

# GEOTECHNICAL GUIDANCE *MANUAL*

COMMONWEALTH OF KENTUCKY  
TRANSPORTATION CABINET

JUNE 2005



Produced by the Organizational Management Branch  
Office of Human Resource Management





**TRANSPORTATION CABINET**

Frankfort, Kentucky 40622  
www.kentucky.gov

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**OFFICE OF THE SECRETARY**

**OFFICIAL ORDER** 103021

**SUBJECT:** *Geotechnical Guidance Manual*

This manual has been prepared to provide information and guidance to personnel of the Kentucky Transportation Cabinet. Its purpose is to establish uniformity in the interpretation and administration of laws, policies, regulations, and procedures applicable to the operation of the Geotechnical Branch and its relationship with other units of the Cabinet.

The policies and procedures set forth herein are hereby approved and declared effective unless officially changed.

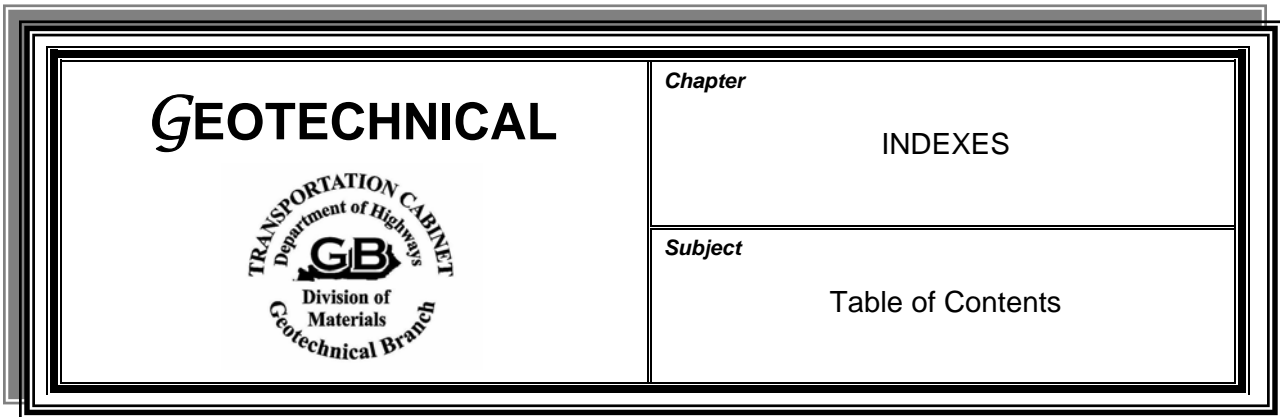
All previous instructions, written and oral, relative to or in conflict with this manual are hereby superseded.

Signed and approved this 28<sup>th</sup> day of June, 2005.

Bill Nighbert  
Acting Secretary

Approved as to Form and Legality

Office of Legal Services



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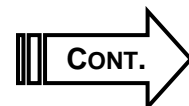
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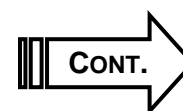


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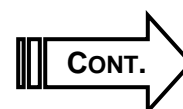
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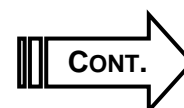
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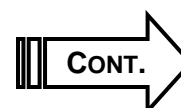
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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>INTRODUCTION</p>
	<p><i>Subject</i></p> <p>Design of This Guidance Manual</p>

**ORGANIZATION & NUMBERING:**

**Chapter (Section) Title**—The subject matter in the manual is divided into chapters or sections. The chapter (section) title appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

**Subject Title**—The title of a subject appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

**“GT” Prefix**—Preceding each subject number, this prefix stands for the manual title *Geotechnical*.

**Date**—The latest issuance date of a subject appears at the bottom of each page of the subject. This date agrees with the latest issuance date shown for the subject in the Table of Contents (**GT-01**).

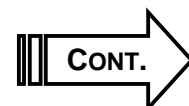
**Page Numbering**—Each subject has its own page numbering, which appears at the bottom of each page.

**LOCATING INFORMATION:**

**Indexes**—To help you quickly find information in the manual, two indexes appear at the front. Each index entry includes the corresponding subject number in the manual where you will find detailed information for the entry.

