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NEVADA DOT

MEMORANDUM

Materials Division

January 9, 2014
(Supercedes Memorandum Dated December 24, 2013)

To: **Steve Bird**
From: **Ronald Siegel, Principal Geotechnical Engineer** RAS
Subject: **US 95 Slope Flattening - EA 73616**

This memo presents the results of our geotechnical investigation for the proposed slope flattening project on US 95 north of Fallon in Churchill County from Mileposts CH 28.31 to CH 55.86. The project consists of adding 5-foot-wide gravel-surfaced shoulders and flattening side slopes to improve roadway safety. Also included in the project are four passing lanes and a turnaround area. This investigation was conducted to help identify areas that will require subgrade stabilization during construction. Seasonal variations in moisture content will greatly affect the need for stabilization.

Site Geology

Geologically, the site lies within an area mapped as Quaternary-aged alluvium deposits consisting of Lake Lahontan deposits, playa deposits, and young fan gravels.[1] A majority of the alignment crosses playa deposits predominately of silt and clay; however, wind-blown sand overlying the playa deposits are prevalent.

Field Exploration

A limited field investigation was performed along the proposed alignment. A NDOT geotechnical engineer used a shovel, probe, and hand auger to investigate subsurface soil and moisture conditions and collect soil samples. Twenty-three soil samples were obtained within the upper one foot of the soil horizon and four additional samples were taken at a culvert located at

1. Geology and Mineral Deposits of Churchill County, Nevada, by Ronald Willden and Robert C. Speed, Nevada Bureau of Mines and Geology, Bulletin 83, 1974

Station 523+60 to an approximate depth of four feet. Soil samples were returned to our NDOT Materials' laboratory for testing.

Laboratory Results

The laboratory testing program consisted of Natural Moisture Contents (Nev. T-104), Particle Size Gradations (Nev. T-206), Atterberg Limits (Nev. T-210, T-211 and T-212), and Resistance Value (R-Value, Nev. T-115). A summary of the laboratory test results is presented in Table 1 on the next page.

Discussion

Soil types sampled included fine-grained and coarse grained soils. Fine-grained soils included sandy silt, sandy lean clay, lean clay with sand, lean clay and fat clay. Coarse-grained soils included silty sand, silty clayey sand, poorly graded sand with silt and poorly graded sand. Particle Size Distribution Reports are attached.

Moisture contents within fine-grained soils ranged from 2 to 65 percent and from 1 to 16 percent within coarse-grained soils.

During the winter months, clays and silts in the playas will generally not support construction equipment. These fine-grained soils will become hard upon drying and can be capable of supporting construction equipment during the summer, subject to their moisture condition at the time of embankment construction. Some areas along the alignment will likely not dry sufficiently during the summer and require stabilization regardless of the season. This is especially the case in areas near culverts and other low lying areas.

Sands may be loose in localized areas and require moisture conditioning and compaction to support construction equipment.

Due to variable conditions along the alignment is not practical to predict exactly where, when and to what extent stabilization will be required. The contractor must be prepared to deal with the uncertainty.

TABLE 1 – SUMMARY OF LABORATORY TEST RESULTS									
Sample No.	Sample Depth (in.)	Approx. Station	AASHTO Soil Group (Group Index)	USCS Soil Group	W%	% Passing #200 Sieve	LL %	PL %	PI %
1A	0-3	138+50	A-2-4 (0)	SP-SM	0.5	11	19	NP	NP
1B	3-6	138+50	A-2-4 (0)	SP-SM	3.0	12	17	NP	NP
2	2-5	152+50	A-6 (11)	CL	10.6	74	34	16	18
3	0-3	202+25	A-4 (1)	CL	8.9	52	24	16	8
4	0-4	217+00	A-2-4 (0)	SM	0.4	23	18	NP	NP
5	1-5	296+50	A-6 (8)	CL	22.6	67	32	16	16
6	0-4	570+50	A-6 (4)	CL	2.1	64	25	14	11
7	3-6	610+75	A-3	SP	2.7	4	19	NP	NP
8	0-4	673+00	A-2-4 (0)	SM	0.6	17	17	NP	NP
9	0-4	716+10	A-4 (0)	SM	11.1	37	18	NP	NP
10	0-4	723+75	A-6 (7)	CL	21.2	73	34	22	12
11	0-6	770+00	A-6 (13)	CL	12.2	77	37	18	19
12	3-7	800+00	A-4 (3)	CL	3.1	65	27	19	8
13	3-7	836+75	A-4 (0)	SM	11.8	37	19	NP	NP
14	0-6	881+50	A-4 (2)	CL	1.5	53	27	17	10
15	2-10	939+15	A-7-6 (40)	CH	29.0	95	62	25	10
16	4-10	981+00	A-4 (0)	ML	20.9	54	27	24	3
17	5-12	1031+25	A-4 (0)	SC-SM	15.5	46	23	18	5
18	4-12	1075+50	A-7-6 (41)	CH	49.3	96	62	25	37
19	4-12	1101+75	A-7-6 (37)	CH	30.2	86	59	20	39
20	3-7	1136+00	A-6 (7)	CL	10.8	59	32	15	17
21	2-6	1191+00	A-2-4 (0)	SM	3.5	18	15	NP	NP
22	6-12	1191+25	A-7-6 (22)	CL	64.9	86	44	19	25
23	2-6	1294+75	A-6 (3)	CL	4.7	57	24	12	12
C1	42-48	1136+00	A-3	SP-SM	7.7	9	18	NP	NP
C2	6-12	1191+00	A-4 (5)	CL	28.0	77	29	21	8
C3	12-18	1191+25	A-4 (2)	ML	43.1	95	29	27	2
C4	24-30	1294+75	A-2-4 (0)	SM	10.7	28	15	NP	NP

For the purpose of estimating stabilization quantities assume the limits presented in Table 2, found on the next page. The limits are approximate and site conditions may change based on

seasonal and annual fluctuations in precipitation. Actual quantities might differ from quantities estimated based on the limits presented in Table 2.

