# THE COUNTY OF GALVESTON

**RUFUS G. CROWDER, CPPO, CPPB**
PURCHASING AGENT

COUNTY COURTHOUSE
722 Moody (21st Street)
Fifth (5th) Floor
GALVESTON, TEXAS 77550
(409) 770-5371

**DATE:** **OCTOBER 22, 2021**

**PROJECT NAME:** **JACKSON AVENUE DRAINAGE IMPROVEMENTS**

**SOLICITATION NO:** **ITB #B211044**

**RE:** **ADDENDUM #1**

To All Prospective Bidders:

The following information is being provided to aid in preparation of your bid submittal(s)

**Submission Deadline / Bid Opening:**
The original submission deadline and bid opening date for ITB #B211044, Jackson Avenue Drainage Improvements, has been revised. The new date and time for the submission deadline and bid opening is as follows:

**Submission Deadline / Bid Opening: Friday, October 29, 2021**
**Time: 2:00 p.m.**

Interested parties can attend the virtual bid opening at:

Join Zoom Meeting
https://us04web.zoom.us/j/72051088985?pwd=c1djMkQ3Ujdpb2Z6VFRZR21iQmJzQT09

Meeting ID: 720 5108 8985
Passcode: B211044

***Item No. 1*** ***The Bid Form is revised and replaced with the attached bid form labeled Addendum No. 1.***

***Item No. 2*** ***The attached Environmental Mitigation Document marked Addendum No. 1 is provided for reference.***

***Item No. 3*** ***The attached Geotechnical Report marked Addendum No. 1 is provided for reference.***

***Item No. 4*** ***Question: Sheet 8 calls for a 7x3 Storm Plug at 0+44.00. There is no pay item for this work.***

Answer: Bid item No. 15 – “12” Grout Plug for 7’x3’ RCB" added.

***Item No. 5*** ***Question: Several inlets do not have ample depth to account for the pipe associated with them. For Example, 4b is 1.57 in depth with 14” x 23” Ellip. The pipe has at minimum 3” walls, putting the RCP in the throat of the inlet and with no cover.***

Answer: Pipe enters the inlet on a side of inlet without any throat. Minimal cover is necessary at the location.

***Item No. 6*** ***Question: Item 22: Inlet Complete PSL RC 4x4 is not the correct callout out for a Type E Inlet. (assuming this since the qty matches) This item either needs to be a Type E or a PAZD Inlet. A PSL RC is a 4x4 box with a slab top with a Ring and cover. Basically a manhole.***

Answer: Bid item No. 22 renumbered to item No. 24 and changed to read “INLET (COMPL)(TY E)”.

***Item No. 7*** ***Question: There is no pay item for the 24” brick plugs called for on sheet 9 and 10.***

Answer: Bid item No. 14 – “8” Grout Plug for 24”’ RCP" added. Remove and replace entire plan sheets 9 and 10 with plan sheets marked Addendum No. 1.

***Item No. 8*** ***Question: The casing to be used on the sanitary sewer is called out to be spilt casing however the Pay Item 34 just references regular casing.***

Answer: Bid item No. 34 renumbered to item No. 36 and description changed to read “STEEL SPLIT CASING (PIPE)(ALL SIZES).

***Item No. 9*** ***Question: Please add items for well pointing and wet sand construction.***

Answer: De-watering and water diversion is incidental to bid item No. 13 – “TRENCH EXCAVATION PROTECTION” per TxDOT Specification 402.

***Item No. 10*** ***Question: Item 23 – wingwall is quantified at 2 ea. One has been found at station 29+10.6. Where is the 2nd?***

Answer: Bid item No. 23 renumbered to item No. 25 – “WINGWALL (FW-0)(HW=7FT) WITH ENERGY DISSIPATION BLOCKS” and quantity adjusted to 1 EA.

*Item No. 11* *Question: Can the existing water lines be isolated "cut off" for/during replacement.*

Answer: Yes, water lines can be isolated and shut off during construction. For duration and further details, contractor is to coordinate with Bacliff MUD. See plan sheet no. 2 for Bacliff MUD contact information.

*Item No. 12* *Question: Will the water line construction be treated as an emergency repair or will each line need to be pressure and bacteria tested?*

Answer: Lines will need to be pressure and bacteria tested.

*Item No. 13* *Question: Will all CenterPoint gas to be relocated by others be completed prior to construction and if so where is it being relocated to?*

Answer: No, relocation positions are unknown at this time.

If you have any further questions regarding this bid, please address them to the following:

**Rufus G. Crowder, CPPO CPPB**
**Galveston County Purchasing Agent**
**722 Moody, Fifth (5th) Floor**
**Galveston, Texas 77550**

or via e-mail at **purchasing.bids@co.galveston.tx.us** or contact the Purchasing Department at (409) 770-5371.

Please excuse us for any inconvenience that this may have caused.

Sincerely,

Rufus Crowder

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
Galveston County

# COUNTY OF GALVESTON

## Jackson Avenue Drainage Improvements
## Contract No. 21-1127

| Item No. | TxDOT Item No. | Item Description(1) | Unit | Unit Quantity | Unit Price(2) | Total |
|---|---|---|---|---|---|---|
| **EARTHWORK AND LANDSCAPE** | | | | | | |
| 1. | 100<br>6002 | PREP ROW | STA | 30 | $_____________ | $_____________ |
| 2. | 105<br>6097 | REMOVING STAB BASE & ASPH PV (5" TO 13") | SY | 3,655 | $_____________ | $_____________ |
| 3. | 162<br>6002 | BLOCK SODDING | SY | 205 | $_____________ | $_____________ |
| 4. | 166<br>6001 | FERTILIZER | AC | 0.1 | $_____________ | $_____________ |
| **SUBGRADE TREATMENTS AND BASE** | | | | | | |
| 5. | 247<br>6132 | FL BS (CMP IN PLC)(TY D GR1-2)(8") | SY | 3,655 | $_____________ | $_____________ |
| 6. | 260<br>6060 | LIME (HYDRATED OR COMMERCIAL)(SLURRY)(5%) | TON | 67 | $_____________ | $_____________ |
| 7. | 260<br>6073 | LIME TRT (SUBGRADE) 8" | SY | 3,726 | $_____________ | $_____________ |
| **SURFACE COURSES AND PAVEMENTS** | | | | | | |
| 8. | 340<br>6106 | D-GR HOTMIX ASPHALT (SQ) TY-D PG64-22 | TON | 819 | $_____________ | $_____________ |
| 9. | 354<br>6002 | PLAN & TEXT ASPH CONC PAV (0" TO 2") | SY | 7,440 | $_____________ | $_____________ |
| **STRUCTURES** | | | | | | |
| 10. | 400<br>6002 | STRUCT EXCAV (BOX) | CY | 12,993 | $_____________ | $_____________ |
| 11. | 400<br>6003 | STRUCT EXCAV (PIPE) | CY | 456 | $_____________ | $_____________ |
| 12. | 400<br>6005 | CEM STABIL BKFL | CY | 4,195 | $_____________ | $_____________ |
| 13. | 402<br>6001 | TRENCH EXCAVATION PROTECTION | LF | 2,940 | $_____________ | $_____________ |
| 14. | 420<br>6010A | 8” GROUT PLUG FOR 24” RCP | EA | 2 | $_____________ | $_____________ |
| 15. | 420<br>6010B | 12” GROUT PLUG FOR 7’ X 3’ RCB | EA | 1 | $_____________ | $_____________ |
| 16. | 432<br>6055 | RIPRAP (STONE TY F)(DRY)(18") | CY | 41 | $_____________ | $_____________ |
| 17. | 462<br>6014 | CONC BOX CULV (7 FT X 3 FT) | LF | 1,317 | $_____________ | $_____________ |
| 18. | 462<br>6015 | CONC BOX CULV (7 FT X 4 FT) | LF | 1,504 | $_____________ | $_____________ |
| 19. | 462<br>6015 | CONC BOX CULV (7 FT X 4 FT) CAST-IN-PLACE | LF | 75 | $_____________ | $_____________ |

| Item No. | TxDOT Item No. | Item Description(1) | Unit | Unit Quantity | Unit Price(2) | Total |
|---|---|---|---|---|---|---|
| 20. | 464<br>6008 | RC PIPE (CL III)(24 IN) | LF | 322 | $____________ | $____________ |
| 21. | 464<br>6005 | RC PIPE (CL III)(36 IN) | LF | 15 | $____________ | $____________ |
| 22. | 0646<br>6072 | RC PIPE (ELLIP)(CL III)(DES 1) | LF | 46 | $____________ | $____________ |
| 23. | 0464<br>6073 | RC PIPE (ELLIP)(CL III)(DES 3) | LF | 56 | $____________ | $____________ |
| 24. | 465 | INLET (COMPL)(TY E) | EA | 23 | $____________ | $____________ |
| 25. | 466<br>6152 | WINGWALL (FW - 0) (HW=7 FT) WITH ENERGY DISSIPATION BLOCKS | EA | 1 | $____________ | $____________ |
| 26. | 496<br>6007 | REMOVE STORM PIPE | LF | 42 | $____________ | $____________ |
| 27. | 0500<br>6001 | MOBILIZATION | LS | 1 | $____________ | $____________ |
| 28. | 0502<br>6001 | BARRICADES, SIGNS AND TRAFFIC HANDLING | MONTH | 10 | $____________ | $____________ |
| 29. | 0506<br>6041 | BIODEG EROSN CONT LOGS (INSTL) (12") | LF | 380 | $____________ | $____________ |
| 30. | 0506<br>6038 | TEMP SEDMT CONT FENCE (INSTALL) | LF | 608 | $____________ | $____________ |
| 31. | 0506<br>6039 | TEMP SEDMT CONT FENCE (REMOVE) | LF | 608 | $____________ | $____________ |
| 32. | 0760<br>6003 | DITCH CLEAN/RESHAPING (CU YD IN VEHICLE) | CY | 257 | $____________ | $____________ |
| 33. | 7017<br>6016 | SANITARY SEWER (6 IN) (PVC) (SDR 26) | LF | 28 | $____________ | $____________ |
| 34. | 7017<br>6017 | SANITARY SEWER (8 IN) (PVC) (SDR 26) | LF | 28 | $____________ | $____________ |
| 35. | 7017<br>6019 | SANITARY SEWER (12 IN) (PVC) (SDR 26) | LF | 14 | $____________ | $____________ |
| 36. | 7017 | STEEL SPLIT CASING (PIPE) (ALL SIZES) | LF | 100 | $____________ | $____________ |
| 37. | 7049 | WATER MAIN PIPE (PVC) (3IN) (C-900) | LF | 329 | $____________ | $____________ |
| 38. | 7049<br>6011 | WATER MAIN PIPE (PVC) (6IN) (C-900) | LF | 43 | $____________ | $____________ |
| 39. | 7049<br>6012 | WATER MAIN PIPE (PVC) (8IN) (C-900) | LF | 50 | $____________ | $____________ |
| 40. | 7136<br>6014 | ABANDON/REMOVE EXISTING WATER LINE (ALL SIZES) | LF | 412 | $____________ | $____________ |
| 41. | 7197<br>6011 | REMOVE EXISTING SEWER LINE (2"-12") | LF | 75 | $____________ | $____________ |
| 42. | COH<br>02081 | FURNISH AND INSTALL RCB MANHOLE (COMPLETE IN PLACE) | EA | 23 | $____________ | $____________ |

ADDENDUM NO. 1

**TOTAL BASE BID**
**(SUM OF ITEMS ABOVE)** $____________________

| **Item No.** | **TxDOT Item No.** | **Item Description**[1] | **Unit** | **Unit Quantity** | **Unit Price**[2] | **Total** |
|---|---|---|---|---|---|---|
| **EXTRA WORK ITEMS** | | | | | | |
| 43. | 104<br>6001 | REMOVING CONC (PAV) | SY | 100 | $_____________ | $_____________ |
| 44. | 0360<br>6028 | CONC PAV (JOINT REINF) (6") | SY | 100 | $_____________ | $_____________ |
| 45. | 0560-6025 | RELOCATE EXISTING MAILBOX | EA | 10 | $_____________ | $_____________ |
| 46. | 6360 | PROJECT SIGN | EA | 1 | $_____________ | $_____________ |

**Subtotal Extra Work Items** $____________________

**TOTAL BID**
**(SUMOF BASE BID and EXTRA WORK ITEMS)** **$____________________**

*Notes:*

[1] *The intent of the Contract Documents is for the Contractor to include all items necessary for the proper execution and completion of the Work described in the Contract Documents. No separate measurement and payment shall be made for any work unless identified as a pay item in the BID. Include the cost of work not identified as a separate pay item in Contract price bid for items of which this work is a component. In case of discrepancy between measurement and payment within the BID and Technical Specification Section, the BID shall govern.*

[2] *In the event of a discrepancy, this column shall govern.*

## Mitigation Measures and Conditions [40 CFR 1505.2(c)]

*Summarize below all mitigation measures adopted by the Responsible Entity to reduce, avoid, or eliminate adverse environmental impacts and to avoid non-compliance or non-conformance with the above-listed authorities and factors. These measures/conditions must be incorporated into project contracts, development agreements, and other relevant documents. The staff responsible for implementing and monitoring mitigation measures should be clearly identified in the mitigation plan.*

| Law, Authority, or Factor | Mitigation Measures and Conditions |
|---|---|
| Section 106 of the National Historic Preservation Act, Historic Preservation | **Above-Ground Resources:**<br>If historic properties are discovered or unanticipated effects on historic properties are found, work with cease in the immediate area and the THC's Historic Programs Division will be contacted at 512-463-5853 to consult on further actions that may be necessary to protect historic properties. The GLO will also be contacted in this instance, or if project scope changes.<br>**Archeological Resources:**<br>If cultural materials are encountered during project activities, work will cease in the immediate area and THC's Archeology Division will be contacted at 512-463-6096 to consult on further actions necessary to protect cultural remains. The GLO will also be contacted in this instance, or if project scope should change. |

| **Law, Authority, or Factor** | **Best Management Practices** |
|---|---|
| Clean Air Act, as amended, particularly section 176(c) & (d); 40 CFR Parts 6, 51, 93 | During project construction, there will be some increase in ambient dust particulate from machinery and soil disturbances. These will be only temporary in nature and all efforts will be made through proper construction methods to ensure dust control and properly functioning equipment. |
| Endangered Species Act of 1973, particularly section 7; 50 CFR Part 402 | Although migratory birds are unlikely to nest on the property, nearby trees should be inspected for any active nests prior to beginning construction. All active nests should be avoided and if found, a qualified biologist with the USFWS should be notified. Consideration will be given to avoiding clearing vegetation during general bird nesting season (between March and August), state listed and rate species lists will be provided to construction workers to ensure consistency with requirements to prevent impact to and/or avoid federally or state listed, threatened, endangered, or special status species; best management practices including silt fencing and berming to prevent stormwater runoff will be used.<br>If construction workers identify or encounter threatened or endangered species during construction, they should cease construction immediately and contact Texas Parks & Wildlife for guidance. |

| | |
|---|---|
| Executive Order 11988, particularly section 2(a); 24 CFR Part 55 | The project shall implement methods designed to protect improvements from flood damage and to protect natural landscapes that serve to maintain or restore natural hydrology through infiltration. The consulting engineer shall take into consideration additional specifications to minimize damage to, and/or restore, the native plant species. The project shall not lead to any significant increases in impermeable cover and shall have no negative impacts on the floodplain. Additionally, prior to construction, the project plans will meet any applicable local floodplain requirements set forth by the community's Floodplain Administrator. |
| Executive Order 11990, particularly sections 2 and 5 | The project shall implement methods designed to protect natural landscapes that serve to maintain or restore natural hydrology through infiltration. Erosion control will be utilized during construction to prevent the unintentional discharge of dredged or fill material into the wetland. The consulting engineer shall take into consideration additional specifications to minimize damage to identified wetlands by avoiding staging and operating heavy machinery within the wetland. The project shall not lead to any significant increases in impermeable cover and shall have no negative impacts on the wetland. |
| Coastal Zone Management Act, sections 307(c) & (d) | Siting and construction willing avoid and minimize impacts to coastal natural resource areas in the coastal zone. Required U.S. Army Corps of Engineers permits will be subject to consistency review under the Texas Coastal Management Program. |

**Determination:**

☒ **Finding of No Significant Impact** [24 CFR 58.40(g)(1); 40 CFR 1508.27]
The project will not result in a significant impact on the quality of the human environment.

☐ **Finding of Significant Impact** [24 CFR 58.40(g)(2); 40 CFR 1508.27]
The project may significantly affect the quality of the human environment.