**Table of Contents (GT-01)**—This index lists the titles of the manual’s chapters (sections) and their subjects, as well as other information, in numerical order. It includes the latest issuance dates of all the subjects. As the manual matures, these dates change.

**Alphabetical Index (GT-02)**—This index alphabetically lists key information in the manual. Generally, it directs the user to subject titles and to margin, paragraph, and subparagraph headings within subjects.



**CROSS-  
REFERENCES  
IN MANUAL:**


**Subject Numbers within Narrative**—When you see a subject number within the narrative on a page, refer to that number for more information about the subject.

**English and Metric Units of Measurement**—The English unit is the primary unit of measurement in this manual. The equivalent metric unit of measurement is in parentheses following the English unit.

**QUESTIONS:**

**Whom to Contact**—If you have any questions concerning the contents of the manual, please contact the Division of Materials, Geotechnical Branch, 1236 Wilkinson Boulevard, Frankfort, KY 40601, at **(502) 564-2374**. If you need additional copies of the manual, please contact the Policy Support Branch at **502-564-3670**.

2 2 2

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>INTRODUCTION</p>
	<p><i>Subject</i></p> <p>Purpose &amp; Content of the Manual</p>


**PURPOSE OF MANUAL:**

The *Geotechnical Manual* is a guide to be used in conducting geotechnical investigations for roadways and structures. The purpose of geotechnical investigations is to furnish information for an optimum design that will eliminate the need for being overconservative (an uneconomical practice used to compensate for lack of knowledge of subsurface conditions) and minimize the cases of underdesign (and the resulting failures attributed to so-called "unforeseen" soil conditions).

It is to be realized that any subsurface investigation will leave certain areas unexplored. It must be further realized that it would be impractical to attempt to provide a set of rigid specifications for all possible cases. Thus, this manual will not answer all subsurface investigation problems; it leaves many areas where individual engineering judgment must be utilized. It is intended that the procedures set forth herein will establish reasonable, uniform policies and procedures while maintaining sufficient flexibility to permit the application of engineering judgment to the solution of special problems.

**REFERENCES TO OTHER PUBLICATIONS:**

This manual frequently references other publications, which present specific engineering design and construction procedures or laboratory testing procedures. Among the most commonly referenced materials are the publications of the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the federal government's Naval Facilities design manual (NAVFAC). Relative to testing procedures, the methods presented by AASHTO are often followed. In other instances, modifications to AASHTO procedures, or additional tests not addressed by AASHTO, are required. A companion manual, *Kentucky Methods (KM)*, presents these testing procedures. AASHTO and KM specifications are referenced, but not reproduced, in this manual. Refer to **GT-500s, Laboratory Testing and Material Classification**, for details relating to these testing procedures.

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Chapter</i> <b>INTRODUCTION</b>
	<i>Subject</i> <b>Functions of the Geotechnical Branch</b>

**OVERVIEW:** The Geotechnical Branch is responsible for all functions relating to geotechnical engineering (with the exception of research) required for the planning, design, construction, and maintenance of roads and bridges under the jurisdiction of the Department of Highways.

**DEFINITION:** *Geotechnical engineering* is defined as the acquisition, interpretation, and application of the knowledge of materials of the earth's crust to the solution of civil engineering problems. It embraces the fields of soil mechanics, rock mechanics, engineering geology, geophysics, and other related sciences.

**FUNCTIONS:** The Geotechnical Branch performs geotechnical investigations for:

- Ø Planning studies
- Ø Roadway design
- Ø Structure foundation design
- Ø Landslides
- Ø Special problems on construction and maintenance projects

Investigations may consist of:

- Ø Site inspections
- Ø Photographs (including aerials)
- Ø Drilling
- Ø Sampling
- Ø Instrumentation
- Ø Laboratory testing
- Ø Engineering analysis
- Ø Preparation of geotechnical engineering reports

Reports include:

- Ø Interpretation and analysis of the subsurface data
- Ø Drawings
- Ø Specifications
- Ø Specific engineering recommendations for design
- Ø Recommendations for solutions of anticipated construction problems




**FUNCTIONS****(cont.):**

In many cases Geotechnical Branch personnel perform investigations. In-house personnel also perform much of the necessary drilling. Other projects, however, involve assistance from district drilling crews or prequalified geotechnical drilling firms. Prequalified geotechnical engineering consultant firms also perform investigations that the Geotechnical Branch monitors.

