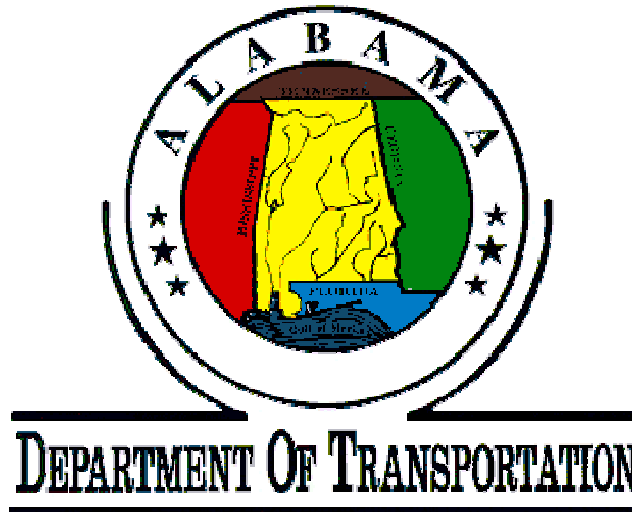


*The Alabama Department of  
Transportation*



**ALDOT Guidance for Preconstruction Activities  
Procedure 398**

**Procedure for Conducting Subsurface Investigation and  
Foundation Reports**

**Bureau of Materials and Tests  
Geotechnical Section  
Revised February 8, 2005**



## TABLE OF CONTENTS

<b>I.</b>	<b>General Project Data</b>	<b>3</b>
<b>II.</b>	<b>Bridge Foundations</b>	<b>4</b>
<b>III.</b>	<b>Bridge Culverts</b>	<b>7</b>
<b>IV.</b>	<b>Retaining Walls</b>	<b>8</b>
<b>V.</b>	<b>Landslides</b>	<b>10</b>
<b>VI.</b>	<b>Slope Studies</b>	<b>11</b>
<b>VII.</b>	<b>Mine Studies</b>	<b>13</b>
<b>VIII.</b>	<b>Soft Soils</b>	<b>13</b>
<b>IX.</b>	<b>Reports</b>	<b>14</b>
<b>X.</b>	<b>Referenced Documents</b>	<b>16</b>

### NOTES:

- For purposes of this document, the term “Engineer” shall refer either to the Geotechnical Engineer or the Consultant hired to perform the work for the Geotechnical Engineer.
- For County Bridge Bond projects, the terms Geotechnical Section and Geotechnical Engineer shall refer to the respective county engineer.
- For county bridges with span lengths of 41’ or less, the Engineer is referred to the March 20, 2001 memo entitled “Guidelines for Use in Developing County Bridge Project Plans” as produced by the County Transportation Bureau Chief. Particular attention should be paid to the guideline for operation at the back of the package entitled, “Policy for Foundation Investigations for County Bridges with Span Lengths of 41 feet or Less Using Pile Bent Construction”.
- Should the plan assembly be metric, the Engineer shall complete all calculations in metric and write the final report using metric units.

## **I. General Project Data**

A plan and profile layout of the project site with planned fill heights and design flood elevations will be forwarded to the Engineer. The Engineer, using standard and accepted geologic and geotechnical engineering practices, shall investigate the site shown on the map included with the plan and profile layout. The Engineer shall conduct a geotechnical investigation, which includes all surveying, drilling, sampling, and laboratory testing, unless otherwise notified in writing. The Engineer shall use this data for the design calculations and foundation recommendations for the requested foundation report for the given structure.

The Engineer shall first conduct a reconnaissance of the site to determine any special characteristics, which could impact their plan of investigation. The Engineer shall also conduct a historical review of the site by reviewing geologic journals, available well logs, aerial photographs, construction logs and performance history of nearby existing structures or other similar documents to determine general geologic conditions that may exist in this area which could affect the project. In particular, the Engineer shall note geologic or man-made hazards such as limestone formations that could lead to sink hole development, underground mines, fault areas, etc., that could impact the project. The Engineer will also check with Bridge Bureau, Construction Bureau, Division Bridge Inspector, Maintenance Bureau (for Underwater Inspection Reports/Videos), District Engineer, and/or County Engineer as well as Materials & Tests Bureau files for the existence of any historical data including boring logs, foundation report, and pile driving records. The Engineer will document whom they contacted in each office and the results of that contact in the cost proposal.