Preparer's Signature

Date: 4/9/2021

Ben Kleesattel, Environmental Specialist
Preparer's Name and Title

GrantWorks, Inc
Preparer's Agency

ADDENDUM NO. 1

May 3, 2021

Responsible Entity Certifying Official Signature Date

Mark Henry, County Judge

Responsible Entity Certifying Official Name and Title

*This original, signed document and related supporting material must be retained on file by the Responsible Entity in an Environmental Review Record (ERR) for the activity/project (ref: 24 CFR Part 58.38) and in accordance with recordkeeping requirements for the HUD program(s).*

# GEOTECHNICAL INVESTIGATION
# JACKSON AVENUE
# DRAINAGE AND PAVING IMPROVEMENTS
# GALVESTON COUNTY, TEXAS

REPORT NO.  1140252701

*Prepared for:*

**IDS ENGINEERING GROUP**

Houston, Texas

*Submitted by:*

**GEOTEST ENGINEERING, INC.**

Houston, Texas

Key Map No. 661 F & J

ADDENDUM NO. 1

**GEOTEST ENGINEERING, INC.**

*Geotechnical Engineers & Materials Testing*

5600 Bintliff Drive Houston, Texas 77036 Telephone: (713) 266-0588
Fax: (713) 266-2977

**Report No. 1140252701**
September 21, 2020

Mr. Travis S. Sellers, P.E., ENV SP
Senior Vice President
IDS Engineering Group
13430 Northwest Freeway, Suite 700
Houston, Texas 77040

**Reference: Geotechnical Investigation**
**Jackson Avenue Drainage and Pavement Improvements**
**Galveston County, Texas**

Dear Mr. Sellers:

Presented herein is the final geotechnical investigation report for the referenced project. A draft report was submitted to you on May 28, 2020. This final report will supersedes previously submitted reports, transmittals, e-mails, etc. for the referenced project. This study was authorized through notice-to-proceed e-mail on April 3, 2020, by accepting our Proposal No 1140483699 dated February 24, 2020.

We appreciate this opportunity to be of service to you. Please call us when we can be of further assistance.

Sincerely,
**GEOTEST ENGINEERING, INC.**
TBPE Registration No. F-410

Krishna M. Pradeep, E.I.T.
Graduate Engineer

Naresh Kolli, P.E.
Project Manager

9/21/20

NARESH KOLLI
110928

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Copies Submitted: (1 pdf)
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ADDENDUM NO. 1

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## ILLUSTRATIONS

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## APPENDIX B

## EXECUTIVE SUMMARY

A geotechnical investigation was performed for the design and construction of the proposed drainage and paving improvements along Jackson Avenue in Galveston County, Texas. The project includes approximately 2,700 linear feet of pavement reconstruction improvements along Jackson Avenue from Bruce Street (9th Street) to Boulevard Street. Based on the provided information, we understand that the proposed storm sewer will be placed at invert depths ranging from 13 to 13.5 feet (elevations ranging from 2.84 to 1.24 feet) below existing grade/existing pavement, and will be installed by open-cut method of construction. The project also includes reconstruction of existing outfall near the intersection Boulevard Street and Jackson Avenue (north end).

The purposes of this investigation were to evaluate soil and water level conditions and to provide geotechnical recommendations for the proposed improvements. The investigation included drilling and sampling three (3) soil borings to depths ranging from 15 to 25 feet, performing laboratory tests on soil samples recovered from the borings, performing engineering analyses and developing geotechnical recommendations and preparing a geotechnical report.

The principal findings and conclusions developed from this investigation are as follows:

- Based on the Houston Sheet, Texas, Geologic Atlas of Texas (Bureau of Economic Geology, University of Texas, 1982) the project alignment lies in the Beaumont Formation.

- Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults for the project alignment, no documented faults cross the project alignment. The nearest known fault is associated with the Clear Lake and Friendswood Salt Domes, which are approximately 9 miles northwest of the project alignment. Hence, a Phase I Geological Fault Study is not warranted for this project.

- The existing pavement along Jackson Avenue as obtained in soil borings GB-1 through GB-3 consists of 4 to 5 inches of asphalt over 9 to 10 inches of sand and gravel mix base.

- The subsurface soil beneath the existing pavement, as encountered in borings GB-1 through GB-3, consists of medium stiff to hard dark gray, light gray, reddish brown, and yellowish brown and gray fat clay, lean clay, lean clay with sand, and sandy silty clay to the maximum explored depths of 15 feet to 25 feet. A stratum of loose reddish brown silty sand was encountered between depths of 12 and 14 feet, in boring GB-2. Fill material consisting of stiff lean clay was encountered below the pavement to a depth of 4 feet in boring GB-1.

- Free water was first encountered at depths ranging from 12 to 18 feet during drilling in borings GB-2 and GB-3. The water level measured 20 minutes after water was first encountered, was at depths ranging from 6.2 to 12.7 feet in these borings. No free water was encountered in boring GB-1 drilled for this investigation.

- All excavation operations for utilities (water, storm sewer and sanitary sewer) should be carried out in accordance with OSHA standards and TxDOT Geotechnical Manual, Chapter 6, Section 4 – "Excavation Support". The bedding and backfill for storm sewer and associated structures should be in accordance with TxDOT Standard Specification Item No. 400 "Excavation and Backfill for Structures".

- The recommendations for outfall structure reconstruction are discussed in Section 5.3 of this report.

- The recommended pavement section and subgrade stabilization for the proposed Jackson Avenue reconstruction are provided in Section 5.4 of this report.

# 1.0 INTRODUCTION

## 1.1 Location and Description of Project

The project includes approximately 2,700 linear feet of pavement reconstruction improvements along Jackson Avenue from Bruce Street (9th Street) to Boulevard Street. Based on the provided information, we understand that the proposed storm sewer will be placed at invert depths ranging from 13 to 13.5 feet (elevations ranging from 2.84 to 1.24 feet) below existing grade/existing pavement, and will be installed by open-cut method of construction. The project also includes reconstruction of existing outfall near the intersection Boulevard Street and Jackson Avenue (north end). The vicinity map of the project alignment is shown on Figure 1.

## 1.2 Scope of Work

The purpose of this investigation was to evaluate the soil and groundwater (if any) conditions along Jackson Avenue to provide geotechnical recommendations for the proposed drainage and pavement improvements in Galveston County, Texas, and to provide geotechnical recommendations for the design and construction of the proposed improvements. The scope of this investigation consisted of the following tasks:

- Coordinated with utility locators to get areas for the proposed borings locations.
- Performed coring on existing pavement along Jackson Avenue to determine the existing pavement thickness and for boring access.
- Drilled and sampled three (3) soil borings to depths ranging from 15 to 25 feet along existing roadway and proposed storm sewer alignment along Jackson Avenue.
- Performed appropriate laboratory tests on selected representative samples to develop the engineering properties of the soil.
- Performed engineering analyses to develop geotechnical recommendations for bedding and backfill, trench safety requirements and groundwater control for the storm sewer

installation, pavement section recommendations including subgrade stabilization, proposed outfall structure, and construction considerations.

- Submitted a geotechnical investigation report containing a plan showing the locations of the borings and recommendations as outlined above.

# 2.0 FIELD INVESTIGATION

## 2.1 General

After obtaining the utilities clearance of proposed three (3) marked borings in the field, the borings were drilled to the explored depths utilizing a truck mounted drilling rig. Traffic control devices and personnel were utilized during coring and drilling to maintain safety of drilling crew and the public. All the drilling and sampling were performed in accordance with appropriate ASTM procedures.

## 2.2 Geotechnical Borings

Subsurface conditions for the project alignment were explored by drilling and sampling three (3) soil borings (designated as GB-1 through GB-3) each to depths ranging from 15 to 25 feet. The approximate boring locations are shown on Figures 2.1 and 2.2, Plan of Borings. Survey information (Northing and Easting coordinates and ground surface elevation) of completed borings was provided to us by IDS Engineering Group and are summarized in Table 1.

Samples were obtained continuously to the depth of 15 and 20 feet, and intermittent sampling thereafter to the termination depth of 25 feet in the deeper boring. Cohesive soils were obtained with a 3-inch thin-walled tube sampler in general accordance with ASTM D1587, and samples of granular soils were obtained with a 2-inch diameter split-barrel sampler in general accordance with ASTM D1586. Each sample was removed from the sampler in the field, carefully examined and then logged by an experienced soils technician. Suitable portions of each sample were sealed and packaged for transportation to Geotest's Laboratory. The shear strength of cohesive soil samples was estimated using a pocket penetrometer in the field. Driving resistances for the split-barrel sampler were recorded as "blows-per-foot" on the boring logs. All the borings were grouted with cement-bentonite grout after completion of drilling and obtaining the water level measurements.

Detailed descriptions of the soils encountered in the borings are given on the boring logs presented on Figures A-1 through A-3 in Appendix A. A key to symbols and terms used on boring logs is given on Figure A-4 in Appendix A.

## 2.3 Piezometer Installation

No piezometers were installed for this study.

## 3.0 LABORATORY TESTING

The laboratory testing program was designed to evaluate the pertinent physical properties and shear strength characteristics of the subsurface soils. Classification tests were performed on selected samples to aid in soil classification. All the tests were performed in accordance with ASTM Standards.

Undrained shear strengths of selected cohesive samples were measured by unconsolidated undrained (UU) triaxial compression tests (ASTM D 2850). The results of the UU triaxial compression tests are plotted on the boring logs as solid squares. The shear strength of cohesive samples was measured in the field with a calibrated hand pocket penetrometer and also in the laboratory with a Torvane. The shear strength values obtained from the penetrometer and Torvane are plotted on the boring logs as open circles and open triangles, respectively.

Measurements of moisture content and dry unit weight were taken for each UU triaxial compression test sample. Moisture content (ASTM D 2216) measurements were also made on other samples to define the moisture profile at each boring location. The liquid and plastic limit tests (ASTM D4318) and percent passing No. 200 sieves (ASTM D1140) were performed on appropriate samples. Sieve analysis (ASTM D6913) was performed on selected sample for classification and grain size analysis.

The results of all tests are tabulated or summarized on the boring logs presented on Figures A-1 through A-3 in Appendix A. The summary of laboratory tests is also presented in a tabular form on Figures B-1 through B-3 in Appendix B. The grain size distribution curve is presented on Figure B-4 in Appendix B.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 Geology

The project alignment lies in the Beaumont Formation. The clays and sands of the Beaumont Formation are over-consolidated as a result of desiccation from frequent rising and lowering of the sea level and the groundwater table. Consequently, clays of this formation have moderate to high shear strength and relatively low compressibility. The sands of the Beaumont Formation are typically very fine and often silty. Further, there is occasional evidence in the Houston area of the occurrence of cemented material (sandstone and siltstone) deposits within the Beaumont Formation.

### 4.2 General Fault Information

A review of information in the Geotest library, relating to known surface and subsurface geologic faults in the general area of the project location, was undertaken. The available information consisted of U.S. Geological and NASA maps, open file reports and information contained in our files relating to geologic faults in the project alignment.

Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults for the project alignment, no documented faults cross the project alignment. The nearest known fault is associated with the Clear Lake and Friendswood Salt Domes, which are approximately 9 miles northwest of the project alignment. Hence, a Phase I Geological Fault Study is not warranted for this project.

### 4.3 Existing Pavement

The existing pavement along Jackson Avenue as obtained in soil borings GB-1 through GB-3 consists of 4 to 5 inches of asphalt over 9 to 10 inches of sand and gravel mix base. The details of the existing pavement thickness at each of the boring locations are summarized below:

| **Boring Nos.** | **Asphalt Thickness (in)** | **Base/Subgrade** | **Total (in.)** |
|---|---|---|---|
| GB-1 | 4.0 | 9.0-inch Sand and Gravel mix | 13.0 |
| GB-2 | 5.0 | 9.0-inch Sand and Gravel mix | 14.0 |
| GB-3 | 4.0 | 10.0-inch Sand and Gravel mix | 14.0 |

### 4.4 Soils Stratigraphy

Based on the subsurface soils encountered in the boreholes, one (1) boring log profile was developed and is presented on Figure 3. To the left of each boring shown on the profile is an indication of the consistency or density of each stratum. More than one consistency for an individual stratum indicates that the consistency is different at different depths within the stratum. For cohesive soils, consistency is related to the undrained shear strength of the soil. To the right of each boring shown on the profile is the overall classification of the soil contained within each stratum. The symbols and abbreviations used on the boring log profile is presented on Figure 4. The soil classification is based on ASTM Standards.

The subsurface soil beneath the existing pavement, as encountered in borings GB-1 through GB-3, consists of medium stiff to hard dark gray, light gray, reddish brown, and yellowish brown and gray fat clay, lean clay, lean clay with sand, and sandy silty clay to the maximum explored depths of 15 feet to 25 feet. A stratum of loose reddish brown silty sand was encountered between depths of 12 and 14 feet, in boring GB-2. Fill material consisting of stiff lean clay was encountered below the pavement to a depth of 4 feet in boring GB-1.

The fat clay and fat clay with sand are of high plasticity with liquid limits ranging from 51 to 62 and plasticity indices ranging from 29 to 37. The lean clays, and lean clay with sand are of low to high plasticity with liquid limits ranging from 24 to 45, and plasticity indices ranging from 9 to 25. The sandy silty clay is of low plasticity with a liquid limit of about 23, and a plasticity index of about 5. The fines content (percent passing No. 200 sieve) of fat clay and lean clay ranged from 87.9 to 96.5 percent, the fines content of lean clay with sand ranged from 75.0 to 84.2 percent, and the fines content of sandy silty clay was about 59.7 percent. The fines content of silty sand was about 39.4 percent.

## 4.5 Water Levels

Free water was first encountered at depths ranging from 12 to 18 feet during drilling in borings GB-2 and GB-3. The water level measured 20 minutes after water was first encountered, was at depths ranging from 6.2 to 12.7 feet in these borings. No free water was encountered in boring GB-1 drilled for this investigation. The details of the water level measurements as encountered at each of the borings are summarized below:

| **Boring No.** | **Water Level Encountered During Drilling** | **Groundwater measured 20 minutes after water was first encountered, feet** |
|---|---|---|
| | **Depth** | **Depth** |
| GB-2 | 12.0 | 6.2 |
| GB-3 | 18.0 | 12.7 |

However, it should be noted that various environmental and man-made factors such as amount of precipitation, nearby subsurface construction activities, and change in area drainage can substantially influence the groundwater level.

## 4.6 Environmental Concerns

No environmental concerns were noticed in the borings drilled for this investigation.

# 5.0 GEOTECHNICAL RECOMMENDATIONS

## 5.1 General

The project includes approximately 2,700 linear feet of pavement reconstruction improvements along Jackson Avenue from Bruce Street (9th Street) to Boulevard Street. Based on the provided information, we understand that the proposed storm sewer will be placed at invert depths ranging from 13 to 13.5 feet (elevations ranging from 2.84 to 1.24 feet) below existing grade/existing pavement, and will be installed by open-cut method of construction. The project also includes reconstruction of existing outfall near the intersection Boulevard Street and Jackson Avenue (north end).

## 5.2 Trench Excavation

Based on the information provided by IDS Engineering Group, it is understood that the proposed drainage improvements will be installed by open cut method of construction. The following subsections provide information for the design and construction of the storm sewer by open cut method of excavation.

5.2.1 Geotechnical Parameters. Based on the soil conditions revealed by the borings GB-1 through GB-3, geotechnical parameters were developed for the design of open cut construction for utilities installation. The design parameters are provided in Table 2. For design, the water level should be assumed to be at the ground surface, since these conditions may exist after a heavy rain or flooding.

5.2.2 Excavation Stability. The open excavation may be shored or laid back to a stable slope or supported by some other equivalent means used to provide safety for workers and adjacent structures, if any. The excavating operations should be in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and TxDOT Geotechnical Manual, Chapter 6, Section 4 – "Excavation Support."

- <u>Excavation Shallower Than 5 Feet</u> - For excavations that are less than 5 feet, the need for protection should be evaluated by a competent person to examine the ground for any indication of potential cave-in. When any indication of hazardous ground movement or potential cave-in is anticipated during construction, adequate protective system should be provided for all excavation even if excavations are shallower than 5 feet. It may include vertical or sloped cuts, benches, shields, support systems, or other systems providing the necessary protection in accordance with Occupational and Safety Health Administration (OSHA) Standards and Interpretations, 29 CFR 1926, Subpart P, 'Excavations'.

