

Geotechnical Engineering Study

Street Resurfacing – Alnor street, Edora Street, Endeis Street, and Grulla Road

San Elizario, El Paso County, Texas

LOI File No. J23-1-1230

Prepared for:

Huitt Zollars Inc.

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El Paso, Texas 79912

Prepared by:

LOI ENGINEERS

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September 20, 2023



File No. J23-1-1230
September 19, 2023



Mr. Floyd Johnson, P.E.
Huitt Zollars Inc.
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Re: Geotechnical Engineering Study
Street Resurfacing – Alnor Street, Eduora Street, Endeis Street, and Grulla Road
San Elizario, El Paso County, Texas

Dear Mr. Johnson:

We thank you for the opportunity to present the enclosed geotechnical engineering report for the above referenced project. This engineering report was prepared in accordance with the scope of services as presented in our proposal No. P23-1-01791, dated June 5, 2023, and authorized on August 8, 2023. The information we are presenting herein describes the procedures utilized for field and laboratory investigation, along with the results of our study.

It was a pleasure to work with you on this phase of your project, and we look forward to assist you further during the subsequent construction activities. If you have any questions regarding the information we present herein, please call us.

Respectfully submitted,
LOI ENGINEERS


Christian Rodriguez, E.I.T.
Project Professional



PP 
Danny R. Anderson, P.E.
Senior Geotechnical Engineer

Copies: Above (1) Via E-mail
File (1)

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1.0 INTRODUCTION

We have completed the geotechnical engineering study for four pavement sections located in San Elizario, El Paso County, Texas. We were authorized to conduct this study by Mr. Floyd Johnson, P.E., Vice President of Huitt Zollars Inc. (Client) on August 8, 2023.

2.0 PROJECT DESCRIPTION AND OBJECTIVE

The project consists of four pavement sections in the following streets:

- Section 1: Alnor Street, southeast of its intersection with Gonzalez Road approximately 550 feet
- Section 2: Eudora Street, between Dalia Lane and Epione Circle
- Section 3: Endeis Street, between Eudora Street and Guitar Drive
- Section 4: Grulla Road, between Las Pompas Road and Gaucho Drive

The purpose of this study is as follows:

- 1) Provide a professional opinion of the factor(s) that may have contributed to the pavement distress from a geotechnical standpoint
- 2) Provide recommendations to help reduce future pavement distress movements
- 3) Provide new flexible pavement section thicknesses

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Field Exploration

In our field exploration phase, we drilled and sampled four soil borings to a depth of 6½-feet each below ground surface throughout the pavement sections at locations selected by Client. We drilled and sampled the soil borings in general accordance with ASTM D-6151 and D-1586 procedures with a truck-mounted CME-55 drill rig. We located the borings in the field using street references included in the information provided by Client.

The soil boring locations are shown in the Boring Plan included in the Appendix A of this report in Sheet A-1. We also prepared a log of each soil boring to delineate the soil strata studied at the site. The soil boring logs (B-1 through B-4) are included in the Appendix A of this report as Sheets A-2 through A-5. A key to the soil terminology used in the logs is included in the Appendix B of this report as Sheets B-1 and B-2.

As part of our field exploration, we collected representative soil samples from the soil borings at regular depth intervals using a standard 2-inch diameter split spoon sampler. We identified and labeled the samples according to boring number and depth, visually classified them according to ASTM D-2488, and placed them in moisture-proof containers for transportation to the laboratory for further evaluation and testing.

Unless we receive prompt notification from Client, we will store the samples collected from the field investigation in our laboratory for a period of 90 days from the date of this report, after which time we will discard the samples.

3.2 Geotechnical Laboratory Testing

In the laboratory, we determined the moisture content, particle size analysis, percent passing the No. 200 sieve, and Atterberg Limits of selected samples. We conducted these tests to determine the physical and engineering properties of representative soils at the site. These tests also allowed us to properly classify the resident soils in accordance with the Unified Soil Classification System (USCS). The results of our tests are included in the soil boring logs, adjacent to the depth at which the sample was recovered.

In addition, we conducted one Moisture-Density Relationship test and one California Bearing Ratio (CBR) tests, in accordance with ASTM D-1557 and D-1883, respectively. The results of these tests can be found on Sheets A-7 and A-8, respectively.

Table 1: Laboratory Testing Program

Type of Test	Number of Tests
Moisture Content (ASTM D-2216)	8
Percent Passing No. 200 Sieve (ASTM D-6913)	4
Atterberg Limits (ASTM D-4318)	4
California Bearing Ratio Test (ASTM D-1883)	1
Moisture-Density Relationship Curve (ASTM D-1557)	1

4.0 GENERAL SITE CONDITIONS

4.1 Site Geology

The project site is located on the Rio Grande flood plain. According to the Soil Conservation Service of El Paso County, the soils in this area correspond to the Harkey-Glendale association, which is described as nearly level soils that have loamy very fine sand to silty clay loam underlying material.

4.2 Site Topography and Site Conditions

The project sites are relatively level. The sites are topped with hot-mix asphaltic concrete (HMAC) pavement. The thicknesses of both the HMAC and Crushed Aggregate Base Course are presented in the table below.

Table 2: Existing Pavement Conditions

Street	HMAC Thickness (in.)	Base Course (in.)	Remarks
Alnor Street	1½	6	<ul style="list-style-type: none"> HMAC pavement experiences potholes, block cracking, longitudinal cracking, raveling, heaving, transversal cracking, rutting, patching, and alligator cracking No lateral support
Eudora Street	2	6½	<ul style="list-style-type: none"> HMAC pavement experiences block cracking, longitudinal cracking, potholes, raveling, and alligator cracking No lateral support
Endeis Street	2	3½	<ul style="list-style-type: none"> HMAC pavement experiences potholes, alligator cracking, longitudinal cracking, rutting, and block cracking No lateral support

Table 2: Existing Pavement Conditions

Street	HMAC Thickness (in.)	Base Course (in.)	Remarks
Grulla Road	1½	6	<ul style="list-style-type: none"> HMAC pavement experience longitudinal cracking, potholes, stripping, raveling, and alligator cracking No lateral support

4.3 Site Vegetation

At the time of our field phase, the sites were free of vegetation.