After conducting the site reconnaissance, historical search, and review of the planned project, the Engineer shall submit an investigation plan which contains the boring pattern layout, proposed boring depth, boring method, sampling frequency and collection method, timetable for completion of the investigation, and any other information deemed pertinent. The investigation plan shall conform to the guidelines of this document and AASHTO R-13: Conducting Geotechnical Subsurface Investigation. The Engineer will specify all testing, with justification, that will be performed on the soils and the frequency with which such tests shall be conducted. The Geotechnical Engineer shall review the number and approximate location of borings and proposed testing. After negotiation of the work effort, a letter of formal approval of the cost estimate and work plan will be forwarded by the Materials & Tests Engineer.

Before initiation of the field work, the Engineer must determine if more than one acre of soil disturbance will be required in order to perform the work. Should the sum of all field disturbances exceed an acre or should the project site be located in the vicinity of a Tier 1 waterway as defined by ADEM Phase II Stormwater Regulations, a stormwater permit per ADEM regulations will be required. The Engineer shall prepare all pertinent applications and documentation for a stormwater permit and submit that information along with the appropriate fees to ADEM. Once approval of the stormwater permit is received, field work can commence. It shall be the responsibility of the Engineer to

perform all site inspections required to maintain the stormwater permit in good standing and to terminate the permit once field work is complete.

The Engineer shall insure that accurate and professional boring logs are maintained at all times, accurately depicting soil conditions encountered during drilling. All borings shall be performed in general accordance with AASHTO T-306: Progressing Auger Borings for Geotechnical Explorations and coring operations shall generally conform to AASHTO T-225. All borings will be surveyed in the field to within 0.3ft in station and offset and to within 0.1ft in elevation of their true locations and elevations, wherever possible. Station numbers and offsets shall be recorded in the log for each boring, as well as GPS Latitude and Longitude coordinates. In no case shall the test boring location be located >10 linear feet from the planned boring location without prior approval. All borings should be plotted on mylar, as outlined below in Section IX, Reports, and transmitted to the Geotechnical Engineer for inclusion in the final plan assembly. All borings shall have standard penetration tests per AASHTO T-206 taken at regular intervals throughout the length of the soil boring, and must show the water table level, if encountered. The water table elevation must be recorded in the log at the time of drilling and also at least 24 hours after the hole is completed, if possible. After a hole has been drilled, a temporary standpipe piezometer per AASHTO T-252 should be installed to full depth in selected borings, which are evenly spaced in the boring layout. In low permeability soils or rock, the static water level may have to be determined after a week or more. If artesian water conditions are encountered during the course of the investigation, a note should be placed on the boring logs along with an estimate of the pressure head and/or rate of flow. If the Engineer has another method that can be used to verify depth to groundwater in lieu of piezometers, then a request can be made, prior to implementation, for approval by the Geotechnical Engineer.

Using the results of the driller's boring logs, the Engineer shall evaluate said data using appropriate engineering tools and judgement to determine the most appropriate foundation design for this project in conjunction with the designer. The Engineer shall evaluate various alternative foundation types if dictated by site specific conditions such as span arrangements, geology, etc.

## **II. Bridge Foundations**

### **A. GENERAL**

In the evaluation of the data gathered above, the Engineer shall consider the use of spread footings, pile footings, pile bents, and drilled shafts for foundation support as a minimum.

#### **Borings:**

Typically, one boring per substructure unit should be taken to determine the site soil stratigraphy. If the use of drilled shafts is anticipated, the Engineer should plan to perform a boring for each planned drilled shaft location. Borings should be advanced through unsuitable materials into competent material for bearing capacity support. If

drilled shafts are anticipated and rock is encountered, borings should be extended at least 20 feet into the underlying bedrock. If artesian flow is encountered while investigating for deep foundations, the foundations must be designed to take into account the projected loss of skin friction due to the artesian water flowing up around the foundation. The Engineer shall use the following as guidance for their design recommendations:

#### Corrosion Potential:

The Engineer shall collect representative samples from ground and/or surface water encountered at the bridge site and analyzes the samples for sulfates, chlorides, resistivity and pH for the purpose of determining the appropriate pile or concrete type (steel or concrete piles or steel encased by concrete). Based on this data the Engineer shall recommend drilled shaft mix type 1, 2, or 3, pre-stressed pile concrete type PPM-02, or type AF-1a substructure concrete in corrosive environments.

