



**SECTION H**

**GEOTECHINCAL**

**PART 4**

**GLEN HELEN  
LIGHTING PROJECT**

**FOR**

**SAN BERNARDINO, CALIFORNIA**

**PROJECT NO.: 30.30.0146**

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**NOT FOR BID**

**APPENDIX A**

**GEOTECHNICAL BORING LOGS**

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## APPENDIX A

### GEOTECHNICAL BORING LOGS

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Encountered soils were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D2488). The logs of this subsurface exploration are included as part of this appendix.

Borings were drilled with a truck-mounted hollow-stem drill rig. Relatively undisturbed soil samples were obtained at selected intervals within the borings using a California Ring Sampler and a Standard Penetration Test (SPT) split-spoon sampler. Bulk samples of representative soil types were also obtained from the borings. These samples were transported to our geotechnical laboratory for evaluation and appropriate testing. Borings were backfilled with the excavated earth materials after logging and sampling was completed.

The attached subsurface exploration logs and related information depict subsurface conditions only at the location indicated and at the particular date designated on the log. Subsurface conditions at other locations may differ from conditions occurring at this location. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

# GEOTECHNICAL BORING LOG LB-1

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1992'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S							<i>This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.</i>	
1990				B-1				SM	@Surface: 2.5 inches of ASPHALT <b>Undocumented Artificial Fill (Afu)</b> @2.5": SILTY SAND (SM), dark brown, slightly moist, fine to coarse sand, trace of gravel, 20% fines (field estimate)	
				R-1	11 14 18	123	3	SP	<b>Alluvial Wash Deposits (Qw)</b> @2.5": POORLY GRADED SAND with GRAVEL (SP), medium dense, olive brown, slightly moist, coarse sand, 15% gravel, 5% fines (field estimate)	
	5			R-2	17 19 19	114	5	SP	@5": POORLY GRADED SAND with GRAVEL (SP), medium dense, olive brown, slightly moist, medium coarse sand, 15% gravel, 5% fines (field estimate)	
1985				R-3	17 24 38	124	5	SP	@7.5": POORLY GRADED SAND with GRAVEL (SP), dense, olive brown, slightly moist, slightly cemented, coarse sand, 20% gravel, 5% fines (field estimate)	
	10			R-4	17 30 40	126	4	SP	@10": POORLY GRADED SAND with GRAVEL (SP), dense, olive brown, moist, slightly cemented, coarse sand, 15% gravel, 5% fines (field estimate)	
1980										
	15			S-1	7 8 10			SP-SM	@15": POORLY GRADED SAND with SILT (SP-SM), medium dense, brown, slightly moist, medium to coarse sand, 10% fines (field estimate) -Auger slightly grinding	
1975										
	20			R-5	30 50/6"			SP	@20": POORLY GRADED SAND with GRAVEL (SP), very dense, brown, slightly moist, medium to coarse sand, 5% fines (field estimate) -Auger slightly grinding, some cobbles in cuttings	
1970										
	25			S-2	38 28 19			SP	@25": POORLY GRADED SAND with GRAVEL (SP), dense, gray and brown, wet, medium to coarse sand, 5% fines (field estimate) -Auger slightly grinding, GW measured @ 25'	
1965										
	30									

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-1

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1992'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
		N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
1960	30	•••••		R-6	50/3"			SP-SM	@30': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), very dense, light brown, wet, medium to coarse sand, 10% fines (field estimate) -Auger slightly grinding	
1955	35	•••••		S-3	8 14 24			SP-SM	@35': POORLY GRADED SAND with SILT (SP-SM), dense, light brown, very moist, medium to coarse sand, trace of gravel, 10% fines (field estimate)	
1950	40	•••••		R-7	19 19 50/5"			SP-SM SC	@40': POORLY GRADED SAND with SILT (SP-SM), light brown, very moist, medium to coarse sand, trace of gravel, 10% fines (field estimate) @41': CLAYEY SAND (SC), very dense, brown, wet, fine to coarse sand, 45% fines (field estimate)	
1945	45	•••••		S-4	11 37 31			SC	@45': CLAYEY SAND (SC), very dense, brown, wet, medium to coarse sand, 20% fines (field estimate)	
1940	50	•••••		R-8	17 50/6"			SC	@50': CLAYEY SAND (SC), very dense, brown, wet, coarse sand, 15% fines (field estimate)	
									<b>TOTAL DEPTH = 51 FEET</b> <b>GROUNDWATER ENCOUNTERED AT 25 FEET</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH</b>	
1935	55	•••••								
60										

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-10

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-21-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2079'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0	N S		B-1				SP-SM	<i>This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.</i> <b>Alluvial Wash Deposits (Qw)</b> @Surface: POORLY GRADED SAND with SILT and GRAVEL (SP-SM), tan, dry, coarse sand, some cobbles (6-8 inches) present, 8% gravel, 8% fines (lab)	MD, SA, CR
2075				R-1	8 11 27	114	2	SP-SM	@2.5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, tan, dry, fine to coarse sand, 15% gravel, 10% fines (field estimate)	
	5			R-2	18 20 22	99	2	SP-SM	@5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, tan, slightly moist, fine to coarse sand, 15% gravel, 10% fines (field estimate)	
2070				R-3	50/6"			SP	@7.5': NO RECOVERY	
	10			R-4	11 15 27			SP	@10': POORLY GRADED SAND with GRAVEL (SP), dense, olive brown, slightly moist, coarse sand, 15% gravel, 5% fines (field estimate) -Auger grinding heavily	
2065				S-1	7 8 17			SM	@15': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, trace of gravel, trace of tree roots, 25% fines (field estimate)	
2060				R-5	32 50/4"			SM	@20': POORLY GRADED SAND with SILT (SP-SM), very dense, brown, moist, medium to coarse sand, fine to coarse gravel, 10% fines (field estimate) -Auger grinding heavily	
2055				S-2	15 17 25			SP-SM	@25': POORLY GRADED SAND with SILT (SP-SM), dense, brown, slightly moist, medium to coarse sand, trace of gravel, 10% fines (field estimate)	
2050										

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-10

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-21-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2079'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
30				R-6	40 50/5"			SM	@30': SILTY SAND (SM), very dense, brown, slightly moist, fine to coarse sand, slightly cemented, trace of gravel, 15% fines (field estimate)	
2045				S-3	16 34 35			SP	@35': POORLY GRADED SAND (SP), very dense, grayish brown, slightly moist, fine to coarse sand, trace of gravel, 5% fines (field estimate)	
2040				S-4	50/6"			SP	@40': POORLY GRADED SAND with GRAVEL (SP), very dense, grayish brown, slightly moist, medium to coarse sand, 15% gravel, 5% fines (field estimate)	
2035				S-5	28 28 50/6"			SP	@45': POORLY GRADED SAND with GRAVEL (SP), very dense, grayish brown, slightly moist, medium to coarse sand, 15% gravel, 5% fines (field estimate)	
2030				S-6	29 36 32			SM	@50': SILTY SAND (SM), very dense, brown, slightly moist, medium to coarse sand, 20% fines (field estimate)	
2025									<b>TOTAL DEPTH = 51.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS</b>	
2020										
60										
SAMPLE TYPES:		TYPE OF TESTS:								
B	BULK SAMPLE	AL	200 % FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS			
C	CORE SAMPLE	AT	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT			
G	GRAB SAMPLE	CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY			
R	RING SAMPLE	CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH			
S	SPLIT SPOON SAMPLE	CR	CORROSION	PP	POCKET PENETROMETER					
T	TUBE SAMPLE	CU	UNDRAINED TRIAXIAL	RV	R VALUE					



# GEOTECHNICAL BORING LOG LB-11

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-25-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2076'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests				
This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.														
2075	0	N S						SM	<b>Alluvial Wash Deposits (Qw)</b> @Surface: SILTY SAND (SM), gray, dry, fine to medium sand, trace of fine to coarse gravel, 30% fines (field estimate)					
				S-1	9 13 12		2	GM	@2.5': SILTY GRAVEL (GM), medium dense, tannish brown, moist, fine to medium sand, trace of coarse sand, fine gravel up to 1", 15% fines (field estimate)					
2070	5			S-2	10 11 11			SP-SM	@5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, tannish brown, moist, fine to medium sand, trace of coarse sand, fine gravel up to 1", 10% fines (field estimate)					
				S-3	9 15 14		3	SP-SM	@7.5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, tannish brown, medium to coarse sand, trace of fine sand, fine gravel up to 1", 10% fines (field estimate)					
2065	10			S-4	15 18 15			SP	@10': POORLY GRADED SAND with GRAVEL (SP), medium dense, tannish brown, fine to coarse sand, fine gravel up to 1", 5% fines (field estimate)					
2060	15			S-5	11 15 13			SP SM	@15': POORLY GRADED SAND with GRAVEL (SP), tannish brown, fine to coarse sand, fine gravel up to 1", 5% fines (field estimate) @16': SILTY SAND (SM), medium dense, brown, fine sand					
2055	20			S-6	7 9 10			SM	@20': SILTY SAND (SM), medium dense, yellowish brown, moist, fine sand, 35% fines (field estimate)					
2050	25			S-7	21 27 35			SP	@25': POORLY GRADED SAND with GRAVEL (SP), very dense, grayish brown, dry to moist, fine to coarse sand, slightly cemented, gravel up to 1", 5% fines (field estimate)					
									<b>TOTAL DEPTH = 26.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS</b>					
<table style="width: 100%; font-size: x-small;"> <tr> <td style="width: 33%;"> <b>SAMPLE TYPES:</b>                      B BULK SAMPLE                      C CORE SAMPLE                      G GRAB SAMPLE                      R RING SAMPLE                      S SPLIT SPOON SAMPLE                      T TUBE SAMPLE                 </td> <td style="width: 33%;"> <b>TYPE OF TESTS:</b>                      -200 % FINES PASSING                      AL ATTERBERG LIMITS                      CN CONSOLIDATION                      CO COLLAPSE                      CR CORROSION                      CU UNDRAINED TRIAXIAL                 </td> <td style="width: 33%;">                     DS DIRECT SHEAR                      EI EXPANSION INDEX                      H HYDROMETER                      MD MAXIMUM DENSITY                      PP POCKET PENETROMETER                      RV R VALUE                 </td> <td style="width: 33%;">                     SA SIEVE ANALYSIS                      SE SAND EQUIVALENT                      SG SPECIFIC GRAVITY                      UC UNCONFINED COMPRESSIVE STRENGTH                 </td> </tr> </table>											<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE	SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH
<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE	SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH											





# GEOTECHNICAL BORING LOG LB-12

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-25-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2063'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests						
	0	N S						SM	<i>This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.</i> <b>Alluvial Wash Deposits (Qw)</b> @Surface: SILTY SAND (SM), gray, dry, fine to medium sand, trace of fine to coarse gravel, 30% fines (field estimate)							
2060	5			S-1	5 9 10			SP-SM	@2.5': POORLY GRADED SAND with SILT (SP-SM), medium dense, grayish brown, dry to moist, fine to medium sand, trace of coarse sand, fine gravel up to 1", 10% fines (field estimate)							
	5			S-2	9 11 11		2	SP-SM	@5': POORLY GRADED SAND with SILT (SP-SM), medium dense, tannish brown, moist, fine to coarse sand, fine gravel, 10% fines (field estimate)							
2055	10			S-3	4 5 5			SP	@7.5': POORLY GRADED SAND with GRAVEL (SP), loose, dark tannish brown, moist, fine to coarse sand, fine gravel, 10% fines (field estimate)							
	10			S-4	5 7 14		3	SP-SM	@10': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, brown, moist, fine to coarse sand, fine gravel, micaceous, 10% fines (field estimate)							
2050	15			S-5	14 12 12			SP	@15': POORLY GRADED SAND with GRAVEL (SP), medium dense, brown, moist, medium to coarse sand, trace of fine sand, fine gravel, 5% fines (field estimate)							
2045	20			S-6	11 11 20			SP	@20': POORLY GRADED SAND with GRAVEL (SP), dense, brown, moist, medium to coarse sand, trace of fine sand, fine gravel, 5% fines (field estimate)							
2040	25			S-7	36 26 23			SP	@25': POORLY GRADED SAND with GRAVEL (SP), dense, tannish brown, moist, medium to coarse sand, trace of fine sand, fine gravel, 5% fines (field estimate)							
2035	30								~Gray rock up to 3 inches found in sampler <b>TOTAL DEPTH = 26.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS</b>							
<table style="width: 100%; font-size: small;"> <tr> <td style="width: 33%;"> <b>SAMPLE TYPES:</b>                      B BULK SAMPLE                      C CORE SAMPLE                      G GRAB SAMPLE                      R RING SAMPLE                      S SPLIT SPOON SAMPLE                      T TUBE SAMPLE                 </td> <td style="width: 33%;"> <b>TYPE OF TESTS:</b>                      -200 % FINES PASSING                      AL ATTERBERG LIMITS                      CN CONSOLIDATION                      CO COLLAPSE                      CR CORROSION                      CU UNDRAINED TRIAXIAL                 </td> <td style="width: 33%;">                     DS DIRECT SHEAR                      EI EXPANSION INDEX                      H HYDROMETER                      MD MAXIMUM DENSITY                      PP POCKET PENETROMETER                      RV R VALUE                 </td> </tr> <tr> <td>                     SA SIEVE ANALYSIS                      SE SAND EQUIVALENT                      SG SPECIFIC GRAVITY                      UC UNCONFINED COMPRESSIVE STRENGTH                 </td> <td colspan="2"></td> </tr> </table>											<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE	SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH		
<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE														
SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH																



# GEOTECHNICAL BORING LOG LB-2

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1996'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
1995								SM	@Surface: 2 inches of ASPHALT <b>Undocumented Artificial Fill (Afu)</b> @2": SILTY SAND (SM), dark brown, slightly moist, fine to coarse sand, trace of gravel, 20% fines (field estimate)	
				S-1	5 8 11			SP	<b>Alluvial Wash Deposits (Qw)</b> @2.5': POORLY GRADED SAND (SP), medium dense, olive brown, slightly moist, medium to coarse sand, trace of gravel, 5% fines (field estimate)	
1990	5			S-2	5 8 15			SP	@5': POORLY GRADED SAND (SP), medium dense, olive brown, moist, medium to coarse sand, trace of gravel, 5% fines (field estimate) -Gray sandstone present in sampler	
				S-3	12 13 11			SP	@7.5': POORLY GRADED SAND (SP), medium dense, olive brown, slightly moist, medium to coarse sand, 5% fines (field estimate)	
1985	10			S-4	8 7 10			SP-SM	@10': POORLY GRADED SAND with SILT (SP-SM), medium dense, brown, moist, fine to coarse sand, 10% fines (field estimate)	
1980	15			S-5	19 9 9			SM	@15': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 40% fines (field estimate)	
1975	20			S-6	3 4 8		16	SM	@20': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 44% fines (lab)	-200, AL
1970	25			S-7	6 8 9			ML	@25': SANDY SILT (ML), very stiff, brown, slightly moist, fine to medium sand, 60% low plasticity fines (field estimate)	
	30								<b>TOTAL DEPTH = 26.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH</b>	
<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE		<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL		DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE		SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH				

# GEOTECHNICAL BORING LOG LB-3

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2002'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
2000				S-1	2 2 2			SM	@Surface: 2 inches of ASPHALT over 4 inches of BASE <b>Undocumented Artificial Fill (Afu)</b> @7": SILTY SAND (SM), dark brown, dry, fine to coarse sand, 30% fines (field estimate)	
	5			S-2	4 4 15			SP	@2.5': SILTY SAND (SM), dark brown, dry, fine to coarse sand, 30% fines (field estimate) <b>Alluvial Wash Deposits (Qw)</b> @3.5': POORLY GRADED SAND (SP), very loose, grayish brown, dry, fine to coarse sand, 5% fines (field estimate) @5': POORLY GRADED SAND (SP), medium dense, grayish brown, slightly moist, fine to coarse sand, 5% fines (field estimate)	
1995				S-3	3 2 2			SM	@7.5': SILTY SAND (SM), very loose, brown, slightly moist, medium to coarse sand, 15% fines (field estimate)	
	10			S-4	3 3 3			SM	@10': SILTY SAND (SM), loose, brown, slightly moist, medium to coarse sand, 25% fines (field estimate)	
1990				S-5	3 4 2		9	SM	@15': SILTY SAND (SM), loose, brown, slightly moist, fine sand, 32% fines (lab)	-200, AL
1985				S-6	3 5 9			ML	@20': SANDY SILT (ML), stiff, brown, slightly moist, fine sand, 70% low plasticity fines (field estimate)	
1980				S-7	9 17 17			SM	@25': SILTY SAND (SM), dense, light brown, moist, medium to coarse sand, 35% fines (field estimate)	
1975									<b>TOTAL DEPTH = 26.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH</b>	
30										

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-4

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1999'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S						SM	This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual. @Surface: 4 inches of ASPHALT <b>Undocumented Artificial Fill (Afu)</b> @4": SILTY SAND (SM), dark brown, slightly moist, fine to coarse sand, 35% fines (field estimate)	
1995	5			S-1	2 3 4			SM	<b>Young Alluvial Fan Deposits (Qyf)</b> @2.5": SILTY SAND (SM), loose, dark brown, slightly moist, fine to coarse sand, 35% fines (field estimate)	
				S-2	3 2 3			SM	@5": SILTY SAND (SM), loose, dark brown, slightly moist, fine to coarse sand, 35% fines (field estimate)	
				S-3	5 7 8			SM	@7.5": SILTY SAND (SM), medium dense, dark brown, slightly moist, fine to coarse sand, 15% fines (field estimate)	
1990	10			S-4	4 3 4			SM	@10": SILTY SAND (SM), loose, dark brown, moist, medium to coarse sand, 28% fines (lab)	-200
1985	15			S-5	5 7 11			SM	@15": SILTY SAND (SM), medium dense, dark brown, moist, medium to coarse sand, 35% fines (field estimate)	
1980	20			S-6	8 10 13			SM	@20": SILTY SAND (SM), medium dense, dark brown, moist, medium to coarse sand, 35% fines (field estimate)	
									@22": Encountered Groundwater	
1975	25			S-7	8 15 15			SM	@25": SILTY SAND (SM), medium dense, dark brown, wet, medium to coarse sand, 30% fines (field estimate)	
1970	30								<b>TOTAL DEPTH = 26.5 FEET</b> <b>GROUNDWATER ENCOUNTERED AT 22 FEET</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH</b>	

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-5

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2042'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
2040				B-1				SM	@Surface: 5 inches of ASPHALT over 4 inches of BASE	
				S-1	3 4 3			SM	<b>Undocumented Artificial Fill (Afu)</b> @9": SILTY SAND (SM), dark brown, slightly moist, fine to coarse sand, 42% fines (lab)	MD, SA, EI, CR
	5			R-1	4 9 11	116	11	SM	@2.5': SILTY SAND (SM), loose, dark brown, slightly moist, fine to coarse sand, 30% fines (field estimate)	
2035				R-2	6 10 14	120	10	SM	<b>Young Alluvial Fan Deposits (Qyf)</b> @7.5': SILTY SAND (SM), medium dense, brown, slightly moist, coarse sand, slightly cemented, 20% fines (field estimate)	
	10			R-3	16 18 23	116	7	SM	@10': SILTY SAND (SM), medium dense, brown, slightly moist, coarse sand, slightly cemented, 15% fines (field estimate)	DS
2030				S-2	15 18 24			SP-SM	@15': POORLY GRADED SAND with SILT (SP-SM), dense, brown, slightly moist, coarse sand, 10% fines (field estimate)	
2025				R-4	37 50/5"			SM	@20': SILTY SAND (SM), very dense, brown, slightly moist, coarse sand, slightly cemented, 20% fines (field estimate)	DS
2020				S-3	16 18 25			SC	@25': CLAYEY SAND (SC), dense, brown, wet, fine to coarse sand, 35% fines (field estimate)	
2015									@29.5': Encountered Groundwater	
	30									

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-5

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2042'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.										
2010	30	N S		R-5	24 37 49			SP-SM	@30': POORLY GRADED SAND with SILT (SP-SM), very dense, olive brown, wet, coarse sand, slightly cemented, 10% fines (field estimate)	
2005	35			S-4	31 38 30			SP-SM	@35': POORLY GRADED SAND with SILT (SP-SM), very dense, olive brown, wet, coarse sand, cemented, 10% fines (field estimate) -Broken pieces of granite present in sampler	
2000	40			S-5	28 37 50/5"			SP-SM	@40': POORLY GRADED SAND with SILT (SP-SM), very dense, olive brown, wet, coarse sand, cemented, trace of granitic gravel, 10% fines (field estimate) -Auger grinding	
1995	45			S-6	22 50/6"			SM	@45': SILTY SAND with GRAVEL (SM), very dense, brown, wet, coarse sand, 15% gravel, 25% fines (field estimate) @46': MET REFUSAL	
1990	50								<b>MET REFUSAL AT 46 FEET                      GROUNDWATER ENCOUNTERED AT 29.5 FEET                      BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH                      COLLAPSED TO 17 FEET</b>	
1985	55									
1980	60									

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-7

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1988'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
	0	N S		B-1				SM	<i>This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.</i> <b>Undocumented Artificial Fill (Afu)</b> @Surface: SILTY SAND (SM), brown, dry, fine to medium sand, 42% fines (lab)	MD, SA, EI, CR RV
1985				R-1	12 17 24	117	8	ML	<b>Young Alluvial Fan Deposits (Qyf)</b> @2.5': SANDY SILT (ML), very stiff, dark brown, fine sand, 55% low plasticity fines (field estimate)	
	5			R-2	9 14 17	123	11	ML	@5': SILT with SAND (ML), very stiff, brown, slightly moist, fine sand, 85% low plasticity fines (field estimate)	
1980				R-3	7 14 22	119	11	ML	@7.5': SANDY SILT (ML), very stiff, brown, slightly moist, fine to coarse sand, 70% low plasticity fines (field estimate)	DS
	10			R-4	18 42 50/4"			SM	@10': SILTY SAND (SM), very dense, brown, slightly moist, medium to coarse sand, slightly cemented, 15% fines (field estimate)	
1975				S-1	6 12 11			SM	@15': SILTY SAND (SM), medium dense, brown, moist, medium to coarse sand, 30% fines (field estimate)	
1970									@18.5': Encountered Groundwater	
	20			R-5	16 30 50			SP-SM	@20': POORLY GRADED SAND with SILT (SP-SM), dense, brown, wet, fine to coarse sand, 10% fines (field estimate)	
1965				S-2	7 19 22			SC	@25': CLAYEY SAND (SC), dense, brown, wet, medium to coarse sand, 30% fines (field estimate)	
1960										
	30									

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-7

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-20-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 1988'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
30		N S		R-6	15 27 41			CL	<i>This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.</i> @30': SANDY LEAN CLAY (CL), hard, brown, wet, coarse sand, low toughness, 60% medium plasticity fines (field estimate)  @35': CLAYEY SAND (SC), dense, tan, wet, medium to coarse sand, 25% fines (field estimate)  @40': POORLY GRADED SAND (SP), olive brown, wet, coarse sand, 5% fines (field estimate) @41': CLAYEY SAND (SC), dense, dark gray, wet, fine to coarse sand, 40% fines (field estimate)  @43': MET REFUSAL  <b>MET REFUSAL AT 43 FEET                      GROUNDWATER ENCOUNTERED AT 18.5 FEET                      BACKFILLED TO SURFACE WITH SOIL CUTTINGS and ASPHALT COLD PATCH</b>	
1955				S-3	15 17 18			SC		
1950				S-4	12 18 26			SP SC		
1945										
1940										
1935										
1930										

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH





# GEOTECHNICAL BORING LOG LB-8

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-21-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2106'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	<b>SOIL DESCRIPTION</b>	Type of Tests
2105	0			B-1				GP	@Surface: POORLY GRADED GRAVEL with SAND (GP), light brown, dry, fine to coarse gravel, coarse sand, trace of cobbles (4 inches) 20% sand, 5% fines (field estimate) <b>Alluvial Wash Deposits (Qw)</b>	MD, SA, CR
				R-1	7 16 14	134	5	SM	@2.5': SILTY SAND with GRAVEL (SM), medium dense, dark brown, slightly moist, fine to coarse sand, 30% gravel, 17% fines (lab) -Auger grinding, some cobble in cuttings	
2100	5			R-2	8 9 14	99	3	SP-SM	@5': POORLY GRADED SAND with SILT (SP-SM), medium dense, brown, slightly moist, medium to coarse sand, trace of gravel, 10% fines (field estimate) -Auger grinding, some cobble in cuttings	
				R-3	14 30 32	130	2	SM	@7.5': SILTY SAND with GRAVEL (SM), dense, brown, slightly moist, medium to coarse sand, trace of gravel, 15% fines (field estimate)	
2095	10			R-4	20 50/6"	123	2	SM	@10': SILTY SAND with GRAVEL (SM), very dense, brown, slightly moist, coarse sand, trace of gravel, 15% fines (field estimate) -Auger grinding	
2090	15			S-1	50/3"			SP	@15': POORLY GRADED SAND with GRAVEL (SP), very dense, brown, moist, fine to coarse sand, 5% fines (field estimate) -Auger grinding, pieces of broken sanstone present in sampler	
2085	20			R-5	50/6"			SP	@20': POORLY GRADED SAND with GRAVEL (SP), very dense, brown, slightly moist, coarse sand, 15% gravel, 5% fines (field estimate) -Auger grinding, some cobbles in cuttings	
2080	25			S-2	17 27 29			SP	@25': POORLY GRADED SAND with GRAVEL (SP), very dense, brown, slightly moist, coarse sand, 20% gravel, 5% fines (field estimate) -Auger grinding	
	30									

