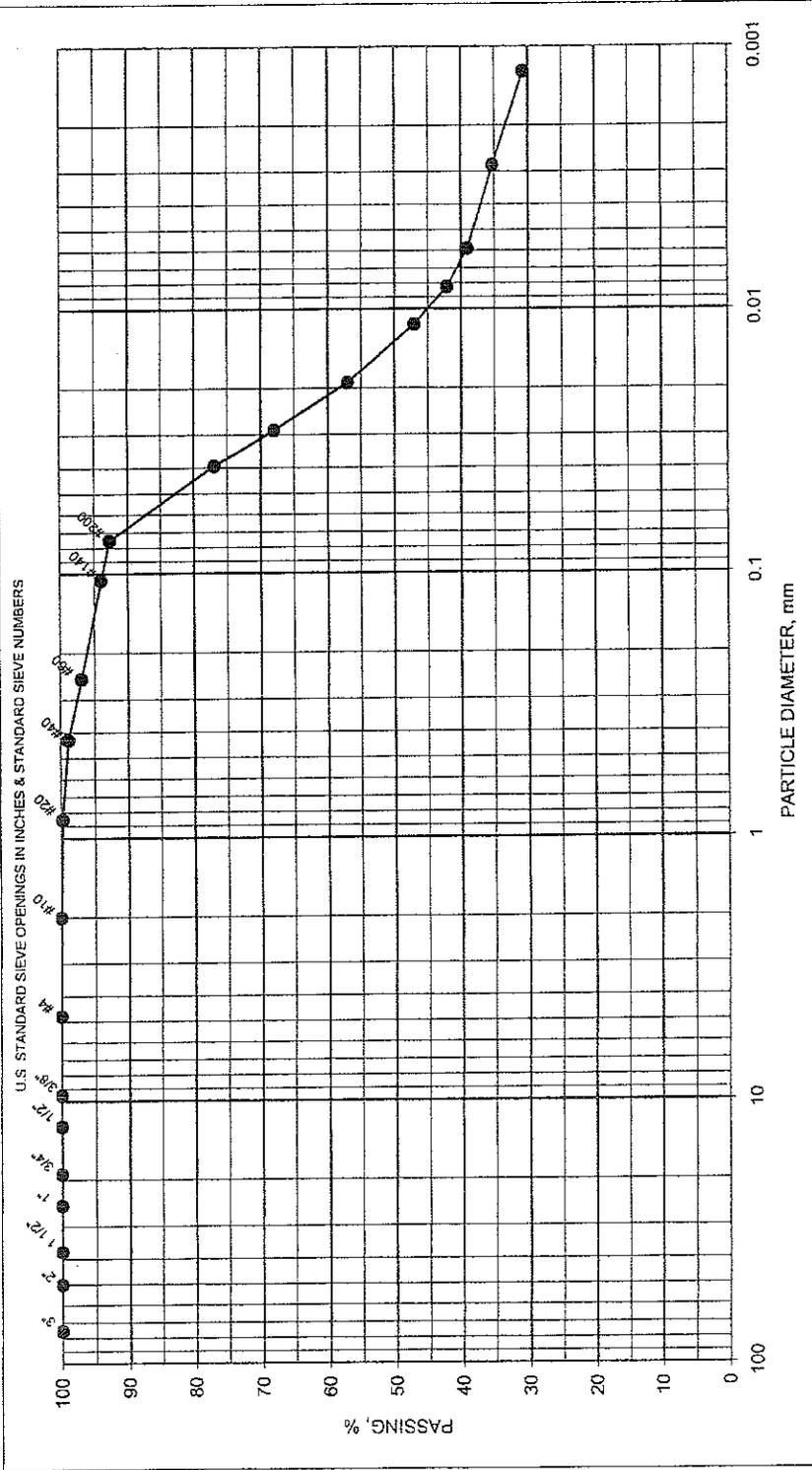
PROJECT LITTLE SALT CREEK WATERSHED

JOB NO. A3085016 DATE 7/18/2008

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SPECIFIC GRAVITY 2.70  
ASSUMED

