GEOTECHNICAL DATA REPORT

H-844, I-700, I-717, I-740 SEISMIC RETROFITS
LYON COUNTY, NEVADA

JANUARY 2022

| **NEVADA DEPARTMENT OF TRANSPORTATION** | MATERIALS DIVISION |
| GEOTECHNICAL SECTION | 1263 S STEWART ST, CARSON CITY, NEVADA 89712 |

STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

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H-844, I-700, I-717, I-740 SEISMIC RETROFITS

LYON COUNTY, NEVADA

JANUARY 2022

Prepared by: _____

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Contents

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Introduction

1.1 Project Description

It is our understanding that this project consists of constructing seismic retrofits for structures on the I-80 corridor in Fernley and Wadsworth, Nevada. These structures consist of H-844, I-700, I-717, and I-740. The proposed seismic retrofits consist of increasing footing sizes for abutments and pier footings. This geotechnical data report presents the information obtained from our geotechnical exploration for the proposed retrofits.

The project Vicinity Map and Exploration Map are shown in Appendix A on Figures A-1 and A-2, respectively.

Each bridge site has a Design Parameters Memo that were previously completed by NDOT. These memos can be found in Appendices D through G. The design parameters presented in the memos are based off Refraction Microtremor (ReMi) surveys. The information in this data report is supplementary to the memo's design parameters.

1.2 Purpose and Scope of Work

The purpose of this investigation is to provide subsurface data for the project site from a geotechnical perspective for the proposed structure's seismic retrofit foundations. We are providing this data for the design by others. The main objectives of the investigation were to characterize the subsurface materials and document our findings in this report. The investigation was conducted in accordance with American Association of State Highway and Traffic Administration (AASHTO) and Federal Highway Administration (FHWA) guidelines.

The scope of our geotechnical investigation includes the following:

- A review of published geologic and geotechnical information pertaining to the site vicinity;
- A field exploration consisting of drilling four borings to a maximum depth of approximately 86 feet below ground surface (bgs) to obtain information about the subsurface conditions for the proposed structures foundations in the geotechnical data report;
- Performing geotechnical laboratory testing on select soil samples collected from the borings; and
- Preparation of this report.

2. Field Exploration and Laboratory Testing

2.1 Field Exploration

Four borings were drilled between October 19, 2021 and October 28, 2021 at the approximate locations shown on the Exploration Map to a maximum depth of 86.5 feet bgs. The borings were drilled utilizing a truck-mounted Diedrich D-120 drill rig. Mud rotary drilling was performed with a three-inch tricone bit. Samples were collected using Standard Penetration Test (SPT) and California Modified (CM) samplers driven by an automatic hammer with a weight of 140 pounds and a drop of 30 inches.

The number of blows required to drive the sampler were recorded for each 6-inch interval of the 18-inch drive. The cumulative blow count for the bottom 12 inches of drive is presented in the boring logs. The blow counts presented in the logs are uncorrected and are shown as they were recorded in the field. Both the samples and drill cuttings were visually classified in the field based on the Unified Soil Classification System (USCS) in general accordance with ASTM D2488.

The subsurface conditions encountered are summarized in Section 3.2. Logs of the boring were prepared based on the field logging and the results of laboratory testing in general accordance with ASTM D2487. The boring logs are presented in Appendix B.

2.2 Geotechnical Laboratory Testing

Laboratory testing was conducted on select soil samples recovered during the field exploration. Tests conducted include the following:

- Method of Test Sieve Analysis of Coarse and Fine Aggregate (Nev. T206);
- Standard Method of Test for Laboratory Determination of Moisture Content of Soils (AASHTO T265);
- Standard Method of Test for Direct Shear Test of Soils under Consolidated Drained Conditions (AASHTO T236);
- Standard Method of Test for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression (AASHTO T296);
- Standard Test Methods for Laboratory Determination of Density (ASTM D7263);
- Method of Test for Determining the Liquid Limit, Plastic Limit, and Plasticity Index of Soil (Nev. T210, T211, and T212);
- Standard Method of Test for Determining Minimum Laboratory Soil Resistivity (AASHTO T288);
- Standard Method of Test for Determining pH of Soil (AASHTO T289);
- Standard Method of Test for Determining Water-Soluble Sulfate Ion Content in Soil (AASHTO T290);
- Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil (AASHTO T291);

Geotechnical laboratory test results are presented in Appendix C.

3. Site and Subsurface Conditions

3.1 Site Conditions

The project sites are located in Fernley and Wadsworth, Nevada on the I-80 corridor. Each one of the four project location sites consist of one bridge structure per direction of traffic, eastbound and westbound. In general, each site's topography is generally flat except for the approximate 15- to 20-foot tall highway embankment fills. The embankments have a slope of approximately 2(H):1(V). I-700 is the only site of the four that does not have slope paving around the bridge embankment. At the time of our exploration, each site's surface consisted of sand with sparse grass and brush.

3.2 Subsurface Conditions

3.2.1 General Geology and Faulting

The site is located within the western portion of the Basin and Range geomorphic province. The project lies mostly in the northern part of Lyon county and extends into the eastern part of Washoe County. The site area is mapped as being comprised of Quaternary Alluvial Deposits. The alluvium generally is composed of fine-grained sediments, silts, and clays. The nearest active fault with historic movement (last 150 years) is the Olinghouse Fault zone, located approximately 5 miles to the West. The location of Bridge I-717 appears to lie over the Pyramid Lake fault zone, a late Pleistocene to early Holocene era fault zone.

3.2.2 Subsurface Materials

The results of our field exploration and laboratory analyses indicate soil profiles for each project site are as follows.

I-700 lies on approximately 16 feet of medium dense, silty SAND (SM) fill. Native material below the fill consists of medium dense silty SAND with gravel (SM) transitioning to dense, well-graded GRAVEL with sand (GW) at approximately 20 feet bgs. Generally, the soil profile becomes less fine with depth.

I-717 soil profile consists mostly of alternating layers of silty SAND (SM) and poorly graded SAND with silt (SP-SM). Generally, the soil becomes denser with depth.

H-844 soil profile starts with approximately 21 feet of dense, silty SAND (SM). Beneath the sand is mostly alternating layers of lean CLAY (CL) and sandy SILT (ML). The fine-grained material ranges from stiff to hard.

I-740 soil profile begins with 30 feet of silty SAND (SM) ranging between medium dense and very dense. The sand becomes poorly graded at five feet and changes to fine-grained below 20 feet. Below the sand consists of CLAY (CL and CH). 35 to 55 feet is a layer of higher plasticity fat CLAY (CH). The clay ranges from medium stiff to hard.

3.2.3 Groundwater Conditions

Groundwater was encountered in each boring during our exploration. Groundwater depth ranged from 29 feet to 52 feet below ground surface and groundwater elevations ranged from 4075 feet to 4119 feet. The depth of groundwater is expected to vary over time due to seasonal fluctuations, regional pumping, and other contributing factors.

4. References

American Association of State Highway and Transportation Officials (AASHTO), 2020, “LRFD Bridge Design Specifications, 9th Edition”

Kakata, K. John, et al, 1982, “Quaternary Fault Map of the Basin and Range and Rio Grande Rift Provinces, Western United States, Department of the Interior United States Geological Survey”

Loehr, Erik, et al, 2016, “FHWA NHI-16-072 Geotechnical Site Characterization”

Mayne, W. Paul, et al, 2002, “FHWA-NHI-01-031 Subsurface Investigation Manual”

Nevada Department of Transportation (NDOT), 2008, “Structures Manual”

Sabatini, P.J., et al, 2002, “FHWA-IF-02-034 Evaluation of Soil and Rock Properties”

Stewart, John H., and Carlson, John E., 1978, “Geologic map of Nevada, Nevada Bureau of Mines and Geology, scale 1:500,00.”

5. Limitations

This report has been prepared by NDOT Geotechnical Section under the supervision of those whose signatures appear herein. The interpretation of data, findings, and recommendations presented in this report were developed from our geotechnical investigation.

If the proposed project is modified or relocated, or if the subsurface conditions found during construction differ from those described in this report, NDOT Geotechnical Section should be contacted immediately to assess the new information or changed conditions and determine if our recommendations need revision.

Appendix A
Figures

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Figure A-1: Vicinity Map

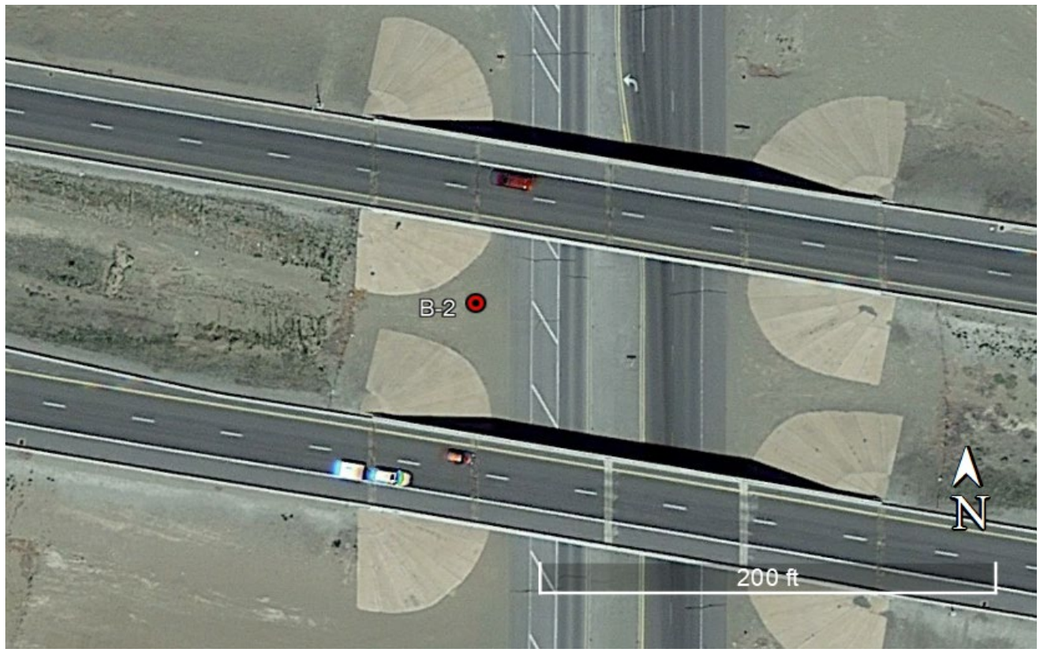
Location: Fernley, NV

Project Name: Fernley Bridge Seismic Retrofit

EA Number: 74046

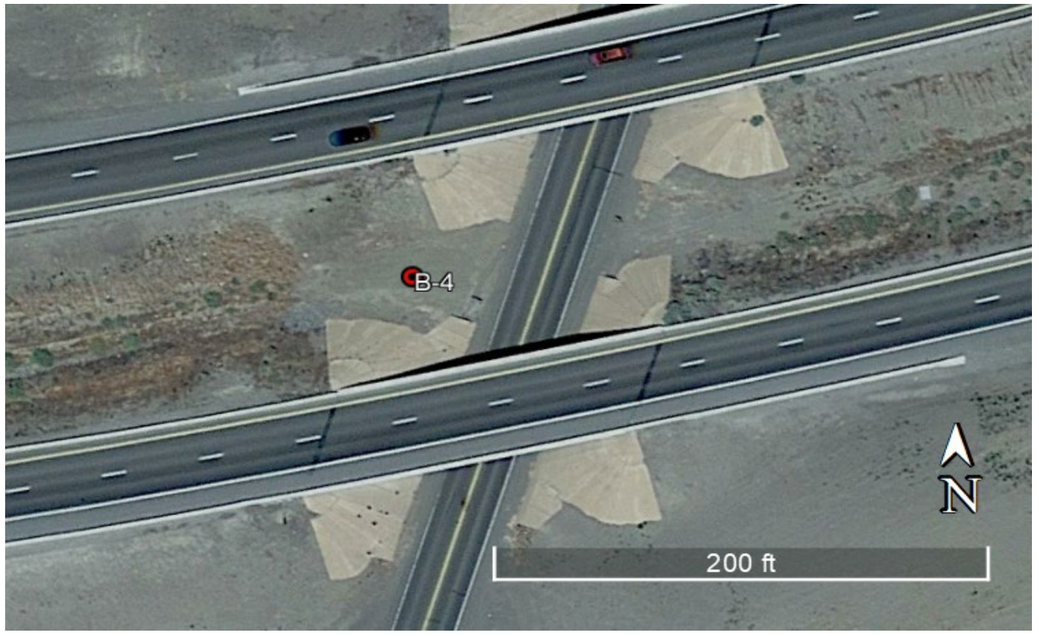
I-700

I-717



H-844

I-740



NEVADA DOT
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Figure A-2: Exploration Map

Location: Fernley, NV

Project Name: Fernley Bridge Seismic Retrofit

EA Number: 74046

Appendix B
Logs of Borings

KEY TO BORING LOGS

PARTICLE SIZE LIMITS								
CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		FINE	MEDIUM	COARSE	FINE	COARSE		
.002 mm		#200	#40	#10	#4	¾ inch	3 inch	12 inch

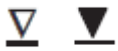
USCS GROUP	TYPICAL SOIL DESCRIPTION
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixtures
SC	Clayey sands, poorly graded sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silt-clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
CS	Claystone/Siltstone
PT	Peat and other highly organic soils

MOISTURE CONDITION CRITERIA

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Damp, no visible free water.
Wet	Visible free water, usually below groundwater table.

SOIL CEMENTATION CRITERIA

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Won't break or crumble w/finger pressure



Groundwater Elevation Symbols

STANDARD PENETRATION CLASSIFICATION*			
GRANULAR SOIL		CLAYEY SOIL	
BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0 - 4	VERY LOOSE	0 - 1	VERY SOFT
5 – 10	LOOSE	2 - 4	SOFT
11 - 30	MEDIUM DENSE	5 - 8	MEDIUM STIFF
31 - 50	DENSE	9 - 15	STIFF
OVER 50	VERY DENSE	16 - 30	VERY STIFF
		31 - 60	HARD
		OVER 60	VERY HARD

*Standard Penetration Test (N) 140 lb hammer
30-inch free fall on 2-inch O.D. x 1.4 inch I.D. sampler.

Blow counts on Calif. Modified Sampler (N_{CMS}) can be converted to N_{SPT} by:

$(N_{CMS})(0.62) = N_{SPT}$

Automatic Hammer Engergy:
Rig # 1627: 82.5%
Rig # 1082: 84%

TEST ABBREVIATIONS

CD CONSOLIDATED DRAINED
CH CHEMICAL (CORROSIVENESS)
CM COMPACTION
CU CONSOLIDATED UNDRAINED
D DISPERSIVE SOILS
DS DIRECT SHEAR
E EXPANSIVE SOIL
G SPECIFIC GRAVITY
H HYDROMETER
HC HYDRO-COLLAPSE
K PERMEABILITY
O ORGANIC CONTENT
OC CONSOLIDATION
PI PLASTICITY INDEX
RQD ROCK QUALITY DESIGNATION
RV R-VALUE
S SIEVE ANALYSIS
SL SHRINKAGE LIMIT
U UNCONFINED COMPRESSION
UU UNCONSOLIDATED UNDRAINED
UW UNIT WEIGHT
W MOISTURE CONTENT

SOIL COLOR DESIGNATIONS ARE FROM THE MUNSELL SOIL COLOR CHART.
EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS CALIF. MODIFIED SAMPLER[1]
CPT CONE PENETRATION TEST
CS CONTINUOUS SAMPLER[2]
CSS CALIFORNIA SPLIT SPOON
P PUSHED (NOT DRIVEN)
PB PITCHER BARREL
RC ROCK CORE[3]
SH SHELBY TUBE[4]
SPT STANDARD PENETRATION TEST
TP TEST PIT

1- I.D.= 2.421 inch
2- I.D.=3.228 inch with tube; 3.50 inch w/o tube
3- NXB I.D.= 1.875 inch
4- I.D.= 2.875 inch

Revised June 2018

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/27/21
END DATE	10/28/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Wadsworth, NV
E.A. #	74046
BORING	B-1
GROUND ELEV. ft	4104.6
TOTAL DEPTH ft	51.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	29.5	4075

LATITUDE	39.61603°N
LONGITUDE	119.30919°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4103.6	1													FILL: Grayish brown silty SAND (SM), fine- to medium-grained, dense, moist	
4102.6	2														
4101.6	3	1		11 16 17	33	83	14	100	14						
4100.6	4														
4099.6	5														
4098.6	6	2		12 13 17	30	80	8			16	NP				
4097.6	7														
4096.6	8	3		15 20 29	49	67	8	100	17	17	NP		SM		
4095.6	9														
4094.6	10														
4093.6	11	4		11 13 17	30	73	18			18	NP				
4092.6	12														
4091.6	13														
4090.6	14														

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Well-graded Gravel

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

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HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4088.6	16	5		4 6 5	11	33	19	92	41				SM	FILL: Grayish brown silty SAND (SM), fine- to medium-grained, dense, moist Becomes medium dense, fines content increased	
4087.6	17	6		6 6 13	19	73	10	85	18					Brown silty SAND with gravel (SM), fine- to coarse-grained sand, fine-subrounded gravel, medium dense, moist	Drilling slowed, rig chatter
4086.6	18												SM		
4085.6	19														
4084.6	20														
4083.6	21	7		29 56 50	106	87	7	45	6					Dark grayish brown well-graded GRAVEL with sand (GW), fine- to coarse-broken subrounded gravel, fine- to coarse-grained sand, very dense, moist	
4082.6	22														
4081.6	23	8		41 47 42	89	83	8	45	11						
4080.6	24														
4079.6	25												GW		
4078.6	26	9		24 37 61	98	60	8	53	12						
4077.6	27														
4076.6	28														
4075.6	29														

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Well-graded Gravel

BORING LOG

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11/1/21	AD	29.5	4075

LATITUDE	39.61603°N
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HAMMER	Automatic
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ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
		10		4 60/5"		0								Dark grayish brown well-graded GRAVEL with sand (GW), fine- to coarse-broken subrounded gravel, fine- to coarse-grained sand, very dense, wet	No returns for samples between 30' and 40' BGS. Problems with the walls caving were occuring due to the gravels and water table. Cuttings consisted of broken gravel with little to no fines.
4073.6	31														
4072.6	32														
4071.6	33														
4070.6	34														
4069.6	35														
4068.6	36														
4067.6	37														
4066.6	38			16 18 22	40	0									
4065.6	39														
4064.6	40														
4063.6	41	11		17 57 61	118	20									
4062.6	42														
4061.6	43	12		16 16 20	36	53	18			32	12				
4060.6	44														

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Well-graded Gravel

BORING LOG

Materials Division
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START DATE 10/27/21
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E.A. # 74046
BORING B-1
GROUND ELEV. ft 4104.6
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DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	29.5	4075

LATITUDE 39.61603°N
LONGITUDE 119.30919°W
ENGINEER G. Helgerson
OPERATOR Travis Sawin
DRILL RIG Diedrich D-120
METHOD Mud Rotary
HAMMER Automatic
BACKFILLED Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS
4058.6	46			16 20 24	44	0							GW	Dark grayish brown well-graded GRAVEL with sand (GW), fine- to coarse-broken subrounded gravel, fine- to coarse-grained sand, very dense, wet	
4057.6	47														
4056.6	48			7 22 51	73	0									
4055.6	49														
4054.6	50														
4053.6	51	13		20 27 27	54	33	14	53	15						
4052.6	52													Boring terminated at 51.5'	
4051.6	53														
4050.6	54														
4049.6	55														
4048.6	56														
4047.6	57														
4046.6	58														
4045.6	59														

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Well-graded Gravel

BORING LOG

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1263 S. Stewart St
Carson City, NV 89712

START DATE	10/21/21
END DATE	10/21/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-2
GROUND ELEV. ft	4133.6
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE	39.61616°N
LONGITUDE	119.26546°W
ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4132.6	1												SM	Brown silty SAND (SM), fine- to medium-grained, medium dense, moist, slight mottling
4131.6	2													
4130.6	3	1		10 10 9	19	73	14	100	29					
4129.6	4													
4128.6	5													
4127.6	6	2		7 10 25	35	83	27	100	51	26	3	DS, Chem	ML	Brown sandy SILT (ML), hard, moist, fine-grained sand
4126.6	7													
4125.6	8	3		9 17 27	44	83	16	100	44					Brown silty SAND (SM), fine-grained, dense, moist,
4124.6	9													
4123.6	10													
4122.6	11	4		20 24 40	64	83	14	100	27	20	NP	DS, Chem	SM	Becomes very dense, dark brown with slight mottling
4121.6	12													
4120.6	13	5		15 18 34	52	83	22	100	39					
4119.6	14													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Silt | USCS Poorly-graded Sand with Silt | USCS Well-graded Sand with Silt

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

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LOCATION	Fernley, NV
E.A. #	74046
BORING	B-2
GROUND ELEV. ft	4133.6
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE	39.61616°N
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ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4117.6	16	6	Modified California Sampler	28 36 46	82	83	12	100	6	12	NP	DS	SP-SM	Grayish brown poorly graded SAND with silt (SP-SM), fine- to medium-grained, very dense, moist
4116.6	17													
4115.6	18													
4114.6	19													
4113.6	20													
4112.6	21	7	Standard Penetration Test	19 25 34	59	83	18	100	10				SW-SM	Grayish brown well-graded SAND with silt (SW-SM), fine- to medium-grained, very dense, moist
4111.6	22													
4110.6	23													
4109.6	24													
4108.6	25													
4107.6	26	8	Standard Penetration Test	24 32 39	71	87	21	100	14				SM	Grayish brown silty SAND (SM), fine- to medium-grained, dense, moist
4106.6	27													
4105.6	28													
4104.6	29													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Silt
USCS Poorly-graded Sand with Silt
USCS Well-graded Sand with Silt

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/21/21
END DATE	10/21/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-2
GROUND ELEV. ft	4133.6
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE	39.61616°N
LONGITUDE	119.26546°W
ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4102.6	31	9		34 52 66	118		7	100	7	13	NP	DS		Grayish brown poorly graded SAND with silt (SP-SM), fine- to medium-grained, very dense, moist
4101.6	32												SP-SM	
4100.6	33													
4099.6	34													
4098.6	35													
4097.6	36	10		11 14 40	54	73	17	99	29	15	NP			Dark redish brown silty SAND (SM), fine- to medium-grained, very dense, moist, slight mottling
4096.6	37													
4095.6	38													
4094.6	39													
4093.6	40												SM	
4092.6	41	11		29 43 55	98	83	18	100	17					
4091.6	42													
4090.6	43													
4089.6	44													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Silt | USCS Poorly-graded Sand with Silt | USCS Well-graded Sand with Silt

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/21/21
END DATE	10/21/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-2
GROUND ELEV. ft	4133.6
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE	39.61616°N
LONGITUDE	119.26546°W
ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4087.6	46	12		56 78 50/3"		80	11	100	11	17	NP		SP-SM	Grayish brown poorly graded SAND with silt (SP-SM), fine- to medium-grained, very dense, moist
4086.6	47													
4085.6	48													
4084.6	49													
4083.6	50													
4082.6	51	13		19 24 32	56	87	22	100	21					Dark brown silty SAND (SM), fine- to medium-grained, very dense, moist
4081.6	52													
4080.6	53													
4079.6	54													
4078.6	55												SM	Becomes wet
4077.6	56	14		18 26 31	57	87	27			22	NP			
4076.6	57													
4075.6	58													
4074.6	59													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Silt | USCS Poorly-graded Sand with Silt | USCS Well-graded Sand with Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 10/21/21
END DATE 10/21/21
PROJECT Fernley Seismic Retrofits
LOCATION Fernley, NV
E.A. # 74046
BORING B-2
GROUND ELEV. ft 4133.6
TOTAL DEPTH ft 76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE 39.61616°N
LONGITUDE 119.26546°W
ENGINEER G. Helgerson
OPERATOR Guillermo Prada-Ponce
DRILL RIG Diedrich D-120
METHOD Mud Rotary
HAMMER Automatic
BACKFILLED Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4072.6	61	15		28 52 78	130	67	30.5 23.5	99	11	31 19	28 NP	DS		Dark brown poorly graded SAND with silt (SP-SM), fine- to medium-grained, very dense, wet
4071.6	62												SP-SM	
4070.6	63													
4069.6	64													
4068.6	65													
4067.6	66	16		33 41 42	83	93	22	100	14					Dark brown silty SAND (SM), fine- to medium-grained, very dense, wet
4066.6	67													
4065.6	68													
4064.6	69													
4063.6	70												SM	
4062.6	71	17		18 36 47	83	93	31	100	40					
4061.6	72													
4060.6	73													
4059.6	74													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Silt
USCS Poorly-graded Sand with Silt
USCS Well-graded Sand with Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 10/21/21
END DATE 10/21/21
PROJECT Fernley Seismic Retrofits
LOCATION Fernley, NV
E.A. # 74046
BORING B-2
GROUND ELEV. ft 4133.6
TOTAL DEPTH ft 76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	52	4082

LATITUDE 39.61616°N
LONGITUDE 119.26546°W
ENGINEER G. Helgerson
OPERATOR Guillermo Prada-Ponce
DRILL RIG Diedrich D-120
METHOD Mud Rotary
HAMMER Automatic
BACKFILLED Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4057.6	76	18		16 29 47	76	87	29			24	NP		SM	Dark brown silty SAND (SM), fine- to medium-grained, very dense, wet Becomes fine-grained sand with mottling
4056.6	77													Boring terminated at 76.5' BGS
4055.6	78													
4054.6	79													
4053.6	80													
4052.6	81													
4051.6	82													
4050.6	83													
4049.6	84													
4048.6	85													
4047.6	86													
4046.6	87													
4045.6	88													
4044.6	89													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Silt
USCS Poorly-graded Sand with Silt
USCS Well-graded Sand with Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4149.1	1													Grayish brown silty SAND (SM), fine- to medium-grained, dense, moist
4148.1	2													
4147.1	3	1		13 15 19	34	80	14	100	39				SM	
4146.1	4													
4145.1	5	2		5 10 20	30	83	23			27	3			
4144.1	6													
4143.1	7													
4142.1	8	3		20 26 41	67		5	100	12			Chem, DS		Dark grayish brown poorly graded SAND with silt (SP-SM), fine-grained, dense, moist
4141.1	9													
4140.1	10	4		14 18 23	41	87	27	100	12				SP-SM	
4139.1	11													
4138.1	12													
4137.1	13	5		16 23 27	50	87	23			19	NP			
4136.1	14													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS Silt

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4134.1	16	6		27 37 45	82		9	100	5			Chem	SP-SM	Dark grayish brown poorly graded SAND with silt (SP-SM), fine-grained, dense, moist Fine- to medium-grained sand
4133.1	17													
4132.1	18													
4131.1	19													
4130.1	20													
4129.1	21	7		20 19 13	32	83	21			24	NP			
4128.1	22												CL	Dark brown lean CLAY (CL), low plasticity, hard, moist to wet
4127.1	23	8		8 12 13	25	100	29	100	91	37	12	UU		Becomes very stiff, slight mottling
4126.1	24													
4125.1	25													
4124.1	26	9		3 4 9	13	100	46	99	95					Becomes stiff
4123.1	27													
4122.1	28	10		4 5 8	13	100	40	100	96	38	14			
4121.1	29													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4119.1	31	11		12 18 25	43		33	100	70	32	NP	DS	ML	Dark brown sandy SILT (ML), hard, moist, fine-grained sand
4118.1	32													
4117.1	33													
4116.1	34													
4115.1	35													
4114.1	36	12		10 13 16	29	83	28	100	25				SM	Grayish brown silty SAND (SM), fine-grained, medium dense, wet
4113.1	37													
4112.1	38													
4111.1	39													
4110.1	40													
4109.1	41	13		5 7 13	20	100	41	100	92	40	19		CL	Grayish brown lean CLAY (CL), moderate plasticity, very stiff, wet
4108.1	42													
4107.1	43													
4106.1	44													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4104.1	46	14	Modified California Sampler	23 30 45	75		26	100	80	29	NP		ML	Dark brown SILT with sand (ML), hard, wet, fine-grained sand
4103.1	47													
4102.1	48													
4101.1	49													
4100.1	50													
4099.1	51	15	Standard Penetration Test	4 5 7	12	100	48	100	96				CL	Dark grayish brown lean CLAY (CL), moderate plasticity, stiff, wet
4098.1	52													
4097.1	53													
4096.1	54													
4095.1	55													
4094.1	56	16	Standard Penetration Test	4 5 8	13	100	44			42	19			
4093.1	57													
4092.1	58													
4091.1	59													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS Silt

BORING LOG

Materials Division
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1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
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LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4089.1	61	17		10 8 13	21	100	38	100	93	49	24	UU	CL	Dark grayish brown lean CLAY (CL), moderate plasticity, stiff, wet Becomes very stiff
4088.1	62													
4087.1	63													
4086.1	64													
4085.1	65													
4084.1	66	18		12 10 11	21	100	41	100	99	42	15		ML	Dark gray to black SILT (ML), very stiff, wet
4083.1	67													
4082.1	68													
4081.1	69													
4080.1	70													
4079.1	71	19		39 60 50/3"			17	100	15	21	NP		SM	Dark gray silty SAND (SM), fine-grained, very dense, wet
4078.1	72													
4077.1	73													
4076.1	74													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS Silt

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/26/21
END DATE	10/26/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-3
GROUND ELEV. ft	4150.1
TOTAL DEPTH ft	76.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	31.5	4119

LATITUDE	39.61471°N
LONGITUDE	119.23627°W
ENGINEER	G. Helgerson
OPERATOR	Travis Sawin
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4074.1	76	20		34 64 50/4"		92	23	100	35				SM	Dark gray silty SAND (SM), fine-grained, very dense, wet Boring terminated at 76.3' BGS.
4073.1	77													
4072.1	78													
4071.1	79													
4070.1	80													
4069.1	81													
4068.1	82													
4067.1	83													
4066.1	84													
4065.1	85													
4064.1	86													
4063.1	87													
4062.1	88													
4061.1	89													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS Silt

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/19/21
END DATE	10/20/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-4
GROUND ELEV. ft	4134.1
TOTAL DEPTH ft	86.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	38.5	4096

LATITUDE	39.613217°N
LONGITUDE	119.21837°W
ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4133.1	1												SM	Dark brown silty SAND (SM), fine-to coarse-grained, medium dense, moist
4132.1	2													
4131.1	3	1		8 8 13	21	87	14	97	21					
4130.1	4													
4129.1	5													
4128.1	6	2		9 12 14	26	80	9	97	6			Chem	SP-SM	Grayish brown poorly graded SAND with silt (SP-SM), fine-to coarse-grained, mdeium dense, moist
4127.1	7													
4126.1	8	3		12 15 23	38	83	7	100	8			DS		Becomes dense
4125.1	9													
4124.1	10													
4123.1	11	4		12 17 21	38	83								
4122.1	12													
4121.1	13													
4120.1	14													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS High Plasticity Clay

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 10/19/21
END DATE 10/20/21
PROJECT Fernley Seismic Retrofits
LOCATION Fernley, NV
E.A. # 74046
BORING B-4
GROUND ELEV. ft 4134.1
TOTAL DEPTH ft 86.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	38.5	4096

LATITUDE 39.613217°N
LONGITUDE 119.21837°W
ENGINEER G. Helgerson
OPERATOR Guillermo Prada-Ponce
DRILL RIG Diedrich D-120
METHOD Mud Rotary
HAMMER Automatic
BACKFILLED Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4118.1	16	5		16 21 24	45	83	22	100	7				SP-SM	Grayish brown poorly graded SAND with silt (SP-SM), fine-to coarse-grained, mdeium dense, moist
4117.1	17													
4116.1	18													
4115.1	19													
4114.1	20													
4113.1	21	6		11 24 43	67		13	100	20	23	NP	DS		Brown silty SAND (SM), fine-grained, very dense, moist
4112.1	22													
4111.1	23													
4110.1	24													
4109.1	25												SM	Becomes dense
4108.1	26	7		13 18 22	40	100	21	100	30					
4107.1	27													
4106.1	28													
4105.1	29													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS High Plasticity Clay

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE 10/19/21
END DATE 10/20/21
PROJECT Fernley Seismic Retrofits
LOCATION Fernley, NV
E.A. # 74046
BORING B-4
GROUND ELEV. ft 4134.1
TOTAL DEPTH ft 86.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	38.5	4096

LATITUDE 39.613217°N
LONGITUDE 119.21837°W
ENGINEER G. Helgerson
OPERATOR Guillermo Prada-Ponce
DRILL RIG Diedrich D-120
METHOD Mud Rotary
HAMMER Automatic
BACKFILLED Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4103.1	31	8		9 13 24	37		35	100	93	33	6		CL	Dark gray lean CLAY (CL), hard, moist, fine-grained sand
4102.1	32													
4101.1	33													
4100.1	34													
4099.1	35													
4098.1	36	9		3 3 5	8	100	51	100	97					
4097.1	37													
4096.1	38	10		4 6 6	12		49	100	98	61	39	UU		Becomes stiff
4095.1	39													
4094.1	40													
4093.1	41	11		3 4 5	9	100	52			50	30			
4092.1	42													
4091.1	43													
4090.1	44													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS High Plasticity Clay

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/19/21
END DATE	10/20/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-4
GROUND ELEV. ft	4134.1
TOTAL DEPTH ft	86.5

GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	38.5	4096

LATITUDE	39.613217°N
LONGITUDE	119.21837°W
ENGINEER	G. Helgerson
OPERATOR	Guillermo Prada-Ponce
DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4088.1	46	12		3 4 5	9	100	55	100	98				CH	Grayish brown fat CLAY (CH), high plasticity, medium stiff, wet
4087.1	47													
4086.1	48													
4085.1	49													
4084.1	50													
4083.1	51	13		7 8 11	19	100	42	100	100	65	42			Becomes very stiff
4082.1	52													
4081.1	53													
4080.1	54													
4079.1	55													
4078.1	56	14		4 4 8	12	100	50			49	27		CL	Grayish brown lean CLAY (CL), moderate plasticity, stiff, wet
4077.1	57													
4076.1	58													
4075.1	59													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS High Plasticity Clay

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

START DATE	10/19/21
END DATE	10/20/21
PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
BORING	B-4
GROUND ELEV. ft	4134.1
TOTAL DEPTH ft	86.5

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DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4073.1	61	15	SPT	4 5 6	11	100	49	100	97				CL	Grayish brown lean CLAY (CL), moderate plasticity, stiff, wet
4072.1	62													
4071.1	63													
4070.1	64													
4069.1	65													
4068.1	66	16	MCS	7 8 10	18	100	49	100	99	47	24	UU		Becomes very stiff
4067.1	67													
4066.1	68													
4065.1	69													
4064.1	70													
4063.1	71	17	SPT	3 4 6	10	100	46			49	27			Becomes stiff
4062.1	72													
4061.1	73													
4060.1	74													

Standard Penetration Test | Modified California Sampler | USCS Silty Sand | USCS Poorly-graded Sand with Silt | USCS Low Plasticity Clay | USCS High Plasticity Clay

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

BORING LOG

Materials Division
Geotechnical Section
1263 S. Stewart St
Carson City, NV 89712

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PROJECT	Fernley Seismic Retrofits
LOCATION	Fernley, NV
E.A. #	74046
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GROUND ELEV. ft	4134.1
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GROUNDWATER LEVEL			
DATE	TIME	DEPTH ft	ELEV. ft
11/1/21	AD	38.5	4096

LATITUDE	39.613217°N
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DRILL RIG	Diedrich D-120
METHOD	Mud Rotary
HAMMER	Automatic
BACKFILLED	Yes DATE 11/2/2021

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	TYPE	BLOWS / 6"	Uncorrected N Value	Recovery (%)	MOISTURE CONTENT (%)	% PASSING NO.4	% PASSING NO.200	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
4058.1	76	18		3 4 6	10	100	44	100	87			H	CL	Grayish brown lean CLAY (CL), moderate plasticity, stiff, wet
4057.1	77													
4056.1	78													
4055.1	79													
4054.1	80													
4053.1	81													
4052.1	82													
4051.1	83													
4050.1	84													
4049.1	85													
4048.1	86	19		15 21 34	55	100	40	100	95	45	16			Becomes hard
4047.1	87													Boring terminated at 86.5' BGS.
4046.1	88													
4045.1	89													

Standard Penetration Test
Modified California Sampler
USCS Silty Sand
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Clay
USCS High Plasticity Clay

SMART SOIL LOG 74046 FERNLEY RETROFITS.GPJ NDOT SMART LOG 2018.10.10.GDT 1/19/22

Appendix C
Laboratory Test Results

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B1 **Elevation (ft)** **Station** **Date** 10/28/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B1-1	2.5 - 4.0	SPT			14.0		13.8									
B1-2	5.0 - 6.5	SPT			7.7			16	NP	NP						
B1-3A	7.5 - 8.0	CMS			16.2			17	NP	NP						
B1-3B	8.0 - 8.5	CMS														
B1-3C	8.5 - 9.0	CMS			7.8		16.7									
B1-4	10.0 - 11.5	SPT			18.2			18	NP	NP						
B1-5	15.0 - 16.5	SPT			19.0		40.7									
B1-6	16.5 - 18.0	SPT			10.0		18.2									
B1-7	20.0 - 21.5	SPT			7.4		6.4									
B1-8	22.5 - 24.0	SPT			8.4		11.0									
B1-9	25.0 - 26.5	SPT			8.2		11.7									
B1-12	42.5 - 44.0	SPT			18.2			32	20	12						

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B1 **Elevation (ft)** **Station** **Date** 10/28/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B1-13	50.0 - 51.5	SPT			14.1		14.6									

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N = No. of blows per ft., sampler

N = Field SPT N = $(N_{css})(0.62)$

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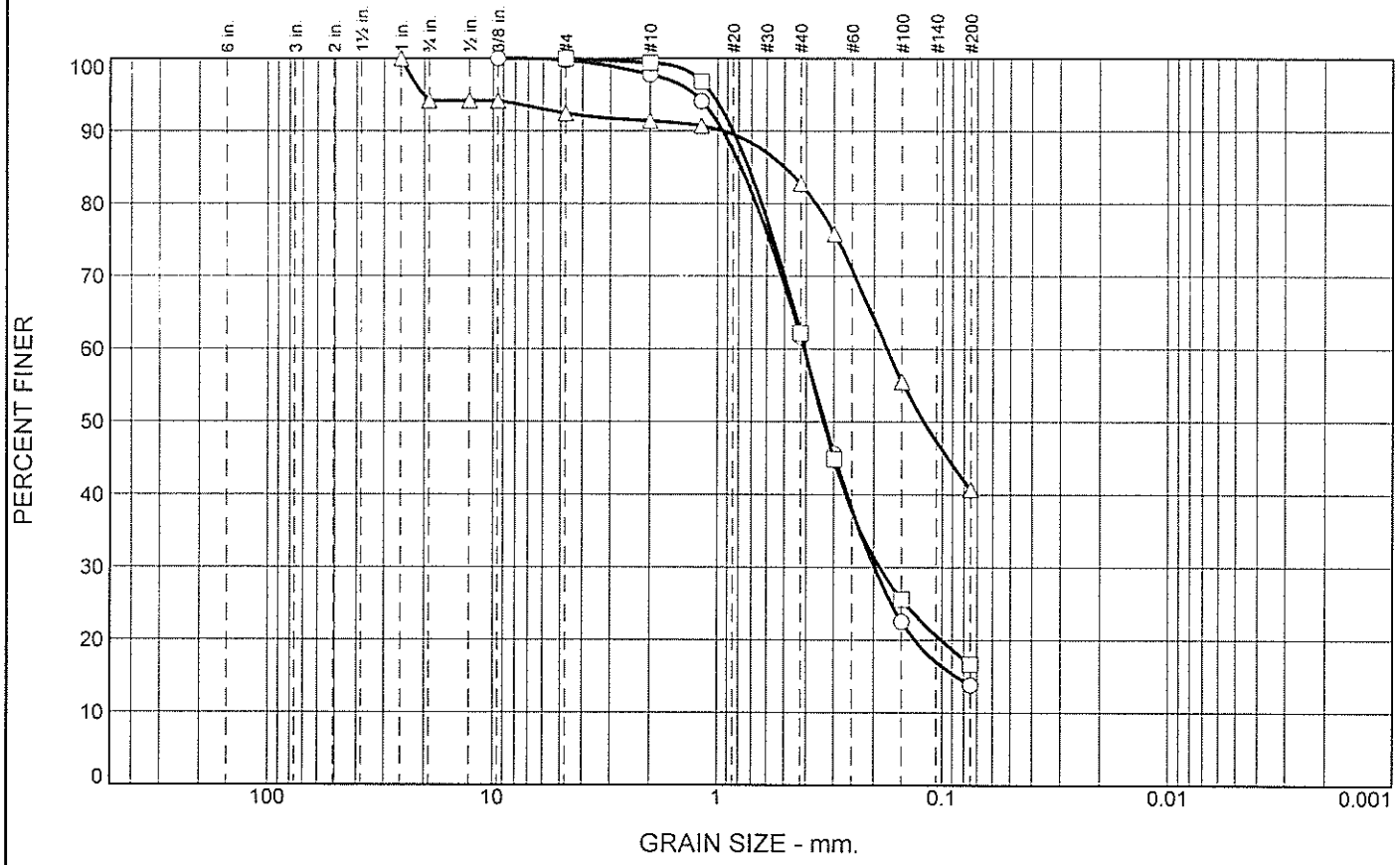
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.3	85.9	13.8					
□	0.0	0.0	83.3	16.7					
△	0.0	7.6	51.7	40.7					

SIEVE inches size	PERCENT FINER ○	□	△
1"			100.0
3/4"			94.1
1/2"			94.1
3/8"	100.0		94.1
	GRAIN SIZE		
D_{60}	0.4096	0.4072	0.1752
D_{30}	0.1988	0.1882	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	99.7	100.0	92.4
#10	97.7	99.4	91.4
#16	94.1	96.8	90.7
#40	61.7	62.2	82.8
#50	45.6	44.9	75.9
#100	22.5	25.6	55.5
#200	13.8	16.7	40.7

Material Description

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REMARKS:

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○ Source of Sample: B1 Depth: 2.5' - 4.0' Sample Number: 1