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-8

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-21-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2106'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
2075	30			R-6	50/2"			SP	@30': NO RECOVERY -Auger grinding	
2070	35			S-3	35 50/6"			SP	@35': POORLY GRADED SAND with GRAVEL (SP), very dense, olive brown, slightly moist, coarse sand, 15% gravel, 5% fines (field estimate) -Auger heavily grinding to 40 FEET, cobbles in cuttings	
2065	40			S-4	25 50/5"			SP	@40': POORLY GRADED SAND with GRAVEL (SP), very dense, olive brown, moist, coarse sand, 15% gravel, 5% fines (field estimate) -Auger heavily grinding to 45 FEET, cobbles in cuttings	
2060	45			S-5	40 50/4"			SP	@45': POORLY GRADED SAND with GRAVEL (SP), very dense, olive brown, slightly moist, coarse sand, 20% gravel, 5% fines (field estimate)	
2055	50			S-6	50/6"			SP	@50': POORLY GRADED SAND with GRAVEL (SP), very dense, olive brown, slightly moist, coarse sand, 20% gravel, 5% fines (field estimate)	
									<b>TOTAL DEPTH = 50.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS</b>	
2050	55									
60										

**SAMPLE TYPES:**

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

**TYPE OF TESTS:**

- 200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL

- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE

- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



# GEOTECHNICAL BORING LOG LB-9

**Project No.** 12108.009  
**Project** Glen Helen Lighting Project  
**Drilling Co.** 2R Drilling  
**Drilling Method** Hollow Stem Auger - Autohammer  
**Location** See Figure 2 - Exploration Location Map

**Date Drilled** 7-25-23  
**Logged By** AA  
**Hole Diameter** 8"  
**Ground Elevation** 2099'  
**Sampled By** AA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests						
		N S							This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.							
2095	0	.						SM	<b>Alluvial Wash Deposits (Qw)</b> @Surface: SILTY SAND (SM), gray, dry, fine to medium sand, trace of fine to coarse gravel, 30% fines (field estimate)							
	5	.		S-1	10 5 8			SP	@2.5': POORLY GRADED SAND (SP), medium dense, tannish brown, moist, medium to coarse sand, trace of gravel, 5% fines (field estimate)							
	10	.		S-2	14 16 16		2	SP-SM	@5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), dense, grayish brown, moist, medium to coarse sand, trace of fine sand, fine gravel up to 1", thin lense of SILTY SAND (SM) 2" thick, 5% fines (field estimate)							
2090	15	.		S-3	17 10 11			SP-SM	@7.5': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, dark grayish brown, moist, medium to coarse sand, trace of fine sand, fine gravel up to 1", 5% fines (field estimate)							
	20	.		S-4	10 11 17		5	SP-SM	@10': POORLY GRADED SAND with SILT and GRAVEL (SP-SM), medium dense, dark grayish brown, moist to very moist, fine to coarse sand, fine gravel, 10% fines (field estimate)							
2085	25	.		S-5	21 50/6"			SP	@15': POORLY GRADED SAND with GRAVEL (SP), very dense, dark grayish brown, moist, fine to coarse sand, 5% fines (field estimate) -Rock found in sampler, gravel up to 3"							
2080	30	.		S-6	22 19 31			SP	@20': POORLY GRADED SAND with GRAVEL (SP), dense, dark grayish brown, moist, fine to coarse sand, 5% fines (field estimate)							
2075	35	.		S-7	27 38 40			SP	@25': POORLY GRADED SAND with GRAVEL (SP), very dense, light tannish brown, moist, fine to medium sand, trace of coarse sand, 5% fines (field estimate)							
2070	40	.							<b>TOTAL DEPTH = 26.5 FEET</b> <b>NO GROUNDWATER ENCOUNTERED</b> <b>BACKFILLED TO SURFACE WITH SOIL CUTTINGS</b>							
<table style="width: 100%; font-size: x-small;"> <tr> <td style="width: 33%;"> <b>SAMPLE TYPES:</b>                      B BULK SAMPLE                      C CORE SAMPLE                      G GRAB SAMPLE                      R RING SAMPLE                      S SPLIT SPOON SAMPLE                      T TUBE SAMPLE                 </td> <td style="width: 33%;"> <b>TYPE OF TESTS:</b>                      -200 % FINES PASSING                      AL ATTERBERG LIMITS                      CN CONSOLIDATION                      CO COLLAPSE                      CR CORROSION                      CU UNDRAINED TRIAXIAL                 </td> <td style="width: 33%;">                     DS DIRECT SHEAR                      EI EXPANSION INDEX                      H HYDROMETER                      MD MAXIMUM DENSITY                      PP POCKET PENETROMETER                      RV R VALUE                 </td> </tr> <tr> <td>                     SA SIEVE ANALYSIS                      SE SAND EQUIVALENT                      SG SPECIFIC GRAVITY                      UC UNCONFINED COMPRESSIVE STRENGTH                 </td> <td colspan="2"></td> </tr> </table>											<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE	SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH		
<b>SAMPLE TYPES:</b> B BULK SAMPLE C CORE SAMPLE G GRAB SAMPLE R RING SAMPLE S SPLIT SPOON SAMPLE T TUBE SAMPLE	<b>TYPE OF TESTS:</b> -200 % FINES PASSING AL ATTERBERG LIMITS CN CONSOLIDATION CO COLLAPSE CR CORROSION CU UNDRAINED TRIAXIAL	DS DIRECT SHEAR EI EXPANSION INDEX H HYDROMETER MD MAXIMUM DENSITY PP POCKET PENETROMETER RV R VALUE														
SA SIEVE ANALYSIS SE SAND EQUIVALENT SG SPECIFIC GRAVITY UC UNCONFINED COMPRESSIVE STRENGTH																





**NOT FOR BID**

**APPENDIX B  
LABORATORY TESTING**

Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 07/27/23  
 Project No.: 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-5 Depth (ft.): 0 - 5.0  
 Sample No.: B-1  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

Preparation Method:

Moist  
 Dry

Mechanical Ram  
 Manual Ram

Mold Volume (ft<sup>3</sup>)

**0.03340**

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5490	5586	5636	5563		
Weight of Mold (g)	3519	3519	3519	3519		
Net Weight of Soil (g)	1971	2067	2117	2044		
Wet Weight of Soil + Cont. (g)	1632.2	1975.7	1376.8	2098.3		
Dry Weight of Soil + Cont. (g)	1547.2	1840.0	1270.6	1893.2		
Weight of Container (g)	280.5	276.3	280.1	275.9		
Moisture Content (%)	6.7	8.7	10.7	12.7		
Wet Density (pcf)	130.1	136.4	139.7	134.9		
Dry Density (pcf)	121.9	125.5	126.2	119.7		

Maximum Dry Density (pcf)

**126.5**

Optimum Moisture Content (%)

**10.0**

### PROCEDURE USED

**Procedure A**  
 Soil Passing No. 4 (4.75 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 May be used if + #4 is 20% or less

**Procedure B**  
 Soil Passing 3/8 in. (9.5 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 Use if + #4 is >20% and +3/8 in. is 20% or less

**Procedure C**  
 Soil Passing 3/4 in. (19.0 mm) Sieve  
 Mold : 6 in. (152.4 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 56 (fifty-six)  
 Use if +3/8 in. is >20% and +3/4 in. is <30%

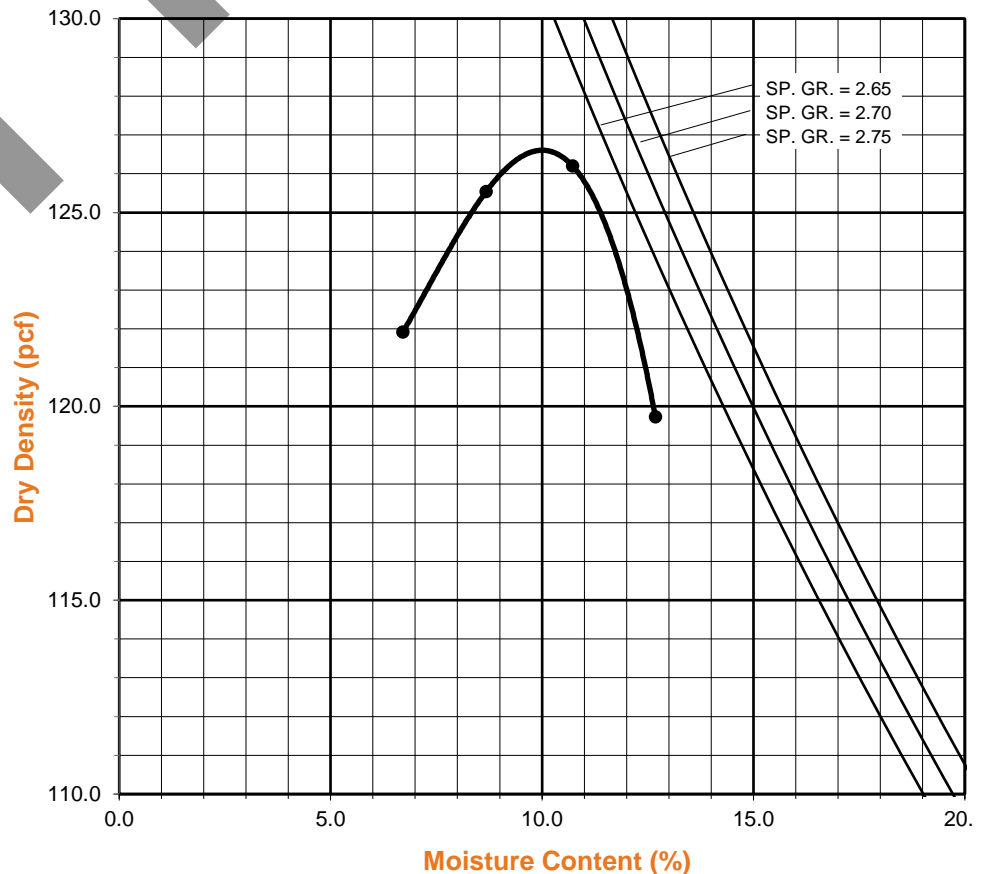
### Particle-Size Distribution:

**4:54:42**

GR:SA:FI

### Atterberg Limits:

LL, PL, PI



Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 07/27/23  
 Project No.: 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-7 Depth (ft.): 0 - 5.0  
 Sample No.: B-1  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

Preparation Method:

Moist  
 Dry

Mechanical Ram  
 Manual Ram

Mold Volume (ft<sup>3</sup>)

**0.03340**

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5483	5591	5619	5541		
Weight of Mold (g)	3519	3519	3519	3519		
Net Weight of Soil (g)	1964	2072	2100	2022		
Wet Weight of Soil + Cont. (g)	1405.6	1811.2	2024.3	2097.5		
Dry Weight of Soil + Cont. (g)	1339.4	1695.0	1862.4	1900.0		
Weight of Container (g)	279.3	278.2	280.1	275.9		
Moisture Content (%)	6.2	8.2	10.2	12.2		
Wet Density (pcf)	129.6	136.8	138.6	133.5		
Dry Density (pcf)	122.0	126.4	125.7	119.0		

Maximum Dry Density (pcf)

**126.9**

Optimum Moisture Content (%)

**9.0**

### PROCEDURE USED

**Procedure A**  
 Soil Passing No. 4 (4.75 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 May be used if + #4 is 20% or less

**Procedure B**  
 Soil Passing 3/8 in. (9.5 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 Use if + #4 is >20% and + 3/8 in. is 20% or less

**Procedure C**  
 Soil Passing 3/4 in. (19.0 mm) Sieve  
 Mold : 6 in. (152.4 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 56 (fifty-six)  
 Use if + 3/8 in. is >20% and + 3/4 in. is <30%

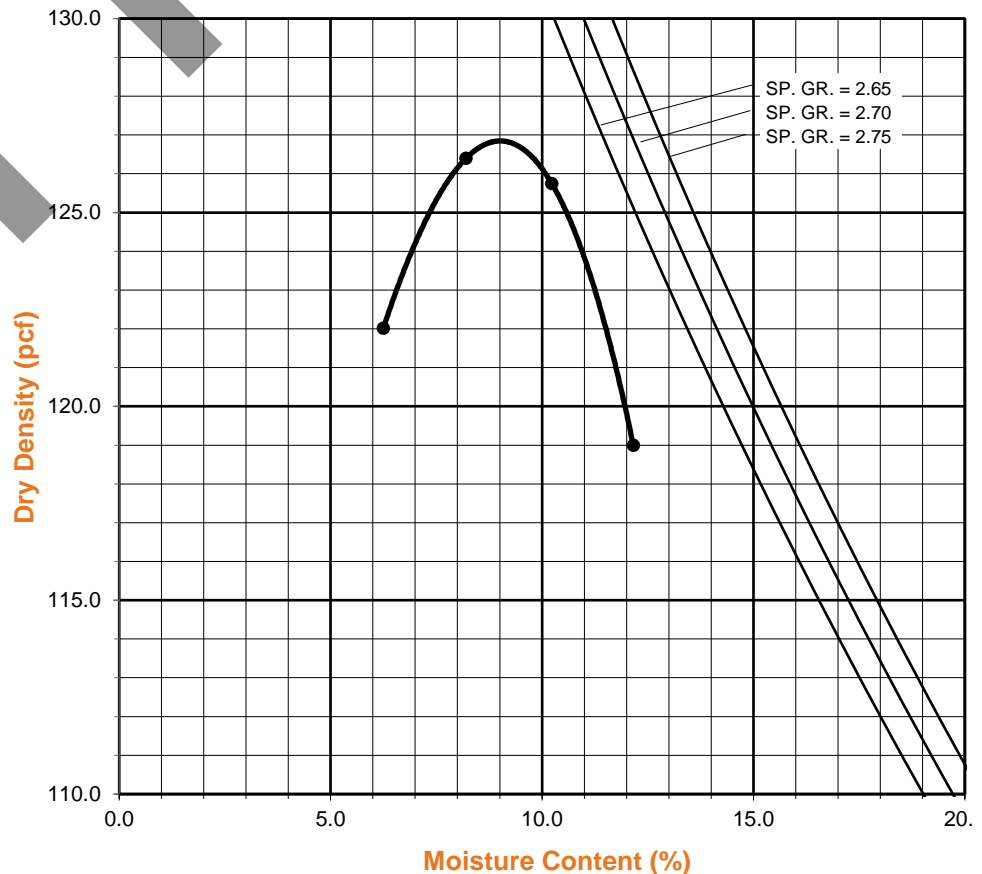
### Particle-Size Distribution:

**1:57:42**

GR:SA:FI

### Atterberg Limits:

LL, PL, PI



## MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 07/27/23  
 Project No.: 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-8 Depth (ft.): 0 - 5.0  
 Sample No.: B-1  
 Soil Identification: Silty Sand with Gravel (SM)g, Dark Yellowish Brown.

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	<input checked="" type="checkbox"/>	Moist		Scalp Fraction (%)	
		Dry		#3/4	10.5
Compaction Method:	<input checked="" type="checkbox"/>	Mechanical Ram		#3/8	
		Manual Ram		#4	
				Rammer Weight (lb.) =	10.0
				Height of Drop (in.) =	18.0
				Mold Volume (ft <sup>3</sup> )	0.07500

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	10137	10331	10234			
Weight of Mold (g)	5479	5479	5479			
Net Weight of Soil (g)	4658	4852	4755			
Wet Weight of Soil + Cont. (g)	1816.0	2253.1	2386.7			
Dry Weight of Soil + Cont. (g)	1751.6	2132.5	2220.0			
Weight of Container (g)	276.0	280.5	279.7			
Moisture Content (%)	4.4	6.5	8.6			
Wet Density (pcf)	136.9	142.6	139.8			
Dry Density (pcf)	131.2	133.9	128.7			

Maximum Dry Density (pcf)	134.0	Optimum Moisture Content (%)	6.0
Corrected Dry Density (pcf)	137.0	Corrected Moisture Content (%)	5.5

**Procedure A**  
 Soil Passing No. 4 (4.75 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 May be used if + #4 is 20% or less

**Procedure B**  
 Soil Passing 3/8 in. (9.5 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 Use if + #4 is >20% and +3/8 in. is 20% or less

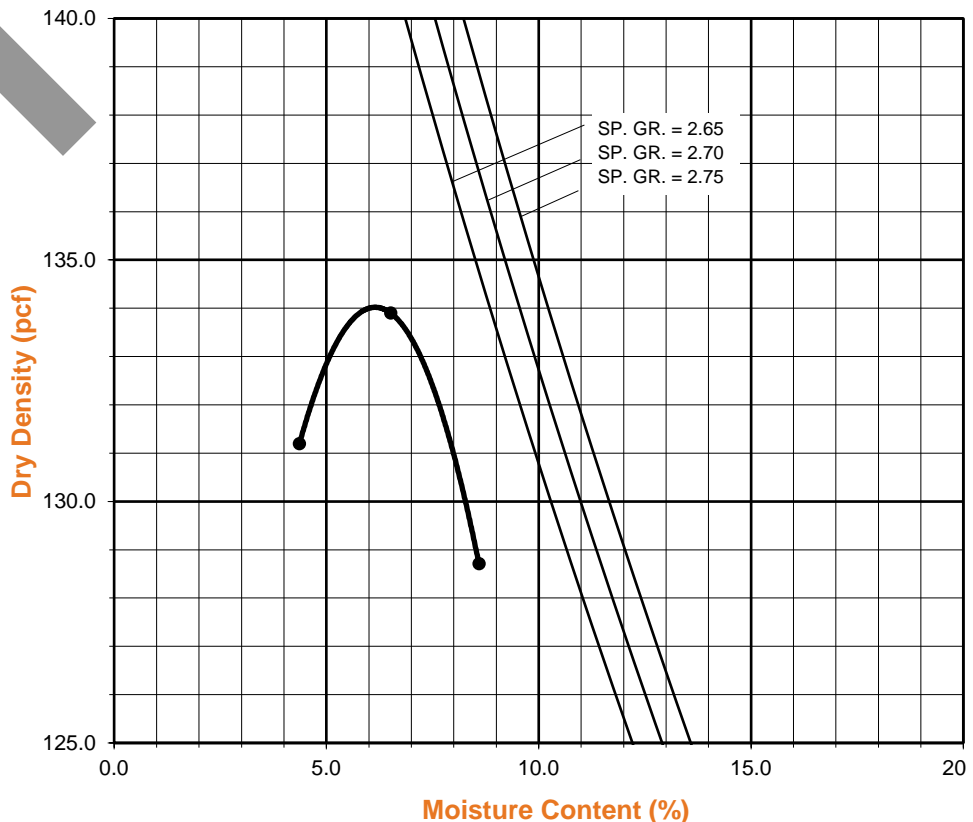
**Procedure C**  
 Soil Passing 3/4 in. (19.0 mm) Sieve  
 Mold : 6 in. (152.4 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 56 (fifty-six)  
 Use if +3/8 in. is >20% and +3/4 in. is <30%

**Particle-Size Distribution:**

**30:53:17**  
GR:SA:FI

**Atterberg Limits:**

LL, PL, PI



Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 07/27/23  
 Project No.: 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-10 Depth (ft.): 0 - 5.0  
 Sample No.: B-1  
 Soil Identification: Poorly Graded Sand with Silt (SP-SM), Yellowish Brown.

Preparation Method:

Moist  
 Dry

Mechanical Ram  
 Manual Ram

Mold Volume (ft<sup>3</sup>)

**0.03340**

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5390	5463	5500	5493		
Weight of Mold (g)	3519	3519	3519	3519		
Net Weight of Soil (g)	1871	1944	1981	1974		
Wet Weight of Soil + Cont. (g)	1304.5	1250.2	1363.1	1225.7		
Dry Weight of Soil + Cont. (g)	1252.2	1175.0	1252.5	1106.5		
Weight of Container (g)	276.5	276.1	279.8	280.3		
Moisture Content (%)	5.4	8.4	11.4	14.4		
Wet Density (pcf)	123.5	128.3	130.8	130.3		
Dry Density (pcf)	117.2	118.4	117.4	113.9		

Maximum Dry Density (pcf)

**118.4**

Optimum Moisture Content (%)

**8.4**

**PROCEDURE USED**

**Procedure A**  
 Soil Passing No. 4 (4.75 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 May be used if + #4 is 20% or less

**Procedure B**  
 Soil Passing 3/8 in. (9.5 mm) Sieve  
 Mold : 4 in. (101.6 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 25 (twenty-five)  
 Use if + #4 is >20% and +3/8 in. is 20% or less

**Procedure C**  
 Soil Passing 3/4 in. (19.0 mm) Sieve  
 Mold : 6 in. (152.4 mm) diameter  
 Layers : 5 (Five)  
 Blows per layer : 56 (fifty-six)  
 Use if +3/8 in. is >20% and +3/4 in. is <30%

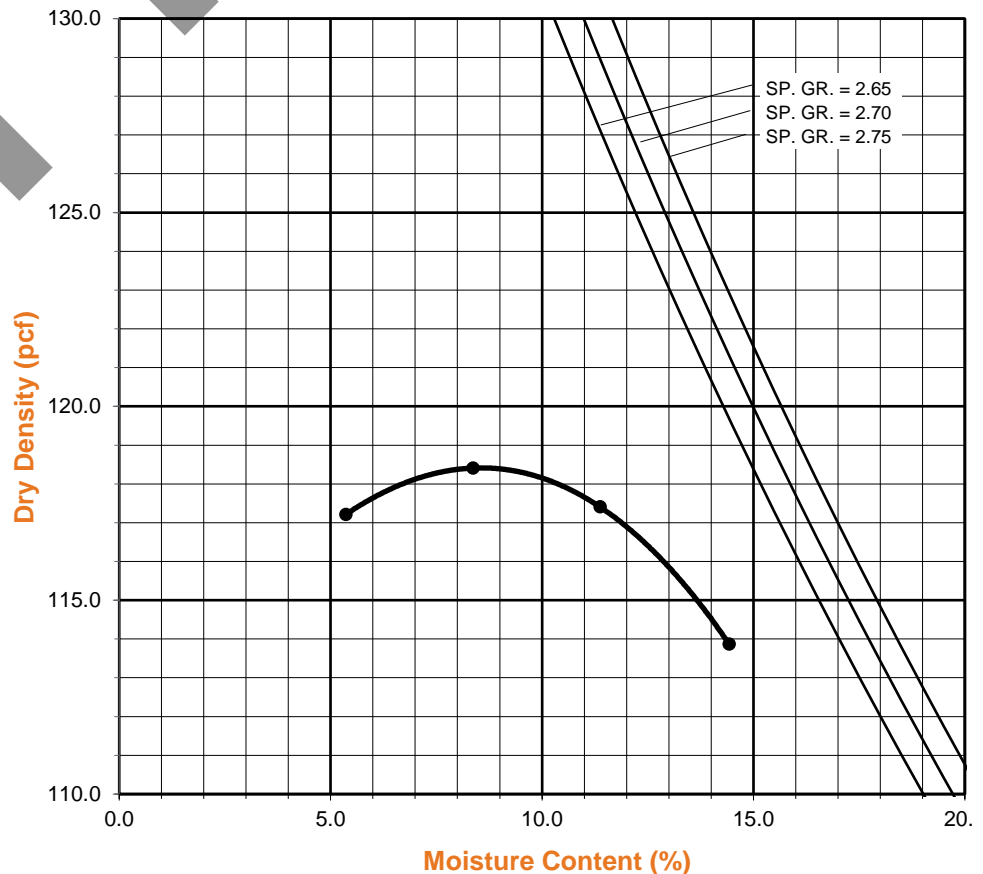
**Particle-Size Distribution:**

**8:84:8**

GR:SA:FI

**Atterberg Limits:**

LL,PL,PI







**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009  
 Boring No.: LB-5  
 Sample No.: B-1  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

Tested By: FLM Date: 07/26/23  
 Checked By: MRV Date: 08/08/23  
 Depth (feet): 0 - 5.0

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	P	P	Wt. of Air-Dry Soil + Cont.(g)	2315.4	1049.3
Wt. Air-Dried Soil + Cont.(g)	2315.4	1049.3	Wt. of Dry Soil + Cont. (g)	2168.8	1049.3
Wt. of Container (g)	716.2	716.2	Wt. of Container No. (g)	716.2	716.2
Dry Wt. of Soil (g)	1452.5	333.1	Moisture Content (%)	10.1	0.0

Passing #4 Material After Wet Sieve	Container No.	P
	Wt. of Dry Soil + Container (g)	904.9
	Wt. of Container (g)	716.2
	Dry Wt. of Soil Retained on # 200 Sieve (g)	188.7

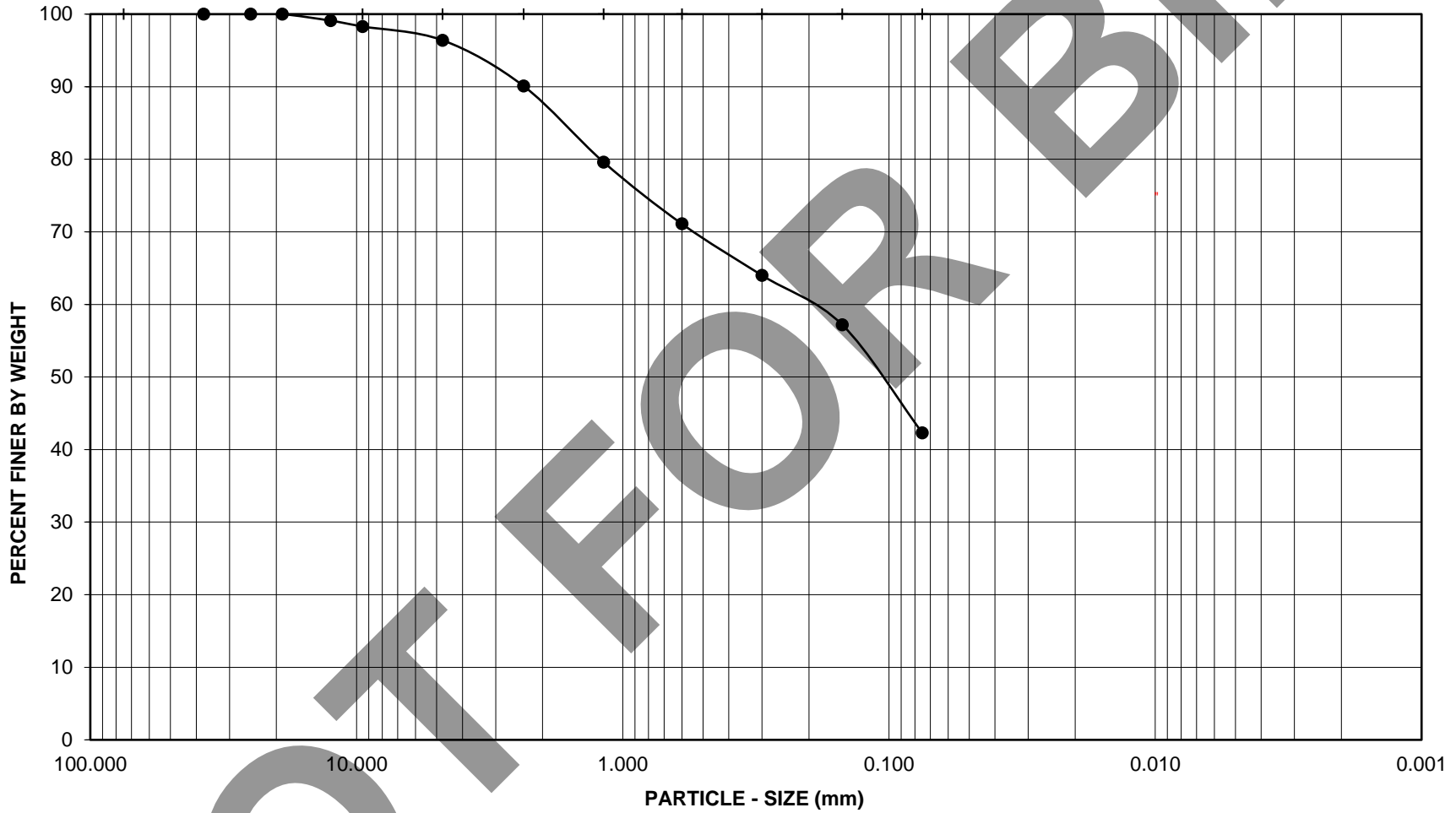
U. S. Sieve Size	(mm.)	Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
		Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000	0.0		100.0
1/2"	12.500	13.2		99.1
3/8"	9.500	24.0		98.3
#4	4.750	52.9		96.4
#8	2.360		21.9	90.1
#16	1.180		58.2	79.6
#30	0.600		87.4	71.1
#50	0.300		112.0	64.0
#100	0.150		135.6	57.2
#200	0.075		187.1	42.3
PAN				