Table 2

Limits of Areas Needing Stabilization

Beginning Station	Ending Station
"P" 289+00	"P" 325+00
"P" 456+00	"P" 469+00
"P" 522+00	"P" 546+00
"P" 955+00	"P" 1030+00
"P" 1135+00	"P" 1290+00

We estimate approximately:

- One third of the alignment will not require stabilization regardless of the time of construction.
- Another third of the alignment will require stabilization regardless of the time of the year. These areas are listed above in Table 2.
- And the remaining third can avoid stabilization if constructed during the warm and dry season.

Unstable subgrade materials are defined as soils with moisture contents above optimum that are prone to pumping or displacements under the loads of construction equipment or during compaction. Subgrade materials need not be stabilized if the condition can be improved by scarifying and air-drying.

In addition there are areas of loose sand that will require moisture conditioning and compaction to provide a firm surface for embankment construction.

In general, roadway excavation can be used for embankment with the exception of roadway excavation required for construction of the proposed southbound passing lane between Station

"P" 1443+00 to "P" 1533+00. Roadway excavation between Station "P" 1443+00 to "P" 1515+00 will generally have very low R-values and should be wasted.

Slope Flattening Stabilization Recommendations:

- Remove vegetation and debris prior to embankment construction. Vegetation and debris should be disposed outside the right-of-way. Disposal in trenches beneath embankment slopes will not be practical and should not be allowed.

- Site preparation activities such as grubbing, scarification, and compaction should be minimized to reduce disturbance of the fine-grained soils. Scarification and compaction will not be required within the *in situ* soils prior to placement of embankment fill with the exception of loose sand areas. Loose, coarse-grained soils encountered during summer months should not require stabilization and can be moisture conditioned and compacted as necessary to provide a stable platform for the placement of embankment fill. Soft, fine-grained soils or loose, coarse-grained soils with high clay and silt content are most likely to require stabilization.

- Where the subgrade is capable of supporting construction equipment without pumping or rutting, construct embankment as specified in the Standard Specifications.

  Subgrade materials should not be considered unstable where the condition can be improved by air-drying during the warmer dryer season of the year. The contractor should make an effort to improve the condition of the subgrade by allowing the material to air-dry.

- Where the subgrade is not capable of supporting construction equipment without pumping or rutting, and where the subgrade does not dry sufficiently during the summer, stabilize the subgrade prior to placing embankment fill.

Stabilize the subgrade with a layer of Class 1 nonwoven needle-punched geotextile place directly upon the subgrade and then a layer of Class 150 Riprap Bedding, 12-inch loose thickness placed directly over the geotextile.

The Class 150 Riprap Bedding shall be placed by end dumping and spreading with a dozer. Compact the first lift until the surface supports construction equipment without pumping or rutting.

If the initial lift of Class 150 Riprap Bedding does not support construction equipment without pumping or rutting, place additional lifts of Class 150 Riprap Bedding, 8-inch maximum loose thickness, until a stable surface is achieved. Compact each lift before placing additional lifts.

Type 1 Drain Rock with 100 percent fractured faces may be substituted for Class 150 Riprap Bedding.

Bridge B-678 Subgrade Stabilization

- For the proposed Bridge B-678 box culvert extensions, overexcavate to an elevation 24 inches below the base of the box culvert and its wing wall footings. Excavate in a manner that avoids disturbing the remaining subgrade and removes all material loosened by excavation. Waste excavated material.

  Stabilization for the proposed box culvert extensions should extend laterally a minimum of 4 feet beyond the base of the box culvert and wing wall footings.

  Stabilize the subgrade with a layer of Class 1 nonwoven needle-punched geotextile place directly upon the subgrade, a layer of geogrid (Tensar BX1200 or equivalent) placed directly over the geotextile, and then a 24-inch-thick layer of Class 150 Riprap Bedding placed directly over the geogrid.

  The initial lift of Class 150 Riprap Bedding shall be 12-inches loose thickness placed by end dumping and spreading with a dozer. Compact the first lift until the surface