- <u>Excavations Deeper Than 5 Feet</u> - Excavations that are deeper than 5 feet should be sloped, shored, sheeted, braced or laid back to a stable slope or supported by some other equivalent means or protection such that workers are not exposed to moving ground or cave-ins. The slopes and shoring should be in accordance with the trench safety requirements as per TxDOT Geotechnical Manual, Chapter 6, Section 4, Subsection – 'Temporary Special Shoring', and OSHA Standards. The following items provide design criteria for trench stability.

  (i) <u>OSHA Soil Type</u>. Based on the soil conditions revealed by borings drilled for this investigation and the assumed water level to be at ground surface, OSHA soil type "C" should be used for determination of allowable maximum slope and/or the design of shoring along the alignments for full proposed depth of open excavation. For shoring deeper than 20 feet, an engineering evaluation is required.

  (ii) <u>Excavation Support Earth Pressure.</u> Based on the subsurface conditions indicated by our field investigation and laboratory testing results, excavation support earth pressure diagrams are developed and are presented on Figures 5.1 and 5.2. These pressure diagrams can be used for the design of temporary trench bracing. For a trench box, a lateral earth pressure resulting from an equivalent fluid with a unit weight of 95 pcf can be used. The effects of any surcharge loads at the ground surface should be added to the computed lateral earth pressures. A surcharge load, q, will typically result in a lateral load equal to 0.5 q. The above value of equivalent fluid pressure is based on assumption that the groundwater level is near the ground surface, since these conditions may exist after a heavy rain or flooding.

(iii) Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the water level within the retained soils and the water level at the interior of the trench excavation. For cuts in cohesive soils as predominantly encountered in all the borings, the bottom stability can be evaluated as outlined on Figure 6. However, in cohesionless soils (such as silty sand) as encountered in boring GB-2, at the invert or within 3 feet of invert depth, the excavation should be done after dewatering to avoid bottom stability problems, if the excavation is planned after a heavy rainfall event.

5.2.3 Water Level Control. Excavations for the proposed storm sewer may encounter water seepage to varying degrees depending upon the water level conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed utilities installation, the excavations will be predominantly in cohesive soils, and cohesive soils underlain by cohesionless soils (near boring GB-2). In general, for cohesive soils for the excavation depths, water (if encountered) may be managed by collection in excavation bottom sumps for pumped disposal. However, for excavations near boring GB-2, where cohesionless soils (silty sand) were encountered at invert, dewatering may be required, if the excavations are planned after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet and deep wells below 15 feet depth may be required to lower the water level to at least 3 feet below the bottom of excavation. The dewatering system should be pumping well ahead of time before excavation starts so that a steady state condition (groundwater elevation at least 3 feet below the proposed excavation bottom) is achieved.

It is recommended that the actual water level conditions should be verified by the contractor at the time of construction and the groundwater control should be carried out in accordance with TxDOT Standard Specifications.

5.2.4 Bedding and Backfill for Storm Sewer. The bedding and backfill for storm sewer should be in accordance with TxDOT Standard Specification Item No. 400 "Excavation and Backfill for Structures," Section 400.3.2 and 400.3.3.

### 5.3 Outfall Structure

5.3.1 Description. The project also reconstruction of existing outfall location near Boulevard Street to the north end of Jackson Avenue. Based on the information provided, we understand that the storm sewer flow line will have an invert depth of about 13 feet (elevation of about 1.24 feet) at the outfall location.

5.3.2 Foundation Conditions. Based on the soil conditions revealed by the boring GB-3, the structure bottom will be in stiff to very stiff fat clay.

5.3.3 Foundation Design Recommendations. The following items provide recommendations and design criteria for construction of the outfall structure.

- Allowable Bearing Pressures. The foundation for supporting the new outfall structure placed at an approximate depth of 13 feet [into stiff to very stiff fat clay] should be designed for an allowable (net) bearing pressure of 4,000 psf. The allowable bearing pressure includes a safety factor of 2.0.

  The above recommendation assumes that the final bearing surfaces consist of undisturbed natural soils and that underlying semi-transmissive zones are properly pressure-relieved and stable undisturbed bearing surfaces are attained.

- Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the water level within the retained soils and the water level at the interior of the trench excavation. For cuts in cohesive soils as predominantly encountered in the borings, the bottom stability can be evaluated as outlined on Figure 6.

- Lateral Earth Pressure. The pressure diagram presented on Figure 5.1 can be used for the design of braced excavation. The lateral earth pressure diagram presented on Figure 7.1 is applicable for the design of the permanent walls.

- Hydrostatic Uplift Resistance. Structures extending below the water level should be designed to resist uplift pressure resulting from excess piezometric head. Design uplift pressures should be computed based on the assumption that the water table is at ground surface. To resist the hydrostatic uplift at the bottom of the structure, one of the following sources of resistance can be utilized in each of the designs.
  a. Dead weight of structure,
  b. Weight of soil above base extensions plus weight of structure, or
  c. Soil-wall friction plus dead weight of structure.

The uplift force and resistance to uplift should be computed as detailed on Figure 8. In determining the configuration and dimensions of the structure using one of the approaches presented on Figure 8, the following factors of safety are recommended.

a. Dead weight of concrete structure, $S_{f1} = 1.10$,
b. Weight of soil (backfill) above base extension, $S_{f2} = 1.5$, and
c. Soil-wall friction, $S_{f3} = 3.0$.

Friction resistance should be discounted for the upper 5 feet, since this zone is affected by seasonal moisture changes.

5.3.4 Protection of Below Grade Structures. The design of the proper means for protection of below grade structures will depend upon the potential of the aggressivity or corrosivity of soil and groundwater properties. Aggressivity testing was not within the scope of this investigation. The design of the protection of below grade structures is beyond the scope of services for this investigation.

5.3.5 Water Level Control During Construction. Water level control should be in accordance with section 5.2.3 of this report.

5.3.6 Structure Backfill. Excavations for the proposed structures should be backfilled in accordance with the TxDOT Specification Item 400, "Excavation and Backfill for Structures".

## 5.4 Pavement Structure Design

It is understood that approximately 2,700 LF of existing pavement along Jackson Avenue from Bruce Street to Boulevard Street will be reconstructed with asphalt pavement. Based on the provided information, the pavement will be approximately 20-foot wide and be considered local street. The pavement design presented below was developed in accordance with “AASHTO Guide for Design of Pavement Structures,” 1993 Edition.

### 5.4.1 Design Parameters

Subgrade Soil Properties. California Bearing Ratio (CBR) tests were not within the scope of this project. Therefore, the roadbed soil resilient modulus is estimated based on physical properties and strength characteristics of the natural subgrade soils. Based on the physical properties and strength characteristics of the natural subgrade soils obtained from laboratory tests, the effective roadbed soil resilient modulus ($M_R$) was estimated to be about 3,120 psi from an assumed CBR value of 2.0.

Traffic Data. No traffic count and vehicle classification data was provided to us at the time of preparation of this report. Therefore, based on the information provided by IDS, we understand that Jackson Avenue is classified as a local street. A traffic loading of $0.75 \times 10^6$ – 18-kip ($W_{18}$) ESALs over a 20-year design period was utilized based on a total daily traffic volume of 2,030 vehicles at 1000 Jackson

Avenue, from a 24-hour weekday count conducted in 2012 obtained from the Houston-Galveston Area Council (H-GAC) Transportation Department's Interactive Traffic Count Website. A distribution of 98% passenger cars and 2% buses and single-unit trucks were assumed along the project alignment.

Other Design Parameters. Other design parameters used in the development of pavement thickness are given below:

Overall Standard Deviation ($S_o$): 0.45
Reliability Level (R): 80%
Serviceability Index
    Initial ($P_o$): 4.2
    Terminal ($P_t$): 2.0
Layer coefficient:

$a_1$, $a_2$, $a_3$ = layer coefficient for surface, base and subbase course, respectively. Values of the layer coefficient for each pavement material are as follows:

$a_1$ = 0.44 for HMHL asphalt concrete surface
$a_2$ = 0.35 for Asphalt concrete black base
    = 0.20 for Cement stabilized base
    = 0.17 for lime and flyash stabilized base
$a_3$ = 0.11 for Lime stabilized soils

Drainage coefficient:

$m_2$, $m_3$ =Drainage coefficient for base and subbase layers;
$m_2$ = 1.0 and $m_3$ = 1.0 (based on a fair to good quality of drainage)

### 5.4.2 Recommended Pavement Section

Based on the design parameters described above, the AASHTO design procedures the thickness of flexible pavement sections was determined. The recommended pavement section is given below:

Flexible Pavement Section:

| **Pavement Course** | **Thickness, inches** |
|---|---|
| HMA Surface | 2 |
| Asphalt Concrete Base/Blackbase | 6 |
| 5% Lime-stabilized subgrade | 6 |

### 5.4.3 Preparation of Pavement Subgrade

Based on the field and laboratory test data, the subgrade soils at the finished grade of the project site consists of predominantly low to high plasticity lean clay, and lean clay with sand. These clay soils have high volume change potential. Hence, lime stabilization of the clay subgrade soils will be required to reduce the swelling and shrinkage potential, to accelerate the construction and provide a stable subgrade on which to construct the pavement sections. The fat clay subgrade soils should be stabilized with 5 percent lime (by dry unit weight of soil) to a depth of at least 6 inches. This corresponds to approximately 25 pounds of lime per square yard based on a dry unit weight of 110 pcf. The actual percentages of lime should be confirmed by laboratory tests at the time of construction. It should be noted that quantity of lime was estimated based on the dry unit weight determined from the specific boring locations only.

Subgrade preparation for the proposed pavement after removing the existing pavement should consist of stripping, proof-rolling, and stabilization. The following procedures for subgrade preparation are recommended:

1. Strip the surficial soils to a suitable depth to remove all surficial vegetation and achieve grade. In isolated areas where soft, compressible, or very loose soils are encountered, additional stripping may be required.

2. After stripping, the exposed surface should be proof-rolled with a minimum of 3 passes of a 30-ton pneumatic-tired roller or a partially loaded truck utilizing a tire pressure of approximately 90 psi. If rutting develops, the tire pressure should be reduced. The purpose of the proof-rolling operation is to identify any underlying

zones or pockets of soft soils, so these soft or weak materials can be removed and replaced.

3. Lime stabilization of cohesive subgrade should be performed in accordance with TxDOT Standard Specification Item No. 260, “Lime Treatment (Road-Mixed)”.

## 6.0 CONSTRUCTION CONSIDERATIONS

Excavations for the proposed storm sewer may encounter water seepage to varying degrees depending upon the water level conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed utilities installation, the excavations will be predominantly in cohesive soils, and cohesive soils underlain by cohesionless soils (near boring GB-2). In general, for cohesive soils as predominantly encountered in all the borings for the excavation depths, water (if encountered) may be managed by collection in excavation bottom sumps for pumped disposal. However, for excavations near boring GB-2, where cohesionless soils (silty sand) were encountered at invert or within 3 feet of invert depth, dewatering may be required, if the excavations are planned after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet and deep wells below 15 feet depth may be required to lower the water level to at least 5 feet below the bottom of excavation. The dewatering system should be pumping well ahead of time before excavation starts so that a steady state condition (groundwater elevation at least 5 feet below the proposed excavation bottom) is achieved.

It is recommended that the actual water level conditions should be verified by the contractor at the time of construction and the groundwater control should be carried out in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and TxDOT Geotechnical Manual, Chapter 6, Section 4 – "Excavation Support".

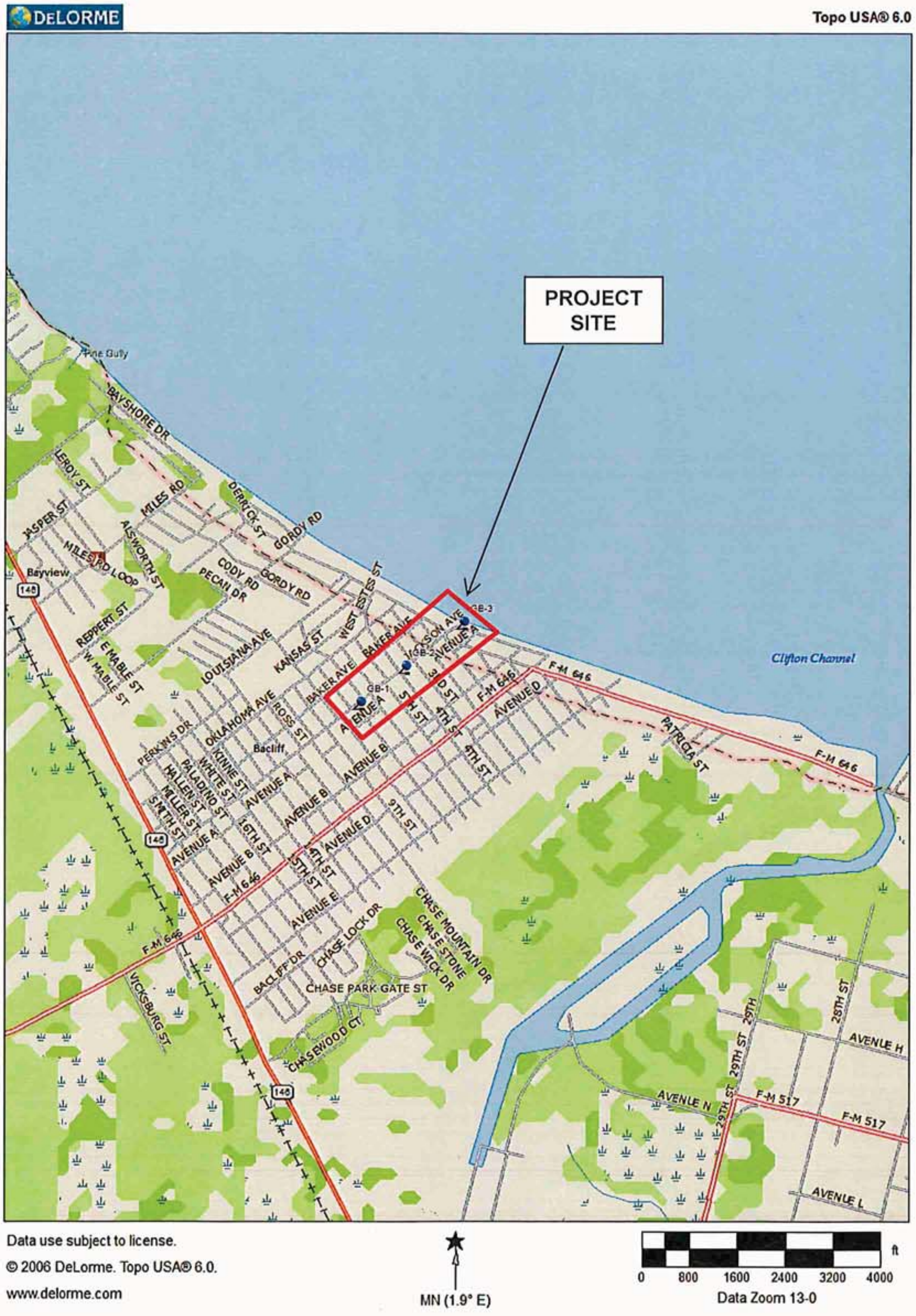
## 7.0 LIMITATIONS

The description of subsurface conditions and the design information contained in this report are based on the soil borings made at the time of drilling at specific locations. However, some variation in soil conditions may occur between soil borings. Should any subsurface conditions other than those described in our boring logs be encountered, Geotest should be immediately notified so that further investigation and supplemental recommendations can be provided. The depth of the water level may vary with changes in environmental conditions such as frequency and magnitude of rainfall. The stratification lines on the log of borings represent the approximate boundaries between soil types, however, the transition between soil types may be more gradual than depicted.

This report has been prepared for the exclusive use of Galveston County, Texas, and IDS Engineering Group, for the Jackson Avenue Paving and Drainage project. This report shall not be reproduced without the written permission of Geotest Engineering, Inc., Galveston County, or IDS Engineering Group.

