



JEFFERSON COUNTY DRAINAGE DISTRICT NO. 6
Karen K. Johnson, MBA, CTCD, CTCM: Chief Business Officer

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IFB Number: IFB 26-009/KKJ
IFB Title: Corley Diversion Project
IFB Originally Due by: 2:00 PM, CST, July 9, 2026
IFB Due by Addendum No. 2: 2:00 PM, CST, July 23, 2026
Addendum No.: 2
Issued (Date): June 22, 2026

TO BIDDER: This Addendum is an integral part of the IFB package under consideration by you as a Bidder in connection with the subject matter herein identified. Drainage District No. 6 deems all sealed bids to have been proffered in recognition and consideration of the entire IFB package – including all addenda. For purposes of clarification, receipt of this present Addendum by a Bidder should be evidenced by returning it (signed) as part of the Bidder’s sealed bid. If the Bid has already been received by the Jefferson County Drainage District No 6 Purchasing Department, Bidder should return this addendum in a separate sealed envelope, clearly marked with the IFB Name, IFB Number, and Opening Date and Time, as stated above.

Reason for Issuance of this addendum: *Due Date Extension and Include Part IV Special Specifications.*

1. DUE DATE EXTENSION:

Due date: 2:00 PM, CST, July 23, 2026

2. PART IV SPECIAL SPECIFICATIONS:

The attached Special Specification IX. ITEM 97 – SUBSURFACE CONDITIONS is hereby added to the Technical Specifications.

All addendums will be posted on the DD6 website:
<https://dd6.org/departments/purchasing/notices-for-bid/>

The information included herein is hereby incorporated into the documents of this present Bid matter and supersedes any conflicting documents or portion thereof previously issued.

Receipt of this Addendum is hereby acknowledged by the undersigned Bidder:

ATTEST:

Witness

Witness

Authorized Signature (Bidder)

Title of Person Signing Above

Typed Name of Business or Individual

Approved by _____ Date

IX. ITEM 97 - SUBSURFACE CONDITIONS

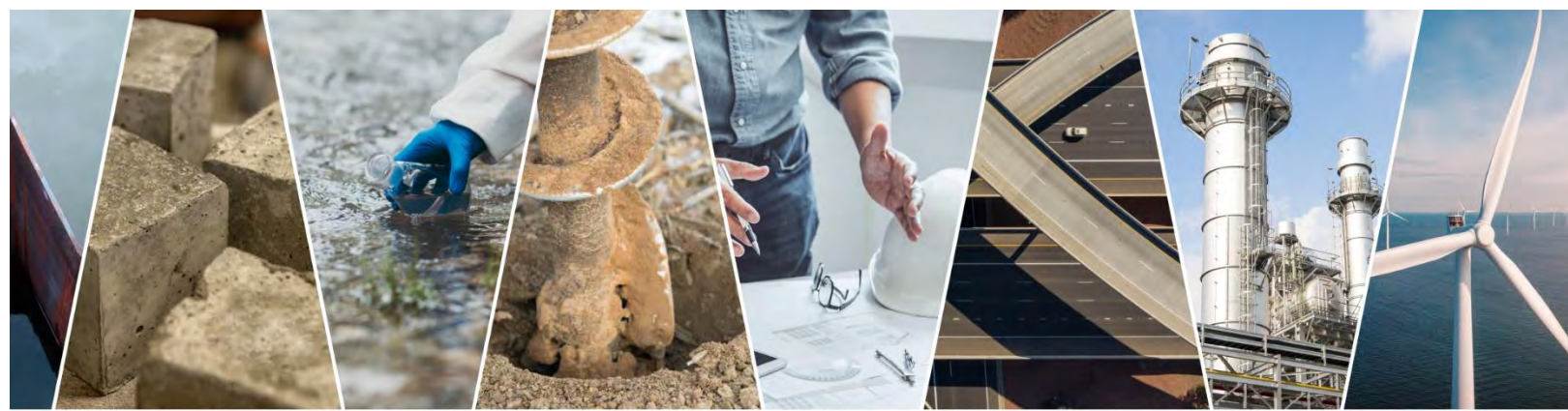
97.01 - DESCRIPTION

A soil investigation report has been prepared by Tolunay-Wong Engineers, Inc., hereinafter referred to as the Soil Engineer; a copy of the soil boring logs and test data is included in this document for the Contractor's convenience.

This report was obtained only for the Owner's use in design and is not a part of the Contract Documents; the report and log of borings are for Contractors' information but are not a warrant of subsurface conditions.

97.02 - ADDITIONAL INFORMATION

The Contractor should visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Engineer.



**Geotechnical Engineering Report
Corley Diversion Project
Jefferson County Drainage District 6
Beaumont, Texas**

Prepared for:

**Schaumburg & Polk, Inc.
8865 College Street, Suite 100
Beaumont, Texas 77707**

Prepared by:

**Tolunay-Wong Engineers, Inc.
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Beaumont, Texas 77705**

TWE Project No. 24.23.093 / Report No. 159150

Date:

October 18, 2024

Tolunay-Wong Engineers, Inc.

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October 18, 2024

Schaumburg & Polk, Inc.
8865 College Street, Suite 100
Beaumont, Texas 77707

Attn: Mr. Alvin Trahan, PE
atraham@spi-eng.com

Ref: Geotechnical Engineering Report
Corley Diversion Project
Jefferson County Drainage District 6
Beaumont, Texas
TWE Project No. 24.23.093 / Report No. 159150


Dear Mr. Trahan,

Tolunay-Wong Engineers, Inc. (TWE) is pleased to submit this report of our geotechnical engineering study performed for the above referenced project. This report contains a detailed description of field and laboratory work performed for this study as well as our geotechnical design and construction recommendations associated with the project.

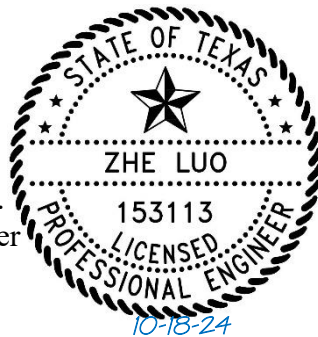
We appreciate the opportunity to work with you on this phase of the project and look forward to the opportunity to provide additional services as the project progresses. If you have any questions regarding this report or if we can be of further assistance, please contact us.

Sincerely,

TOLUNAY-WONG ENGINEERS, INC.
TBPELS Firm Registration No. F-000124



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1 INTRODUCTION AND PROJECT DESCRIPTION

1.1 Introduction

This report presents the results of our geotechnical engineering study performed for the design and construction of drainage improvements within the City of Beaumont by Jefferson County Drainage District No. 6 in Jefferson County, Texas. Our investigations were conducted in general accordance with TWE Proposal No. P23-B469 dated January 25, 2024 and authorized by Schaumburg & Polk Inc. (SPI) (Client) dated May 15, 2024.

1.2 Project Description

The project includes the design and construction of drainage improvements within the City of Beaumont by Jefferson County Drainage District No. 6 to install large box culverts to divert stormwater directly to the Neches River. An improved drainage channel was planned with 10-ft by 10-ft and 12-ft by 8-ft Reinforced Concrete Box (RCB) culverts in single and double run configurations placed within existing roadway right-of-ways which would require roadway reconstruction throughout the project alignment. In addition, multiple jack-and-bore railroad crossings were planned as well as a jack-and-bore crossing under Spur 380 where the deepest installed depth would be around 22-ft below grade. A pile-supported outlet also was anticipated within the Port of Beaumont at the Neches River terminus of the diversion alignment. The project alignment spans approximately 15,800-ft as shown in Appendix A, provided by SPI.

2 PURPOSE AND SCOPE OF SERVICES

The purposes of our geotechnical study were to provide the geotechnical information and recommendations needed to assist the Client in the design and construction of the drainage improvements. Our scope of services for the project consisted of:

1. Conducting geotechnical investigations consisting of nineteen (19) Test Borings (TBs) to evaluate subsurface stratigraphy and groundwater conditions within the project site;
2. Performing geotechnical laboratory tests on the recovered soil samples from the TBs to evaluate the physical and engineering properties of the subsurface materials encountered;
3. Preparing a synopsis of our findings including existing project site conditions, subsurface soil and groundwater conditions, TB logs including tabulated field and laboratory test results presenting charted field data and basic interpretation plots, and existing project alignment surface and pavement section conditions with photographic documentation;
4. Providing geotechnical design recommendations for new drainage inlets, culverts or structures including allowable soil bearing capacity, allowable bearing capacities and settlement estimates;
5. Providing geotechnical design recommendations for below grade structures and utilities including design soil parameters and lateral earth pressure coefficients for temporary and permanent soil conditions, allowable bearing capacities and settlement estimates;
6. Providing geotechnical design recommendations deep foundations including suitable types and sizes, axial compression and tension capacities, lateral pile response design parameters, pile group considerations and settlement estimates;
7. Providing geotechnical design recommendations for pavement systems including pavement types, assumed traffic loads and frequencies, material layer thicknesses and subgrade support characteristics; and,
8. Providing geotechnical construction recommendations including site development, subgrade preparation, excavation considerations and OSHA soil types, groundwater control and dewatering, suitable fill, bedding and backfill material types, compaction requirements, foundation installation and overall quality control guidelines.

Our scope of services did not include any environmental assessment for the presence or absence of wetlands or of hazardous or toxic materials within or on the soil, air or water at this site. Any statements in this report or on the logs regarding odors, colors, unusual items and conditions are strictly for the information of the Client. A geological fault study was also beyond the scope of this study.

3 FIELD PROGRAM

The field program for this project consisted of nineteen (19) test borings (TBs) to depths of 30-ft, 50-ft or 60-ft below existing grade. The field program was conducted between June 24 and July 9, 2024. The TB locations and depths are presented on the exploration location plan in Appendix B.

3.1 Test Boring (TB)

3.1.1 Drilling Methods

The TBs were performed in general accordance with the Standard Practice for Soil Investigation and Sampling by Auger Borings (ASTM D1452) using conventional truck-mounted drilling equipment. The TBs were performed using dry-auger drilling methods until groundwater was encountered or borehole conditions required the use of wash or mud-rotary drilling methods. Soil samples were obtained continuously to a depth of 12-ft, at 13-ft to 15-ft and at 5-ft depth intervals thereafter until the boring completion depths were reached. Upon drilling and sampling completion, the TB boreholes were backfilled with cement-bentonite grout upon completion.

3.1.2 Soil Sampling

Fine-grained, cohesive soil samples were recovered from the TBs by hydraulically pushing a 3-in diameter, thin-walled tube a distance of about 24-in. The field sampling procedures were conducted in general accordance with the Standard Practice for Thin-Walled Fine-grained, cohesive soil samples were recovered from the soil borings by hydraulically pushing a 3-in diameter, thin-walled tube a distance of about 24-in. The field sampling procedures were conducted in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587). Our Geotechnician visually classified the recovered soils and obtained field strength measurements of the recovered soils using a calibrated pocket penetrometer and/or hand torvane device. The tube samples were extruded in the field, wrapped in foil, placed in moisture-sealed plastic bags and protected from disturbance prior to transport to the laboratory.

Cohesive soils thought to be coarse-grained, as well as cohesionless and semi-cohesionless coarse-grained soils, were collected with the Standard Penetration Test (SPT) sampler driven 18-in by blows from a 140-lb hammer falling 30-in in accordance with the Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils (ASTM D1586). The number of blows required to advance the sampler three (3) consecutive 6-in depths are recorded for each corresponding sample on the boring logs. The N-value, in blows per foot, is obtained from SPTs by adding the last two (2) blow count numbers. The consistency of cohesive soils and the relative density of cohesionless and semi-cohesionless soils can be inferred from the N-value. The samples obtained from the split-barrel sampler were visually classified, placed in moisture-sealed plastic bags and transported to our laboratory.

3.1.3 Boring Logs

Our interpretations of general subsurface soil and groundwater conditions at the TB locations are included on the project boring logs in Appendix C. The interpretations of the soil types throughout the boring depths and the locations of strata changes were based on visual classifications during field sampling and laboratory testing using the Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) [ASTM D2487] and the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) [ASTM D2488]. A key to the symbols and terms used on the boring logs is also included in Appendix C.

3.1.4 Groundwater Measurements

Groundwater level measurements were attempted in the open TB boreholes during dry-auger drilling. Measurements were taken initially during dry-auger drilling when groundwater was first encountered and at 5-min intervals thereafter over a 15-min time period. The groundwater measurements observed within the TBs are provided on the logs in Appendix C and described in Section 5.3 of this report.

4 LABORATORY SERVICES

A laboratory testing program was conducted on selected soil samples from the TBs to assist in classification and evaluation of the physical and engineering properties of the soils encountered within the project site. Geotechnical laboratory tests were performed in general accordance with ASTM International standards. The types and brief descriptions of the geotechnical laboratory tests performed are presented in Table 4-1 below. Standard geotechnical laboratory test results are provided on the TB logs provided in Appendix C.

Table 4-1: Geotechnical Laboratory Testing Program	
Test Description	Test Method
Amount of Material Finer than No. 200 Sieve	ASTM D1140
Unconfined Compression	ASTM D2166
Water (Moisture) Content	ASTM D2216
Unconsolidated-Undrained Triaxial Compression	ASTM D2850
Liquid Limit, Plastic Limit and Plasticity Index	ASTM D4318
Density (Unit Weight)	ASTM D7263

5 PROJECT SITE CONDITIONS

Our interpretations of soil and groundwater conditions within the project site are based on information obtained at the locations of the project explorations referenced in this report. Subsurface conditions could vary at areas not explored by the geotechnical explorations.

5.1 Site Description and Surface Conditions

The site photos along the project alignment through TB-1 to TB-19 are presented in Appendix D. Details and photographs detailing the existing pavement thicknesses and base materials within the pavement core locations are presented on the pavement core logs provided in Appendix E of this report.

5.2 Subsurface Soil Stratigraphy

The subsurface profiles along the project alignment were determined from the TB logs in Appendix C and are presented in Appendix F. The generalized subsurface soil conditions within the project site were interpreted from the project explorations as presented on the TB logs in Appendix C. The generalized subsurface soil profile considered for the project site is summarized in Table 5-1 and Table 5-2 below.

Table 5-1: Generalized Subsurface Stratigraphy (Profile 1) TB-1 through TB-6, TB-8, TB-17 & TB-18	
Depth Range (ft)	Strata Description
0 to 1	Pavement and Base Materials
1 to 45	Firm to Very Stiff Clay
45 to 50	Medium Dense Sand

Table 5-2: Generalized Subsurface Stratigraphy (Profile 2) TB-7, TB-9 through TB-11, TB-15, TB-16 & TB-19	
Depth Range (ft)	Strata Description
0 to 1	Pavement and Base Materials
1 to 15	Stiff to Very Stiff Clay
15 to 25	Medium Dense to Dense Sand
25 to 48	Very Stiff Clay
48 to 50	Medium Dense to Very Dense Sand

5.2.1 Design Soil Parameters

Plots of interpreted design soil strength, N_{60} corrected blow counts, angle of internal friction, unit weight and moisture content interpreted from our field measurements and laboratory testing presented in Appendix G. Details of the soil conditions encountered in the TBs can be found on the corresponding logs presented in Appendix C. These design soil parameters were used to develop the conclusions and recommendations provided in this report.

A line indicating the ratio of undrained cohesion to effective overburden pressure (c/p) equaling 0.31 is also superimposed on the undrained shear strength plot in Appendix G. This line represents the minimum value of undrained shear strength with depth according to the SHANSEP (Soil Stress History and Normalized Soil Engineering Properties) relation (Ladd and Foote, 1974). The SHANSEP line was considered in developing the design shear strength lines for this project.

Soil design parameters were selected using the available subsurface information obtained for this project. Please note the generalized design soil stratification and soil types along with depth, assumed for engineering analyses purposes, can vary from the soil types and conditions encountered in the individual exploration locations.

5.3 Groundwater Observations

Groundwater level measurements were attempted in the open TB boreholes when groundwater was first encountered during dry-auger drilling and at 5-min intervals over a 15-min time period. Groundwater measurements obtained from the available and supplemental TBs are summarized in Table 5-3 below.

Table 5-3: Groundwater Level Measurements					
Test Boring	Date Boring Performed	Boring Completion Depth (ft)	Free Water Depth during Dry-Auger Drilling (ft)	15-min Static Water Depth (ft)	15-min Total Borehole Depth (ft)
TB-1	6/24/2023	30	13.5	11.4	14.1
TB-2	6/24/2023	30	13.3	11.5	14.0
TB-3	6/25/2024	50	13.9	11.2	16.4
TB-4	6/25/2024	40	12.4	13.8	13.8
TB-5	6/25/2024	30	10.0	7.3	15.2
TB-6	6/26/2024	50	15.1	14.1	15.3
TB-7	6/24/2023	30	14.4	14.2	14.8
TB-8	6/24/2023	30	28.0	21.1	21.1
TB-9	6/27/2023	50	15.9	12.0	16.0
TB-10	6/28/2023	30	6.0	5.4	12.7
TB-11	6/27/2023	50	11.2	9.1	13.4
TB-12	6/28/2023	30	17.1	14.1	17.9
TB-13	7/1/2024	50	10.6	10.4	10.8
TB-14	7/1/2024	50	14.7	14.0	17.7
TB-15	7/2/2024	30	17.3	15.4	19.8

Table 5-3: Groundwater Level Measurements					
TB-16	7/2/2024	30	16.9	15.6	18.1
TB-17	7/9/2024	50	13.7	12.4	19.1
TB-18	7/9/2024	30	14.8	13.4	20.8
TB-19	7/3/2024	60	15.5	14.5	17.6

A design groundwater level of 11.0-ft below existing grade was considered for our analyses as shown on the plot in Appendix G. Please note groundwater levels at the project site could fluctuate with climatic, tidal and seasonal variations, as well as external facility operations or construction activities. We recommend groundwater levels be verified before construction commences to verify the information provided in Table 5-3 above.

Accurate determination of static groundwater levels is typically made with standpipe piezometers. Installation of standpipe piezometers to evaluate long-term groundwater conditions within the project site was not included in our scope of services for this project. If groundwater or perched water is encountered during construction, the Contractor should be prepared to dewater the site and any excavations using appropriate means and methods.

6 JACK-AND-BORE RECOMMENDATIONS

We understand multiple jack-and-bores are planned at railroad crossings and one jack-and-bore is planned under Spur 380 where the deepest installation depth will be approximately 22-ft below grade. The static water levels range from 5.4-ft to 15.6-ft among TBs as shown in Table 5-3. If bore face is below groundwater level and/or within cohesionless soils, some bore instability can be expected due to groundwater seepage and bore sloughing. Auger boring equipment should be selected that is suitable for maintaining stable face.

For pipes to be installed by jacking, whereby sections of pipe are jacked forward against the surrounding soil, pipes should be designed to resist significant bending moments, along with the jacking forces exerted on the pipe during installation. These forces generally depend on the subsurface soil conditions such as friction angle, cohesion and adhesion, the depth of overburden, the depth of the groundwater, surcharge loads, the length and diameter of pipe is being jacked and the time taken for operation. The derived soil design parameters presented in Appendix G, can be used to estimate these forces. The pipes designed to resist construction loads during jacking operations should have adequate strength for most long-term overburden and traffic loads.

Design and construction of temporary facilities including excavation retention systems are the responsibility of the Contractor. TWE provides excavation planning comments and suggestions for strictly informational purposes.

6.1 Pit Construction Recommendation

Pits serve as the locations for entry and exits for the pipeline installation. They vary in size and depth, and their design and construction are key to the successful completion of any jack and bore project. The pits size depends on whether the pit is a drive or receive pit, size of boring machine, and length of pit. The pit should be designed to the appropriate factors of safety against yielding, deformation and instability.

6.1.1 Pit Wall Stability

Pit excavations shall be braced or shored or some other equivalent means may be used to provide safety for workers and adjacent structures. Assessment of the need for excavation shoring or other measures required to provide a stable excavation, and the use of appropriate construction practices and/or equipment is the Contractor's responsibility.

To facilitate analysis of shoring systems, we have included design parameters considering drained (long-term or effective stress) and undrained (short-term or total stress) conditions. If the shoring systems are planned for short period of time, undrained soil parameters should be used for the shoring design. If the anticipated construction prologs for a relatively long time period (over one month), the shoring design should be checked using both short and long terms soil parameters. Recommended design soil parameters for shoring system design for both conditions are provided on the tables in Appendix K. All applicable design condition(s) should be considered for analysis of lateral earth pressures (effective stress of soil, hydrostatic pressure and surcharge loads) acting on shoring systems.

If sheet pile is used as temporary shoring to install pit, sheet piles could consist of cantilevered walls or braced walls. A cantilever wall derives support from the passive resistance below the pit bottom to support the active pressures from the soil and hydrostatic pressures above the pit bottom without any bracing. This type of wall is suitable for heights up to about 15-ft and is more practical when constructed in stiff clays or granular soils. Internally braced flexible walls can be braced laterally as the excavation proceeds. This restrains lateral movement of the soil and causes loads on the braces which exceed those expected from active earth pressures. Braces can be either long raking braces or relatively short horizontal cross braces between opposing walls.

6.1.2 Pit Bottom Stability

Bottom instability results from inadequate shear strength in clay soils to resist stress relief at the base of the excavation, or from piping of water bearing granular soil. This mode of failure results in the loss of ground at the ground surface outside the pit and heave of the excavation base inside the pit. We recommend the base of pit excavations be planned within competent soils. Based on the water level readings, we anticipate the pit will be constructed in wet conditions. Groundwater control can be performed as discussed in Section 10.3.

7 DEEP FOUNDATION DESIGN

This section applies to deep foundation systems to support the culvert outlet within the Port of Beaumont at the Neches River Terminus of the diversion alignment. Deep foundation systems considered herein include drilled, non-displacement piles such as augered cast-in-place (ACIP) piles and driven displacement piles such as precast concrete piles (PCPs) and timber piles. The design soil parameters on Figure 8 in Appendix G for TB-19 are used in our pile capacity evaluations.

7.1 Axial Capacity

For driven (full displacement) piles, we computed ultimate compression and tension capacities of a single pile using the static method of analysis recommended by American Petroleum Institute (API RP 2A - WSD, 2002). The analyses were performed using the computer code APILE Plus, Version 2019 (Ensoft, Inc.) for square PCPs with widths ranging from 14-in, 16-in, 18-in and 20-in. Ultimate axial pile capacity curves for the driven piles considered are provided in Appendix H.

We used the computer program SHAFT Version 2017 (Ensoft, Inc.) to compute the axial capacities of non-displacement ACIP piles with diameters of 16-in, 18-in and 24-in. These pile types are considered to be non-displacement whereby the pile replaces the excavated soils and the construction process does not densify or increase horizontal stress during installation. Non-displacement ACIP piles utilize a continuous flight auger to reach design tip and then a cementitious grout is pumped through the hollow-stem of the tooling as it is withdrawn. During this process, the spoils are returned to the surface for handling and disposal. The ultimate axial capacity curves for these specified pile sizes are provided in Appendix I.

Ultimate axial pile capacities obtained from the curves in Appendices H and I should be reduced by an appropriate factor of safety to compute the allowable axial pile capacity. A factor of safety of 2.5 is recommended to compute allowable compression capacity. A factor of safety of 3.0 is recommended to compute allowable tension capacity. Also, the buoyant weight of the pile can be added to the tension capacity. The computed weight of the pile should be reduced by a factor of 1.2 for design. If load testing will be conducted as part of the construction scope, reduced factors of safety as low as 2.0 could be considered. If static load testing is conducted, we recommend test piles be utilized rather than production piles so incremental loads can be applied until failure is reached so the maximum ultimate pile capacity can be realized. Please note, we recommend TWE be retained to conduct the load testing and provide analysis of the results.

We discounted frictional resistance of the soils to 5-ft below existing grade to account for pile cut-off elevation and possible disturbances during construction. It should also be noted the tension capacity is based solely on soil/pile interaction. Therefore, piles and pile cap connections should be structurally capable of resisting design uplift loads.

7.1.1 Individual Pile Settlement

Detailed analysis of axial load versus settlement for deep foundations could be performed for the specified pile type, length and diameter, based on t-z and q-z analysis using the computer program APile. The design pile information is not available at the time of this report.

However, for single-isolated piles designed in accordance with this report, individual pile settlements should be less than about 0.5-in. For a single element, the primary component of settlement is due to elastic shortening. Therefore, the variation of single pile settlement with variation of loading could be approximated as a linear variation. If the piles will have center-to-center spacing less than three (3) diameters, group efficiency should be evaluated.

7.2 Lateral Response

For deep foundations, lateral loads are resisted by the soil as well as the rigidity of the pile. Lateral capacity will vary with pile type and properties, degree of fixity and pile spacing. Typically, lateral loads are analyzed using the p-y method in which the soil is modeled as a series of non-linear springs. This procedure with appropriate computer codes (i.e., LPILE by Ensoft, Inc.) has the advantage that major factors influencing soil resistance are inherently included in the semi-empirical p-y design criteria.

For the subsurface conditions observed at the project location of TB-19, we developed the soil design parameters in Appendix J for use with lateral analyses of pile foundations associated with this project. The Engineer responsible for final pile design should verify the deflection, internal shear force and bending moment of the piles are within tolerable limits.

Horizontal loads acting on pile caps can also be resisted by passive earth pressure acting on one (1) side of the pile cap. An allowable passive pressure of 750-psf can be used for properly-compacted fill material used as backfill around pile caps. This value should provide a factor of safety of 2.0 with respect to the ultimate value.

7.3 Pile Groups

7.3.1 Axial Group Efficiency

The following method can be used to determine the axial capacity and efficiency of pile groups. To evaluate group capacity, two (2) distinct failure modes are considered.

In the first mode, a block-type behavior is assumed in which the piles and confined soil mass encompassed by the group act as a unit. The ultimate bearing capacity of the unit, Q_c , is equal to the ultimate load carried in friction by the circumferential area of the group plus the ultimate load resistance derived from the base of the assumed equivalent pier.

$$Q_c = f_s A_c + q_b A_b$$

f_s	=	Ultimate Unit Soil-Pile Adhesion (psf)
A_c	=	Circumferential Embedded Area of Equivalent Pier (ft)
q_b	=	Ultimate Unit End Bearing (psf)
A_b	=	Base Area of Equivalent Pier (ft ²)

In the second mode of failure, it is assumed the piles in the group act individually. The ultimate bearing capacity of the group, Q_c , considering individual mode of failure is determined by multiplying the number of piles in a group by the ultimate load carrying capacity of the individual piles.

$$Q_c = \sum Q_i$$

Q_i = Ultimate Capacity of Individual Piles in the Group

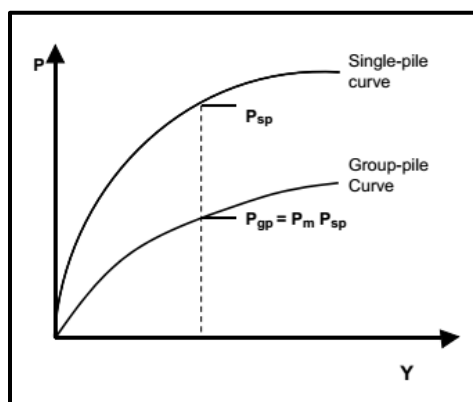
The lower of the two (2) capacities of the group considering the block and individual modes of failure is taken as the required ultimate capacity of the pile group. The group efficiency is defined as the ratio of the group capacity considering the block mode of failure and the group capacity considering the individual mode of pile failure.

A pile group is considered safe against bearing failure if the number of piles in the group times the applied design load per pile does not exceed $Q_c/F.S.$ (F.S. = Factor of Safety). If the total group design load is greater than $Q_c/F.S.$, one (1) alternative is to reduce the design load for the individual piles within the group. Based on this approach to pile group capacity analysis, pile spacing can be determined in which the full capacity of the individual piles is utilized. Generally, a pile spacing of at least three (3) pile widths or diameters, center-to-center, is selected as a first approximation.

7.3.2 Lateral Group Effects

Piles subjected to lateral loading are commonly designed using the p-y method in which the soil is modeled as a series of non-linear springs. This procedure is used with appropriate computer codes (i.e., LPILE by Ensoft, Inc., or equivalent) and has the advantage that the major factors influencing lateral soil resistance are inherently included in the semi-empirical p-y design criteria.

