GEOTECHNICAL EXPLORATION REPORT
LONE MOUNTAIN ROAD BRIDGE WIDENING
LONE MOUNTAIN ROAD OVER US 95
LAS VEGAS, NEVADA

PROJECT NO.: G-19-067
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1.0 INTRODUCTION

This report presents the results of our geotechnical exploration for the proposed widening of the Lone Mountain Road bridge over US 95 in Las Vegas, Nevada. The general location of the site is shown on Figure No. 1, Vicinity Map.

The purpose of our services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- General geology of the area
- Foundation design and construction
- Retaining wall design and construction
- Pavement design and construction
- Earthwork

This report is for the purpose of providing geotechnical engineering and/or testing information and requirements. The scope of our services for this project did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic material in structures, soil, surface water, groundwater or air, below or around this site.

2.0 PROJECT INFORMATION

The Lone Mountain Road bridge currently consists of a two-lane bridge over US 95. It is our understanding that the proposed project will include widening the existing bridge to accommodate four lanes. The project will also include new retaining walls at the bridge embankments and a full depth pavement reconstruction from Rancho Road to Tenaya Way.

We understand that maximum structural loads for the bridge widening will be approximately 1,490 kips per column and 1,950 kips per column at the center pier for service and strength limit states, respectively. Maximum loads at the abutment will be approximately 465 kips per drilled shaft and 610 kips per drilled shaft for service and strength limit states, respectively. The widened bridge will require two new columns at the center pier, each supported by a six- or seven-foot diameter drilled shaft foundation. The abutments will be founded on four, three-foot diameter drilled shafts connected by a pile cap.

3.0 SITE EXPLORATION

The scope of our services for this project included a subsurface exploration program. The subsurface exploration program consisted of drilling three (3) borings to depths ranging from approximately 80 to 110 feet below existing site grades. Borings were drilled between July 10 and July 13, 2019 using a CME 85 truck-mounted drill rig equipped with 8-inch O.D. hollow stem augers and a 140-pound automatic hammer. The number of blows required to drive a 2-inch O.D. SPT Sampler or 3-inch O.D. California Modified Sampler 12 inches using a 140-pound weight dropped 30 inches are shown on the logs.

The borings were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. The approximate locations of the borings are shown on Figure No. 2, Site Map. The locations of the borings were determined in the field by approximating distances from existing features or improvements. The locations of the borings should be accurate only to the degree implied by the method used. Results of the borings are presented in Appendix A.

A geophysical exploration survey was performed at the site to determine the soil shear wave velocity to a depth of 100 feet (30-m). The results of the geophysical exploration survey are presented in Appendix B.

Two (2) asphalt cores were obtained from within the existing paved alignment of Lone Mountain Road to evaluate the existing pavement sections. The cores were taken from the approach ramps on both sides of the existing bridge. The asphalt thickness was measured and the aggregate base beneath the asphalt was hand excavated to assess the base thickness as well. The approximate locations of the cores are shown on Figure 2, Site Map. Results of the pavement section evaluation are presented in Appendix A.

4.0 SITE CONDITIONS

4.1 Surface

The Lone Mountain Road bridge consisted of a two-lane bridge over US 95 at the time of our exploration. US 95 was developed five lanes wide in the northbound direction and four lanes wide in the southbound direction. The northbound and southbound lanes were separated by concrete jersey barriers, and the bridge was supported by two columns at the center pier. The bridge abutments were protected by concrete aprons which extended toward the highway and toward the north.

Sound walls were present along the west side of US 95, beyond which were residential developments. There were commercial developments along the east side of US 95 north of Lone Mountain Road. Along the east side of US 95 south of Lone Mountain Road there were sound walls and additional residential developments.

4.2 Subsurface

Fill was encountered in all of the explorations. The fill generally consisted of asphalt over aggregate base and clayey sand. Total fill depths were approximately 6 feet. However, due to previous site development there could be deeper and/or poorer quality fill in other areas of the site beyond our explorations.

Natural soils at the site generally consisted of soft to hard lean clay and fat clay, in addition to loose to very dense clayey sand and clayey gravel. Moderately hard to very hard caliche was encountered in all of the explorations. Caliche was first encountered at a depths ranging from 28 to 29 feet below existing site grades.

Groundwater was encountered in all of the explorations. The groundwater was measured at depths ranging from 74.3 to 79 feet below existing site grades. Groundwater levels can fluctuate due to seasonal variations, irrigation practices, and due to groundwater withdrawal and recharge. The boring logs and laboratory test results presented in Appendix A should be referred to for more detailed information.

5.0 GEOLOGIC INFORMATION

The site is located in the northwestern portion of the Las Vegas Valley. This location places the site in an area underlain by thick alluvial deposits (hundreds of feet).

The nearest mapped fault is approximately ¼-mile northwest of the west abutment of the Lone Mountain Road bridge.[1] As indicated on the Clark County Soil Guidelines Map, the site is located within 2,000 feet of a fault. According to published information, 90% of all fissures in the Las Vegas Valley occur within this 2,000 foot zone. The cumulative evidence indicates that fissures are the result of a subsurface erosional process. The erosional process occurs in tensional fractures at or near the surface in uncemented, relatively fine-grained soils. A visual evaluation of the existing surface was performed, but no visible surface expressions of fissures were noted. The nearest mapped fissure zone is approximately 2 miles northeast of the bridge.[2]

Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Due to the presence of cemented soils (caliche), in addition to the consistency and generally cohesive nature of the on-site uncemented soils, as well as the depth of

[1] Clark County Geographic Information System Management Office (GISMO), 2016
[2] Bell, John W., et. al., 2001, “Las Vegas Valley, 1998 Subsidence Report", Nevada Bureau of Mines and Geology, Open-File Report 01-4, Plate No. 1.

groundwater encountered in the borings, liquefaction is not likely to occur at the site during the design seismic event.

6.0 RECOMMENDATIONS

6.1 General

Our recommendations are based on the assumption that the soil conditions are similar to those disclosed by the explorations. If variations are noted during construction or if changes are made in site plan, structural loading, or foundation type, we should be notified so we can supplement our recommendations, as applicable. Calculations in support of our recommendations are presented in Appendix C.

6.2 Foundations

6.2.1 Lone Mountain Road Bridge Foundations

The proposed bridge structure should receive adequate support from a foundation system consisting of drilled shaft foundations. Specific design recommendations are provided as follows:

The compressive resistance for the strength limit state was computed for shafts with a diameter of 6- and 7-feet at the center Pier and 3-feet at the abutments using the computer program SHAFT v2012 by Ensoft, Inc. The shaft axial resistance is based on the strength of the soils. The strength limit state shaft resistance was estimated using resistance factors from the AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1. The following table summarizes the results of our axial resistance analysis based on the axial loads and diameter.

Table 1 - Drilled Shaft Axial Resistance Summary

Support	Shaft Diameter (ft)	Center-to-Center Spacing (diameters)	Shaft Length (ft)	Nominal Resistance (kips)	Strength Limit Factored Load (kips)	Strength Limit Factored Resistance (kips)	Service Limit Factored Load (kips)	Strength Limit Factored Side Resistance (kips)
Abutment 1 (West)	3	4.33	44	1,514	610	796	465	472
Center Pier	6	3.41	78	3,720	2,006	2,020	1,420	1,660
	7	2.92	73	3,780	2,006	2,040	1,420	1,766
Abutment 2 (east)	3	4.33	54	1,136	610	692	465	526

Compressive geotechnical resistances are based on the estimated strength of the soils for side shear resistance (skin friction) and tip resistance (end bearing). Actual shaft capacities may be controlled by the structural strength of the drilled shafts.

Table 2 - Estimated Drilled Shaft Settlement

Support	Shaft Diameter (ft)	Minimum Shaft Length (ft)	Service Limit Factored Load (kips)	Estimated Settlement (in)
Abutment 1 (West)	3	44	465	0.13
Center Pier	6	78	1,420	0.20
	7	73	1,420	0.19
Abutment 2 (east)	3	54	465	0.11

For this bridge, the lateral analysis of the drilled shaft foundations has been performed by the Structural Engineer with the computer program LPile from Ensoft, Inc. using the following soil parameters that we provided previously in an email communication. We recommend that the Structural Engineer incorporate provisions for group effect in accordance with AASHTO Article 10.8.3.8 in the LPile analysis.

Table 3 - LPile Soil Input Parameters for Abutment 1 (West)

Layer Number	LPile Layer Type	Depth Range* (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Uniaxial Compressive Strength (psi)	k (pci)	E_{50}
1	Sand	0 to 22	130	34	-	-	225	-
2	Stiff Clay w/o Free Water	22 to 26	125	-	2,000	-	-	0.005
3	Sand	26 to 44.5	125	32	-	-	225	-
4	Sand	44.5 to 47.5	126	38	-	-	225	-
5	Strong Rock	47.5 to 50.5	130	-	-	500	-	-
6	Stiff Clay w/o Free Water	50.5 to 60	117	-	2,000	-	-	0.005

Table 4 - LPile Soil Input Parameters for Center Pier

Layer Number	LPile Layer Type	Depth Range* (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Uniaxial Compressive Strength (psi)	k (pci)	E_{50}
1	Sand	0 to 6	124	32	-	-	90	-
2	Sand	6 to 10	124	34	-	-	90	-
3	Sand	10 to 15	110	28	-	-	25	-
4	Sand	15 to 29	125	35	-	-	225	-
5	Strong Rock	29 to 32	130	-	-	500	-	-
6	Sand	32 to 33.5	125	35	-	-	225	-
7	Strong Rock	33.5 to 37	130	-	-	500	-	-
8	Sand	37 to 41	125	38	-	-	225	-
9	Stiff Clay w/o Free Water	41 to 44	120	-	1,600	-	-	0.007
10	Strong Rock	44 to 49.5	130	-	-	500	-	-
11	Sand	49.5 to 51	125	38	-	-	225	-
12	Strong Rock	51 to 54	130	-	-	500	-	-
13	Stiff Clay w/o Free Water	54 to 64	128	-	2,400	-	-	0.005
14	Sand	64 to 68	133	38	-	-	225	-
15	Stiff Clay w/o Free Water	68 to 73	120	-	2,000	-	-	0.005
16	Sand	73 to 85	59	30	-	-	90	-
17	Sand	85 to 89	61	38	-	-	125	-
18	Stiff Clay w/o Free Water	89 to 100	67	-	2,000	-	-	0.005
19	Stiff Clay w/o Free Water	100 to 111.5	55	-	1,600	-	-	0.007

Table 5 - LPile Soil Input Parameters for Abutment 2 (East)

Layer Number	LPile Layer Type	Depth Range* (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Uniaxial Compressive Strength (psi)	k (pci)	E_{50}
1	Sand	0 to 22	130	34	-	-	225	-
2	Stiff Clay w/o Free Water	22 to 33	124	-	2000	-	-	0.005
3	Sand	33 to 38	125	34	-	-	225	-
4	Sand	38 to 44	115	30	-	-	90	-
5	Strong Rock	44 to 50.5	130	-	-	500	-	-
6	Sand	50.5 to 54.5	125	38	-	-	225	-
7	Stiff Clay w/o Free Water	54.5 to 59	122	-	2000	-	-	0.005

All drilled shafts should be properly reinforced to resist uplift and lateral loading.

Anticipated total settlements of properly designed and constructed drilled shafts are presented in the following table, for the minimum calculated shaft dimensions, as shown in the table:

6.2.2 Retaining Wall Foundations

The nominal bearing capacity (q_n), in kips per square foot (ksf) to be used in the design for MSE and CIP walls may be calculated using the following formula:

$$q_n = 1.78\ B' + 2.87\ D_f$$

Where D_f is the depth of embedment to the bottom of the reinforced soil mass or footing at the face of the wall or footing (in feet) below the lowest adjacent grade. B' is the effective width of the reinforced soil mass or footing, which includes a reduction from the total width to account for any eccentricity (in feet). The equation above is simplified from Equation 10.6.3.1.2a-1 of the AASHTO LRFD Bridge Design Specifications, using a coefficient of internal friction for soil (ϕ_f) of 32º, a soil unit weight (γ) of 0.12 kips per cubic foot (kcf), and neglecting soil cohesion.

Based on the soil conditions encountered, settlements will be limited to elastic settlement since long term consolidation and secondary settlement are not likely to occur. Therefore, settlement of the foundation soils is expected to occur as the retaining wall is constructed and backfilled. Settlement of the tallest MSE walls along the embankment was calculated to range between ¾ and 2 inches.

6.3 Seismic Design Recommendations

Seismic forces should be determined using the following values obtained from Figure 12.3-H in Section 12.3.5 of the NDOT Structures Manual: a Peak Ground Acceleration Coefficient (PGA) of 0.15, a Short-Period Spectral Acceleration Coefficient (S_S) of 0.40, and a Long-Period Spectral Acceleration Coefficient (S_1) of 0.15.

A Site Class of C (as defined by the AASHTO LRFD Bridge Design Specifications Table 3.10.3.1-1) may be used in design of the bridge and retaining wall structures. Appendix B includes the model created from the ReMi survey data and the resulting average shear wave velocity determination, which are the basis of the Site Class determination.

6.4 Lateral Earth Pressures and Retaining Walls

Lateral earth pressures for use in retaining wall design may be computed using a coefficient of internal friction for soil (ϕ_f) of 34º and a soil unit weight (γ) of 0.125 kips per cubic foot (kcf), assuming that all retaining walls will be backfilled with or will retain Granular Backfill conforming to section 207.02.02 of the NDOT Standard Specifications for Road and Bridge Construction. Any soil cohesion should be neglected in determining the lateral earth pressures on retaining walls.

The exterior stability analyses for sliding, bearing, and eccentricity for the MSE walls based on a minimum strap length of 80 percent of the wall height or 8 feet (as selected by the structural engineer) are provided in the calculations included in Appendix C. The analyses show that the stand-alone walls are stable under both static and seismic loading at 80 percent of the wall height or 8 feet; however, the MSE wall portion of the hybrid wall beneath the abutment will require a minimum strap length of 11 feet to satisfy the seismic sliding and eccentricity conditions.

The global stability of the tallest MSE retaining wall and the hybrid MSE-tie back retaining wall system were checked using the computer program STABL6H2 by Purdue University. The results of the analyses are summarized below. The equivalent resistance factor is the reciprocal of the factor of safety calculated in the analysis.

Table 6 - Retaining Wall Global Stability Results

Retaining Wall	Factor of Safety		Equivalent Resistance Factor		Maximum Resistance Factor	
	Static	Seismic	Static	Seismic	Static	Seismic
Tallest Stand-Alone MSE Wall	2.83	1.93	0.35	0.52	0.75	0.9
Hybrid MSE-Tie Back Wall at Abutment No. 2 (based on 8-foot strap length)	1.81	1.45	0.55	0.69	0.65	0.9

6.5 Utility Lines

6.5.1 Trench Excavation

- It is anticipated that excavation of the on-site natural non-cemented deposits for the proposed project can be accomplished with conventional earthmoving equipment.

- Excavations penetrating moderately hard or relatively thin (less than one foot) hard layers of caliche should be able to be excavated using heavy-duty equipment.

- Excavations penetrating hard or very hard caliche will require special consideration where they are to be performed.

- Contractors, especially those excavating for utilities, should satisfy themselves as to the hardness of materials and equipment required.

- Excavation, trenching and shoring should be conducted in accordance with the U.S. Department of Labor Occupational Safety and Health Administration's (OSHA) Excavation and Trenching Standard, Title 29 of the Code of Federal Regulation (CFR), Part 1926.650. Safety of construction personnel is the responsibility of the contractor.

6.5.2 Subgrade and Bedding

Natural soils having a consistency of at least stiff/medium dense and/or caliche will provide adequate support for the proposed utility lines. Overexcavation should not be necessary except to remove uncontrolled fill and loose/firm or disturbed natural soils. Sufficient Aggregate Base per Sections 704.03.02 through 704.03.05 of the NDOT Standard Specifications for Road and Bridge Construction (Standard Specifications), latest edition, should be used for bedding and pipe zone material. Pipe bedding and pipe zone material should be placed below and around the pipe to provide uniform support. Alternately, Slurry Cement Backfill per Section 207.02.02 of the Standard Specifications may be used for bedding and pipe zone material. Any fill placed beneath pipes and within the pipe zone should be compacted to at least 90 percent of the maximum density obtainable by the Nev. T108 laboratory method of compaction

6.5.3 Trench Backfill

It is our opinion that most of the natural soils encountered in our exploration will not meet the Granular Backfill criteria as specified in the Standard Specifications Section 704.03.11. Although some of the natural soils onsite may meet the requirements for Backfill specified in the Standard Specifications Section 704.03.10. Trench backfill should be placed and compacted in accordance with the provisions of Standard Specifications Section 207. Moisture content at the time of compaction should be at two percent below optimum or higher.

Precautions should be taken during backfilling to avoid damage to the pipes. Field and laboratory testing of backfill material should be performed to determine whether applicable requirements have been met.

6.6 Permanent Slopes

Earthwork activities to construct slopes at the site should be done in accordance with the following:

- Cut and/or fill slopes should be constructed no steeper than 2 horizontal to 1 vertical.
- If any slope exceeds 30 feet in height, the slope design should include mid-height benches to intercept surface drainage and divert flow from the slope face.
- The surfaces of slopes should be compacted (not necessary where caliche is exposed) to the minimum specifications recommended in the Earthwork section of this report and until the slopes are stable and there are no loose soils on the slopes. Alternately, fill slopes could be constructed by over-filling and cutting back to expose fully compacted soil.
- The ground surface adjacent to the top of slopes should be graded to drain away from the slopes. Any required erosion control measures should be provided for all slopes as soon as possible after grading.

6.7 Pavement

The pavement area subgrade should be properly prepared before placing any asphalt or base materials. Proper drainage of the paved areas should be provided to increase the pavement life. In addition, pavements must be maintained for durability and integrity during their life. Therefore, periodic seal coating, crack sealing, and/or patching may be required.

Based on our experience, the on-site natural soils should have an R-value of at least 25; however, due to NDOT's requirements for Embankment Fill, the embankment fill soils should have an R-value of at least 45. Accordingly, based on the Pavement Structure Design Guideline Chart (DWG. Nos. 200) in the Uniform Standard Drawings for Clark County Area, Nevada, the following preliminary pavement sections will be applicable:

Table 7 - Pavement Section Recommendations

ROADWAY TYPE	SUBGRADE TYPE	R-VALUE	PAVEMENT SECTION (Inches)		
			UTACS	ASPHALT CONCRETE	TYPE II BASE
Arterial (Lone Mountain Road)	Natural Soil	25	1	5.5	20
	Embankment Fill	45	1	5.5	11.5

Asphalt and base course materials and compaction should meet the criteria set forth in the Uniform Standard Specifications for Public Works' Construction, Off-Site Improvements, Clark County Area, Nevada. Subgrade should be compacted to a minimum of 90 percent (ASTM D1557). Field and laboratory testing of asphalt and base materials should be performed to determine whether specified requirements have been met.

The performance of the pavement can be enhanced by minimizing excess moisture which can reach the subgrade soils. The following recommendations should be followed, where possible:

- Site grading at a minimum 2% grade away from the pavements.
- Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
- Landscaped areas should have cutoff walls/moisture barriers adjacent to pavement areas to minimize or prevent moisture migration to subgrade soils.
- Consideration should be given to using "desert" landscaping and/or minimizing watering to help prevent surface runoff.
- Placing compacted backfill against the exterior side of curb and gutter.

6.8 Corrosivity

Based on test results and Table 4.2.1 of ACI 318 Section 4.2, the on-site soils classify as having a severe sulfate exposure. Consideration should be given to providing protection to buried metal pipes or use of nonmetallic pipe where permitted by local building codes. Non-corrosive backfills, protective coatings and wrappings, sacrificial anodes, or a combination of these methods could be considered. It should be understood that NOVA Geotechnical & Inspection Services personnel are not experts regarding corrosion and/or corrosion protection and that we recommend a “Corrosion Engineer” be consulted for actual recommendations regarding the necessity and/or method of cathodic protection.

7.0 OTHER SERVICES

NOVA Geotechnical & Inspection Services should be retained to provide a general review of final design plans and specifications in order that grading and foundation recommendations may be interpreted and implemented. In the event that any changes of the proposed project are planned,

the conclusions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

NOVA Geotechnical & Inspection Services should also be retained to provide services during excavation, grading, foundation and construction phases of work. Observation of foundation excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present. Field and laboratory testing of concrete and soils should be performed to determine whether applicable requirements have been met.

The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the locations of the explorations may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

8.0 CLOSURE

Our professional services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranties, either expressed or implied, are intended or made. We prepared this report as an aid in design of the proposed project. This report is not a bidding document. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

NOVA GEOTECHNICAL & INSPECTION SERVICES

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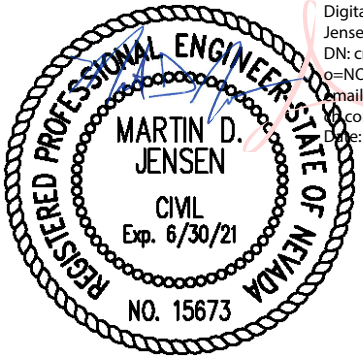

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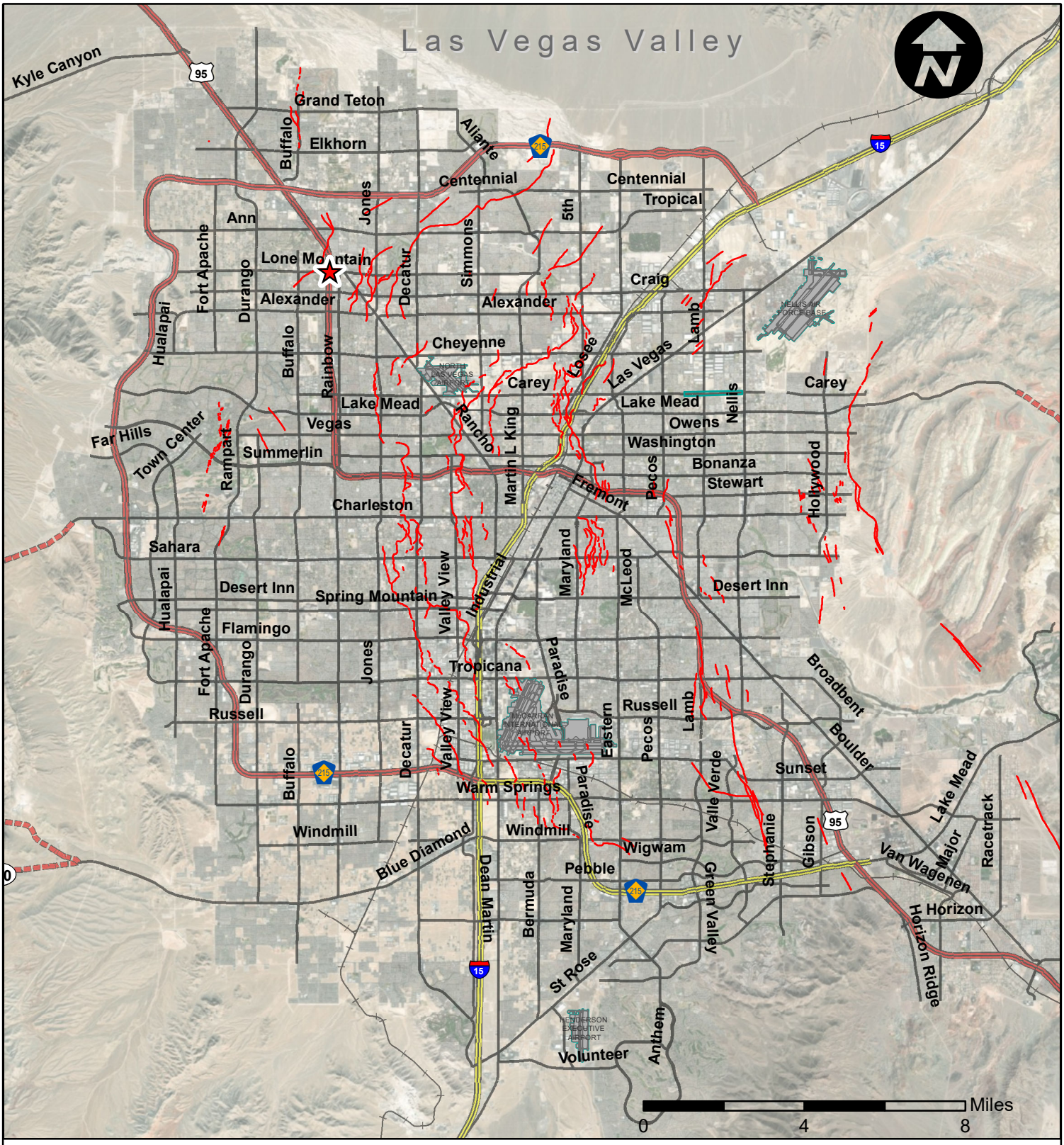
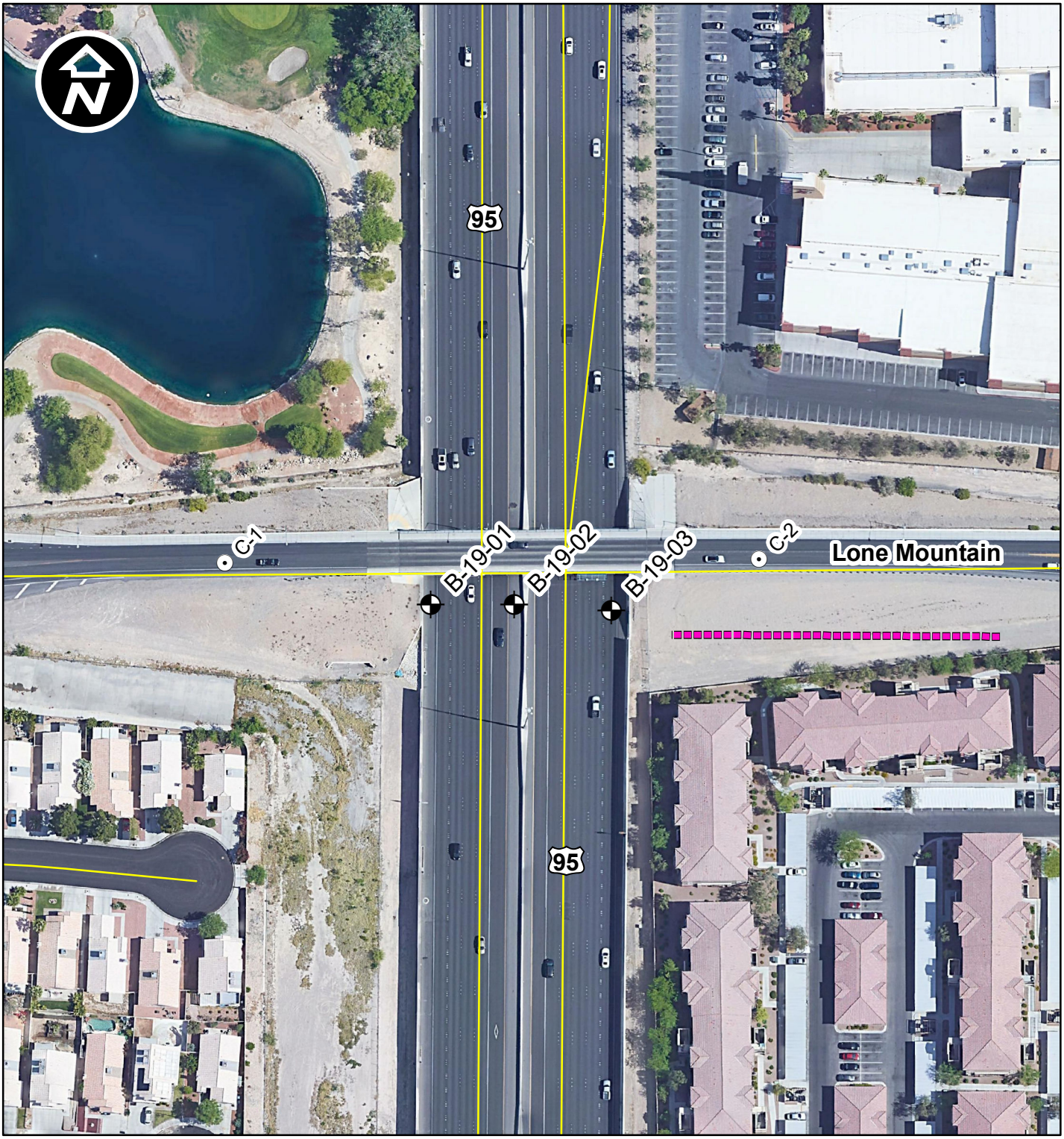


Legend

- Las Vegas Faults (CCBD GISMO, 2016)
- Approximate Project Site

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: **Lone Mountain Road Bridge Widening**	**VICINITY MAP**	
	CLIENT: **GCW Engineering**	PROJECT NO: **G-19-067**	FIGURE NO: **1**



Legend

- Approximate Boring Location
- Approximate Asphalt Core Location
- Approximate ReMi Array Location

0 50 100 200 300 Feet

NOVA Geotechnical & Inspection Services	PROJECT: **Lone Mountain Road Bridge Widening**	SITE MAP	
	CLIENT: **GCW Engineering**	PROJECT NO: **G-19-067**	FIGURE NO: **2**

APPENDIX A

APPENDIX A

Site Exploration

The subsurface conditions of the site were explored by drilling three (3) borings to depths ranging from approximately 80 to 110 feet below existing site grades. Borings were drilled using a hollow stem auger drill rig.

Soils were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. Boring logs are presented on Plates 1 through 3. The number of blows required to drive a 2-inch O.D. SPT Sampler or 3-inch O.D. California Modified Sampler 12 inches using a 140-pound weight dropped 30 inches are shown on the logs. The soils are generally classified by the Unified Soil Classification System. Plate 4 presents an explanation of material classifications used in this report.

Two (2) asphalt cores were obtained from within the existing paved alignment of Lone Mountain Road to evaluate the existing pavement sections. The cores were taken from the approach ramps on both sides of the existing bridge. The asphalt thickness was measured and the aggregate base beneath the asphalt was hand excavated to assess the base thickness. The results of the pavement section evaluation are presented in the following table:

CORE LOCATION	ASPHALT THICKNESS (inches)	AGGREGATE BASE THICKNESS (inches)
C-1	5.75	0.0*
C-2	5.5	0.0*

* Asphalt placed directly on Embankment Fill.

Laboratory Testing

Laboratory testing was performed on selected samples of on-site soils. Tests were performed in general accordance with applicable ASTM, AASHTO, or local standards.

For cohesive soils, index strength tests were performed using a hand penetrometer device. Penetrometer ("ppt") readings are presented on the boring logs in tons per square foot (tsf).

Field moisture content (AASHTO T265) and unit weight (ASTM D7263) determinations were performed on undisturbed samples. Results of these tests are presented in the following table:

SAMPLE LOCATION		MOISTURE (%)	DRY DENSITY (pcf)
Boring	Depth (ft.)		
B-19-01	10	11	113
	20	12	82
	30	19	106

SAMPLE LOCATION		MOISTURE (%)	DRY DENSITY (pcf)
Boring	Depth (ft.)		
B-19-01	40	19	98
	70	49	70
	80	33	92
B-19-02	5	17	106
	55	16	110
	65	18	113
	75	27	95
	85	18	104
	95	26	102
	105	30	90
B-19-03	10	14	109
	20	14	93
	40	15	106
	60	13	117
	70	34	89

Consolidation tests (NV T216) were performed on representative samples to illustrate the compressibility of on-site soils. Water was added during testing to illustrate the influence of moisture on compressibility. The test results are presented on Plates 5a through 5d.

Sieve analyses (NV T206) and Atterberg Limits tests (NV T210, T211, & T212) were performed to determine the grain-size distribution and soil classification of representative materials. The test results are presented on Plates 6a through 6i.

The percent passing the No. 200 sieve was determined on selected samples to aid in classification. The test was performed in accordance with ASTM D1140. Test results are presented in the table below:

SAMPLE LOCATION		% PASSING NO. 200 SIEVE
Boring	Depth (ft.)	
B-19-01	20	27
	25	38
	35	51
	45	28
	55	84
B-19-02	20	38
	55	60
B-19-02	75	46
	95	61

SAMPLE LOCATION		% PASSING NO. 200 SIEVE
Boring	Depth (ft.)	
B-19-03	20	22
	25	49
	55	80
	60	43

Atterberg Limits tests (NV T210, T211, & T212) were performed on selected samples to aid in classification. Test results are presented on Plates 7a through 7f and are summarized in the table below:

SAMPLE LOCATION		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
Boring	Depth (ft.)			
B-19-01	10 to 14	38	18	20
	20	48	23	25
	25	50	21	29
	35	60	26	34
	45	80	33	47
	55	36	16	20
	70	78	26	52
	80	46	17	29
B-19-02	10 to 15	40	20	20
	20	49	23	26
	55	29	18	11
	65	31	17	14
	75	25	15	10
	95	40	20	20
	105	47	22	25
B-19-03	10 to 13	45	19	26
	20	44	24	20
	40	62	22	40
	55	38	18	20
	60	28	19	9
	70	72	26	46

Chemical tests were performed by Silver State Analytical Laboratories on representative samples from the explorations to determine standard corrosivity parameters. Test results are presented on Plates 8a through 8c.