# ILLUSTRATIONS

Job No. 1140252701



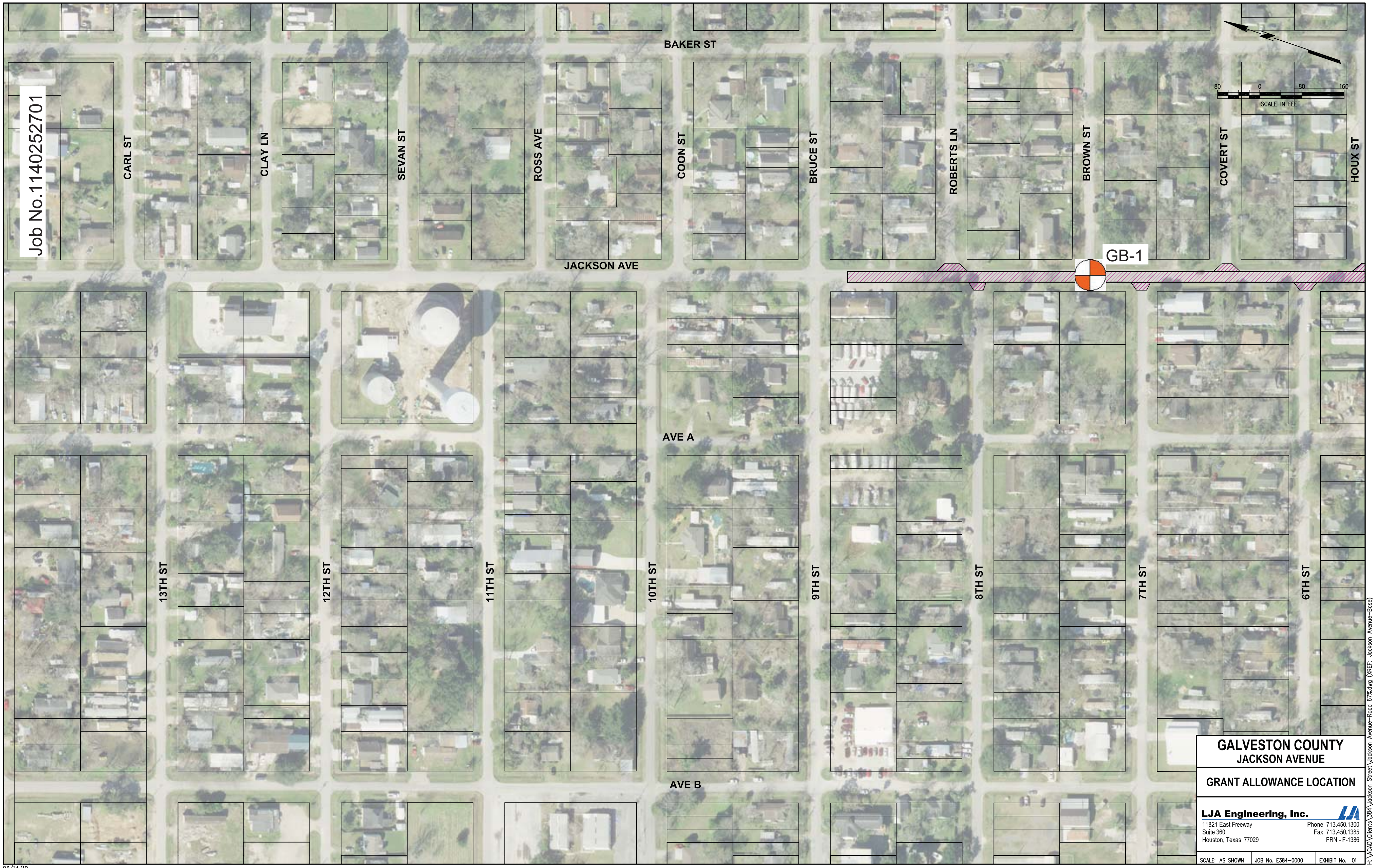
JACKSON AVENUE DRAINAGE AND
PAVING IMPROVEMENTS
GALVESTON COUNTY, TEXAS

## VICINITY MAP

*Geotest Engineering, Inc.*

FIGURE 1

ADDENDUM NO. 1



**GALVESTON COUNTY**
**JACKSON AVENUE**

**GRANT ALLOWANCE LOCATION**

**LJA Engineering, Inc.**

11821 East Freeway
Suite 360
Houston, Texas 77029

Phone 713.450.1300
Fax 713.450.1385
FRN - F-1386

SCALE: AS SHOWN | JOB No. E384–0000 | EXHIBIT No. 01

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03/14/19

## LEGEND

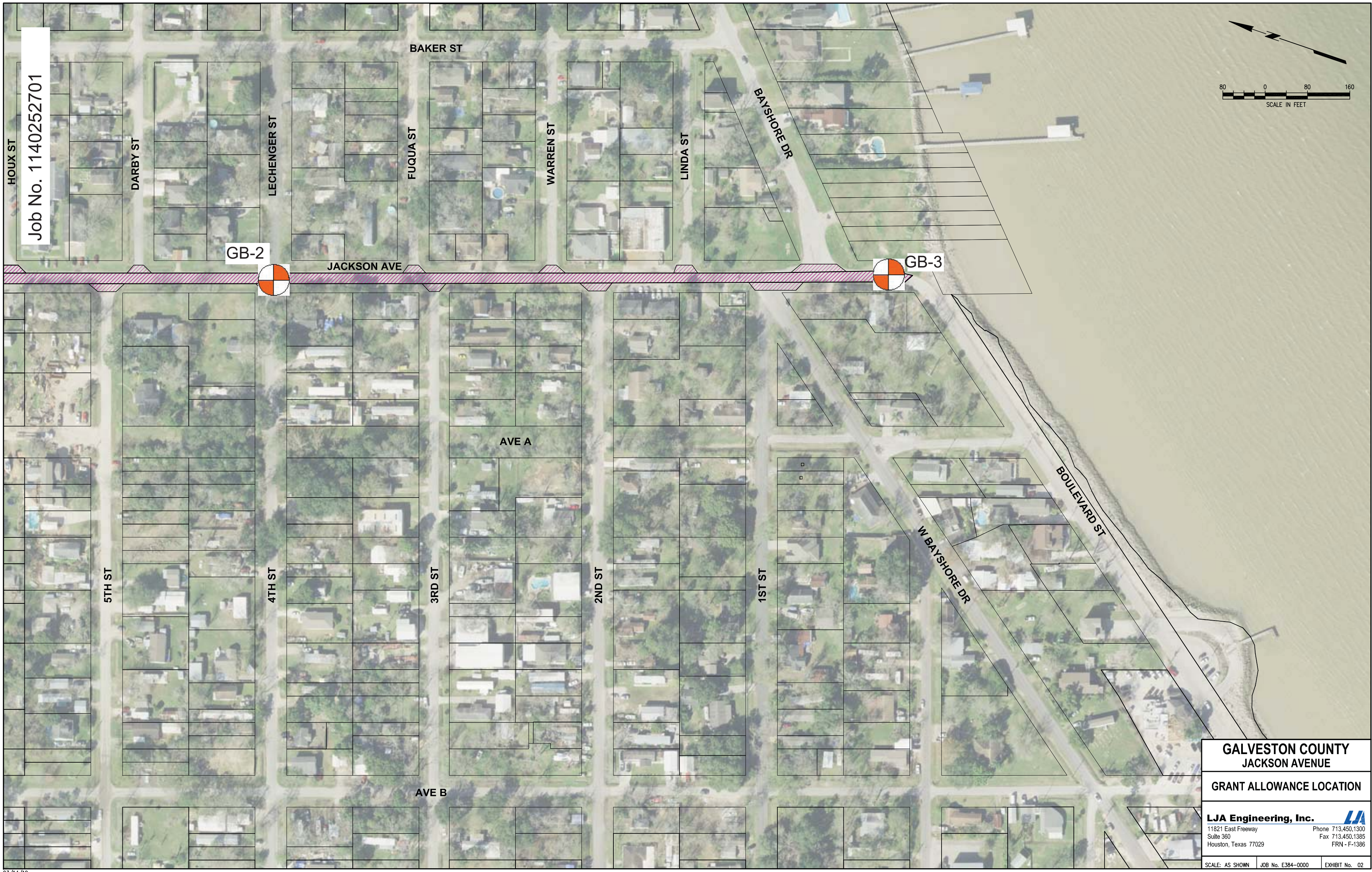
⊕ BORING

## PLAN OF BORINGS

FIGURE 2.1

ADDENDUM NO. 1

Job No. 1140252701



**GALVESTON COUNTY**
**JACKSON AVENUE**

**GRANT ALLOWANCE LOCATION**

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03/14/19

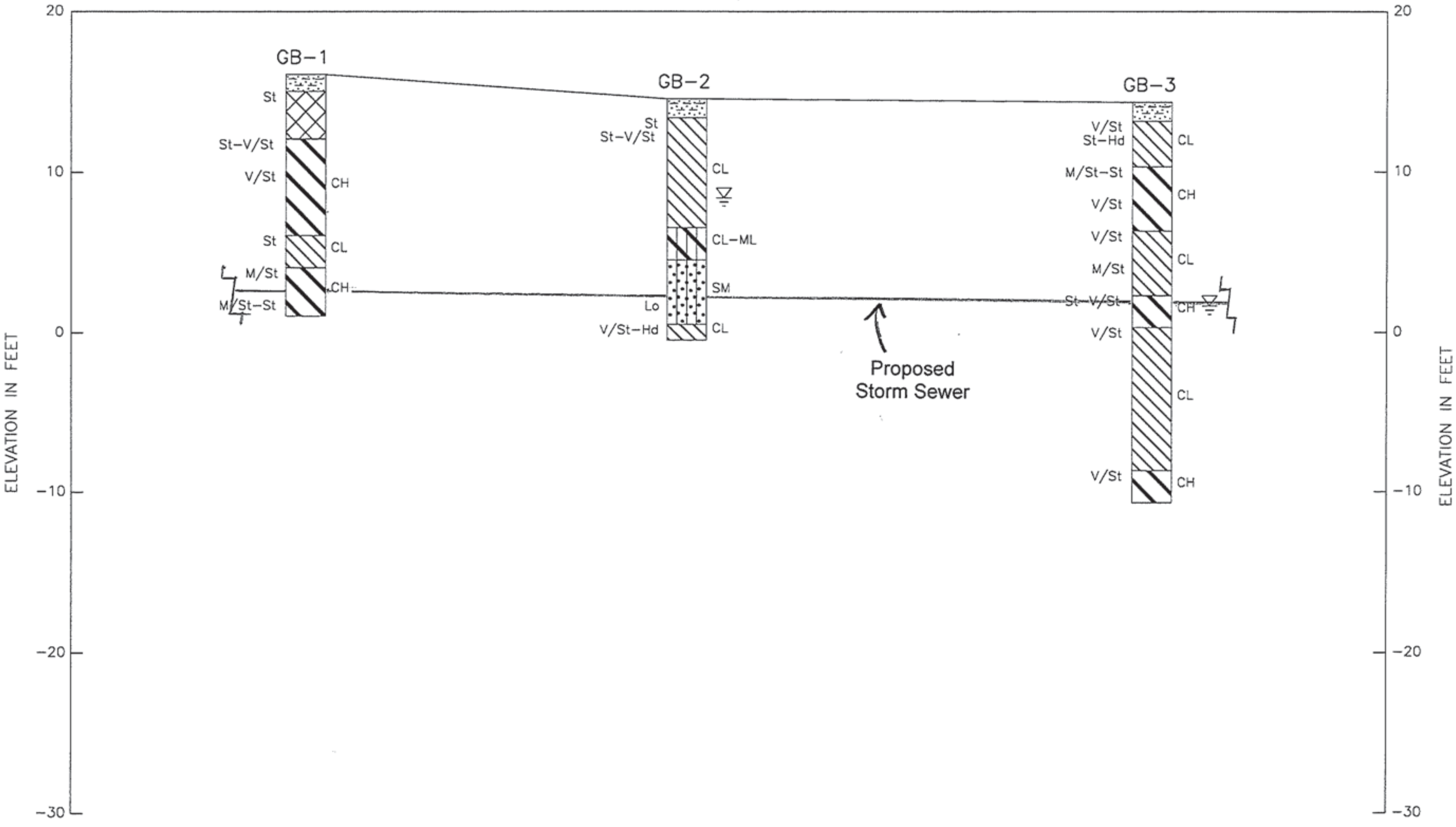
LEGEND

BORING

# PLAN OF BORINGS

FIGURE 2.2

ADDENDUM NO. 1



GENERAL NOTES:

1. See Figures 2.1 & 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by IDS Engineering Group.

# BORING LOG PROFILE

## JACKSON AVENUE
## BORINGS GB-1 THRU GB-3

0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140252701

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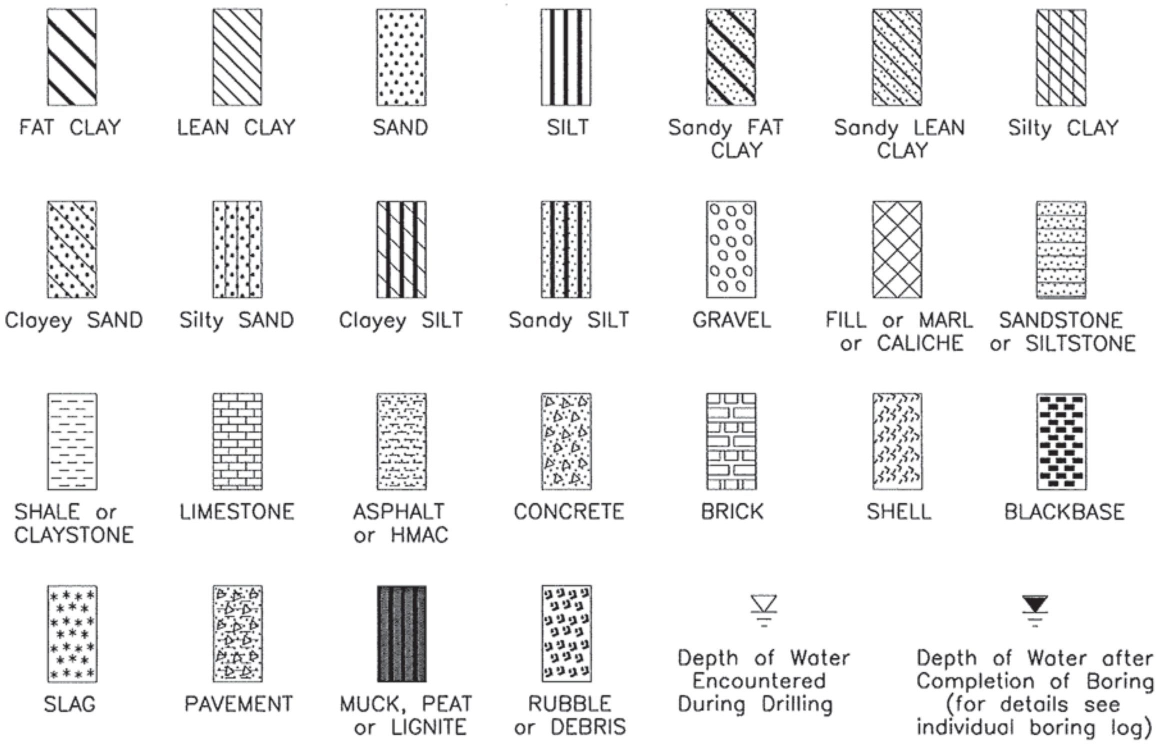
FIGURE 3

ADDENDUM NO. 1

Job No.1140252701

# SYMBOLS AND ABBREVIATIONS USED ON BORING LOG PROFILE

## LEGEND



## ABBREVIATIONS USED FOR CONSISTENCY/DENSITY

### COHESIVE SOILS

V/So : Very Soft
So : Soft
Fm : Firm
M/St : Medium Stiff
St : Stiff
V/St : Very Stiff
Hd : Hard
V/Hd : Very Hard

### COHESIONLESS SOILS

V/Lo : Very Loose
Lo : Loose
S/Co : Slightly Compact
Co : Compact
M/De : Medium Dense
De : Dense
V/De : Very Dense