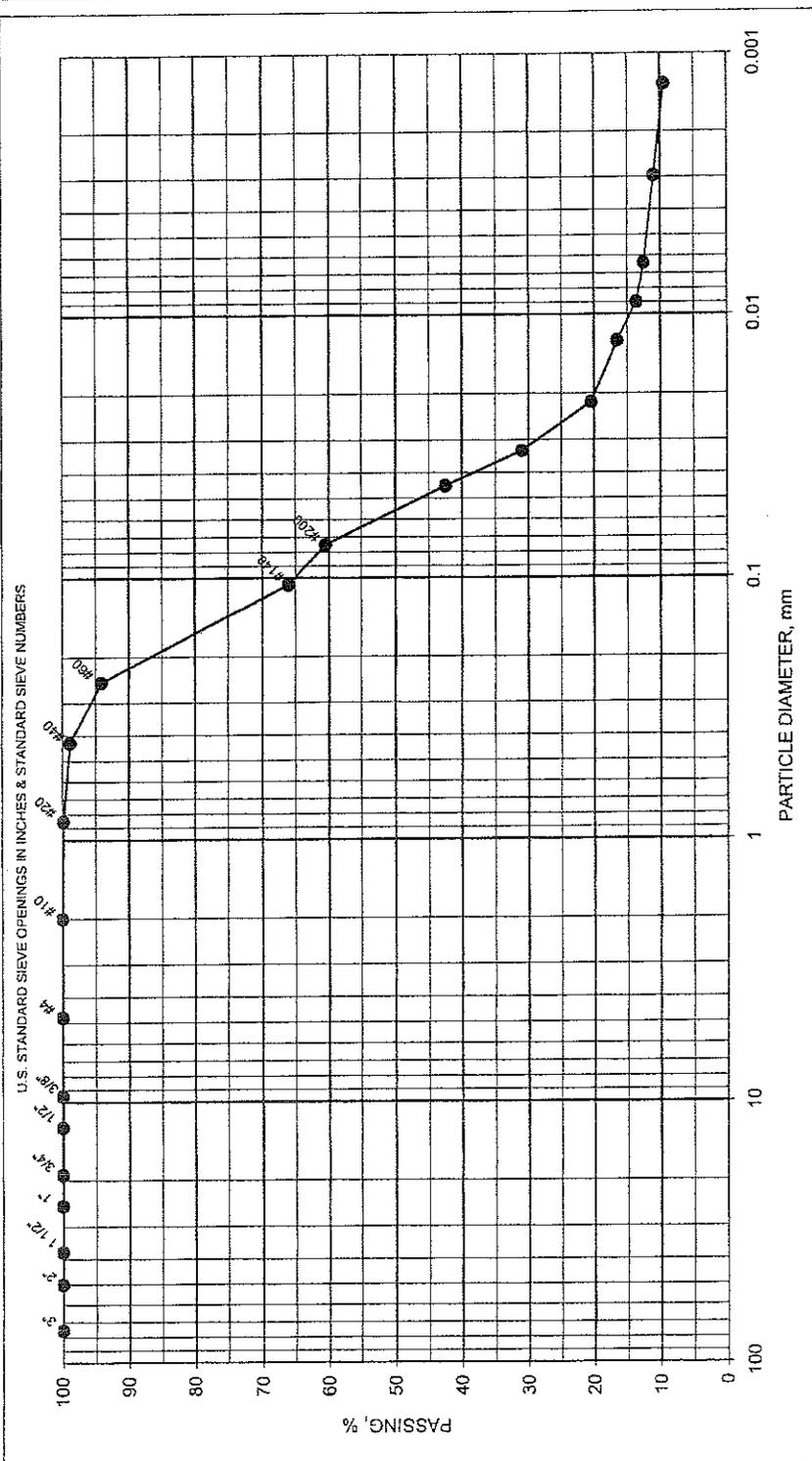
GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	SPECIMEN DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS	
						LL	PL
B-5	1	3 TO 4.9	LEAN CLAY, BROWN TRACE DARK BROWN	CL	22.2	45	18
							27