EXPLORATION LOG

START DATE: 07/12/19
END DATE: 07/13/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-01
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/13/19	79	

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	5.0							FILL	FILL: Asphaltic Concrete, 9 inches -FILL: Aggregate Base, 21 inches -FILL: Clayey SAND with gravel, slightly moist, light brown -concrete debris	
	6.5	1	SPT	16-21-10	31	100			6.00	
	10.0							CL	Sandy lean CLAY, few caliche nodules, hard, slightly moist, light brown	
	11.5	2	RING	10-10-11	21	100			10.00 Clayey SAND with gravel, medium dense, slightly moist, light brown	
	14.0	3	BULK			100	CH, PI, S			
	15.0									
	16.5	4	SPT	3-5-6	11	100			-few gravel, medium dense	
	20.0							SC	-partially cemented -uncemented	
	21.5	5	RING	20-17-19	36	100	PI		-with gravel, medium dense	
	25.0								-few caliche nodules	
	26.5	6	SPT	4-4-2	6	100	PI		-loose	
	30.0								28.50	
								CAL	CALICHE, moderately hard, dry, light brown and gray	1-2 min/ft
									30.00	

EXPLORATION LOG

START DATE: 07/12/19
END DATE: 07/13/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-01
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/13/19	79	

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	31.4	7	RING	45-16-50/5"	R	100		GC	Clayey GRAVEL with sand, partially cemented, very dense, slightly moist, light brown	
									31.50	
								CAL	CALICHE, moderately hard, dry, light brown	2 min/ft
									-very hard	9 min/ft
	35.0								34.50	
	36.5	8	SPT	7-4-7	11	100	PI	CH	Sandy fat CLAY, few caliche nodules, stiff, moist, light brown	ppt=0.75 tsf
	40.0								-with gravel -thin partially cemented layer	
	41.5	9	RING	22-10-11	21	100			-stiff, light gray and brown	
	45.0								44.00	
								CAL	CALICHE, hard, dry, light gray	5 min/ft
									45.00	
	46.5	10	SPT	5-7-8	15	100	PI	SC	Clayey SAND, few caliche nodules, medium dense, moist, light brown	
	50.0								-partially cemented	
	50.2								50.00	
		11	RING	50/2"	R	0		CAL	CALICHE, hard to very hard, dry, light gray	7 min/ft
										9 min/ft
										6 min/ft
	55.0								53.00	
	56.5	12	SPT	22-13-12	25	100	PI	CL	Lean CLAY with sand, moist, light brown -partially cemented -thin caliche layer -uncemented, very stiff	ppt=0.75 tsf
	60.0									

EXPLORATION LOG

START DATE: 07/12/19
END DATE: 07/13/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-01
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/13/19	79	

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	60.3	13	RING	50/4"	R	0		CL	-thin partially cemented layer Lean CLAY with sand, very stiff, moist, light brown	
	65.0									
	65.3	14	SPT	50/3"	R	0			-partially cemented, hard, light gray	
									66.50	
	70.0							CH	Sandy fat CLAY, moist, light brown	
	71.5	15	RING	8-11-13	24	100	OC, PI, S		-few caliche nodules, very stiff	ppt=1.75 tsf
	75.0									
	75.6	16	SPT	38-50/1"	R	100			-partially cemented, hard	
									76.00	
								CAL	CALICHE, moderately hard, dry, light gray	1 min/ft 3 min/ft 2 min/ft
	80.0								79.00	
	81.5	17	RING	9-41-30	71	100	PI, S	SC	Clayey SAND with gravel, partially cemented, very dense, wet, light gray	
									81.50	

EXPLORATION LOG

START DATE: 07/10/19
END DATE: 07/11/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-02
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/11/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/10/19	73	
07/11/19	74.3	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	5.0							FILL	FILL: Asphaltic Concrete, 9 inches -FILL: Aggregate Base, 22 inches -FILL: Clayey SAND with gravel, slightly moist, light brown	
	6.5	1	RING	13-22-17	39	100			6.00 -asphalt debris	
	10.0							SC	Clayey SAND with gravel, medium dense, slightly moist, light gray-brown	
	11.5	2	SPT	3-3-4	7	50			-loose	
	15.0	3	BULK			100	CH, PI, S			
	16.5	4	RING	11-12-13	25	100			-medium dense	
	20.0								-partially cemented -uncemented, dense	
	21.5	5	SPT	6-8-20	28	100	PI		-few gravel	
	25.0									
	26.5	6	RING	11-13-10	23	100			-medium dense	
	30.0								29.00	
								CAL	CALICHE, moderately hard, dry, light brown	2-3 min/ft

EXPLORATION LOG

START DATE: 07/10/19
END DATE: 07/11/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-02
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/11/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/10/19	73	
07/11/19	74.3	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	30.2	7	SPT	50/2"	R	0		CAL	CALICHE, moderately hard, dry, light brown and gray	1 min/ft
	32.00							SC	Clayey SAND with gravel, slightly moist, light brown and gray	
	33.50							CAL	CALICHE, hard to very hard, dry, light brown and gray	5 min/ft
	35.0	8	RING	50/0"	R	0				7 min/ft
										10 min/ft
	37.00							SC	Clayey SAND, few caliche nodules, slightly moist, light gray	
	40.0								-partially cemented	
									-dense	
	41.5	9	SPT	8-28-12	40	100				
	41.00							CL	Sandy lean CLAY, hard, moist, olive-gray	
	44.00							CAL	CALICHE, hard, dry, light gray	5 min/ft
	45.0	10	RING	50/0"	R	0			-very hard	9 min/ft
									-moderately hard	2 min/ft
									-hard	4 min/ft
	49.50								-moderately hard	
	50.0							SC	Clayey SAND, partially cemented, very dense, slightly moist, light gray	
	50.8	11	SPT	30-50/3"	R	0				
	51.00							CAL	CALICHE, very hard, dry, light gray	11 min/ft
	54.00								-hard	12 min/ft
	55.0							CL	Sandy lean CLAY, very stiff, moist, light grayish brown	ppt=0.75 tsf
	56.5	12	RING	12-19-18	37	100	OC, PI			
	60.0									

EXPLORATION LOG

START DATE: 07/10/19
END DATE: 07/11/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-02
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/11/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/10/19	73	
07/11/19	74.3	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	61.5	13	SPT	16-11-12	23	100		CL	Sandy lean CLAY, very stiff, moist, light grayish brown	ppt=2.25 tsf
	64.00									
	65.0							SC	Clayey SAND with gravel, dense, moist, light gray	
	66.5	14	RING	10-23-31	54	100	PI, S			
	68.00									
	70.0							CL	Sandy lean CLAY, moist, light gray	
	71.5	15	SPT	26-9-7	16	50			-very stiff	
	73.00									
	75.0							SC	Clayey SAND, very moist, light gray and brown	
	76.5	16	RING	6-8-13	21	100	PI		-medium dense	
	80.0								-few caliche nodules, medium dense	
	81.5	17	SPT	10-6-6	12	100				
	85.0									
	85.4	18	RING	50/5"	R	100			-with gravel, partially cemented, very dense, moist, light gray	
	87.00									
	89.00							CAL	CALICHE, hard, dry, light gray	3 min/ft 6 min/ft
	90.0							CL	Sandy lean CLAY, very stiff, moist, light olive	

EXPLORATION LOG

START DATE: 07/10/19
END DATE: 07/11/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-02
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/11/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/10/19	73	
07/11/19	74.3	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	91.5	19	SPT	4-11-7	18	100			Sandy lean CLAY, very stiff, moist, light olive and gray	ppt=1.0 tsf
	95.0									
	96.5	20	RING	10-19-22	41	100	PI		-very stiff	ppt=2.5 tsf
	100.0									
	101.5	21	SPT	4-7-6	13	100		CL	-stiff, very moist	ppt=3.0 tsf
	105.0									
	106.5	22	RING	6-10-15	25	100	PI, S		-with gravel, trace sand, very stiff	ppt=2.5 tsf
	110.0									
	111.5	23	SPT	7-11-13	24	100			-very stiff	ppt=0.75 tsf
									111.50	

EXPLORATION LOG

NOVA GEOTECHNICAL & inspection services

START DATE: 07/11/19
END DATE: 07/12/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-03
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/12/19	75	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	5.0							FILL	FILL: Asphaltic Concrete, 9 inches -FILL: Aggregate Base, 20 inches -FILL: Clayey SAND with gravel, slightly moist, light brown	
	6.5	1	SPT	9-6-5	11	100			6.00 -asphalt debris	
	10.0							CL	Sandy lean CLAY, few caliche nodules, stiff, slightly moist, light brown	
	11.5	2	RING	4-6-9	15	100			-stiff	ppt=2.5 tsf
	13.0	3	BULK			100	CH, PI, S			
	15.0									
	16.5	4	SPT	2-4-5	9	0			-stiff	Caliche nodule in shoe
	20.0								17.00	
	21.5	5	RING	12-16-18	34	100	PI	GC	Clayey GRAVEL with sand, partially cemented, slightly moist, light brown -uncemented -medium dense	
	25.0								22.00	
	26.5	6	SPT	3-3-4	7	50		SC	Clayey SAND, few caliche nodules, slightly moist, light brown -loose	
	30.0								28.00	
								CAL	CALICHE, moderately hard, dry, light brown and gray	2 min/ft
									29.50	
								SC	30.00 Clayey SAND, slightly moist, brown	

EXPLORATION LOG

START DATE: 07/11/19
END DATE: 07/12/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: _____ LONGITUDE: _____
BORING: B-19-03
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/12/19	75	

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD: _____
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	30.2	7	RING	50/2"	R	0		CAL	CALICHE, moderately hard, dry, light brown	1 min/ft
	31.00							SC	Clayey SAND, partially cemented, slightly moist, light brown	
	32.00							CAL	CALICHE, very hard, dry, light brown	9 min/ft
									-hard	4 min/ft
	34.50								-moderately hard	
	35.0							SC	Clayey SAND, partially cemented, very dense, slightly moist, light brown	
	35.9	8	SPT	43-50/5"	R	0				
	38.50									
	40.0							CH	Sandy fat CLAY, slightly moist, light brown	
	41.1	9	RING	15-36-50/1"	R	100	PI, S		-partially cemented, gravelly, with sand, hard	ppt=2.5 tsf
	43.00							CAL	CALICHE, moderately hard, dry, light gray	2-3 min/ft
	45.0									
	45.00							SC	Clayey SAND with gravel, partially cemented, very dense, slightly moist, light brown-gray	
	45.9	10	SPT	41-50/5"	R	100		CAL	CALICHE, hard, dry, light gray	5 min/ft
	46.00									
	47.50							SC	Clayey SAND with gravel, partially cemented, slightly moist, light brown-gray	
	49.00							CAL	CALICHE, hard, dry, light gray	4 min/ft
	50.0								-very hard	8 min/ft
		11	RING	50/0"	R	0				11 min/ft
	53.00									9 min/ft
	55.0							CL	Lean CLAY with sand, moist, light brown	
		12	SPT	5-8-50/4"	R	100	PI			ppt=0.75 tsf
	56.3								-partially cemented, hard	
									-uncemented	
	60.0									

EXPLORATION LOG

START DATE: 07/11/19
END DATE: 07/12/19
JOB DESCRIPTION: LONE MOUNTAIN ROAD BRIDGE WIDENING
LATITUDE: LONGITUDE:
BORING: B-19-03
PROJECT No.: G-19-067
GROUND ELEV.: N/A
HAMMER DROP SYSTEM: Auto (ETR=70.3)

DRILLING: 8-inch O.D. Hollow Stem Augers
METHOD:
EQUIPMENT: CME 85
DRILLING COMPANY: Cascade
OPERATOR: M. Alvarado
ENGINEER: J. Scheffner
BACKFILLED: with CLSM DATE: 07/15/19

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft
07/12/19	75	

ELEV. (ft.)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 Inch Increments	BLOW COUNT Last foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
	61.5	13	RING	19-19-11	30	100	PI	SC	Clayey SAND, medium dense, moist, light brown	
	65.0									
	65.1	14	SPT	50/1"	R	0			-partially cemented, very dense, light gray	
									-uncemented, light brown	
									68.00	
	70.0							CH	Sandy fat CLAY, moist, light brown	
	71.5	15	RING	9-11-17	28	100	PI, S		-few caliche nodules, very stiff	ppt=2.5 tsf
	75.0									
	76.5	16	SPT	2-1-2	3	100			-soft, wet	
	80.0								-partially cemented	
	80.4	17	RING	50/5"	R	0			80.40 -hard	

KEY TO BORING LOGS

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

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

MOISTURE CONDITION CRITERIA

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

SOIL CEMENTATION CRITERIA

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

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

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

Field Blow counts on California Modified Sampler (N_{CMS}) for ($6<N_{CMS}<50$) can be converted to $N_{SPT\ field}$ by:

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

TEST ABBREVIATIONS

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

SOIL COLOR DESIGNATIONS ARE FROM THE MUNSELL SOIL/ROCK COLOR CHARTS.

EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS	CALIF. MODIFIED SAMPLER[1]
CPT	CONE PENETRATION TEST
CS	CONTINUOUS SAMPLER[2]
PB	PITCHER BARREL
RC	ROCK CORE[3]
SH	SHELBY TUBE[4]
SPT	STANDARD PENETRATION TEST
TP	TEST PIT

1- I.D.= 2.421 inch

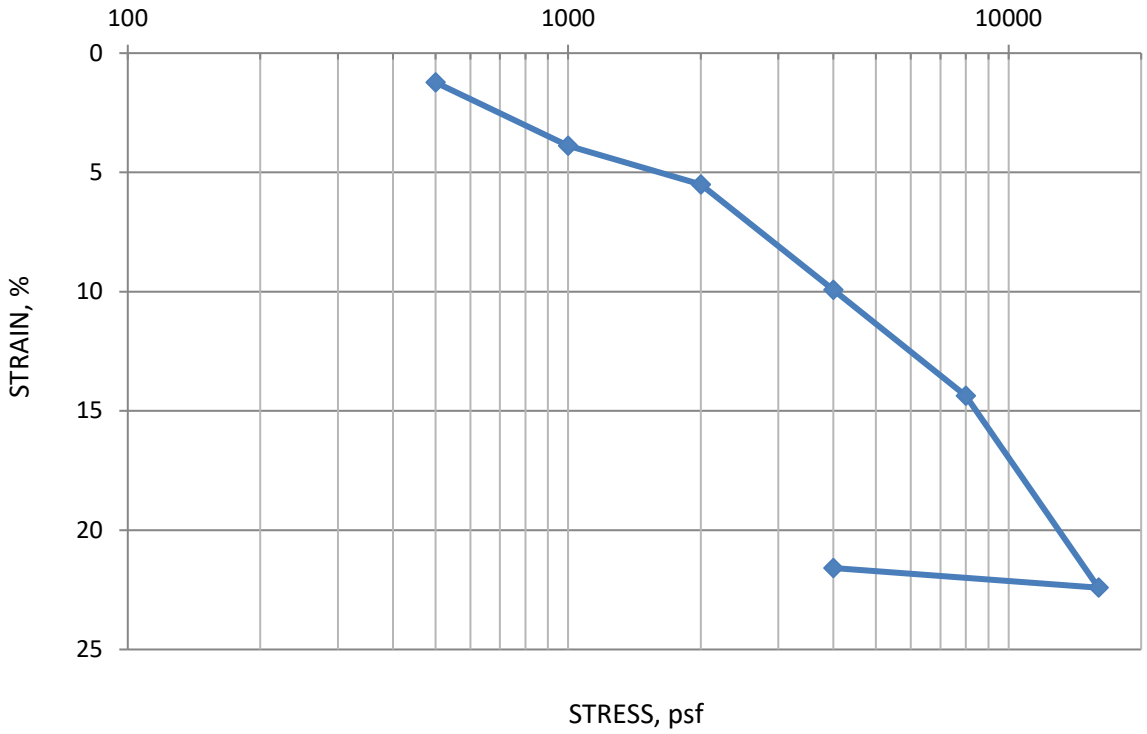
2- I.D.=3.228 inch with tube; 3.50 inch w/o tube

3- NXB I.D.= 1.875 inch

4- I.D.= 2.875 inch

Revised August 2010

B-1 @ 70 FT

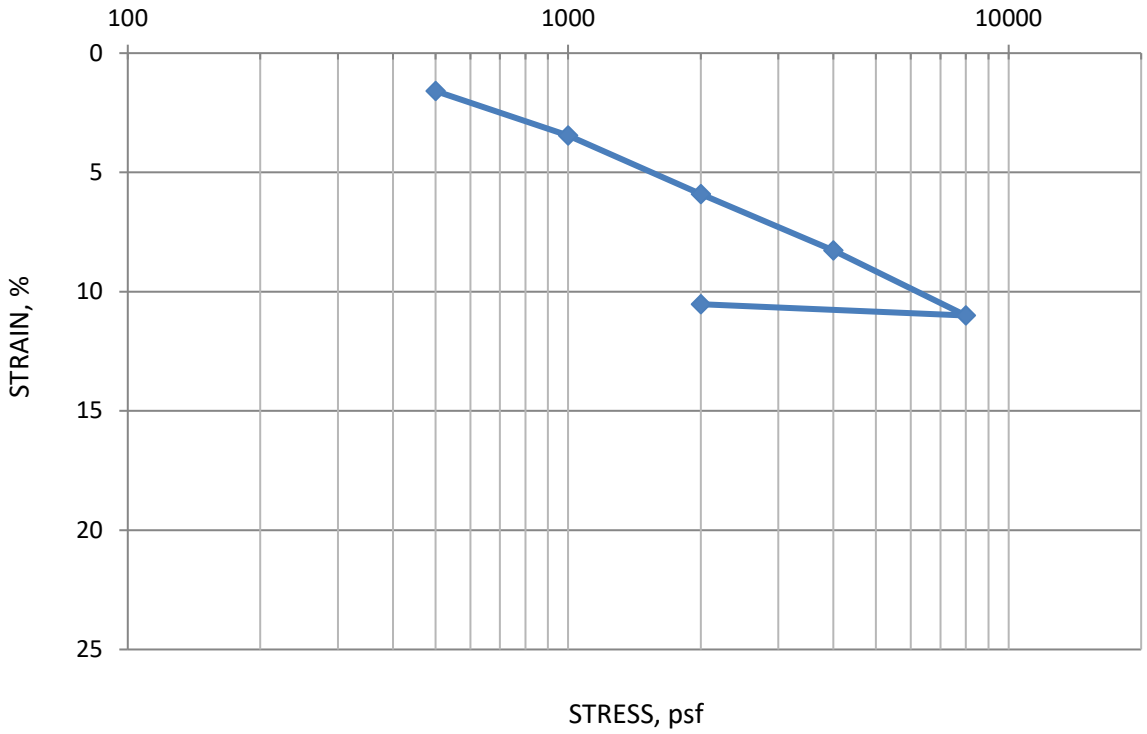


SAMPLE IDENTIFICATION		NOTES	Ɣd, pcf	MC%
●	B-1 @ 70 FT	NO WATER ADDED	70	49.0%

Υ_d: DRY DENSITY
PSF: POUNDS PER SQUARE FOOT
PCF: POUNDS PER CUBIC FOOT
MC: MOISTURE CONTENT

NOVA GEOTECHNICAL & INSPECTION SERVICES	CLIENT: GCW	**CONSOLIDATION TEST**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 5a

B-2 @ 55 FT

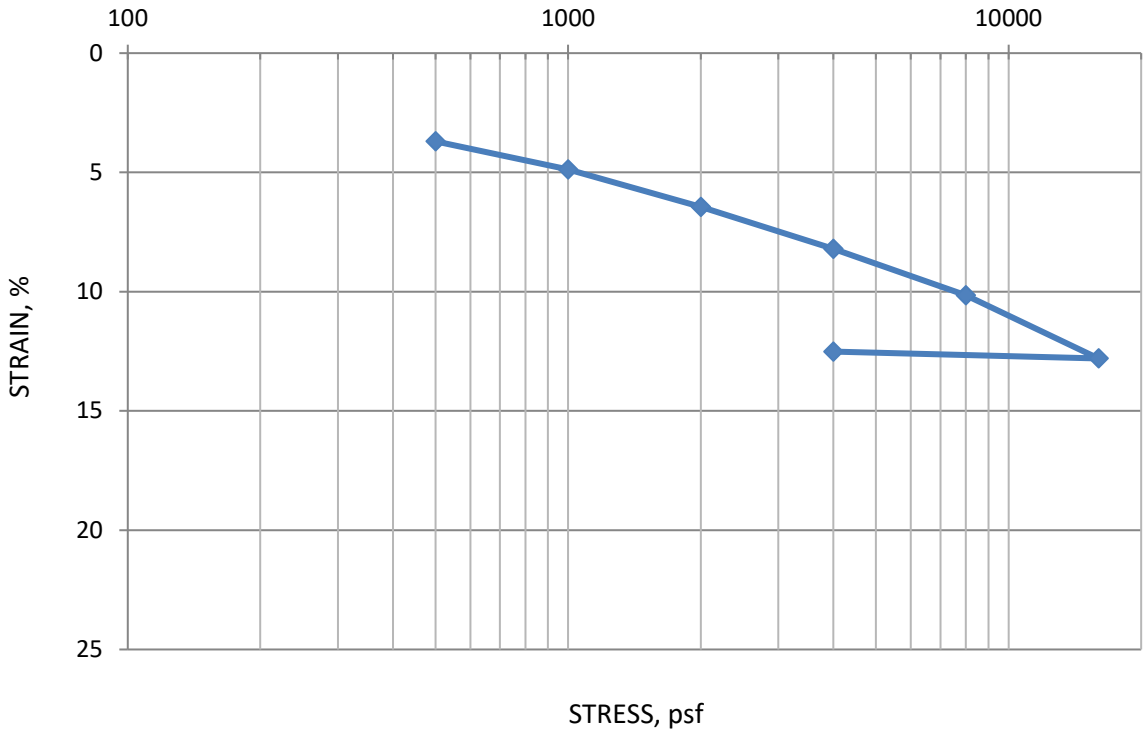


SAMPLE IDENTIFICATION		NOTES	Ɣd, pcf	MC%
●	B-2 @ 55 FT	NO WATER ADDED	110	16.0%

γ_d: DRY DENSITY
PSF: POUNDS PER SQUARE FOOT
PCF: POUNDS PER CUBIC FOOT
MC: MOISTURE CONTENT

NOVA GEOTECHNICAL & INSPECTION SERVICES	CLIENT: GCW	**CONSOLIDATION TEST**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 5b

B-2 @ 75 FT

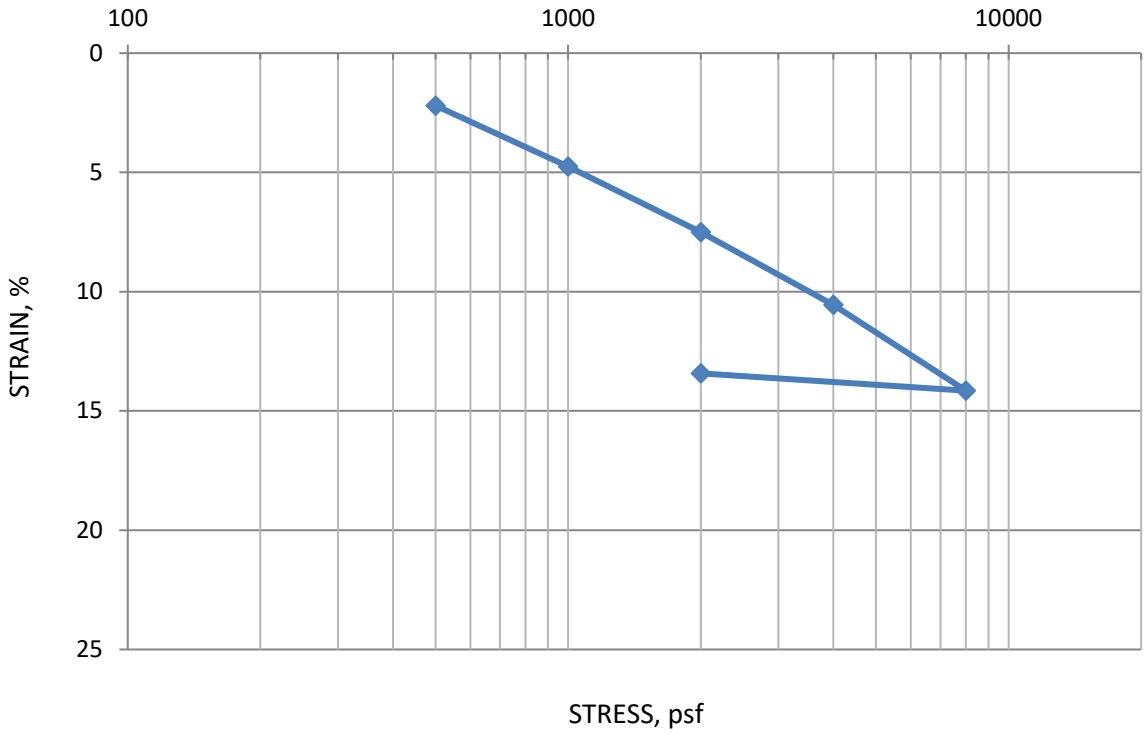


SAMPLE IDENTIFICATION		NOTES	ϒd, pcf	MC%
●	B-2 @ 75 FT	WATER ADDED AT BEGINNING OF TEST	95	27.0%

Υ_d: DRY DENSITY
PSF: POUNDS PER SQUARE FOOT
PCF: POUNDS PER CUBIC FOOT
MC: MOISTURE CONTENT

NOVA GEOTECHNICAL & INSPECTION SERVICES	CLIENT: GCW	**CONSOLIDATION TEST**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 5c

B-3 @ 60 FT

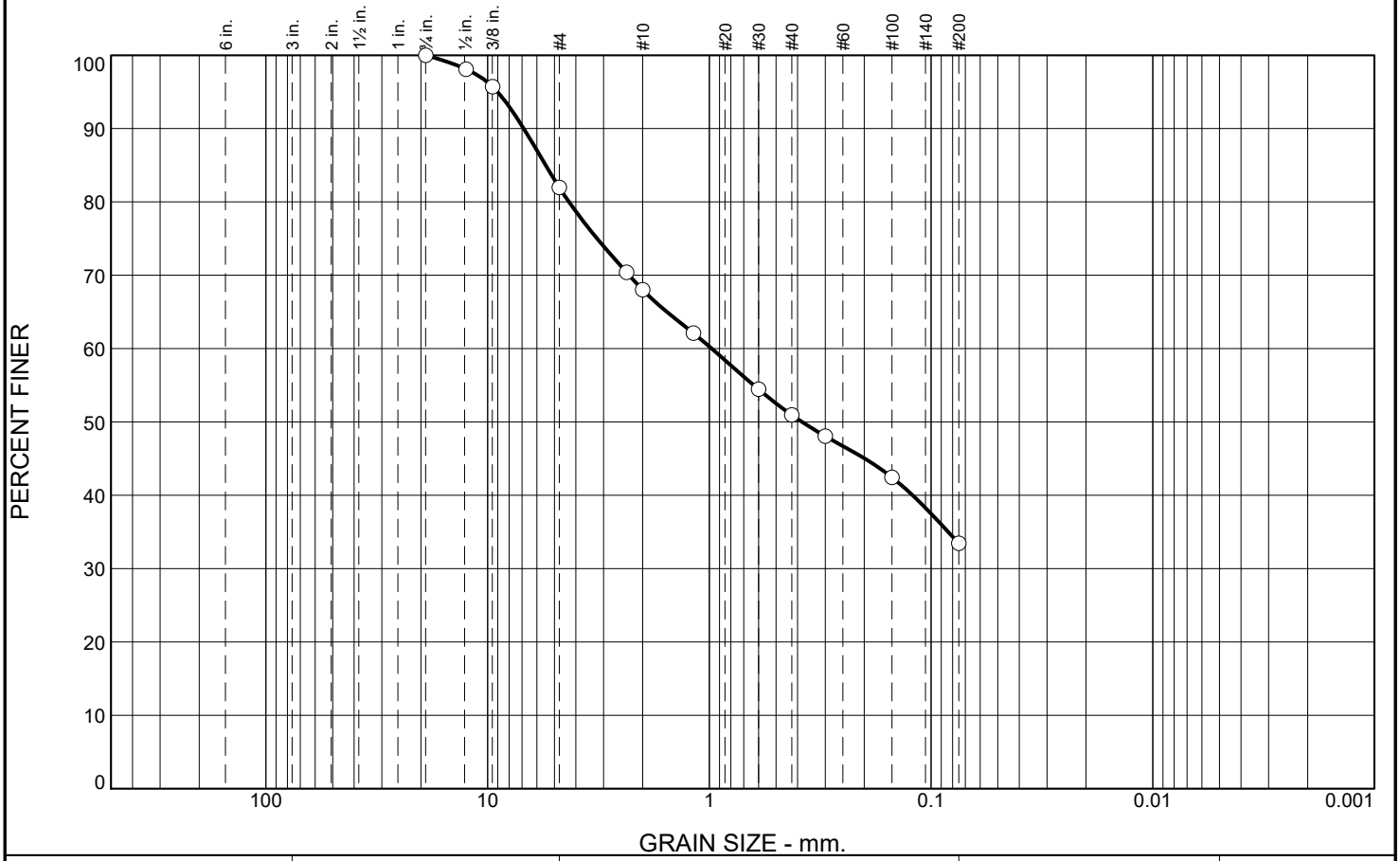


SAMPLE IDENTIFICATION		NOTES	Ɣd, pcf	MC%
●	B-3 @ 60 FT	NO WATER ADDED	117	13.0%

Υ_d: DRY DENSITY
PSF: POUNDS PER SQUARE FOOT
PCF: POUNDS PER CUBIC FOOT
MC: MOISTURE CONTENT

NOVA GEOTECHNICAL & INSPECTION SERVICES	CLIENT: GCW	**CONSOLIDATION TEST**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 5d

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	18	49	33	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	98		
3/8"	96		
#4	82		
#8	70		
#10	68		
#16	62		
#30	54		
#40	51		
#50	48		
#100	42		
#200	33		

* (no specification provided)

Material Description

Clayey SAND with gravel

Atterberg Limits

PL= 18 LL= 38 PI= 20

Coefficients

D_{90}= 6.8740 D_{85}= 5.4739 D_{60}= 0.9755
D_{50}= 0.3821 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(2)

Remarks

Source of Sample: B-1 **Depth:** 10 to 14 ft.

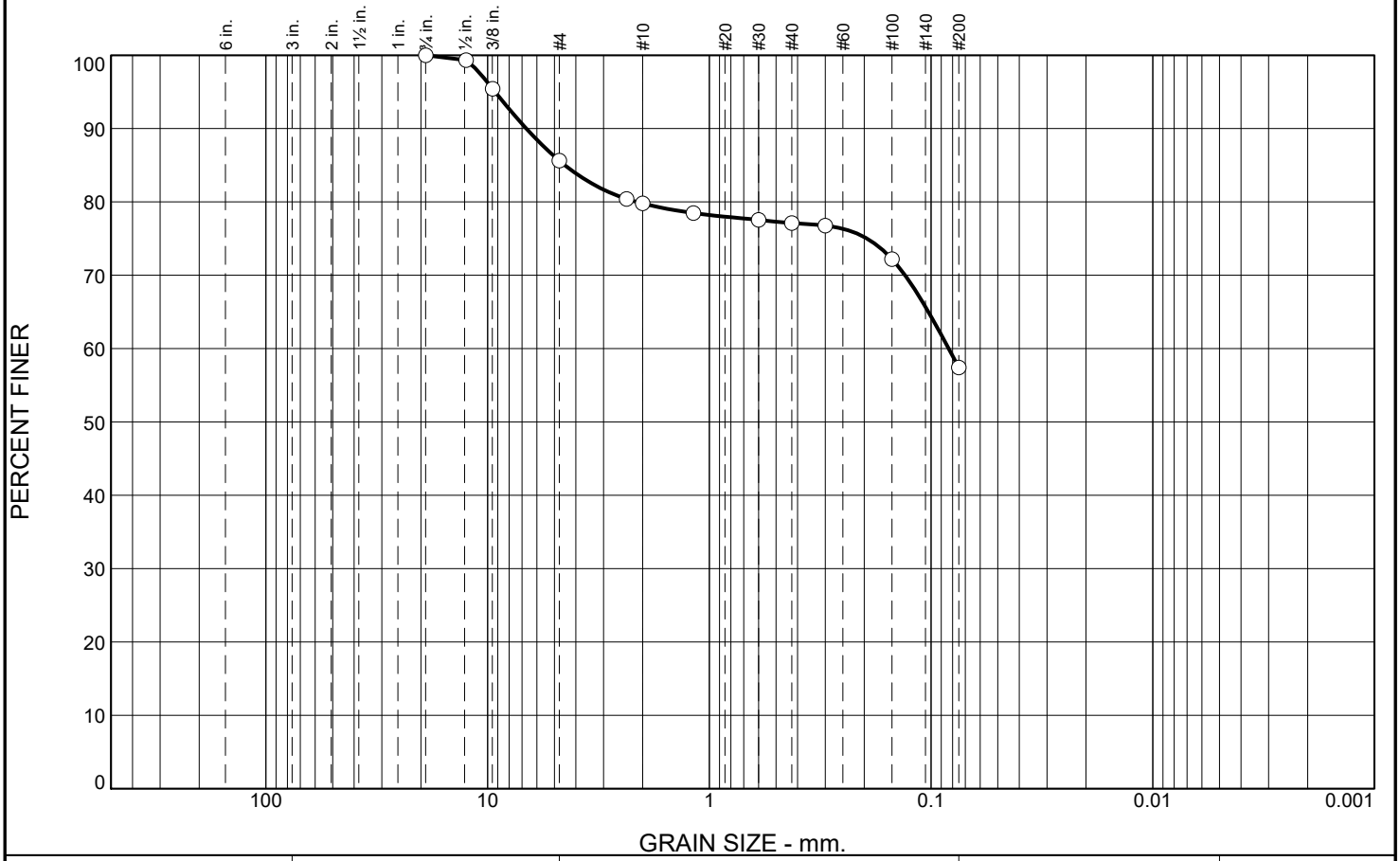
Date: 08/12/19

Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6a

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	14	29	57	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	99		
3/8"	95		
#4	86		
#8	80		
#10	80		
#16	78		
#30	78		
#40	77		
#50	77		
#100	72		
#200	57		

* (no specification provided)

Material Description

Sandy fat CLAY

Atterberg Limits

PL= 26 LL= 78 PI= 52

Coefficients

D_{90}= 6.6890 D_{85}= 4.4837 D_{60}= 0.0833
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(26)

Remarks

Source of Sample: B-1 **Depth:** 70

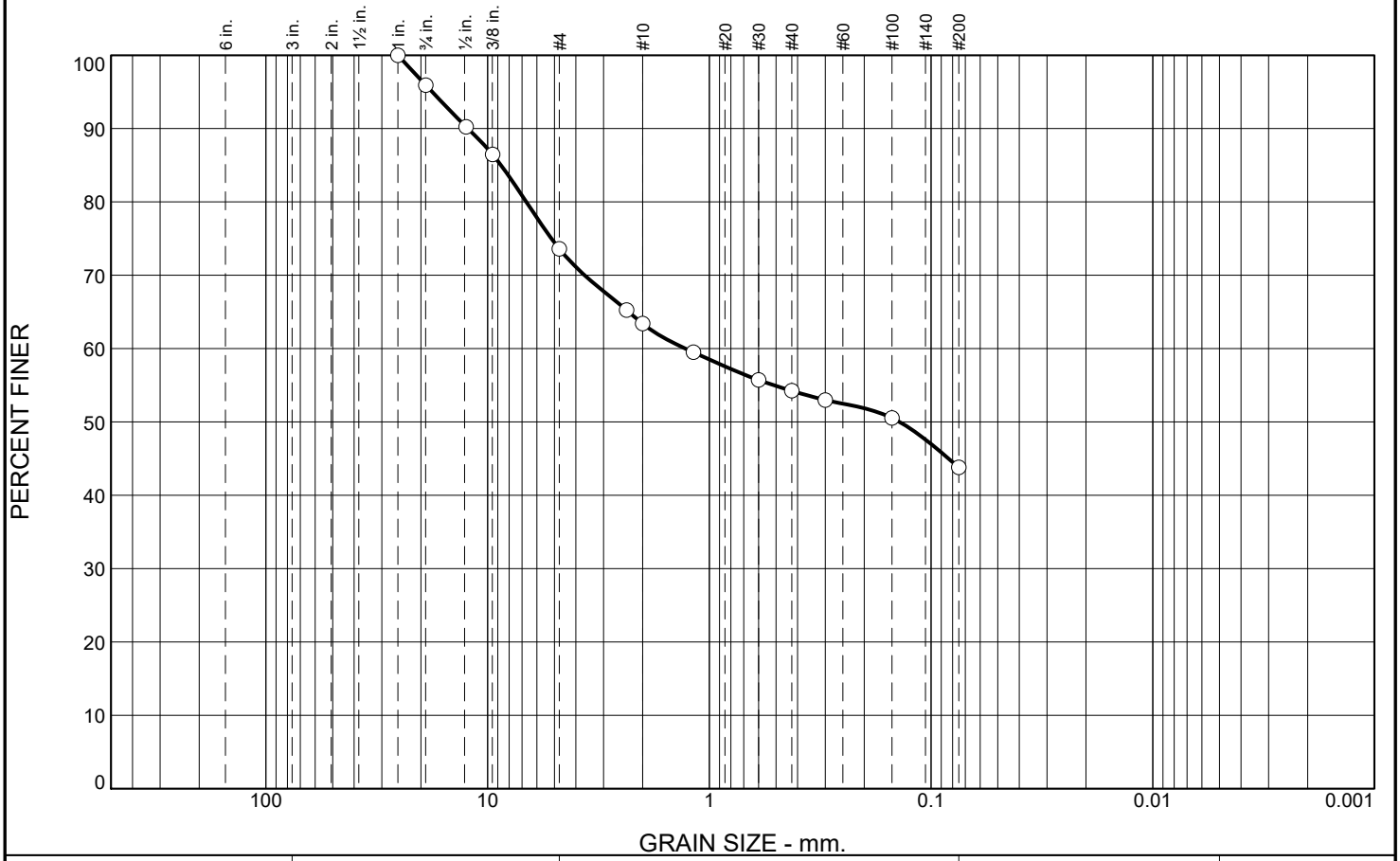
Date: 08/15/19

Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6b

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	26	30	44	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	96		
1/2"	90		
3/8"	86		
#4	74		
#8	65		
#10	63		
#16	59		
#30	56		
#40	54		
#50	53		
#100	51		
#200	44		

* (no specification provided)

Material Description

Clayey SAND with gravel

Atterberg Limits

PL= 17 LL= 46 PI= 29

Coefficients

D_{90}= 12.2761 D_{85}= 8.6972 D_{60}= 1.2830
D_{50}= 0.1389 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(8)

Remarks

Source of Sample: B-1 **Depth:** 80

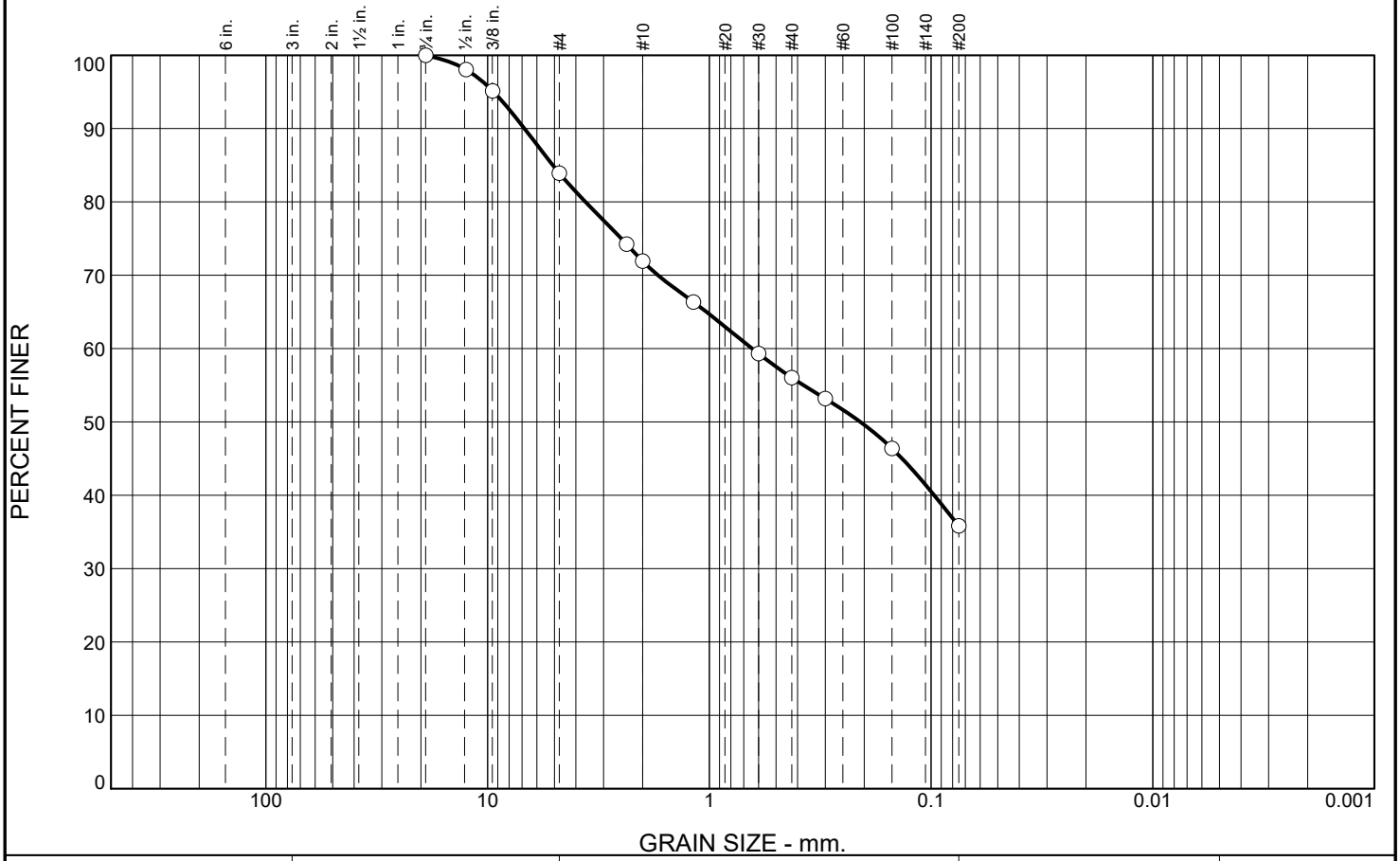
Date: 08/12/19

Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6c

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	16	48	36	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	98		
3/8"	95		
#4	84		
#8	74		
#10	72		
#16	66		
#30	59		
#40	56		
#50	53		
#100	46		
#200	36		

* (no specification provided)

Material Description

Clayey SAND with gravel

Atterberg Limits

PL= 20 LL= 40 PI= 20

Coefficients

D_{90}= 6.8187 D_{85}= 5.0797 D_{60}= 0.6403
D_{50}= 0.2084 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Source of Sample: B-2 **Depth:** 10 to 15 ft.

