GEOTECHNICAL ENGINEERING REPORT

HCAD – 13013 NORTHWEST FREEWAY

HOUSTON, TEXAS

GEOTECHNICAL ENGINEERING REPORT

HCAD – 13013 Northwest Freeway

Houston, Texas

Prepared by:

Gorrondona & Associates, Inc.

Prepared for:

Collier Property Management
Harris County Appraisal District
13013 Northwest Freeway
Houston, Texas 77040

Attention: Ms. Erica Houck

September 29, 2015

G&AI Project No. 15-0227

September 29, 2015

Ms. Erica Houck
Collier Property Management
Harris County Appraisal District
13013 Northwest Freeway
Houston, Texas 77040

Re: GEOTECHNICAL ENGINEERING REPORT
HCAD – 13013 Northwest Freeway
Houston, Texas
G&AI Project No. 15-0227

Dear Ms. Houck:

Gorrondona & Associates, Inc. (G&AI) is pleased to submit this Geotechnical Engineering Report for the referenced project. We appreciate the opportunity of working with you. Please contact us if you have any questions or require additional services.

Respectfully submitted,

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2015.09.29 09:14:44
-05'00'

Hamed Ardalan, Ph.D.
Project Engineer

Vivek Chikyala, P.E.
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GEOTECHNICAL ENGINEERING REPORT

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Houston, Texas

1.0 INTRODUCTION

Project Location. The project is located at 13013 Northwest Freeway in Houston, Texas. The general location and orientation of the site are provided in Appendix A - Project Location Diagrams.

Project Description. The project consists of proposed two new stairwells. Based on available information, we understand the mat foundation for the existing building is bearing at a depth of approximately 9-feet below slab elevation near the west stairwell and approximately to 11-feet below slab elevation near the east stairwell. We understand the foundation support system for an existing small stairwell on the west side of the building is bearing at a depth of approximately 5'-11" below slab elevation (i.e. approximately 2.5-feet below surrounding grade). Based on available information, we understand the new stairwells will be supported partly on new spread footings and partly on existing mat foundation.

Project Authorization. This geotechnical investigation was authorized by Ms. Erica Houck with Collier Property Management and performed in accordance with G&AI Proposal No. P15-0313 dated June 24, 2015.

Purpose and Methodology. The principal purposes of this investigation were to evaluate the general soil conditions at the proposed site and to develop geotechnical engineering design recommendations. To accomplish its intended purposes, the study was conducted in the following phases: (1) drill sample borings to evaluate the soil conditions at the boring locations and to obtain soil samples; (2) conduct laboratory tests on selected samples recovered from the borings to establish the pertinent engineering characteristics of the soils; and (3) perform engineering analyses, using field and laboratory data, to develop design criteria.

Cautionary Statement Regarding Use of this Report. As with any geotechnical engineering report, this report presents technical information and provides detailed technical recommendations for civil and structural engineering design and construction purposes. G&AI, by necessity, has assumed the user of this document possesses the technical acumen to understand and properly utilize information and recommendations provided herein. G&AI strives to be clear in its presentation and, like the user, does not want potentially detrimental misinterpretation or misunderstanding of this report. Therefore, we encourage any user of this report with questions regarding its content to contact G&AI for clarification. Clarification will be provided verbally and/or issued by G&AI in the form of a report addendum, as appropriate.

Report Specificity. This report was prepared to meet the specific needs of the client for the specific project identified. Recommendations contained herein should not be applied to any other project at this site by the client or anyone else without the explicit approval of G&AI.

2.0 FIELD INVESTIGATION

Subsurface Investigation. The subsurface investigation for this project is summarized below. Boring locations are provided in Appendix B - Boring Location Diagram.

Boring Nos.	Depth, feet bgs[1]	Date Drilled	Location[2]
B-01 & B-02	35	7/1 & 11/2015	Stairwells Area

Notes:
1. bgs = below ground surface
2. Boring locations provided in Appendix B - Boring Location Diagram were not surveyed and should be considered approximate. Borings were located by recreational hand-held GPS unit. Horizontal accuracy of such units is typically on the order of 20-feet.

Boring Logs. Subsurface conditions were defined using the sample borings. Boring logs generated during this study are included in Appendix C - Boring Logs and Laboratory Results. Borings were advanced between sample intervals using continuous flight auger drilling procedures.

Cohesive Soil Sampling. Cohesive soil samples were generally obtained using Shelby tube samplers in general accordance with American Society for Testing and Materials (ASTM) D1587. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the undisturbed soils by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency using a hand penetrometer, sealed and packaged to maintain "in situ" moisture content.

Consistency of Cohesive Soils. The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25-inch diameter piston is pushed into the undisturbed sample at a constant rate to a depth of 0.25-inch. The results of these tests are tabulated at the respective sample depths on the boring logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Granular Soil Sampling. Granular soil samples were generally obtained using split-barrel sampling procedures in general accordance with ASTM D1586. In the split-barrel procedure, a disturbed sample is obtained in a standard 2-inch outside diameter (OD) split barrel sampling spoon driven 18-inches into the ground using a 140-pound (lb) hammer falling freely 30 inches. The number of blows for the last 12-inches of a standard 18-inch penetration is recorded as the Standard Penetration Test resistance (N-value). The N-values are recorded on the boring logs at the depth of sampling. Samples were sealed and returned to our laboratory for further examination and testing.

Groundwater Observations. Groundwater observations are shown on the boring logs.

Borehole Plugging. Upon completion of the borings, the boreholes were backfilled from the top and plugged at the surface.

3.0 LABORATORY TESTING

G&AI performs visual classification and any of a number of laboratory tests, as appropriate, to define pertinent engineering characteristics of the soils encountered. Tests are performed in general accordance with ASTM or other standards and the results included at the respective sample depths on the boring logs or separately tabulated, as appropriate, and included in Appendix C - Boring Logs and Laboratory Results. Laboratory tests and procedures routinely utilized, as appropriate, for geotechnical investigations are tabulated below.

Test Procedure	Description
ASTM D421	Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2217	Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D2435	Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2850	Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soil
ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D4220	Standard Practices for Preserving and Transporting Soil Samples
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive

Test Procedure	Description
	Soils
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D4644	Standard Test Method for Slake Durability of Shales and Similar Weak Rocks
ASTM D4647	Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4767	Standard Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
ASTM D4972	Standard Test method for pH of Soils
Manufacturer's Instructions	Soil Strength Determination Using a Torvane
Tex-145-E	Determining Sulfate Content in Soils - Colorimetric Method

4.0 SITE CONDITIONS

4.1 General

Review of Aerial Photographs. Historical aerial photographs of the site were reviewed for potential past alterations to the site which could impact geotechnical design conditions. Specifically, aerial photographs were reviewed to visually assess obvious areas of significant past fill on site. Aerial photographs were reviewed for the years 2014, 2010, 2006, 2002, 1995, 1989, 1978, 1953, and 1944. Reviewed aerial photographs are included in Appendix D - Aerial Photographs. Based on aerial photographs, existing buildings and the associated paving were noted on the site since at least 1978. Due to previous site development, we would expect surficial disturbance of site soils. Our review revealed no obvious areas of significant fill on-site. Due to the intermittent nature and relatively low resolution of aerial photographs, as well as our lack of detailed information regarding the past land use of the site, our review should not be interpreted as eliminating the possibility of cuts and/or fills on site which could detrimentally affect future construction.

Topography. A United States Geological Survey (USGS) topographic map of the site is provided in Appendix E - USGS Topographic Map. The map indicates the site is flat.

Site Photographs. Photographs representative of the site at the time of this investigation are provided in Appendix F - Site Photographs. Photographed conditions are consistent with the aerial photographs and topographic map.

4.2 Geology

Geologic Formation. Based on available surface geology maps and our experience, it appears this site is located in the Lissie formation. A geologic atlas and USGS formation description are provided in Appendix G - Geologic Information. Soils within the Lissie formation can generally be characterized as sand, silt, clay, and minor amount of gravel.

Geologic Faults. A review of the attached geologic map indicates the nearest geologic fault is about 1.6-miles northwest of the project site. A geologic fault study was beyond the scope of this investigation.

4.3 Soil

Stratigraphy. Descriptions of the various strata and their approximate depths and thickness per the Unified Soil Classification System (USCS) are provided on the boring logs included in Appendix C - Boring Logs and Laboratory Results. Terms and symbols used in the USCS are presented in Appendix H - Unified Soil Classification System. A brief summary of the stratigraphy indicated by the borings is provided below.

Generalized Subsurface Conditions at Proposed Stairwells Location (Borings B-01 and B-02)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	0 to 1.5	PAVEMENT	15-inch CONCRETE over 3-inch STABILIZED SOIL.
0 to 1.5	10 to 15	LEAN CLAY	Stiff to very stiff SANDY LEAN CLAY (CL).
10 to 15	35	SAND	Medium dense to dense SILTY SAND (SM).
Note: Boring Termination Depth = 35 feet bgs.			

Moisture Change Susceptibility of Near Surface Soils. The sandier soils encountered at and near the ground surface at this site are very susceptible to changes in moisture. The presence of surface water due to precipitation or groundwater may result in a decrease in the ability to compact and work with the soil. It is common for these soils to pump when subjected to high levels of moisture. In addition, these soils located at and near the ground surface will allow surface water to infiltrate until the water becomes perched on a less permeable layer at depth. Soils of this type are especially prone to requiring the implementation of wet weather/soft subgrade recommendations provided in this report.

Swell Potential based on Atterberg Limits. Atterberg (plastic and liquid) limits were performed on 2 shallow soil samples obtained at depths between 2- and 8-feet bgs. The plasticity index of the samples was 18 and 20 with an average of 19 indicating that the soils have a moderate potential for shrinking and swelling with changes in soil moisture content.

4.4 Groundwater

Groundwater Levels. The borings were advanced using auger drilling and intermittent sampling methods in order to observe groundwater seepage levels. Groundwater levels encountered in the borings during this investigation are identified below.

