

GUIDELINES FOR CONSULTANTS  
PERFORMING GEOTECHNICAL  
INVESTIGATIONS



FOR  
PROJECTS MAINTAINED BY  
HARRIS COUNTY, TEXAS

**EFFECTIVE DATE**  
**JANUARY 1, 2011**

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## **Section I – Introduction**

These guidelines are to be used in order to implement a uniform approach to geotechnical investigation and reporting for infrastructure to be designed for, constructed on behalf of, or maintained by Harris County Texas. The intent is not to supersede the engineering judgment of the consultant, but rather to define minimum levels of effort, and establish the required report organization. Harris County consists of 1778 square miles of land with varying soils, topography and hydrologic conditions, so detailed geotechnical studies are required on most projects.

## **Section II – Applicability**

These guidelines are to be used on horizontal and vertical construction projects where the ultimate infrastructure is to be maintained by Harris County. These guidelines are not applicable when another agency such as Harris County Flood Control District will maintain the infrastructure, in which case, Harris County Flood Control District's guidelines should be applicable. Additionally, these guidelines are not applicable if a project funding source such as TxDOT has specific requirements that must be met in order to receive funding for the project, in which case those requirements should be applicable. These guidelines are also not applicable for soil studies conducted for onsite sewage facilities.

Where Harris County is not funding the geotechnical services, the reconnaissance geotechnical study portion of the geotechnical investigation is not required. On projects built by developers and accepted for maintenance by Harris County, the guidelines and reporting standards outlined in the "Regulations of Harris County for Approval and Acceptance of Infrastructure" shall be followed. However, this document should guide the boring spacing, depth, location, etc., of the geotechnical investigation.

### **Section III – Reconnaissance Geotechnical Studies**

Upon written request by the County Engineer, the Consultant shall perform a reconnaissance geotechnical study in general accordance with Appendix “A” of the project alignment/project site.

The goals and objectives of reconnaissance studies generally include the following:

1. Estimate what soil types are within the project area,
2. Identify the characteristics and properties of the soils present,
3. Use available soil characteristics, properties and potential project geometrics to identify possible geotechnical concerns,
4. Review existing data including available fault maps,
5. Establish a geotechnical scope of services for the geotechnical study plan (GSP) in general accordance with Appendix “B”, and
6. Make recommendations for any necessary variances to the approved Harris County Geotechnical Guidelines.

The consultant shall submit a Reconnaissance Geotechnical Study Report, stating the results of the reconnaissance study, to the County Engineer, along with a request-to-proceed with the GSP. The format for the Reconnaissance Study Report and a sample request-to-proceed with the GIP letter are found in Appendix “A”.

### **Section IV – Geotechnical Study**

#### *Project Initiation*

Immediately upon written notice, from the County Engineer, to proceed with the GSP, the geotechnical consultant should begin their geotechnical study.

### **A. Field Investigation**

The location and number of soil borings should be in accordance with the approved GSP. The drilling equipment and sampling methods should be in general accordance with the appropriate ASTM designations. If there is no applicable ASTM designation, the drilling equipment and sampling methods should generally be left to the discretion of the geotechnical engineering consultant. The presentation format of the data in the report and in electronic database must adhere to HCPID standards.

#### *Boring Spacing, Depth, and Groundwater Observations*

Soil boring and sampling should be conducted to obtain pertinent information about the subsurface soil stratigraphy and groundwater conditions. The minimum depth and frequency of borings are outlined in Appendix "B". However, the geotechnical consultant may recommend alternative boring spacing and depths if justified, subject to the approval of the County Engineer. Borings should be strategically located in the immediate vicinity of the area of interest and away from any existing underlying or overhead utility lines.

The consultant should notify the County Engineer of any unusual conditions so they can be addressed.

The depth at which groundwater is encountered during drilling should be measured and recorded. Upon the completion of drilling and sampling, the borehole should be covered to minimize the flow of surface water into the borehole. About 24 hours after the boring has been drilled, the depth to

groundwater in the borehole and the depth to which the borehole is open should be measured and recorded.