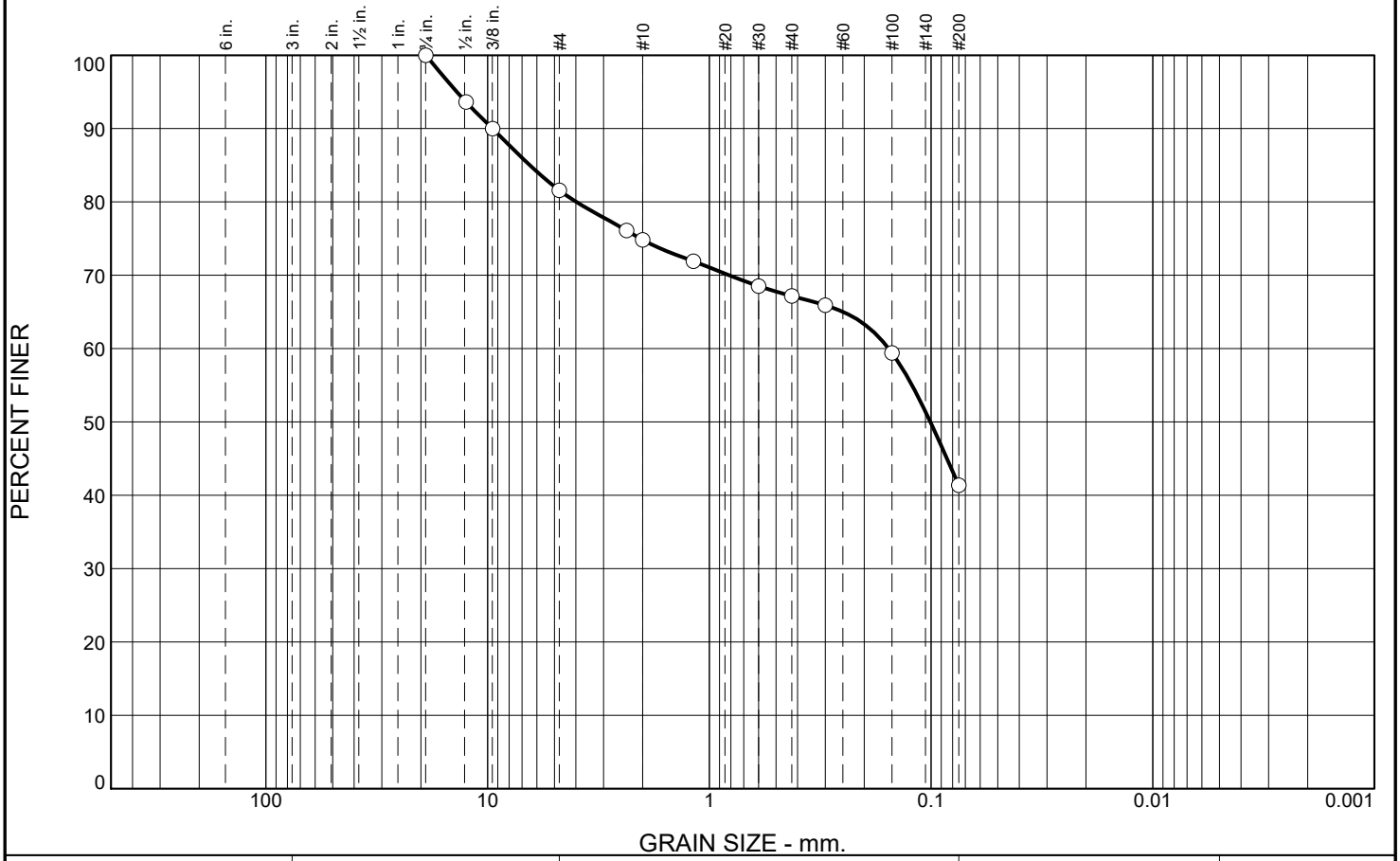
Date: 08/13/19

Nova Geotechnical and Inspection Services Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6d

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	18	41	41	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	94		
3/8"	90		
#4	82		
#8	76		
#10	75		
#16	72		
#30	69		
#40	67		
#50	66		
#100	59		
#200	41		

* (no specification provided)

Material Description

Clayey SAND with gravel

Atterberg Limits

PL= 17 LL= 31 PI= 14

Coefficients

D_{90}= 9.5096 D_{85}= 6.4485 D_{60}= 0.1552
D_{50}= 0.1007 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Source of Sample: B-2 **Depth:** 65

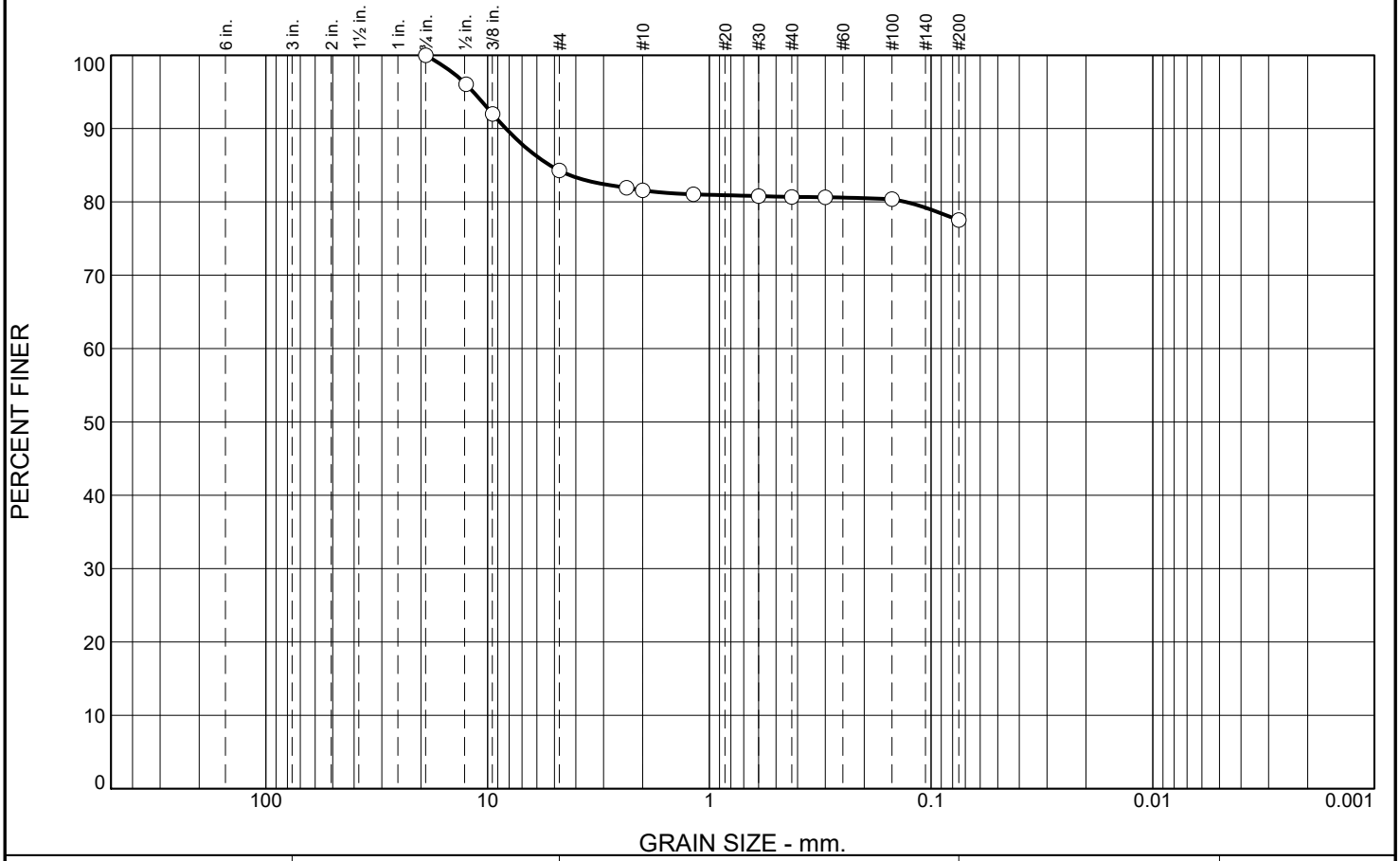
Date: 08/15/19

Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6e

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	16	6	78	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	96		
3/8"	92		
#4	84		
#8	82		
#10	82		
#16	81		
#30	81		
#40	81		
#50	81		
#100	80		
#200	78		

* (no specification provided)

Material Description

Lean CLAY with gravel

Atterberg Limits

PL= 22 LL= 47 PI= 25

Coefficients

D_{90}= 8.2746 D_{85}= 5.2443 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(20)

Remarks

Source of Sample: B-2 **Depth:** 105

Date: 08/15/19

Nova Geotechnical and Inspection Services Las Vegas, Nevada

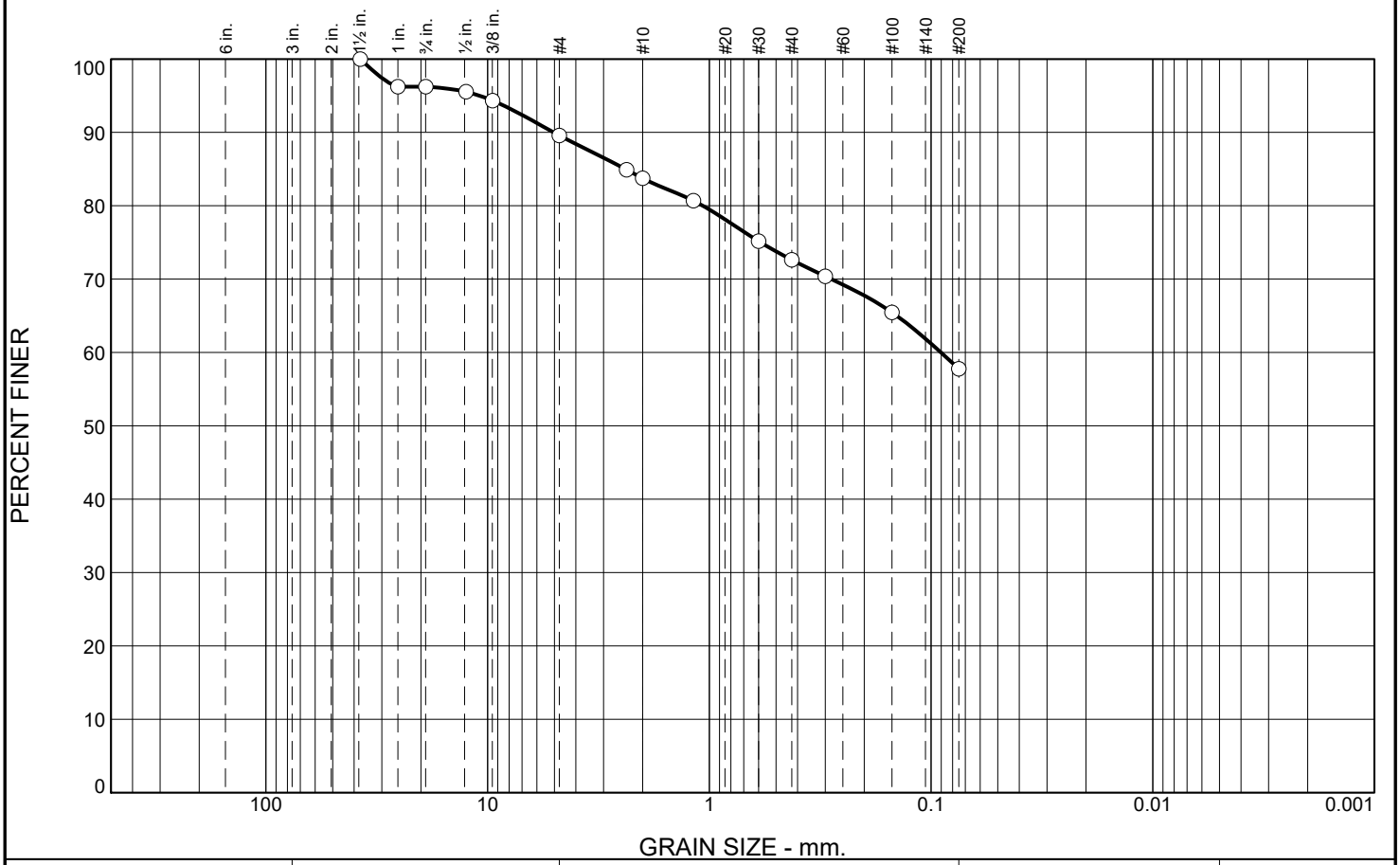
Client: GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

Project No: G-19-067 **Plate** 6f

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	10	32	58	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100		
1"	96		
3/4"	96		
1/2"	96		
3/8"	94		
#4	90		
#8	85		
#10	84		
#16	81		
#30	75		
#40	73		
#50	70		
#100	65		
#200	58		

* (no specification provided)

Material Description

Sandy lean CLAY

Atterberg Limits

PL= 19 LL= 45 PI= 26

Coefficients

D_{90}= 5.0405 D_{85}= 2.3891 D_{60}= 0.0903
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(12)

Remarks

Source of Sample: B-3 **Depth:** 10 to 13 ft.

Date: 08/15/19

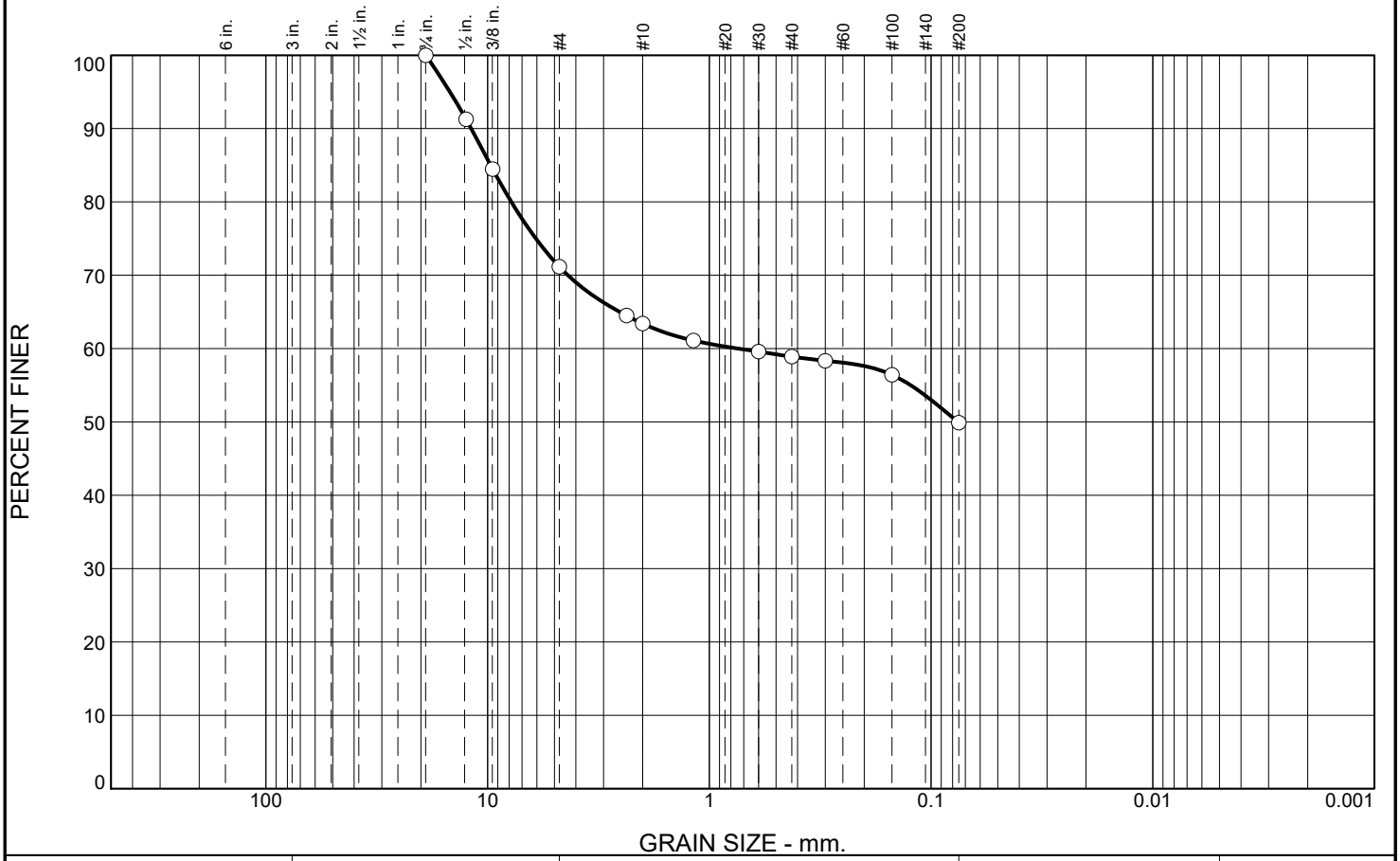
Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

Project No: G-19-067 **Plate** 6g

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	29	21	50	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	91		
3/8"	84		
#4	71		
#8	65		
#10	63		
#16	61		
#30	60		
#40	59		
#50	58		
#100	56		
#200	50		

* (no specification provided)

Material Description

Gravelly fat CLAY with sand

Atterberg Limits

PL= 22 LL= 62 PI= 40

Coefficients

D_{90}= 11.8559 D_{85}= 9.7031 D_{60}= 0.7414
D_{50}= 0.0757 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(15)

Remarks

Source of Sample: B-3 **Depth:** 40

Date: 08/15/19

Nova Geotechnical and Inspection Services Las Vegas, Nevada

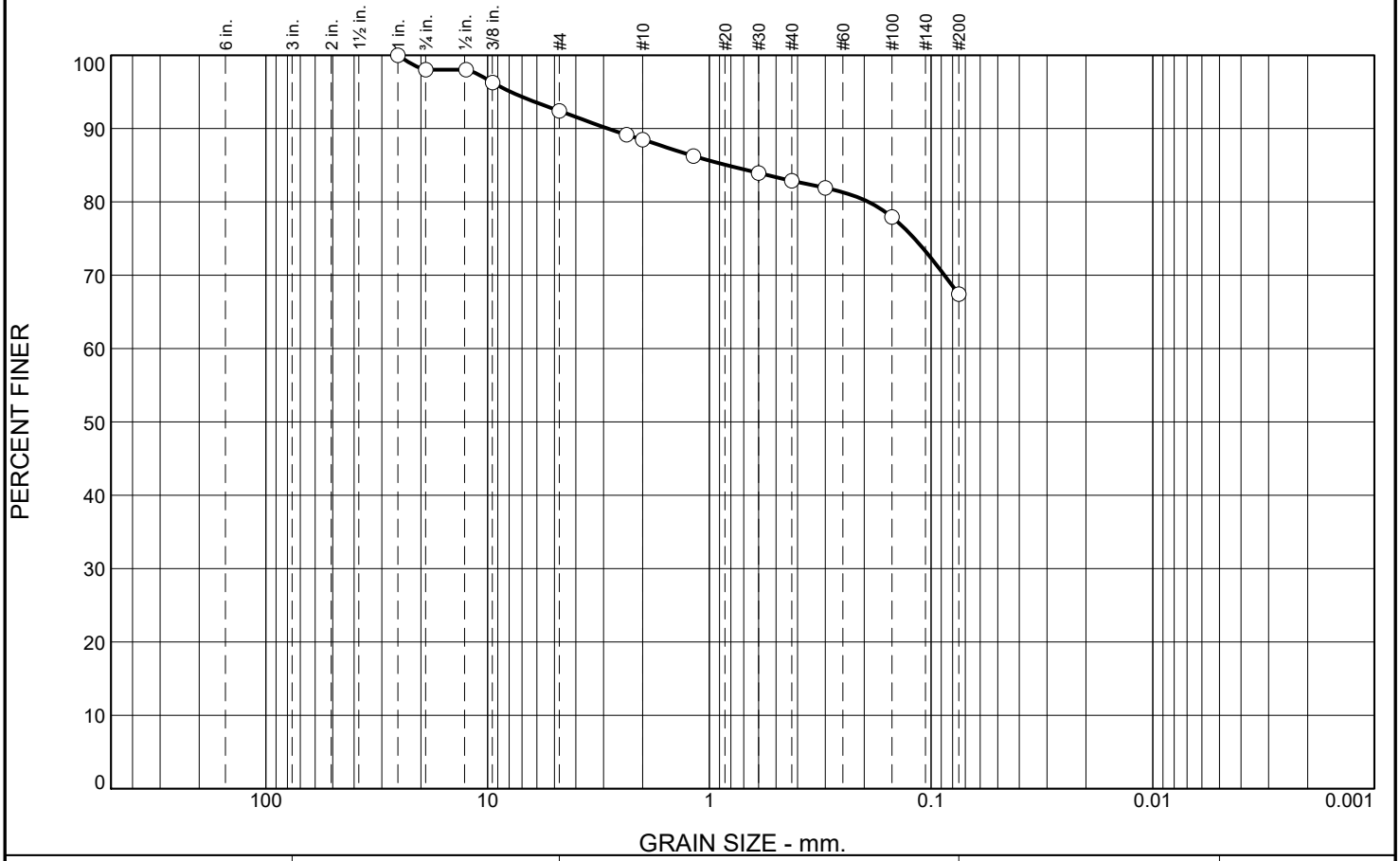
Client: GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

Project No: G-19-067 **Plate** 6h

Tested By: DP **Checked By:** JS

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0	8	25	67	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	98		
1/2"	98		
3/8"	96		
#4	92		
#8	89		
#10	88		
#16	86		
#30	84		
#40	83		
#50	82		
#100	78		
#200	67		

* (no specification provided)

Material Description

Sandy fat CLAY

Atterberg Limits

PL= 26 LL= 72 PI= 46

Coefficients

D_{90}= 2.8664 D_{85}= 0.8331 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(30)

Remarks

Source of Sample: B-3 **Depth:** 70

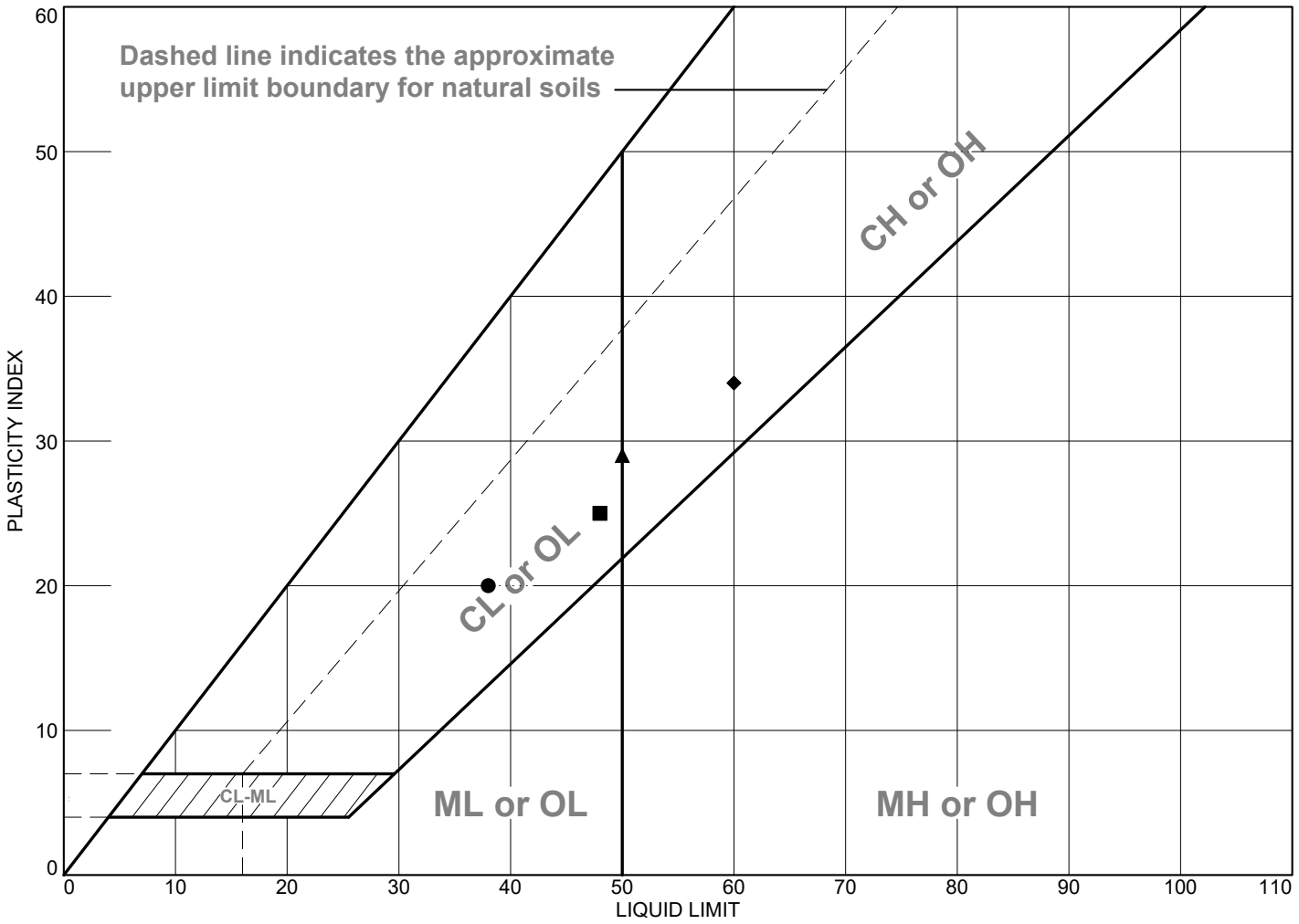
Date: 08/15/19

Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Client: GCW
Project: LONE MOUNTAIN ROAD BRIDGE WIDENING
Project No: G-19-067 **Plate** 6i

Tested By: DP **Checked By:** JS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey SAND with gravel	38	18	20	51	33	SC
■	Clayey SAND with gravel	48	23	25		27	
▲	Clayey SAND with gravel	50	21	29		38	
◆	Sandy fat CLAY	60	26	34		51	

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-1 **Depth:** 10 to 14 ft.
■ **Source of Sample:** B-1 **Depth:** 20
▲ **Source of Sample:** B-1 **Depth:** 25
◆ **Source of Sample:** B-1 **Depth:** 35

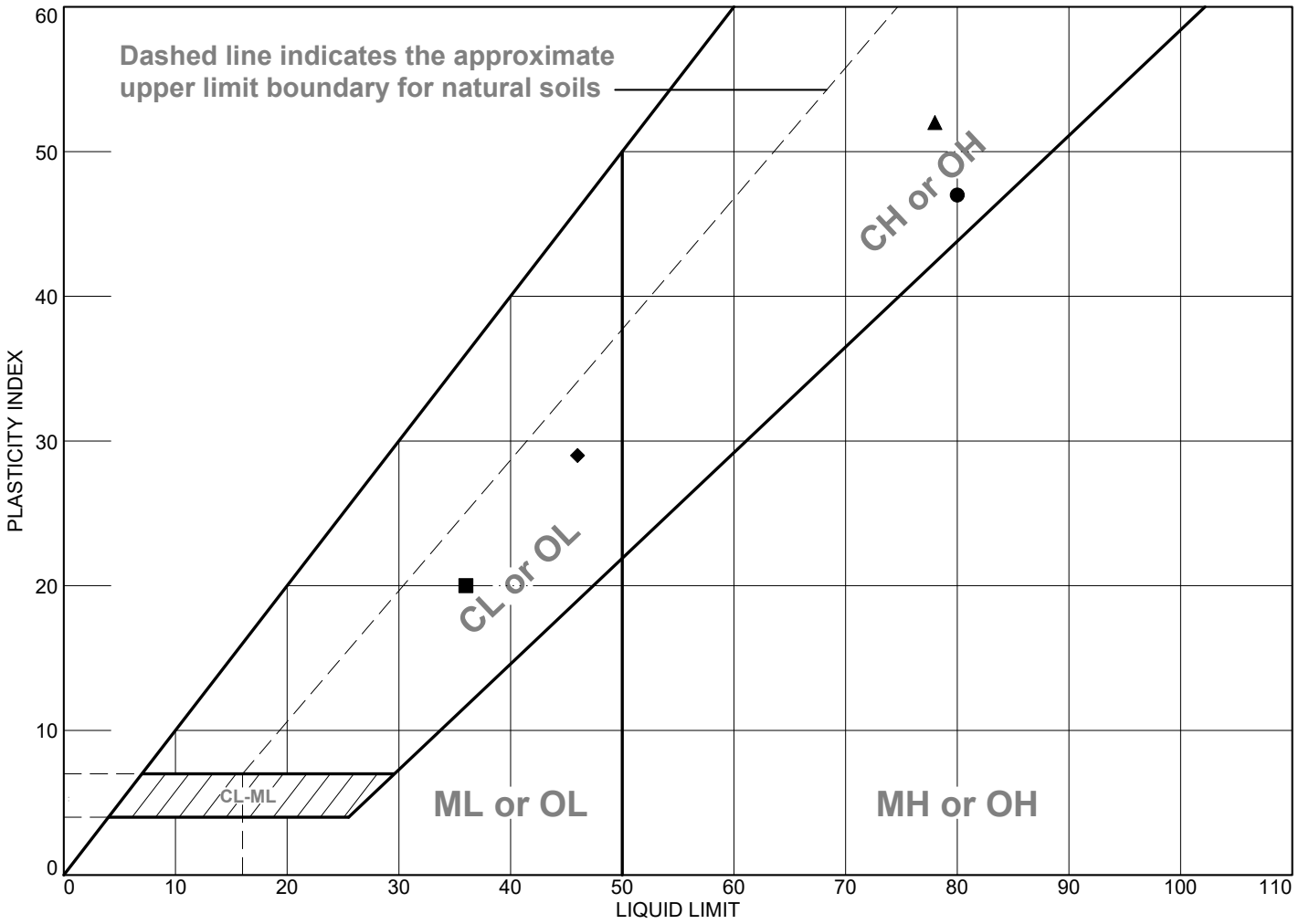
Remarks:

Nova Geotechnical and Inspection Services Las Vegas, Nevada

Plate 7a

Tested By: _____ **Checked By:** _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey SAND	80	33	47		28	
■	Lean CLAY with sand	36	16	20		84	
▲	Sandy fat CLAY	78	26	52	77	57	CH
◆	Clayey SAND with gravel	46	17	29	54	44	SC

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-1 **Depth:** 45
■ **Source of Sample:** B-1 **Depth:** 55
▲ **Source of Sample:** B-1 **Depth:** 70
◆ **Source of Sample:** B-1 **Depth:** 80

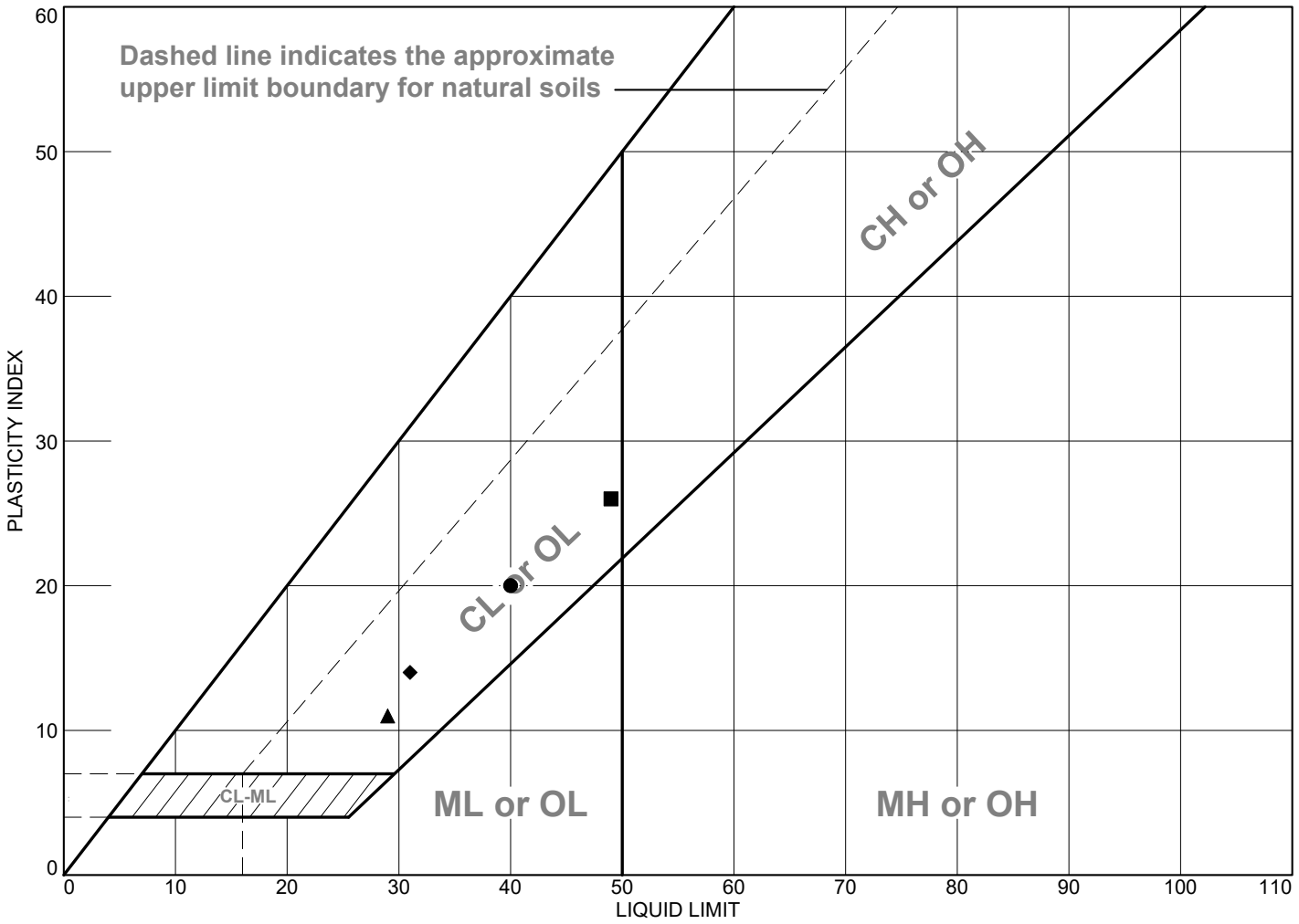
Remarks:

Nova Geotechnical and Inspection Services Las Vegas, Nevada

Plate 7b

Tested By: _____ **Checked By:** _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey SAND with gravel	40	20	20	56	36	SC
■	Clayey SAND	49	23	26		38	
▲	Sandy lean CLAY	29	18	11		60	
◆	Clayey SAND with gravel	31	17	14	67	41	SC

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-2 **Depth:** 10 to 15 ft.
■ **Source of Sample:** B-2 **Depth:** 20
▲ **Source of Sample:** B-2 **Depth:** 55
◆ **Source of Sample:** B-2 **Depth:** 65