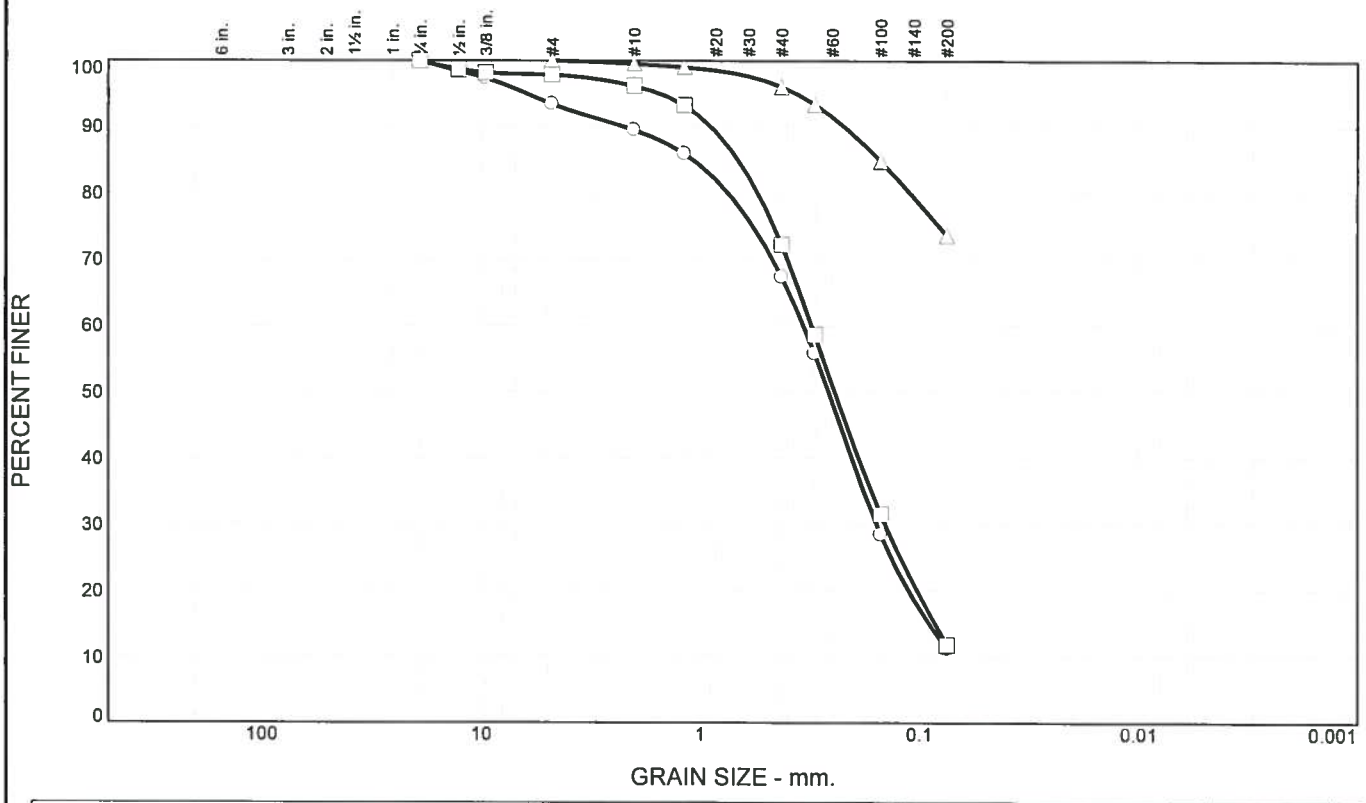
supports construction equipment without pumping or rutting. Place the subsequent lifts of Class 150 Riprap Bedding in lifts of 8-inch maximum loose thickness. Compact each lift before placing additional lifts.

Pipe Culvert Extension Subgrade Stabilization

- Where soft subgrade conditions are encountered, minimize excavation and place Class A Slurry Cement Backfill around the pipe.

C. Michael Griswold, Chief Geotechnical Engineer
Warren Coles, Roadway Design
Roshelle Olson, Roadbed Design
Michele Maher, Principal Pavement Design Engineer
Nate Mangoba, Structural Design

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.6	82.2	11.2		SP-SM	A-2-4(0)	NP	19
□	0.0	2.2	85.9	11.9		SP-SM	A-2-4(0)	NP	17
△	0.0	0.0	26.3	73.7		CL	A-6(11)	16	34

SIEVE inches size	PERCENT FINER ○	□	△
3/4"	100.0	100.0	
1/2"	98.4	98.7	
3/8"	97.4	98.2	
	GRAIN SIZE		
D_{60}	0.3368	0.3101	
D_{30}	0.1567	0.1431	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	93.4	97.8	100.0
#10	89.5	96.1	99.5
#16	86.0	93.3	99.0
#40	67.4	72.3	96.1
#50	55.8	58.6	93.4
#100	28.5	31.6	84.9
#200	11.2	11.9	73.7

Material Description
○ poorly graded sand with silt
□ poorly graded sand with silt
△ lean clay with sand

REMARKS:
○
□
△

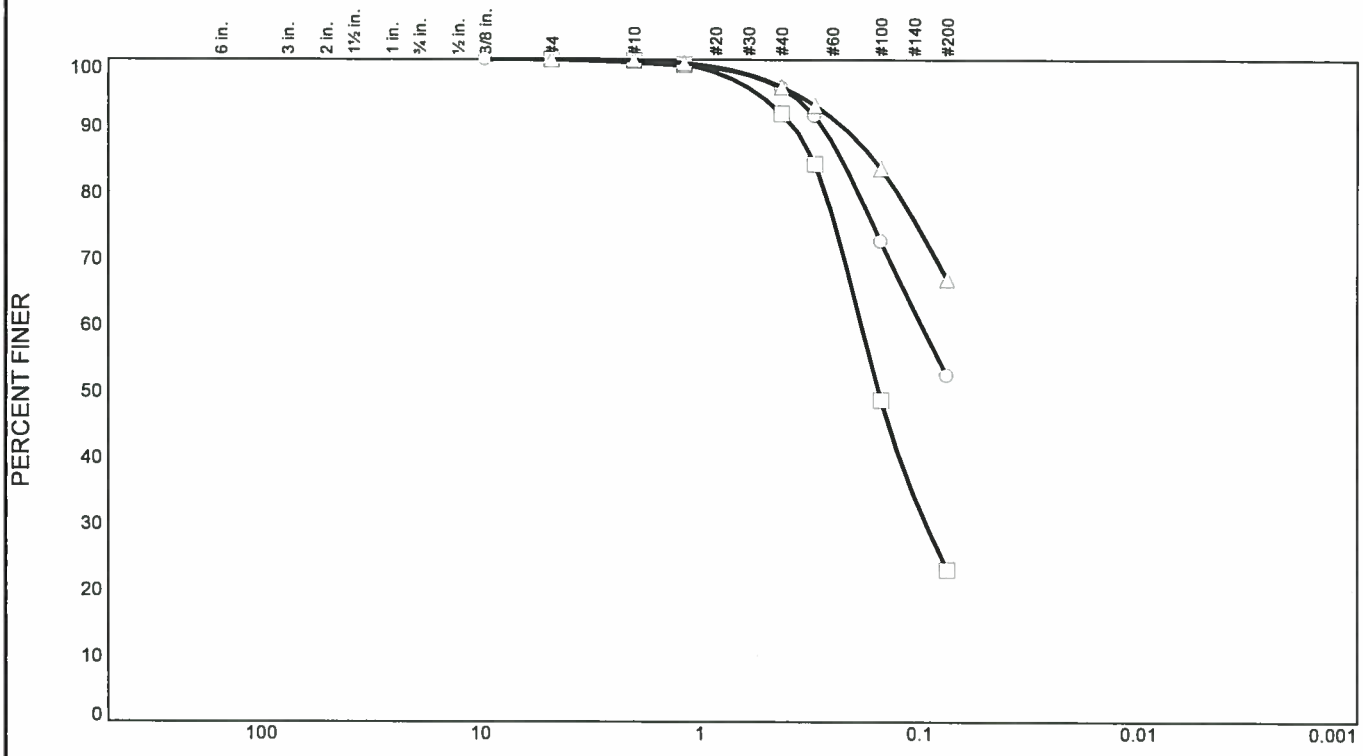
○ Source of Sample: Bags Depth: 0"-3" Sample Number: 1A
□ Source of Sample: Bags Depth: 3"-6" Sample Number: 1B
△ Source of Sample: Bags Depth: 2"-5" Sample Number: 2