PROJECT LITTLE CREEK WATERSHED

JOB NO. A3085016 DATE 7/18/2008





SPECIFIC GRAVITY 2.70  
ASSUMED

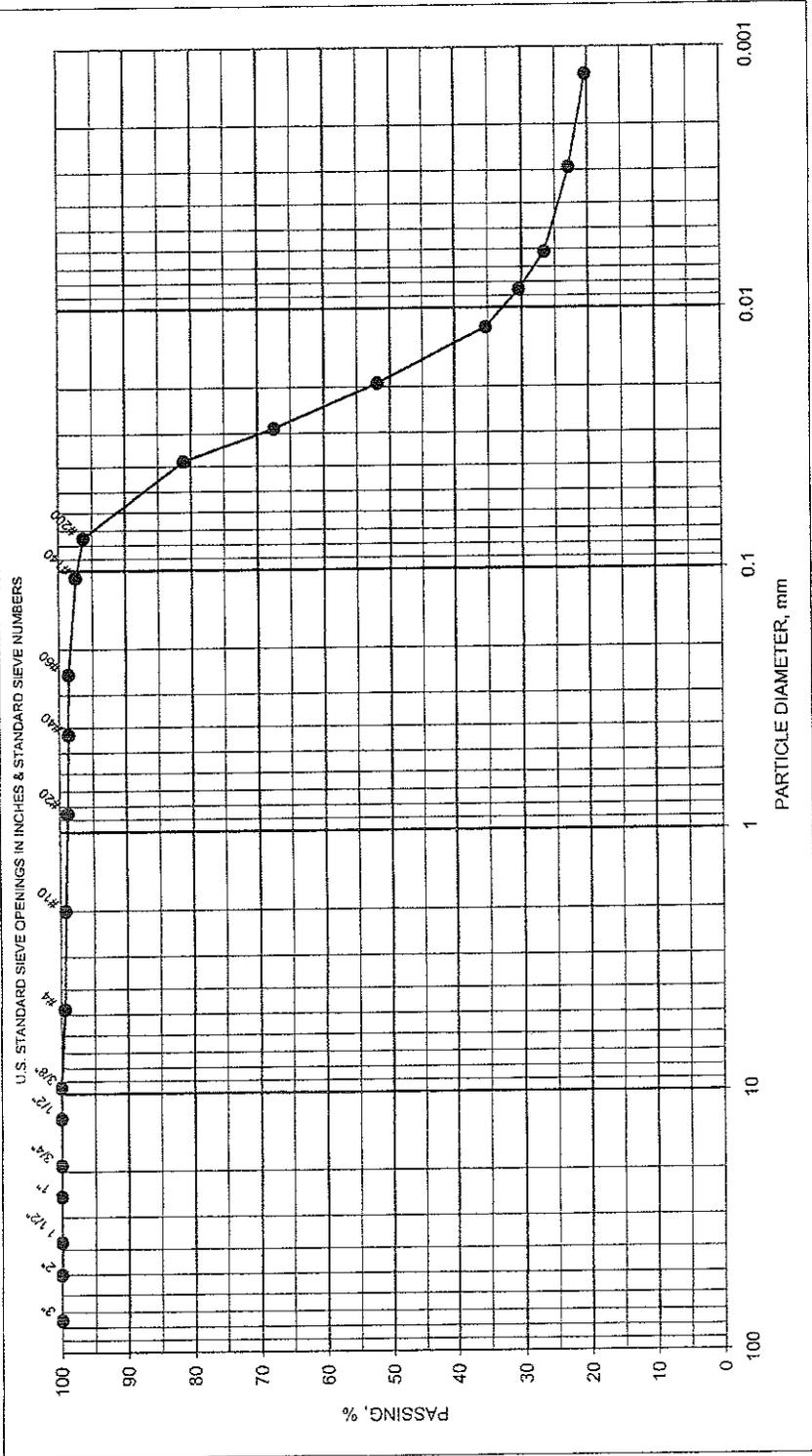
GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	SPECIMEN DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS	
						LL	PL
B-6	1	3 TO 4.9	SANDY SILT, GRAYISH BROWN	ML	20.6	NP	NP

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SPECIFIC GRAVITY 2.70  
ASSUMED

