



THE COUNTY OF GALVESTON

RUFUS G. CROWDER, CPPO, CPPB
PURCHASING AGENT

GWEN MCLAREN, CPPB
ASST. PURCHASING AGENT

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

April 26, 2018

PROJECT NAME: Gum Bayou Channel Improvement

BID NO: B181036

RE: ADDENDUM #1

To All Prospective Bidders:

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

Question #1: *There are three attested signatures on the bid bond form. Who other than the principal and surety are requested to sign?*

Response: The principle and surety are only required to sign.

Question #2: *Will the engineer/owners provide control staking?*

Response: The engineer/ owners will provide control staking at the start of Construction Contract.

Question #3: *I assume the dirt generated on items 6,7,& 8 will go offsite. Are you aware of a disposal site?*

Response: It is the intent of the Contract that all surplus excavated material will be hauled off the site. The Contractor is responsible to find a disposal site that should have approval of Galveston County.

Question #4: *Does Galveston County have any restrictions regarding where surplus dirt may be disposed?*

Response: See answer to Question # 3.

Question #5: *Are there Geotechs available for this project?*

Response: The Geotechnical Report is included in the Project Manual as part of Contract Documents.

Question #6: *Will the pre-bid sign-in sheet be available as well as if any addenda have been issued?*

Response: The pre-bid sign-in sheet is included with this addendum.

Question #7: *Which bridge is being demolished?*

Response: The wooden bridge at Sta.16+30 is called out for removal. There are other removals called out in the plans.

Question #8: *What permits, if any, is the Contractor required to obtain?*

Response: Galveston County does not require a permit for the construction of the project. Depending on the location of the disposal of excess dirt, a permit may be required from the jurisdiction having authority of the disposal location. Heavy haul or oversize permits may be required depending on contractor's haul route and equipment.

Question #9: *Is there a burn policy effective in Galveston County?*

Response: The Texas Commission on Environmental Quality regulates outdoor burning in the unincorporated part of the County. The Galveston County Health District has an "Outdoor Burning Rule & Checklist" located at <http://www.gchd.org/home/showdocument?id=2436>. In drought conditions the County Judge has authority to issue a burn ban.

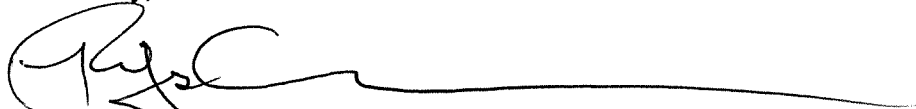
As a reminder, all questions regarding this proposal must be submitted in writing to:

Rufus G. Crowder, CPPO CPPB
Galveston County Purchasing Agent
722 Moody, Fifth (5th) Floor
Galveston, Texas 77550
E-mail: rufus.crowder@co.galveston.tx.us

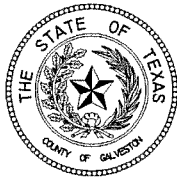
If you have any further questions regarding this proposal, please address them to Rufus Crowder, CPPO CPPB, Purchasing Agent, via e-mail at rufus.crowder@co.galveston.tx.us, or contact the Purchasing Department at (409) 770-5371.

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

Sincerely,



Rufus G. Crowder, CPPO CPPB
Purchasing Agent
Galveston County



THE COUNTY OF GALVESTON

RUFUS G. CROWDER, CPPO, CPPB
PURCHASING AGENT

GWEN MCLAREN, CPPB
ASST. PURCHASING AGENT

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

April 30, 2018

PROJECT NAME: Gum Bayou Channel Improvement

BID NO: B181036

RE: ADDENDUM #2

To All Prospective Bidders:

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

OPENING DATE:

Bid #B181036, Gum Bayou Channel Improvement originally scheduled to be opened on Thursday, May 3, 2018 at 2:00 P.M has been re-scheduled. The new deadline for submitting a proposal is as follows:

Date: Thursday, May 10, 2018
Time: 2:00 P.M.

Question #1: *You indicate in Addendum #1 that a Geotechnical Report is included in the project manual. Looking through the Specifications and Contract Documents, I don't see one.*

Response: Attached to this addendum you will find the Geotechnical Report.

As a reminder, all questions regarding this proposal must be submitted in writing to:

Rufus G. Crowder, CPPO CPPB
Galveston County Purchasing Agent
722 Moody, Fifth (5th) Floor
Galveston, Texas 77550
E-mail: rufus.crowder@co.galveston.tx.us

If you have any further questions regarding this proposal, please address them to Rufus Crowder, CPPO CPPB, Purchasing Agent, via e-mail at rufus.crowder@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,

Handwritten signature of Rufus G. Crowder in black ink, with the initials "RD" written above the name.

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
Galveston County

PROJECT SCOPE

1. Project Scope

(a) Under this Contract, the Contractor shall furnish all materials, appliances, tools, equipment, transportation, services, and all labor and superintendence necessary for construction of the work as described in these Specifications and as shown on the Plans and/or Exhibits. The completed installation shall not lack any part which can be reasonably implied as necessary to its proper functioning nor any subsidiary item which is customarily furnished, and the Contractor shall deliver the completed and operating installation to the Owner.

(b) Work in general under this Contract includes, but is not limited to, the following:

Providing the necessary materials, equipment, supervision, labor and appurtenances to construct improvements for Gum Bayou Sections (M15, N10, M3). The upstream limits of the channel improvements is located approximately 500ft South of FM 646 (River Station 129+62) and downstream limit is located approximately 700 ft north of Branding Iron Circle (River Station 94+80). The total length of channel improvements is 3482 feet.

Crossing removal and construction: Wood Bridge at RAS River Station (RS) 122+01 (Structure 1), Water Crossing at RS 118+03 (Structure 2), Wood Bridge at RS 109+08 (Structure 3), & Water Crossing at RS 98+33 (Structure 4) will be removed. Structures 1 & 2 will not be replaced. Structure 3 will be replaced with a Water Crossing (5-10'x10'); and Structure 4 will be replaced with an improved Water Crossing (4-60" RCP).

Channel improvements: The proposed channel improvements within the project limits will have side slopes of 4:1 (H:V) or flatter and maintenance berms of 15 feet. Improvements start at an elevation of 3.0 feet from RAS River Station (RS) 129+62 to RS 109+26.8 and RS 98+58.6 to RS 94+80. Improvements start at an elevation of 4.0 feet from RS 109+26.8 to RS 98+58.6. No work will be performed below OHWM (Ordinary High Water Mark) designated at elevation 2.07 feet.

**LIMITED GEOTECHNICAL STUDY
PROPOSED GUM BAYOU CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS
PROJECT ID: P21471**

PROJECT NO. 13-792E



TO

**DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS**

BY

GEOTECH ENGINEERING AND TESTING

SERVICING

TEXAS, LOUISIANA, NEW MEXICO, OKLAHOMA

www.geotecheng.com

FEBRUARY 2014



GEOTECH ENGINEERING and TESTING



ACCREDITED

Geotechnical, Environmental, Construction Materials, and Forensic Engineering

Dannenbaum Engineering Corporation
3100 West Alabama
Houston, Texas 77098

Project No. 13-792E
Report No. 1
Report Type: 10/29/E
February 11, 2014

Attention: Mr. Larry Marr, P.E.
Senior Project Manager

**LIMITED GEOTECHNICAL STUDY
PROPOSED GUM BAYOU CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS
PROJECT ID: P21471**

Gentlemen:

Submitted here is the report of Geotech Engineering and Testing (GET) geotechnical study for the proposed Gum Bayou Channel Improvements at the above referenced location. This study was conducted in general accordance with our proposal No. P13-276, dated November 01, 2013. Authorization to proceed with this study was received through a Subcontract for Consultant Services Agreement between Dannenbaum Engineering Corporation and Geotech Engineering and Testing, signed by Mr. Wayne G. Ahrens, P.E., Executive V.P. on November 18, 2013.

This report presents the results of our field exploration and laboratory testing together with design recommendations for the proposed Gum Bayou Channel Improvements in Galveston County, Texas.

We appreciate the opportunity to be of service. Should you have any questions or need additional assistance, please call.

Very truly yours,

GEOTECH ENGINEERING AND TESTING

Rick Manzur, Ph.D., E.I.T.
Project Manager

Moe Tavassoli, Ph.D., P.E.
Engineering Manager



Moe Tavassoli
02-11-14

RM/MT/rm

- Copies Submitted: (1) Hard Copy – Dannenbaum Engineering Corporation – Mr. Larry Marr, P.E.
(1) PDF Copy Email – Mr. Larry Marr, P.E.
(1) PDF Copy Email – Isani Consultants – Mr. Mark Mareda

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APPENDICES

Appendix A – Project Site Pictures

1.0 EXECUTIVE SUMMARY

It is planned to make improvements to the existing Gum Bayou Channel in Galveston County, Texas. The proposed improvements will consist of widening and deepening the existing channel. Furnished information indicated that the length of the channel improvements will be about 3,060-ft and the channel will be about 10-ft deep. A site vicinity map is presented on Plate 1.