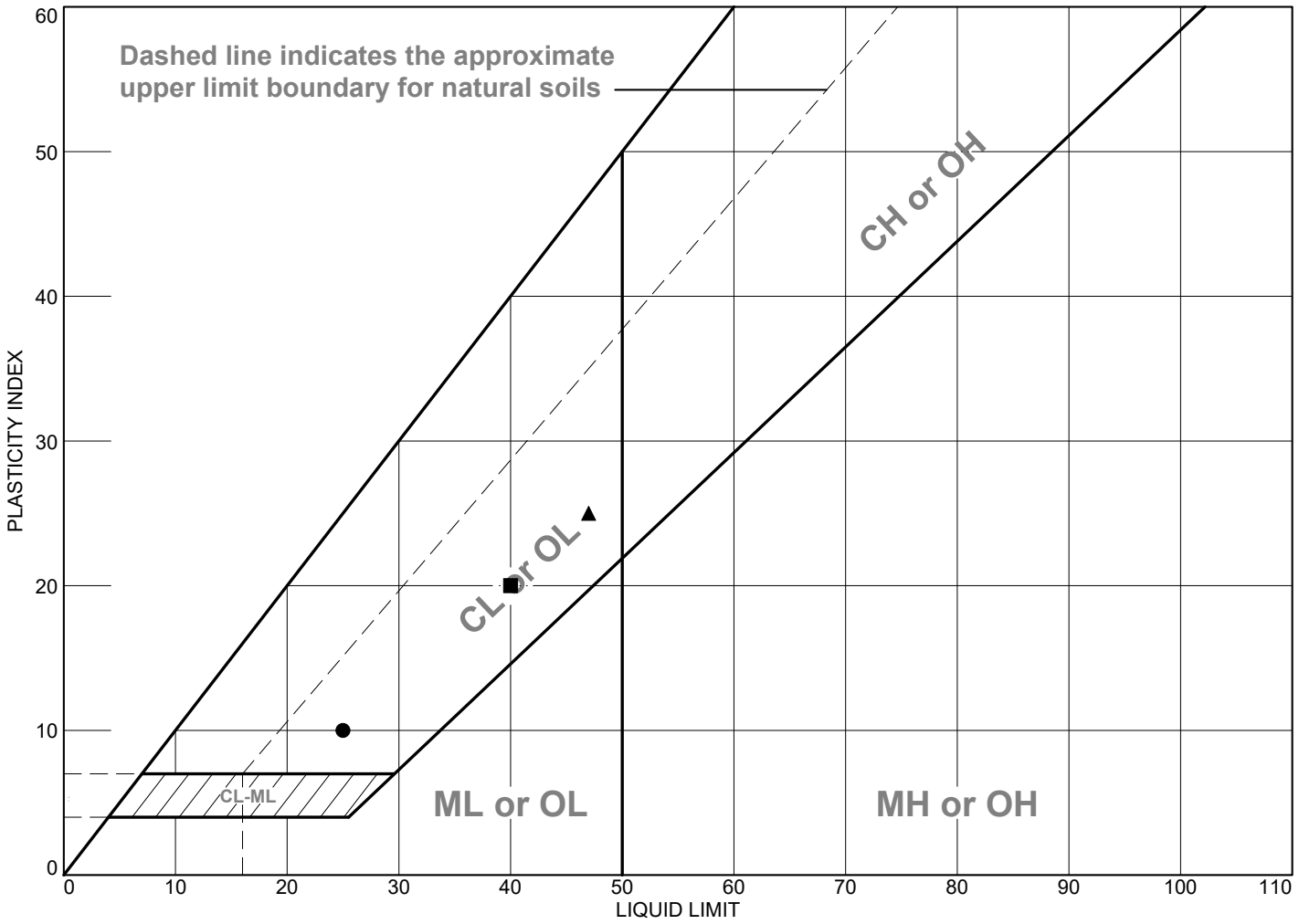
Nova Geotechnical and Inspection Services
Las Vegas, Nevada

Remarks:

Plate 7c

Tested By: _____ **Checked By:** _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey SAND	25	15	10		46	
■	Sandy lean CLAY	40	20	20		61	
▲	Lean CLAY with gravel	47	22	25	81	78	CL

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-2 **Depth:** 75

■ **Source of Sample:** B-2 **Depth:** 95

▲ **Source of Sample:** B-2 **Depth:** 105

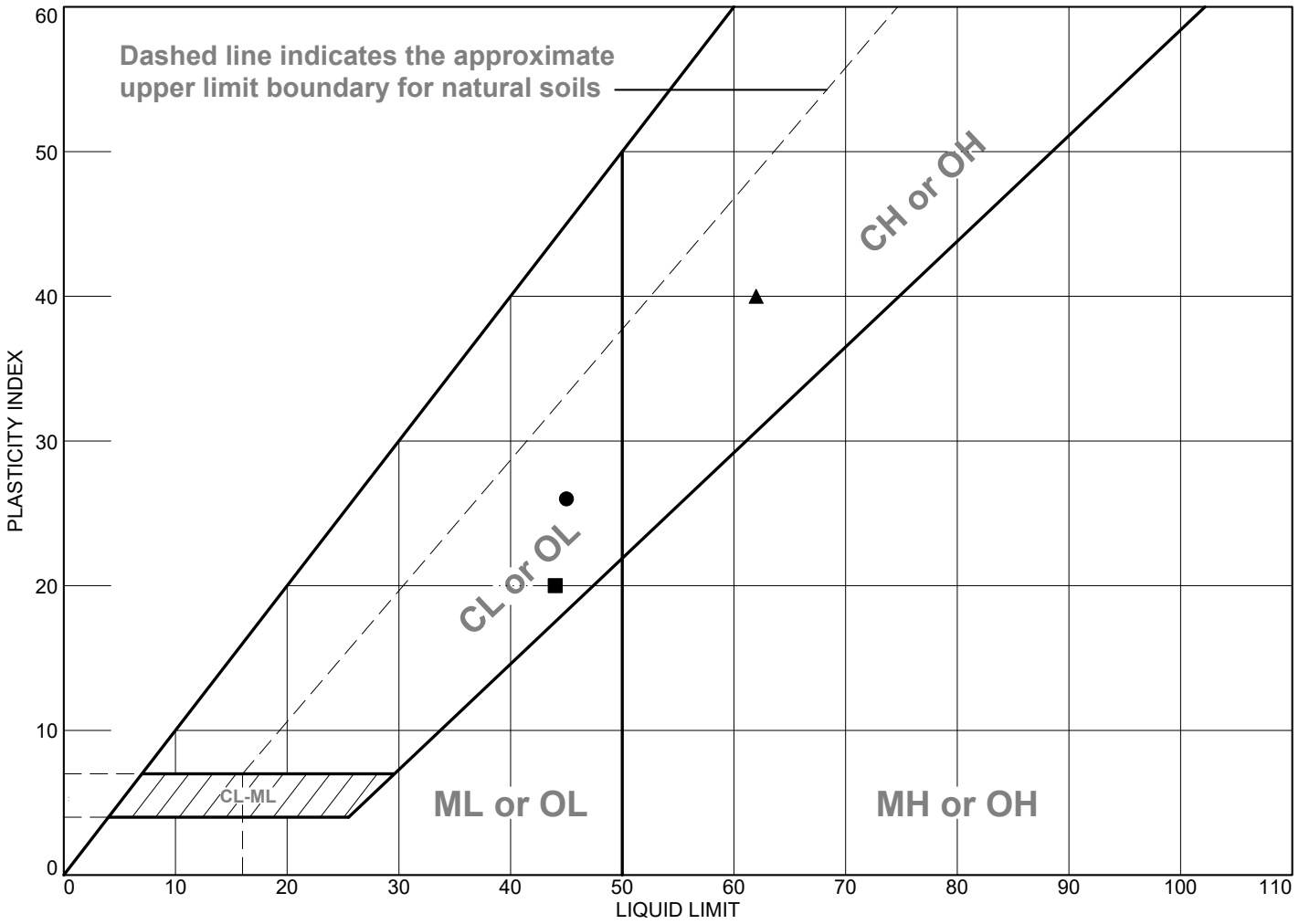
Remarks:

Nova Geotechnical
and Inspection Services
Las Vegas, Nevada

Plate 7d

Tested By: _____ **Checked By:** _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy lean CLAY	45	19	26	73	58	CL
■	Clayey GRAVEL with sand	44	24	20		22	
▲	Gravelly fat CLAY with sand	62	22	40	59	50	CH

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-3 **Depth:** 10 to 13 ft.

■ **Source of Sample:** B-3 **Depth:** 20

▲ **Source of Sample:** B-3 **Depth:** 40

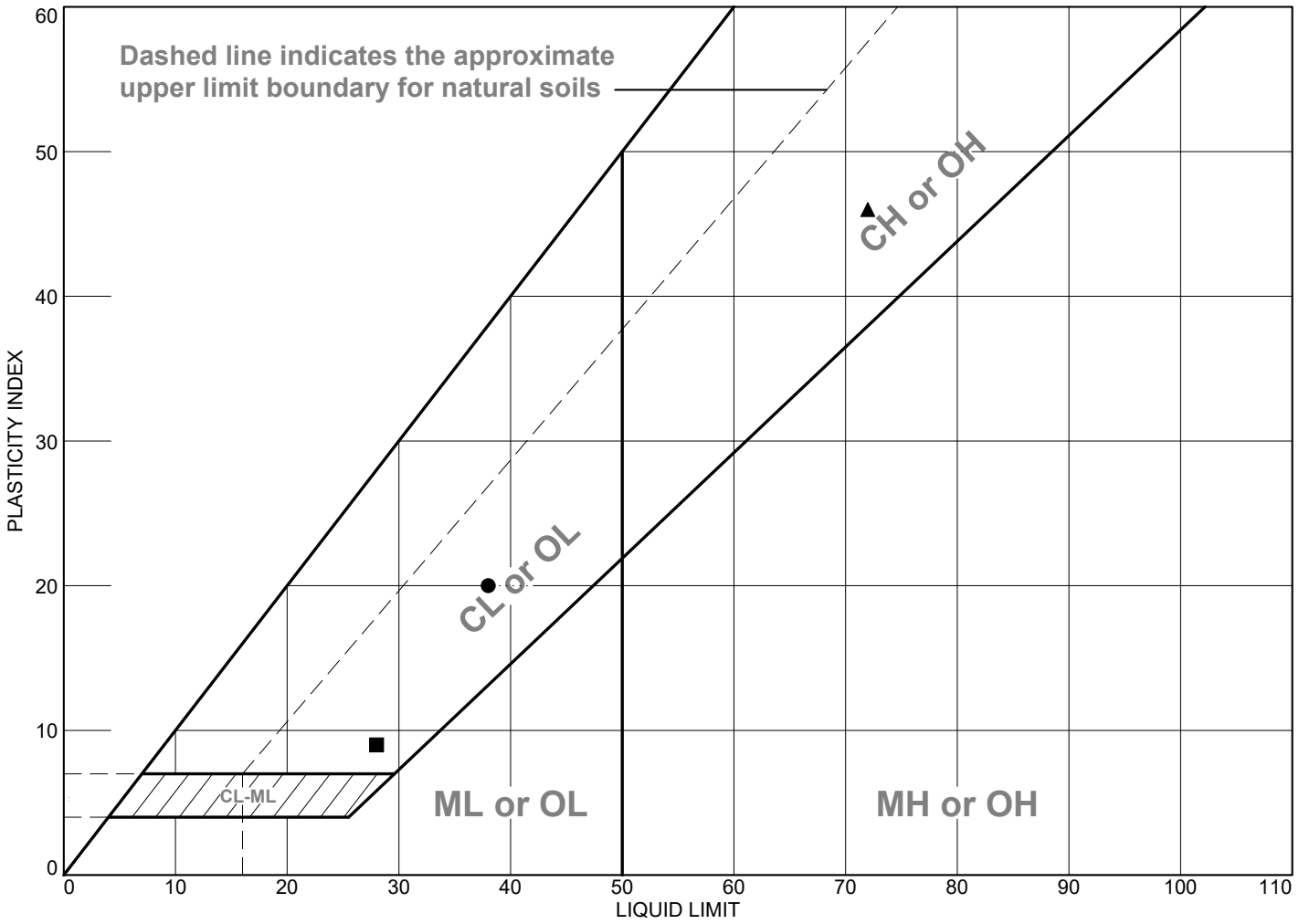
Remarks:

Nova Geotechnical and Inspection Services Las Vegas, Nevada

Plate 7e

Tested By: _____ **Checked By:** _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean CLAY with sand	38	18	20		80	
■	Clayey SAND	28	19	9		43	
▲	Sandy fat CLAY	72	26	46	83	67	CH

Project No. G-19-067 **Client:** GCW

Project: LONE MOUNTAIN ROAD BRIDGE WIDENING

● **Source of Sample:** B-3 **Depth:** 55

■ **Source of Sample:** B-3 **Depth:** 60

▲ **Source of Sample:** B-3 **Depth:** 70

Remarks:

Nova Geotechnical
and Inspection Services
Las Vegas, Nevada

Plate 7f

Tested By: _____ **Checked By:** _____

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: **19080193**
Date Reported: **8/9/2019**

CLIENT: Nova Geotechnical
Project: G19-067
Lab ID: 19080193-01
Client Sample ID: B1 @ 10-14'
Collection Date:
Matrix: SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT CHLORIDE - SOILS			**SM 4500CL B**			Analyst: **SBK**
Chloride	ND	50		mg/Kg	5	8/6/2019 1:45:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SODIUM SULFATES - CALCULATION 0NLY.			**CALCULATION**			Analyst: **SBK**
Sodium Sulfate as Na2SO4	0.0210	0		%	1	8/6/2019 3:42:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT PH - SOILS			**SM 4500H**			Analyst: **OE**
pH	8.00	0		pH Units	1	8/6/2019 4:08:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT REDUCTION - OXIDATION POTENTIAL - SOILS			**SM 2580 B**			Analyst: **SBK**
Oxidation-Reduction Potential	507	1.00		mV	1	8/8/2019 11:11:00 AM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT RESISTIVITY BY NDOT METHOD T235B			**NDOT T235 B**			Analyst: **OE**
Resistivity	540	0		Ohms-cm	1	8/7/2019 3:40:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SULFATE (SO4)			**SM 4500 SO4 E**			Analyst: **SBK**
Sulfate	0.130	0.0100		%	1	8/6/2019 1:43:41 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SODIUM (NA)			**ASTM D2791**			Analyst: **SBK**
Sodium	0.0100	0.0100		%	1	8/6/2019 1:46:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SULFIDE - SOILS			**SM 4500S2 F**			Analyst: **SBK**
Sulfide	ND	1.00		mg/L	1	8/8/2019 11:27:00 AM

Qualifiers: (Qual)

DF	Dilution Factor.
MCL	Maximum Contaminant Level.
PQL	Practical Quantitation Limit.
H	Holding times for preparation or analysis exceeded.
ND	Not Detected at the PQL.

Original

Plate 8a

Silver State Labs-Las Vegas
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Analytical Report

WO#: **19080193**
Date Reported: **8/9/2019**

CLIENT: Nova Geotechnical
Project: G19-067
Lab ID: 19080193-02
Client Sample ID: B2 @ 10-15'
Collection Date:
Matrix: SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT CHLORIDE - SOILS			**SM 4500CL B**			Analyst: **SBK**
Chloride	190	50		mg/Kg	5	8/6/2019 1:45:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SODIUM SULFATES - CALCULATION 0NLY.			**CALCULATION**			Analyst: **SBK**
Sodium Sulfate as Na2SO4	0.0440	0		%	1	8/6/2019 3:42:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT PH - SOILS			**SM 4500H**			Analyst: **OE**
pH	8.19	0		pH Units	1	8/6/2019 4:08:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT REDUCTION - OXIDATION POTENTIAL - SOILS			**SM 2580 B**			Analyst: **SBK**
Oxidation-Reduction Potential	507	1.00		mV	1	8/8/2019 11:11:00 AM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT RESISTIVITY BY NDOT METHOD T235B			**NDOT T235 B**			Analyst: **OE**
Resistivity	526	0		Ohms-cm	1	8/7/2019 3:40:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SULFATE (SO4)			**SM 4500 SO4 E**			Analyst: **SBK**
Sulfate	0.0900	0.0100		%	1	8/6/2019 1:43:41 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SODIUM (NA)			**ASTM D2791**			Analyst: **SBK**
Sodium	0.0100	0.0100		%	1	8/6/2019 1:46:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SULFIDE - SOILS			**SM 4500S2 F**			Analyst: **SBK**
Sulfide	ND	1.00		mg/L	1	8/8/2019 11:27:00 AM

Qualifiers: (Qual)

DF	Dilution Factor.
MCL	Maximum Contaminant Level.
PQL	Practical Quantitation Limit.
H	Holding times for preparation or analysis exceeded.
ND	Not Detected at the PQL.

Original

Plate 8b

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Analytical Report

WO#: **19080193**
Date Reported: **8/9/2019**

CLIENT: Nova Geotechnical
Project: G19-067
Lab ID: 19080193-03
Client Sample ID: B3 @ 10-13'
Collection Date:
Matrix: SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT CHLORIDE - SOILS			**SM 4500CL B**			Analyst: **SBK**
Chloride	52	50		mg/Kg	5	8/6/2019 1:45:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SODIUM SULFATES - CALCULATION 0NLY.			**CALCULATION**			Analyst: **SBK**
Sodium Sulfate as Na2SO4	0.00900	0		%	1	8/6/2019 3:42:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT PH - SOILS			**SM 4500H**			Analyst: **OE**
pH	8.00	0		pH Units	1	8/6/2019 4:08:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT REDUCTION - OXIDATION POTENTIAL - SOILS			**SM 2580 B**			Analyst: **SBK**
Oxidation-Reduction Potential	500	1.00		mV	1	8/8/2019 11:11:00 AM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT RESISTIVITY BY NDOT METHOD T235B			**NDOT T235 B**			Analyst: **OE**
Resistivity	567	0		Ohms-cm	1	8/7/2019 3:40:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SULFATE (SO4)			**SM 4500 SO4 E**			Analyst: **SBK**
Sulfate	0.260	0.0100		%	1	8/6/2019 1:43:41 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT WATER SOLUBLE SODIUM (NA)			**ASTM D2791**			Analyst: **SBK**
Sodium	ND	0.0100		%	1	8/6/2019 1:46:00 PM
SOILS-CORROSION SUITE W/ RESISTIVITY-NDOT SULFIDE - SOILS			**SM 4500S2 F**			Analyst: **SBK**
Sulfide	ND	1.00		mg/L	1	8/8/2019 11:27:00 AM

Qualifiers: (Qual)

DF	Dilution Factor.
MCL	Maximum Contaminant Level.
PQL	Practical Quantitation Limit.
H	Holding times for preparation or analysis exceeded.
ND	Not Detected at the PQL.

Original

Plate 8c

APPENDIX B

APPENDIX B

Site Class Determination

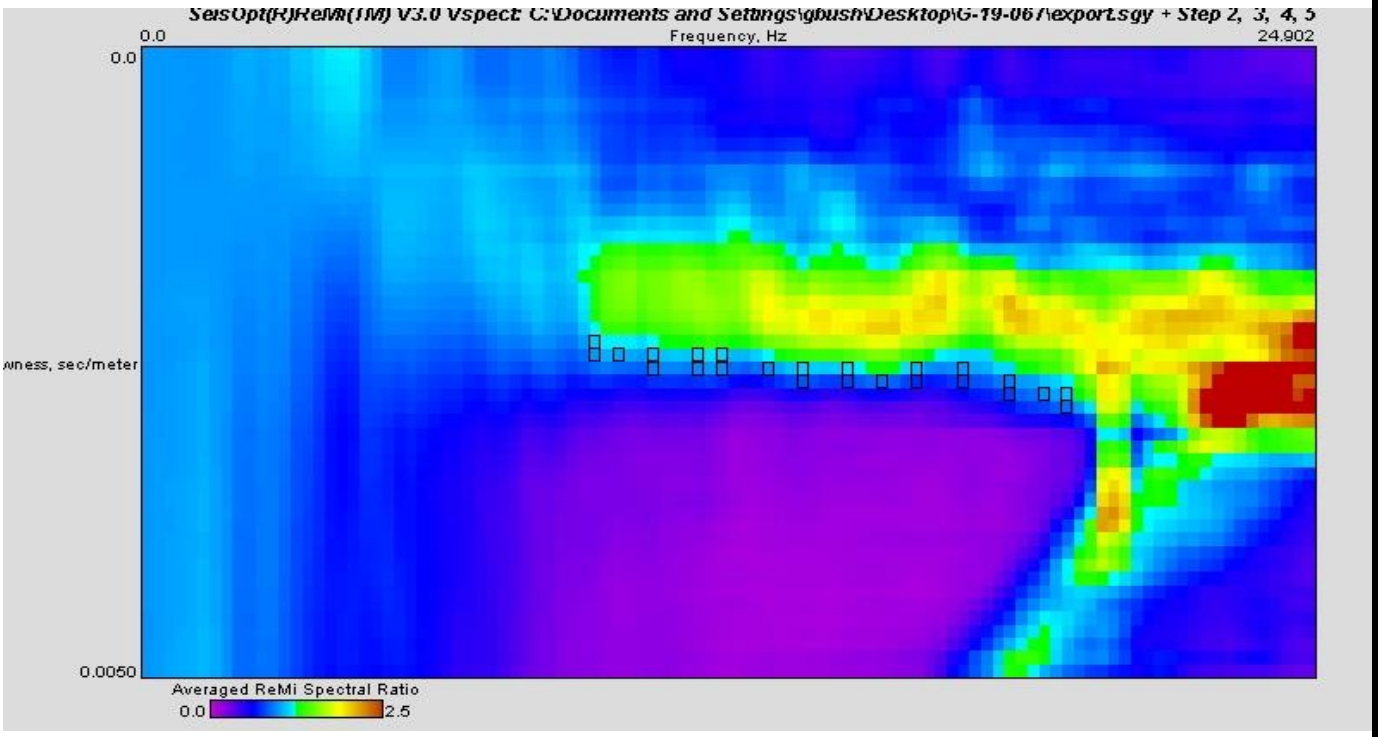
Measurement of surface waves with a geophone array was performed on August 2, 2019 using a DAQLINK4 seismograph and standard P-wave geophones. Ambient noise/refraction microtremor data was recorded on 12 channels at a 2-millisecond sampling rate for 30-second sampling periods.

The approximate location of the geophone array is shown on Figure No. 2, Site Map. The location of the array was determined in the field by approximating distances from existing features or improvements. The location of the array should be accurate only to the degree implied by the method used.

A one-dimensional shear wave velocity profile and average shear wave velocity to a depth of 100 feet (30 meters) were determined using Optim Software's SeisOpt® ReMi™v3.0 software. A p-f image is produced by the software for the data gathered at the array and the normal-mode dispersion trend is identified. The p-f image generated by the software, with dispersion modeling picks, is shown on Plate 1, p-f Image. The dispersion picks developed from the p-f image are then used to establish a calculated dispersion curve and develop a shear wave velocity model for the site. The picks and calculated dispersion curve fit are shown on Plate 2, Dispersion Curve. The shear wave velocity profile for the site is presented on Plate 3, Shear Wave Velocity Profile.

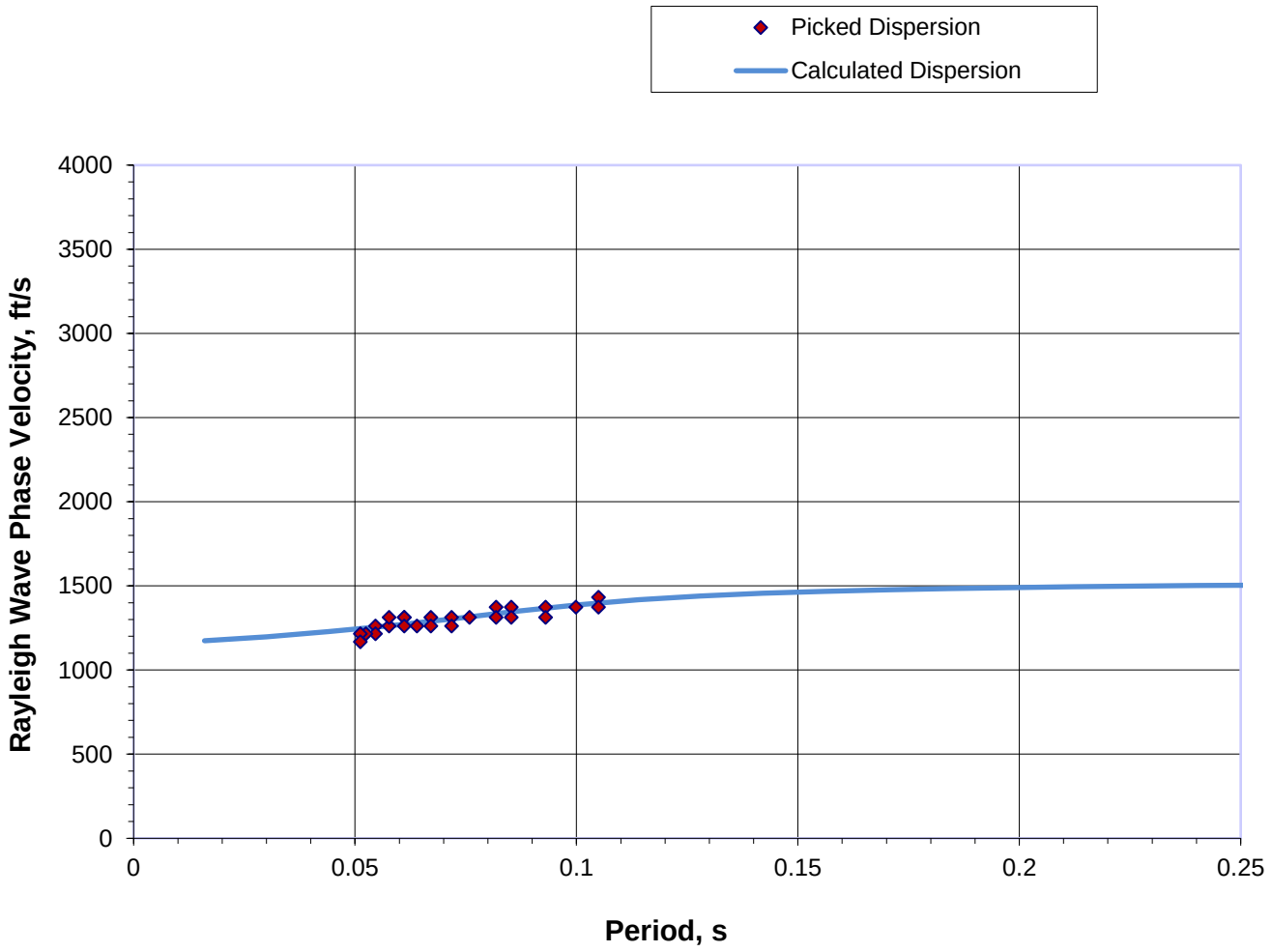
The average calculated shear wave velocity for a 100-foot depth (Vs30) at this site is 1,483 feet/second. In accordance with ASCE Standard 7, a Site Class C is appropriate for this site.

p-f Image with Dispersion Picks



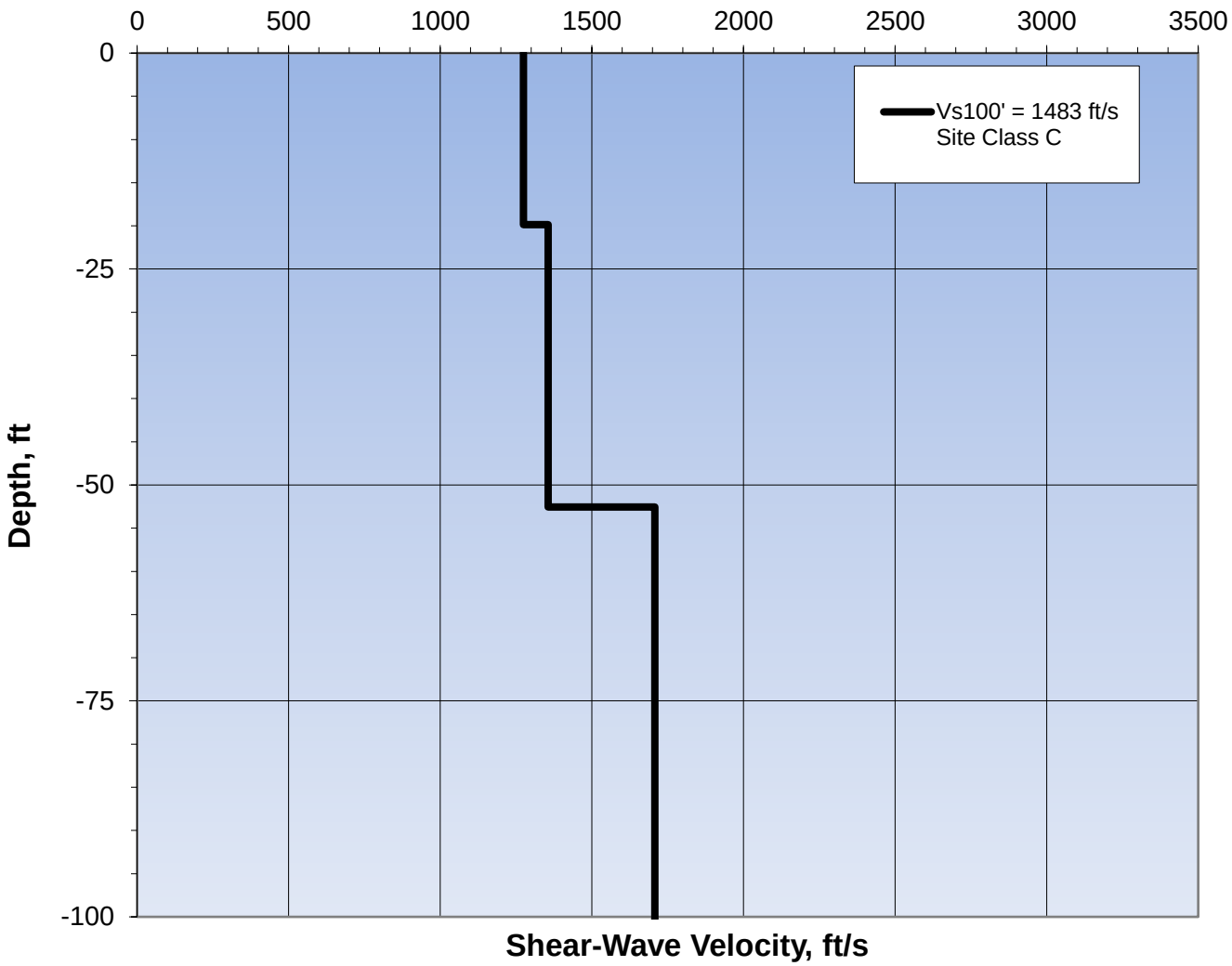
NOVA GEOTECHNICAL AND INSPECTION SERVICES	**CLIENT:** GCW	**p-f IMAGE**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 1

Dispersion Curve Showing Picks and Fit



NOVA GEOTECHNICAL AND INPECTION SERVICES	**CLIENT:** GCW	**DISPERSION CURVE**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 2

Shear-Wave Velocity Profile



NOVA GEOTECNICAL AND INSPECTION SERVICES	**CLIENT:** GCW	**SHEAR-WAVE VELOCITY PROFILE**	
	PROJECT: Lone Mountain Bridge Widening	PROJECT NO.: G-19-067	PLATE NO. 3

APPENDIX C

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Wall Parameters:

Start Station	End Station	L_i (ft)	H_i (ft)	L_i x H_i (ft^2)	B_i (ft)	L_i x B_i (ft^2)
13+87	13+98	11.5	8	92	8	92
13+98	14+06	8	10	80	8	64
14+06	14+14	8	13	104	10.4	83.2
14+14	14+22	8	17	136	13.6	108.8
14+22	14+30	8	21	168	16.8	134.4
14+30	15+10	80	23	1840	18.4	1472
15+10	15+60	50	23	1150	18.4	920
15+60	16+26	66	23	1518	18.4	1214.4
16+26	16+83	57	21	1197	16.8	957.6
16+83	17+40	57	17	969	13.6	775.2
		ΣL_i = 353.5	ΣL_i x H_i = 7254		ΣL_i x B_i = 5821.6	

L	353.5	ft	$= \Sigma L_i$	total wall length
H_{avg}	20.5	ft	$= (\Sigma L_i \times H_i) / \Sigma L_i$	weighted average wall height
B_{avg}	16.5	ft	$= (\Sigma L_i \times B_i) / \Sigma L_i$	weighted average MSE strap length/CIP footing width
$\gamma_{backfill}$	0.130	kcf		total unit weight of MSE fill/CIP backfill
H_{above}	2	ft		height of soil above top of wall
$H_{surchage}$	2	ft	☑ Traffic above wall?	additional height of soil to account for traffic above wall
q_0	3.185	ksf	$= (H_{avg} + H_{above} + H_{surcharge}) \times \gamma_{backfill}$	average vertical pressure beneath wall

Foundation Soil Parameters:

γ	0.120	kcf	total unit weight of soil
ϕ	32	degrees	internal angle of friction of soil

General Ultimate Bearing Resistance Equation

q_n	$= cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B' N_{\gamma m} C_{w\gamma}$		Equation 10.6.3.1.2a-1 (Nominal Bearing Resistance, ksf)
c	= 0	ksf	Cohesion neglected for granular soil contitions
C_{wq}	= 1.0		per Table 10.6.3.1.2a-2, depth to groundwater >1.5B+D_f
$C_{w\gamma}$	= 1.0		

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

General Nominal Bearing Resistance Equation reduces to:

$q_n = \gamma D_f N_{qm} + 0.5\gamma B' N_{\gamma m}$

Bearing Capacity Factors

N_{qm}	$= N_q s_q d_q i_q$	Equation 10.6.3.1.2a-3 (Modified Surcharge Bearing Capacity Factor, dim)
$N_{\gamma m}$	$= N_\gamma s_\gamma i_\gamma$	Equation 10.6.3.1.2a-4 (Modified Unit Weight Bearing Capacity Factor, dim)
d_q	$= 1.0$	Depth Correction Factor taken as 1.0 per discusion beneath Table 10.6.3.1.2a-4
i_q	$= 1.0$	Load Inclination Factors neglected per Commentary Section C10.6.3.1.2a
i_γ	$= 1.0$	
s_q	$= 1 + (B'/L') \tan \phi$	Shape Correction Factors per Table 10.6.3.1.2a-3
s_γ	$= 1 - 0.4 (B'/L')$	

By substitution, General Nominal Bearing Resistance Equation further reduces to:

$q_n = \gamma D_f N_q [1+(B'/L') \tan\phi_f] + 0.5\gamma B' N_\gamma [1-0.4(B'/L')]$

B'/L' 0.05 approximated as B_{avg}/L from above

s_q	1.031
s_γ	0.980

Bearing Capacity Factors from ASSHTO LRFD Bridge Design Specifications Table 10.6.3.1.2a-1

N_q	23.2
N_γ	30.2

General Ultimate Bearing Capacity Equation for MSE Walls/CIP Wall Footings

$q_n = 1.78\ B + 2.87\ D_f$ in ksf

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Settlement of Wall During Construction

$S_t = S_e+S_c+S_s$ — Equation 10.6.2.4.1-1 (Total Settlement, ft)

$$S_e = \frac{\left[q_0\left(1-\nu^2\right)\sqrt{A'}\right]}{144 E_s \beta_z}$$ — Equation 10.6.2.4.2-1 (Elastic Settlement, ft)

$S_c = 0$ — Consolidation Settlement is not applicable for this soil type

$S_s = 0$ — Secondary Settlement is not applicable for this soil type

A = 5832.75 ft^2 = area of footing

β_z = 1.41 — from Table 10.6.2.4.2-1 for L/B > 10

Elastic Constants for upper end of "medium dense sand" per Table C10.4.6.3-1

ν = 0.38 = Poisson's ratio

E_s = 6.94 ksi = Young's modulus

Wall Settlement

$S_t = S_e$ = 0.148 ft x (12 in/ft) = 1.78 in — estimated average settlement

H_{min}/H_{avg} = 39% — ratio of minimum wall height to average wall height

S_{min} = 0.69 in = S_t x H_{min}/H_{avg} — estimated settlement for the shortest portion of the wall

H_{max}/H_{avg} = 112% — ratio of maximum wall height to average wall height

S_{min} = 1.99 in = S_t x H_{max}/H_{avg} — estimated settlement for the tallest portion of the wall

---

External Stability Analysis

For maximum wall height

Loading

$F_1 = (1/2)*\gamma_f*H^2*k_{af}$ — Active earth pressure from backfill soil

$$k_{af} = \frac{\sin^2(\theta+\phi'_f)}{\Gamma[\sin^2\theta\sin(\theta-\delta)]}$$ — Equation 3.11.5.3-1

$$\Gamma = \left[1+\sqrt{\frac{\sin(\phi'_f+\delta)\sin(\phi'_f-\beta)}{\sin(\theta-\delta)\sin(\theta+\beta)}}\right]^2$$ — Equation 3.11.5.3-2

Loading (cont.)