Boring No.	Depth Groundwater Initially Encountered (feet, bgs)	Groundwater Depth after 15 Minutes (feet, bgs)
B-01	12.5	9.0
B-02	18.0	15.0

Long-term Groundwater Monitoring. Long-term monitoring of groundwater conditions via piezometers was not performed during this investigation and was beyond the scope of this study. Long-term monitoring can reveal groundwater levels materially different than those encountered during measurements taken while drilling the borings.

Groundwater Fluctuations. Future construction activities may alter the surface and subsurface drainage characteristics of this site. It is difficult to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The groundwater level should be expected to fluctuate throughout the years with variations in precipitation.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Seismic Site Classification

The seismic site classification is based on the 2012 International Building Code (IBC) and is a classification of the site based on the type of soils encountered at the site and their engineering properties. Per Table 20.3-1 of ASCE 7-10, the seismic site classification for this site is D.

5.2 Potential Vertical Soil Movements

TxDOT Method Tex-124-E. Potential Vertical Rise (PVR) calculations were performed in general accordance with the Texas Department of Transportation (TxDOT) Method Tex-124-E. The Tex-124-E method is empirical and is based on the Atterberg limits and moisture content of the subsurface soils. The calculated PVR is an empirical estimate of a soil's potential for swell based upon the soil's plasticity index, applied loading (due to structures or overburden), and antecedent moisture condition. The wetter a soil's antecedent moisture condition, the lower its calculated PVR will be for a given plasticity index and load. However, soil with a higher antecedent moisture content will be more susceptible to shrinkage due to drying. Maintaining a consistent moisture content in the soil is the key to minimizing both heave and shrinkage related structural problems.

Calculated PVR using TxDOT Method Tex-124-E. The PVR calculated using TxDOT Method Tex-124-E is about 1-inch assuming an average antecedent moisture condition. The calculated PVR is consistent with soil moisture conditions at the time this investigation was conducted.

5.3 Construction Excavations

Applicability. Recommendations in this section apply to short-term construction-related excavations for this project.

Sloped Excavations. All sloped short-term construction excavations on-site should be designed in accordance with Occupational Safety and Health Administration (OSHA) excavation standards. The following table addresses OSHA soil type based on the observed soils in the project borings.

OSHA Soil Type by Depth of Trench (feet)	
0 - 10	10 - 20
B	C

For Type B soils, short-term construction excavations may be constructed with a maximum slope of 1:1, horizontal to vertical (H:V). For Type C soils, short-term construction excavations may be constructed with a maximum slope of 1.5:1, horizontal to vertical (H:V). Recommendations provided herein are not valid for any long-term or permanent slopes on-site. We should be contacted to review sloped excavations deeper than 20 feet.

Shored Excavations. As an alternative to sloped excavations, vertical short-term construction excavations may be used in conjunction with trench boxes or other shoring systems. Shoring systems should be designed using an equivalent fluid weight of 65 pounds per cubic foot (pcf) above the groundwater table and 95 pcf below the groundwater table. Surcharge pressures at the ground surface due to dead and live loads should be added to the lateral earth pressures where they may occur. Lateral surcharge pressures should be assumed to act as a uniform pressure along the upper 10-feet of the excavation based on a lateral earth coefficient of 0.5. Surcharge loads set back behind the excavation at a horizontal distance equal to or greater than the excavation depth may be ignored. We recommend that no more than 200-feet of unshored excavation should be open at any one time to prevent the possibility of failure and excessive ground movement to occur. We also recommend that unshored excavations do not remain open for a period of time longer than 24-hours.

Limitations. Recommendations provided herein assume there are no nearby structures or other improvements which might be detrimentally affected by the construction excavation. Before proceeding, we should be contacted to evaluate construction excavations with the potential to affect nearby structures or other improvements.

Excavation Monitoring. Excavations should be monitored to confirm site soil conditions consistent with those encountered in the borings drilled as part of this study. Discrepancies in soil conditions should be brought to the attention of G&AI for review and revision of recommendations, as appropriate.

5.4 Groundwater Control

Groundwater was encountered at depths as shallow as approximately 9-feet bgs during the subsurface investigation. If groundwater is encountered during excavation, dewatering to bring the groundwater below the bottom of excavations may be required. Dewatering could consist of standard sump pits and pumping procedures, which may be adequate to control seepage on a local basis during excavation. Supplemental dewatering will be required in areas where standard sump pits and pumping is not effective. Supplemental dewatering could include submersible pumps in slotted casings, well points, or eductors. The contractor should submit a groundwater control plan, prepared by a licensed engineer experienced in that type of work.

5.5 Earthwork

5.5.1 Site Preparation

In the area of improvements, all concrete, trees, stumps, brush, debris, septic tanks, abandoned structures, roots, vegetation, rubbish and any other undesirable matter should be removed and properly disposed. All vegetation should be removed and the exposed surface should be scarified to an additional depth of at least 6 inches. It is the intent of these recommendations to provide a loose surface with no features that would tend to prevent uniform compaction by the equipment to be used.

5.5.2 Fill

Fill. Fill should consist of soil with a liquid limit less than 35 and a Plasticity Index between 7 and 20. The select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum moisture content. The subgrade to receive fill should be scarified to a depth of 6 inches and compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum.

Fill Restrictions. Fill should consist of those materials meeting the requirements stated. Fill should not contain material greater than 4-inches in any direction, debris, vegetation, waste material, environmentally contaminated material, or any other unsuitable material.

Unsuitable Materials. Materials considered unsuitable for use as fill include low and high plasticity silt (ML and MH), silty clay (CL-ML), organic clay and silt (OH and OL) and highly organic soils such as peat (Pt). These soils may be used for site grading and restoration in unimproved areas as approved by the Geotechnical Engineer. Soil placed in unimproved areas should be placed in loose lifts not exceeding 10-inches and should be compacted to at least 92 percent maximum dry density (per ASTM D-698) and at a moisture content within ±4 percentage points of optimum.

5.5.3 Testing

Required Testing and Inspections. Field compaction and classification tests should be performed by G&AI. Compaction tests should be performed in each lift of the compacted material. We recommend a minimum one test per lift per stairwell area. If the materials fail to meet the density or moisture content specified, the course should be reworked as necessary to obtain the specified compaction.

Liability Limitations. Since proper field inspection and testing are critical to the design recommendations provided herein, G&AI cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing is performed by another party.

5.6 Demolition Considerations

Applicability. Recommendations in this section apply to the removal of any existing foundations, utilities or pavement which may be present on this site.

General. Special care should be taken in the demolition and removal of existing floor slabs, foundations, utilities and pavements to minimize disturbance of the subgrade. Excessive disturbance of the subgrade resulting from demolition activities can have serious detrimental effects on planned foundation and paving elements.

Existing Foundations. Existing foundations are typically slabs, shallow footings, or drilled piers. If slab or shallow footings are encountered, they should be completely removed. If drilled piers are encountered, they should be cut off at an elevation at least 24-inches below proposed grade beams or the final subgrade elevation, whichever is deeper. The remainder of the drilled pier should remain in place. Foundation elements to remain in place should be surveyed and superimposed on the proposed development plans to determine the potential for obstructions to the planned construction. G&AI should be contacted if drilled piers are to be excavated and removed completely. Additional earthwork activities will be required to make the site suitable for new construction if the piers are to be removed completely.

<u>Existing Utilities</u>. Existing utilities and bedding to be abandoned should be completely removed. Existing utilities and bedding may be abandoned in place if they do not interfere with planned development. Utilities which are abandoned in place should be properly pressure-grouted to completely fill the utility.

<u>Backfill</u>. Excavations resulting from the excavation of existing foundations and utilities should be backfilled in accordance with Section 5.5.5 – Fill.

<u>Other Buried Structures</u>. Other types of buried structures (wells, cisterns, etc.) could be located on the site. If encountered, G&AI should be contacted to address these types of structures on a case-by-case basis.

5.7 Retaining Structures

<u>Applicability</u>. G&AI was not notified of any specific retaining structures in conjunction with this project. Recommendations provided in this section are applicable to structures 5-feet or less in height. Retaining structures in excess of 5-feet should be brought to the attention of G&AI for a more detailed assessment. <u>*It is imperative that global stability be reviewed by G&AI on any retaining structure in excess of 5-feet in height.*</u>

<u>Lateral Pressure</u>. Lateral pressures on retaining structures due to soil loading can be determined using an equivalent fluid weight of 65 pounds per cubic foot (pcf) if fill behind the wall is free-draining and above the groundwater table and 95 pcf if fill behind the wall is not free draining or is below the groundwater table. This does not include surcharge loads. This also assumes a horizontal ground surface behind the structure. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of the buried structure. Surcharge loads set back behind the retaining structure at a horizontal distance equal to or greater than the structure height may be ignored.

<u>Lateral Resistance</u>. Resistance to lateral loads may be provided by the soil adjacent to the structure. We recommend using an equivalent fluid weight of 100 pcf for lateral resistance (using a Factor of Safety of 3). An allowable coefficient of sliding friction of 0.3 (using a Factor of Safety of 2) between the retaining structure concrete footings and underlying soil may be combined with the passive lateral resistance.

Bearing Capacity. Assuming a minimum embedment depth of 24-inches, an allowable bearing capacity of 2,000 psf may be used for retaining structure footings (using a Factor of Safety of 3).

5.8 Foundation System

Appropriate Foundation Types. Based on information provided by the Project Structural Engineer, Rogers Moore Engineers, we understand the proposed stairwells will be supported on columns bearing partly on new spread footing foundations and partly on existing mat foundation.

Column Loads. Based on the information provided by the Project Structural Engineer, we understand the maximum total individual column load is approximately 675 Kips (dead Load = 315 Kips and live load = 235 Kips) and maximum sustained load is approximately 433 kips.

Mixing Foundation Types. Proposed shallow spread footing foundations for the stairwells and the existing mat foundations may have incompatible movement characteristics. The Structural Engineer should allow for differential settlement between the proposed and existing foundation systems. We estimate differential settlement between the shallow and mat foundations to be on the order of 1-inch.