Soil stratigraphy and groundwater conditions for the proposed channel improvements were explored by conducting seven (7) soil borings (B-1 through B-7) along the channel alignment to a depth of 20-ft to evaluate soil stratigraphy and to obtain soil samples for laboratory testing. Results of these data and our engineering analyses are summarized below:

1. In general, based on our field exploration and laboratory test data, the soils in the area of the proposed channel improvements appear to be variable. The soils stratigraphy for the channel improvements based on Borings B-1 through B-7 are summarized as follows:

<u>Stratum No.</u>	<u>Range of Depth, ft.</u>	<u>Soil Description</u>
I	0 – 6	SANDY LEAN CLAY, firm to very stiff, light brown, brownish yellow, light gray, dark brown, with root fibers, ferrous and calcareous nodules (CL)
II	0 – 20	FAT CLAY, firm to very stiff, light brown, brownish yellow, reddish brown, dark brown, with root fibers to 8', ferrous and calcareous nodules, moist (CH)
III	0 – 4	SILTY SAND, dark brown, light gray (SM); Boring B-7 only
IV	6 – 20	LEAN CLAY, very soft to stiff, light brown, dark brown, brownish yellow, reddish brown, light gray, with ferrous and calcareous nodules, sands, moist (CL); Borings B-3 and B-5 only
V	16 – 20	SANDY SILT, loose to medium dense, dark brown, reddish brown, light gray, with clay pockets (ML); Boring B-3 only

2. Depth to groundwater is important for the proposed channel improvements. Water level observations were made during and short term after drilling. Our short-term field exploration indicated that groundwater was encountered at a depth of 13-ft to 15-ft below the existing grade during drilling. Groundwater level was recorded at a depth of 5-ft to 15-ft shortly after drilling.
3. Based on the review of soil and groundwater data, we recommend a slope ratio of 4 (h): 1 (v).
4. We recommend a grass slope protection along the channel side slopes, provided flow velocities are less than four feet per second.

2.0 INTRODUCTION

It is planned to make improvements to the existing Gum Bayou Channel in Galveston County, Texas. The proposed improvements will consist of widening and deepening the existing channel. Furnished information indicated that the length of the channel improvements will be about 3,060-ft and the channel will be about 10-ft deep. A site vicinity map is presented on Plate 1.

The purpose of our work was to conduct a field exploration, laboratory testing, engineering analyses and develop general recommendations regarding suitable slopes and erosion protection based on soil type and experience. **Detailed slope stability analysis was outside the scope of the current study.**

3.0 FIELD EXPLORATION

At the request of the client, the soil conditions were explored by conducting seven (7) soil borings (B-1 through B-7), located approximately as shown on Plate 2. Borings B-1 through B-3 were drilled using a truck mounted drilling rig. Due to the inaccessibility of the site to truck mounted drilling rig and presence of soft ground condition, the remaining borings (B-4 through B-7) were drilled using a portable hand rig. Soil samples were obtained continuously at boring locations from the ground surface to a depth of 20-ft. The cohesive soils were sampled in general accordance with ASTM D 1587.

Cohesionless soils were generally sampled with a split-spoon sampler driven in general accordance with the Standard Penetration Test (SPT), ASTM D 1586. This test is conducted by recording the number of blows required for a 140-pound weight falling 30 inches to drive the sampler 12 inches into the soil. Driving resistance for the SPT, expressed as blows per foot of sampler resistance (N), is tabulated on the boring logs.

Soil samples were examined and classified in the field, and cohesive soil strengths were estimated using a calibrated hand penetrometer. This data, together with a classification of the soils encountered and strata limits, is presented on the soil stratigraphy profile, Plate 3 and logs of borings, Plates 4 through 10. A key to the log terms and symbols is shown on Plate 11.

The borings were drilled dry, without the aid of drilling fluids, to more accurately estimate the depth to groundwater. Water level observations made during and short terms after drilling are indicated at the bottom portion of the individual logs.

4.0 LABORATORY TESTS

4.1 General

Soil classifications and shear strengths were further evaluated by laboratory tests on representative samples of the major strata. The laboratory tests were performed in general accordance with ASTM Standards. Specifically, ASTM D 2487 is used for classification of soils for engineering purposes.

4.2 Classification Tests

As an aid to visual soil classifications, physical properties of the soils were evaluated by classification tests. The tests were conducted in general accordance with ASTM Standards. These tests consisted of natural moisture content tests (ASTM D 4643), percent finer than the No. 200 sieve tests (ASTM D 1140), Atterberg limit determinations (ASTM D 4318, Method A) and dry unit weights. Similarity of these properties is indicative of uniform strength and compressibility characteristics for soils of essentially the same geological origin. Results of these tests are tabulated on the boring logs at respective sample depths.

4.3 Strength Tests

Undrained shear strengths of the cohesive soils, measured in the field, were verified by calibrated hand penetrometer tests, unconfined compressive strength tests (ASTM D 2166) and torvane tests. Natural water content and dry unit weight were determined routinely for each unconfined compressive strength test. These test results are also presented on the boring logs.

4.4 Particle Size Analysis Tests

This test was conducted in general accordance with ASTM D 422, the Standard Method for Particle-Size Analysis of Soils. The soil sample was first separated into two portions using the No. 10 (2.0-mm) sieve. A sieve analysis was performed on the soil samples retained on the No. 200 sieve, if any obtained. The portion of soil samples passing the No. 10 sieve then went into the hydrometer tests followed by another sieve analysis to complete the particle size distribution curve. Soil samples had to be soaked in the sodium hexametaphosphate solution (40 g/L), dispersed by stirring the beaker, and kept in the sedimentation cylinder in order to obtain accurate hydrometer readings. This test was performed on selected samples obtained from Borings B-1, B-3, B-5 and B-7. The analysis results are presented on Plates 12 through 15.

4.5 Soil Sample Storage

Soil samples tested or not tested in the laboratory will be stored for a period of two weeks subsequent to submittal of the final report. The samples will be discarded after this period, unless we are instructed otherwise.

5.0 GENERAL SOILS AND DESIGN CONDITIONS

5.1 Site Conditions

The project alignment along the channel banks is generally cleared and covered with grass, shrubs and some trees. Project site pictures were taken during our site visit and drilling operations. These pictures are presented on the cover page and Appendix A.

5.2 Soil Stratigraphy

Details of subsoil conditions at each boring location are presented on the respective boring logs. In general, the soil stratigraphy for the proposed channel improvements are as follows:

Stratum No.	Range of Depth, ft.	Soil Description
I	0 – 6	SANDY LEAN CLAY, firm to very stiff, light brown, brownish yellow, light gray, dark brown, with root fibers, ferrous and calcareous nodules (CL)
II	0 – 20	FAT CLAY, firm to very stiff, light brown, brownish yellow, reddish brown, dark brown, with root fibers to 8', ferrous and calcareous nodules, moist (CH)
III	0 – 4	SILTY SAND, dark brown, light gray (SM); Boring B-7 only
IV	6 – 20	LEAN CLAY, very soft to stiff, light brown, dark brown, brownish yellow, reddish brown, light gray, with ferrous and calcareous nodules, sands, moist (CL); Borings B-3 and B-5 only
V	16 – 20	SANDY SILT, loose to medium dense, dark brown, reddish brown, light gray, with clay pockets (ML); Boring B-3 only

5.3 Soil Properties

Soil strength and index properties and how they relate to design of the proposed channel are summarized below:

Stratum No.	Soil Type	PI(s)	SPT	Soil Expansivity	Soil Strength, tsf	Remarks
I	Sandy Lean Clay (CL)	18– 30	–	Non-Expansive to Expansive	0.46 – 1.56	–
II	Fat Clay (CH)	31– 52	–	Expansive to Highly Expansive	0.07 – 1.50	–
III	Silty Sand (SM)	–	–	Non-Expansive	–	Moisture Sensitive
IV	Lean Clay with Sand (CL)	23	–	Expansive	0.07 – 0.54	–
V	Sandy Silt (ML)	–	10 – 11	Non-Expansive	–	Moisture Sensitive

Legend: PI = Plasticity Index
SPT = Standard Penetration Tests

5.4 Water-Level Measurements

The soil borings were drilled dry to evaluate the presence of perched or free-water conditions. The levels where free water was encountered in the open boreholes during and short term after drilling are shown on the boring logs. Groundwater measurements are summarized below:

Boring No.	Measured Groundwater Depth, ft.	
	During Drilling	After 0.33-hours
B-1 and B-4	13	13
B-2, B-3 and B-5	15	15
B-6	13	5
B-7	14	14

Fluctuations in groundwater generally occur as a function of seasonal moisture variation, temperature, groundwater withdrawal, water level in the existing channel and future construction activities that may alter the surface drainage and subdrainage characteristics at the proposed project site.

We recommend that the groundwater level be verified just channel improvement construction. We also recommend that GET be immediately notified if a noticeable change in groundwater occurs from that mentioned in our report. We would be pleased to evaluate the effect of any groundwater changes on our design and construction sections of this report.

6.0 CHANNEL IMPROVEMENT RECOMMENDATIONS

6.1 General

It is planned to make improvements to the existing Gum Bayou Channel in Galveston County, Texas. Furnished information indicated that the length of the channel improvements will be about 3,060-ft and the channel will be about 10-ft deep.

6.2 Soil Stratigraphy

Based on our field exploration and laboratory test data, the soils generally consist of firm to very stiff reddish brown and dark brown Sandy Lean Clay (CL), Fat Clay (CH) and loose dark brown Silty Sand (SM) soils to about 10-ft. This is underlain by very soft to stiff dark brown, dark gray, brownish yellow, reddish brown Fat Clay (CH) and Lean Clay (CL) to about 10 to 20-ft. However, loose to medium dense dark brown, reddish brown, light gray Sandy Silt (ML) was encountered in Boring B-3 at a depth of 16 to 20-ft. All borings were terminated at a depth of 20-ft.