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

ϕ'_f	34	degrees	internal angle of friction of backfill soil
γ_f	0.125	kcf	unit weight of backfill soil
θ	90	degrees	angle of wall back face of wall from horizontal
β	0	degrees	angle of backfill slope from horizontal
δ	0	degrees	friction angle between fill and wall (equals β per 11.10.5.2)
Γ	2.43	dim	
k_{af}	0.283	dim	active earth pressure coefficient
H_{max}	23.0	ft	Maximum wall height
F_1	9.36	klf	
F_2	$= q*H*k_{af}$		Active earth pressure from traffic surcharge
q	0.250	ksf	Traffic surcharge load eaqual to 2 feet of backfill soil
F_2	1.63	klf	
V_1	$= \gamma_r*H*L$		Weight of the reinforced soil mass (for this analysis, L=B from bearing capacity and settlement analysis above)
L_{max}	18.4	ft	Maximum strap length associated with maximum wall height above
V_1	55.0	klf	

Sliding

R_R	$= \phi_\tau R_\tau + \phi_{ep} R_{ep}$		Equation 10.6.3.4-1 (Factored Resistance)
R_{ep}	$= 0$	klf	Passive resistance neglected
ϕ_τ	0.90	dim	Per Table 10.5.5.2.2-1 for soil on soil
R_τ	$= V \tan \phi$		Equation 10.6.3.4-2, modified for MSE walls (ϕ = minimum from foundation soils or reinforced soil mass)
R_τ	34.38	klf	Nominal sliding resistance
R_R	30.94	klf	Factored sliding resistance
$Q_{sliding}$	$=F_1 + F_2$		Total sliding force
$Q_{sliding}$	10.99	klf	

$R_R \geq Q_{sliding}$ → OK

Bearing Capacity

$q_n = 1.78\ B + 2.87\ D_f$ in ksf — from above

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

D_f	4	ft	
q_n	44.16	ksf	
q_R	$= \phi_b q_n$		Equation 10.6.3.1.1-1
ϕ_b	0.45		per Table 10.5.5.2.2-1
q_R	19.87		
q_{str}	$= V_1/L$		Bearing pressure
q_{str}	2.99	ksf	

$q_R \geq q_{str}$ → OK

Overturning (Eccentricity)

e	$= M/V_1$		Eccentricity measesured from centerlin of reinforced soil mass
M	$= F_1*H/3 + F_2*H/2$		Overturning moment
M	90.5	ft-klf	
e	1.64	ft	
e_{max}	$= L/3$		Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3
e_{max}	6.13	ft	

$e \leq e_{max}$ → OK

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Seismic Loading

P_{IR}	$= k_h*\gamma_r*H*H/2$		Inertial force cause by acceleration of reinforced soil per Figure 11.10.7.1-1
k_h	$= F_{pga}*PGA$		Seismic horizontal acceleration coeffiecient
PGA	0.15		per NDOT Structures Manual
F_{pga}	1.2		Per Table 3.10.3.2-1 for Site Class C and PGA = 0.15
k_h	0.18		
P_{IR}	6.19		
k_{AE}	$= \frac{\cos^2(\phi-\theta_{MO}-\beta)}{\cos\theta_{MO}\cos^2\beta\cos(\delta+\beta+\theta_{MO})} x \left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta_{MO}-i)}{\cos(\delta+\beta+\theta_{MO})\cos(i-\beta)}}\right]^{-2}$		Equation A11.3.1-1 (seismic active earth pressure coefficient)
ϕ	34	degrees	friction angle of retained soil
β	0	degrees	slope of wall to vertical
δ	0	degrees	wall backfill interface friction angle = friction angle of retained soil
ί	0	degrees	backfill slope angle
θ_{MO}	$= \tan^{-1}[k_h/(1-k_v)]$		
k_v	0		Per 11.6.5.2
θ_{MO}	10.2	degrees	
k_{AE}	0.395		
P_{AE}	$= (1/2)*\gamma_f*H^2*k_{ae}$		
P_{AE}	13.06	klf	
$P_{AE}+½P_{IR}$	16.16	klf	Combination 1
$½P_{AE}+P_{IR}$	12.72	klf	Combination 2

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Seismic Sliding

R_R	$= \phi_\tau R_\tau + \phi_{ep} R_{ep}$		Equation 10.6.3.4-1 (Factored Resistance)
R_{ep}	$= 0$	klf	Passive resistance neglected
ϕ_τ	1.00	dim	
R_τ	$= V \tan \phi$		Equation 10.6.3.4-2, modified for MSE walls (ϕ = minimum from foundation soils or reinforced soil mass)
R_τ	34.38	klf	Nominal sliding resistance
R_R	34.38	klf	Factored sliding resistance
$Q_{sliding}$	$= P_{AE} + \frac{1}{2}P_{IR} + F_2$		Total sliding force
$Q_{sliding}$	17.79	klf	

$R_R \geq Q_{sliding}$ → OK

Seismic Overturning (Eccentricity)

e	$= M/V_1$		Eccentricity measesured from centerlin of reinforced soil mass
M	$= P_{AE}*H/3 + \frac{1}{2}P_{IR}*H/2 + F_2*H/2$		Overturning moment
M	154.5	ft-klf	
e	2.81	ft	
e_{max}	$= L/3$		Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3
e_{max}	6.13	ft	

$e \leq e_{max}$ → OK

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

For minimum wall height

Loading

H_{min}	8.0	ft	Minimum wall height
F_1	1.13	klf	Active earth pressure from backfill soil
q	0.250	ksf	Traffic surcharge load eaqual to 2 feet of backfill soil
F_2	0.57	klf	Active earth pressure from traffic surcharge
L_{min}	8.0	ft	Minimum strap length associated with minimum wall height above
V_1	8.3	klf	Weight of the reinforced soil mass

Sliding

R_{ep}	= 0	klf	Passive resistance neglected
ϕ_τ	0.90	dim	Per Table 10.5.5.2.2-1 for soil on soil
R_τ	5.20	klf	
R_R	4.68	klf	Factored Resistance
$Q_{sliding}$	$=F_1 + F_2$		
$Q_{sliding}$	1.70	klf	Total sliding force

$R_R \geq Q_{sliding}$ → OK

Bearing Capacity

D_f	4	ft	
q_n	25.69	ksf	Nominal bearing resistance
ϕ_b	0.45		per Table 10.5.5.2.2-1
q_R	11.56		Factored bearing resistance
q_{str}	1.04	ksf	Bearing pressure

$q_R \geq q_{str}$ → OK

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Overturning (Eccentricity)

M	5.3	ft-klf	
e	0.64	ft	Eccentricity measesured from centerlin of reinforced soil mass
e_{max}	2.67	ft	Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3

$e \le e_{max}$ → OK

Seismic Loading

P_{IR}	0.75	klf	Inertial force cause by acceleration of reinforced soil per Figure 11.10.7.1-1
P_{AE}	1.58	klf	Seismic lateral earth pressure
$P_{AE}+½P_{IR}$	1.96	klf	Combination 1
$½P_{AE}+P_{IR}$	1.54	klf	Combination 2

Seismic Sliding

ϕ_τ	1.00	dim	
R_τ	5.20	klf	Nominal sliding resistance
R_R	5.20	klf	Factored sliding resistance
$Q_{sliding}$	2.53	klf	Total sliding force

$R_R \ge Q_{sliding}$ → OK

Seismic Overturning (Eccentricity)

M	8.0	ft-klf	Overturning moment
e	0.96	ft	Eccentricity measesured from centerlin of reinforced soil mass
e_{max}	2.67	ft	

$e \le e_{max}$ → OK

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

For average wall height

Loading

H_{avg}	20.5	ft	Average wall height (from above)
F_1	7.43	klf	Active earth pressure from backfill soil
q	0.250	ksf	Traffic surcharge load eaqual to 2 feet of backfill soil
F_2	1.45	klf	Active earth pressure from traffic surcharge
L_{min}	16.5	ft	Average strap length associated with average wall height above
V_1	44.0	kli	Weight of the reinforced soil mass

Sliding

R_{ep}	= 0	klf	Passive resistance neglected
ϕ_τ	0.90	dim	Per Table 10.5.5.2.2-1 for soil on soil
R_τ	27.48	klf	
R_R	24.73	klf	Factored Resistance
$Q_{sliding}$	$=F_1 + F_2$		
$Q_{sliding}$	8.88	klf	Total sliding force

$R_R \geq Q_{sliding}$ → OK

Bearing Capacity

D_f	4	ft	
q_n	40.78	ksf	Nominal bearing resistance
ϕ_b	0.45		per Table 10.5.5.2.2-1
q_R	18.35		Factored bearing resistance
q_{str}	2.67	ksf	Bearing pressure

$q_R \geq q_{str}$ → OK

MSE Wall Calculations - Stand Alone

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Overturning (Eccentricity)

M	65.6	ft-klf	
e	1.49	ft	Eccentricity measesured from centerlin of reinforced soil mass
e_{max}	5.50	ft	Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3

$e \le e_{max}$ → OK

Seismic Loading

P_{IR}	4.92	klf	Inertial force cause by acceleration of reinforced soil per Figure 11.10.7.1-1
P_{AE}	10.37	klf	Seismic lateral earth pressure
$P_{AE}+½P_{IR}$	12.83	klf	Combination 1
$½P_{AE}+P_{IR}$	10.11	klf	Combination 2

Seismic Sliding

ϕ_τ	1.00	dim	
R_τ	27.48	klf	Nominal sliding resistance
R_R	27.48	klf	Factored sliding resistance
$Q_{sliding}$	14.28	klf	Total sliding force

$R_R \ge Q_{sliding}$ → OK

Seismic Overturning (Eccentricity)

M	110.9	ft-klf	Overturning moment
e	2.52	ft	Eccentricity measesured from centerlin of reinforced soil mass
e_{max}	2.67	ft	

$e \le e_{max}$ → OK

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Wall Parameters:

H	8.67	ft		wall height
L	21.5	ft		wall length
B	11	ft		MSE strap length
$\gamma_{backfill}$	0.130	kcf		total unit weight of MSE fill
β	26.6	degrees		angle of backfill slope from horizontal
H_{wedge}	= B tan β			height of soil wedge above top of wall at back of wall
H_{wedge}	5.5	ft		
$H_{surchage}$	0	ft	☐ Traffic above wall?	additional height of soil to account for traffic above wall
q_0	1.485	ksf	= (H_{avg} + ½H_{wedge} + $H_{surcharge}$) x $\gamma_{backfill}$	average vertical pressure beneath wall

Foundation Soil Parameters:

γ	0.125	kcf	total unit weight of soil
ϕ	34	degrees	internal angle of friction of soil

General Ultimate Bearing Resistance Equation

q_n	= $cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B' N_{\gamma m} C_{w\gamma}$		Equation 10.6.3.1.2a-1 (Nominal Bearing Resistance, ksf)
c	= 0	ksf	Cohesion neglected for granular soil contitions
C_{wq}	= 1.0		per Table 10.6.3.1.2a-2, depth to groundwater >1.5B+D_f
$C_{w\gamma}$	= 1.0		

General Nominal Bearing Resistance Equation reduces to:

$q_n = \gamma D_f N_{qm} + 0.5\gamma B' N_{\gamma m}$

Bearing Capacity Factors

N_{qm}	= $N_q s_q d_q i_q$	Equation 10.6.3.1.2a-3 (Modified Surcharge Bearing Capacity Factor, dim)
$N_{\gamma m}$	= $N_\gamma s_\gamma i_\gamma$	Equation 10.6.3.1.2a-4 (Modified Unit Weight Bearing Capacity Factor, dim)
d_q	= 1.0	Depth Correction Factor taken as 1.0 per discusion beneath Table 10.6.3.1.2a-4
i_q	= 1.0	Load Inclination Factors neglected per Commentary Section C10.6.3.1.2a
i_γ	= 1.0	
s_q	= 1 + (B'/L') tan ϕ	Shape Correction Factors per Table 10.6.3.1.2a-3
s_γ	= 1 - 0.4 (B'/L')	

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

By substitution, General Nominal Bearing Resistance Equation further reduces to:

$q_n = \gamma D_f N_q [1+(B'/L') \tan\phi_f] + 0.5\gamma B' N_\gamma [1-0.4(B'/L')]$

B'/L' = 0.51 approximated as B_{avg}/L from above

s_q = 1.344

s_γ = 0.796

Bearing Capacity Factors from ASSHTO LRFD Bridge Design Specifications Table 10.6.3.1.2a-1

N_q = 29.4

N_γ = 41.1

General Ultimate Bearing Capacity Equation for MSE Walls/CIP Wall Footings

$q_n = 2.04\ B + 4.94\ D_f$ in ksf

Settlement of Wall During Construction

$S_t = S_e+S_c+S_s$ Equation 10.6.2.4.1-1 (Total Settlement, ft)

$$S_e = \frac{\left[q_0\left(1-\nu^2\right)\sqrt{A'}\right]}{144 E_s \beta_z}$$ Equation 10.6.2.4.2-1 (Elastic Settlement, ft)

$S_c = 0$ Consolidation Settlement is not applicable for this soil type

$S_s = 0$ Secondary Settlement is not applicable for this soil type

A = 236.5 ft^2 = area of footing

β_z = 1.41 from Table 10.6.2.4.2-1 for L/B > 10

Elastic Constants for upper end of "medium dense sand" per Table C10.4.6.3-1

ν = 0.38 = Poisson's ratio

E_s = 6.94 ksi = Young's modulus

Wall Settlement

$S_t = S_e$ 0.014 ft x (12 in/ft) = 0.17 in estimated average settlement

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

External Stability Analysis

Loading

F_1 = $\frac{1}{2}*\gamma_f*(H+H_{wedge})^2*k_{af}$ — Active earth pressure from backfill soil

$k_{af} = \frac{\sin^2(\theta+\phi'_f)}{\Gamma[\sin^2\theta\sin(\theta-\delta)]}$ — Equation 3.11.5.3-1

$\Gamma = \left[1+\sqrt{\frac{\sin(\phi'_f+\delta)\sin(\phi'_f-\beta)}{\sin(\theta-\delta)\sin(\theta+\beta)}}\right]^2$ — Equation 3.11.5.3-2

ϕ'_f	34	degrees		internal angle of friction of backfill soil
γ_f	0.125	kcf		unit weight of backfill soil
θ	90	degrees		angle of wall back face of wall from horizontal
β	26.6	degrees		angle of backfill slope from horizontal
δ	26.6	degrees		friction angle between fill and wall (equals β per 11.10.5.2)
Γ	1.89	dim		
k_{af}	0.407	dim		active earth pressure coefficient
F_1	5.11	klf		
F_{1H}	4.57	klf	= $F_1 \cos\beta$	Horizontal component of F_1
F_{1V}	2.29	klf	= $F_1 \sin\beta$	Vertical component of F_1
F_2	= $q*H*k_{af}$			Active earth pressure from traffic surcharge
q	0.000	ksf		Traffic surcharge load eaqual to 2 feet of backfill soil (no trafic surcharge)
F_2	0.00	klf		
V_1	= γ_r*H*L			Weight of the reinforced soil mass (for this analysis, L=B from bearing capacity and settlement analysis above)
L	11.0	ft		Strap length
V_1	12.4	klf		
V_2	= $\frac{1}{2}\gamma_r*H_{wedge}*L$			Weight of soil wedge above reinforced soil mass (for this analysis, L=B from bearing capacity and settlement analysis above)
V_2	3.8	klf		

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Sliding

R_R	$= \phi_\tau R_\tau + \phi_{ep} R_{ep}$		Equation 10.6.3.4-1 (Factored Resistance)
R_{ep}	= 0	klf	Passive resistance neglected
ϕ_τ	0.90	dim	Per Table 10.5.5.2.2-1 for soil on soil
R_τ	$= (V_1+V_2) \tan \phi$		Equation 10.6.3.4-2, modified for MSE walls (ϕ = minimum from foundation soils or reinforced soil mass)
R_τ	10.91	klf	Nominal sliding resistance
R_R	9.82	klf	Factored sliding resistance
$Q_{sliding}$	$= F_{1H} + F_2$		Total sliding force
$Q_{sliding}$	4.57	klf	

$R_R \geq Q_{sliding}$ → OK

Bearing Capacity

q_n	$= 2.04\ B + 4.94\ D_f$	in ksf	from above
D_f	0	ft	
q_n	22.49	ksf	
q_R	$= \phi_b q_n$		Equation 10.6.3.1.1-1
ϕ_b	0.45		per Table 10.5.5.2.2-1
q_R	10.12		Factored bearing resistance
q_{str}	$= (V_1+V_2+F_{1V})/L$		Bearing pressure
q_{str}	1.68	ksf	

$q_R \geq q_{str}$ → OK

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Overturning (Eccentricity)

e	= M/V_1	Eccentricity measesured from centerlin of reinforced soil mass
M	= F_{1H}*H/3 + F_2*H/2 - V_2*B/6 - F_{1V}*B/2	Overturning moment
M	-6.3 ft-klf	
e	-0.51 ft	
e_{max}	= L/3	Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3
e_{max}	3.67 ft	

$e \le e_{max}$ → OK

Seismic Loading

H_2	$= H + \frac{0.5H \tan\beta}{1 - 0.5\tan\beta}$	Equation 11.10.7.1-1
H_2	11.6 ft	
P_{IR}	=P_{ir} + P_{is}	Inertial force cause by acceleration of reinforced soil per Figure 11.10.7.1-1b
P_{ir}	= k_h*γ_r*H*0.5H_2	
k_h	= F_{pga}*PGA	Seismic horizontal acceleration coeffiecient
PGA	0.15	per NDOT Structures Manual
F_{pga}	1.2	Per Table 3.10.3.2-1 for Site Class C and PGA = 0.15
k_h	0.18	
P_{ir}	1.18	
P_{is}	= k_h*γ_r*(H_2-H)*0.5H_2/2	
P_{is}	0.20	
P_{IR}	1.38	

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Seismic Loading (cont)

$k_{AE} = \frac{\cos^2(\phi-\theta_{MO}-\beta)}{\cos\theta_{MO}\cos^2\beta\cos(\delta+\beta+\theta_{MO})}\chi\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta_{MO}-i)}{\cos(\delta+\beta+\theta_{MO})\cos(i-\beta)}}\right]^{-2}$ Equation A11.3.1-1 (seismic active earth pressure coefficient)

ϕ	36	degrees	friction angle of retained soil (increased slightly to produce non imaginary result)
β	0	degrees	slope of wall to vertical
δ	34	degrees	wall backfill interface friction angle = friction angle of retained soil
i	25.0	degrees	backfill slope angle (modified to produce a non-imaginary result)

$\theta_{MO} = \tan^{-1}[k_h/(1-k_v)]$

k_v 0 Per 11.6.5.2

θ_{MO} 10.2 degrees

k_{AE} 0.881

$P_{AE} = (1/2)*\gamma_f*(H+H_{wedge})^2*k_{ae}$

P_{AE} 11.06 klf

P_{AEH} 10.02 klf $= P_{AE}\cos i$ Horizontal component of P_{AE}

P_{AEV} 4.67 klf $= P_{AE}\sin i$ Vertical component of P_{AE}

$P_{AEH}+½P_{IR}$ 10.71 klf Combination 1

$½P_{AE}+P_{IR}$ 6.39 klf Combination 2

Seismic Sliding

$R_R = \phi_\tau R_\tau + \phi_{ep}R_{ep}$ Equation 10.6.3.4-1 (Factored Resistance)

$R_{ep} = 0$ klf Passive resistance neglected

ϕ_τ 1.00 dim

$R_\tau = (V_1 + V_2)\tan\phi$ Equation 10.6.3.4-2, modified for MSE walls (ϕ = minimum from foundation soils or reinforced soil mass)

R_τ 10.91 klf Nominal sliding resistance

R_R 10.91 klf Factored sliding resistance

$Q_{sliding} = P_{AEH} + ½P_{IR} + F_2$ Total sliding force

$Q_{sliding}$ 10.71 klf

$R_R \geq Q_{sliding}$ → OK

MSE Wall Calculations - Hybrid Wall

Bearing Capacity and Estimated Settlement Calculations for MSE Walls per AASHTO LRFD Bridge Design Specifications Section 11

Seismic Overturning (Eccentricity)

$e = M/V_1$ — Eccentricity measesured from centerlin of reinforced soil mass

$M = P_{AEH}*(H+H_{wedge})/3 + ½(P_{ir}*H/2) + ½(Pis*(H+1/3(H_2-H))) + F_2*H/2 - P_{AEV}*B/2$ — Overturning moment

M = 25.2 ft-klf

e = 2.03 ft

$e_{max} = L/3$ — Eccentricity must be within middle 2/3 of reinforced soil mass per 11.6.3.3

e_{max} = 3.67 ft

$e \le e_{max}$ → OK

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SHAFT for Windows, Version 2012.7.17

Serial Number : 157290693

VERTICALLY LOADED DRILLED SHAFT ANALYSIS

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Path to file locations : G:\2019 Projects\G-19-067 Lone Mountain Bridge Widening\SHAFT\
Name of input data file : West Abut.sfd
Name of output file : West Abut.sfo
Name of plot output file : West Abut.sfp
Name of runtime file : West Abut.sfr

Time and Date of Analysis

Date: January 08, 2020 Time: 17:13:22

G-19-067 Lone Mountain Bridge Widening West Abutment (No. 1)

PROPOSED DEPTH = 44.0 FT

NUMBER OF LAYERS = 11

WATER TABLE DEPTH = 91.0 FT.

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.867E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.220E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.220E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11

DEPTH, FT = 0.260E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.599E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.445E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.599E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.126E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.445E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.570E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.126E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.475E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 5----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.475E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.505E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00

END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.505E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.600E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO 7----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.180E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.403E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.180E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.660E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 8----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.660E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.690E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 9----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.535E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.350E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.690E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.535E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.350E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.920E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO10----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.920E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO11----SAND

AT THE TOP

```
  SKIN FRICTION COEFFICIENT- BETA                    = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.122E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.950E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                    = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.122E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.975E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.500E+00



DRILLED SHAFT INFORMATION
-------------------------

 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.382E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.



PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
```

LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	LRFD QS (TONS)	LRFD QB (TONS)	LRFD QU (TONS)
1.0	0.26	0.37	13.33	13.70	0.20	6.67	6.87
2.0	0.52	1.47	15.85	17.32	0.81	7.92	8.73
3.0	0.79	3.31	18.36	21.67	1.82	9.18	11.00
4.0	1.05	5.88	20.87	26.75	3.24	10.44	13.67
5.0	1.31	9.19	23.39	32.57	5.05	11.69	16.75
6.0	1.57	13.13	25.90	39.03	7.22	12.95	20.17
7.0	1.83	17.68	28.41	46.09	9.72	14.21	23.93
8.0	2.09	22.81	30.93	53.74	12.55	15.46	28.01
9.0	2.36	28.52	33.44	61.96	15.68	16.72	32.41
10.0	2.62	34.76	35.96	70.72	19.12	17.98	37.10
11.0	2.88	41.53	38.47	80.00	22.84	19.24	42.08
12.0	3.14	48.81	40.98	89.79	26.84	20.49	47.34
13.0	3.40	56.57	43.50	100.07	31.11	21.75	52.86
14.0	3.67	64.80	46.01	110.81	35.64	23.01	58.64
15.0	3.93	73.48	48.53	122.00	40.41	24.26	64.68
16.0	4.19	82.59	51.04	133.63	45.43	25.52	70.95
17.0	4.45	92.13	58.16	150.29	50.67	29.08	79.75
18.0	4.71	102.07	65.40	167.48	56.14	32.70	88.84
19.0	4.97	112.40	72.70	185.10	61.82	36.35	98.17
20.0	5.24	123.11	77.33	200.44	67.71	38.66	106.38
21.0	5.50	134.18	69.86	204.04	73.80	34.93	108.73
22.0	5.76	145.60	59.07	204.67	80.08	23.63	103.71
23.0	6.02	152.08	47.21	199.29	83.00	18.88	101.88
24.0	6.28	158.56	39.83	198.40	85.91	15.93	101.85
25.0	6.55	165.04	36.57	201.61	88.83	14.63	103.46
26.0	6.81	171.52	37.25	208.77	91.75	18.63	110.37
27.0	7.07	184.40	37.59	222.00	98.83	18.80	117.63
28.0	7.33	197.54	37.71	235.25	106.05	18.85	124.91
29.0	7.59	210.92	37.71	248.63	113.41	18.85	132.27
30.0	7.86	224.53	37.71	262.24	120.90	18.85	139.75
31.0	8.12	238.36	37.71	276.07	128.51	18.85	147.36
32.0	8.38	252.41	37.71	290.12	136.23	18.85	155.09
33.0	8.64	266.66	37.71	304.37	144.07	18.85	162.92
34.0	8.90	281.10	37.71	318.80	152.01	18.85	170.86
35.0	9.16	295.71	37.71	333.42	160.05	18.85	178.90
36.0	9.43	310.50	37.71	348.21	168.18	18.85	187.04
37.0	9.69	325.45	37.71	363.16	176.41	18.85	195.26
38.0	9.95	340.55	37.71	378.26	184.71	18.85	203.56
39.0	10.21	355.79	37.71	393.50	193.09	18.85	211.95
40.0	10.47	371.16	68.10	439.26	201.55	34.05	235.60
41.0	10.74	386.66	102.83	489.49	210.07	51.42	261.48

42.0	11.00	402.26	141.91	544.17	218.65	70.95	289.61
43.0	11.26	417.97	234.54	652.51	227.29	117.27	344.56
44.0	11.52	433.78	323.65	757.43	235.99	161.83	397.81

RESULT FROM TREND (AVERAGED) LINE

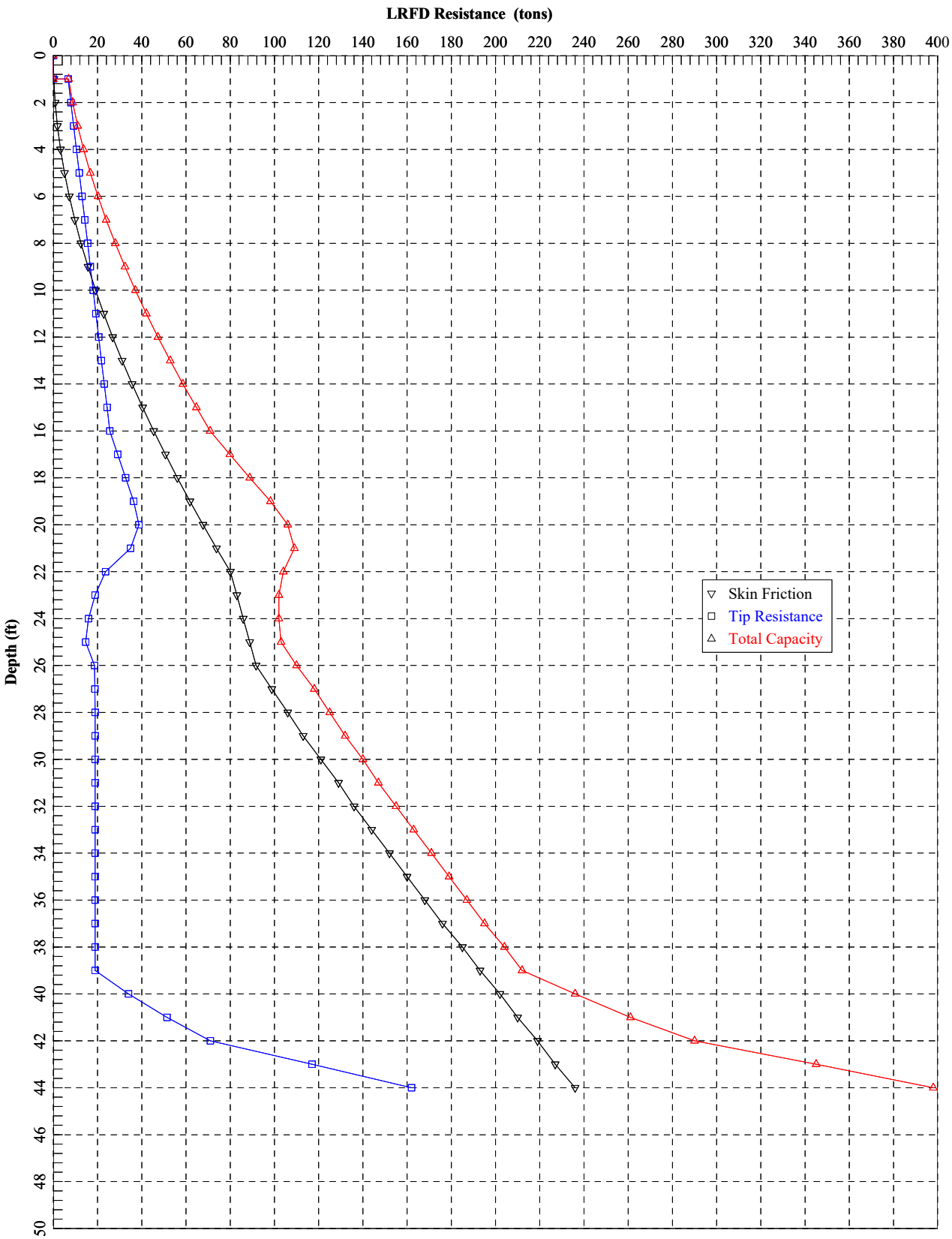
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.5160E-01	0.1862E-04	0.3147E-02	0.1000E-04
0.2580E+00	0.9309E-04	0.1573E-01	0.5000E-04
0.5160E+00	0.1862E-03	0.3147E-01	0.1000E-03
0.2580E+02	0.9309E-02	0.1573E+01	0.5000E-02
0.3876E+02	0.1397E-01	0.2360E+01	0.7500E-02
0.5177E+02	0.1863E-01	0.3147E+01	0.1000E-01
0.1293E+03	0.4661E-01	0.7867E+01	0.2500E-01
0.2276E+03	0.8886E-01	0.1573E+02	0.5000E-01
0.2989E+03	0.1272E+00	0.2360E+02	0.7500E-01
0.3452E+03	0.1612E+00	0.3147E+02	0.1000E+00
0.4773E+03	0.3393E+00	0.7804E+02	0.2500E+00
0.5537E+03	0.6095E+00	0.1469E+03	0.5000E+00
0.5737E+03	0.7402E+00	0.1688E+03	0.6250E+00
0.6110E+03	0.1025E+01	0.2071E+03	0.9000E+00
0.7311E+03	0.1958E+01	0.3285E+03	0.1800E+01

RESULT FROM UPPER-BOUND LINE

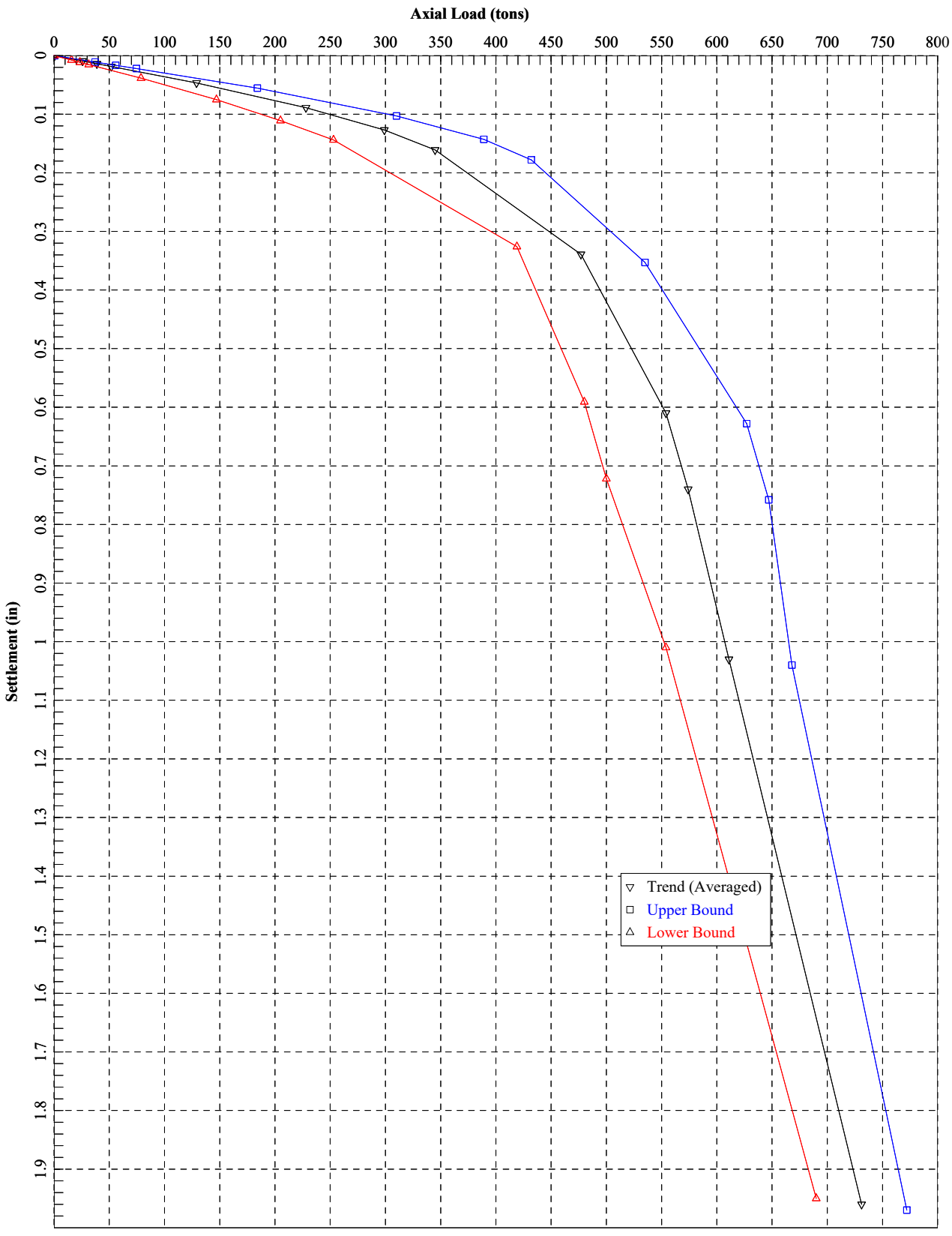
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7408E-01	0.2214E-04	0.4495E-02	0.1000E-04
0.3704E+00	0.1107E-03	0.2248E-01	0.5000E-04
0.7408E+00	0.2214E-03	0.4495E-01	0.1000E-03
0.3709E+02	0.1107E-01	0.2248E+01	0.5000E-02
0.5582E+02	0.1663E-01	0.3371E+01	0.7500E-02
0.7454E+02	0.2219E-01	0.4495E+01	0.1000E-01
0.1842E+03	0.5540E-01	0.1124E+02	0.2500E-01
0.3102E+03	0.1028E+00	0.2248E+02	0.5000E-01
0.3889E+03	0.1434E+00	0.3371E+02	0.7500E-01
0.4316E+03	0.1776E+00	0.4495E+02	0.1000E+00
0.5349E+03	0.3526E+00	0.1099E+03	0.2500E+00
0.6269E+03	0.6277E+00	0.2032E+03	0.5000E+00
0.6465E+03	0.7581E+00	0.2237E+03	0.6250E+00
0.6684E+03	0.1039E+01	0.2460E+03	0.9000E+00
0.7720E+03	0.1967E+01	0.3495E+03	0.1800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.3137E-01	0.1533E-04	0.1798E-02	0.1000E-04
0.1569E+00	0.7667E-04	0.8990E-02	0.5000E-04
0.3137E+00	0.1533E-03	0.1798E-01	0.1000E-03
0.1569E+02	0.7667E-02	0.8990E+00	0.5000E-02
0.2353E+02	0.1150E-01	0.1349E+01	0.7500E-02
0.3137E+02	0.1533E-01	0.1798E+01	0.1000E-01
0.7870E+02	0.3836E-01	0.4495E+01	0.2500E-01
0.1471E+03	0.7520E-01	0.8990E+01	0.5000E-01
0.2055E+03	0.1106E+00	0.1349E+02	0.7500E-01
0.2528E+03	0.1441E+00	0.1798E+02	0.1000E+00
0.4185E+03	0.3258E+00	0.4621E+02	0.2500E+00
0.4800E+03	0.5913E+00	0.9062E+02	0.5000E+00
0.5005E+03	0.7222E+00	0.1139E+03	0.6250E+00
0.5535E+03	0.1012E+01	0.1683E+03	0.9000E+00
0.6903E+03	0.1949E+01	0.3075E+03	0.1800E+01



Lone Mountain Bridge - West Abutment - 3-foot Diameter



Lone Mountain Bridge - West Abutment - 3-foot Diameter

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SHAFT for Windows, Version 2012.7.17

Serial Number : 157290693

VERTICALLY LOADED DRILLED SHAFT ANALYSIS

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Path to file locations : G:\2019 Projects\G-19-067 Lone Mountain Bridge Widening\SHAFT\
Name of input data file : Center Pier - 6-ft.sfd
Name of output file : Center Pier - 6-ft.sfo
Name of plot output file : Center Pier - 6-ft.sfp
Name of runtime file : Center Pier - 6-ft.sfr

Time and Date of Analysis

Date: January 08, 2020 Time: 16:52:04

G-19-067 Lone Mountain Bridge Widening Center Pier

PROPOSED DEPTH = 78.0 FT

NUMBER OF LAYERS = 19

WATER TABLE DEPTH = 74.0 FT.

