FUEL FARM GEOTECH REPORT

REPORT OF

SUBSURFACE EXPLORATION SERVICES

BULK FUEL STORAGE FACILITY
ADDISON, TEXAS

FOR

WASHINGTON GROUP INTERNATIONAL, INC.

APRIL 13, 2004

ENGINEERING CONSULTING SERVICES, LTD.
Geotechnical • Construction Materials • Environmental

April 13, 2004

Mr. Samuel Lundgren, P.E.
Washington Group International
7800 East Union Avenue, Suite 100
Denver, Colorado 80237

ECS Job No. 19-3846

Reference: Report of Subsurface Exploration and Engineering Services
Bulk Fuel Storage Facility
SWC of Addison Road and George Haddaway Street
Addison, Texas

Dear Mr. Lundgren:

Engineering Consulting Services, Ltd. has completed the subsurface exploration for the proposed bulk fuel storage facility to be located at the referenced site in Addison, Texas. The enclosed report describes the subsurface exploration procedures and laboratory testing, and provides geotechnical recommendations for development of the site. A Boring Location Diagram is included in the Appendix of this report along with the Boring Logs performed for the exploration.

We appreciate this opportunity to be of service to you during the design phase of this project. If you have any questions with regard to the information and recommendations presented in this report, or if we can be of further assistance to you in any way during the planning or construction of this project, please do not hesitate to contact us.

Respectfully,

ENGINEERING CONSULTING SERVICES, LTD.

Christopher W. Eddy, P.E.
Geotechnical Department Manager

STATE OF TEXAS
CHRISTOPHER W. EDDY
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LICENSED
PROFESSIONAL ENGINEER
4/13/4

FOR
Daniel L. Franklin, Jr., P.E.
Vice President/Principal Engineer

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REPORT

PROJECT

Subsurface Exploration and Engineering Services
Bulk Fuel Storage Facility
SWC of Addison Road and George Haddaway Street
Addison, Texas

CLIENT

Washington Group International
7800 East Union Avenue, Suite 100
Denver, Colorado 80237

SUBMITTED BY

Engineering Consulting Services, Ltd.
4950 Keller Springs Road
Suite 480
Addison, Texas 75001

PROJECT	#19-3846
DATE	April 13, 2004

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PROJECT OVERVIEW

Introduction

This report presents the results of our subsurface exploration and engineering recommendations for the proposed bulk fuel storage to be located at the southwest corner of Addison Road and George Haddaway Street in Addison, Texas. The Boring Location Diagram included in the Appendix of this report shows the approximate location of this project.

Scope of Work

The conclusions and recommendations contained in this report are based on two soil borings drilled within the proposed location of the fuel storage facility, a bulk soil sample obtained from the site, and associated laboratory testing of selected soil samples obtained from the borings and the bulk soil sample. The borings were drilled to depths of about 20 to 25 feet within the planned location of the fuel storage facility. The results of the soil borings, along with a Boring Location Diagram, are included in the Appendix of this report.

This report presents our recommendations for geotechnical parameters for foundation design for the project. In addition, the report provides construction considerations based upon the results of the soil borings, laboratory tests, and our previous experience.

Proposed Construction

According to the information provided, the project consists of constructing a bulk fuel storage facility at Addison Airport in Addison, Texas. We understand the fuel storage facility will consist of fourteen fuel tanks (approximately 25,000 gallons) and paved drive lanes.

Purposes of Exploration

The purposes of this exploration were to explore the soil and groundwater conditions at the site and to develop engineering recommendations to guide design and construction of the project. We accomplished these purposes by:

1. Drilling two borings in the vicinity of the proposed fuel storage facility to depths of about 20 to 25 feet to explore the subsurface soil and groundwater conditions.

2. Performing laboratory tests on selected representative soil samples from the borings and a bulk soil sample to evaluate pertinent engineering properties.

3. Analyzing the field and laboratory data to develop appropriate engineering recommendations.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were located in the field by a representative of ECS, Ltd. based on a site plan provided by Washington Group International, Inc. The boring locations were selected to explore the proposed project area. The soil borings were performed with a truck-mounted rotary-type auger drill rig that utilized continuous-flight augers to advance the boreholes.

Representative samples were obtained using thin-walled tube sampling procedures in general accordance with ASTM Specifications D-1587. In the thin-walled tube sampling procedure, a thin-walled seamless steel tube with a sharp cutting edge is pushed hydraulically into the ground to obtain relatively undisturbed samples of cohesive or moderately cohesive soils. These samples were sealed and returned to the laboratory for testing and classification.

A Texas cone penetrometer test was were performed to evaluate the load carrying capacity of the shale encountered. The test was performed in general accordance with test method Tex-132-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures. The results of the test are shown on the attached boring log at the depth of occurrence.

A field log of the soils encountered in the boring was maintained by the drill crew. After recovery, each soil sample was removed from the sampler and visually classified. Representative portions of each soil sample were then wrapped in foil and plastic and transported to our laboratory for further visual examination and laboratory testing. After completion of the drilling operations, the borehole was backfilled with auger cuttings to the existing ground surface.

As previously mentioned, a bulk soil sample was obtained at the site. The bulk soil sample was taken from the grassy area to the east of the existing parking lot for CBR testing and lime series testing.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory. The soil samples were tested for moisture content, unconfined compressive strength, Atterberg limits and swell potential. A calibrated hand penetrometer was used to estimate the unconfined compressive strength of several of the soil samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of the soil consistency than visual observation alone. These test results are provided on the attached boring log and Swell Test Results sheet in the Appendix.

A lime series test and CBR test were also performed on a bulk soil sample obtained from the project site. The results of these tests are also provided in the Appendix.

An experienced geotechnical engineer classified each soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring log. A brief explanation of the Unified System is included with this report. The geotechnical engineer grouped the various soil types into the major zones noted on the boring log. The stratification lines designating the interfaces between earth materials on the boring log and profiles are approximate; in situ, the transitions may be gradual.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition.