The effects of a close pile spacing results primarily in a reduction in the maximum soil resistance which can be mobilized, and thus leads to the concept of a “p-multiplier”. A factor, P_m , can be applied to a single p-y by multiplying the soil resistance values “p” by P_m to compute a p-y which includes the pile group effects. This concept is shown on the figure provided below.



The selection of the appropriate p-multiplier factor depends on if the pile is located in the front or “leading” row or in the back or “trailing” row in the direction of loading. Recommended P_m values for front row and back row piles are presented in Table 7-1 (Mokwa and Duncan, 2001) on the following page.

Table 7-1: Recommended P_m Values				
Pile Spacing (center to center)	Leading Row	1st Trailing Row	2nd Trailing Row	3rd and Subsequent Trailing Rows
3 Diameters	0.82	0.68	0.58	0.52
4 Diameters	0.90	0.78	0.72	0.68
5 Diameters	0.94	0.89	0.86	0.84
6 Diameters	1.00	1.00	1.00	1.00

The lateral group efficiency factor (G_e) can be *approximately* taken as the average of the P_m values from Table 7-1 for all piles in the group as suggested by Duncan, Robinette and Mokwa (2005). For instance, a 3 by 3 pile group with a center-to-center spacing of three (3) widths or diameters, the lateral group efficiency will be approximately 0.69 [= (0.82 + 0.68 + 0.58) / 3]. Based on Table 7-1, the lateral group effects can be neglected for center-to-center pile spacing of six (6) widths or more.

There is commercially available software (e.g., GROUP by Ensoft) which can perform more refined lateral pile group response analyses, in particular for complex pile group configurations. Such analyses should be performed on a case-by-case basis since it depends on the specific pile configuration, pile type and penetration, loading condition, etc.

7.3.3 Pile Group Settlement

Pile group design is typically governed by group settlement rather than axial group capacity or lateral group response. The settlement of a group of piles is significantly influenced by the size of the pile group and the compressibility of the soils below the pile tips. For typical spacing of about three (3) widths or diameters center-to-center, settlement estimates of pile groups (4 by 4 or larger) should be determined. When final pile group sizes and depths are selected, TWE can be contacted to estimate pile group settlement.

8 BELOW GRADE STRUCTURES

The project will include below grade structures such as utilities, sumps and pits. We have developed soil design parameters for use with design of below-grade structures based on the subsurface conditions encountered in the project alignment as presented in Appendix K.

In addition to lateral earth pressures imposed by the effective stress of soil, hydrostatic pressures acting on structures should also be considered for drained conditions. To facilitate analysis of below-grade structures, we have included design parameters which consider drained (long-term or effective stress) and undrained (short-term or total stress) conditions. All applicable design conditions should be considered for analysis of lateral earth pressures acting on below-grade structures. This section provides design recommendations for temporary and/or permanent below grade structures as well as recommendations for open-cut and/or braced excavations.

8.1 Open Cut Excavations

The open-cut excavation option is the most basic installation technique for below grade structures. This approach provides the best access for construction and has the least effect on the design of the structure. However, dewatering of transmissive strata must be sufficient to avoid slope instabilities and maintain a stable bearing surface. The following considerations should be met to maintain safe and stable working conditions during open excavations.

According to Occupational Safety and Health Administration (OSHA) standard 29 CFR - Subpart 1926 – Subpart P, if excavations are deeper than 5-ft and the excavations are not performed in stable rock, the excavations must be sloped, shored or shielded. Protective systems for use in excavations greater than 20-ft in depth should be designed by a registered Professional Engineer in accordance with OSHA standard 29 CFR – Part 1926.652(b) and (c). Soil classification, per OSHA guidelines, is based on three (3) types of soils: Type A, Type B and Type C.

Sloped excavations could be considered for below grade excavations. OSHA standards provide four (4) options for the design of sloped or benched excavations [29 CFR Part 1926.652(b)]. Option 2 of this standard is based on soil type strength. Based on the OSHA definitions, the soils encountered in the upper footage of the project alignment are interpreted as Type B. Excavations in Type B soils should have side slopes no steeper than 1H:1V or sloped angles no steeper than 45° from the horizontal.

8.2 Lateral Earth Pressures

Two (2) soil conditions exist for analyzing lateral pressures on below grade structures: permanent (long-term, drained soil conditions) and temporary (short-term, undrained soil conditions). For lateral pressures on a permanent structure, the controlling factors include the nature of the retained material, the drainage of the material and the relative rigidity of the walls. Recommended design soil parameters for retention system design for both conditions are provided in the table in Appendix K.

The design of the permanent earth retention structures should consider long-term lateral earth and hydrostatic pressures and the hydrostatic uplift pressures at the base of the structures if the bottom of the structure is below the static groundwater level. For hydrostatic pressure considerations, it should be assumed the static groundwater level is at existing grade. Surcharge loads behind the walls, if present, should be included by considering a lateral uniform load equal to the lateral earth pressure coefficient times the vertical uniform surcharge load.

8.2.1 Temporary (Short-Term) Lateral Earth Pressures

If sheet piles are used as temporary shoring to facilitate construction of below grade structures, sheet piles could consist of cantilevered walls or braced walls. A cantilever wall derives support from the passive resistance below the mudline to support the active pressures from the soil and hydrostatic pressures above the mudline without an anchorage. This type of wall is suitable for heights up to about 15-ft and is more practical when constructed in stiff clays or granular soils. Internally braced flexible walls can be braced laterally as the excavation proceeds. This restrains lateral movement of the soil and causes loads on the braces which exceed those expected from active earth pressures. Braces can be either long raking braces or relatively short horizontal cross braces between opposing walls. Recommended undrained soil parameters provided in Appendix K should be used for design of temporary sheet pile shoring systems or proprietary shielding systems.

8.2.2 Permanent (Long-Term) Lateral Earth Pressures

Permanent walls should be designed using long-term (drained) soil parameters. The recommended parameters for drained conditions were based on soil friction angles and zero effective cohesion values. The effective or drained friction angles of cohesive soils were estimated using published correlation which relates friction angles to the plasticity indices (Kenney, 1959, Bjerrum and Simons, 1960 and Ladd et al. 1977). For rigid or non-yielding walls, at-rest earth pressure coefficients should be applicable. For yielding walls, active and passive earth pressure coefficients should be considered.

Where sheet piling is used for temporary excavation support to facilitate construction of the below grade structure, backfill will be placed within only a narrow zone between the permanent wall and sheeting, and the sheeting is typically pulled and salvaged. Alternately, the sheet pile could also serve as formwork for below grade cast-in-place concrete walls and remain in place permanently after the concrete retaining wall is constructed. In such situations, the design soil parameters for in-situ soils provided in Appendix K should be used for design.

Where excavations will be made as a sloped cut with temporary slopes, lateral earth pressures can be calculated by multiplying the equivalent fluid density of the backfill type by the depth below ground surface. Equivalent fluid densities for various backfill materials and compaction efforts are outlined in Table 8-1 on the following page. The equivalent fluid densities outlined for the higher compaction effort should be used for backfill with surcharge.

**Table 8-1: Equivalent Fluid Pressures for Permanent Earth Retention System Design
Backfill Soil Parameters – Non-Yielding Walls**

Soil Type	Compactive Effort (ASTM D 698)	Equivalent Fluid Density (pcf)	
		Above Water Table	Below Water Table ⁽¹⁾
Structural Clay Fill ($10 \leq PI \leq 20$)	88% to 92%	65	95
	93% to 98%	85	103
General Clay Fill ($PI > 20$)	88% to 92%	75	105
	93% to 98%	100	113
Structural Sand Fill (Fines content < 15%)	88% to 92%	55	88
	93% to 98%	75	96

Note: (1) These magnitudes include a water component, if applicable.

8.3 Uplift Considerations

Considering the anticipated static groundwater depth at the site, the bottom of below grade structures will extend below the groundwater table. Therefore, the uplift pressures resulting from excess piezometric head will need to be resisted. Hydrostatic uplift pressures can be computed by multiplying the water head between the bottom of the excavation and the groundwater elevation by the unit weight of water. We recommend using a factor of safety of 2.0 on the uplift pressure when designing against hydrostatic uplift.

Groundwater seepage should be expected to occur within excavations for below grade structures at this project site based on the near-surface soil conditions and static groundwater depths encountered in the project borings. The Contractor should review the soil and groundwater information in this report and plan dewatering systems accordingly.

8.4 Construction Considerations

The soils exposed at the base of the deep excavations should be protected from disturbance by the installation of a lean concrete seal slab, flowable fill (CLSM) or other suitable methods. All excavations made for the construction of below-grade structures should conform to OSHA guidelines. A surcharge pressure would be exerted by the excavator on the ground surface adjacent to the sump during construction activities. Large surface loadings nearby can be evaluated on a specific basis using additional pressure at the ground surface near the wall. Typical surcharge loads from construction equipment are on the order of 200-psf to 500-psf.

Design and construction of temporary facilities including excavation retention systems are the responsibility of the Contractor. TWE provides excavation planning comments and suggestions for strictly informational purposes.

To avoid surcharging temporary slopes or walls, stockpiling of materials immediately adjacent to the excavation should be prohibited. We recommend stockpiled materials be placed away from the excavation at a minimum distance of 6-ft from the edge. Experienced personnel who can assess the performance of excavations or retention systems should monitor all excavations and retaining structures on a continuous basis. A competent supervisor or inspector should be provided by the Contractor to oversee these operations during construction.

9 PAVEMENT RECOMMENDATIONS

We anticipate aggregate-surfaced, flexible asphalt-surfaced and rigid concrete-surfaced pavements could be considered. The geotechnical design and construction recommendations provided in this report section are based on the assumption the site paving will be constructed on properly-prepared, existing site soils. Detailed pavement design based on specific type and frequency of vehicles and traffic can be provided upon request.

9.1 Light and Medium Duty Pavements

The pavement thickness recommendations presented below are for light and medium duty vehicles for aggregate, asphalt and concrete-surfaced roads and parking lots and concrete unit area paving. The recommended thicknesses are based on our experience with similar pavement construction on properly-prepared subgrade clayey sand soils. Table 9-1 presents minimum pavement component thicknesses which can be used as a guide for pavement systems based on our experience with similar subsurface conditions.

Table 9-1: Recommended Pavement Material Thicknesses	
Aggregate-Surfaced Roadways (Light Duty Vehicles)	
Crushed Limestone Base	8-in
Properly-Prepared Existing Site Soils	8-in
Aggregate-Surfaced Roadways (Medium Duty Vehicles)	
Crushed Limestone Base	12-in
Properly-Prepared Existing Site Soils	8-in
Flexible Pavements (Parking Lots and Light Duty Roadways)	
Hot-Mix Asphaltic Concrete	2-in
Crushed Limestone Base	8-in
Properly-Prepared Existing Site Soils	8-in
Rigid Pavement (Area Paving, Parking Lots and Light Duty Roadways)	
Portland Cement Concrete	6-in
Properly-Prepared Existing Site Soils	8-in

TWE recommends the use of geosynthetic interlayers (non-woven or woven geotextile fabric and/or geogrid) for mechanical reinforcement of base and subgrade layers within aggregate and asphalt-surfaced pavement sections. If used, TWE can economize the above aggregate and asphalt-surfaced pavement sections. TWE should be contacted once final pavement types and traffic frequencies are known to provide additional recommendations regarding the use of geosynthetics.

9.2 Heavy Duty Flexible Pavements

Advantages to flexible pavement systems include less cost when compared to rigid concrete pavement systems, faster construction times, better traction and easy maintenance. Disadvantages to asphaltic concrete-surfaced roadways include less durability than concrete pavements, more frequent repairs and higher maintenance costs as well as sensitivity to extreme weather conditions which can lead to premature pavement failure.

For areas subjected to HS-20 type heavy truck traffic, flexible pavement thickness design was performed using the computer program WinPAS (SW03) which is based on 1993 AASHTO Guide for Design of Pavement Structures. In the absence of any given data, we assumed the following design parameters in Table 9-2 for use with design of heavy-duty flexible pavement systems for this project. The corresponding flexible pavement design thicknesses are provided in Table 9-3 below as well.

Table 9-2: Flexible Pavement Analysis Design Parameters	
Parameter	Value
Pavement Service Life	20-yrs
Flexible ESAL / Truck	1.05
Reliability	97%
Overall Standard Deviation	0.47
Subgrade Soil Resilient Modulus	5,000-psi
Initial Serviceability	4.3
Terminal Serviceability	2.5

Table 9-3: Flexible Pavement Section Recommendations (Heavy Duty Roads)					
Description	Traffic Count				
HS-20 Type Trucks/Day	15	30	70	150	300
Total ESALS	122,724	230,108	536,918	1,150,538	2,301,075
Required SN	3.20	3.54	4.04	4.53	5.01
Pavement Layer	Recommended Thickness (in)				
Asphaltic Concrete Surface Course	3	3	3.5	4	5
Geogrid-Reinforced Crushed Limestone Base Course	8	10	10	12	12
Properly-Prepared Existing Site Soils	8	8	12	12	12
Computed SN	3.32	3.72	4.14	4.76	5.20

9.3 Heavy Duty Rigid Pavements

Advantages to rigid pavement systems include durability, long service life and less frequent maintenance than asphalt-surfaced roadways. Concrete roadways are also resistant to vehicle leaks, spills and extreme weather conditions such as excess rain or extreme heat. Disadvantages to concrete-surfaced roadways include initial construction costs and reconstruction costs if the pavement slab fractures requiring replacement.

For areas subjected to HS-20 type heavy truck traffic, rigid pavement thickness design was performed using the computer program WinPAS (SW03) which is based on 1993 AASHTO Guide for Design of Pavement Structures. In the absence of any given data, we assumed the following design parameters in Table 9-4 for use with design of rigid pavement systems for this project. The corresponding rigid pavement design thicknesses are provided in Table 9-5 below as well.

Table 9-4: Rigid Pavement Analysis Design Parameters	
Parameter	Value
Pavement Service Life	20-yrs
Rigid ESAL/Truck	1.79
Reliability	95%
Overall Deviation	0.37
Concrete Modulus of Rupture	600-psi
Concrete Modulus of Elasticity	4,200,000-psi
Load Transfer Coefficient	2.5
Composite Modulus of Subgrade Reaction	170-psi
Drainage Coefficient	1.1
Initial Serviceability	4.3
Terminal Serviceability	2.5

Table 9-5: Rigid Pavement Thickness (Heavy Duty Roads)			
HS-20 Type Trucks Per Day	Total ESALS	Concrete Pavement	Properly-Prepared Existing Site Soils
Up to 70	915,316	6-in	12-in
70 to 150	1,961,392	7-in	12-in
150 to 300	3,922,785	8-in	12-in

9.4 Site Preparation

Areas designated for pavement construction should be stripped and proofrolled in accordance with the guidance provided in Section 10.1 of this report. If pumping or yielding of subgrade soils is encountered, such soils should be removed to the depth of competent subgrade material and replaced with properly-compacted structural fill materials. In pavement areas, the depth of over-excavation should be no more than 2-ft if required. TWE should be contacted if this situation arises during construction.

9.5 Section Materials

9.5.1 Reinforced Concrete

Concrete should be designed to exhibit a flexural strength [three (3) point loading] of at least 600-psi at 28-days. Flexural strength (M_r) can be approximated by the following formula from ACI 330R: $M_r=2.3(f_c)^{2/3}$ where f_c is the compressive strength of the concrete. The actual relationship between flexural and compressive strength for the proposed mix should be evaluated in the laboratory. In general, 600-psi flexural strength can be typically achieved with a concrete mix designed for a minimum 28-day compressive strength of 4,000-psi.

Reinforcing steel consisting of deformed steel rebar, or other proprietary reinforcement materials, should be used in reinforced-concrete pavement. Selection of reinforcement is dependent on joint spacing, slab thickness and other factors as discussed in Portland Cement Association (PCA) and American Concrete Institute (ACI) publications. The suggested guidelines for reinforced-concrete pavement in Table 9-6 below should be modified by the Engineer based upon the actual configuration of the pavement layout and published guidelines.

Table 9-6: Rigid Pavement Components	
Component	Description
Minimum Reinforcing Steel	#3 bars should be spaced at 18-in on centers in both directions.
Minimum Dowel Size	3/4-in bars, 18-in in length, with one (1) end treated to slip should be spaced at 12-in on centers at each joint.
Control Joint Spacing	Maximum control joint spacing should be 15-ft. If sawcut, control joints should be cut as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling which is usually within four (4) to twenty-four (24) hours of concrete placement.
Isolation / Expansion Joints	Expansion joints should be used in areas adjacent to structures, such as manholes and walls.

9.5.2 Hot-Mix Asphaltic Concrete

Hot-Mix Asphaltic Concrete (HMAC) should be a plant-mixed, hot-laid, dense-graded mixture of aggregate and asphalt binder meeting the requirements of Texas Department of Transportation (TxDOT) 2014 Standard Specifications Items 340 or 341 (depending on quantity) and specific criteria for the job mix formula. The HMAC mix should be compacted uniformly to contain between 3.8% to 8.5% in-place air voids (91.5% to 96.2% of the maximum theoretical density) as measured by ASTM D2041. Pneumatic-tired rollers should be used to seal the surface unless excessive pickup of fines occurs.

On the first day of production, rolling patterns should be established which produce the desired in-place air voids. All compaction operations should be completed before the pavement temperature drops below 160°F unless otherwise directed by the project specifications. The compacted pavement should be allowed to cool to 160°F or lower before opening to traffic. After final compaction, field density tests should be performed at locations representative of the entire pavement area.

9.5.3 Crushed Aggregate Flexible Base

Flexible base course material should be composed of crushed limestone meeting the requirements of TxDOT 2014 Standard Specifications Item 247, Type A, Grade 1-2. When used as base material for this project, it is not considered necessary to confirm Wet Ball Mill or Triaxial Compressive Strength requirements listed in TxDOT Item 247. Base material should be compacted in thin lifts (maximum 6-in after compaction).

In flexible pavement sections where HMAC will be placed on top of the base, we recommend the base be compacted to a minimum of 95% of the maximum density as determined by ASTM D1557 and moisture-conditioned until it is within $\pm 3\%$ of the optimum moisture content. In aggregate-surfaced roadways, we recommend the base be compacted to a minimum of 95% of the maximum density as determined by ASTM D698 and moisture-conditioned until it is within $\pm 3\%$ of the optimum moisture content. After final compaction, field density tests should be performed at locations representative of the entire pavement area.

9.5.4 Mechanical Geosynthetic Interlayers

TWE should be contacted if mechanical geosynthetic interlayers will be considered within pavement sections at this project site. Geosynthetics used in pavements generally consist of non-woven or woven geotextile separator fabrics, geogrids (biaxial, triaxial or interaxial apertures) or combined products where the separator fabric is bonded to the underside of the geogrid prior to installation. The use of these pavement interlayer materials could reduce the overall aggregate base course thicknesses in the applicable pavement sections recommended herein. TWE should be contacted if the use of these geosynthetic materials will be considered for the project.

9.6 Pavement Maintenance and Drainage

Maintaining pavements to prevent infiltration of water into the base and subgrade layers is essential. Allowing water to infiltrate these layers will result in high maintenance costs and premature pavement failure. Periodic maintenance should be performed on the pavement sections to seal any surface cracks and prevent infiltration of water into the subgrade.

Drainage is also important to the proper operation and function of pavement systems. The pavement surface should be raised above adjacent grade and properly sloped into drainage inlets or lateral ditches. Water should not be allowed to pond on or adjacent to the pavement whereby the base and subgrade layers can become saturated. If these pavement layers become saturated, bearing capacity will be greatly reduced and the useful life of the pavement will be decreased. Periodic inspections and repair of cracks in pavement sections should be performed as part of future facility maintenance.

10 CONSTRUCTION CONSIDERATIONS

10.1 Site Development and Subgrade Preparation

The site should be stripped of vegetation, organics, debris and other deleterious materials to the depth of competent subgrade capable of supporting proofrolling activities. After stripping, The site should be graded to establish positive drainage so ponding of surface water does not collect and inhibit site access or construction activities. Proper site drainage should be maintained during construction so ponding of surface runoff does not occur. If the subgrade is exposed to excess moisture, the natural soils will likely soften and lose capacity. Once the soils soften and lose capacity, it generally becomes necessary to either consider drying efforts, removal and replacement of the wet material with structural fill or stabilization using chemical reagents.

After stripping and grading, we recommend the existing subgrade soils be proofrolled by crossing the area repeatedly and methodically with a 10-ton minimum weight, and up to 25-ton (roadway and paving areas), rubber-tired pneumatic compactor or a loaded dump truck to detect significant weak areas. We do not recommend using off-road earth moving equipment (e.g. loaders or scrapers) or tracked vehicles for proofrolling. Proofrolling should be performed during dry periods and not immediately after wet weather events.

Proofrolling should be observed and documented by TWE and areas which do not meet acceptance criteria should be delineated. Remedial options could include scarifying and recompacting, excavation and replacement and/or chemical treatment. If proofrolling demonstrates ruts less than 1-in deep, the subgrade is considered acceptable. For ruts 1-in to 2-in deep, we recommend the surficial 6-in of material be scarified and recompacted. For areas where ruts exceed 2-in deep, we recommend the surficial 12-in of material be scarified and recompacted. The exposed subgrade soils should be moisture-conditioned to within 2% dry to 3% wet of optimum moisture content and compacted to at least 95% of the maximum dry density as determined by ASTM D698 (standard Proctor). If scarification and recompaction does not improve the subgrade conditions, we recommend over-excavation and replacement or chemical stabilization be considered to similar depths or deeper, if required.

10.2 Fill and Backfill

Fill material types can be grouped according to their application. Fill materials used to support foundations, structures and within pavement sections are typically identified as structural fill and are usually associated with engineering specifications. General fill materials are typically not associated with engineering specifications and are used for site grading purposes.

10.2.1 Structural Clay Fill

Structural clay fill should consist of clean lean clay (CL) or lean clay with sand (CL) material with a liquid limit (LL) less than 40 and a plasticity index (PI) between 10 and 20. Structural clay fill should be placed in thin lifts (maximum 8-in loose lifts), moisture conditioned between -2% to +3% of optimum moisture content and compacted to a minimum 95% of the maximum dry density as determined by ASTM D698 (standard Proctor).

10.2.2 General Fill

General fill could consist of clayey sand (SC), fat clay (CH) and lean clay (CL) soils having a maximum particle size of 3-in, be free of organics, deleterious or otherwise unsuitable materials and be able to undergo ordinary compaction. General fill should be placed in thin lifts (maximum 12-in loose lifts), moisture-conditioned between -2% and +3% of optimum moisture content and compacted to a minimum 95% of the maximum dry density as determined by ASTM D698 (Standard Proctor).

10.2.3 Structural Fill Alternative

As an alternative to the structural fill materials described above, general fill or other suitable soil which is stabilized with a chemical admixture could be considered. The type and quantity of chemical stabilization required should be determined by TWE via bench scale treatability studies in the laboratory on the actual soils planned for use.

10.2.4 Structural Sand Fill

Structural sand fill material should consist of clean sand with less than 15% material finer than the No. 200 sieve. The sand should be placed in maximum 8-in loose lifts and uniformly compacted to at least 80% relative density as determined by ASTM D4253 and ASTM D4254.

10.2.5 Controlled Low-Strength Material

Controlled Low-Strength Material (CLSM), or flowable fill, can be used for seal slabs beneath foundations and backfill around utilities. CLSM should be in accordance with published information from the American Concrete Institute (ACI) Committee 229R-99, the National Ready Mixed Concrete Association (NRMCA) Guide Specification for Controlled Low-Strength Materials (CLSM) and ASTM International standard test methods.

Prior to placing CLSM, a representative of TWE should observe and document the condition of the excavation subgrade to confirm the consistency and homogeneity of the subgrade soils. If soft, weak or otherwise unsuitable subgrade soils are encountered, the exposed soils should be over-excavated to competent soils and backfilled with select structural fill or CLSM. CLSM should be thoroughly-mixed and should contain no more than 30% fines. A minimum compressive strength of 50-psi at 7-days or 100-psi at 28-days should be achieved while remaining workable for placement. At these strengths, CLSM should remain excavatable. Construction activities over CLSM should not be performed until a minimum set time of 4-hrs has been achieved for the CLSM.

10.2.6 Compaction

Prior to use, samples of proposed fill and backfill material should be obtained by TWE for laboratory classification (Atterberg limits and percent passing the No. 200 sieve), gradation and moisture-density relationship testing. These tests will provide a basis for acceptance and evaluation of compaction by in-place density testing. TWE should be retained to perform sufficient in-place density tests during placement to verify compaction requirements are met.

Maximum loose lift thicknesses for fill placement will depend on the type of compaction equipment used. Recommended fill layers are summarized in Table 10-1. The values shown on Table 10-1 are based on Section 4.3.7.6 of the Process Industry Practices (PIP) CVS02100 Site Preparation, Excavation, and Backfill Specification (June 2019).

Table 10-1: Compaction Equipment and Maximum Lift Thickness	
Compaction Equipment	Maximum Lift Thickness
Structural or General Fill using Hand-Operated Equipment	4-in
Structural Fill using Conventional Equipment	8-in
General Fill Using Conventional Equipment	12-in

10.2.7 Quality Control Testing

We recommend any proposed source of fill or backfill be tested by TWE for compliance with the project specifications prior to use. In addition, it is imperative specific provisions be made to include testing of the actual materials delivered to the project site to verify they meet the specification requirements stated herein or in the project plans and specifications.

10.3 Excavation Construction

10.3.1 Groundwater Control/Dewatering

Based on the subsurface soil and groundwater conditions encountered in the project borings, excavations within the upper 5.4-ft to 15.6-ft depth range of the site should be able to be performed in the dry. Below this depth range, perched water or groundwater seepage should be expected. Provisions should be made by the Contractor to remove any water which accumulates within excavations to maintain a dry bottom. Provisions should also be made to divert surface water runoff from open excavations. If encountered, any water accumulations within foundation excavations should be pumped out immediately and not allowed to deteriorate the foundation soils.

Over-excavation and removal of any loose, saturated soils should also be performed prior to placement of the seal slabs, foundation base slabs, utilities or piping. The exposed soils at the base of excavations should be protected from disturbance by the installation of a lean concrete seal slab, flowable fill (CLSM) or other suitable methods.

10.3.2 Excavation Considerations

All excavations made during construction should conform to OSHA guidelines. According to OSHA Standard 29 CFR - Subpart 1926 – Subpart P, if excavations are deeper than 5-ft and the excavations are not performed in stable rock, the excavations must be sloped, shored or shielded. Protective systems for use in excavations greater than 20-ft in depth should be designed by a registered Professional Engineer in accordance with OSHA Standard 29 CFR – Part 1926.652(b) and (c). Based on the OSHA definitions, the soils encountered in the upper footage of the project site are interpreted as Type B. Excavations in Type B soils should have side slopes no steeper than 1H:1V or sloped angles no steeper than 45° from the horizontal.

The sides of open excavations are susceptible to deterioration upon exposure and could become unstable. The Contractor’s competent Supervisor should inspect all excavations and take appropriate safety measures including the use of trench shields and sloped excavations. We recommend Occupational Safety and Health Administration (OSHA) standards be observed with all excavations.

Positive drainage should be established and maintained so ponding of surface water does not collect near foundation excavations or inhibit construction activities. If the subgrade soils are exposed to excess moisture, the bearing soils will likely soften and lose capacity. Once this occurs, it generally becomes necessary to either consider drying efforts or removal and replacement of the saturated material with structural fill.

10.4 Deep Foundation Installation

Performance of project structures supported on deep foundation systems will be directly related to the Contractor's adherence to the recommendations in this report and the project plans and specifications. Therefore, we recommend pile installation monitoring and testing services be provided by TWE for this project.

As noted herein, alternating layers of variable sands and clays are present at this site, which could impact deep foundation capacity and installation. Based on the information provided in this report, we recommend deep foundations extend at least 30-ft below existing grade to bridge the upper loose sands and soft clays and transfer loads into the underlying competent sand or clay strata.

10.4.1 Driven Piles

Pile driving hammers should be selected according to pile type, length, size and weight of pile, as well as potential vibrations resulting from pile driving operations. Care should be taken to assure the hammer selected is capable of achieving the desired penetration without causing damage to the piles or causing excessive vibrations which could cause damage to nearby structures.