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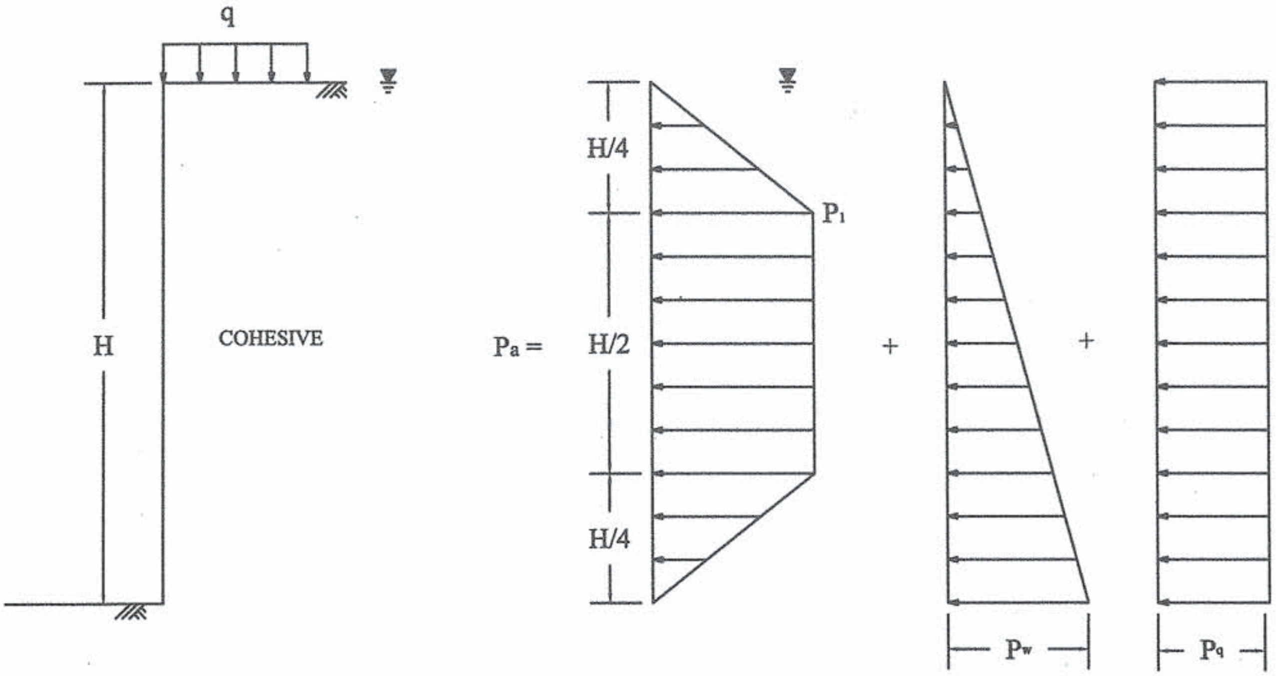
FIGURE 4

ADDENDUM NO. 1

Job No. 11402527O1



**TYPICAL SOIL PARAMETERS**

**BRACED WALL**

See Table 2 for typical values of soil parameters

For $\gamma H/c \leq 4$

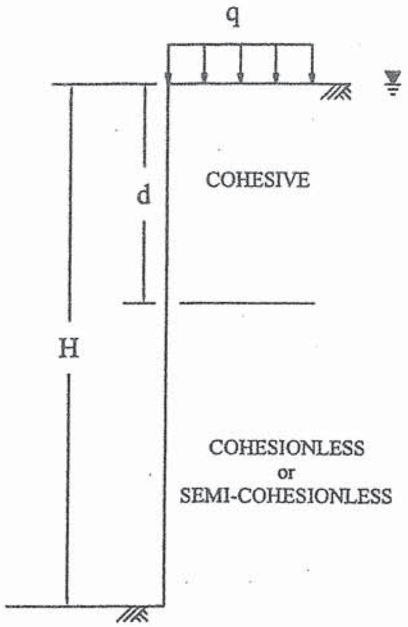
$P_1 = 0.3\ \gamma_c'\ H$
$P_w = \gamma_w\ H = 62.4\ H$
$P_q = 0.5\ q$

Where:

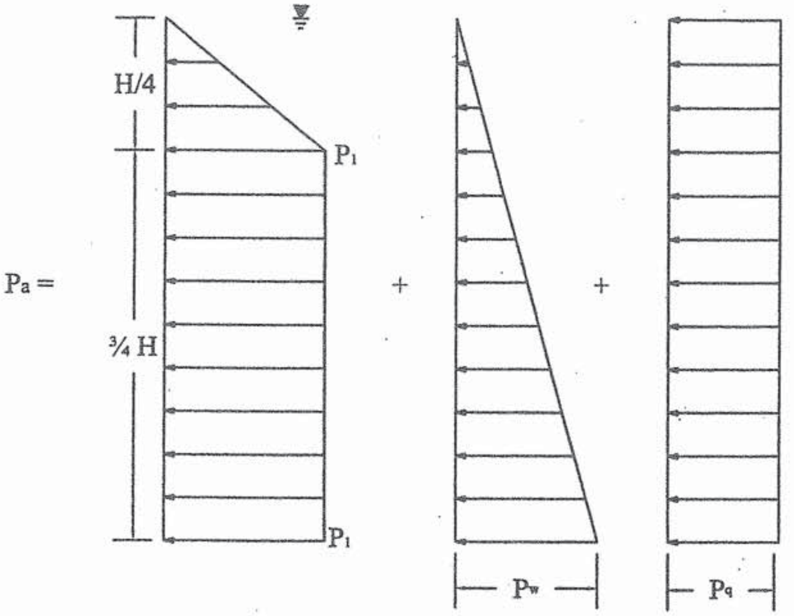
- $\gamma_c'$ = Submerged unit weight of cohesive soil, pcf;
- $\gamma_w$ = Unit weight of water, pcf;
- q = Surcharge load at surface, psf;
- $P_a$ = Lateral pressure, psf;
- $P_1$ = Active earth pressure, psf;
- $P_q$ = Horizontal pressure due to surcharge, psf;
- $P_w$ = Hydrostatic pressure due to groundwater, psf;
- H = Depth of braced excavation, feet
- c = Shear strength of cohesion soil, psf;

# EXCAVATION SUPPORT EARTH PRESSURE

## SUBMERGED COHESIVE SOIL



TYPICAL SOIL PARAMETERS



BRACED WALL

See Table 2 for typical values of soil parameters

$$\gamma'_{avg} = \frac{\gamma_c'\, d + \gamma_s'\,(H-d)}{H}$$

$P_1 = 0.3\,\gamma'_{avg}\,H$
$P_w = 62.4\,H$
$P_q = 0.5\,q$

Where:

$\gamma_c'$ = Submerged unit weight of cohesive soil, pcf;
$\gamma_s'$ = Submerged unit weight of cohesionless soil, pcf;
$\gamma'_{avg}$ = Average submerged unit weight of soils, pcf;
q = Surcharge load at surface, psf;
$P_a$ = Lateral pressure, psf;
$P_1$ = Active earth pressure, psf;
$P_q$ = Horizontal pressure due to surcharge, psf;
$P_w$ = Hydrostatic pressure due to groundwater, psf;
H = Depth of braced excavation, feet

## EXCAVATION SUPPORT EARTH PRESSURE

## SUBMERGED COHESIVE SOIL OVER COHESIONLESS OR SEMI-COHESIONLESS SOIL

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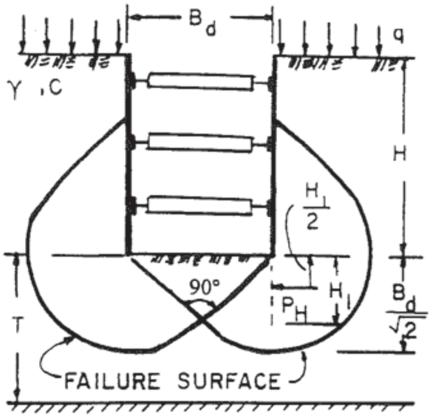
FIGURE 5.2

ADDENDUM NO. 1

Job No.1140252701

CUT IN COHESIVE SOIL,
DEPTH OF COHESIVE SOIL UNLIMITED ($T > 0.7\ B_d$)
L = LENGTH OF CUT



If sheeting terminates at base of cut:

$$\text{Safety factor, } F_S = \frac{N_C C}{\gamma H + q}$$

$N_C$ = Bearing capacity factor, which depends on dimensions of the excavation : $B_d$, L and H (use $N_C$ from graph below)

C = Undrained shear strength of clay in failure zone beneath and surrounding base of cut

γ = Unit weight of soil (see Table 2)

q = Surface surcharge (assumed q = 500 psf)

If safety factor is less than 1.5, sheeting or soldier piles must be carried below the base of cut to insure stability - (see note)

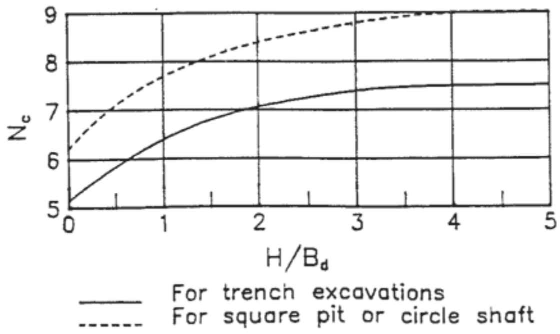
$$H_1 = \text{Buried length} = \frac{B_d}{2} \geq 5 \text{ feet}$$

Note : If soldier piles are used, the center to center spacing should not exceed 3 times the width or diameter of soldier pile .

Force on buried length, $P_H$:

$$\text{If } H_1 > \frac{2}{3}\frac{B_d}{\sqrt{2}},\quad P_H = 0.7\,(\gamma\, HB_d - 1.4CH - \pi CB_d) \text{ in lbs/ linear foot}$$

$$\text{If } H_1 < \frac{2}{3}\frac{B_d}{\sqrt{2}},\quad P_H = 1.5H_1\,(\gamma\, H - \frac{1.4CH}{B_d} - \pi C) \text{ in lbs/ linear foot}$$



## STABILITY OF BOTTOM
## FOR
## BRACED CUT

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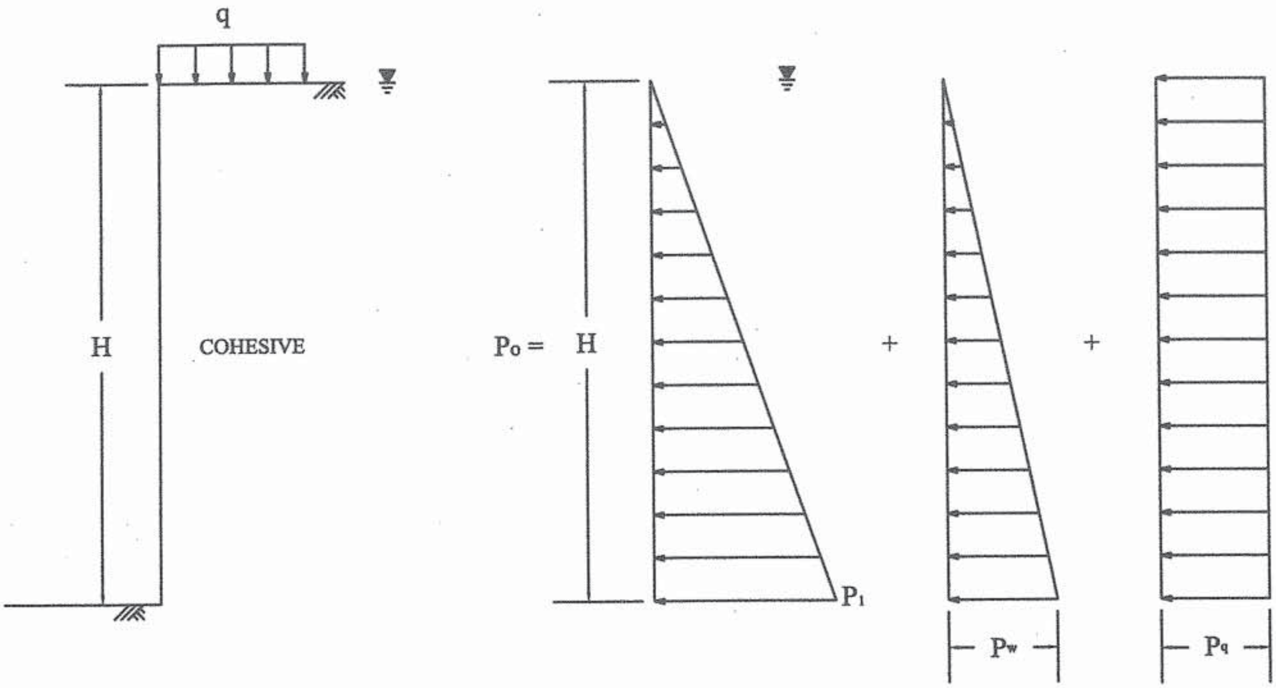
FIGURE 6

ADDENDUM NO. 1

Job No. 1140252701



TYPICAL SOIL PARAMETERS

See Table 2 for typical
values of soil parameters

$K_{oc} = 1.0$

PERMANENT WALL

$P_1 = K_{oc}\, \gamma_c'\, H$
$P_w = \gamma_w\, H = 62.4\, H$
$P_q = 0.5\, q$

Where:

$\gamma_c'$ = Submerged unit weight of cohesive soil, pcf;
$K_{oc}$ = Coefficient of at-rest earth pressure in cohesive soil;
$\gamma_w$ = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
$P_o$ = Lateral pressure, psf;
$P_1$ = At-rest earth pressure, psf;
$P_q$ = Horizontal pressure due to surcharge, psf;
$P_w$ = Hydrostatic pressure due to groundwater, psf;
H = Depth of excavation, feet

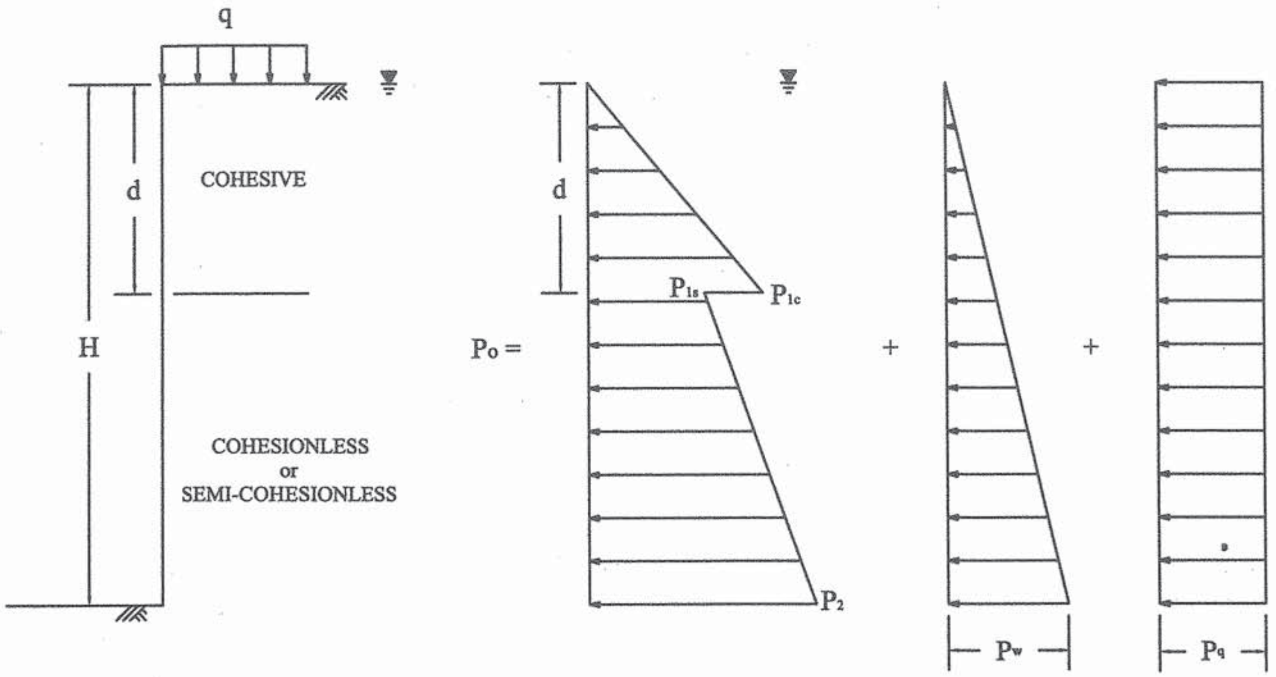
## LATERAL EARTH PRESSURE DIAGRAM FOR PERMANENT WALL

SUBMERGED COHESIVE SOIL

*Geotest Engineering, Inc.*

FIGURE 7.1

ADDENDUM NO. 1



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

$K_{oc} = 1.0$

$K_{os} = 1\text{-}\sin\phi_s$

PERMANENT WALL

$P_{1c} = \gamma_c' \, d \, K_{oc}$

$P_{1s} = \gamma_c' \, d \, K_{os}$

$P_2 = [\gamma_c' \, d + \gamma_s' \, (H\text{-}d)] \, K_{os}$

$P_w = \gamma_w \, H = 62.4 \, H$

$P_q = 0.5 \, q$

Where:

$\gamma_c'$ = Submerged unit weight of cohesive soil, pcf;

$\gamma'_s$ = Submerged unit weight of cohesionless or semi-cohesionless soil, pcf;

$\phi_s$ = Internal friction angle of cohesionless or semi-cohesionless soil, degree;

$K_{oc}$ = Coefficient of at-rest earth pressure in cohesive soil;

$K_{os}$ = Coefficient of at-rest earth pressure in cohesionless or semi-cohesionless soil;

$\gamma_w$ = Unit weight of water, pcf;

$q$ = Surcharge load at surface, psf;