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Pryor
Project: US 95 Fallon - Trinity
Project No.: EA 73616

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	47.7	52.3		CL	A-4(1)	16	24
□	0.0	0.0	77.0	23.0		SM	A-2-4(0)	NP	18
△	0.0	0.0	33.1	66.9		CL	A-6(8)	16	32

SIEVE inches size	○	□	△
3/8"	100.0		
GRAIN SIZE			
D_{60}	0.0984	0.1849	
D_{30}		0.0939	
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	○	□	△
#4	100.0	100.0	100.0
#10	99.5	99.8	99.9
#16	99.1	99.2	99.5
#40	95.7	91.8	95.9
#50	91.5	84.3	93.1
#100	72.5	48.6	83.6
#200	52.3	23.0	66.9

Material Description
○ sandy lean clay
□ silty sand
△ sandy lean clay

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 0"-3" Sample Number: 3
□ Source of Sample: Bags Depth: 0"-4" Sample Number: 4
△ Source of Sample: Bags Depth: 1"-5" Sample Number: 5

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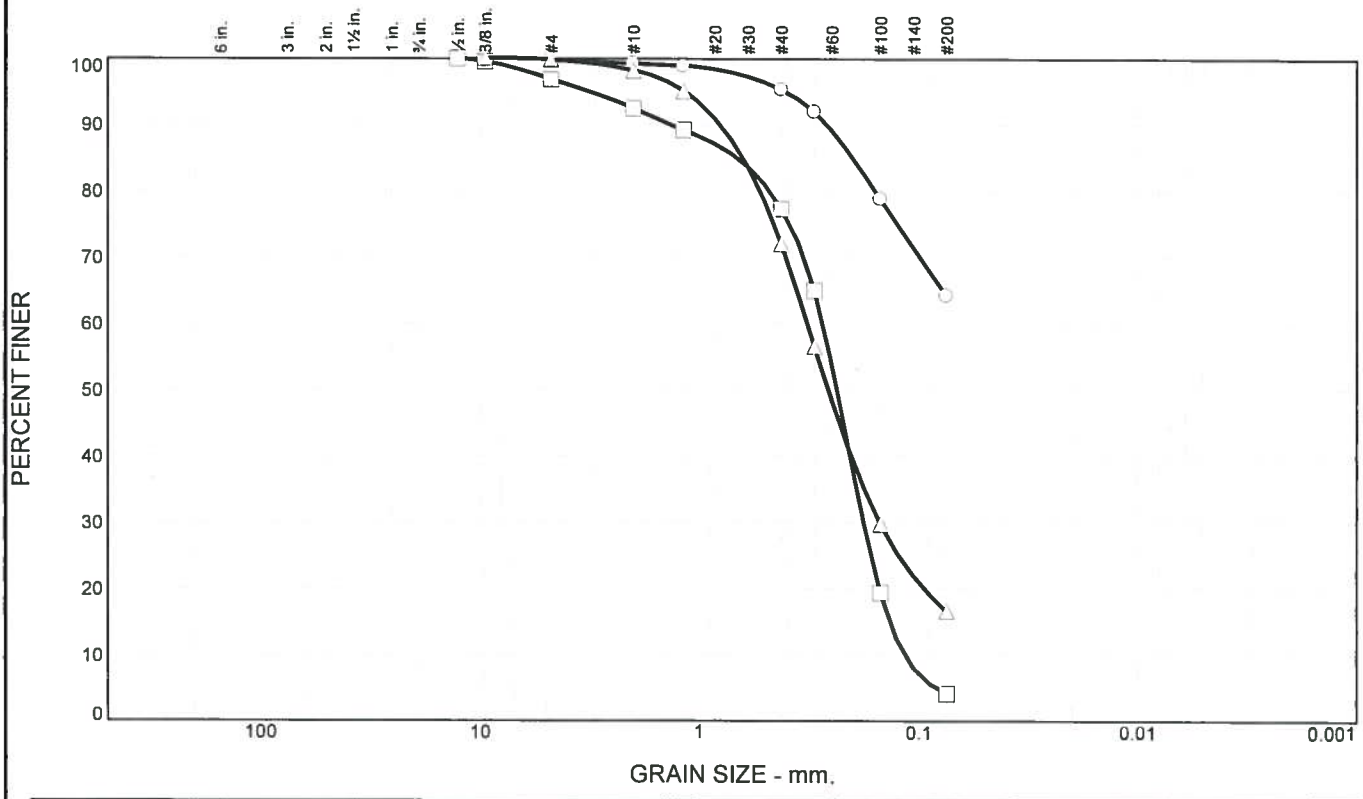
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.2	35.6	64.2		CL	A-6(4)	14	25
□	0.0	3.2	92.7	4.1		SP	A-3	NP	19
△	0.0	0.2	83.2	16.6		SM	A-2-4(0)	NP	17