GRAVEL: **4 %**  
 SAND: **54 %**  
 FINES: **42 %**  
 GROUP SYMBOL: **SM**

Cu = D60/D10 = N/A  
 Cc = (D30)<sup>2</sup>/(D60\*D10) = N/A

Remarks: \_\_\_\_\_

GRAVEL				SAND						FINES		
COARSE		FINE		COARSE	MEDIUM		FINE		SILT	CLAY		
U.S. STANDARD SIEVE OPENING				U.S. STANDARD SIEVE NUMBER						HYDROMETER		
3.0"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200		



Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009

Boring No.: LB-5                      Sample No.: B-1  
 Depth (feet): 0 - 5.0                      Soil Type : SM

Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

**GR:SA:FI : (%)                      4 : 54 : 42**



**PARTICLE - SIZE  
 DISTRIBUTION  
 ASTM D 6913**

Aug-23



**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009  
 Boring No.: LB-7  
 Sample No.: B-1  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

Tested By: FLM Date: 07/26/23  
 Checked By: MRV Date: 08/08/23  
 Depth (feet): 0 - 5.0

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	SR	SR	Wt. of Air-Dry Soil + Cont.(g)	2255.9	1053.9
Wt. Air-Dried Soil + Cont.(g)	2255.9	1053.9	Wt. of Dry Soil + Cont. (g)	2162.7	1053.9
Wt. of Container (g)	696.5	696.5	Wt. of Container No. (g)	696.5	696.5
Dry Wt. of Soil (g)	1465.6	357.4	Moisture Content (%)	6.4	0.0

Passing #4 Material After Wet Sieve	Container No.	SR
	Wt. of Dry Soil + Container (g)	905.4
	Wt. of Container (g)	696.5
	Dry Wt. of Soil Retained on # 200 Sieve (g)	208.9

U. S. Sieve Size	(mm.)	Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
		Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000			100.0
1/2"	12.500	0.0		100.0
3/8"	9.500	1.5		99.9
#4	4.750	17.1		98.8
#8	2.360		9.5	96.2
#16	1.180		26.0	91.6
#30	0.600		48.8	85.3
#50	0.300		82.0	76.1
#100	0.150		126.4	63.9
#200	0.075		206.1	41.8
PAN				

GRAVEL: **1 %**  
 SAND: **57 %**  
 FINES: **42 %**  
 GROUP SYMBOL: **SM**

Cu = D60/D10 = N/A  
 Cc = (D30)<sup>2</sup>/(D60\*D10) = N/A

Remarks: \_\_\_\_\_

GRAVEL				SAND						FINES		
COARSE		FINE		COARSE	MEDIUM		FINE		SILT		CLAY	
U.S. STANDARD SIEVE OPENING				U.S. STANDARD SIEVE NUMBER						HYDROMETER		
3.0"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200		



Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009

Boring No.: LB-7                      Sample No.: B-1  
 Depth (feet): 0 - 5.0                      Soil Type : SM

Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

**GR:SA:FI : (%)                      1 : 57 : 42**

	<b>PARTICLE - SIZE DISTRIBUTION</b>
	<b>ASTM D 6913</b>

Aug-23



**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009  
 Boring No.: LB-8  
 Sample No.: B-1

Tested By: FLM Date: 07/26/23  
 Checked By: MRV Date: 08/08/23  
 Depth (feet): 0 - 5.0

Soil Identification: Silty Sand with Gravel (SM)g, Dark Yellowish Brown.

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	S	S	Wt. of Air-Dry Soil + Cont.(g)	2983.8	1278.4
Wt. Air-Dried Soil + Cont.(g)	2983.8	1278.4	Wt. of Dry Soil + Cont. (g)	2903.4	1278.4
Wt. of Container (g)	946.7	946.7	Wt. of Container No. (g)	946.7	946.7
Dry Wt. of Soil (g)	1956.9	331.7	Moisture Content (%)	4.1	0.0

Passing #4 Material After Wet Sieve	Container No.	S
	Wt. of Dry Soil + Container (g)	1201.8
	Wt. of Container (g)	946.7
	Dry Wt. of Soil Retained on # 200 Sieve (g)	255.1

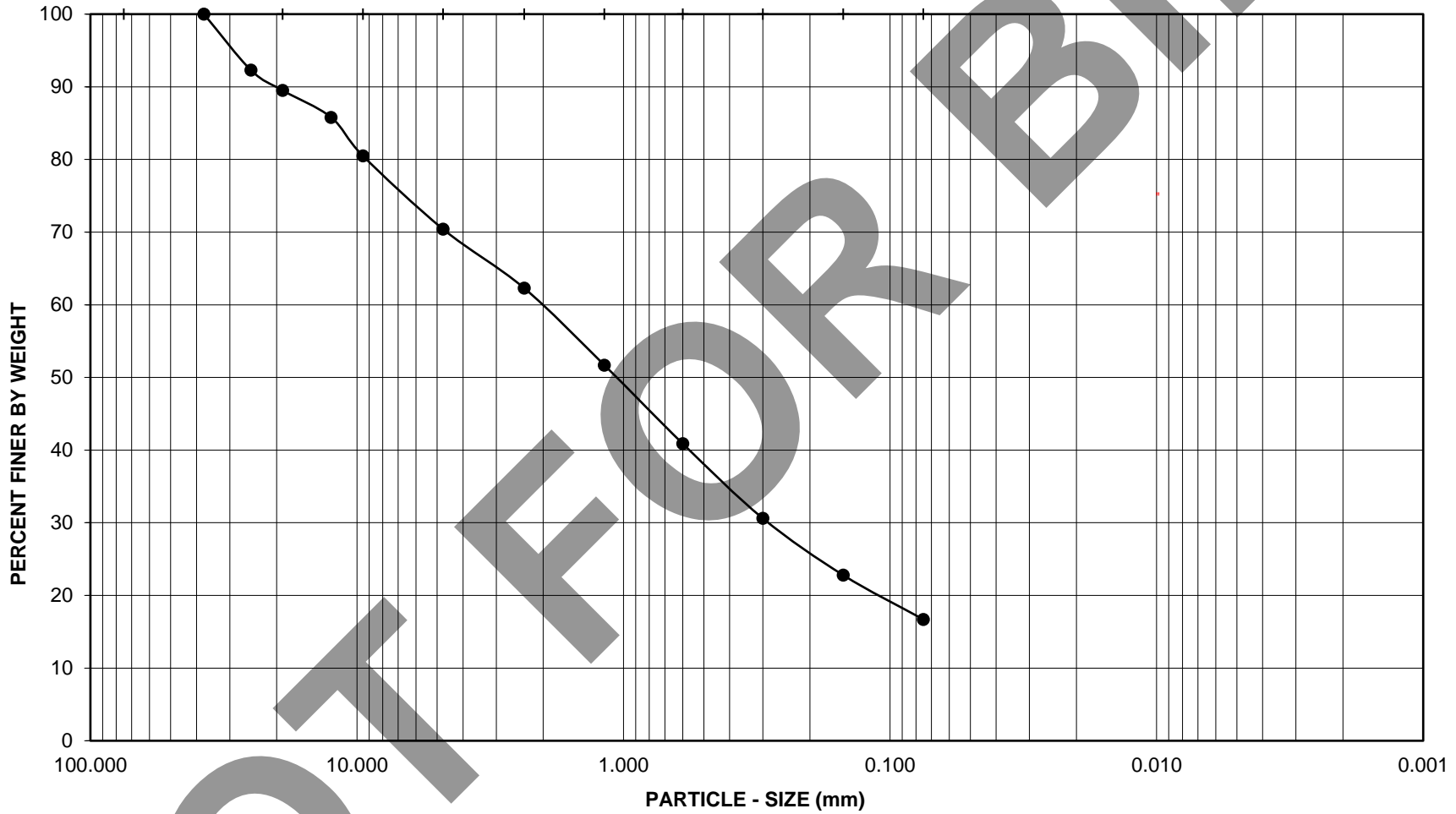
U. S. Sieve Size	(mm.)	Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
		Whole Sample	Sample Passing #4	
1 1/2"	37.500	0.0		100.0
1"	25.000	150.5		92.3
3/4"	19.000	205.0		89.5
1/2"	12.500	277.6		85.8
3/8"	9.500	381.4		80.5
#4	4.750	579.4		70.4
#8	2.360		38.1	62.3
#16	1.180		88.1	51.7
#30	0.600		138.9	40.9
#50	0.300		187.5	30.6
#100	0.150		224.5	22.8
#200	0.075		253.1	16.7
PAN				

GRAVEL: **30 %**  
 SAND: **53 %**  
 FINES: **17 %**  
 GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = N/A  
 Cc = (D30)<sup>2</sup>/(D60\*D10) = N/A

Remarks: \_\_\_\_\_

GRAVEL				SAND				FINES				
COARSE		FINE		COARSE	MEDIUM	FINE		SILT		CLAY		
U.S. STANDARD SIEVE OPENING				U.S. STANDARD SIEVE NUMBER				HYDROMETER				
3.0"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200		



Project Name: Glen Helen Lighting/GE

Project No.: 12108.009

Boring No.: LB-8

Sample No.: B-1

Depth (feet): 0 - 5.0

Soil Type : (SM)g

Soil Identification: Silty Sand with Gravel (SM)g, Dark Yellowish Brown.

**GR:SA:FI : (%)      30 : 53 : 17**



**PARTICLE - SIZE  
DISTRIBUTION  
ASTM D 6913**

Aug-23



**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Glen Helen Lighting/GE  
 Project No.: 12108.009  
 Boring No.: LB-10  
 Sample No.: B-1

Tested By: FLM Date: 07/26/23  
 Checked By: MRV Date: 08/08/23  
 Depth (feet): 0 - 5.0

Soil Identification: Poorly Graded Sand with Silt (SP-SM), Yellowish Brown.

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	12	12	Wt. of Air-Dry Soil + Cont.(g)	2415.7	1078.4
Wt. Air-Dried Soil + Cont.(g)	2415.7	1078.4	Wt. of Dry Soil + Cont. (g)	2374.1	1078.4
Wt. of Container (g)	699.5	699.5	Wt. of Container No. (g)	699.5	699.5
Dry Wt. of Soil (g)	1674.3	378.9	Moisture Content (%)	2.5	0.0

Passing #4 Material After Wet Sieve	Container No.	12
	Wt. of Dry Soil + Container (g)	1049.3
	Wt. of Container (g)	699.5
	Dry Wt. of Soil Retained on # 200 Sieve (g)	349.8

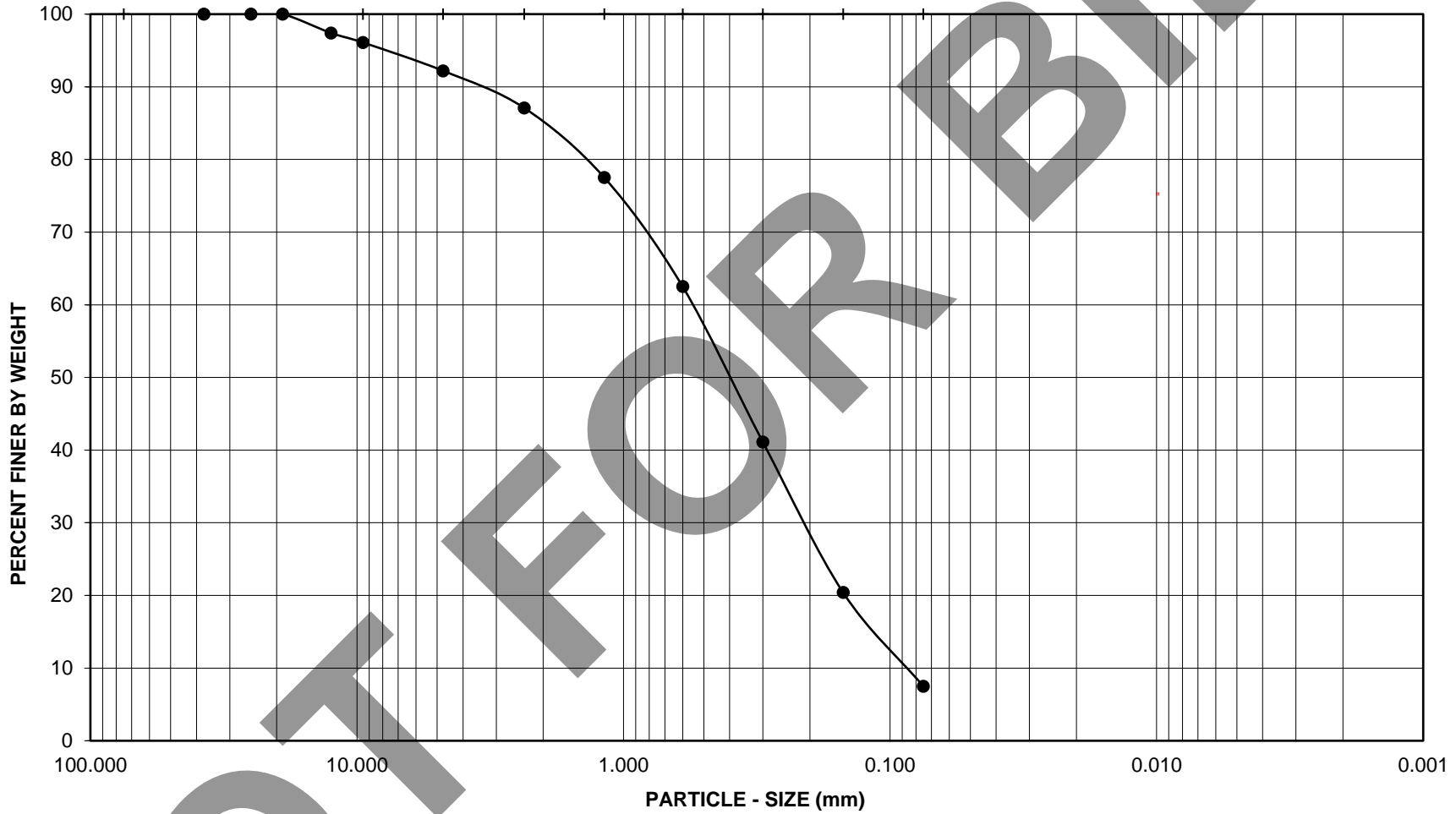
U. S. Sieve Size	(mm.)	Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
		Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000	0.0		100.0
1/2"	12.500	43.6		97.4
3/8"	9.500	65.1		96.1
#4	4.750	130.8		92.2
#8	2.360		20.9	87.1
#16	1.180		60.6	77.5
#30	0.600		122.1	62.5
#50	0.300		209.9	41.1
#100	0.150		295.2	20.4
#200	0.075		347.9	7.5
PAN				

GRAVEL: **8 %**  
 SAND: **84 %**  
 FINES: **8 %**  
 GROUP SYMBOL: **SP-SM**

Cu = D60/D10 = 6.25  
 Cc = (D30)<sup>2</sup>/(D60\*D10) = 0.91

Remarks: \_\_\_\_\_

GRAVEL			SAND				FINES		
COARSE		FINE	COARSE	MEDIUM	FINE		SILT	CLAY	
U.S. STANDARD SIEVE OPENING			U.S. STANDARD SIEVE NUMBER				HYDROMETER		
3.0"	1 1/2"	3/4"	#4	#8	#16	#30	#50	#100	#200



Project Name: Glen Helen Lighting/GE

Project No.: 12108.009

Boring No.: LB-10

Sample No.: B-1

Depth (feet): 0 - 5.0

Soil Type : SP-SM

Soil Identification: Poorly Graded Sand with Silt (SP-SM), Yellowish Brown.


**GR:SA:FI : (%)      8 : 84 : 8**

Aug-23



**PARTICLE - SIZE  
DISTRIBUTION  
ASTM D 6913**



Boring No.	LB-2	LB-3	LB-4					
Sample No.	S-6	S-5	S-4					
Depth (ft.)	20.0	15.0	10.0					
Sample Type	SPT	SPT	SPT					
Soil Classification	SM	SM	SM					
Soak Time (min)	10	10	10					
<b>Moisture Correction</b>								
Wet Weight of Soil + Container (gm.)	505.1	506.0	556.1					
Dry Weight of Soil + Container (gm.)	481.5	492.1	527.7					
Weight of Container (gm)	329.4	327.7	328.7					
Moisture Content (%)	15.5	8.5	14.3					
Container No.:	W	K	Q					
<b>Sample Dry Weight Determination</b>								
Weight of Sample + Container (gm.)	481.5	492.1	527.7					
Weight of Container (gm.)	329.4	327.7	328.7					
Weight of Dry Sample (gm.)	152.1	164.4	199.0					
Container No.:	W	K	Q					
<b>After Wash</b>								
Dry Weight of Sample + Container (gm)	414.9	440.2	471.1					
Weight of Container (gm)	329.4	327.7	328.7					
Dry Weight of Sample (gm)	85.5	112.5	142.4					
<b>% Passing No. 200 Sieve</b>	<b>44</b>	<b>32</b>	<b>28</b>					
<b>% Retained No. 200 Sieve</b>	<b>56</b>	<b>68</b>	<b>72</b>					
	<b>PERCENT PASSING No. 200 SIEVE ASTM D 1140</b>			Project Name: <u>Glen Helen Lighting/GE</u>				
				Project No.: <u>12108.009</u>				
				Client Name: <u>SBCSSD</u>				
				Tested By: <u>F. Mina</u>		Date: <u>07/28/23</u>		

Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 08/01/23  
 Project No. : 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-2 Checked By: M. Vinet  
 Sample No.: S-6 Depth (ft.) 20.0  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

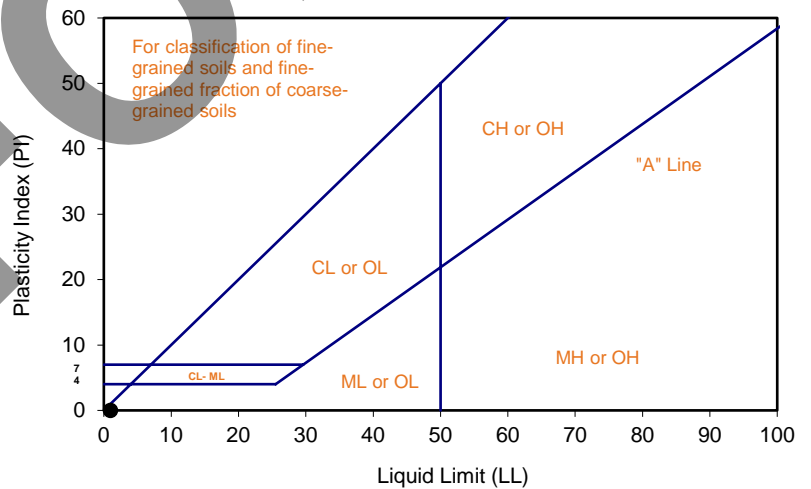
TEST NO.	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]						
Wet Wt. of Soil + Cont. (g)						
Dry Wt. of Soil + Cont. (g)						
Wt. of Container (g)						
Moisture Content (%) [Wn]						
	Non-Plastic (NP)		Non-Plastic (NP)			

<b>Liquid Limit</b>	<b>NP</b>
<b>Plastic Limit</b>	<b>NP</b>
<b>Plasticity Index</b>	<b>NP</b>
<b>Classification</b>	<b>SM</b>

PI at "A" - Line =  $0.73(LL-20)$  =

One - Point Liquid Limit Calculation

$$LL = Wn(N/25)^{0.121}$$

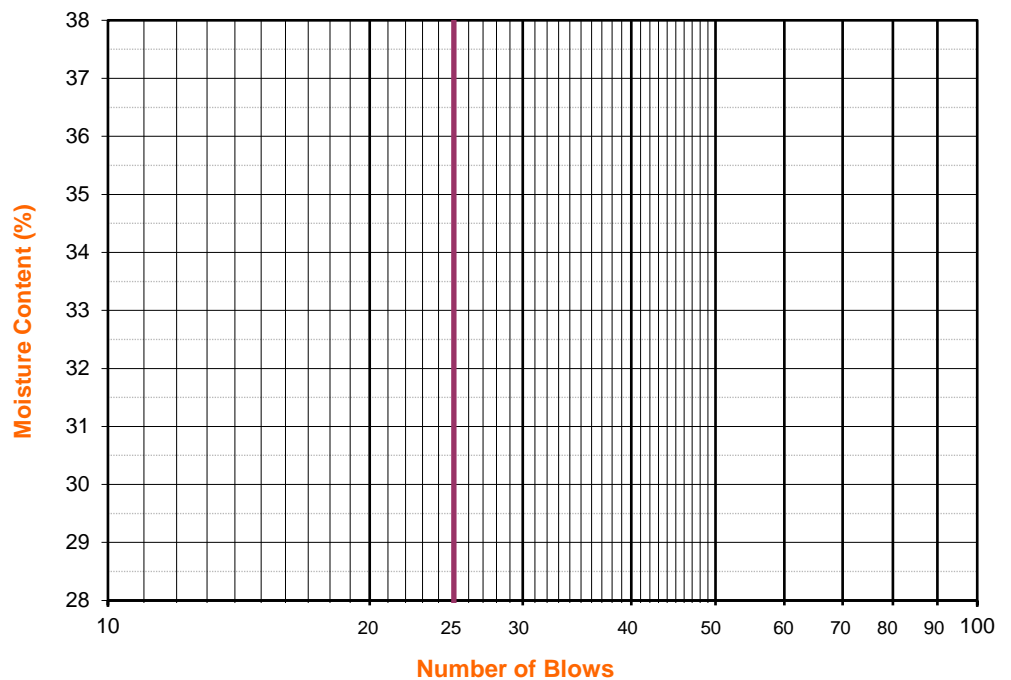

**PROCEDURES USED**

Wet Preparation  
Multipoint - Wet

Dry Preparation  
Multipoint - Dry

Procedure A  
Multipoint Test

Procedure B  
One-point Test

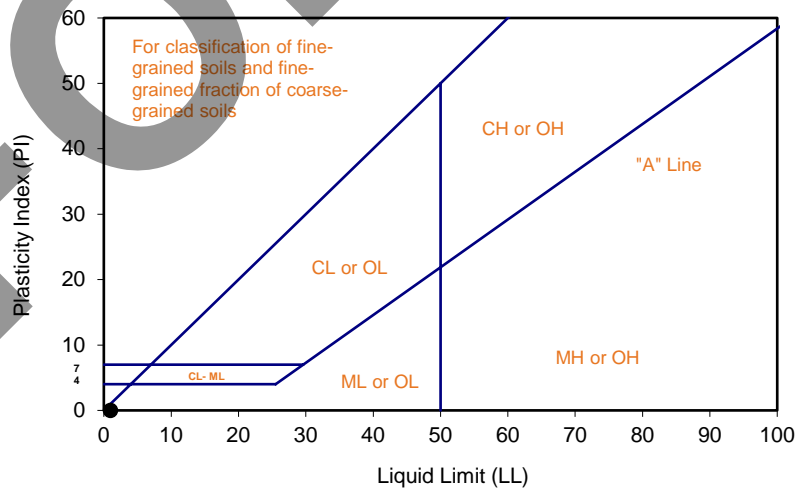


Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 08/01/23  
 Project No. : 12108.009 Input By: M. Vinet Date: 08/08/23  
 Boring No.: LB-3 Checked By: M. Vinet  
 Sample No.: S-5 Depth (ft.) 15.0  
 Soil Identification: Silty Sand (SM), Dark Yellowish Brown.