EXPLORATION RESULTS

Site Conditions

The proposed bulk fuel storage facility will be located at Addison Airport along the west side of Addison Road, south of George Haddaway Street in Addison, Texas. At the time of this investigation, the site was relatively flat and covered with asphalt pavement.

Subsurface Conditions

The soil conditions encountered at the boring location can be summarized as follows. Approximately 10 inches of ashpaltic concrete pavement was present at the ground surface. Tan-brown clayey sandy gravel fill was present beneath the pavement, and extended to the top of native dark brown clay. The clay soil became tan in color with increasing depth in boring B-1. The clay soil extended to the top of tan limestone that was encountered at depth of about 4 feet in the borings. Gray limestone was encountered at depths of about 22 feet and 14 feet in borings B-1 and B-2, respectively, and extended to the termination of these borings at depths of about 25 to 20 feet.

The clay soils encountered in the borings are highly plastic and considered active. Active soils are subject to volume changes with fluctuations in their moisture content. The active clay soils can swell with moisture increases and shrink when they dry. The volume changes can subject foundation (footings, shafts, slabs, etc.) to significant soil pressures and movements with the typical moisture changes that occur beneath a structure after construction.

Moisture fluctuations in the active clays can occur due to several factors that include, but are not limited to, poor drainage, vegetation, seasonal wetting and drying, and trapping of moisture beneath the floor slab. Subsurface moisture tends to accumulate in the soils directly beneath the slab after construction. The slab traps moisture that normally migrates up through the soil profile and would otherwise evaporate from an exposed ground surface.

Groundwater Observations

The boring was monitored while drilling and after the completion of drilling for the presence and level of groundwater. Groundwater seepage was not observed while advancing, or at the completion of drilling the borings. Although seepage was not observed in the borings, groundwater seepage can be present in and above the tan limestone, particularly during or following wet periods of the year. Fluctuations of the groundwater level can occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was drilled. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

ANALYSIS AND RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, ECS, Ltd. should be consulted so that the recommendations of this report can be reviewed.

Earthwork Operations

In preparing the site for construction, all loose, poorly compacted existing soils, vegetation, organic soil, pavements or other unsuitable materials should be removed from all proposed construction areas, and any areas receiving new fill. After stripping the site and prior to placing any fill, we recommend proofrolling the area with heavy construction equipment such as a fully loaded scraper or tandem axle dump truck with a minimum axle load of 10 tons. The purpose of the proofrolling is to attempt to locate any soft or compressible soils prior to placing new fill. Unsuitable materials located during proofrolling should be removed to firm ground and replaced with properly compacted fill as described in the following paragraph.

Prior to placement of any new fill, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted to at least 95% of maximum standard Proctor dry density (ASTM D-698). Clay soils should be moisture conditioned to a workable moisture content above optimum value. Soil moisture levels should be preserved (by various methods that can include covering with plastic, watering, etc.) until new fill, pavements or slabs are placed.

Placement and compaction of new fill will depend on soil type and its intended purpose. Clay fills used in the building area and pavement areas should be placed in 9 inch loose lifts and compacted to at least 95% of maximum standard Proctor dry density (ASTM D-698) at a workable moisture content above optimum value. Fills placed in general landscape areas should be compacted to at least 90% of maximum standard Proctor dry density (ASTM D-698) at a workable moisture content near optimum value. Imported fills for general site grading should be similar to on-site soils, or preferably have a liquid limit less than 50.

Upon completion of the filling operation, care should be taken to maintain the subgrade moisture content prior to construction of slabs and pavements. If the subgrade becomes desiccated, the affected material should be removed and replaced or these materials should be scarified, moisture conditioned and recompacted.

Foundation Recommendations

The active clay soils encountered at this site can subject shallow foundation systems to differential movements due to moisture-induced volume changes in these soils. Moisture changes in the soil can be the result of seasonal wet/dry periods, vegetation changes, plumbing leaks, etc. We anticipate the risk of active clay soil movements to be minimal due to the presence of concrete pavement around the proposed fuel storage facility and the lack of vegetation. Consideration can be given to supporting the proposed project on a shallow footing foundation system bearing in the tan limestone stratum, straight-sided drilled shafts bearing in the tan or limestone, or a mat foundation. Geotechnical design parameters are provided below for each foundation type.

Shallow Footing Foundations

The proposed construction can be supported on a shallow footing foundation system bearing in the tan limestone that was present at a depth of about 4 feet in the borings. We recommended a net allowable bearing pressure of 8,000 psf be used to proportion shallow foundations bearing at least 8 inches into the tan limestone. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure and includes a factor of safety of at least 3 for a bearing capacity failure. Properly designed and installed footings could be subject to potential settlements on the order of 1/2 inch.

We recommend that continuous footing foundations have a minimum width of 18 inches and that isolated footings have a minimum lateral dimension of 30 inches to reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" failures.

Construction Considerations - Footings

Excavation of footings and placement of concrete and steel should proceed in a continuous manner, and exposed bearing materials should be protected from excessive wetting or drying before concrete placement. Concrete in footing excavations should be placed directly against the sides of the cut, with no previous backfill adjacent to the footings below the surface of the rock. Any excessively soft or disturbed materials should be removed from the base of excavations prior to concrete placement. The tan limestone can deteriorate rapidly when exposed, and the base of footing excavations should be protected by a seal slab of footing strength concrete if left open more than 48 hours. We recommend that all footing excavations be observed by qualified geotechnical personnel to verify proper installation.

Straight-Sided Drilled Shaft Foundation

Straight-sided drilled shafts should bear in the gray or tan limestone.

The shafts will develop their load carrying capacity through a combination of end bearing and skin friction in the limestone. We recommend using an allowable ending bearing pressure of 50,000 pounds per square foot (psf) for drilled shafts bearing at least 2 feet into the gray limestone. An allowable skin friction of 7,500 psf can be used for proportioning drilled shafts bearing in the gray limestone stratum.

Shafts bearing at least 3 feet into the tan limestone can be proportioned using an allowable bearing pressure of 10,000 psf and skin friction of 1,500 psf. The drilled shafts should penetrate any clay layers encountered and bear in competent tan limestone. Skin friction in the tan limestone should only be considered for that portion of the shaft extending below the recommended minimum 3 foot penetration into the tan limestone.