SIEVE inches size	PERCENT FINER ○	□	△
1/2"		100.0	
3/8"	100.0	99.5	100.0
GRAIN SIZE			
D_{60}		0.2746	0.3231
D_{30}		0.1789	0.1513
D_{10}		0.1166	
COEFFICIENTS			
C_c		1.00	
C_u		2.36	

SIEVE number size	PERCENT FINER ○	□	△
#4	99.8	96.8	99.8
#10	99.3	92.5	98.2
#16	98.9	89.2	95.1
#40	95.3	77.3	72.0
#50	91.9	65.0	56.6
#100	78.8	19.4	29.8
#200	64.2	4.1	16.6

Material Description
○ sandy lean clay
□ poorly graded sand
△ silty sand

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 0"-4" Sample Number: 6
□ Source of Sample: Bags Depth: 3"-6" Sample Number: 7
△ Source of Sample: Bags Depth: 0"-4" Sample Number: 8

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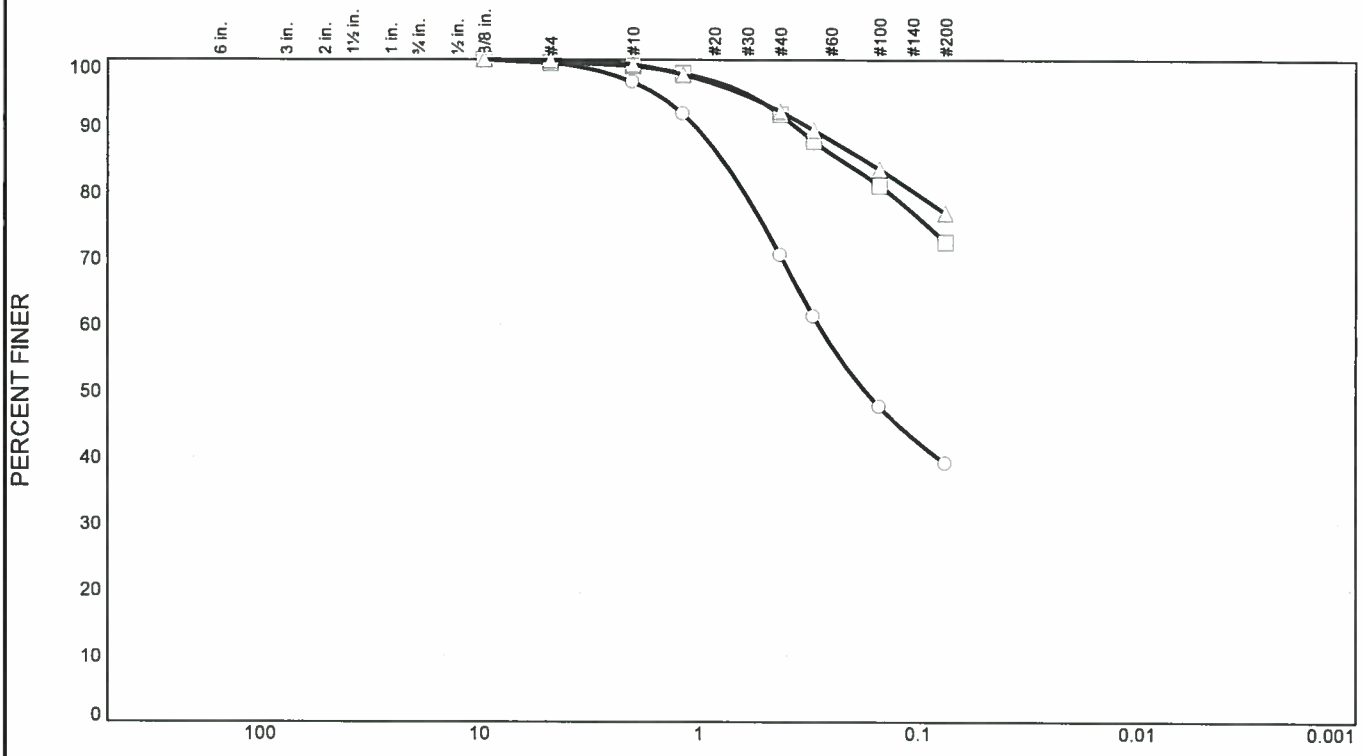
Project: US 95 Fallon - Trinity
Project No.: EA 73616

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.5	60.5	39.0		SM	A-4(0)	NP	18
□	0.0	0.5	27.0	72.5		CL	A-6(7)	22	34
△	0.0	0.1	23.1	76.8		CL	A-6(13)	18	37

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0	100.0	100.0
GRAIN SIZE			
D_{60}	0.2859		
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	99.5	99.5	99.9
#10	96.6	99.0	99.3
#16	91.8	97.9	97.7
#40	70.5	91.7	92.2
#50	61.2	87.7	89.4
#100	47.6	81.0	83.5
#200	39.0	72.5	76.8

Material Description
○ silty sand
□ lean clay with sand
△ lean clay with sand

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 0"-4" Sample Number: 9
□ Source of Sample: Bags Depth: 0"-4" Sample Number: 10
△ Source of Sample: Bags Depth: 0"-6" Sample Number: 11