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.117E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+01

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.117E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.572E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.521E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.330E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.773E+00

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.330E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.290E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 5----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.290E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 6----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.736E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02

BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.719E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.335E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 7----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.335E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 8----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.470E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.636E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.470E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 9----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.200E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.200E+04

INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO10----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.495E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO11----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.550E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.495E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.536E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.510E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO12----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.510E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.540E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO13----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.128E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.540E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.128E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.640E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.400E+00

LAYER NO14----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.420E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.133E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.640E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02

BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.133E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO15----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.730E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO16----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.323E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.140E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.121E+03

MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.730E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.140E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.121E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.850E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO17----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.255E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.123E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.850E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.123E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.890E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO18----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.129E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.890E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.129E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+03

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.400E+00

LAYER NO19----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+03

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

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  SOIL UNIT WEIGHT, LB/CU FT                          = 0.117E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.115E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.400E+00



DRILLED SHAFT INFORMATION
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 DIAMETER OF STEM          =    6.000  FT.
 DIAMETER OF BASE          =    6.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   40.720  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.382E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.



PREDICTED RESULTS
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QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     1.05     0.70    12.82    13.53     0.39     6.41      6.80
 2.0     2.09     2.81    14.98    17.78     1.54     7.49      9.03
 3.0     3.14     6.31    16.98    23.29     3.47     8.49     11.96
 4.0     4.19    11.22    26.20    37.42     6.17    13.10     19.27
 5.0     5.24    17.52    36.28    53.80     9.64    18.14     27.78
 6.0     6.28    25.04    47.22    72.26    13.77    23.61     37.38
 7.0     7.33    33.72    59.29    93.01    18.55    29.64     48.19
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8.0	8.38	43.52	72.53	116.05	23.94	36.26	60.20
9.0	9.43	54.40	86.97	141.38	29.92	43.49	73.41
10.0	10.47	66.32	100.39	166.71	36.48	50.20	86.67
11.0	11.52	73.17	112.63	185.80	40.24	56.32	96.56
12.0	12.57	80.46	123.60	204.06	44.25	61.80	106.05
13.0	13.62	88.18	133.17	221.35	48.50	66.59	115.08
14.0	14.66	96.30	141.25	237.56	52.97	70.63	123.59
15.0	15.71	104.83	147.73	252.56	57.66	73.87	131.52
16.0	16.76	121.59	154.21	275.81	66.87	77.11	143.98
17.0	17.80	139.18	160.69	299.87	76.55	80.35	156.89
18.0	18.85	157.55	335.33	492.88	86.65	167.67	254.32
19.0	19.90	176.69	522.29	698.98	97.18	261.15	358.33
20.0	20.95	196.57	721.53	918.10	108.11	360.77	468.88
21.0	21.99	217.15	757.39	974.53	119.43	378.69	498.12
22.0	23.04	238.41	792.24	1030.65	131.13	396.12	527.25
23.0	24.09	260.33	1001.04	1261.37	143.18	500.52	643.70
24.0	25.14	282.88	1170.19	1453.07	155.58	585.09	740.68
25.0	26.18	306.03	1299.83	1605.86	168.32	649.91	818.23
26.0	27.23	329.77	1236.66	1566.43	181.37	618.33	799.71
27.0	28.28	354.06	1177.38	1531.44	194.73	588.69	783.42
28.0	29.33	378.89	1122.07	1500.96	208.39	561.04	769.42
29.0	30.37	404.23	1017.02	1421.25	222.32	559.36	781.69
30.0	31.42	430.90	888.69	1319.60	238.33	488.78	727.11
31.0	32.47	457.58	747.87	1205.45	254.34	411.33	665.66
32.0	33.51	484.26	641.75	1126.01	270.34	320.88	591.22
33.0	34.56	511.52	692.05	1203.57	285.34	346.02	631.36
34.0	35.61	539.19	748.56	1287.75	300.56	411.71	712.27
35.0	36.66	565.87	851.49	1417.36	316.56	468.32	784.88
36.0	37.70	592.54	1004.42	1596.96	332.57	552.43	885.00
37.0	38.75	619.22	1207.34	1826.56	348.57	603.67	952.24
38.0	39.80	648.38	1424.85	2073.24	364.61	712.43	1077.04
39.0	40.85	677.84	1437.47	2115.31	380.82	718.73	1099.55
40.0	41.89	707.58	1571.72	2279.30	397.17	785.86	1183.03
41.0	42.94	737.58	1671.16	2408.74	413.67	668.46	1082.14
42.0	43.99	747.95	1733.10	2481.05	418.34	693.24	1111.58
43.0	45.04	758.32	1607.04	2365.36	423.00	642.82	1065.82
44.0	46.08	768.69	1431.90	2200.59	427.67	787.55	1215.22
45.0	47.13	795.36	1297.40	2092.76	443.68	713.57	1157.24
46.0	48.18	822.04	1151.32	1973.36	459.68	633.22	1092.91
47.0	49.22	848.72	993.66	1842.38	475.69	546.51	1022.20
48.0	50.27	875.39	824.42	1699.82	491.70	453.43	945.13
49.0	51.32	902.07	689.92	1591.99	507.70	379.46	887.16
50.0	52.37	928.75	590.15	1518.90	523.71	295.07	818.78
51.0	53.41	960.43	485.95	1446.39	541.13	267.27	808.41
52.0	54.46	987.11	416.49	1403.60	557.14	229.07	786.21
53.0	55.51	1013.79	365.53	1379.32	573.15	201.04	774.19
54.0	56.56	1040.47	348.05	1388.52	589.15	139.22	728.37
55.0	57.60	1056.02	329.33	1385.35	596.15	131.73	727.88
56.0	58.65	1071.57	309.35	1380.93	603.15	123.74	726.89

57.0	59.70	1087.13	298.37	1385.49	610.15	119.35	729.50
58.0	60.75	1102.68	286.92	1389.60	617.15	114.77	731.92
59.0	61.79	1118.23	280.00	1398.23	624.15	112.00	736.15
60.0	62.84	1133.78	277.62	1411.40	631.15	111.05	742.19
61.0	63.89	1149.34	279.77	1429.10	638.15	111.91	750.05
62.0	64.93	1164.89	272.02	1436.91	645.14	108.81	753.95
63.0	65.98	1180.44	264.54	1444.99	652.14	105.82	757.96
64.0	67.03	1196.00	257.34	1453.34	659.14	128.67	787.81
65.0	68.08	1227.31	246.67	1473.98	676.37	123.33	799.70
66.0	69.12	1258.50	232.52	1491.02	693.52	116.26	809.78
67.0	70.17	1289.54	214.90	1504.44	710.59	107.45	818.04
68.0	71.22	1320.42	198.25	1518.67	727.57	79.30	806.88
69.0	72.27	1333.38	184.93	1518.31	733.41	73.97	807.38
70.0	73.31	1346.34	174.94	1521.28	739.24	69.98	809.22
71.0	74.36	1359.30	168.28	1527.58	745.07	67.31	812.38
72.0	75.41	1372.26	164.96	1537.22	750.90	65.98	816.89
73.0	76.46	1385.22	164.96	1550.18	756.74	82.48	839.21
74.0	77.50	1412.63	204.91	1617.54	771.81	102.46	874.27
75.0	78.55	1439.66	247.94	1687.60	786.68	123.97	910.65
76.0	79.60	1466.23	294.05	1760.28	801.29	147.03	948.31
77.0	80.64	1492.32	343.23	1835.55	815.64	171.61	987.25
78.0	81.69	1517.94	369.95	1887.89	829.73	184.98	1014.71

RESULT FROM TREND (AVERAGED) LINE

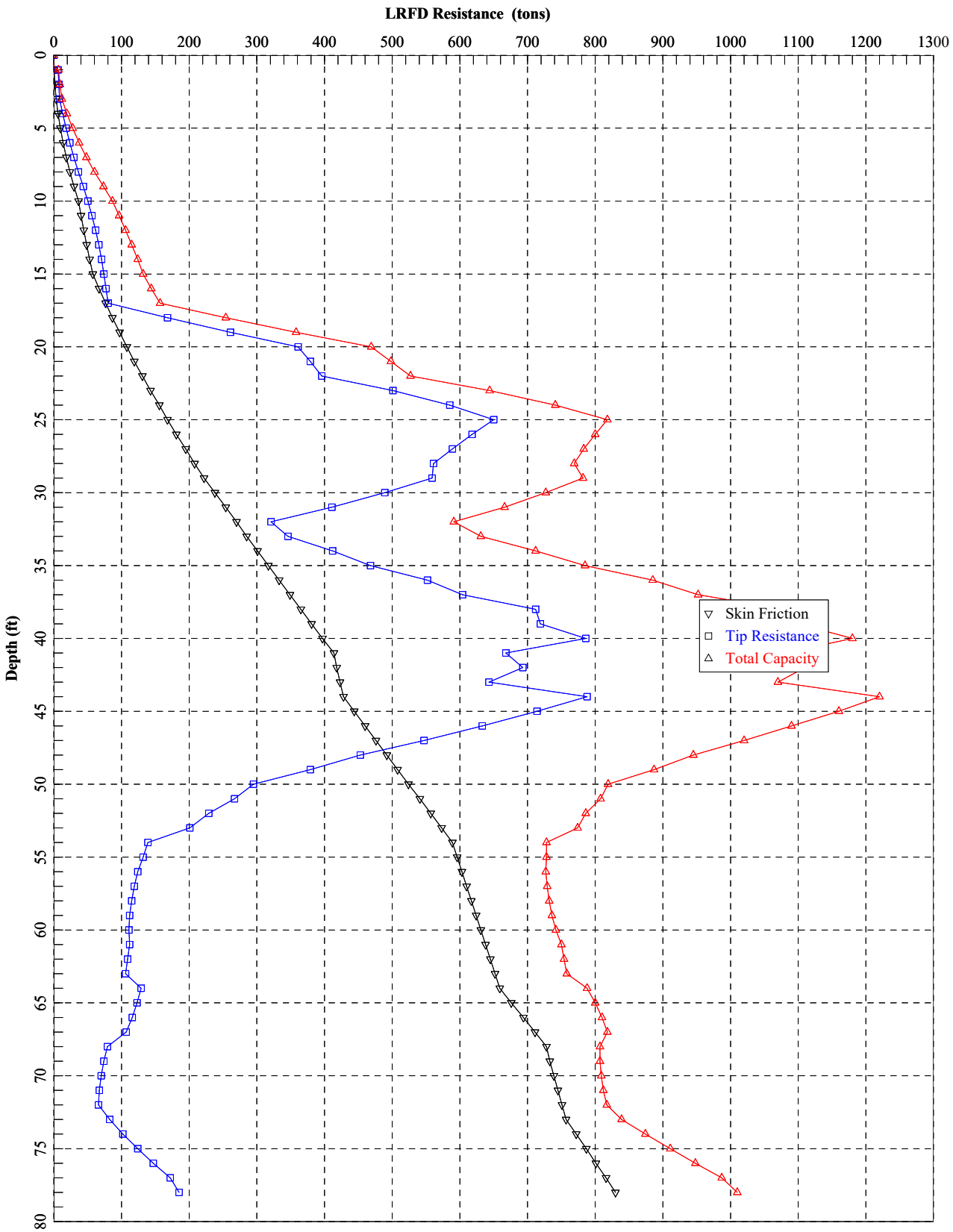
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1040E+00	0.1704E-04	0.4059E-02	0.1000E-04
0.5202E+00	0.8521E-04	0.2030E-01	0.5000E-04
0.1040E+01	0.1704E-03	0.4059E-01	0.1000E-03
0.5202E+02	0.8521E-02	0.2030E+01	0.5000E-02
0.7803E+02	0.1278E-01	0.3044E+01	0.7500E-02
0.1040E+03	0.1704E-01	0.4059E+01	0.1000E-01
0.2607E+03	0.4263E-01	0.1015E+02	0.2500E-01
0.5210E+03	0.8528E-01	0.2030E+02	0.5000E-01
0.7274E+03	0.1250E+00	0.3044E+02	0.7500E-01
0.8701E+03	0.1597E+00	0.4059E+02	0.1000E+00
0.1364E+04	0.3473E+00	0.1015E+03	0.2500E+00
0.1591E+04	0.6160E+00	0.1699E+03	0.5000E+00
0.1636E+04	0.8411E+00	0.2072E+03	0.7200E+00
0.1682E+04	0.1929E+01	0.3200E+03	0.1800E+01
0.1718E+04	0.3734E+01	0.3589E+03	0.3600E+01

RESULT FROM UPPER-BOUND LINE

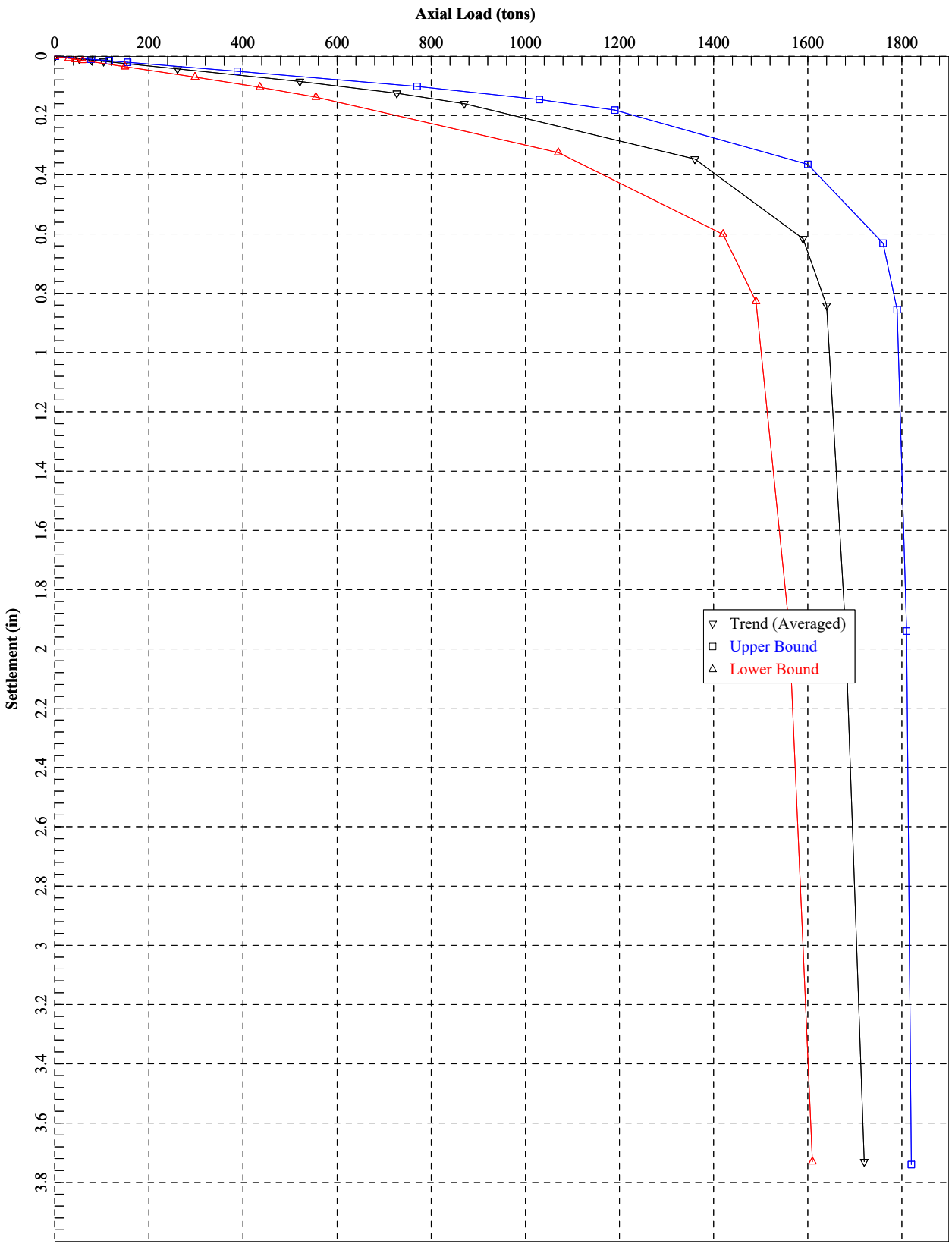
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1546E+00	0.2033E-04	0.6063E-02	0.1000E-04
0.7728E+00	0.1016E-03	0.3032E-01	0.5000E-04
0.1546E+01	0.2033E-03	0.6063E-01	0.1000E-03
0.7728E+02	0.1016E-01	0.3032E+01	0.5000E-02
0.1159E+03	0.1525E-01	0.4547E+01	0.7500E-02
0.1547E+03	0.2033E-01	0.6063E+01	0.1000E-01
0.3879E+03	0.5089E-01	0.1516E+02	0.2500E-01
0.7700E+03	0.1017E+00	0.3032E+02	0.5000E-01
0.1034E+04	0.1458E+00	0.4547E+02	0.7500E-01
0.1193E+04	0.1819E+00	0.6063E+02	0.1000E+00
0.1597E+04	0.3653E+00	0.1516E+03	0.2500E+00
0.1758E+04	0.6314E+00	0.2413E+03	0.5000E+00
0.1787E+04	0.8551E+00	0.2775E+03	0.7200E+00
0.1807E+04	0.1940E+01	0.3552E+03	0.1800E+01
0.1820E+04	0.3742E+01	0.3681E+03	0.3600E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.5950E-01	0.1405E-04	0.2055E-02	0.1000E-04
0.2975E+00	0.7026E-04	0.1028E-01	0.5000E-04
0.5950E+00	0.1405E-03	0.2055E-01	0.1000E-03
0.2975E+02	0.7026E-02	0.1028E+01	0.5000E-02
0.4463E+02	0.1054E-01	0.1541E+01	0.7500E-02
0.5950E+02	0.1405E-01	0.2055E+01	0.1000E-01
0.1488E+03	0.3513E-01	0.5138E+01	0.2500E-01
0.2980E+03	0.7028E-01	0.1028E+02	0.5000E-01
0.4361E+03	0.1049E+00	0.1541E+02	0.7500E-01
0.5554E+03	0.1381E+00	0.2055E+02	0.1000E+00
0.1068E+04	0.3245E+00	0.5138E+02	0.2500E+00
0.1421E+04	0.6005E+00	0.9845E+02	0.5000E+00
0.1486E+04	0.8270E+00	0.1369E+03	0.7200E+00
0.1556E+04	0.1919E+01	0.2849E+03	0.1800E+01
0.1614E+04	0.3726E+01	0.3478E+03	0.3600E+01



Lone Mountain Bridge - Center Pier - 6-foot Diameter



Lone Mountain Bridge - Center Pier - 6-foot Diameter

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=========================================================================

                  SHAFT for Windows, Version 2012.7.17

                   Serial Number :  157290693

                VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                 (c) Copyright ENSOFT, Inc., 1987-2012
                       All Rights Reserved

=========================================================================

     Path to file locations      : G:\2019 Projects\G-19-067 Lone Mountain Bridge
Widening\SHAFT\
     Name of input data file     : Center Pier - 7-ft.sfd
     Name of output file         : Center Pier - 7-ft.sfo
     Name of plot output file    : Center Pier - 7-ft.sfp
     Name of runtime file        : Center Pier - 7-ft.sfr

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  January 08, 2020     Time:  17:07:13

     G-19-067 Lone Mountain Bridge Widening Center Pier


     PROPOSED DEPTH =      73.0 FT
     ----------------


     NUMBER OF LAYERS =   19
     ------------------


     WATER TABLE DEPTH =      74.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------

     LAYER NO 1----SAND
```

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.117E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+01

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.117E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.572E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.521E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.330E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.773E+00

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.330E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.290E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 5----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.290E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 6----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.736E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02

BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.719E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.335E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 7----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.335E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 8----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.470E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.636E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.470E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 9----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.200E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.200E+04

INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO10----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.495E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO11----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.550E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.495E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.536E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.510E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO12----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.510E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.540E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO13----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.128E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.540E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.128E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.640E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.400E+00

LAYER NO14----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.420E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.133E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.640E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02

BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.133E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO15----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.730E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO16----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.323E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.140E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.121E+03

MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.730E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.140E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.121E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.850E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO17----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.255E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.123E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.850E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.123E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.890E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO18----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.129E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.890E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.129E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+03

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.400E+00

LAYER NO19----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+03

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT = 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.115E+03

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 7.000 FT.
DIAMETER OF BASE = 7.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 0.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 55.425 SQ.IN.
ELASTIC MODULUS, Ec = 0.382E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	LRFD QS (TONS)	LRFD QB (TONS)	LRFD QU (TONS)
1.0	1.43	0.82	14.99	15.81	0.45	7.50	7.95
2.0	2.85	3.27	23.19	26.46	1.80	11.60	13.40
3.0	4.28	7.36	32.08	39.45	4.05	16.04	20.09
4.0	5.70	13.09	41.70	54.79	7.20	20.85	28.05
5.0	7.13	20.44	52.06	72.50	11.24	26.03	37.27
6.0	8.55	29.21	63.14	92.36	16.07	31.57	47.64
7.0	9.98	39.34	75.16	114.50	21.64	37.58	59.22

8.0	11.40	50.78	88.13	138.91	27.93	44.07	72.00
9.0	12.83	63.47	100.43	163.90	34.91	50.22	85.12
10.0	14.26	77.37	111.98	189.35	42.55	55.99	98.54
11.0	15.68	85.36	122.67	208.03	46.95	61.33	108.28
12.0	17.11	93.87	132.42	226.29	51.63	66.21	117.84
13.0	18.53	102.87	141.16	244.03	56.58	70.58	127.16
14.0	19.96	112.36	148.81	261.16	61.80	74.40	136.20
15.0	21.38	122.30	155.29	277.59	67.26	77.64	144.91
16.0	22.81	141.86	253.04	394.90	78.02	126.52	204.54
17.0	24.23	162.37	356.37	518.74	89.30	178.18	267.49
18.0	25.66	183.81	465.22	649.03	101.10	232.61	333.71
19.0	27.09	206.14	482.03	688.17	113.38	241.01	354.39
20.0	28.51	229.33	498.07	727.40	126.13	249.04	375.17
21.0	29.94	253.34	610.35	863.69	139.34	305.17	444.51
22.0	31.36	278.15	728.02	1006.17	152.98	364.01	516.99
23.0	32.79	303.72	826.72	1130.44	167.04	413.36	580.40
24.0	34.21	330.03	827.68	1157.70	181.51	413.84	595.35
25.0	35.64	357.04	805.34	1162.38	196.37	402.67	599.04
26.0	37.06	384.73	785.88	1170.61	211.60	392.94	604.54
27.0	38.49	413.07	769.37	1182.44	227.19	384.69	611.87
28.0	39.92	442.04	723.36	1165.40	243.12	361.68	604.80
29.0	41.34	471.60	653.49	1125.09	259.38	359.42	618.80
30.0	42.77	502.72	578.12	1080.84	278.05	317.96	596.02
31.0	44.19	533.84	600.86	1134.70	296.73	330.47	627.20
32.0	45.62	564.97	644.43	1209.40	315.40	322.22	637.62
33.0	47.04	596.78	689.14	1285.92	332.90	344.57	677.47
34.0	48.47	629.05	734.84	1363.89	350.65	404.16	754.81
35.0	49.89	660.18	802.56	1462.73	369.32	441.41	810.73
36.0	51.32	691.30	892.30	1583.60	388.00	490.77	878.76
37.0	52.74	722.42	911.50	1633.93	406.67	455.75	862.42
38.0	54.17	756.45	1001.33	1757.77	425.38	500.66	926.05
39.0	55.60	790.81	1075.53	1866.34	444.29	537.76	982.05
40.0	57.02	825.51	1134.25	1959.76	463.37	567.12	1030.49
41.0	58.45	860.51	1103.06	1963.57	482.62	441.23	923.84
42.0	59.87	872.61	1050.39	1922.99	488.06	420.16	908.22
43.0	61.30	884.70	976.22	1860.93	493.50	390.49	883.99
44.0	62.72	896.80	905.25	1802.05	498.95	497.89	996.84
45.0	64.15	927.92	829.31	1757.23	517.62	456.12	973.74
46.0	65.57	959.05	748.40	1707.44	536.30	411.62	947.92
47.0	67.00	990.17	662.51	1652.68	554.97	364.38	919.35
48.0	68.43	1021.29	591.54	1612.84	573.64	325.35	898.99
49.0	69.85	1052.42	535.49	1587.90	592.32	294.52	886.84
50.0	71.28	1083.54	494.35	1577.89	610.99	247.17	858.17
51.0	72.70	1120.51	435.48	1555.99	631.32	239.52	870.84
52.0	74.13	1151.63	390.87	1542.50	650.00	214.98	864.98
53.0	75.55	1182.75	360.53	1543.28	668.67	198.29	866.96
54.0	76.98	1213.88	344.47	1558.35	687.35	137.79	825.13
55.0	78.40	1232.02	336.96	1568.98	695.51	134.78	830.29
56.0	79.83	1250.17	329.19	1579.35	703.68	131.67	835.35

57.0	81.26	1268.31	321.16	1589.47	711.84	128.46	840.31
58.0	82.68	1286.46	316.64	1603.09	720.01	126.65	846.66
59.0	84.11	1304.60	315.55	1620.15	728.17	126.22	854.39
60.0	85.53	1322.75	304.83	1627.57	736.34	121.93	858.27
61.0	86.96	1340.89	296.52	1637.41	744.50	118.61	863.11
62.0	88.38	1359.04	288.12	1647.16	752.67	115.25	867.92
63.0	89.81	1377.18	279.63	1656.81	760.83	111.85	872.68
64.0	91.23	1395.33	271.04	1666.36	769.00	135.52	904.52
65.0	92.66	1431.86	259.53	1691.39	789.09	129.76	918.86
66.0	94.09	1468.25	245.16	1713.40	809.10	122.58	931.68
67.0	95.51	1504.46	231.44	1735.90	829.02	115.72	944.74
68.0	96.94	1540.49	218.45	1758.93	848.84	87.38	936.22
69.0	98.36	1555.61	208.05	1763.65	855.64	83.22	938.86
70.0	99.79	1570.73	200.25	1770.98	862.45	80.10	942.54
71.0	101.21	1585.85	195.05	1780.90	869.25	78.02	947.27
72.0	102.64	1600.97	231.72	1832.69	876.05	92.69	968.74
73.0	104.06	1616.09	273.62	1889.71	882.86	136.81	1019.67

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.9012E-01	0.1429E-04	0.2573E-02	0.1000E-04
0.4506E+00	0.7145E-04	0.1287E-01	0.5000E-04
0.9012E+00	0.1429E-03	0.2573E-01	0.1000E-03
0.4506E+02	0.7145E-02	0.1287E+01	0.5000E-02
0.6759E+02	0.1072E-01	0.1930E+01	0.7500E-02
0.9012E+02	0.1429E-01	0.2573E+01	0.1000E-01
0.2255E+03	0.3573E-01	0.6433E+01	0.2500E-01
0.4514E+03	0.7147E-01	0.1287E+02	0.5000E-01
0.6720E+03	0.1071E+00	0.1930E+02	0.7500E-01
0.8116E+03	0.1389E+00	0.2573E+02	0.1000E+00
0.1374E+04	0.3167E+00	0.6433E+02	0.2500E+00
0.1611E+04	0.5788E+00	0.1167E+03	0.5000E+00
0.1679E+04	0.9230E+00	0.1532E+03	0.8400E+00
0.1685E+04	0.2186E+01	0.2367E+03	0.2100E+01
0.1711E+04	0.4288E+01	0.2654E+03	0.4200E+01

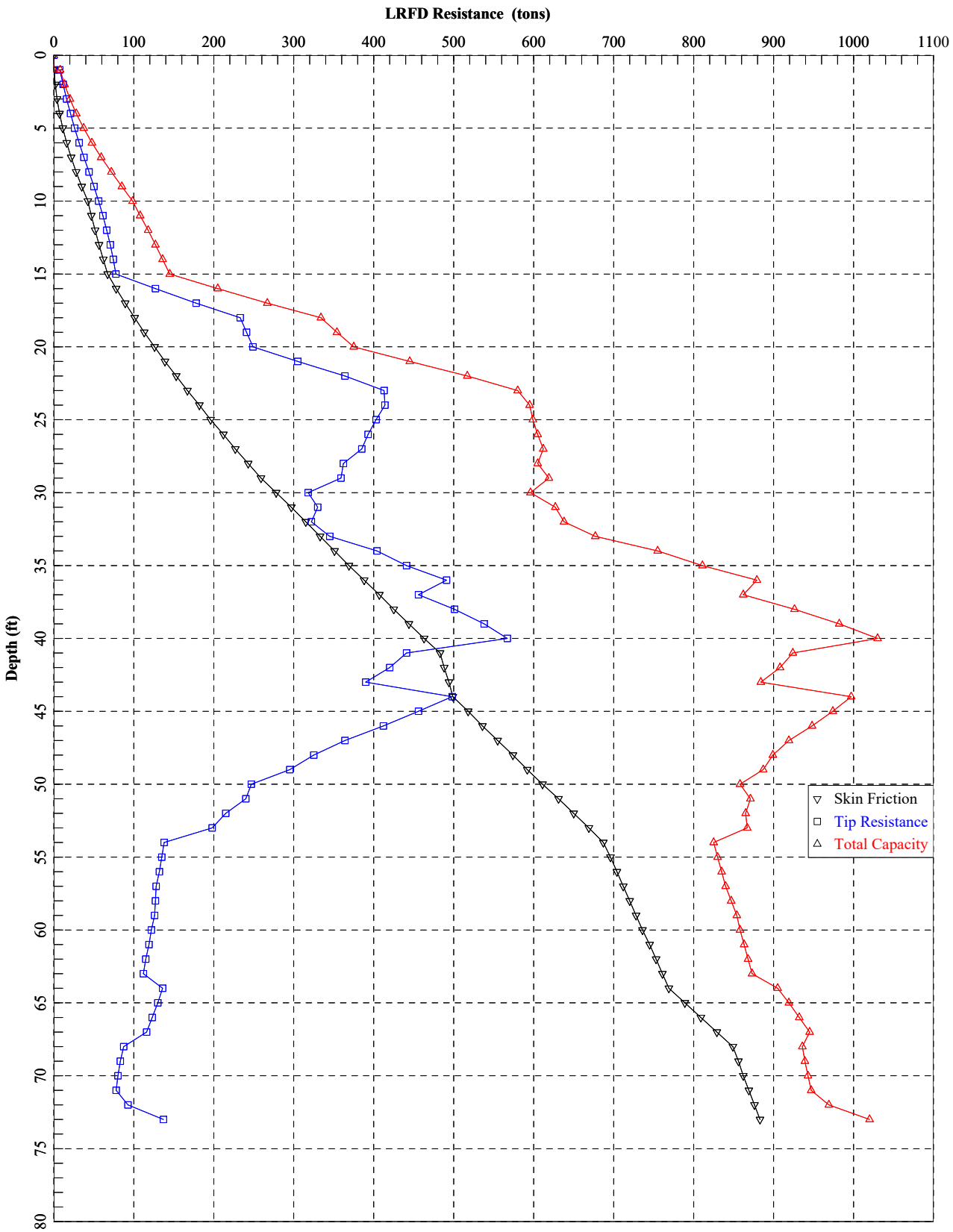
RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1314E+00	0.1623E-04	0.3844E-02	0.1000E-04
0.6570E+00	0.8114E-04	0.1922E-01	0.5000E-04
0.1314E+01	0.1623E-03	0.3844E-01	0.1000E-03

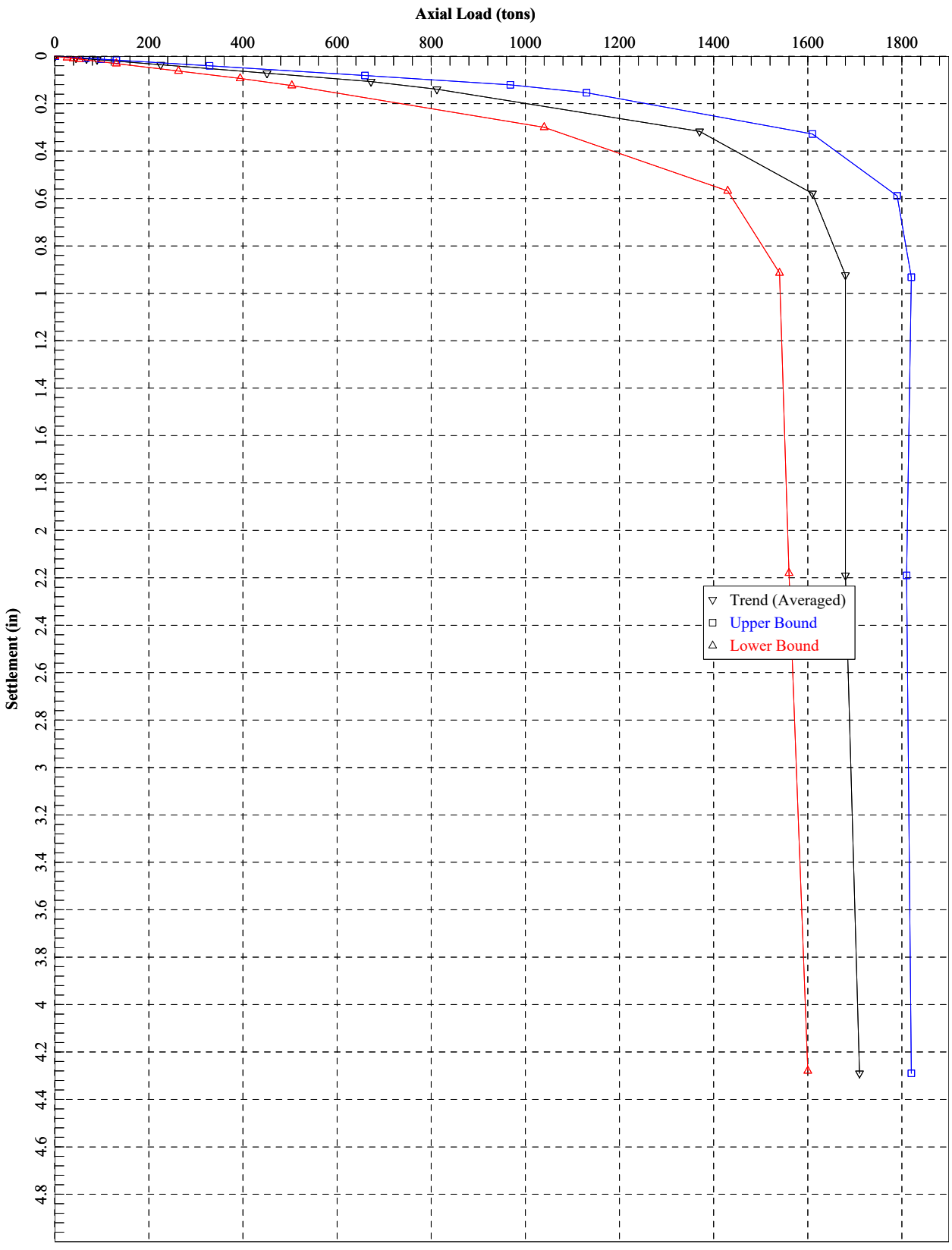
0.6570E+02	0.8114E-02	0.1922E+01	0.5000E-02
0.9854E+02	0.1217E-01	0.2883E+01	0.7500E-02
0.1314E+03	0.1623E-01	0.3844E+01	0.1000E-01
0.3292E+03	0.4059E-01	0.9609E+01	0.2500E-01
0.6589E+03	0.8121E-01	0.1922E+02	0.5000E-01
0.9680E+03	0.1213E+00	0.2883E+02	0.7500E-01
0.1132E+04	0.1542E+00	0.3844E+02	0.1000E+00
0.1608E+04	0.3280E+00	0.9609E+02	0.2500E+00
0.1792E+04	0.5891E+00	0.1698E+03	0.5000E+00
0.1819E+04	0.9316E+00	0.2052E+03	0.8400E+00
0.1810E+04	0.2193E+01	0.2627E+03	0.2100E+01
0.1819E+04	0.4293E+01	0.2722E+03	0.4200E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.5249E-01	0.1249E-04	0.1303E-02	0.1000E-04
0.2625E+00	0.6244E-04	0.6515E-02	0.5000E-04
0.5249E+00	0.1249E-03	0.1303E-01	0.1000E-03
0.2625E+02	0.6244E-02	0.6515E+00	0.5000E-02
0.3937E+02	0.9366E-02	0.9772E+00	0.7500E-02
0.5249E+02	0.1249E-01	0.1303E+01	0.1000E-01
0.1312E+03	0.3122E-01	0.3257E+01	0.2500E-01
0.2626E+03	0.6244E-01	0.6515E+01	0.5000E-01
0.3937E+03	0.9367E-01	0.9772E+01	0.7500E-01
0.5042E+03	0.1240E+00	0.1303E+02	0.1000E+00
0.1040E+04	0.3000E+00	0.3257E+02	0.2500E+00
0.1428E+04	0.5684E+00	0.6358E+02	0.5000E+00
0.1539E+04	0.9144E+00	0.1012E+03	0.8400E+00
0.1559E+04	0.2178E+01	0.2107E+03	0.2100E+01
0.1601E+04	0.4282E+01	0.2572E+03	0.4200E+01



Lone Mountain Bridge - Center Pier - 7-foot Diameter



Lone Mountain Bridge - Center Pier - 7-foot Diameter

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SHAFT for Windows, Version 2012.7.17

Serial Number : 157290693

VERTICALLY LOADED DRILLED SHAFT ANALYSIS

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Path to file locations : G:\2019 Projects\G-19-067 Lone Mountain Bridge Widening\SHAFT\
Name of input data file : East Abut.sfd
Name of output file : East Abut.sfo
Name of plot output file : East Abut.sfp
Name of runtime file : East Abut.sfr

Time and Date of Analysis

Date: January 15, 2020 Time: 16:29:35

G-19-067 Lone Mountain Bridge Widening East Abutment (No. 2)

PROPOSED DEPTH = 54.0 FT

NUMBER OF LAYERS = 14

WATER TABLE DEPTH = 91.0 FT.

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.867E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.220E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.220E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.124E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11

DEPTH, FT = 0.330E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.724E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.330E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.668E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.380E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.356E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.380E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.322E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.800E+01
SOIL UNIT WEIGHT, LB/CU FT = 0.115E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 5----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.440E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.505E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 6----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.541E+00

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.505E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.503E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.545E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 7----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.545E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.590E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO 8----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.590E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.620E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO 9----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.437E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.620E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.412E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.650E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO10----CLAY SHALE

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.650E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.750E+00
END BEARING COEFFICIENT-Nc = 0.700E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.100E+03
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.690E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.600E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.550E+00

LAYER NO11----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.150E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.690E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.150E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.760E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO12----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.323E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.132E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.760E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.263E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.132E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.840E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.550E+00

LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO13----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.119E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.840E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.100E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.119E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.910E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.450E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.400E+00

LAYER NO14----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.100E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.119E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.910E+02

AT THE BOTTOM