Properly installed and constructed drilled shafts bearing in the tan or gray limestone could be subject to potential settlements on the order of 1/2 inch or less.

Expansion of the near surface clays with moisture increases can subject the shafts to uplift forces. The magnitude of these forces is difficult to estimate and depends on several factors including the in-situ moisture levels at the time of construction and the availability of water. We estimate the magnitude of these forces to be approximately 2,000 psf to a depth of 4 feet, or to the top of tan limestone, if encountered at shallower depths.

Uplift forces must be resisted by the dead load on the shafts and uplift skin friction resistance in the limestone. We recommend using an allowable skin friction resistance of 5,000 psf in the gray limestone. An allowable skin friction resistance of 1,000 psf can be used in the tan limestone below the recommended minimum 3 foot penetration. The shafts should contain sufficient reinforcing steel continuously throughout the shaft depth to resist anticipated tensile forces.

Construction Considerations - Drilled Shafts

The possibility of encountering groundwater seepage during shaft installation increases during wet periods of the year. Concrete and steel should be placed as soon as possible after shaft excavations are complete to reduce the potential for seepage problems and deterioration of the bearing surface. During wet periods, seepage in and above the tan limestone could, in some cases, require the use of temporary casing to properly install the shafts. The casing should be seated in the limestone below any seepage. All water should be removed from the cased excavation before beginning the design rock penetration. A sufficient head of concrete must be maintained in the casing during withdrawal. Installation of individual shafts should be completed in one day.

The concrete placed for drilled shafts should have a slump between 5 and 7 inches and should be placed in a manner that prevents it from striking the reinforcing steel and sides of the excavation. We recommend that all drilled shafts be observed by qualified geotechnical personnel, to verify proper shaft installation.

Mat Foundation

As previously indicated, the clay soils present at this site are considered active. The active clay soils can experience volume changes due to fluctuations in the soil moisture content. These potential volume changes should be taken into account when designing a mat foundation system to support the proposed tanks.

Based on test method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures and our experience with similar soils, we estimate soil movements on the order of 1 to 2 inches could occur, depending on the thickness of the clay layer above the tan limestone. These movements are based on dry conditions that can occur prior to construction. The actual movements could be greater if poor drainage, ponded water and/or other unusual sources of moisture are allowed to saturate the soils beneath the structure after construction.

Consideration can be given to reworking the existing soils with proper moisture and density control to the top of tan limestone to reduce the potential active clay soil movements at this site. A minimum thickness of 1-foot of select fill material should be placed above the reworked soil zone to reduce the potential for moisture losses in these soils prior to placement of the mat foundation. Reworking the clay soils to the top of tan limestone (approximately 4 feet) and installation of 1-foot of select fill above the reworked soils should reduce active clay soil movements to less than 1 inch. As an alternative, consideration can be given to removing the active clay soils to the top of tan limestone and replacing these soils with a full depth section of select fill material.

Reworking of the existing clays is performed to increase the moisture of the clays to a level that reduces their ability to absorb additional water that could result in post-construction heave in these soils. The existing clays in the mat foundation area should be excavated to the top of tan limestone. The excavated clays can then be replaced to the base of the planned select fill layer in loose lifts less than 9 inches thick and compacted to between 92% and 97% of standard Proctor maximum dry density at a workable moisture content at least 3% above optimum value. Care should be taken to verify and preserve the specified moisture levels in the reworked clays prior to placement of select fill.

Select fill material (such as clayey sand or very sandy clay that is free of debris and organic matter) should have a liquid limit less than 35 and a plasticity index between 5 and 15. The non-expansive replacement soil should be placed in loose lifts of 9 inches or less and compacted to at least 95% of its standard Proctor dry density at a moisture content ranging from -2% to +3% of its optimum value. Before placing the select fill on a clay subgrade, the subgrade should be scarified to a depth of at least 6 inches, moisture conditioned to at least 3% above the optimum value (at a workable moisture level) and compacted to at least 95% of the maximum standard Proctor dry density.

After completing the filling operations, care should be taken to maintain the subgrade moisture content prior to constructing the foundation slab. If the subgrade becomes desiccated, the affected material should be scarified, moistened and recompacted prior to floor slab placement.

Mat foundations can be designed using a modulus of subgrade reaction of 50 pci.

Pavement Subgrades

The surficial clays are subject to strength loss with the increases in moisture content that normally occur beneath paving. These soils are generally considered to provide poor subgrade support as indicated by the CBR test results included in the Appendix. The CBR values varied from about 1.4 to 5.9, depending on the soil moisture content.

Treatment of the clay soils with hydrated lime will improve their subgrade characteristics. Based on the result of the lime series tests, we recommend a minimum of 7% hydrated lime be used to modify the clay subgrade soils. The hydrated lime should meet the requirements of Item 264 (Type A) in the TxDOT Standard Specifications for Construction of Highways, Streets and Bridges, and should be thoroughly mixed and blended with the upper 6 inches of the clay subgrade (TxDOT Item 260). This mixture should be uniformly compacted to a minimum of 95% of its maximum Standard Proctor dry density (ASTM D-698) at a moisture content in the range of –2% to +3% of optimum moisture content as determined by that test. Lime treatment should extend at least 1 foot beyond exposed pavement edges to reduce the effects of shrinkage and associated loss of subgrade support.

If lime treatment of the pavement subgrade is not performed, we recommend the pavement subgrades be scarified to a depth of 6 inches, moisture conditioned to above optimum value and compacted to at least 95% of maximum standard proctor dry density.

Utility/Trench Excavations

All trenches should comply with OSHA and state law requirements for trench safety. It is important that a qualified and experienced contractor be retained to perform the excavation and shoring work. Continuous observations by qualified personnel should be made during excavation, shoring and backfilling operations.

Care should be taken when excavating near and below any existing utility trenches because backfill materials associated with these lines could be loose and/or contain water seepage. Careful observation of these existing trenches is recommended to determine if adjustments in side slopes or shoring is required.