Foundations Adjacent to Slopes. Foundations placed too close to adjacent slopes steeper than 5:1 (H:V) may experience reduced bearing capacities and/or excessive settlement. Recommendations provided herein assume foundations are not close enough to adjacent slopes in excess of 5:1 (H:V) to be detrimentally affected. Therefore, foundations closer than 5 times the depth of adjacent slopes, pits or excavations in excess of 5:1 (H:V) should be brought to our attention in order that we may review the appropriateness of our recommendations.

5.8.1 Shallow Footings

General Requirement. Shallow spread footing foundations may be used for support of the proposed stairwells.

Foundation Depth. Spread footing foundations should bear on native soil at a depth of 4- to 6-feet below the surrounding grade (approximately 7.5- to 9.5-feet below slab elevation).

Bearing Capacity. Individual spread footings can be proportioned using a net dead load plus sustained live load bearing pressure of 3,000 psf or a net total load bearing pressure of 4,500 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively.

Geometry. Individual spread footings should be at least 30 inches wide.

Settlement. Settlement of footing foundations is influenced by a number of factors, including: load (pressure), soil consolidation properties, depth to groundwater, geometry (width and length), depth, spacing, and quality of construction. Although a detailed settlement analysis is beyond the scope of this study, settlement for foundations constructed as described above should be about 1 inch. We believe the proposed shallow footings will settle more than the existing mat foundation.

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the footings. We recommend using an equivalent fluid weight of 100 pcf for lateral resistance. An allowable coefficient of sliding friction of 0.3 (using a Factor of Safety of 2) between the concrete footings and underlying soil may be combined with the passive resistance.

Construction and Observation. The geotechnical engineer should monitor foundation construction to verify conditions are as anticipated and that the materials encountered are suitable for support of foundations. Soft or unsuitable soils encountered at the foundation bearing level should be removed to expose suitable, firm soil. Foundation excavations should be dry and free of loose material. Excavations for foundations should be filled with concrete before the end of the workday or sooner if necessary to prevent deterioration of the bearing surface. Prolonged exposure or inundation of the bearing surface with water will result in changes in strength and compressibility characteristics. If delays occur, the excavation should be deepened as necessary and cleaned, in order to provide a fresh bearing surface. If more than 24 hours of exposure of the bearing surface is anticipated in the excavation, a "mud slab" should be used to protect the bearing surfaces. If a mud slab is used, the foundation excavations should initially be over-excavated by approximately 4 inches and a lean concrete mud slab of approximately 4 inches in thickness should be placed in the bottom of the excavation immediately following exposure of the bearing surface by excavation. The mud slab will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required and provide a working surface for the placement of formwork and reinforcing steel.

5.8.2 Existing Mat Foundation

Based on available information, we understand the mat foundation for the existing building is bearing at a depth of approximately 9-feet below slab elevation near the west stairwell and approximately to 11-feet below slab elevation near the east stairwell. Based on available information, we understand the new stairwells will be supported partly on new spread footings and partly on existing mat foundation. Based on the information provided by the Structural Engineer, Mr. Ernest Blaszczyk, EIT with Rogers Moore Engineers, LLC, we understand the following:

- The existing mat foundation is approximately 40.5-feet width and 55-feet long.

- The thickness of the existing mat foundation is 4-feet.
- The existing mat foundation is currently supporting four columns with total loads of 847, 638, 359, and 370 kips.
- The uniform soil surcharge pressure applied on the existing mat foundation is about 600 psf.
- The live load surcharge at first floor is about 100 psf.
- The mat foundation will support four new columns associated with the proposed stairwells. The new columns will have sustain loads of 263, 146, 48, and 22 kips.

Settlement. Settlement of mat foundations is influenced by a number of factors, including: load (pressure), soil consolidation properties, depth to groundwater, geometry (width and length) and depth. Based on the limited information available at the time of writing this report, we estimate long term settlement of mat foundations to be on the order of 0.2- to 0.4-inches depending on the actual thickness and compressibility of clay layer beneath the existing mat foundation. Please note, our settlement estimates are based on subsurface conditions encountered in the borings drilled outside the existing mat foundation area.

6.0 GENERAL COMMENTS

Data Assumptions. By necessity, geotechnical engineering design recommendations are based on a limited amount of information about subsurface conditions. In the analysis, the geotechnical engineer must assume subsurface conditions are similar to those encountered in the borings. The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of the field investigation and on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed.

Subsurface Anomalies. Anomalies in subsurface conditions are often revealed during construction. If during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary.

Change of Conditions. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we should be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Design Review. G&AI, Inc. should be retained to review those portions of the plans and specifications for this particular project that pertain to earthwork and foundations as a means to determine whether the plans and specifications are consistent with the recommendations contained in this report.

Construction Materials Testing and Inspection. G&AI should be retained to observe earthwork and foundation installation and perform materials evaluation and testing during the construction phase of the project. This enables G&AI's geotechnical engineer to stay abreast of the project and to be readily available to evaluate unanticipated conditions, to conduct additional tests if required and, when necessary, to recommend alternative solutions to unanticipated conditions. It is proposed that construction phase observation and materials testing commence by the project geotechnical engineer (G&AI) at the outset of the project. Experience has shown that the most suitable method for procuring these services is for the owner to contact directly with the project geotechnical engineer. This results in a clear, direct line of communication between the owner and the owner's design engineers and the geotechnical engineer.

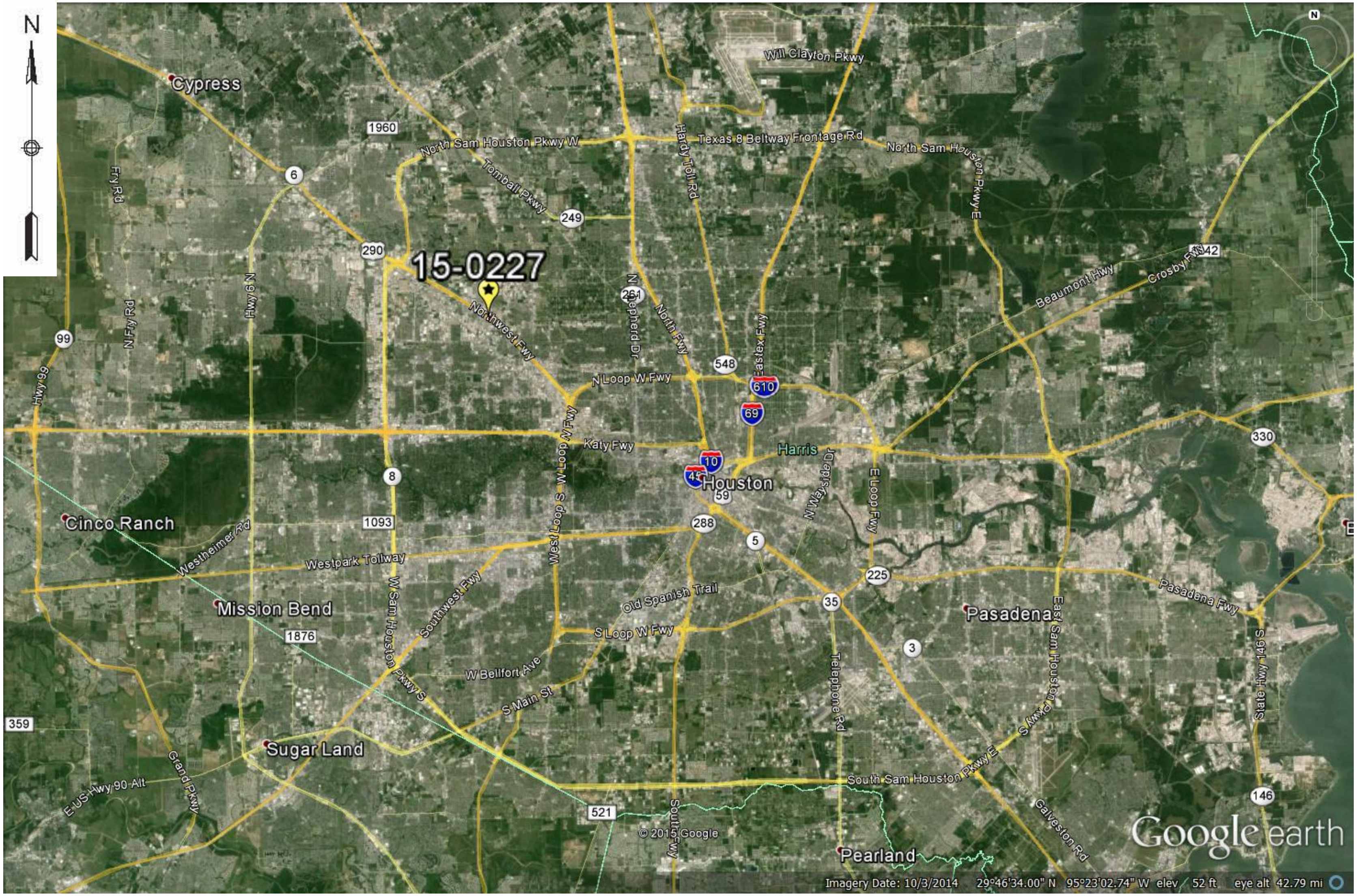
Report Recommendations are Preliminary. Until the recommended construction phase services are performed by G&AI, the recommendations contained in this report on such items as final foundation bearing elevations, final depth of undercut of expansive soils for non-expansive earth fill pads and other such subsurface-related recommendations should be considered as preliminary.

Liability Limitation. G&AI cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing recommended herein is performed by another party.

Warranty. This report has been prepared for the exclusive use of the Client and their designated agents for specific application to design of this project. We have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended.