2 2 2




<p style="text-align: center;"><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p style="text-align: center;">INTRODUCTION</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Organization of the Geotechnical Branch</p>

**ORGANIZATION:** The Geotechnical Branch operates under the direct supervision of the Geotechnical Engineering Branch Manager of the Division of Materials. The Geotechnical Branch is subdivided into the following sections (**Exhibit 01**):

- Ø Soil Survey and Test
- Ø Drilling and Instrumentation
- Ø Engineering Geology
- Ø Structure Foundations
- Ø Construction

2 2 2

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>PROJECT INITIATION</p>
	<p><i>Subject</i></p> <p>Introduction</p>

**OVERVIEW:** This chapter presents recommendations for having a geotechnical investigation performed by the department. In some cases it lists preliminary requirements. For example, a roadway investigation is to be requested after the preliminary line and grade meeting. It also lists the types of information to be submitted with the request. These items typically include project identification (item number, project number, etc.) and project location (county, site map, station limits, etc.). The specific subjects explored in this chapter are as follows.

**PLANNING STUDIES:** **GT-201** lists the kind of data included in any preliminary geotechnical overview.

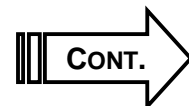
**ROADWAY DESIGN INVESTIGATIONS:** **GT-202** discusses the kind of data specific to a request for a geotechnical report of a proposed roadway project.

**STRUCTURAL FOUNDATION INVESTIGATIONS:** The following subjects explore the kind of data included in requests for structural foundation investigations:

- GT-203-1** Data for All Investigations (regardless of structure type)
- GT-203-2** Bridges
- GT-203-3** Culverts
- GT-203-4** Retaining Walls
- GT-203-5** Noise Barrier Walls

**MAINTENANCE INVESTIGATIONS:** The following subjects explore the kind of data included in requests for maintenance investigations:

- GT-204-1** Landslides
- GT-204-2** Unstable Rock Slopes



**CONSTRUCTION**


**INVESTIGATIONS:** The following subjects explore the kind of data included in requests for construction investigations:

- GT-205-1      Landslides
- GT-205-2      Rock Cuts
- GT-205-3      Excess Material Sites
- GT-205-4      Subgrade Stabilization
- GT-205-5      Field Instrumentation

**PERMITS:** The following subjects explore requests for review of permits:

- GT-206-1      Right-of-Way Encroachment
- GT-206-2      Mining Encroachment

2 2 2


<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>PROJECT INITIATION</p>
	<p><i>Subject</i></p> <p>Planning Studies</p>

**DATA TO BE INCLUDED:**

The Division of Planning or others may request a preliminary geotechnical overview. This request should include:

- Ø County name
- Ø Project number
- Ø MARS (Management Administrative and Reporting System) number
- Ø Item number
- Ø Location and limits of project area or corridors on a topographic map (Scale 1 inch = 2,000 feet [1:24,000])
- Ø Class of proposed roadway
- Ø Project manager
- Ø Desired completion date
- Ø Aerial photographs, if available

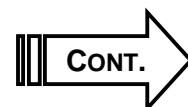
2 2 2

<h1>GEOTECHNICAL</h1> 	<i>Chapter</i> PROJECT INITIATION
	<i>Subject</i> Roadway Design Investigations

**OVERVIEW:** This section describes the data that should be included in a request for a geotechnical report. Submittals shall be made by the Division of Highway Design, the District Project Manager, or the design consultant after the preliminary line and grade have been approved.

**ROADWAY DESIGN INVESTIGATIONS:** The designer may request a geotechnical report for a proposed roadway project. This request should include:

- Ø County name, project number (MARS number), and item number
- Ø Project layout, location, and manuscript sheets
- Ø Location of proposed alignment on a topographic map (1 inch = 2,000 feet [1:24,000]) with stations indicated on maximum 1,000 feet (300 meters) intervals (**Exhibit 02**)
- Ø Datum (sea level/benchmark datum, or assumed datum)
- Ø Preliminary plan and profile sheets (half-size only; minimum of two sets)
- Ø Preliminary cross-section sheets (half-size only; minimum of two sets)
- Ø Property owner strip map (minimum of two sets)
- Ø Upon request, aerial photographs, if available
- Ø Design engineer or consultant responsible for the project