6.3 Recommended Slope Ratios

Based on subsoils encountered along the proposed channel improvements, results of laboratory tests and our local experience, we recommend a channel slope ratio of 4 horizontal to 1 vertical, 4(h):1(v) for the proposed channel improvements.

6.4 Slope Erosion Protection

6.4.1 General

Our laboratory testing indicated the subsoils along with the Gum Bayou consist of clay, silty sand and sandy silt soils. The clay soils are generally non-dispersive. The sandy silt and silty sand soils are generally dispersive. Erosion problems are usually associated with channel slopes especially where control structures such as outfall and weir structures will be located. Excessive erosion can lead to a loss of ground and gradual (progressive) sloughing of the slopes. Consequently, progressive slope failures can occur. Our recommendations for slopes erosion protection are as follows:

6.4.2 Slope Erosion Protection

Our erosion protection recommendations are generally in accordance with Section III of Galveston County “Rules, Regulations and Requirements to the Approval and Acceptance or Improvements in Subdivisions or Re-subdivisions”, October 03, 2005 (Ref. 1). Dressing of the channel slopes with surface erosion control systems should ensure successful long-term performance. These systems may consist of the following:

6.4.2.1 Grass Cover

Grass cover can provide a suitable erosion protection system provided the root systems can sustain the peak velocities or less than four feet per second. Turf grass shall be established per the guidelines contained in Section III of Galveston County Rules, Regulations and Requirements to the Approval and Acceptance or Improvements in Subdivisions or Re-subdivisions, October 03, 2005 (Ref. 1). Periodic observation of channel basin slopes should be planned to identify areas that may require a more positive erosion protection system.

6.4.2.2 Riprap

Ripraps are stone or broken concrete rubbles widely used for erosion protection of slopes. Protection of the toe is critical for providing acceptable stability. The design and construction of rip-rap for the channel locations should be in general accordance with Section 10.5 - Riprap and Appendix D- Riprap Detail Sheet of HCFCD, Policy, Criteria, and Procedure Manual, December 2010 (Ref. 1) and Section 02378 - Riprap and Granular Fill of HCFCD Standard Specifications, August 2005 (Ref. 3).

6.4.2.3 Geotextiles

Geotextiles may be placed directly against the slope to serve as a filter layer to prevent migration on site soils through a crushed stone rip-rap layer. The rip-rap layer should consist of four to eight-inch diameter crushed stone with thicknesses on the order of 12-inches. In the areas of steeper slopes, baskets should be used for support of the geotextile and rip-rap layer. Alternatively, geotextiles are now available that can be used without rip-rap to minimize erosion.

6.4.2.4 Concrete Lining

This type of erosion control system is effective when placed on top of subgrade soils compacted to at least 95% of maximum standard density (ASTM D 698) at a moisture content between optimum and + 3% of optimum. The concrete lining shall be constructed per the guidelines presented in Section III of Galveston County “Rules, Regulations and Requirements to the Approval and Acceptance or Improvements in Subdivisions or Re-subdivisions”, October 03, 2005 (Ref. 1). Fully lined cross-section should have a minimum bottom width of eight ft.

The minimum concrete lining thickness on slope and bottom should be in accordance with Section III of Galveston County "Rules, Regulations and Requirements to the Approval and Acceptance or Improvements in Subdivisions or Re-subdivisions", October 03, 2005 (Ref. 1), and be reinforced in each direction with reinforcement as discussed in Ref. 1. In the areas where loose or soft soils are encountered, a seal of slab of Class C concrete should be placed in channel bottom prior to the placement of concrete slope paving. The loose or soft soils should be removed, moisture conditioned and recompact to at least 95% of maximum dry density (ASTM D 698). Drainage holes should be placed at fixed intervals at the lower portion of concrete lining to prevent hydrostatic pressure build up behind the concrete liner.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Site Drainage

It is recommended that site drainage be well developed. Surface water should be directed away from the top bank of the slope. Drainage weep holes should be placed at fixed intervals on the concrete lining (if used) to prevent ponding of water behind the concrete liner.

7.2 Groundwater Control

We understand that the maximum channel depth will be about 10-ft. Water level observations were made during and shortly after drilling. The range of short term groundwater level encountered was approximately between 5-ft and 15-ft below existing grade.

Therefore, groundwater dewatering may be required along the channel alignment. In the event that groundwater is encountered during construction, it is our opinion that groundwater should be lowered to a depth of at least three-ft below the deepest excavation grade in order to provide dry working conditions and firm bedding. Any minor water inflow in cohesive soil layers can probably be removed using a sump-pump or trench sump-pump. Wellpoint system can be used in the area where silty sand/sandy silt soils are present. The selection and proper implementation of an effective groundwater control system is the responsibility of the contractor.

Design of a wellpoint system should consider the amount of groundwater to be lowered and the permeability of the affected soils. The selection and proper implementation of an effective groundwater control system is the responsibility of the contractor. The design of groundwater and surface water should be in accordance with The City of Galveston Specifications, Section 01563 – Control of Groundwater and Surface Water.

7.3 Excavations

Each side of an excavation or trench which is five-ft or deeper must be protected by sheeting/bracing shoring or sloped. Based on soil strength data and OSHA soil classifications, temporary (less than 24 hours) open-trenched, non-surcharged, and unsupported excavations should be made on slopes of about 1.5(h):1(v). Vertical cuts can be constructed, provided shoring and bracing are used for the excavation wall stability. Benched excavation can also be used with average slopes of about 1(h):1(v) and steps should not be higher than five-ft. In all cases, excavations should conform to OSHA guidelines. Flatter slopes may have to be used if large amounts of sand need to be excavated for deep installations. Specifications should require that no water be allowed to pond in the excavations. The surface slopes should be protected from deterioration and weathering if they are to be left open for more than 24 hours.

Excavations should be performed with equipment capable of providing a relatively clean bearing area. Excavation equipment should not disturb the soil beneath the design excavation bottom and should not leave large amounts of loose soil in the excavation.

Based on our field exploration and laboratory test results, cohesionless soils may be encountered during excavation. In addition, shallow groundwater table exists at the project site. Therefore, bottom blow up will be an issue during excavation. The excavation process should be properly monitored by an experienced geotechnical engineer.

7.4 Earthwork

Site preparation for the proposed channel improvements should be conducted in accordance with The City of Galveston Specifications, Section 02105 – Site Preparations. In general, our recommendations for site preparations are summarized below:

1. Remove all soft soils, vegetation, root fibers and any organic materials from the face of the slopes.
2. The bearing surface should be protected against disturbance and deterioration by completing the back-filling operations as quickly as possible. The excavation bottom should be properly sloped to allow any water infiltrating into the excavation at the convenient location along the edge of the excavation. Water should not be allowed to stand on the bearing area.
3. Remove all soft and wet soils. The excavation bottom areas should then be proofrolled with a loaded dump truck, or similar pneumatic-tired equipment with loads ranging from 25- to 50-tons. The proofrolling serves to compact surficial soils and to detect any soft or loose zones. The proofrolling should be conducted in accordance with TxDOT Standard Specification Item 216. Any soils deflecting excessively under moving loads should be undercut to firm soils and recompacted. The proofrolling operations should be observed by an experienced geotechnician.

4. Scarify the subgrade, add moisture, or dry if necessary, and recompact to 95% of the maximum dry density as determined by ASTM D 698 (Standard Proctor). The moisture content at the time of compaction of subgrade soils should be between optimum and +3% of the Proctor optimum value. We recommend that the degree of compaction and moisture in the subgrade soils be verified by field density tests at the time of construction.
5. If off-site fills are used to stabilize or construct the slope, they should consist of sandy clay (CL) soils with liquid limit of less than 50 and plasticity index between 15 to 30, non-dispersive in Pinhole test Method A and 60% to 85% passing the No. 200 sieve. In addition, each layer should be placed in lifts not exceeding 8-inches and compacted to 95% of maximum Proctor dry density (ASTM D 698) in accordance to the City of Galveston Specifications, Section 02226 through 02229 (Ref. 4).
6. Side slopes should be compacted to 95% of standard Proctor density (ASTM D 698) with moisture content between optimum and +3% of the Proctor optimum value, using a heavy crawler tractor, winching the compactor up and down the slope with cable (Yo-Yo fashion) or a vibrator tractor compactor.

7.5 Suitability of On-site Soils for Use as Fill

Fill requirements should be in accordance with in accordance to the City of Galveston Specifications, Section 02226 through 02229 (Ref. 4).

7.5.1 General

The on-site soils can be used as fill. There are typically three types of fill at a site. These fills can be classified as described in the following report sections.

7.5.2 Select Structural Fill

This is the type of fill that can be used under the floor slabs, paving, etc. These soils should consist of lean clays, free of root organics, with plasticity indices between 7 and 20 and amount of passing No. 200 sieve greater than 50 percent.

7.5.3 Structural Fill

This type does not meet the Atterberg limit requirements for select structural fill. This fill should consist of lean clays or fat clays. They can be used for the underground utilities backfill and post-tensioned slab after treatment.

7.5.4 General Fill

This type of fill consists of sands and silts. These soils are moisture sensitive and are difficult to compact in a wet condition (they may pump). These soils can be used as structural fill with the understating that they can erode easily and if they get wet, they are difficult to compact (they may pump). These soils can result in a perched water table. The owner and the civil engineer must be aware of these potential issues.