#### Scour Analysis:

Where applicable, the Engineer shall provide soil D50 values to the ALDOT, which shall be used for scour analysis calculations. Using the D50 soil analysis data, the ALDOT shall provide the Engineer the scour estimate. Should the situation occur that the foundation is to be founded in rock, the Engineer, after consultation with the Geotechnical Engineer, may assume no formal scour analysis is required and thus the scour limit is the top of the rock. This assumption and its basis shall be included in the report. The Engineer shall evaluate the foundation alternatives using this scour estimate to calculate the minimum tip elevations at each selected foundation.

### B. PILE FOUNDATIONS (Pile footings and Pile bents)

1. The Engineer shall use a safety factor of 2.0 with respect to full axial loading. The Engineer shall apply a safety factor of 1.2 for design of pile lengths for the estimated Q100 scour, (minimum tip elevation). Tip elevations shall also be checked for the Q500 scour. The Bridge Bureau will specify, usually on the bridge layout sheet, the design load to be used in the design calculations. In highly corrosive areas such as Mobile and Baldwin Counties, the Engineer shall evaluate the use of concrete piles.
2. The final foundation report should recommend the type of pile and reasons for the choice and/or exclusion of any pile types.
3. If difficult driving is anticipated, this should be noted in the foundation report along with the need for any pre-drilling or pile driving shoes.

### C. SPREAD FOOTINGS

1. The Engineer shall determine the required depth for the bottom of the footing and provide a reason for the recommendation. Spread footings are not generally considered economical at depths greater than 10 feet.
2. The Engineer shall determine the ultimate bearing capacity ( $q_u$ ) of the soil at the bottom of footing depth and recommend the safe allowable bearing capacity ( $q_a$ ) with a safety factor of 3.0, i.e.,  $q_a = q_u / 3.0$ .

3. The Engineer will discuss the need for dewatering, sheeting or shoring, and other construction considerations. This discussion will include a detailed description of the founding material so that the project inspector can verify the material is, as expected.
4. The Engineer will provide an estimate of the footing settlement and time rate of settlement. If significant settlement is expected, the Engineer shall recommend a method to decrease the amount of settlement.

#### D. DRILLED SHAFTS

1. The Bridge Bureau will specify, usually on the bridge layout sheet, the design load to be used in the design calculations. The Engineer shall provide the Geotechnical Engineer with required depth for estimated tip elevations (safety factor of 3.0), minimum tip elevation for the estimated Q100 scour, (safety factor of 1.5). Tip elevations shall also be checked for the Q500 scour. These tip elevations should be set such that excessive settlement will not occur under the design load. Settlement calculations shall be performed per Appendix C of the FHWA Drilled Shaft manual. Excessive settlement will be defined as settlement which exceeds the tolerable total settlement and/or differential settlement for the particular superstructure as defined by the bridge designer. If the Bridge Bureau does not indicate a design load and size, the Engineer shall provide a range of sizes and allowable bearing capacities commensurate with the height and span length of the given bridge.
2. The Engineer shall make recommendations on the need for permanent casing and the depth for casing, if required. Casing should be self-supporting using skin friction alone with a safety factor of 1.5.
3. Suggestions of probable method of construction, whether the shaft may be cast using slurry, temporary or permanent casing or in the dry shall be included in the foundation recommendations. These suggestions shall not be statements of fact and shall contain caveats stating the suggestions are based upon interpreted site conditions.
4. If the drilled shaft will have a rock socket, the socket shall be one diameter into competent rock. Lateral analysis is the responsibility of the Bridge Bureau
5. The Engineer shall indicate whether probe/boring/core holes are required at planned tip elevation to verify subsurface conditions. Please specify which type of hole is needed, if any, and the number of holes required per shaft, if more than one is needed, a minimum depth of these holes. Please indicate in the foundation report if the holes need to be deeper than ten feet with supporting justification.
6. Should the Engineer recommend drilled shafts, the Engineer shall be prepared to evaluate and make recommendations on data collected from the cross hole sonic logging report, if required by the wet method of construction.
7. If coring is required to verify the cross-hole sonic logging results, the Engineer shall be prepared to evaluate and make recommendations on the cores collected.