□ Source of Sample: B1 Depth: 8.5' - 9.0' Sample Number: 3C

△ Source of Sample: B1 Depth: 15.0' - 16.5' Sample Number: 5

NEVADA DEPARTMENT OF TRANSPORTATION

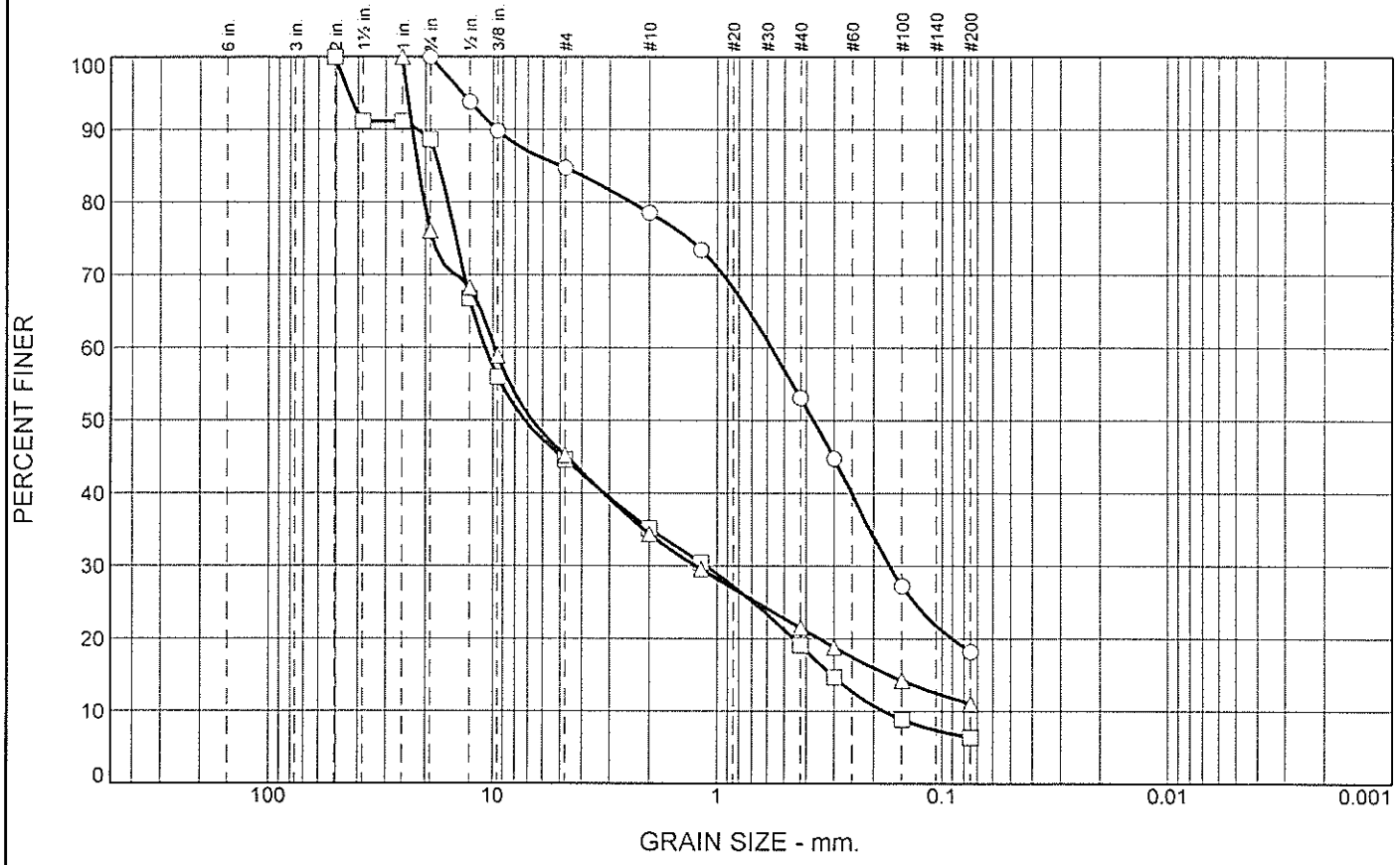
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	15.3	66.5	18.2					
□	0.0	55.4	38.2	6.4					
△	0.0	54.8	34.2	11.0					

SIEVE inches size	PERCENT FINER ○	□	△
2"		100.0	
1.5"		91.1	
1"		91.1	100.0
3/4"	100.0	88.6	76.1
1/2"	93.8	66.8	68.3
3/8"	89.8	56.0	58.9
	GRAIN SIZE		
D_{60}	0.5739	10.8603	9.8339
D_{30}	0.1702	1.1215	1.2426
D_{10}		0.1805	
	COEFFICIENTS		
C_c		0.64	
C_u		60.16	

SIEVE number size	PERCENT FINER ○	□	△
#4	84.7	44.6	45.2
#10	78.5	35.2	34.4
#16	73.5	30.5	29.6
#40	53.1	19.1	21.5
#50	44.7	14.7	18.8
#100	27.3	8.9	14.2
#200	18.2	6.4	11.0

Material Description

○

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△

REMARKS:

○

□

△

○ Source of Sample: B1 Depth: 16.5' - 18.0' Sample Number: 6

□ Source of Sample: B1 Depth: 20.0' - 21.5' Sample Number: 7

△ Source of Sample: B1 Depth: 22.5' - 24.0' Sample Number: 8

NEVADA DEPARTMENT OF TRANSPORTATION

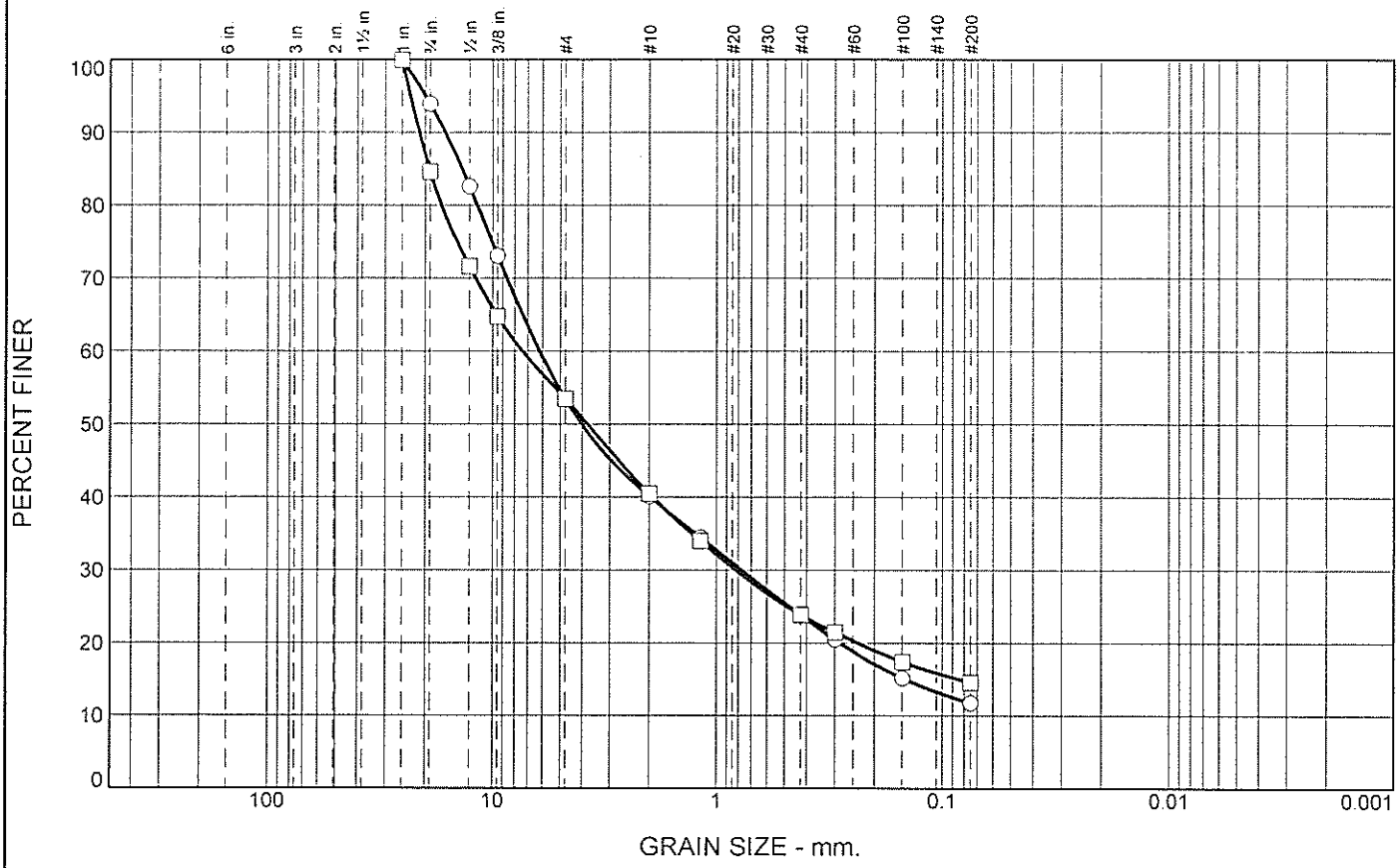
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	46.6	41.7	11.7					
□	0.0	46.6	38.8	14.6					

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □
1"	100.0	100.0
3/4"	93.9	84.6
1/2"	82.6	71.7
3/8"	73.1	64.8
GRAIN SIZE		
D_{60}	6.1905	7.3834
D_{30}	0.7706	0.8205
D_{10}		
COEFFICIENTS		
C_c		
C_u		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □
#4	53.4	53.4
#10	40.2	40.5
#16	34.5	34.0
#40	23.9	23.9
#50	20.5	21.5
#100	15.2	17.4
#200	11.7	14.6

Material Description

○

□

REMARKS:

○

□

○ Source of Sample: B1 Depth: 25.0' - 26.5' Sample Number: 9

□ Source of Sample: B1 Depth: 50.0' - 51.5' Sample Number: 13

NEVADA DEPARTMENT OF TRANSPORTATION

Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B2 **Elevation (ft)** 4130 **Station** **Date**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B2-1	2.5 - 4.0	SPT			13.8		28.9									
B2-2A	5.0 - 5.5	CMS			26.8			26	23	3						
B2-2B	5.5 - 6.0	CMS			27.1											Ch
B2-2C	6.0 - 6.5	CMS					50.7				DS	26	5.0	33	2.0	
B2-3	7.5 - 9.0	SPT			15.6		44.1									
B2-4A	10.0 - 10.5	CMS			14.3			20	NP	NP						Ch
B2-4B	10.5 - 11.0	CMS			15.9											
B2-4C	11.0 - 11.5	CMS					26.9				DS	36	1.1	35	0.4	
B2-5	12.5 - 14.0	SPT			22.3		39.2									
B2-6B	15.5 - 16.0	CMS			11.6			12	NP	NP						
B2-6C	16.0 - 16.5	CMS					6.3				DS	44	3.1	31	1.9	
B2-7	20.0 - 21.5	SPT			18.0		9.8									

CMS = California Modified Sampler 2.42" ID
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CS = Continuous Sample 3.23" ID
RC = Rock Core
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CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
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U = Unconfined Compressive
UU = Unconsolidated Undrained
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CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
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G = Specific Gravity
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Ch = Chemical
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K = Permeability
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HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B2 **Elevation (ft)** 4130 **Station** **Date**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
B2-8	25.0 - 26.5	SPT			20.6		13.6									
B2-9B	30.5 - 31.0	CMS						13	NP	NP	DS	44	7.4	36	1.6	
B2-9C	31.0 - 31.5	CMS			6.8		6.9									
B2-10	35.0 - 36.5	SPT		SM	17.3		28.8	15	NP	NP						
B2-11	40.0 - 41.5	SPT			17.8		17.3									
B2-12B	45.5 - 46.0	CMS			15.6			17	NP	NP						
B2-12C	46.0 - 46.5	CMS			10.6		11.4									
B2-13	50.0 - 51.5	SPT			21.9		20.9									
B2-14	55.0 - 56.5	SPT			27.3			22	NP	NP						
B2-15A	61.5 - 61.8	CMS			30.5			31	28	3						
B2-15B	60.5 - 61.0	CMS			23.5			19	NP	NP						
B2-15C	61.0 - 61.5	CMS					11.0				DS	35	6.4	32	2.3	

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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B2 **Elevation (ft)** 4130 **Station** **Date**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B2-16	65.0 - 66.5	SPT			21.5		14.4									
B2-17	70.0 - 71.5	SPT			30.8		39.9									
B2-18	75.0 - 76.5	SPT			29.4			24	NP	NP						

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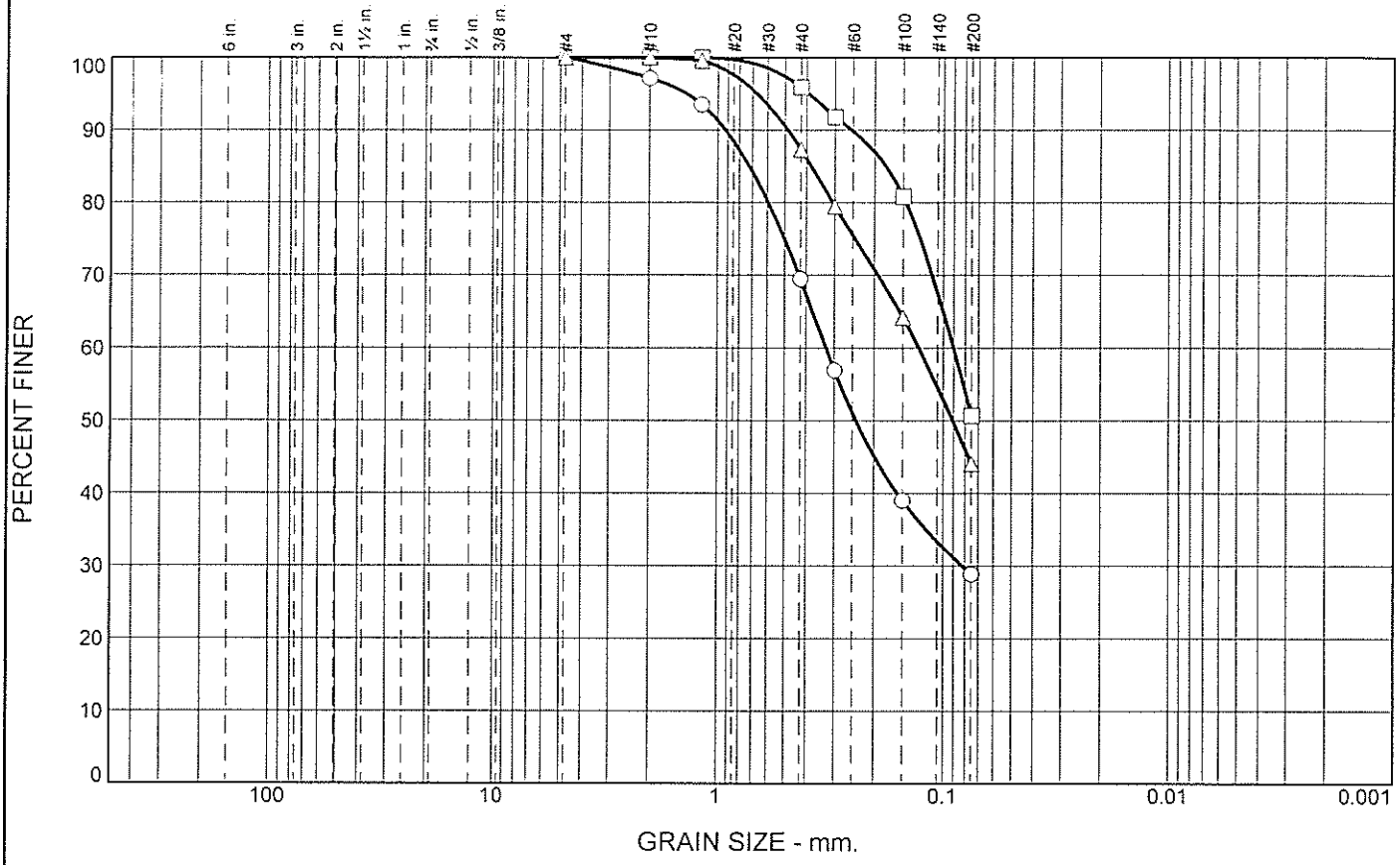
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	71.1	28.9					
□	0.0	0.0	49.3	50.7					
△	0.0	0.0	55.9	44.1					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.3275	0.0903	0.1278
D_{30}	0.0820		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0		100.0
#10	97.2	100.0	100.0
#16	93.5	100.0	99.6
#40	69.5	95.9	87.3
#50	56.9	91.8	79.5
#100	39.0	80.8	64.2
#200	28.9	50.7	44.1

Material Description

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REMARKS:

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○ Source of Sample: B2 Depth: 2.5' - 4.0' Sample Number: 1

□ Source of Sample: B2 Depth: 6.0' - 6.5' Sample Number: 2C

△ Source of Sample: B2 Depth: 7.5' - 9.0' Sample Number: 3

NEVADA DEPARTMENT OF TRANSPORTATION

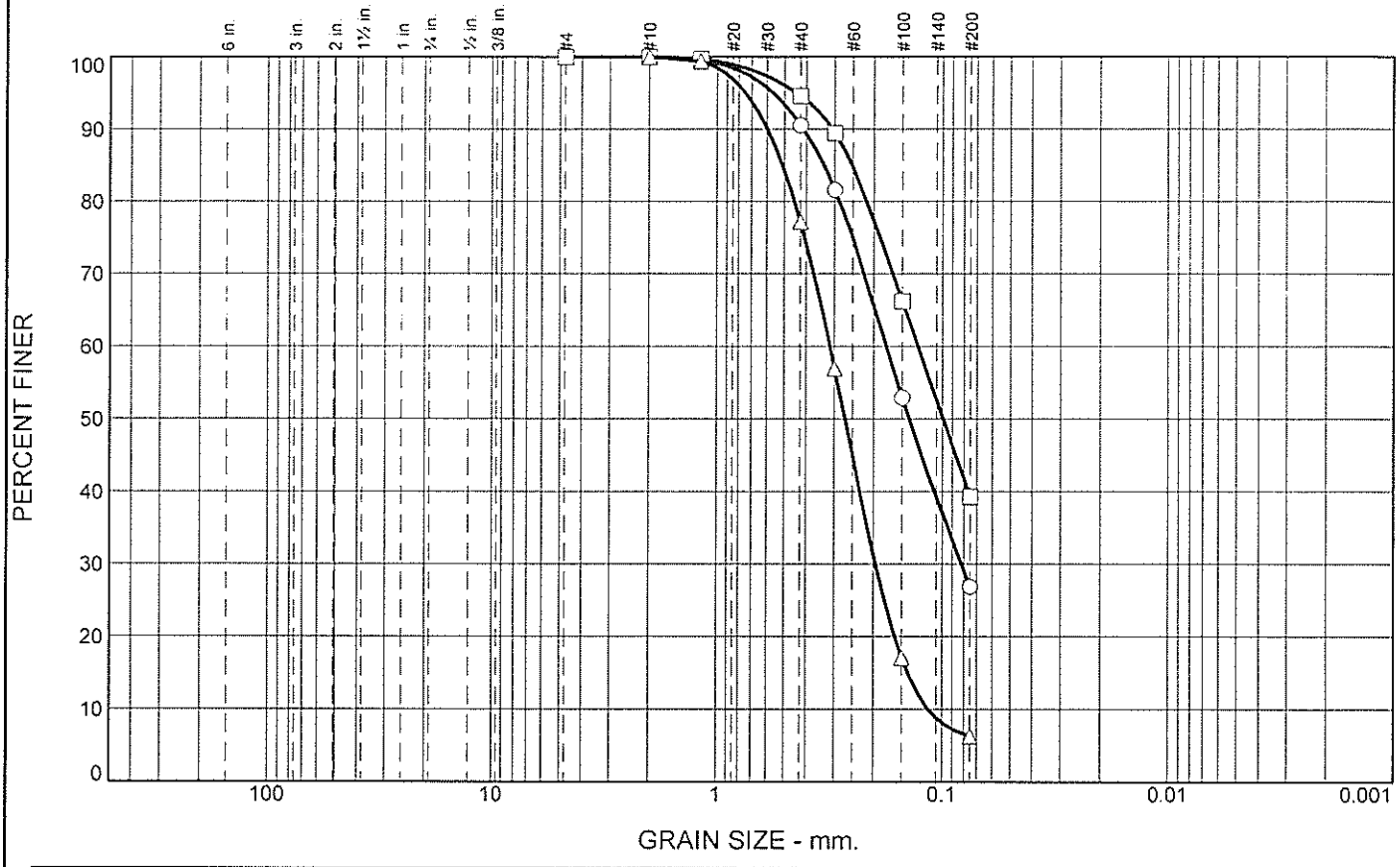
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	73.1	26.9					
□	0.0	0.0	60.8	39.2					
△	0.0	0.0	93.7	6.3					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.1765	0.1280	0.3146
D_{30}	0.0820		0.1959
D_{10}			0.1147
	COEFFICIENTS		
C_c			1.06
C_u			2.74

SIEVE number size	PERCENT FINER ○	□	△
#4		100.0	
#10	100.0	100.0	100.0
#16	99.5	99.7	99.4
#40	90.5	94.5	77.2
#50	81.6	89.4	57.0
#100	52.9	66.2	17.1
#200	26.9	39.2	6.3

Material Description

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REMARKS:

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○ Source of Sample: B2 Depth: 11.0' - 11.5' Sample Number: 4C

□ Source of Sample: B2 Depth: 12.5' - 14.0' Sample Number: 5

△ Source of Sample: B2 Depth: 16.0' - 16.5' Sample Number: 6C

NEVADA DEPARTMENT OF TRANSPORTATION

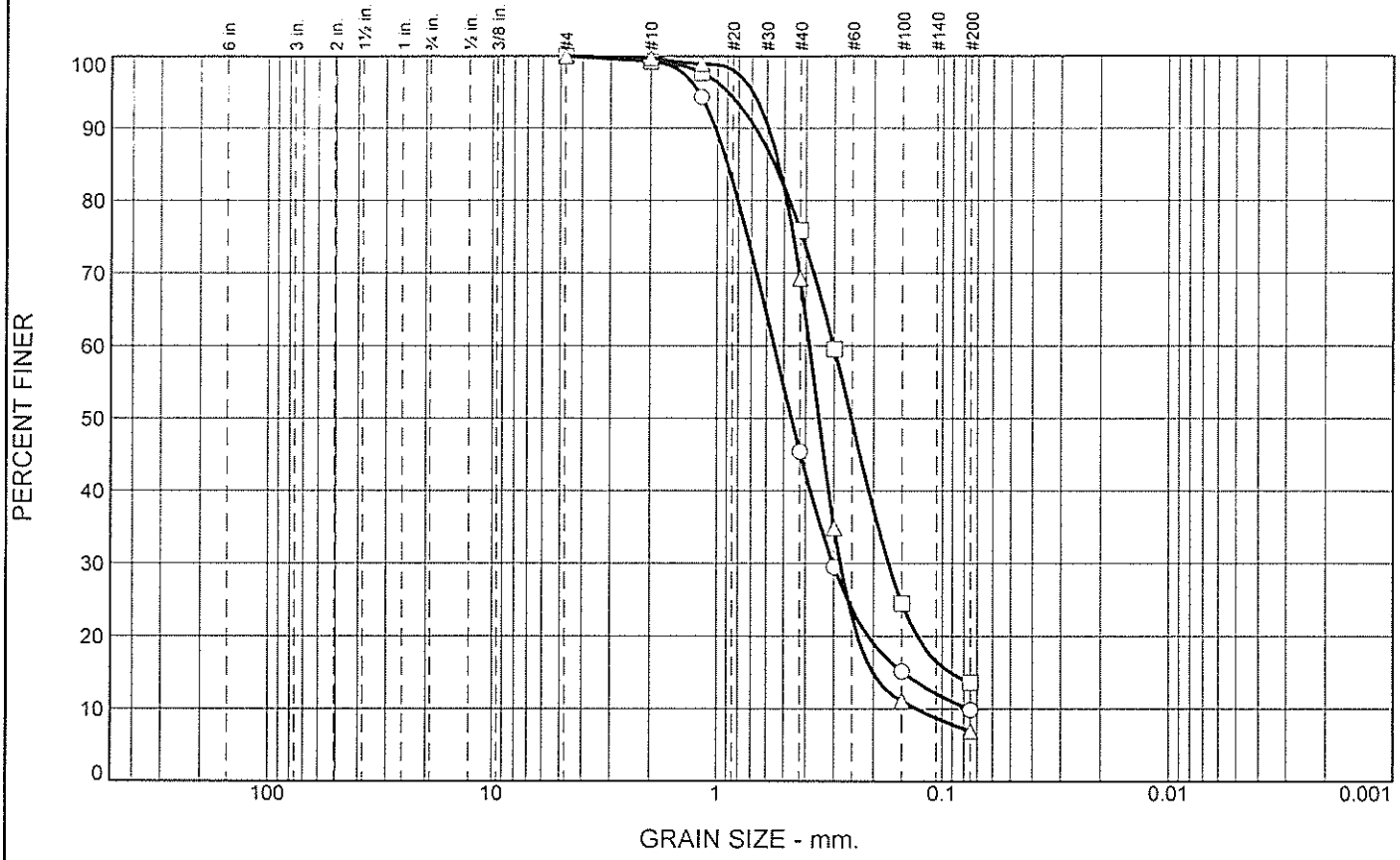
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	90.2	9.8					
□	0.0	0.0	86.4	13.6					
△	0.0	0.0	93.1	6.9					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.5537	0.3027	0.3863
D_{30}	0.3037	0.1720	0.2817
D_{10}	0.0769		0.1294
	COEFFICIENTS		
C_c	2.17		1.59
C_u	7.20		2.98

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	100.0	100.0
#10	99.2	99.2	99.7
#16	94.3	97.7	98.9
#40	45.5	75.9	69.3
#50	29.5	59.5	34.9
#100	15.2	24.5	11.1
#200	9.8	13.6	6.9

Material Description

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REMARKS:

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○ Source of Sample: B2 Depth: 20.0' - 21.5' Sample Number: 7

□ Source of Sample: B2 Depth: 25.0' - 26.5' Sample Number: 8

△ Source of Sample: B2 Depth: 31.0' - 31.5' Sample Number: 9C

NEVADA DEPARTMENT OF TRANSPORTATION

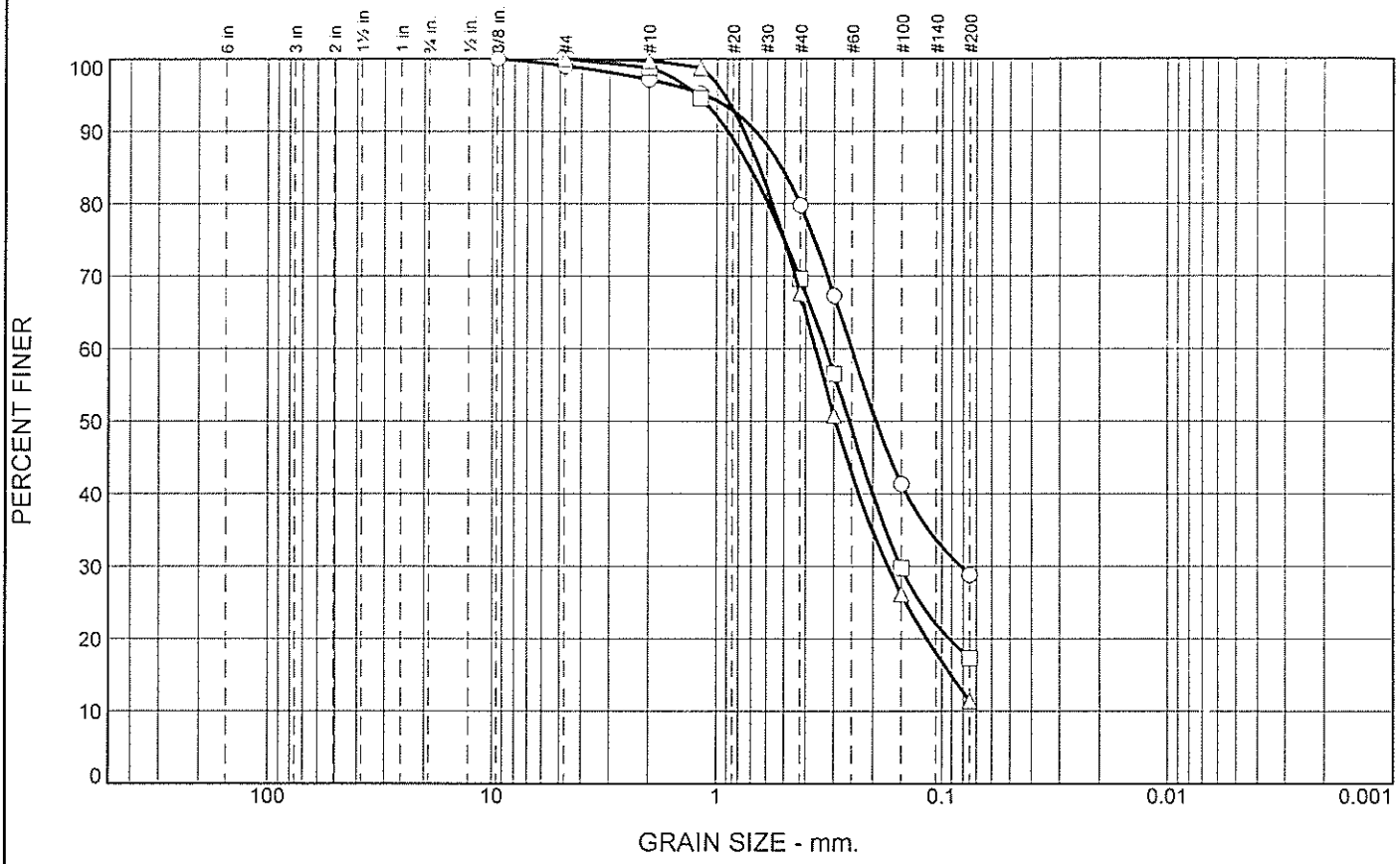
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	1.0	70.2	28.8		SM	A-2-4(0)	NP	15
□	0.0	0.0	82.7	17.3					
△	0.0	0.0	88.6	11.4					

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0		
GRAIN SIZE			
D_{60}	0.2504	0.3273	0.3634
D_{30}	0.0820	0.1511	0.1720
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	99.0	100.0	100.0
#10	97.1	98.8	99.7
#16	95.2	94.5	98.7
#40	79.8	69.6	67.6
#50	67.3	56.5	50.8
#100	41.3	29.8	26.2
#200	28.8	17.3	11.4

Material Description
○ silty sand
□
△

REMARKS:
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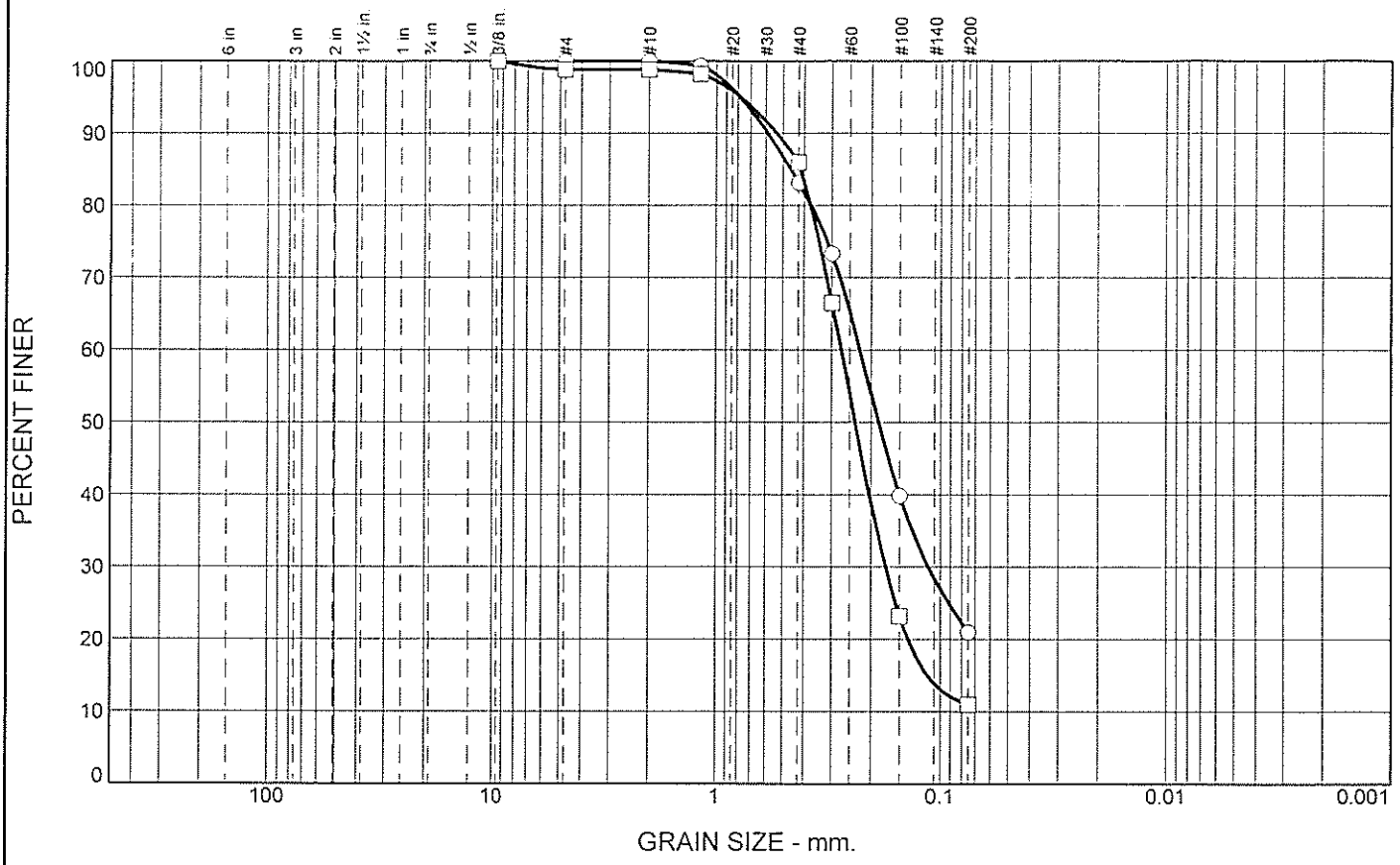
△

○ Source of Sample: B2 Depth: 35.0' - 36.5' Sample Number: 10
□ Source of Sample: B2 Depth: 40.0' - 41.5' Sample Number: 11
△ Source of Sample: B2 Depth: 46.0' - 46.5' Sample Number: 12C

NEVADA DEPARTMENT OF TRANSPORTATION

Client: G. Helgerson
Project: Fernley Seismic Retrofits
Project No.: EA 74046 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	79.1	20.9					
□	0.0	1.2	87.8	11.0					

SIEVE inches size	PERCENT FINER ○	□	
3/8"		100.0	
	GRAIN SIZE		
D_{60}	0.2247	0.2726	
D_{30}	0.1125	0.1724	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	
#4	100.0	98.8	
#10	100.0	98.8	
#16	99.3	98.2	
#40	83.1	86.0	
#50	73.3	66.5	
#100	39.9	23.2	
#200	20.9	11.0	

Material Description

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REMARKS:

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○ Source of Sample: B2 Depth: 50.0' - 51.5' Sample Number: 13

□ Source of Sample: B2 Depth: 61.0' - 61.5' Sample Number: 15C

NEVADA DEPARTMENT OF TRANSPORTATION

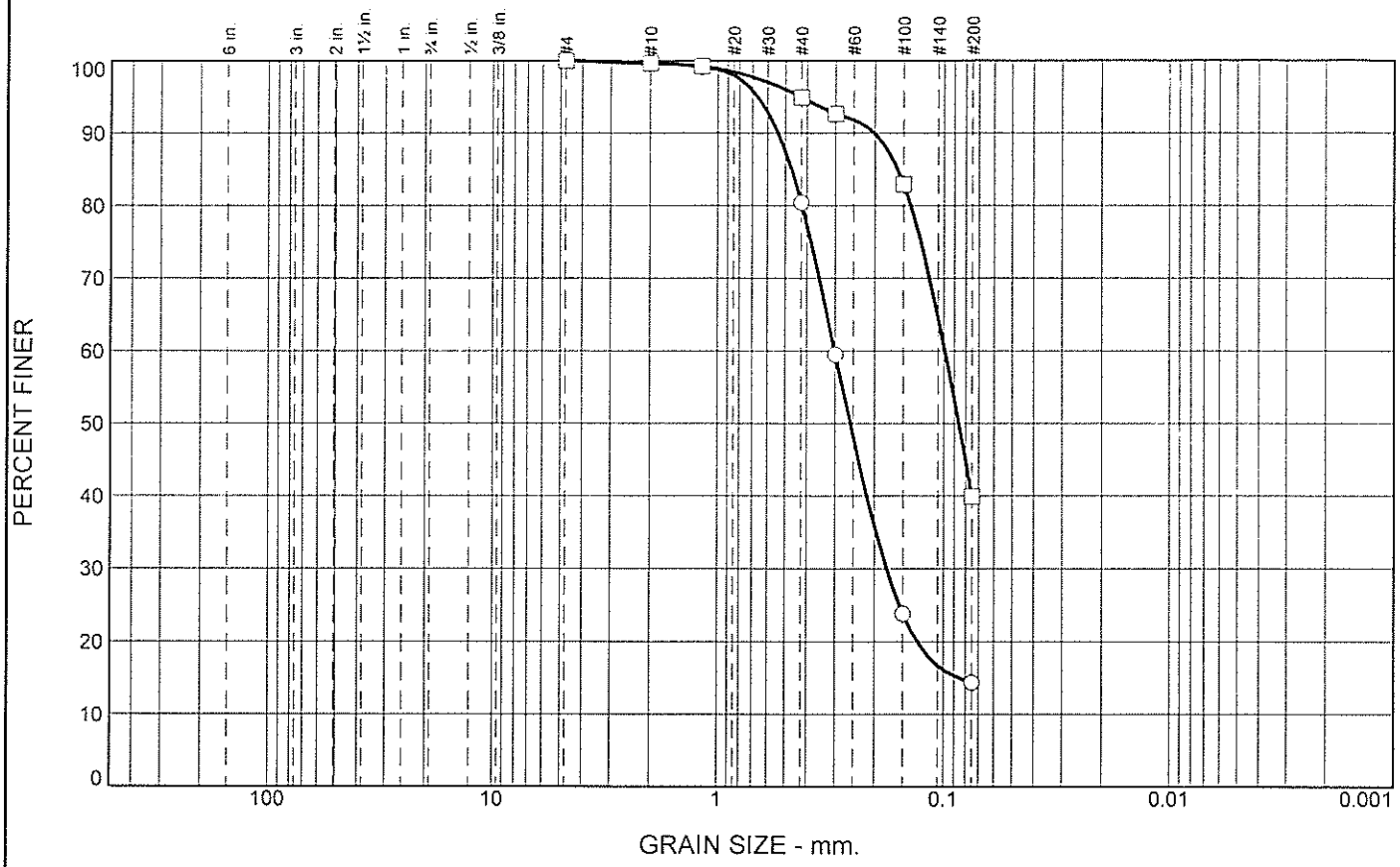
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	85.6	14.4					
□	0.0	0.0	60.1	39.9					

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □
GRAIN SIZE		
D_{60}	0.3024	0.0989
D_{30}	0.1766	
D_{10}		
COEFFICIENTS		
C_c		
C_u		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □
#4	100.0	100.0
#10	99.7	99.6
#16	99.1	99.2
#40	80.5	95.0
#50	59.5	92.6
#100	23.9	82.9
#200	14.4	39.9

Material Description

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REMARKS:

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○ Source of Sample: B2 Depth: 65.0' - 66.5' Sample Number: 16

□ Source of Sample: B2 Depth: 70.0' - 71.5' Sample Number: 17

NEVADA DEPARTMENT OF TRANSPORTATION

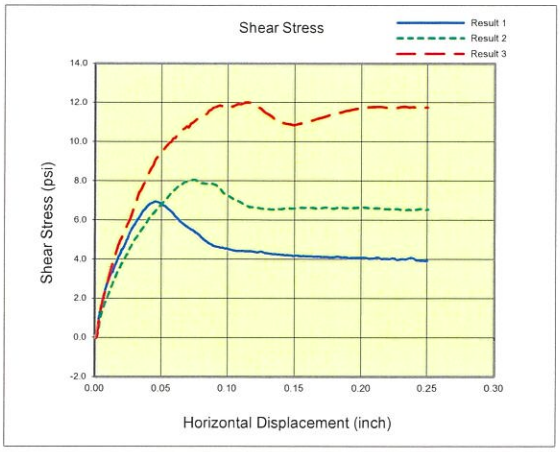
Client: G. Helgerson

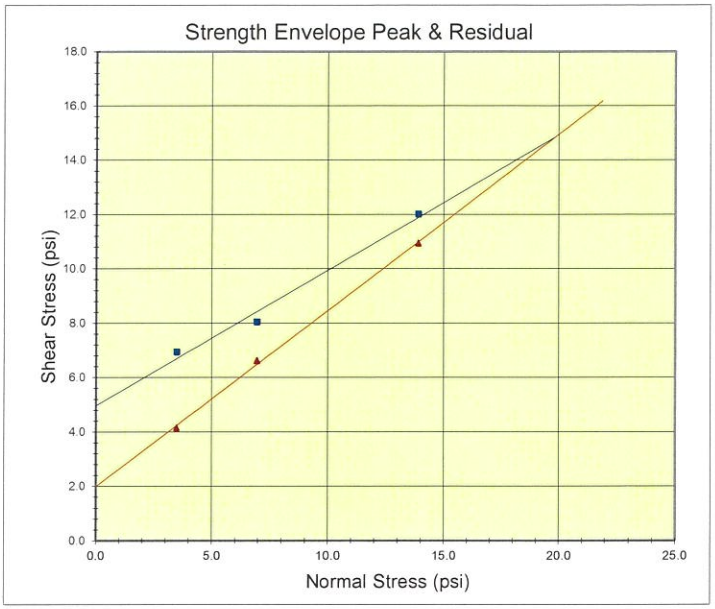
Project: Fernley Seismic Retrofits

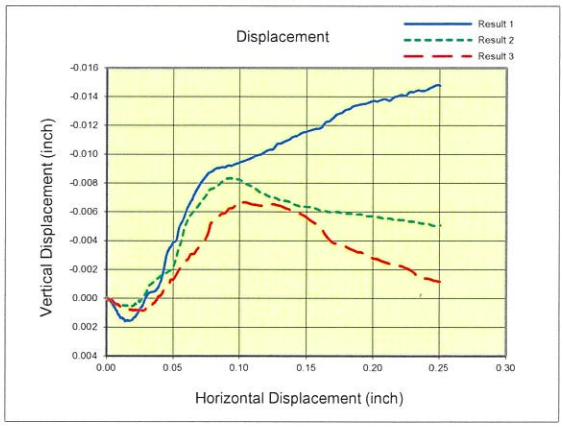
Project No.: EA 74046

Figure

DIRECT SHEAR TEST REPORT







Strength Parameters				
		Peak		Residual
Friction Angle =		26	degrees	33
Cohesion =		4.96	psi	1.99

Project: FL-5-21 Boring: B2 Sample: 2C

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/3/2021	11/3/2021	11/3/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	6.00	8.00	6.00
Moisture (%)	34.1	35.8	35.7
Dry Unit Wt (pcf)	84.2	84.7	84.4
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	3.48	6.95	13.90
Peak Shear Stress(psi)	6.95	8.05	12.01
Residual Shear Stress(psi)	4.1	6.6	10.9
Residual Point Picked @(in)	0.155	0.155	0.155
Time @ Peak Failure (min)	15.0	25.0	38.6

Specimen Comments

a Dark silty material sheared at 500 psf

b Dark silty material sheared at 1,000 psf

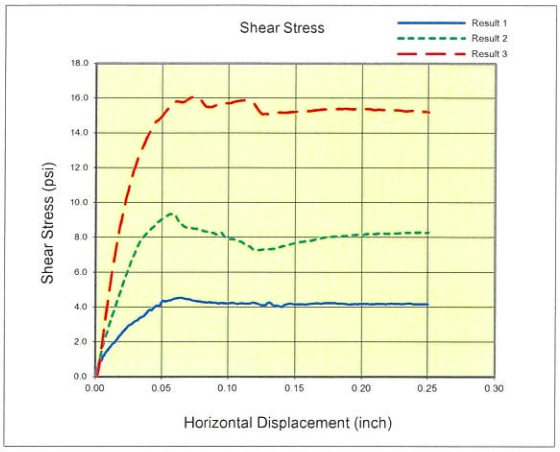
c Dark silty material sheared at 2,000 psf