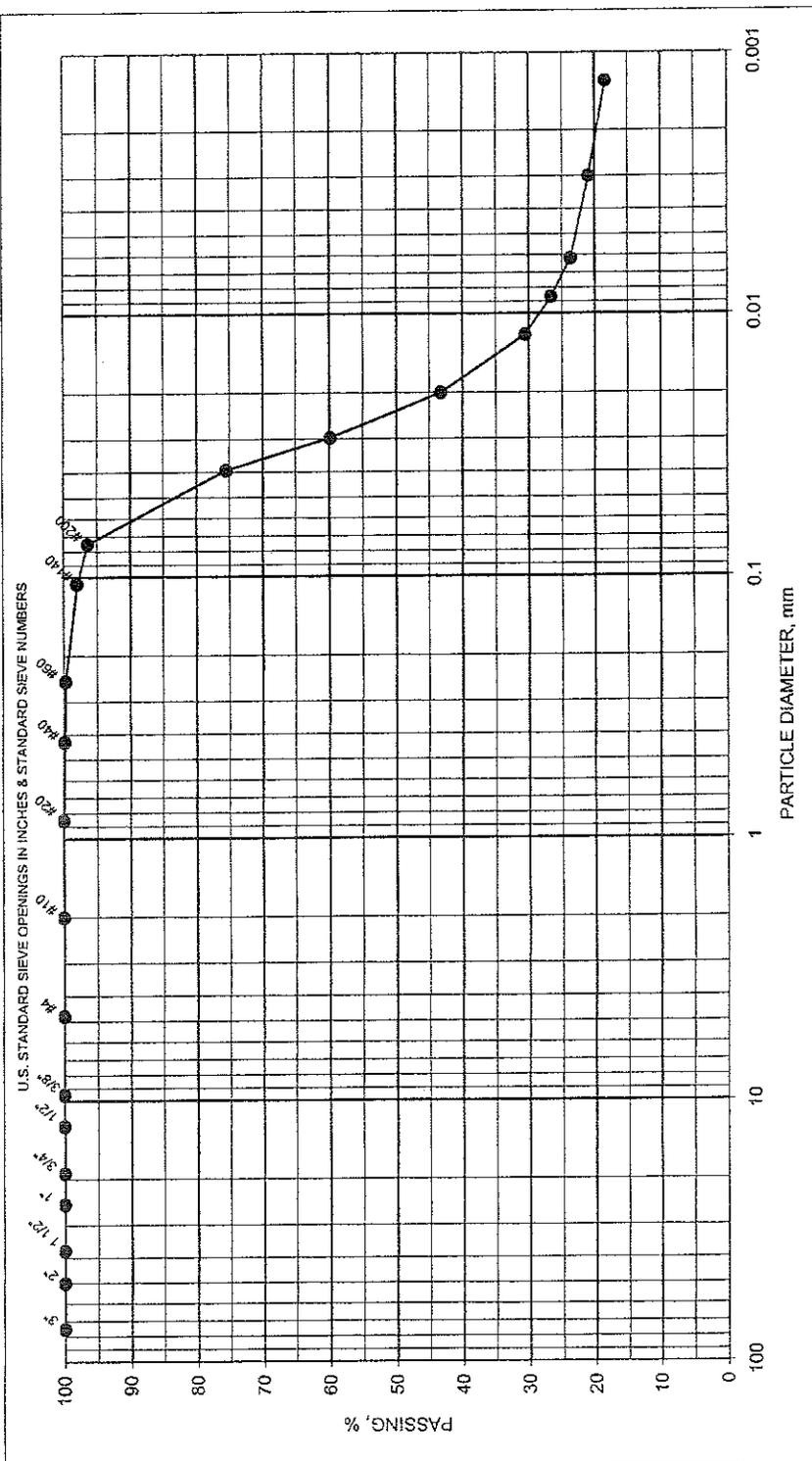
GRAIN SIZE DISTRIBUTION CURVE

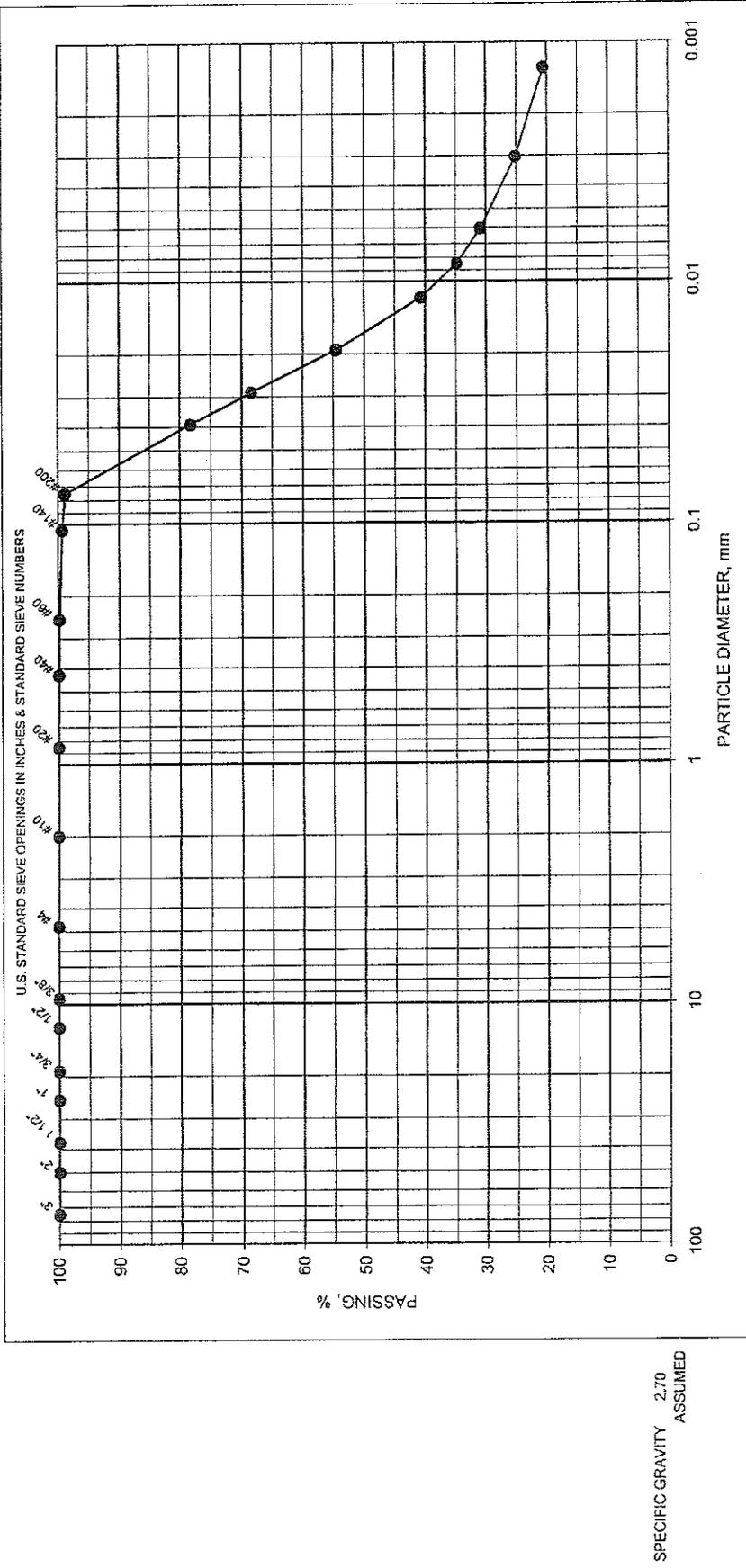
BORING ID	SAMPLE ID	DEPTH, feet	SPECIMEN DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
B-7	1	3 TO 5	LEAN CLAY, GRAYISH BROWN	CL	32.8	48	20	28