7.5.5 Use of On-Site Soils as Fill

The on-site soils can be used as fill materials as described below:

Stratum No. ⁽¹⁾	Soil Type	Use as Fill			Notes
		Select Structural Fill	Structural Fill	General Fill	
I	Sandy Lean Clay (CL)	–	✓	✓	2, 3
II	Fat Clay (CH)	–	✓	✓	2, 4
III	Silty Sand (SM)	–	✓	✓	2, 5
IV	Lean Clay (CL)	–	✓	✓	2, 6
V	Sandy Silt (ML)	–	✓	✓	2, 5

Notes:

1. See soil stratigraphy and design conditions sections of this report for strata description.
2. All fill soils should be free of organics, roots, etc.
3. Some of these soils, once lime modified (5% by dry weight), can be used as select structural fill.
4. These soils, once lime modified (7% by dry weight), can be used as select structural fill.
5. The on-site cohesionless soils are moisture sensitive and erode easily. These soils will pump when they get wet. Compaction difficulties will occur in these soils in a wet condition.
6. These soils, once lime modified (4% by dry weight), can be used as select structural fill.

7.6 Construction Surveillance

Construction surveillance and quality control tests should be planned to verify materials and placement in accordance with the specifications. The recommendations presented in this report were based on a discrete number of soil test borings. Soil type and properties may vary across the site. As a part of quality control, if this condition is noted during the construction, we can then evaluate and revise the design and construction to minimize construction delays. We recommend the following quality control procedures be followed by a qualified engineer or technician during the construction of the proposed channel basin:

- Observe all phases of excavations.
- Observe the site stripping, sloping and proofrolling.
- Monitor the dewatering during excavation for potential bottom blow up.
- Verify the compaction of subgrade soils.
- Evaluate the quality of fill and monitor the fill compaction for all lifts.
- Monitor concrete placement, conduct slump tests and make concrete cylinders.

It is the responsibility of the client to notify GET when each phase of the construction is taking place so that proper quality control and procedures are implemented.

8.0 RECOMMENDED ADDITIONAL STUDIES

The recommendations provided in this report are preliminary and are based on very limited number of soil borings. We recommend additional soil borings be conducted for the detailed design and construction of the proposed channel improvements.

9.0 STANDARD OF CARE

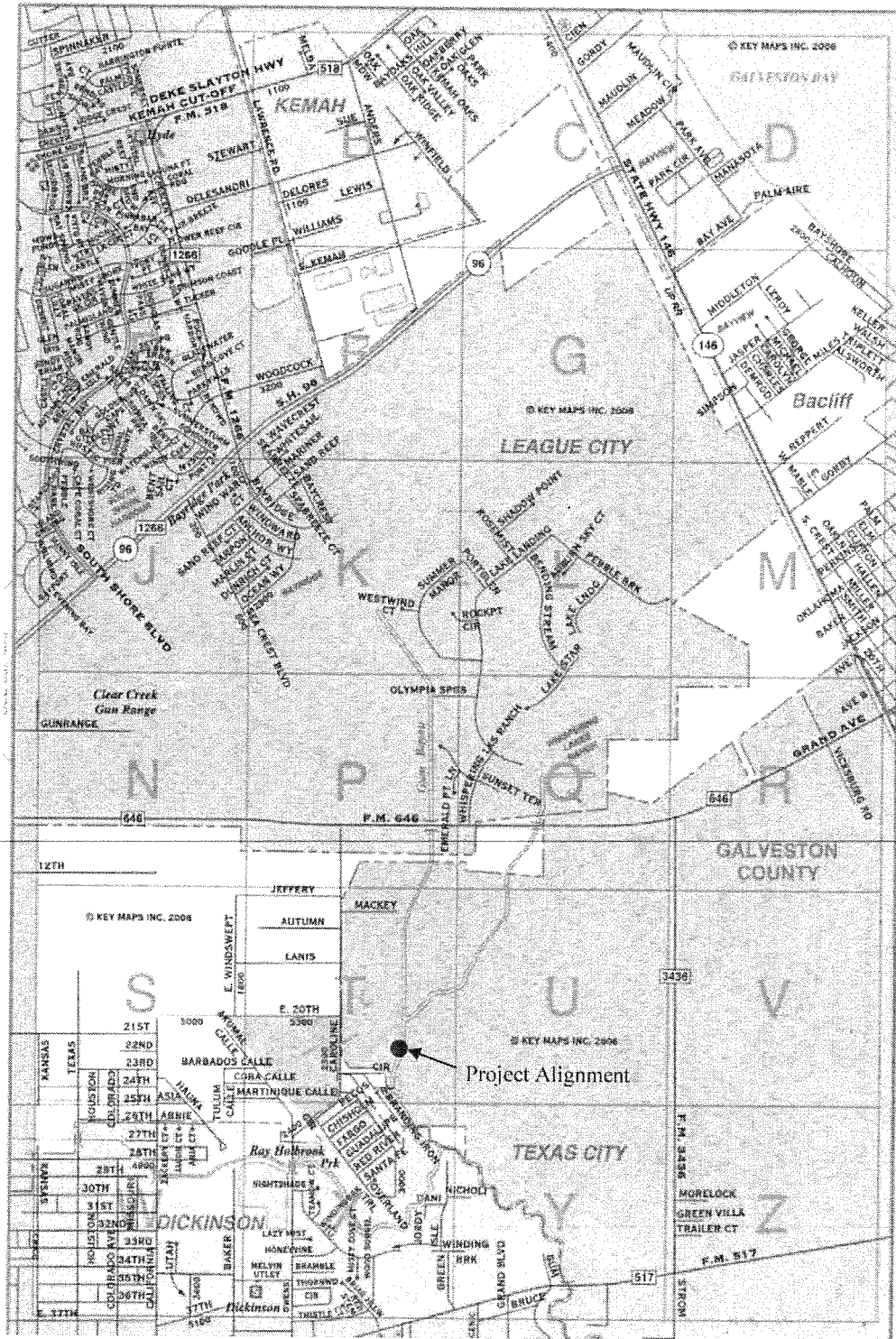
The recommendations described herein were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical engineering profession practicing contemporaneously under similar conditions in the locality of the project. No other warranty or guarantee, expressed or implied, is made other than the work was performed in a proper and workmanlike manner.

10.0 REPORT DISTRIBUTION

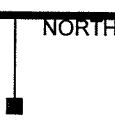
This report was prepared for the sole and exclusive use by our client, based on specific and limited objectives. All reports, boring logs, field data, laboratory test results, maps and other documents prepared by GET as instruments of service shall remain the property of GET. Reuse of these documents is not permitted without written approval by GET. GET assumes no responsibility or obligation for the unauthorized use of this report by other parties and for purposes beyond the stated project objectives and work limitations.

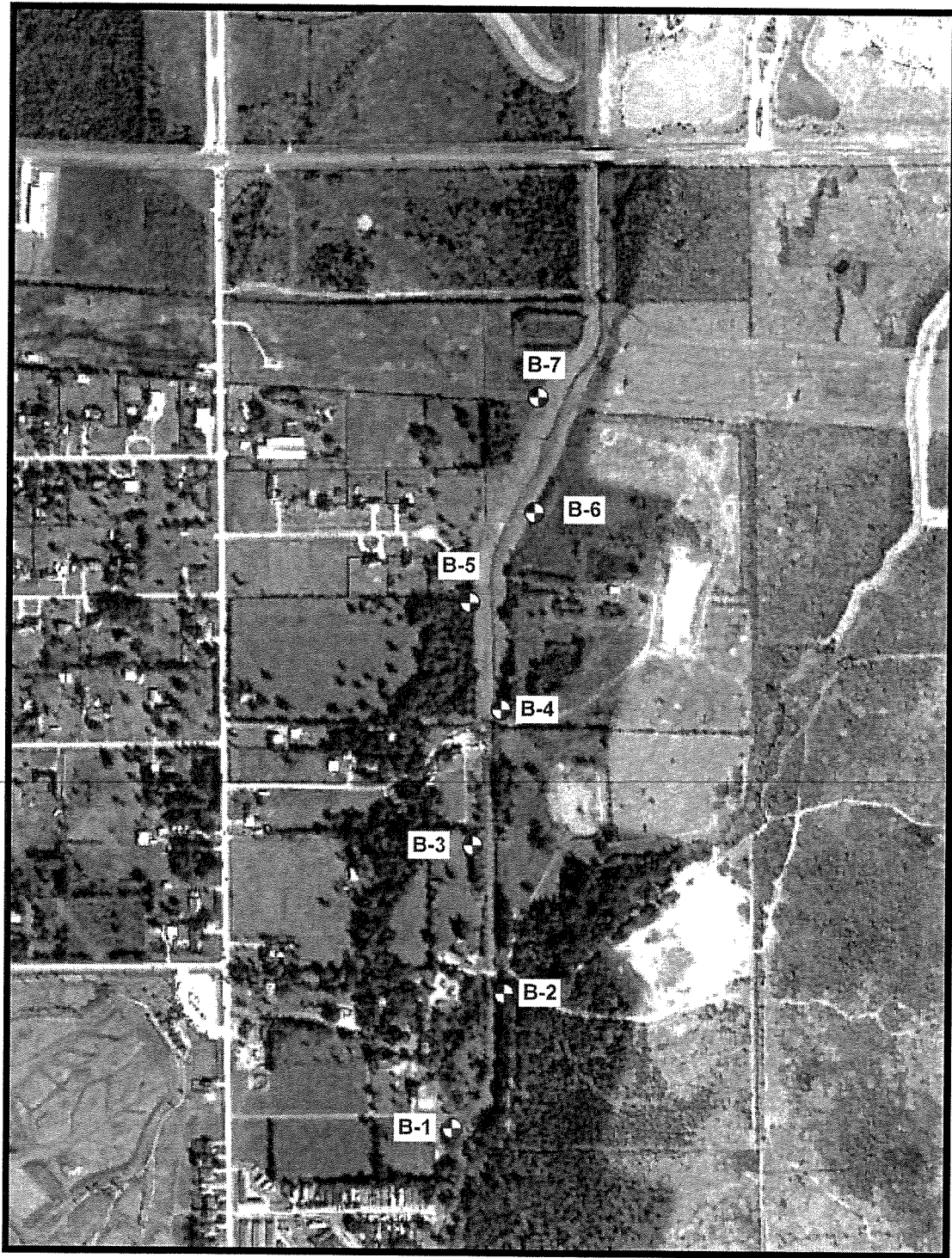
11.0 REFERENCES

1. Galveston County "Rules, Regulations and Requirements Relating to the Approval and Acceptance of Improvements in Subdivisions or Re-Subdivisions" dated October 03, 2005.
2. "Harris County Flood Control District Policy, Criteria, and Procedure Manual", by Harris County Flood Control District, 2010.
3. "Harris County Flood Control District 2005 Standard Specifications Book", by Harris County Flood Control District, August 2005.
4. "City of Galveston Specifications", City of Galveston.