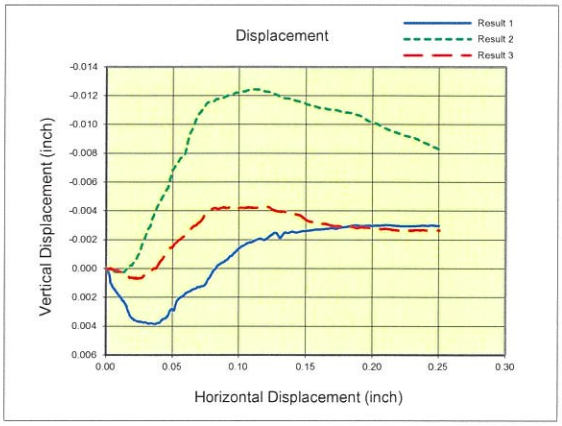
Geotechnical Section

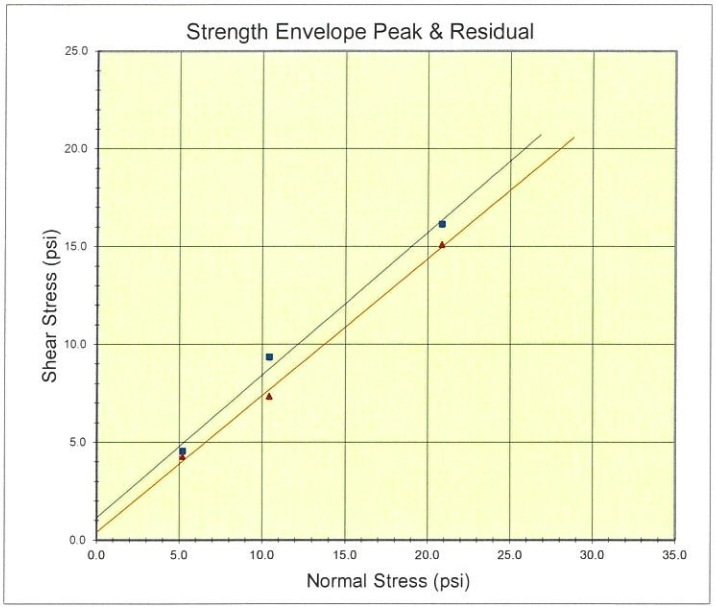
NEVADA DOT

DigiShear Report v4b __ B2 2C

DIRECT SHEAR TEST REPORT







Strength Parameters				
	Peak		Residual
Friction Angle =	36	degrees	35
Cohesion =	1.14	psi	0.40

Project: FL-5-21 Boring: B2 Sample: 4C

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/16/2021	11/16/2021	11/16/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	11.00	11.00	11.00
Moisture (%)	9.2	17.4	24.4
Dry Unit Wt (pcf)	101.1	101.7	99.9
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	5.21	10.42	20.84
Peak Shear Stress(psi)	4.54	9.35	16.14
Residual Shear Stress(psi)	4.3	7.3	15.1
Residual Point Picked @(in)	0.131	0.131	0.131
Time @ Peak Failure (min)	21.5	18.5	25.0

Specimen Comments

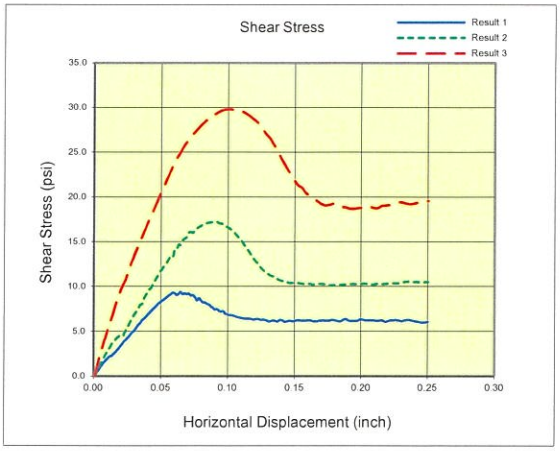
a Brown sandy material sheared at 750 psf
b Silty/sandy material sheared at 1,500 psf
c Brown silty material sheared at 3,000 psf

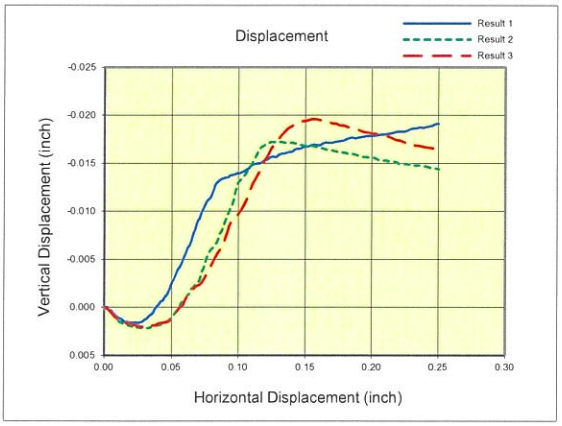
Geotechnical Section

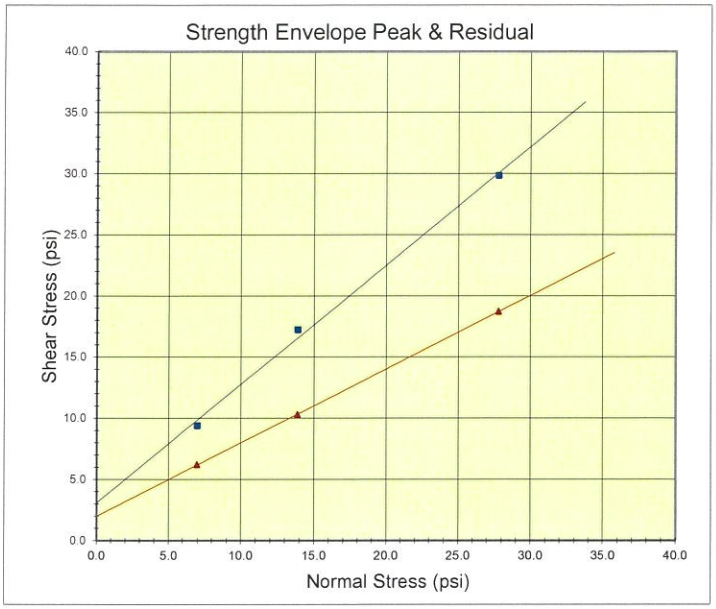
NEVADA DOT

DigiShear Report v4b __ B2 4C

DIRECT SHEAR TEST REPORT







Strength Parameters	Peak		Residual
Friction Angle =	44	degrees	31
Cohesion =	3.06	psi	1.98

Project: FL-5-21 Boring: B2 Sample: 6C

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/5/2021	11/4/2021	11/4/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	16.00	16.00	16.00
Moisture (%)	10.4	9.3	9.5
Dry Unit Wt (pcf)	95.5	95.8	96.8
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	6.96	13.89	27.78
Peak Shear Stress(psi)	9.38	17.22	29.83
Residual Shear Stress(psi)	6.2	10.3	18.7
Residual Point Picked @(in)	0.194	0.194	0.194
Time @ Peak Failure (min)	21.6	29.6	33.6

Specimen Comments

a Sandy material sheared at 1,000 psf

b Sandy material sheared at 2,000 psf

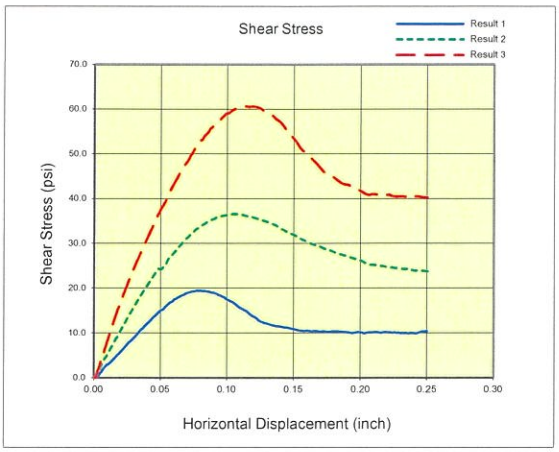
c Sandy material sheared at 4,000 psf

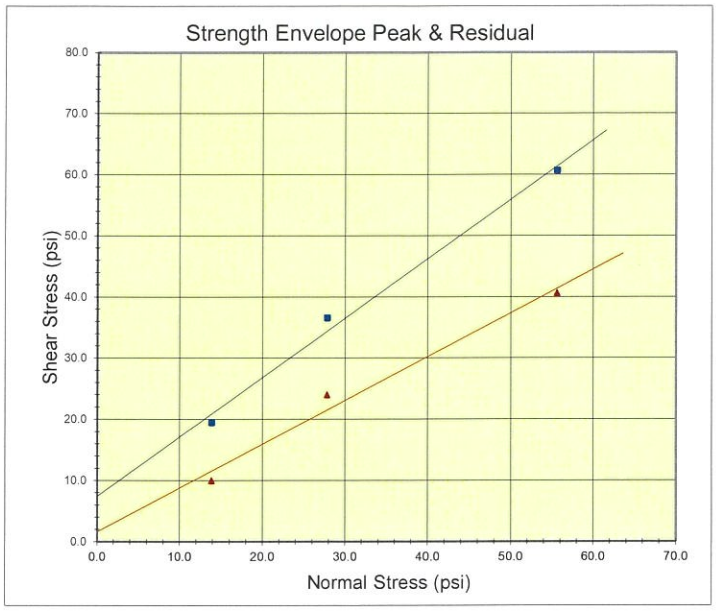
Geotechnical Section

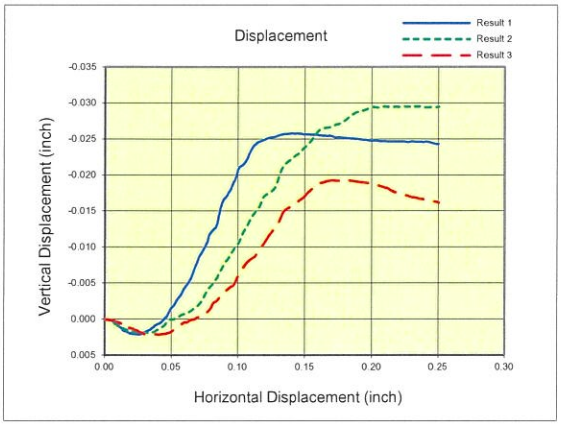
NEVADA DOT

DigiShear Report v4b __ B2 6C

DIRECT SHEAR TEST REPORT







Strength Parameters	Peak		Residual
Friction Angle =	44	degrees	36
Cohesion =	7.40	psi	1.62

Project: FL-5-21 Boring: B2 Sample: 9B

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/18/2021	11/17/2021	11/17/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	30.50	30.50	30.50
Moisture (%)	13.5	12.8	14.4
Dry Unit Wt (pcf)	104.1	103.4	103.2
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	13.89	27.79	55.60
Peak Shear Stress(psi)	19.45	36.55	60.66
Residual Shear Stress(psi)	9.9	24.0	40.6
Residual Point Picked @(in)	0.242	0.242	0.242
Time @ Peak Failure (min)	26.6	34.6	37.6

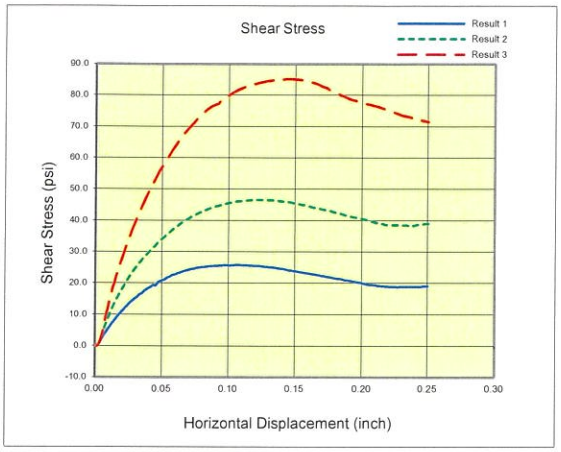
Specimen Comments

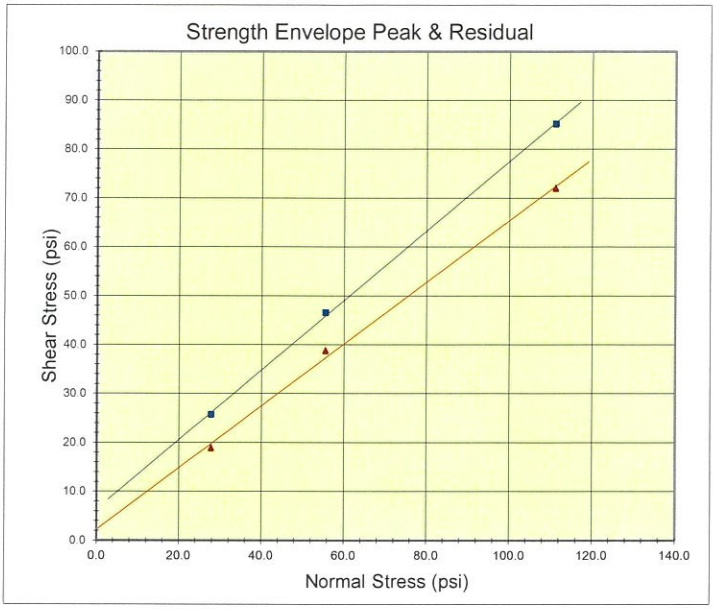
a Sandy material sheared at 2,000 psf
b Sandy material sheared at 4,000 psf
c Sandy material sheared at 8,000 psf

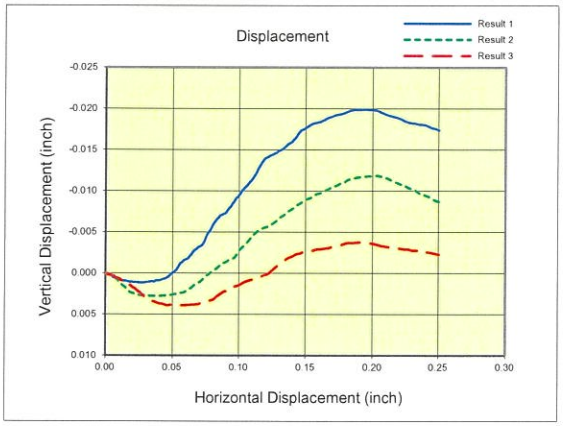
Geotechnical Section
NEVADA DOT

DigiShear Report v4b __ B2 9B

DIRECT SHEAR TEST REPORT







Strength Parameters				
	Peak		Residual
Friction Angle =	35	degrees	32
Cohesion =	6.41	psi	2.29

Project: FL-5-21 Boring: B2 Sample: 15C

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/18/2021	11/19/2021	11/18/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	61.00	61.00	61.00
Moisture (%)	24.5	23.4	24.6
Dry Unit Wt (pcf)	97.1	97.6	99.3
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	27.77	55.56	111.11
Peak Shear Stress(psi)	25.74	46.52	85.20
Residual Shear Stress(psi)	18.9	38.8	72.0
Residual Point Picked @(in)	0.245	0.245	0.245
Time @ Peak Failure (min)	35.5	40.6	48.6

Specimen Comments

a Sandy material sheared at 4,000 psf
b Sandy material sheared at 8,000 psf
c Sandy material sheared at 16,000 psf

Geotechnical Section

NEVADA DOT

DigiShear Report v4b __ B2 15C

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B3 **Elevation (ft)** 4130 **Station** **Date** 10/26/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B3-1	2.5 - 4.0	SPT			14.0		38.6									
B3-2	5.0 - 6.5	SPT			23.2			27	24	3						
B3-3A	7.5 - 8.0	CMS			17.2											Ch
B3-3B	8.0 - 8.5	CMS					5.6				DS	44	0.6	42	0.00	
B3-3C	8.5 - 9.0	CMS			5.0		12.2									
B3-4	10.0 - 11.5	SPT			27.0		11.6									
B3-5	12.5 - 14.0	SPT			22.7			19	NP	NP						
B3-6	15.0 - 16.5	CMS			9.3		5.4									Ch
B3-7	20.0 - 21.5	SPT			20.9			24	21	3						
B3-8A	22.5 - 23.0	CMS			32.4		90.5									
B3-8B	23.0 - 23.5	CMS														UU
B3-8C	22.5 - 24.0	CMS			29.3			37	25	12						

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B3 **Elevation (ft)** 4130 **Station** **Date** 10/26/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
B3-9	25.0 - 26.5	SPT			45.9		94.5									
B3-10	27.5 - 29.0	SPT		CL	40.3		95.8	38	24	14						
B3-11A	30.0 - 30.5	CMS			30.8		69.7									
B3-11B	30.5 - 31.0	CMS									DS	35	5.0	35	2.0	
B3-11C	31.0 - 31.5	CMS			32.5			32	NP	NP						
B3-12	35.0 - 36.5	SPT			28.3		24.5									
B3-13	40.0 - 41.5	SPT		CL	41.4		91.8	40	21	19						
B3-14A	45.0 - 45.5	CMS			27.6			29	NP	NP						
B3-14B	45.5 - 46.0	CMS			26.4		79.5									
B3-14C	46.0 - 46.5	CMS														
B3-15	50.0 - 51.5	SPT			48.0		96.3									
B3-16	55.0 - 56.5	SPT			43.8			42	23	19						

CMS = California Modified Sampler 2.42" ID
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CU = Consolidated Undrained
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Φ = Fri Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

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Ch = Chemical
RV = R - Value
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CM = Compaction
E = Swell/Pressure on Expansive Soils
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HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B3 **Elevation (ft)** 4130 **Station** **Date** 10/26/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B3-17A	60.0 - 60.5	CMS			40.4		93.4									
B3-17B	60.5 - 61.0	CMS														UU
B3-17C	61.0 - 61.5	CMS			37.9			49	25	24						
B3-18	65.0 - 66.5	SPT		ML	41.2		98.6	42	27	15						
B3-19B	70.5 - 71.0	CMS			16.7			21	NP	NP						
B3-19C	71.0 - 71.5	CMS			16.7		14.7									
B3-20	75.0 - 76.5	SPT			22.7		34.7									

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
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U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Fri· Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

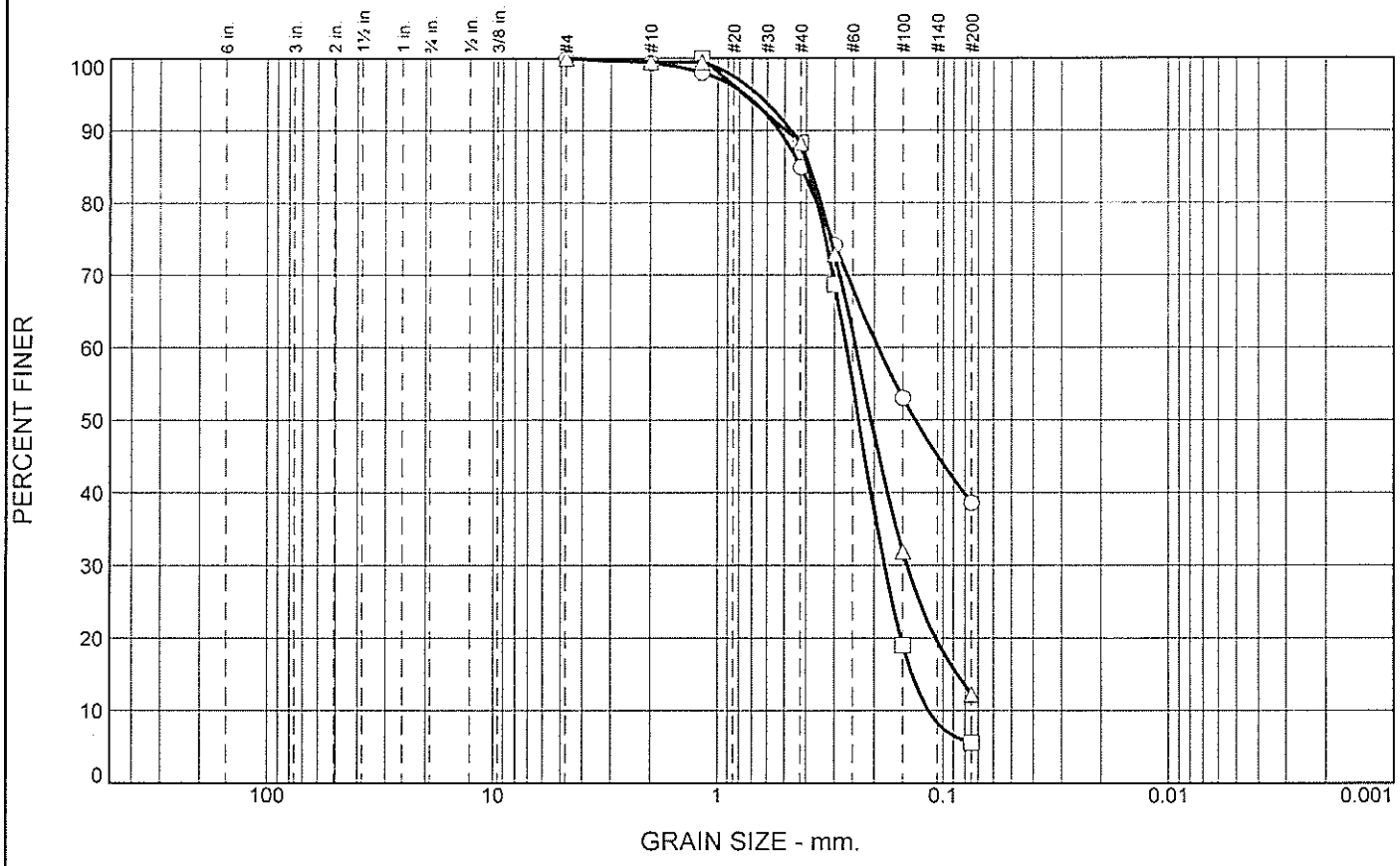
N = Field SPT N = $(N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	61.4	38.6					
□	0.0	0.0	94.4	5.6					
△	0.0	0.0	87.8	12.2					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.1925	0.2665	0.2418
D_{30}		0.1801	0.1438
D_{10}		0.1160	
	COEFFICIENTS		
C_c		1.05	
C_u		2.30	

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0		100.0
#10	99.3		99.5
#16	98.0	100.0	99.5
#40	84.9	88.3	88.3
#50	74.2	68.7	72.9
#100	53.0	19.0	31.9
#200	38.6	5.6	12.2

Material Description

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REMARKS:

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○ Source of Sample: B3 Depth: 2.5' - 4.0' Sample Number: 1

□ Source of Sample: B3 Depth: 8.0' - 8.5' Sample Number: 3B

△ Source of Sample: B3 Depth: 8.5' - 9.0' Sample Number: 3C

NEVADA DEPARTMENT OF TRANSPORTATION

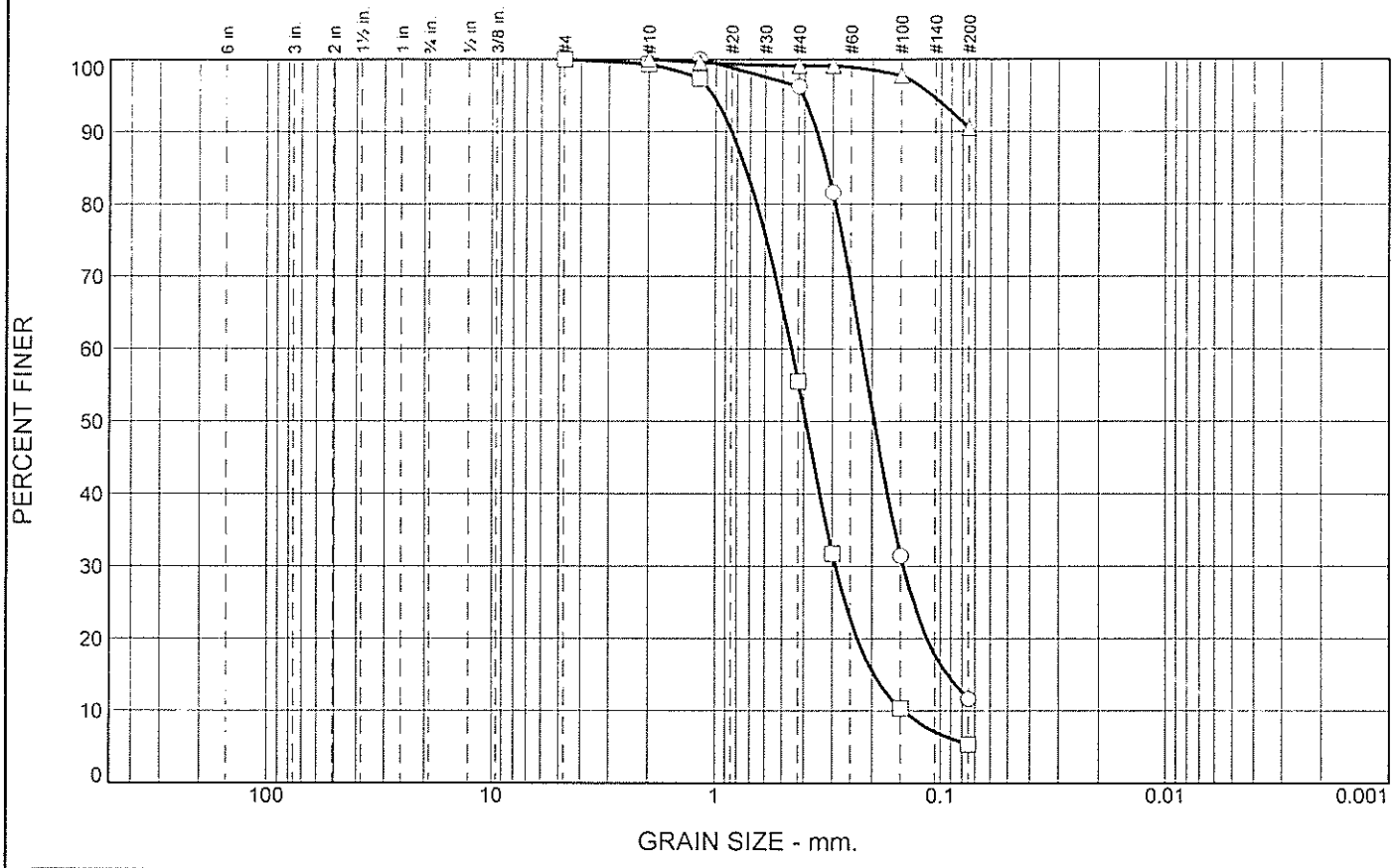
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	88.4	11.6					
□	0.0	0.0	94.6	5.4					
△	0.0	0.0	9.5	90.5					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.2221	0.4546	
D_{30}	0.1461	0.2908	
D_{10}		0.1456	
	COEFFICIENTS		
C_c		1.28	
C_u		3.12	

SIEVE number size	PERCENT FINER ○	□	△
#4		100.0	
#10		99.3	100.0
#16	100.0	97.3	99.5
#40	96.3	55.5	99.1
#50	81.6	31.8	99.1
#100	31.5	10.4	97.7
#200	11.6	5.4	90.5

Material Description

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REMARKS:

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○ Source of Sample: B3 Depth: 10.0' - 11.5' Sample Number: 4

□ Source of Sample: B3 Depth: 15.0' - 16.5' Sample Number: 6

△ Source of Sample: B3 Depth: 22.5' - 23.0' Sample Number: 8A

NEVADA DEPARTMENT OF TRANSPORTATION

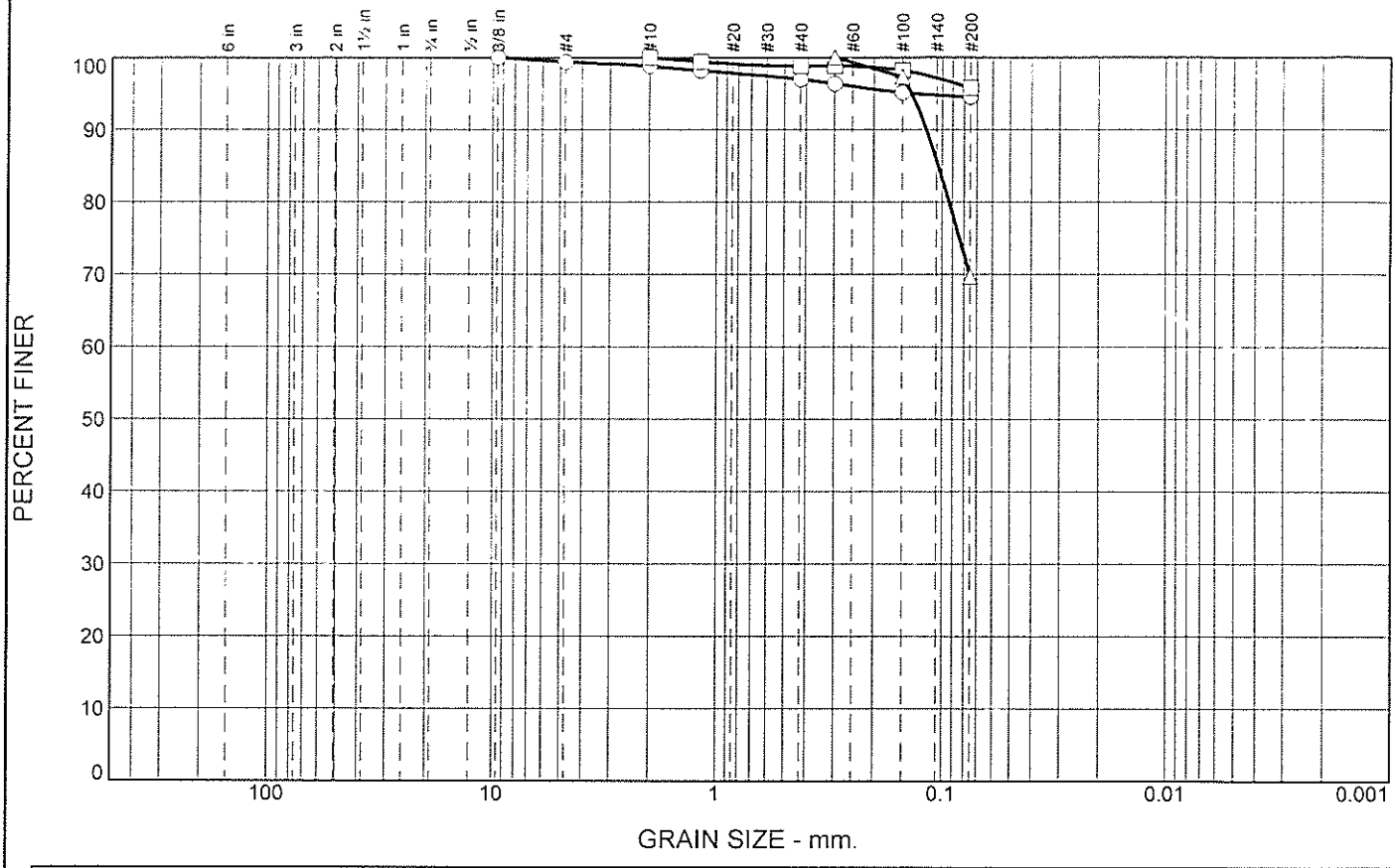
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.6	4.9	94.5					
□	0.0	0.0	4.2	95.8		CL	A-6(15)	24	38
△	0.0	0.0	30.3	69.7					

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

SIEVE number size	PERCENT FINER ○	□	△
#4	99.4		
#10	98.8	100.0	
#16	98.2	99.4	
#40	97.0	98.8	
#50	96.3	98.8	100.0
#100	95.1	98.2	97.3
#200	94.5	95.8	69.7

Material Description

○

□ lean clay

△

REMARKS:

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○ Source of Sample: B3 Depth: 25.0' - 26.5' Sample Number: 9

□ Source of Sample: B3 Depth: 27.5' - 29.0' Sample Number: 10

△ Source of Sample: B3 Depth: 30.0' - 30.5' Sample Number: 11A

NEVADA DEPARTMENT OF TRANSPORTATION

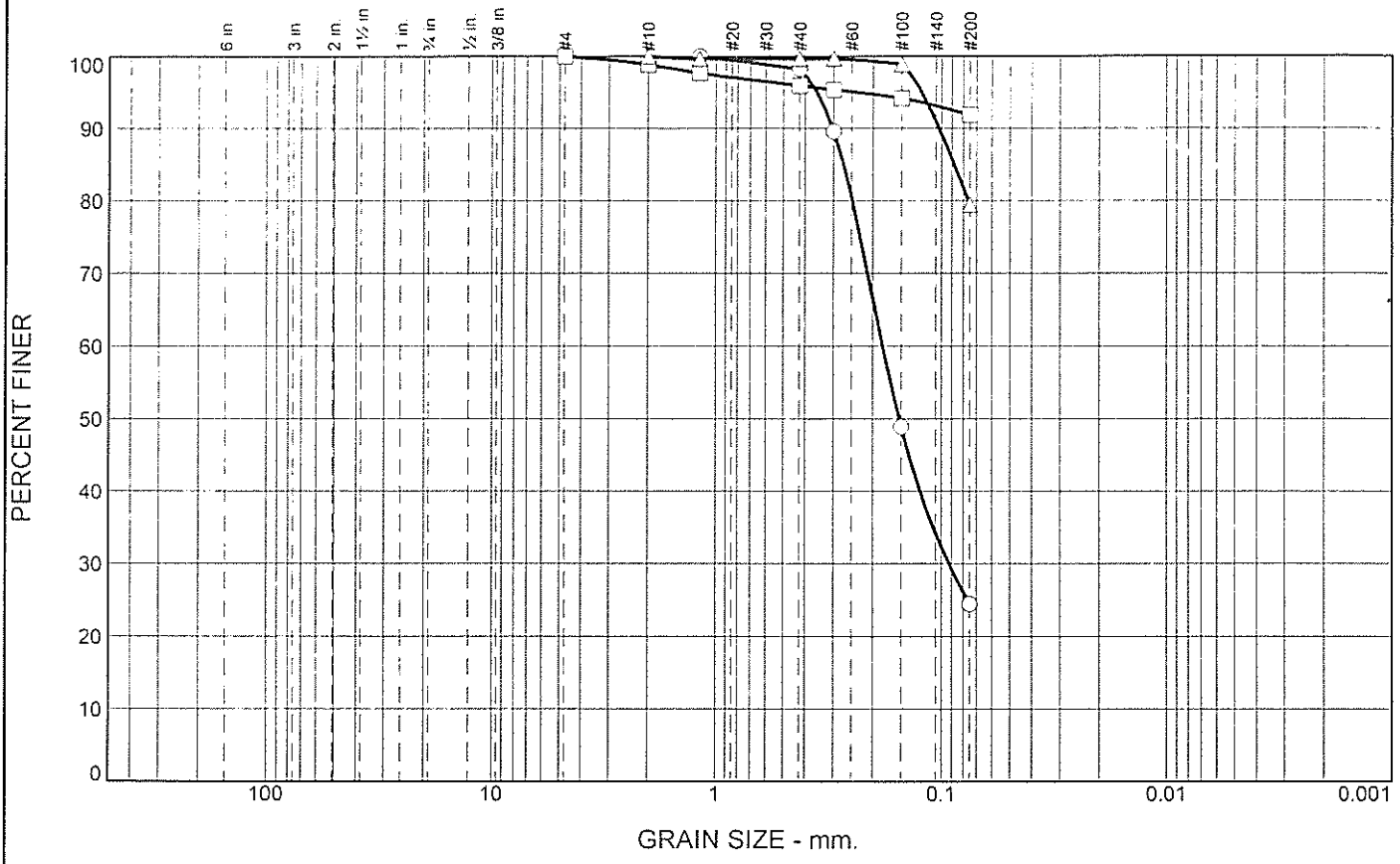
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	75.5	24.5					
□	0.0	0.0	8.2	91.8		CL	A-6(18)	21	40
△	0.0	0.0	20.5	79.5					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.1806		
D_{30}	0.0922		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4		100.0	
#10		98.8	100.0
#16	100.0	97.7	99.6
#40	98.2	95.9	99.6
#50	89.6	95.3	99.6
#100	48.9	94.2	98.8
#200	24.5	91.8	79.5

Material Description

○

□ lean clay

△

REMARKS:

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○ Source of Sample: B3 Depth: 35.0' - 36.5' Sample Number: 12

□ Source of Sample: B3 Depth: 40.0' - 41.5' Sample Number: 13

△ Source of Sample: B3 Depth: 45.5' - 46.0' Sample Number: 14B

NEVADA DEPARTMENT OF TRANSPORTATION

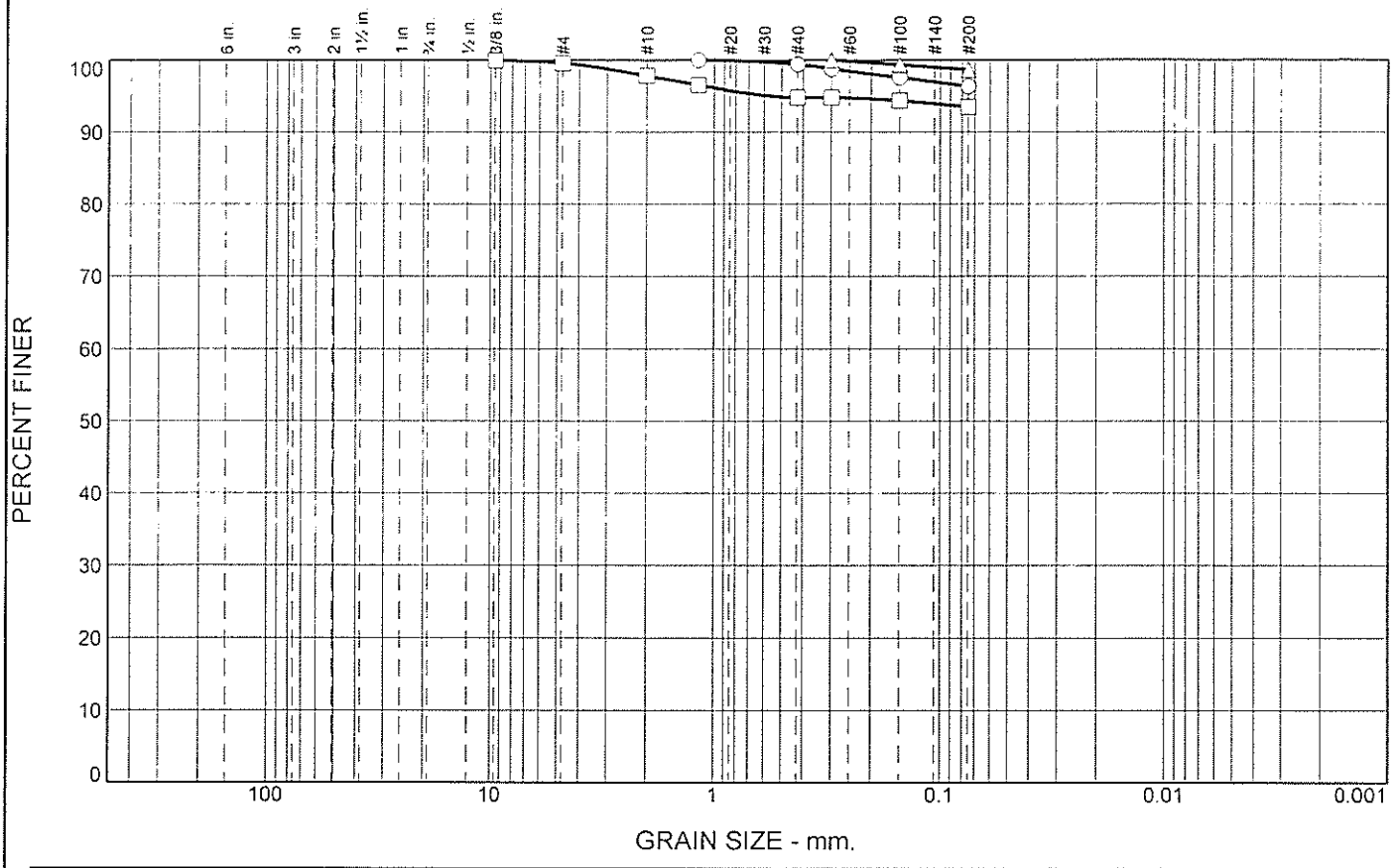
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	3.7	96.3					
□	0.0	0.4	6.2	93.4					
△	0.0	0.0	1.4	98.6		ML	A-7-6(18)	27	42

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

SIEVE number size	PERCENT FINER ○	□	△
#4		99.6	
#10		97.8	
#16	100.0	96.5	
#40	99.4	94.8	
#50	98.8	94.8	100.0
#100	97.5	94.3	99.3
#200	96.3	93.4	98.6

Material Description

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□

△ silt

REMARKS:

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○ Source of Sample: B3 Depth: 50.0' - 51.5' Sample Number: 15

□ Source of Sample: B3 Depth: 60.0' - 60.5' Sample Number: 17A

△ Source of Sample: B3 Depth: 65.0' - 66.5' Sample Number: 18

NEVADA DEPARTMENT OF TRANSPORTATION

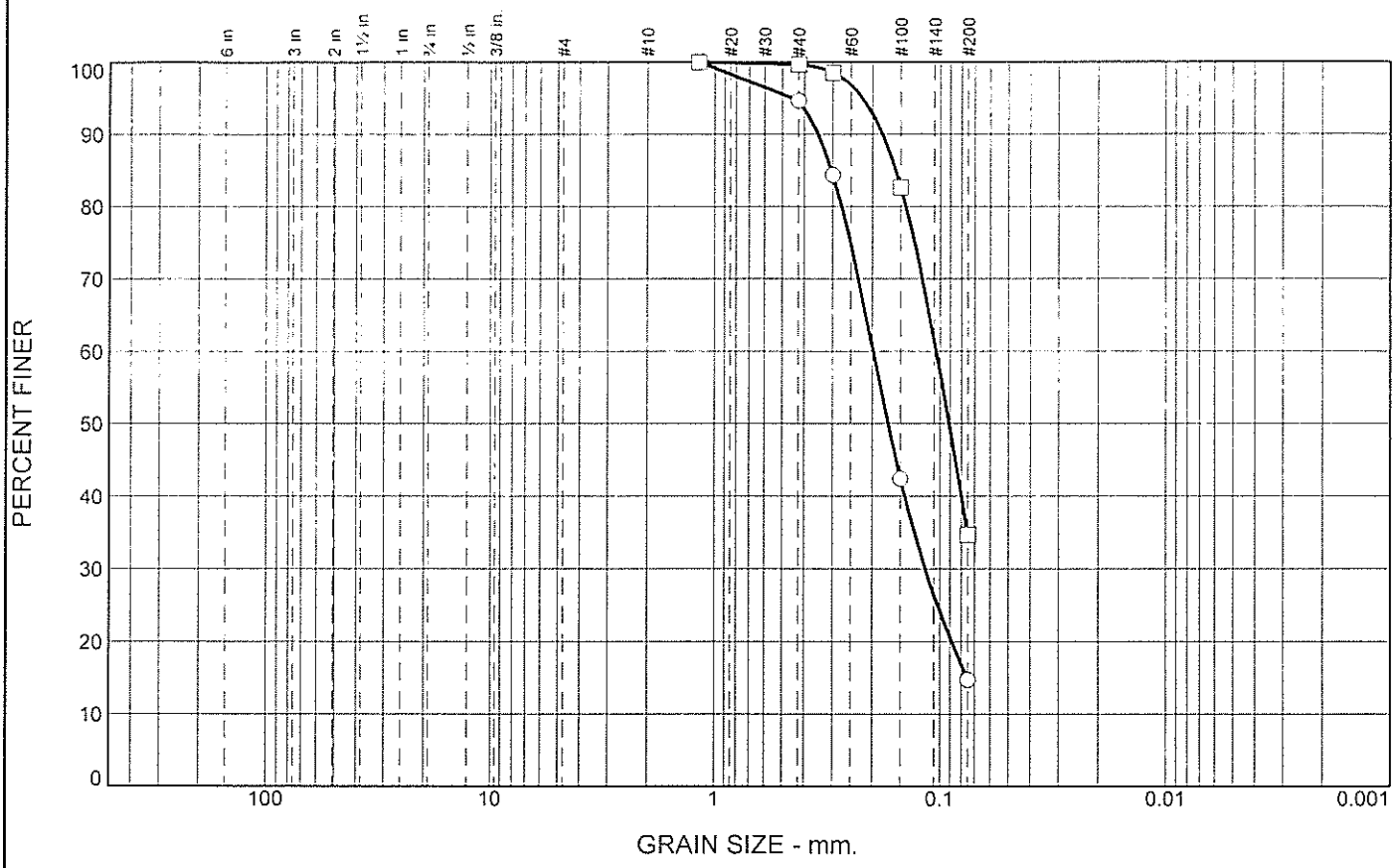
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	85.3	14.7					
□	0.0	0.0	65.3	34.7					