4.4 Soil Stratigraphy

The soils we encountered in the borings can be divided into three generalized soil strata as follows:

Stratum A, consisting of brown lean clays, intermixed with various amounts of fine grained sands, was encountered from beneath the pavement layer and extended to depths ranging from 5 feet to 6½ feet below ground surface elevation (BGS) in the soil borings. These soils were encountered at a soft to stiff consistency, with SPT values results ranging from 3 to 10 blows per foot of penetration. These soils were encountered at a moist to very moist condition, with tested moisture content values ranging from 11 percent to 28 percent, and percent finer than the No. 200 sieve test results ranging from 64 percent to 83 percent. These soils exhibited tested liquid limit values ranging from 28 to 33, yielding plasticity index values ranging from 11 to 18. Soils in this stratum can be classified as CL in accordance with the USCS.

Stratum B, consisting of brown fine grained clayey sands, was encountered from beneath the pavement layer and extended to a depth of 2½ feet BGS in soil boring B-1. These soils were encountered at loose relative density, with an SPT value of 4 blows per foot of penetration. These soils were encountered at a moist condition, with a tested moisture content value of 14 percent, and a percent finer than the No. 200 sieve test result of 41

percent. These soils exhibited a tested liquid limit of 28 and yielded a plasticity index value of 14. Soils in this stratum can be classified as SC in accordance with the USCS.

Stratum C, consisting of brown fine-grained silty sands, was encountered underlying the Stratum A soils in borings B-2 and B-4 and extended to depths ranging from 6½ feet to 8 feet BGS. These soils were encountered at loose to medium dense relative density, with SPT values ranging from 8 to 12 blows per foot of penetration. These soils were encountered at a dry to moist condition, with tested moisture content values ranging from 2 to 6 percent. Soils in this stratum can be classified as SM in accordance with the USCS.

4.5 Groundwater

Groundwater was not present in the borings drilled during the time of our field exploration. However, it is our opinion that the depth to groundwater at the site may vary considerably after periods of significant rainfall or during irrigation seasons. Fluctuations in groundwater may also occur as a function of temperature, groundwater withdrawal and future construction activities that may alter the surface drainage and sub-drainage characteristics of this site.

5.0 ENGINEERING EVALUATION

5.1 Existing Flexible Pavement Condition

As previously noted, during our subsurface exploration and field activities, we observed multiple signs of pavement distress throughout the project site.

The above-described signs of distress are normally associated with a reduction in the pavement support, which may be attributed to the following:

- Water seepage
- Poor drainage
- Poor trench backfill material compaction

- Presence of expansive subgrade material

The pictures below present a graphical representation of existing conditions at the time of our exploration:



Figure 1: Looking southeast about 240 feet from Gonzalez Road,
location of soil boring B-1



Figure 2: Looking southeast about 460 feet from Dalia Lane,
location of soil boring B-2



Figure 3: Looking southwest about 440 feet from Eudora Street,
location of soil boring B-3



Figure 4: Looking southeast from Las Pompas Road,
location of soil boring B-4

5.2 Discussion of Findings

The findings in our soil borings are outlined below:

- The subgrade soils encountered in boring B-1 through B-4 exhibited high moisture content values.
- The base course encountered on Alnor Street, Eudora Street, and Endeis Street are not up to standard with the Texas Department of Transportation (TXDOT) Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges.
- The soils in the borings revealed moderate plasticity properties in the upper 5 feet.
- The soils in the borings exhibited plasticity index values ranging from 11 to 18.
- PVR- values ranged from 1/10-inch to 1/4-inch under the existing moisture content conditions at the time of our exploration.
- The tested moisture content in the soils ranged from 3 percent to 28 percent. The higher moisture content encountered in the clayey layer in the upper 5 feet BGS in soil borings B-1 through B-4, suggests the clayey layer is receiving moisture from an external source such as water seepage from the surface runoff, irrigation, or possibly leaky underground water lines.
- The introduction of moisture can cause clayey soils to expand. Conversely, when moisture leaves the clay soil matrix, clay particles contract. This expansion-and-contraction cycle may promote differential movement in the pavement structures.

5.3 Conclusions

It is our professional opinion that the pavement distress may have taken place due to one or more than one of the following factors:

- The pavement system may have experienced distress due to a reduction in soil bearing capacity that resulted from undesired and excessive moisture infiltration.

- The presence of clayey soils, in addition to the undesired introduction of water to the subgrade soils, may have resulted in structural distress.
- Absence of competent subgrade and drainage below the HMAC layer.
- The useful life cycle of existing pavement sections has been exceeded.

5.4 Recommendations

Based on our analysis, the subsurface soil conditions, the signs of distress and laboratory results, we offer the following pavement remediation recommendations.

Micro-surfacing Treatment

Micro-surfacing treatment consists of installing a mixture of dense-graded aggregate, asphalt emulsion, water, mineral fillers (Portland Cement) and other additives.

Supplemental additives to the mixture may include aluminum sulfate crystals, ammonium sulfate, inorganic salts, and commercially available anti-stripping agents. The contractor shall submit a mix design for materials engineer verification prior to installation of the micro-surface course. Mix design may be verified by the requirements per the test methods Tex-230-F and Tex-240-F Parts I through IV.

Sand Seal

In the event that the construction budget does not allow micro-surfacing treatment of the proposed pavement structures, asphalt surface treatment may be implemented. A “sand seal” will improve the performance and appearance of the pavement surface.