We recommend the Contractor submit a pre-construction wave equation analysis (GRLWEAP or equivalent) prior to mobilization to appropriately size the hammer for the planned pile size and the site subsurface profile. Each pile should be driven to the desired tip elevation and driving resistance without interruption in the driving operations. Pile driving records should be maintained by TWE on-site throughout the duration of pile driving activities.

If refusal is encountered during pile driving operations, TWE should be contacted to evaluate pile capacity and provide recommendations on a case-by-case basis. We recommend pre-construction WEAPs and drivability studies be performed to estimate driving resistance and required hammer energy for driven piles installed for this project.

Some pile heaving could be experienced during installation of adjacent displacement type piles. We recommend that tip elevations of piles be recorded and if significant heave is noted after driving of subsequent piles, provisions should be made for reseating them by the Contractor.

10.4.2 ACIP Piles

The proper installation of ACIP piles is dependent on Contractor experience, construction procedure and equipment. The Contractor should have relevant experience with augering and pumping equipment, installing ACIP piles in similar subsurface conditions and placing of reinforcing steel. Key personnel including the crane operator, grout pump operator and full-time field supervisor should have experience with installing ACIP piles of similar size and depth in the local area.

We recommend a pile installation monitoring program be implemented and performed by TWE. Several aspects to monitor during ACIP pile installation are viscosity of the pumped grout mixture, initial grout placement prior to raising the augers, resulting grout head observed at pile completion, incremental grout factors computed over 5-ft intervals during auger withdrawal, uniformity of grout placement, computed grout factor along completed pile length, continuous grout placement, auger withdrawal without delays or grout pressure fluctuations and reinforcing steel placement. Cross-communication of grout, or bleeding, between freshly-installed piles should also be monitored.

A grout mix should be furnished to meet the requirements of the project and tested TWE. A minimum of six (6) 2-in square grout cubes should be cast each day during which piles are installed. Two (2) grout cubes should be tested in compression at seven (7) days and twenty-eight (28) days after placement. The remaining grout cubes should be held for additional testing, if necessary.

The required grout volume to obtain a uniform pile will vary depending on subsurface soil conditions. Installation of piles with inappropriate grout volumes will affect the performance of the foundation system. Therefore, the Contractor should calibrate the grout pump before ACIP pile installation commences. Grout should be pumped with sufficient pressure typically ranging from 300-psi to 400-psi. The auger should be withdrawn slowly enough to keep the hole filled to prevent collapse and lateral penetration of grout into soft or porous zone surrounding the pile.

The auger withdrawal rate should be constant and not exceed 10-ft per minute. Pumped grout volumes typically range from 115% to 150% of the theoretical volume of the pile. A pressure head of at least 10-ft of grout above the injection point should be maintained at all times during auger withdrawal so that the grout exhibits a displacing action and resists the movement of loose material into the hole. The Contractor should determine the appropriate pressure head requirement during construction.

Specific criteria regarding the minimum curing time before drilling adjacent piles and the minimum distance between new and previously installed, freshly grouted piles should be established in the project specifications. These criteria are necessary to protect newly-completed piles from damage during the installation of adjacent piles.

10.5 Pile Load and Integrity Testing

TWE would be pleased to develop a detailed integrity and load testing program for the deep foundations being considered for this project. The purpose of the integrity and load tests would be to evaluate as-built conditions, loading/unloading versus displacement response, ultimate axial compression, axial tension and lateral capacity, compare measured capacities and deflections with design criteria and develop installation guidelines for the remaining deep foundations to be installed for the project.

The load testing program could include a combination of static pile testing and high-strain dynamic testing to investigate a variety of pile types, sizes and depths. Refined WEAP analyses could also be performed for driven piles utilizing the data obtained from the static and dynamic tests. Using this information, pile driving criteria can be developed to establish a reliable relationship between hammer blow count and pile capacity and to establish pile driving and refusal criteria.

10.5.1 Static Load Testing

Compression testing should be performed in general accordance with ASTM D1143 “Standard Tests Method for Piles Under Static Axial Compressive Load” with loading procedures as specified in Section 8.1.2 “Quick Test”.

Tension testing should be performed in accordance with ASTM D3689 “Standard Test Methods for Deep Foundations Under Static Axial Tensile Loads” with loading procedures as specified in Section 8.1.2 “Quick Test”.

Lateral testing should be performed in accordance with ASTM D3966 “Standard Test Method for Piles Under Lateral Loads”.

10.5.2 Dynamic Load Testing

If driven piles are selected, we recommend all piles included in the test program be dynamically monitored during initial driving and during restrike events after the end of initial driving. Dynamic monitoring should utilize the most current state-of-the-art equipment and software including CAPWAP and WEAP Analysis programs. Additional pile sizes and lengths of interest which are not tested using static methods can be tested by dynamic testing methods at relatively low cost as compared to static testing.

For driven piles, we recommend full-drive monitoring of selected piles during initial driving to evaluate hammer performance, driving behavior, pile stresses and to establish pile driving or refusal criteria. We recommend dynamic monitoring also be performed on driven piles at 1-hr, 24-hrs and 3-days after the end of initial driving to evaluate pile set up and long-term axial capacity. Additional longer term restrikes could be necessary depending on test results. Dynamic monitoring should also be performed on a restrike event following the end of the static compression load test.

For driven piles, we also suggest performing dynamic tests at beginning of restrike (BOR) on a minimum of 2% of the production piles at least 24-hrs after initial driving as part of a comprehensive construction quality control testing program.

ACIP piles can also be dynamically tested for capacity verification. If considered, TWE should be contacted to discuss an appropriate testing program for verification of axial capacity of ACIP piles using dynamic load tests.

10.5.3 Integrity Testing

We recommend the piles installed for this project be tested for quality and consistency using the Pile Integrity Tester (PIT) or Thermal Integrity Profiler (TIP) using the wire or probe method, developed by Pile Dynamics, Inc. We recommend testing at least 5% of the production piles with these test methods. PIT would be most appropriate for precast concrete piles whereby either PIT or TIP could be utilized on ACIP piles.

The PIT consists of low-strain dynamic testing to approximate relative diameter changes down the shaft of the pile. Data is taken with an accelerometer, processed, and compared to grout installation records in a formal report. Testing is performed in accordance with ASTM D5882.

The TIP is considered the more advanced and accurate integrity test method to date. Based on our experience with the thermal wire method, we recommend the wire or probe method be specified as a more reliable data collection procedure. We recommend instrumenting all test piles and at least 5% of the production piles with TIP. TIP is considered the most advanced and accurate integrity test method to date. This process allows for significantly more accurate analysis of the shaft diameter down the pile. Testing is performed in accordance with ASTM D7949.

11 DESIGN REVIEW AND LIMITATIONS

11.1 Design Review and Construction Monitoring

11.1.1 Geotechnical Design Review

Geotechnical review of the design drawings and specifications should be performed prior to construction. This review is recommended to check the geotechnical recommendations and construction guidelines presented herein have been properly interpreted and incorporated into the construction documents.

11.1.2 Construction Monitoring

The performance of the foundations and pavements for this project will be highly dependent on the quality of construction. Thus, we recommend construction activities be monitored by TWE. Construction surveillance by TWE is recommended and has been assumed in preparing our recommendations. These field services are required to check for changes in conditions which could result in modifications to our recommendations.

Performance of the foundation system and pavements will be directly related to the Contractor's adherence to the recommendations in this report and the project plans and specifications. Testing and inspection should be provided for all site preparation, fill and backfill placements, foundation installations, concrete pours and pavement construction activities. TWE would be pleased to provide these services to verify construction has been performed in accordance with the intentions of this report upon request.

11.2 Limitations

11.2.1 Scope of Study

The scope of this study, as well as the conclusions and recommendations provided herein, were developed based on our understanding of the project. Assumptions were made when specific information was unknown. Revisions to our conclusions and recommendations could be necessary as a result of any significant project changes or if our assumptions are incorrect. Construction dewatering design, earth retention design, and construction site safety are the responsibility of the Contractor and have not been addressed herein. The scope of our study did not include geologic faults. In addition, assessment of environmental conditions, including investigation for hazardous materials/pollutants/wastes, regulatory compliance, threatened or endangered species, cultural resources and floodplains were beyond the scope of our study.

11.2.2 Warranty

The professional services which form the basis for this report have been performed using a degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in the same locality. No warranty, expressed or implied, is made as to the professional advice set forth.

11.2.3 Subsurface Variations

Our interpretations of subsurface conditions are based on data obtained at the exploration locations only and only at the time of our field explorations. Subsurface variations could exist between the exploration locations and at areas not explored within the site. The validity of our recommendations is based, in part, on assumptions made about subsurface conditions in areas not explored. Such assumptions can only be confirmed during construction. Therefore, construction observations by TWE are recommended to check for variations in subsurface conditions. Significant changes from our assumptions could require modification to our findings and recommendations.

11.2.4 Report Reliance

This report was prepared as an instrument of service for the sole and exclusive use by Schaumburg & Polk, Inc. and their project team, subject to the limitations stated herein and with specific application to the referenced project. This report should not be applied for any other purpose or project, except as described herein.

This report shall remain the property of Tolunay-Wong Engineers, Inc. No third party may use or rely upon the information provided herein without our express written consent. If any party other than Schaumburg & Polk, Inc. chooses to rely on this instrument without our consent, said party expressly waives any rights it may otherwise have to claim its reliance on this instrument of professional service that resulted in injury, loss, or damage of any kind and will defend and indemnify Tolunay-Wong Engineers, Inc., from any such claim.

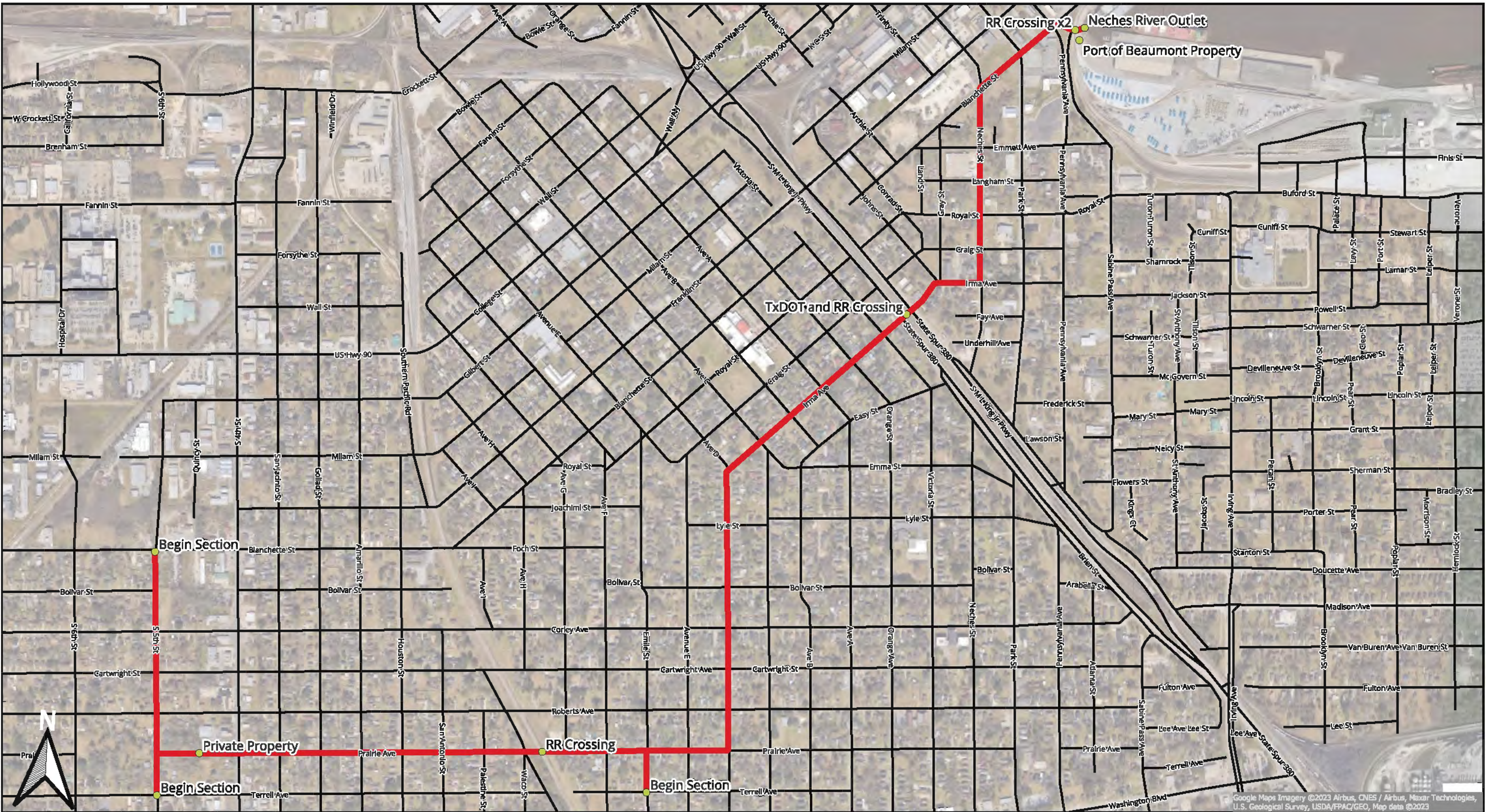
11.2.5 Report Distribution

This report is intended to be used in its entirety. This report should be considered in whole and should not be distributed or made available in partial form.

If any changes in the nature, design or location of the project are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions modified or verified in writing by TWE. TWE is not responsible for any claims, damages or liability associated with interpretation or reuse of the subsurface data or engineering analyses without the expressed written authorization of TWE.

APPENDIX A

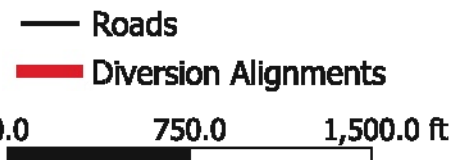
PROJECT EXHIBIT



SPI
 SCHAUMBURG & POLK, INC.
 Firm Registration No. F-000520
 8865 College Street
 Beaumont, Texas 77707
 (409) 866-0341

Jefferson County DD6
 CBDG-MIT Corley Diversion

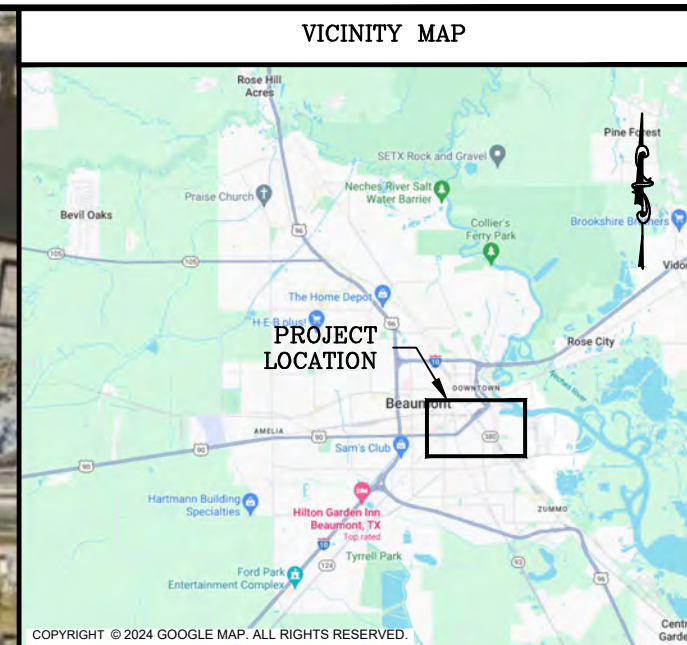
Exhibit 1: Diversion Route



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APPENDIX B

EXPLORATION LOCATION PLAN



TEST BORING COORDINATES			
BORING	DEPTH	LATITUDE	LONGITUDE
TB-1	30'	30° 03' 49.02" N	94° 07' 04.53" W
TB-2	30'	30° 03' 38.53" N	94° 07' 04.32" W
TB-3	50'	30° 03' 28.91" N	94° 07' 04.21" W
TB-4	30'	30° 03' 31.95" N	94° 06' 52.29" W
TB-5	30'	30° 03' 32.02" N	94° 06' 38.58" W
TB-6	50'	30° 03' 32.55" N	94° 06' 27.52" W
TB-7	30'	30° 03' 32.47" N	94° 06' 15.70" W
TB-8	30'	30° 03' 29.59" N	94° 06' 06.78" W
TB-9	50'	30° 03' 40.08" N	94° 06' 06.90" W
TB-10	30'	30° 03' 49.02" N	94° 06' 07.31" W
TB-11	50'	30° 03' 57.41" N	94° 06' 06.60" W
TB-12	30'	30° 04' 03.91" N	94° 05' 58.19" W
TB-13	50'	30° 04' 08.93" N	94° 05' 50.44" W
TB-14	50'	30° 04' 11.82" N	94° 05' 48.12" W
TB-15	30'	30° 04' 14.08" N	94° 05' 41.93" W
TB-16	30'	30° 04' 21.40" N	94° 05' 42.04" W
TB-17	50'	30° 04' 31.42" N	94° 05' 41.49" W
TB-18	30'	30° 04' 33.94" N	94° 05' 37.73" W
TB-19	60'	30° 04' 36.45" N	94° 05' 34.53" W

LEGEND	
SYMBOL	DESCRIPTION
	TEST BORING LOCATION
	PROJECT ALIGNMENT

Tolunay-Wong Engineers, Inc.

TEST BORING LOCATION PLAN
CORLEY DIVERSION PROJECT
JEFFERSON COUNTY DRAINAGE DISTRICT 6
BEAUMONT, TEXAS

<i>Drawn</i>	<i>O.R.</i>	<i>09-12-2024</i>
<i>Checked</i>	<i>J.L.</i>	<i>09-12-2024</i>
<i>Approved</i>	<i>T.G.H.</i>	<i>09-12-2024</i>
<i>Scale</i>	<i>N.T.S.</i>	
<i>TWE DRAWING NO.</i>		<i>24.23.093-1</i>

APPENDIX C

SOIL BORING LOGS & KEY TO SYMBOLS & TERMS

LOG OF BORING TB-1

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 49.02" W 94° 07' 04.32"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
				SURFACE ELEVATION: --														
				MATERIAL DESCRIPTION														
	0			ASPHALT (2.5")														
				FILL: CRUSHED AGGREGATE (9.5")				23		58	38						57	
				FILL: Brown SANDY FAT CLAY (CH), with crushed aggregate -becomes stiff at 2'	(P)2.00													
				-with ferrous nodules from 4' to 6'	(P)1.50													
	5			Stiff, gray and tan FAT CLAY (CH)	(P)2.25													
					(P)1.75			36	88				1.03	6	8	100		
				-becomes very stiff at 10' -slickensided from 10' to 12'	(P)3.00													
	10			Firm, gray and tan LEAN CLAY (CL)	(P)1.25			27		35	18						92	
				-with sand pockets from 13' to 15'														
				-becomes very stiff and tan at 18.5'														
	20																	
				-brown from 23' to 25'	(P)3.50			29		46	23							
	25																	
				-becomes stiff at 28' -with shell fragments from 28' to 30'	(P)2.25													
	30			Bottom @ 30'														
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/24/2024
 DATE BORING COMPLETED: 06/24/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 13.5-ft. 15-min Static Water Depth = 11.4-ft. 15-min Total Hole Depth = 14.1-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-2

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 38.53" W 94° 07' 04.23"	SURFACE ELEVATION: --	DRILLING METHOD: Dry Augered: 0' to 15' Wash Bored: 15' to 30'	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
																				MATERIAL DESCRIPTION
	0																			
						ASPHALT (2.75")														
						FILL: CRUSHED AGGREGATE (9.25")														
						Gray FAT CLAY (CH) -becomes stiff at 2'	(P)2.00			41		113	78							
	5					-slickensided with ferrous nodules from 4' to 6'	(P)1.75													
						-firm from 6' to 8'	(P)1.75			40	78	95	64	0.82	8	6				
						-slickensided with sand pockets from 8' to 10'	(P)1.50													
	10					-with ferrous nodules from 10' to 12'	(P)1.75													
						Firm tan LEAN CLAY (CL), with sand pockets	(P)1.25			26		31	15						87	
	15																			
										28									93	
	20																			
						-becomes very stiff, brown and tan at 23'	(P)3.25													
	25																			
						Firm tan FAT CLAY with SAND (CH)				35									82	
	30					Bottom @ 30'														
	35																			

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/24/2024
 DATE BORING COMPLETED: 06/24/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 13.3-ft. 15-min Static Water Depth = 11.5-ft. 15-min Total Hole Depth = 14.0-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-3

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --													
				DRILLING METHOD: Dry Augered: 0' to 15' Wash Bored: 15' to 50'													
	0			ASPHALT (1.5")													
				FILL: CRUSHED AGGREGATE (10.5")													
				Stiff, brown and gray FAT CLAY (CH)	(P)2.25												
				-slickensided from 2' to 6'	(P)2.50			38		111	83					99	
				-with shell fragments from 6' to 8'	(P)2.50												
				-very stiff with calcareous nodules from 8' to 10'	(P)3.50			38		101	68					100	
				-with sand pockets at 10' to 12'	(P)3.25			26	94	72	47		1.14	12	9		
				Stiff tan LEAN CLAY with SAND (CL)				24		38	22					85	
				-becomes firm at 18.5'													
				Stiff, tan and red LEAN CLAY (CL)	(P)2.00			27		37	18					98	
				-with shell fragments from 23' to 25'													
				-very stiff with ferrous nodules from 28' to 30'	(P)3.50												
					(P)2.75												

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/25/2024
 DATE BORING COMPLETED: 06/25/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 13.9-ft. 15-min Static Water Depth = 11.2-ft. 15-min Total Hole Depth = 16.4-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-3

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 28.91" W 94° 07' 04.21"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
			SURFACE ELEVATION: --														
			DRILLING METHOD: Dry Augered: 0' to 15' Wash Bored: 15' to 50'	MATERIAL DESCRIPTION													
35		▲	Stiff, tan and red LEAN CLAY (CL)														
40		■	-becomes very stiff at 38'	(P)3.50													
45		■	Tan and gray SILTY CLAYEY SAND (SC-SM)	(T)0.25			25		27	7					46		
50		X	-becomes loose at 48.5'		6/6" 5/6" 5/6"												
			Bottom @ 50'														
55																	
60																	
65																	
70																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/25/2024
 DATE BORING COMPLETED: 06/25/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 13.9-ft. 15-min Static Water Depth = 11.2-ft. 15-min Total Hole Depth = 16.4-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-4

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --													
				DRILLING METHOD: Dry Augered: 0' to 14' Wash Bored: 14' to 30'													
	0			ASPHALT (2.5") FILL: STABILIZED SHELL (9.5") Gray FAT CLAY (CH)													
	3			-becomes very stiff, brown and gray at 3' -slickensided from 3' to 8'	(P)3.25			34		81	56					95	
	6			-becomes stiff at 6' -with calcareous deposits from 6' to 8'	(P)1.75												
	9				(P)3.50			29	97	66	44		1.28	9	8		
	12.5			-becomes firm and slickensided at 12.5'		2/6" 3/6" 4/6"		36		104	75						
	15			Firm tan LEAN CLAY with SAND (CL)		3/6" 3/6" 4/6"											
	18.5			-becomes stiff at 18.5'		4/6" 6/6" 7/6"		26		30	11					80	
	23.5			-with shell fragments from 23.5' to 30'		6/6" 6/6" 6/6"											
	30			Bottom @ 30'	(P)2.75												

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/25/2024
 DATE BORING COMPLETED: 06/25/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 12.4-ft. 15-min Static Water Depth = 13.8-ft. 15-min Total Hole Depth = 13.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-5

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 32.02" W 94° 06' 38.58"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 30'		MATERIAL DESCRIPTION												
	0			ASPHALT (1.5")					6									
				FILL: STABILIZED SAND (10.5")		(P)2.75			29		66	45						
				Stiff gray FAT CLAY (CH)		(P)2.50												
				-slickensided with ferrous nodules from 3' to 5'														
	5			-becomes very stiff at 6'		(P)4.00												
				-with calcareous nodules from 6' to 8'														
				-becomes firm at 9'		(P)1.50			36	87	82	54	0.86	13	8	97		
	10			Firm gray LEAN CLAY with SAND (CL)		(T)0.35			21		34	19					72	
				-becomes stiff at 15.5'			4/6"		21									
				-becomes tan at 18.5'			6/6"											
				-becomes tan at 18.5'			6/6"											
				-becomes tan at 18.5'			6/6"											
	20			Firm tan FAT CLAY (CH)			3/6"		30								96	
				-becomes very stiff at 28'		(P)4.25	3/6"											
				-with ferrous nodules from 28' to 30'			3/6"											
				-with ferrous nodules from 28' to 30'			4/6"											
	30			Bottom @ 30'														
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/25/2024
 DATE BORING COMPLETED: 06/25/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 10.0-ft. 15-min Static Water Depth = 7.3-ft. 15-min Total Hole Depth = 15.2-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-6

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 32.55" W 94° 06' 27.52"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 50'		MATERIAL DESCRIPTION												
	0			ASPHALT (3.5")														
				FILL: STABILIZED RECLAIMED BASE (8.5")														
				Gray FAT CLAY (CH)														
				-becomes very stiff and tan at 3' -slickensided from 3' to 5'		(P)3.25			29		75	54						
	5			-with shell fragments from 6' to 8'		(P)3.75												
				-with calcareous nodules from 9' to 11'		(P)4.25			28		69	49						
	10			-becomes stiff and slickensided at 12'		(P)4.25			33	90	105	75	1.63	2 *	11			
	15			Stiff tan SANDY LEAN CLAY (CL)			2/6" 4/6" 5/6"											
				-becomes firm at 18'		(T)0.55			23								51	
	20			Stiff tan LEAN CLAY with SAND (CL)			4/6" 6/6" 7/6"		26		29	8					80	
	25			Stiff, tan and brown FAT CLAY (CH)			6/6" 5/6" 6/6"		39		94	60						
	30			-becomes very stiff at 33' -with shell fragments from 33' to 35'		(P)4.25												
	35																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/26/2024
 DATE BORING COMPLETED: 06/26/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.1-ft. 15-min Static Water Depth = 14.1-ft. 15-min Total Hole Depth = 15.3-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-6

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 32.55" W 94° 06' 27.52"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
			SURFACE ELEVATION: --														
			DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 50'	MATERIAL DESCRIPTION													
35		▲	Very stiff, tan and brown FAT CLAY (CH)														
40		■	-slickensided from 38' to 40'	(P)3.50													
45		■		(P)4.00			35		107	77					100		
50		■		(P)3.50													
			Bottom @ 50'														
55																	
60																	
65																	
70																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/26/2024
 DATE BORING COMPLETED: 06/26/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.1-ft. 15-min Static Water Depth = 14.1-ft. 15-min Total Hole Depth = 15.3-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-7

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 32.47" W 94° 06' 15.70"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 14' Wash Bored: 14' to 30'		MATERIAL DESCRIPTION												
	0			ASPHALT (4")														
				FILL: STABILIZED RECLAIMED BASE (8")		(P)3.50			23		56	38						
				Very stiff gray FAT CLAY (CH)		(P)2.75												
				-becomes stiff and tan at 3'														
	5			Very stiff, gray and tan LEAN CLAY (CL)		(P)3.50			21		32	15						
				-becomes firm and tan at 9.5' -with calcareous nodules from 9.5' to 11'			2/6" 2/6" 3/6"											
	10			Stiff tan FAT CLAY (CH), slickensided		(P)2.00			39	86			1.72	2 *	8			
				Loose, gray and tan CLAYEY SAND (SC)			2/6" 2/6" 3/6"		23								46	
	15			Stiff, gray and tan SANDY LEAN CLAY (CL)			4/6" 5/6" 9/6"		20		28	14					50	
	20			Very stiff, gray and tan LEAN CLAY with SAND (CL)		(P)3.75			27								73	
	25			Very stiff brown FAT CLAY (CH)			4/6" 7/6" 8/6"		31									
	30			Bottom @ 30'														
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/24/2024
 DATE BORING COMPLETED: 06/24/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 14.4-ft. 15-min Static Water Depth = 14.2-ft. 15-min Total Hole Depth = 14.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-9