#### E. REPORT

The Engineer shall provide the Geotechnical Section, with a foundation report as outlined in Section IX. The final foundation report shall also include the following information:

1. Most suitable foundation type with justification
2. Where feasible, foundation alternates
3. Method of foundation support (end bearing, skin friction or combination)
4. Foundation tip elevations to include range of variations in length, with scour considerations take into account
5. Software used in the design and/or sample calculations
6. Settlement considerations to include down drag and/or surcharging of the fill
7. Discussion of pile drivability, with particular attention paid to underlying soft soils and/or boulders
8. LPILE data for use by Bridge Bureau in determining the lateral load capacity of the pile or shaft
9. Advisability of using test piles to include best location of test piles to obtain maximum information regarding length and driving stress considerations
10. Recommendation on load tests to include location and test methods and procedures if the test methods and procedures are different from those specified in the ALDOT's Standard Specifications for Highway Construction
11. Effect of pile driving on adjacent structures
12. Recommended elevations for base of spread and pile footings
13. Evaluation of the safe allowable design loads giving full consideration to the bearing, time-settlement relationships
14. Evaluation of approach embankments by considering settlement of embankments due to consolidation of sub-soil foundations, densification within the embankment, embankment stability, abutment rotation and horizontal component of vertical settlement of approach embankments
15. Precautions that should be taken to reduce the possibility of damage to the structure caused by activities associated with the approach embankment
16. Where applicable, recommendations on ways to accelerate drainage/settlement by evaluating items such as wick drains, surcharging, etc. The Engineer shall determine the impact this activity may have on adjacent structures and streams

### **III. Bridge Culverts**

#### **A. DEFINITION**

Bridge culverts are defined as culverts where the length of the culvert along centerline will equal or exceed 20 feet.

#### **B. GUIDANCE**

If drainage sections are not available and transmitted at the time of the request, use the tables Earth Slopes Horizontal to Vertical for Types of Terrain, found in Notes 106, 107 and/or 108 of the ALDOT Special Drawing No. GN-2 in conjunction with the applicable "typical roadway section" and planned roadway profile to establish the probable inlet and outlet locations of the culvert.

1. Culverts having a length of 300 feet or less should be drilled at mid-length and at each end.
2. Culverts exceeding 300 feet in length should be drilled so that the distance between inlet and outlet borings is equally divided into approximately 150 linear foot increments.

#### C. BORINGS

1. Extend borings to a depth of 1.5 times the expected fill height, a minimum of ten vertical feet, or ten vertical feet into competent material, whichever occurs first.
2. Sufficient undisturbed samples (AASHTO T-207) should be recovered and tested to permit calculation of the soil bearing capacity and expected settlement of the assumed culvert(s) as outlined in FHWA publication NHI-00-045 Soils & Foundations, Chapter 6.
3. Should soft soils be encountered, such that the execution of borings is prohibited, “soundings” should be performed to determine the depth and lateral extent of the soft soils, as outlined in Section VIII of this document.

#### D. REPORT

A brief foundation report should be prepared for each investigated culvert location. The report shall include:

1. Expected site soil profile(s)
2. Results of soil bearing capacity calculations
3. Estimated settlement with analyses
4. The Engineer’s recommendations for subgrade improvement(s) should the available bearing capacity appear to be inadequate and/or excessive differential settlement is anticipated.

### **IV. Retaining Walls**

#### A. GENERAL

1. The Engineer will receive the plan, profile and cross-sections for the proposed wall location. The plans may or may not indicate whether the wall is to be cast-in-place (CIP), mechanically stabilized earth (MSE), etc. If the wall type is not specified, the Engineer should recommend the type wall to be used with supporting data or recommend the final plans contain alternates if several types are equally viable. Generally, the wall type selection should be left to the contractor, if at all possible.
2. Using the information provided, the Engineer should plan an appropriate number of boring and sampling locations to adequately determine the soil stratification beneath the proposed wall. Typically, borings should be placed every 100 to 200 feet along the length of the wall, and should extend to a depth of twice the wall height or ten feet into competent material, whichever occurs first.
3. Design of the actual wall elements will be the responsibility of the wall designer.