The sand seal is a spray application of asphalt emulsion followed with a light covering of fine aggregate, such as clean sand or screenings. The sand seal will prevent the intrusion of moisture and air, and develop a skid-resistant surface.

Asphalt Pavement Overlay

Milling the existing pavement and applying a thin asphalt layer overlay. The asphalt milling should reach the entire thickness of the surface course before the installation of the overlay.

Flexible Pavement Reconstruction

We understand that flexible pavements at the project site will be used in the construction of Residential Lane Streets with right-of-way (R.O.W) widths of 50 feet. A traffic loading of 45,000 equivalent single-axle load (ESAL) applications may be used for design of pavement structures. Additionally, a CBR value of 5 may be implemented for pavement design calculations. The CBR value was obtained from laboratory testing.

The flexible pavement remediation alternatives were evaluated using a numerical scale where the higher the number the more preferable the alternative. For instance, a value of 5 means the alternative is the most desirable one, where a value of 1 is the least desirable for each street section proposed to be rehabilitated.

Table 3: Flexible Pavement Remediation Alternative Evaluation

Remdiation Alternative	Cost	Constructability	Pavement Life Expectancy	Operations and Maintenance
Micro-surfacing	4	4	2	1
Sand Seal	3	5	1	2
Asphalt overlay	2	3	4	3
Reconstruction	1	2	5	5

Rating: 5= More Preferable, 1= Least Preferable

Based on the comparison evaluation table above, we present the following recommendations for each street section planned to be rehabilitated or reconstructed:

Table 4: Street Recommendations

Street	Recommendations
Alnor Street	<ul style="list-style-type: none"> • We recommend doing pavement reconstruction on Alnor Street. See information in Section 5.6. • Construct head curb that's 18 inches deep along pavement edges. • Replacement of expansive clayey sands with suitable select fill as discussed in Section 5.7
Eudora Street	<ul style="list-style-type: none"> • We recommend doing pavement reconstruction on Eudora Street. See information in Section 5.6. • Construct head curb that's 18 inches deep along pavement edges • Replacement of expansive clayey sands with suitable select fill as discussed in Section 5.7
Endeis Street	<ul style="list-style-type: none"> • We recommend doing pavement reconstruction on Endeis Street. See information in Section 5.6. • Construct head curb that's 18 inches deep along pavement edges • Replacement of expansive clayey sands with suitable select fill as discussed in Section 5.7
Grulla Road	<ul style="list-style-type: none"> • We recommend doing pavement reconstruction on Grulla Street. See information in Section 5.6. • Construct head curb that's 18 inches deep along pavement edges • Replacement of expansive clayey sands with suitable select fill as discussed in Section 5.7 • Improve drainage conditions

5.5 Traffic loads

Based on experience with similar projects, the City of El Paso design standards, the right-of-way widths of the proposed streets and existing major thoroughfares, we assigned traffic loadings of 45,000 equivalent single-axle loads (ESAL's) for residential lanes, as further discussed in Section 5.6 of this report. If the final traffic volumes differ significantly from the assumed value as presented herein, LOI ENGINEERS should be notified immediately so that we may conduct further analysis to determine whether our recommendations need to be revised, as appropriate.

The recommendations presented in this report are predicated on the assumption that cut and fill sections at the site will be within ± 1 foot from existing grade elevations.

5.6 Flexible Pavement Recommendations

We used a traffic loading of 45,000 equivalent single-axle load (ESAL) applications for areas that will be subjected to the estimated traffic loads. This parameter is estimated based on the parking characteristics and estimated heavy automobile traffic for a

design period of 20 years. Additionally, based on our laboratory analysis we calculated a California Bearing Ratio (CBR) value of 5 for pavement design calculations.

We recommend that flexible pavement for the reconstructed streets consist of the following minimum thickness section for the estimated traffic conditions:

Table 5: Flexible Pavement Recommendations

Design Parameters	Pavement Component (in.)		
	Compacted Select Fill ¹	Crushed Stone Base Course	Hot-Mix Asphaltic Concrete
<ul style="list-style-type: none"> Residential Lane 50' Right-of-Way CBR Value – 5 	12	6	2

1-Select fill shall be placed on 8 inches of compacted subgrade

As a minimum, the HMAC material should conform to Type C, in accordance with the City of El Paso standards. The HMAC mix should have a minimum 1,500 pounds of Marshall Stability when compacted at 75 blows in accordance with ASTM D-1559, and should have a flow between 8 and 16. The HMAC course should be placed at a target density of at least 98 percent.

The Crushed Stone Base Course (CSBC) should be Item 247, Type A, Grade 3 in accordance with the Texas Department of Transportation (TXDOT) Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges. CSBC materials should be placed in loose lifts not exceeding 6 inches in compacted thickness, and compacted to a minimum 100 percent of maximum dry density and a moisture content within plus or minus 2 percent, in accordance with ASTM D-1557.

5.7 Select Fill

Select fill material used for site grading should be granular, cohesionless, and free of deleterious material and particles over 4 inches in greatest dimension. Soils proposed for use as fill materials should be classified in accordance with ASTM D-2487. The following

soils classified in accordance with the Unified Soil Classification System (USCS) can be considered satisfactory for use as select fill.

GM, GC, GW-GM, GW-GC, GP, GP-GM and GP-GC, SM, SC, SW-SM, SW-SC, SP-SM, SW-SC and SC-SM.

The following USCS-classified soils are not considered satisfactory for use as select fill.

CH, CL, MH, ML, OH, OL and PT, or soils that exceed a liquid limit of 40 and a plasticity index of 15.

The soils in Stratum B and Stratum C are suitable for use as select fill, provided they meet the above criteria for acceptable fill materials.