SITE VICINITY MAP		
PROJECT: Limited Geotechnical Study for Gum Bayou Channel Improvements, Galveston County, Texas Project ID: P21471		
SCALE: NOT TO SCALE	DATE: FEBRUARY 2014	PROJECT NO.: 13-792E





PLAN OF BORINGS (boring locations are approximate)

PROJECT: Limited Geotechnical Study for Gum Bayou Channel Improvements, Galveston County, Texas
 Project ID: P21471

SCALE: NOT TO SCALE



DATE: FEBRUARY 2014



PROJECT NO.: 13-792E

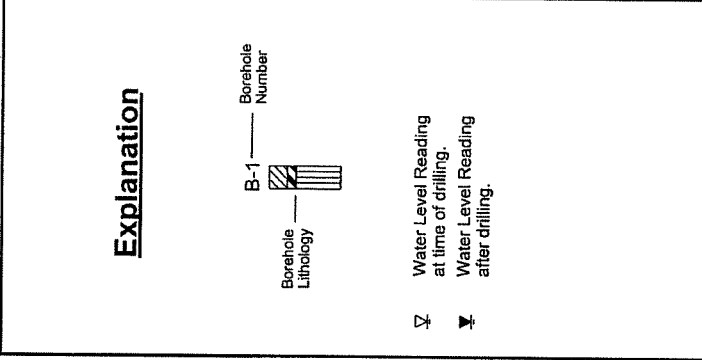
NORTH



Explanation

 Borehole Lithology
 Borehole Number

 Water Level Reading at time of drilling.
 Water Level Reading after drilling.



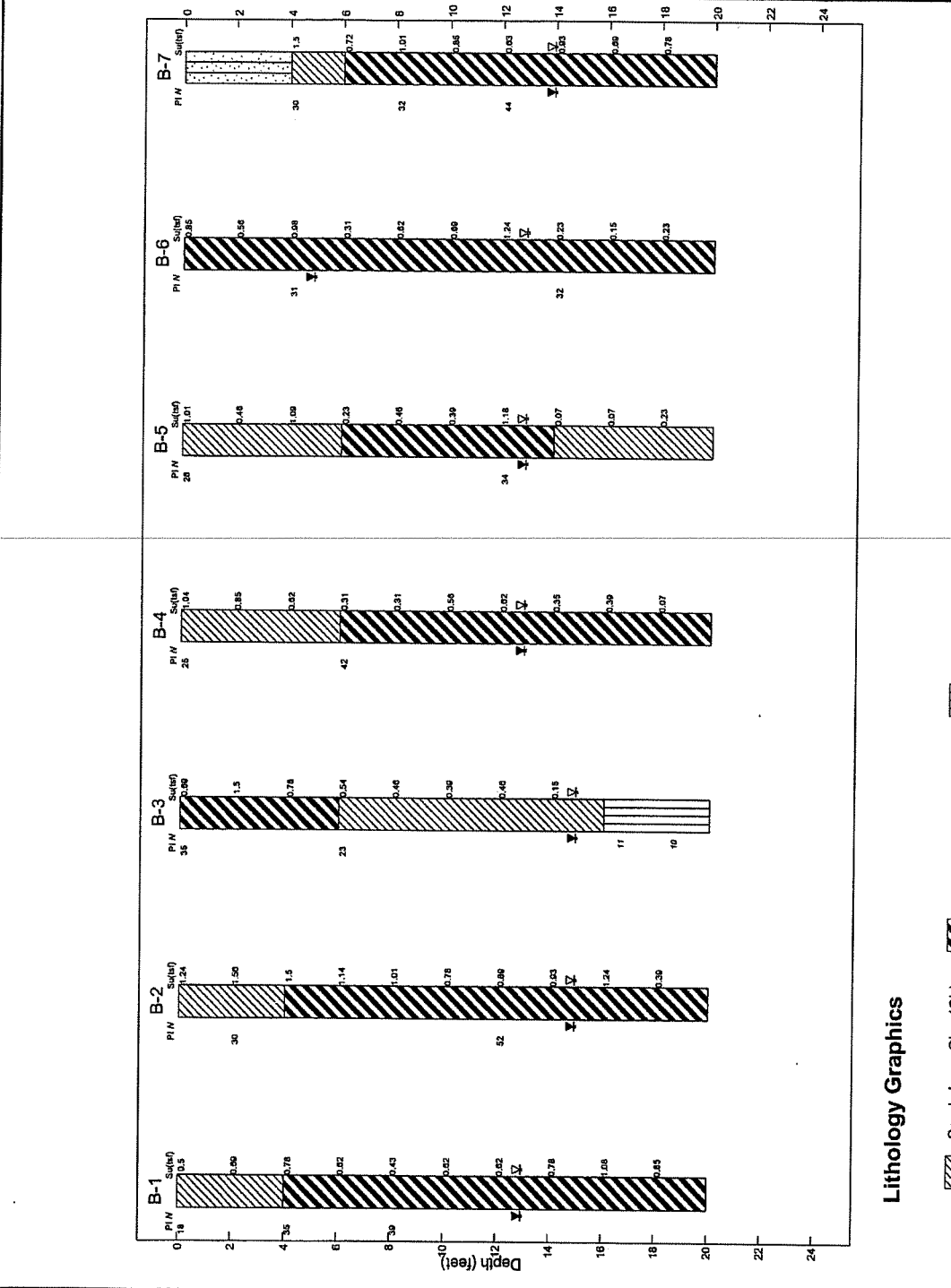
Geotech Engineering and Testing
800 Victoria Drive
Houston, Texas 77022

Proposed Gum Bayou Channel Improvement

Galveston County
Texas

JOB NUMBER	PLATE NUMBER
13-792E	PLATE 3

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Proposed Gum Bayou Channel Improvement

Galveston County
Texas

JOB NUMBER	PLATE NUMBER
13-792E	PLATE 3

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LOG OF BORING NO. B-1

Sheet 1 of 1



Geotech Engineering and Testing
 800 Victoria Drive
 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
LOCATION: Galveston County, Texas
PROJECT NO.: 13-792E **STATION NO.:**
DATE: 12-3-13 **COMPLETION DEPTH:** 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (PIF)	UNDRAINED SHEAR STRENGTH, tsf																									
														0.5	1.0	1.5	2.0	2.5																					
0				ELEVATION: Existing Grade																																			
				SANDY LEAN CLAY (CL), stiff, light brown, brownish yellow, with root fibers, ferrous and calcareous nodules	21	35	17	18	62		105			▲	■																								
5				FAT CLAY (CH), stiff, light brown, brownish yellow, with root fibers to 8', ferrous and calcareous nodules	24	54	19	35						▲	■																								
				- firm 8' to 10'																																			
10				- dark brown, reddish brown 10' to 20'	31	60	21	39			95			▲	■																								
15				- very stiff 16' to 18'										▲	■																								
20														▲	■																								

WATER OBSERVATIONS:

∇ : WATER ENCOUNTERED AT 13.0 ft. DURING DRILLING

▽ : WATER DEPTH AT 13.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: _____ TO _____ ft.

DRILLED BY: GET(T)
 LOGGED BY: Abraham

OVM2 13-792E.GPJ OVM.GDT 1/24/14

LOG OF BORING NO. B-2

Sheet 1 of 1



Geotech Engineering and Testing
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 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-3-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf
0				ELEVATION: Existing Grade										
				SANDY LEAN CLAY (CL), very stiff, light brown, brownish yellow, with root fibers, ferrous and calcareous nodules	19	48	18	30			120			▲ HAND PENETROMETER ■ TORVANE ● UNCONFINED COMPRESSION ○ UNCONSOLIDATED-UNDRAINED TRIAXIAL 0.5 1.0 1.5 2.0 2.5
5				FAT CLAY (CH), very stiff, light brown, brownish yellow, light gray, with root fibers to 6', ferrous and calcareous nodules	22						90			
10				- stiff, reddish brown 10' to 16'										
15				- reddish brown, light gray 16' to 20'										
20				- firm 18' to 20'	33	74	22	52	93		85			

WATER OBSERVATIONS:

▽: WATER ENCOUNTERED AT 15.0 ft. DURING DRILLING
 ▼: WATER DEPTH AT 15.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: TO TO ft.