## B. ENGINEER'S RESPONSIBILITIES

1. Provide the allowable bearing capacity
2. Check the factors of safety for all phases of global stability
  - a. Sliding, (FS=1.5)
  - b. Overturning, (FS=2.0)
  - c. External slope stability (FS=1.5), i.e., rotational failure beneath the wall.
  - d. Stability of the construction excavation, (FS=1.2).
3. If soft soils are encountered such that bearing capacity for the height of wall specified is of concern, the Engineer will recommend a method of remediation.  
Recommendations may include but are not limited to:
  - a. undercut and backfill
  - b. founding of the footing on deep foundations
  - c. stone columns
  - d. proprietary options
4. The recommendations should contain the depth of undercut and specifications on the type of backfill to use per ALDOT Standard Specifications for Highway Construction. For further guidance on investigations in soft soils, please refer to Section VIII, Soft Soils.
5. The foundation report shall indicate an estimate of the total settlement, differential settlement, and time rate of settlement. The report shall also indicate if the type wall chosen will allow for the differential settlement and/or recommend alternatives.
6. Should site characteristics indicate the use of other types of retaining structures such as rock bolts, soil nails, tiebacks, gabions, or shotcrete surfacing, the Engineer will be required to write and/or review pertinent special provisions to the ALDOT Standard Specifications for Highway Construction. Special attention should be paid to the location of the ROW line as it pertains to rock bolts, soil nails, and tiebacks.

## C. REPORT

1. The foundation report for retaining walls shall follow the guidelines outlined in Section IX, Reports.
2. The Engineer shall provide a drawing, suitable for inclusion in the plans, with the "wall envelope" shown. The wall envelope includes:
  - a. A profile view of the wall with the top of wall, bottom of wall, bottom of footing, and begin and end stations clearly indicated.
  - b. The bearing capacity along the length of the wall, particularly if the bearing capacity changes along the length of the wall.
  - c. The limits (length and depth) of undercut and backfill or locations for other soil remediation which may be necessary beneath the wall.
3. The foundation report shall also cover any construction details such as dewatering, sheeting, shoring, etc.
4. The lateral earth pressures, which will be exerted on the wall, shall also be provided so that the wall designer can account for these loads during the design phase.

5. If special, site specific, drainage details are needed; these shall also be covered in the final foundation report.

## **V. Landslides**

### **A. PROJECT INFORMATION**

1. For any landslide remediation request, the Engineer will receive a location and vicinity map along with cross-sections of the landslide, if available at the time of the request.
2. The Engineer shall be expected to contact the ALDOT District Engineer and/or County Engineer to ascertain the maintenance history of the slide area, to include any previous corrective measures taken.
3. Once a site reconnaissance has been completed, the Engineer will propose an investigation plan including boring and instrumentation locations with rationale for each sampling and testing location. If the use of slope inclinometers is proposed, the installation, monitoring and processing of the data shall conform to the guidelines in AASHTO T-254.
4. Once the Geotechnical Engineer has approved the investigation plan, the Engineer shall proceed with the investigation phase.

### **B. DATA ANALYSIS**

1. Perform field work per approved investigation plan
2. Perform laboratory analyses
3. Utilize design software to prepare a remediation procedure

### **C. REPORT**

Once the Engineer has gathered, reviewed and analyzed all pertinent data, the Engineer shall provide a foundation report outlining the proposed remediation procedure. This foundation report shall include, but is not limited to, the following:

1. Site soil profile cross-section used for analysis
2. Site plan indicating length, ground surface cracks, head scarp, toe bulge and general location of slide, along with any springs emitting from the face of the slide
3. Detailed narrative history of the slide area, including movement history, maintenance work, and previous corrective measures
4. Assumed or back calculated soil strength parameters and probable slide failure plane
5. Proposed remediation technique with cross-section drawn to a reasonable scale and showing dimensions with an estimated safety factor ( $>1.3$  or  $>1.5$  if a structure is involved), estimated cost, advantages and disadvantages. Remediation techniques may include but is not limited to :
  - a. Rock buttress
  - b. Shear key
  - c. Rebuild slope

- d. Surface drainage
  - e. Subsurface drainage-interceptor
  - f. Drain trenches
  - g. Horizontal drains
  - h. Retaining structures
6. Construction sequence and factor of safety for excavated slope during construction.
  7. If special construction techniques or materials are to be used, the Engineer will write and/or review all special provisions related to the special construction techniques or materials. The Engineer shall also indicate what types of material to use for regular construction techniques and any gradation and/or compaction requirements, per ALDOT Standard Specifications for Highway Construction.