$P_o$ = Lateral pressure, psf;

$P_i$, $P_{ic}$, $P_{is}$ = At-rest earth pressure, psf; i = 1, 2;

$P_q$ = Horizontal pressure due to surcharge, psf;

$P_w$ = Hydrostatic pressure due to groundwater, psf;

$H$ = Height of wall, feet

## LATERAL EARTH PRESSURE DIAGRAM FOR PERMANENT WALL

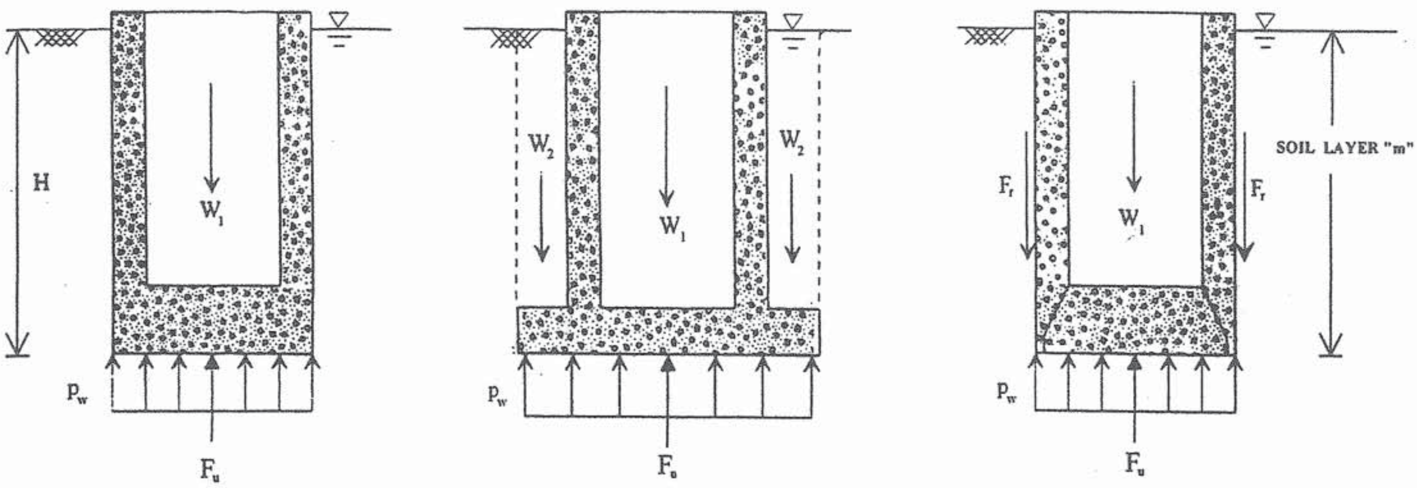
### SUBMERGED COHESIVE SOIL OVER COHESIONLESS OR SEMI-COHESIONLESS SOIL

*Geotest Engineering, Inc.*

FIGURE 7.2

ADDENDUM NO. 1

Job No. 1140252701



**(a) DEAD WEIGHT OF STRUCTURE**

$$p_w = H\gamma_w$$

$$F_u = A_b p_w$$

$$\frac{W_1}{Sf_1} = F_u$$

See Table 2 for typical values of soil parameters

**(b) WEIGHT OF SOIL ABOVE BASE EXTENSION PLUS DEAD WEIGHT OF STRUCTURE**

$$p_w = H\gamma_w$$

$$F_u = A_b p_w$$

$$\frac{W_1}{Sf_1} + \frac{W_2}{Sf_2} = F_u$$

**(c) SOIL-WALL FRICTION PLUS DEAD WEIGHT OF STRUCTURE**

$$p_w = H\gamma_w$$

$$F_u = A_b p_w$$

$$\frac{W_1}{Sf_1} + \frac{F_r}{Sf_3} = F_u$$

Predominantly Cohesive Soils, $F_r = \alpha c_m A_m$

Predominantly Cohesionless Soils, $F_r = p_m A_m K \tan \delta_m$

Where: $A_b$ = area of base, sq. ft.
$A_m$ = cylindrical surface area of layer "m" , sq. ft.
$c_m$ = undrained cohesion of soil layer "m", psf.
$F_u$ = hydrostatic uplift force, lbs.
$F_r$ = frictional resistance, lbs.
H = height of buried structure, ft.
K = coefficient of lateral pressure = 0.5.
$p_m$ = average overburden pressure for layer "m," psf.
$p_w$ = hydrostatic uplift pressure, psf.
$Sf_{1,\ 2,\ 3}$ = factor of safety.
$W_1$ = dead weight of concrete structure, lbs.
$W_2$ = weight of backfill above base extension, lbs.
$\alpha$ = cohesion reduction factor = 0.5.
$\delta_m$ = friction angle between soil layer "m" and concrete wall, degrees = 0.75 $\phi_m$
$\phi_m$ = internal angle of friction of soil layer "m", degrees.
$\gamma_w$ = unit weight of water = 62.4 pcf.

# UPLIFT PRESSURE AND RESISTANCE

# TABLES

# TABLE 1

# SUMMARY OF BORING INFORMATION

| Location/ Street | Boring No. | Depth (feet) | Northing | Easting | Elevation (feet) |
|---|---|---|---|---|---|
| Jackson Avenue | GB-1 | 15 | 13756239.38 | 3244980.98 | 16.07 |
| | GB-2 | 15 | 13756857.17 | 3245717.02 | 14.53 |
| | GB-3 | 25 | 13757623.52 | 3246605.05 | 14.31 |

Note: The survey information was provided by IDS Engineering Group..

# TABLE 2

## GEOTECHNICAL DESIGN PARAMETER SUMMARY
## OPEN-CUT EXCAVATION

| Street | Boring Nos. | Stratigraphic Unit | Range of Depths, ft. | Wet** Unit Weight, $\gamma$, pcf | Submerged Unit Weight, $\gamma'$, pcf | Undrained Cohesion, psf | Internal Friction Angle, $\varphi$, degree |
|---|---|---|---|---|---|---|---|
| Jackson Avenue | GB-1 | FILL/Cohesive | *0-2 | 125 | 63 | 1,000 | -- |
| | | | 2-4 | 125 | 63 | 1,500 | -- |
| | | Cohesive | 4-10 | 127 | 64 | 1,500 | -- |
| | | | 10-15 | 129 | 65 | 800 | -- |
| | GB-2 | Cohesive | *0-2 | 134 | 67 | 1,000 | -- |
| | | | 2-8 | 134 | 67 | 1,200 | -- |
| | | | 8-10 | 123 | 61 | 500 | -- |
| | | Cohesionless | 10-14 | 112 | 50 | -- | 29 |
| | | Cohesive | 14-15 | 123 | 61 | 2,000 | -- |
| | GB-3 | Cohesive | *0-4 | 136 | 68 | 2,000 | -- |
| | | | 4-6 | 130 | 65 | 1,000 | -- |
| | | | 6-10 | 130 | 65 | 2,500 | -- |
| | | | 10-12 | 129 | 65 | 800 | -- |
| | | | 12-16 | 128 | 64 | 1,600 | -- |
| | | | 16-25 | 128 | 64 | 2,000 | -- |

1. Cohesive soils include Fat Clay, Lean Clay, Lean Clay with Sand, and Sandy Silty Clay.
2. Cohesionless soils include Silty Sand.

* 0 feet – Below the pavement

# APPENDIX A

# LOG OF BORING NO. GB-1

PROJECT : Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NO. : 1140252701

LOCATION : N 13756239.38, E 3244980.98
See Plan of Borings (Figure 2)

SURFACE ELEVATION : 16.07 FT.

COMPLETION DEPTH : 15.0 FT.

DATE : 04-13-20

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

| ELEVATION, FEET | DEPTH, FEET | DESCRIPTION OF MATERIAL | STANDARD PENETRATION TEST, BLOWS PER FOOT | PERCENT PASSING NO. 200 SIEVE | DRY UNIT WEIGHT, PCF | NATURAL MOISTURE CONTENT, % | LIQUID LIMIT, % | PLASTIC LIMIT, % | PLASTICITY INDEX, % |
|---|---|---|---|---|---|---|---|---|---|
| 16.1 | 0 | 4" Asphalt over 9" Gray Sand and Gravel Mix | | | | | | | |
| 15.0 | | FILL: stiff dark gray lean clay w/calcareous nodules | | | | 18.2 | | | |
| | | | | 91.3 | 104 | 19.8 | 43 | 20 | 23 |
| 12.1 | 5 | Stiff to very stiff dark gray FAT CLAY (CH) w/ferrous nodules and ferrous stains<br>-very stiff light gray w/calcareous nodules 6'-8'<br>-yellowish brown and gray 8'-10' | | | | 22.8 | | | |
| | | | | | | 21.8 | | | |
| | | | | 87.9 | 103 | 25.6 | 62 | 25 | 37 |
| 6.1 | 10 | Stiff brown LEAN CLAY (CL) w/silt seams | | 91.0 | | 22.4 | 30 | 18 | 12 |
| 4.1 | | Medium stiff reddish brown and gray FAT CLAY (CH) w/ferrous<br>-w/sand and silt seams 12'-14'<br>-medium stiff to stiff w/calcareous nodules 14'-15' | | 90.4 | | 27.0 | 51 | 22 | 29 |
| | | | | | | 26.7 | | | |
| 1.1 | 15 | | | | | | | | |
| | 20 | | | | | | | | |
| | 25 | | | | | | | | |
| | 30 | | | | | | | | |
| | 35 | | | | | | | | |

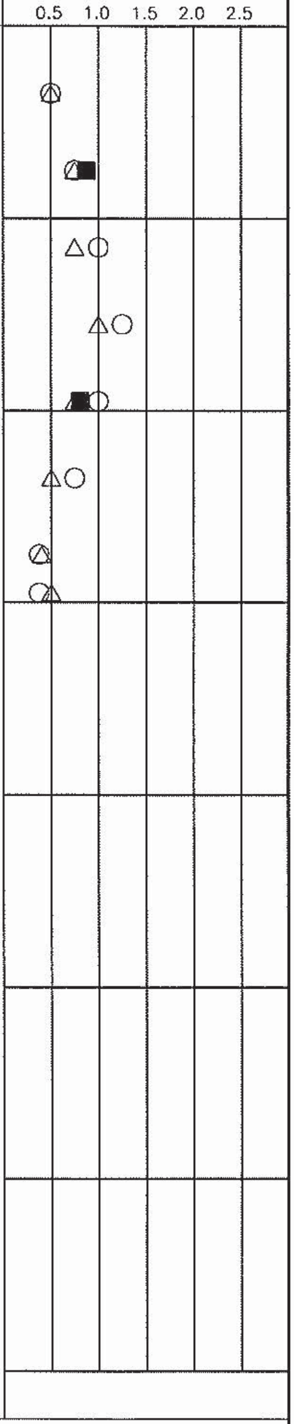
UNDRAINED SHEAR STRENGTH, TSF

○ HAND PENETROMETER

● UNCONFINED COMPRESSION

■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION

△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

*Geotest Engineering, Inc.*

ADDENDUM NO. 1

# LOG OF BORING NO. GB-2

PROJECT : Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NO. : 1140252701

LOCATION : N 13756857.17, E 3245717.02
See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

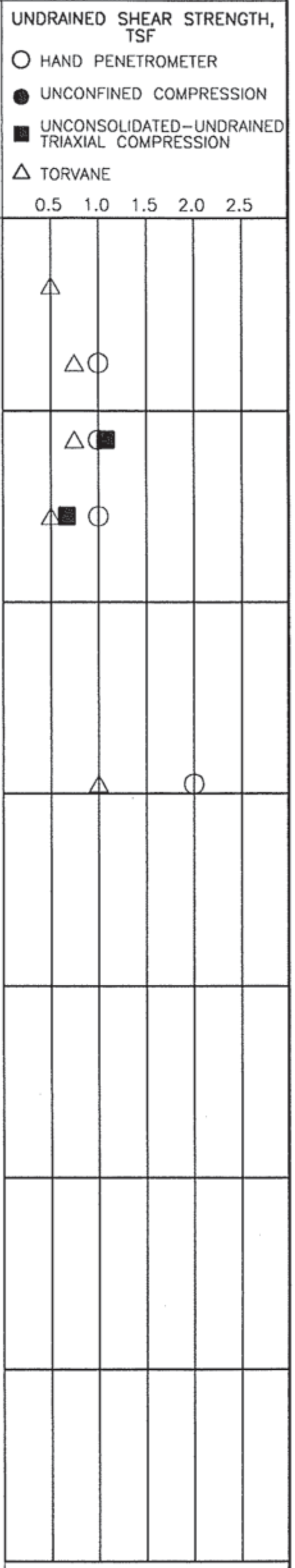
SURFACE ELEVATION : 14.53 FT.

DATE : 04-13-20

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 FT.
WET ROTARY : 12.0 TO 15.0 FT.

| ELEVATION, FEET | DEPTH, FEET | DESCRIPTION OF MATERIAL |
|---|---|---|
| 14.5 | 0 | 5" Asphalt over 9" Dark Gray Sand and Gravel Mix |
| 13.4 | | Stiff dark gray LEAN CLAY WITH SAND (CL)<br>-stiff to very stiff 2'-8'<br>-yellowish brown and gray w/ferrous stains 4'-8' |
| 6.5 | | Brown and gray SANDY SILTY CLAY (CL-ML) |
| 4.5 | 10 | Reddish brown SILTY SAND (SM)<br>-loose 12.5'-14' |
| 0.5 | | Very stiff to hard yellowish brown LEAN CLAY (CL) w/sand seams and calcareous nodules |
| -0.5 | 15 | |
| | 20 | |
| | 25 | |
| | 30 | |
| | 35 | |

| STANDARD PENETRATION TEST, BLOWS PER FOOT | PERCENT PASSING NO. 200 SIEVE | DRY UNIT WEIGHT, PCF | NATURAL MOISTURE CONTENT, % | LIQUID LIMIT, % | PLASTIC LIMIT, % | PLASTICITY INDEX, % |
|---|---|---|---|---|---|---|
| | 84.2 | | 19.5 | 24 | 15 | 9 |
| | | | 21.0 | | | |
| | 80.5 | 110 | 22.3 | 45 | 20 | 25 |
| | | 113 | 18.4 | | | |
| | 59.7 | | 20.6 | 23 | 18 | 5 |
| | | | 20.9 | | | |
| 7 | 39.4 | | 20.7 | | | |
| | | | 20.7 | | | |



DEPTH TO WATER IN BORING :
∇: FREE WATER 1st ENCOUNTERED AT 12.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 6.2 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

*Geotest Engineering, Inc.*

ADDENDUM NO. 1

# LOG OF BORING NO. GB-3

PROJECT : Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NO. : 1140252701

LOCATION : N 13757623.52, E 3246605.05
See Plan of Borings (Figure 2)

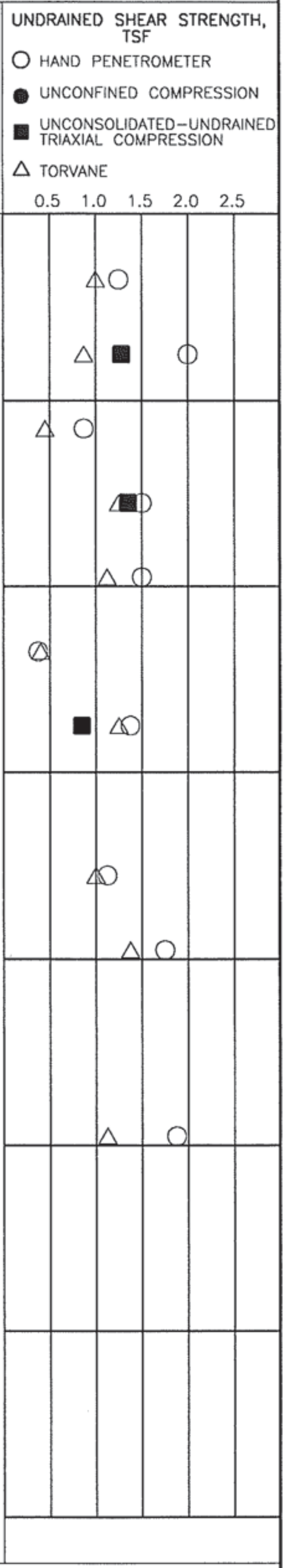
COMPLETION DEPTH : 25.0 FT.

SURFACE ELEVATION : 14.31 FT.