### *Sampling Methods and Intervals*

Undisturbed samples should be generally recovered in cohesive soils using a thin-walled metal tube sampler that complies with ASTM D1587 requirements. For granular soils, Standard Penetration Split-Barrel samplers should be used in general compliance with ASTM D1586 requirements. Continuous sampling should be performed to a minimum depth of 15 feet, and at 5-foot intervals below that depth. All drilling and sampling should generally comply with the appropriate ASTM method.

### *Relevant Data and Format of Boring Logs and Data Files*

Geographical locations and depths of borings and/or piezometers, date, weather conditions, and methods of drilling should be recorded and shown on the boring logs. Elevation data should be provided by the project surveyor and shown on the boring logs relative to the survey datum for the project. Northing coordinates (y coordinates) and easting coordinates (x coordinates) should also be provided by the project surveyor and shown on the boring logs. Each boring must have reference points or ties so that the location of the boring can be recovered. The ties can be a distance to two or more permanent objects or x-y coordinates with a recoverable reference point.

For granular materials, “blow counts” for the SPT samples should be recorded. For cohesive soils, pocket penetrometer readings should be taken at the site from undisturbed thin-wall tube samples. Soil descriptions should be based on visual inspection of the samples and the requirements of ASTM D2488. Soil descriptions should include texture, color, and inclusions such as nodules, stains, organic materials, etc. Layer variations should be recorded when applicable.

The geotechnical engineering consultant should record the water bearing layers, the depth to groundwater encountered during drilling, the depth to groundwater

about 24 hours after the completion of drilling, and the depth of the open borehole about 24 hours after the completion of drilling. Piezometric water level readings should be presented in tabular form with their corresponding reading dates. Any unusual conditions such as perched water should be reported and seasonal groundwater fluctuations should be noted.

#### *Location Map and Soil Profile Drawings*

A boring location map and soil profile drawing(s) should be included in the report. The boring location map should be on sheets no larger than 11" X 17" and can be constructed from a variety of sources such as Baca maps, ground surveys, and USGS Quad maps. The boring location map should clearly show landmarks such as cross streets, outfall channels, or any other permanent feature that can be used to describe the location.

The soil profile drawing(s) should show the subsurface soil and groundwater conditions along a line of borings for the full depth of the borings. The geotechnical engineering consultant should provide a soil profile drawing for the project alignment, so a reasonable representation of the subsurface soil and groundwater conditions at the site is presented. This provision would not apply to projects funded by developers, unless a major thoroughfare is proposed. If a major thoroughfare is proposed only the area surrounding the major thoroughfare shall be depicted in the drawings.

#### *Environmental Concerns*

Should environmental concerns be identified during geotechnical drilling and no previous provisions for environmental sampling protocol have been provided in the project scope, drilling should cease and the County should be notified. If the project scope includes environmental protocol sampling, the geotechnical engineering consultant is responsible for adhering to all pertinent federal, state, and local regulations and laws.

### *Site Restoration*

Where necessary, it is the responsibility of the geotechnical engineering consultant to remove cuttings resulting from the geotechnical exploration upon completion of drilling and sampling activities. In the case of borings through pavements, similar or equivalent materials should be used to restore the site. Backfilling of borings and sealing off piezometers should be conducted by using non-shrink grout placed with a tremie pipe.

### *Piezometers*

Temporary piezometers should be installed when included in the project scope. The piezometers should be read at least 24-hours after initial installation and periodically during 30 days after installation. Piezometers should be spaced no further than 2,500 feet apart along underground utilities where water-bearing layers (or potentially water-bearing layers) are encountered, unless otherwise recommended by the geotechnical engineer and approved by the County Engineer. Piezometers are to be abandoned in accordance with Texas Commission on Environmental Quality (TCEQ) when they are no longer necessary.

### *Fault Investigation*

All projects requiring a geotechnical study should include, as a separate task, a review of available existing fault maps and a field visit to identify any significant visual fault activity along the project alignment or at the specific project site that may have an impact on the design of the project.