Although groundwater seepage was not encountered in the borings, the possibility of encountering seepage increases during wet periods of the year. Dewatering the area of the planned excavations may be necessary to maintain a safe trench excavation during construction.

Drainage

Positive drainage should be developed around the facility to minimize any increase in moisture content of the clay soils underlying structures and on-grade slabs/pavements. All adjacent flatwork should be sloped to prevent ponding of water. Water should not be allowed to pond near or adjacent to the structures. Joints between the paving and the structure should be sealed, periodically inspected and resealed to prevent the infiltration of surface water.

Closing

We recommend that the construction activities be monitored by ECS, Ltd. to provide the necessary overview and to check the suitability of the subgrade soils for supporting the foundations and pavements. We would be most pleased to provide these services.

This report has been prepared in order to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope is limited to the specific project and locations described herein and our description of the project represents our understanding of the significant aspects relative to soil and foundation characteristics. In the event that any change in the nature or location of the proposed construction outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified or approved in writing by the geotechnical engineer. It is recommended that all construction operations dealing with earthwork and foundations be reviewed by an experienced geotechnical engineer to provide information on which to base a decision as to whether the design requirements are fulfilled in the actual construction. If you wish, we would welcome the opportunity to provide field construction services for you during construction.

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings and tests performed at the locations as indicated on the Boring Location Diagram and other information referenced in this report. This report does not reflect any variations, which may occur between the borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after performing on-site observations during the construction period and noting characteristics and variations, a reevaluation of the recommendations for this report will be necessary.

APPENDIX

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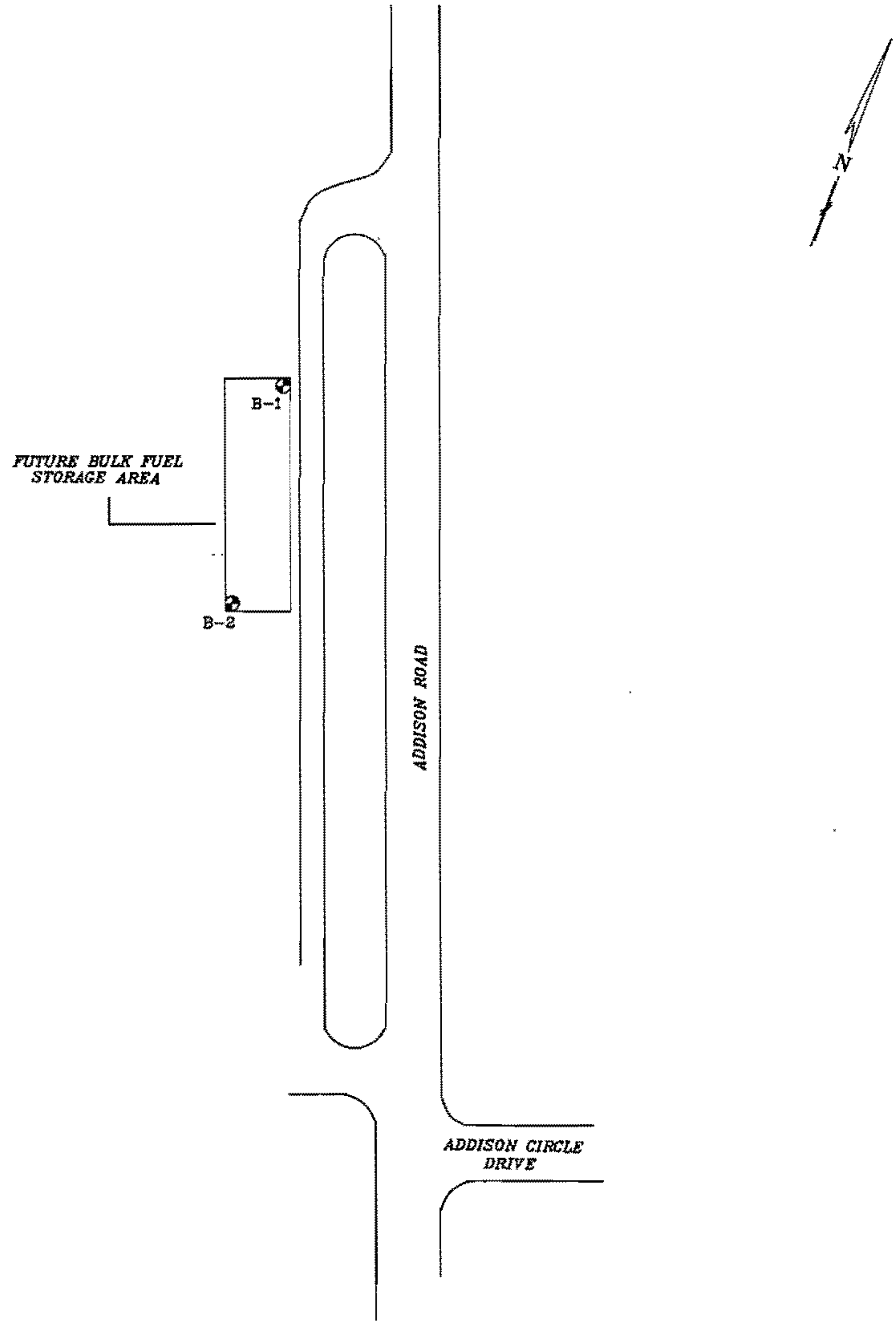