DRILLED BY: GET(T)
 LOGGED BY: Abraham

OVM2 13-792E.GPJ OVM.GDT 1/22/14

LOG OF BORING NO. B-3

Sheet 1 of 1



Geotech Engineering and Testing
 800 Victoria Drive
 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-3-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf						
														0.5	1.0	1.5	2.0	2.5		
0				ELEVATION: Existing Grade																
0 - 5			Diagonal Hatching	FAT CLAY (CH), very stiff, light brown, brownish yellow, dark brown, with root fibers to 4', ferrous and calcareous nodules - very stiff 2' to 4'	28	55	20	35							▲	■				
5 - 10			Diagonal Hatching	LEAN CLAY WITH SAND (CL), stiff, light brown, light gray, brownish yellow, with ferrous and calcareous nodules - firm, reddish brown 8' to 14'	20	41	18	23	84		105				■					
10 - 15			Diagonal Hatching	- soft, reddish brown 14' to 16'											▲	■				
15 - 20			Vertical Lines	SANDY SILT (ML), medium dense, dark brown, reddish brown, light gray, with clay pockets - loose 18' to 20'											■					

WATER OBSERVATIONS:
 ▽ : WATER ENCOUNTERED AT 15.0 ft. DURING DRILLING
 ▼ : WATER DEPTH AT 15.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: TO TO ft.

DRILLED BY: GET(T)
 LOGGED BY: Abraham

OVM2 13-792E.GPJ OVM.GDT 1/24/14

LOG OF BORING NO. B-4

Sheet 1 of 1



Geotech Engineering and Testing
 800 Victoria Drive
 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-12-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf
0				ELEVATION: Existing Grade										
				SANDY LEAN CLAY (CL), very stiff, light gray, dark brown, with root fibers to 4', ferrous and calcareous nodules	18	44	19	25	67		111			▲
				- stiff, brownish yellow 2' to 6'										■
5				FAT CLAY (CH), firm, reddish brown, dark brown, with ferrous and calcareous nodules	21	52	10	42						▲
				- stiff, light gray 10' to 14'										■
10				- light gray 14' to 20'										▲
15				- soft 18' to 20'	27						100			■
20														▲

WATER OBSERVATIONS:

▽ : WATER ENCOUNTERED AT 13.0 ft. DURING DRILLING
 ▼ : WATER DEPTH AT 13.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: TO ft.

DRILLED BY: GET(P)
 LOGGED BY: Samson

OVM2 13-792E.GPJ OVM.GDT 1/22/14

LOG OF BORING NO. B-5

Sheet 1 of 1



Geotech Engineering and Testing
 800 Victoria Drive
 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-12-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FALLING (P/F)	UNDRAINED SHEAR STRENGTH, tsf
0					ELEVATION: Existing Grade										0.5 1.0 1.5 2.0 2.5
					SANDY LEAN CLAY (CL), very stiff, light gray, dark brown, with root fibers to 6', ferrous and calcareous nodules	18	45	19	26						▲
					- firm, brownish yellow 2' to 4'										■
5					FAT CLAY (CH), soft, brownish yellow, light gray, with ferrous nodules	18						111			●
					- firm 8' to 12'										○
10					- very stiff, reddish brown 12' to 14'										▲
						21	55	21	34	94		106			■
15					LEAN CLAY WITH SAND (CL), very soft, light gray, dark brown, reddish brown, with ferrous and calcareous nodules, wet										●
					- soft 18' to 20'										○
20															▲

WATER OBSERVATIONS:

▽ : WATER ENCOUNTERED AT 13.0 ft. DURING DRILLING
 ▼ : WATER DEPTH AT 13.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: TO TO ft.

DRILLED BY: GET(P)
 LOGGED BY: Samson

OVM2 13-792E.GPJ OVM.GDT 1/24/14

LOG OF BORING NO. B-6

Sheet 1 of 1



Geotech Engineering and Testing
 800 Victoria Drive
 Houston, Texas 77022
 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-12-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVM, ppm	SYMBOL	SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (PIF)	UNDRAINED SHEAR STRENGTH, tsf
0					ELEVATION: Existing Grade										0.5 1.0 1.5 2.0 2.5
					FAT CLAY (CH), stiff, dark brown, light gray, with root fibers to 4', ferrous and calcareous nodules										▲ HAND PENETROMETER
					- brownish yellow 2' to 20'										■ TORVANE
5					- firm 6' to 8'	20	50	19	31	88		103			● UNCONFINED COMPRESSION
															○ UNCONSOLIDATED-UNDRAINED TRIAXIAL
10					- very stiff 12' to 14'	40						94			
					- light brown, soft 14' to 20'	25	50	18	32						
15															
20															

WATER OBSERVATIONS:
 ▽ : WATER ENCOUNTERED AT 13.0 ft. DURING DRILLING
 ▼ : WATER DEPTH AT 5.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft. DRILLED BY: GET(P)
 WET ROTARY: TO TO ft. LOGGED BY: Samson

OVM2 13-792E.GPJ OVM.GDT 1/24/14

LOG OF BORING NO. B-7

Sheet 1 of 1



Geotech Engineering and Testing
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 Phone: 713-699-4000 Fax: 713-699-9200

PROJECT: Proposed Gum Bayou Channel Improvement
 LOCATION: Galveston County, Texas
 PROJECT NO.: 13-792E STATION NO.:
 DATE: 12-12-13 COMPLETION DEPTH: 20.0 ft.

DEPTH, ft	SPT N-VALUE blows per foot	OVN, ppm	SYMBOL SAMPLES	DESCRIPTION	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	PERCENT PASSING NO. 200 SIEVE	SUCTION (pF)	DRY UNIT WEIGHT, pcf	PERCENT COMPACTION	PASSING/FAILING (P/F)	UNDRAINED SHEAR STRENGTH, tsf
0				ELEVATION: Existing Grade										
0				SILTY SAND (SM), dark brown, light gray, with root fibers to 4', clay pockets, moist										
5				SANDY LEAN CLAY (CL), very stiff, light gray, light brown, with ferrous and calcareous nodules, moist	17	48	18	30						
5				FAT CLAY (CH), stiff, light brown, brownish yellow, light gray, with ferrous and calcareous nodules	22						95			
				- very stiff 8' to 10'										
10					21	51	19	32	90					
				- dark brown, reddish brown 12' to 14'										
15					28	65	21	44			82			
20														

WATER OBSERVATIONS:

∇ : WATER ENCOUNTERED AT 14.0 ft. DURING DRILLING

∇ : WATER DEPTH AT 14.0 ft. AFTER 0.33-HOUR

DRY AUGER: 0 TO 20 ft.
 WET ROTARY: TO TO ft.

DRILLED BY: GET(P)
 LOGGED BY: Samson

OVN/2 13-792E.GPJ OVM.GDT 1/22/14

KEY TO LOG TERMS AND SYMBOLS

UNIFIED SOIL CLASSIFICATIONS		TERMS CHARACTERIZING SOIL STRUCTURE	
Symbol	Material Descriptions		
GW	WELL GRADED-GRAVELS, GRAVEL-SAND MIXTURES LITTLE OR NO FINES	Slickensided	- Having incline planes of weakness that are slick and glossy in appearance.
GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	Fissured	- Containing shrinkage cracks frequently filled with fine sand or silt; usually vertical.
GM	SILTY GRAVELS, GRAVEL-SAND SILT MIXTURES	Laminated	- Composed of thin layers of varying colors and soil sample texture.
GC	CLAY GRAVELS, GRAVEL-SAND CLAY MIXTURES	Interbedded	- Composed of alternate layers of different soil types.
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	Calcareous	- Containing appreciable quantities of calcium carbonate.
SP	POORLY GRADED SANDS, OR GRAVELLY SANDS, LITTLE OR NO FINES	Well Graded	- Having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
SM	SILTY SANDS, SAND-SILT MIXTURES a	Poorly Graded	- Predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.
SC	CLAYEY SANDS, SAND-SILT MIXTURES b	Pocket	- Inclusion of material of different texture that is smaller than the diameter of the sample.
ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	Parting	- Inclusion less than 1/8-inch thick extending through the sample.
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	Seam	- Inclusion 1/8- to 3-inch thick extending through the sample.
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	Layer	- Inclusion greater than 3-inch thick extending through the sample.
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	Interlayered	- Soils sample composed of alternating layers of different soil types.
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	Intermixed	- Soil samples composed of pockets of different soil type and layered or laminated structure is not evident.
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS		
PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT		
	FILL SOILS		

COARSE GRAINED SOILS (major portion retained on No. 200 Sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Conditions rated according to standard penetration test (SPT)* as performed in the field.

FINE GRAINED SOILS (major portion passing No. 200 Sieve): Include (1) inorganic or organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength as indicated by hand penetrometer readings or by unconfined compression tests.