TEST NO.	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]	Non-Plastic (NP)		Non-Plastic (NP)			
Wet Wt. of Soil + Cont. (g)						
Dry Wt. of Soil + Cont. (g)						
Wt. of Container (g)						
Moisture Content (%) [Wn]						

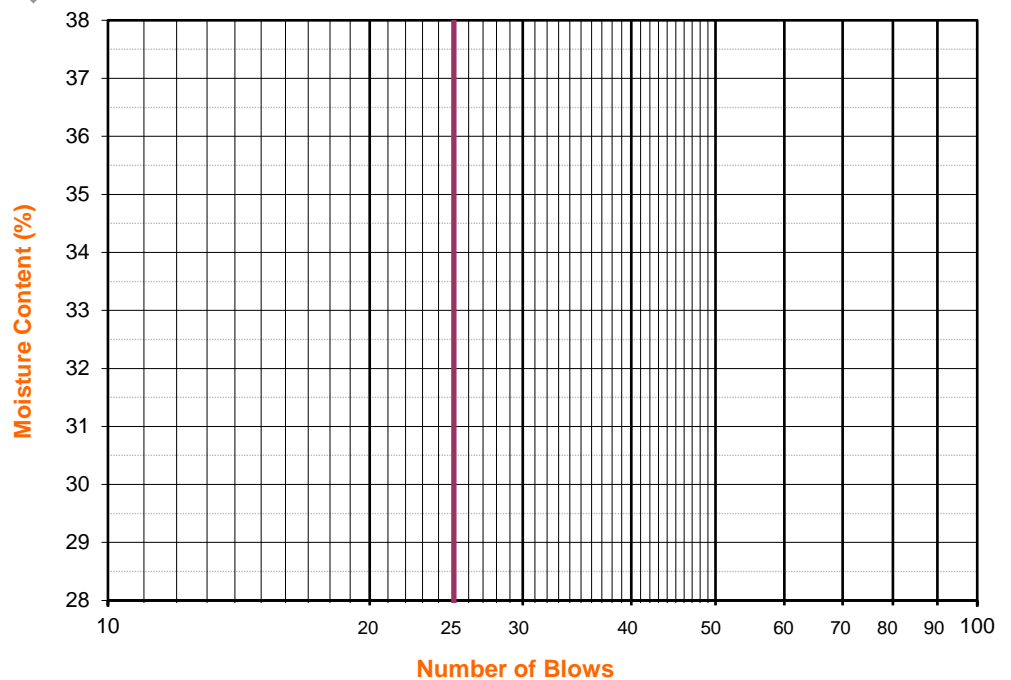
<b>Liquid Limit</b>	<b>NP</b>
<b>Plastic Limit</b>	<b>NP</b>
<b>Plasticity Index</b>	<b>NP</b>
<b>Classification</b>	<b>SM</b>

PI at "A" - Line =  $0.73(LL-20)$  =   
 One - Point Liquid Limit Calculation  
 $LL = Wn(N/25)^{0.121}$



### PROCEDURES USED

- Wet Preparation Multipoint - Wet
- Dry Preparation Multipoint - Dry
- Procedure A Multipoint Test
- Procedure B One-point Test



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name: <u>Glen Helen Lighting/GE</u>	Tested By: <u>F. Mina</u>	Date: <u>8/2/23</u>
Project No. : <u>12108.009</u>	Checked By: <u>M. Vinet</u>	Date: <u>8/8/23</u>
Boring No.: <u>LB-5</u>	Depth: <u>0 - 5.0</u>	
Sample No. : <u>B-1</u>	Location: <u>N/A</u>	
Sample Description: <u>Silty Sand (SM), Dark Yellowish Brown.</u>		

Dry Wt. of Soil + Cont. (gm.)	1452.5
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	1452.5
Weight Soil Retained on #4 Sieve	52.9
Percent Passing # 4	96.4

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0025
Wt. Comp. Soil + Mold (gm.)	594.0	612.9
Wt. of Mold (gm.)	178.3	178.3
Specific Gravity (Assumed)	2.70	2.70
Container No.	7	7
Wet Wt. of Soil + Cont. (gm.)	300.0	612.9
Dry Wt. of Soil + Cont. (gm.)	276.5	383.1
Wt. of Container (gm.)	0.0	178.3
Moisture Content (%)	8.5	13.4
Wet Density (pcf)	125.4	130.8
Dry Density (pcf)	115.6	115.3
Void Ratio	0.459	0.462
Total Porosity	0.314	0.316
Pore Volume (cc)	65.1	65.6
Degree of Saturation (%) [ S meas]	<b>50.0</b>	<b>78.4</b>

**SPECIMEN INUNDATION** in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
8/2/23	8:15	1.0	0	0.5000
8/2/23	8:25	1.0	10	0.5000
Add Distilled Water to the Specimen				
8/3/23	8:00	1.0	1415	0.5025
8/3/23	9:00	1.0	1475	0.5025

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>2.5</b>
Expansion Index ( Report ) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	<b>3</b>

**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name:	<u>Glen Helen Lighting/GE</u>	Tested By:	<u>F. Mina</u>	Date:	<u>8/2/23</u>
Project No. :	<u>12108.009</u>	Checked By:	<u>M. Vinet</u>	Date:	<u>8/8/23</u>
Boring No.:	<u>LB-7</u>	Depth:	<u>0 - 5.0</u>		
Sample No. :	<u>B-1</u>	Location:	<u>N/A</u>		
Sample Description:	<u>Silty Sand (SM), Dark Yellowish Brown.</u>				

Dry Wt. of Soil + Cont. (gm.)	1465.6
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	1465.6
Weight Soil Retained on #4 Sieve	17.1
Percent Passing # 4	98.8

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	0.9997
Wt. Comp. Soil + Mold (gm.)	613.7	637.6
Wt. of Mold (gm.)	200.6	200.6
Specific Gravity (Assumed)	2.70	2.70
Container No.	8	8
Wet Wt. of Soil + Cont. (gm.)	300.0	637.6
Dry Wt. of Soil + Cont. (gm.)	276.5	380.7
Wt. of Container (gm.)	0.0	200.6
Moisture Content (%)	8.5	14.8
Wet Density (pcf)	124.6	131.9
Dry Density (pcf)	114.8	114.9
Void Ratio	0.468	0.467
Total Porosity	0.319	0.319
Pore Volume (cc)	66.0	65.9
Degree of Saturation (%) [ S meas]	<b>49.0</b>	<b>85.4</b>

**SPECIMEN INUNDATION** in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
8/2/23	9:45	1.0	0	0.5000
8/2/23	9:55	1.0	10	0.5000
Add Distilled Water to the Specimen				
8/3/23	8:00	1.0	1325	0.4997
8/3/23	9:00	1.0	1385	0.4997

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>-0.3</b>
Expansion Index ( Report ) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	<b>0</b>

Project Name:	<u>Glen Helen Lighting/GE</u>	Tested By:	<u>F. Mina</u>	Date:	<u>08/03/23</u>
Project No.:	<u>12108.009</u>	Checked By:	<u>M. Vinet</u>	Date:	<u>08/09/23</u>
Boring No.:	<u>LB-5</u>	Sample Type:	<u>Ring</u>		
Sample No.:	<u>R-3</u>	Depth (ft.):	<u>10.0</u>		
Soil Identification:	<u>Silty Sand (SM), Dark Yellowish Brown.</u>				

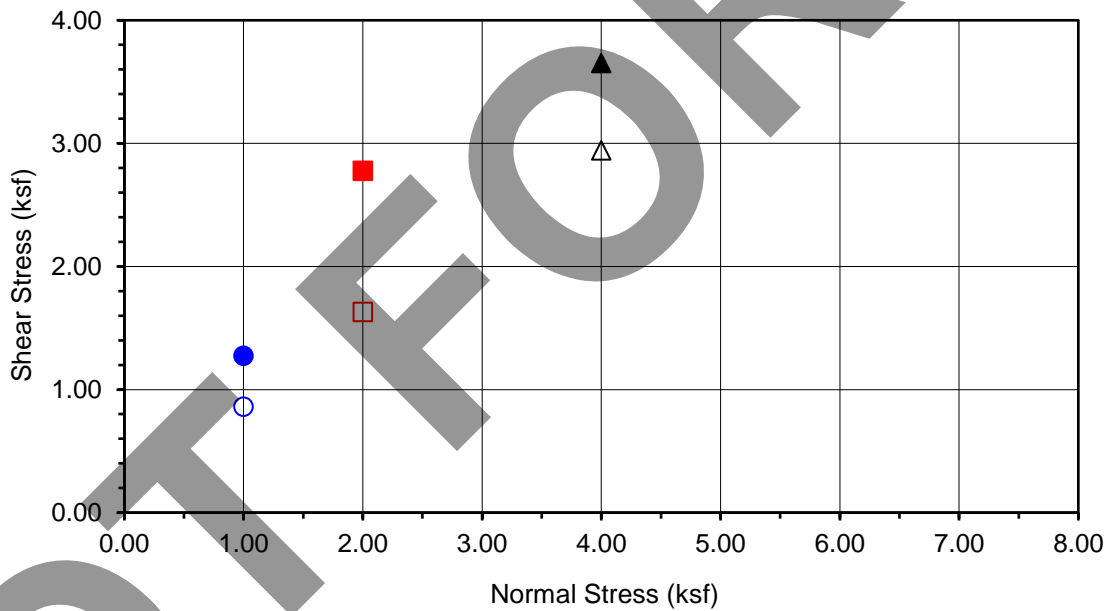
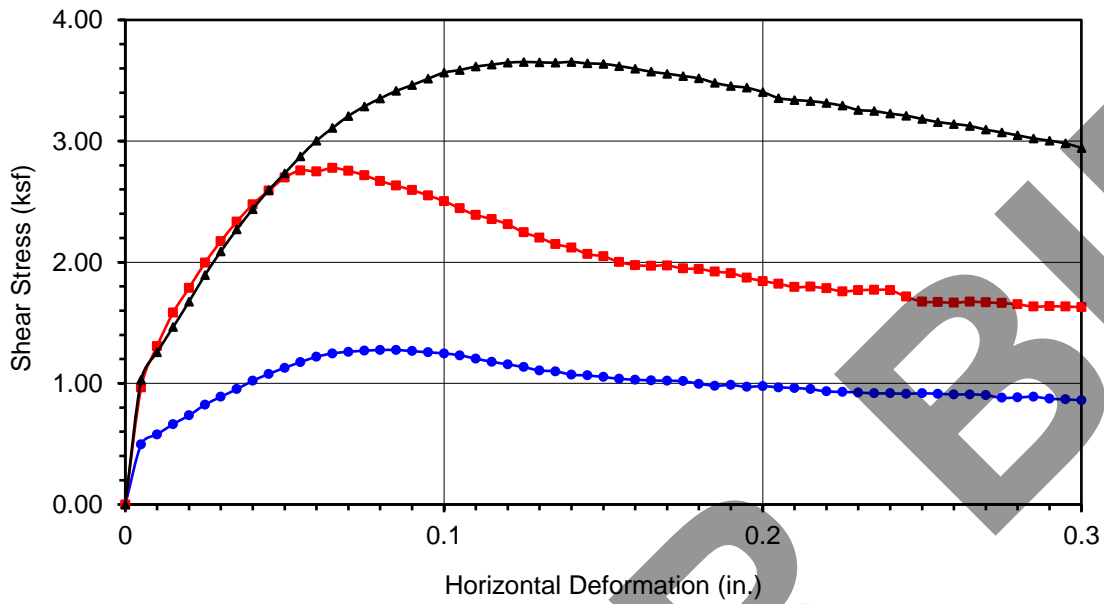
Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	190.48	193.08	186.18
Weight of Ring(gm):	44.21	45.14	43.83

**Before Shearing**

Weight of Wet Sample+Cont.(gm):	284.20	284.20	284.20
Weight of Dry Sample+Cont.(gm):	268.80	268.80	268.80
Weight of Container(gm):	36.10	36.10	36.10
Vertical Rdg.(in): Initial	0.0000	0.2343	0.2685
Vertical Rdg.(in): Final	-0.0020	0.2451	0.2871

**After Shearing**

Weight of Wet Sample+Cont.(gm):	198.80	182.21	194.78
Weight of Dry Sample+Cont.(gm):	178.23	163.93	175.58
Weight of Container(gm):	50.89	38.28	49.82
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43



<b>Boring No.</b>	<b>LB-5</b>
<b>Sample No.</b>	<b>R-3</b>
<b>Depth (ft)</b>	<b>10</b>
<u>Sample Type:</u>	
Ring	
<u>Soil Identification:</u>	
Silty Sand (SM), Dark Yellowish Brown.	

Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.275	■ 2.777	▲ 3.653
Shear Stress @ End of Test (ksf)	○ 0.861	□ 1.630	△ 2.943
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	6.62	6.62	6.62
Dry Density (pcf)	114.1	115.4	111.0
Saturation (%)	37.4	38.8	34.5
Soil Height Before Shearing (in.)	0.9980	0.9892	0.9814
Final Moisture Content (%)	16.2	14.5	15.3

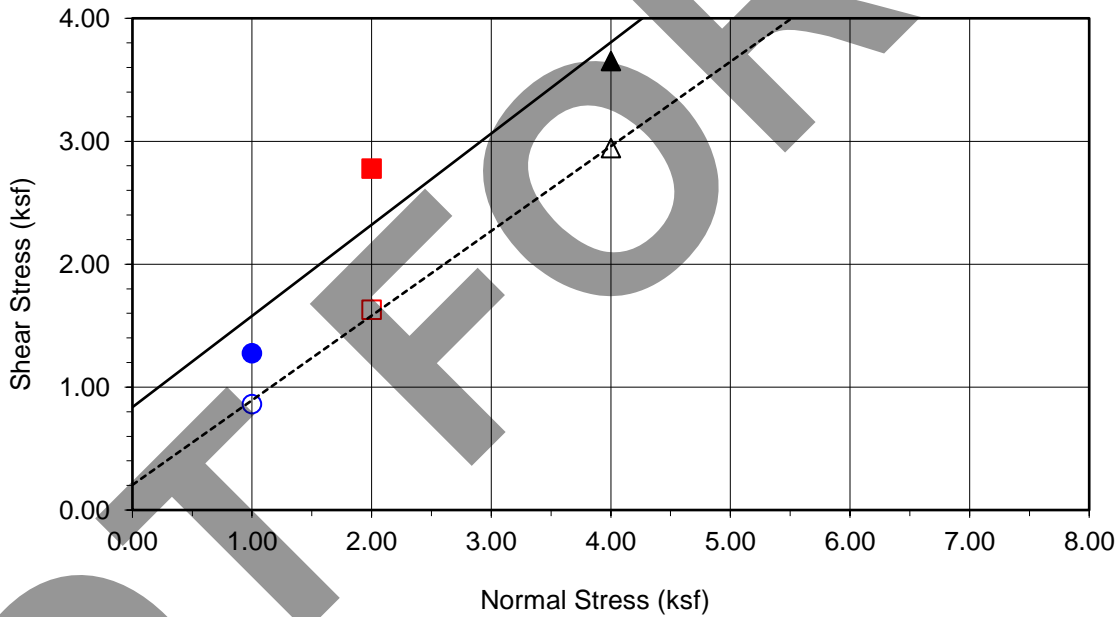
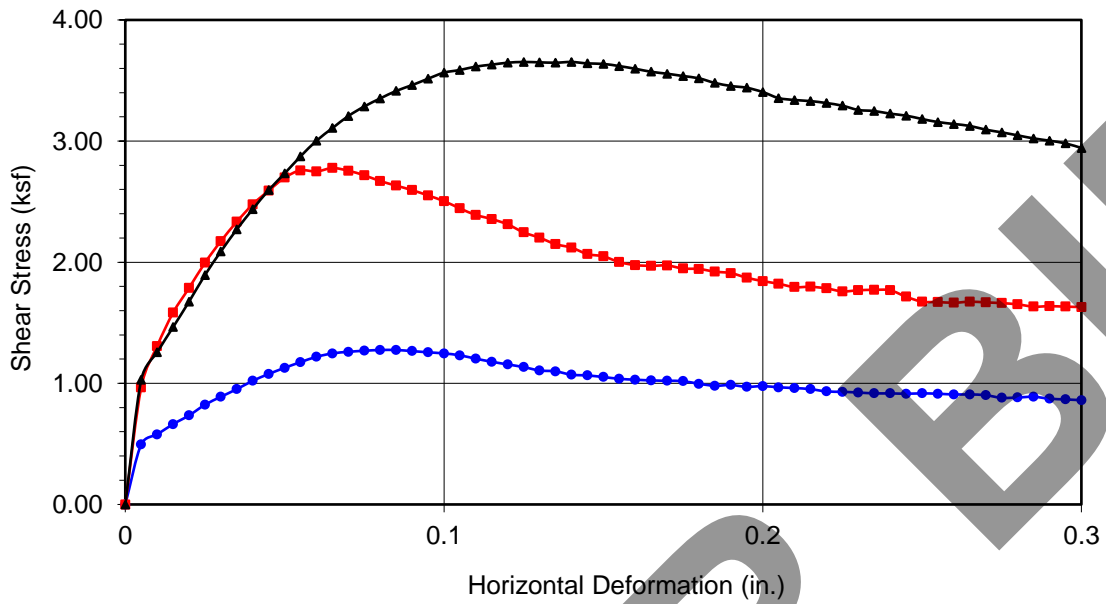


**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE

08-23



<b>Boring No.</b>	<b>LB-5</b>	
<b>Sample No.</b>	<b>R-3</b>	
<b>Depth (ft)</b>	<b>10</b>	
Sample Type:	Ring	
Soil Identification: Silty Sand (SM), Dark Yellowish Brown.		
<b>Strength Parameters</b>		
	C (psf)	$\phi$ (°)
Peak	837	37
Ultimate	205	35

Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.275	■ 2.777	▲ 3.653
Shear Stress @ End of Test (ksf)	○ 0.861	□ 1.630	△ 2.943
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	6.62	6.62	6.62
Dry Density (pcf)	114.1	115.4	111.0
Saturation (%)	37.4	38.8	34.5
Soil Height Before Shearing (in.)	0.9980	0.9892	0.9814
Final Moisture Content (%)	16.2	14.5	15.3



**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE

08-23



Project Name: <u>Glen Helen Lighting/GE</u>	Tested By: <u>F. Mina</u>	Date: <u>08/02/23</u>
Project No.: <u>12108.009</u>	Checked By: <u>M. Vinet</u>	Date: <u>08/09/23</u>
Boring No.: <u>LB-5</u>	Sample Type: <u>Ring</u>	
Sample No.: <u>R-4</u>	Depth (ft.): <u>20.0</u>	
Soil Identification: <u>Silty Sand (SM), Yellowish Brown.</u>		

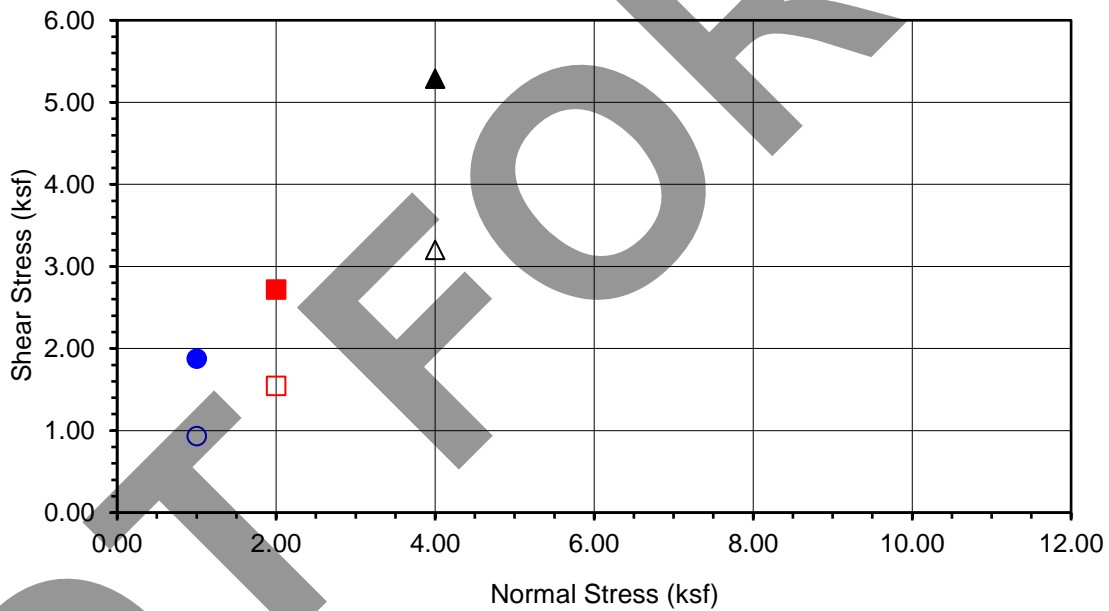
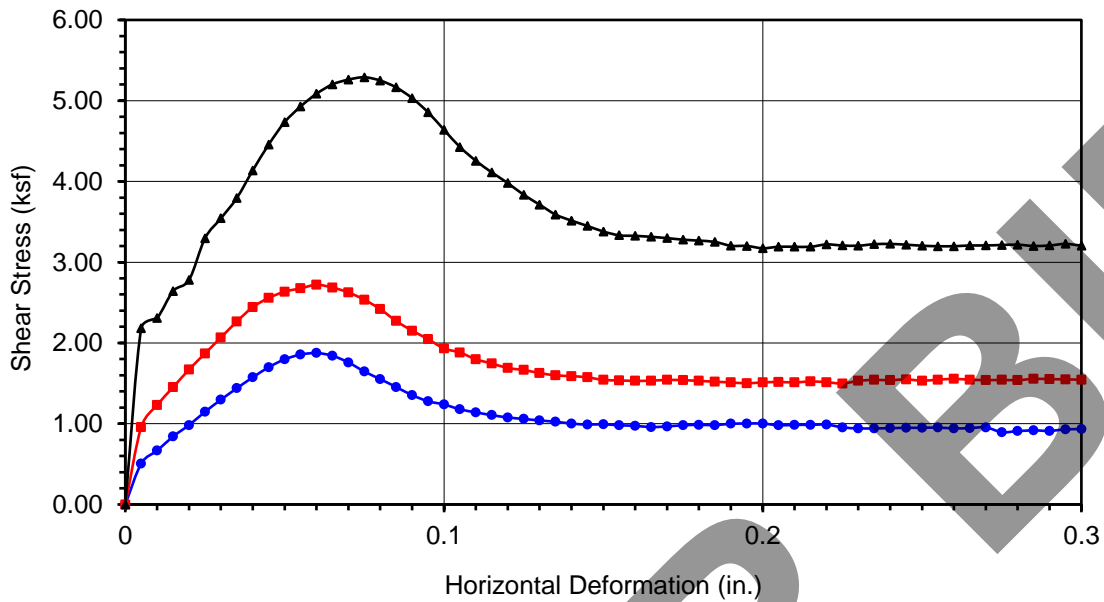
Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	183.38	186.18	189.86
Weight of Ring(gm):	40.59	44.61	45.76

**Before Shearing**

Weight of Wet Sample+Cont.(gm):	142.79	142.79	142.79
Weight of Dry Sample+Cont.(gm):	123.53	123.53	123.53
Weight of Container(gm):	0.00	0.00	0.00
Vertical Rdg.(in): Initial	0.0000	0.2485	0.2506
Vertical Rdg.(in): Final	-0.0050	0.2578	0.2690

**After Shearing**

Weight of Wet Sample+Cont.(gm):	196.30	202.39	204.25
Weight of Dry Sample+Cont.(gm):	173.33	180.10	181.93
Weight of Container(gm):	49.78	50.58	50.68
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43



<b>Boring No.</b>	<b>LB-5</b>
<b>Sample No.</b>	<b>R-4</b>
<b>Depth (ft)</b>	<b>20</b>
<u>Sample Type:</u>	
Ring	
<u>Soil Identification:</u>	
Silty Sand (SM), Yellowish Brown.	

Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.875	■ 2.720	▲ 5.290
Shear Stress @ End of Test (ksf)	○ 0.933	□ 1.545	△ 3.204
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	15.59	15.59	15.59
Dry Density (pcf)	102.7	101.9	103.7
Saturation (%)	65.7	64.3	67.3
Soil Height Before Shearing (in.)	0.9950	0.9907	0.9816
Final Moisture Content (%)	18.6	17.2	17.0

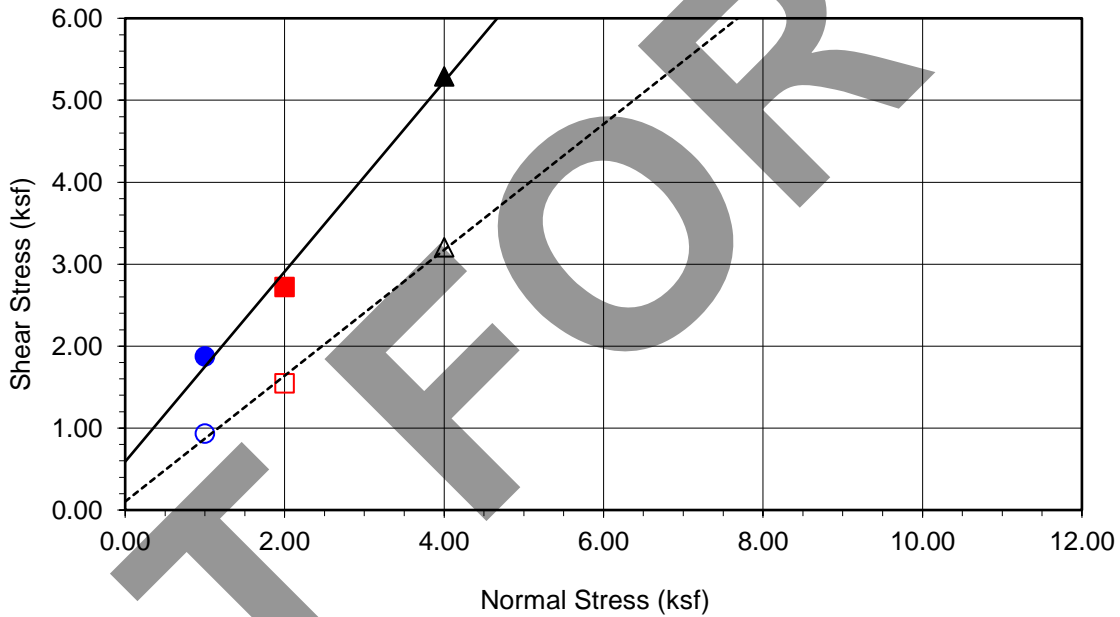
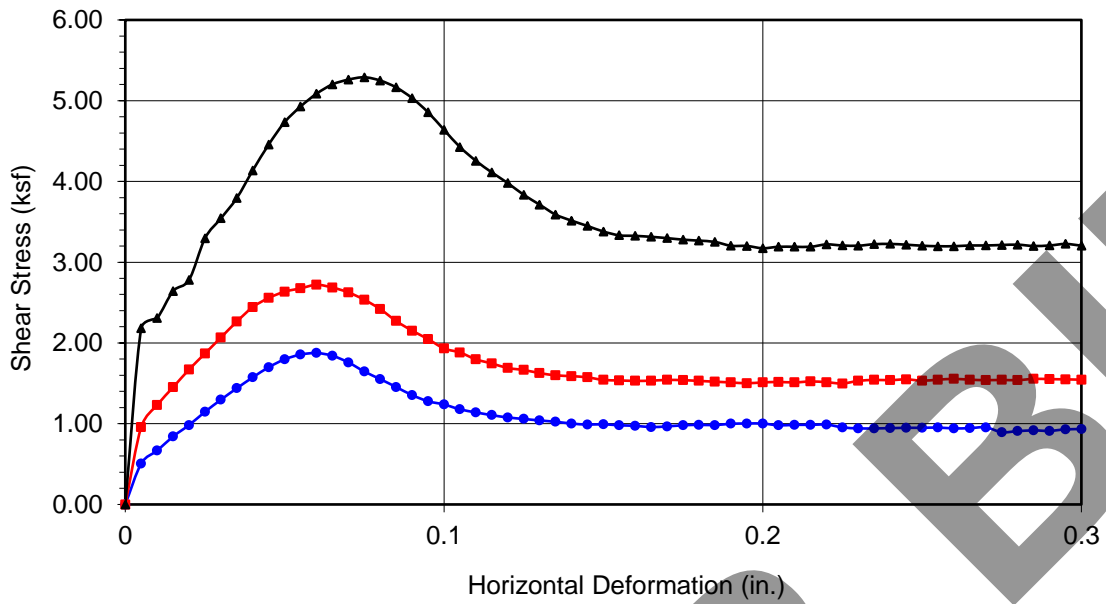


**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE

08-23



<b>Boring No.</b>	<b>LB-5</b>	
<b>Sample No.</b>	<b>R-4</b>	
<b>Depth (ft)</b>	<b>20</b>	
Sample Type:	Ring	
<b>Soil Identification:</b>		
Silty Sand (SM), Yellowish Brown.		
<b>Strength Parameters</b>		
	C (psf)	$\phi$ (°)
Peak	590	49
Ultimate	104	38

Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.875	■ 2.720	▲ 5.290
Shear Stress @ End of Test (ksf)	○ 0.933	□ 1.545	△ 3.204
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	15.59	15.59	15.59
Dry Density (pcf)	102.7	101.9	103.7
Saturation (%)	65.7	64.3	67.3
Soil Height Before Shearing (in.)	0.9950	0.9907	0.9816
Final Moisture Content (%)	18.6	17.2	17.0



**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE

08-23



**DIRECT SHEAR TEST**  
Consolidated Drained - ASTM D 3080

Project Name: Glen Helen Lighting/GE Tested By: F. Mina Date: 08/08/23  
Project No.: 12108.009 Checked By: M. Vinet Date: 08/09/23  
Boring No.: LB-7 Sample Type: Ring  
Sample No.: R-3 Depth (ft.): 20.0  
Soil Identification: Silt (ML), Dark Yellowish Brown.

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	189.57	203.04	202.45
Weight of Ring(gm):	39.14	45.13	45.70

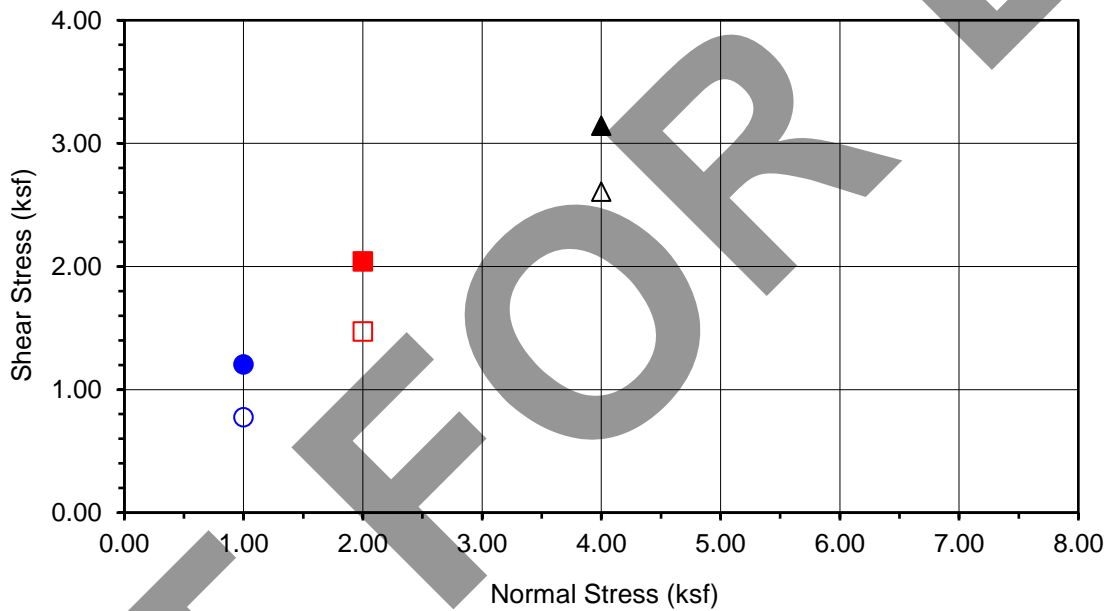
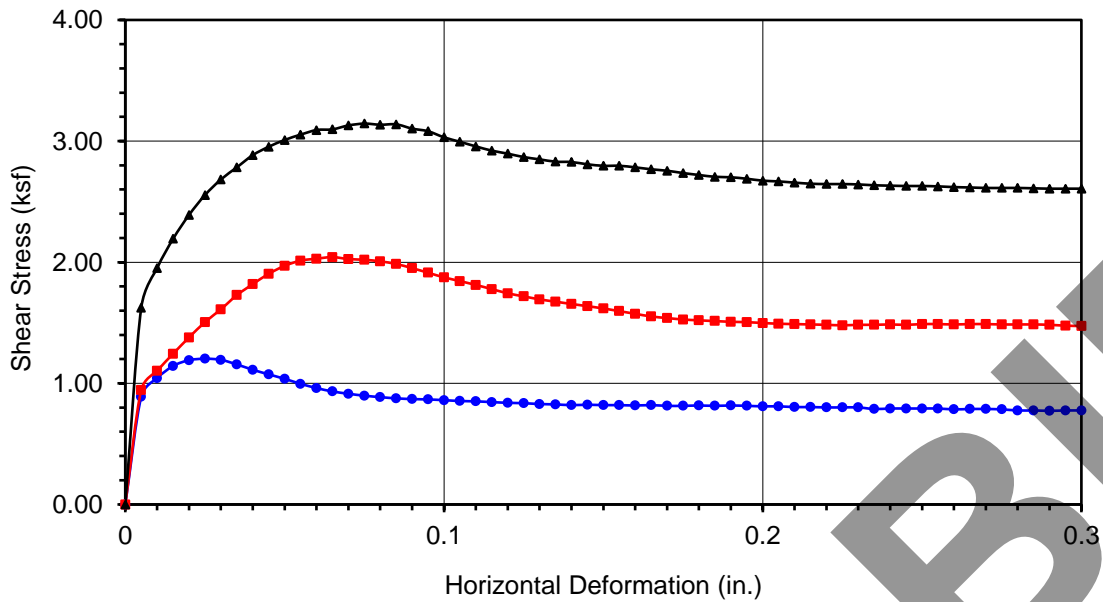
**Before Shearing**

Weight of Wet Sample+Cont.(gm):	150.43	150.43	150.43
Weight of Dry Sample+Cont.(gm):	133.67	133.67	133.67
Weight of Container(gm):	0.00	0.00	0.00
Vertical Rdg.(in): Initial	0.0000	0.2538	0.2418
Vertical Rdg.(in): Final	0.0011	0.2547	0.2470

**After Shearing**

Weight of Wet Sample+Cont.(gm):	205.41	212.12	209.80
Weight of Dry Sample+Cont.(gm):	183.89	191.39	188.90
Weight of Container(gm):	50.22	50.70	50.00
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43

NOT FOR



<b>Boring No.</b>	<b>LB-7</b>
<b>Sample No.</b>	<b>R-3</b>
<b>Depth (ft)</b>	<b>20</b>
<u>Sample Type:</u>	
Ring	
<u>Soil Identification:</u>	
Silt (ML), Dark Yellowish Brown.	

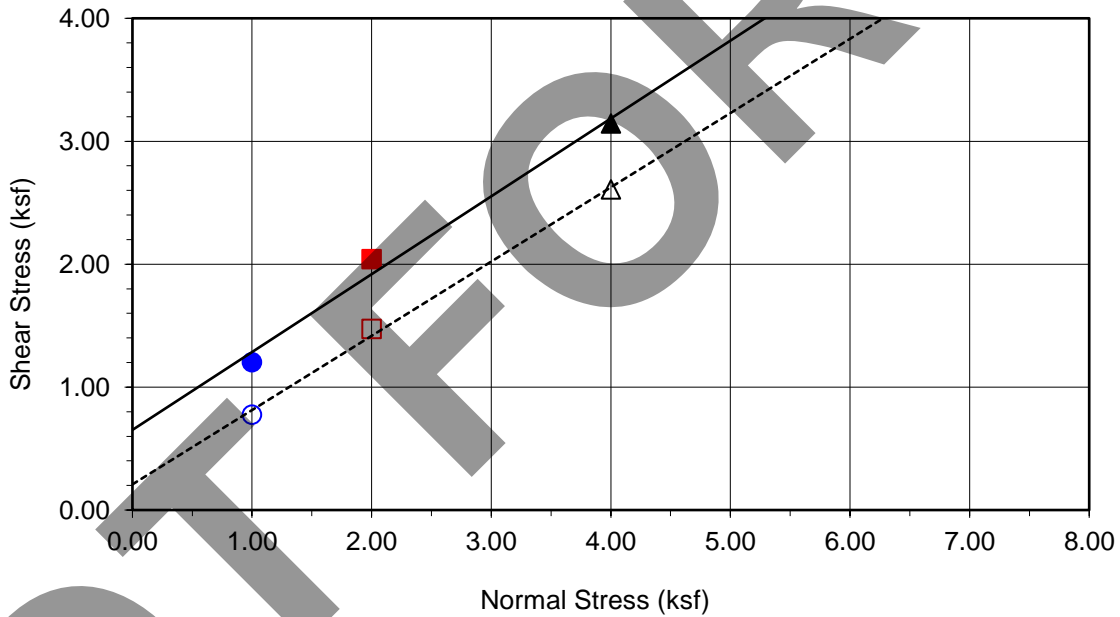
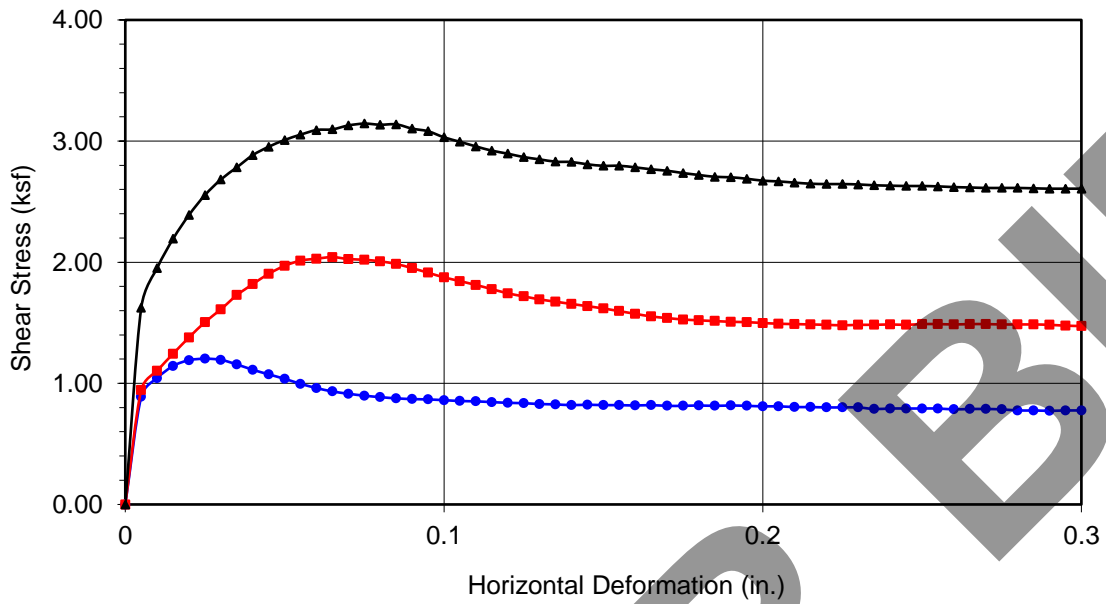
Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.203	■ 2.042	▲ 3.144
Shear Stress @ End of Test (ksf)	○ 0.776	□ 1.473	△ 2.607
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	12.54	12.54	12.54
Dry Density (pcf)	111.2	116.7	115.8
Saturation (%)	65.6	76.2	74.4
Soil Height Before Shearing (in.)	1.0011	0.9991	0.9948
Final Moisture Content (%)	16.1	14.7	15.0



**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE



<b>Boring No.</b>	<b>LB-7</b>	
<b>Sample No.</b>	<b>R-3</b>	
<b>Depth (ft)</b>	<b>20</b>	
Sample Type:	Ring	
<u>Soil Identification:</u>		
Silt (ML), Dark Yellowish Brown.		
<b>Strength Parameters</b>		
	C (psf)	$\phi$ (°)
Peak	652	32
Ultimate	209	31

Normal Stress (kip/ft <sup>2</sup> )	1.000	2.000	4.000
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.203	■ 2.042	▲ 3.144
Shear Stress @ End of Test (ksf)	○ 0.776	□ 1.473	△ 2.607
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	12.54	12.54	12.54
Dry Density (pcf)	111.2	116.7	115.8
Saturation (%)	65.6	76.2	74.4
Soil Height Before Shearing (in.)	1.0011	0.9991	0.9948
Final Moisture Content (%)	16.1	14.7	15.0



**DIRECT SHEAR TEST RESULTS**  
Consolidated Drained - ASTM D 3080

Project No.: 12108.009

Glen Helen Lighting/GE

08-23

**TESTS for SULFATE CONTENT  
CHLORIDE CONTENT and pH of SOILS**

Project Name: Glen Helen Lighting/GE Tested By : F. Mina Date: 08/04/23  
 Project No. : 12108.009 Data Input By: M. Vinet Date: 08/08/23

Boring No.	LB-5	LB-7	LB-8	LB-10
Sample No.	B-1	B-1	B-1	B-1
Sample Depth (ft)	0 - 5.0	0 - 5.0	0 - 5.0	0 - 5.0
Soil Identification:	Silty Sand (SM)	Silty Sand (SM)	Silty Sand (SM)	Poorly Graded Sand with Silt (SP-SM)
Wet Weight of Soil + Container (g)	100.0	100.0	100.0	100.0
Dry Weight of Soil + Container (g)	100.0	100.0	100.0	100.0
Weight of Container (g)	0.0	0.0	0.0	0.0
Moisture Content (%)	0.0	0.0	0.0	0.0
Weight of Soaked Soil (g)	100.0	100.0	100.0	100.0

**SULFATE CONTENT, Hach Kit Method**

Dilution : 1	3	3	3	3
Water Fraction (ml)	25	25	25	25
Tube Reading	<50	<50	50	<50
<b>PPM Sulfate</b>	<b>&lt;150</b>	<b>&lt;150</b>	<b>150</b>	<b>&lt;150</b>
% Sulfate	<0.0150	<0.0150	0.0150	<0.0150

**CHLORIDE CONTENT, DOT California Test 422**

ml of Extract For Titration (B)	30	30	30	30
ml of AgNO <sub>3</sub> Soln. Used in Titration (C)	0.3	0.3	0.6	0.3
PPM of Chloride (C -0.2) * 100 * 30 / B	10	10	40	10
<b>PPM of Chloride, Dry Wt. Basis</b>	<b>10</b>	<b>10</b>	<b>40</b>	<b>10</b>

**pH TEST, DOT California Test 643**

<b>pH Value</b>	<b>6.80</b>	<b>6.80</b>	<b>7.20</b>	<b>6.80</b>
<b>Temperature °C</b>	21.0	21.0	21.0	21.0

## SOIL RESISTIVITY TEST

### DOT CA TEST 643

Project Name: Glen Helen Lighting/GE

Tested By : F. Mina Date: 08/04/23

Project No. : 12108.009

Data Input By: M. Vinet Date: 08/08/23

Boring No.: LB-5

Depth (ft.) : 0 - 5.0

Sample No. : B-1

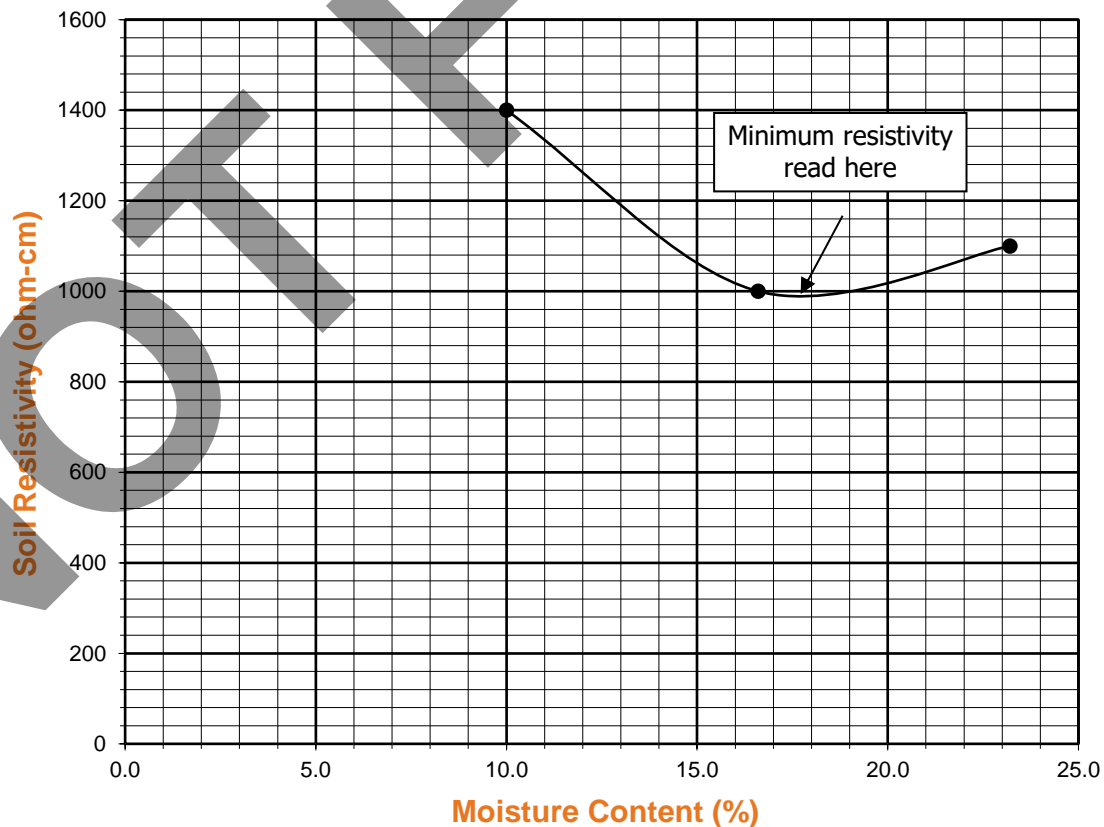
Soil Identification:\* Silty Sand (SM)

\*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	1400	1400
2	83	16.60	1000	1000
3	116	23.20	1100	1100
4				
5				

Moisture Content (%) (M <sub>ci</sub> )	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (W <sub>t</sub> )	500.00
Box Constant	1.000
$MC = (((1 + M_{ci}/100) \times (W_a/W_t + 1)) - 1) \times 100$	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		Hach Kit	DOT CA Test 422		DOT CA Test 643
<b>980</b>	<b>17.5</b>	<b>&lt;150</b>	<b>10</b>	<b>6.80</b>	<b>21.0</b>





## SOIL RESISTIVITY TEST

### DOT CA TEST 643

Project Name: Glen Helen Lighting/GE  
 Project No. : 12108.009  
 Boring No.: LB-7  
 Sample No. : B-1

Tested By : F. Mina Date: 08/04/23  
 Data Input By: M. Vinet Date: 08/08/23  
 Depth (ft.) : 0 - 5.0

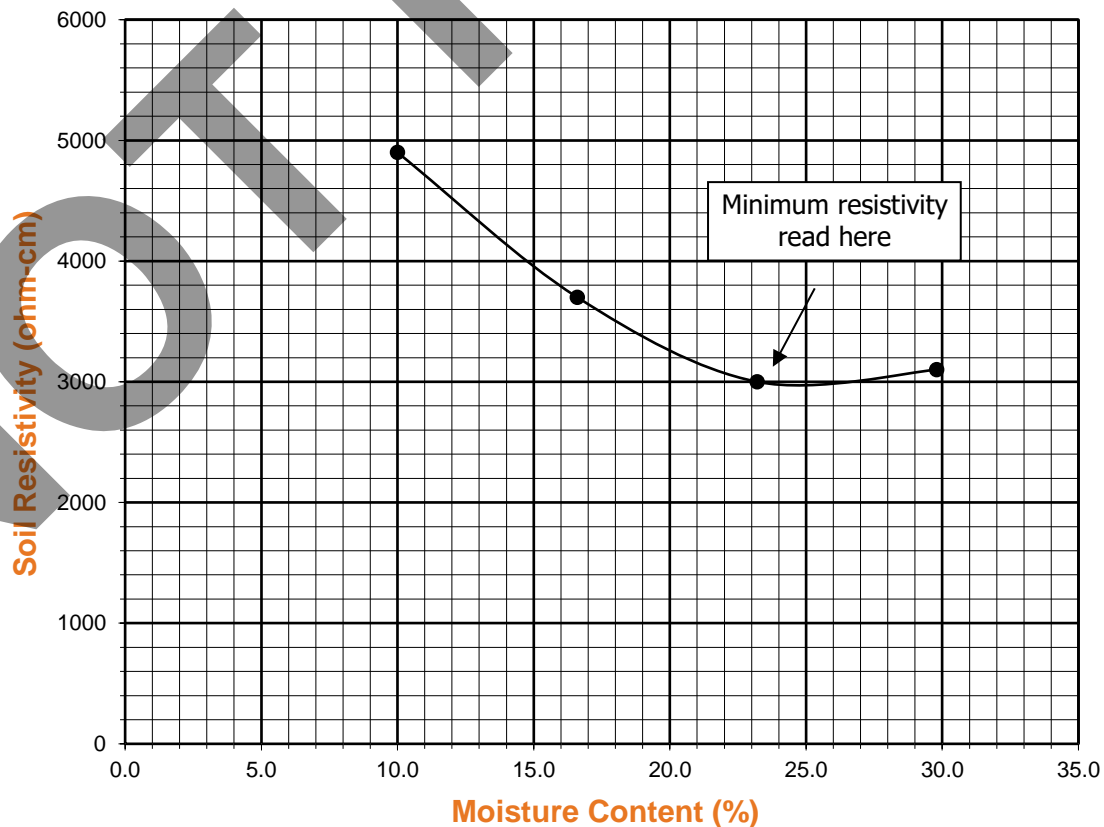
Soil Identification:\* Silty Sand (SM)

\*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	4900	4900
2	83	16.60	3700	3700
3	116	23.20	3000	3000
4	149	29.80	3100	3100
5				

Moisture Content (%) (Mci)	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (Wt)	500.00
Box Constant	1.000
$MC = (((1 + Mci / 100) \times (Wa / Wt + 1)) - 1) \times 100$	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		Hach Kit	DOT CA Test 422		DOT CA Test 643
<b>3000</b>	<b>23.2</b>	<b>&lt;150</b>	<b>10</b>		<b>6.80</b> <b>21.0</b>



## SOIL RESISTIVITY TEST

### DOT CA TEST 643

Project Name: Glen Helen Lighting/GE

Tested By : F. Mina Date: 08/04/23

Project No. : 12108.009

Data Input By: M. Vinet Date: 08/08/23

Boring No.: LB-8

Depth (ft.) : 0 - 5.0

Sample No. : B-1

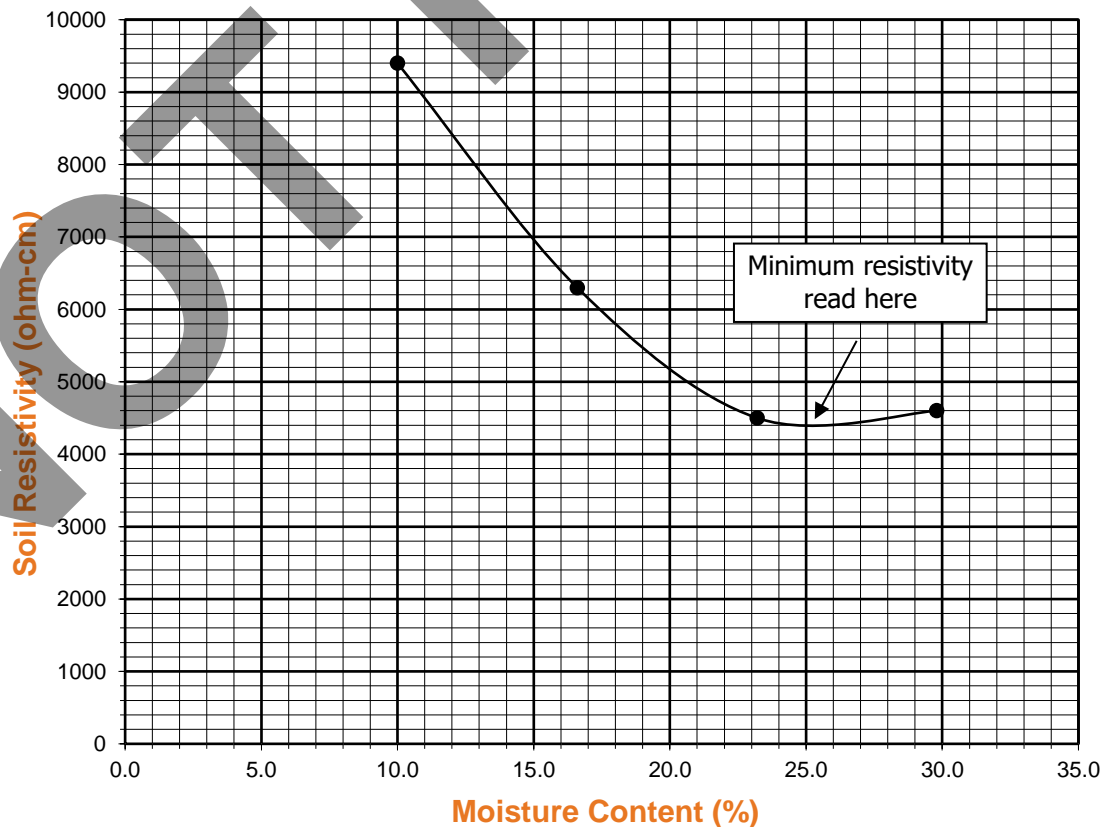
Soil Identification:\* Silty Sand (SM)