SIEVE inches size	○	□
GRAIN SIZE		
D_{60}	0.1983	0.1039
D_{30}	0.1161	
D_{10}		
COEFFICIENTS		
C_c		
C_u		

SIEVE number size	○	□
#16	100.0	100.0
#40	94.6	99.6
#50	84.4	98.5
#100	42.4	82.6
#200	14.7	34.7

Material Description

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REMARKS:

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○ Source of Sample: B3 Depth: 71.0' - 71.5' Sample Number: 19C

□ Source of Sample: B3 Depth: 75.0' - 76.5' Sample Number: 20

NEVADA DEPARTMENT OF TRANSPORTATION

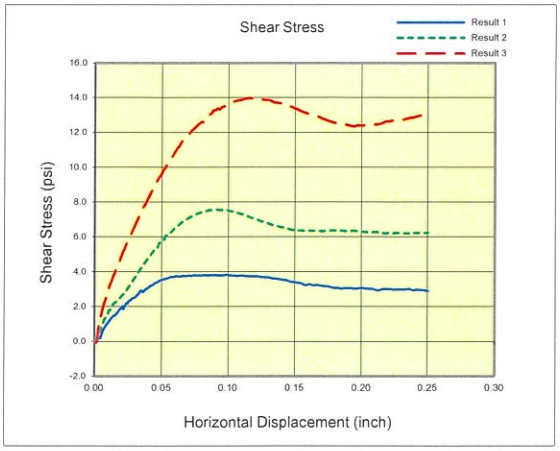
Client: G. Helgerson

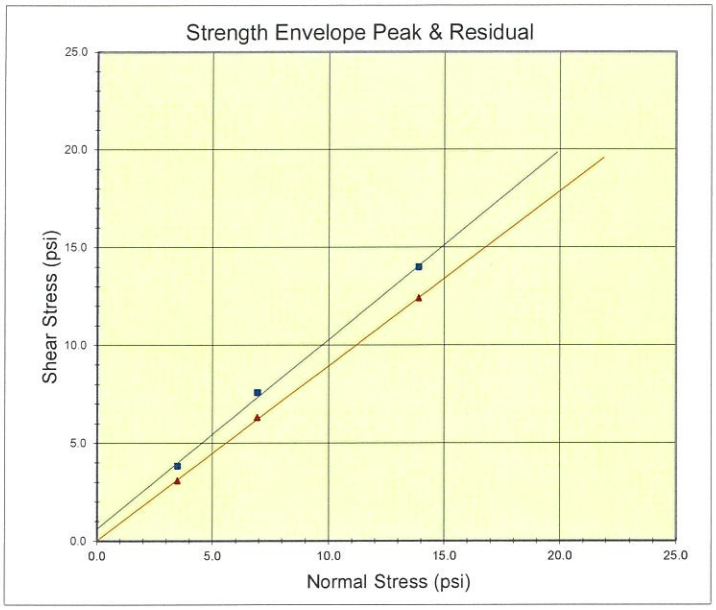
Project: Fernley Seismic Retrofits

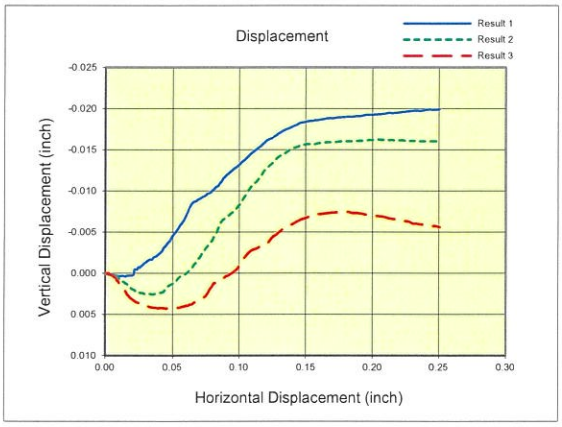
Project No.: EA 74046

Figure

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	44	degrees	42
Cohesion =	0.62	psi	0.02

Project: FL-5-21 Boring: B3 Sample: 3B

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/23/2021	11/23/2021	11/23/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	8.00	8.00	8.00
Moisture (%)	12.4	12.5	13.8
Dry Unit Wt (pcf)	92.8	93.8	92.0
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	3.48	6.95	13.90
Peak Shear Stress(psi)	3.83	7.57	13.99
Residual Shear Stress(psi)	3.1	6.3	12.4
Residual Point Picked @(in)	0.200	0.200	0.200
Time @ Peak Failure (min)	33.1	30.6	38.6

Specimen Comments

a Dark brown sandy material sheared at 500 psf

b Dark brown sandy material sheared at 1,000 psf

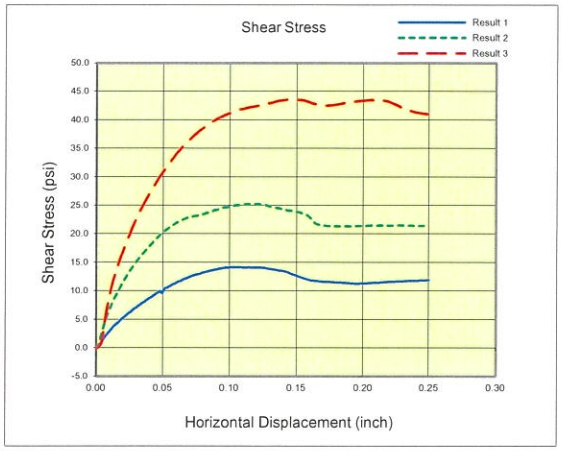
c Dark brown sandy material sheared at 2,000 psf

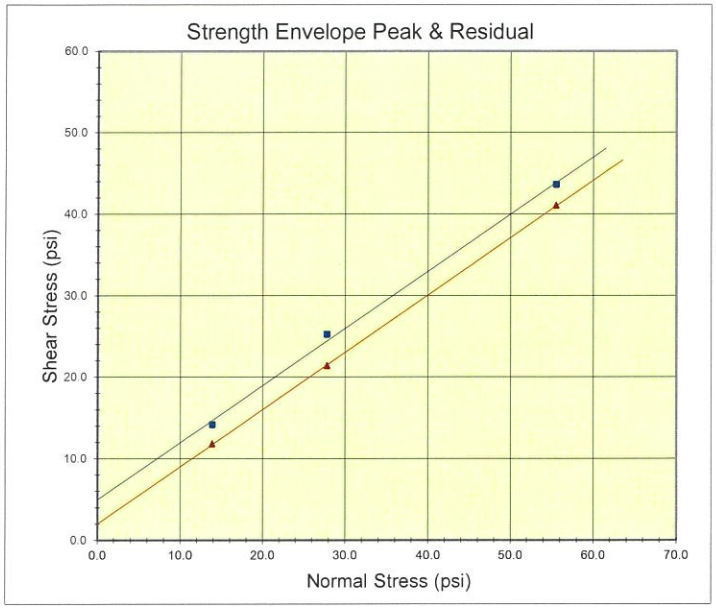
Geotechnical Section

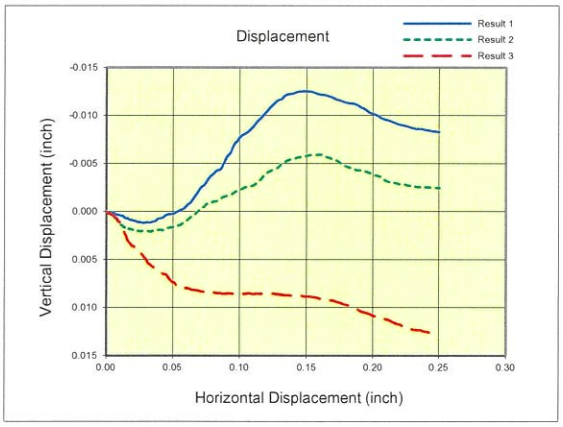
NEVADA DOT

DigiShear Report v4b __ B3 3B

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	35	degrees	35
Cohesion =	4.99	psi	2.01

Project: FL-5-21 Boring: B3 Sample: 11B

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/30/2021	11/30/2021	11/30/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	30.50	30.50	30.50
Moisture (%)	38.6	34.1	41.9
Dry Unit Wt (pcf)	81.3	88.0	79.0
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	13.89	27.79	55.55
Peak Shear Stress(psi)	14.17	25.25	43.60
Residual Shear Stress(psi)	11.8	21.4	41.1
Residual Point Picked @(in)	0.248	0.248	0.248
Time @ Peak Failure (min)	33.6	39.6	49.6

Specimen Comments

a Dark brown silty material sheared at 2,000 psf
b Dark brown silty material sheared at 4,000 psf
c Dark brown silty material sheared at 8,000 psf

Geotechnical Section
NEVADA DOT

DigiShear Report v4b __ B3 11B

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B4 **Elevation (ft)** 4130 **Station** **Date** 10/20/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg.	C psi	Φ deg.	C psi	
												Peak		Residual		
B4-1	2.5 - 4.0	SPT			14.4		20.6									
B4-2	5.0 - 6.5	SPT			9.2		6.0									Ch
B4-3B	8.0 - 8.5	CMS									DS	46	1.1	33	1.1	
B4-3C	8.5 - 9.0	CMS			6.5		7.7									
B4-4	10.0 - 11.5	SPT														
B4-5	15.0 - 16.5	SPT			22.0		6.8									
B4-6B	20.5 - 21.0	CMS		SM	13.1		29.6	23	NP	NP						
B4-6C	21.0 - 21.5	CMS					20.2				DS	34	3.1	34	1.4	
B4-7	25.0 - 26.5	SPT			20.9		29.9									
B4-8B	30.5 - 31.0	CMS			35.2		92.6									
B4-8C	31.0 - 31.5	CMS			35.2			33	27	6						
B4-9	35.0 - 36.5	SPT			50.7		97.0									

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B4 **Elevation (ft)** 4130 **Station** **Date** 10/20/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B4-10A	37.5 - 38.0	CMS			50.0			61	22	39						
B4-10B	38.0 - 38.5	CMS														UU
B4-10C	38.5 - 39.0	CMS			49.1		98.0									
B4-11	40.0 - 41.5	SPT			51.7			50	20	30						
B4-12	45.0 - 46.5	SPT			55.3		97.5									
B4-13A	50.0 - 50.5	CMS														
B4-13B	50.5 - 51.0	CMS			48.6			65	23	42						
B4-13C	51.0 - 51.5	CMS			42.1		100.0									
B4-14	55.0 - 56.5	SPT			50.1			49	22	27						
B4-15	60.0 - 61.5	SPT			49.4		96.8									
B4-16A	65.0 - 65.5	CMS			47.1			47	23	24						
B4-16B	65.5 - 66.0	CMS														UU

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # 74046 **Job Description** Fernley Seismic Retrofits

Boring No. B4 **Elevation (ft)** 4130 **Station** **Date** 10/20/2021

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					COMMENTS
											TEST TYPE	Φ deg. (Peak)	C psi (Peak)	Φ deg. (Residual)	C psi (Residual)	
B4-16C	66.0 - 66.5	CMS			48.7		99.0									
B4-17	70.0 - 71.5	SPT			46.4			49	22	27						
B4-18	75.0 - 76.5	SPT			44.3		87.0									H
B4-19A	85.0 - 85.5	CMS			40.0			45	29	16						
B4-19B	85.5 - 86.0	CMS			39.9		95.2									
B4-19C	86.0 - 86.5	CMS														

CMS = California Modified Sampler 2.42" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
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CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

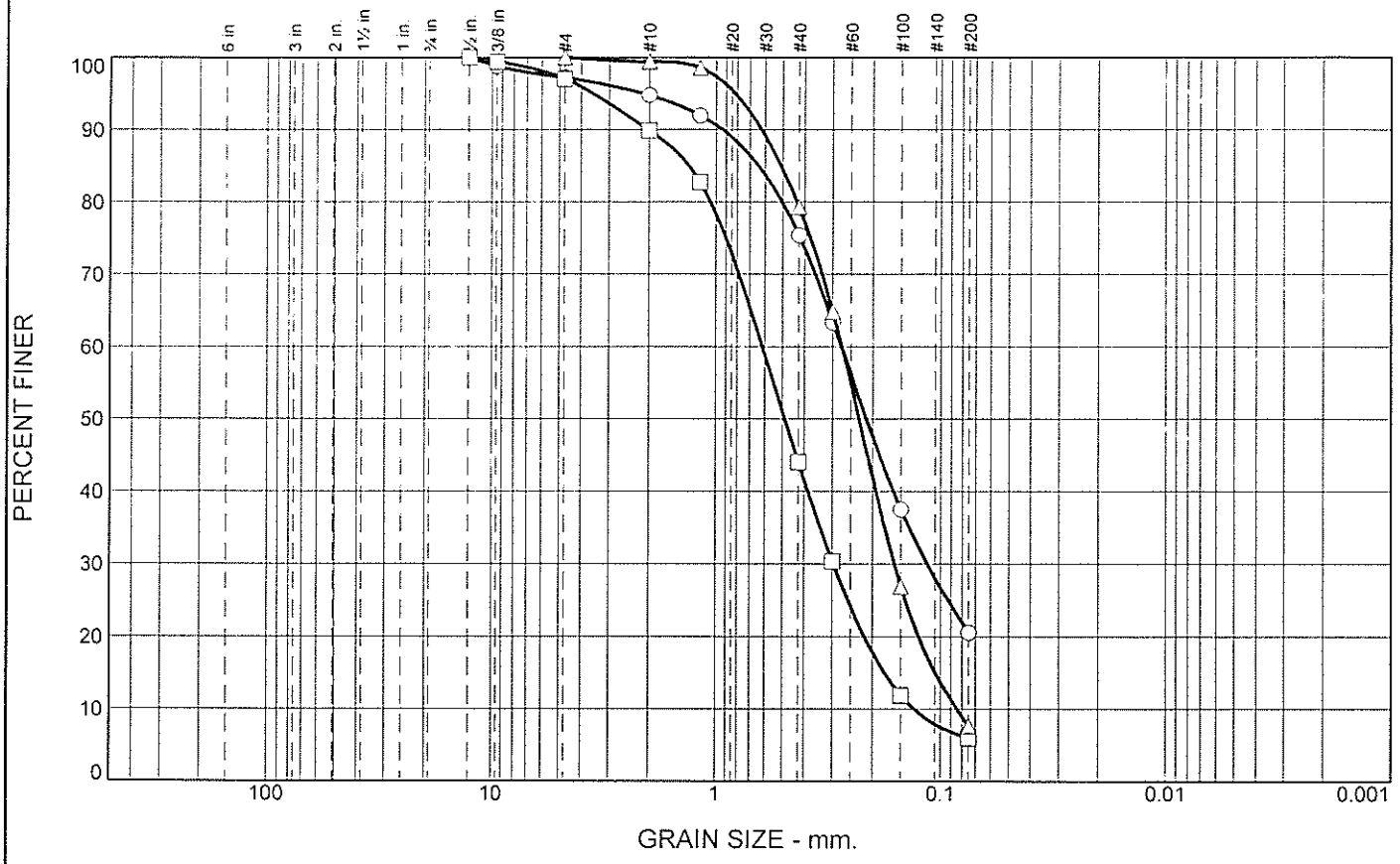
N = Field SPT $N = (N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	2.8	76.6	20.6					
□	0.0	3.0	91.0	6.0					
△	0.0	0.0	92.3	7.7					

SIEVE inches size	PERCENT FINER ○	□	△
1/2"	100.0	100.0	
3/8"	98.8	99.4	
	GRAIN SIZE		
D_{60}	0.2753	0.6149	0.2738
D_{30}	0.1147	0.2970	0.1602
D_{10}		0.1311	0.0843
	COEFFICIENTS		
C_c		1.09	1.11
C_u		4.69	3.25

SIEVE number size	PERCENT FINER ○	□	△
#4	97.2	97.0	100.0
#10	94.8	89.9	99.4
#16	91.9	82.7	98.5
#40	75.4	44.0	79.3
#50	63.3	30.4	64.8
#100	37.5	11.9	26.9
#200	20.6	6.0	7.7

Material Description

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REMARKS:

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○ Source of Sample: B4 Depth: 2.5' - 4.0' Sample Number: 1

□ Source of Sample: B4 Depth: 5.0' - 6.5' Sample Number: 2

△ Source of Sample: B4 Depth: 8.5' - 9.0' Sample Number: 3C

NEVADA DEPARTMENT OF TRANSPORTATION

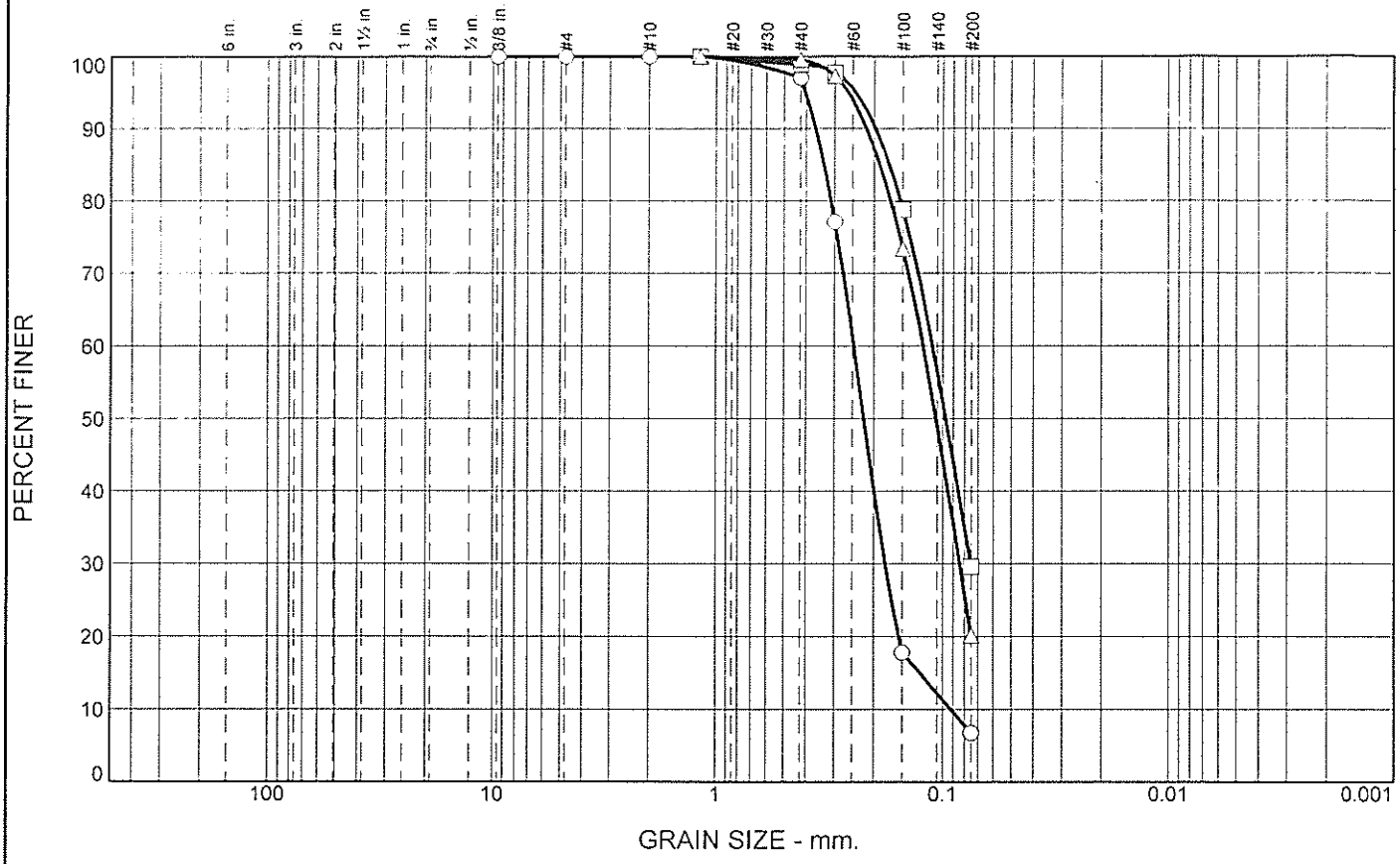
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	93.2	6.8					
□	0.0	0.0	70.4	29.6		SM	A-2-4(0)	NP	23
△	0.0	0.0	79.8	20.2					

SIEVE inches size	PERCENT FINER ○	□	△
3/8"	100.0		
	GRAIN SIZE		
D_{60}	0.2466	0.1110	0.1224
D_{30}	0.1780	0.0754	0.0841
D_{10}	0.0918		
	COEFFICIENTS		
C_c	1.40		
C_u	2.69		

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0		
#10	100.0		
#16	100.0	100.0	100.0
#40	97.0	98.9	99.5
#50	77.1	97.8	97.2
#100	17.8	78.8	73.4
#200	6.8	29.6	20.2

Material Description

○

□ silty sand

△

REMARKS:

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○ Source of Sample: B4 Depth: 15.0' - 16.5' Sample Number: 5

□ Source of Sample: B4 Depth: 20.5' - 21.0' Sample Number: 6B

△ Source of Sample: B4 Depth: 21.0' - 21.5' Sample Number: 6C

NEVADA DEPARTMENT OF TRANSPORTATION

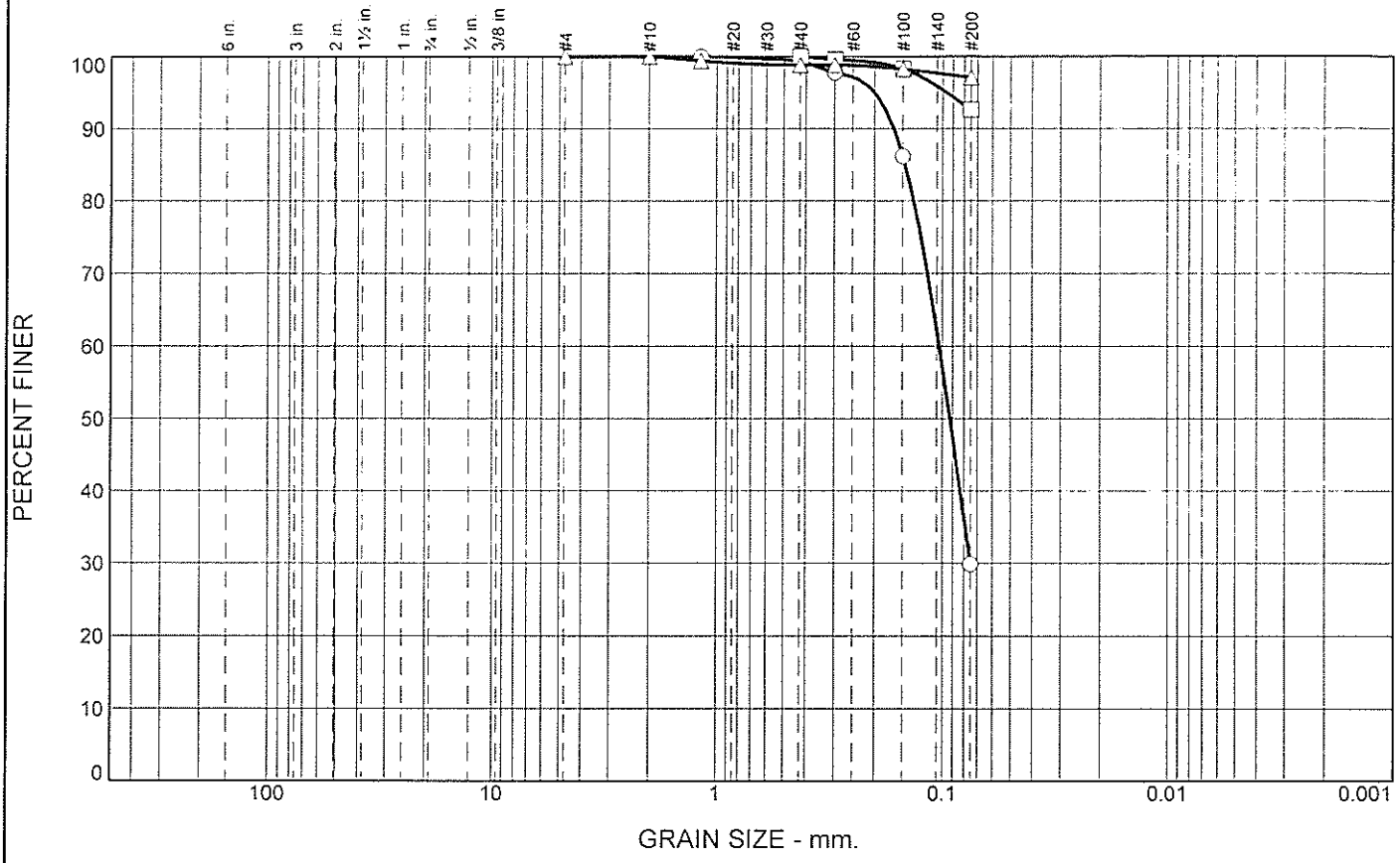
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	70.1	29.9					
□	0.0	0.0	7.4	92.6					
△	0.0	0.0	3.0	97.0					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.1032		
D_{30}	0.0751		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4			100.0
#10	100.0		100.0
#16	100.0		99.4
#40	99.4	100.0	98.8
#50	97.7	99.6	98.8
#100	86.2	98.3	98.2
#200	29.9	92.6	97.0

Material Description

○

□

△

REMARKS:

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○ Source of Sample: B4 Depth: 25.0' - 26.5' Sample Number: 7

□ Source of Sample: B4 Depth: 30.5' - 31.0' Sample Number: 8B

△ Source of Sample: B4 Depth: 35.0' - 36.5' Sample Number: 9

NEVADA DEPARTMENT OF TRANSPORTATION

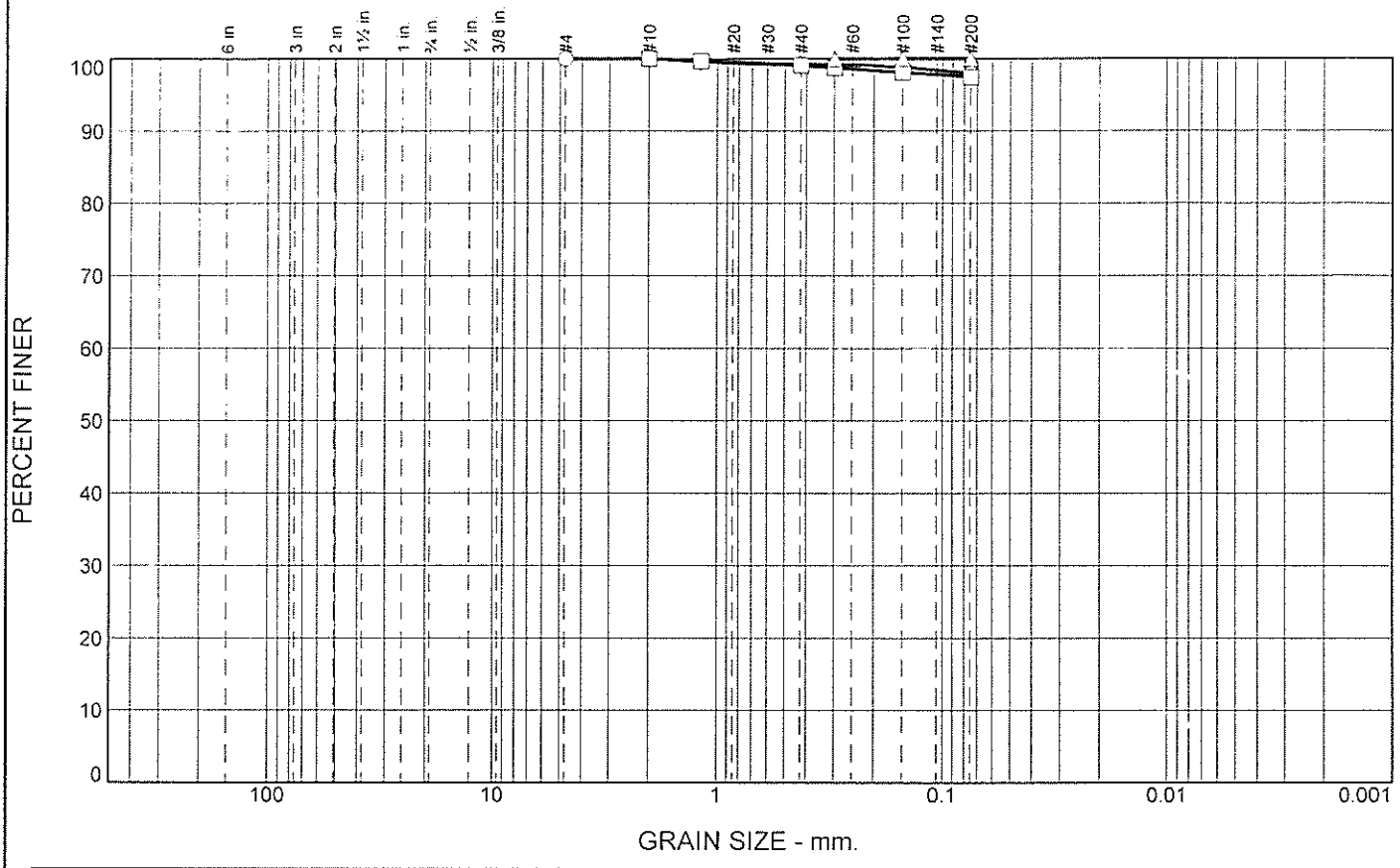
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	2.0	98.0					
□	0.0	0.0	2.5	97.5					
△	0.0	0.0	0.0	100.0					

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0		
#10	100.0	100.0	
#16	99.6	99.7	
#40	99.2	99.0	
#50	99.2	98.7	100.0
#100	98.8	98.1	100.0
#200	98.0	97.5	100.0

Material Description
○
□
△

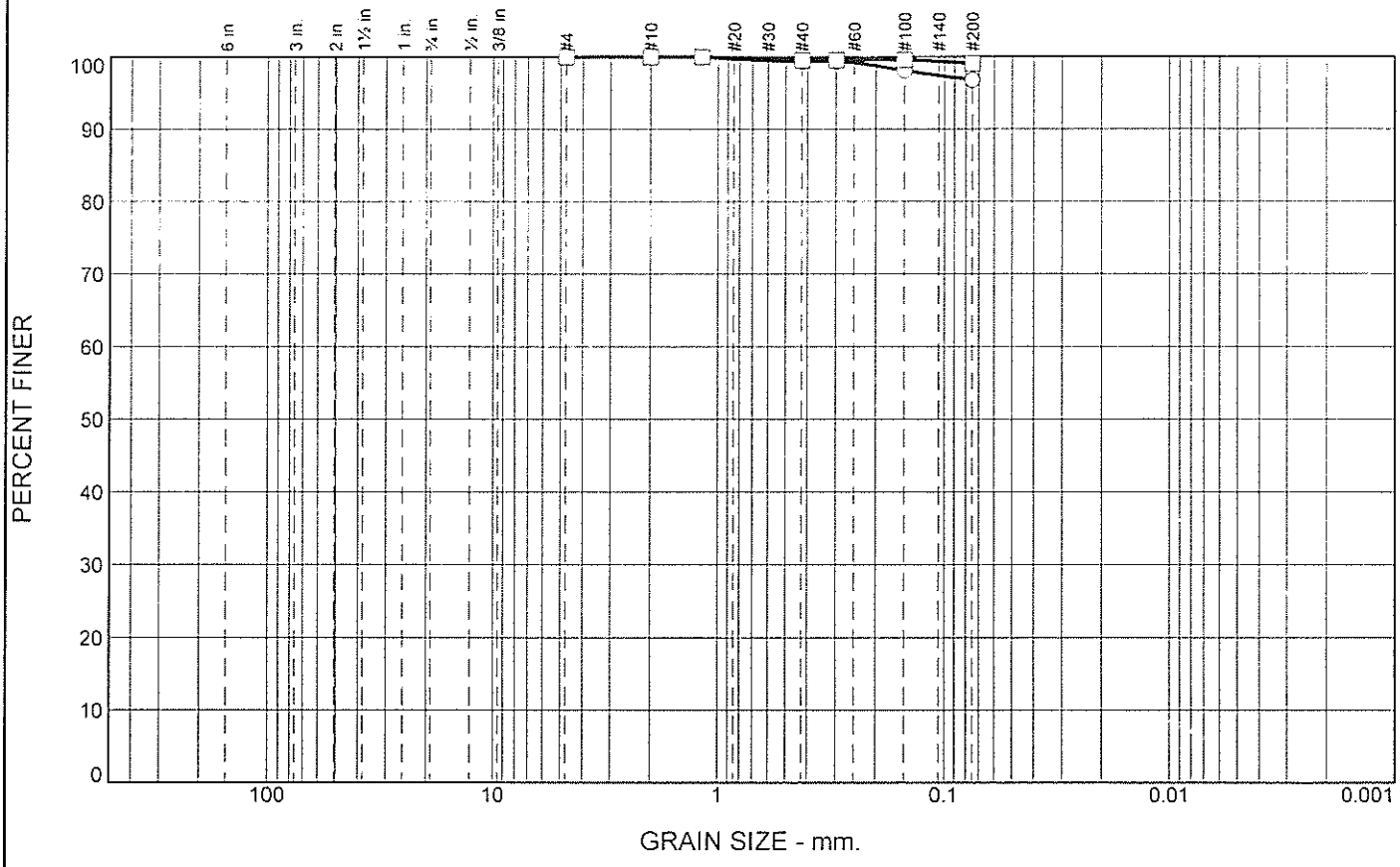
REMARKS:
○
□
△

○ Source of Sample: B4 Depth: 38.5' - 39.0' Sample Number: 10C
□ Source of Sample: B4 Depth: 45.0' - 46.5' Sample Number: 12
△ Source of Sample: B4 Depth: 51.0' - 51.5' Sample Number: 13C

NEVADA DEPARTMENT OF TRANSPORTATION

Client: G. Helgerson
Project: Fernley Seismic Retrofits
Project No.: EA 74046
Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	3.2	96.8					
□	0.0	0.0	1.0	99.0					

SIEVE inches size	PERCENT FINER ○	□	
	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	
#4		100.0	
#10		100.0	
#16	100.0	100.0	
#40	99.4	99.5	
#50	99.4	99.5	
#100	98.1	99.5	
#200	96.8	99.0	

Material Description

○

□

REMARKS:

○

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○ Source of Sample: B4 Depth: 60.0' - 61.5' Sample Number: 15

□ Source of Sample: B4 Depth: 66.0' - 66.5' Sample Number: 16C

NEVADA DEPARTMENT OF TRANSPORTATION

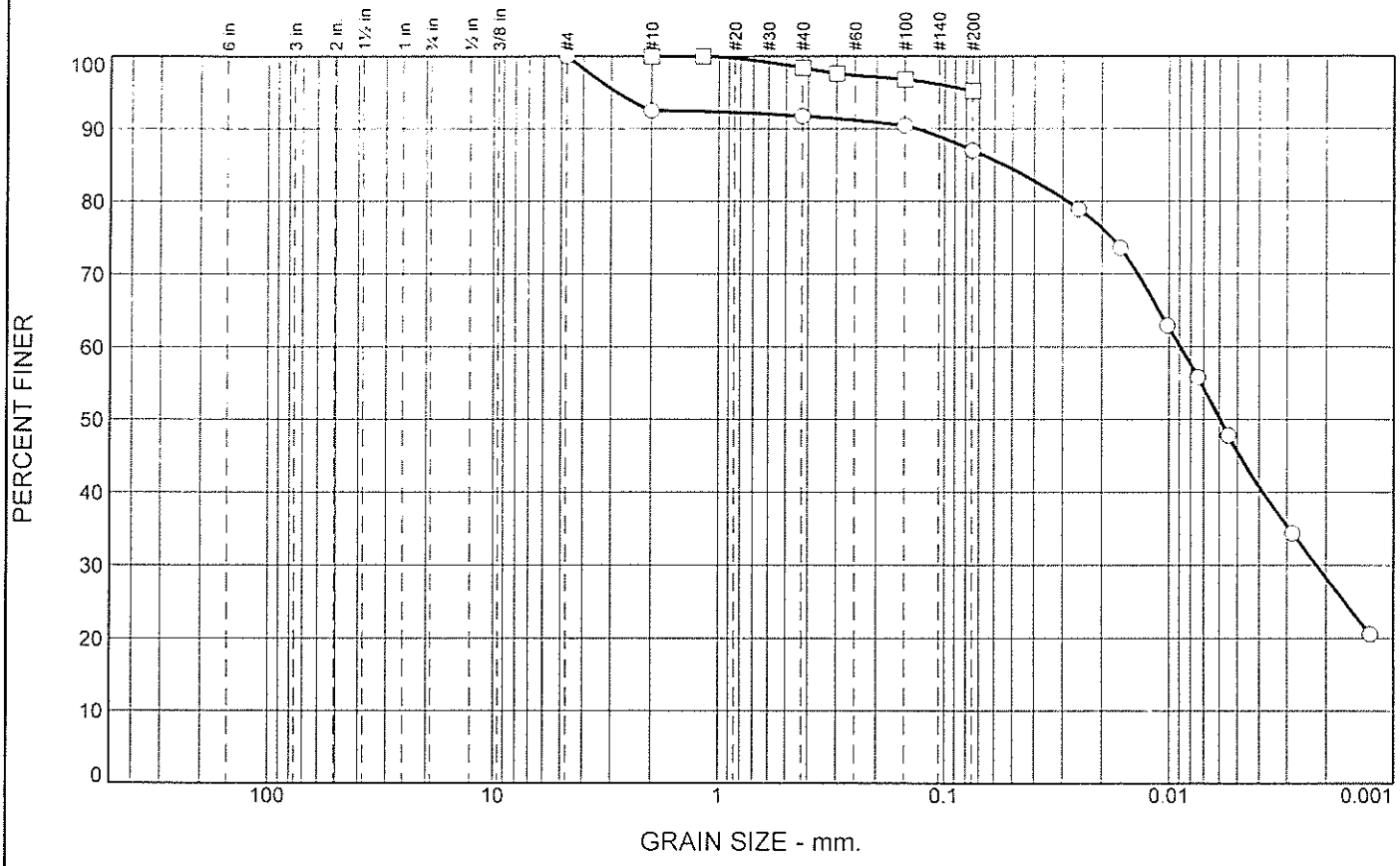
Client: G. Helgerson

Project: Fernley Seismic Retrofits

Project No.: EA 74046

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	13.0	58.7	28.3				
□	0.0	0.0	4.8	95.2					

SIEVE inches size	PERCENT FINER ○	□	
	GRAIN SIZE		
D_{60}	0.0089		
D_{30}	0.0022		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	
#4	100.0		
#10	92.5	100.0	
#16		100.0	
#40	91.7	98.4	
#50		97.6	
#100	90.4	96.8	
#200	87.0	95.2	

Material Description

○

□

REMARKS:

○

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○ Source of Sample: B4 Depth: 75.0' - 76.5' Sample Number: 18

□ Source of Sample: B4 Depth: 85.5' - 86.0' Sample Number: 19B

NEVADA DEPARTMENT OF TRANSPORTATION

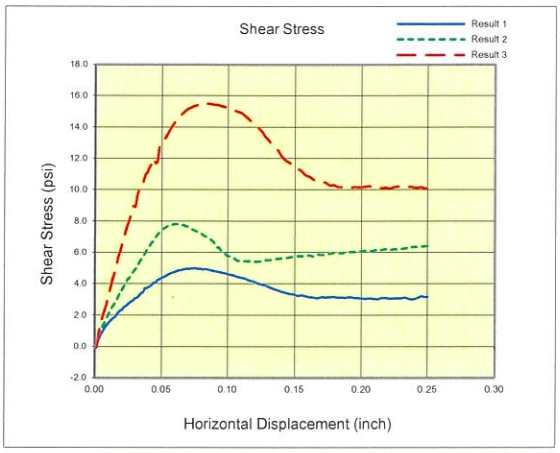
Client: G. Helgerson

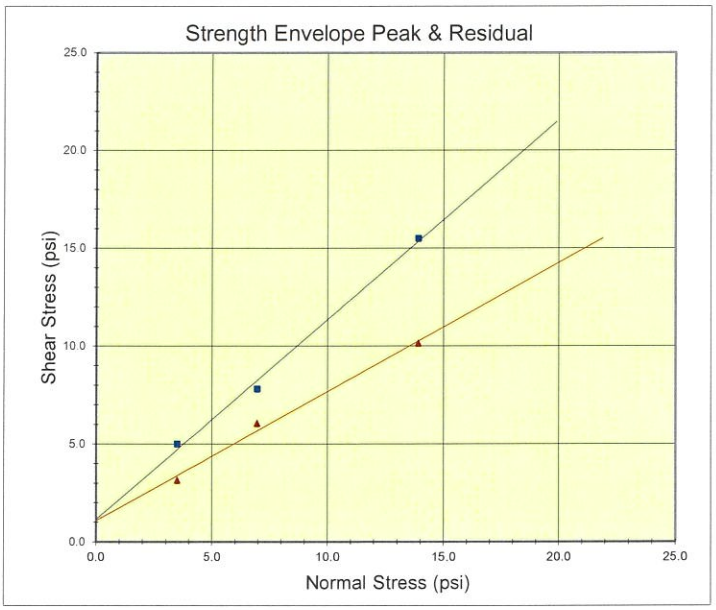
Project: Fernley Seismic Retrofits

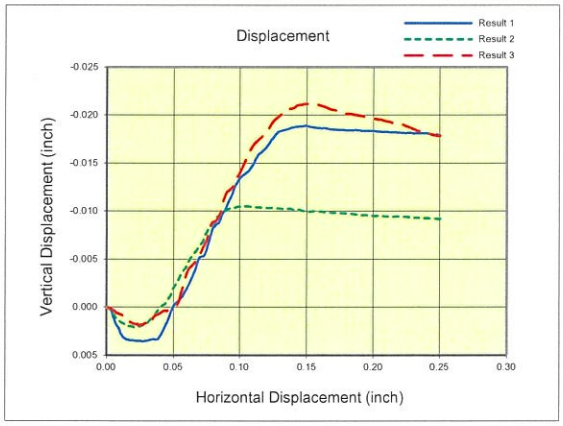
Project No.: EA 74046

Figure

DIRECT SHEAR TEST REPORT







Strength Parameters			
	Peak		Residual
Friction Angle =	46	degrees	33
Cohesion =	1.13	psi	1.08

Project: FL-5-21 Boring: B4 Sample: 3B

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	10/27/2021	10/27/2021	10/27/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	8.00	8.00	8.00
Moisture (%)	9.6	17.5	12.7
Dry Unit Wt (pcf)	97.1	98.7	101.1
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	3.49	6.95	13.91
Peak Shear Stress(psi)	4.99	7.80	15.49
Residual Shear Stress(psi)	3.1	6.0	10.1
Residual Point Picked @(in)	0.191	0.191	0.191
Time @ Peak Failure (min)	25.0	20.5	28.1

Specimen Comments

a Sandy material sheared at 500 psf

b Sandy material sheared at 1,000 psf

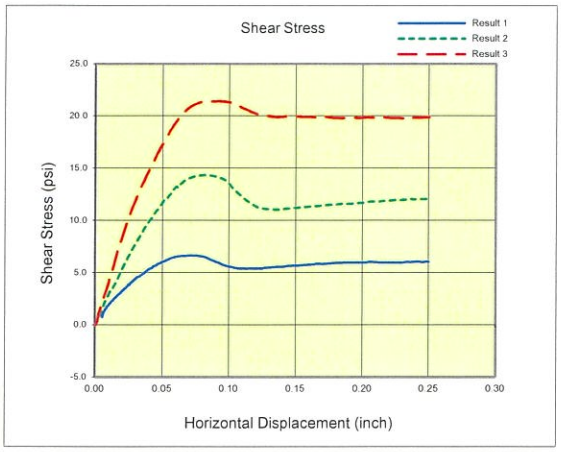
c Sandy material sheared at 2,000 psf

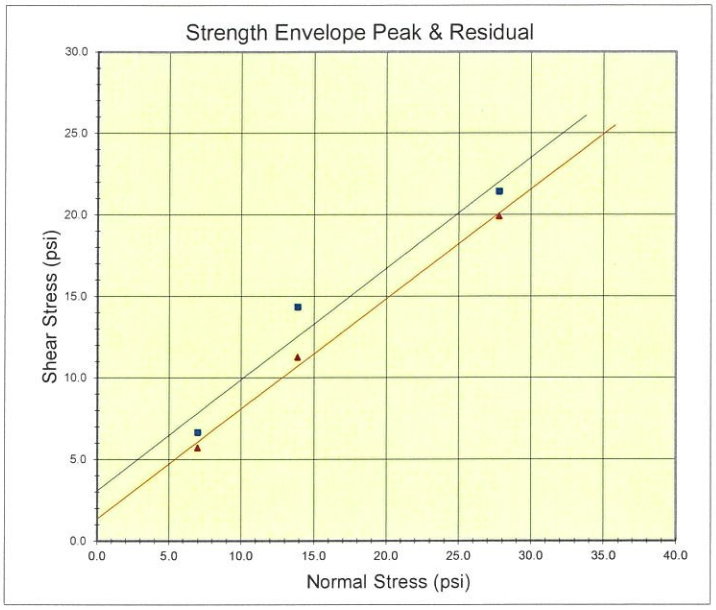
Geotechnical Section

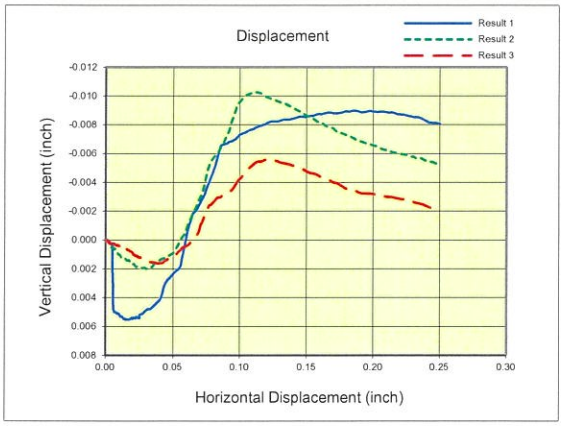
NEVADA DOT

DigiShear Report v4b __ B4 3B

DIRECT SHEAR TEST REPORT







Strength Parameters

	Peak		Residual
Friction Angle =	34	degrees	34
Cohesion =	3.08	psi	1.36

Project: FL-5-21 Boring: B4 Sample: 6C

	Result 1	Result 2	Result 3
Specimen:	a	b	c
Date Tested	11/2/2021	11/2/2021	11/2/2021
Diameter (inch):	2.42	2.42	2.42
Height (inch):	1.00	1.00	1.00
Depth (ft):	21.00	21.00	21.00
Moisture (%)	9.1	9.3	8.6
Dry Unit Wt (pcf)	95.5	93.8	94.0
SHEAR			
Displacement Rate($^{in}/_{min}$)	0.0030	0.0030	0.0030
Normal Stress (psi)	6.98	13.89	27.78
Peak Shear Stress(psi)	6.63	14.33	21.42
Residual Shear Stress(psi)	5.7	11.3	19.9
Residual Point Picked @(in)	0.155	0.155	0.155
Time @ Peak Failure (min)	24.1	27.6	30.6

Specimen Comments

a Dark sandy material sheared at 1,000 psf
b Dark sandy material sheared at 2,000 psf
c Dark sandy material sheared at 4,000 psf

Geotechnical Section

NEVADA DOT

DigiShear Report v4b __ B4 6C

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL SECTION

CHEMICAL ANALYSIS

EA No.: 74046

Project: Fernley Seismic Retrofits

Sample ID	Date Tested	Chlorides ppm AASHTO T 291 A	Sulfates ppm AASHTO T 290 B	pH AASHTO T 289	Resistivity ohm - cm AASHTO T 288
B2-2B	12/14/21	71	331	7.5	815*
B2-4A	12/14/21	51	281	7.3	1,550*
B3-3A	12/14/21	30	218	7.7	2,050*
B3-6	12/14/21	20	60	7.8	5,500*
B4-2	12/14/21	586	582	8.3	360*

* Deviated from AASHTO by using a small 4 pin box

Appendix D
H-844 Design Parameters Memo

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

MEMORANDUM

8/23/2018

To: **Michael Mayberry, P.E., Structures Division**

From: **Mike Griswold, P.E., Materials Division**

Subject: **Geotechnical Design Parameters for the Seismic Retrofit of H-844**

Project No. 74046

This memorandum presents our recommended geotechnical design criteria for the proposed structural retrofit of structure H-844, based on our geophysical exploration, record research, and limited geotechnical analysis.