A Phase I fault study should be performed in general accordance with the most current version of Houston Geological Society (HGS) Bulletin technical article entitled "Investigation of Surface Faults in Texas Gulf Coast Region" should be performed, to confirm fault activity, if:

- 1.) The review of fault maps and/or field reconnaissance identified potential fault activity,
- 2.) It is recommended by the geotechnical engineer, and
- 3.) It is approved by the County Engineer.

If the results of the Phase I study show sufficient evidence of the presence of a fault that could potentially impact the project site, a Phase II study should be undertaken as described in the above-referenced most current HGS Bulletin and approved by the County Engineer. A Phase II study requires the collection and analysis of existing geophysical logs and/or the drilling and logging of geophysical borings.

If the Phase II study establishes the presence of a fault at the project site, a topographic survey should be performed and additional geophysical borings drilled/logged as part of a Phase III fault study as required by the above-referenced HGS Bulletin and approved by the County Engineer. The location and width of the fault zone, strike, and dip of the fault should be determined. Prediction of the movement of the fault should be formulated and the impact of fault activity on site structures should be assessed. Detailed fault studies are most applicable to development of buildings or other structures and less applicable to standard road sections where fault damage can be repaired inexpensively.

## **B. Laboratory Testing**

### *General Requirements and Standards*

The purpose of the laboratory testing program is to define the soil classification, soil stratigraphy, and the relevant engineering properties of the encountered soils. Laboratory analysis testing should be conducted and combined with geologic information to classify the soils and determine the stratification. The

selection of appropriate laboratory tests is left to the discretion of the geotechnical engineering consultant. The approved laboratory testing program should be outlined in the Geotechnical Study Plan (GSP) and must be approved by the County Engineer.

Laboratory testing should be conducted in general accordance with the corresponding ASTM standards. Standards other than ASTM standards may be used only with the approval of the County Engineer.

#### *Description and Classification of Soils*

The subsurface stratification should be clearly defined and soils should be classified according to the appropriate ASTM standards and to laboratory classification tests. Wherever a soil sample or soil type is referenced in the report, the ASTM group name and symbol should be provided. The County requires that the boring log soil descriptions be in the order of the ASTM classification and group symbol [e.g. Fat Clay (CH)], followed by the consistency [e.g. stiff, very stiff, loose, etc], followed by a descriptor for plasticity [e.g. slight plasticity, highly plastic, etc], followed by the color, followed by a description of the moisture conditions. The consistency of cohesive soils should be described as very soft, soft, firm, stiff, very stiff, or hard. The relative density of cohesionless soils including silts shall be described as very loose, loose, medium dense, dense, and very dense. Soil group name and consistency should also be shown on soil profiles taken through the boring locations so as to represent the site subsurface soil conditions.

#### *Minimum Series of Tests*

Relevant soil parameters should be given for every layer. These parameters include strength data, classification test results, and moisture content. For cohesive soils, Atterberg limits, dry density, strength tests, and minus 200 sieve tests should all be performed on at least one sample within each distinct layer. For granular soils, minus 200 sieve tests should be conducted on at least one sample. Engineering properties such as shear strength can be estimated using

pocket penetrometer and/or torvane tests for cohesive soils and SPT blow counts for granular soils.

## **Section V - Engineering Analysis and Recommendations**

The goal of the engineering analyses is to provide geotechnical information to guide the design of the project and address conditions anticipated during construction. This information should be an interpretation of the field and laboratory data applied to the specific conditions and purpose of the project. Design information may include recommendations for pavement type, thickness and reinforcement, subgrade treatment alternatives, acceptable foundation types and design criteria. Constraints on the design will be given by the County Engineer on projects commissioned by Harris County.

## **Section VI – Geotechnical Report Format**

The geotechnical report should be in general compliance with the following format.

Transmittal letter with Professional Engineer's seal and approval signatures.

### **EXECUTIVE SUMMARY**

#### **INTRODUCTION**

Name of department and person authorizing the report

Date of authorization

Brief background information about the project

#### **PURPOSE & SCOPE OF WORK**

Description of the work to be done in the report

Reiteration of scope of work

Description of the proposed facilities including type, length, and other detailed descriptions.