NOT TO SCALE

ECS LTD

BORING LOCATION DIAGRAM

BULK FUEL STORAGE SYSTEM
ADDISON ROAD & GEORGE HADDAWAY STREET
ADDISON, TEXAS

Project No.: 3846

Date: 04/13/04

CLIENT	JOB #	BORING #	SHEET
Washington Group International, Inc.	3846	B-1	1 OF 1

ECS LTD

PROJECT NAME	ARCHITECT-ENGINEER
Bulk Fuel Storage System	

SITE LOCATION
Addison Rd & George Haddaway St – Addison, Texas

ENGLISH UNITS
SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (IN)	SPT, N(*) OR TCP BLOWS/IN	DESCRIPTION OF MATERIAL	STRATUM DEPTH	MOISTURE CONTENT (%)	HAND PENETROMETER (*) OR UNCONFINED COMPRESSIVE STRENGTH (PSF)	DRY DENSITY (PCF)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	% PASSING #200 SIEVE	RQD (%)
0					Asphalt Depth 10"	0.8								
					(FILL) Clayey Sandy Gravel, tan-brown	2.0								
	1	ST	12		CLAY (CH), dark brown, very stiff	3.0	30.3	*6000		70	29	41		
	2	ST	12		CLAY (CH), tan, with weathered limestone fragments, hard	4.0	18.2	*9000+						
5	3	TCP	12	100/2.00	LIMESTONE, tan, with clay layers, highly weathered									
10	4	TCP	12	100/1.50	– clay layer from 11' to 13'									
15	5	TCP	12	100/1.50										
20	6	TCP	12	100/1.25		22.0								
					LIMESTONE, gray									
25	7	TCP	12	100/.25										
					END OF BORING @ 25.0'									
30														

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WATER LEVEL OBSERVATIONS		
Groundwater seepage was not observed while advancing, or at the completion of drilling the boring.	BORING STARTED 03/30/04	
	BORING COMPLETED 03/30/04	CAVE IN DEPTH ●
	RIG B-61 FOREMAN TD	DRILLING METHOD CFA

REFERENCE NOTES FOR BORING LOGS

I. Drilling and Sampling Symbols:

SS - Split Spoon Sampler
ST - Shelby Tube Sampler
RC - Rock Core: NX, BX, AX
PM - Pressuremeter
DC - Dutch Cone Penetrometer
TC - Texas Cone Penetrometer

RB - Rock Bit Drilling
BS -Bulk Sample of Cuttings
PA - Power Auger (no sample)
HS - Hollow Stem Auger
WS - Wash Sample

Standard penetration (blows/ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2 inch O.D. split spoon sampler, as specified in ASTM D-1586. The blow count is commonly referred to as the N-value.

Texas cone penetrometer (blows/in) refers to the penetration of a 3-inch diameter cone after the cone is driven 100 blows with a 140 lb. hammer falling 30 inches. This is a modification of the Texas Department of Transportation test method TEX-132-E that requires a 170 lb. hammer falling 24 inches.

II. Correlation of Penetration Resistances to Soil Properties:

Relative Density-Sands, Silts

SPT-N	Relative Density
0- 3	Very Loose
4- 9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense

Consistency of Cohesive Soils

Unconfined Compressive Strength, Q_P, psf	Consistency
under 500	Very Soft
500-1,000	Soft
1,000-2,000	Firm
2,000-4,000	Stiff
4,000-8,000	Very Stiff
8,000-16,000	Hard
over 16,000	Very Hard

III. Unified Soil Classification Symbols:

GP- Poorly Graded Gravel
GW-Well Graded Gravel
GM -Silty Gravel
GC - Clayey Gravels
SP - Poorly Graded Sands
SW -Well Graded Sands
SM - Silty Sands
SC - Clayey Sands

ML - Low Plasticity Silts
MH -High Plasticity Silts
CL - Low Plasticity Clays
CH - High Plasticity Clays
OL - Low Plasticity Organics
OH - High Plasticity Organics
CL-ML - Dual Classification (Typical)

IV. Water Level Measurement Symbols:

WL - Water Level
WS - While Sampling
WD - While Drilling
AB – After Boring Completion

BCR - Before Casing Removal
ACR - After Casing Removal
WCI - Wet Cave In
DCI - Dry Cave In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

SWELL TEST RESULTS
BULK FUEL STORAGE FACILITY
SWC OF ADDISON ROAD AND GEORGE HADDAWAY STREET
ADDISON, TEXAS

ECS JOB NO. 19-3846

BORING	SAMPLE	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	INITIAL MOISTURE (%)	FINAL MOISTURE (%)	LOAD (psf)	% SWELL
B-1	3	2-3	70	29	41	30.3	33.7	310	0.7
B-2	3	2-3	69	28	41	33.5	35.4	310	0.7

Engineering Consulting Services, Ltd.
Dallas, Texas

California Bearing Ratio
ASTM D-1883

Date: 4/12/04

Project Name: Bulk Fuel Storage
Project Number: 19-3846

Reported By: CWE/EH

Sample Number:
Location:

Description: Dark Brown Clay

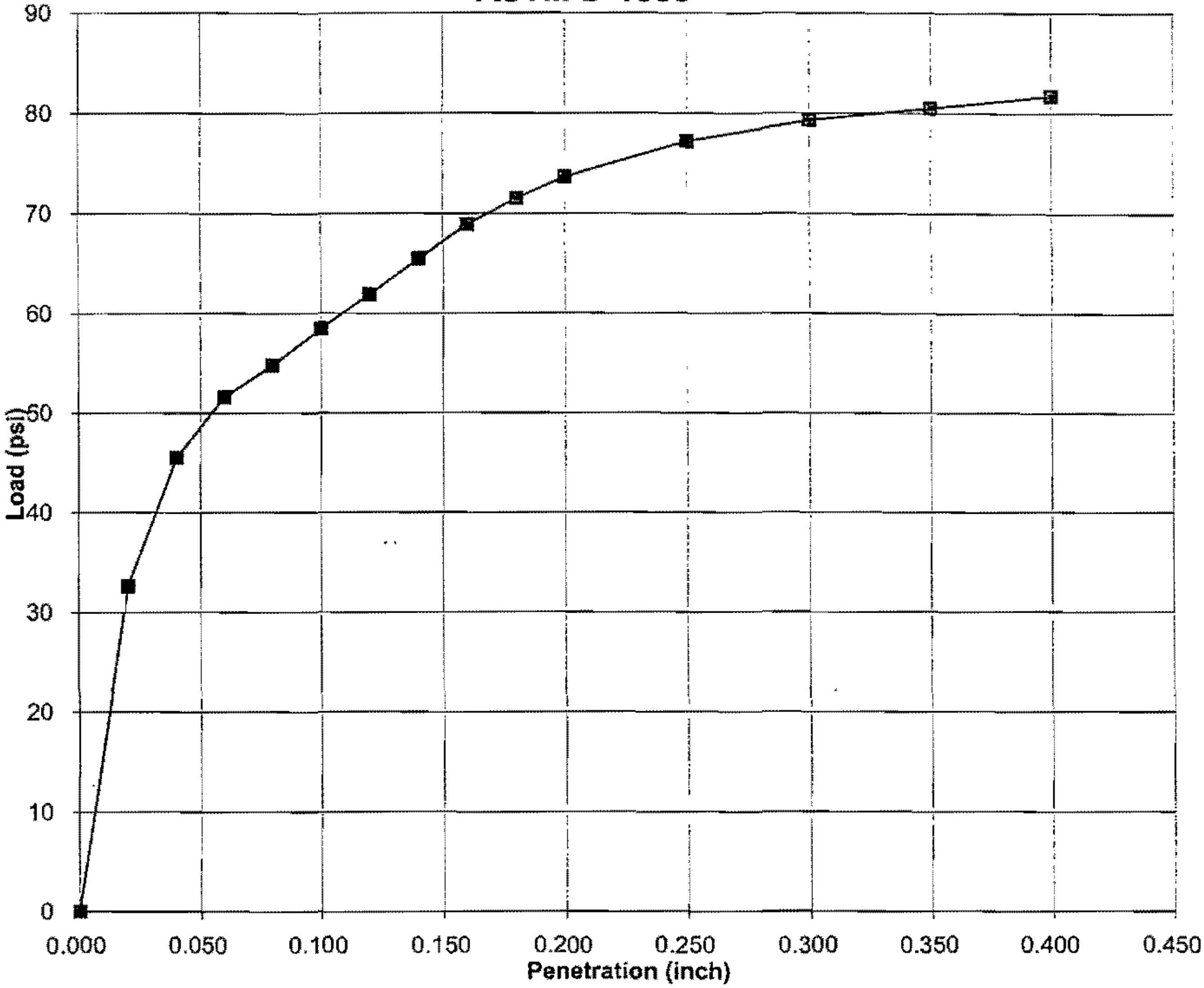
Weight of Hammer (lbs): 5.5
Number of Layers: 3
Surcharge (lbs): 10

Proctor Method: ASTM D 698
Percent +4 Material: 0.0

Maximum Dry Density (pcf): 94.5
Optimum Moisture Content (%): 25.0

Blows per Lift	CBR @ 0.1"	CBR @ 0.2"	Percent of Maximum Density	Molded +/ Optimum Moisture Content (%)	Molded Dry Density (pcf)	Molded Moisture Content (%)	Dry Density after Soaking (pcf)	Moisture Content after Soaking (%)	Change in Moisture Content (%)	Swell (%)
38	1.5	1.4	93.1	-2.6	89.8	22.4	86.0	33.6	11.4	6.0
32	2.9	2.8	94.6	0.8	89.4	25.8	86.4	31.4	5.6	4.5
30	5.9	4.9	95.1	3.5	89.8	28.5	88.6	30.5	2.0	2.2

CBR Penetration
ASTM D-1883



Sample No.: +3%	Street: 0
Description: Dark Brown Clay	Station No.: 0
Classification: CH	Remark:

Maximum Dry Density (pcf)	94.5		CBR 3
Opt. Moisture Content (%)	25.0	Corrected CBR @ 0.1"	5.9
Natural Moisture Content	N/A	Corrected CBR @ 0.2"	4.9
Liquid Limit (LL)	74		
Plastic Limit (PL)	28	Dry Density as Molded	89.9
Plasticity Index (PI)	46	Molded Moisture Content	28.5
Liquidity Index (LI)	N/A	Percent of Maximum Density	95.1
Percent Retained 3/4" Sieve	0.0	Moisture Content +/- Opt	3.5
Percent Retained No. 4 Sieve	0.0	Percent (%)Swell	1.9
Percent Passing No.200 Sieve	N/A		