Project Description

Review of the as-built plans indicates the eastbound and westbound H-844 structures are three-span bridges, with abutments supported on 3-foot wide strip footings founded on embankment fill. The intermediate bents are supported on 10- by 8-foot square footings founded on native soils approximately 4 to 5 feet below ground surface (bgs).

It is our understanding that the proposed seismic retrofit will consist of constructing a single rectangular footing with a dimension of 38- by 8-feet at each bent location.

Site Description

Structure H-844 is located on I-80 in Fernley, Nevada in Lyon County. The site consists of one bridge structure per direction of traffic, eastbound and westbound. The site topography is generally flat except for the approximately 15-foot tall embankment fills for the eastbound and westbound lanes of the highway. The embankments have a slope of approximately 2(H):1(V) and have concrete slope paving near the bridges. At the time of our exploration, the surface consisted of sand with sparse grass and brush. The Vicinity Map is presented on Figure A-1 in the attachments.

Geophysical Exploration

On December 6th, 2017, we performed four Refraction Microtremor (ReMi) surveys. Two lines were orientated perpendicular to each other and performed at the existing bridge abutments. The ReMi lines were placed in general accordance with FHWA NHI-01-031, and locations shown on Figure A-2.

The purpose of the geophysical exploration was to determine the shear wave velocity, (Vs_{100}) within the top 100 feet. The Vs_{100} was used in determining the seismic Site Class and estimating soil properties based on published correlations. The ReMi lines were performed using a DAQLink III 12-channel seismograph with 10-Hz geophones spaced at 20-foot intervals,

and Vibrascope Version 2.4.79 acquisition software. Passive energy sources consisted of vehicular traffic along Interstate 80.

Analysis of Geophysical Data

Analysis of collected data was performed using the software package, Optim SeisOpt ReMi™ Version 4.1. SEG-Y files were exported from the data collection software and processed to generate the velocity spectrum, from which picks could be made along the Rayleigh wave dispersion profile. Dispersion inversion was performed to generate the dispersion curve and shear wave velocity profiles.

Analysis and interpretation of the ReMi data was performed by Optim. One dimensional shear wave velocity profiles for each of the surveys are presented in Appendix C.

Geotechnical Review of Existing Data

A review of records, indicates four borings were performed by Sprout Engineers Inc. in November and December 1961 with the site subsurface materials generally consisting of loose sand and silty sand to a depth of approximately 10 feet bgs. The loose soils are underlain by dense sand, silty sand, and sandy silt to approximately 70 feet bgs, the maximum extents explored

Design Parameter Recommendations

Published correlations found in AASHTO LRFD Bridge Design Specifications, as well as FHWA-NHI-01-03, FHWA-HRT-06-032, and NAVFAC 7.2 were utilized in the development of following design parameters as presented in the table below.

H-844 Soil Design Parameters

Parameter	Value*	Reference
Unit weight, γ_t (pcf)	125	FHWA-NHI-01-031 9-5
Poisson's ratio, v	0.3	AASHTO LRFD 7th Table C10.4.6.3-1
Cohesion, c (psf)	0	NAVFAC 7.2-39
Internal friction angle, φ (degrees)	34	AASHTO LRFD 7th Table 10.4.6.2.4-1
Large strain shear modulus G (ksf)	620	FHWA-HRT-06-032 6.2.2.1
Elastic modulus, E (ksf)	1,600	AASHTO LRFD 7th Table 10.4.6.3-1
Average blow count	24	AASHTO LRFD 7th Table C3.10.3.1-1
Average shear wave velocity, Vs100 (fps)	970	AASHTO LRFD 7th Table C3.10.3.1-1
Site Class	D	AASHTO LRFD 7th Table 3.10.3.1-1

* Based on limited existing boring data and shear wave velocity (ReMi) geophysical surveys.

In general, the soil bearing resistance using Load Resistance and Factor Design (LRFD) considers the following three loading conditions:

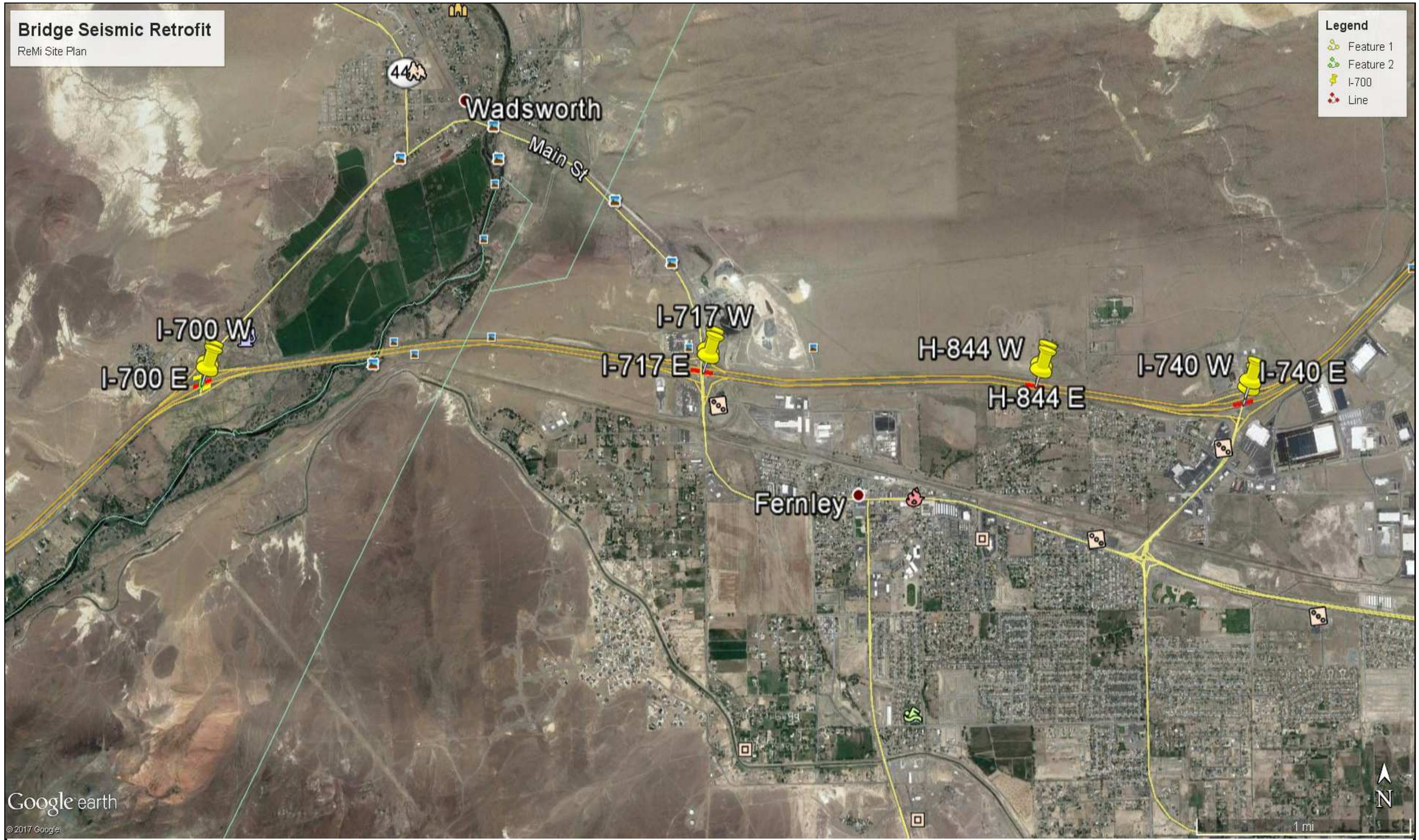
1. Strength Limit State – The ability of the soil to support an applied load without producing a shear failure (bearing failure) within the soil mass;
2. Service Limit State – The bearing resistance of the soil for a given deformation (settlement) tolerance;
3. Extreme Limit State – the bearing resistance of the soil during extreme events such as liquefaction and seismic events.

As requested, we provided only the service limit bearing resistance for the Structure H-844. Settlement estimates can vary widely, therefore to determine the range of settlement for a 8-foot by 38-foot foundation under varying loads, we considered two different methods; the half-space method (AASHTO 2014) and the elastic theory method (Day, 2005). A plot showing the range of estimated settlement values for a given load is presented on Figure A-3 in Appendix A.

If you have any questions or wish to discuss further, please do not hesitate to contact me at 775-888-7821 or Kyle Jermstad at 775-888-7332.

KJ:MG:kj

Appendix A
Figures



1263 South Stewart Street
Carson City, Nevada 89712
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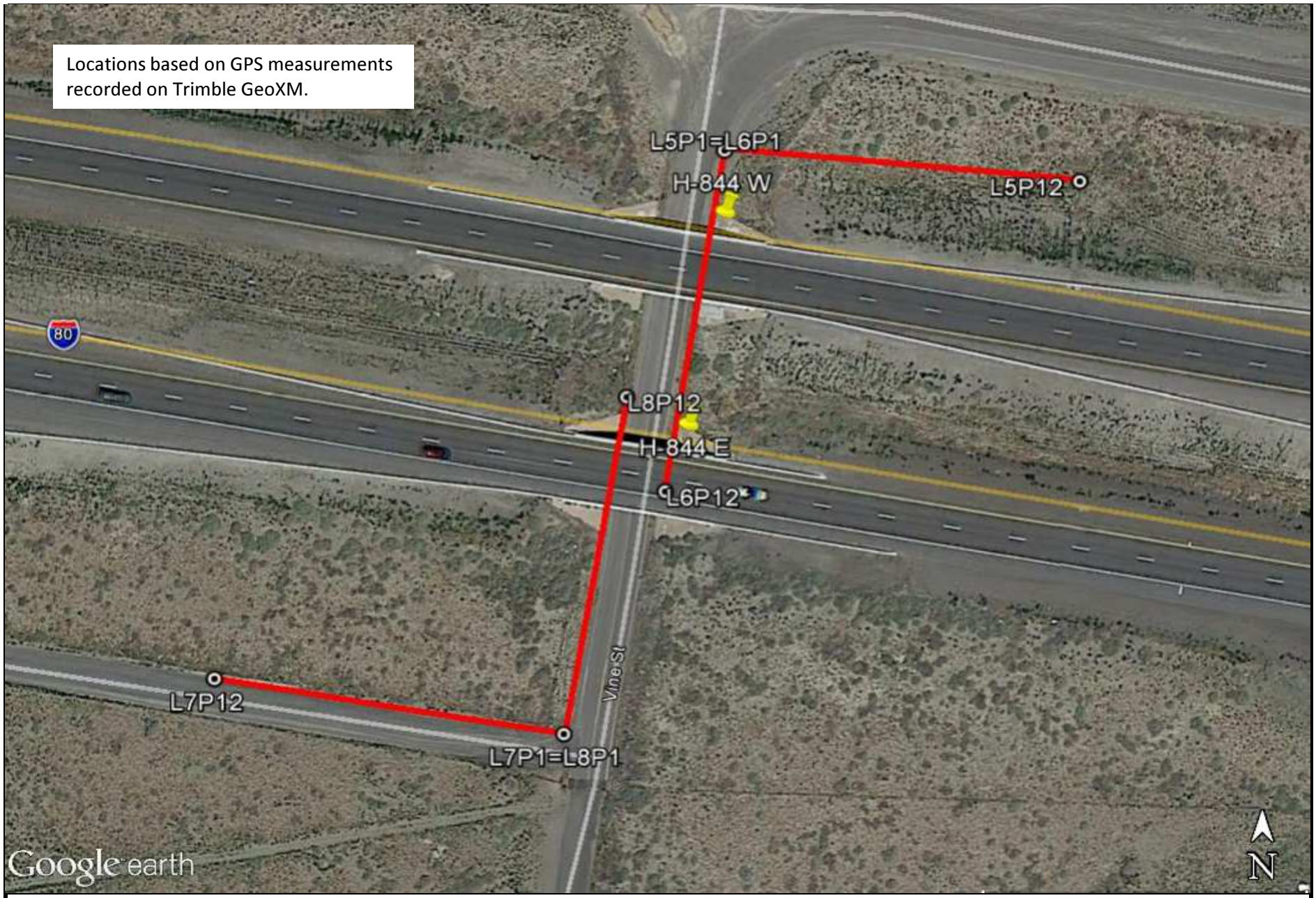
Fax: (775) 888-7201

Figure A-1: Vicinity Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



NEVADA DOT

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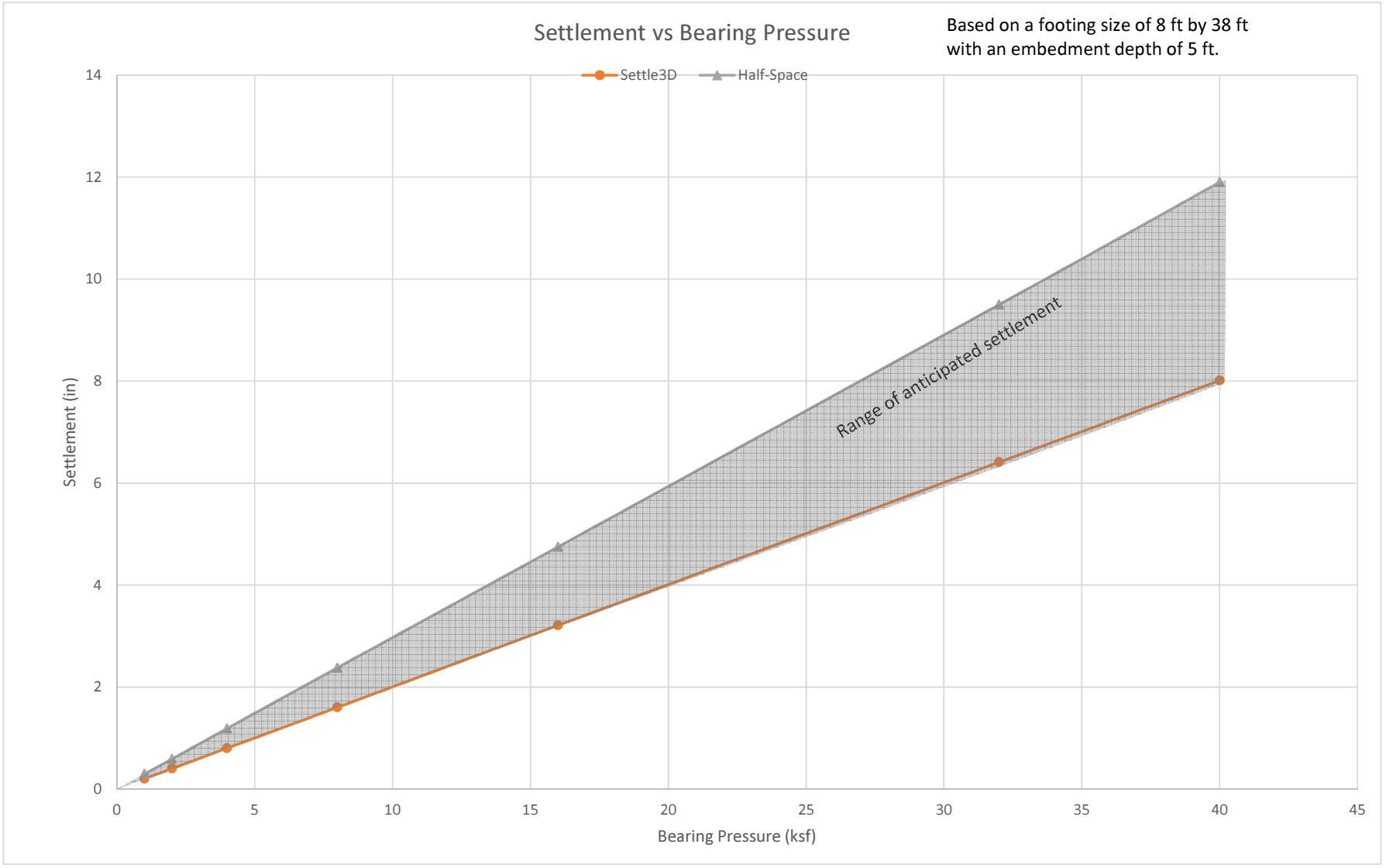
Fax: (775) 888-7201

Figure 2: H-844 Site Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



1263 South Stewart Street
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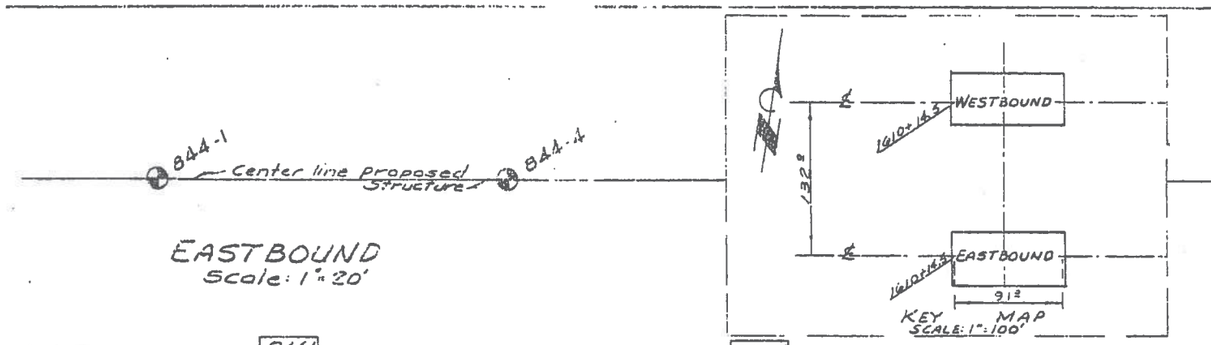
Fax: (775) 888-7201

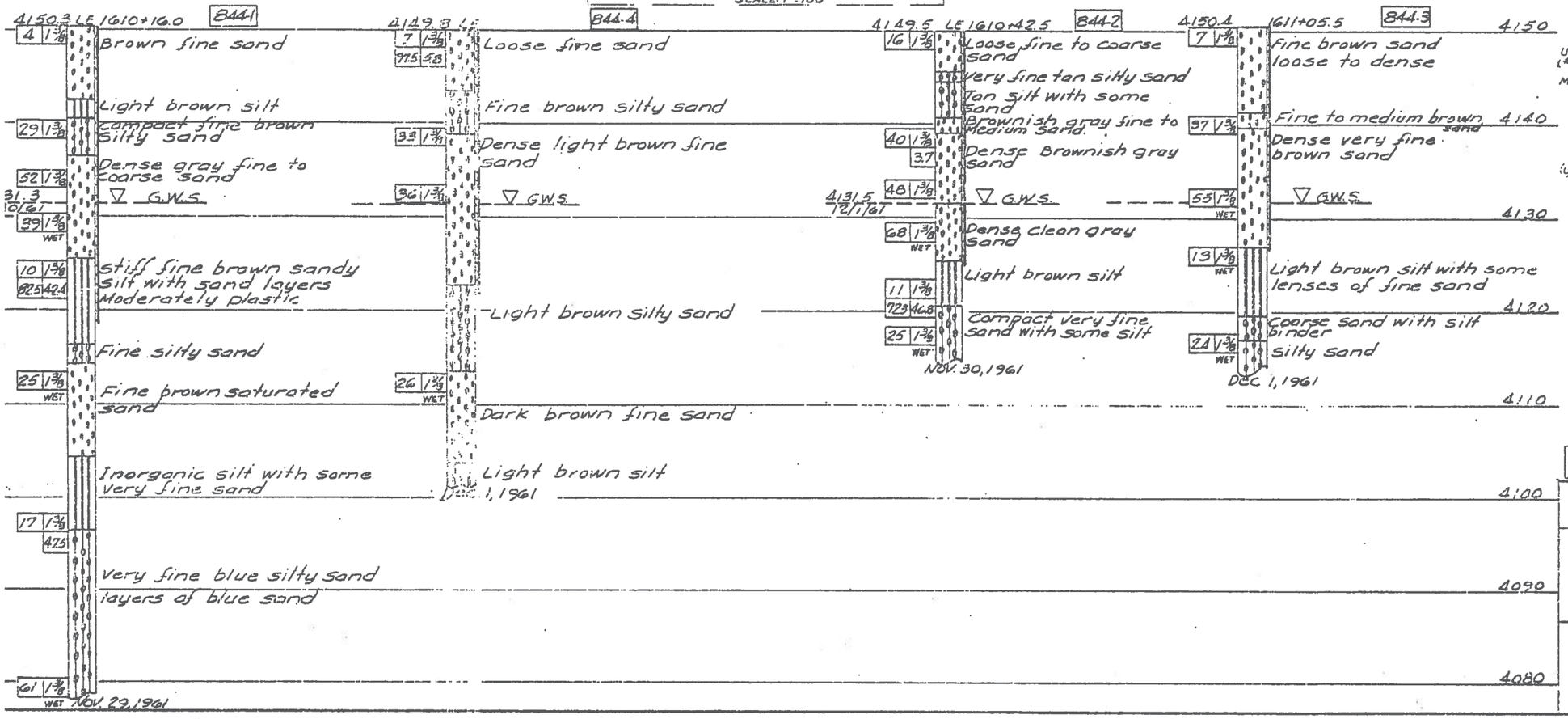
Figure A-3 Settlement vs Bearing Pressure

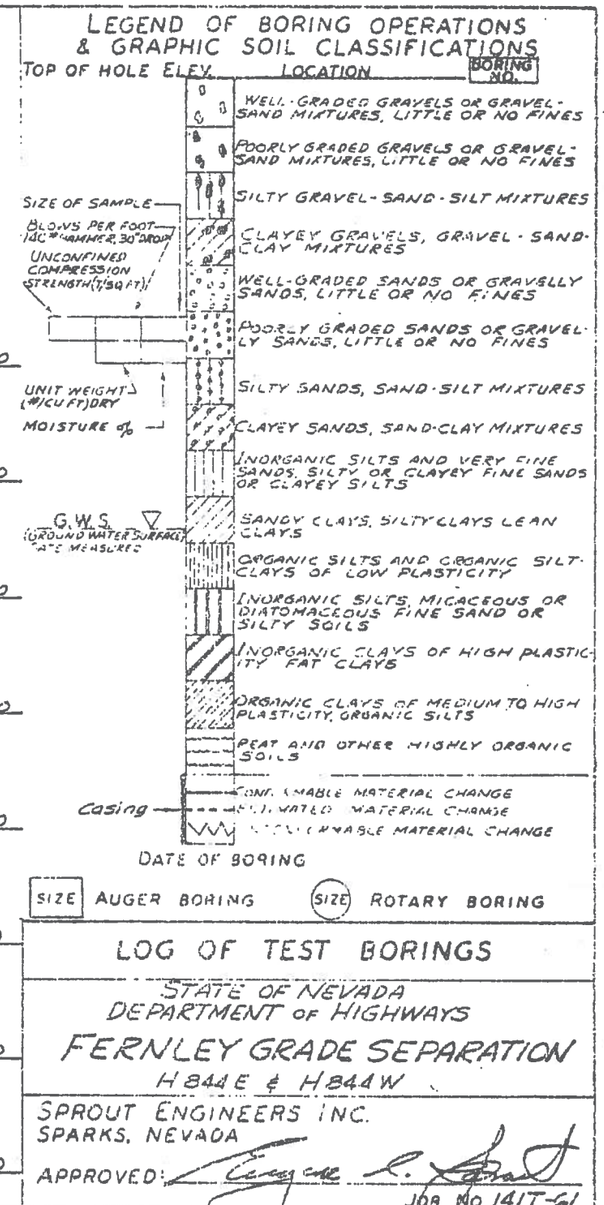
Location: H-844
Project Name: Seismic Retrofit
EA Number: 74046

Appendix B

Boring Logs







LOG OF TEST BORINGS

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

FERNLEY GRADE SEPARATION
H 844 E & H 844 W

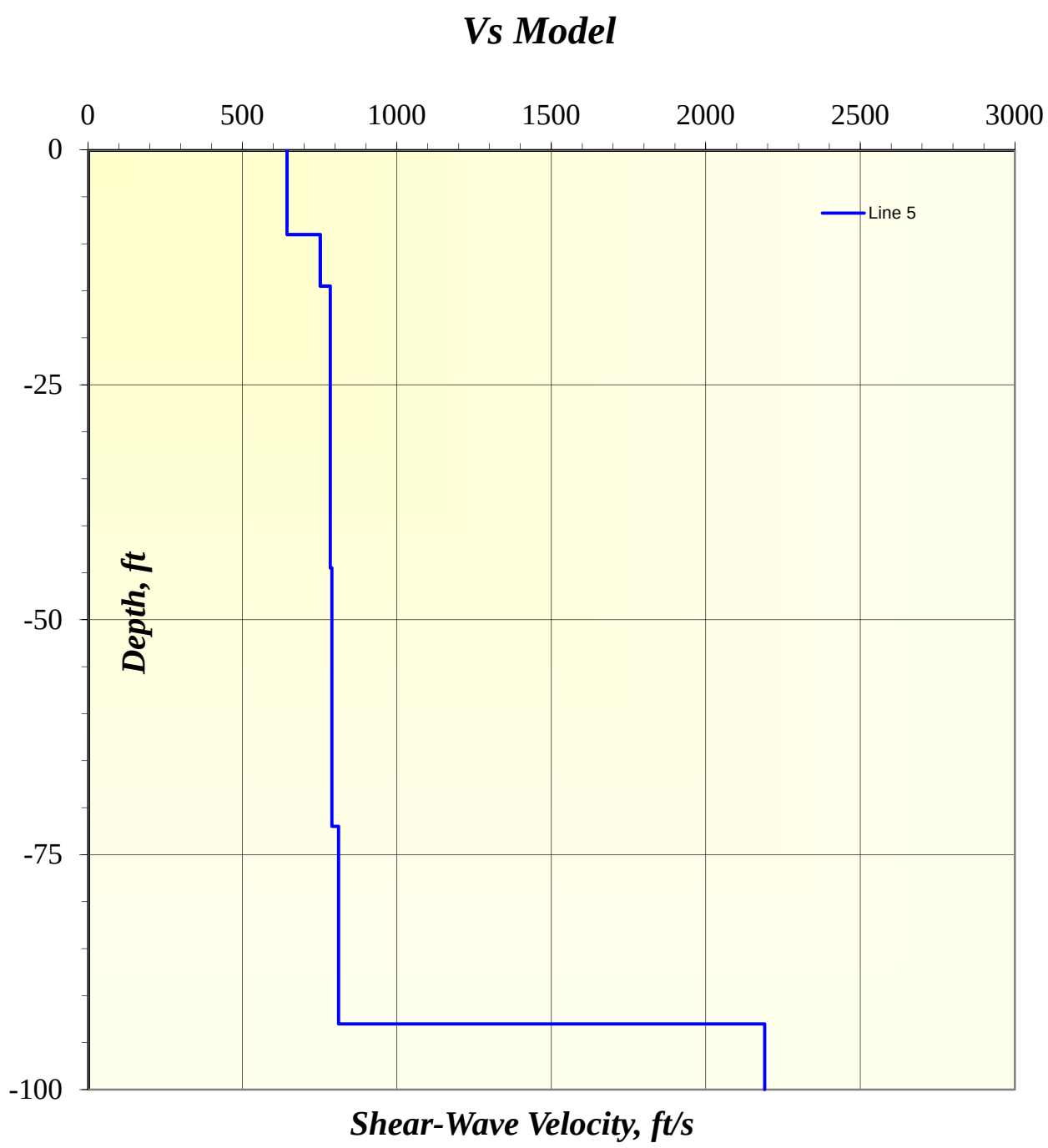
SPROUT ENGINEERS INC.
SPARKS, NEVADA

APPROVED: [signature]

JOB NO. 141T-61
PAGE NO. 121

Appendix C
Geophysical Survey Results

Shear Wave Velocity Profile



IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **810.24** **ft/s**

1263 South Stewart Street
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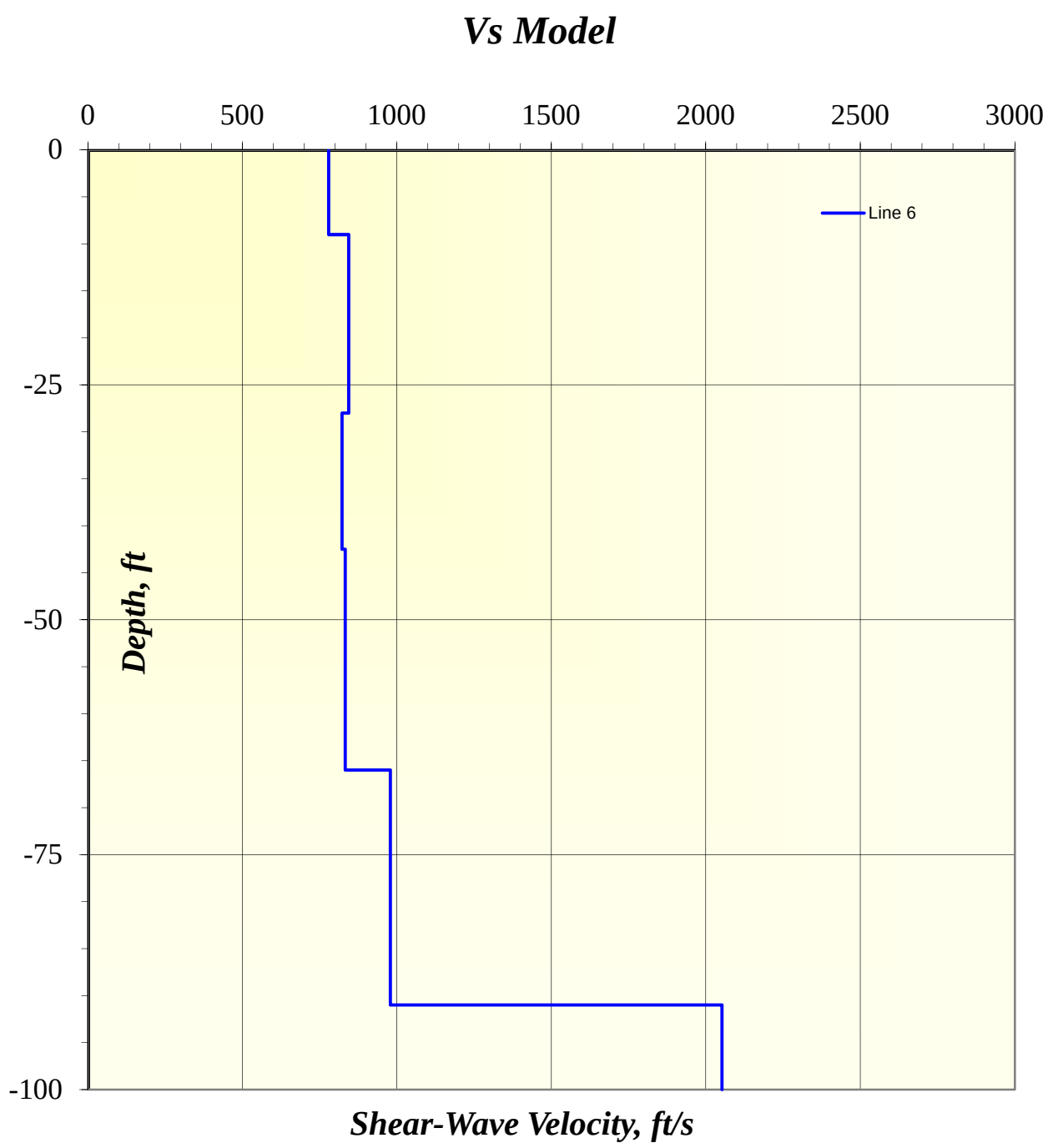
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: 5
Location: H-844
Project Name: Seismic Retrofit
EA Number: 74046

Shear Wave Velocity Profile



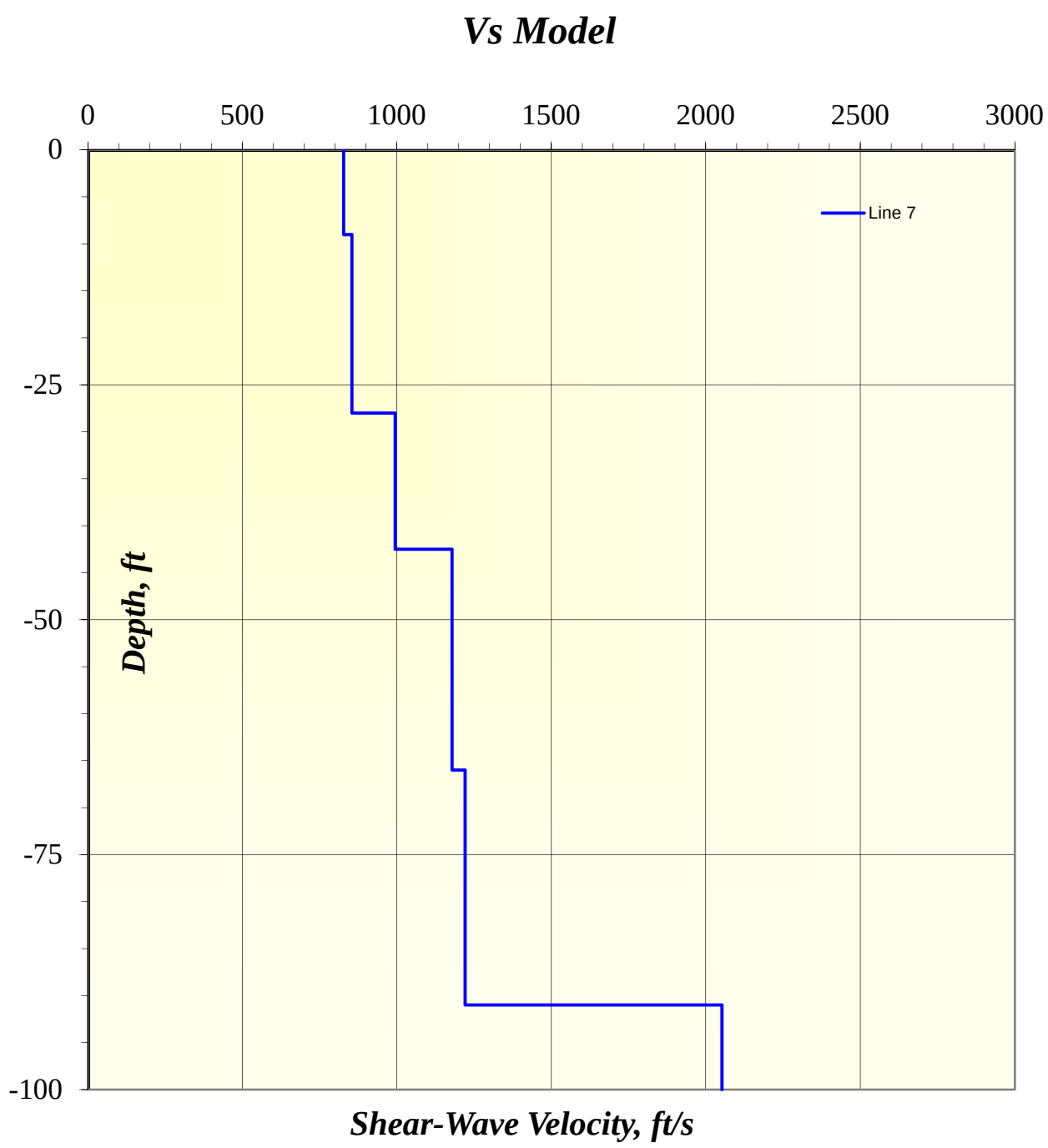
IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **910.36** **ft/s**

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: 6
Location: H-844
Project Name: Seismic Retrofit
EA Number: 74046

Shear Wave Velocity Profile



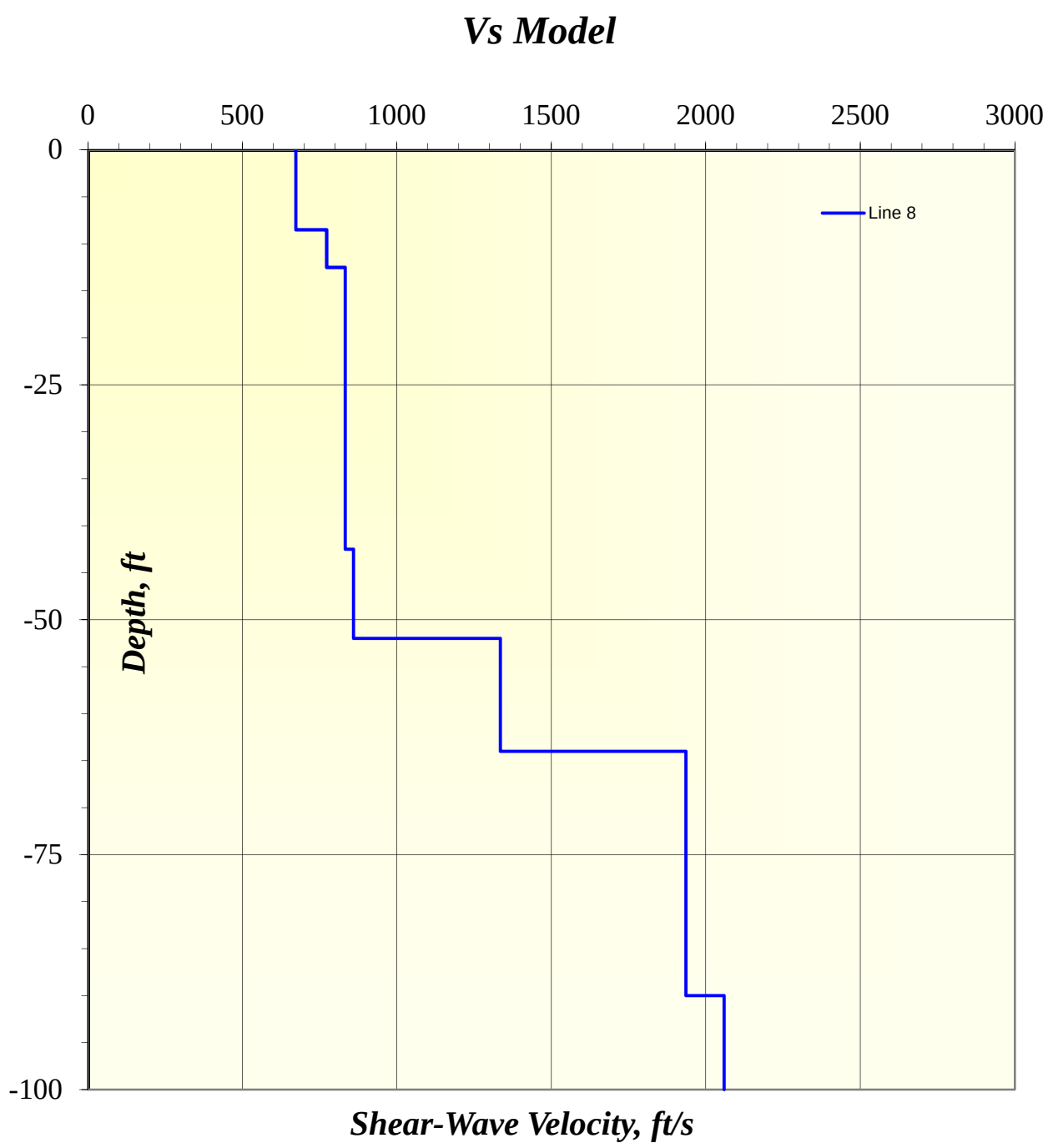
IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **1081.31** **ft/s**

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: 7
Location: H-844
Project Name: Seismic Retrofit
EA Number: 74046

Shear Wave Velocity Profile



IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **1085.19** **ft/s**

1263 South Stewart Street
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Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: 8
Location: H-844
Project Name: Seismic Retrofit
EA Number: 74046

Appendix D
Seismic Design Parameters

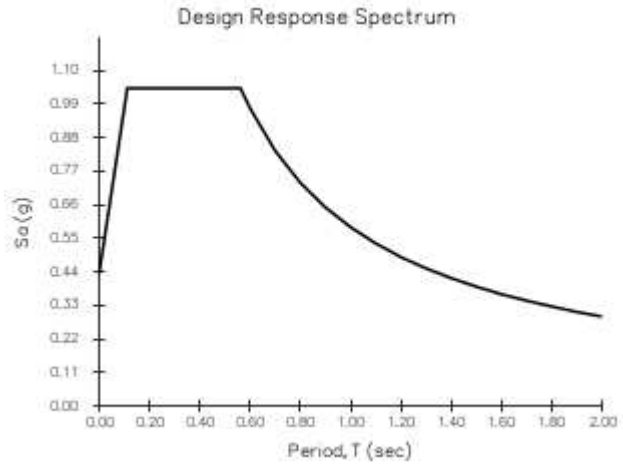
USGS Design Maps Summary Report

User–Specified Input

Report Title	H-844 Mon December 18, 2017 19:31:28 UTC
Building Code Reference Document	2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (which utilizes USGS hazard data available in 2002)
Site Coordinates	39.61456°N, 119.23618°W
Site Soil Classification	Site Class D – "Stiff Soil"

USGS–Provided Output

PGA =	0.392 g	**A_s =**	0.434 g
S_s =	0.921 g	**S_{DS} =**	1.042 g
S_1 =	0.341 g	**S_{D1} =**	0.586 g



Appendix E
I-700 Design Parameters Memo

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

MEMORANDUM

6/18/2018

To: **Michael Mayberry, P.E., Structures Division**

From: **Jesse Ruzicka, P.E., Materials Division**

Subject: **Geotechnical Design Parameters for the Seismic Retrofit of I-700**

Project No. 74046

This memorandum presents our recommended geotechnical design criteria for the proposed structural retrofit of structure I-700, based on our geophysical exploration, record research, and limited geotechnical analysis.