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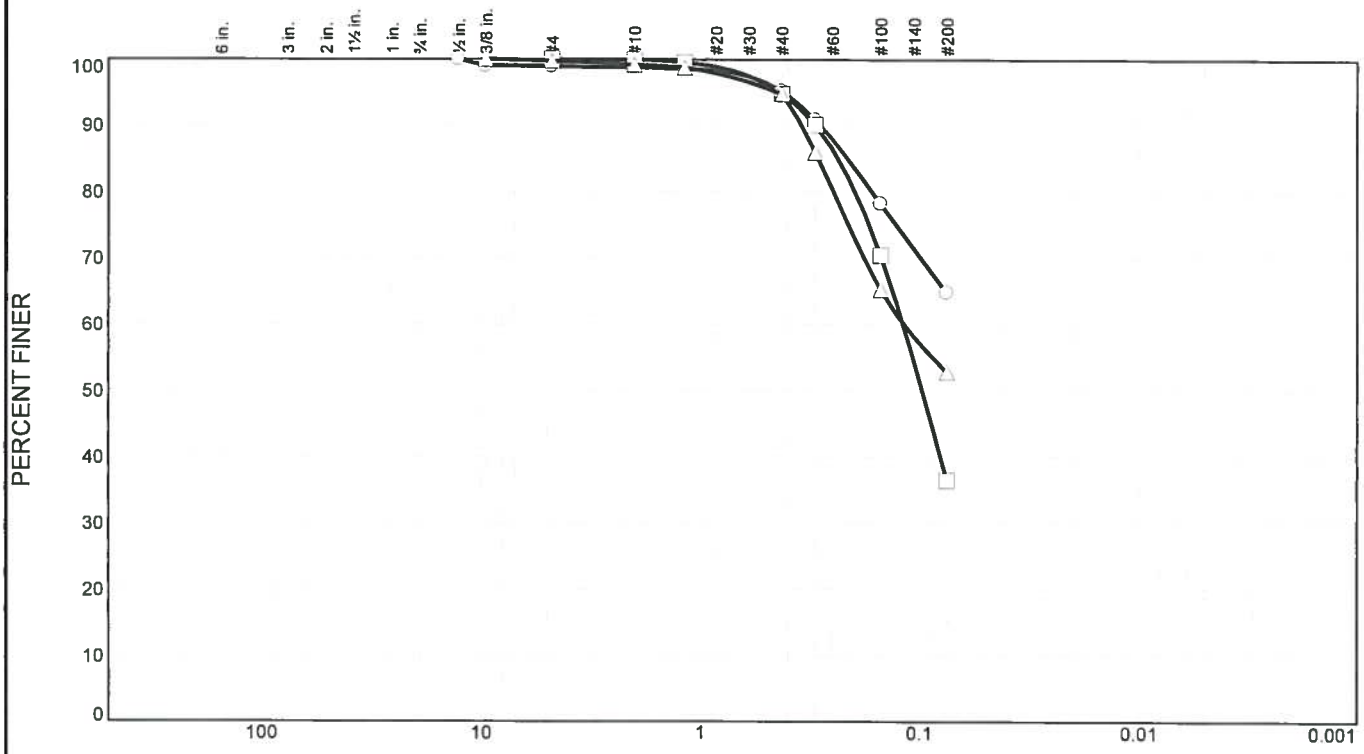
Client: M. Pryor
Project: US 95 Fallon - Trinity
Project No.: EA 73616

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	1.1	34.1	64.8		CL	A-4(3)	19	27
□	0.0	0.0	63.5	36.5		SM	A-4(0)	NP	19
△	0.0	0.3	46.8	52.9		CL	A-4(2)	17	27

SIEVE inches size	PERCENT FINER ○	□	△
1/2"	100.0		
3/8"	99.0		100.0
GRAIN SIZE			
D_{60}		0.1184	0.1171
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	98.9	100.0	99.7
#10	98.8	99.9	99.2
#16	98.5	99.5	98.7
#40	95.2	94.8	94.8
#50	90.8	90.1	86.0
#100	78.2	70.5	65.3
#200	64.8	36.5	52.9

Material Description
○ sandy lean clay
□ silty sand
△ sandy lean clay

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 3"-7" Sample Number: 12
□ Source of Sample: Bags Depth: 3"-7" Sample Number: 13
△ Source of Sample: Bags Depth: 0"-6" Sample Number: 14

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Project: US 95 Fallon - Trinity
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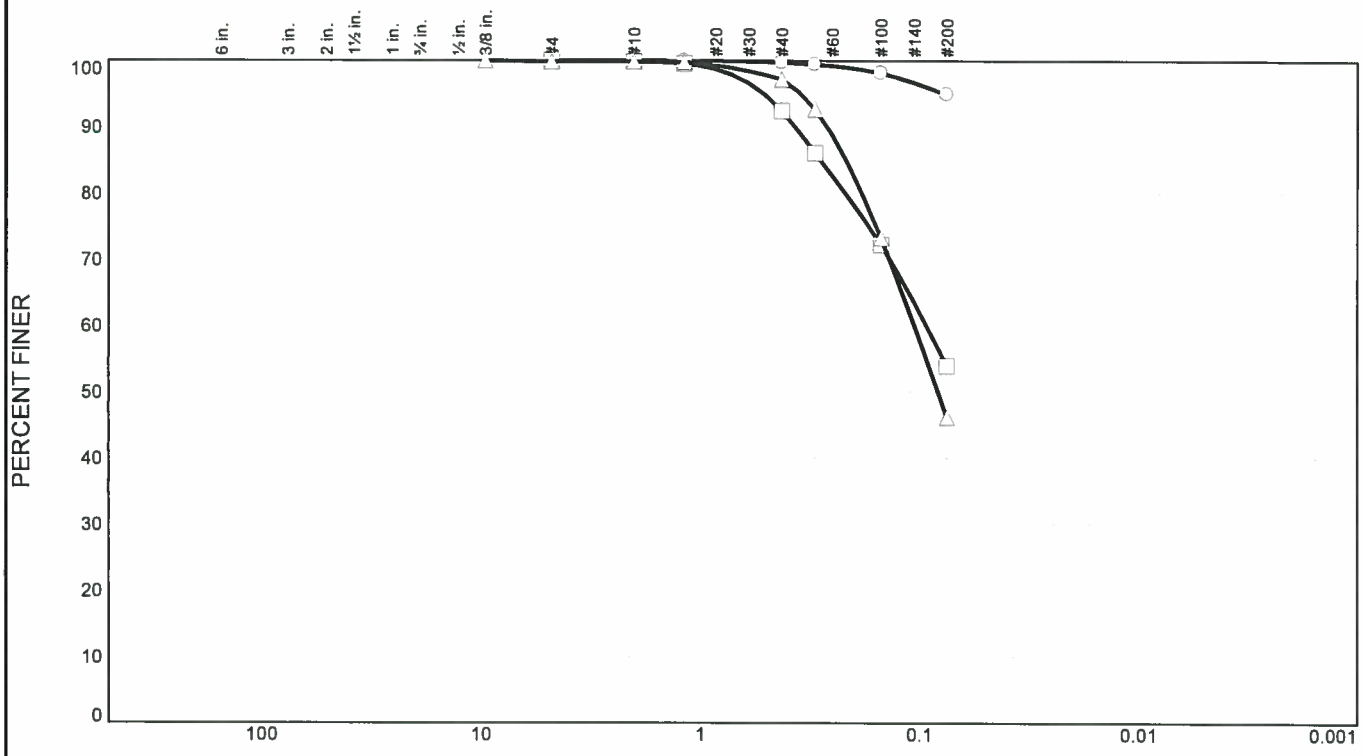
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	5.1	94.9		CH	A-7-6(40)	25	62
□	0.0	0.0	46.0	54.0		ML	A-4(0)	24	27
△	0.0	0.2	53.6	46.2		SC-SM	A-4(0)	18	23