Project: Bulk Fuel Storage
Project No.: 19-3846
Date: 04-06-04

Engineering Consulting Services, Ltd.
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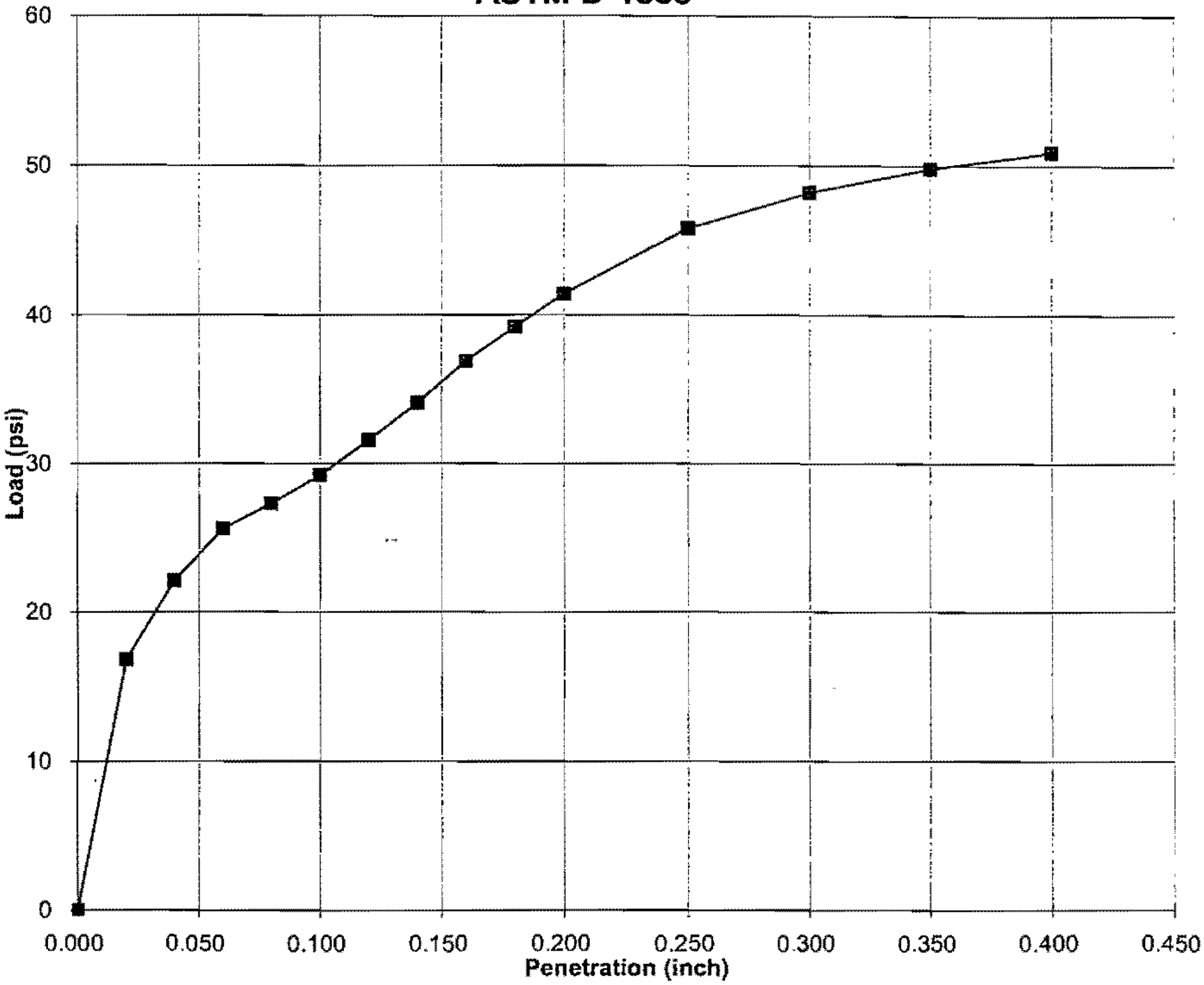
California Bearing Ratio Curves

CBR Penetration
ASTM D-1883



Sample No.: Optimum Moisture	Street: Street:
Description: CLAY, dark brown, trace limestone	Station No.: 0
Classification: CH	Remark:

Maximum Dry Density (pcf)	94.5		CBR 2
Opt. Moisture Content (%)	25.0	Corrected CBR @ 0.1"	2.9
Natural Moisture Content	N/A	Corrected CBR @ 0.2"	2.8
Liquid Limit (LL)	74		
Plastic Limit (PL)	28	Dry Density as Molded	89.3
Plasticity Index (PI)	46	Molded Moisture Content	25.8
Liquidity Index (LI)	N/A	Percent of Maximum Density	94.5
Percent Retained 3/4" Sieve	0.0	Moisture Content +/- Opt	0.8
Percent Retained No. 4 Sieve	0.0	Percent (%)Swell	4.6
Percent Passing No.200 Sieve	N/A		

Project: Bulk Fuel Storage
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Date: April 06, 2004