The soils in Stratum A are **NOT** Suitable for use as select fill.

Select fill should be placed in uniform layers not exceeding 8 inches in compacted thickness, moisture-conditioned to add the amount of moisture required for optimum compaction and compacted to a minimum of 95 percent of maximum density in accordance with ASTM D-1557 (modified Proctor) procedures. The moisture content should be at plus or minus 3 percent of optimum moisture content in accordance with ASTM D-1557.

This compaction requirement also applies to the subgrade soils that will receive select fill. However, if the subgrade soils consist of cohesive soils such as CL or CH, or if the plasticity index exceeds 18, the subgrade soils should be compacted to a minimum of 90 percent of the above standard.

Compaction of the fill material and subgrade soils should be conducted with approved types of pneumatic, power or tamping equipment. Determination of density in the field should be conducted in accordance with ASTM D-2922 or D-1556.

5.8 Pavement Reconstruction near Existing Structures and Utilities

Contractor shall exercise extreme care during damaged pavement removal and site preparation near the existing structures (such as manholes, sidewalks, or concrete curbs) to avoid encroaching into the existing foundation systems, hence preventing adversely affecting or undermining the performance and structural integrity of the existing utilities and manhole structures.

We recommend that 10 days prior to commencing any excavation, the contractor shall submit a plan describing how they will protect the existing structures during construction activities. Protective measures may include, but may not be limited to temporary shoring and/or phased excavation.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Construction Monitoring

We recommend that Client retain LOI ENGINEERS during the construction phase of this project to verify the findings of our study, and to provide supplemental data to this study in the event that site conditions vary from those described in this report.

The geotechnical engineer should also conduct testing of fill materials used for earthwork operations at the following frequencies:

- At least one (1) moisture-density relationship (ASTM D-1557) and soil classification tests (ASTM D-6913 and ASTM D-4318) for each type of material encountered, or imported material to be used.
- Soil density (compaction) testing in accordance with ASTM D-6938 or D-1556 using the following testing frequencies:
 - Pavement area – A minimum of one (1) density test per lift (8-inch compacted) for every 2,500 square feet.

Sampling and testing for quality assurance of concrete materials should be performed at the following frequency:

- A minimum of one (1) set of four specimens should be collected for every 50 cubic yards of concrete placed, or fraction thereof. Concrete field testing shall include temperature, slump, and air content (if applicable).

Sampling and testing for quality assurance of asphaltic concrete materials should be performed at the following frequencies:

- A minimum of one (1) hot-mix asphaltic concrete (HMAC) analysis, to include Marshall test, Rice test, asphalt content and gradation, and Marshall flow and stability, for every 500 tons of HMAC material.
- A minimum of one (1) nuclear density test in accordance with ASTM D-2950 for every 2,500 square feet.

6.2 Limitations

We have performed our professional services and have obtained the data presented in this report in accordance with generally accepted geotechnical engineering principles and practices. The information in this report is based on the data obtained from eight representative test borings and laboratory testing conducted on representative samples, and on our knowledge of the project conditions at the time of our subsurface soil study.

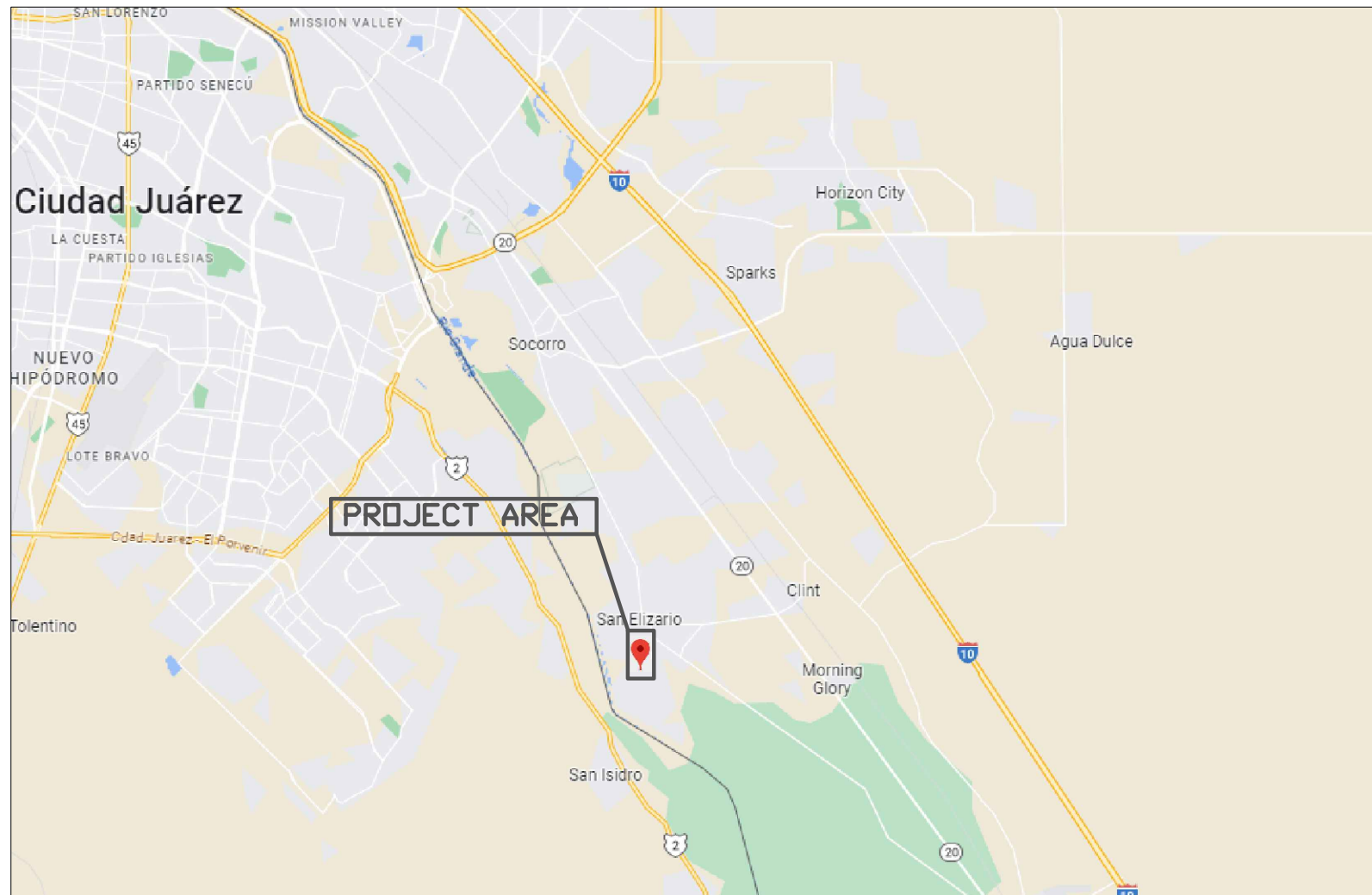
The data in this report reflects subsurface soil conditions only at the specific sampling location, time of sampling, and to the depths indicated in our report. This report is not intended to identify or address any potential environmental concerns associated with the project site.