\*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	9400	9400
2	83	16.60	6300	6300
3	116	23.20	4500	4500
4	149	29.80	4600	4600
5				

Moisture Content (%) (Mci)	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (Wt)	500.00
Box Constant	1.000
$MC = (((1 + Mci / 100) \times (Wa / Wt + 1)) - 1) \times 100$	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		Hach Kit	DOT CA Test 422		DOT CA Test 643
<b>4400</b>	<b>25.0</b>	<b>150</b>	<b>40</b>	<b>7.20</b>	<b>21.0</b>



## SOIL RESISTIVITY TEST

### DOT CA TEST 643

Project Name: Glen Helen Lighting/GE  
 Project No. : 12108.009  
 Boring No.: LB-10  
 Sample No. : B-1

Tested By : F. Mina Date: 08/04/23  
 Data Input By: M. Vinet Date: 08/08/23  
 Depth (ft.) : 0 - 5.0

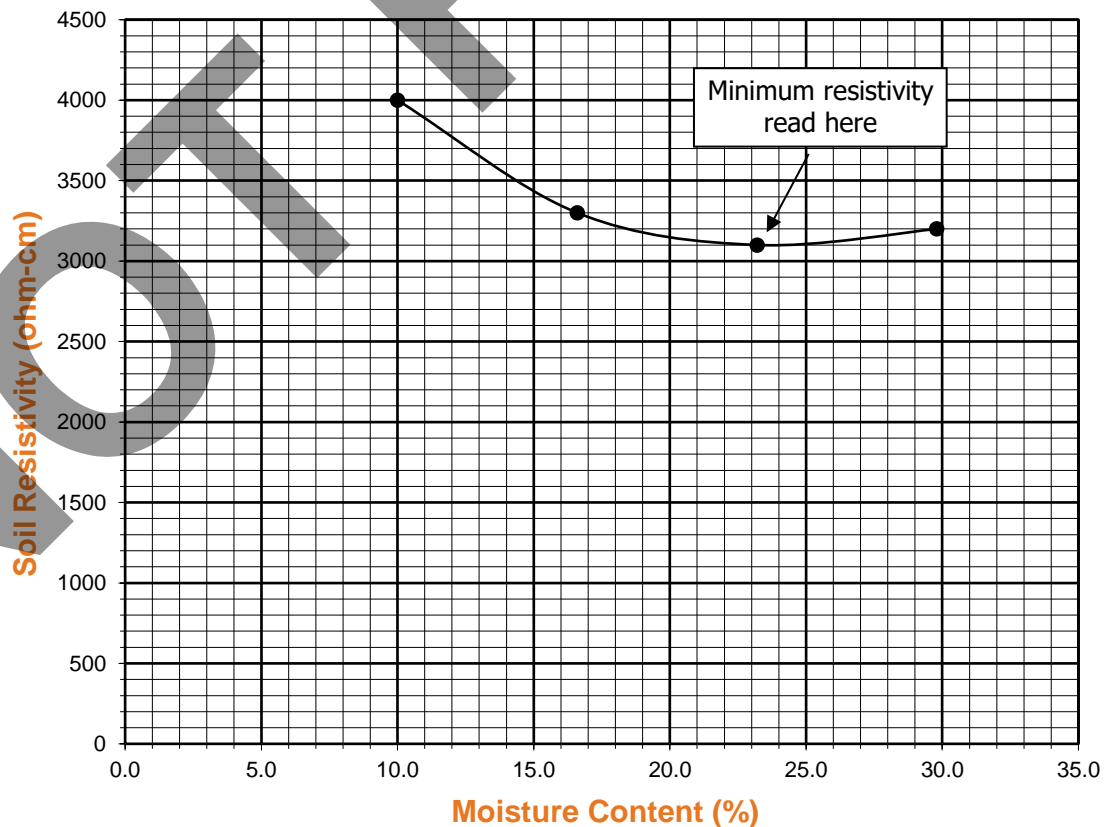
Soil Identification:\* Poorly Graded Sand with Silt (SP-SM)

\*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	4000	4000
2	83	16.60	3300	3300
3	116	23.20	3100	3100
4	149	29.80	3200	3200
5				

Moisture Content (%) (Mci)	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (Wt)	500.00
Box Constant	1.000
$MC = (((1 + Mci/100) \times (Wa/Wt + 1)) - 1) \times 100$	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		Hach Kit	DOT CA Test 422	DOT CA Test 643	
<b>3100</b>	<b>23.2</b>	<b>&lt;150</b>	<b>10</b>	<b>6.80</b>	<b>21.0</b>





## R-VALUE TEST RESULTS

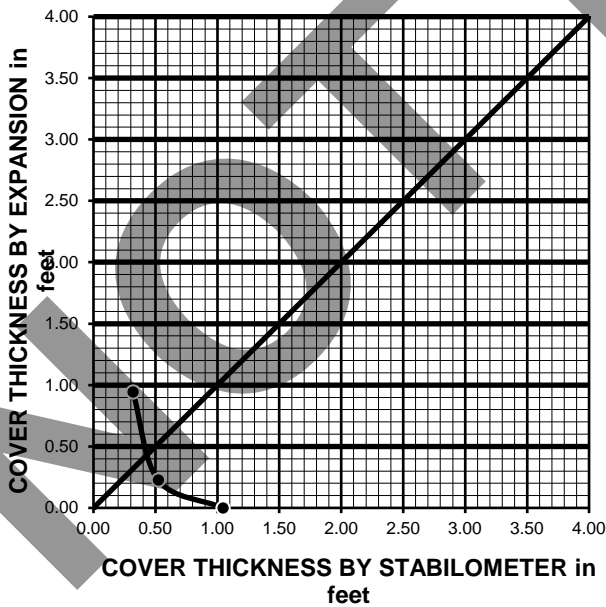
### ASTM D 2844

Project Name:	Glen Helen Lighting/GE	Date:	8/2/23
Project Number:	12108.009	Technician:	F. Mina
Boring Number:	LB-7	Depth (ft.):	0 - 5.0
Sample Number:	B-1		
Sample Description:	Silty Sand (SM), Dark Yellowish Brown.	Sample Location:	N/A

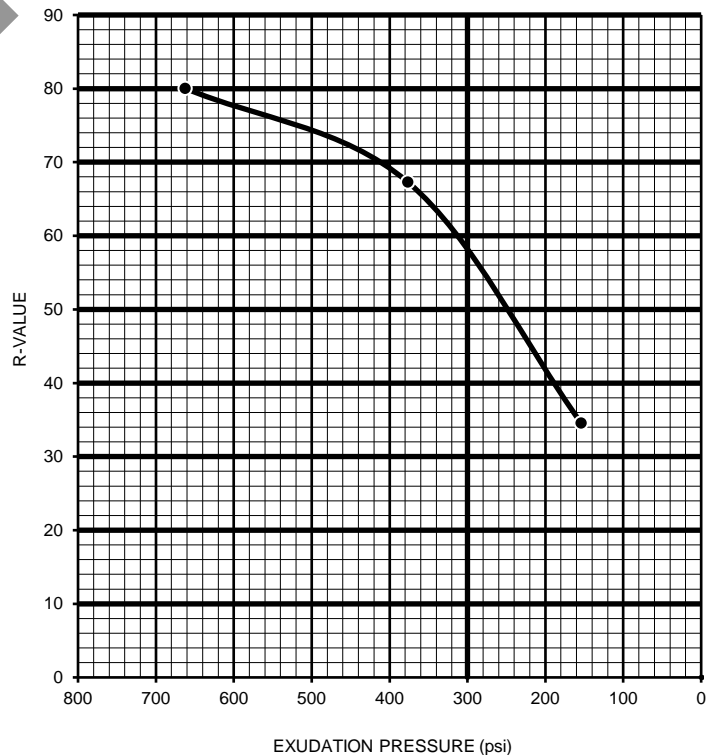
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	9.6	10.1	11.7
HEIGHT OF SAMPLE, Inches	2.50	2.54	2.51
DRY DENSITY, pcf	114.1	114.6	115.2
COMPACTOR AIR PRESSURE, psi	250	225	200
EXUDATION PRESSURE, psi	663	377	154
EXPANSION, Inches x 10 <sup>exp-4</sup>	25	6	0
STABILITY Ph 2,000 lbs (160 psi)	20	34	71
TURNS DISPLACEMENT	4.36	4.50	5.93
R-VALUE UNCORRECTED	80	67	35
R-VALUE CORRECTED	80	67	35

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.32	0.52	1.05
EXPANSION PRESSURE THICKNESS, ft.	0.94	0.23	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	74
R-VALUE BY EXUDATION:	58
EQUILIBRIUM R-VALUE:	58



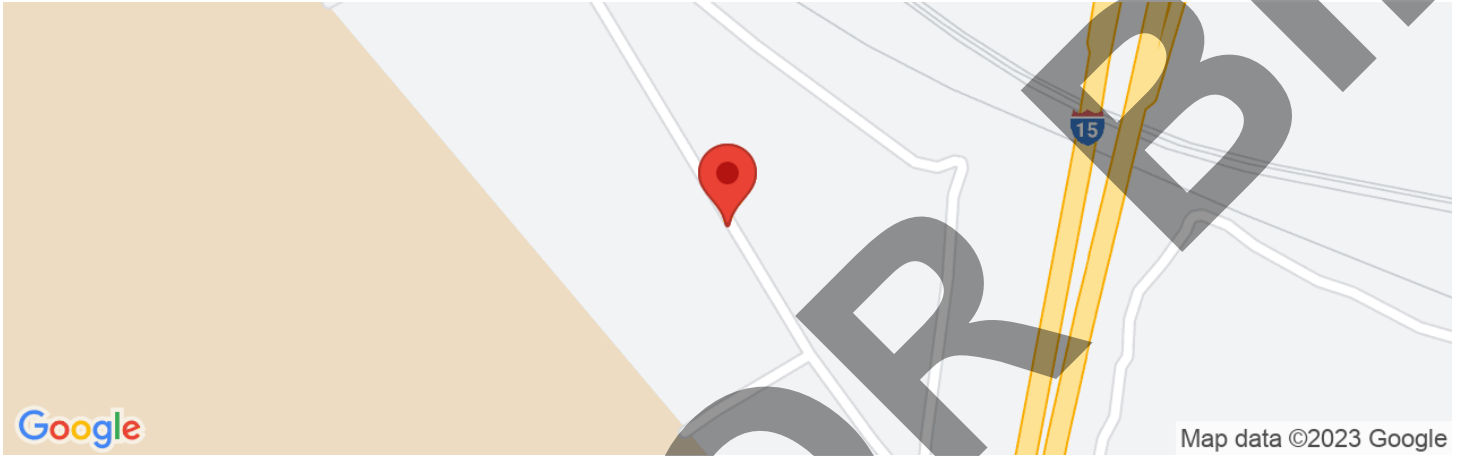
**NOT FOR BID**

**APPENDIX C**  
**SUMMARY OF SEISMIC ANALYSIS**

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.  
 USGS web services are now operational so this tool should work as expected.



Latitude, Longitude: 34.2180, -117.4143



<b>Date</b>	8/9/2023, 9:22:18 AM
<b>Design Code Reference Document</b>	ASCE7-16
<b>Risk Category</b>	I
<b>Site Class</b>	C - Very Dense Soil and Soft Rock

Type	Value	Description
$S_S$	2.403	$MCE_R$ ground motion. (for 0.2 second period)
$S_1$	0.975	$MCE_R$ ground motion. (for 1.0s period)
$S_{MS}$	2.884	Site-modified spectral acceleration value
$S_{M1}$	1.365	Site-modified spectral acceleration value
$S_{DS}$	1.922	Numeric seismic design value at 0.2 second SA
$S_{D1}$	0.91	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	E	Seismic design category
$F_a$	1.2	Site amplification factor at 0.2 second
$F_v$	1.4	Site amplification factor at 1.0 second
PGA	1.012	$MCE_G$ peak ground acceleration
$F_{PGA}$	1.2	Site amplification factor at PGA
$PGA_M$	1.214	Site modified peak ground acceleration
$T_L$	12	Long-period transition period in seconds
$SsRT$	3.094	Probabilistic risk-targeted ground motion. (0.2 second)
$SsUH$	3.444	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
$SsD$	2.403	Factored deterministic acceleration value. (0.2 second)
$S1RT$	1.278	Probabilistic risk-targeted ground motion. (1.0 second)
$S1UH$	1.45	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
$S1D$	0.975	Factored deterministic acceleration value. (1.0 second)
PGAd	1.012	Factored deterministic acceleration value. (Peak Ground Acceleration)
$PGA_{UH}$	1.36	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
$C_{RS}$	0.898	Mapped value of the risk coefficient at short periods

Type	Value	Description
$C_{R1}$	0.881	Mapped value of the risk coefficient at a period of 1 s
$C_V$	1.3	Vertical coefficient

NOT FOR BID

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NOT FOR BID



# Unified Hazard Tool

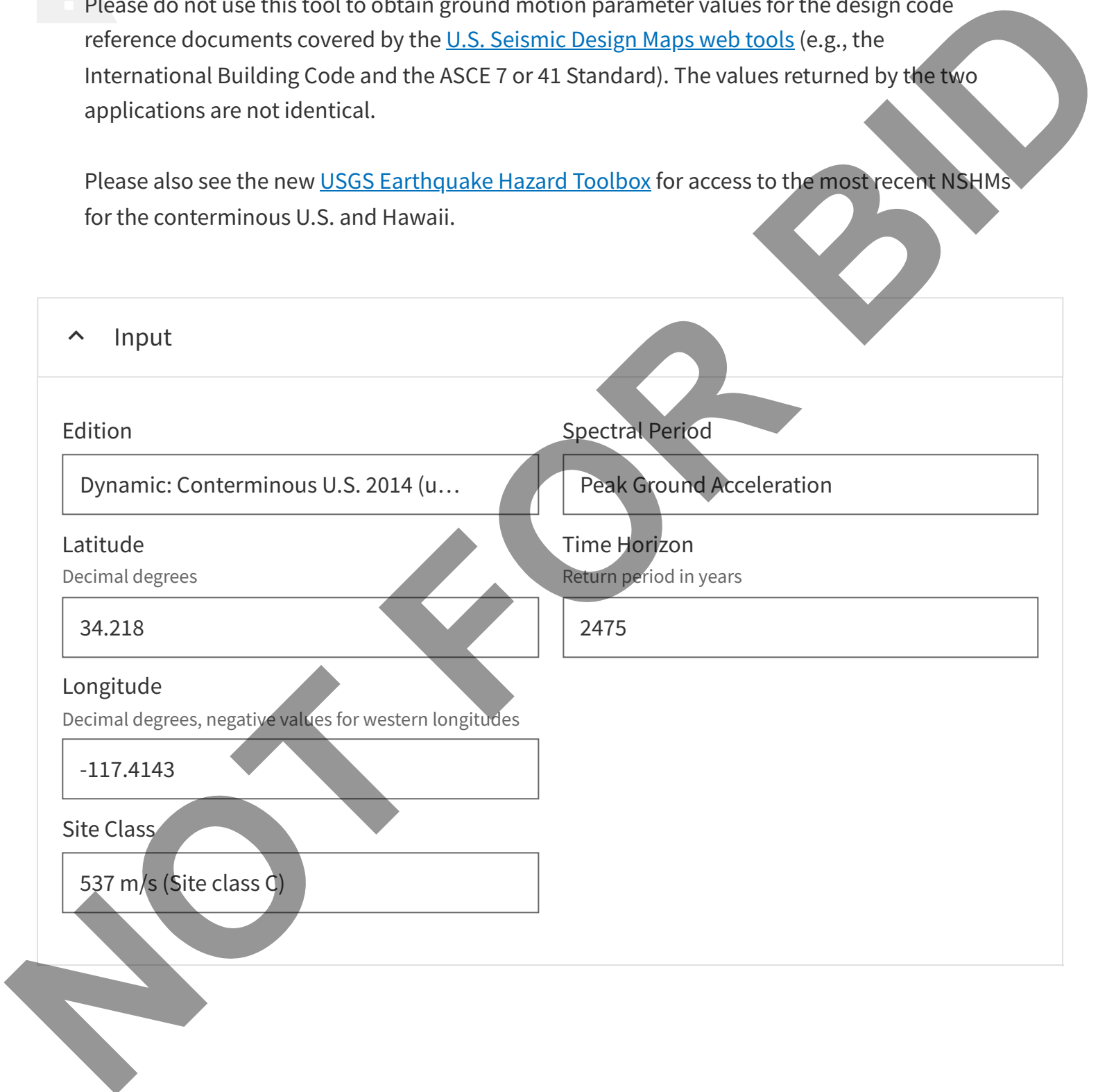


Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

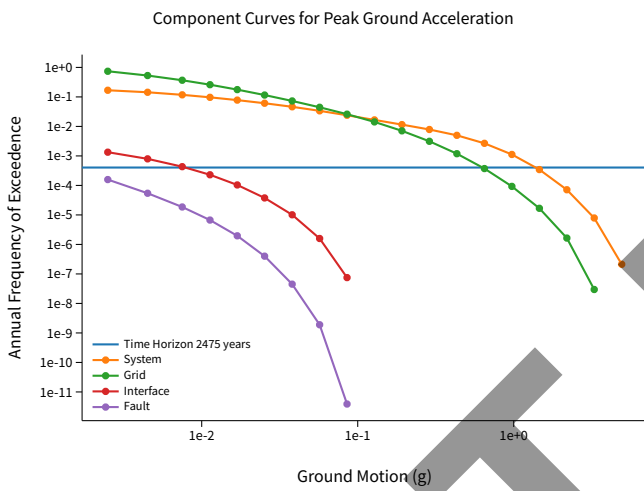
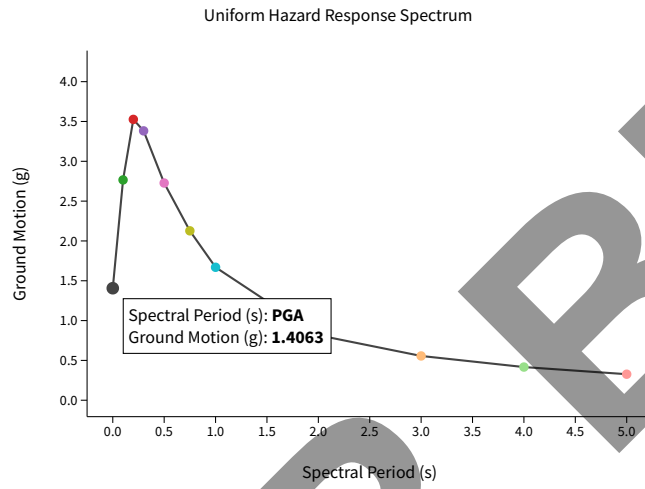
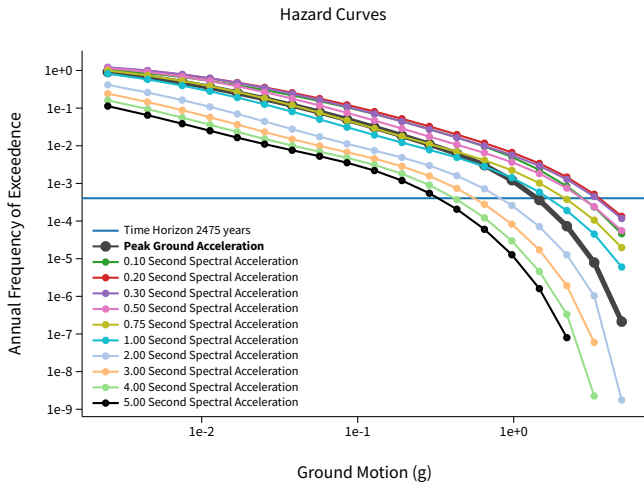
Please also see the new [USGS Earthquake Hazard Toolbox](#) for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

^ Input

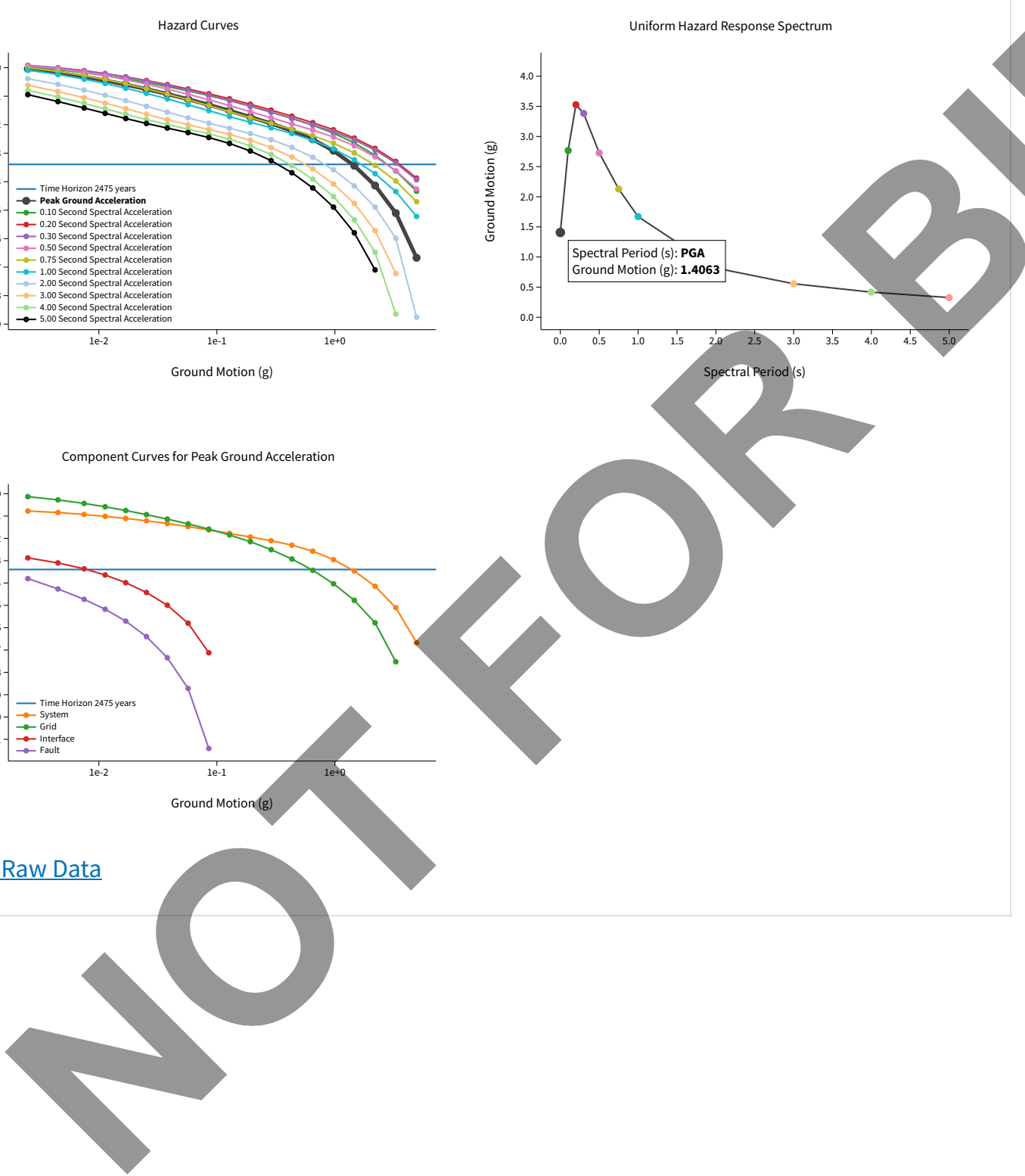
Edition	Spectral Period
Dynamic: Conterminous U.S. 2014 (u...)	Peak Ground Acceleration
Latitude	Time Horizon
Decimal degrees	Return period in years
34.218	2475
Longitude	
Decimal degrees, negative values for western longitudes	
-117.4143	
Site Class	
537 m/s (Site class C)	



# ^ Hazard Curve



[View Raw Data](#)