Descriptive Terms	Blows Per Foot*
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	over 50

* 140 pound weight having a free fall of 30-inch

Descriptive Term	Undrained Shear Strength Ton/Sq. Ft.
Very Soft	Less than 0.13
Soft	0.13 to 0.25
Firm	0.25 to 0.50
Stiff	0.50 to 1.00
Very Stiff	1.00 to 2.00
Hard	2.00 or higher

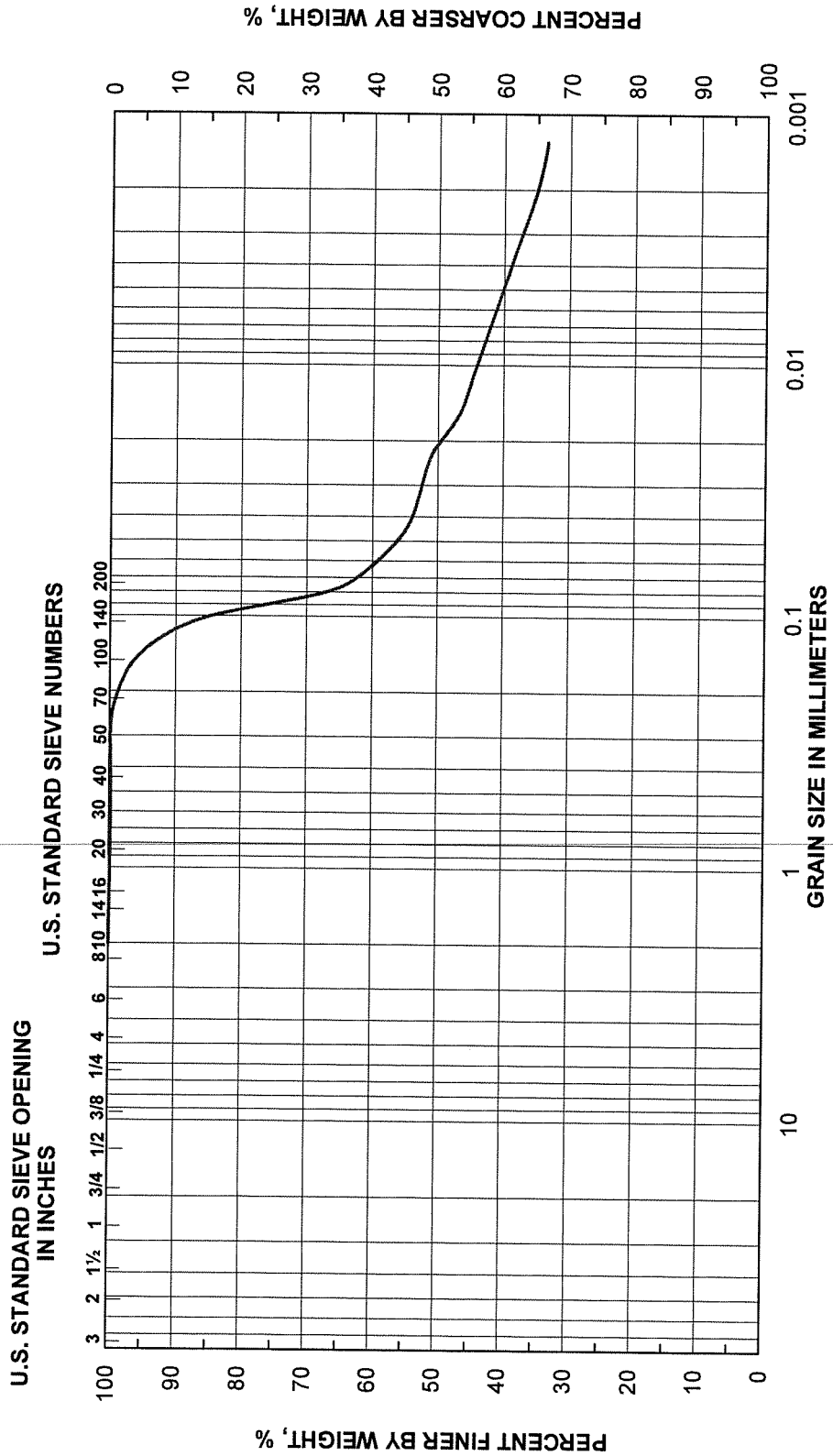
NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of weakness or cracks in the soil. The consistency ratings of such soils are based on hand penetrometer readings.

SOIL SAMPLERS

- SHELBY TUBE SAMPLER
- STANDARD PENETRATION TEST
- AUGER SAMPLING

TERMS CHARACTERIZING ROCK PROPERTIES

VERY SOFT OR PLASTIC	Can be remolded in hand; corresponds in consistency up to very stiff in soils.
SOFT	Can be scratched with fingernail.
MODERATELY HARD	Can be scratched easily with knife; cannot be scratched with fingernail.
	Difficult to scratch with knife.
VERY HARD	Cannot be scratched with knife.
POORLY CEMENTED OR FRIABLE	Easily crumbled.
CEMENTED	Bounded Together by chemically precipitated materials.
UNWEATHERED	Rock in its natural state before being exposed to atmospheric agents.
SLIGHTLY WEATHERED	Noted predominantly by color change with no disintegrated zones.
WEATHERED	Complete color change with zones of slightly decomposed rock.
EXTREMELY WEATHERED	Complete color change with consistency, texture, and general appearance or soil.

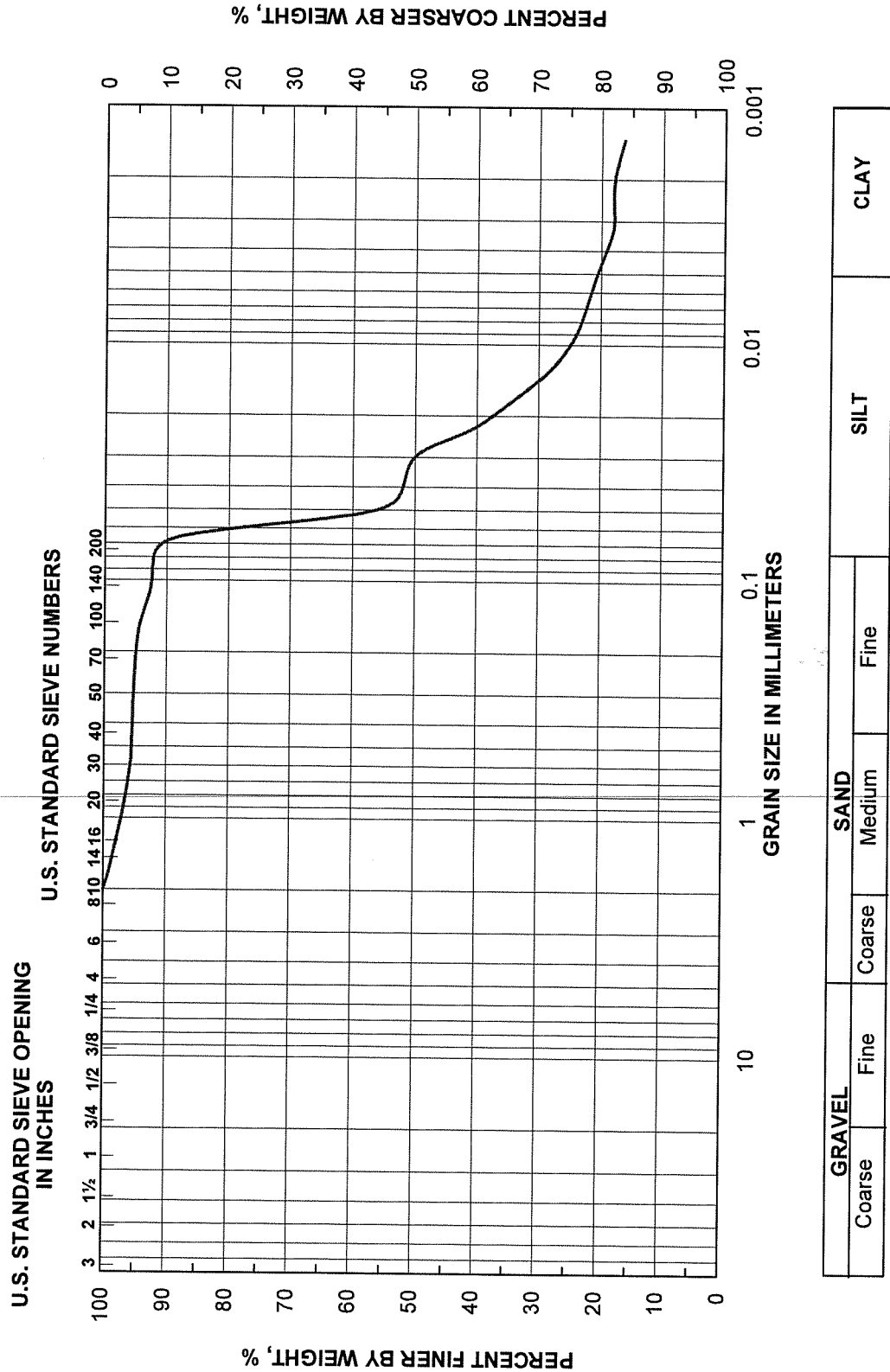


USCS Soil Classification: Sandy Lean Clay (CL)

Percent Passing #200 Sieve: 69%

PARTICLE SIZE DISTRIBUTION CURVES FOR B-1 (2' TO 4')