```
  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.119E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.964E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00
```

DRILLED SHAFT INFORMATION

```
 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.382E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.
```

PREDICTED RESULTS

```
QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.
```

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	LRFD QS (TONS)	LRFD QB (TONS)	LRFD QU (TONS)
1.0	0.26	0.37	13.33	13.70	0.20	6.67	6.87
2.0	0.52	1.47	15.85	17.32	0.81	7.92	8.73

3.0	0.79	3.31	18.36	21.67	1.82	9.18	11.00
4.0	1.05	5.88	20.87	26.75	3.24	10.44	13.67
5.0	1.31	9.19	23.39	32.57	5.05	11.69	16.75
6.0	1.57	13.13	25.90	39.03	7.22	12.95	20.17
7.0	1.83	17.68	28.41	46.09	9.72	14.21	23.93
8.0	2.09	22.81	30.93	53.74	12.55	15.46	28.01
9.0	2.36	28.52	33.44	61.96	15.68	16.72	32.41
10.0	2.62	34.76	35.96	70.72	19.12	17.98	37.10
11.0	2.88	41.53	38.47	80.00	22.84	19.24	42.08
12.0	3.14	48.81	40.98	89.79	26.84	20.49	47.34
13.0	3.40	56.57	43.50	100.07	31.11	21.75	52.86
14.0	3.67	64.80	46.01	110.81	35.64	23.01	58.64
15.0	3.93	73.48	48.53	122.00	40.41	24.26	64.68
16.0	4.19	82.59	51.04	133.63	45.43	25.52	70.95
17.0	4.45	92.13	58.16	150.29	50.67	29.08	79.75
18.0	4.71	102.07	65.40	167.48	56.14	32.70	88.84
19.0	4.97	112.40	72.70	185.10	61.82	36.35	98.17
20.0	5.24	123.11	77.33	200.44	67.71	38.66	106.38
21.0	5.50	134.18	79.53	213.71	73.80	39.77	113.57
22.0	5.76	145.60	79.53	225.13	80.08	31.81	111.89
23.0	6.02	152.08	79.53	231.61	83.00	31.81	114.81
24.0	6.28	158.56	79.53	238.09	85.91	31.81	117.73
25.0	6.55	165.04	79.53	244.57	88.83	31.81	120.64
26.0	6.81	171.52	79.53	251.05	91.75	31.81	123.56
27.0	7.07	178.00	79.53	257.53	94.66	31.81	126.47
28.0	7.33	184.48	78.66	263.14	97.58	31.46	129.04
29.0	7.59	190.96	77.66	268.63	100.49	31.06	131.56
30.0	7.86	197.44	76.54	273.98	103.41	30.62	134.03
31.0	8.12	203.92	75.79	279.72	106.33	30.32	136.64
32.0	8.38	210.40	75.42	285.82	109.24	30.17	139.41
33.0	8.64	216.89	66.62	283.50	112.16	33.31	145.47
34.0	8.90	231.29	56.56	287.85	120.08	28.28	148.36
35.0	9.16	245.87	45.25	291.11	128.10	22.62	150.72
36.0	9.43	260.62	37.70	298.32	136.21	18.85	155.06
37.0	9.69	275.53	33.93	309.47	144.41	16.97	161.38
38.0	9.95	290.60	33.93	324.53	152.70	16.97	169.67
39.0	10.21	298.70	131.71	430.41	157.16	65.85	223.01
40.0	10.47	306.86	243.45	550.30	161.64	121.72	283.37
41.0	10.74	315.06	369.16	684.22	166.16	184.58	350.73
42.0	11.00	323.31	452.96	776.28	170.69	226.48	397.18
43.0	11.26	331.61	494.86	826.47	175.26	247.43	422.69
44.0	11.52	339.94	494.86	834.80	179.84	272.18	452.01
45.0	11.78	353.27	494.86	848.14	187.84	272.18	460.01
46.0	12.04	366.61	428.28	794.90	195.84	235.56	431.40
47.0	12.31	379.95	352.19	732.14	203.85	193.70	397.55
48.0	12.57	393.29	266.58	659.87	211.85	146.62	358.47
49.0	12.83	406.63	209.51	616.14	219.85	115.23	335.08
50.0	13.09	419.97	159.46	579.43	227.86	87.70	315.56
51.0	13.35	433.31	134.87	568.17	235.86	67.43	303.29

52.0	13.62	449.46	107.20	556.66	244.75	53.60	298.34
53.0	13.88	465.64	88.75	554.39	253.64	44.38	298.02
54.0	14.14	481.83	167.63	649.46	262.55	83.82	346.36

RESULT FROM TREND (AVERAGED) LINE

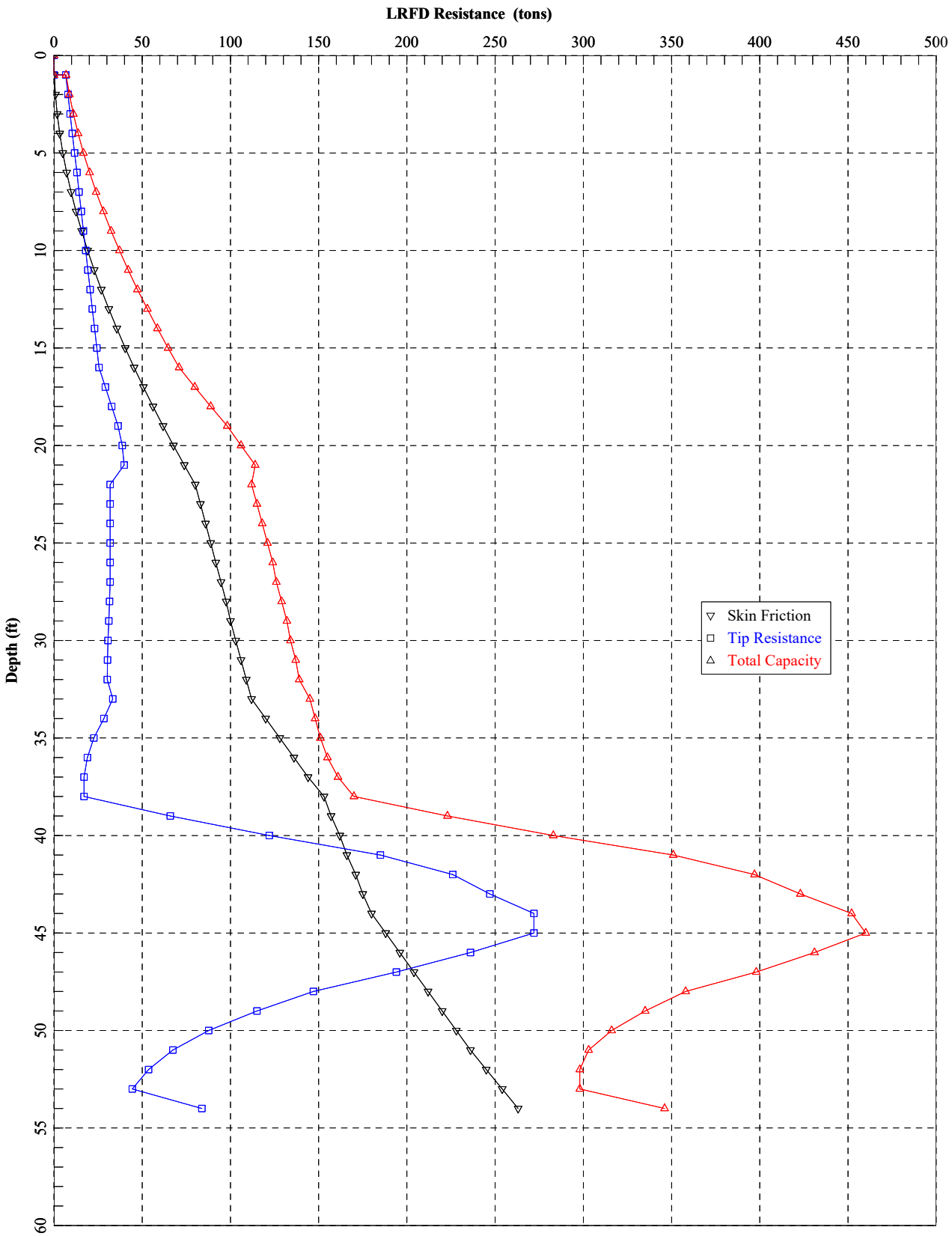
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7191E-01	0.2405E-04	0.3679E-02	0.1000E-04
0.3596E+00	0.1202E-03	0.1839E-01	0.5000E-04
0.7191E+00	0.2405E-03	0.3679E-01	0.1000E-03
0.3599E+02	0.1202E-01	0.1839E+01	0.5000E-02
0.5416E+02	0.1806E-01	0.2759E+01	0.7500E-02
0.7231E+02	0.2409E-01	0.3679E+01	0.1000E-01
0.1777E+03	0.6005E-01	0.9197E+01	0.2500E-01
0.2902E+03	0.1088E+00	0.1839E+02	0.5000E-01
0.3655E+03	0.1508E+00	0.2759E+02	0.7500E-01
0.4161E+03	0.1881E+00	0.3679E+02	0.1000E+00
0.5236E+03	0.3655E+00	0.7697E+02	0.2500E+00
0.5569E+03	0.6268E+00	0.1121E+03	0.5000E+00
0.5614E+03	0.7540E+00	0.1239E+03	0.6250E+00
0.5768E+03	0.1035E+01	0.1450E+03	0.9000E+00
0.5935E+03	0.1940E+01	0.1626E+03	0.1800E+01

RESULT FROM UPPER-BOUND LINE

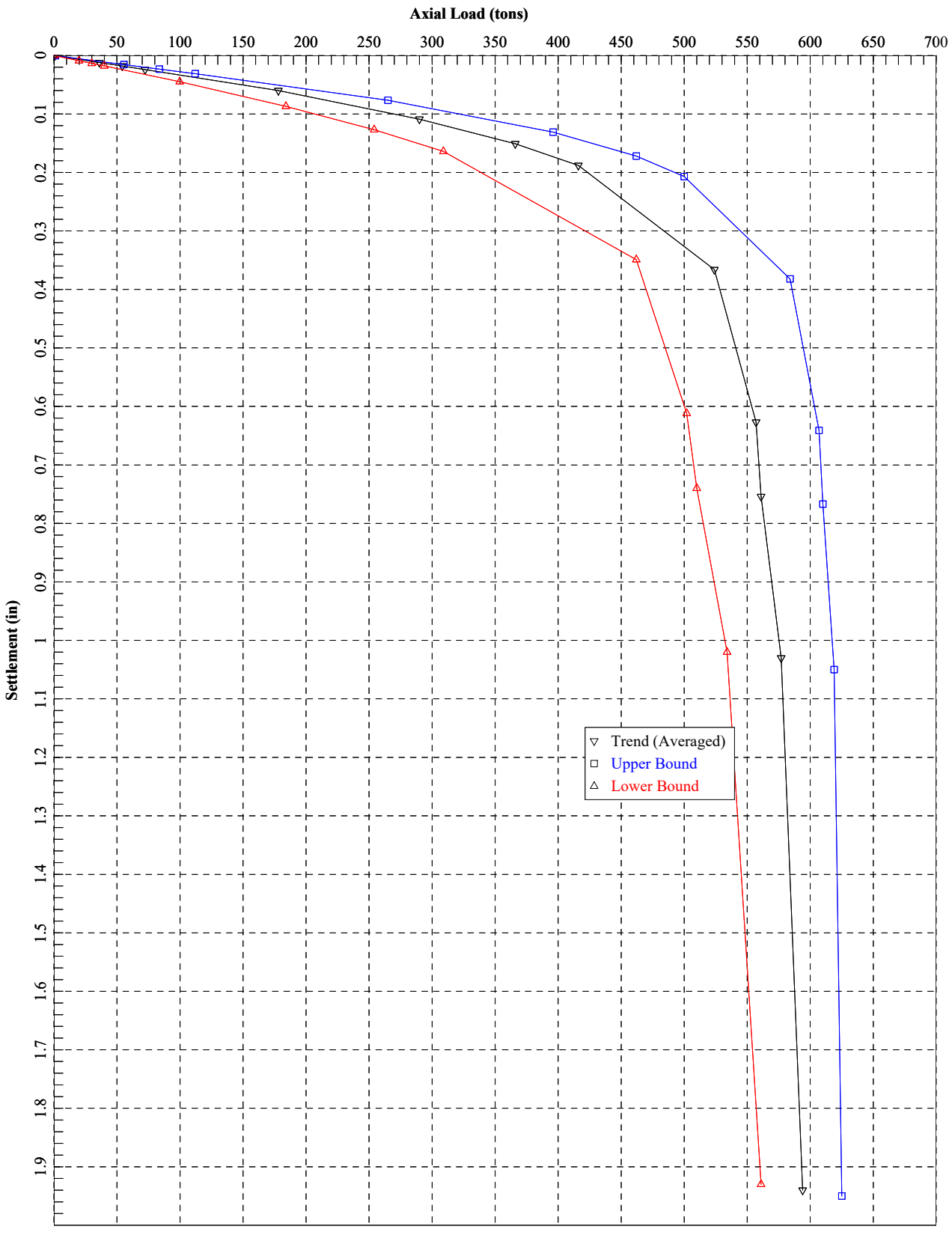
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1105E+00	0.3101E-04	0.5495E-02	0.1000E-04
0.5523E+00	0.1551E-03	0.2747E-01	0.5000E-04
0.1105E+01	0.3101E-03	0.5495E-01	0.1000E-03
0.5552E+02	0.1553E-01	0.2747E+01	0.5000E-02
0.8353E+02	0.2334E-01	0.4121E+01	0.7500E-02
0.1115E+03	0.3115E-01	0.5495E+01	0.1000E-01
0.2650E+03	0.7661E-01	0.1374E+02	0.2500E-01
0.3961E+03	0.1306E+00	0.2747E+02	0.5000E-01
0.4622E+03	0.1723E+00	0.4121E+02	0.7500E-01
0.5000E+03	0.2073E+00	0.5495E+02	0.1000E+00
0.5842E+03	0.3824E+00	0.1093E+03	0.2500E+00
0.6075E+03	0.6408E+00	0.1401E+03	0.5000E+00
0.6098E+03	0.7671E+00	0.1481E+03	0.6250E+00
0.6194E+03	0.1046E+01	0.1609E+03	0.9000E+00
0.6253E+03	0.1948E+01	0.1668E+03	0.1800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.3983E-01	0.1794E-04	0.1863E-02	0.1000E-04
0.1992E+00	0.8969E-04	0.9313E-02	0.5000E-04
0.3983E+00	0.1794E-03	0.1863E-01	0.1000E-03
0.1992E+02	0.8969E-02	0.9313E+00	0.5000E-02
0.2987E+02	0.1345E-01	0.1397E+01	0.7500E-02
0.3989E+02	0.1794E-01	0.1863E+01	0.1000E-01
0.9980E+02	0.4489E-01	0.4656E+01	0.2500E-01
0.1840E+03	0.8715E-01	0.9313E+01	0.5000E-01
0.2541E+03	0.1269E+00	0.1397E+02	0.7500E-01
0.3086E+03	0.1639E+00	0.1863E+02	0.1000E+00
0.4620E+03	0.3485E+00	0.4461E+02	0.2500E+00
0.5024E+03	0.6118E+00	0.8419E+02	0.5000E+00
0.5097E+03	0.7400E+00	0.9963E+02	0.6250E+00
0.5343E+03	0.1024E+01	0.1291E+03	0.9000E+00
0.5609E+03	0.1933E+01	0.1576E+03	0.1800E+01



Lone Mountain Bridge - East Abutment - 3-foot Diameter



Lone Mountain Bridge - East Abutment - 3-foot Diameter

Project Name: Lone Mountain Bridge Widening
Project No.: G-19-067

Flexible Pavement Design per
1993 AASHTO Guide for Design of Pavement Structures and
1996 NDOT Pavement Structural Design and Policy Manual

Lone Mountain Road between Rancho Drive and Tenaya Way

W_{18}	1,575,000	ESALs
R	85	Reliability (%)
Z_R	-1.037	Standard Normal Diviate
S_0	0.45	Standard Deviation
P_0	4.2	Initial Serviceability
P_t	2.5	Final Serviceability
R-Value	25	R-Value
M_R	5760	Resilient Modulus
SN	3.96	Required Structural Number

	Material	Layer Coefficient	Thickness	Drainage Coefficient	Resilient Modulus	Structural Number	Layer Required Structural Number	
Layer 1	NDOT PBS	0.35	6.5	N/A	450000	2.28	2.24	OK
Layer 2	NDOT AB	0.1	17	1	25440	1.70	3.96	OK
Layer 3	None	0	0	0	5760	0.00	3.96	OK

Design Structural Number 3.98 OK

Project Name: Lone Mountain Bridge Widening
Project No.: G-19-067

Flexible Pavement Design per
1993 AASHTO Guide for Design of Pavement Structures and
1996 NDOT Pavement Structural Design and Policy Manual

Lone Mountain Road between Rancho Drive and Tenaya Way

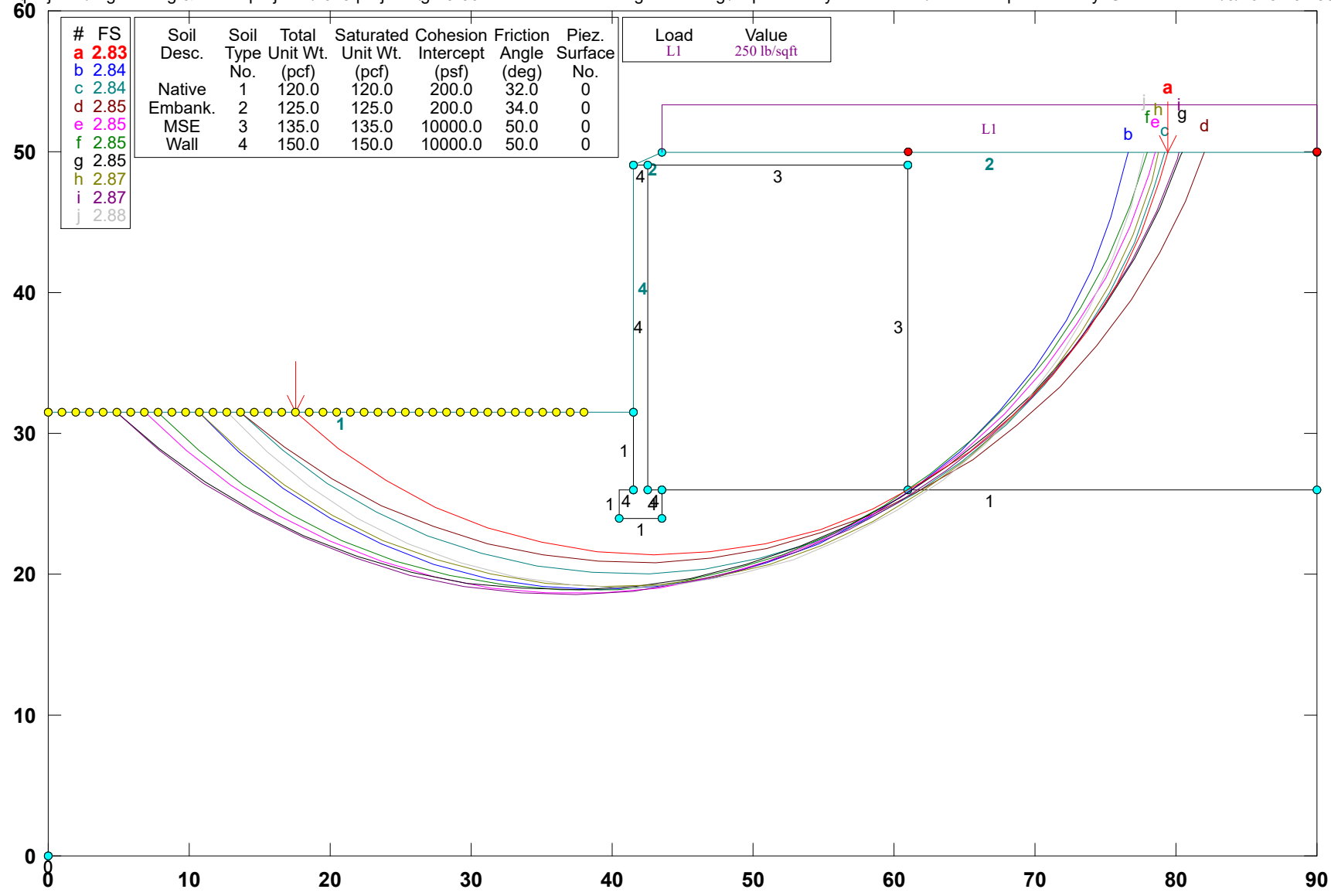
W_{18}	1,575,000	ESALs
R	85	Reliability (%)
Z_R	-1.037	Standard Normal Diviate
S_0	0.45	Standard Deviation
P_0	4.2	Initial Serviceability
P_t	2.5	Final Serviceability
R-Value	45	R-Value
M_R	11150	Resilient Modulus
SN	3.09	Required Structural Number

	Material	Layer Coefficient	Thickness	Drainage Coefficient	Resilient Modulus	Structural Number	Layer Required Structural Number	
Layer 1	NDOT PBS	0.35	6.5	N/A	450000	2.28	2.24	OK
Layer 2	NDOT AB	0.1	9	1	25440	0.90	3.09	OK
Layer 3	None	0	0	0	11150	0.00	3.09	OK
					Design Structural Number	3.18		OK

APPENDIX D

Lone Mtn. Bridge MSE Walls - Static

h:\projects\engineering & enviro projects\2019 projects\g-19-067 lone mountain bridge widening\slope stability - mse walls\mse walls.pl2 Run By: Username 12/6/2019 02:50PM



STABL6H FSmin=2.83

Safety Factors Are Calculated By The Modified Bishop Method

NOVA GEOTECHNICAL & inspection services

**** STABL6H ****

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop or Spencer`s Method of Slices

Run Date: 12/6/2019
Time of Run: 02:50PM
Run By: Username
Input Data Filename: H:mse walls.in
Output Filename: H:mse walls.OUT
Plotted Output Filename: H:mse walls.PLT
PROBLEM DESCRIPTION Lone Mtn. Bridge MSE Walls - Static

BOUNDARY COORDINATES

4 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	31.50	41.50	31.50	1
2	41.50	31.50	41.51	49.00	4
3	41.51	49.00	43.50	50.00	2
4	43.50	50.00	90.00	50.00	2
5	41.51	49.00	42.50	49.00	4
6	42.50	49.00	61.00	49.00	3
7	42.50	49.00	42.51	26.00	4
8	61.00	49.00	61.01	26.00	3
9	42.51	26.00	43.50	26.00	4
10	0.00	0.00	0.00	0.00	0
11	0.00	0.00	0.00	0.00	0
12	43.50	26.00	90.00	26.00	1
13	41.50	31.50	41.51	26.00	1
14	40.50	26.00	41.51	26.00	4
15	40.50	26.00	40.51	24.00	1
16	43.50	26.00	43.51	24.00	4
17	40.51	24.00	43.51	24.00	1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	200.0	32.0	0.00	0.0	0
2	125.0	125.0	200.0	34.0	0.00	0.0	0
3	135.0	135.0	10000.0	50.0	0.00	0.0	0
4	150.0	150.0	10000.0	50.0	0.00	0.0	0

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	43.50	90.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

800 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.
and X = 38.00 ft.

Each Surface Terminates Between X = 61.00 ft.
and X = 90.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

4.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.54	31.50
2	20.59	28.92

3	23.91	26.68
4	27.44	24.81
5	31.16	23.32
6	35.01	22.24
7	38.95	21.58
8	42.95	21.35
9	46.94	21.55
10	50.89	22.17
11	54.76	23.21
12	58.49	24.66
13	62.04	26.49
14	65.37	28.70
15	68.45	31.25
16	71.24	34.12
17	73.71	37.27
18	75.82	40.67
19	77.56	44.27
20	78.91	48.04
21	79.38	50.00

Circle Center At X = 43.1 ; Y = 58.7 and Radius, 37.3

*** 2.833 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.72	31.50
2	13.55	28.67
3	16.66	26.16
4	20.01	23.98
5	23.58	22.16
6	27.31	20.73
7	31.18	19.70
8	35.13	19.08
9	39.12	18.87
10	43.12	19.09
11	47.07	19.72
12	50.93	20.76
13	54.66	22.20
14	58.22	24.02
15	61.57	26.20
16	64.68	28.73
17	67.50	31.56
18	70.01	34.67
19	72.18	38.03
20	73.99	41.60
21	75.42	45.34
22	76.44	49.21
23	76.57	50.00

Circle Center At X = 39.1 ; Y = 57.0 and Radius, 38.2

*** 2.837 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.64	31.50
2	16.61	28.82
3	19.83	26.45
4	23.28	24.43
5	26.92	22.77
6	30.71	21.49
7	34.62	20.61
8	38.59	20.13
9	42.59	20.06
10	46.57	20.40
11	50.50	21.15
12	54.33	22.30
13	58.03	23.83
14	61.55	25.73
15	64.85	27.98
16	67.91	30.56
17	70.69	33.44
18	73.15	36.59
19	75.29	39.98
20	77.06	43.56

21	78.46	47.31
22	79.16	50.00

Circle Center At X = 41.3 ; Y = 59.0 and Radius, 39.0

*** 2.843 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.64	31.50
2	16.76	28.99
3	20.10	26.79
4	23.63	24.91
5	27.32	23.38
6	31.14	22.19
7	35.06	21.38
8	39.03	20.93
9	43.03	20.87
10	47.02	21.18
11	50.96	21.86
12	54.82	22.92
13	58.56	24.33
14	62.16	26.09
15	65.57	28.18
16	68.77	30.58
17	71.72	33.27
18	74.41	36.23
19	76.81	39.43
20	78.90	42.85
21	80.66	46.44
22	82.00	50.00

Circle Center At X = 41.7 ; Y = 63.2 and Radius, 42.4

*** 2.849 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	6.82	31.50
2	9.75	28.77
3	12.91	26.33
4	16.30	24.19
5	19.86	22.38
6	23.58	20.92
7	27.43	19.80
8	31.36	19.05
9	35.34	18.67
10	39.34	18.67
11	43.32	19.04
12	47.25	19.78
13	51.10	20.89
14	54.82	22.34
15	58.39	24.15
16	61.78	26.27
17	64.95	28.71
18	67.88	31.43
19	70.55	34.41
20	72.92	37.63
21	74.98	41.06
22	76.71	44.67
23	78.10	48.42
24	78.52	50.00

Circle Center At X = 37.4 ; Y = 61.3 and Radius, 42.7

*** 2.853 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.80	31.50
2	10.72	28.77
3	13.88	26.32
4	17.27	24.20
5	20.85	22.41
6	24.58	20.97
7	28.43	19.89
8	32.37	19.20
9	36.36	18.88

10	40.36	18.94
11	44.33	19.39
12	48.25	20.22
13	52.06	21.42
14	55.75	22.98
15	59.26	24.89
16	62.58	27.13
17	65.67	29.67
18	68.49	32.50
19	71.04	35.58
20	73.27	38.90
21	75.18	42.42
22	76.74	46.10
23	77.94	49.92
24	77.96	50.00

Circle Center At X = 37.7 ; Y = 60.5 and Radius, 41.6

*** 2.854 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.87	31.50
2	7.90	28.88
3	11.14	26.54
4	14.57	24.48
5	18.16	22.72
6	21.89	21.29
7	25.74	20.18
8	29.66	19.40
9	33.64	18.97
10	37.64	18.88
11	41.63	19.13
12	45.58	19.73
13	49.47	20.67
14	53.26	21.94
15	56.93	23.53
16	60.45	25.44
17	63.79	27.64
18	66.93	30.12
19	69.84	32.86
20	72.51	35.84
21	74.91	39.04
22	77.02	42.44
23	78.84	46.00
24	80.33	49.71
25	80.42	50.00

Circle Center At X = 36.7 ; Y = 65.2 and Radius, 46.3

*** 2.854 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.72	31.50
2	13.62	28.75
3	16.79	26.30
4	20.18	24.18
5	23.76	22.41
6	27.51	21.00
7	31.37	19.97
8	35.32	19.33
9	39.31	19.09
10	43.31	19.25
11	47.27	19.80
12	51.16	20.75
13	54.93	22.08
14	58.55	23.77
15	61.99	25.82
16	65.21	28.20
17	68.17	30.89
18	70.85	33.86
19	73.22	37.08
20	75.26	40.52
21	76.94	44.15
22	78.26	47.93

23	78.76	50.00

Circle Center At X = 39.7 ; Y = 59.2 and Radius, 40.1

*** 2.865 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.87	31.50
2	7.86	28.84
3	11.07	26.46
4	14.48	24.36
5	18.06	22.57
6	21.78	21.10
7	25.61	19.96
8	29.53	19.16
9	33.50	18.70
10	37.50	18.59
11	41.50	18.83
12	45.45	19.42
13	49.34	20.35
14	53.14	21.61
15	56.81	23.20
16	60.32	25.11
17	63.66	27.32
18	66.79	29.80
19	69.69	32.56
20	72.35	35.55
21	74.73	38.77
22	76.82	42.18
23	78.60	45.75
24	80.07	49.48
25	80.22	50.00

Circle Center At X = 36.8 ; Y = 64.4 and Radius, 45.8

*** 2.871 ***

Failure Surface Specified By 22 Coordinate Points

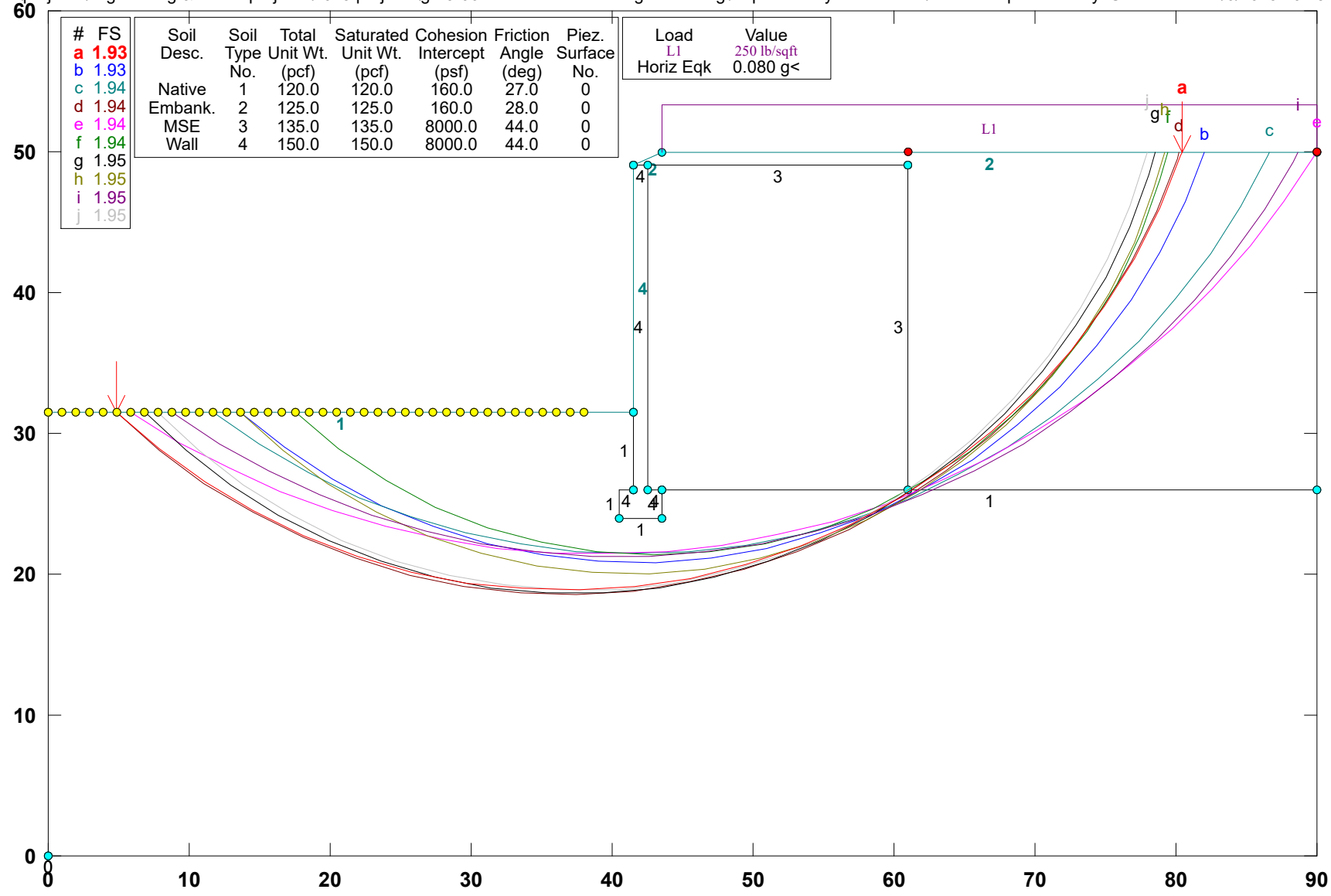
Point No.	X-Surf (ft)	Y-Surf (ft)
1	12.67	31.50
2	15.50	28.67
3	18.61	26.16
4	21.97	24.00
5	25.55	22.20
6	29.29	20.79
7	33.16	19.79
8	37.12	19.20
9	41.12	19.04
10	45.11	19.30
11	49.05	19.99
12	52.90	21.08
13	56.61	22.58
14	60.13	24.47
15	63.44	26.72
16	66.49	29.30
17	69.25	32.20
18	71.69	35.37
19	73.78	38.79
20	75.49	42.40
21	76.81	46.18
22	77.70	50.00

Circle Center At X = 40.7 ; Y = 56.7 and Radius, 37.7

*** 2.877 ***

Lone Mtn. Bridge MSE Walls - Seismic

h:\projects\engineering & enviro projects\2019 projects\g-19-067 lone mountain bridge widening\slope stability - mse walls\mse walls.pl2 Run By: Username 12/6/2019 02:52PM



STABL6H FSmin=1.93

Safety Factors Are Calculated By The Modified Bishop Method

NOVA GEOTECHNICAL & inspection services

**** STABL6H ****

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer`s Method of Slices

Run Date: 12/6/2019
Time of Run: 02:52PM
Run By: Username
Input Data Filename: H:mse walls.in
Output Filename: H:mse walls.OUT
Plotted Output Filename: H:mse walls.PLT
PROBLEM DESCRIPTION Lone Mtn. Bridge MSE Walls - Seismic

BOUNDARY COORDINATES

4 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	31.50	41.50	31.50	1
2	41.50	31.50	41.51	49.00	4
3	41.51	49.00	43.50	50.00	2
4	43.50	50.00	90.00	50.00	2
5	41.51	49.00	42.50	49.00	4
6	42.50	49.00	61.00	49.00	3
7	42.50	49.00	42.51	26.00	4
8	61.00	49.00	61.01	26.00	3
9	42.51	26.00	43.50	26.00	4
10	0.00	0.00	0.00	0.00	0
11	0.00	0.00	0.00	0.00	0
12	43.50	26.00	90.00	26.00	1
13	41.50	31.50	41.51	26.00	1
14	40.50	26.00	41.51	26.00	4
15	40.50	26.00	40.51	24.00	1
16	43.50	26.00	43.51	24.00	4
17	40.51	24.00	43.51	24.00	1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	160.0	27.0	0.00	0.0	0
2	125.0	125.0	160.0	28.0	0.00	0.0	0
3	135.0	135.0	8000.0	44.0	0.00	0.0	0
4	150.0	150.0	8000.0	44.0	0.00	0.0	0

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	43.50	90.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.080 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 psf
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
800 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.
and X = 38.00 ft.
Each Surface Terminates Between X = 61.00 ft.
and X = 90.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.
4.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.87	31.50
2	7.90	28.88
3	11.14	26.54
4	14.57	24.48
5	18.16	22.72
6	21.89	21.29
7	25.74	20.18
8	29.66	19.40
9	33.64	18.97
10	37.64	18.88
11	41.63	19.13
12	45.58	19.73
13	49.47	20.67
14	53.26	21.94
15	56.93	23.53
16	60.45	25.44
17	63.79	27.64
18	66.93	30.12
19	69.84	32.86
20	72.51	35.84
21	74.91	39.04
22	77.02	42.44
23	78.84	46.00
24	80.33	49.71
25	80.42	50.00

Circle Center At X = 36.7 ; Y = 65.2 and Radius, 46.3

*** 1.929 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.64	31.50
2	16.76	28.99
3	20.10	26.79
4	23.63	24.91
5	27.32	23.38
6	31.14	22.19
7	35.06	21.38
8	39.03	20.93
9	43.03	20.87
10	47.02	21.18
11	50.96	21.86
12	54.82	22.92
13	58.56	24.33
14	62.16	26.09
15	65.57	28.18
16	68.77	30.58
17	71.72	33.27
18	74.41	36.23
19	76.81	39.43
20	78.90	42.85
21	80.66	46.44
22	82.00	50.00

Circle Center At X = 41.7 ; Y = 63.2 and Radius, 42.4

*** 1.932 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.69	31.50
2	14.98	29.22
3	18.44	27.21
4	22.04	25.48
5	25.78	24.05
6	29.62	22.93
7	33.53	22.11
8	37.50	21.62
9	41.50	21.45
10	45.50	21.59
11	49.47	22.06
12	53.39	22.85

13	57.24	23.95
14	60.98	25.36
15	64.60	27.07
16	68.07	29.06
17	71.37	31.32
18	74.47	33.84
19	77.37	36.60
20	80.03	39.59
21	82.44	42.78
22	84.59	46.15
23	86.46	49.69
24	86.59	50.00

Circle Center At X = 41.7 ; Y = 71.1 and Radius, 49.7

*** 1.935 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.87	31.50
2	7.86	28.84
3	11.07	26.46
4	14.48	24.36
5	18.06	22.57
6	21.78	21.10
7	25.61	19.96
8	29.53	19.16
9	33.50	18.70
10	37.50	18.59
11	41.50	18.83
12	45.45	19.42
13	49.34	20.35
14	53.14	21.61
15	56.81	23.20
16	60.32	25.11
17	63.66	27.32
18	66.79	29.80
19	69.69	32.56
20	72.35	35.55
21	74.73	38.77
22	76.82	42.18
23	78.60	45.75
24	80.07	49.48
25	80.22	50.00

Circle Center At X = 36.8 ; Y = 64.4 and Radius, 45.8

*** 1.942 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.85	31.50
2	9.24	29.39
3	12.78	27.51
4	16.42	25.87
5	20.18	24.48
6	24.01	23.35
7	27.91	22.47
8	31.87	21.86
9	35.85	21.51
10	39.85	21.43
11	43.85	21.62
12	47.82	22.08
13	51.75	22.80
14	55.63	23.78
15	59.43	25.02
16	63.15	26.51
17	66.75	28.25
18	70.23	30.23
19	73.57	32.43
20	76.75	34.85
21	79.76	37.48
22	82.59	40.31
23	85.23	43.32
24	87.66	46.49
25	89.87	49.83

26	89.97	50.00

Circle Center At X = 39.0 ; Y = 81.1 and Radius, 59.7

*** 1.943 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.54	31.50
2	20.59	28.92
3	23.91	26.68
4	27.44	24.81
5	31.16	23.32
6	35.01	22.24
7	38.95	21.58
8	42.95	21.35
9	46.94	21.55
10	50.89	22.17
11	54.76	23.21
12	58.49	24.66
13	62.04	26.49
14	65.37	28.70
15	68.45	31.25
16	71.24	34.12
17	73.71	37.27
18	75.82	40.67
19	77.56	44.27
20	78.91	48.04
21	79.38	50.00

Circle Center At X = 43.1 ; Y = 58.7 and Radius, 37.3

*** 1.944 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	6.82	31.50
2	9.75	28.77
3	12.91	26.33
4	16.30	24.19
5	19.86	22.38
6	23.58	20.92
7	27.43	19.80
8	31.36	19.05
9	35.34	18.67
10	39.34	18.67
11	43.32	19.04
12	47.25	19.78
13	51.10	20.89
14	54.82	22.34
15	58.39	24.15
16	61.78	26.27
17	64.95	28.71
18	67.88	31.43
19	70.55	34.41
20	72.92	37.63
21	74.98	41.06
22	76.71	44.67
23	78.10	48.42
24	78.52	50.00

Circle Center At X = 37.4 ; Y = 61.3 and Radius, 42.7

*** 1.945 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.64	31.50
2	16.61	28.82
3	19.83	26.45
4	23.28	24.43
5	26.92	22.77
6	30.71	21.49
7	34.62	20.61
8	38.59	20.13
9	42.59	20.06
10	46.57	20.40
11	50.50	21.15

12	54.33	22.30
13	58.03	23.83
14	61.55	25.73
15	64.85	27.98
16	67.91	30.56
17	70.69	33.44
18	73.15	36.59
19	75.29	39.98
20	77.06	43.56
21	78.46	47.31
22	79.16	50.00

Circle Center At X = 41.3 ; Y = 59.0 and Radius, 39.0

*** 1.949 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.77	31.50
2	12.10	29.29
3	15.59	27.33
4	19.21	25.62
5	22.94	24.19
6	26.77	23.04
7	30.68	22.17
8	34.63	21.58
9	38.62	21.29
10	42.62	21.29
11	46.61	21.58
12	50.57	22.17
13	54.47	23.04
14	58.30	24.19
15	62.04	25.63
16	65.66	27.33
17	69.14	29.29
18	72.48	31.50
19	75.64	33.95
20	78.61	36.63
21	81.38	39.51
22	83.93	42.59
23	86.25	45.85
24	88.33	49.27
25	88.70	50.00

Circle Center At X = 40.6 ; Y = 75.9 and Radius, 54.6

*** 1.950 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.80	31.50
2	10.72	28.77
3	13.88	26.32
4	17.27	24.20
5	20.85	22.41
6	24.58	20.97
7	28.43	19.89
8	32.37	19.20
9	36.36	18.88
10	40.36	18.94
11	44.33	19.39
12	48.25	20.22
13	52.06	21.42
14	55.75	22.98
15	59.26	24.89
16	62.58	27.13
17	65.67	29.67
18	68.49	32.50
19	71.04	35.58
20	73.27	38.90
21	75.18	42.42
22	76.74	46.10
23	77.94	49.92
24	77.96	50.00

Circle Center At X = 37.7 ; Y = 60.5 and Radius, 41.6

*** 1.951 ***

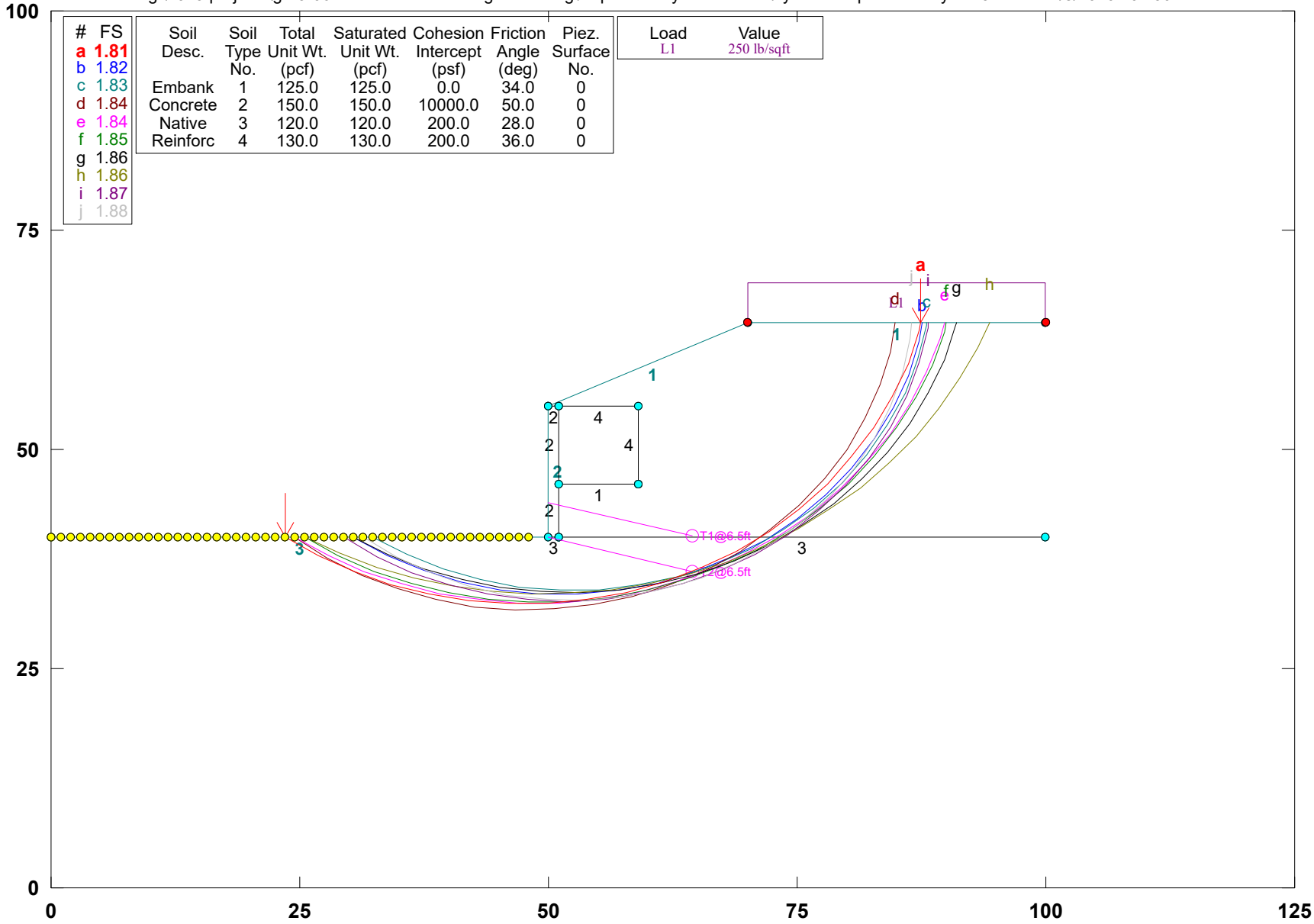
Lone Mtn. Hybrid Wall Abut. 2 - Static

g:\2019 projects\g-19-067 lone mountain bridge widening\slope stability - mse walls\hybrid wall.pl2 Run By: M. Jensen 1/8/2020 04:30PM

#	FS
a	1.81
b	1.82
c	1.83
d	1.84
e	1.84
f	1.85
g	1.86
h	1.86
i	1.87
j	1.88

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Embank	1	125.0	125.0	0.0	34.0	0
Concrete	2	150.0	150.0	10000.0	50.0	0
Native	3	120.0	120.0	200.0	28.0	0
Reinforc	4	130.0	130.0	200.0	36.0	0

Load	Value
L1	250 lb/sqft



STABL6H FSmin=1.81

Safety Factors Are Calculated By The Modified Bishop Method

NOVA GEOTECHNICAL & inspection services

**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/8/2020
Time of Run: 04:30PM
Run By: M. Jensen
Input Data Filename: G:hybrid wall.in
Output Filename: G:hybrid wall.OUT
Plotted Output Filename: G:hybrid wall.PLT
PROBLEM DESCRIPTION Lone Mtn. Hybrid Wall Abut. 2 - Static

BOUNDARY COORDINATES
4 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	40.00	50.00	40.00	3
2	50.00	40.00	50.01	55.00	2
3	50.01	55.00	70.00	64.50	1
4	70.00	64.50	100.00	64.50	1
5	50.01	55.00	51.00	55.00	2
6	51.00	55.00	59.00	55.00	4
7	59.00	55.00	59.01	46.00	4
8	51.00	55.00	51.01	46.00	2
9	51.01	46.00	59.01	46.00	1
10	51.01	46.00	51.02	40.00	2
11	50.00	40.00	51.02	40.00	3
12	51.01	40.00	100.00	40.00	3

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	0.0	34.0	0.00	0.0	0
2	150.0	150.0	10000.0	50.0	0.00	0.0	0
3	120.0	120.0	200.0	28.0	0.00	0.0	0
4	130.0	130.0	200.0	36.0	0.00	0.0	0

BOUNDARY LOAD(S)
1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	70.00	100.00	250.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.
A Horizontal Earthquake Loading Coefficient
Of0.080 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 psf
A Horizontal Earthquake Loading Coefficient
Of0.000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 psf

TIEBACK LOAD(S)
2 Tieback Load(s) Specified

Tieback No.	X-Pos (ft)	Y-Pos (ft)	Load (lbs)	Spacing (ft)	Inclination (deg)	Length (ft)
1	50.00	44.00	40900.0	6.5	15.00	15.0
2	50.00	40.01	37600.0	6.5	15.00	15.0

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks Assuming A Uniform Distribution Of Load Horizontally Between Individual Tiebacks.
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 50 Points Equally Spaced

Along The Ground Surface Between X =   0.00 ft.
and X = 48.00 ft.
Each Surface Terminates Between   X = 70.00 ft.
and   X = 100.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
4.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.51	40.00
2	26.88	37.84
3	30.44	36.01
4	34.16	34.54
5	38.00	33.44
6	41.94	32.72
7	45.92	32.38
8	49.92	32.43
9	53.90	32.88
10	57.81	33.70
11	61.63	34.90
12	65.31	36.47
13	68.82	38.39
14	72.12	40.63
15	75.20	43.19
16	78.01	46.04
17	80.53	49.15
18	82.73	52.48
19	84.61	56.02
20	86.12	59.72
21	87.28	63.55
22	87.46	64.50

Circle Center At X = 47.4 ; Y = 73.5 and Radius, 41.1
*** 1.809 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.37	40.00
2	33.78	37.91
3	37.39	36.20
4	41.17	34.89
5	45.07	34.00
6	49.05	33.54
7	53.05	33.51
8	57.02	33.91
9	60.94	34.75
10	64.73	36.01
11	68.37	37.67
12	71.81	39.71
13	75.01	42.12
14	77.92	44.86
15	80.52	47.90
16	82.78	51.20
17	84.66	54.73
18	86.15	58.44
19	87.23	62.29
20	87.59	64.50

Circle Center At X = 51.3 ; Y = 70.3 and Radius, 36.8
*** 1.820 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.33	40.00
2	35.77	37.97
3	39.42	36.33
4	43.23	35.10

5	47.15	34.30
6	51.13	33.95
7	55.13	34.03
8	59.10	34.55
9	62.98	35.52
10	66.73	36.90
11	70.31	38.69
12	73.67	40.87
13	76.76	43.40
14	79.56	46.26
15	82.02	49.41
16	84.12	52.82
17	85.83	56.43
18	87.13	60.21
19	88.00	64.12
20	88.05	64.50

Circle Center At X = 52.4 ; Y = 70.0 and Radius, 36.1

*** 1.833 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.49	40.00
2	27.73	37.65
3	31.20	35.66
4	34.86	34.06
5	38.68	32.86
6	42.60	32.07
7	46.59	31.71
8	50.59	31.78
9	54.55	32.28
10	58.45	33.20
11	62.22	34.54
12	65.82	36.27
13	69.22	38.38
14	72.38	40.84
15	75.25	43.62
16	77.81	46.70
17	80.02	50.03
18	81.86	53.58
19	83.31	57.31
20	84.35	61.17
21	84.88	64.50

Circle Center At X = 47.9 ; Y = 68.9 and Radius, 37.2

*** 1.840 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.49	40.00
2	27.88	37.88
3	31.46	36.09
4	35.19	34.65
5	39.04	33.56
6	42.97	32.84
7	46.96	32.49
8	50.96	32.51
9	54.94	32.91
10	58.86	33.69
11	62.70	34.83
12	66.41	36.32
13	69.96	38.16
14	73.33	40.32
15	76.47	42.79
16	79.37	45.54
17	82.00	48.56
18	84.34	51.81
19	86.36	55.26
20	88.04	58.89
21	89.38	62.66
22	89.85	64.50

Circle Center At X = 48.7 ; Y = 75.0 and Radius, 42.5