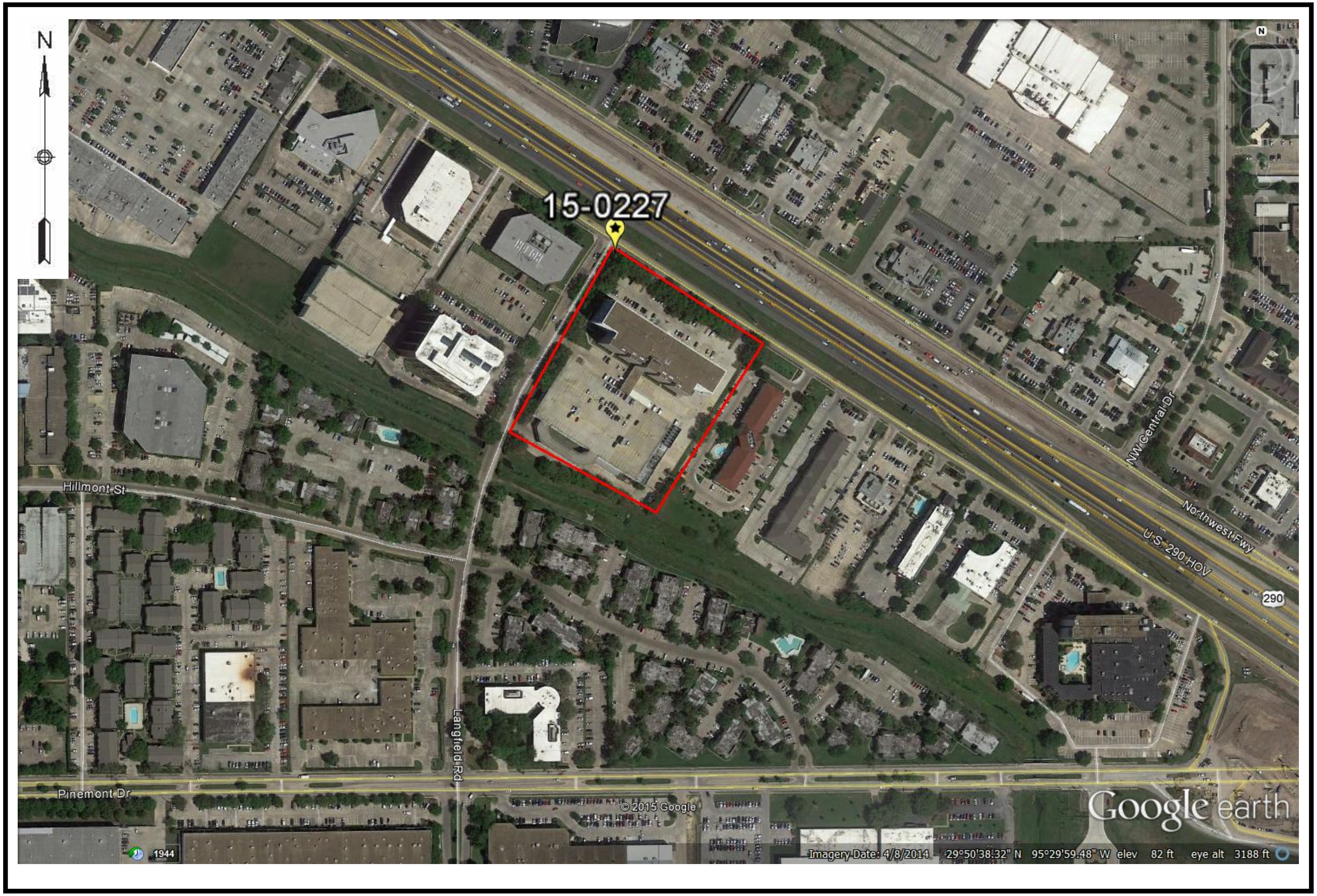
Appendix A - Project Location Diagrams

PROJECT LOCATION DIAGRAM - GENERAL



Project No. 15-0227 HCAD - 13013 Northwest Freeway

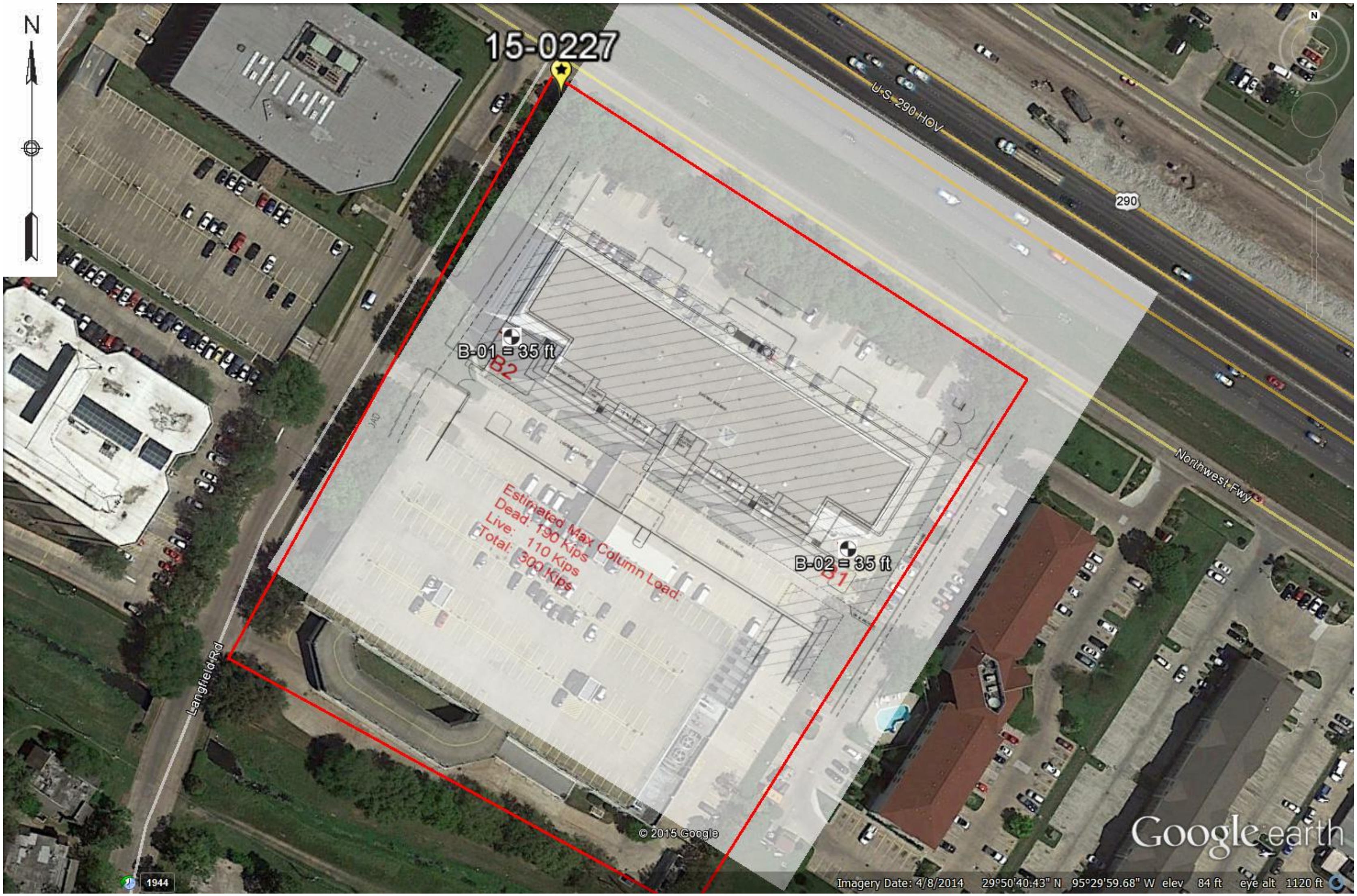
PROJECT LOCATION DIAGRAM - LOCAL



Project No. 15-0227 HCAD - 13013 Northwest Freeway

Appendix B - Boring Location Diagram

BORING LOCATION DIAGRAM



Project No. 15-0227

HCAD - 13013 Northwest Freeway

Appendix C - Boring Logs and Laboratory Results

Gorrondona & Associates
11710 North Freeway, Suite 700, Houston, TX 77060
7524 Jack Newell Blvd. So, Fort Worth, Texas 76118
Telephone: HOU: 281-469-3347; FW: 817-496-1424
Fax: HOU: 281-469.3594; FW: 817-496-1768

BORING NUMBER B-01

CLIENT Collier Property Management
PROJECT NAME HCAD - 13013 Northwest Freeway
PROJECT NUMBER 15-0227
PROJECT LOCATION Houston, Texas
DATE STARTED 7/11/15 **COMPLETED** 7/11/15
GROUND ELEVATION **HOLE SIZE**
CONTRACTOR G&AI
GROUND WATER LEVELS:
METHOD Auger 0 to 15-feet, Rotary Wash 15 to 35-feet
▽ **INITIALLY ENCOUNTERED** 12.5 ft
LOGGED BY JA **CHECKED BY** HA
▼ **AFTER 15 MIN.** 9.0 ft
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		SANDY LEAN CLAY (CL) - Stiff to very stiff, gray and light gray, with calcareous nodules.	ST			4.50	1.4				11				
			ST			3.00	0.5				12				
5		Light gray and light brown at 4 to 10 feet.	ST			2.00	0.3				19	33	13	20	50
			ST			2.50	0.2				16				
10	▼		ST			4.00	0.9	2.2		111	19				
	▽	SILTY SAND (SM) - Medium dense to dense, light gray.													
15			SS		7-4-10 (14)						24				
20			SS		9-12-17 (29)						22				
25			SS		8-11-14 (25)						24				
30			SS		9-13-18 (31)						23				
35			SS		10-10-13 (23)						23				

Bottom of hole at 35.0 feet.