Project Description

Review of the as-built plans indicates the eastbound and westbound I-700 structures are three-span bridges, with abutments supported on 3½-foot wide strip footings founded on embankment fill. The intermediate bents for the eastbound structure are supported on 9½- by 9½-foot square footings founded on native soils approximately 8.5-feet below ground surface (bgs). The intermediate bents for the westbound structure are supported on 11- by 11-foot square footings founded on native soils approximately 12-feet bgs.

It is our understanding that the proposed retrofit will consist of increasing the footprint of the existing foundations by 2-feet on all sides, resulting in 13½- by 13½-foot square footings for the eastbound structure and 15- by 15-foot square footings for the westbound structure.

Site Description

Structure I-700 is located on I-80 in Wadsworth, Nevada in Washoe County. The site consists of one bridge structure per direction of traffic, eastbound and westbound. The site topography is generally flat except for the approximately 20-foot tall highway embankment fills for the eastbound and westbound lanes of the highway. The embankments have a slope of approximately 2(H):1(V). 30-inch corrugated metal culverts with concrete headwalls were observed at the toe of the slope perpendicular to the highway. At the time of our exploration, the surface consisted of sand with sparse grass and brush. The Vicinity Map is presented on Figure A-1 in the attachments.

Geophysical Exploration

On December 12th, 2017, we performed four Refraction Microtremor (ReMi) surveys. Two lines were orientated perpendicular to each other and performed at the existing bridge abutments.

The ReMi lines were placed in general accordance with FHWA NHI-01-031, and locations shown on Figure A-2.

The purpose of the geophysical exploration was to determine the shear wave velocity, (Vs_{100}) within the top 100 feet. The Vs_{100} was used in determining the seismic Site Class and estimating soil properties based on published correlations. The ReMi lines were performed using a DAQLink III 12-channel seismograph with 10-Hz geophones spaced at 20-foot intervals, and Vibrascope Version 2.4.79 acquisition software. Passive energy sources consisted of vehicular traffic along Interstate 80.

Analysis of Geophysical Data

Analysis of collected data was performed using the software package, Optim SeisOpt ReMi™ Version 4.1. SEG-Y files were exported from the data collection software and processed to generate the velocity spectrum, from which picks could be made along the Rayleigh wave dispersion profile. Dispersion inversion was performed to generate the dispersion curve and shear wave velocity profiles.

Analysis and interpretation of the ReMi data was performed by Optim. One dimensional shear wave velocity profiles for each of the surveys are presented in Appendix C.

Geotechnical Analysis of Existing Data

A review of records indicates five borings were performed by Sprout Engineers Inc. in December 1961. The site subsurface materials generally consist of loose to dense sand and gravel to a depth of approximately 25-feet bgs, underlain by approximately 5-feet of loose sand and gravel. Below the loose sand and gravel, dense sand and gravel was encountered to the maximum extents explored of approximately 55-feet bgs. Groundwater was measured at an approximate depth of 15-feet bgs.

Design Parameter Recommendations

Published correlations found in AASHTO LRFD Bridge Design Specifications, as well as FHWA-NHI-01-03, FHWA-HRT-06-032, and NAVFAC 7.2 were utilized in the development of following design parameters as presented in the table below.

I-700 Soil Design Parameters

Parameter	Value*	Reference
Unit weight, γ_t (pcf)	110	FHWA-NHI-01-031 9-5
Poisson's ratio, v	0.3	AASHTO LRFD 7th Table C10.4.6.3-1
Cohesion, c (psf)	0	NAVFAC 7.2-39
Internal friction angle, φ (degrees)	34	AASHTO LRFD 7th Table 10.4.6.2.4-1
Large strain shear modulus G (ksf)	677	FHWA-HRT-06-032 6.2.2.1
Elastic modulus, E (ksf)	1,801	AASHTO LRFD 7th Table 10.4.6.3-1
Average blow count	27	AASHTO LRFD 7th Table C3.10.3.1-1
Average Shear wave velocity, Vs_{100} (fps)	1436	AASHTO LRFD 7th Table C3.10.3.1-1
Site Class	C	AASHTO LRFD 7th Table 3.10.3.1-1

* Based on limited existing boring data and shear wave velocity (ReMi) geophysical surveys.

In general, the soil bearing resistance using Load Resistance and Factor Design (LRFD) considers the following three loading conditions:

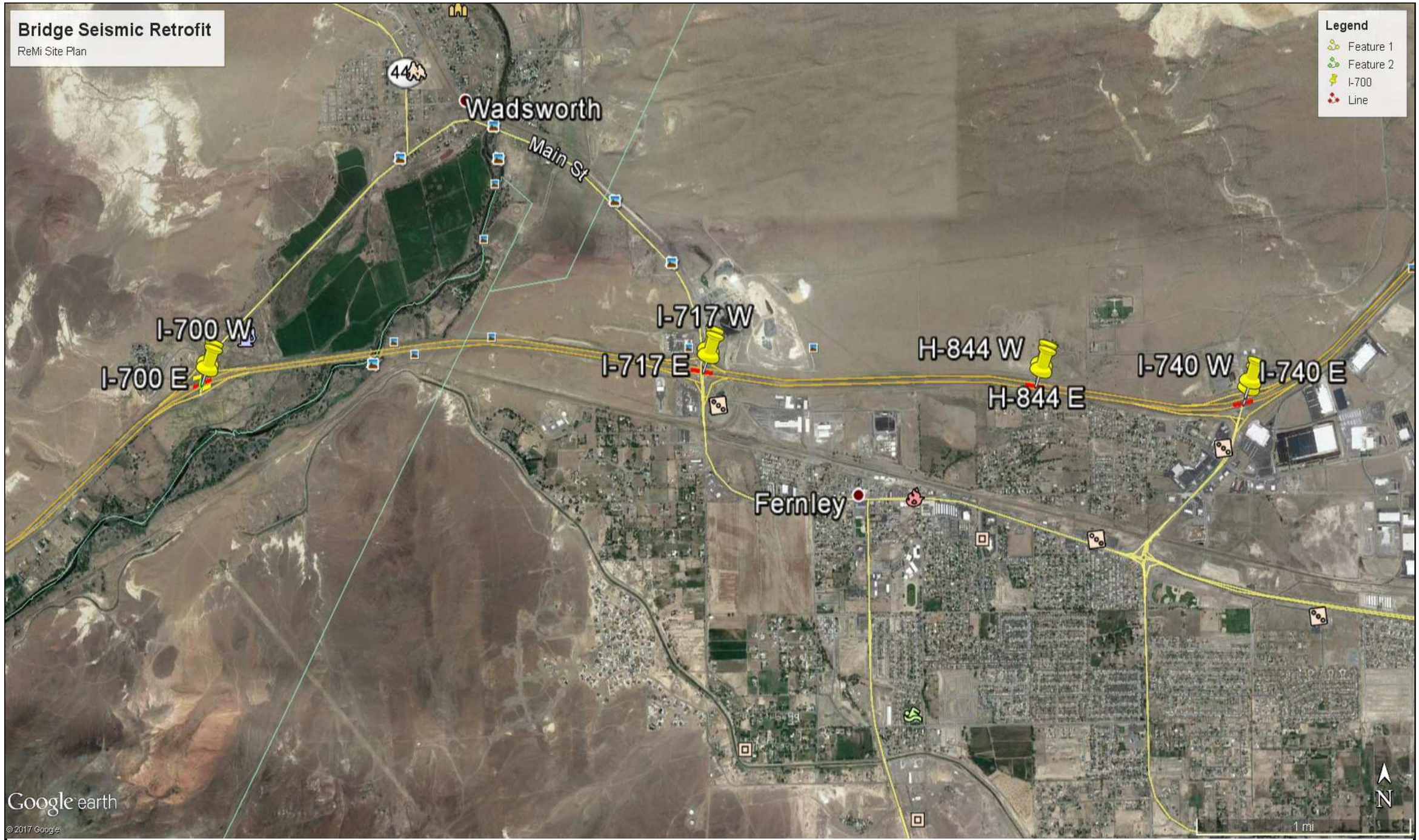
1. Strength Limit State – The ability of the soil to support an applied load without producing a shear failure (bearing failure) within the soil mass;
2. Service Limit State – The bearing resistance of the soil for a given deformation (settlement) tolerance;
3. Extreme Limit State – the bearing resistance of the soil during extreme events such as liquefaction and seismic events.

As requested, we provided only the service limit bearing resistances for the eastbound and westbound I-700 structures. Settlement estimates can vary widely, therefore to determine the range of settlement for the foundations under varying loads, we considered two different methods; the half-space method (AASHTO 2014) and the elastic theory method (Day, 2005). Plots showing the range of estimated settlement values for a given load is presented on Figures A-3 and A-4 in Appendix A.

If you have any questions or wish to discuss further, please do not hesitate to contact me at 775-888-7821 or Kyle Jermstad at 775-888-7332.

KJ:JR:kj

Appendix A
Figures



1263 South Stewart Street
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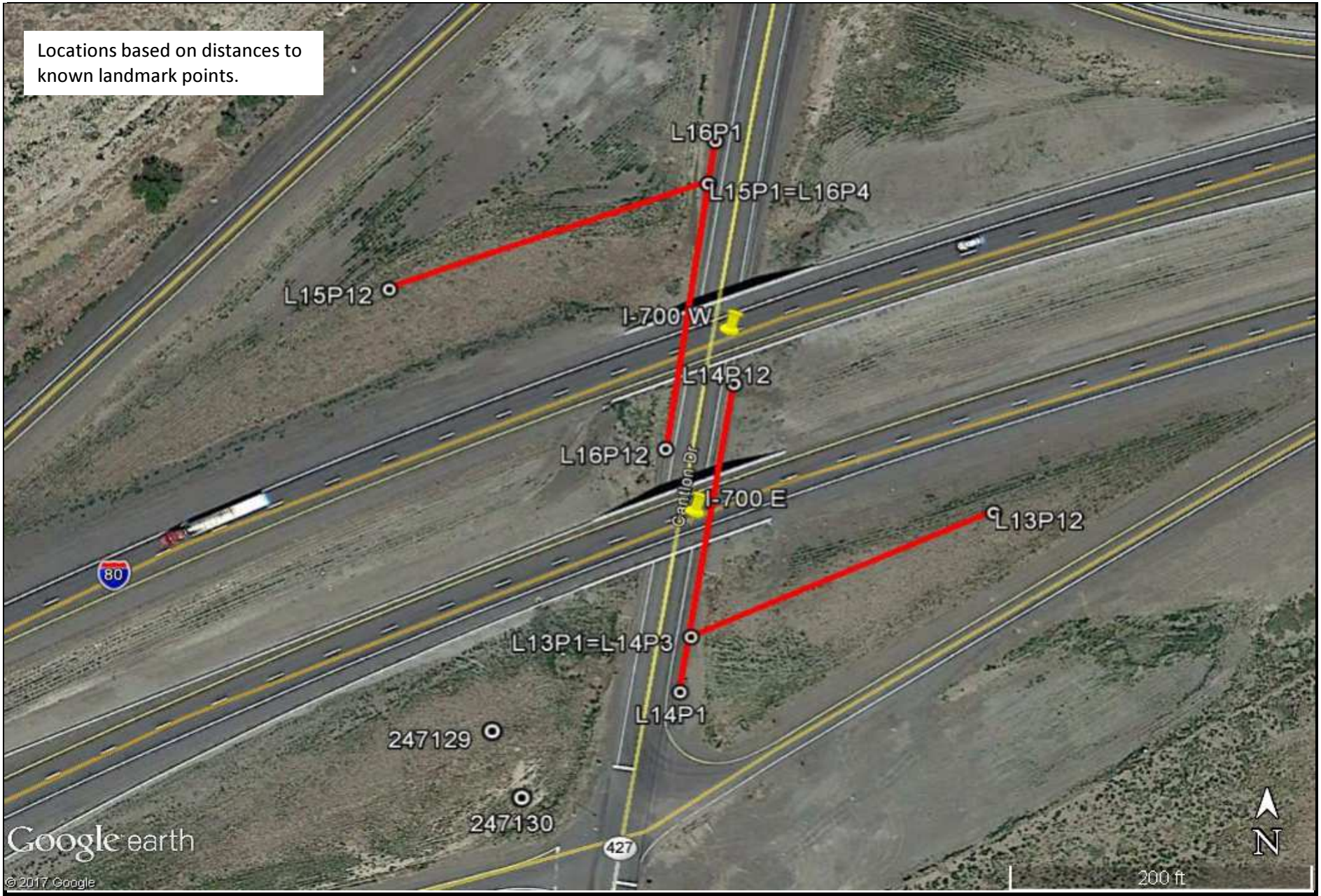
Fax: (775) 888-7201

Figure A-1: Vicinity Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



NEVADA DOT

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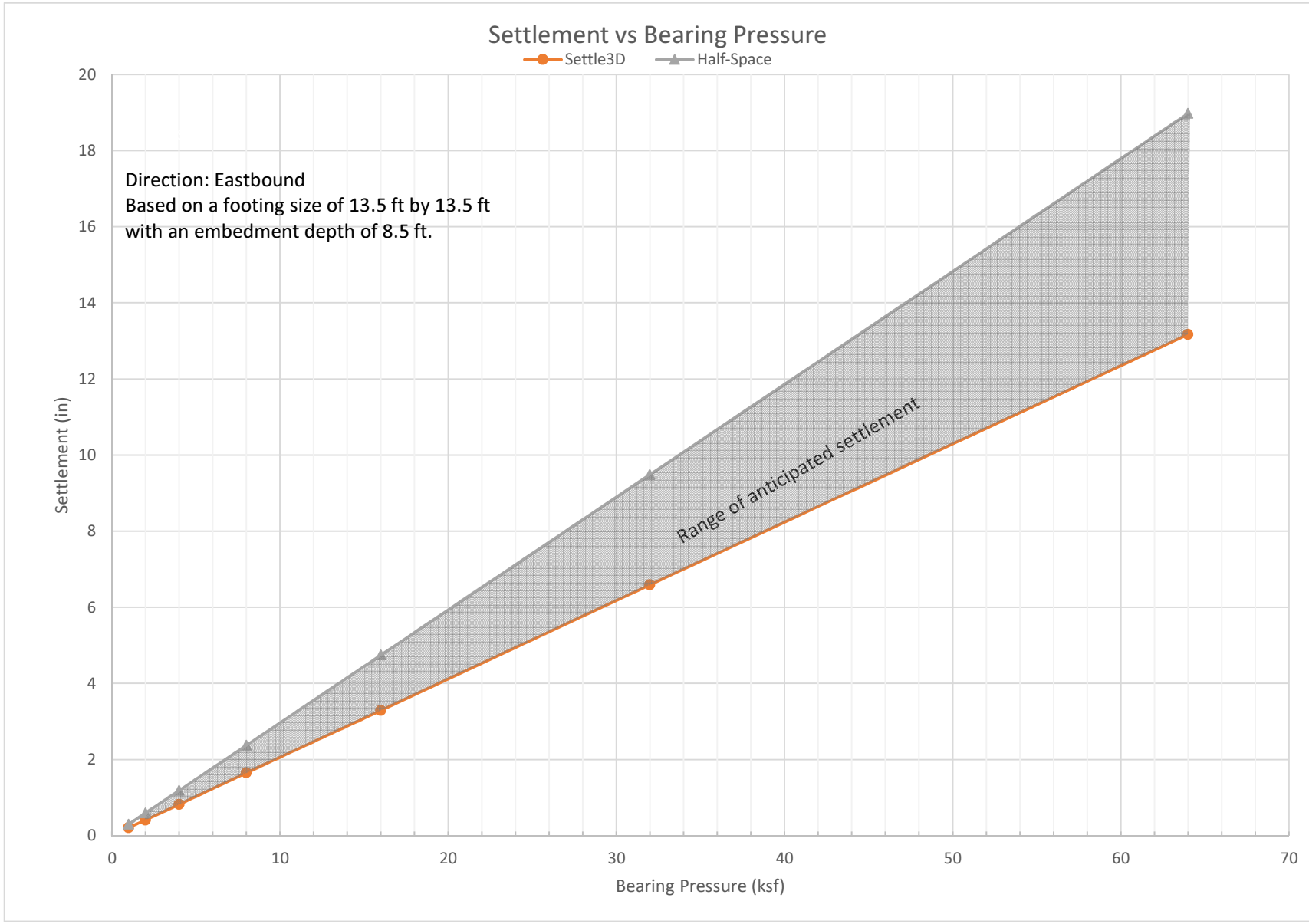
Fax: (775) 888-7201

Figure 2: I-700 Site Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



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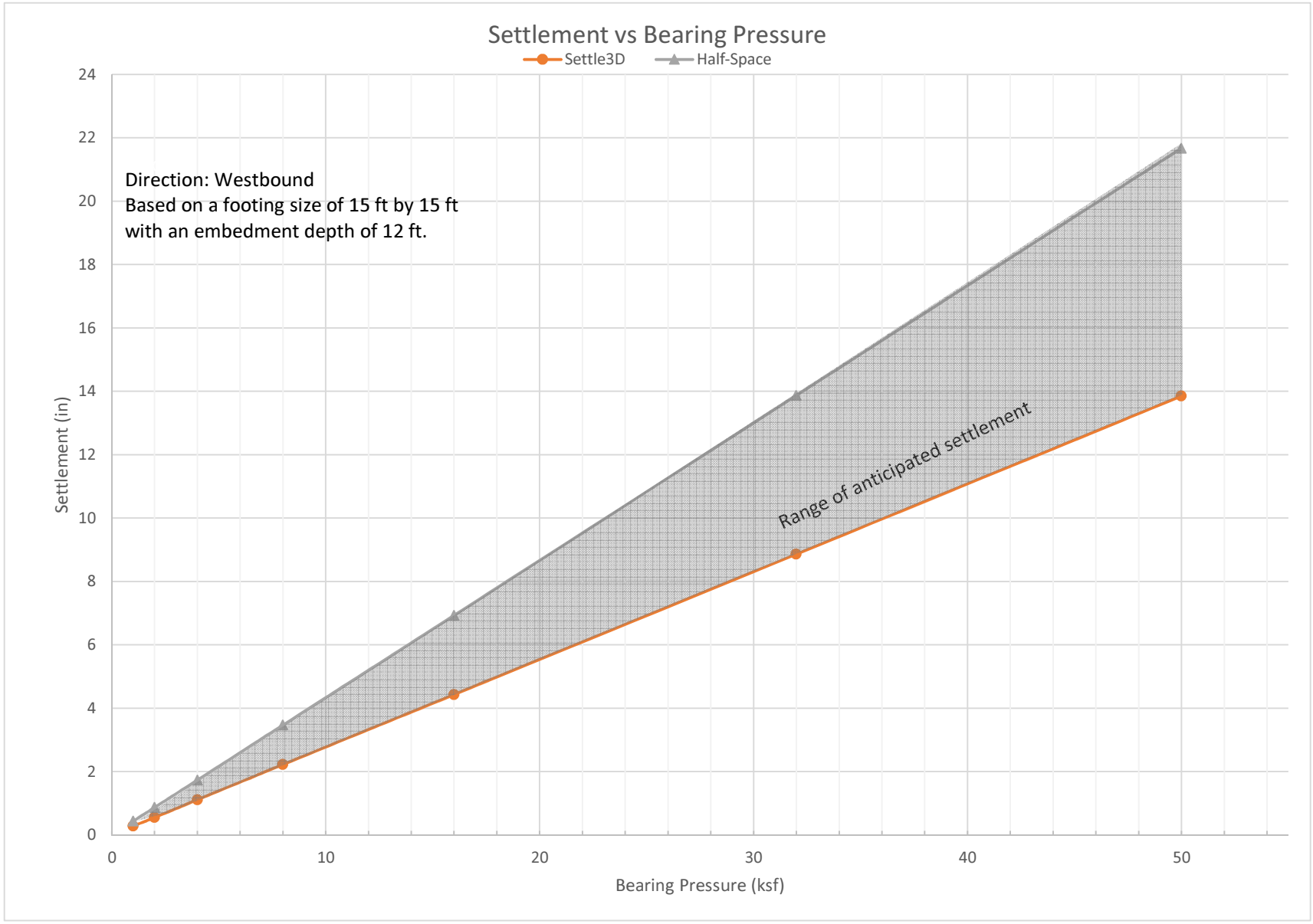
Phone: (775) 888-7440
Fax: (775) 888-7201

Figure A-3: Bearing Pressure vs Settlement

Location: I-700 EB
Project Name: Seismic Retrofit
EA Number: 74046



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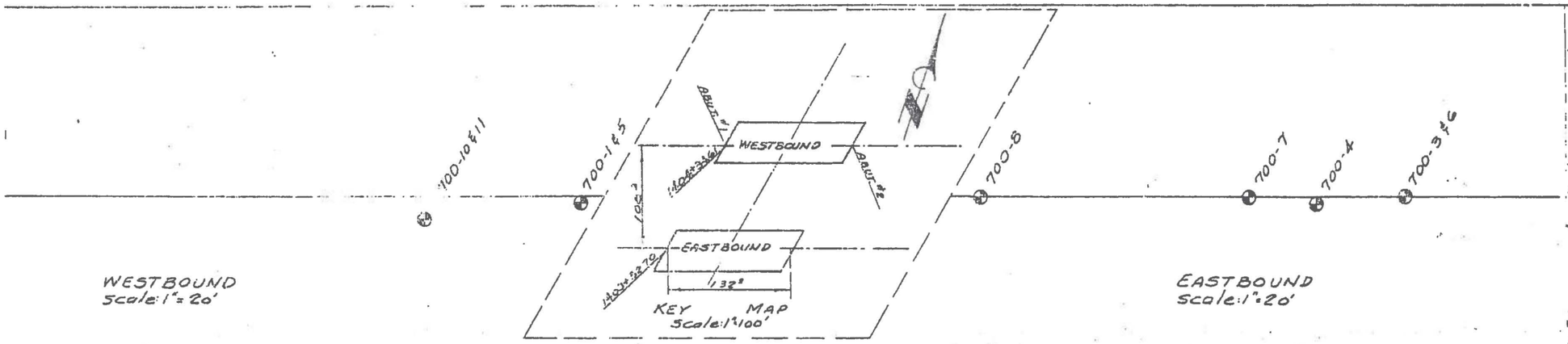
Phone: (775) 888-7440
Fax: (775) 888-7201

Figure A-4: Bearing Pressure vs Settlement

Location: I-700 WB
Project Name: Seismic Retrofit
EA Number: 74046

Appendix B

Boring Logs



LEGEND OF BORING OPERATIONS & GRAPHIC SOIL CLASSIFICATIONS

TOP OF HOLE ELEV. LOCATION BORING NO.

SIZE OF SAMPLE
BLOWS PER FOOT (140# HAMMER, 30" DROP)
UNCONFINED COMPRESSION STRENGTH (T/SQ FT)
UNIT WEIGHT (#/CU.FT) DRY
MOISTURE %

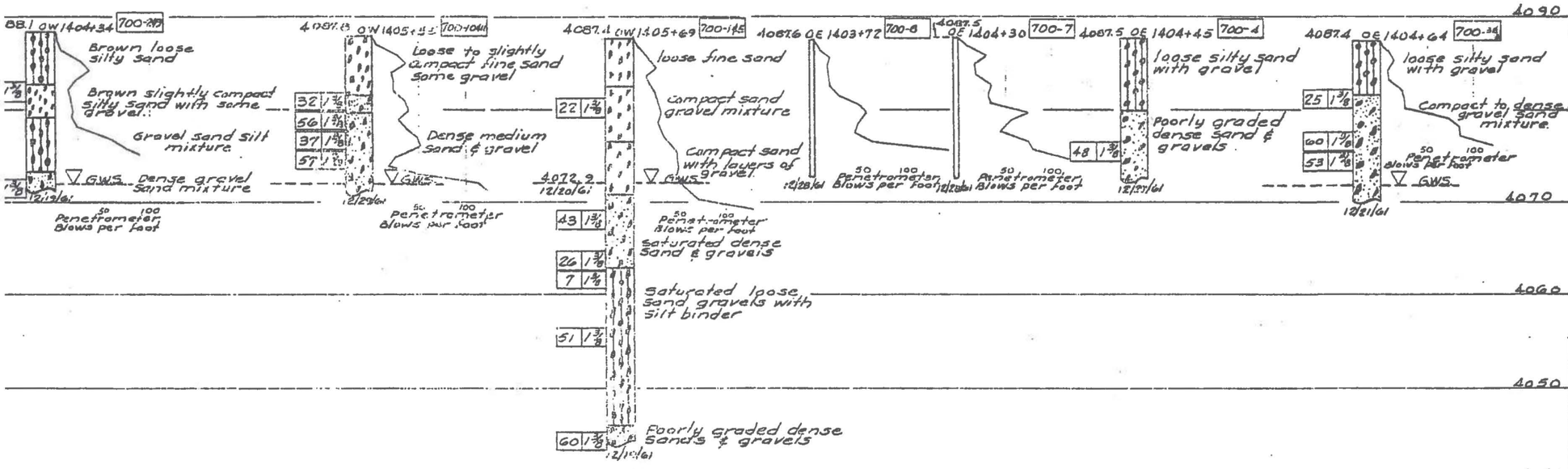
- WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- SILTY GRAVEL-SAND-SILT MIXTURES
- CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
- WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- SILTY SANDS, SAND-SILT MIXTURES
- CLAYEY SANDS, SAND-CLAY MIXTURES
- INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS
- SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
- ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
- INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
- INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
- ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
- PEAT AND OTHER HIGHLY ORGANIC SOILS

G.W.S. (GROUND WATER SURFACE) (DATE MEASURED)

CONFORMABLE MATERIAL CHANGE
ESTIMATED MATERIAL CHANGE
UNCONFORMABLE MATERIAL CHANGE

DATE OF BORING

SIZE AUGER BORING (SIZE) ROTARY BORING



LOG OF TEST BORINGS

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

WEST WADSWORTH INTERCHANGE
I-700E & I-700W

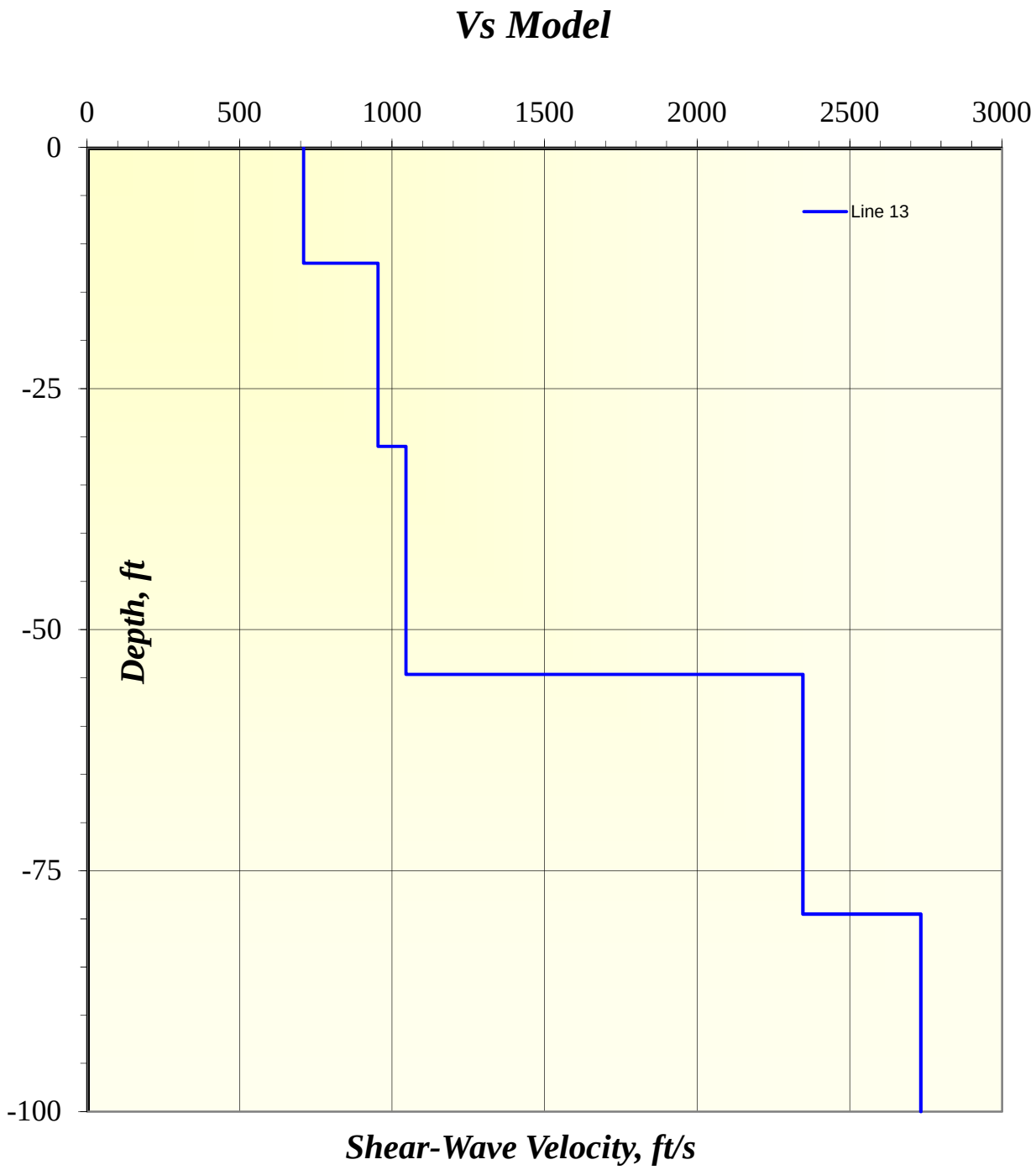
SPROUT ENGINEERS INC.
SPARKS, NEVADA

APPROVED: Eugene C. Sprout

JOB NO. 141T-61
PAGE NO. 83

Appendix C
Geophysical Survey Results

Shear Wave Velocity Profile



IBC Site Class: C

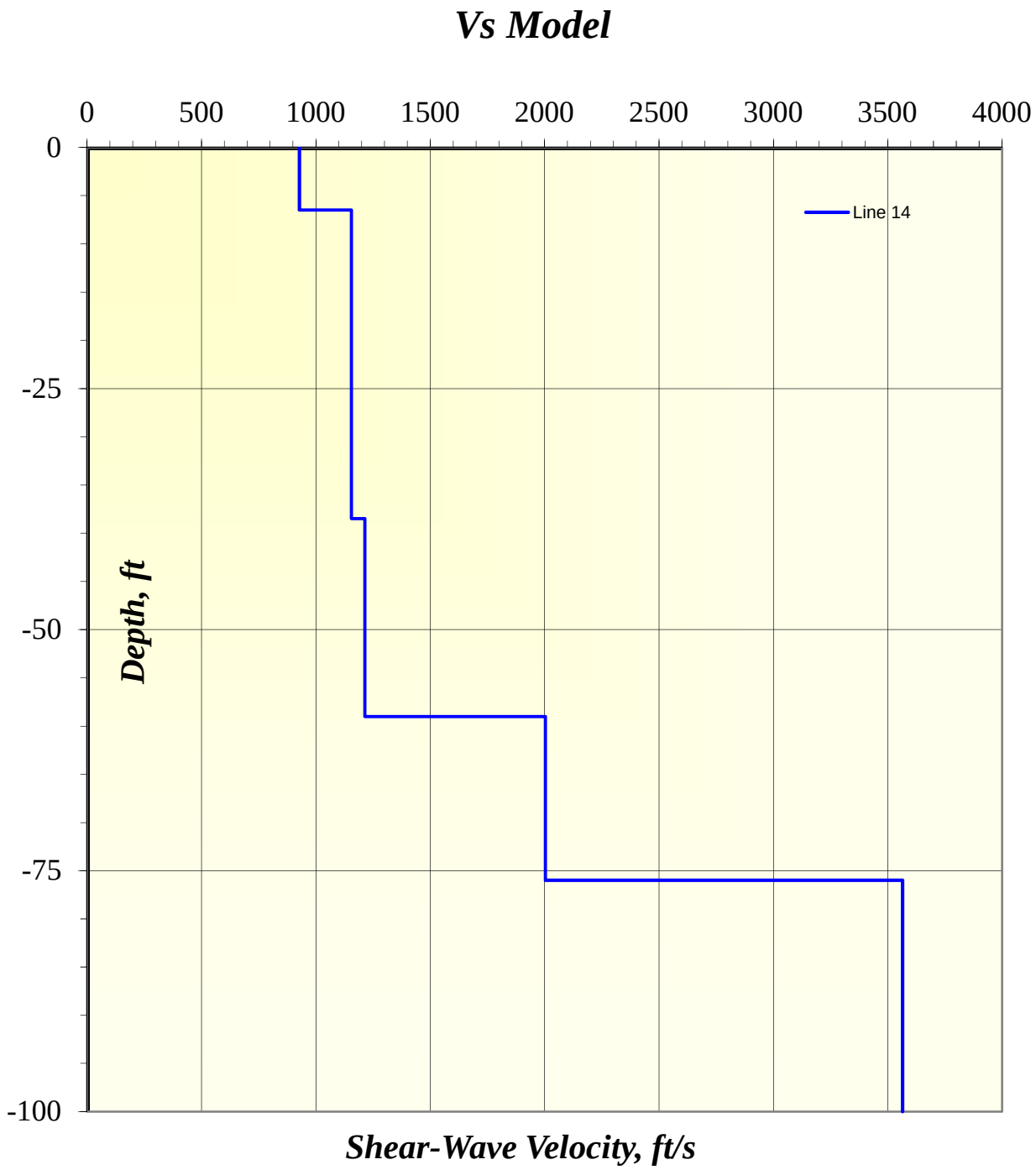
Average Shear Wave Velocity within 100 feet, Vs 1289.79

NEVADA DOT

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: Line 13
Location: I-700 Structure
Project Name: Seismic Retrofits
EA Number: 74046

Shear Wave Velocity Profile



IBC Site Class: C

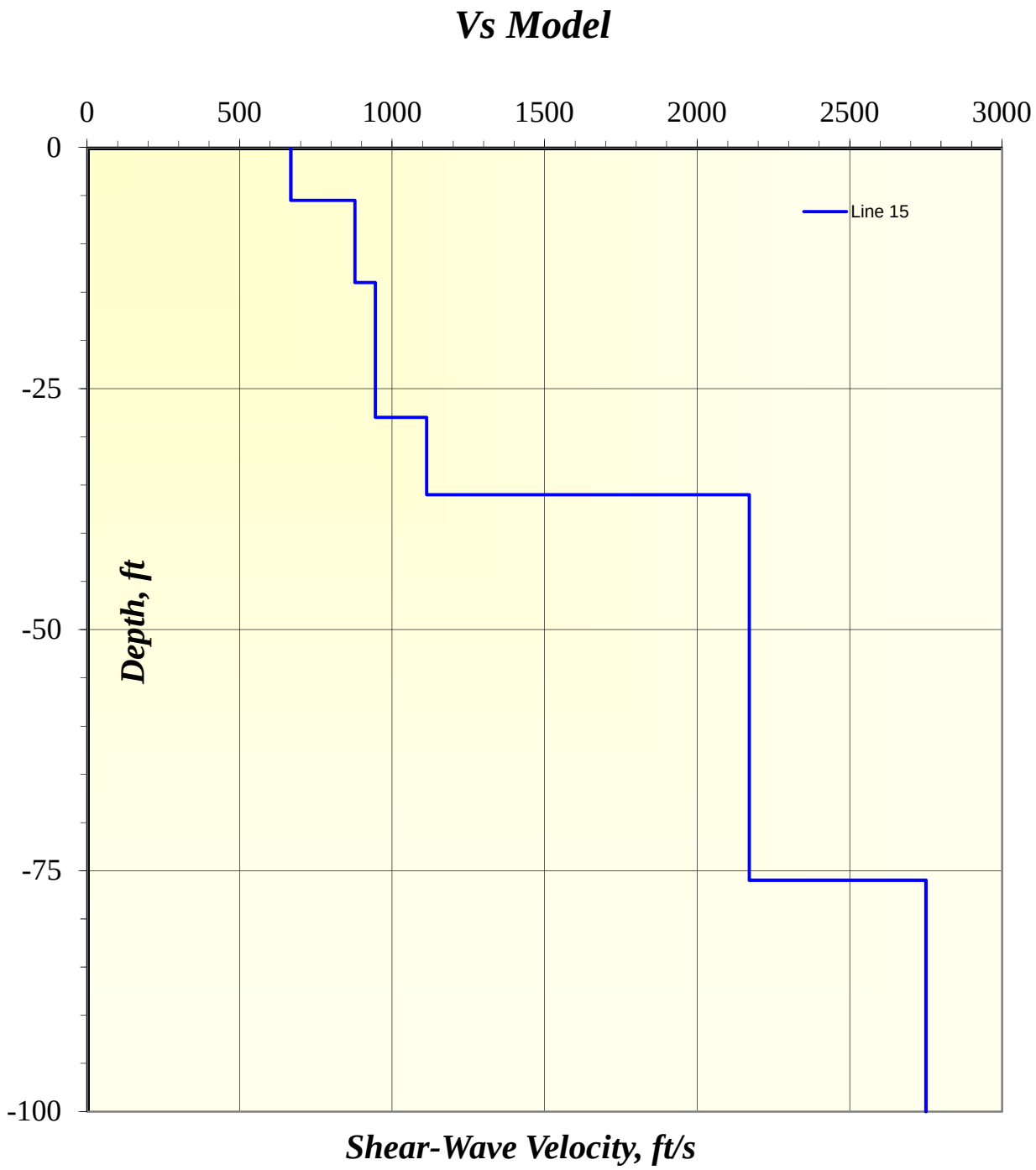
Average Shear Wave Velocity within 100 feet, Vs 1496.54

NEVADA DOT

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: Line 14
Location: I-700 Structure
Project Name: Seismic Retrofits
EA Number: 74046

Shear Wave Velocity Profile



IBC Site Class: C

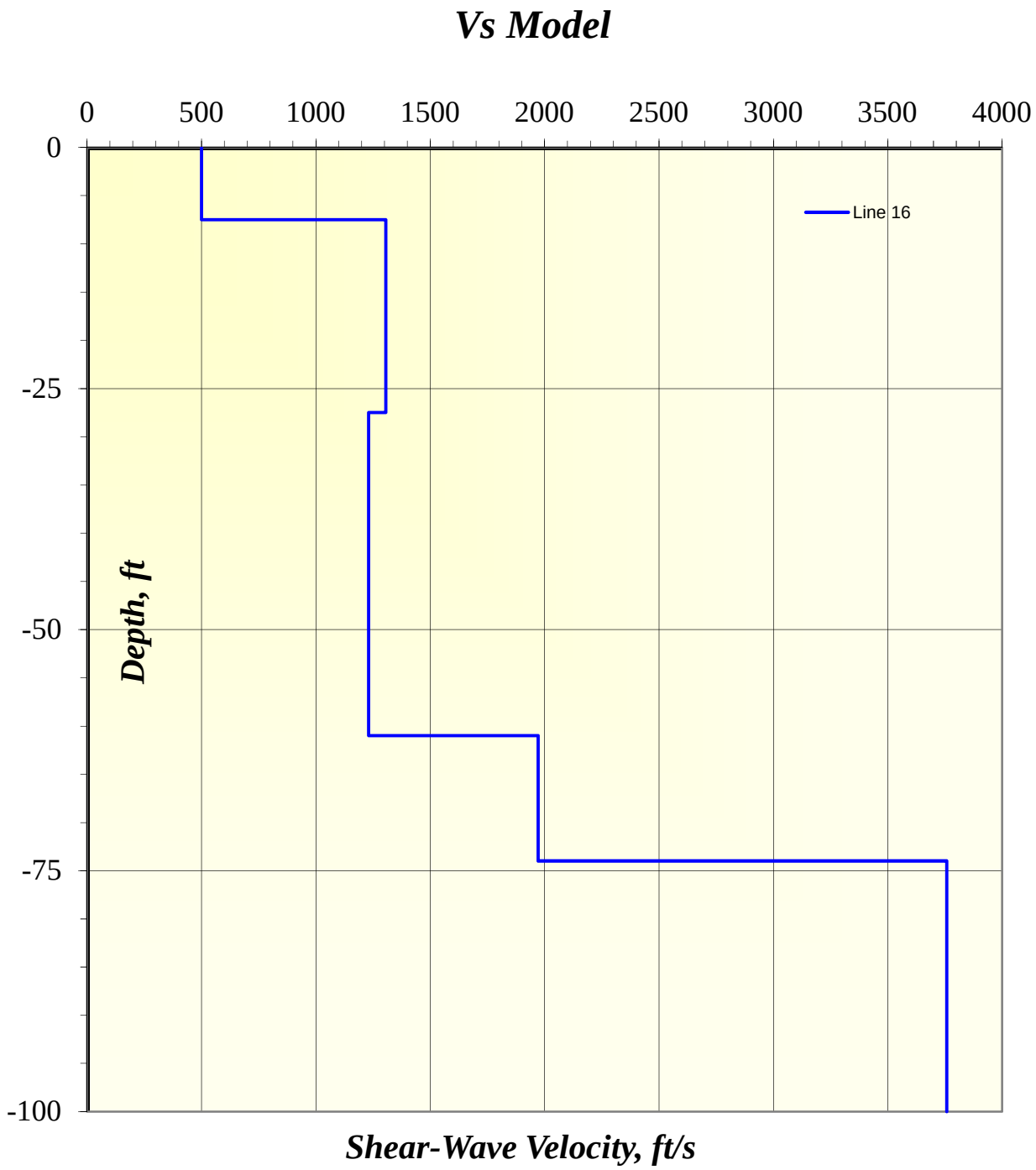
Average Shear Wave Velocity within 100 feet, Vs 1490.92

NEVADA DOT

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: Line 15
Location: I-700 Structure
Project Name: Seismic Retrofits
EA Number: 74046

Shear Wave Velocity Profile



IBC Site Class: C

Average Shear Wave Velocity within 100 feet, Vs 1407.42

NEVADA DOT

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Line Number: Line 16
Location: I-700 Structure
Project Name: Seismic Retrofits
EA Number: 74046

Appendix D
Seismic Design Parameters

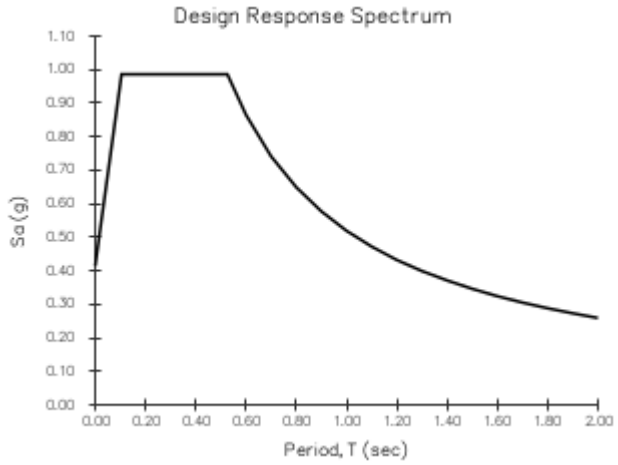
USGS Design Maps Summary Report

User–Specified Input

Report Title	I-700 Wed December 20, 2017 17:58:03 UTC
Building Code Reference Document	2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (which utilizes USGS hazard data available in 2002)
Site Coordinates	39.61592°N, 119.30899°W
Site Soil Classification	Site Class C – "Very Dense Soil and Soft Rock"

USGS–Provided Output

PGA =	0.414 g	**A_s =**	0.414 g
S_S =	0.977 g	**S_{DS} =**	0.986 g
S_1 =	0.360 g	**S_{D1} =**	0.519 g



Appendix F
I-717 Design Parameters Memo

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

MEMORANDUM

6/20/2019

To: **Michael Mayberry, P.E., Structures Division**

From: **Kyle Jermstad, P.E., Materials Division**

Subject: **Geotechnical Design Parameters for the Seismic Retrofit of I-717**

Project No. 74046

This memorandum presents our recommended geotechnical design criteria for the proposed structural retrofit of structure I-717, based on our geophysical exploration, record research, and limited geotechnical analysis.