Project No. 13-792E

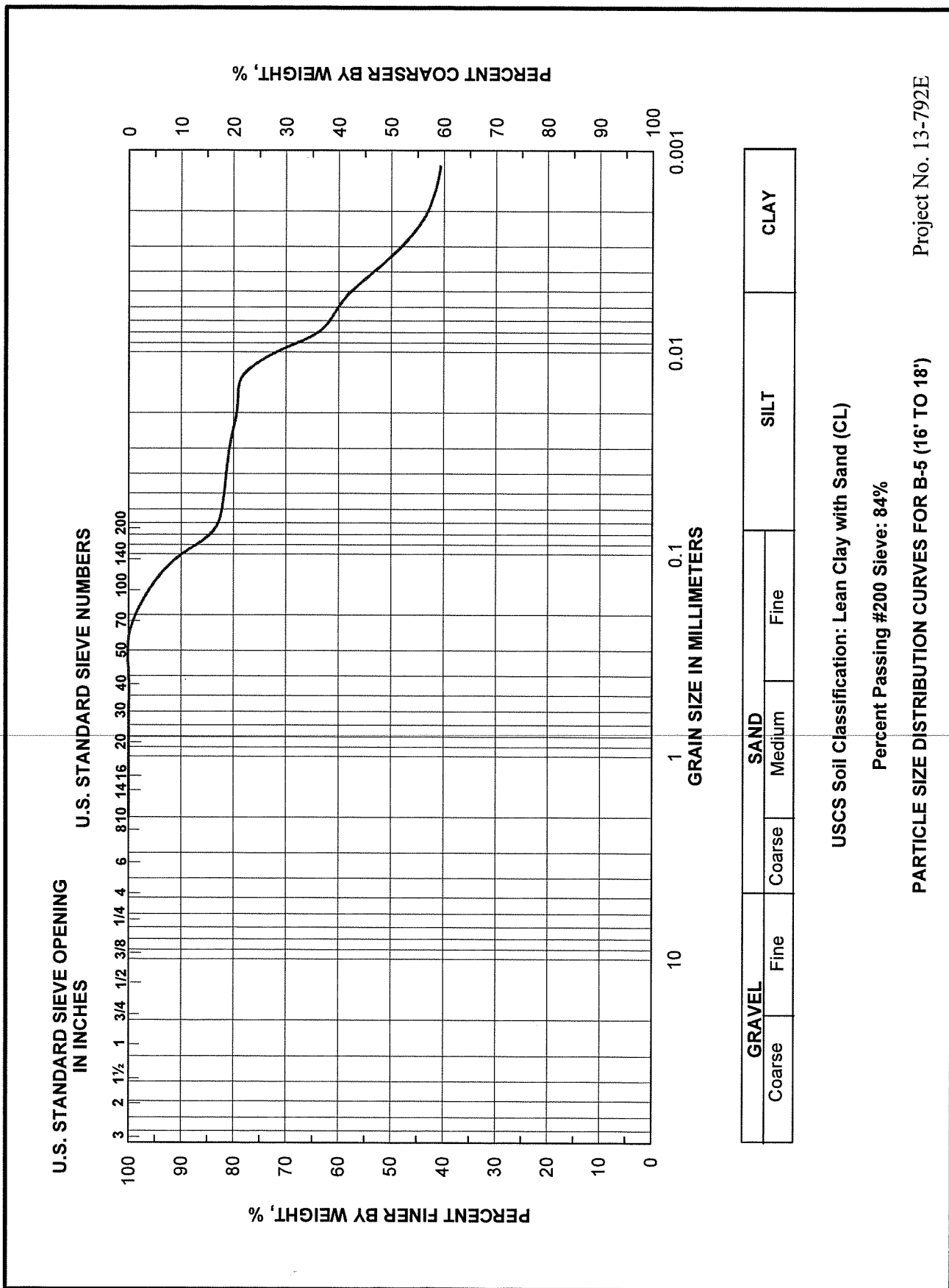


USCS Soil Classification: Fat Clay (CH)

Percent Passing #200 Sieve: 92%

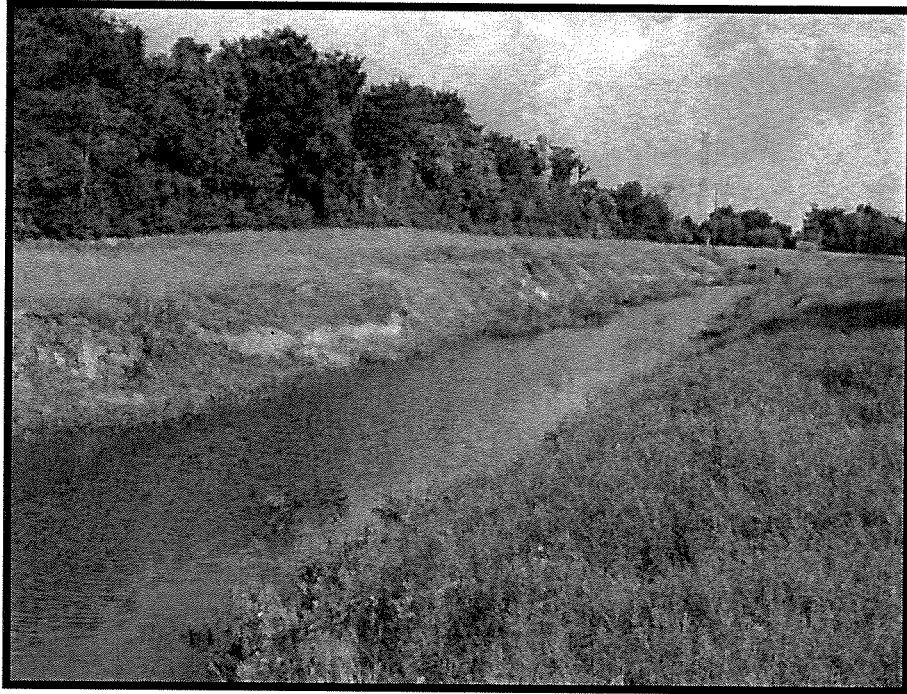
PARTICLE SIZE DISTRIBUTION CURVES FOR B-3 (0' TO 2')

Project No. 13-792E

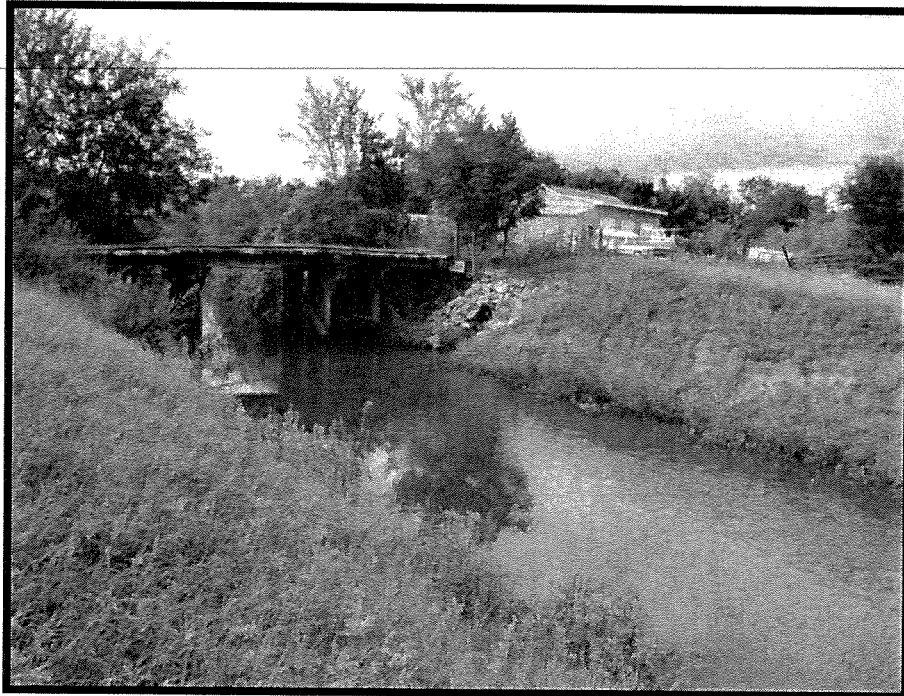


APPENDIX A

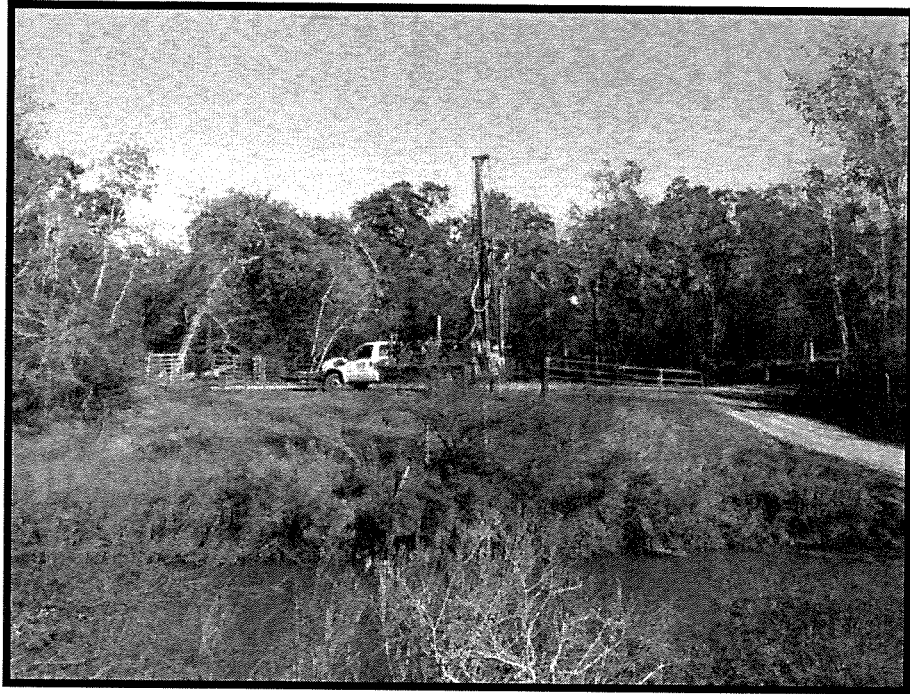
Project Site Pictures



Picture #1



Picture #2



Picture #3



Picture #4