SIEVE inches size	PERCENT FINER ○	□	△
3/8"			100.0
GRAIN SIZE			
D_{60}		0.0931	0.1056
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	100.0	99.8
#10	100.0	99.8	99.8
#16	99.9	99.5	99.7
#40	99.7	92.4	97.2
#50	99.4	86.1	92.7
#100	98.1	72.2	73.2
#200	94.9	54.0	46.2

Material Description
○ fat clay
□ sandy silt
△ silty, clayey sand

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 2"-10" Sample Number: 15
□ Source of Sample: Bags Depth: 4"-10" Sample Number: 16
△ Source of Sample: Bags Depth: 5"-12" Sample Number: 17

NEVADA DEPARTMENT OF TRANSPORTATION

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Project: US 95 Fallon - Trinity
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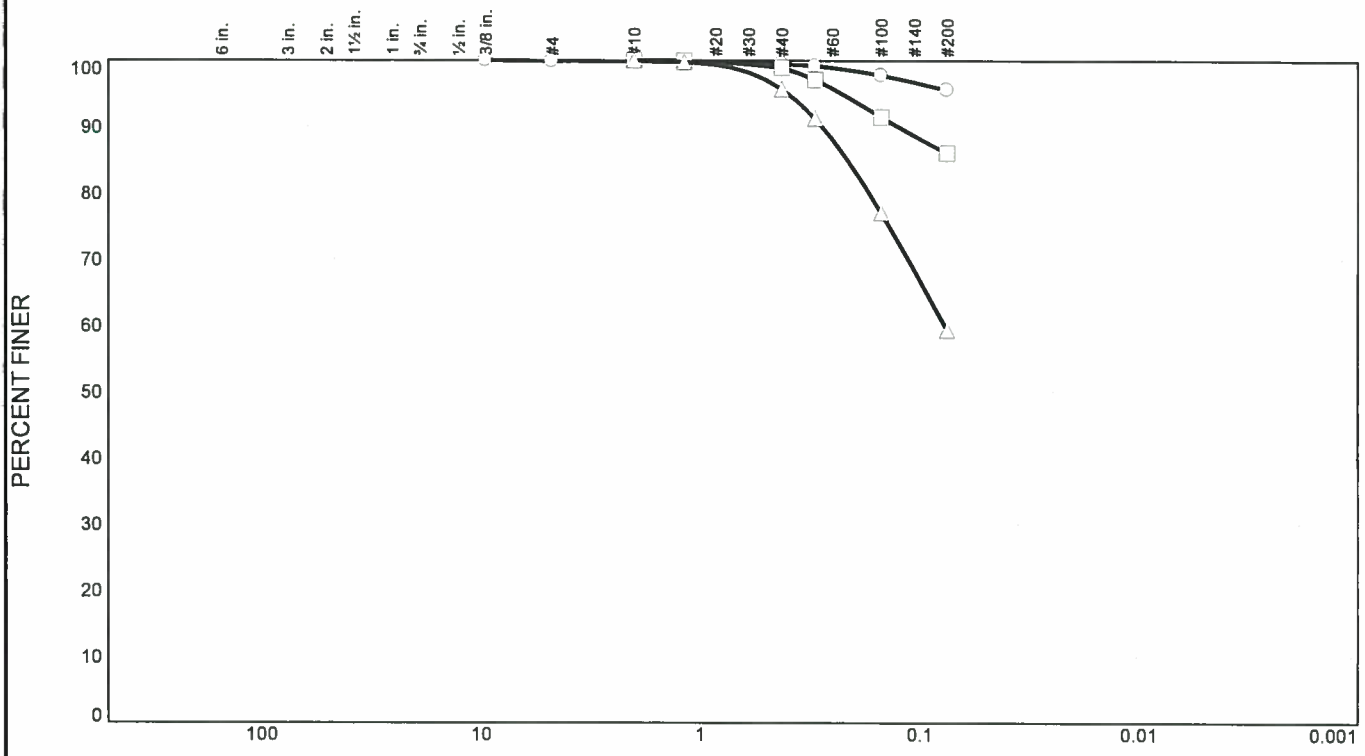
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.1	4.3	95.6		CH	A-7-6(41)	25	62
□	0.0	0.0	14.0	86.0		CH	A-7-6(36)	20	59
△	0.0	0.0	40.7	59.3		CL	A-6(7)	15	32