We recommend that Client notify LOI ENGINEERS of any changes to the project conditions considered in this report, so that we may provide pertinent modifications to our recommendations if deemed necessary. Additionally, once construction

commences, we should be notified of any unusual site conditions that appear to vary from those reported herein, so that we may conduct further investigations and prepare supplemental recommendations if deemed necessary.



We conducted this investigation for the purpose of defining the subsurface soil conditions for the Geotechnical Engineering Study for Street Resurfacing in San Elizario, El Paso County, Texas. Use of this information for projects other than the one described herein will not be adequate.

APPENDIX A





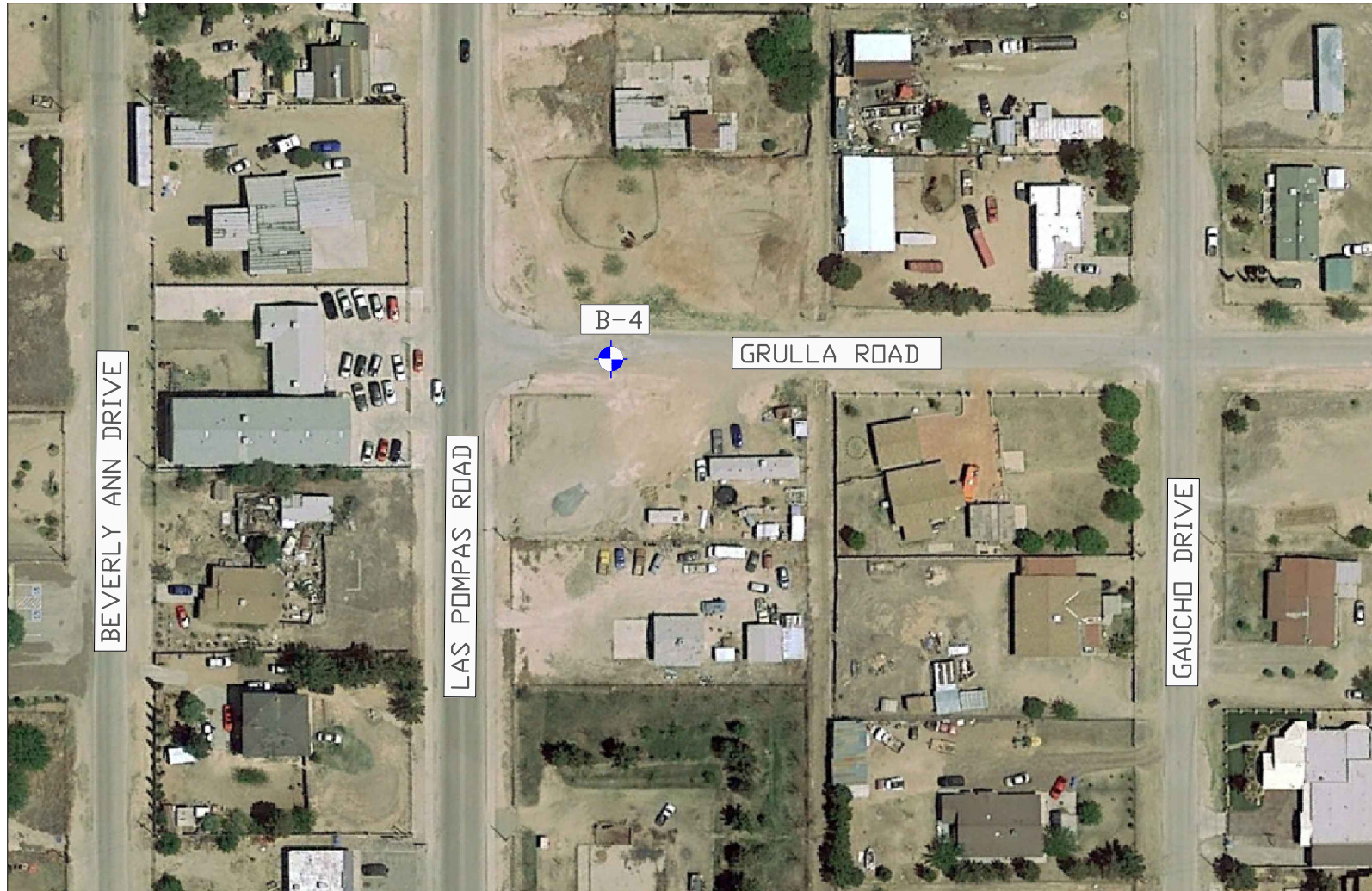
LEGEND		GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	DRAWING TITLE GENERAL LOCATION MAP			
	APPROXIMATE PROJECT LOCATION	 LOI ENGINEERS	915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	PROJECT NAME STREET RESURFACING SAN ELIZARIO SAN ELIZARIO, EL PASO COUNTY, TEXAS			
				DRAWN BY S.V.	REVIEWED BY G.M.	APPROVED BY B.O.	SCALE N.T.S.
				PROJECT No. J23-1-1230	FILE NAME SITE PLAN	DATE 9/7/2023	SHEET No. A-1.1