Gorrondona & Associates
11710 North Freeway, Suite 700, Houston, TX 77060
7524 Jack Newell Blvd. So, Fort Worth, Texas 76118
Telephone: HOU: 281-469-3347; FW: 817-496-1424
Fax: HOU: 281-469.3594; FW: 817-496-1768

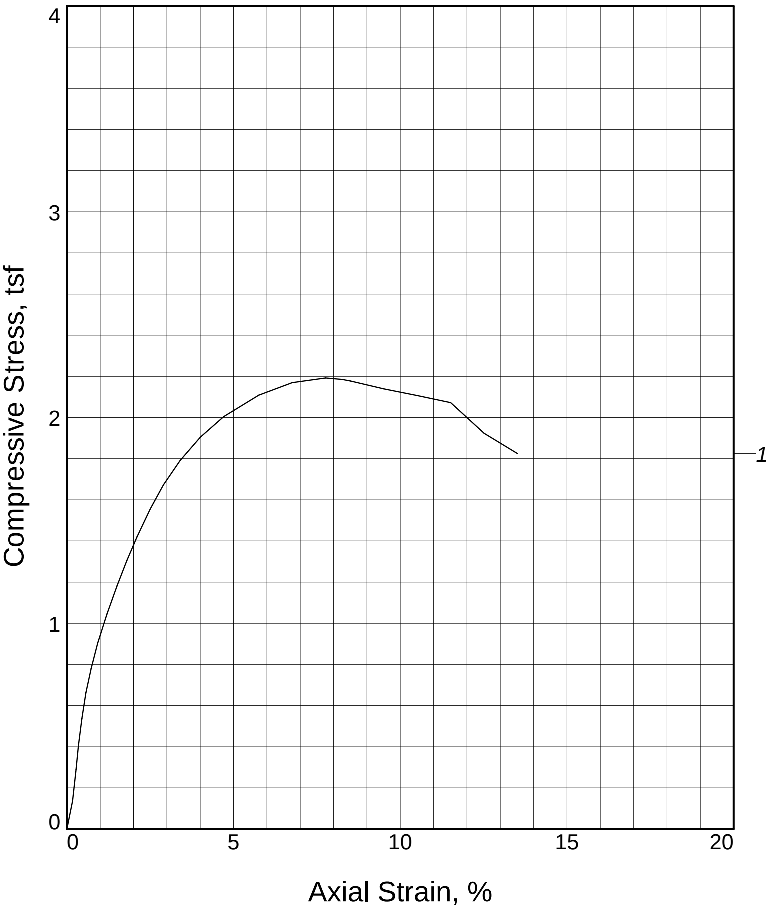
BORING NUMBER B-02

CLIENT Collier Property Management
PROJECT NAME HCAD - 13013 Northwest Freeway
PROJECT NUMBER 15-0227
PROJECT LOCATION Houston, Texas
DATE STARTED 7/1/15 **COMPLETED** 7/1/15
GROUND ELEVATION **HOLE SIZE**
CONTRACTOR G&AI
GROUND WATER LEVELS:
METHOD Auger 0 to 20-feet, Rotary Wash 20 to 35-feet
▽ **INITIALLY ENCOUNTERED** 18.0 ft
LOGGED BY LR **CHECKED BY** HA
▼ **AFTER 15 MIN.** 15.0 ft
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		PAVEMENT - 15-inch CONCRETE over 3-inch STABILIZED SOIL.	AU								17				
		SANDY LEAN CLAY (CL) - Stiff to very stiff, gray and light gray, with calcareous nodules.	ST			2.50	0.8				15	30	12	18	65
5			ST			3.00	1.3				18				
		Light gray and light brown at 6 to 15 feet.	ST			2.00	0.8				19				
			ST			4.00	1.6	2.5		119	15				
10															
			ST			2.5	0.2				19				
15		SILTY SAND (SM) - Medium dense, light gray.													
			ST								21				
20															
			ST								24				
25															
			SS		7-9-12 (21)						20				
30															
			SS		10-11-15 (26)						21				
35															

Bottom of hole at 35.0 feet.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	2.192			
Undrained shear strength, tsf	1.096			
Failure strain, %	7.8			
Strain rate, in./min.	1.00			
Water content, %	18.7			
Wet density, pcf	132.3			
Dry density, pcf	111.4			
Saturation, %	97.2			
Void ratio	0.5242			
Specimen diameter, in.	2.75			
Specimen height, in.	5.75			
Height/diameter ratio	2.09			

Description: Light Gray and Light Brown SANDY LEAN CLAY (CL)

LL =	PL =	PI =	GS= 2.72	Type: Shelby Tube

Project No.: 15-0227

Date Sampled: 7/11/2015

Remarks:

Figure ______

Client: Collier Property Management

Project: HCAD - 13013 Northwest Freeway

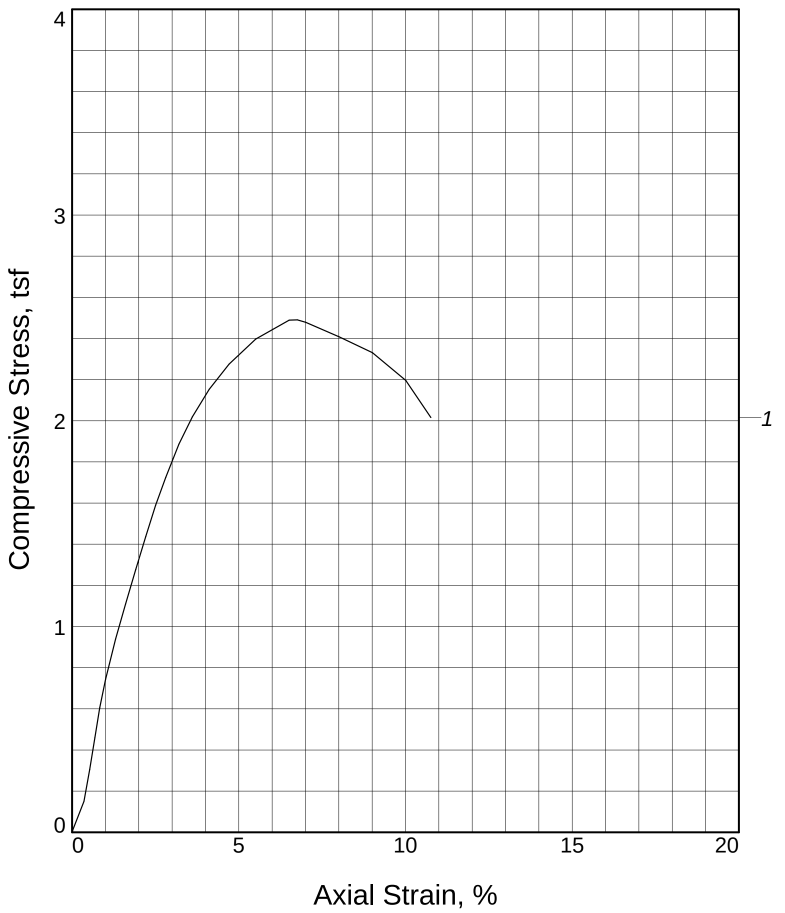
Location: Boring B-01

Sample Number: 5 **Depth:** 8' - 10'

UNCONFINED COMPRESSION TEST

Gorrondona & Associates, Inc.
Houston, Texas

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	2.491			
Undrained shear strength, tsf	1.245			
Failure strain, %	6.8			
Strain rate, in./min.	1.00			
Water content, %	15.2			
Wet density, pcf	136.8			
Dry density, pcf	118.8			
Saturation, %	96.2			
Void ratio	0.4293			
Specimen diameter, in.	2.75			
Specimen height, in.	5.75			
Height/diameter ratio	2.09			

Description: Light Gray and Light Brown SANDY LEAN CLAY (CL)

LL =	PL =	PI =	GS= 2.72	Type: Shelby Tube

Project No.: 15-0227

Date Sampled: 7/1/2015

Remarks:

Figure ______

Client: Collier Property Management

Project: HCAD - 13013 Northwest Freeway

Location: Boring B-02

Sample Number: 5 **Depth:** 8' - 10'