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 40.08" W 94° 06' 06.90"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 50'		MATERIAL DESCRIPTION												
	0			ASPHALT (1.5") CONCRETE (5.5")		(P)3.25			19		52	32					91	
				Very stiff, brown and tan FAT CLAY (CH), with sand pockets		(P)3.75												
	5			Very stiff tan LEAN CLAY (CL), with sand pockets		(P)4.00			19	111	45	27		3.67	10	6	92	
				-slickensided with calcareous nodules from 9' to 11'		(P)3.75												
	10			-becomes brown and tan at 12'		(P)3.75			31									
	15			Medium dense, brown and tan CLAYEY SAND (SC)			4/6" 7/6" 9/6"		19								43	
							7/6" 14/6" 11/6"		20								23	
	20			Firm, brown and red SANDY LEAN CLAY (CL)			4/6" 3/6" 4/6"											
	25			Hard, brown and red FAT CLAY (CH)		(P)4.50			39		77	48					100	
	30			-becomes gray at 33' -stiff with shell fragments from 33' to 35'		(P)2.75												
	35																	





COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/27/2024
 DATE BORING COMPLETED: 06/27/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.9-ft. 15-min Static Water Depth = 12.0-ft. 15-min Total Hole Depth = 16.0-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-9

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 40.08" W 94° 06' 06.90" SURFACE ELEVATION: -- DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 50'	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
			MATERIAL DESCRIPTION													
35			Hard gray FAT CLAY (CH)													
40			Hard, brown and tan LEAN CLAY (CL)	(P)4.50			21		39	25						
45			Dense tan POORLY GRADED SAND with SILT (SP-SM)		15/6" 22/6" 28/6"		23								8	
50			-becomes medium dense, gray and tan at 48.5'		12/6" 14/6" 17/6"											
			Bottom @ 50'													
55																
60																
65																
70																

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/27/2024
 DATE BORING COMPLETED: 06/27/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.9-ft. 15-min Static Water Depth = 12.0-ft. 15-min Total Hole Depth = 16.0-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-10

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 49.02" W 94° 06' 07.31"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 14' Wash Bored: 14' to 30'		MATERIAL DESCRIPTION												
	0			ASPHALT (2.5")														
				CONCRETE (6")		(P)2.00												
				Stiff gray FAT CLAY with SAND (CH)														
				-becomes very stiff with calcareous deposits at 3'		(P)3.00		19			54	37					83	
	5			Hard, gray and tan FAT CLAY (CH)		(P)4.50												
				-with calcareous nodules from 6' to 8'														
				-becomes stiff at 9'		(P)2.75		25	99		53	33		1.66	8	8	94	
				-with sand pockets from 9' to 11'														
				-with calcareous nodules from 12' to 14'		(P)2.50												
	15			Medium dense tan CLAYEY SAND (SC)			5/6" 7/6" 6/6"	20									29	
							7/6" 9/6" 11/6"											
				-becomes loose, red and tan at 23.5'			4/6" 4/6" 6/6"											
	25			Very stiff, red and tan FAT CLAY (CH)		(P)4.25		32			69	44						
	30			Bottom @ 30'														
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/28/2024
 DATE BORING COMPLETED: 06/28/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 6.0-ft. 15-min Static Water Depth = 5.4-ft. 15-min Total Hole Depth = 12.7-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-11

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 57.41" W 94° 06' 06.60"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 14' Wash Bored: 14' to 50'		MATERIAL DESCRIPTION												
	0			ASPHALT (1.5")		(P)1.50												
				FILL: STABILIZED RECLAIMED BASE (3")														
				Stiff, brown and tan FAT CLAY (CH)														
				-becomes very stiff and tan at 3'		(P)4.00												
				-with calcareous nodules from 3' to 5'														
	5			-becomes gray at 6'		(P)4.25		23		53	34						92	
				-with sand pockets and calcareous nodules from 6' to 8'														
				-becomes gray and tan at 9'		(P)2.75		21	101				1.74	5 *	8			
				-stiff and slickensided from 9' to 11'														
				-becomes tan at 12'		(P)4.25		34		90	60							
				-with sand pockets and calcareous nodules from 12' to 14'														
	15			Stiff, gray and tan SANDY LEAN CLAY (CL)		(P)2.50		19									55	
				Medium dense, gray and tan CLAYEY SAND (SC)				21		29	11						34	
	20																	
				Stiff, gray and red SANDY LEAN CLAY (CL)														
	25																	
				Stiff, brown and tan FAT CLAY (CH)														
	30																	
				-becomes hard and gray at 33'		(P)4.50		22		53	32							
				-with shell fragments from 33' to 35'														
	35																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/27/2024
 DATE BORING COMPLETED: 06/27/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 11.2-ft. 15-min Static Water Depth = 9.1-ft. 15-min Total Hole Depth = 13.4-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-11

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 03' 57.41" W 94° 06' 06.60"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
			SURFACE ELEVATION: --													
			MATERIAL DESCRIPTION													
35			Hard gray FAT CLAY (CH)													
40			Hard gray LEAN CLAY (CL)	(P)4.50												
45			Very stiff gray SANDY LEAN CLAY (CL)	(P)3.75			21		32	16					64	
50			Gray and tan CLAYEY SAND (SC)	(T)0.25			26								41	
			Bottom @ 50'													
55																
60																
65																
70																

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 06/27/2024
 DATE BORING COMPLETED: 06/27/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 11.2-ft. 15-min Static Water Depth = 9.1-ft. 15-min Total Hole Depth = 13.4-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-12

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 03.91" W 94° 05' 58.19"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 17' Wash Bored: 17' to 30'	MATERIAL DESCRIPTION													
	0			ASPHALT (4") FILL: STABILIZED SAND				21										
	5			Stiff, gray and tan FAT CLAY (CH)	(P)2.50			23		53	31					98		
	10			-becomes gray at 9' -with calcareous nodules from 9' to 14'	(P)1.50			24								94		
	15			-becomes very stiff and tan at 12'	(P)3.25			21		51	32					97		
	20			Stiff, gray and tan SANDY LEAN CLAY (CL) -with calcareous nodules from 18.5' to 20'	(P)2.50	3/6" 5/6" 9/6"		28		28	17					50		
	25			-becomes very stiff at 23.5'		7/6" 7/6" 9/6"												
	30			Stiff, brown and tan FAT CLAY (CH)		5/6" 5/6" 9/6"												
	35			Bottom @ 30'														

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 06/28/2024
 DATE BORING COMPLETED: 06/28/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 17.1-ft. 15-min Static Water Depth = 14.1-ft. 15-min Total Hole Depth = 17.9-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-13

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 09.83" W 94° 05' 50.44"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 11' Wash Bored: 11' to 50'		MATERIAL DESCRIPTION												
	0			ASPHALT (5")					17									57
				FILL: STABILIZED RECLAIMED BASE (7")														
				Brown LEAN CLAY (CL)														
				-becomes very stiff, brown and tan at 3' -with shell fragments from 3' to 5'		(P)3.00												
	5			-becomes gray and tan at 6'		(P)3.50		22		47	30						97	
				Stiff, tan and red FAT CLAY (CH), slickensided		(P)2.50												
						(P)2.25												
	15					(P)2.25		34	89	88	55		1.67	5 *	13			
				Firm tan LEAN CLAY with SAND (CL)		(T)0.45		21		26	15							
	20																	
				Stiff, brown and tan SANDY LEAN CLAY (CL)				24		27	11						60	
	25																	
				Stiff tan FAT CLAY (CH)														
	30																	
				-becomes very stiff at 33' -with shell fragments from 33' to 35'		(P)4.00												
	35																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 07/01/2024
 DATE BORING COMPLETED: 07/01/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 10.6-ft. 15-min Static Water Depth = 10.4-ft. 15-min Total Hole Depth = 10.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-13

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 09.83" W 94° 05' 50.44"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
			SURFACE ELEVATION: --													
			DRILLING METHOD: Dry Augered: 0' to 11' Wash Bored: 11' to 50'	MATERIAL DESCRIPTION												
35		▲	Very stiff tan FAT CLAY (CH)	(P)4.00			34		99	70					100	
40		▲														
45		▲	Very stiff, gray and tan LEAN CLAY (CL)	(P)3.00												
50		▲	Medium dense, gray and tan CLAYEY SAND (SC)		7/6" 9/6" 12/6"		24								35	
			Bottom @ 50'													
55																
60																
65																
70																

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 07/01/2024
 DATE BORING COMPLETED: 07/01/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 10.6-ft. 15-min Static Water Depth = 10.4-ft. 15-min Total Hole Depth = 10.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-14

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 11.82" W 94° 05' 48.12"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
				SURFACE ELEVATION: --														
				MATERIAL DESCRIPTION														
	0			ASHPALT (1.5") FILL: STABILIZED RECLAIMED BASE (3.5") Stiff, brown and gray FAT CLAY (CH)	(P)2.50													
	3			-becomes very stiff and gray at 3' -with calcareous nodules from 3' to 11'	(P)3.75			21		59	39						92	
	6			-becomes gray and tan at 6'	(P)3.50													
	9			-slickensided from 9' to 11'	(P)3.00			33	89				2.03	3 *	8			
	12			-becomes brown at 12'	(P)4.00			33		88	65							
	15			Stiff, gray and tan SANDY LEAN CLAY (CL)	(P)2.50			20									60	
	18.5			-becomes tan at 18.5'				22		31	16						54	
	20																	
	25							24		27	8							
	30			Very stiff, red and tan LEAN CLAY (CL)	(P)4.25													
	33			-becomes gray and tan at 33'	(P)4.00			18		42	27							
	35																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 07/01/2024
 DATE BORING COMPLETED: 07/01/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 14.7-ft. 15-min Static Water Depth = 14.0-ft. 15-min Total Hole Depth = 17.7-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-14

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 11.82" W 94° 05' 48.12"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
			SURFACE ELEVATION: --														
			DRILLING METHOD: Dry Augered: 0' to 14' Wash Bored: 14' to 50'														
			MATERIAL DESCRIPTION														
35		▲	Very stiff, gray and tan LEAN CLAY (CL)														
40		■	-brown and tan from 38' to 40'	(P)4.25													
45		■	Very stiff, tan and gray LEAN CLAY with SAND (CL)	(P)4.00			21		35	21							
50		⊗	Stiff tan SANDY LEAN CLAY (CL)		4/6" 3/6" 7/6"		23								67		
			Bottom @ 50'														
55																	
60																	
65																	
70																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 07/01/2024
 DATE BORING COMPLETED: 07/01/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 14.7-ft. 15-min Static Water Depth = 14.0-ft. 15-min Total Hole Depth = 17.7-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-15

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 14.08" W 94° 05' 41.93" SURFACE ELEVATION: -- DRILLING METHOD: Dry Augered: 0' to 20' Wash Bored: 20' to 30'	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
																		MATERIAL DESCRIPTION
	0			ASPHALT (2")														
				CONCRETE (8")	(P)1.25			25		50	32							
				Firm, gray and red FAT CLAY (CH)														
				-becomes very stiff at 3' -with silt pockets from 3' to 8'	(P)4.00													
	5			-becomes tan at 6' -hard from 6' to 8'	(P)4.50													
					(P)3.75			35		95	69							
	10			-stiff and slickensided from 12' to 14'	(P)2.00			38	83	108	79	1.46	2 *	11	99			
	15			Very stiff tan LEAN CLAY with SAND (CL)	(P)4.25													
					(P)3.00			21								74		
	20																	
				Medium dense tan CLAYEY SAND (SC)														24
	25							22										
				Very stiff, gray and tan FAT CLAY (CH)														
	30							29		74	44							
				Bottom @ 30'														
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 07/02/2024
 DATE BORING COMPLETED: 07/02/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 17.3-ft. 15-min Static Water Depth = 15.4-ft. 15-min Total Hole Depth = 19.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-16

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 21.40" W 94° 05' 42.04"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
				SURFACE ELEVATION: --														
				MATERIAL DESCRIPTION														
	0			ASPHALT (5")														
				CONCRETE (5.5")	(P)1.50			24		46	32							
				Stiff gray LEAN CLAY (CH)														
				-becomes very stiff at 3'	(P)3.50													
	5			Very stiff, tan and gray FAT CLAY (CH)	(P)3.50													
				-becomes stiff at 9'	(P)2.75			27	97	73	50		1.97	5 *	8			
	10			Very stiff gray SANDY LEAN CLAY (CL), with calcareous nodules	(P)4.00													
	15			Gray and tan CLAYEY SAND (SC)	(P)3.50			19		27	11						45	
				-becomes medium dense and tan at 18.5'				20									39	
	20			Stiff tan FAT CLAY with SAND (CH)														
				-becomes hard at 28' -with shell fragments from 28' to 30'	(P)4.50			30		72	45							
	25			Bottom @ 30'														
	30																	
	35																	

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 07/02/2024
 DATE BORING COMPLETED: 07/02/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 16.9-ft. 15-min Static Water Depth = 15.6-ft. 15-min Total Hole Depth = 18.1-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-17

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT) DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 31.42" W 94° 05' 41.49"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
			SURFACE ELEVATION: --														
			MATERIAL DESCRIPTION														
35		▲	Stiff gray FAT CLAY (CH), with sand pockets														
40		■	-slickensided from 38' to 40'	(P)4.00			29		73	52					93		
45		■	Very stiff, gray and tan SANDY LEAN CLAY (CL)	(P)4.25													
50		■	Gray CLAYEY SAND (SC)	(P)3.00			18								49		
55			Bottom @ 50'														
60																	
65																	
70																	

COMPLETION DEPTH: 50 ft
 DATE BORING STARTED: 07/09/2024
 DATE BORING COMPLETED: 07/09/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 13.7-ft. 15-min Static Water Depth = 12.4-ft. 15-min Total Hole Depth = 19.1-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-18

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 33.94" W 94° 05' 37.73"		(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 20' Wash Bored: 20' to 30'		MATERIAL DESCRIPTION												
	0			ASPHALT (2")														
				CONCRETE (4")														
				FILL: STABILIZED SHELL (4")														
				Gray FAT CLAY (CH)														
				-becomes very stiff at 3'		(P)3.00												
	5			-becomes gray and tan at 6'		(P)4.00		23			66	43						
				-with calcareous nodules from 6' to 8'														
				-slickensided from 9' to 11'		(P)3.25		23			63	42					97	
	10			-gray with calcareous nodules from 12' to 14'		(P)4.00												
	15			-becomes stiff at 15'		(P)2.25		35	89		67	45	1.41	2 *	13	97		
				-slickensided with ferrous nodules from 15' to 17'														
	20			Hard, brown and gray LEAN CLAY (CL)		(P)4.50		20			44	23						
				-with ferrous nodules from 18' to 20'														
	25			-becomes stiff and tan at 23.5'				28									86	
				-with sand pockets from 23.5' to 25'														
	30			Stiff, gray and tan FAT CLAY (CH)														
				Bottom @ 30'														

COMPLETION DEPTH: 30 ft
 DATE BORING STARTED: 07/09/2024
 DATE BORING COMPLETED: 07/09/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 14.8-ft. 15-min Static Water Depth = 13.4-ft. 15-min Total Hole Depth = 20.8-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-19

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 36.45" W 94° 05' 34.53"	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
				SURFACE ELEVATION: --														
				DRILLING METHOD: Dry Augered: 0' to 18' Wash Bored: 18' to 60'	MATERIAL DESCRIPTION													
	0			ASPHALT (2") CONCRETE (22")														
	3			Brown and gray FAT CLAY (CH) -becomes very stiff at 3'	(P)3.50			22		55	37							
	6			-with calcareous nodules from 6' to 8'	(P)4.00													
	9			-becomes tan at 9' -slickensided from 9' to 14'	(P)4.25			32	91	96	66	2.03	2 *	8	99			
	12			-becomes hard, gray and tan at 12' -with calcareous nodules from 12' to 14'	(P)4.50													
	15			Gray and tan CLAYEY SAND (SC)	(P)4.00			14								48		
	20			Medium dense tan SANDY SILTY CLAY (CL-ML)		4/6" 7/6" 5/6"												
	25					4/6" 7/6" 7/6"		25								64		
	30			Very stiff, brown and gray FAT CLAY (CH) -with shell fragments from 28' to 30'	(P)4.00			35	89	73	44	2.13	4 *	24	100			
	35			-becomes brown and tan at 33' -with calcareous nodules from 33' to 35'	(P)3.00			30		57	35							

COMPLETION DEPTH: 60 ft
 DATE BORING STARTED: 07/03/2024
 DATE BORING COMPLETED: 07/03/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.5-ft. 15-min Static Water Depth = 14.5-ft. 15-min Total Hole Depth = 17.6-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

LOG OF BORING TB-19

PROJECT: Corley Diversion Project
 Drainage District 6 - Beaumont, Texas

CLIENT: Schaumburg & Polk, Inc.
 Beaumont, Texas

ELEVATION (FT)	DEPTH (FT)	SAMPLE TYPE	SYMBOL	COORDINATES: N 30° 04' 36.45" W 94° 05' 34.53"	SURFACE ELEVATION: --	DRILLING METHOD: Dry Augered: 0' to 18' Wash Bored: 18' to 60'	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	N ₆₀	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED	
																				MATERIAL DESCRIPTION
	35																			
						Very stiff, brown and tan FAT CLAY (CH)														
	40					-becomes gray and tan at 38' -slickensided from 38' to 40'	(P)3.75													
	45					-becomes gray at 43' -with calcareous nodules from 43' to 45'	(P)4.25			25	100	69	48		3.04	6	37			
	50					Medium dense, gray and tan SILTY SAND (SM)		7/6" 9/6" 12/6"		25									39	
	55					-becomes very dense and gray at 53.5'		17/6" 34/6" 50/6"		20									17	
	60					-becomes tan at 58.5'		25/6" 50/5"												
						Bottom @ 60'														
	65																			
	70																			

COMPLETION DEPTH: 60 ft
 DATE BORING STARTED: 07/03/2024
 DATE BORING COMPLETED: 07/03/2024
 LOGGER: N. Salinas
 PROJECT NO.: 24.23.093

NOTES: Free Water Depth = 15.5-ft. 15-min Static Water Depth = 14.5-ft. 15-min Total Hole Depth = 17.6-ft. Borehole was backfilled with cement-bentonite grout and asphalt patching mix.

KEY TO SYMBOLS AND TERMS USED ON BORING LOGS FOR SOIL

Most Common Unified Soil Classifications System Symbols

	Lean Clay (CL)		Well Graded Sand (SW)
	Lean Clay w/ Sand (CL)		Well Graded Sand w/ Gravel (SW-GM)
	Sandy Lean Clay (CL)		Poorly Graded Sand (SP)
	Fat Clay (CH)		Poorly Graded Sand w/ Silt (SP-SM)
	Fat Clay w/ Sand (CH)		Silt (ML)
	Sandy Fat Clay (CH)		Elastic Silt (MH)
	Silty Clay (CL-ML)		Elastic Silt w/ Sand (MH-SP)
	Sandy Silty Clay (CL-ML)		Silty Gravel (GM)
	Silty Clayey Sand (SC-SM)		Clayey Gravel (GC)
	Clayey Sand (SC)		Well Graded Gravel (GW)
	Sandy Silt (ML)		Well Graded Gravel w/ Sand (SP-GM)
	Silty Sand (SM)		Poorly Graded Gravel (GP)
	Silt w/ Sand (ML)		Peat

Miscellaneous Materials

	Fill		Concrete		Asphalt and/or Base
--	------	--	----------	--	---------------------

Sampler Symbols

Meaning

	Pavement core
	Thin - walled tube sample
	Standard Penetration Test (SPT)
	Auger sample
	Sampling attempt with no recovery
	TxDOT Cone Penetrometer Test

Field Test Data

2.50	Pocket penetrometer reading in tons per square foot
(T)1.13	Torvane Measurement in tons per square foot
8/6"	Blow count per 6 - in. interval of the Standard Penetration Test
	Observed free water during drilling
	Observed static water level

Laboratory Test Data

Wc (%)	Moisture content in percent
Dens. (pcf)	Dry unit weight in pounds per cubic foot
Qu (tsf)	Unconfined compressive strength in tons per square foot
UU (tsf)	Compressive strength under confining pressure in tons per square foot
Str. (%)	Strain at failure in percent
LL	Liquid Limit in percent
PI	Plasticity Index
#200 (%)	Percent passing the No. 200 mesh sieve
()	Confining pressure in pounds per square inch
*	Slickensided failure
**	Did not fail @ 15% strain

RELATIVE DENSITY OF COHESIONLESS & SEMI-COHESIONLESS SOILS

The following descriptive terms for relative density apply to cohesionless soils such as gravels, silty sands, and sands as well as semi-cohesive and semi-cohesionless soils such as sandy silts, and clayey sands.

Relative Density	Typical N_{60} Value Range*
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	Over 50

* N_{60} is the number of blows from a 140-lb weight having a free fall of 30-in. required to penetrate the final 12-in. of an 18-in. sample interval, corrected for field procedure to an average energy ratio of 60% (Terzaghi, Peck, and Mesri, 1996).

CONSISTENCY OF COHESIVE SOILS

The following descriptive terms for consistency apply to cohesive soils such as clays, sandy clays, and silty clays.

Typical Compressive Strength (tsf)	Consistency	Typical SPT " N_{60} " Value Range**
$q_u < 0.25$	Very soft	≤ 2
$0.25 \leq q_u < 0.50$	Soft	3-4
$0.50 \leq q_u < 1.00$	Firm	5-8
$1.00 \leq q_u < 2.00$	Stiff	9-15
$2.00 \leq q_u < 4.00$	Very Stiff	16-30
$q_u \geq 4.00$	Hard	≥ 31

** An " N_{60} " value of 31 or greater corresponds to a hard consistency. The correlation of consistency with a typical SPT " N_{60} " value range is approximate.



APPENDIX D

SITE PHOTOS



Looking south on 5th St
TB-1



Looking south on 5th St
TB-2



Looking north on 5th St
TB-3



Looking east on Prairie
Ave TB-4



Looking east on Prairie
Ave TB-5



Looking south on Waco
St TB-6



Looking east on Prairie
Ave TB-7



Looking north on
Avenue D TB-8



Looking north on
Avenue D TB-9



Looking north on
Avenue D TB-10



Looking Northeast on
Irma TB-11

TWIE
⊕
TB-11



Looking Northeast on
Irma TB-12



Looking Northeast on
Irma TB-13



Looking Northeast on
Irma TB-14



Looking north on
Neches St TB-15



Looking north on
Neches St TB- 16



Looking Northeast on
Blanchette St TB-17



Looking Northeast on
Blanchett St TB-18



Looking Northeast on
Blanchette St TB-19

APPENDIX E

PAVEMENT CORE LOGS

LOG OF PAVEMENT CORE

Core No. TB-1

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 24, 2024
Sampled By: N. Salinas
Location: N 30° 03' 49.02"
 W 94° 07' 04.32"

Pavement Thickness and Material Description

Depth	Description
0" - 3"	Surface Course: Asphaltic Concrete (3")
3" - 12"	Base: Crushed Aggregate (9")

Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by: *Zhe Luo*
 Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By: *Armando Gomez*
 Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-2

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 24, 2024
Sampled By: N. Salinas
Location: N 30° 03' 38.53"
 W 94° 07' 04.23"

Pavement Thickness and Material Description

Depth	Description
0" - 2.75"	Surface Course: Asphaltic Concrete (2.75")
2.75" - 12"	Base: Crushed Aggregate (9.25")

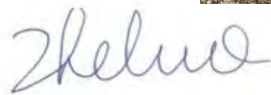
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-3

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 25, 2024
Sampled By: N. Salinas
Location: N 30° 03' 28.91"
 W 94° 07' 04.21"

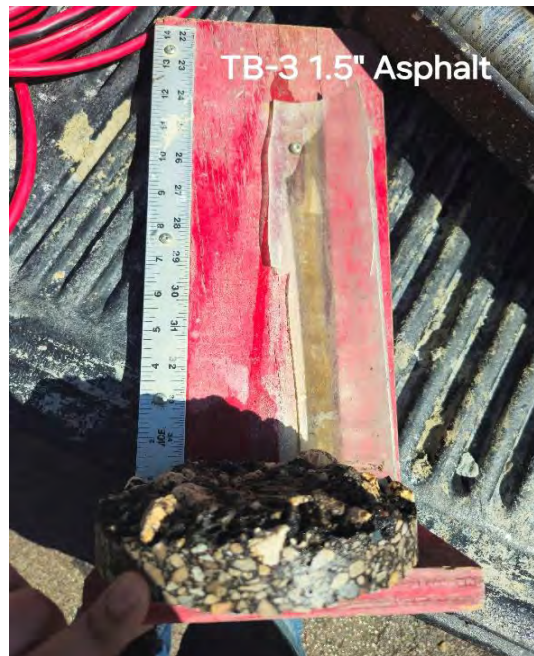
Pavement Thickness and Material Description

Depth	Description
0" - 1.5"	Surface Course: Asphaltic Concrete (1.5")
1.5" - 12"	Base: Crushed Aggregate (10.5")

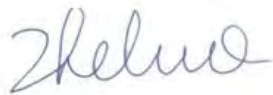
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-4

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 25, 2024
Sampled By: N. Salinas
Location: N 30° 03' 31.95"
 W 94° 06' 52.29"

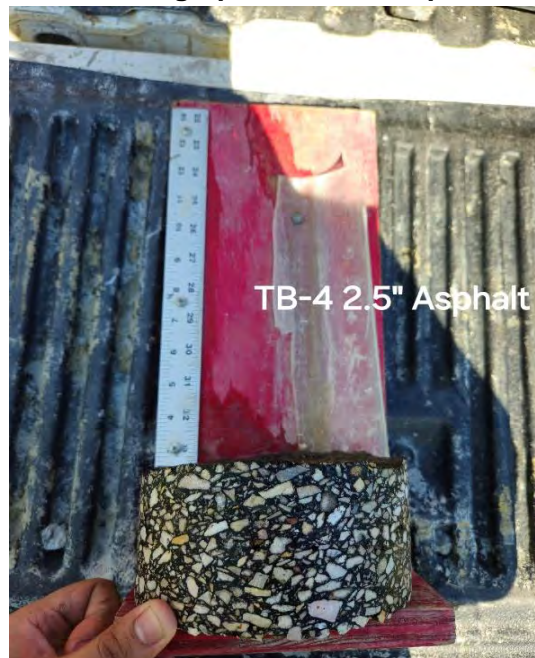
Pavement Thickness and Material Description

Depth	Description
0" - 2.5"	Surface Course: Asphaltic Concrete (2.5")
2.5" - 12"	Base: Stabilized Shell (9.5")

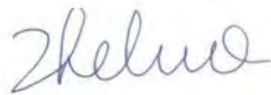
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



 Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



 Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-5

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 25, 2024
Sampled By: N. Salinas
Location: N 30° 03' 32.02"
 W 94° 06' 38.58"

Pavement Thickness and Material Description

Depth	Description
0" - 1.5"	Surface Course: Asphaltic Concrete (1.5")
1.5" - 12"	Base: Stabilized Sand (10.5")

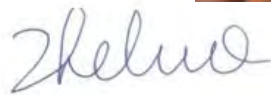
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-6

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 26, 2024
Sampled By: N. Salinas
Location: N 30° 03' 32.55"
 W 94° 06' 27.52"

Pavement Thickness and Material Description

Depth	Description
0" - 4"	Surface Course: Asphaltic Concrete (4")
4" - 12"	Base: Stabilized Reclaimed Base (8")

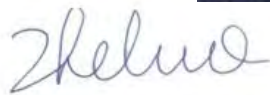
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-7

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 24, 2024
Sampled By: N. Salinas
Location: N 30° 03' 32.47"
 W 94° 06' 15.70"

Pavement Thickness and Material Description

Depth	Description
0" - 6"	Surface Course: Asphaltic Concrete (6")
6" - 12"	Base: Stabilized Reclaimed Base (6")

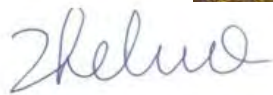
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-8

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 24, 2024
Sampled By: N. Salinas
Location: N 30° 03' 29.59"
 W 94° 06' 06.78"

Pavement Thickness and Material Description

Depth	Description
0" - 2.5"	Surface Course: Asphaltic Concrete (2.5")
2.5" - 8.5"	Base: Stabilized Concrete (6")