SIEVE inches size	○	□	△
3/8"	100.0		
GRAIN SIZE			
D_{60}			0.0769
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	○	□	△
#4	99.9		
#10	99.8	100.0	100.0
#16	99.8	100.0	99.7
#40	99.5	98.9	95.7
#50	99.2	97.1	91.3
#100	97.8	91.5	77.0
#200	95.6	86.0	59.3

Material Description
○ fat clay
□ fat clay
△ sandy lean clay

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 4"-12" Sample Number: 18
□ Source of Sample: Bags Depth: 4"-12" Sample Number: 19
△ Source of Sample: Bags Depth: 3"-7" Sample Number: 20

NEVADA DEPARTMENT OF TRANSPORTATION

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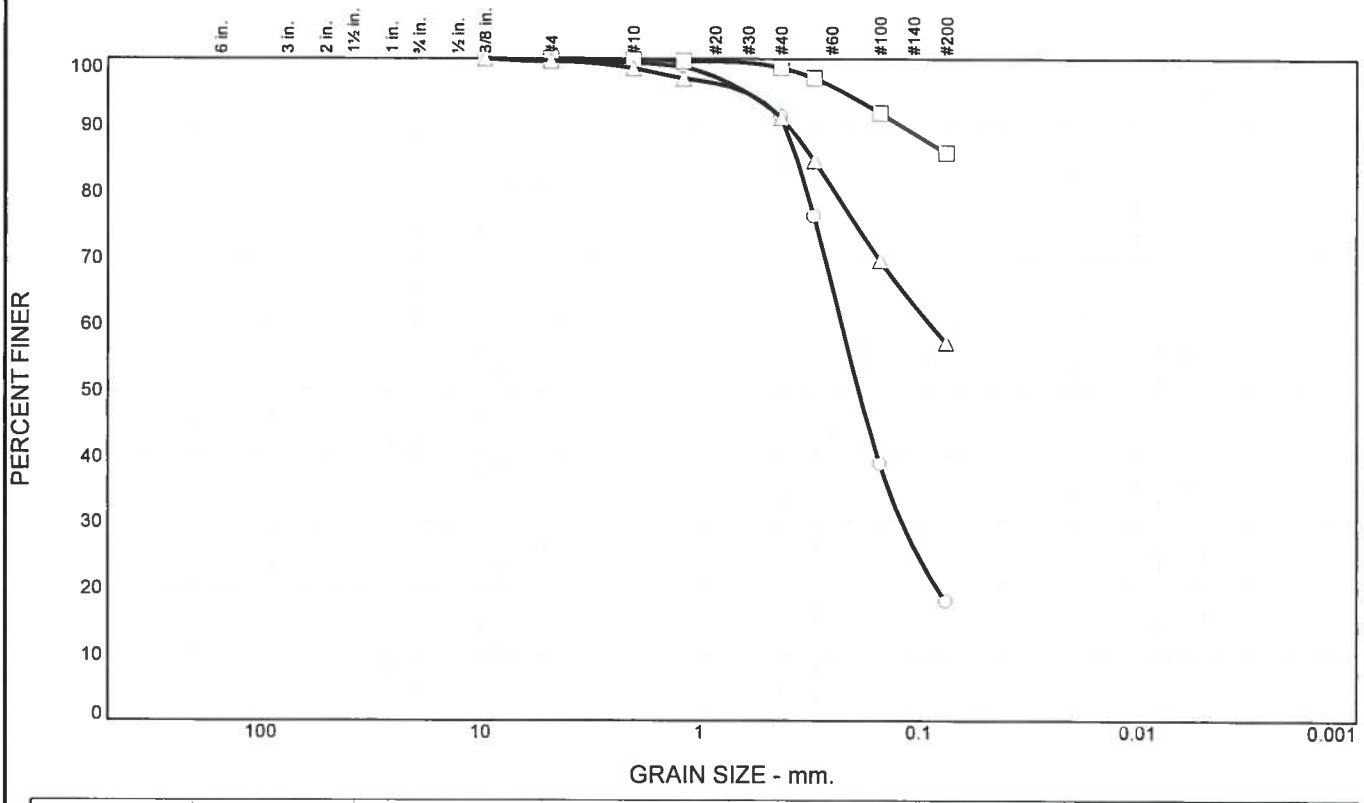
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.4	81.6	18.0		SM	A-2-4(0)	NP	15
□	0.0	0.0	14.2	85.8		CL	A-7-6(22)	19	44
△	0.0	0.3	42.5	57.2		CL	A-6(3)	12	24

SIEVE inches size	○	□	△
3/8"	100.0		100.0
GRAIN SIZE			
D_{60}	0.2245		0.0885
D_{30}	0.1189		
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	○	□	△
#4	99.6	100.0	99.7
#10	99.4	99.8	98.5
#16	98.8	99.6	97.0
#40	91.3	98.7	91.1
#50	76.2	97.1	84.7
#100	38.8	91.8	69.6
#200	18.0	85.8	57.2

Material Description
○ silty sand
□ lean clay
△ sandy lean clay

REMARKS:
○
□
△

○ Source of Sample: Bags Depth: 2"-6" Sample Number: 21
□ Source of Sample: Bags Depth: 6"-12" Sample Number: 22
△ Source of Sample: Bags Depth: 2"-6" Sample Number: 23

NEVADA DEPARTMENT OF TRANSPORTATION

Client: M. Pryor
Project: US 95 Fallon - Trinity
Project No.: EA 73616

Figure