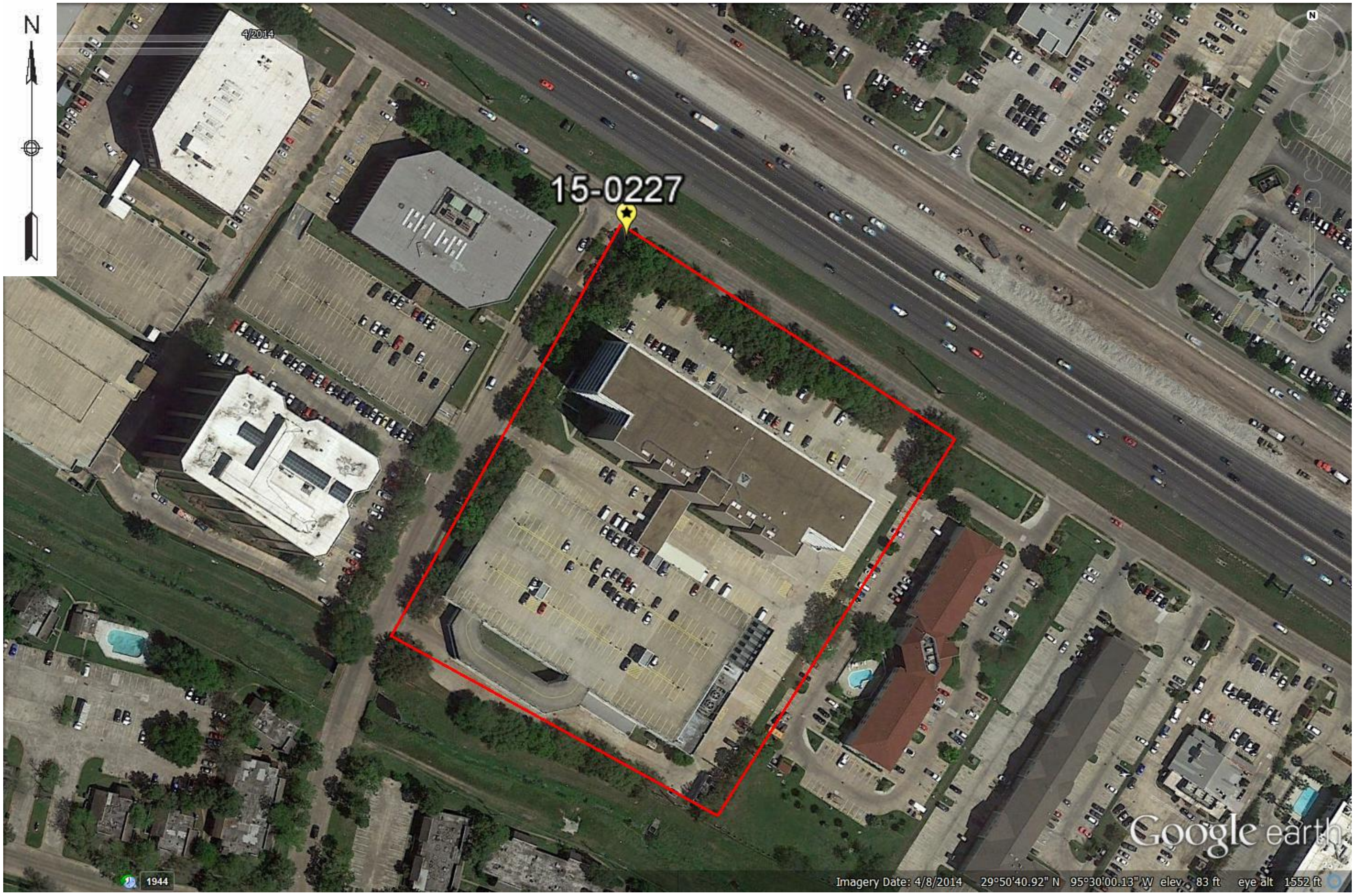
UNCONFINED COMPRESSION TEST

Gorrondona & Associates, Inc.