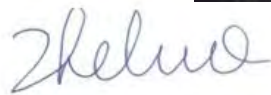
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-9

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 27, 2024
Sampled By: N. Salinas
Location: N 30° 03' 40.08"
 W 94° 06' 06.90"

Pavement Thickness and Material Description

Depth	Description
0" - 1.5"	Surface Course: Asphaltic Concrete (1.5")
1.5" - 7"	Base: Stabilized Concrete (5.5")

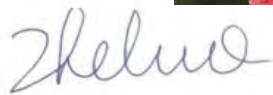
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-10

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 28, 2024
Sampled By: N. Salinas
Location: N 30° 03' 49.02"
 W 94° 06' 07.31"

Pavement Thickness and Material Description

Depth	Description
0" - 2.5"	Surface Course: Asphaltic Concrete (2.5")
2.5" - 8.5"	Base: Stabilized Concrete (6")

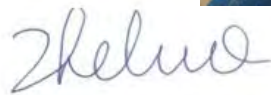
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-11

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 27, 2024
Sampled By: N. Salinas
Location: N 30° 03' 57.41"
 W 94° 06' 06.60"

Pavement Thickness and Material Description

Depth	Description
0" - 1.5"	Surface Course: Asphaltic Concrete (1.5")
1.5" - 4.5"	Base: Compacted Shell Base (3")

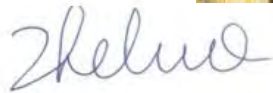
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-12

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: June 27, 2024
Sampled By: N. Salinas
Location: N 30° 04' 03.91"
 W 94° 05' 58.19"

Pavement Thickness and Material Description

Depth	Description
0" - 4"	Surface Course: Asphaltic Concrete (4")
1.5" - 5' 0"	Base: Stabilized Sand (4' 8")

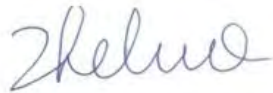
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-13

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 1, 2024
Sampled By: N. Salinas
Location: N 30° 04' 09.83"
 W 94° 05' 50.44"

Pavement Thickness and Material Description

Depth	Description
0" - 5"	Surface Course: Asphaltic Concrete (5")
5" - 7.5"	Base: Stabilized Reclaimed Base (2.5")

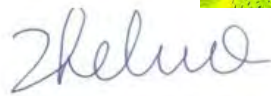
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-14

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 1, 2024
Sampled By: N. Salinas
Location: N 30° 04' 11.82"
 W 94° 05' 48.12"

Pavement Thickness and Material Description

Depth	Description
0" - 2"	Surface Course: Asphaltic Concrete (2")
2" - 5.5"	Base: Stabilized Reclaimed Base (3.5")

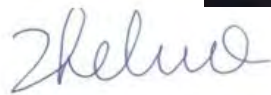
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-15

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 2, 2024
Sampled By: N. Salinas
Location: N 30° 04' 14.08"
 W 94° 05' 41.93"

Pavement Thickness and Material Description

Depth	Description
0" - 2"	Surface Course: Asphaltic Concrete (2")
2" - 10"	Base: Stabilized Concrete (8")

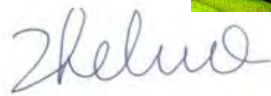
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-16

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 2, 2024
Sampled By: N. Salinas
Location: N 30° 04' 21.40"
 W 94° 05' 42.04"

Pavement Thickness and Material Description

Depth	Description
0" - 5"	Surface Course: Asphaltic Concrete (5")
5" - 10.5"	Base: Stabilized Concrete (5.5")

Notes:

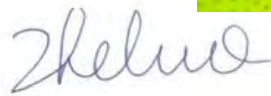
- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



TB-16 5" Asphalt
 5.5" Stabilized Concrete

Prepared by:



 Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



 Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-17

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 9, 2024
Sampled By: N. Salinas
Location: N 30° 04' 31.42"
 W 94° 05' 41.49"

Pavement Thickness and Material Description

Depth	Description
0" - 2"	Surface Course: Asphaltic Concrete (2")
2" - 9"	Base: Stabilized Concrete (7")

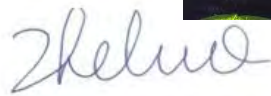
Notes:

- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-18

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 9, 2024
Sampled By: N. Salinas
Location: N 30° 04' 33.94"
 W 94° 05' 37.73"

Pavement Thickness and Material Description

Depth	Description
0" - 2"	Surface Course: Asphaltic Concrete (2")
2" - 6"	Base: Brick (4")
6" - 10"	Subbase: Stabilized Shell (4")

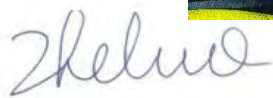
Notes:

1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



Prepared by:



Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:



Armando Gomez, P.E.
 Branch Manager

LOG OF PAVEMENT CORE

Core No. TB-19

Project: Corley Diversion Project
 Beaumont, Texas

Project No. 24.23.093
Report No. 159150
Report Date: October 1, 2024

Client: Schaumburg & Polk, Inc.
 8865 College Street, Suite 100
 Beaumont, Texas 77707
 Attn: Mr. Alvin Trahan

Sample Date: July 3, 2024
Sampled By: N. Salinas
Location: N 30° 04' 36.45"
 W 94° 05' 34.53"

Pavement Thickness and Material Description

Depth	Description
0" - 2"	Surface Course: Asphaltic Concrete (2")
2" - 9.5"	Base: Stabilized Concrete (7.5")

Notes:

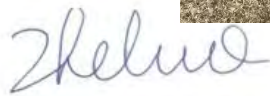
- 1) The borehole was backfilled with asphalt patch material.

Photograph of Core Sample



TB-19 2" Asphalt
 7.5" Stabilized Concrete

Prepared by:



 Zhe "Jerry" Luo, Ph.D., P.E.
 Senior Geotechnical Engineer

Reviewed By:

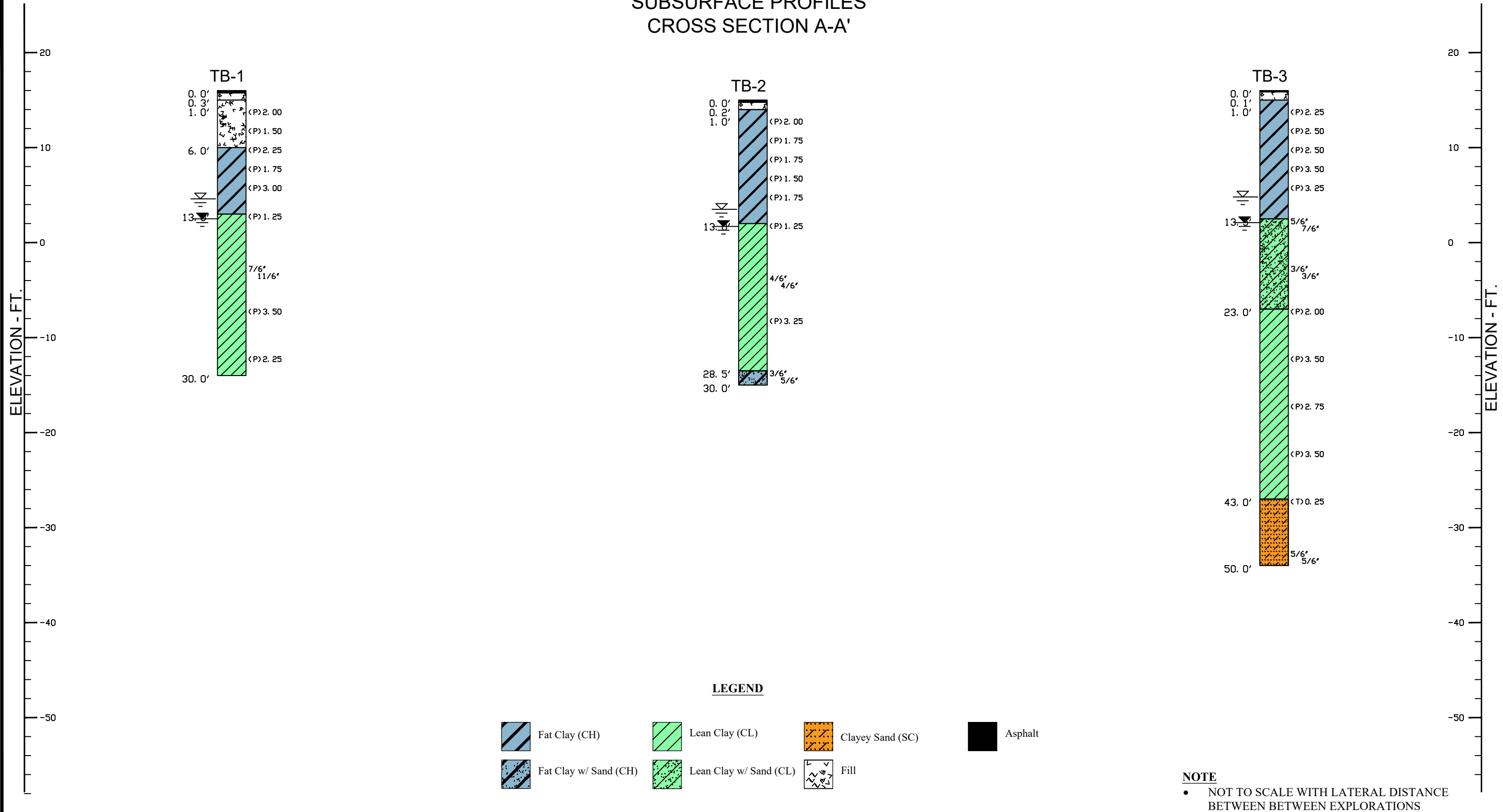


 Armando Gomez, P.E.
 Branch Manager

APPENDIX F

SUBSURFACE PROFILES

SUBSURFACE PROFILES CROSS SECTION A-A'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS

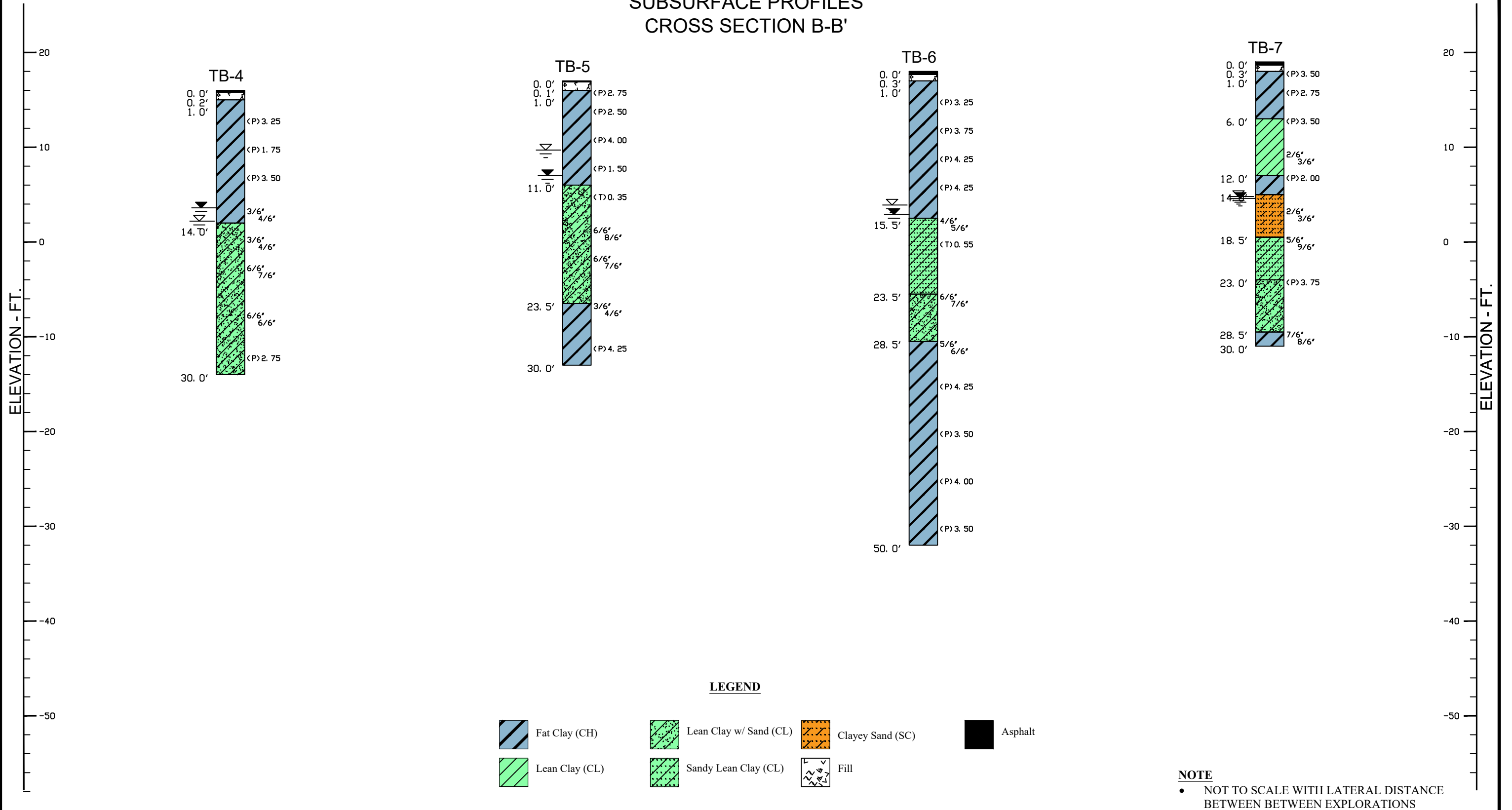


SUBSURFACE PROFILES
CROSS SECTION A - A'

PROJECT NO.: 24.23.093

FIGURE 1

SUBSURFACE PROFILES CROSS SECTION B-B'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS

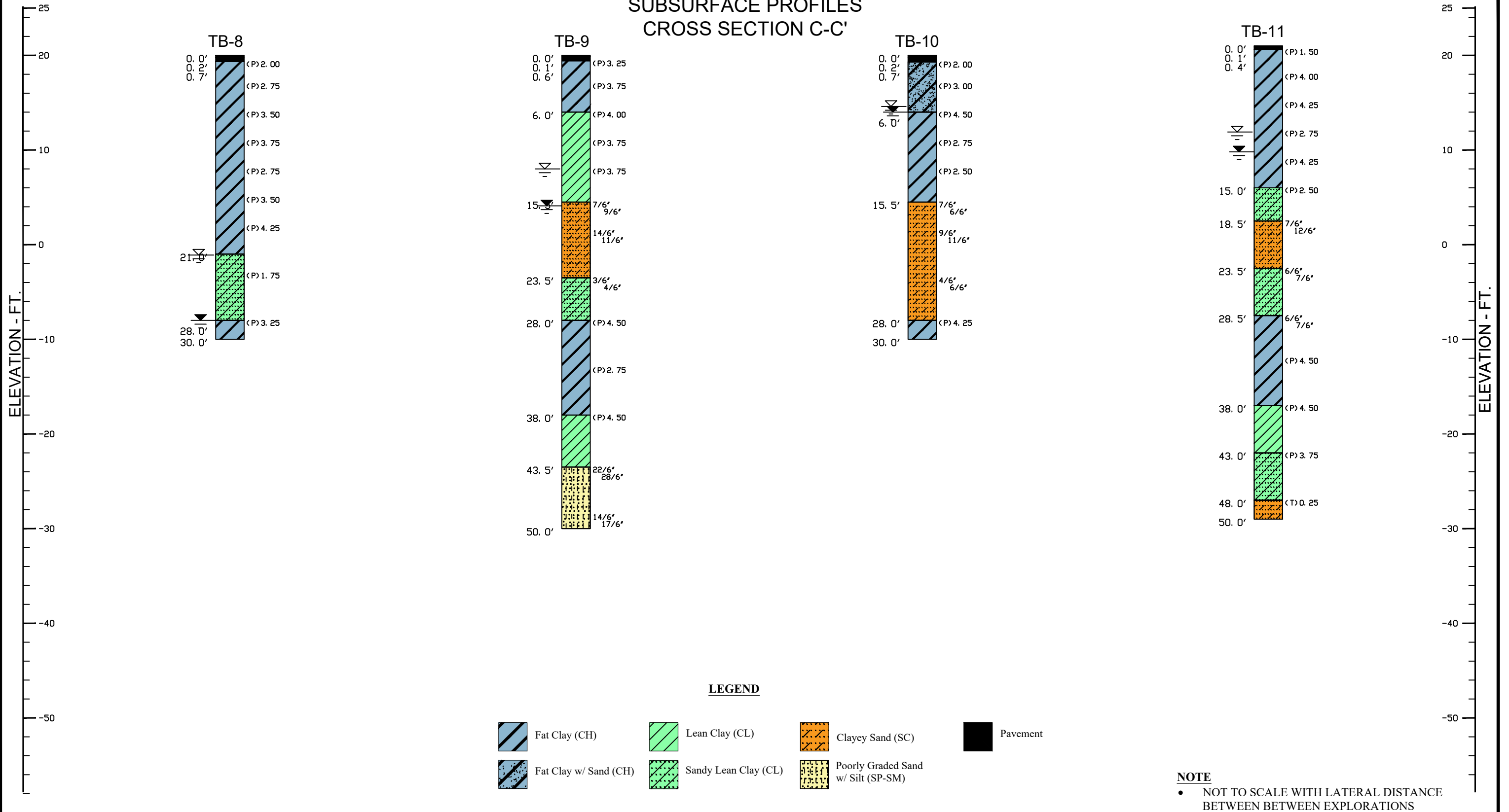


SUBSURFACE PROFILES
CROSS SECTION B - B'

PROJECT NO.: 24.23.093

FIGURE 2

SUBSURFACE PROFILES CROSS SECTION C-C'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS



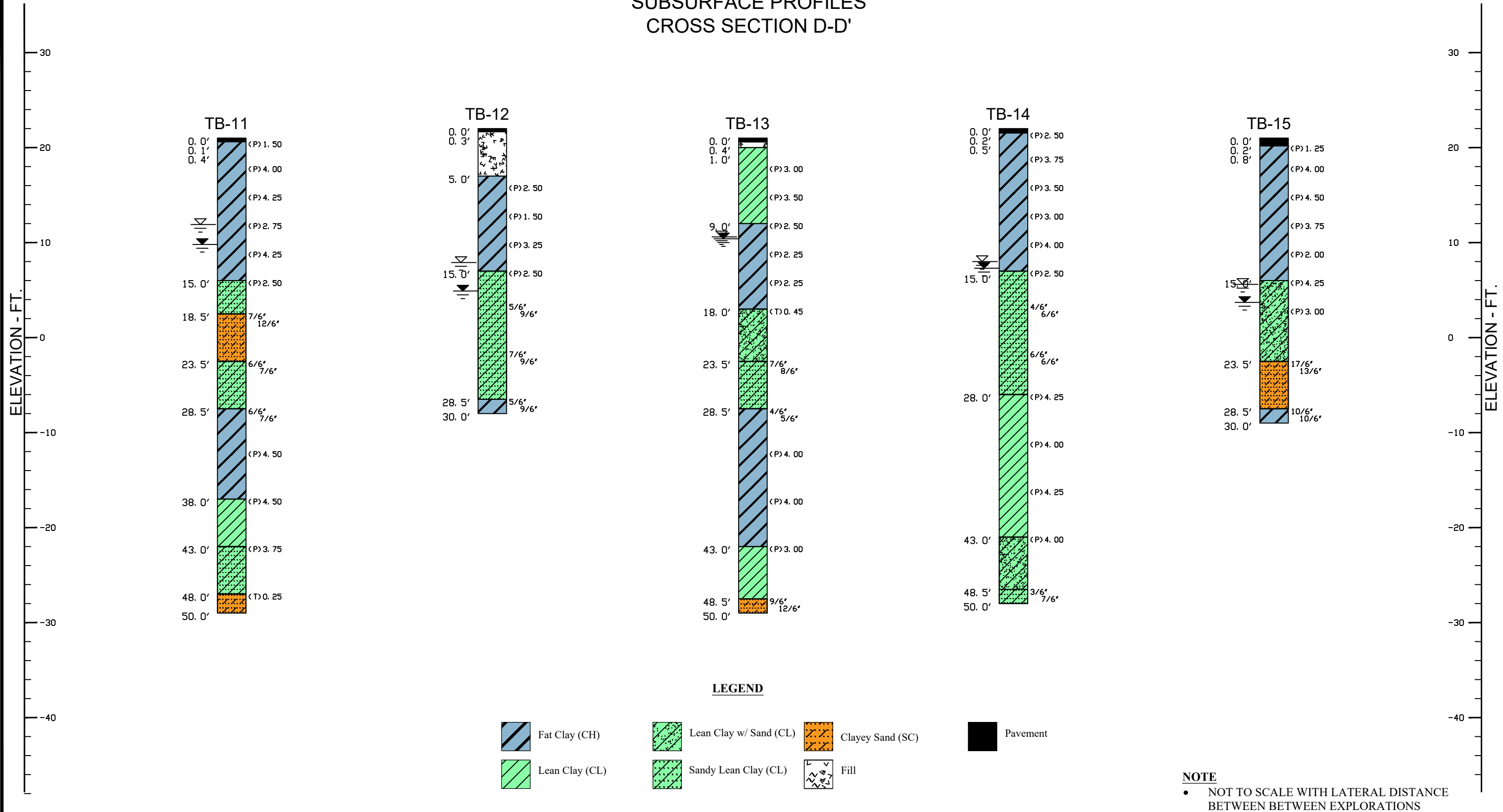
Tolunay-Wong
Engineers, Inc.

SUBSURFACE PROFILES
CROSS SECTION C-C'

PROJECT NO.: 24.23.093

FIGURE 3

SUBSURFACE PROFILES CROSS SECTION D-D'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS

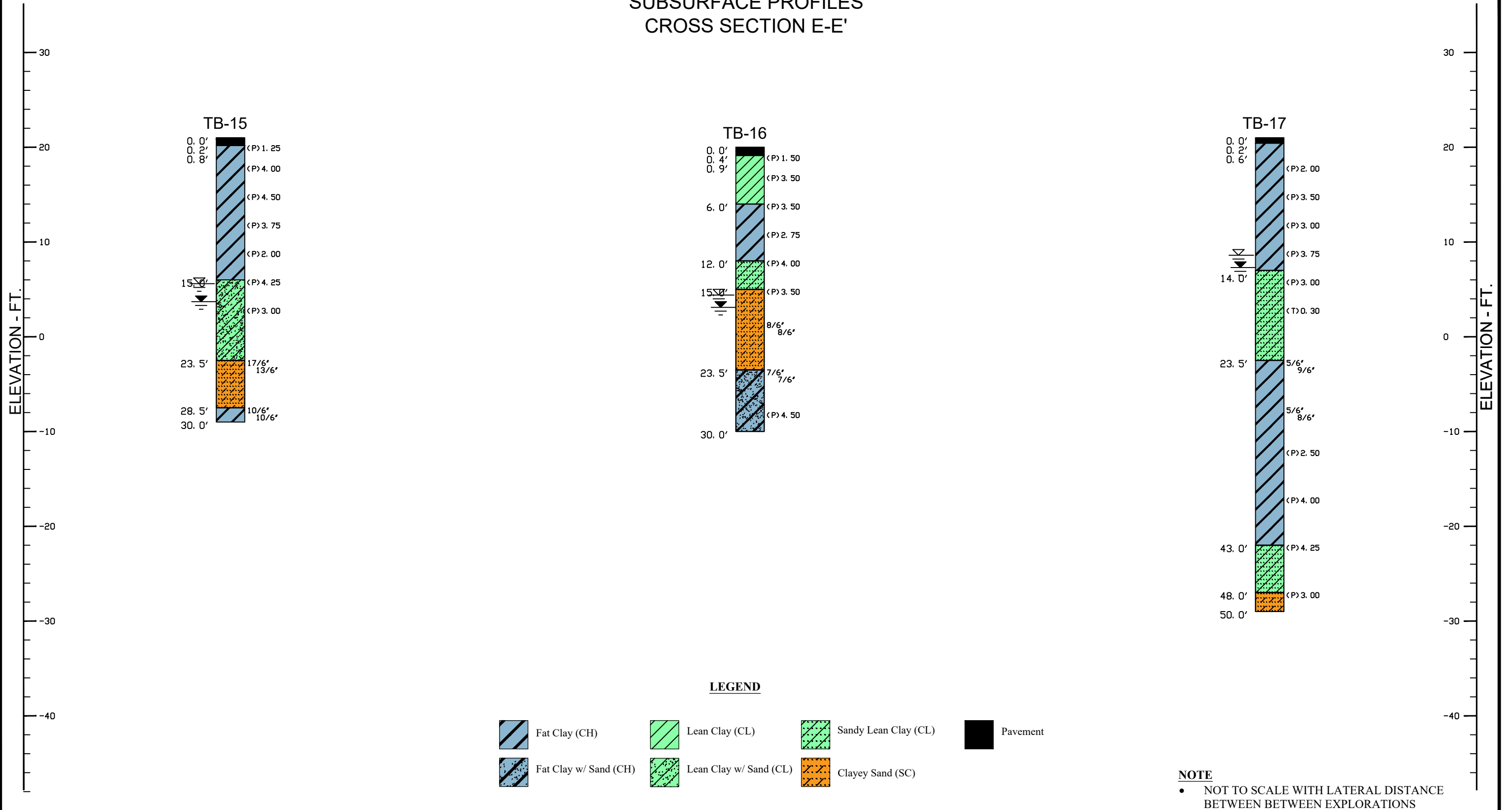


SUBSURFACE PROFILES
CROSS SECTION D - D'

PROJECT NO.: 24.23.093

FIGURE 4

SUBSURFACE PROFILES CROSS SECTION E-E'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS

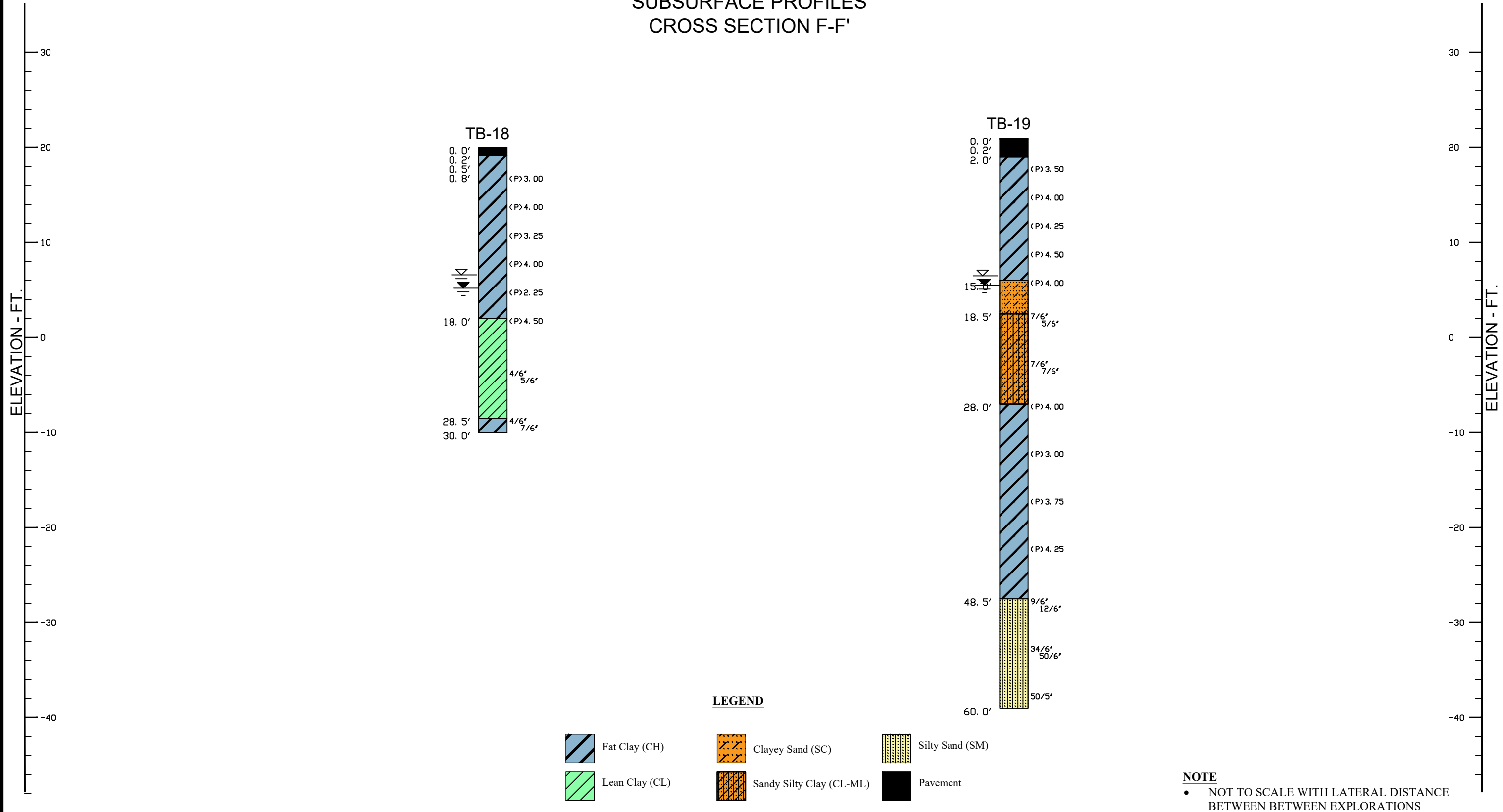


SUBSURFACE PROFILES
CROSS SECTION E - E'