## **VI. Slope Studies**

### **A. RECEIVE PROJECT INFORMATION**

Which will include but is not limited to:

- General Roadway Alignment
- Plan & Profile of project,
- Cross sections of project

### **B. DETERMINE BORING LOCATIONS AND DEPTHS**

1. Borings should typically be spaced every 200 feet to 500 feet along centerline
2. At least one boring should be taken in each separate landform.
3. Borings shall be taken in the left and right ditch lines, extending approximately 3 feet below the ditch line, in order to establish a geologic cross-section for analysis.
4. For large cuts, the geologic cross-sections should be taken at approximately the quarter points of the cut or where considered most effective.
5. Borings in fill areas should be extended to 1.5 times the proposed fill height or to augur refusal, whichever is shallowest, but no more than 10 feet into competent material. A limited amount of coring should be completed to ensure augur refusal did not occur on a boulder. If boulders are encountered, borings should be extended until true, competent is reached.
6. If soft soils are encountered, follow the guidelines under Section VIII, Soft Soils, below.

### **C. PERFORM FIELD WORK**

Once the Geotechnical Section has approved the boring location plan, the Engineer can proceed with the boring and sampling phase of the project. The information obtained during this phase of the project will be used by the Engineer and their Geologist to determine the appropriate slopes. Borings shall be plotted on cross-sections in order to provide site soil profiles through the cuts and fills.

If caves, sinkholes, and/or karst features are encountered on the project, the following steps should be included in the investigation process:

- Perform site inspection of the cave itself
- Determine the exact location of the feature to include elevations
- Gather historical data from Speological Society
- Determine the impact of the proposed roadway construction on the feature
- Determine if sink hole activity is current or dormant
- Obtain a copy of the sink hole map for the county
- Overlay the sinkhole/cave/karst feature on the project alignment maps

#### D. REPORT

A slope study report shall be produced by the Engineer which includes the following items:

1. A table giving slope recommendations by station, left and right of centerline throughout the length of the project, with references to the figures associated with each station. Slope recommendations should be for the steepest slope that can be utilized and still remain stable.
2. Typical sections for each slope cross-section configuration, e.g. rock cuts and soil cuts.
3. Profiles along each cut as viewed from the centerline which graphically indicates the following:
  - a. approximate top of cut,
  - b. ditch line,
  - c. zone of weathered rock and/or soil with slope recommendation,
  - d. approximate top of rock cut,
  - e. zone of rock cut with slope recommendations
  - f. bench locations.
  - g. These profiles should cover each cut section from station to station, and indicate the stations covered and approximate elevations.
4. If cuts are located on both sides of the projected roadway at any station, then two profiles, one right and one left of centerline will be required.
5. Discussion of any evidence of springs and excessively wet areas, along with a general note regarding the surface and subsurface drainage observed.
6. If slides, slumps, and faults are noted during the course of the investigation, these should be discussed along with measures to prevent problems in the future.
7. If soil cut slopes are included on the project, a formal stability analysis may be required in order to determine if the proposed slope has a sufficient factor of safety against failure
8. If any of the soil or rock materials encountered in the cuts are not suitable for reuse on the project, a plan note should be included detailing the station to station location and elevations of the unsuitable material.
9. Recommendations on the need for blasting for rock cuts and an evaluation of the effects of blast induced vibrations on adjacent structures.
10. Recommendations on the need for special rock slope stabilization measures such as rock fall catch ditch, wire mesh slope protection, shotcrete, rock bolts, etc.

11. Recommendations on the slope angle to use in fill areas.
12. Maps indicating the location of any caves/sinkholes/karst features encountered on the project and recommendations to minimize impacts from said features.