LEGEND		GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	DRAWING TITLE BORING LOCATION PLAN			
 APPROXIMATE BORING LOCATION AND NUMBER	 LOI ENGINEERS	915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	HUITT ZOLLARS INC. 5822 CROMO DRIVE, SUITE 210 EL PASO, TEXAS 79912	PROJECT NAME STREET RESURFACING SAN ELIZARIO SAN ELIZARIO, EL PASO COUNTY, TEXAS			
				DRAWN BY S.V.	REVIEWED BY G.M.	APPROVED BY B.O.	SCALE N.T.S.
				PROJECT No. J23-1-1230	FILE NAME SITE PLAN	DATE 9/7/2023	SHEET No. A-1.2



LEGEND		GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	DRAWING TITLE BORING LOCATION PLAN			
 B-1 APPROXIMATE BORING LOCATION AND NUMBER	 ENGINEERS LOI ENGINEERS		915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	PROJECT NAME STREET RESURFACING SAN ELIZARIO SAN ELIZARIO, EL PASO COUNTY, TEXAS			
				DRAWN BY S.V.	REVIEWED BY G.M.	APPROVED BY B.O.	SCALE N.T.S.
				PROJECT No. J23-1-1230	FILE NAME SITE PLAN	DATE 9/7/2023	SHEET No. A-1.3



LEGEND		GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	DRAWING TITLE BORING LOCATION PLAN			
 APPROXIMATE BORING LOCATION AND NUMBER	 LOI ENGINEERS	915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	HUITT ZOLLARS INC. 5822 CROMO DRIVE, SUITE 210 EL PASO, TEXAS 79912	PROJECT NAME STREET RESURFACING SAN ELIZARIO SAN ELIZARIO, EL PASO COUNTY, TEXAS			
				DRAWN BY S.V.	REVIEWED BY G.M.	APPROVED BY B.O.	SCALE N.T.S.
				PROJECT No. J23-1-1230	FILE NAME SITE PLAN	DATE 9/7/2023	SHEET No. A-1.4

LOG OF TEST BORING No. B-1



Project name: Street Resurfacing San Elizario, TX
 File No.: J23-1-1230
 Date Drilled: 9/14/23
 Boring Location: See Sheet A-1.2
 Elevation (ft): N/A North: N/A West: N/A

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)	SPT N-Value CURVE		
											10	30	50
0			1.5" ASPHALT PAVEMENT										
			6" BASE COURSE MATERIAL										
			SAND, fine grained, clayey, brown, loose, moist	SC	14	41	28	14	14	4			
2.5			CLAY, lean, sandy, brown, firm, moist	CL						5			
5			-very moist at 5 feet		28					8			
6.5			Termination depth at 6.5 feet										
7.5													
10													
12.5													
15													

Groundwater Table Data

Depth	Date	Time
N/A	N/A	N/A

Sample Type

- ☐ Auger cutting
- ☒ 2" O.D. split spoon
- ☒ 3" O.D. split tube
- ☐ Thin-walled Shelby tube

Rig type: CME-55
 Boring type: HSA
 Drilled by: FM
 Logger: GT
 Sheet No.: A-2

LOG OF TEST BORING No. B-2



Project name: Street Resurfacing San Elizario, TX
 File No.: J23-1-1230
 Date Drilled: 9/14/23
 Boring Location: See Sheet A-1.2
 Elevation (ft): N/A North: N/A West: N/A

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)	SPT N-Value CURVE		
											10	30	50
0			2" ASPHALT PAVEMENT										
			6.5" BASE COURSE MATERIAL										
			CLAY, lean, sandy, brown, firm, moist							5			
2.5			-soft at 2.5 feet	CL	15	64	33	15	18	3			
5										3			
7.5			SAND, fine grained, silty, brown, loose, dry to moist	SM	6					8			
			Termination depth at 8 feet										
10													
12.5													
15													

Groundwater Table Data

Depth	Date	Time
N/A	N/A	N/A

Sample Type

- ☐ Auger cutting
- ☒ 2" O.D. split spoon
- ☒ 3" O.D. split tube
- ☐ Thin-walled Shelby tube

Rig type: CME-55
 Boring type: HSA
 Drilled by: FM
 Logger: GT
 Sheet No.: A-3

LOG OF TEST BORING No. B-3



Project name: Street Resurfacing San Elizario, TX
 File No.: J23-1-1230
 Date Drilled: 9/14/23
 Boring Location: See Sheet A-1.2
 Elevation (ft): N/A North: N/A West: N/A

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)	SPT N-Value CURVE		
											10	30	50
0			2" ASPHALT PAVEMENT										
			3.5" BASE COURSE MATERIAL										
			CLAY, lean, brown, stiff, moist with sand		11	70	31	15	16	9			
2.5			-firm at 2.5 feet	CL						7			
5			-very moist at 5 feet		24					7			
6.5			Termination depth at 6.5 feet										
7.5													
10													
12.5													
15													

Groundwater Table Data

Depth	Date	Time
N/A	N/A	N/A

Sample Type

- ☐ Auger cutting
- ☒ 2" O.D. split spoon
- ☒ 3" O.D. split tube
- ☐ Thin-walled Shelby tube