**ROADWAY DESIGN  
INVESTIGATIONS  
(cont.):**

- Ø Baseline profile sheets, showing groundline and gradeline, are to be used for developing the soil profile. It is required that all of the above be submitted electronically in Microstation format. The vertical and horizontal scales shall be 1 inch = 10 feet (1:120) and 1 inch = 100 feet (1:1,200), respectively, on English drawings or 1:100 and 1:1,000 on drawings with metric units. If approved by the Geotechnical Branch, the vertical and horizontal scales may be 1 inch = 5 feet (1:60) and 1 inch = 50 feet (1:600), respectively, on English drawings or 1:50 and 1:500 on drawings with metric units. (Refer to the *Highway Design Guidance Manual* for details concerning the preparation of the soil profile sheets.)

The District Branch Manager for Preconstruction shall notify the Division of Materials, Geotechnical Branch, of the estimated date when right-of-way plans are due in the Central Office and the milestone date for final joint inspection. The Geotechnical Branch shall arrange for a drill crew to perform the subsurface investigation. This may be a Geotechnical Branch drill crew, a district drill crew, or a prequalified drilling company.

The Geotechnical Branch will prepare a boring plan and, if necessary, schedule a preliminary meeting at the project site with the District Branch Manager for Preconstruction and the drill crew supervisor. The purpose will be to discuss the scope of work and the proposed boring plan. Drilling operations shall not begin prior to receiving an approved boring plan from the Geotechnical Branch.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURAL FOUNDATION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Data for All Structural Investigations</p>

**REQUESTING AN INVESTIGATION:**

After the approval of the preliminary line and grade, the District Project Manager, the Division of Bridge Design, or, if applicable, the design consultant shall be responsible for submitting to the Geotechnical Branch a request for a structural foundation investigation. Such a request is to include certain data.

**DATA TO BE SUBMITTED FOR ALL INVESTIGATIONS:**


The following data shall be submitted with all requests for geotechnical investigations, regardless of the type of structure:

- Ø County name
- Ø Project number (including MARS number)
- Ø Road number and name
- Ø List of structures on project
- Ø Project manager responsible for project
- Ø Firm or agency responsible for staking boring locations
- Ø Item number
- Ø Type of datum used (sea level/benchmark datum, or assumed)
- Ø All drawings to be submitted electronically in Microstation format
- Ø Location on a 1 inch = 1,000 feet [1:24,000] topographic map

**ADDITIONAL DATA FOR SPECIFIC TYPES OF STRUCTURES:**

Other data to be submitted with requests for specific types of structures are listed in subsequent subjects. Submittals shall be within 10 days after preliminary line and grade have been approved for structure replacement projects.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURAL FOUNDATION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Bridges</p>


**ADDITIONAL DATA  
FOR BRIDGE  
FOUNDATION**

**INVESTIGATIONS:** A submittal for a bridge foundation investigation includes the data listed in **GT- 203-1**. In addition, the submittal includes:

- ∅ Plan and profile sheets showing structure with abutment and pier stations
- ∅ Plan view and natural scale profile view of proposed bridge showing normal pool and high-water elevations, if applicable
- ∅ Contour map showing project centerline, with stations and proposed substructure units, if available
- ∅ Estimated foundation loading, if available
- ∅ Scour analysis, if applicable, presented at each substructure location, as elevations rather than as depths
  - ◆ For bridges at wet crossings, if rock is known to be deep and deep foundations are anticipated, a scour analysis is required.
  - ◆ If rock is shallow and spread footings are anticipated, a scour analysis is not required.
  - ◆ If subsurface investigation subsequently indicates a possibility that piles will be used or that footings might be placed on scourable bedrock, the bridge designer will be informed that a scour analysis is required and that the final report will not be issued until this information is received.
  - ◆ If subsurface investigation indicates footings are to be placed on nonscourable bedrock, scour analysis is not required.