DATE : 04-13-20

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 18.0 FT.
WET ROTARY : 18.0 TO 25.0 FT.

| ELEVATION, FEET | DEPTH, FEET | DESCRIPTION OF MATERIAL | STANDARD PENETRATION TEST, BLOWS PER FOOT | PERCENT PASSING NO. 200 SIEVE | DRY UNIT WEIGHT, PCF | NATURAL MOISTURE CONTENT, % | LIQUID LIMIT, % | PLASTIC LIMIT, % | PLASTICITY INDEX, % |
|---|---|---|---|---|---|---|---|---|---|
| 14.3 | 0 | 4" Asphalt over 10" Dark Gray Sand and Gravel Mix w/shell fragments | | | | | | | |
| 13.1 | | | | | | 24.4 | | | |
| 10.3 | | Very stiff dark gray LEAN CLAY WITH SAND (CL) w/calcareous nodules<br>-stiff to hard light gray 2'-4' | | 75.0 | 116 | 16.9 | 43 | 20 | 23 |
| | 5 | | | | | 20.5 | | | |
| 6.3 | | Medium stiff to stiff light gray FAT CLAY (CH)<br>-very stiff brown and gray w/ferrous nodules and ferrous stains 6'-8' | | 96.5 | 106 | 23.1 | 62 | 26 | 36 |
| | 10 | | | | | 27.9 | | | |
| 2.3 | | Very stiff reddish brown and gray LEAN CLAY (CL) w/silt seams<br>-w/calcareous and ferrous nodules 8'-10'<br>-medium stiff 10'-12' | | 93.6 | | 23.6 | 35 | 19 | 16 |
| 0.3 | | | | 96.0 | 103 | 24.0 | 61 | 26 | 35 |
| | 15 | Stiff to very stiff reddish brown FAT CLAY (CH) w/calcareous nodules | | | | | | | |
| | | Very stiff yellowish brown and gray LEAN CLAY WITH SAND (CL) w/calcareous nodules<br>-w/ferrous nodules and ferrous stains 16'-18' | | 82.7 | | 18.9 | 41 | 19 | 22 |
| | 20 | | | | | 22.6 | | | |
| -8.7 | | Very stiff reddish brown and gray FAT CLAY (CH) | | | | 28.3 | | | |
| -10.7 | 25 | | | | | | | | |
| | 30 | | | | | | | | |
| | 35 | | | | | | | | |



DEPTH TO WATER IN BORING :
∇: FREE WATER 1st ENCOUNTERED AT 18.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 12.7 FT.
HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

*Geotest Engineering, Inc.*

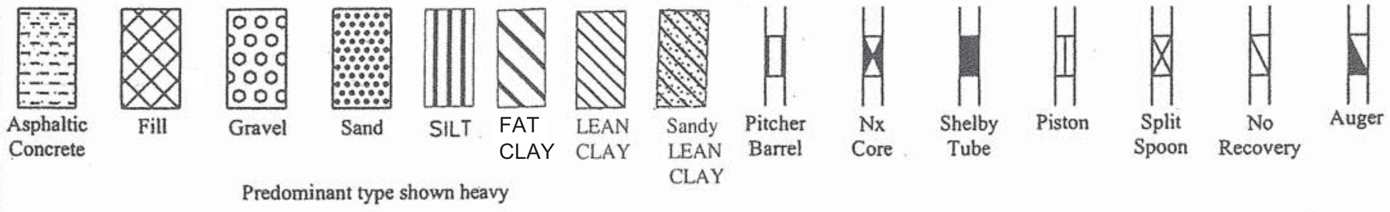
ADDENDUM NO. 1

Job No. 1140252701

# SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOL COLUMN)

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



## TERMS DESCRIBING CONSISTENCY OR CONDITION

| Basic Soil Type | Density or Consistency | Standard Penetration Resistance, (1) Blows/ft. | Unconfined Compressive Strength ($q_u$), (2) Tons/sq. ft. |
|---|---|---|---|
| Cohesionless | Very loose | Less than 4 | Not applicable |
| | Loose | 4 to <10 | Not applicable |
| | Medium dense | 10 to <30 | Not applicable |
| | Dense | 30 to <50 | Not applicable |
| | Very dense | 50 or greater | Not applicable |
| Cohesive | Very soft | Less than 2 | Less than 0.25 |
| | Soft | 2 to <4 | 0.25 to <0.5 |
| | Firm/Medium stiff | 4 to <8 | 0.5 to <1.0 |
| | Stiff | 8 to <15 | 1.0 to <2.0 |
| | Very stiff | 15 to <30 | 2.0 to <4.0 |
| | Hard | 30 or greater | 4 or greater |

(1) Number of blows from 140-lb. weight falling 30-in. to drive 2-in. OD, 1-3/8-in. ID, split barrel sampler (ASTM D1586)

(2) $q_u$ may also be approximated using a pocket penetrometer

## TERMS CHARACTERIZING SOIL STRUCTURE

Parting: -paper thin in size
Seam: -1/8" to 3" thick
Layer: -greater than 3"

| | |
|---|---|
| Slickensided | - having inclined planes of weakness that are slick and glossy in appearance. |
| Fissured | - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical. |
| Laminated | - composed of thin layers of varying color and texture. |
| Interbedded | - composed of alternate layers of different soil types. |
| Calcareous | - containing appreciable quantities of calcium carbonate. |
| Well graded | - having wide range in grain sizes and substantial amounts of all intermediate particle sizes. |
| Poorly graded | - predominantly of one grain size, or having a range of sizes with some intermediate size missing. |
| Flocculated | - pertaining to cohesive soils that exhibit a loose knit or flakey structure. |

*Geotest Engineering, Inc.*

FIGURE A-4

# APPENDIX B

## SUMMARY OF LABORATORY TEST RESULTS

*GEOTEST ENGINEERING, INC.*

PROJECT NAME: Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NUMBER: 1140252701

| BORING NO. | SAMPLE |  |  |  | SPT (blows/ft.) | WATER CONTENT (%) | DRY DENSITY (pcf) | ATTERBERG LIMITS |  |  | PASSING NO. 200 SIEVE (%) | UNCONFINED COMPRESSION TEST | TRIAXIAL COMPRESSION TEST (U-U) |  | TORVANE | POCKET PENE-TROMETER | TYPE OF MATERIAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | No. | Depth (ft.) Top | Depth (ft.) Bottom | Type |  |  |  | LL | PL | PI |  | Shear Strength (tsf) | Shear Strength (tsf) | Conf. Press. (tsf) | Shear Strength (tsf) | Shear Strength (tsf) |  |
| GB-1 | 1 | 0.0 | 1.1 | UD |  | 8.8 |  |  |  |  |  |  |  |  |  |  | Asphalt |
|  | 2 | 1.1 | 2.0 | UD |  | 18.2 |  |  |  |  |  |  |  |  | 0.50 | 0.50 | Fill |
|  | 3 | 2.0 | 4.0 | UD |  | 19.8 | 104 | 43 | 20 | 23 | 91.3 |  | 0.88 | 0.29 | 0.75 | 0.75 | Fill |
|  | 4 | 4.0 | 6.0 | UD |  | 22.8 |  |  |  |  |  |  |  |  | 0.75 | 1.00 | Fat Clay |
|  | 5 | 6.0 | 8.0 | UD |  | 21.8 |  |  |  |  |  |  |  |  | 1.00 | 1.25 | Fat Clay |
|  | 6 | 8.0 | 10.0 | UD |  | 45.3 | 89 | 62 | 25 | 37 | 87.9 |  | 0.81 | 0.65 | 0.75 | 1.00 | Fat Clay |
|  | 7 | 10.0 | 12.0 | UD |  | 22.4 |  | 30 | 18 | 12 | 91.0 |  |  |  | 0.50 | 0.75 | Lean Clay |
|  | 8 | 12.0 | 14.0 | UD |  | 27.0 |  | 51 | 22 | 29 | 90.4 |  |  |  | 0.40 | 0.38 | Fat Clay |
|  | 9 | 14.0 | 15.0 | UD |  | 26.7 |  |  |  |  |  |  |  |  | 0.50 | 0.38 | Fat Clay |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-1

ADDENDUM NO. 1

SUMMARY OF LABORATORY TEST RESULTS

*GEOTEST ENGINEERING, INC.*

PROJECT NAME: Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NUMBER: 1140252701

| BORING NO. | SAMPLE | | | | SPT (blows/ft.) | WATER CONTENT (%) | DRY DENSITY (pcf) | ATTERBERG LIMITS | | | PASSING NO. 200 SIEVE (%) | UNCONFINED COMPRESSION TEST | TRIAXIAL COMPRESSION TEST (U–U) | | TORVANE | POCKET PENE–TROMETER | TYPE OF MATERIAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth (ft.) | | | | | | | | | | | | | | | |
| | No. | Top | Bottom | Type | | | | LL | PL | PI | | Shear Strength (tsf) | Shear Strength (tsf) | Conf. Press. (tsf) | Shear Strength (tsf) | Shear Strength (tsf) | |
| GB–2 | 1 | 0.0 | 1.2 | UD | | 14.5 | | | | | | | | | | | Asphalt |
| | 2 | 1.2 | 2.0 | UD | | 19.5 | | 24 | 15 | 9 | 84.2 | | | | 0.50 | | Lean Clay w/Sand |
| | 3 | 2.0 | 4.0 | UD | | 21.0 | | | | | | | | | 0.75 | 1.00 | Lean Clay w/Sand |
| | 4 | 4.0 | 6.0 | UD | | 22.3 | 110 | 45 | 20 | 25 | 80.5 | | 1.08 | 0.43 | 0.75 | 1.00 | Lean Clay w/Sand |
| | 5 | 6.0 | 8.0 | UD | | 18.4 | 113 | | | | | | 0.67 | 0.58 | 0.50 | 1.00 | Lean Clay w/Sand |
| | 6 | 8.0 | 10.0 | UD | | 20.6 | | 23 | 18 | 5 | 59.7 | | | | | | Sandy Silt |
| | 7 | 10.0 | 12.0 | UD | | 20.9 | | | | | | | | | | | Sandy Silt |
| | 8 | 12.5 | 14.0 | SS | 7 | 20.7 | | | | | 39.4 | | | | | | Silty Sand |
| | 9 | 14.0 | 15.0 | UD | | 20.7 | | | | | | | | | 1.00 | 2.00 | Lean Clay |
| | | | | | | | | | | | | | | | | | |
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LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx–DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B–2

ADDENDUM NO. 1

# SUMMARY OF LABORATORY TEST RESULTS

*GEOTEST ENGINEERING, INC.*

PROJECT NAME: Jackson Avenue Drainage and Pavement Improvements
Galveston County, Texas

PROJECT NUMBER: 1140252701

| BORING NO. | SAMPLE | | | | SPT (blows/ft.) | WATER CONTENT (%) | DRY DENSITY (pcf) | ATTERBERG LIMITS | | | PASSING NO. 200 SIEVE (%) | UNCONFINED COMPRESSION TEST | TRIAXIAL COMPRESSION TEST (U-U) | | TORVANE | POCKET PENE-TROMETER | TYPE OF MATERIAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Depth (ft.) Top | Depth (ft.) Bottom | Type | | | | LL | PL | PI | | Shear Strength (tsf) | Shear Strength (tsf) | Conf. Press. (tsf) | Shear Strength (tsf) | Shear Strength (tsf) | |
| GB-3 | 2 | 1.2 | 2.0 | UD | | 24.4 | | | | | | | | | 1.00 | 1.25 | Lean Clay w/Sand |
| | 3 | 2.0 | 4.0 | UD | | 16.9 | 116 | 43 | 20 | 23 | 75.0 | | 1.28 | 0.29 | 0.88 | 2.00 | Lean Clay w/Sand |
| | 4 | 4.0 | 6.0 | UD | | 20.5 | | | | | | | | | 0.45 | 0.88 | Fat Clay |
| | 5 | 6.0 | 8.0 | UD | | 23.1 | 106 | 62 | 26 | 36 | 96.5 | | 1.35 | 0.58 | 1.25 | 1.50 | Fat Clay |
| | 6 | 8.0 | 10.0 | UD | | 27.9 | | | | | | | | | 1.13 | 1.50 | Lean Clay |
| | 7 | 10.0 | 12.0 | UD | | 23.6 | | 35 | 19 | 16 | 93.6 | | | | 0.40 | 0.38 | Lean Clay |
| | 8 | 12.0 | 14.0 | UD | | 24.0 | 103 | 61 | 26 | 35 | 96.0 | | 0.85 | 1.01 | 1.25 | 1.38 | Fat Clay |
| | 10 | 16.0 | 18.0 | UD | | 18.9 | | 41 | 19 | 22 | 82.7 | | | | 1.00 | 1.13 | Lean Clay w/Sand |
| | 11 | 18.0 | 20.0 | UD | | 22.6 | | | | | | | | | 1.38 | 1.75 | Lean Clay w/Sand |
| | 12 | 23.0 | 25.0 | UD | | 28.3 | | | | | | | | | 1.13 | 1.88 | Fat Clay |
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LEGEND:

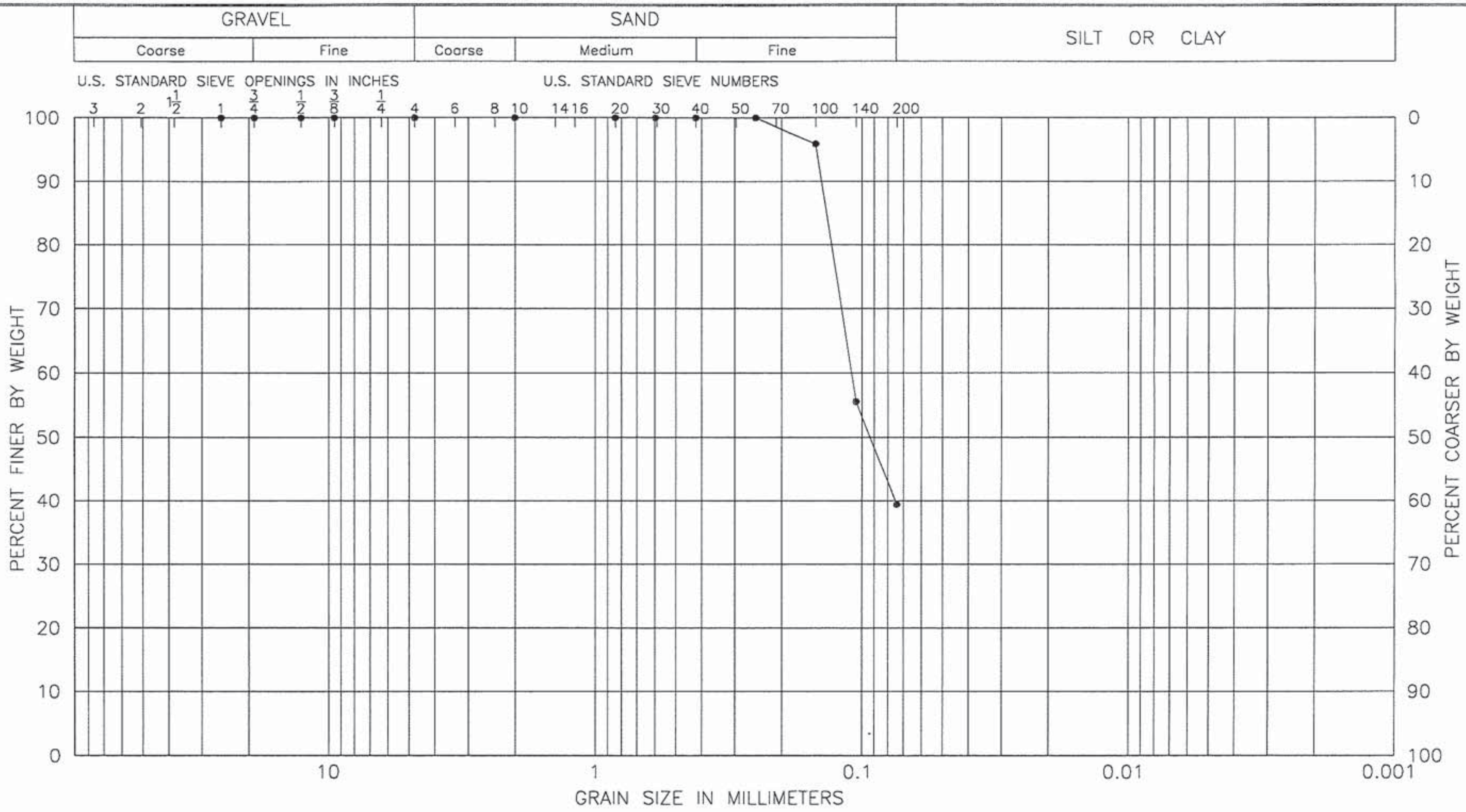
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-3