Houston, Texas

Appendix D - Aerial Photographs

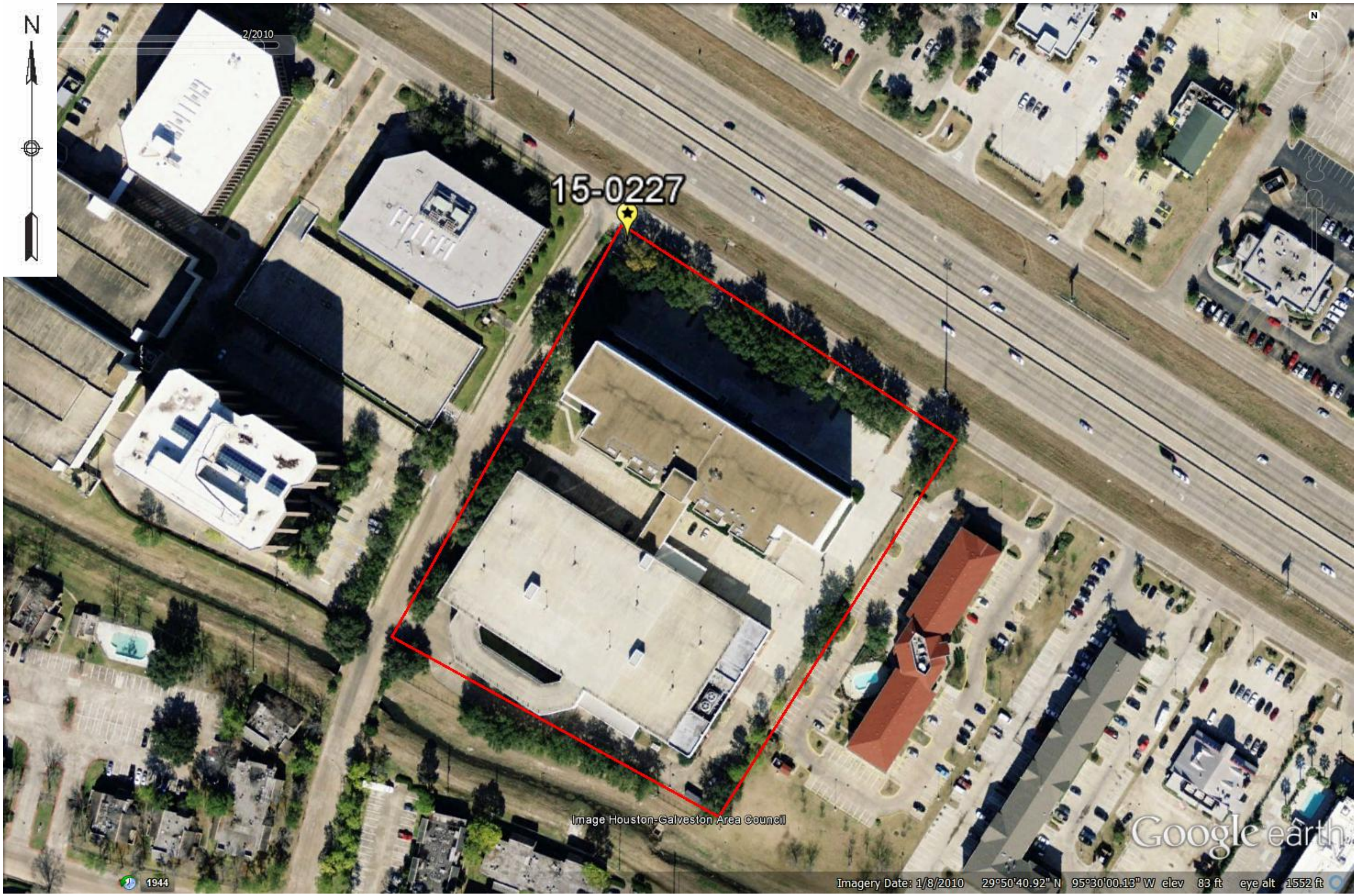
AERIAL PHOTOGRAPH - 2014



Project No. 15-0227

HCAD - 13013 Northwest Freeway

AERIAL PHOTOGRAPH - 2010



AERIAL PHOTOGRAPH - 2006

HCAD - 13013 Northwest Freeway

AERIAL PHOTOGRAPH - 2002

Project No. 15-0227

HCAD - 13013 Northwest Freeway

AERIAL PHOTOGRAPH - 1995

Project No. 15-0227

HCAD - 13013 Northwest Freeway

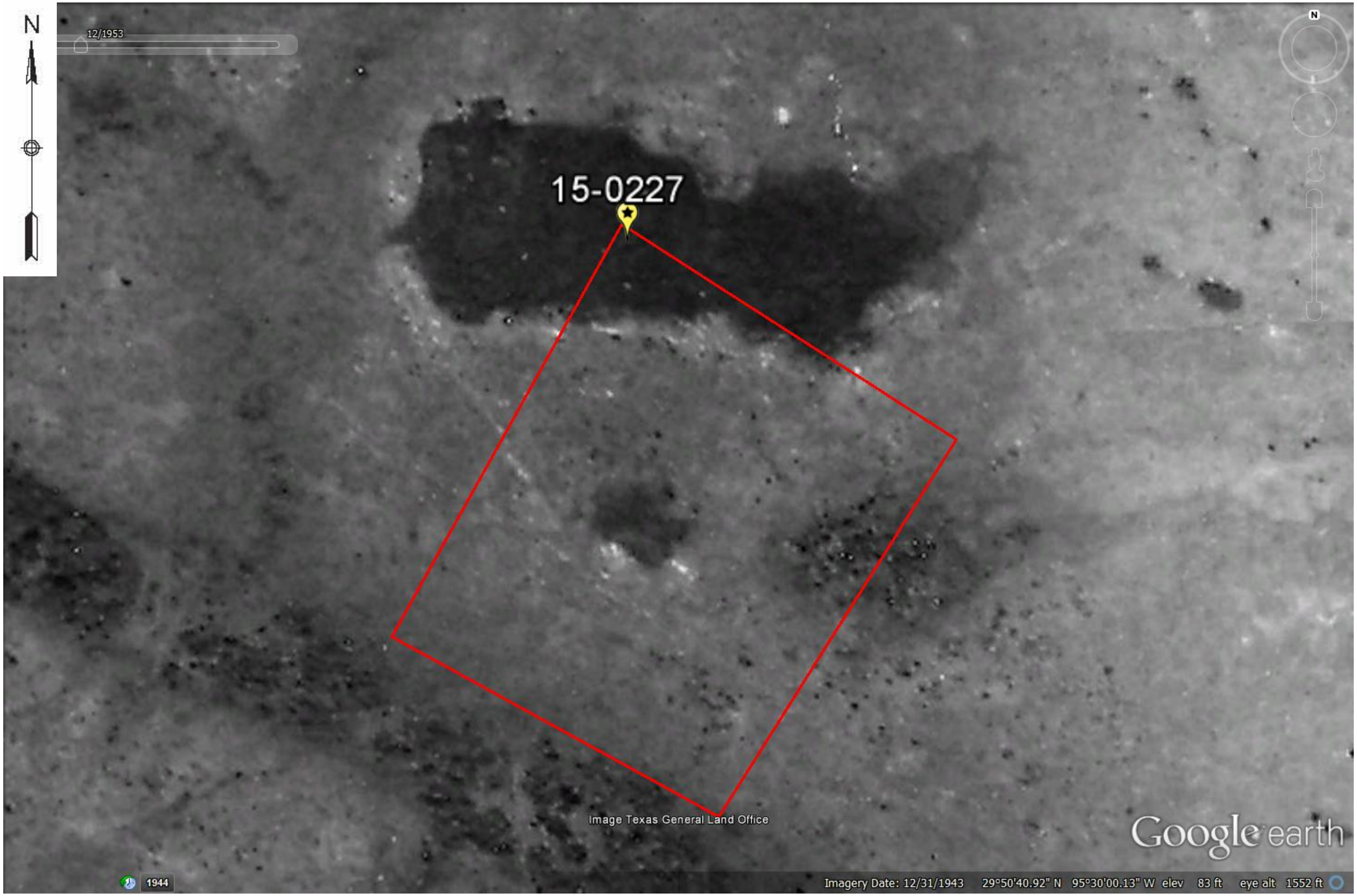
AERIAL PHOTOGRAPH - 1989

AERIAL PHOTOGRAPH - 1978

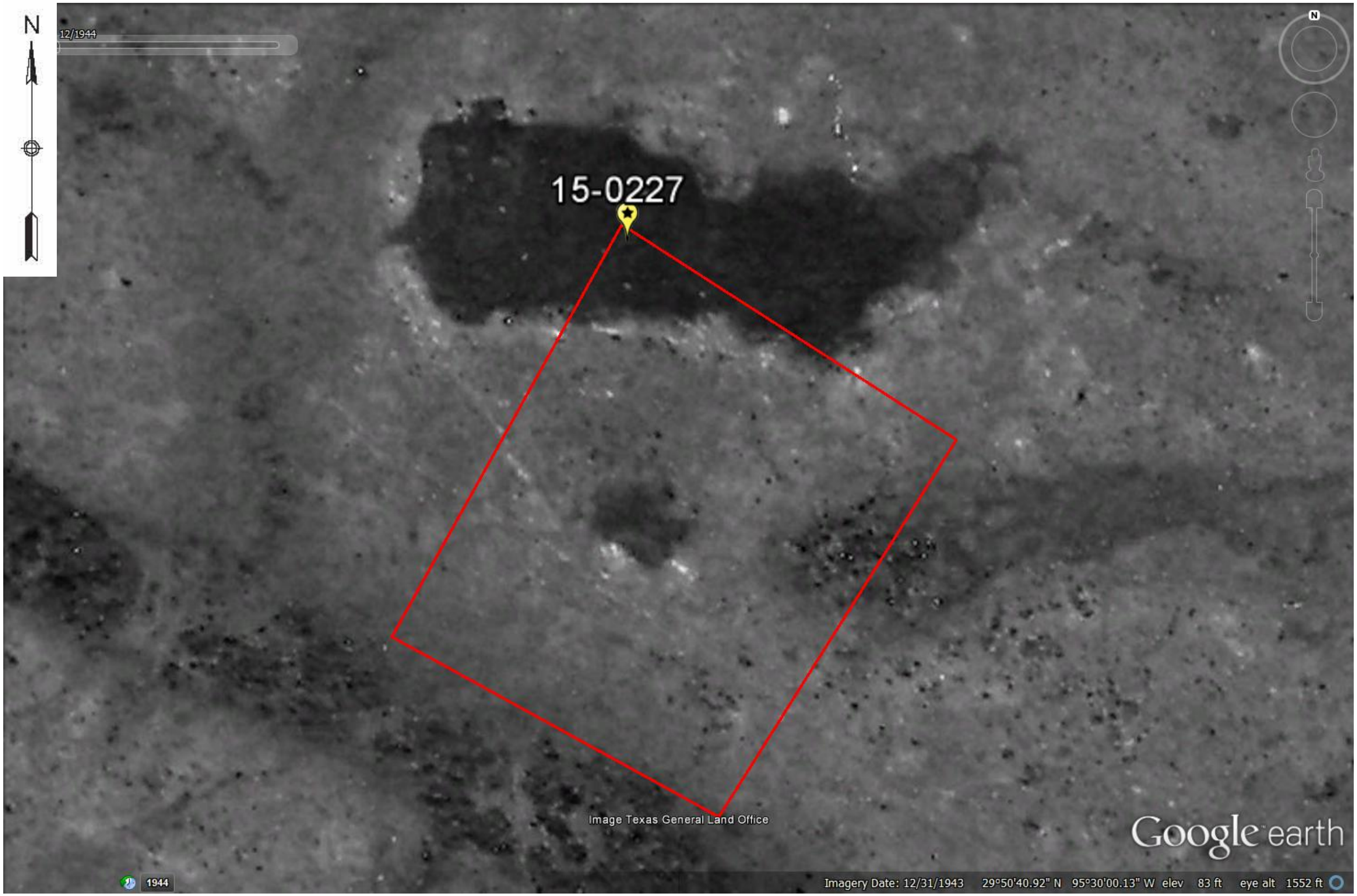
Project No. 15-0227

HCAD - 13013 Northwest Freeway

AERIAL PHOTOGRAPH - 1953



AERIAL PHOTOGRAPH - 1944

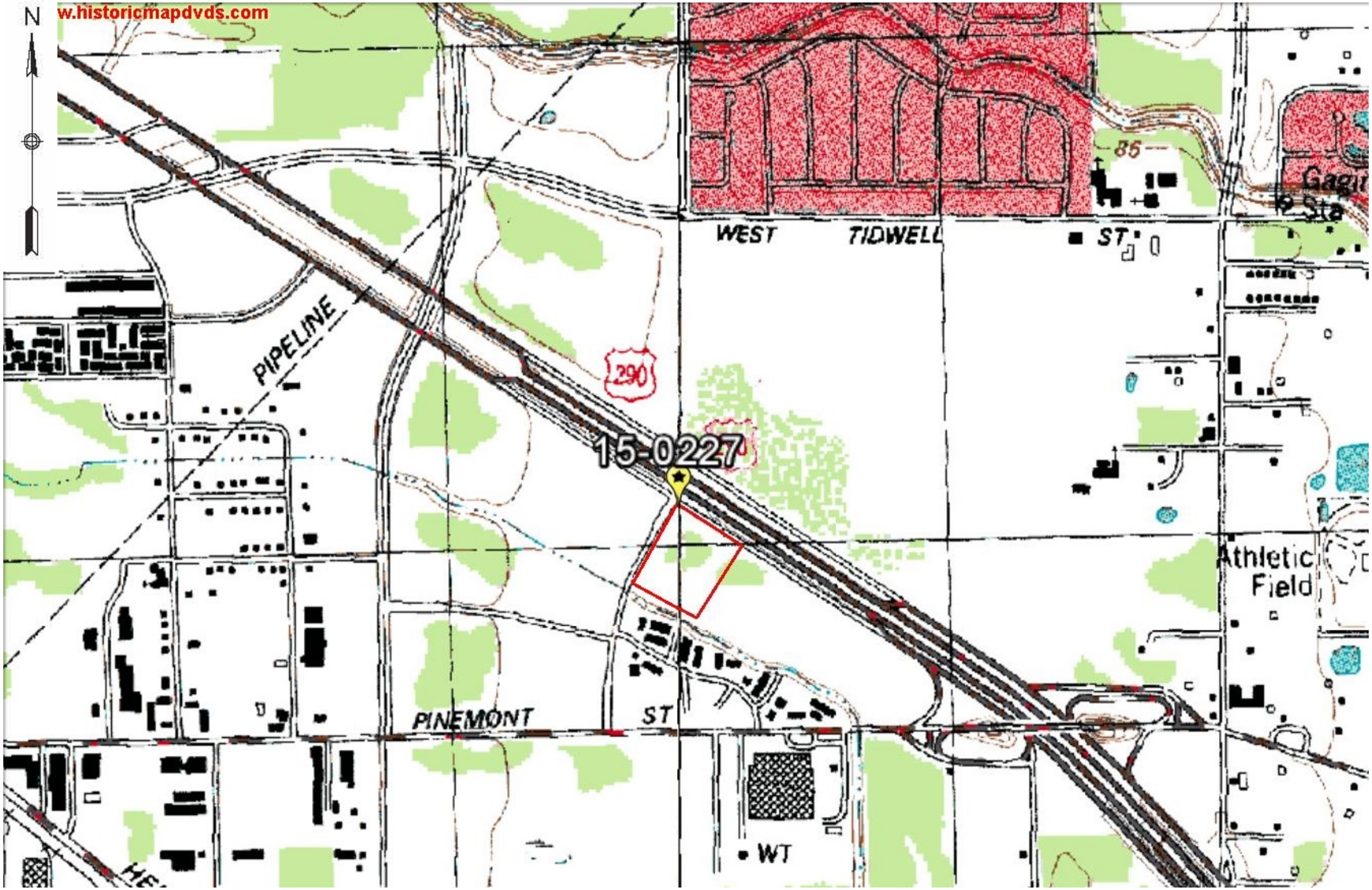


Project No. 15-0227

HCAD - 13013 Northwest Freeway

Appendix E - USGS Topographic Map

USGS TOPOGRAPHIC MAP



Appendix F - Site Photographs

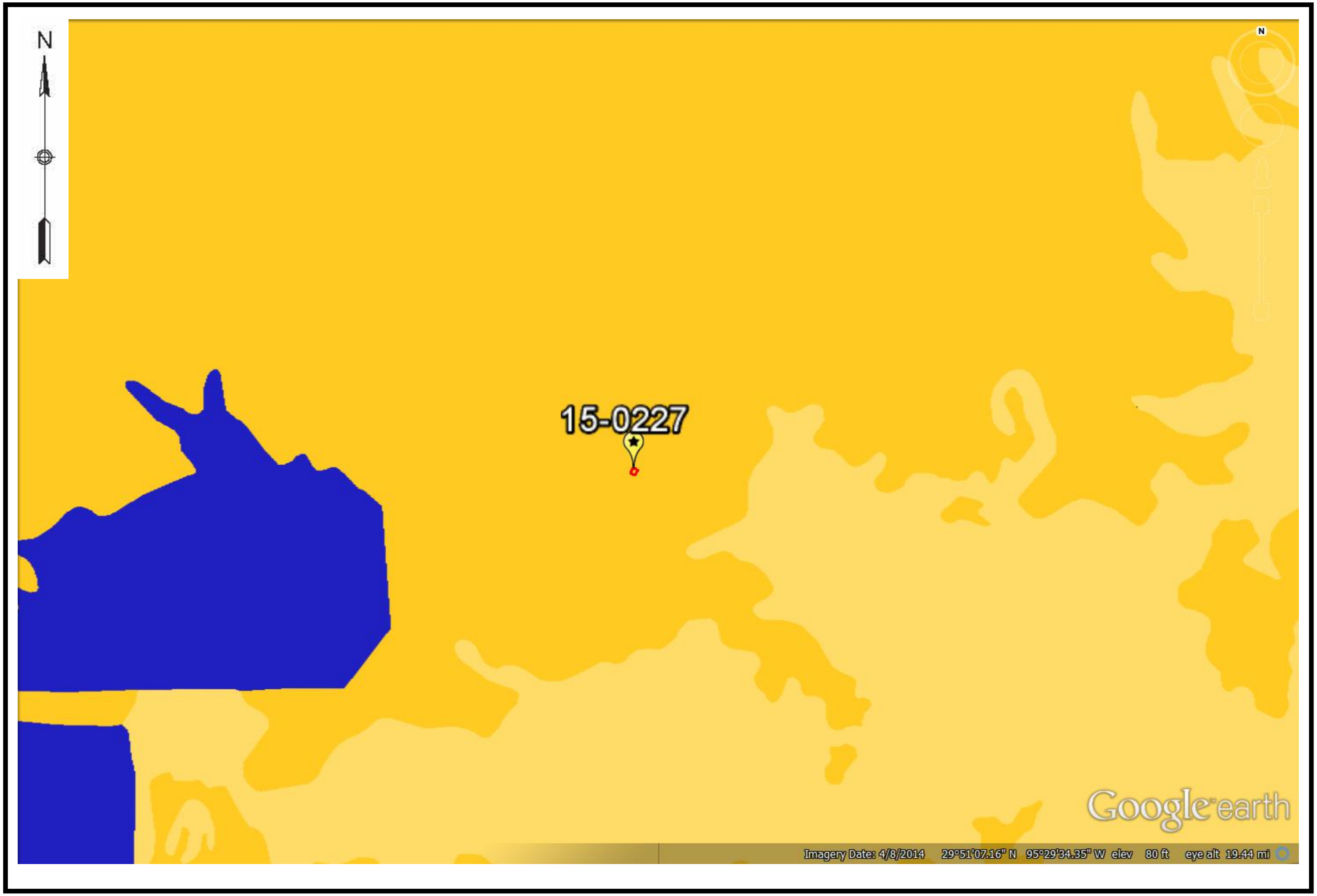
SITE PHOTOGRAPHS

Facing Northwest at Boring B-01

Facing West at Boring B-02

Appendix G - Geologic Information

GEOLOGIC ATLAS



Mineral Resources On-Line Spatial Data

Lissie Formation

Lissie Formation

State	Texas
Name	Lissie Formation
Geologic age	Phanerozoic | Cenozoic | Quaternary | Pleistocene-Middle
Original map label	Ql
Comments	Sand, silt, clay, and minor amount of gravel. Iron oxide and iron-manganese nodules common in zone of weathering; locally calcareous. Surface fairly flat and featureless except for many shallow depressions and pimple mounds. Moore and Wermund (1993a) mapped three units--(1) alluvium undifferentiated as to texture and origin--includes meander belt, levee, crevasse splay, and distributary sand, and flood-basin mud deposits, about 60 m thick, (2) fine-grained channel facies (alluvial sand, silt, and clay) about 10-25 m thick, thicker seward, and (3) fine-grained overbank facies (alluvial silt and clay) about 55-65 m thick, thicker seaward. Together, these deposits form a deltaic plain that parallels the Gulf Coast. Unit contains Pleistocene vertebrate fauna, dips seaward beneath the Beaumont Fm. and disconformably overlies deposits of the Pliocene and early Pleistocene Willis Formation. The deltaic plain is entrenched as much as 7 m by streams. In Hidalgo County (southernmost part of Texas) the unit underlies a semiarid plain, widely irrigated and cultivated. Unit is locally veneered with thin, discontinuous stabilized eolian sand.