2 2 2



<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURAL FOUNDATION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Culverts</p>


**ADDITIONAL DATA  
FOR CULVERT  
FOUNDATION**

**INVESTIGATIONS:** A submittal for a culvert foundation investigation includes the data listed in **GT-203-1**. In addition, the submittal includes:

- ∅ Natural scale section along the centerline of the culvert showing:
  - ◆ Roadway grade
  - ◆ Fill slopes
  - ◆ Existing and proposed profiles (including inlet and outlet elevations)
  - ◆ Flowline
- ∅ Contour map with project centerline with stations and structure baseline, if available
- ∅ Plan sheet showing structure location
- ∅ Cross-sections in area of culvert

**PIPE CULVERTS:** The roadway designer may request subsurface investigations for pipe culverts whenever the fill height at the pipe location, the depth of the foundation soils, or the size of the pipe is sufficient to indicate the possible development of settlement or stability problems. Submittals for pipe culvert investigations shall be the same as above.

2 2 2


<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURAL FOUNDATION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Retaining Walls</p>

**ADDITIONAL DATA  
FOR RETAINING WALL  
FOUNDATION**

**INVESTIGATIONS :** A submittal for a retaining wall foundation investigation includes all data listed in **GT-203-1**. In addition, the submittal includes:

- ∅ Wall profile showing existing groundline, low-side finished grade, high-side finished grade, and top of wall
- ∅ Cross-sections showing the proposed wall, backslope, and foreslope, every 20 feet (6 meters) along the wall
- ∅ Plan sheet showing the proposed wall
- ∅ Contour map showing project centerline and stations

2 2 2


<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURAL FOUNDATION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Noise Barrier Walls</p>

**ADDITIONAL DATA  
FOR NOISE  
BARRIER WALL  
FOUNDATION**

**INVESTIGATIONS:** A submittal for a noise barrier wall foundation investigation includes all data listed in **GT-203-1**. In addition, the submittal includes:

- ∅ Wall profile showing existing groundline and finished grade, including proposed top and bottom of wall
- ∅ Centerline cross-sections, every 50 feet (15 meters), showing the proposed wall
- ∅ Plan sheet showing the proposed wall
- ∅ Contour map showing project centerline and stations


2 2 2

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">MAINTENANCE INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Landslides</p>

**POLICY:**


A request for the Geotechnical Branch to conduct a preliminary investigation of a landslide shall originate from the Chief District Engineer or from the Director of the Division of Maintenance. If necessary, the requesting party will provide surveying and utility locations and obtain right of entry. The Division of Maintenance will be responsible for obtaining the necessary funds if a comprehensive geotechnical investigation is required. Total funding shall include expenses for surveying, drilling, aerial photography, traffic control, etc. The Geotechnical Branch should be contacted for input on the funds necessary for a geotechnical investigation.

2 2 2

<p style="text-align: center;"><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p style="text-align: center;">MAINTENANCE INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Unstable Rock Slopes</p>


**POLICY:** Requests for the Geotechnical Branch to conduct a preliminary investigation of an unstable rock slope shall originate from the Chief District Engineer or from the Director of the Division of Maintenance. If necessary, the requesting party will provide surveying and utility locations and obtain right of entry. The Division of Maintenance will be responsible for obtaining the necessary funds if a comprehensive geotechnical investigation is required. Total funding shall include expenses for surveying, drilling, aerial photography, traffic control, etc. The Geotechnical Branch should be contacted for input on the funds necessary for geotechnical investigations.

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<b>GEOTECHNICAL</b> 	<i>Section</i> CONSTRUCTION INVESTIGATIONS
	<i>Subject</i> Landslides


**POLICY:** A geotechnical investigation for a landslide that occurs on a construction project shall be conducted at the request of the District Branch Manager for Construction or the Project Engineer. If necessary, the requesting party will provide surveying and utility locations and obtain right of entry.

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<b>GEOTECHNICAL</b> 	<i>Section</i> CONSTRUCTION INVESTIGATIONS
	<i>Subject</i> Rock Cuts

**POLICY:** A geotechnical investigation necessary to revise a rock-cut slope on a construction project shall be conducted at the request of the District Branch Manager for Construction or the Project Engineer. If necessary, the requesting party will provide surveying and utility locations and obtain right of entry.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">CONSTRUCTION INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Excess Material Sites</p>


**POLICY:** The Geotechnical Branch will review the contractor's excess material site proposals upon request of the District Branch Manager for Construction or Project Engineer. All excess material sites meeting any of the conditions specified in the Transportation Cabinet's *Construction Guidance Manual*, **Section 63-07**, shall be considered for investigation. Proposals shall include the following:

- Ø Topographic map (1 inch = 2,000 feet [1:24,000]) showing the limits of the proposed excess material site
- Ø Profiles and cross-sections showing the natural groundline, proposed template, proposed benching, drainage, etc.
- Ø Recommendations for lift thickness, type of material, compaction requirements, etc.