## **VII. Mine Studies**

In order to determine if a mining operation may impact the project area, the Engineer/Geologist shall conduct the following activities:

1. Evaluate the need for study: Make an initial evaluation of the study area by reviewing available topographic maps and regional geology to determine the possibility of underground or strip mines.
2. Historical research: After confirming the need to complete a study, the Engineer/Geologist shall conduct a detailed literature search to determine the possible locations, type, and extent of mining activities.
3. Agency search: The Engineer/Geologist shall visit the Mine Safety and Inspection Office, the Surface Mining Commission, the Alabama Geological Survey, other government offices or commercial facilities, such as USX, in order to find detailed maps and records of mining activity.
4. Field reconnaissance: The Engineer/Geologist shall walk the project area to evaluate potential impact of the suspected mining activity on the construction project.
5. Drilling confirmation: The Engineer/Geologist shall attempt to locate any suspected mines by using slope study drilling, soil profile drilling or additional drilling.
6. Present findings: The Engineer/Geologist shall submit a written report of their findings to include the mine location, type of mine, material mined, approximate mine depths, approximate mine alignment in relation to the proposed road way layout, potential impact on the road and construction, recommended method of treatment, if needed, and any other information that the Engineer/Geologist deems appropriate.

## **VIII. Soft Soils**

- A. If during the course of an investigation, the Engineer encounters areas of muck, unsuitable material, and/or soft soils, further investigation and analysis of the area shall be performed.
- B. Where unsuitable material and/or muck is encountered, soundings or boring and sampling shall be taken along the centerline and right and left of centerline out to the limits of construction to determine the depth and extent of the unsuitable material and/or muck. Recommendations shall be made for removal and/or treatment of any unsuitable material and/or muck encountered.
- C. In the case of soft soils, particularly those located beneath a proposed embankment, the stability and settlement of the fill must be carefully evaluated.

1. The factor of safety for stability of the embankment must be equal to or greater than 1.3 or 1.5 if a structure is involved.
  2. If the soft soils preclude the embankment from meeting this criterion, the Engineer shall provide recommendations for treatment of the soft soils. Treatment options may include but are not limited to:
    - a. change of alignment,
    - b. change of grade,
    - c. use of stabilizing counter berms,
    - d. excavation and replacement of weak subsoil,
    - e. staged construction with/without surcharging and/or wick drains,
    - f. lightweight fill,
    - g. geosynthetic reinforcement, etc.
  3. The Engineer shall also provide cost comparisons and advantages and disadvantages for the various treatment alternatives given.
  4. Recommend the best alternate for the site, taking into account cost, timeliness, and safety.
- D. The consolidation properties of the soft soils should be determined through laboratory testing so that an estimate of the amount of settlement and the time rate of settlement can be determined.
1. The Engineer shall provide an estimate of the delay time for the contractor due to settlement.
  2. If instrumentation will be required to monitor the fill stability and/or settlement, the specific location of the device(s) should be indicated in the report.
  3. The Engineer will also be responsible for developing and/or reviewing any special provisions which are required for the instrumentation.
- E. If excavation and replacement is the recommended option for remediating the soft soils, the Engineer shall provide mylar drawings indicating the vertical and lateral limits of the excavation.
- F. If a surcharge program is recommended, the Engineer shall provide mylar plan and cross-section views of the treatment plan along with a recommendation of where to dispose of the surcharge material once settlement is complete.

## **IX. Reports**

- A. The final foundation report provided by the Engineer shall include the following items as a minimum:
1. A brief description of the field work to include such information/data as when and who performed the work, site conditions at time work was performed, scope and purpose of the investigation,
  2. Brief description of in place structures to include foundation type, design load, pile tips, etc., the structure's performance, and a copy of any boring logs and driving records found during the historical search ,