Engineering Consulting Services, Ltd.
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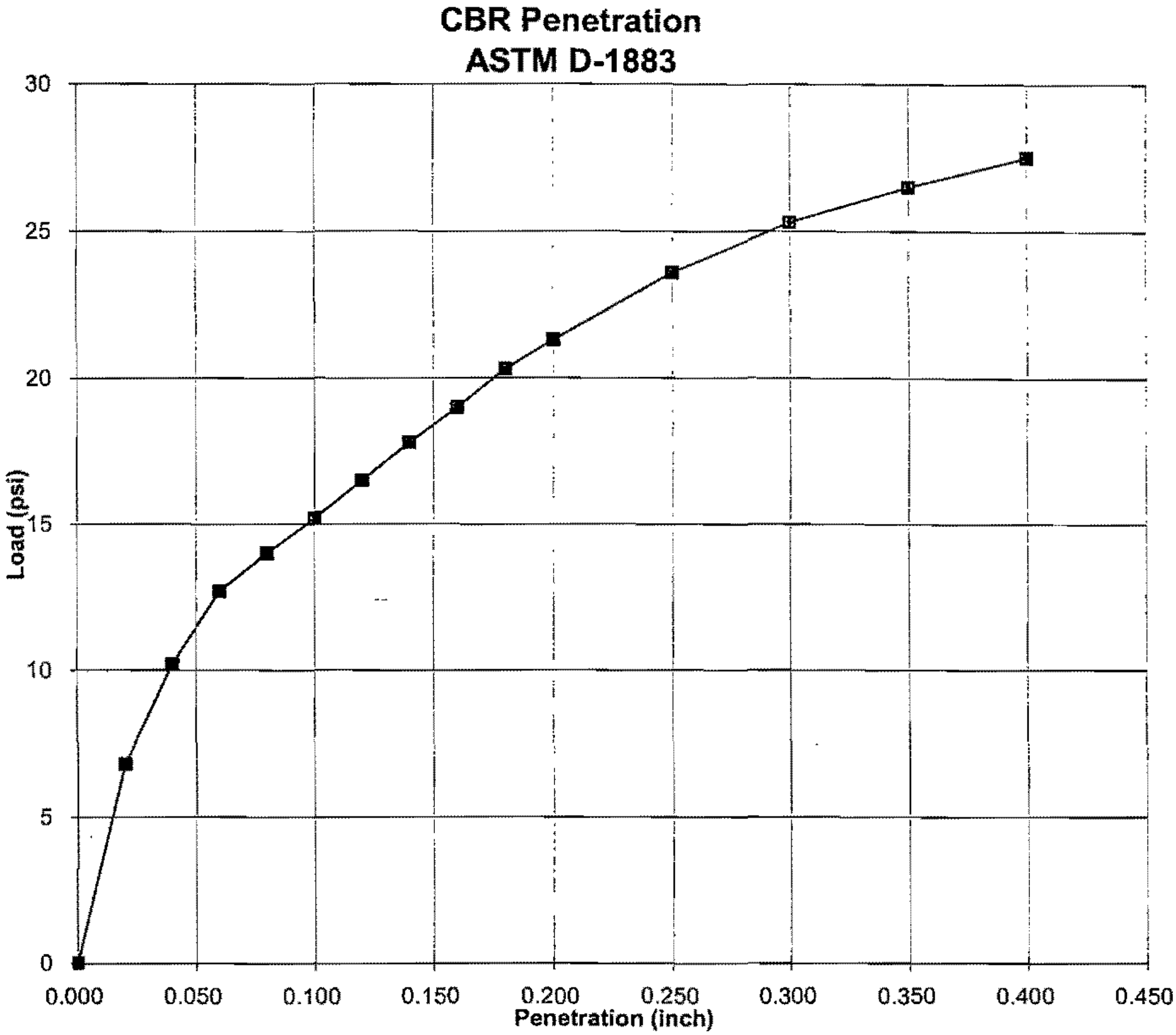
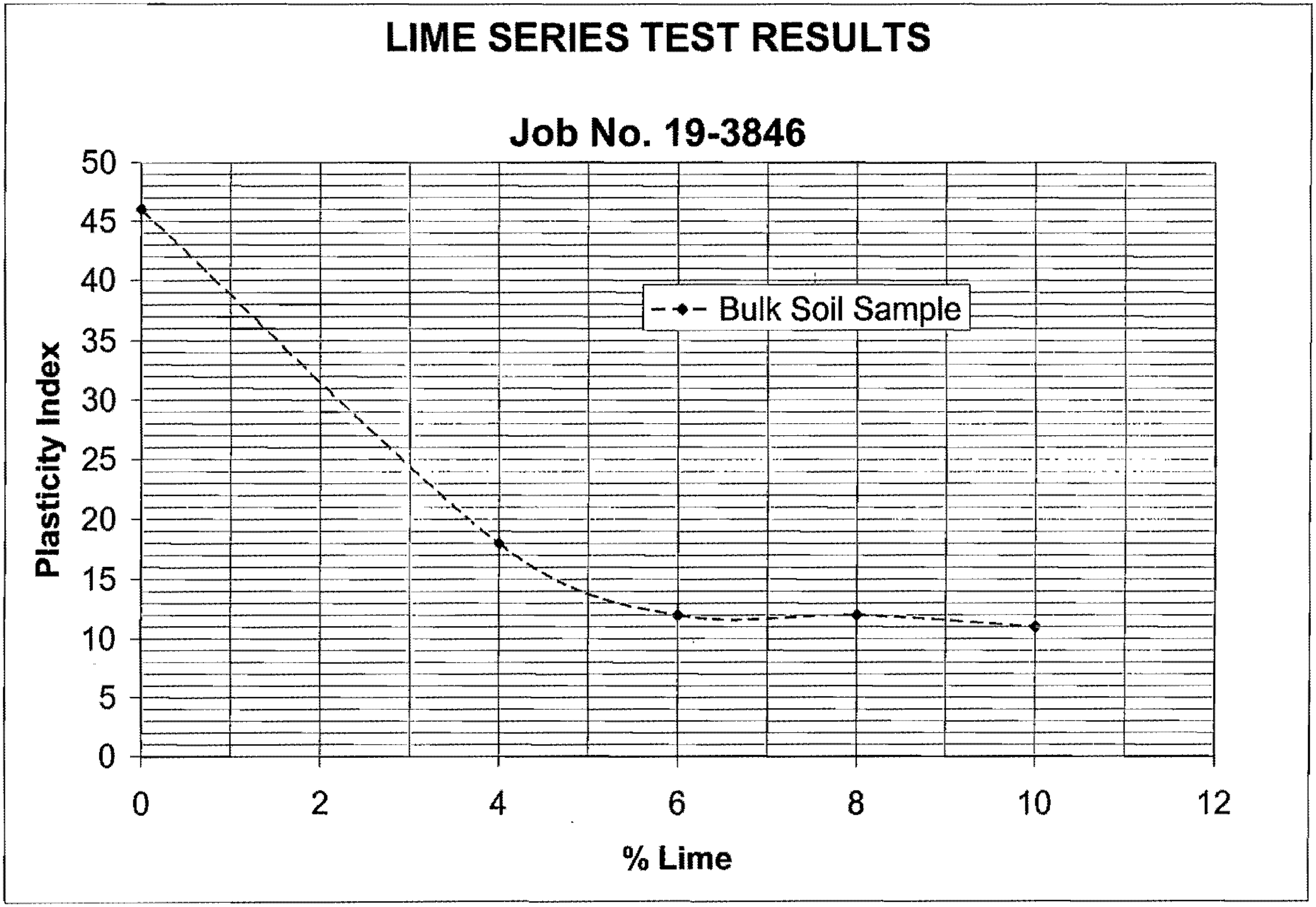


Sample No.:	-3.00%	Street:	
Description:	CLAY, dark brown	Station No.:	
Classification:	CH	Remark:	Composite Sample

Maximum Dry Density (pcf)	94.5		CBR 1
Opt. Moisture Content (%)	25.0	Corrected CBR @ 0.1"	1.5
Natural Moisture Content	N/A	Corrected CBR @ 0.2"	1.4
Liquid Limit (LL)	74		
Plastic Limit (PL)	28	Dry Density as Molded	89.8
Plasticity Index (PI)	46	Molded Moisture Content	22.4
Liquidity Index (LI)	N/A	Percent of Maximum Density	95.0
Percent Retained 3/4" Sieve	0.0	Moisture Content +/- Opt	-2.6
Percent Retained No. 4 Sieve	0.0	Percent (%)Swell	6.1
Percent Passing No.200 Sieve	N/A		

Project:	Bulk Fuel Storage	**Engineering Consulting Services, Ltd.**
Project No:	19-3846	**Dallas, Texas**
Date:	04/06/04	**California Bearing Ratio Curves**



LIME SERIES TEST RESULTS
Job No. 19-3846
Bulk Soil Sample
Plasticity Index
50
45
40
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
% Lime