PROJECT NO.: 24.23.093

FIGURE 5

SUBSURFACE PROFILES CROSS SECTION F-F'



CORLEY DIVERSION PROJECT
DRAINAGE DISTRICT 6 - BEAUMONT, TEXAS

SCHAUMBURG & POLK, INC.
BEAUMONT, TEXAS



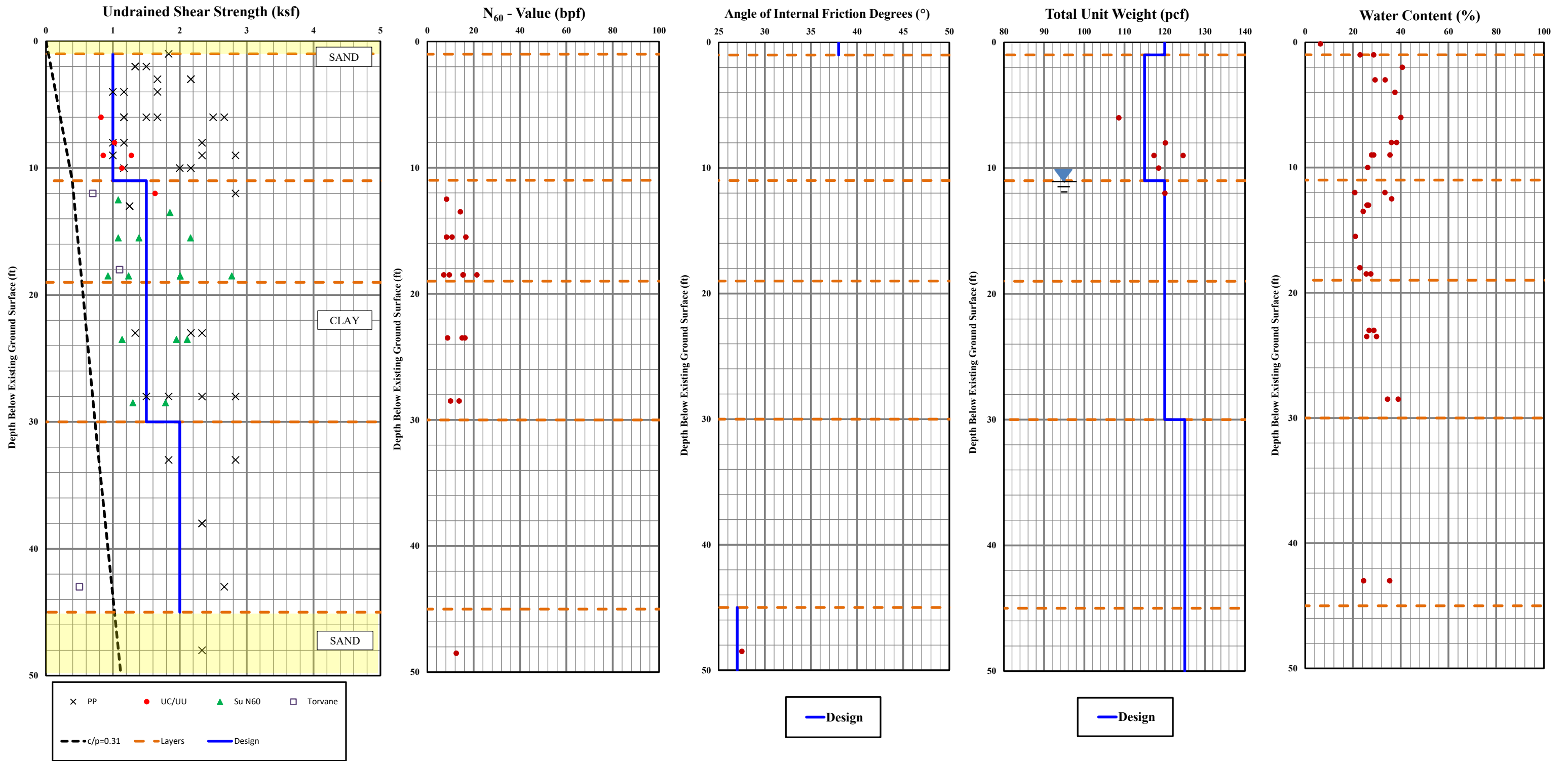
SUBSURFACE PROFILES
CROSS SECTION F-F'

PROJECT NO.: 24.23.093

FIGURE 6

APPENDIX G

DESIGN SOIL PARAMETERS



Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



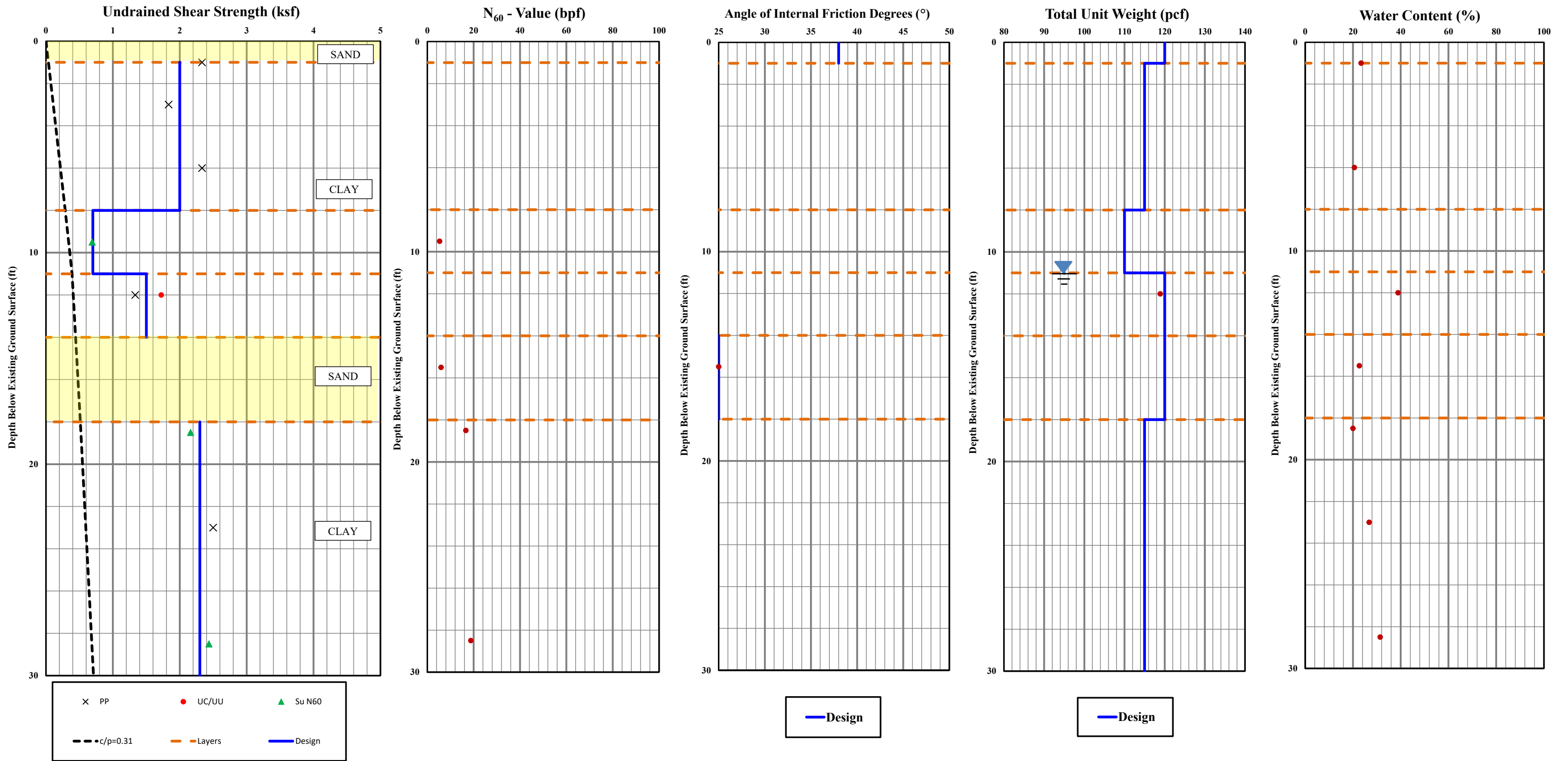
Design Soil Parameters
TB-1 through TB-6

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 1



Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



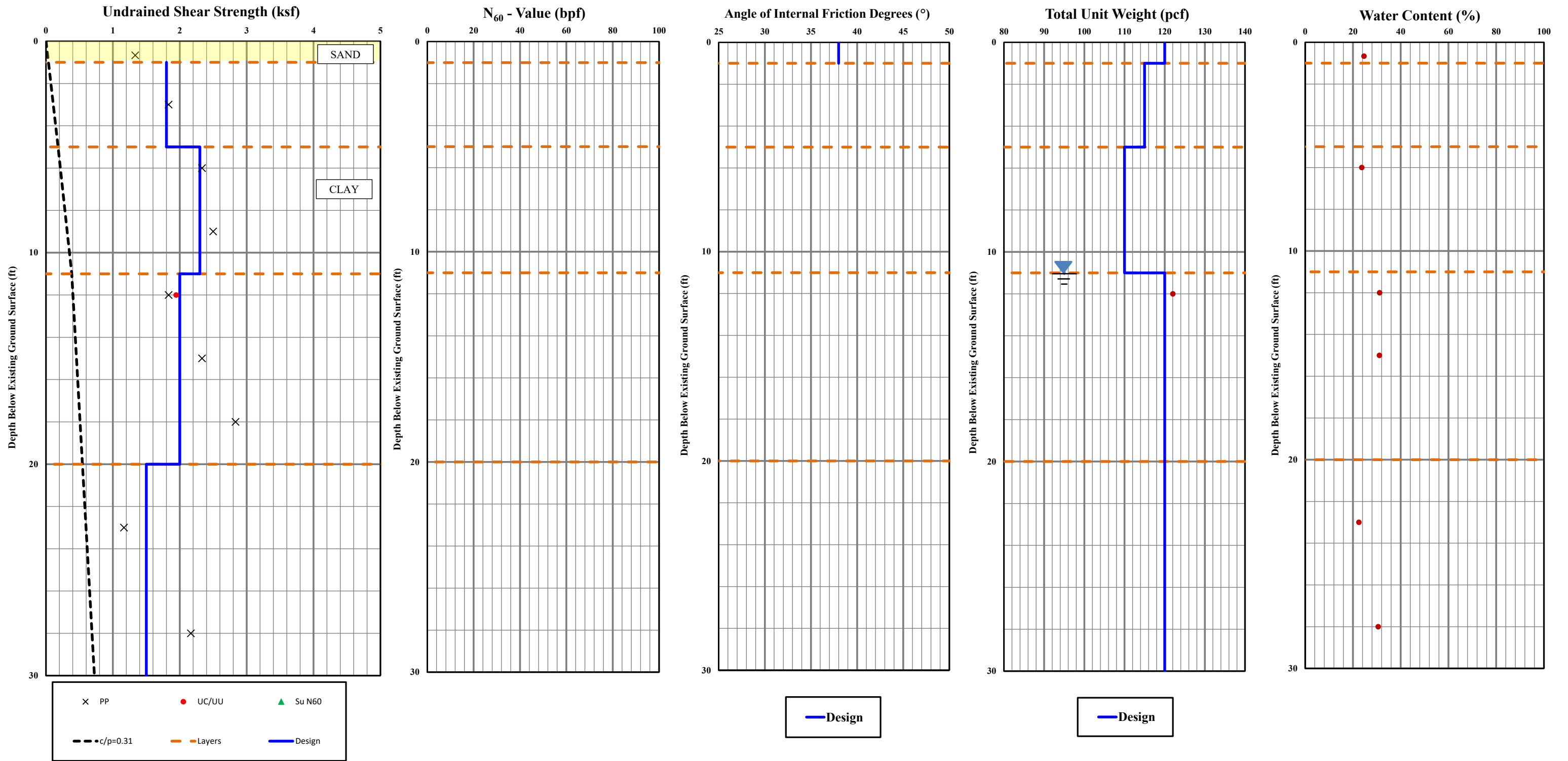
Design Soil Parameters
TB-7

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 2



Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



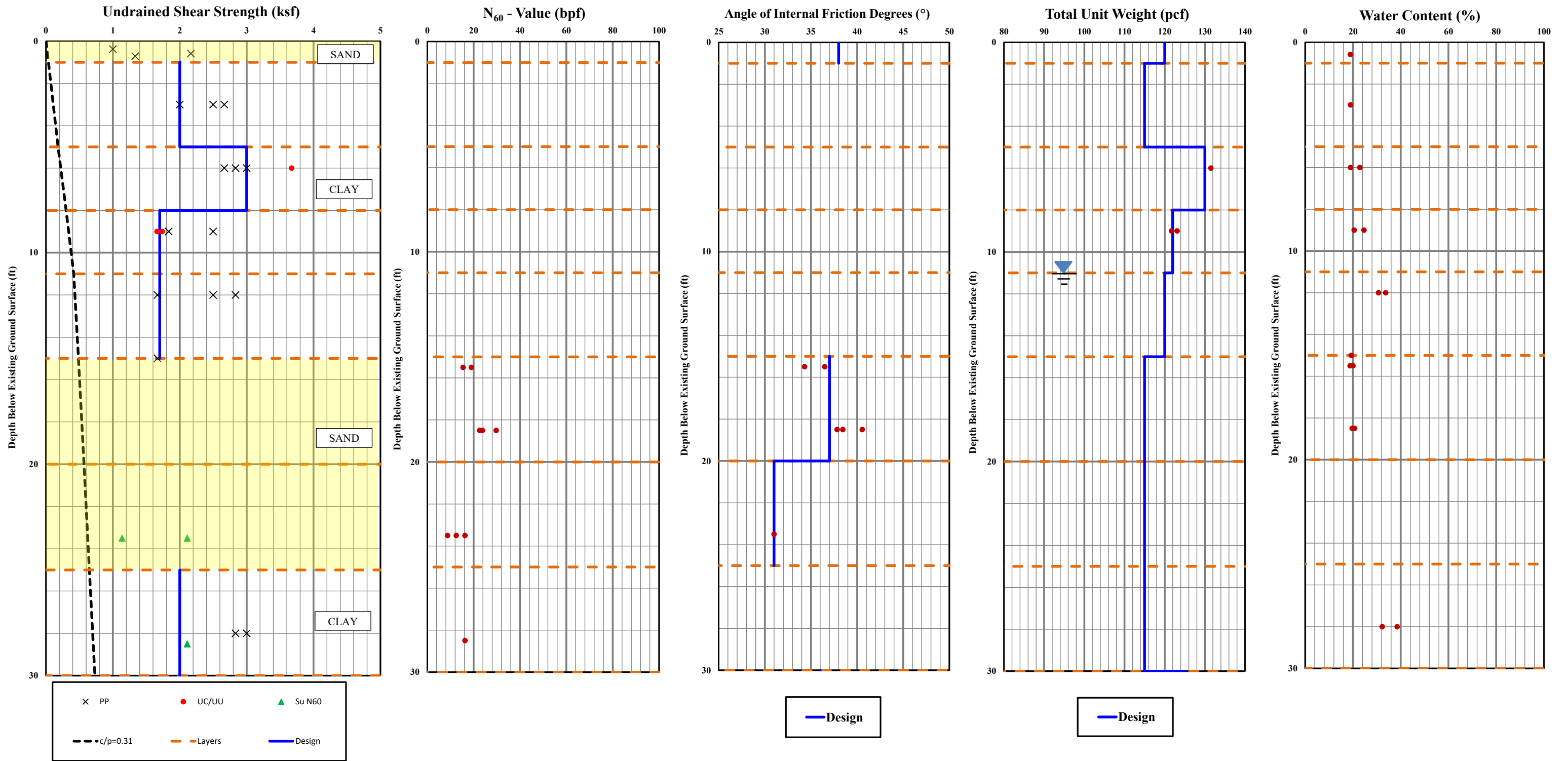
Design Soil Parameters
TB-8

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 3



Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



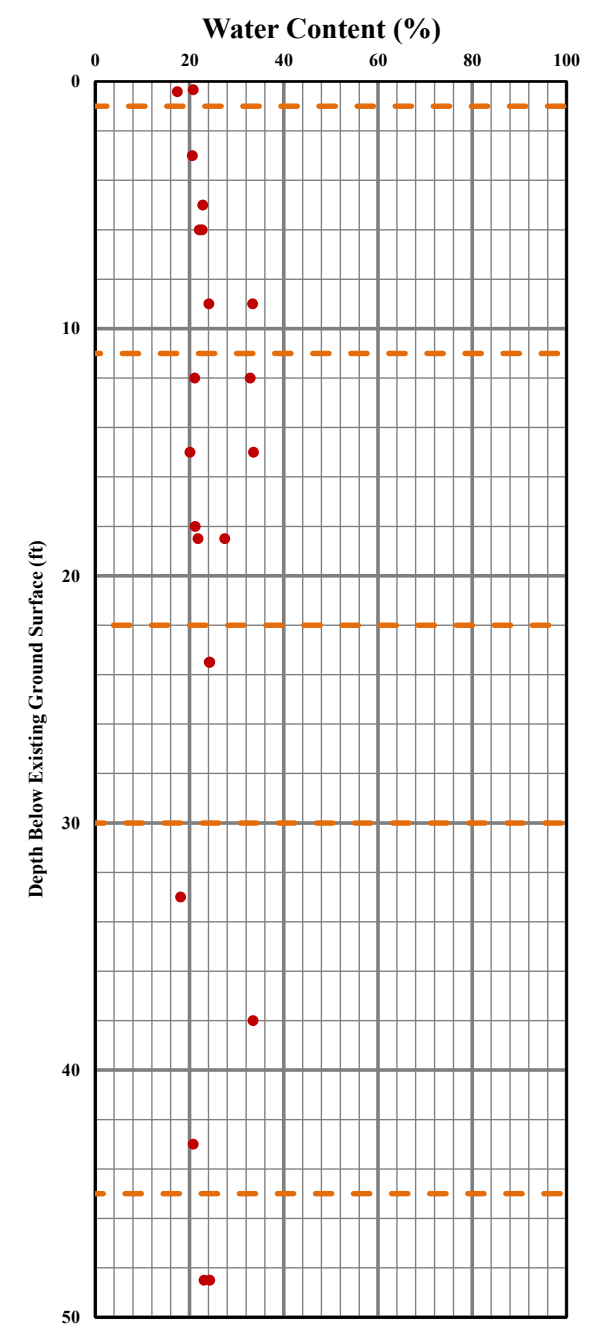
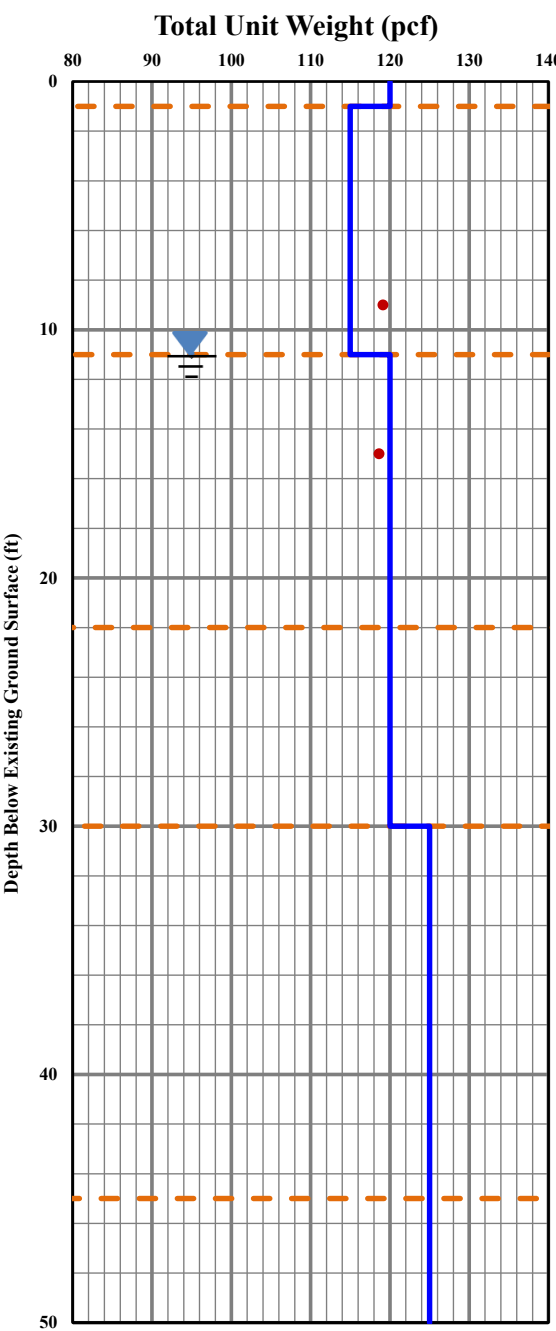
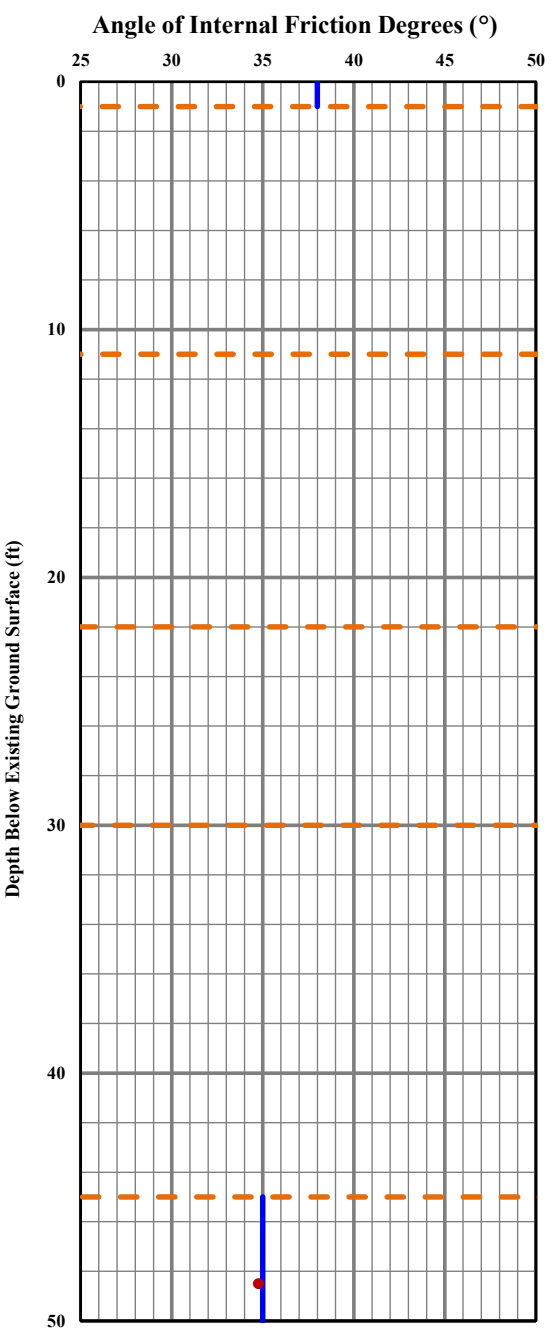
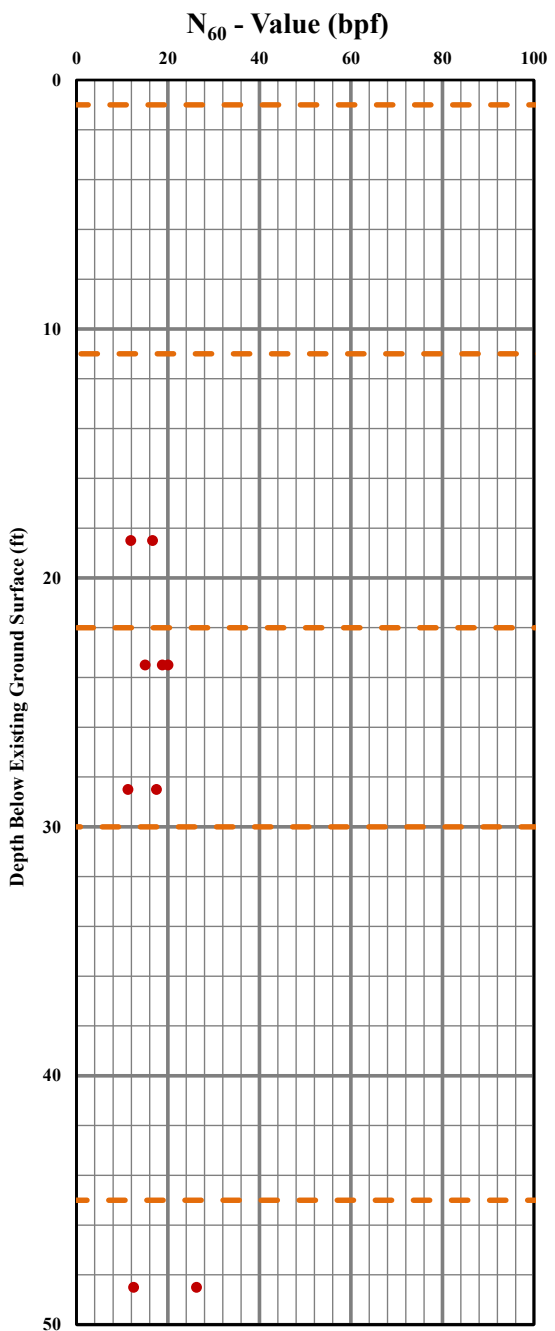
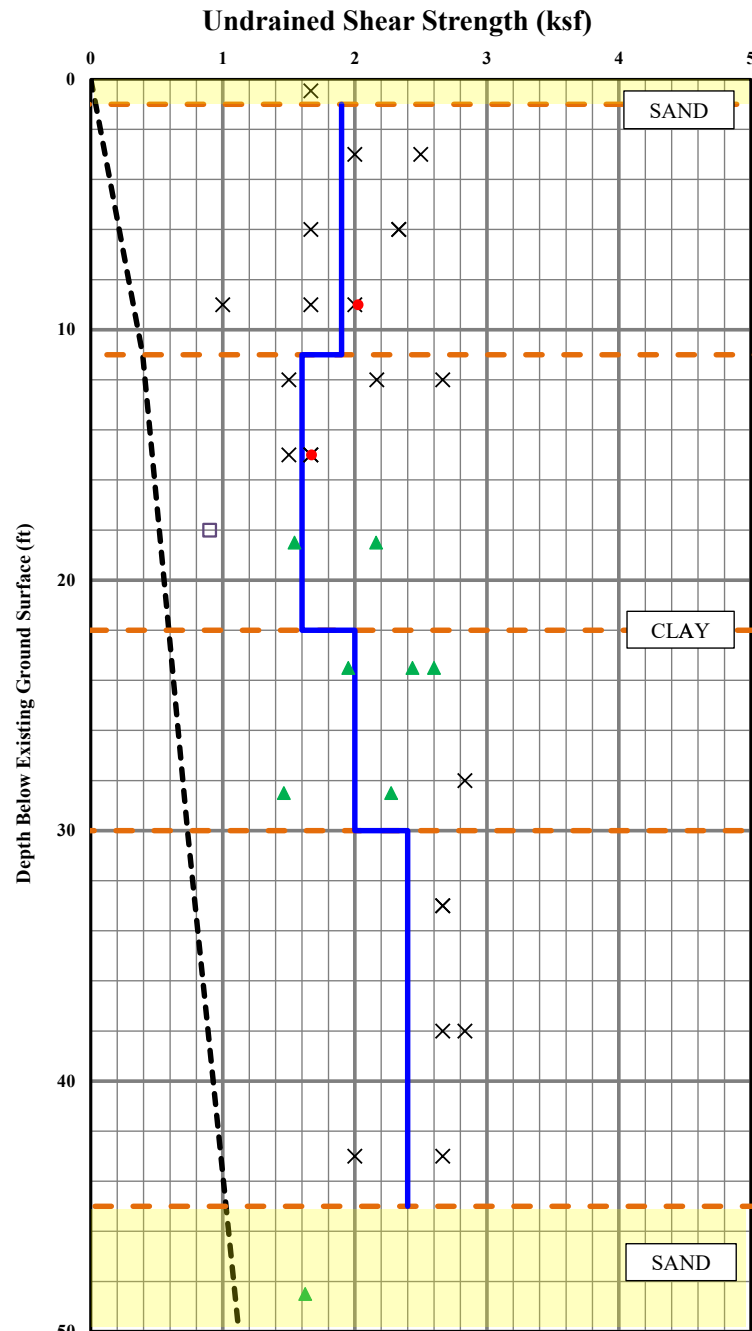
Design Soil Parameters
TB-9, TB-10 and TB-11