Rig type: CME-55
 Boring type: HSA
 Drilled by: FM
 Logger: GT
 Sheet No.: A-4

LOG OF TEST BORING No. B-4



Project name: Street Resurfacing San Elizario, TX
 File No.: J23-1-1230
 Date Drilled: 9/14/23
 Boring Location: See Sheet A-1.2
 Elevation (ft): N/A North: N/A West: N/A

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)	SPT N-Value CURVE		
											10	30	50
0			1.5" ASPHALT PAVEMENT										
			6" BASE COURSE MATERIAL										
			CLAY, lean, brown, firm, moist							8			
2.5			-stiff and very moist at 2.5 feet	CL	23	83	31	20	11	10			
5			SAND, fine grained, silty, brown, medium dense, dry	SM	2					12			
			Termination depth at 6.5 feet										
7.5													
10													
12.5													
15													

Groundwater Table Data

Depth	Date	Time
N/A	N/A	N/A

Sample Type

- ☐ Auger cutting
- ☒ 2" O.D. split spoon
- ☒ 3" O.D. split tube
- ☐ Thin-walled Shelby tube

Rig type: CME-55
 Boring type: HSA
 Drilled by: FM
 Logger: GT
 Sheet No.: A-5

SUMMARY OF RESULTS

Project: San Elizario Street Resurfacing

LOI Project No.: J23-1-1230

Date: 09/15/23



Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
1	0-1½	14			41	28	14	14	Clayey sand (SC)
1	5-6½	28							
2	2½-4	15			64	33	15	18	Sandy lean clay (CL)
2	6½-8	6							
3	0-1½	11			70	31	15	16	Lean clay with sand (CL)
3	5-6½	24							
4	2½-4	23			83	31	20	11	Lean clay with sand (CL)
4	5-6½	3							

REPORT OF MOISTURE-DENSITY RELATIONSHIP, SIEVE ANALYSIS, AND PLASTICITY INDEX

ASTM D-2487, C-136, D-4318, D-1557

Project Name: Street Resurfacing
San Elizario, El Paso County, Texas

Client: Huitt Zollars Inc.
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Sample Location: Existing material; Sample collected at Soil Boring
B-1; 0'-3' in depth.

Soil Classification: Clayey sand (SC)

Method Used: B

Preparation: Dry

Rammer: Mechanical

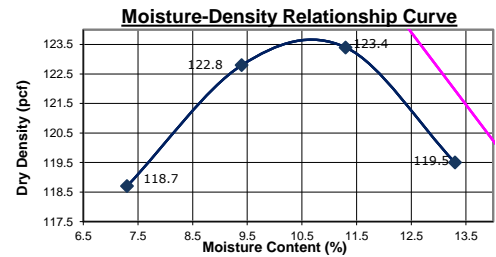
Project Number: J23-1-1230

Sample date: 9/14/23

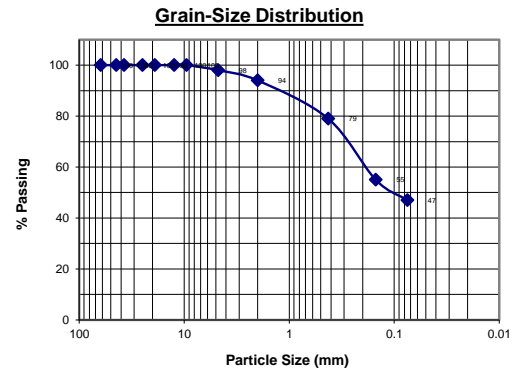
Sampler: JFL

Sample Number: 091423-B1

Corrected Maximum Dry Unit Weight: 123.7 pcf
Corrected Optimum Water Content: 10.7 %



Sieve Analysis					
Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Specs.
2-1/2"	62.50	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	0	-	100	-
3/4"	19.00	0	-	100	-
1/2"	12.50	0	-	100	-
3/8"	9.50	0	-	100	-
#4	4.75	2	-	98	-
#10	2.00	6	-	94	-
#40	0.425	21	-	79	-
#100	0.150	45	-	55	-
#200	0.075	53	-	47	-



Plasticity Index

Process: Air-dry

Actual LL= 34 PL= 14 PI= 20
Typical LL= 45 Max. PL= - PI= 15 Max.

Gradation Parameters

D ₁₀ =	0.02	C _c =	0.69
D ₃₀ =	0.05	C _u =	12.99
D ₆₀ =	0.21	-	-

REPORT OF CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D-1883

Project Name: Street Resurfacing
San Elizario, El Paso County, Texas

Project Number: J23-1-1230

Client: Huitt Zollars Inc.
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Sample date: 9/14/23

Sample Location: Existing material; Sample collected at soil boring
B-1; 0' to 3' in depth.

Sampler by: JFL

USCS Classification: Clayey sand (SC)

Sample Number: 091423-B1

MOISTURE-DENSITY DATA:

Compaction Method:	ASTM D-1557 (Modified Proctor Test)		
Maximum dry unit weight:	123.7 pcf	Optimum moisture content:	10.7 %
		Prescribed relative compaction:	95.0 %