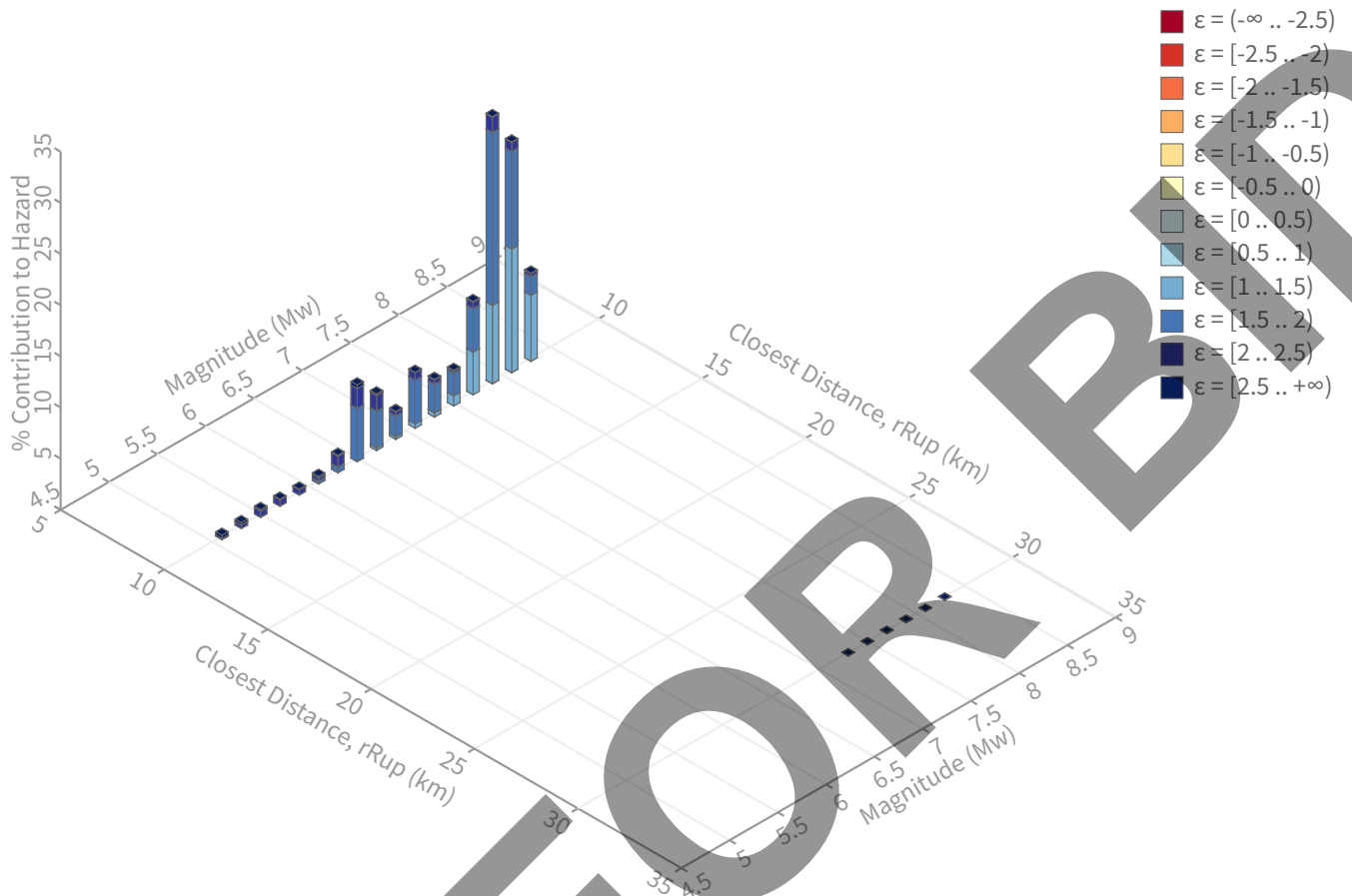


^ Deaggregation

Component

Total

NOT FOR BID



NOT FOR B/D

# Summary statistics for, Deaggregation: Total

## Deaggregation targets

---

**Return period:** 2475 yrs  
**Exceedance rate:** 0.0004040404 yr<sup>-1</sup>  
**PGA ground motion:** 1.4063135 g

## Recovered targets

---

**Return period:** 3117.6318 yrs  
**Exceedance rate:** 0.00032075629 yr<sup>-1</sup>

## Totals

---

**Binned:** 100 %  
**Residual:** 0 %  
**Trace:** 0.03 %

## Mean (over all sources)

---

**m:** 7.57  
**r:** 2.7 km  
**ε<sub>0</sub>:** 1.66 σ

## Mode (largest m-r bin)

---

**m:** 7.91  
**r:** 2.49 km  
**ε<sub>0</sub>:** 1.57 σ  
**Contribution:** 26.08 %

## Mode (largest m-r-ε<sub>0</sub> bin)

---

**m:** 7.91  
**r:** 2.75 km  
**ε<sub>0</sub>:** 1.6 σ  
**Contribution:** 16.89 %

## Discretization

---

**r:** min = 0.0, max = 1000.0, Δ = 20.0 km  
**m:** min = 4.4, max = 9.4, Δ = 0.2  
**ε:** min = -3.0, max = 3.0, Δ = 0.5 σ

## Epsilon keys

---

**ε0:** [-∞ .. -2.5)  
**ε1:** [-2.5 .. -2.0)  
**ε2:** [-2.0 .. -1.5)  
**ε3:** [-1.5 .. -1.0)  
**ε4:** [-1.0 .. -0.5)  
**ε5:** [-0.5 .. 0.0)  
**ε6:** [0.0 .. 0.5)  
**ε7:** [0.5 .. 1.0)  
**ε8:** [1.0 .. 1.5)  
**ε9:** [1.5 .. 2.0)  
**ε10:** [2.0 .. 2.5)  
**ε11:** [2.5 .. +∞]

## Deaggregation Contributors

Source Set ↴ Source	Type	r	m	$\epsilon_0$	lon	lat	az	%
UC33brAvg_FM31	System							48.16
San Andreas (San Bernardino N) [2]		2.73	7.50	1.68	117.395°W	34.237°N	39.74	30.14
San Jacinto (San Bernardino) [1]		1.17	8.01	1.46	117.421°W	34.212°N	222.12	13.09
Cucamonga [0]		4.20	7.65	1.53	117.445°W	34.192°N	223.72	1.48
San Jacinto (Lytle Creek connector) [1]		4.83	8.02	1.76	117.452°W	34.191°N	228.76	1.40
UC33brAvg_FM32	System							47.84
San Andreas (San Bernardino N) [2]		2.73	7.53	1.67	117.395°W	34.237°N	39.74	30.03
San Jacinto (San Bernardino) [1]		1.17	8.00	1.46	117.421°W	34.212°N	222.12	13.01
Cucamonga [0]		4.20	7.67	1.54	117.445°W	34.192°N	223.72	1.50
San Jacinto (Lytle Creek connector) [1]		4.83	8.02	1.76	117.452°W	34.191°N	228.76	1.37
UC33brAvg_FM31 (opt)	Grid							2.00
UC33brAvg_FM32 (opt)	Grid							2.00

NOT FOR BLD

### Liquefaction Susceptibility Analysis: SPT Method

Youd and Idriss (2001), Martin and Lew (1999)

Description: Glen Helen Lighting Project - Parking Lot Site ; Case 1; PGAm 1.214; design GW 58; No overex 0

Project No.: 12108.009

Jul 2023

#### General Boring Information:

Boring No.	Existing	Design	Design	Overex.	Ground	Boring Location Coordinates X (ft) Y (ft)
	GW Depth (ft)	GW Depth (ft)	Fill Height (ft)	depth bgs (ft)	Surface Elev (ft)	
LB-8	98	58		0	2100	-1136.0 1936.3
LB-9	98	58		0	2099	-648.1 1850.8
LB-10	98	58		0	2079	90.0 1255.2
LB-11	98	58		0	2076	-567.0 928.9
LB-12	98	58		0	2063	-99.81 310.87

General Parameters:	
$a_{max}$	= 1.21g
$M_w$	= 7.91
MSF eq:	1
MSF	= 0.87
Hammer Efficiency	= 84
$C_E$	= 1.40
$C_B$	= 1
$C_S$ for SPT?	TRUE
Unlined, but room for liner	
Rod Stickup (feet)	= 3
Ring sample correction	= 0.65

## Summary of Liquefaction Susceptibility Analysis: SPT Method

Leighton

Liquefaction Method: Youd and Idriss (2001). Seismic Settlement Method: Tokimatsu and Seed (1987) and Martin and Lew (1999).

Project: Glen Helen Lighting Project - Parking Lot Site ; Case 1; PGAm 1.214; design GW 58; No overex 0

Project No.: 12108.009

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thickness (ft)	Plasticity (Ip=non susc. to liq.) (%)	Estimated Fines Cont (%)	$\gamma_t$ (pcf)	$N_m$ or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	$N_m$ (corrected for Cs and ring->SPT) (blows/ft)	Exist $\sigma'_{vo}$ (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	CRR <sub>7.5</sub>	Design $\sigma'_{vo}$ (psf)	CSR <sub>7.5</sub>	CSR <sub>M</sub>	Liquefaction Factor of Safety	$(N_1)_{60CS}$ (for Settlement) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87)	Sat Sand Strain (%) (Tok/ Seed 87)	Seismic Sett. of Layer (in.)	Cummulative Seismic Settlement (in.)
LB-8	0 to 3.8	2.5	3.8	17	120	30	2	1	19.5	300	34.8	39.9	>Range	300	0.78	0.90	NonLiq	39.9	0.34	0.15	1.1		
LB-8	3.8 to 6.3	5	2.5	10	120	23	2	1	15.0	600	26.7	28.1	0.374	600	0.78	0.89	NonLiq	28.1	1.13	0.34	0.9		
LB-8	6.3 to 8.8	7.5	2.5	15	120	62	2	1	40.3	900	68.7	74.6	>Range	900	0.78	0.89	NonLiq	74.6	0.10	0.03	0.6		
LB-8	8.8 to 12.5	10	3.8	15	120	100	2	1	65.0	1200	102.0	109.4	>Range	1200	0.77	0.88	NonLiq	109.4	0.10	0.05	0.6		
LB-8	12.5 to 17.5	15	5.0	5	120	100	1	1.3	130.0	1800	166.6	166.6	>Range	1800	0.76	0.87	NonLiq	166.6	0.04	0.02	0.5		
LB-8	17.5 to 22.5	20	5.0	5	120	100	2	1	65.0	2400	80.6	80.6	>Range	2400	0.75	0.86	NonLiq	80.6	0.16	0.09	0.5		
LB-8	22.5 to 27.5	25	5.0	5	120	56	1	1.3	72.8	3000	80.8	80.8	>Range	3000	0.74	0.85	NonLiq	80.8	0.19	0.12	0.4		
LB-8	27.5 to 32.5	30	5.0	5	120	100	2	1	65.0	3600	69.3	69.3	>Range	3600	0.73	0.84	NonLiq	69.3	0.14	0.08	0.3		
LB-8	32.5 to 37.5	35	5.0	5	120	95	1	1.3	123.5	4200	121.9	121.9	>Range	4200	0.70	0.80	NonLiq	121.9	0.07	0.04	0.2		
LB-8	37.5 to 42.5	40	5.0	5	120	100	1	1.3	130.0	4800	120.0	120.0	>Range	4800	0.67	0.77	NonLiq	120.0	0.08	0.05	0.2		
LB-8	42.5 to 47.5	45	5.0	5	120	100	1	1.3	130.0	5400	113.2	113.2	>Range	5400	0.64	0.73	NonLiq	113.2	0.09	0.05	0.1		
LB-8	47.5 to 52.0	50	4.5	5	120	100	1	1.3	130.0	6000	107.4	107.4	>Range	6000	0.61	0.69	NonLiq	107.4	0.10	0.05	0.1		
LB-9	0 to 3.8	2.5	3.8	5	120	13	1	1.3	16.9	300	30.2	30.2	>Range	300	0.78	0.90	NonLiq	30.2	0.46	0.21	0.6		
LB-9	3.8 to 6.3	5	2.5	10	120	32	1	1.3	41.6	600	74.3	76.7	>Range	600	0.78	0.89	NonLiq	76.7	0.17	0.05	0.4		
LB-9	6.3 to 8.8	7.5	2.5	10	120	21	1	1.3	27.3	900	46.6	48.4	>Range	900	0.78	0.89	NonLiq	48.4	0.15	0.04	0.3		
LB-9	8.8 to 12.5	10	3.8	10	120	28	1	1.3	36.4	1200	57.1	59.2	>Range	1200	0.77	0.88	NonLiq	59.2	0.19	0.08	0.3		
LB-9	12.5 to 17.5	15	5.0	5	120	100	1	1.3	130.0	1800	166.6	166.6	>Range	1800	0.76	0.87	NonLiq	166.6	0.04	0.02	0.2		
LB-9	17.5 to 22.5	20	5.0	5	120	50	1	1.3	65.0	2400	80.6	80.6	>Range	2400	0.75	0.86	NonLiq	80.6	0.16	0.09	0.2		
LB-9	22.5 to 27.0	25	4.5	5	120	78	1	1.3	101.4	3000	112.5	112.5	>Range	3000	0.74	0.85	NonLiq	112.5	0.15	0.08	0.1		
LB-10	0 to 3.8	2.5	3.8	8	120	38	2	1	24.7	300	44.1	44.9	>Range	300	0.78	0.90	NonLiq	44.9	0.10	0.05	1.0		
LB-10	3.8 to 6.3	5	2.5	10	120	42	2	1	27.3	600	48.7	50.7	>Range	600	0.78	0.89	NonLiq	50.7	0.20	0.06	0.9		
LB-10	6.3 to 8.8	7.5	2.5	5	120	100	2	1	65.0	900	110.9	110.9	>Range	900	0.78	0.89	NonLiq	110.9	0.07	0.02	0.9		
LB-10	8.8 to 12.5	10	3.8	5	120	42	2	1	27.3	1200	42.9	42.9	>Range	1200	0.77	0.88	NonLiq	42.9	0.21	0.09	0.8		
LB-10	12.5 to 17.5	15	5.0	25	120	25	1	1.3	32.5	1800	41.7	50.7	>Range	1800	0.76	0.87	NonLiq	50.7	0.16	0.10	0.8		
LB-10	17.5 to 22.5	20	5.0	10	120	100	2	1	65.0	2400	80.6	83.2	>Range	2400	0.75	0.86	NonLiq	83.2	0.15	0.09	0.7		
LB-10	22.5 to 27.5	25	5.0	10	120	42	1	1.3	54.6	3000	60.6	62.8	>Range	3000	0.74	0.85	NonLiq	62.8	0.20	0.12	0.6		
LB-10	27.5 to 32.5	30	5.0	15	120	100	2	1	65.0	3600	69.3	75.1	>Range	3600	0.73	0.84	NonLiq	75.1	0.12	0.07	0.4		
LB-10	32.5 to 37.5	35	5.0	5	120	69	1	1.3	89.7	4200	88.5	88.5	>Range	4200	0.70	0.80	NonLiq	88.5	0.11	0.07	0.4		
LB-10	37.5 to 42.5	40	5.0	5	120	100	2	1	65.0	4800	60.0	60.0	>Range	4800	0.67	0.77	NonLiq	60.0	0.19	0.11	0.3		
LB-10	42.5 to 47.5	45	5.0	5	120	78	1	1.3	101.4	5400	88.3	88.3	>Range	5400	0.64	0.73	NonLiq	88.3	0.13	0.08	0.2		
LB-10	47.5 to 52.0	50	4.5	20	120	68	2	1	44.2	6000	36.5	43.0	>Range	6000	0.61	0.69	NonLiq	43.0	0.20	0.11	0.1		
LB-11	0 to 3.8	2.5	3.8	15	120	25	1	1.3	32.5	300	58.0	63.3	>Range	300	0.78	0.90	NonLiq	63.3	0.07	0.03	0.5		
LB-11	3.8 to 6.3	5	2.5	10	120	22	1	1.3	28.6	600	51.1	53.0	>Range	600	0.78	0.89	NonLiq	53.0	0.20	0.06	0.5		
LB-11	6.3 to 8.8	7.5	2.5	10	120	29	1	1.3	37.7	900	64.3	66.6	>Range	900	0.78	0.89	NonLiq	66.6	0.11	0.03	0.4		



Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thickness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	$\gamma_t$	$N_m$ or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	$N_m$ (corrected for Cs and ring->SPT) (blows/ft)	Exist $\sigma_{vo}'$ (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	$CRR_{7.5}$	Design $\sigma_{vo}'$ (psf)	CSR <sub>7.5</sub>	CSR <sub>M</sub>	Liquefaction Factor of Safety	$(N_1)_{60CS}$ (for Settlement) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87)	Sat Sand Strain (%) (Tok/ Seed 87)	Seismic Sett. of Layer (in.)	Cummulative Seismic Settlement (in.)
LB-11	8.8 to 12.5	10	3.8		5	120	33	1	1.3	42.9	1200	67.3	67.3	>Range	1200	0.77	0.88	NonLiq	67.3	0.16		0.07	0.4
LB-11	12.5 to 17.5	15	5.0		25	120	29	1	1.3	37.7	1800	48.3	58.2	>Range	1800	0.76	0.87	NonLiq	58.2	0.15		0.09	0.3
LB-11	17.5 to 22.5	20	5.0		35	120	19	1	1.3	24.7	2400	30.6	41.8	>Range	2400	0.75	0.86	NonLiq	41.8	0.21		0.12	0.2
LB-11	22.5 to 27.0	25	4.5		5	120	62	1	1.3	80.6	3000	89.4	89.4	>Range	3000	0.74	0.85	NonLiq	89.4	0.18		0.10	0.1
LB-12	0 to 3.8	2.5	3.8		10	120	19	1	1.3	24.7	300	44.1	45.9	>Range	300	0.78	0.90	NonLiq	45.9	0.10		0.05	1.1
LB-12	3.8 to 6.3	5	2.5		10	120	22	1	1.3	28.6	600	51.1	53.0	>Range	600	0.78	0.89	NonLiq	53.0	0.20		0.06	1.1
LB-12	6.3 to 8.8	7.5	2.5		5	120	10	1	1.21	12.1	900	20.6	20.6	0.222	900	0.78	0.89	NonLiq	20.6	1.14		0.34	1.0
LB-12	8.8 to 12.5	10	3.8		10	120	21	1	1.3	27.3	1200	42.9	44.6	>Range	1200	0.77	0.88	NonLiq	44.6	0.20		0.09	0.7
LB-12	12.5 to 17.5	15	5.0		5	120	24	1	1.3	31.2	1800	40.0	40.0	>Range	1800	0.76	0.87	NonLiq	40.0	0.58		0.35	0.6
LB-12	17.5 to 22.5	20	5.0		5	120	31	1	1.3	40.3	2400	50.0	50.0	>Range	2400	0.75	0.86	NonLiq	50.0	0.20		0.12	0.2
LB-12	22.5 to 27.0	25	4.5		5	120	49	1	1.3	63.7	3000	70.7	70.7	>Range	3000	0.74	0.85	NonLiq	70.7	0.20		0.11	0.1

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.  
 USGS web services are now operational so this tool should work as expected.



Latitude, Longitude: 34.2071, -117.4069



<b>Date</b>	8/9/2023, 11:01:11 AM
<b>Design Code Reference Document</b>	ASCE7-16
<b>Risk Category</b>	I
<b>Site Class</b>	C - Very Dense Soil and Soft Rock

Type	Value	Description
$S_S$	2.44	$MCE_R$ ground motion. (for 0.2 second period)
$S_1$	0.978	$MCE_R$ ground motion. (for 1.0s period)
$S_{MS}$	2.928	Site-modified spectral acceleration value
$S_{M1}$	1.369	Site-modified spectral acceleration value
$S_{DS}$	1.952	Numeric seismic design value at 0.2 second SA
$S_{D1}$	0.913	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	E	Seismic design category
$F_a$	1.2	Site amplification factor at 0.2 second
$F_v$	1.4	Site amplification factor at 1.0 second
PGA	1.027	$MCE_G$ peak ground acceleration
$F_{PGA}$	1.2	Site amplification factor at PGA
$PGA_M$	1.233	Site modified peak ground acceleration
$T_L$	12	Long-period transition period in seconds
$S_{sRT}$	3.061	Probabilistic risk-targeted ground motion. (0.2 second)
$S_{sUH}$	3.406	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
$S_{sD}$	2.44	Factored deterministic acceleration value. (0.2 second)
$S_{1RT}$	1.266	Probabilistic risk-targeted ground motion. (1.0 second)
$S_{1UH}$	1.438	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
$S_{1D}$	0.978	Factored deterministic acceleration value. (1.0 second)
PGAd	1.027	Factored deterministic acceleration value. (Peak Ground Acceleration)
$PGA_{UH}$	1.344	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
$C_{RS}$	0.899	Mapped value of the risk coefficient at short periods

Type	Value	Description
$C_{R1}$	0.88	Mapped value of the risk coefficient at a period of 1 s
$C_V$	1.3	Vertical coefficient

NOT FOR BID

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# Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new [USGS Earthquake Hazard Toolbox](#) for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

## ^ Input

Edition

Dynamic: Conterminous U.S. 2014 (u...)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.2071

Time Horizon

Return period in years

2475

Longitude

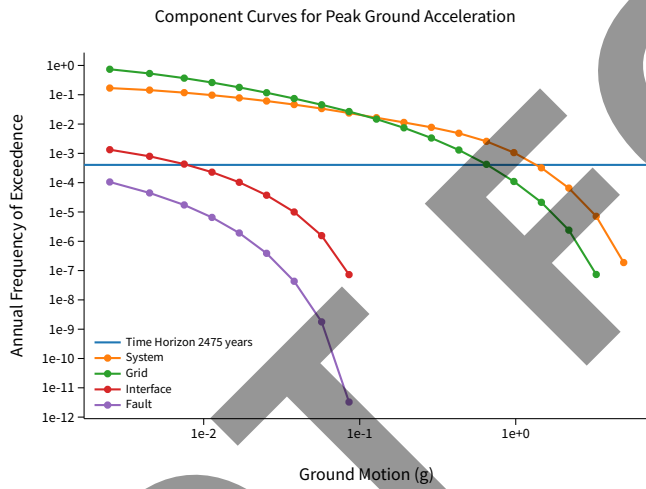
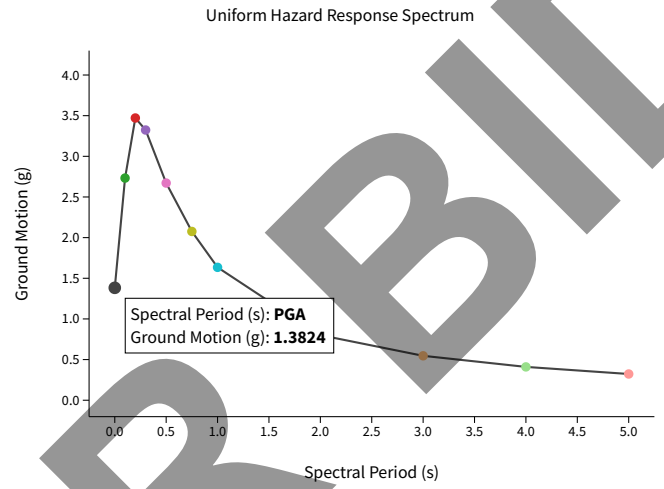
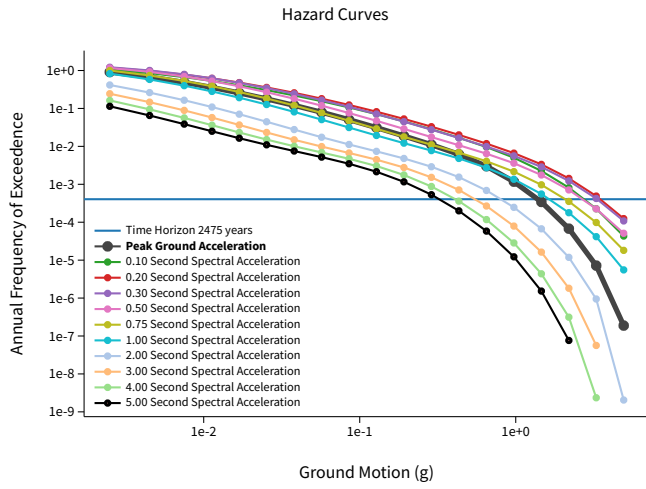
Decimal degrees, negative values for western longitudes

-117.4069

Site Class

537 m/s (Site class C)

# ^ Hazard Curve



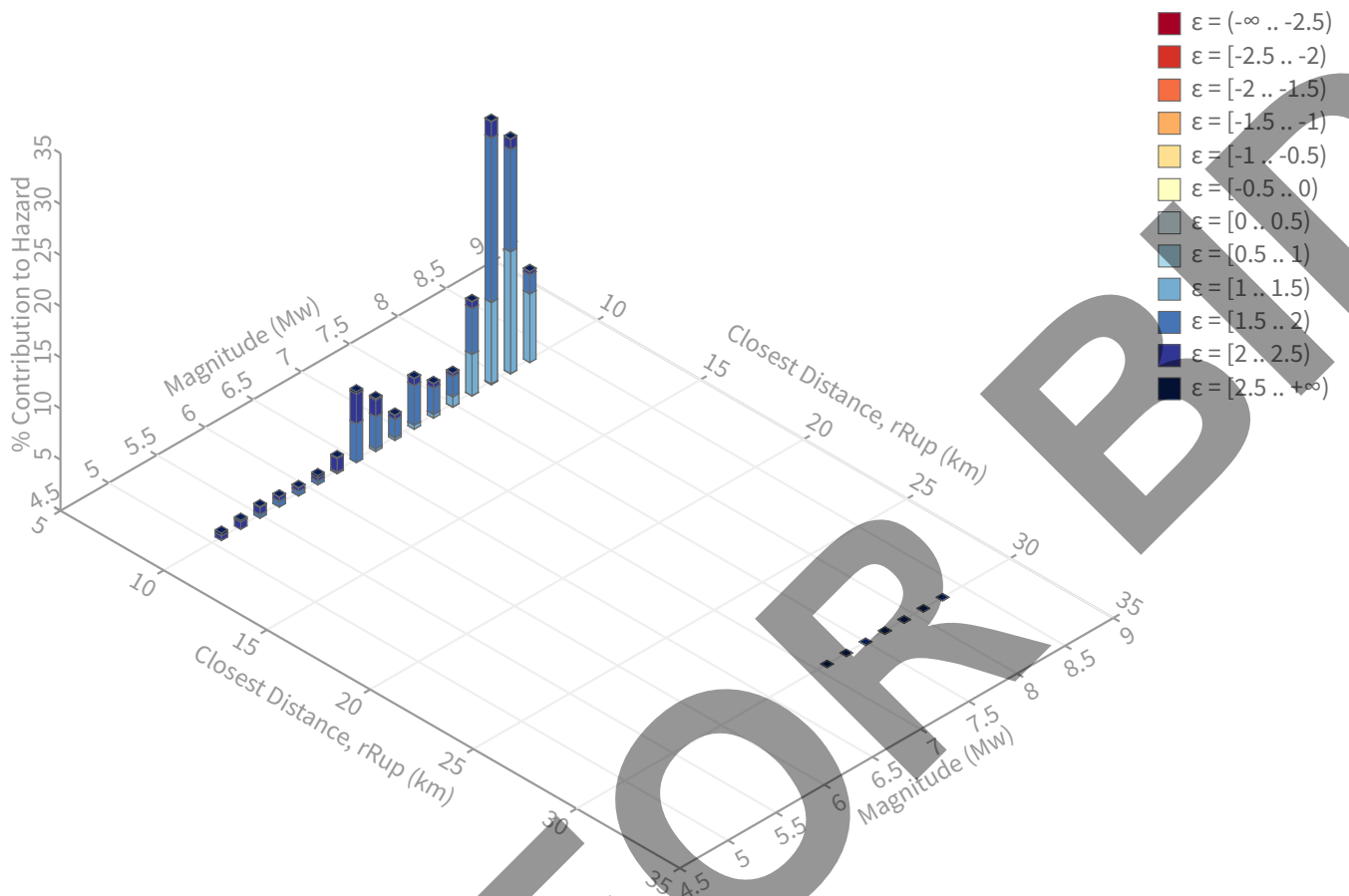
[View Raw Data](#)