3. A general description of subsurface soil, rock, and groundwater conditions,
  4. A geologic and physiographic description of the site to include location, geologic, and topographic maps,
  5. Boring logs, boring location plan, field test data, summary of laboratory test data, and subsurface profile with word descriptions of the various soil and rock types along with abbreviated boring logs and water levels indicated
  6. Graphical and/or tabular information obtained through field soft soil soundings
  7. Specific engineering recommendations for design based upon the soil features encountered at the site, to include:
    - a. A listing of assumptions used in producing the report and recommendations,
    - b. A description of software used in evaluating the various design alternatives,
    - c. A thorough discussion of groundwater conditions at the site, to include artesian conditions, if present, and impacts it may have on the project.
  8. A discussion of construction considerations to include:
    - a. Groundwater impacts on construction such as fluctuations in height of ground or surface water, control in excavations, well points, pumping, tremie seals, etc.
    - b. Adjacent structures and any damage that may result from excavation, pile driving, blasting, drainage, etc.
    - c. Evaluation of pile driving to include difficulties or unusual conditions which may be encountered (i.e. hard driving), special precautions which may be required, special equipment, pile driving sequence
    - d. Excavation to include control of earth slopes, types of material to be encountered, and the need for a cofferdam or sheeting and shoring.
    - e. A sequence of construction for landslides and other special construction situations. The sequence of construction shall include but is not limited to recommended lengths for open excavations, placement of fill on specialized areas, recommended location to start construction (i.e., start downhill on excavations so as not to create drainage problems), and any other instruction as deemed pertinent.
- B. The Engineer will submit a draft copy of the foundation report for review by the Geotechnical Section. Along with the draft, the Engineer will submit a completed copy of the FHWA document “Checklists and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specifications”. Once the Geotechnical Section has returned comments, the Engineer will finalize the report and submit ten (10) copies of the final report to the Geotechnical Section for distribution.
- C. BORING LOGS
1. A 24”x36” plan sheet depicting boring logs (mylar) produced by the Geotechnical Section has been forwarded to the Engineer and should be the basis for the soil display used by the Engineer.
  2. The Engineer shall prepare 24”x36” mylars depicting the boring information for inclusion in the final plan assembly. These boring logs shall be easily readable when produced as half-scale, quarter size prints and/or 11”x17” plots. The

- appropriate font types and sizes as well as line weights for use in microstation are available on the ALDOT website under the Design Bureau.
3. All boring logs shall indicate the water level in the boring, depth to caving, if the hole caved in, and/or no water table encountered.
  4. The boring log shall also indicate the make and model of the drill rig, method of drilling and/or coring, and the type of hammer used for SPT sampling.
  5. A note should be placed on the boring log sheet indicating where the cores taken on the project, if any, will be stored.
    - a. Core shall be taken to the nearest district or division office to the project site and stored for review by potential contractors.
    - b. The boxes shall be labeled with the ALDOT project number on all four sides of the boxes.
    - c. The top of the box shall be labeled with the box number, boring number, hole depth, elevations, station number, and county.
  6. All borings shall be identified sequentially referencing station numbers, offsets and bent/abutment/pier numbers as designated on the bridge layout.
  7. If soft soil “soundings” were obtained on the project, a graphical interpretation of this information should also be placed on mylar for inclusion in the final plan assembly.
  8. The Engineer can propose a different boring log product for review at time of boring layout submittal as long as said proposal is accepted by the Geotechnical Engineer, prior to initiation of the work.

## **X. Referenced Documents**

- AASHTO T-206: Penetration Test and Split-Barrel Sampling of Soils
- AASHTO T-207: Thin-Walled Tube Sampling of Soils
- AASHTO T-225: Diamond Core Drilling for Site Investigation
- AASHTO T-252: Measurements of Pore Pressures in Soils
- AASHTO T-254: Installing, Monitoring, and Processing Data of the Traveling Type Slope Inclinator
- AASHTO T-306: Progressing Auger Borings for Geotechnical Explorations
- AASHTO R-13: Conducting Geotechnical Subsurface Investigations
- ALDOT Special Drawing No. GN-2
- FHWA Publication NHI-00-045 Soils & Foundations
- ALDOT Standard Specifications for Highway Construction
- FHWA Drilled Shafts: Construction Procedures & Design Methods
- FHWA Checklists & Guidelines for Review of Geotechnical Reports & Preliminary Plans & Specifications
- ADEM Phase II Stormwater Regulations



## REVISIONS

<b>Revision #</b>	<b>Subject</b>	<b>Date</b>
1	Change of Title & Added Front Cover	September 21, 1999
2	Changed Title; Added historical checklist; Added items for inclusion on boring logs; Added settlement criteria for drilled shafts; Referenced the County Trans. Memo; Requested draft copy for review and 10 final copies	May 2, 2001
3	Added sections for Bridge Culverts, Retaining Walls, Landslides, Slope Studies, Mine Studies, and Soft Soils	February 8, 2005