Project Description

Review of the as-built plans indicates the eastbound and westbound I-717 structures are four-span bridges, with abutments supported on 7-foot wide strip footings founded on embankment fill. The eastbound intermediate bents are supported on 10½- by 10½-foot square footings founded on native soils approximately 11-feet below ground surface (bgs). The westbound intermediate bents are supported on 9- by 9-foot square footings founded on native soils approximately 8-feet bgs.

It is our understanding that the proposed seismic retrofit will consist of constructing a single rectangular footing with a dimension of 39½- by 14-feet at each bent location at the westbound structure and 40½- by 14½-feet at the eastbound structure.

Site Description

Structure I-717 is located on I-80 in Fernley, Nevada in Lyon County. The site consists of one bridge structure per direction of traffic, eastbound and westbound. The site topography is generally flat except for the approximately 20-foot tall embankment fills for the eastbound and westbound lanes of the highway. The embankments have a slope of approximately 2(H):1(V) and have concrete slope paving near the bridges. At the time of our exploration, the surface consisted of sand with sparse grass and brush. The Vicinity Map is presented on Figure A-1 in the attachments.

Geophysical Exploration

On December 12th, 2017, we performed four Refraction Microtremor (ReMi) surveys. Two lines were orientated perpendicular to each other and performed at the existing bridge abutments. The ReMi lines were placed in general accordance with FHWA NHI-01-031, and locations shown on Figure A-2.

The purpose of the geophysical exploration was to determine the shear wave velocity, (Vs_{100}) within the top 100 feet. The Vs_{100} was used in determining the seismic Site Class and

estimating soil properties based on published correlations. The ReMi lines were performed using a DAQLink III 12-channel seismograph with 10-Hz geophones spaced at 20-foot intervals, and Vibrascope Version 2.4.79 acquisition software. Passive energy sources consisted of vehicular traffic along Interstate 80.

Analysis of Geophysical Data

Analysis of collected data was performed using the software package, Optim SeisOpt ReMi™ Version 4.1. SEG-Y files were exported from the data collection software and processed to generate the velocity spectrum, from which picks could be made along the Rayleigh wave dispersion profile. Dispersion inversion was performed to generate the dispersion curve and shear wave velocity profiles.

Analysis and interpretation of the ReMi data was performed by Optim. One dimensional shear wave velocity profiles for each of the surveys are presented in Appendix C.

Geotechnical Review of Existing Data

A review of records, indicates four borings were performed by Sprout Engineers Inc. in December 1961 with the site subsurface materials generally consisting of loose to very dense sand to the maximum depth explored of approximately 45 feet bgs.

Design Parameter Recommendations

Published correlations found in AASHTO LRFD Bridge Design Specifications, as well as FHWA-NHI-01-03, FHWA-HRT-06-032, and NAVFAC 7.2 were utilized in the development of following design parameters as presented in the table below.

I-717 Soil Design Parameters

Parameter	Value*	Reference
Unit weight, γ_t (pcf)	130	FHWA-NHI-01-031 9-5
Poisson's ratio, v	0.3	AASHTO LRFD 7th Table C10.4.6.3-1
Cohesion, c (psf)	0	NAVFAC 7.2-39
Internal friction angle, φ (degrees)	36	AASHTO LRFD 7th Table 10.4.6.2.4-1
Large strain shear modulus G (ksf)	917	FHWA-HRT-06-032 6.2.2.1
Elastic modulus, E (ksf)	2,384	AASHTO LRFD 7th Table 10.4.6.3-1
Average blow count	34	AASHTO LRFD 7th Table C3.10.3.1-1
Average shear wave velocity, Vs100 (fps)	998	AASHTO LRFD 7th Table C3.10.3.1-1
Site Class	D	AASHTO LRFD 7th Table 3.10.3.1-1

* Based on limited existing boring data and shear wave velocity (ReMi) geophysical surveys.

In general, the soil bearing resistance using Load Resistance and Factor Design (LRFD) considers the following three loading conditions:

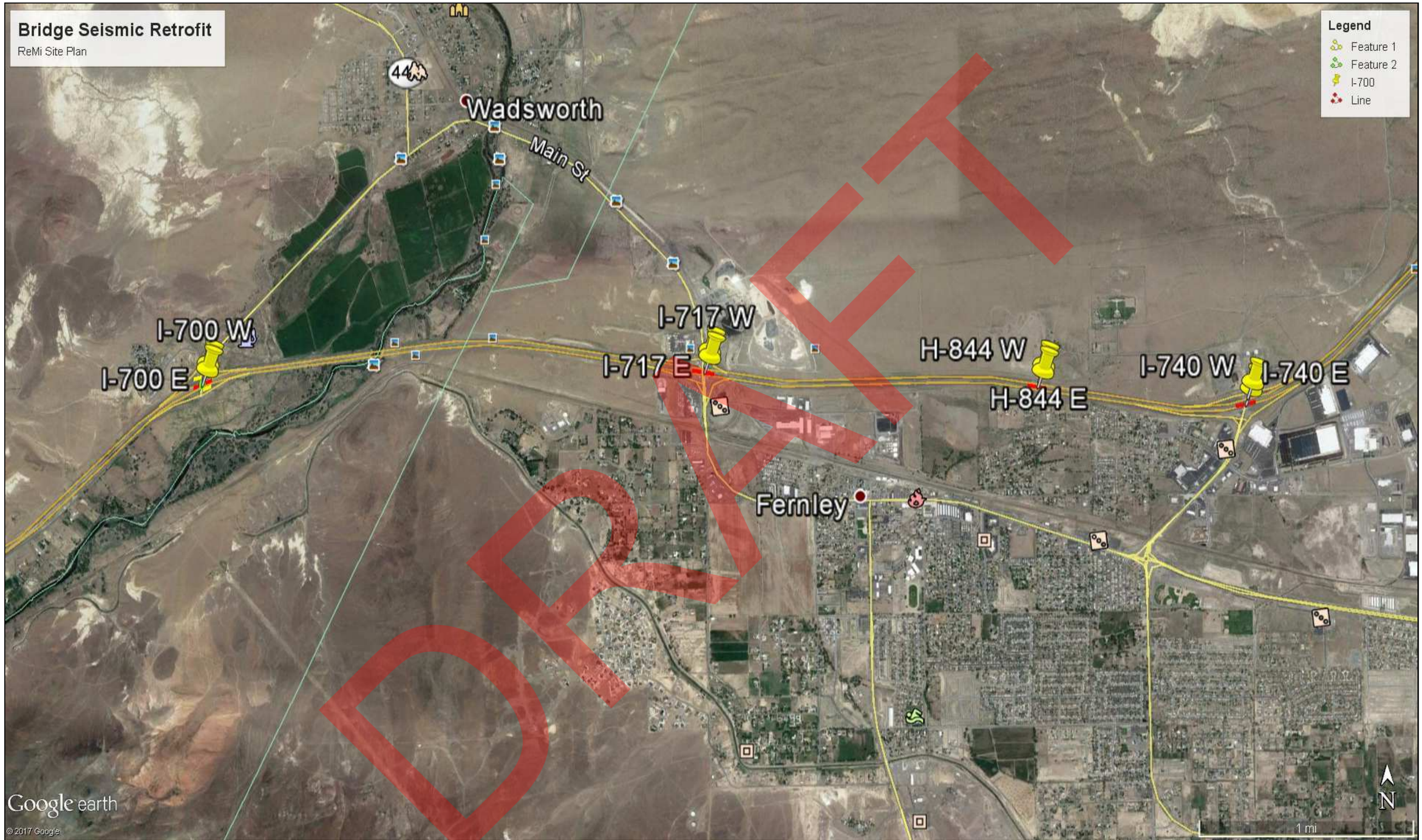
1. Strength Limit State – The ability of the soil to support an applied load without producing a shear failure (bearing failure) within the soil mass;
2. Service Limit State – The bearing resistance of the soil for a given deformation (settlement) tolerance;
3. Extreme Limit State – the bearing resistance of the soil during extreme events such as liquefaction and seismic events.

As requested, we provided only the service limit bearing resistance for the eastbound and westbound I-717 Structures. Settlement estimates can vary widely, therefore to determine the range of settlement for both the eastbound and westbound foundations under varying loads, we considered two different methods; the half-space method (AASHTO 2014) and the elastic theory method (Day, 2005). Plots showing the range of estimated settlement values for a given load is presented on Figures A-3 and A-4 in Appendix A.

If you have any questions or wish to discuss further, please do not hesitate to contact me at 775-888-7332.

KJ:MG:kj

Appendix A
Figures



1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

Figure A-1: Vicinity Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046

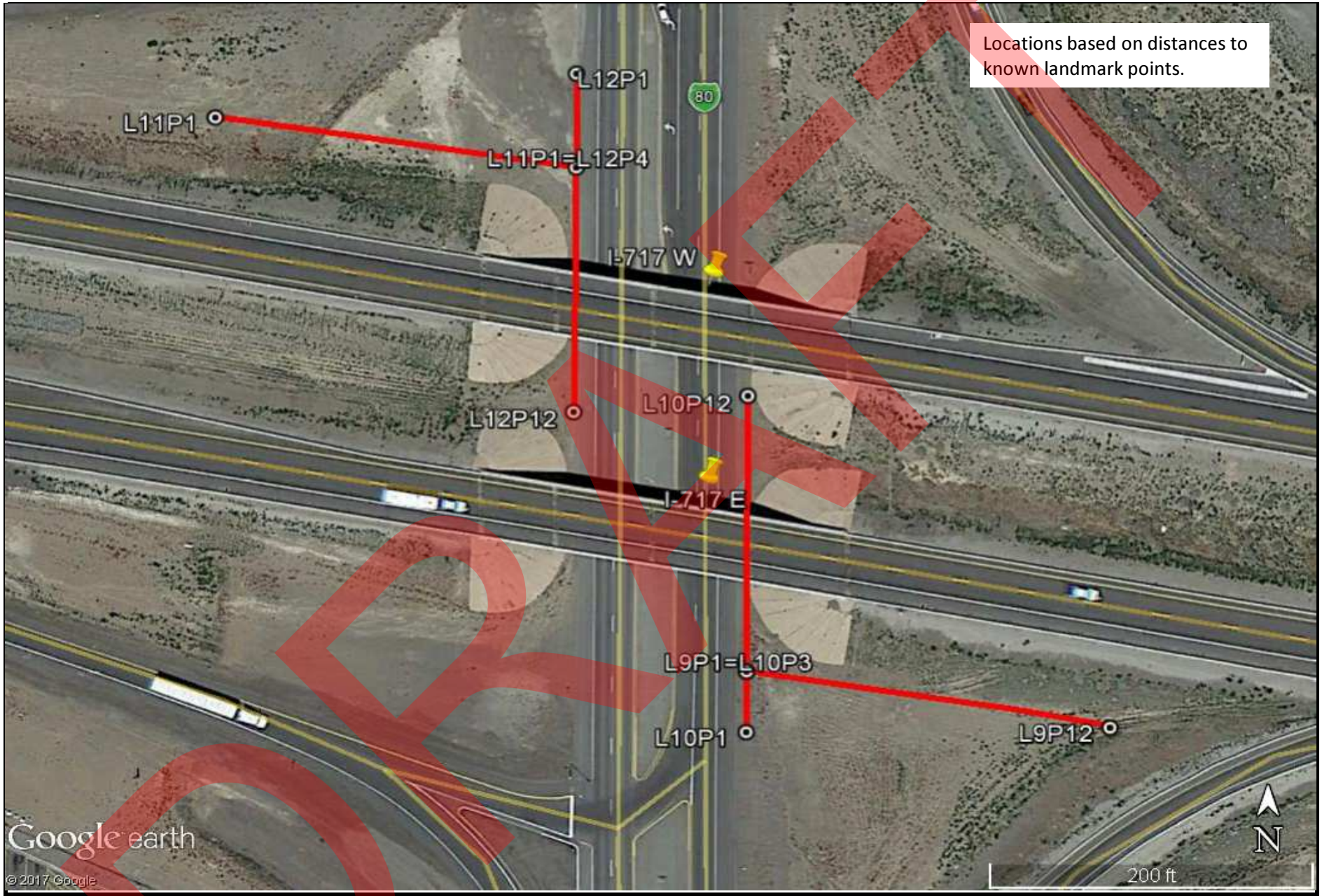


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Figure 2: I-717 Site Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046

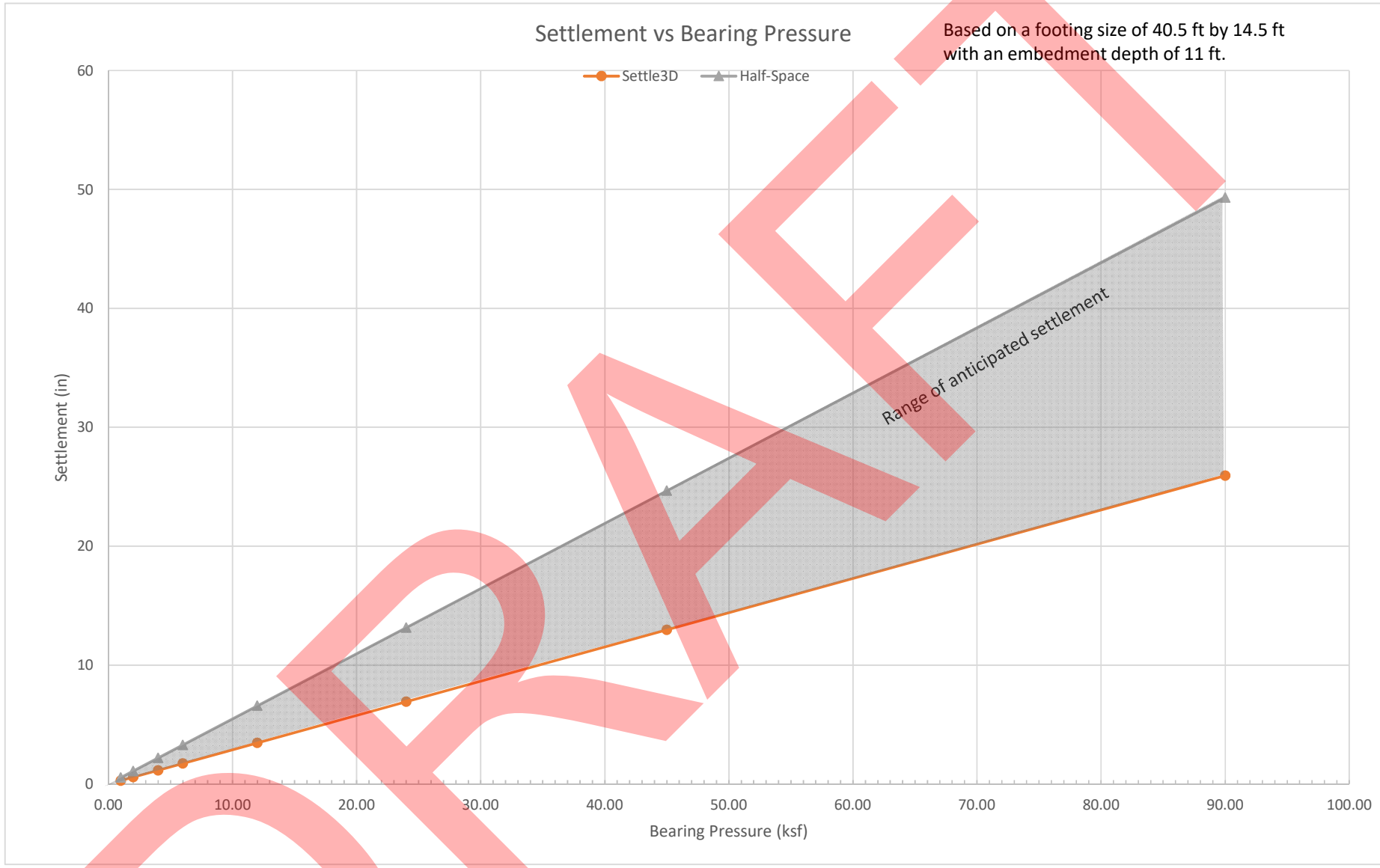

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Figure A-3: Settlement vs Bearing Pressure

Location: I-717 EB
Project Name: Seismic Retrofit
EA Number: 74046

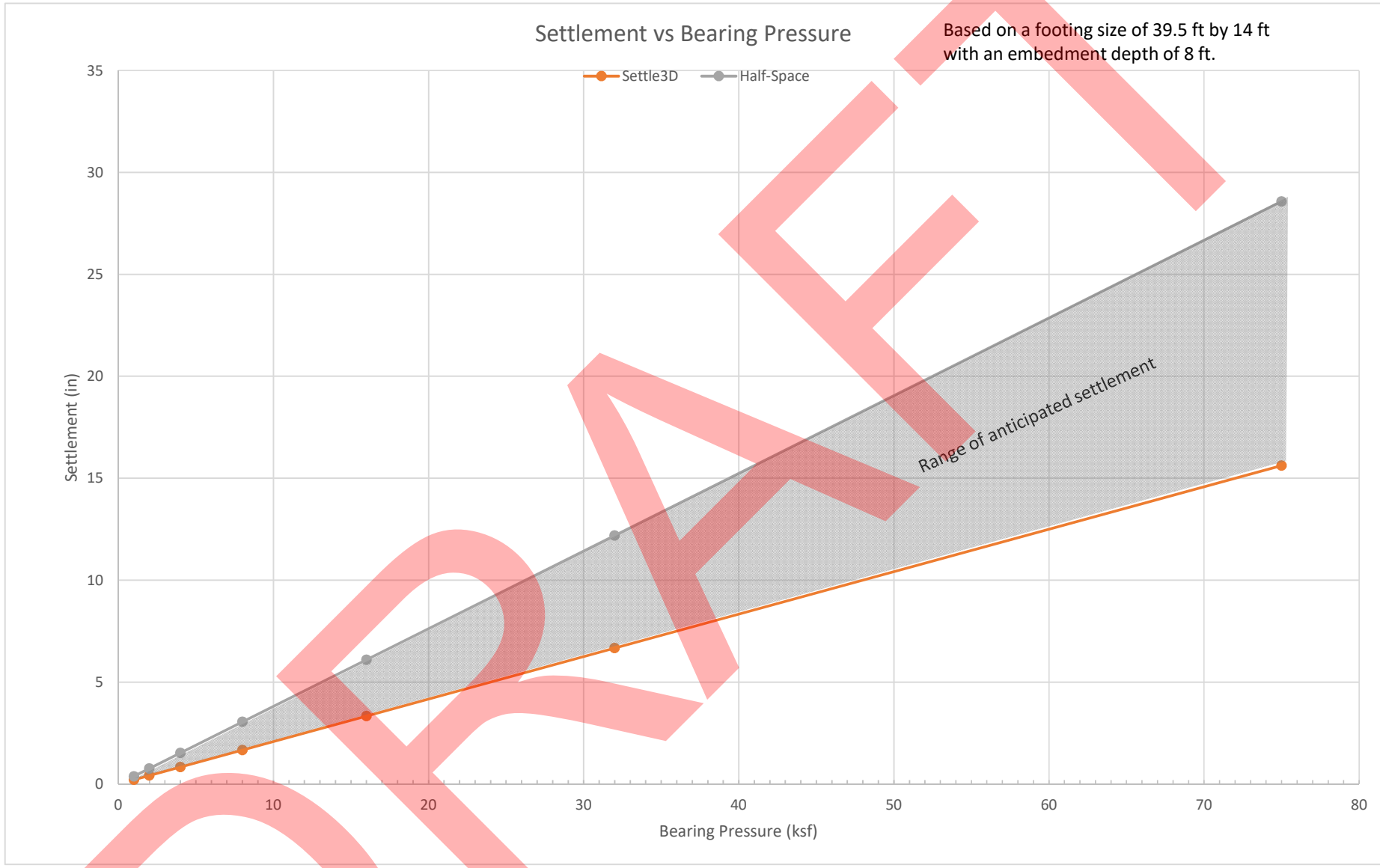

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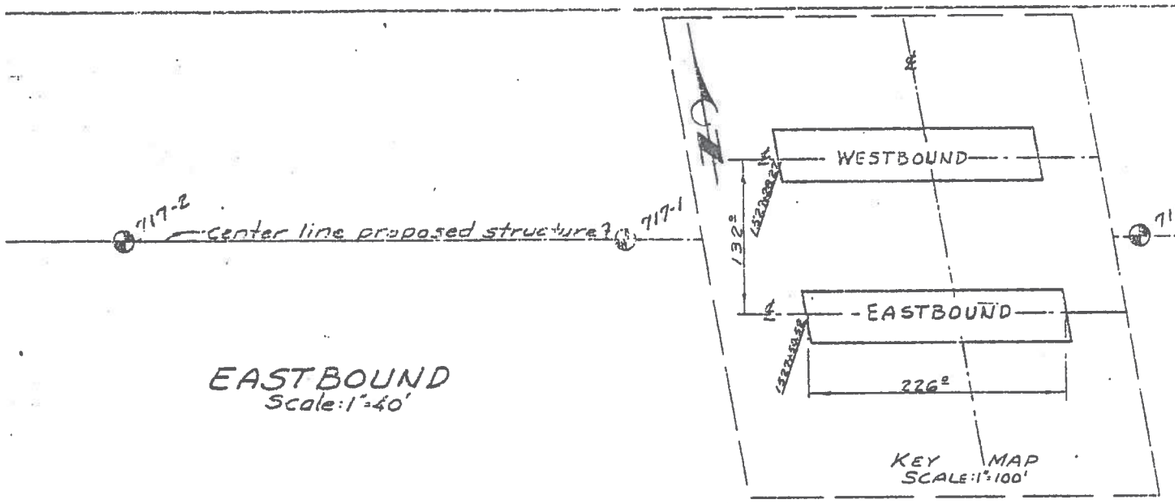
Figure A-4: Settlement vs Bearing Pressure

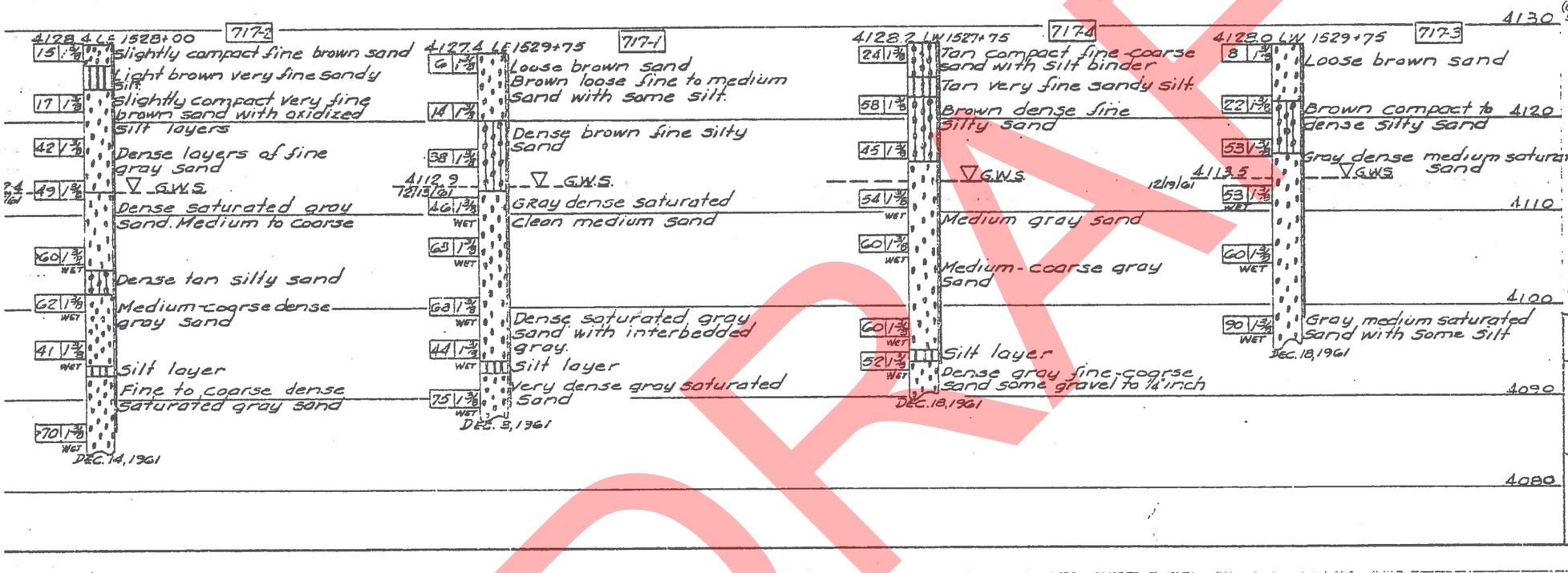
Location: I-717 WB
Project Name: Seismic Retrofit
EA Number: 74046

Appendix B
Boring Logs



EASTBOUND
Scale: 1"=40'

WESTBOUND
Scale: 1"= 50'



LEGEND OF BORING OPERATIONS & GRAPHIC SOIL CLASSIFICATIONS

TOP OF HOLE ELEV. LOCATION BORING NO.

SIZE OF SAMPLE
BLOWS PER FOOT (140 lb HAMMER, 30" DROP)
UNCONFINED COMPRESSION STRENGTH (T/SQ.FT.)
UNIT WEIGHT (#/CU.FT.) DRY
MOISTURE %
G.W.S. (GROUND WATER SURFACE) DATE MEASURED

- WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- SILTY GRAVEL-SAND-SILT MIXTURES
- CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
- WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- SILTY SANDS, SAND-SILT MIXTURES
- CLAYEY SANDS, SAND-CLAY MIXTURES
- INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS
- SANDY CLAYS, SILTY CLAYS LEAN CLAYS
- ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
- INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
- INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
- ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
- PEAT AND OTHER HIGHLY ORGANIC SOILS

Casing
- CONFORMABLE MATERIAL CHANGE
- ESTIMATED MATERIAL CHANGE
- UNCONFORMABLE MATERIAL CHANGE

DATE OF BORING

SIZE AUGER BORING (SIZE) ROTARY BORING

LOG OF TEST BORINGS

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS
WADSWORTH-FERNLEY INTERCHANGE
I 71 7E & I 71 7W

SPROUT ENGINEERS INC.
SPARKS, NEVADA

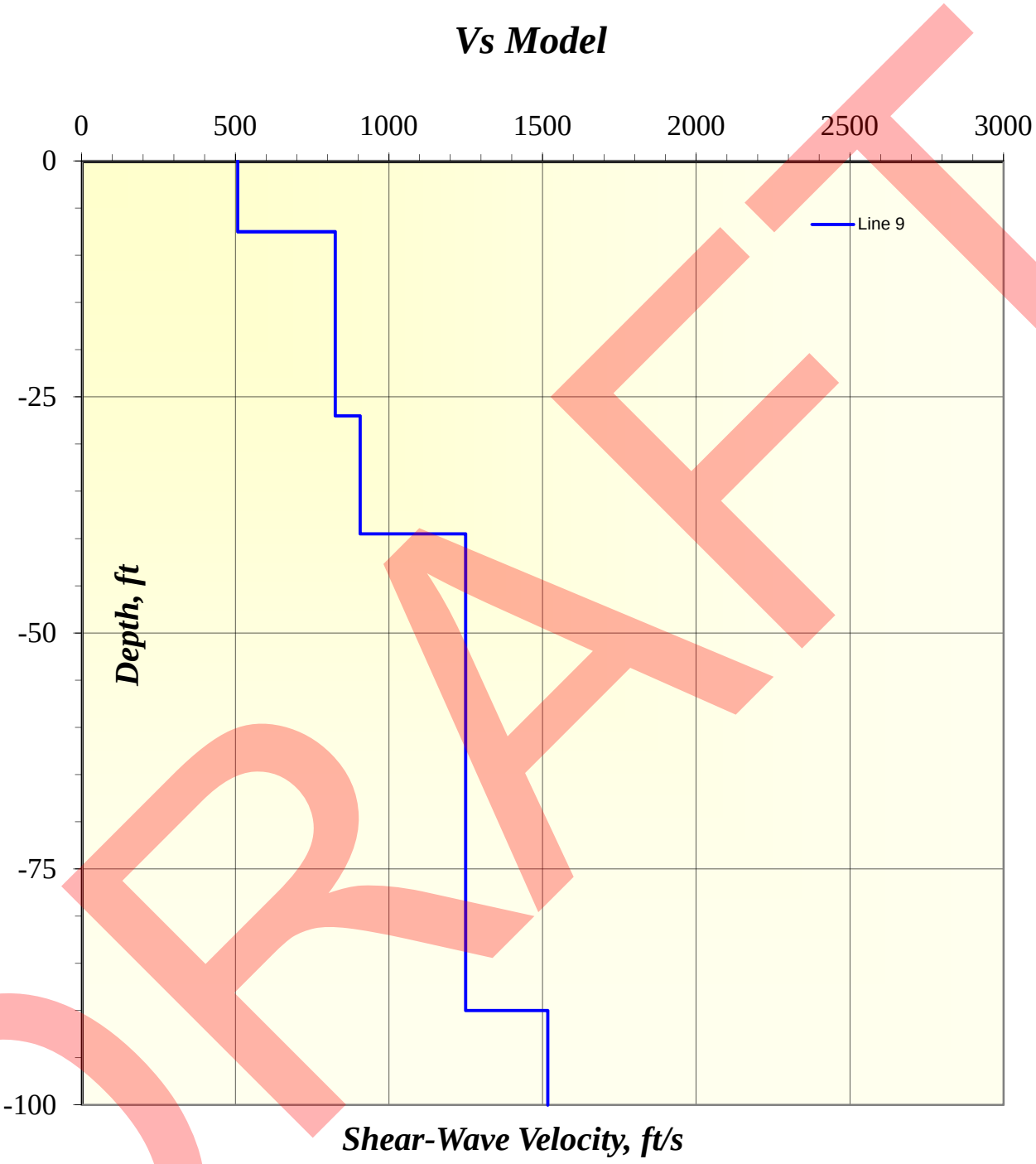
APPROVED: Eugene C. Sprout

JOB NO. 141T-61
PAGE NO. 98

Appendix C

Geophysical Survey Results

Shear Wave Velocity Profile



IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **1008.00** **ft/s**

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Figure C-1: Line 9 Vs100

Location: I-717

Project Name: Seismic Retrofit

EA Number: 74046

Shear Wave Velocity Profile

IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **921.20** **ft/s**

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Fax: (775) 888-7201

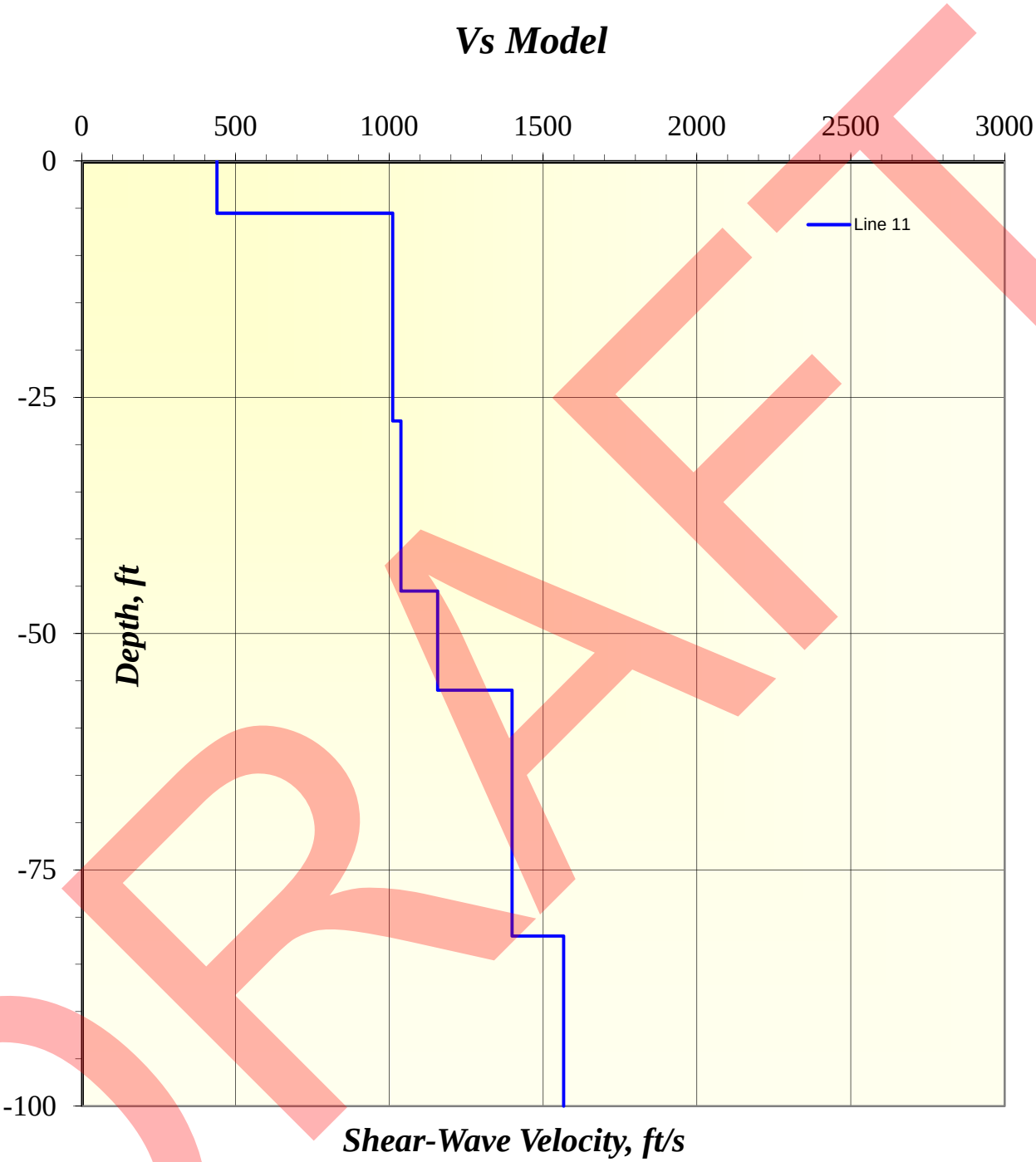
Figure C-2: Line 10 Vs100

Location: I-717

Project Name: Seismic Retrofit

EA Number: 74046

Shear Wave Velocity Profile



AASHTO Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **1101.69** **ft/s**

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Fax: (775) 888-7201

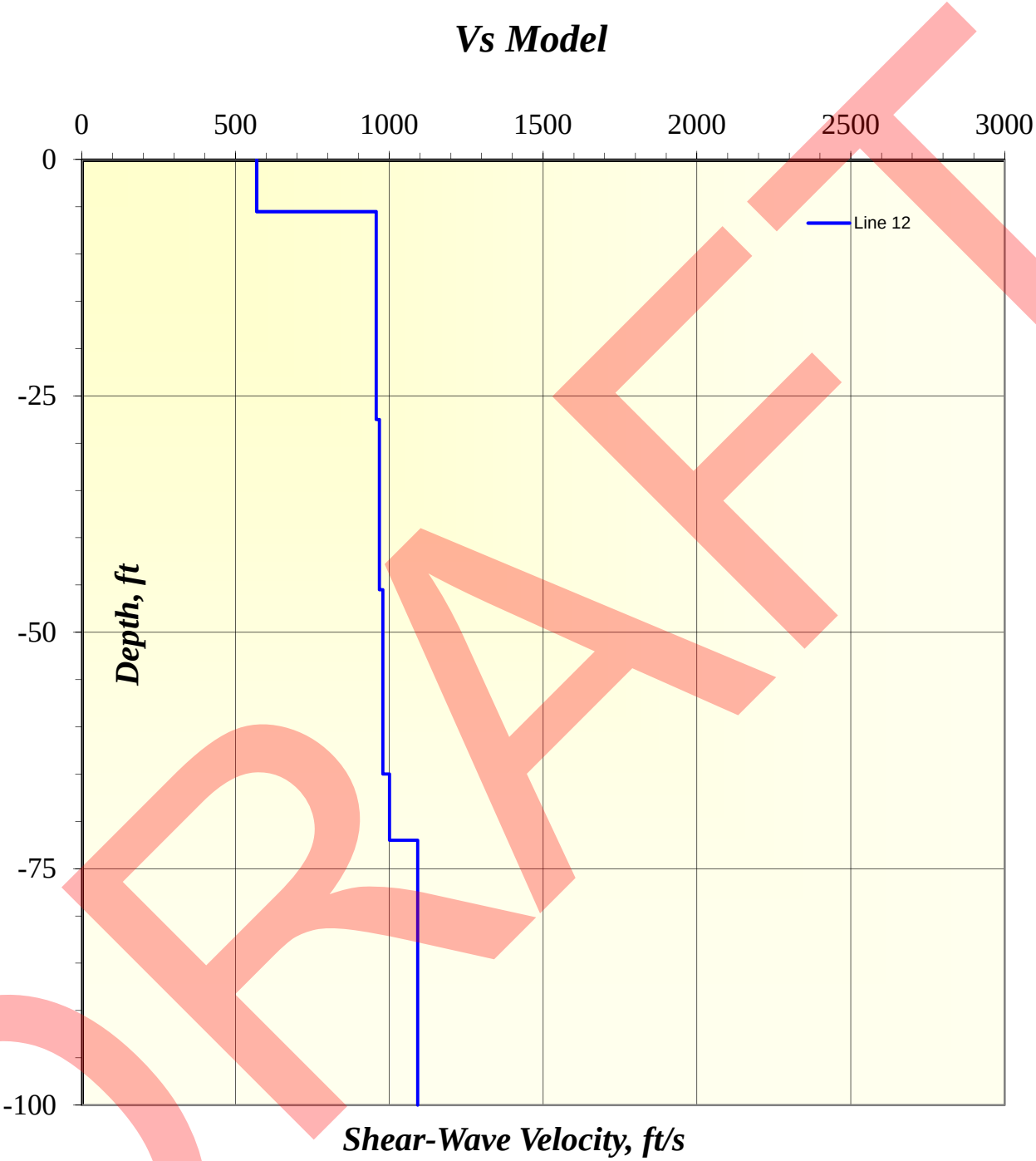
Figure C-3: Line 11 Vs100

Location: I-717

Project Name: Seismic Retrofit

EA Number: 74046

Shear Wave Velocity Profile



AASHTO Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **963.19** **ft/s**

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Figure C-3: Line 12 Vs100

Location: I-717

Project Name: Seismic Retrofit

EA Number: 74046

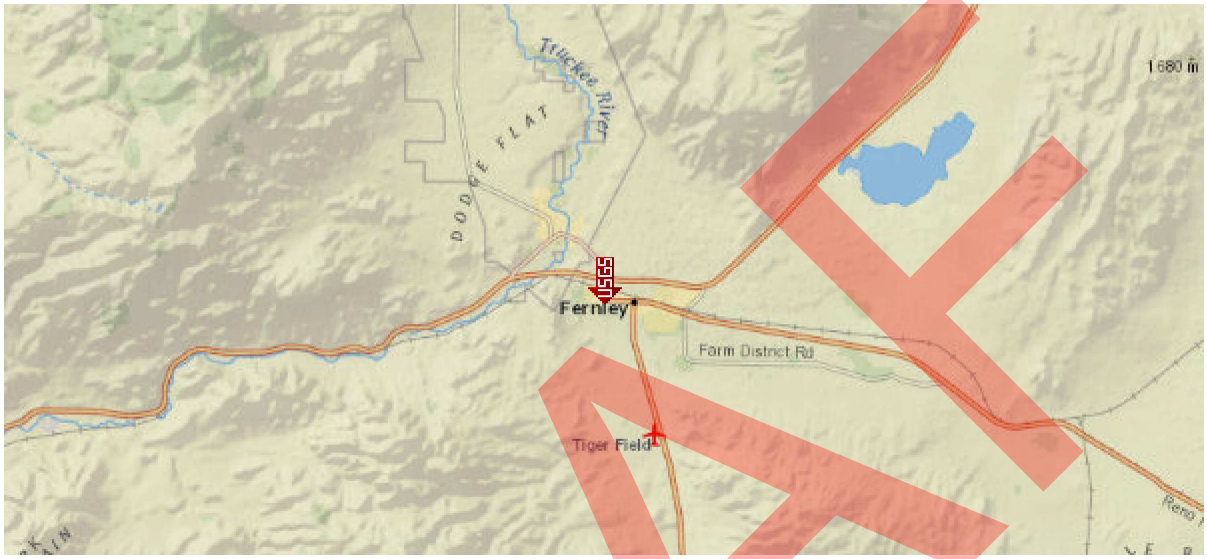
Appendix D

Seismic Design Parameters

USGS Design Maps Summary Report

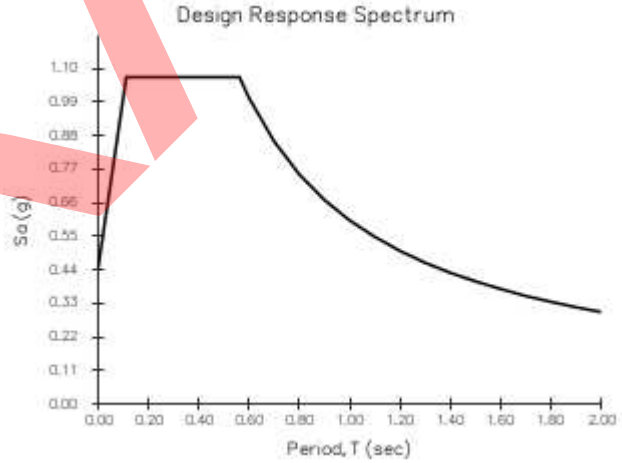
User–Specified Input

Report Title	I-717 E Thu October 26, 2017 16:00:45 UTC
Building Code Reference Document	2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (which utilizes USGS hazard data available in 2002)
Site Coordinates	39.61599°N, 119.26516°W
Site Soil Classification	Site Class D – "Stiff Soil"



USGS–Provided Output

PGA =	0.409 g	**A_s =**	0.446 g
S_s =	0.961 g	**S_{DS} =**	1.072 g
S_1 =	0.358 g	**S_{D1} =**	0.602 g



Appendix G
I-740 Design Parameters Memo

1263 South Stewart Street
Carson City, Nevada 89712
Phone: (775) 888-7440
Fax: (775) 888-7201

MEMORANDUM

6/18/2018

To: **Michael Mayberry, P.E., Structures Division**

From: **Jesse Ruzicka, P.E., Materials Division**

Subject: **Geotechnical Design Parameters for the Seismic Retrofit of I-740**

Project No. 74046

This memorandum presents our recommended geotechnical design criteria for the proposed structural retrofit of structure I-740, based on our geophysical exploration, record research, and limited geotechnical analysis.