ADDENDUM NO. 1

Job No. 1140252701



| LEGEND | BORING NO. | SAMPLE NO. | DEPTH FT. | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| ●●●●● | GB-2 | S-7 | 12.5-140.0 | Reddish brown silty sand |

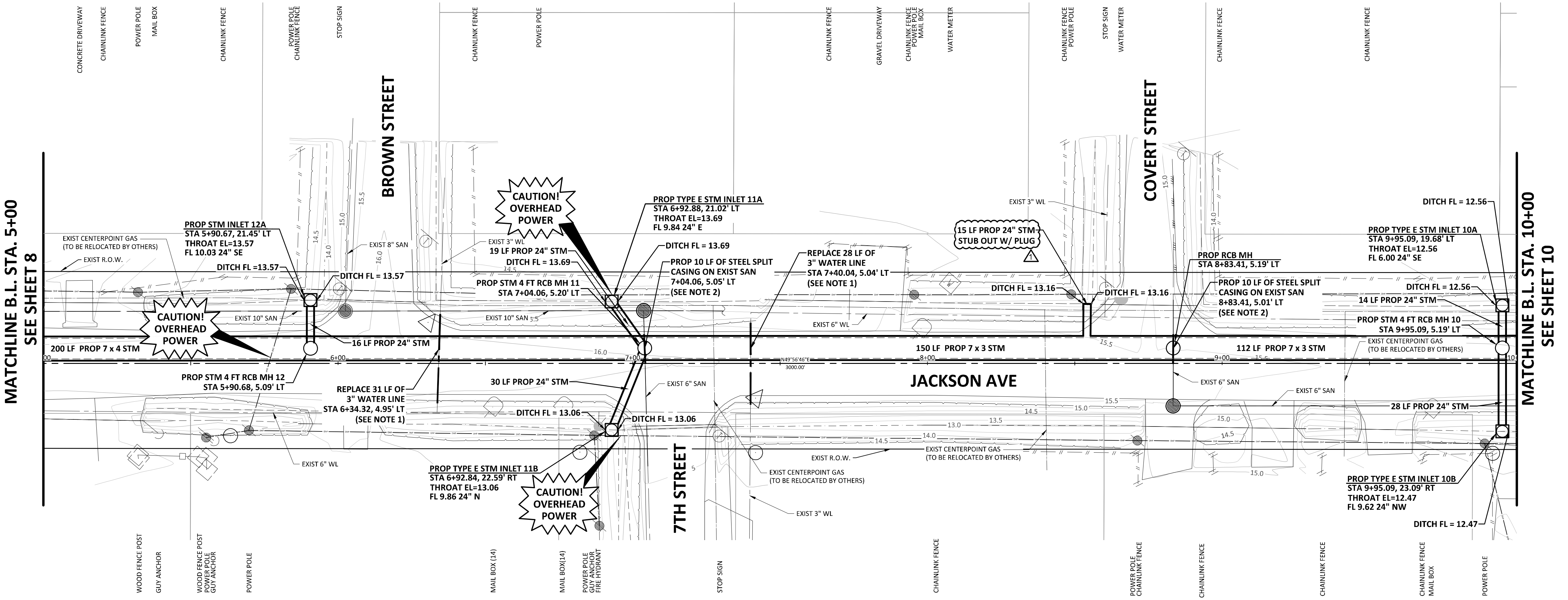
# GRAIN SIZE DISTRIBUTION CURVES

*Geotest Engineering, Inc.*

FIGURE B-4

ADDENDUM NO. 1

ADDENDUM NO. 1



20' 0' 20'
SCALE
1"=20'

NOTES:

1. 3" WATER LINE TO BE REPLACED WITH NEW PVC MATCHING EXISTING O.D. NEW PIPING TO EXTEND 2' PAST EDGE OF PAVEMENT WITH NEW QUANTAM COUPLINGS (STYLE 461).
2. IF EXISTING SAN IS CLAY REPLACE WITH PVC SDR26 MATCHING EXISTING O.D. AND ENCASE WITH SPLIT STEEL CASING. IF EXISTING SAN IS PVC, SAN TO REMAIN IN PLACE AND ADD SPLIT STEEL CASING.
3. MILL AND OVERLAY FULL WIDTH OF PAVEMENT FROM STA. 0+00 TO STA. 28+62.
4. REGRADE DITCHES AROUND INLETS FOR POSITIVE DRAINAGE. BOTH SIDES TO MATCH FLOW LINES.

## NOTICE:

FOR YOUR SAFETY, YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG SO THAT UNDERGROUND LINES CAN BE MARKED. THIS SIGNATURE DOES NOT FULFILL YOUR OBLIGATION TO CALL 811

## VERIFICATION OF PRIVATE UTILITY LINES

Date

CenterPoint Energy natural gas utilities shown.
(Gas service lines are not shown). This signature not to be used for conflict verification.

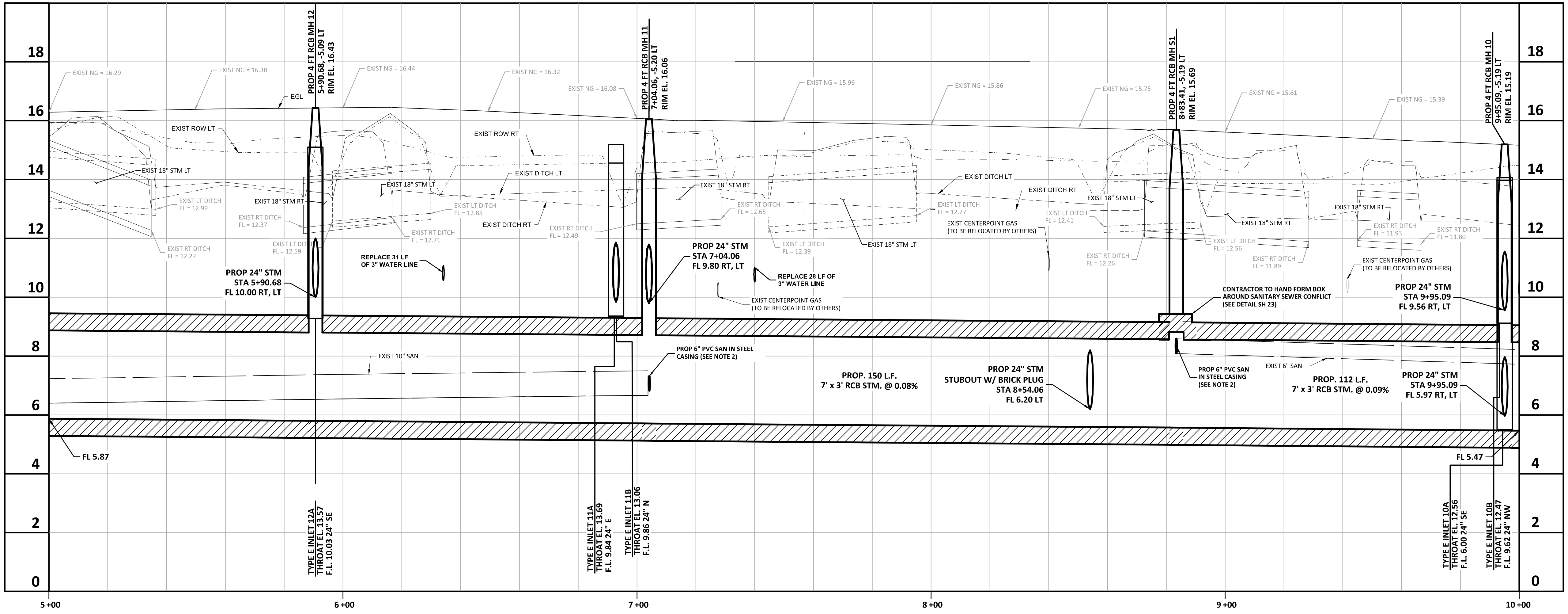
Signature valid for six months.

Date

CenterPoint Energy/UNDERGROUND Electrical Facilities Verification ONLY.
(This signature verifies existing underground facilities - not to be used for conflict verification)

Signature valid for six months.

## JACKSON AVENUE



\\fs3\projects\1300\13060800 Jackson Avenue Paving & Drainage Improvements\CAD\DWG\C-PP1.dwg [10 JACKSON AVENUE PLAN AND PROFILE STA. 5+00 TO STA. 10+00] Plotted Oct 22, 2021 at 8:40am by mpoulin (Last Saved by: mpoulin)

| MK | DESCRIPTION | DATE | DWN. | CHK. |
|---|---|---|---|---|
| 1 | ADDENDUM 1 | 10/22/21 | MTP | RAF |
| | | | | |
| | | | | |
| | | | | |

RICHARD A. FULLER
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10/12/2021

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TxEng Firm 2726
TxSurv Firm 10110700

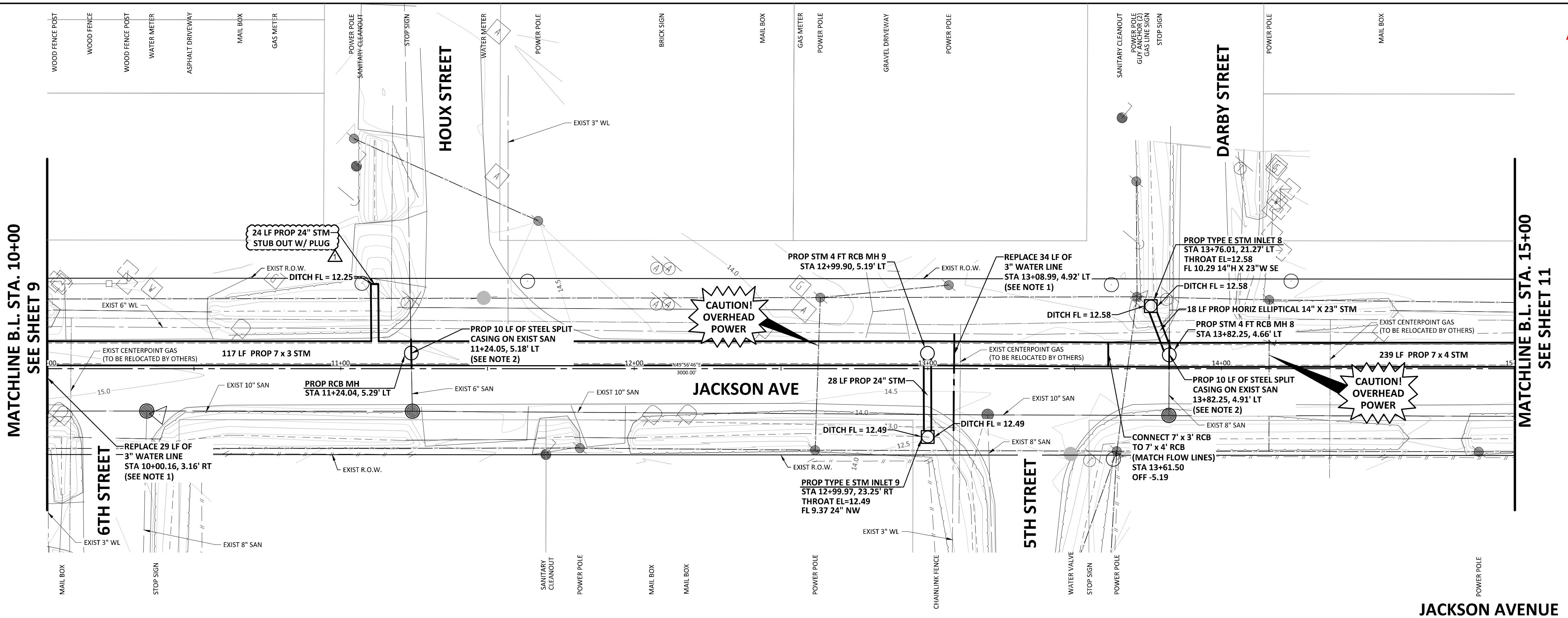
COUNTY OF GALVESTON

JACKSON AVENUE DRAINAGE
IMPROVEMENTS

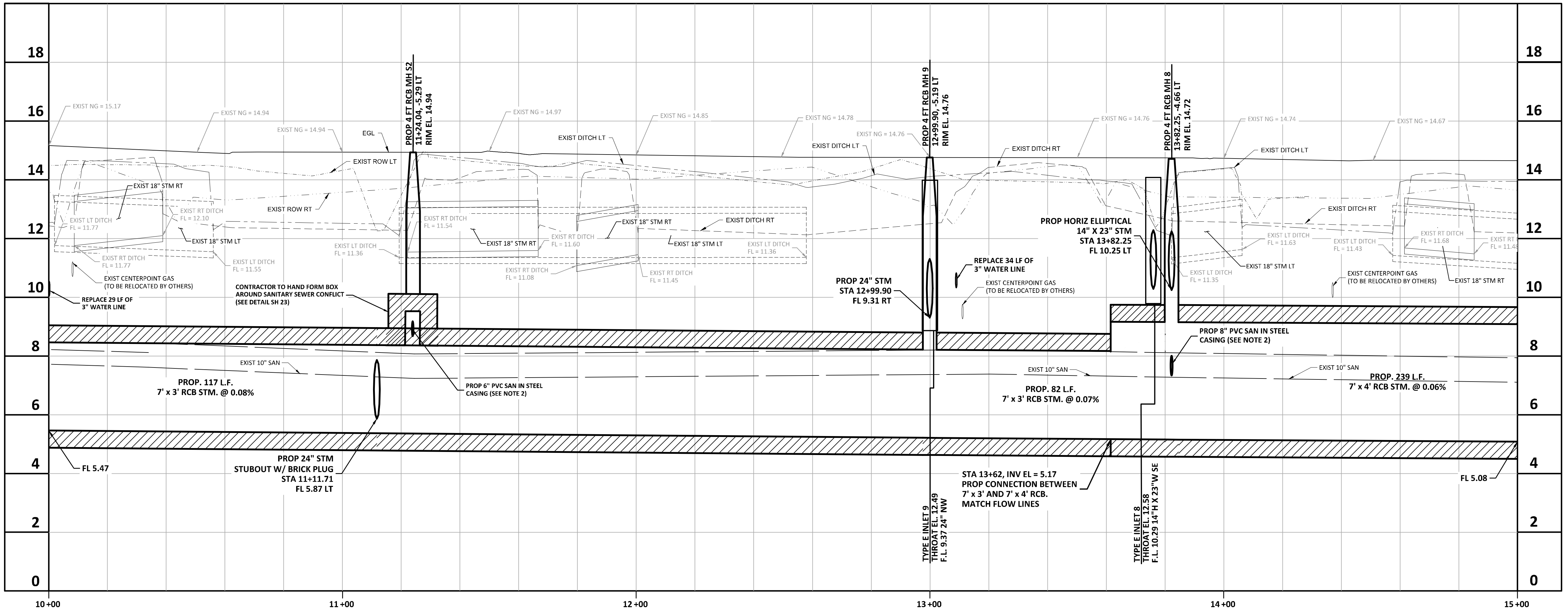
# JACKSON AVENUE
# PLAN AND PROFILE
# STA. 5+00 TO STA. 10+00

Project No.: 1306-008-00
Date: 10-04-2021
Dwn By: A.A./A.B.
Chkd By: R.A.F.
Scale:
HORZ : 1"=20'
VERT : 1"=2'
SHEET 9 OF 32

ADDENDUM NO. 1



## JACKSON AVENUE



20' 0' 20'
SCALE
1"=20'

NOTES:

1. 3" WATER LINE TO BE REPLACED WITH NEW PVC MATCHING EXISTING O.D. NEW PIPING TO EXTEND 2' PAST EDGE OF PAVEMENT WITH NEW QUANTAM COUPLINGS (STYLE 461).
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| MK | DESCRIPTION | DATE | DWN. | CHK. |
|---|---|---|---|---|
| 1 | ADDENDUM 1 | 10/22/21 | MTP | RAF |
| | | | | |
| | | | | |
| | | | | |

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COUNTY OF GALVESTON

JACKSON AVENUE DRAINAGE
IMPROVEMENTS

JACKSON AVENUE
PLAN AND PROFILE
STA 10+00 TO STA 15+00

Project No.: 1306-008-00
Date: 10-04-2021
Dwn By: A.A./A.B.
Chkd By: R.A.F.
Scale:
HORZ : 1"=20'
VERT : 1"=2'
SHEET 10 OF 32

\\fs3\projects\1300\130600800 Jackson Avenue Paving & Drainage Improvements\CAD\DWG\C-PP1.dwg [11 JACKSON AVENUE PLAN AND PROFILE STA 10+00 TO STA 15+00] Plotted Oct 22, 2021 at 8:41am by mpoulin (Last Saved by: mpoulin)