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 4



× PP • UC/UU ▲ Su N60 □ Torvane
 - - - c/p=0.31 - - - Layers — Design

— Design

— Design

Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



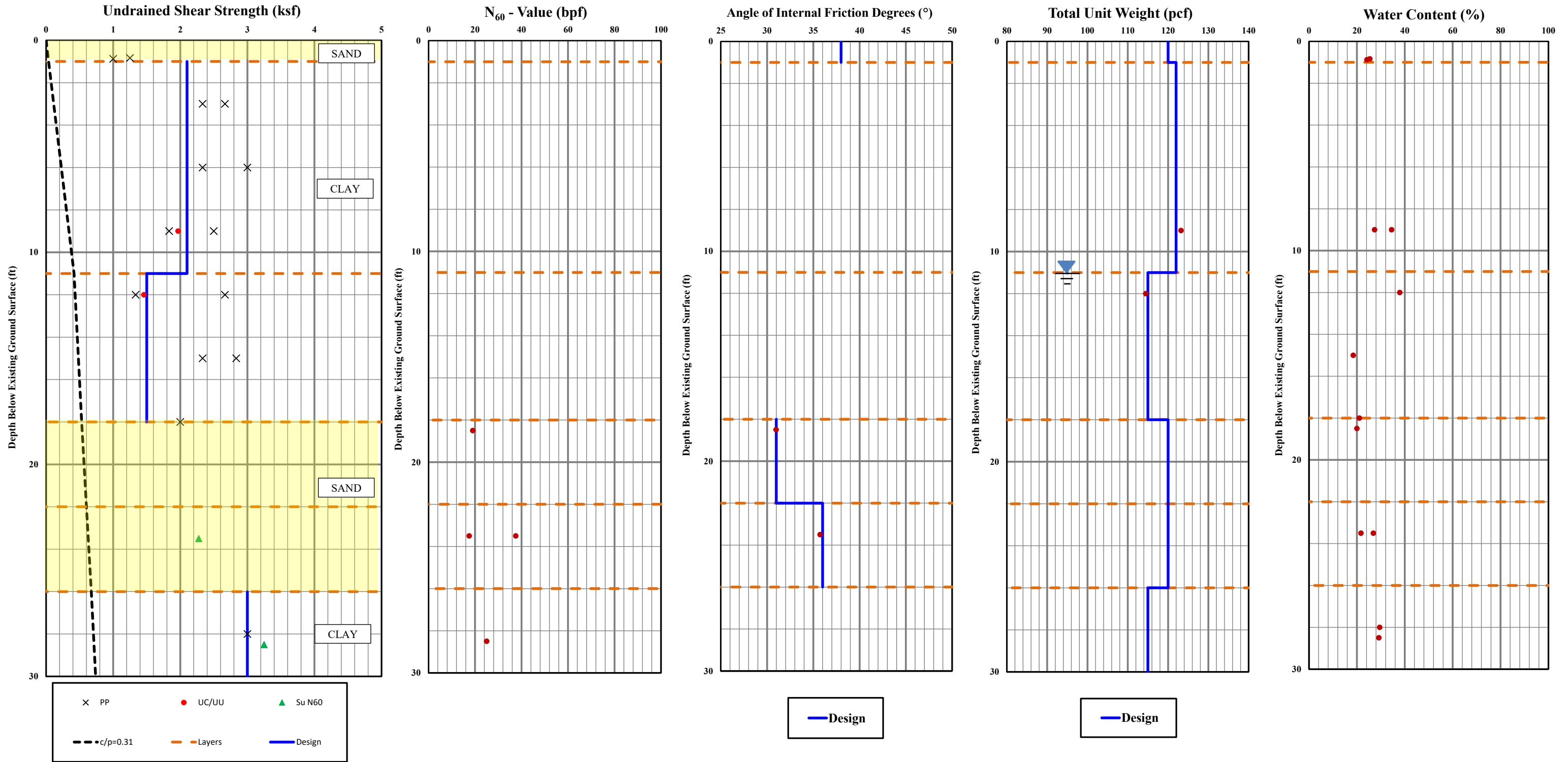
Design Soil Parameters
TB-12 through TB-14

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 5



Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



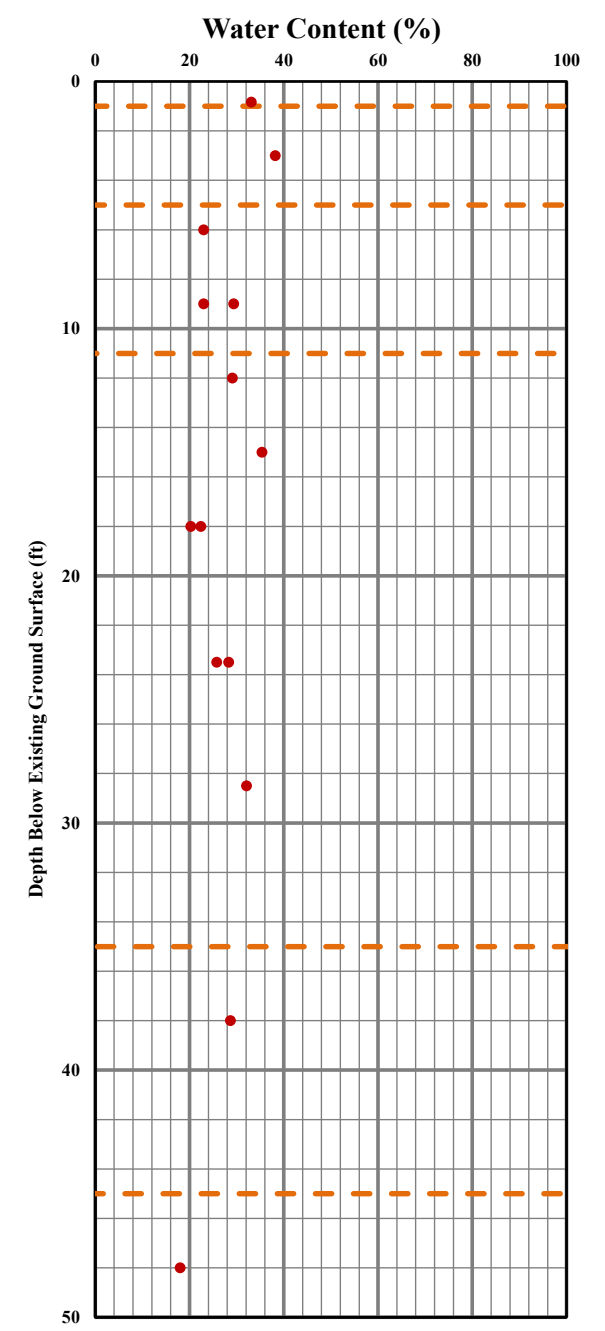
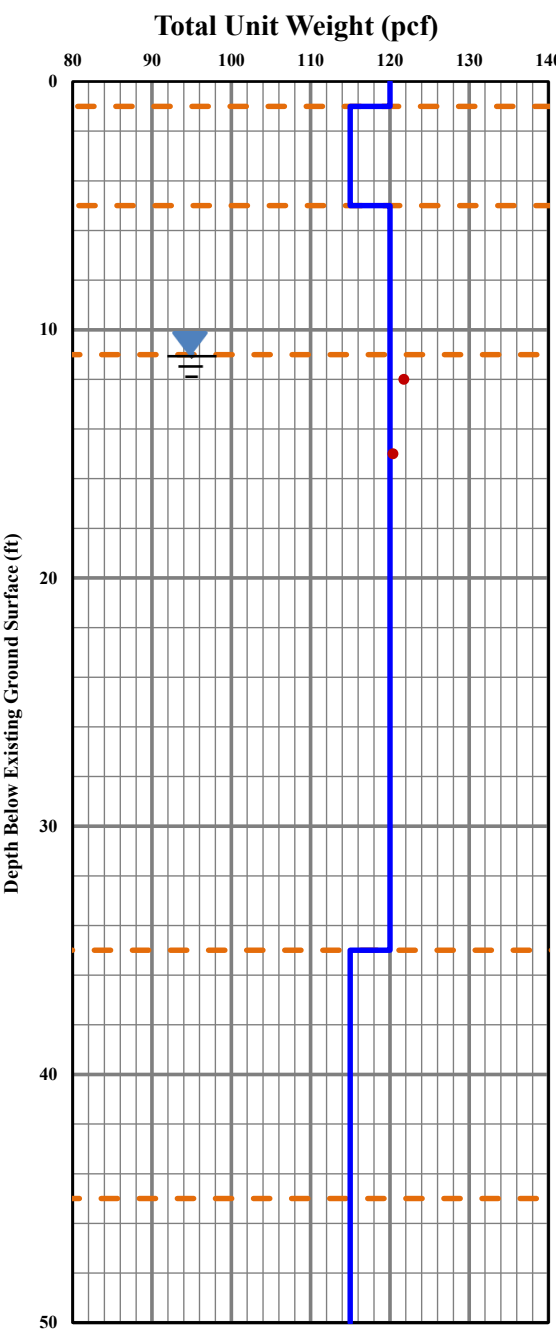
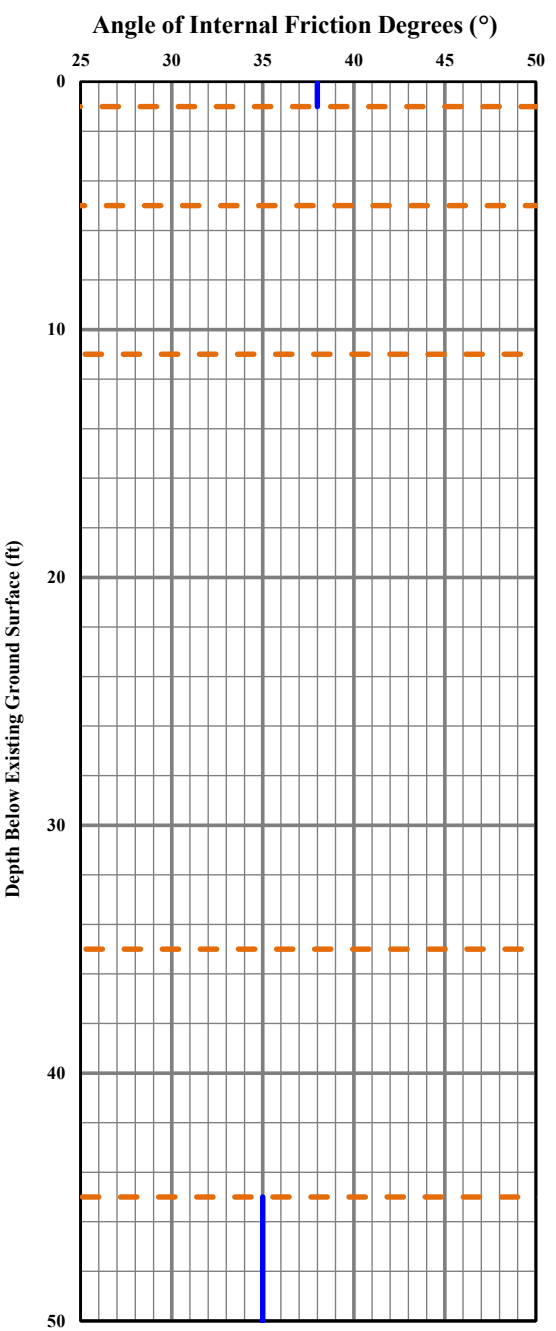
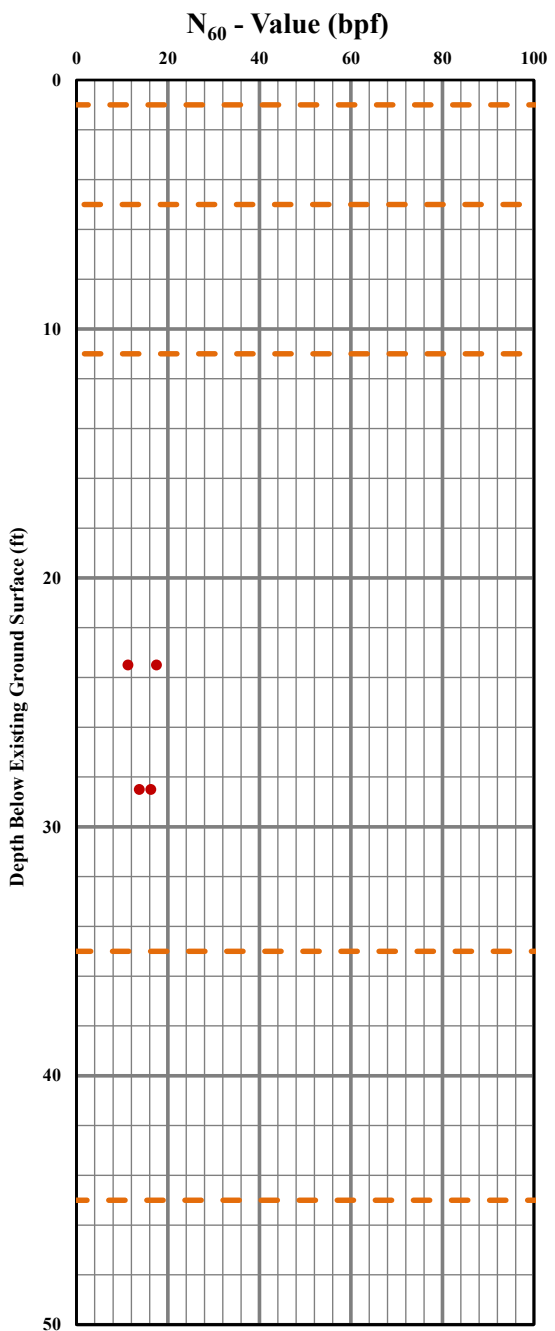
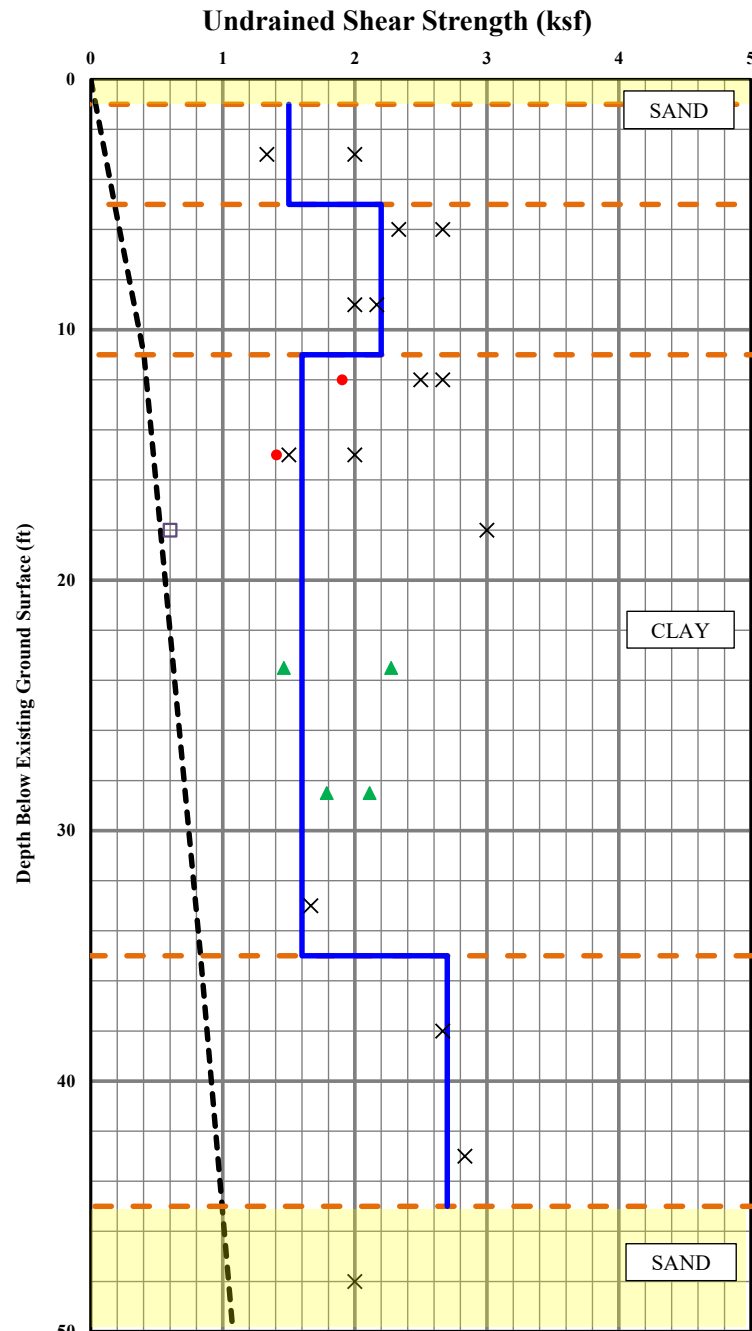
Design Soil Parameters
TB-15 and TB-16

Project Number: 24.23.093

Report Number: 159150

Appendix G

Figure 6



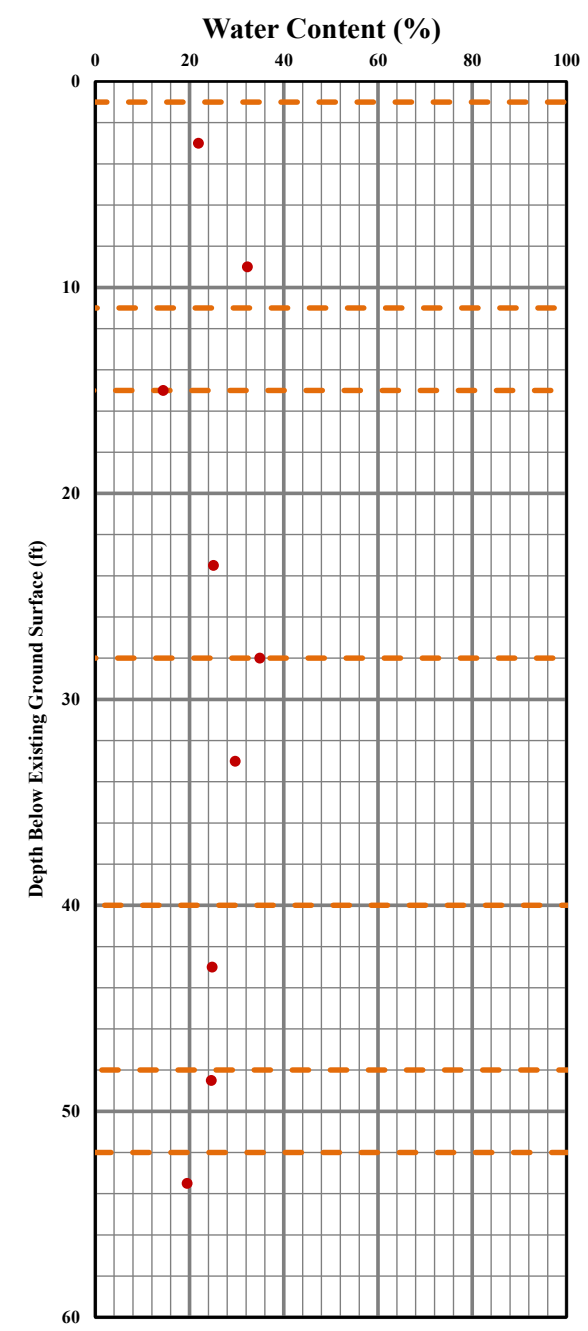
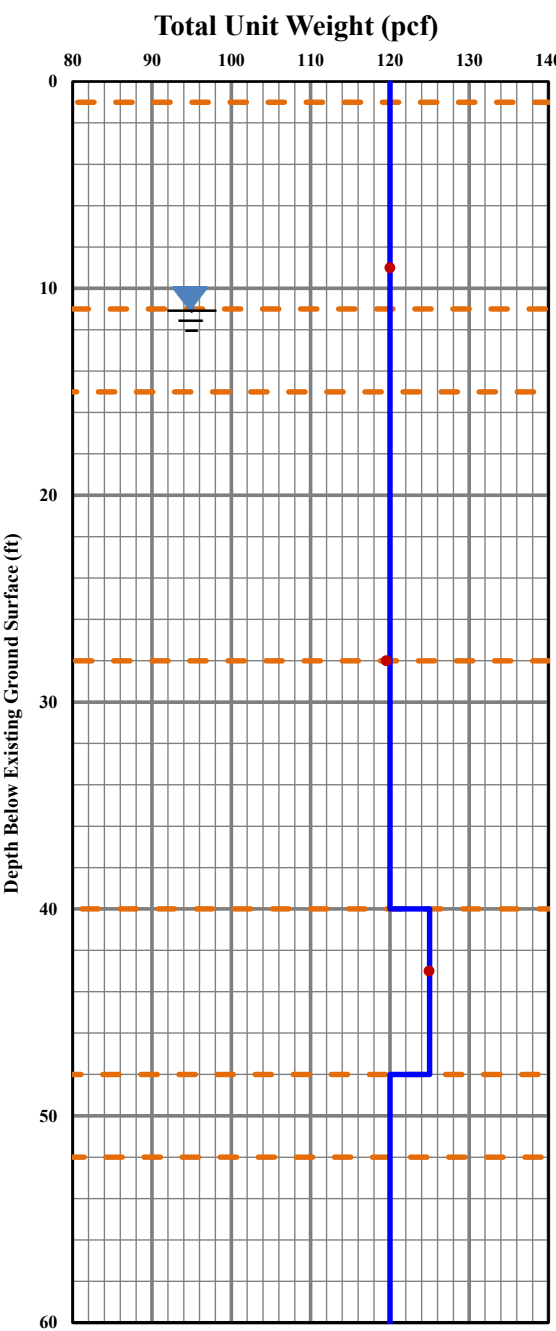
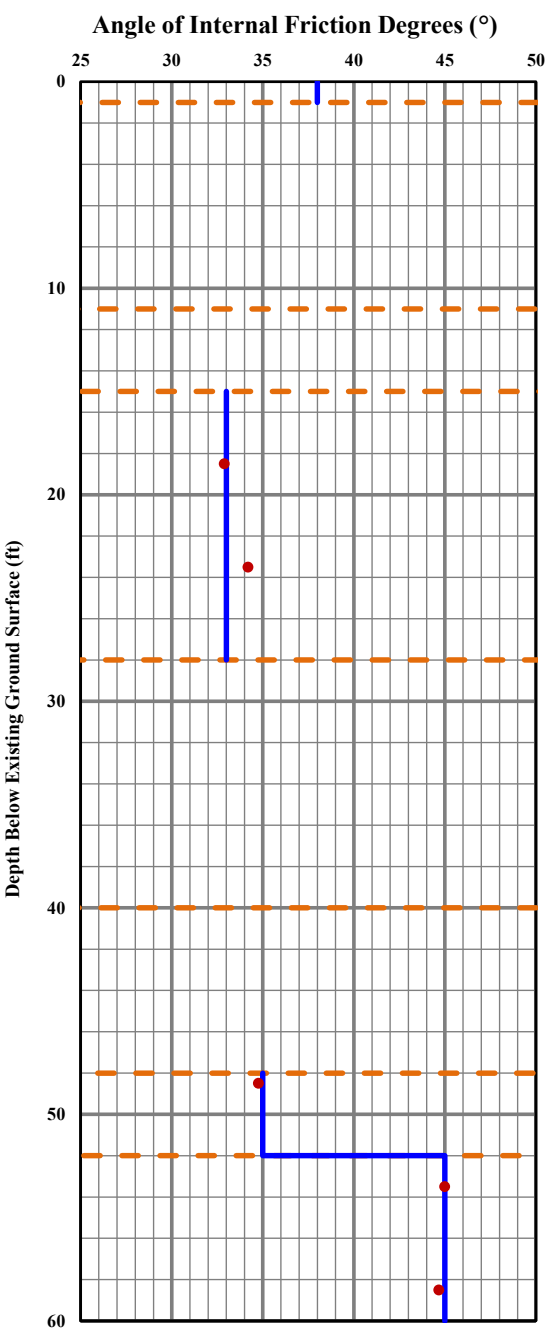
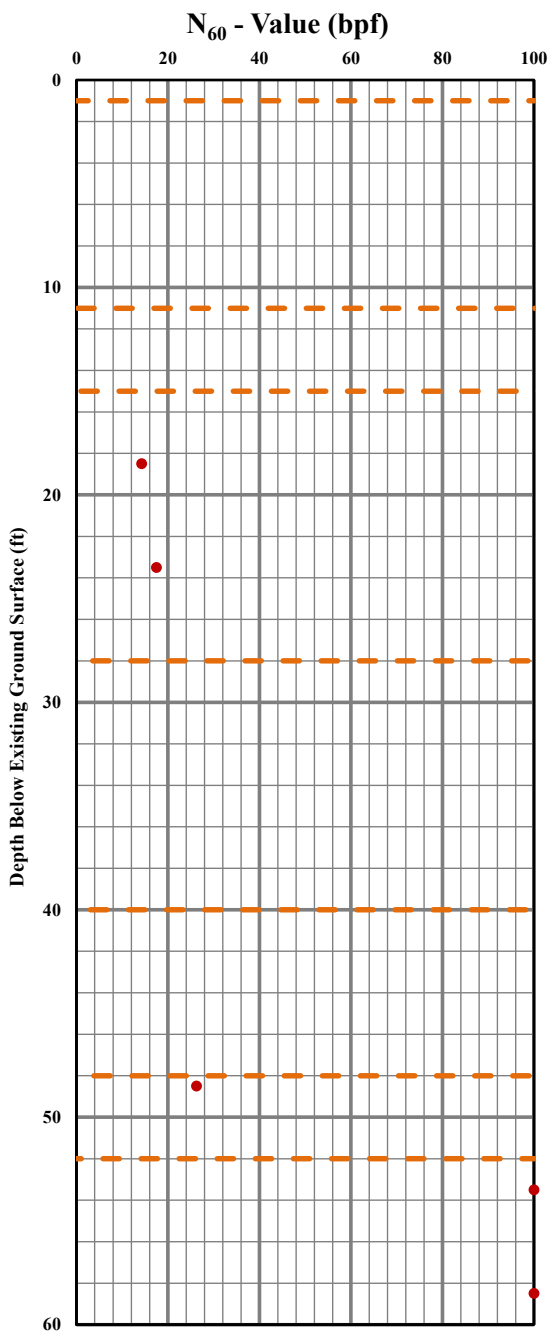
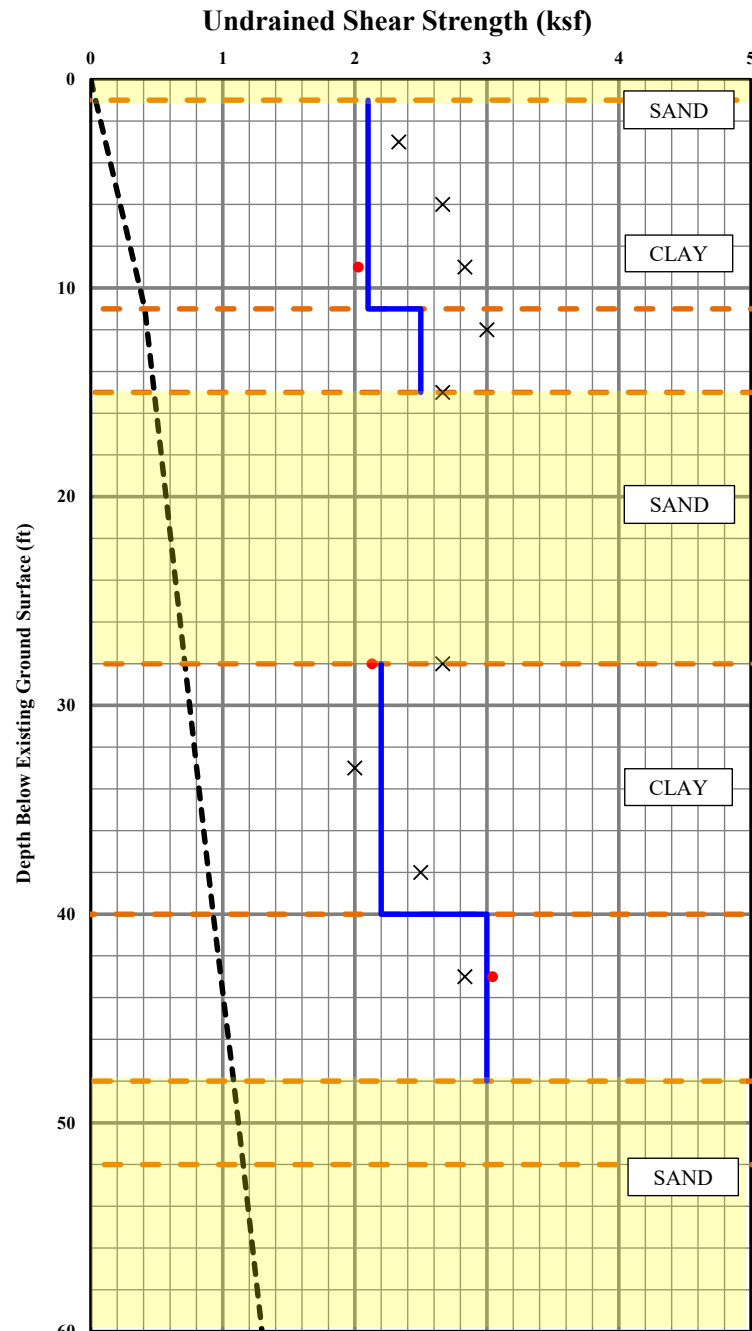
Corley Diversion Project
 Beaumont, Texas
 Schaumburg & Polk, Inc.
 Beaumont, Texas



Design Soil Parameters
 TB-17 and TB-18

Project Number: 24.23.093
 Report Number: 159150

Appendix G
 Figure 7



× PP ● UC/UU ▲ Su N60 □ Torvane
 - - - c/p=0.31 - - - Layers — Design

— Design

— Design

Corley Diversion Project

Beaumont, Texas

Schaumburg & Polk, Inc.