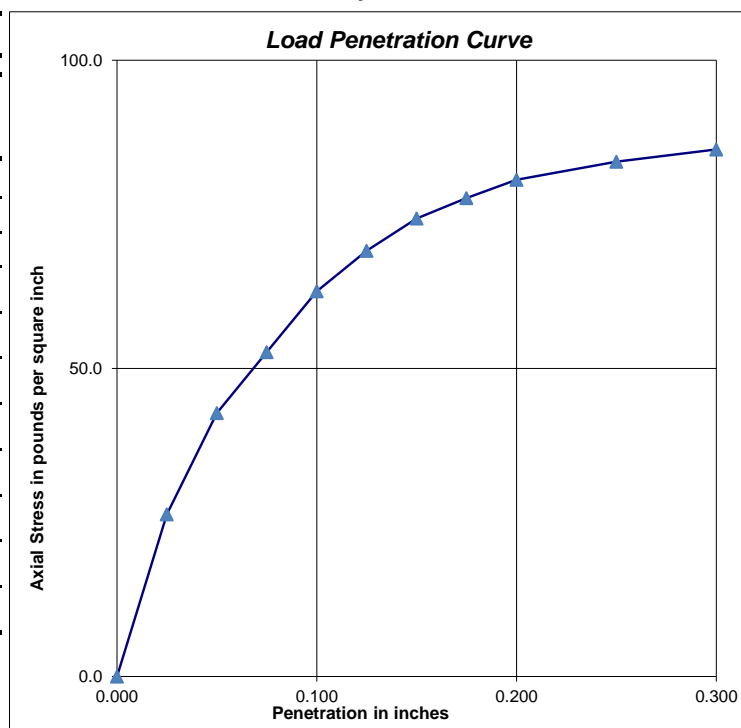
SOAKING PERIOD OUTPUT PARAMETERS:

Initial dry unit weight:	117.5 pcf	Initial moisture content:	10.7 %
Final dry unit weight:	114.9 pcf	Final water content, top 1-inch layer:	21.2 %
Swell index:	4.1%	Final water content, middle layer:	14.3 %

BEARING TEST DATA:

Penetration (inch.)	Load (lbs.)	Axial Stress (psi)
0.000	0	0.0
0.025	80	26.3
0.050	130	42.8
0.075	160	52.6
0.100	190	62.5
0.125	210	69.1
0.150	226	74.3
0.175	236	77.6
0.200	245	80.6
0.250	254	83.6
0.300	260	85.5

Corrected 0.1 inch penetration:	6%
Corrected 0.2 inch penetration:	5%



APPENDIX B

SOIL TERMINOLOGY

COARSE GRAINED SOILS: More than 50 percent retained on No. 200 sieve. Includes fine, medium, or coarse grained (depending on grain size) gravel and sand, and silty and/or clayey gravel and sand. Density is described according to relative density measured in the laboratory, or sampler resistance in the field as follows:

Penetration Resistance* (Blows per Foot)	Descriptive Term	Relative Density** (Percent)
0 - 4	Very Loose	0 - 15
5 - 9	Loose	15 - 35
10 - 29	Medium Dense	35 - 65
30 - 49	Dense	65 - 85
More than 50	Very Dense	85 - 100

* From Standard Penetration Test with 140-pound hammer, 30-inch drop.
 ** From relative density tests on undisturbed sand sample.

FINE GRAINED SOILS: More than 50 percent passing through the No. 200 sieve. Includes organic and inorganic silt and clay, gravelly and/or sandy silt and clay, silty clay, and clayey silt. Consistency is described according to shear strength, from unconfined compression tests in the laboratory, penetrometer tests in the field or laboratory, or sampler resistance in the field as follows:

Compressive Strength* (Tons per Square Foot)	Descriptive Term	Penetration Resistance** (Blows per Foot)
Less than 0.25	Very Soft	Less than 2
0.25 - 0.50	Soft	2 - 4
0.50 - 1.00	Firm	5 - 8
1.00 - 2.00	Stiff	9 - 15
2.00 - 4.00	Very Stiff	16 - 50
4.00 and higher	Hard	50 and higher

* From unconfined compression strength test.
 ** From Standard Penetration Test with 140-pound hammer, 30 inch drop.

Slicken sided: With inclined planes of weakness of slick and glassy appearance.

Fissured: With shrinkage cracks that are frequently filled with fine sand.

Laminated: With thin layers of varying colors and texture.

Interbedded: With alternate layers of different soil types.

Calcareous: With noticeable quantities of calcium carbonate.






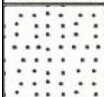
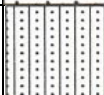
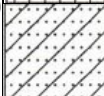




Sensitive: Applies to cohesive soils that are subject to loss of strength when remolded.

Well graded: With wide range in grain sizes and good distribution of intermediate particle sizes.

Poorly graded: With one predominant grain size, or a poor distribution with intermediate sizes missing.

SOIL SYMBOLS

Identification of the major soil divisions used to distinguish the change of a different stratum. For their combinations and a more detailed description, see UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487-00)

MAJOR SOIL DIVISIONS			SOIL SYMBOL	USCS SYMBOL	TYPICAL NAME
Coarse-Grained Soils ($< 50\%$ pass No. 200 sieve)	GRAVELS ($< 50\%$ pass No. 4 sieve)	Clean Gravels ($< 5\%$ pass No. 200 sieve)		GW	Well-Graded Gravels
				GP	Poorly-Graded Gravels
		Gravels with fines ($> 12\%$ pass No. 200 sieve)		GM	Silty Gravels
				GC	Clayey Gravels
	SANDS ($> 50\%$ pass No. 4 sieve)	Clean Sands ($< 5\%$ pass No. 200 sieve)		SW	Well-Graded Sands
				SP	Poorly-Graded Sands
		Sands with fines ($> 12\%$ pass No. 200 sieve)		SM	Silty Sands
				SC	Clayey Sands
Fine-Grained Soils ($> 50\%$ pass No. 200 sieve)	SILTS	Silts of Low Plasticity ($*LL < 50$)		ML	Inorganic Silts (slightly plastic)
		Silts of High Plasticity ($*LL > 50$)		MH	Inorganic Silts (elastic)
	CLAYS	Clays of Low Plasticity ($*LL < 50$)		CL	Inorganic Clays (lean clays)
		Clays of High Plasticity ($*LL > 50$)		CH	Inorganic Clays (Fat clays)

*Liquid Limit of the soil

NV: No value obtained; NP: Non-plastic