PROJECT LITTLE SALT CREEK WATERSHED

JOB NO. A3085016 DATE 7/18/2008







# UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests<sup>A</sup>

				Soil Classification	
				Group Symbol	Group Name <sup>B</sup>
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines <sup>C</sup>	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well-graded gravel <sup>F</sup>
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel <sup>F</sup>
		Gravels with Fines More than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F, G, H</sup>
			Fines classify as CL or CH	GC	Clayey gravel <sup>F, G, H</sup>
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines <sup>E</sup>	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand <sup>I</sup>
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand <sup>I</sup>
		Sands with Fines More than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G, H, I</sup>
			Fines classify as CL or CH	SC	Clayey sand <sup>G, H, I</sup>
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silt and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line <sup>J</sup>	CL	Lean clay <sup>K, L, M</sup>
			$PI < 4$ or plots below "A" line <sup>J</sup>	ML	Silt <sup>K, L, M</sup>
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OL	Organic clay <sup>K, L, M, N</sup> Organic silt <sup>K, L, M, O</sup>
	Silt and Clays Liquid limit 50 or more	inorganic	$PI$ plots on or above "A" line	CH	Fat clay <sup>K, L, M</sup>
			$PI$ plots below "A" line	MH	Elastic silt <sup>K, L, M</sup>
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OH	Organic clay <sup>K, L, M, P</sup> Organic silt <sup>K, L, M, Q</sup>
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

<sup>A</sup>Based on the material passing the 3-in. (75-mm) sieve.

<sup>B</sup>If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup>Gravels with 5 to 12% fines require dual symbols:  
GW-GM well-graded gravel with silt  
GW-GC well-graded gravel with clay  
GP-GM poorly graded gravel with silt  
GP-GC poorly graded gravel with clay

<sup>D</sup>Sands with 5 to 12% fines require dual symbols:  
SW-SM well-graded sand with silt  
SW-SC well-graded sand with clay  
SP-SM poorly graded sand with silt  
SP-SC poorly graded sand with clay

$$e_{Cu} = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>E</sup>If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>F</sup>If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>G</sup>If fines are organic, add "with organic fines" to group name.

<sup>H</sup>If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>I</sup>If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>J</sup>If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

<sup>K</sup>If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

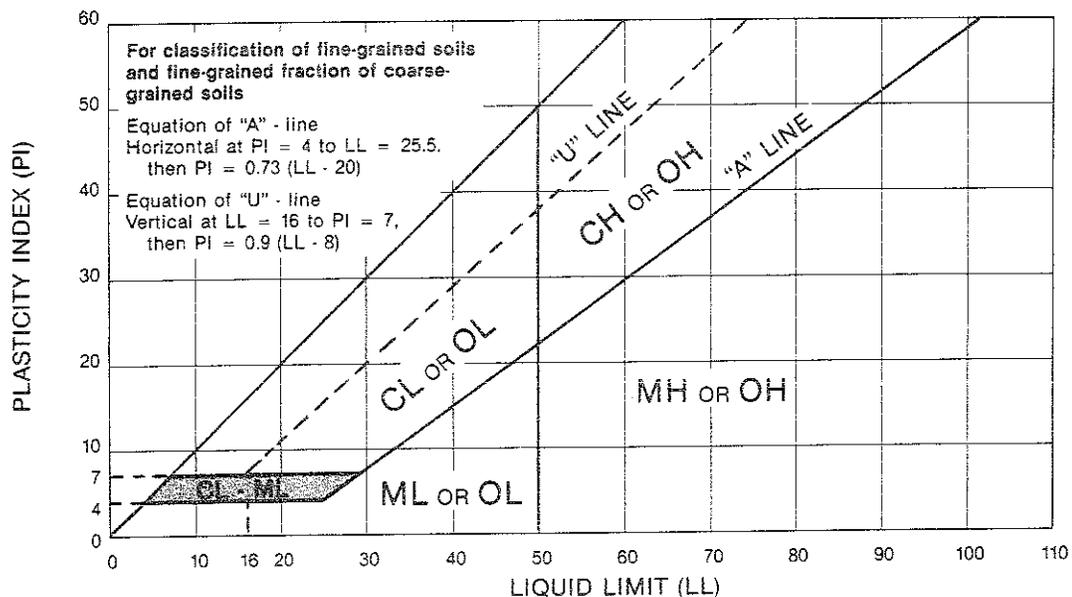
<sup>L</sup>If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>M</sup> $PI \geq 4$  and plots on or above "A" line.

<sup>N</sup> $PI < 4$  or plots below "A" line.

<sup>O</sup> $PI$  plots on or above "A" line.

<sup>P</sup> $PI$  plots below "A" line.



# Terracon

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