#### SITE EXPLORATION

Physical description of area

Geology

#### FIELD WORK

Soil borings and sampling

Piezometer installation (If applicable)

Environmental issues (If applicable)

#### LABORATORY TESTING

#### DESCRIPTION OF SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

Description of soil stratigraphy

Description of groundwater conditions

Description of soil properties

#### ENGINEERING ANALYSIS AND RECOMMENDATIONS

Description of engineering methods & assumptions

Pavement analyses (If applicable)

Subgrade treatment recommendations (If applicable)

Drilled shaft and driven pile analysis (If applicable)

#### CONSTRUCTION CONSIDERATIONS

#### APPENDICES

Site Vicinity Map

Plan of Borings

Laboratory Test Results

Boring Logs

Soil Profile Drawings Showing Soil and Groundwater conditions

Engineering Data

Boring Logs

Applicable engineering analysis output

Geologic Fault Study (as a separate study)

# **APPENDICES**

## **Appendix “A”**

### **Reconnaissance Study Report Format**

- Title Page – Project Name, APIN Number (County Projects Only), Preliminary Investigative Report, Consulting Firms Name, Address and Date, and Engineer’s seal
- Table of Contents
- Summary of soils likely to be within project area
- Discussion of potential problematic areas due to project type
- Discussion of findings from “tabletop” format evaluation
- Outline of Geotechnical Study Plan (GSP) including recommended testing type, boring depth, and frequency
- Justification for any additional geotechnical studies and/or testing in excess of that prescribed in the “Guidelines for Consultants Performing Geotechnical Investigation on Behalf of Harris County, Texas”.
- 11” X 17” Map outlining proposed boring locations and depth in relationship to the project.
- 11” X 17” Map outlining project area on the soil survey of Harris County, and delineating the various surface soils.

## **Appendix “B”**

### **Minimum requirements for frequency and depth of borings**

#### **Storm Sewer Construction – Boring Depth and Frequency**

Trench depth plus 5 feet for trenches up to 10 feet deep.

Trench depth plus 10 feet for trenches from 10 to 25 feet deep.

One and one half times trench depth for trenches greater than 25 feet deep.

Bore an additional 5 feet if the last planned sample is in water-bearing sand.

Frequency shall be at a spacing not greater than 500 feet.

#### **Street Paving**

Boring depth shall be at least 10 feet below existing grade or the final grade elevation (if provided before the exploration commences), whichever is greater.

Frequency shall be at a spacing not greater than 500 feet.

#### **Building Foundations**

Bore Depth:

One story under 1,500 SF: 20’

One storey over 1,500 SF: 20’

Two storey under 2,000 SF: 20’

Two storey over 2,000 SF: 20’

(Bore a minimum of 5’ below any water producing sand layer)

Frequency one bore hole per 2,000 SF of slab area, with a minimum of two borings

#### **Parking Areas**

Bore depth to be 10 feet below finished grade.

Bore frequency to be one bore hole per 20,000 SF of proposed parking

#### **Other Infrastructure**

Lift stations - follow current City of Houston criteria.

Open channels - follow current Harris County Flood Control District Criteria

Detention Ponds – follow current Harris County Flood Control District Criteria

Ground Storage Tanks – follow current City of Houston criteria

Bridges and retaining walls – follow the most current TxDOT guidelines with the exception that the Texas Cone Penetrometer (TCP) testing and associated analysis will not be required. **If there is existing pavement, borings are required where new and old pavement connect.**

# *SAMPLE LETTER*

## **Request to Proceed Letter**

Date

Name of Consultant

Address

City, State & Zip

Attention: Contact Name

**Subject: Name of Project and APIN No.**

Dear Mr. or Ms. \_\_\_\_\_:

Attached you will find our Preliminary Investigative Report, including the Geotechnical Study Plan (GSP). The proposed GSP complies with the "Guidelines for Consultants Performing Geotechnical Studies on Behalf of Harris County" and we request authorization to proceed with the plan.

**OR**

Attached you will find our Preliminary Investigative Report, including the Geotechnical Study Plan (GSP). The proposed GSP exceeds the requirements in the "Guidelines for Consultants Performing Geotechnical Investigation on Behalf of Harris County, Texas" and proper justification is given in the report. We request a variance for the additional studies from the County Engineer.