Project Description

Review of the as-built plans indicates the I-740 structure is a three-span bridge, with abutments supported on 3½-foot wide strip footings founded on embankment fill. The intermediate bents are supported on 9½- by 9½-foot square footings founded on native soils approximately 4- to 5-feet below ground surface (bgs).

It is our understanding that the proposed seismic retrofit will consist of constructing a single rectangular footing with a dimension of 43½- by 9½-feet at each bent location.

Site Description

Structure I-740 is located on I-80 in Fernley, Nevada in Lyon County. The site consists of one bridge structure per direction of traffic, eastbound and westbound. The site topography is generally flat except for the approximately 20-foot tall embankment fills for the eastbound and westbound lanes of the highway. The embankments have a slope of approximately 2(H):1(V) and have concrete slope paving near the bridges. 30-inch corrugated metal culverts with concrete headwalls were observed at the toe of the slope perpendicular to the highway. At the time of our exploration, the surface consisted of sand with sparse grass and brush. The Vicinity Map is presented on Figure A-1 in the attachments.

Geophysical Exploration

On December 6th, 2017, we performed four Refraction Microtremor (ReMi) surveys. Two lines were orientated perpendicular to each other and performed at the existing bridge abutments. The ReMi lines were placed in general accordance with FHWA NHI-01-031, and locations shown on Figure A-2.

The purpose of the geophysical exploration was to determine the shear wave velocity, (Vs_{100}) within the top 100 feet. The Vs_{100} was used in determining the seismic Site Class and estimating soil properties based on published correlations. The ReMi lines were performed using a DAQLink III 12-channel seismograph with 10-Hz geophones spaced at 20-foot intervals,

and Vibrascope Version 2.4.79 acquisition software. Passive energy sources consisted of vehicular traffic along Interstate 80.

Analysis of Geophysical Data

Analysis of collected data was performed using the software package, Optim SeisOpt ReMi™ Version 4.1. SEG-Y files were exported from the data collection software and processed to generate the velocity spectrum, from which picks could be made along the Rayleigh wave dispersion profile. Dispersion inversion was performed to generate the dispersion curve and shear wave velocity profiles.

Analysis and interpretation of the ReMi data was performed by Optim. One dimensional shear wave velocity profiles for each of the surveys are presented in Appendix C.

Geotechnical Review of Existing Data

A review of records indicates four borings were performed by Sprout Engineers Inc. in November 1961 with the site subsurface materials generally consisting of loose to medium dense sand to a depth of approximately 30 feet (bgs). Below the sand, stiff inorganic silt was encountered to the maximum depth explored of approximately 80 feet below ground surface (bgs).

Design Parameter Recommendations

Published correlations found in AASHTO LRFD Bridge Design Specifications, as well as FHWA-NHI-01-03, FHWA-HRT-06-032, and NAVFAC 7.2 were utilized in the development of following design parameters as presented in the table below.

I-740 Soil Design Parameters

Parameter	Value*	Reference
Unit weight, γ_t (pcf)	125	FHWA-NHI-01-031 9-5
Poisson's ratio, v	0.3	AASHTO LRFD 7th Table C10.4.6.3-1
Cohesion, c (psf)	0	NAVFAC 7.2-39
Internal friction angle, φ (degrees)	34	AASHTO LRFD 7th Table 10.4.6.2.4-1
Large strain shear modulus G (ksf)	545	FHWA-HRT-06-032 6.2.2.1
Elastic modulus, E (ksf)	1,400	AASHTO LRFD 7th Table 10.4.6.3-1
Average blow count	13	AASHTO LRFD 7th Table C3.10.3.1-1
Average shear wave velocity, Vs_{100} (fps)	905	AASHTO LRFD 7th Table C3.10.3.1-1
Site Class	D	AASHTO LRFD 7th Table 3.10.3.1-1

* Based on limited existing boring data and shear wave velocity (ReMi) geophysical surveys.

In general, the soil bearing resistance using Load Resistance and Factor Design (LRFD) considers the following three loading conditions:

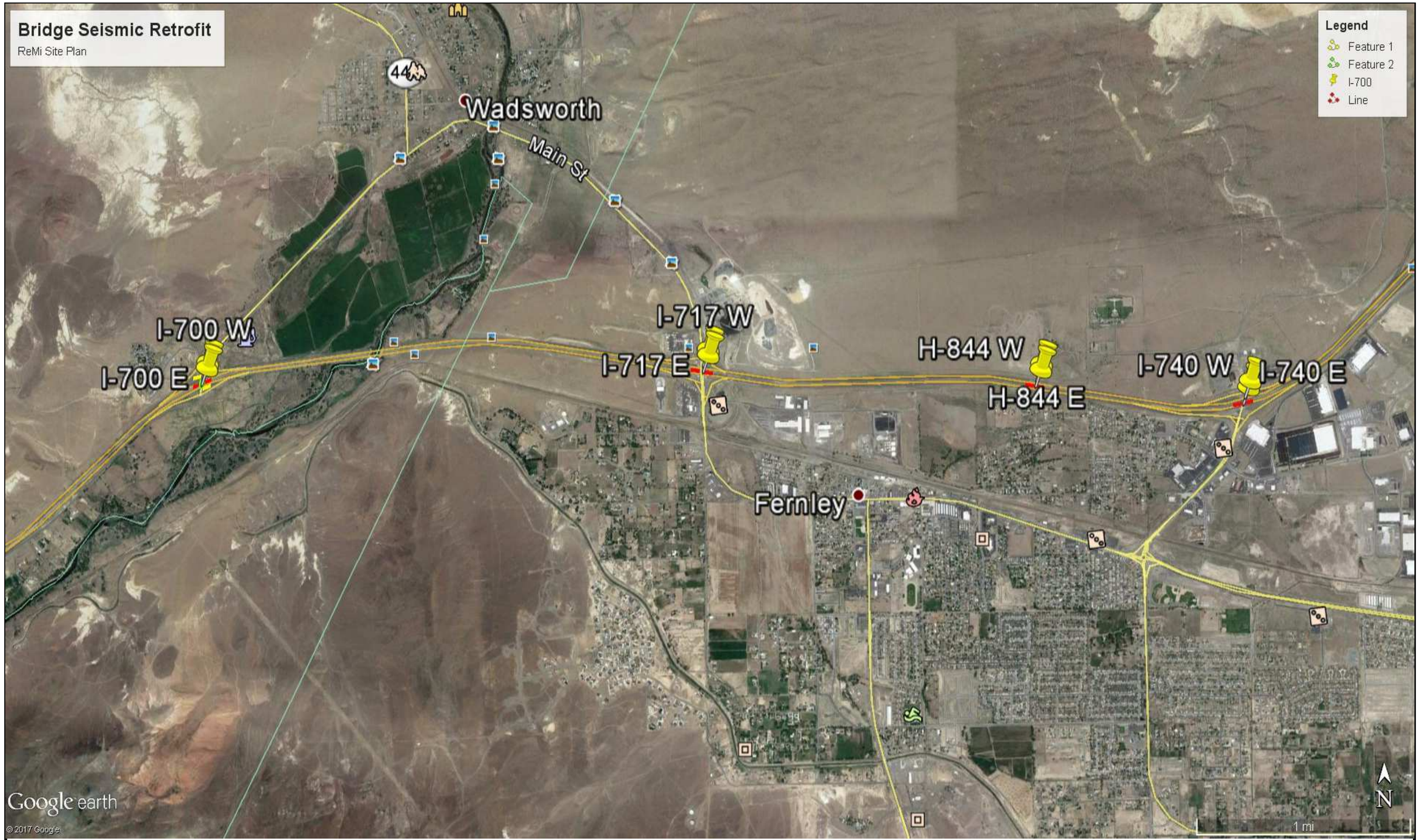
1. Strength Limit State – The ability of the soil to support an applied load without producing a shear failure (bearing failure) within the soil mass;
2. Service Limit State – The bearing resistance of the soil for a given deformation (settlement) tolerance;
3. Extreme Limit State – the bearing resistance of the soil during extreme events such as liquefaction and seismic events.

As requested, we provided only the service limit bearing resistance for the Structure I-740. Settlement estimates can vary widely, therefore to determine the range of settlement for a 9.5-foot x 43.5-foot foundation under varying loads, we considered two different methods; the half-space method (AASHTO 2014) and the elastic theory method (Day, 2005). A plot showing the range of estimated settlement values for a given load is presented on Figure A-3 in Appendix A.

If you have any questions or wish to discuss further, please do not hesitate to contact me at 775-888-7821 or Kyle Jermstad at 775-888-7332.

KJ:JR:kj

Appendix A
Figures



1263 South Stewart Street
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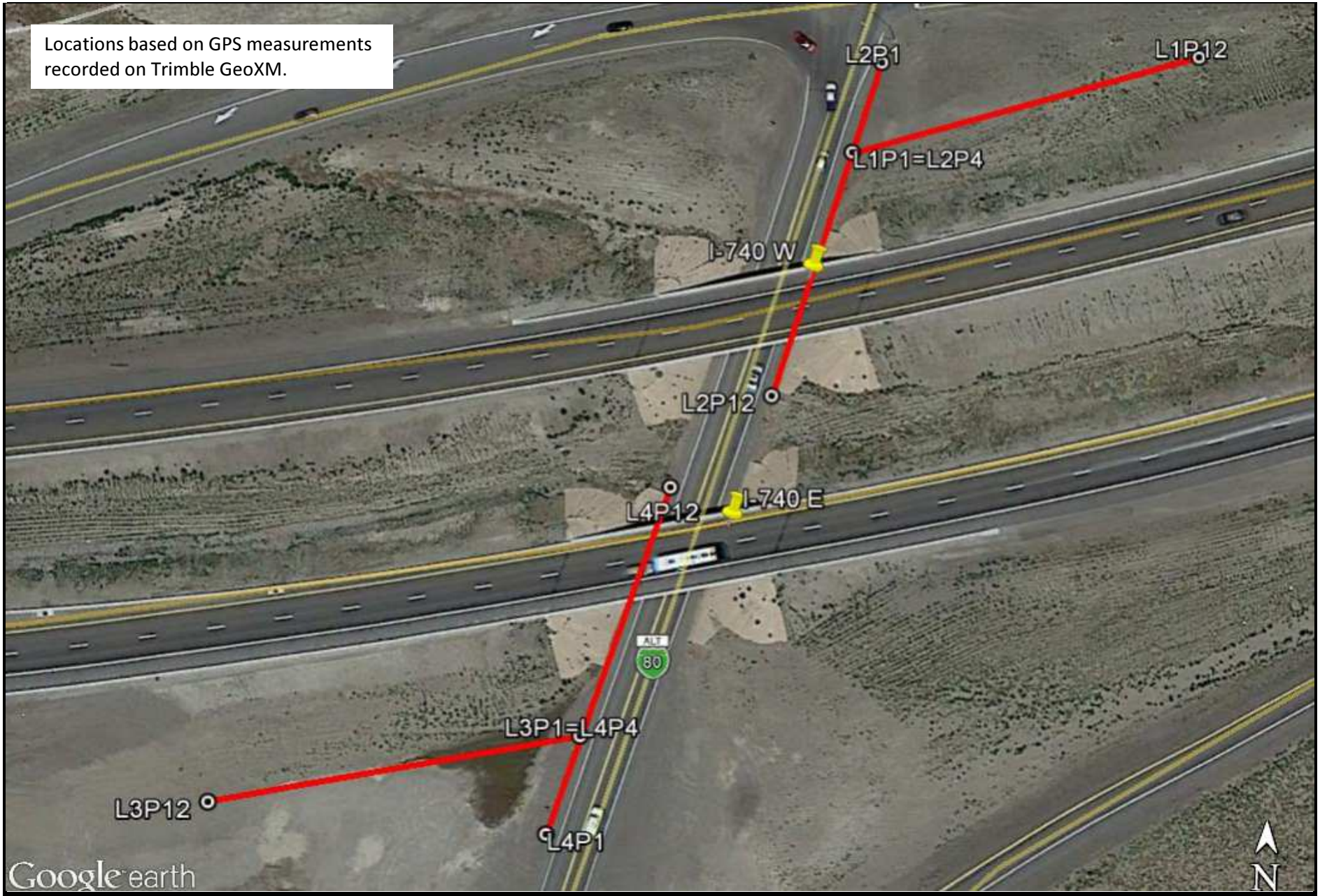
Fax: (775) 888-7201

Figure A-1: Vicinity Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



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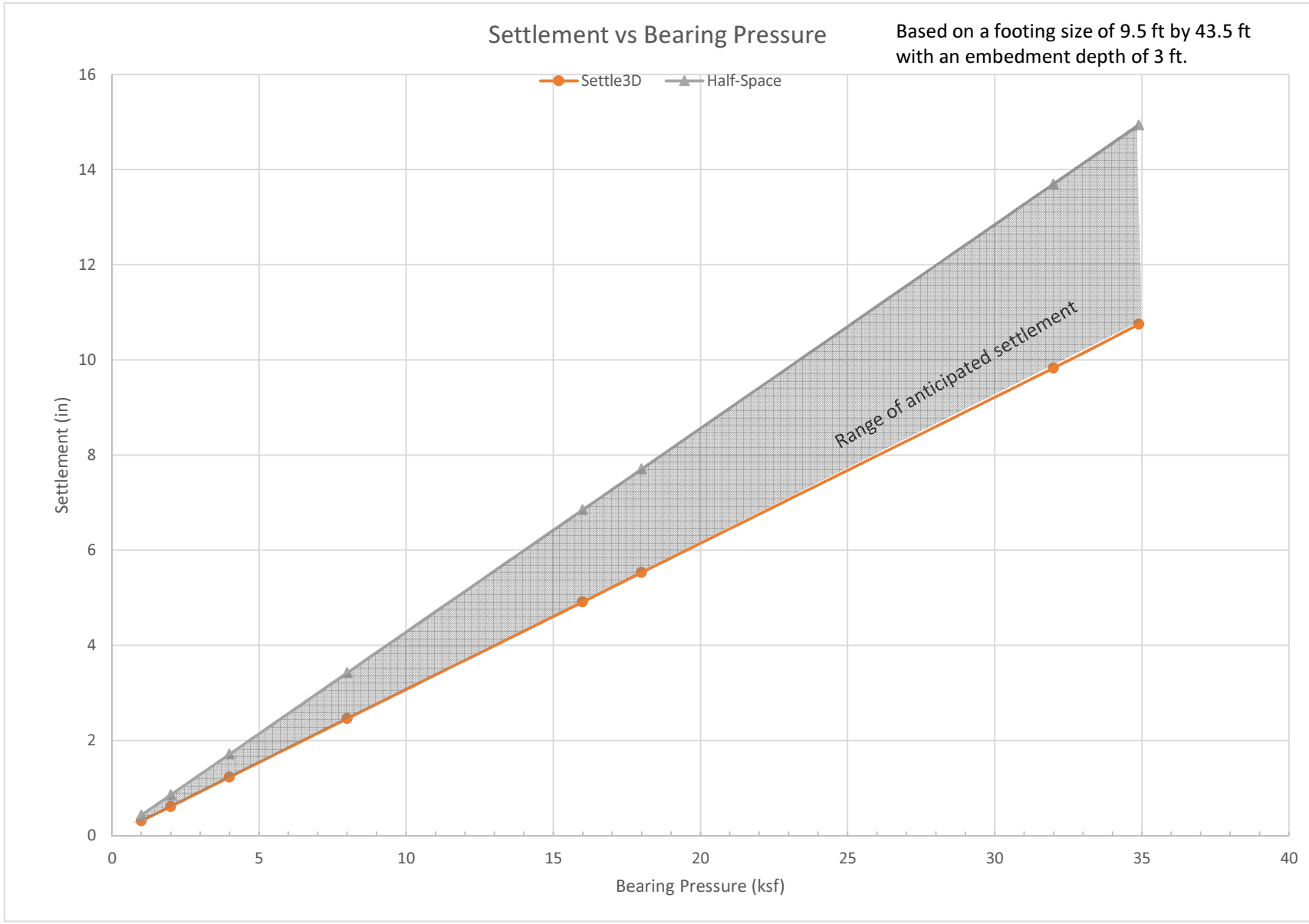
Fax: (775) 888-7201

Figure A-2: I-740 Site Map

Location: Fernley, NV

Project Name: Bridge Seismic Retrofit

EA Number: 74046



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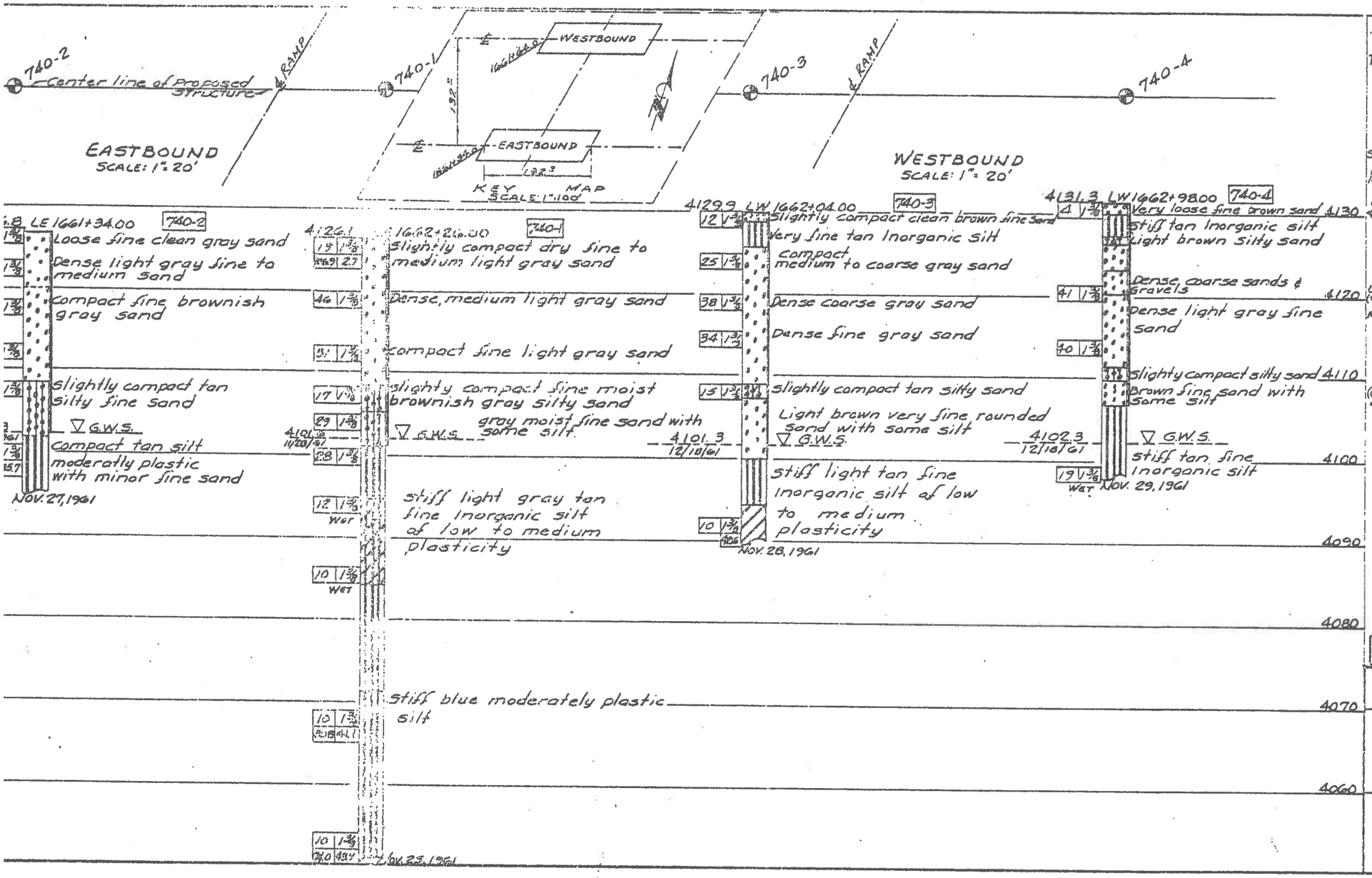
Fax: (775) 888-7201

Figure A-3: Settlement vs Bearing Pressure

Location: I-740
Project Name: Seismic Retrofit
EA Number: 74046

Appendix B

Boring Logs



LEGEND OF BORING OPERATIONS & GRAPHIC SOIL CLASSIFICATIONS

TOP OF HOLE ELEV. LOCATION

SIZE OF SAMPLE

BLOWS PER FOOT (140# HAMMER, 30" DROP)

UNCONFINED COMPRESSION STRENGTH (T/SQ.FT.)

UNIT WEIGHT (#/CU.FT.) DRY

MOISTURE %

G.W.S. (GROUND WATER SURFACE) DATE MEASURED

Casing

- WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
- SILTY GRAVEL-SAND-SILT MIXTURES
- CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
- WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
- SILTY SANDS, SAND-SILT MIXTURES
- CLAYEY SANDS, SAND-CLAY MIXTURES
- INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS
- SANDY CLAYS, SILTY CLAYS LEAN CLAYS
- ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
- INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
- INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
- ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
- PEAT AND OTHER HIGHLY ORGANIC SOILS

CONFORMABLE MATERIAL CHANGE
ESTIMATED MATERIAL CHANGE
UNCONFORMABLE MATERIAL CHANGE

DATE OF BORING

SIZE AUGER BORING (SIZE) ROTARY BORING

LOG OF TEST BORINGS

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS
EAST FERNLEY INTERCHANGE
I 740 E & I 740 W

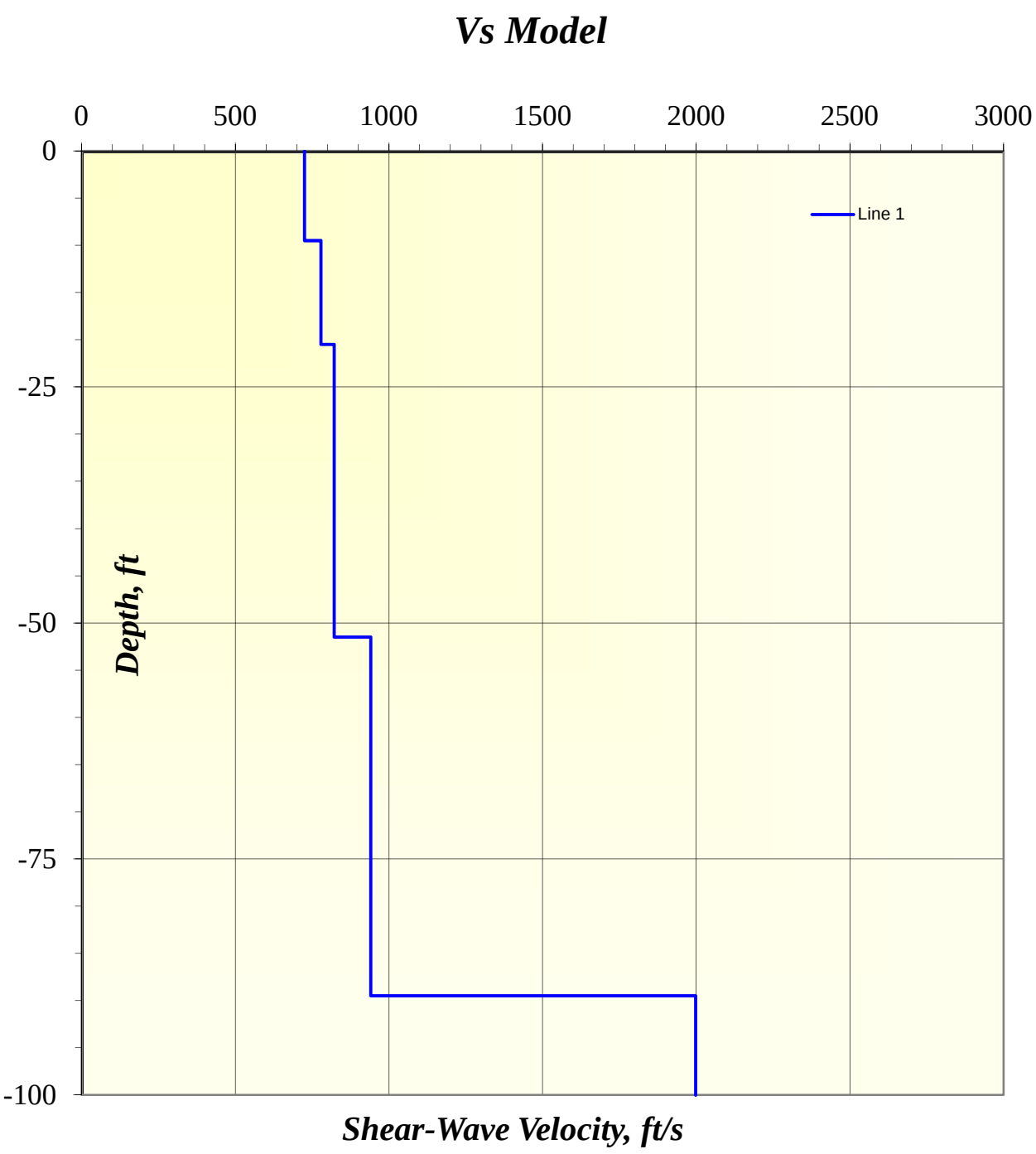
SPROUT ENGINEERS INC.
SPARKS, NEVADA

APPROVED: Eugene C. Sprout

JOB NO. 141T-61
PAGE NO. 135

Appendix C
Geophysical Survey Results

Shear Wave Velocity Profile



IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **904.44** **ft/s**

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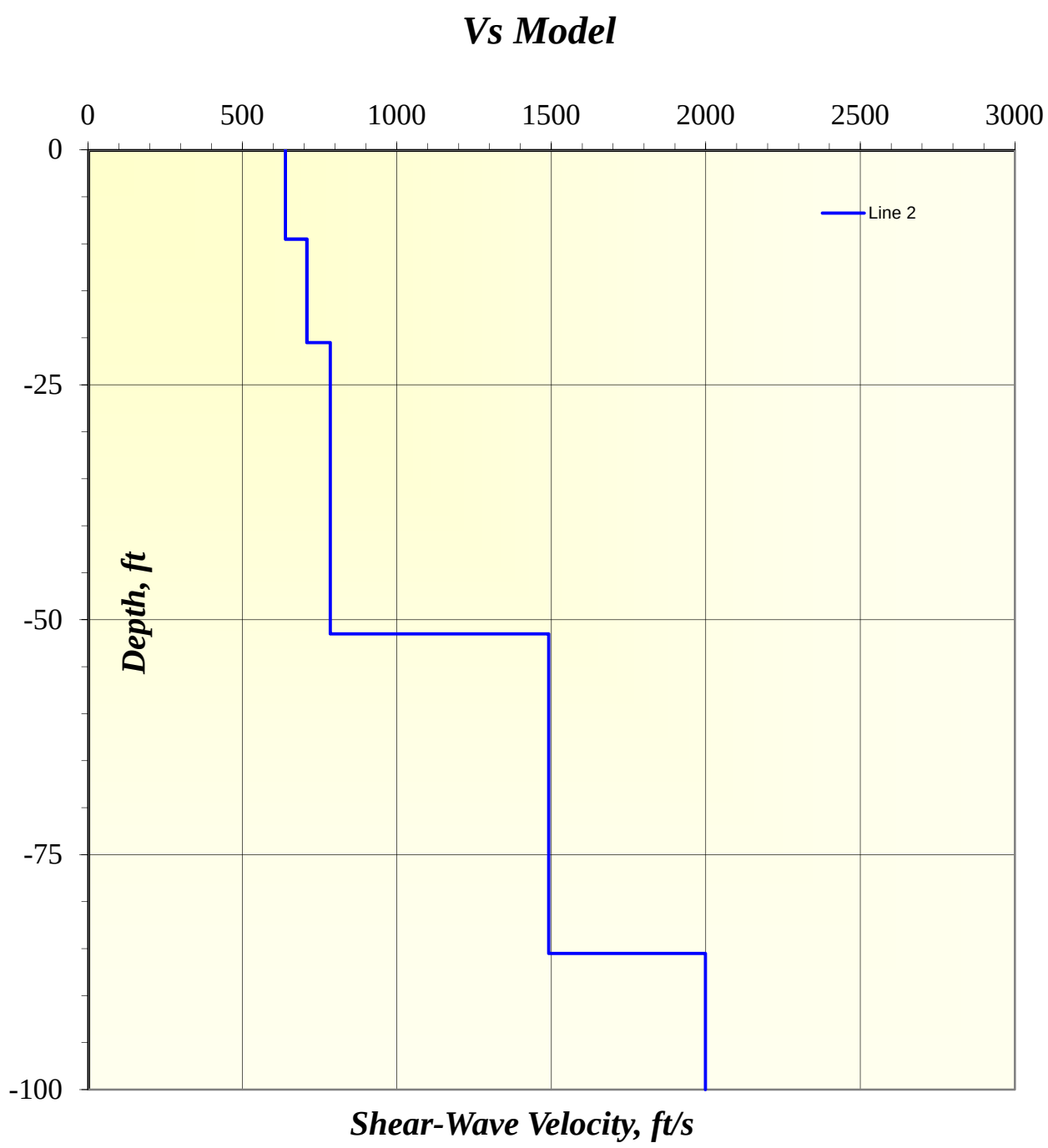
Figure C-1: Line 1 Vs100

Location: I-740

Project Name: Seismic Retrofit

EA Number: 74046

Shear Wave Velocity Profile



IBC Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **1000.36** **ft/s**

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Fax: (775) 888-7201

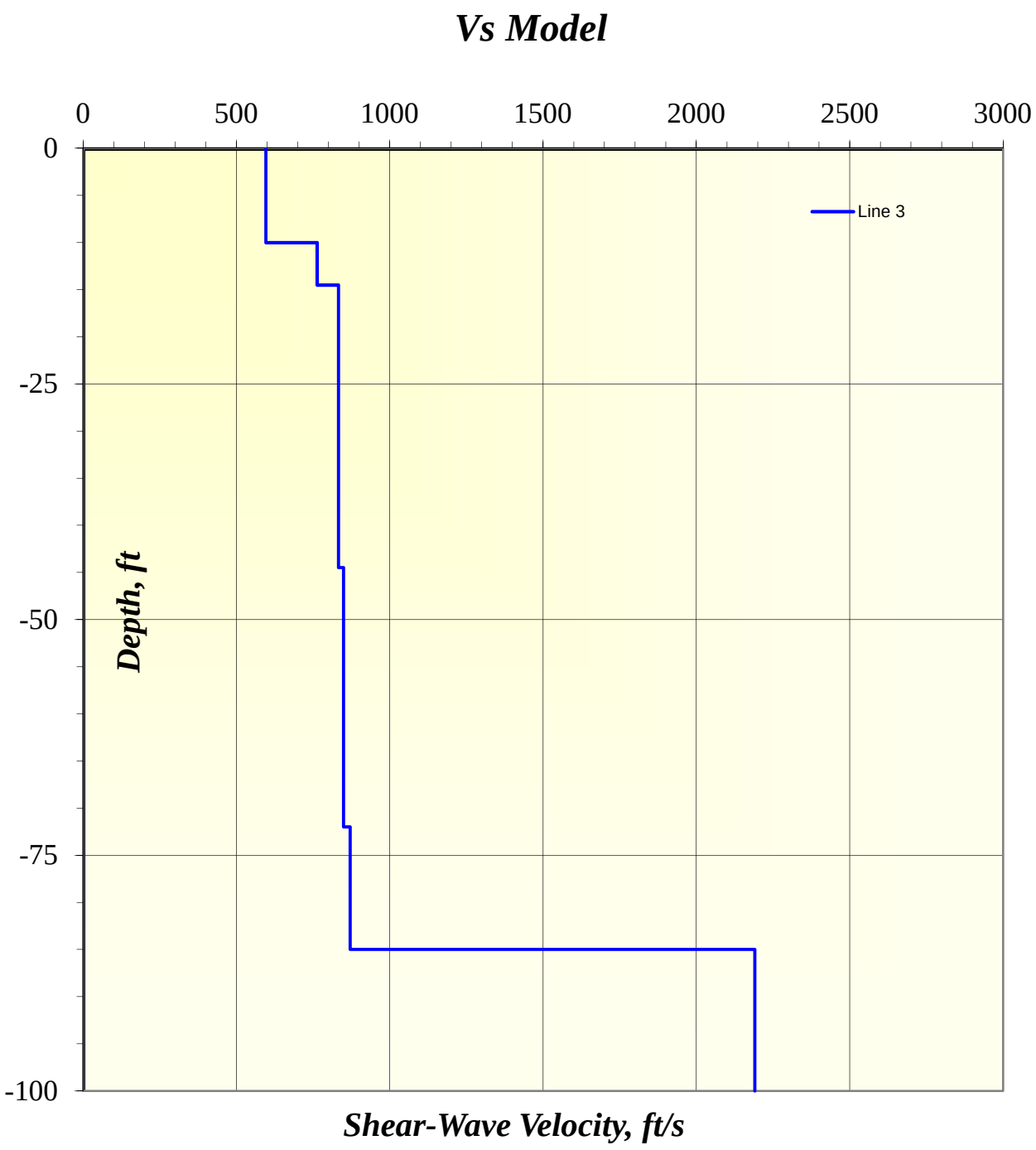
Figure C-2: Line 2 Vs100

Location: I-740

Project Name: Seismic Retrofit

EA Number: 74046

Shear Wave Velocity Profile



AASHTO Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **886.03** **ft/s**

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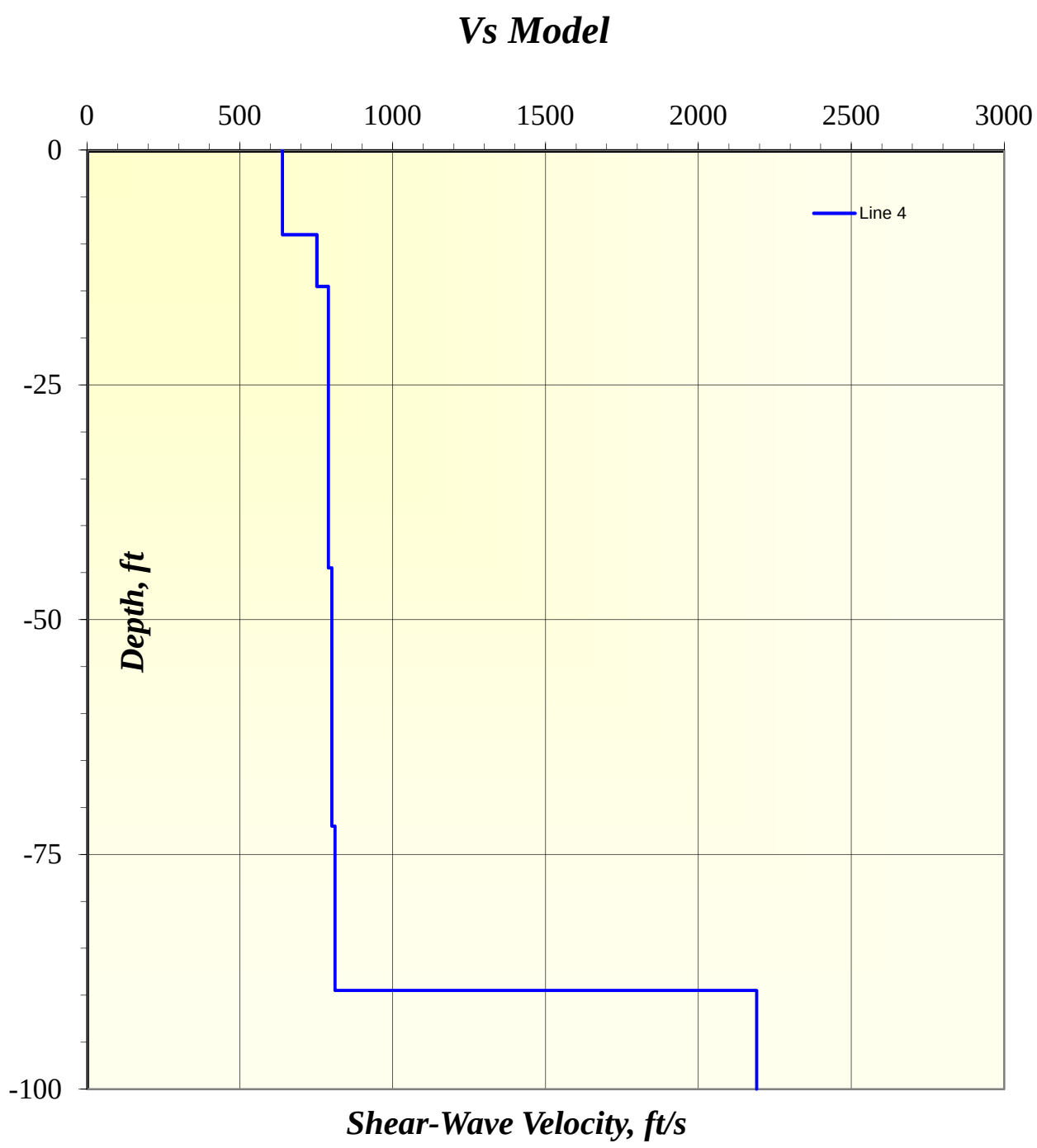
Figure C-3: Line 3 Vs100
Location: I-740
Project Name: Seismic Retrofit
EA Number: 74046

Shear Wave Velocity Profile



AASHTO Site Class: **D**

Average Shear Wave Velocity within 100 feet, Vs **832.69** **ft/s**

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Carson City, Nevada 89712
Phone: (775) 888-7440
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Figure C-4: Line 4 Vs100
Location: I-740
Project Name: Seismic Retrofit
EA Number: 74046

Appendix D
Seismic Design Parameters

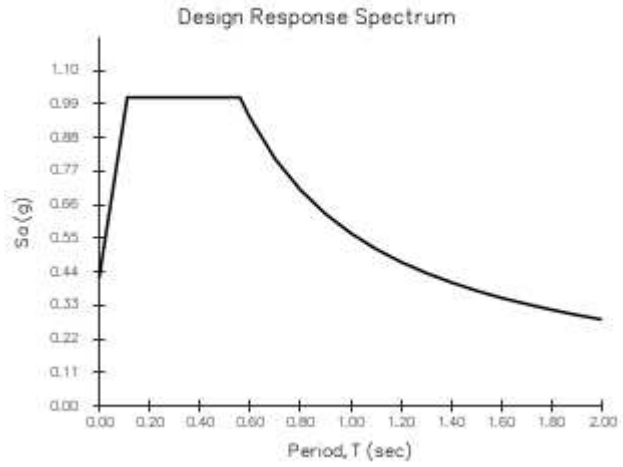
USGS Design Maps Summary Report

User–Specified Input

Report Title	I-740 Mon December 18, 2017 17:33:11 UTC
Building Code Reference Document	2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (which utilizes USGS hazard data available in 2002)
Site Coordinates	39.61312°N, 119.21806°W
Site Soil Classification	Site Class D – "Stiff Soil"

USGS–Provided Output

PGA =	0.373 g	**A_s =**	0.420 g
S_s =	0.882 g	**S_{DS} =**	1.012 g
S_1 =	0.323 g	**S_{D1} =**	0.567 g



NEVADA DEPARTMENT OF TRANSPORTATION

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