Primary rock type	sand
Secondary rock type	silt
Other rock types	clay or mud
Lithologic constituents	Major Unconsolidated > Fine-detrital > Clay *(Bed)* Unconsolidated > Coarse-detrital > Sand *(Bed)* Unconsolidated > Fine-detrital > Silt *(Bed)*
Map references	Bureau of Economic Geology, 1992, Geologic Map of Texas: University

of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000

Unit references

Bureau of Economic Geology, 1975, Corpus Christi Sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.

Moore, D.W. and Wermund, E.G., Jr., 1993a, Quaternary geologic map of the Austin 4 x 6 degree quadrangle, United States: U.S. Geological Survey Miscellaneous Investigations Series Map I-1420 (NH-14), scale 1:1,000,000.
[http://pubs.er.usgs.gov/publication/i1420(NH14)]

Moore, D.W. and Wermund, E.G., Jr., 1993b, Quaternary geologic map of the Monterrey 4 x 6 degree quadrangle, United States: U.S. Geological Survey Miscellaneous Investigations Series Map I-1420 (NG-14), scale 1:1,000,000.
[http://pubs.er.usgs.gov/publication/i1420(NG14)]

Bureau of Economic Geology, 1974, Seguin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Bureau of Economic Geology, 1976, Crystal City-Eagle Pass Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

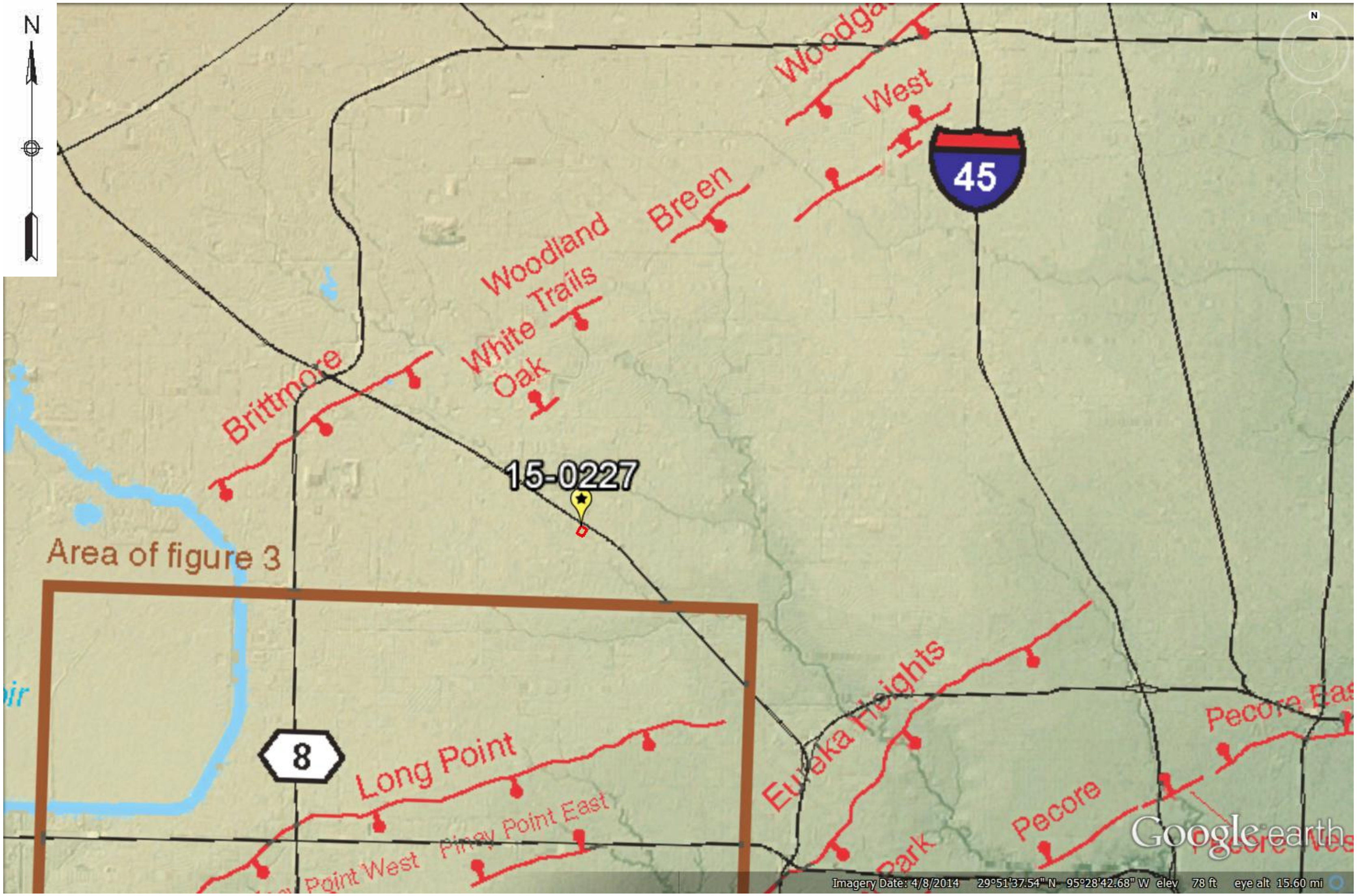
Bureau of Economic Geology, 1975, Beeville-Bay City Sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.

Bureau of Economic Geology, 1982, Houston Sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.

Geographic coverage Austin - Bee - Calhoun - Colorado - DeWitt - Duval - Fort Bend - Goliad - Grimes - Hardin - Harris - Hidalgo - Jackson - Jasper - Jim Wells - Lavaca - Liberty - Live Oak - Montgomery - Newton - Nueces - Polk - Refugio - San Jacinto - San Patricio - Tyler - Victoria - Waller - Wharton - Willacy

Show this information as [XML] - [JSON]

USGS GEOLOGIC FAULT MAP



Project No. 15-0227 HCAD - 13013 Northwest Freeway

Appendix H - Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

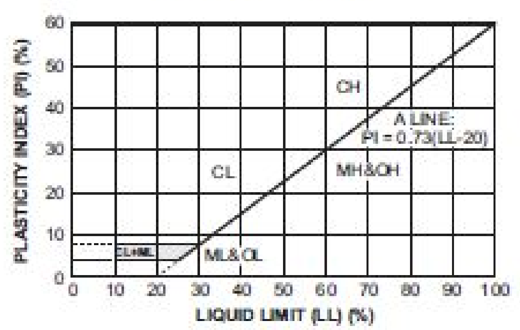
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



TERMS DESCRIBING SOIL CONSISTENCY

Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%