```
      ***     1.842   ***
Failure Surface Specified By 22 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         25.47       40.00
    2         28.87       37.89
    3         32.45       36.11
    4         36.19       34.68
    5         40.04       33.62
    6         43.98       32.92
    7         47.97       32.61
    8         51.97       32.67
    9         55.94       33.11
   10         59.86       33.93
   11         63.68       35.12
   12         67.37       36.67
   13         70.89       38.56
   14         74.22       40.78
   15         77.33       43.30
   16         80.18       46.11
   17         82.75       49.17
   18         85.01       52.47
   19         86.95       55.96
   20         88.55       59.63
   21         89.80       63.43
   22         90.04       64.50
Circle Center At X =   49.3 ; Y =   74.6  and Radius,   42.0
      ***     1.846   ***
Failure Surface Specified By 21 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         30.37       40.00
    2         33.84       38.01
    3         37.49       36.38
    4         41.29       35.12
    5         45.19       34.25
    6         49.16       33.76
    7         53.16       33.68
    8         57.15       33.99
    9         61.09       34.70
   10         64.93       35.80
   11         68.65       37.28
   12         72.20       39.12
   13         75.55       41.30
   14         78.67       43.81
   15         81.52       46.61
   16         84.08       49.69
   17         86.32       53.00
   18         88.22       56.52
   19         89.76       60.21
   20         90.92       64.04
   21         91.01       64.50
Circle Center At X =   52.0 ; Y =   73.8  and Radius,   40.1
      ***     1.856   ***
Failure Surface Specified By 22 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         25.47       40.00
    2         29.01       38.14
    3         32.70       36.59
    4         36.50       35.34
    5         40.39       34.42
    6         44.35       33.82
    7         48.34       33.56
    8         52.34       33.63
    9         56.32       34.03
   10         60.25       34.76
   11         64.11       35.82
   12         67.86       37.19
   13         71.49       38.87
```

14	74.97	40.85
15	78.27	43.11
16	81.37	45.64
17	84.25	48.42
18	86.88	51.43
19	89.26	54.64
20	91.36	58.05
21	93.17	61.62
22	94.35	64.50

Circle Center At X = 49.5 ; Y = 81.5 and Radius, 48.0

*** 1.860 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.39	40.00
2	32.72	37.79
3	36.28	35.95
4	40.01	34.51
5	43.87	33.48
6	47.82	32.86
7	51.82	32.68
8	55.81	32.93
9	59.75	33.60
10	63.60	34.70
11	67.31	36.21
12	70.83	38.10
13	74.13	40.36
14	77.17	42.97
15	79.90	45.88
16	82.31	49.07
17	84.36	52.51
18	86.03	56.14
19	87.30	59.94
20	88.15	63.85
21	88.23	64.50

Circle Center At X = 51.5 ; Y = 69.8 and Radius, 37.1

*** 1.871 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.35	40.00
2	34.65	37.74
3	38.18	35.87
4	41.92	34.43
5	45.79	33.44
6	49.75	32.90
7	53.75	32.83
8	57.73	33.22
9	61.64	34.07
10	65.42	35.38
11	69.03	37.11
12	72.41	39.25
13	75.51	41.77
14	78.30	44.64
15	80.74	47.81
16	82.79	51.24
17	84.43	54.89
18	85.64	58.71
19	86.39	62.64
20	86.52	64.50

Circle Center At X = 52.4 ; Y = 67.1 and Radius, 34.3

*** 1.878 ***

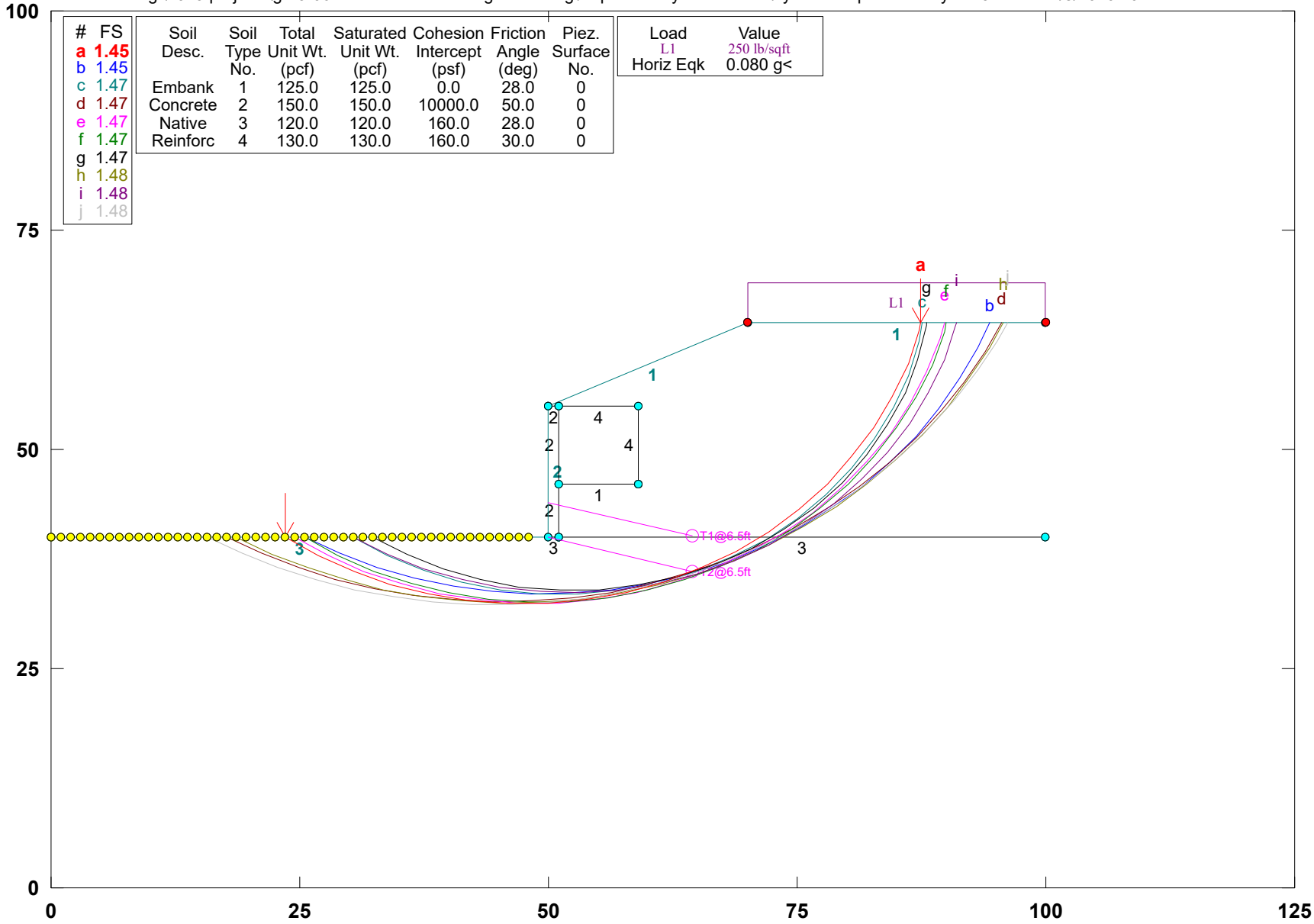
Lone Mtn. Hybrid Wall Abut. 2 - Seismic

g:\2019 projects\g-19-067 lone mountain bridge widening\slope stability - mse walls\hybrid wall.pl2 Run By: M. Jensen 1/8/2020 04:21PM

#	FS
a	1.45
b	1.45
c	1.47
d	1.47
e	1.47
f	1.47
g	1.47
h	1.48
i	1.48
j	1.48

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Embank	1	125.0	125.0	0.0	28.0	0
Concrete	2	150.0	150.0	10000.0	50.0	0
Native	3	120.0	120.0	160.0	28.0	0
Reinforc	4	130.0	130.0	160.0	30.0	0

Load	Value
L1	250 lb/sqft
Horiz Eqk	0.080 g<



STABL6H FSmin=1.45

Safety Factors Are Calculated By The Modified Bishop Method

NOVA GEOTECHNICAL & inspection services

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                    ** STABL6H  **
                         by
                    Purdue University
               --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer`s Method of Slices
 Run Date:                 1/8/2020
 Time of Run:              04:21PM
 Run By:                   M. Jensen
 Input Data Filename:      G:hybrid wall.in
 Output Filename:          G:hybrid wall.OUT
 Plotted Output Filename:  G:hybrid wall.PLT
 PROBLEM DESCRIPTION   Lone Mtn. Hybrid Wall Abut. 2 -
                       Seismic
 BOUNDARY COORDINATES
     4 Top   Boundaries
    12 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)    Below Bnd
     1          0.00      40.00      50.00      40.00        3
     2         50.00      40.00      50.01      55.00        2
     3         50.01      55.00      70.00      64.50        1
     4         70.00      64.50     100.00      64.50        1
     5         50.01      55.00      51.00      55.00        2
     6         51.00      55.00      59.00      55.00        4
     7         59.00      55.00      59.01      46.00        4
     8         51.00      55.00      51.01      46.00        2
     9         51.01      46.00      59.01      46.00        1
    10         51.01      46.00      51.02      40.00        2
    11         50.00      40.00      51.02      40.00        3
    12         51.01      40.00     100.00      40.00        3
ISOTROPIC SOIL PARAMETERS
  4 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   125.0    125.0       0.0     28.0    0.00       0.0      0
   2   150.0    150.0   10000.0     50.0    0.00       0.0      0
   3   120.0    120.0     160.0     28.0    0.00       0.0      0
   4   130.0    130.0     160.0     30.0    0.00       0.0      0
BOUNDARY LOAD(S)
     1 Load(s) Specified
 Load        X-Left      X-Right     Intensity     Deflection
  No.         (ft)         (ft)      (lb/sqft)       (deg)
   1         70.00       100.00        250.0          0.0
 NOTE - Intensity Is Specified As A Uniformly Distributed
        Force Acting On A Horizontally Projected Surface.
 A Horizontal Earthquake Loading Coefficient
 Of0.080 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of0.000 Has Been Assigned
 Cavitation Pressure =    0.0 psf
TIEBACK LOAD(S)
     2 Tieback Load(s) Specified
 Tieback   X-Pos    Y-Pos     Load    Spacing  Inclination  Length
   No.     (ft)     (ft)      (lbs)     (ft)      (deg)      (ft)
    1      50.00    44.00    40900.0     6.5      15.00       15.0
    2      50.00    40.01    37600.0     6.5      15.00       15.0
 NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
        Assuming A Uniform Distribution Of Load Horizontally Between
        Individual Tiebacks.
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
  20 Surfaces Initiate From Each Of 50 Points Equally Spaced
```

Along The Ground Surface Between X =   0.00 ft.
and X = 48.00 ft.
Each Surface Terminates Between X = 70.00 ft.
and X = 100.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
4.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.51	40.00
2	26.88	37.84
3	30.44	36.01
4	34.16	34.54
5	38.00	33.44
6	41.94	32.72
7	45.92	32.38
8	49.92	32.43
9	53.90	32.88
10	57.81	33.70
11	61.63	34.90
12	65.31	36.47
13	68.82	38.39
14	72.12	40.63
15	75.20	43.19
16	78.01	46.04
17	80.53	49.15
18	82.73	52.48
19	84.61	56.02
20	86.12	59.72
21	87.28	63.55
22	87.46	64.50

Circle Center At X = 47.4 ; Y = 73.5 and Radius, 41.1
*** 1.446 ***
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.47	40.00
2	29.01	38.14
3	32.70	36.59
4	36.50	35.34
5	40.39	34.42
6	44.35	33.82
7	48.34	33.56
8	52.34	33.63
9	56.32	34.03
10	60.25	34.76
11	64.11	35.82
12	67.86	37.19
13	71.49	38.87
14	74.97	40.85
15	78.27	43.11
16	81.37	45.64
17	84.25	48.42
18	86.88	51.43
19	89.26	54.64
20	91.36	58.05
21	93.17	61.62
22	94.35	64.50

Circle Center At X = 49.5 ; Y = 81.5 and Radius, 48.0
*** 1.454 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.37	40.00
2	33.78	37.91
3	37.39	36.20
4	41.17	34.89
5	45.07	34.00
6	49.05	33.54
7	53.05	33.51
8	57.02	33.91
9	60.94	34.75
10	64.73	36.01
11	68.37	37.67
12	71.81	39.71
13	75.01	42.12
14	77.92	44.86
15	80.52	47.90
16	82.78	51.20
17	84.66	54.73
18	86.15	58.44
19	87.23	62.29
20	87.59	64.50

Circle Center At X = 51.3 ; Y = 70.3 and Radius, 36.8

*** 1.465 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.63	40.00
2	21.17	38.14
3	24.84	36.53
4	28.61	35.19
5	32.46	34.13
6	36.38	33.35
7	40.35	32.85
8	44.35	32.64
9	48.35	32.71
10	52.33	33.08
11	56.28	33.72
12	60.17	34.65
13	63.98	35.86
14	67.70	37.34
15	71.30	39.08
16	74.76	41.08
17	78.08	43.32
18	81.22	45.79
19	84.18	48.49
20	86.94	51.39
21	89.48	54.48
22	91.79	57.74
23	93.86	61.16
24	95.57	64.50

Circle Center At X = 45.3 ; Y = 88.2 and Radius, 55.6

*** 1.466 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.49	40.00
2	27.88	37.88
3	31.46	36.09
4	35.19	34.65
5	39.04	33.56
6	42.97	32.84
7	46.96	32.49
8	50.96	32.51
9	54.94	32.91
10	58.86	33.69

11	62.70	34.83
12	66.41	36.32
13	69.96	38.16
14	73.33	40.32
15	76.47	42.79
16	79.37	45.54
17	82.00	48.56
18	84.34	51.81
19	86.36	55.26
20	88.04	58.89
21	89.38	62.66
22	89.85	64.50

Circle Center At X = 48.7 ; Y = 75.0 and Radius, 42.5

*** 1.469 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.47	40.00
2	28.87	37.89
3	32.45	36.11
4	36.19	34.68
5	40.04	33.62
6	43.98	32.92
7	47.97	32.61
8	51.97	32.67
9	55.94	33.11
10	59.86	33.93
11	63.68	35.12
12	67.37	36.67
13	70.89	38.56
14	74.22	40.78
15	77.33	43.30
16	80.18	46.11
17	82.75	49.17
18	85.01	52.47
19	86.95	55.96
20	88.55	59.63
21	89.80	63.43
22	90.04	64.50

Circle Center At X = 49.3 ; Y = 74.6 and Radius, 42.0

*** 1.473 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.33	40.00
2	35.77	37.97
3	39.42	36.33
4	43.23	35.10
5	47.15	34.30
6	51.13	33.95
7	55.13	34.03
8	59.10	34.55
9	62.98	35.52
10	66.73	36.90
11	70.31	38.69
12	73.67	40.87
13	76.76	43.40
14	79.56	46.26
15	82.02	49.41
16	84.12	52.82
17	85.83	56.43
18	87.13	60.21
19	88.00	64.12
20	88.05	64.50

Circle Center At X = 52.4 ; Y = 70.0 and Radius, 36.1

*** 1.473 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	18.61	40.00
2	22.13	38.10
3	25.78	36.46
4	29.54	35.10
5	33.39	34.02
6	37.31	33.22
7	41.28	32.71
8	45.28	32.50
9	49.27	32.58
10	53.26	32.96
11	57.20	33.63
12	61.08	34.58
13	64.89	35.82
14	68.59	37.34
15	72.17	39.12
16	75.61	41.17
17	78.89	43.46
18	81.99	45.99
19	84.89	48.73
20	87.59	51.69
21	90.06	54.83
22	92.30	58.15
23	94.28	61.62
24	95.65	64.50

Circle Center At X = 46.2 ; Y = 86.8 and Radius, 54.3

***** 1.476 *****

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.37	40.00
2	33.84	38.01
3	37.49	36.38
4	41.29	35.12
5	45.19	34.25
6	49.16	33.76
7	53.16	33.68
8	57.15	33.99
9	61.09	34.70
10	64.93	35.80
11	68.65	37.28
12	72.20	39.12
13	75.55	41.30
14	78.67	43.81
15	81.52	46.61
16	84.08	49.69
17	86.32	53.00
18	88.22	56.52
19	89.76	60.21
20	90.92	64.04
21	91.01	64.50

Circle Center At X = 52.0 ; Y = 73.8 and Radius, 40.1

***** 1.477 *****

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.67	40.00
2	19.20	38.12
3	22.86	36.49
4	26.61	35.12
5	30.46	34.01
6	34.37	33.17
7	38.33	32.60
8	42.32	32.32

9	46.32	32.30
10	50.31	32.57
11	54.27	33.11
12	58.19	33.93
13	62.04	35.01
14	65.80	36.36
15	69.47	37.97
16	73.01	39.83
17	76.41	41.93
18	79.66	44.26
19	82.74	46.81
20	85.64	49.57
21	88.34	52.52
22	90.83	55.66
23	93.09	58.95
24	95.12	62.40
25	96.16	64.50

Circle Center At X = 44.5 ; Y = 89.9 and Radius, 57.6

*** 1.482 ***

APPENDIX E

SPT CAL

SPT HAMMER ENERGY MEASUREMENTS

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Date: 12/27/18

Project Title: Cascade Las Vegas 2018
P.O. Number: 12/27/18
CME 85 02-34463 Auto Hammer

Energy Transfer Ratio = 70.3 @ 41.3 blows per minute

Testing was performed on December 27, 2018 in Las Vegas, NV

Hammer Energy Measurements performed in accordance to ASTM D4633 using an approved and calibrated SPT Analyzer from Pile Dynamics, Inc.

PRESENTATION OF SPT ANALYZER TEST DATA

1. Introduction

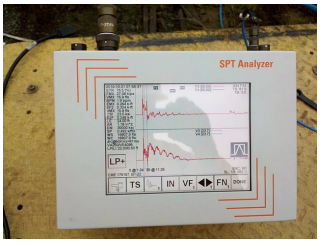
This report presents the results of SPT Hammer Energy Measurements recorded with an SPT Analyzer from Pile Dynamics carried out on December 27, 2018 in Las Vegas, NV

2. Field Equipment and Procedures

The CME 1050 had a mounted CME Auto Hammer. The CME Auto Hammer uses a 140 lb. weight dropped 30” on to an anvil above the bore hole. AWJ drill rod connects the anvil to a split spoon type soil sampler inside an 8” o.d. hollow stem auger at the designated sample depth. After a seeding blow the sampler is driven 18”. The number of blows required to penetrate the last 12" is referred to as the “N value”, which is related to soil strength.

The first recording was taken at 3' below ground surface and then every 3' to final recording at 15'.

3. Instrumentation



An SPT Analyzer from Pile Dynamics was used to record and the process the data. The raw data was stored directly in the SPT Analyzer computer with subsequent analysis in the office with PDA-W and PDIPlot software. The measurements and analysis were conducted in general accordance with ASTM D4945 and ASTM D6066 test standards.

The SPT Analyzer is fully compliant with the minimum digital sampling frequency requirements of ASTM D4633-05 (50 kHz) and EN ISO 22476-3:2005 (100 kHz), as well as with the low pass filter, (cutoff frequency of 5000 Hz instead of 3000 Hz) requirements of ASTM D4633-05. All equipment and analysis also conform to ASTM D6066.

A 2' instrumented section of AWJ rod, with two sets of accelerometers and strain transducers mounted on opposite sides of the drill rod, was placed below the anvil. It measured strain and acceleration of every hammer blow. The SPT Analyzer then calculates the amount of energy transferred to the rod by force and velocity measurements.

4. Observations

The drill rig motor is diesel fueled. The drill and sample equipment looked to be well operated and maintained.

5. Results

Results from the SPT Hammer Energy Measurements are summarized below. It shows the Energy Transfer Ratio (ETR) at each sampling depth. ETR is the ratio of the measured maximum transferred energy to rated energy of the hammer which is the product of the weight of the hammer times the height of the fall. 140 lb x 30" = 4200 lb-in = 0.350 kip-ft.

Energy Transfer Ratio = 70.3 @ 41.3 blows per minute

N60=(ETR/60)N

Depth	ETR%	BPM
3	70.1	40.8
6	69.9	41.0
9	70.5	41.3
12	70.6	41.6
15	70.2	41.8
Average	70.3	41.3

If you have any questions please do not hesitate to call or email.

Thank you,

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