Beaumont, Texas



Design Soil Parameters
TB-19

Project Number: 24.23.093

Report Number: 159150

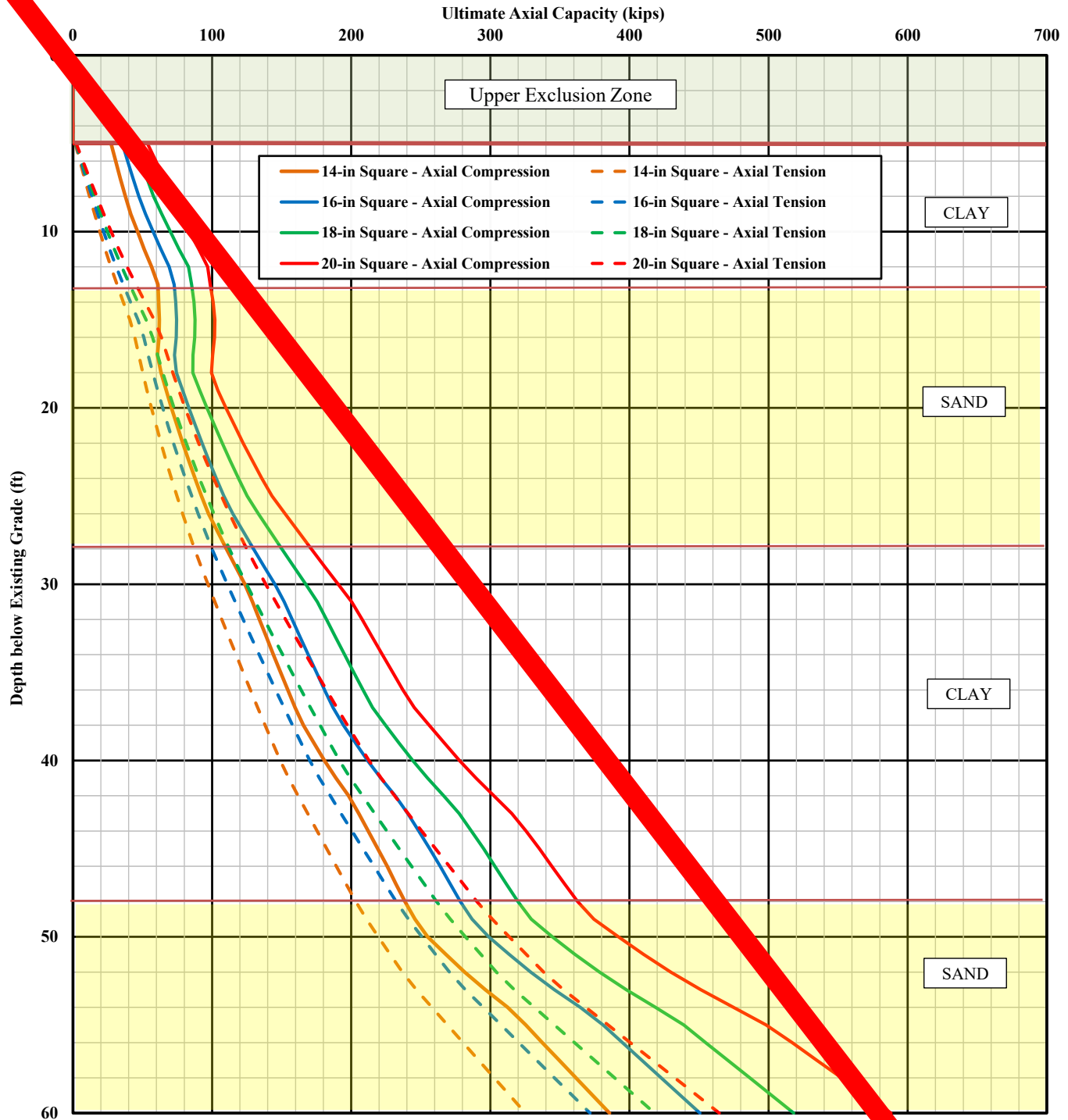
Appendix G

Figure 8

APPENDIX H

ULTIMATE AXIAL PILE CAPACITY CURVES - PCPS

ULTIMATE AXIAL PILE CAPACITY SQUARE PRECAST CONCRETE PILES

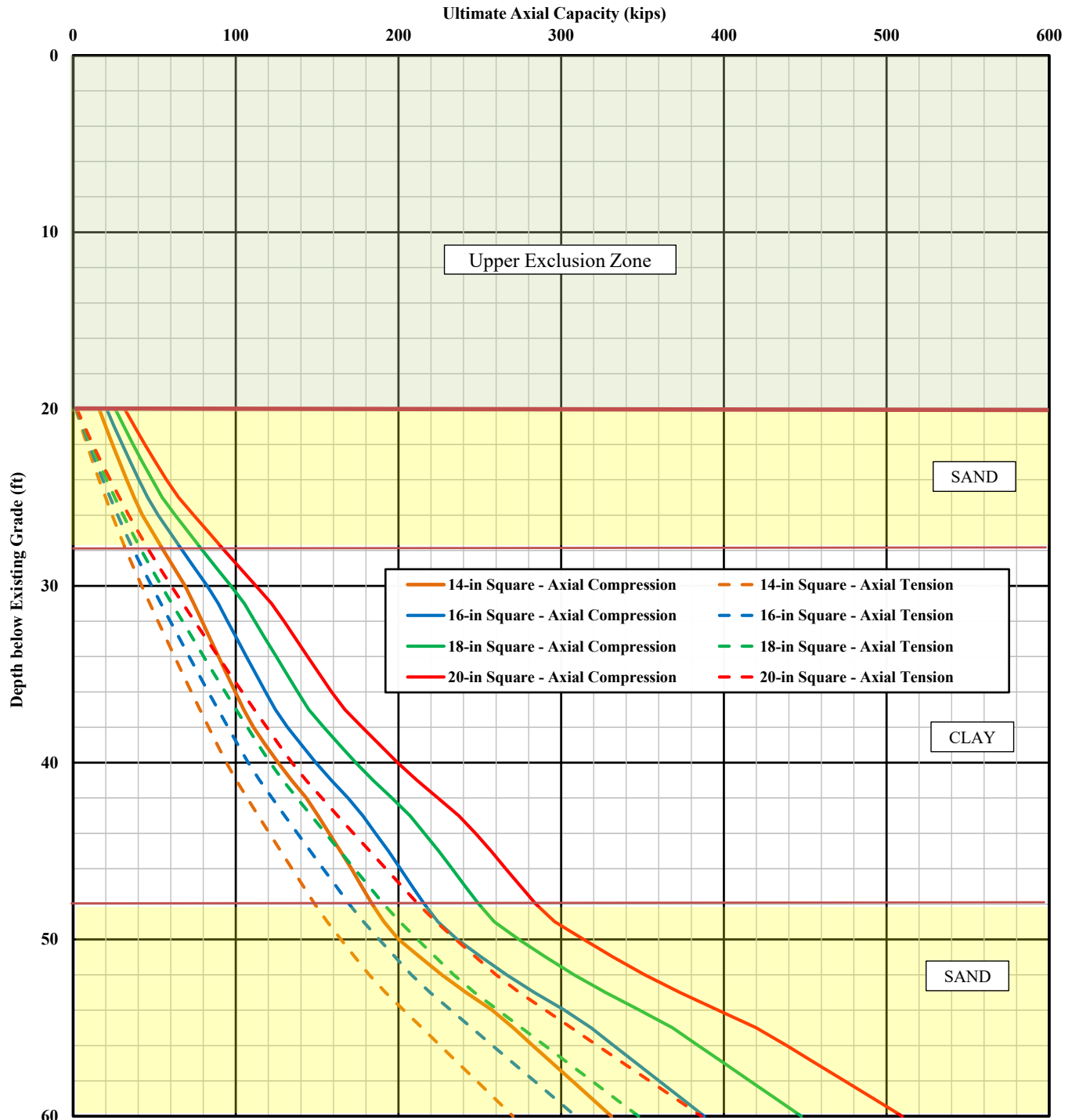


NOTES:

- 1) Center-to-center spacing of the pile should be at least three (3) times the pile width.
- 2) A factor of safety of 2.5 is recommended for allowable compression loads.
- 3) A factor of safety of 3.0 is recommended for allowable tension loads (does not include the weight of pile).
- 4) Reduced factors of safety can be applied with performance of capacity verifying static and/or dynamic load tests.
- 5) Increased driving resistance, and/or possible refusal, should be anticipated in sand strata shown.

Project Corley Diversion Project JCDD6 - Beaumont, Texas	Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Client Schaumburg & Polk, Inc. Beaumont, Texas	Ultimate Axial Pile Capacity Precast Concrete Piles	Appendix H Figure: 1

ULTIMATE AXIAL PILE CAPACITY SQUARE PRECAST CONCRETE PILES



NOTES:

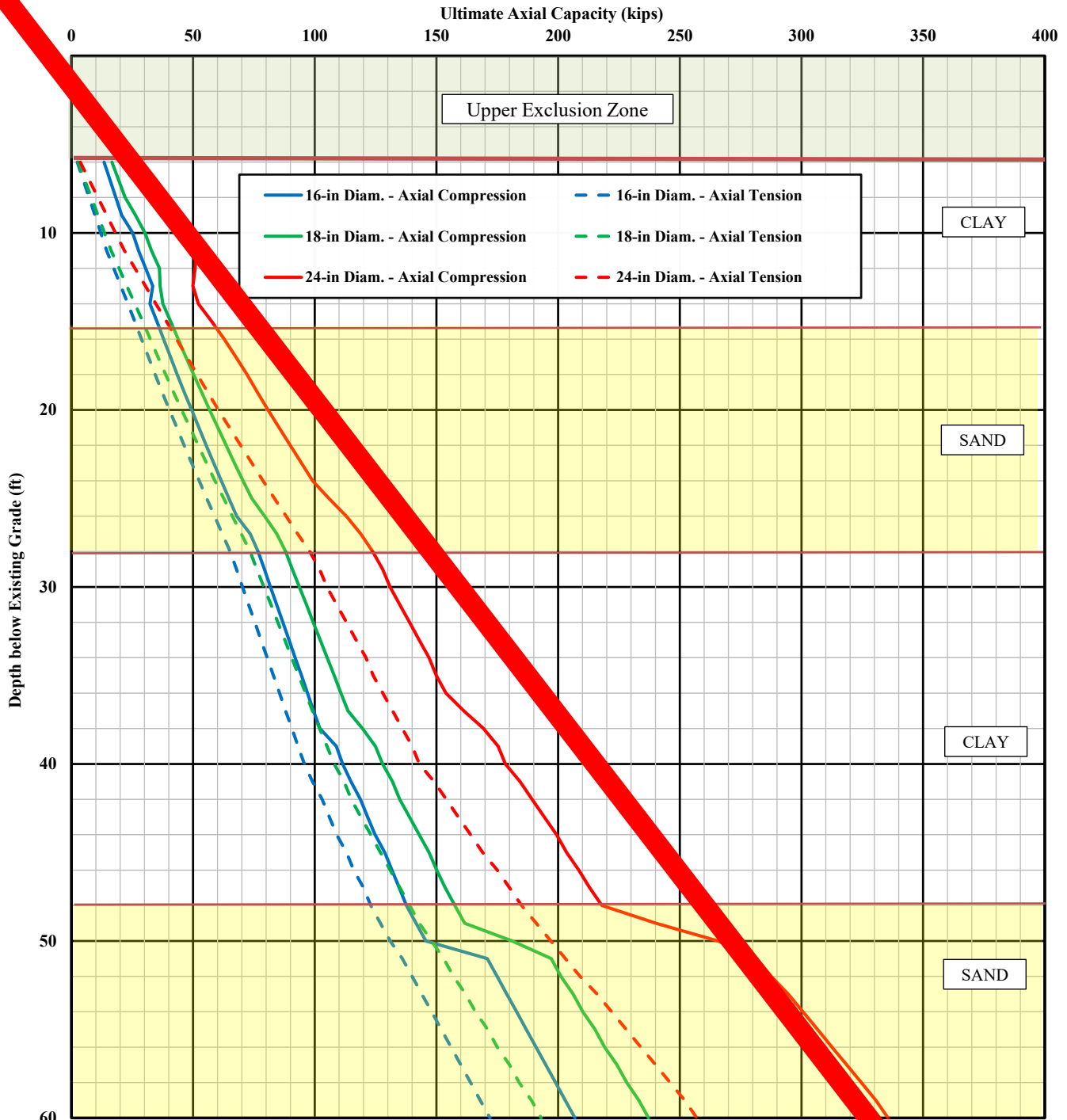
- 1) Center-to-center spacing of the pile should be at least three (3) times the pile width.
- 2) A factor of safety of 2.5 is recommended for allowable compression loads.
- 3) A factor of safety of 3.0 is recommended for allowable tension loads (does not include the weight of pile).
- 4) Reduced factors of safety can be applied with performance of capacity verifying static and/or dynamic load tests.
- 5) Increased driving resistance, and/or possible refusal, should be anticipated in sand strata shown.

Project Corley Diversion Project JCDD6 - Beaumont, Texas	Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Client Schaumburg & Polk, Inc. Beaumont, Texas	Ultimate Axial Pile Capacity Precast Concrete Piles TB-19	Appendix H Figure: 1

APPENDIX I

ULTIMATE AXIAL PILE CAPACITY CURVES - ACIPS

ULTIMATE AXIAL PILE CAPACITY AUGERED CAST IN-PLACE PILES

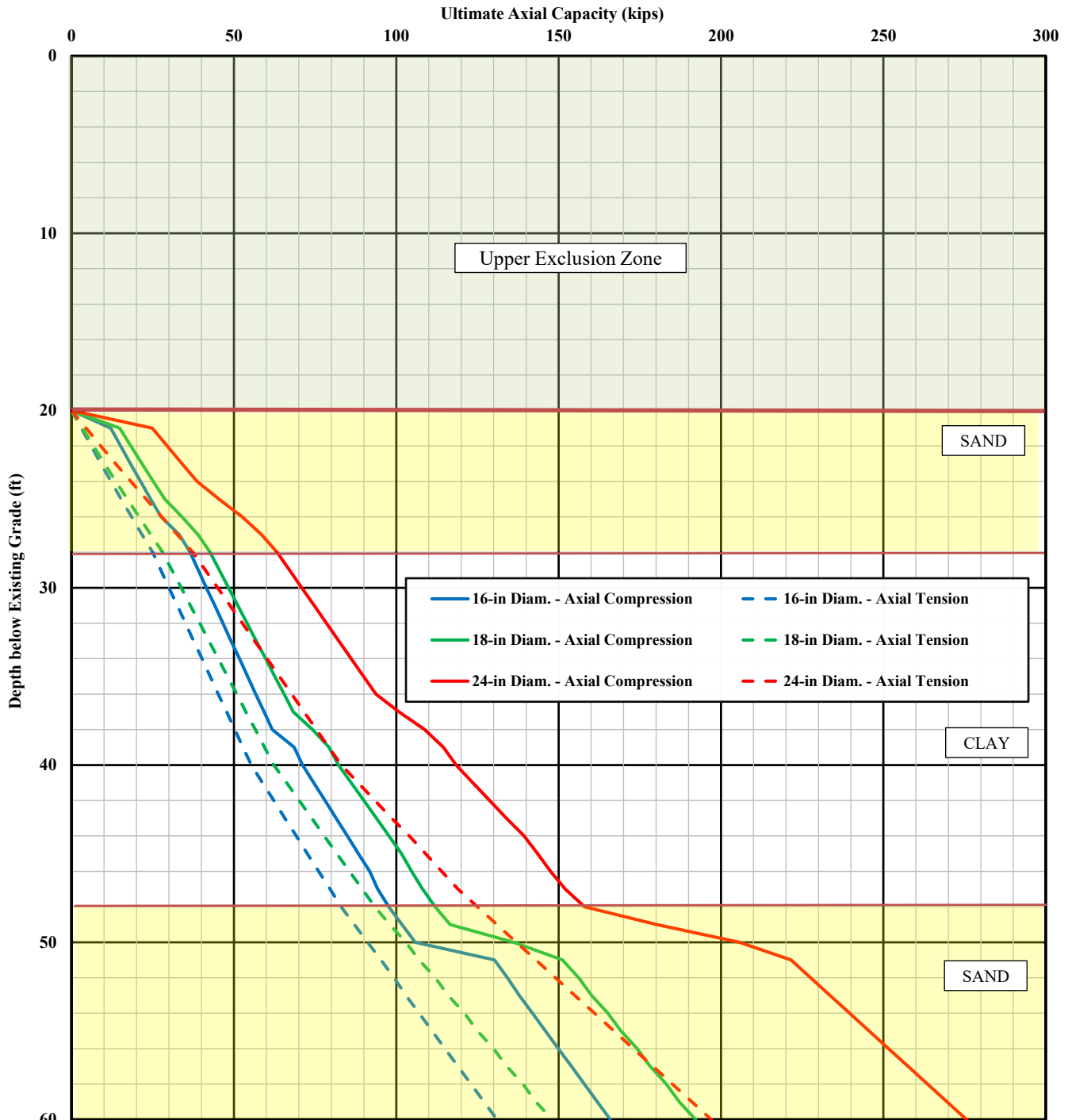


NOTES:

- 1) Center-to-center spacing of the pile should be at least three (3) times the pile diameter.
- 2) A factor of safety of 2.5 is recommended for allowable compression loads.
- 3) A factor of safety of 3.0 is recommended for allowable tension loads (does not include the weight of pile).
- 4) Reduced factors of safety can be applied with performance of capacity verifying static and/or dynamic load tests.
- 5) Higher than normal grout factors are anticipated from existing grade to the 30-ft depth at this site due to loose sand and soft clay soils.

Project Corley Diversion Project JCDD6 - Beaumont, Texas	Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Client Schaumburg & Polk, Inc. Beaumont, Texas	Ultimate Axial Pile Capacity Augered Cast In-Place Piles	Appendix I Figure: 1

ULTIMATE AXIAL PILE CAPACITY AUGERED CAST IN-PLACE PILES



NOTES:


- 1) Center-to-center spacing of the pile should be at least three (3) times the pile diameter.
- 2) A factor of safety of 2.5 is recommended for allowable compression loads.
- 3) A factor of safety of 3.0 is recommended for allowable tension loads (does not include the weight of pile).
- 4) Reduced factors of safety can be applied with performance of capacity verifying static and/or dynamic load tests.
- 5) Higher than normal grout factors are anticipated from existing grade to the 30-ft depth at this site due to loose sand and soft clay soils.

Project Corley Diversion Project JCDD6 - Beaumont, Texas	Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Client Schaumburg & Polk, Inc. Beaumont, Texas	Ultimate Axial Pile Capacity Augered Cast In-Place Piles TB-19	Appendix I Figure: 1

APPENDIX J

LATERAL PILE RESPONSE

Lateral Pile Analysis Soil Design Parameters

LPILE Soil Type	Depth (ft)		Effective Unit Weight, γ' (pcf)	Cohesion, c (psf)	Friction Angle ($^{\circ}$)	Static Lateral Modulus, k (pci)	Strain Factor, ϵ_{50}
	Top	Bottom					
Sand (Reese)	0	1	120	--	38	225	--
Stiff Clay without Free Water	1	11	120	2,100	--	1,000	0.005
Stiff Clay without Free Water	11	15	58	2,500	--	1,000	0.005
Sand (Reese)	15	28	58	--	33	125	--
Stiff Clay without Free Water	28	40	58	2,200	--	1,000	0.005
Stiff Clay without Free Water	40	48	63	3,000	--	1,000	0.005
Sand (Reese)	48	52	58	--	35	125	--
Sand (Reese)	52	60	58	--	45	125	--
Corley Diversion Project Beaumont, Texas			 Tolunay-Wong Engineers, Inc.			Project Number: 24.23.093 Report Number: 159150	
Schaumburg & Polk, Inc. Beaumont, Texas			Lateral Pile Analysis Soil Design Parameters (TB-19)			Appendix J Figure 1	

APPENDIX K

DESIGN SOIL PARAMETERS FOR BELOW GRADE STRUCTURES

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 11	115	115	1,000	--		750	100	17		100
3	Clay	11 to 19	120	58	1,500	--		850	150	19		150
4	Clay	19 to 30	120	58	1,500	--		850	150	20		150
5	Clay	30 to 45	125	63	2,000	--		950	200	19		200
6	Sand	45 to 50	125	63	--	27		--	--	27		--

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-1 through TB-6	Appendix: K Figure: 1

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 8	115	115	2,000	--		950	200	28		200
3	Clay	8 to 11	110	110	700	--		600	70	28		70
4	Clay	11 to 14	120	58	1,500	--		850	150	28		150
5	Sand	14 to 18	120	58	--	25		--	--	25		--
6	Clay	18 to 30	115	53	2,300	--		1,003	200	28		200

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-7	Appendix: K Figure: 2

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 5	115	115	1,800	--		910	180	20		180
3	Clay	5 to 11	110	110	2,300	--		1,003	200	20		200
4	Clay	11 to 20	120	58	2,000	--		950	200	18		200
5	Clay	20 to 30	120	58	1,500	--		850	150	18		150

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-8	Appendix: K Figure: 3

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case			Drained (Long-Term) Case				
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 5	115	115	2,000	--		950	200	21		200
3	Clay	5 to 8	130	130	3,000	--		1,125	200	22		200
4	Clay	8 to 11	122	122	1,700	--		890	170	22		170
5	Clay	11 to 15	120	58	1,700	--		890	170	18		170
6	Sand	15 to 20	115	53	--	37		--	--	37		--
7	Sand	20 to 25	115	53	--	31		--	--	31		--
8	Clay	25 to 30	115	53	2,000	--		950	200	19		200

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-9, TB-10 and TB-11	Appendix: K Figure: 4

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 11	115	115	1,900	--		930	190	22		190
3	Clay	11 to 22	120	58	1,600	--		870	160	19		160
4	Clay	22 to 30	120	58	2,000	--		950	200	29		200
5	Clay	30 to 45	125	63	2,400	--		1,020	200	19		200
6	Sand	45 to 50	125	63	--	35		--	--	35		--

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-12 through TB-14	Appendix: K Figure: 5

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 11	122	122	2,100	--		968	200	18		200
3	Clay	11 to 18	115	53	1,500	--		850	150	18		150
4	Sand	18 to 22	120	58	--	31		--	--	31		--
5	Sand	22 to 26	120	58	--	36		--	--	36		--
6	Clay	26 to 30	115	53	3,000	--		1,125	200	19		200

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-15 and TB-16	Appendix: K Figure: 6

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 5	115	115	1,500	--		850	150	17		150
3	Clay	5 to 11	120	120	2,200	--		985	200	20		200
4	Clay	11 to 35	120	58	1,600	--		870	160	19		160
5	Clay	35 to 45	115	53	2,700	--		1,073	200	18		200
6	Sand	45 to 50	115	53	--	35		--	--	35		--

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
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Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-17 and TB-18	Appendix: K Figure: 7

Recommended Soil Design Parameters for Below Grade Structures


Soil Layer	Soil Description	Depth Range (ft)	γ (pcf)	γ' (pcf)	Undrained (Short-Term) Case				Drained (Long-Term) Case			
					c (psf)	ϕ (°)	δ (°)	a (psf)	c' (psf)	ϕ' (°)	δ (°)	a (psf)
1	Sand	0 to 1	120	120	--	38	See Notes (4) & (5)	--	--	38	See Notes (4) & (5)	--
2	Clay	1 to 11	120	120	2,100	--		968	200	18		200
3	Clay	11 to 15	120	58	2,500	--		1,038	200	18		200
4	Sand	15 to 28	120	58	--	33		--	--	33		--
5	Clay	28 to 40	120	58	2,200	--		985	200	20		200
6	Clay	40 to 48	125	63	3,000	--		1,125	200	18		200
7	Sand	48 to 52	120	58	--	35		--	--	35		--
8	Sand	52 to 60	120	58	--	45		--	--	45		--

Notes:

- (1) Plasticity index (PI) was used to estimate drained friction angle for cohesive soils.
- (2) Effective cohesion values were estimated using published correlations and our experience with similar soils.
- (3) Effective cohesion values at shallow depths were neglected to account for weathering and strain softening effects.
- (4) If Rankine's earth pressure theory is used, the wall friction should be neglected.
- (5) If Coulomb's earth pressure theory is used, the wall friction can be considered.

Legend:

γ = Total Unit Weight ϕ = Friction Angle
 γ' = Submerged Unit Weight δ = Angle of Wall Friction, $\delta = (0.5) \phi$ for steel, $\delta = (0.67) \phi$ for concrete
c = Cohesion a = Adhesion

Corley Diversin Project Beaumont, Texas	 Tolunay-Wong Engineers, Inc.	Project No. 24.23.093 Report No. 159150
Schaumburg & Polk, Inc. Beaumont, Texas	Recommended Soil Design Parameters for Below Grade Structures TB-19	Appendix: K Figure: 8