^ Deaggregation

Component

Total

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# Summary statistics for, Deaggregation: Total

## Deaggregation targets

---

**Return period:** 2475 yrs  
**Exceedance rate:** 0.0004040404 yr<sup>-1</sup>  
**PGA ground motion:** 1.3824373 g

## Recovered targets

---

**Return period:** 3106.1932 yrs  
**Exceedance rate:** 0.00032193747 yr<sup>-1</sup>

## Totals

---

**Binned:** 100 %  
**Residual:** 0 %  
**Trace:** 0.04 %

## Mean (over all sources)

---

**m:** 7.56  
**r:** 2.97 km  
**ε<sub>0</sub>:** 1.67 σ

## Mode (largest m-r bin)

---

**m:** 7.9  
**r:** 2.71 km  
**ε<sub>0</sub>:** 1.57 σ  
**Contribution:** 25.79 %

## Mode (largest m-r-ε<sub>0</sub> bin)

---

**m:** 7.91  
**r:** 3.35 km  
**ε<sub>0</sub>:** 1.62 σ  
**Contribution:** 16.09 %

## Discretization

---

**r:** min = 0.0, max = 1000.0, Δ = 20.0 km  
**m:** min = 4.4, max = 9.4, Δ = 0.2  
**ε:** min = -3.0, max = 3.0, Δ = 0.5 σ

## Epsilon keys

---

**ε0:** [-∞ .. -2.5)  
**ε1:** [-2.5 .. -2.0)  
**ε2:** [-2.0 .. -1.5)  
**ε3:** [-1.5 .. -1.0)  
**ε4:** [-1.0 .. -0.5)  
**ε5:** [-0.5 .. 0.0)  
**ε6:** [0.0 .. 0.5)  
**ε7:** [0.5 .. 1.0)  
**ε8:** [1.0 .. 1.5)  
**ε9:** [1.5 .. 2.0)  
**ε10:** [2.0 .. 2.5)  
**ε11:** [2.5 .. +∞]

## Deaggregation Contributors

Source Set ↴ Source	Type	r	m	$\epsilon_0$	lon	lat	az	%
UC33brAvg_FM31	System							47.33
San Andreas (San Bernardino N) [3]		3.32	7.55	1.70	117.387°W	34.232°N	34.21	26.38
San Jacinto (San Bernardino) [1]		0.94	8.01	1.41	117.413°W	34.207°N	268.59	14.20
San Andreas (San Bernardino N) [2]		3.32	7.04	1.78	117.387°W	34.232°N	34.21	2.05
San Jacinto (Lytle Creek connector) [1]		4.64	8.02	1.72	117.438°W	34.178°N	221.50	1.55
Cucamonga [0]		4.08	7.65	1.55	117.445°W	34.192°N	243.85	1.43
UC33brAvg_FM32	System							46.97
San Andreas (San Bernardino N) [3]		3.32	7.57	1.70	117.387°W	34.232°N	34.21	26.30
San Jacinto (San Bernardino) [1]		0.94	8.00	1.41	117.413°W	34.207°N	268.59	14.11
San Andreas (San Bernardino N) [2]		3.32	7.07	1.78	117.387°W	34.232°N	34.21	2.01
San Jacinto (Lytle Creek connector) [1]		4.64	8.02	1.72	117.438°W	34.178°N	221.50	1.51
Cucamonga [0]		4.08	7.67	1.56	117.445°W	34.192°N	243.85	1.44
UC33brAvg_FM31 (opt)	Grid							2.85
PointSourceFinite: -117.407, 34.221		5.37	5.61	2.19	117.407°W	34.221°N	0.00	1.32
PointSourceFinite: -117.407, 34.221		5.37	5.61	2.19	117.407°W	34.221°N	0.00	1.32
UC33brAvg_FM32 (opt)	Grid							2.85
PointSourceFinite: -117.407, 34.221		5.37	5.61	2.19	117.407°W	34.221°N	0.00	1.32
PointSourceFinite: -117.407, 34.221		5.37	5.61	2.19	117.407°W	34.221°N	0.00	1.32

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# Liquefaction Susceptibility Analysis: SPT Method

Youd and Idriss (2001), Martin and Lew (1999)

Description: Glen Helen Lighting Project - Park Site ; Case 1; PGAm 1.233; design GW 11; No overex 0

Project No.: 12108.009

Jul 2023

Leighton

## General Boring Information:

Boring No.	Existing	Design	Design	Overex.	Ground	Boring Location	
	GW	GW	Fill Height	depth bgs	Surface	Coordinates	
	Depth (ft)	Depth (ft)	(ft)	(ft)	Elev (ft)	X (ft)	Y (ft)
LB-1	18.5	11		0	1987	266.5	2201.9
LB-2	18.5	11		0	1991	-88.6	2029.1
LB-3	18.5	11		0	1999	-504.5	2038.5
LB-4	18.5	11		0	1995	-249.6	1430.4
LB-5	18.5	11		0	2035	-519.8	646.46
LB-7	18.5	11		0	1982	1020.6	1389.4

General Parameters:	
$a_{max}$	= 1.23g
$M_w$	= 7.91
MSF eq:	1
MSF	= 0.87
Hammer Efficiency	= 84
$C_E$	= 1.40
$C_B$	= 1
$C_S$ for SPT?	TRUE
Unlined, but room for liner	
Rod Stickup (feet)	= 3
Ring sample correction	= 0.65

## Summary of Liquefaction Susceptibility Analysis: SPT Method

Leighton

Liquefaction Method: Youd and Idriss (2001). Seismic Settlement Method: Tokimatsu and Seed (1987) and Martin and Lew (1999).

Project: Glen Helen Lighting Project - Park Site ; Case 1; PGAm 1.233; design GW 11; No overex 0

Project No.: 12108.009

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thickness (ft)	Plasticity (n <sub>p</sub> =non susc. to liq.) (%)	Estimated Fines Cont (%)	γ <sub>t</sub> (pcf)	N <sub>m</sub> or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	N <sub>m</sub> (corrected for Cs and ring->SPT) (blows/ft)	Exist σ <sub>vo</sub> ' (psf)	(N <sub>1</sub> ) <sub>60</sub>	(N <sub>1</sub> ) <sub>60CS</sub>	CRR <sub>7.5</sub>	Design σ <sub>vo</sub> ' (psf)	CSR <sub>7.5</sub>	CSR <sub>M</sub>	Liquefaction Factor of Safety	(N <sub>1</sub> ) <sub>60CS</sub> (for Settlement) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87)	Sat Sand Strain (%) (Tok/ Seed 87)	Seismic Sett. of Layer (in.)	Cummulative Seismic Settlement (in.)
LB-1	0 to 3.8	2.5	3.8	5	120	32	2	1	20.8	300	37.1	37.1	>Range	300	0.80	0.91	NonLiq	37.1	0.39	0.17	0.3		
LB-1	3.8 to 6.3	5	2.5	5	120	38	2	1	24.7	600	44.1	44.1	>Range	600	0.79	0.91	NonLiq	44.1	0.21	0.06	0.1		
LB-1	6.3 to 8.8	7.5	2.5	5	120	62	2	1	40.3	900	68.7	68.7	>Range	900	0.79	0.90	NonLiq	68.7	0.11	0.03	0.1		
LB-1	8.8 to 11.0	10	2.3	5	120	70	2	1	45.5	1200	71.4	71.4	>Range	1200	0.78	0.90	NonLiq	71.4	0.16	0.04	0.0		
LB-1	11.0 to 12.5	10	1.5	5	120	70	2	1	45.5	1200	71.4	71.4	>Range	1200	0.78	0.90	NonLiq	71.4		0.00	0.0		
LB-1	12.5 to 17.5	15	5.0	10	120	18	1	1.3	23.4	1800	30.0	31.5	>Range	1550.4	0.90	1.03	NonLiq	31.5		0.00	0.0		
LB-1	17.5 to 22.5	20	5.0	5	120	100	2	1	65.0	2306	82.3	82.3	>Range	1838.4	1.00	1.14	NonLiq	82.3		0.00	0.0		
LB-1	22.5 to 27.5	25	5.0	5	120	47	1	1.3	61.1	2594	72.9	72.9	>Range	2126.4	1.06	1.22	NonLiq	72.9		0.00	0.0		
LB-1	27.5 to 32.5	30	5.0	10	120	100	2	1	65.0	2882	77.5	80.0	>Range	2414.4	1.11	1.27	NonLiq	80.0		0.00	0.0		
LB-1	32.5 to 37.5	35	5.0	10	120	38	1	1.3	49.4	3170	56.1	58.2	>Range	2702.4	1.11	1.27	NonLiq	58.2		0.00	0.0		
LB-1	37.5 to 42.5	40	5.0	45	120	79	2	1	51.4	3458	55.9	72.0	>Range	2990.4	1.09	1.25	NonLiq	72.0		0.00	0.0		
LB-1	42.5 to 47.5	45	5.0	20	120	68	1	1.3	88.4	3746	92.4	103.3	>Range	3278.4	1.07	1.22	NonLiq	103.3		0.00	0.0		
LB-1	47.5 to 52.0	50	4.5	15	120	100	2	1	65.0	4034	65.5	71.1	>Range	3566.4	1.03	1.19	NonLiq	71.1		0.00	0.0		
LB-2	0 to 3.8	2.5	3.8	20	120	19	1	1.3	24.7	300	44.1	51.2	>Range	300	0.80	0.91	NonLiq	51.2	0.10	0.04	1.2		
LB-2	3.8 to 6.3	5	2.5	5	120	23	1	1.3	29.9	600	53.4	53.4	>Range	600	0.79	0.91	NonLiq	53.4	0.20	0.06	1.2		
LB-2	6.3 to 8.8	7.5	2.5	5	120	34	1	1.3	44.2	900	75.4	75.4	>Range	900	0.79	0.90	NonLiq	75.4	0.10	0.03	1.1		
LB-2	8.8 to 11.0	10	2.3	10	120	18	1	1.3	23.4	1200	36.7	38.4	>Range	1200	0.78	0.90	NonLiq	38.4	0.63	0.17	1.1		
LB-2	11.0 to 12.5	10	1.5	10	120	18	1	1.3	23.4	1200	36.7	38.4	>Range	1200	0.78	0.90	NonLiq	38.4		0.00	0.9		
LB-2	12.5 to 17.5	15	5.0	40	120	18	1	1.3	23.4	1800	30.0	41.0	>Range	1550.4	0.90	1.03	NonLiq	41.0		0.00	0.9		
LB-2	17.5 to 22.5	20	5.0	44	120	12	1	1.18	14.1	2306	17.9	26.5	0.325	1838.4	1.00	1.14	0.28	19.9	1.56	0.94	0.9		
LB-2	22.5 to 27.0	25	4.5	60	120	17	1	1.25	21.3	2594	25.4	35.5	>Range	2126.4	1.06	1.22	NonLiq	35.5		0.00	0.0		
LB-3	0 to 3.8	2.5	3.8	30	120	4	1	1.1	4.4	300	7.9	13.8	0.148	300	0.80	0.91	NonLiq	13.8	2.41	1.09	4.3		
LB-3	3.8 to 6.3	5	2.5	5	120	19	1	1.3	24.7	600	44.1	44.1	>Range	600	0.79	0.91	NonLiq	44.1	0.21	0.06	3.2		
LB-3	6.3 to 8.8	7.5	2.5	15	120	4	1	1.1	4.4	900	7.5	10.4	0.116	900	0.79	0.90	NonLiq	10.4	2.51	0.75	3.2		
LB-3	8.8 to 11.0	10	2.3	25	120	6	1	1.1	6.6	1200	10.4	15.9	0.169	1200	0.78	0.90	NonLiq	15.9	1.78	0.48	2.4		
LB-3	11.0 to 12.5	10	1.5	25	120	6	1	1.1	6.6	1200	10.4	15.9	0.169	1200	0.78	0.90	0.19	12.4	2.24	0.40	1.9		
LB-3	12.5 to 17.5	15	5.0	32	120	6	1	1.1	6.6	1800	8.5	14.7	0.157	1550.4	0.90	1.03	0.15	10.5	2.53	1.52	1.5		
LB-3	17.5 to 22.5	20	5.0	70	120	14	1	1.21	17.0	2306	21.5	30.8	>Range	1838.4	1.00	1.14	NonLiq	30.8		0.00	0.0		
LB-3	22.5 to 27.0	25	4.5	35	120	34	1	1.3	44.2	2594	52.7	68.3	>Range	2126.4	1.06	1.22	NonLiq	68.3		0.00	0.0		
LB-4	0 to 3.8	2.5	3.8	35	120	7	1	1.14	8.0	300	14.3	22.1	0.244	300	0.80	0.91	NonLiq	22.1	1.05	0.47	2.0		
LB-4	3.8 to 6.3	5	2.5	35	120	5	1	1.1	5.5	600	9.8	16.8	0.178	600	0.79	0.91	NonLiq	16.8	1.78	0.53	1.5		
LB-4	6.3 to 8.8	7.5	2.5	15	120	15	1	1.3	19.5	900	33.3	37.4	>Range	900	0.79	0.90	NonLiq	37.4	0.59	0.18	1.0		
LB-4	8.8 to 11.0	10	2.3	28	120	7	1	1.12	7.9	1200	12.3	18.6	0.199	1200	0.78	0.90	NonLiq	18.6	1.78	0.48	0.8		
LB-4	11.0 to 12.5	10	1.5	28	120	7	1	1.12	7.9	1200	12.3	18.6	0.199	1200	0.78	0.90	0.22	14.3	1.97	0.35	0.4		

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thickness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	$\gamma_t$	$N_m$ or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	$C_s$	$N_m$ (corrected for $C_s$ and ring->SPT) (blows/ft)	Exist $\sigma_{vo}'$ (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	$CRR_{7.5}$	Design $\sigma_{vo}'$ (psf)	$CSR_{7.5}$	$CSR_M$	Liquefaction Factor of Safety	$(N_1)_{60CS}$ (for Settlement) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87)	Sat Sand Strain (%) (Tok/ Seed 87)	Seismic Sett. of Layer (in.)	Cummulative Seismic Settlement (in.)
LB-4	12.5 to 17.5	15	5.0		35	120	18	1	1.3	23.4	1800	30.0	41.0	>Range	1550.4	0.90	1.03	NonLiq	41.0			0.00	0.0
LB-4	17.5 to 22.5	20	5.0		35	120	23	1	1.3	29.9	2306	37.8	50.4	>Range	1838.4	1.00	1.14	NonLiq	50.4			0.00	0.0
LB-4	22.5 to 27.0	25	4.5		30	120	30	1	1.3	39.0	2594	46.5	58.4	>Range	2126.4	1.06	1.22	NonLiq	58.4			0.00	0.0
LB-5	0 to 3.8	2.5	3.8		<b>42</b>	120	7	2	1	4.6	300	8.1	<b>14.7</b>	0.158	300	0.80	0.91	NonLiq	14.7	2.39		1.07	1.5
LB-5	3.8 to 6.3	5	2.5		30	120	20	2	1	13.0	600	23.2	31.5	>Range	600	0.79	0.91	NonLiq	31.5	0.63		0.19	0.4
LB-5	6.3 to 8.8	7.5	2.5		20	120	24	2	1	15.6	900	26.6	32.3	>Range	900	0.79	0.90	NonLiq	32.3	0.60		0.18	0.2
LB-5	8.8 to 11.0	10	2.3		15	120	41	2	1	26.7	1200	41.8	46.3	>Range	1200	0.78	0.90	NonLiq	46.3	0.21		0.06	0.1
LB-5	11.0 to 12.5	10	1.5		15	120	41	2	1	26.7	1200	41.8	46.3	>Range	1200	0.78	0.90	NonLiq	46.3			0.00	0.0
LB-5	12.5 to 17.5	15	5.0		10	120	42	1	1.3	54.6	1800	70.0	72.4	>Range	1550.4	0.90	1.03	NonLiq	72.4			0.00	0.0
LB-5	17.5 to 22.5	20	5.0		20	120	100	2	1	65.0	2306	82.3	92.4	>Range	1838.4	1.00	1.14	NonLiq	92.4			0.00	0.0
LB-5	22.5 to 27.5	25	5.0		35	120	43	1	1.3	55.9	2594	66.7	85.0	>Range	2126.4	1.06	1.22	NonLiq	85.0			0.00	0.0
LB-5	27.5 to 32.5	30	5.0		10	120	86	2	1	55.9	2882	66.6	68.9	>Range	2414.4	1.11	1.27	NonLiq	68.9			0.00	0.0
LB-5	32.5 to 37.5	35	5.0		10	120	68	1	1.3	88.4	3170	100.4	103.5	>Range	2702.4	1.11	1.27	NonLiq	103.5			0.00	0.0
LB-5	37.5 to 42.5	40	5.0		10	120	98	1	1.3	127.4	3458	138.6	142.5	>Range	2990.4	1.09	1.25	NonLiq	142.5			0.00	0.0
LB-5	42.5 to 47.0	45	4.5		25	120	100	1	1.3	130.0	3746	135.9	155.8	>Range	3278.4	1.07	1.22	NonLiq	155.8			0.00	0.0
LB-7	0 to 3.8	2.5	3.8		<b>42</b>	120	41	2	1	26.7	300	47.6	62.1	>Range	300	0.80	0.91	NonLiq	62.1	0.08		0.03	0.2
LB-7	3.8 to 6.3	5	2.5		85	120	31	2	1	20.2	600	36.0	48.2	>Range	600	0.79	0.91	NonLiq	48.2	0.21		0.06	0.1
LB-7	6.3 to 8.8	7.5	2.5		70	120	36	2	1	23.4	900	39.9	52.9	>Range	900	0.79	0.90	NonLiq	52.9	0.14		0.04	0.1
LB-7	8.8 to 11.0	10	2.3		15	120	100	2	1	65.0	1200	102.0	109.4	>Range	1200	0.78	0.90	NonLiq	109.4	0.11		0.03	0.0
LB-7	11.0 to 12.5	10	1.5		15	120	100	2	1	65.0	1200	102.0	109.4	>Range	1200	0.78	0.90	NonLiq	109.4			0.00	0.0
LB-7	12.5 to 17.5	15	5.0		30	120	23	1	1.3	29.9	1800	38.3	48.9	>Range	1550.4	0.90	1.03	NonLiq	48.9			0.00	0.0
LB-7	17.5 to 22.5	20	5.0		10	120	80	2	1	52.0	2306	65.8	68.1	>Range	1838.4	1.00	1.14	NonLiq	68.1			0.00	0.0
LB-7	22.5 to 27.5	25	5.0		30	120	41	1	1.3	53.3	2594	63.6	78.1	>Range	2126.4	1.06	1.22	NonLiq	78.1			0.00	0.0
LB-7	27.5 to 32.5	30	5.0		60	120	68	2	1	44.2	2882	52.7	68.2	>Range	2414.4	1.11	1.27	NonLiq	68.2			0.00	0.0
LB-7	32.5 to 37.5	35	5.0		25	120	35	1	1.3	45.5	3170	51.7	61.9	>Range	2702.4	1.11	1.27	NonLiq	61.9			0.00	0.0
LB-7	37.5 to 42.0	40	4.5		40	120	44	1	1.3	57.2	3458	62.2	79.7	>Range	2990.4	1.09	1.25	NonLiq	79.7			0.00	0.0

## Surface Manifestations of Liquefaction and Liquefaction Bearing Capacity Analysis

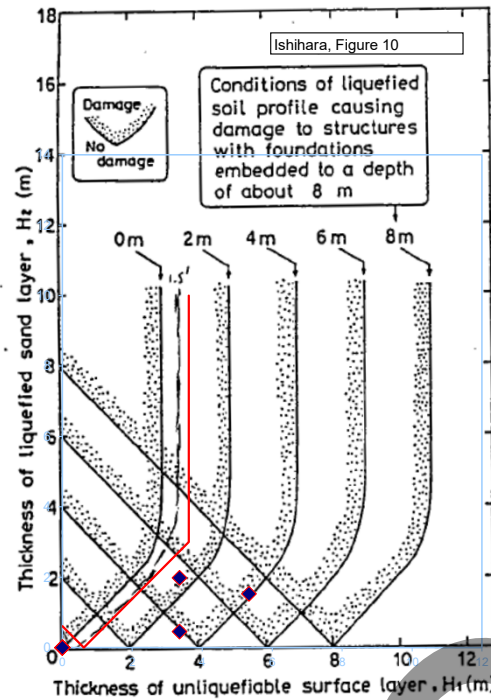
Glen Helen Lighting Project - Park Site ; Case 1; PGAm 1.233; design GW 11; No overex 0  
12108.009

Leighton

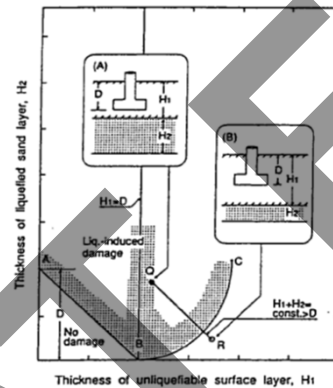
Boring No.	New Fill (raise grade) (ft)	Footing Depth (ft)	Ishihara, 1995, Surface Manifestations of Liquefaction Analysis:				Thickness		Struct Damage/ Surface Manifestations? (Ishihara, 1995)	Amount of New Fill needed to mitigate (ft)	Or, Amount of Overex. needed to mitigate (ft)
			Z1 (non) (ft)	Za (liq) (ft)	Zb (non) (ft)	Zc (liq) (ft)	H1 (ft)	H2 (ft)			
LB-1	0	2	52.0				52.0	15.8	no	0	0
LB-2	0	2	17.5	22.5	27.0		17.5	5.3	1.5	no	0
LB-3	0	2	11.0	17.5	27.0		11.0	6.5	3.4	2.0	no
LB-4	0	2	11.0	12.5	27.0		11.0	1.5	3.4	0.5	no
LB-5	0	2	47.0				47.0	14.3			no
LB-7	0	2	42.0				42.0	12.8			no

Karamitros et al., 2013, Liquefaction Bearing Capacity:			
Assumed maximum Footing Width		In order to achieve critical thickness of Non-liquefiable upper clay crust (where additional thickness does not further increase $F_{liq}$ of bearing capacity):	
Square ftg (ft)	Strip ftg (ft)	Amount of New Fill Needed (ft) square ftg	Or, Amount of Overex. Needed (ft) Strip ftg
11	5	0.0	0.0
11	5	1.4	0.0
11	5	7.9	0.0
11	5	7.9	0.0
11	5	0.0	0.0
11	5	0.0	0.0

Juang (2005) based on Iwasaki (1982), as presented in Tonkin & Taylor (2013), Liquefaction Potential Index (LPI):	
LPI = $\sum [F1 \cdot W(z) \cdot dz]$	Risk of Liquefaction Damage Based on LPI
0.0	Very Low
0.0	Very Low
0.0	Very Low
0.0	Very Low
0.0	Very Low
0.0	Very Low



Footing Depth= 2 ft  
0.61 m



**LPI range:**  
LPI=0  
0<LPI<=5  
5<LPI<=15  
LPI>15

**Liquefaction Risk:**  
Very low  
Low  
High  
Very High

### References:

Ishihara, K., 1995, Effects of At-Depth Liquefaction on Embedded Foundations During Earthquakes, Proceedings of 11th Asian Regional Conference on Soil Mechanics and Foundation Engineering, Vol. 2, 1995.

Iwasaki, T., Arakawa, T., and Tokida, K., 1982, Simplified Procedures for Assessing Soil Liquefaction During Earthquakes Proc. Conference on Soil Dynamics and Earthquake Engineering. Southampton, 925-939

Juang, C.H, Yang, S.H, Yuan, H., and Fang, S.Y., 2005, Liquefaction in the Chi-Chi earthquake – effect of fines and capping non-liquefiable layers Journal of the Japanese Geotechnical Society of Soils and Foundations, Vol. 45 No. 6 pp 89-101

Karamitros, Bouckovalas, Chaloulos, and Andrianopoulos, 2013, Numerical analysis of liquefaction-induced bearing capacity degradation of shallow foundations on a two-layered soil profile, Soil Dynamics and Earthquake Engineering, Vol 44.

Tonkin & Taylor Ltd, 2013, Liquefaction Vulnerability Study, Earthquake Commission, T&T Ref



**NOT FOR BID**

**APPENDIX D  
EARTHWORK AND GRADING SPECIFICATIONS**

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

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1.0 General

- 1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).
- 1.2 The Geotechnical Consultant of Record: Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

- 1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

## 2.0 Preparation of Areas to be Filled

- 2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

- 2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.
- 2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.
- 2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.
- 2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

### 3.0 Fill Material

- 3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.
- 3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.
- 3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

### 4.0 Fill Placement and Compaction

- 4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.
- 4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

- 4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.
- 4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.
- 4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).
- 4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.
- 4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

## 5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

## 6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

## 7.0 Trench Backfills

7.1 Safety: The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill: All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.3 Lift Thickness: Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.