It shall be the contractor's responsibility to engage a prequalified geotechnical engineering consultant, approved by the department, when a geotechnical investigation is required. The department will pay for the geotechnical investigation and analysis of the proposed excess material site when the Project Engineer requests one (see **Section 204** of the *Standard Specifications for Road and Bridge Construction*, current edition). The consultant shall prepare a plan consisting of the proposed borings, plotted on cross-sections, with a discussion of any analysis necessary, and submit it to the Geotechnical Branch for review. Subsurface investigations shall not begin without approval from the Geotechnical Branch.


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<b>GEOTECHNICAL</b> 	<i>Section</i> CONSTRUCTION INVESTIGATIONS
	<i>Subject</i> Subgrade Stabilization


**POLICY:** The Geotechnical Branch will conduct investigations of subgrades upon request of the District Branch Manager for Construction or the Project Engineer.

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<b>GEOTECHNICAL</b> 	<i>Section</i> CONSTRUCTION INVESTIGATIONS
	<i>Subject</i> Field Instrumentation

**POLICY:** The District Branch Manager for Construction or the Project Engineer (not the contractor) shall notify the Geotechnical Branch or the geotechnical consultant (if applicable) when the contractor is ready for any instrumentation to be installed. Plan notes shall specify the time necessary for installation from time of notification.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PERMITS</p>
	<p><i>Subject</i></p> <p>Right-of-Way Encroachment</p>

**POLICY:** The Permits Branch may request that the Geotechnical Branch review right-of-way encroachment permits and offer comments and recommendations.

Requests for review of a right-of-way encroachment permit should include:

- Ø County name and project number (MARS number), if applicable
- Ø Location of proposed encroachment on a topographic map (1 inch = 2,000 feet [1:24,000])
- Ø Any plan, manuscript, or cross-section sheets showing proposed encroachment
- Ø Any subsurface information obtained or geotechnical report prepared for proposed encroachment
- Ø Any construction procedures to be followed

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<h1>GEOTECHNICAL</h1> 	<i>Section</i> PERMITS
	<i>Subject</i> Mining Encroachment

**POLICY:** The Permits Branch may request that the Geotechnical Branch review mining encroachment permits and offer comments and recommendations.

Requests for review of a proposed mining encroachment permit should include:

- Ø Topographic map (1 inch = 2,000 feet [1:24,000]) showing proposed mine crossing
- Ø Mine production map with crossings and surface features indicated
- Ø Name, elevation, and thickness of coal seam
- Ø Drill logs of borings through the coal seam and rock profiles in the vicinity of crossings
- Ø Proposed mining method
- Ø Sizes of entries, crosscuts, and pillars if room-and-pillar method is proposed
- Ø Secondary recovery plans for the area
- Ø Problems with water or ground control
- Ø Planned subsidence control measures
- Ø Names and/or owners of other known mines in the area

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Chapter</i>  DRILLING, SAMPLING, & INSTRUMENTATION
	<i>Subject</i>  Introduction

**OVERVIEW:** This chapter addresses drilling procedures and other activities related to drilling. The subsequent chapter covers the scope of drilling for individual projects (that is, how many borings are recommended for a specific structure or landslide, etc.). The specific subjects this chapter explores are as follows.

**PRELIMINARY CONSIDERATIONS:** The following subjects explore preliminary considerations for drilling:

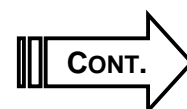
- |                 |                                   |
|-----------------|-----------------------------------|
| <b>GT-301-1</b> | Permission to Drill               |
| <b>GT-301-2</b> | Locating and Protecting Utilities |
| <b>GT 301-3</b> | Hazardous Waste                   |
| <b>GT 301-4</b> | Underground Storage Tanks         |

**DRILLING, SAMPLING, & IN-SITU TESTING:** The following subjects discuss specific drilling, sampling, and in-situ testing procedures:

- |                 |                             |
|-----------------|-----------------------------|
| <b>GT-302-1</b> | Defining Refusal on Bedrock |
| <b>GT-302-2</b> | Rockline Soundings          |
| <b>GT-302-3</b> | Disturbed Soil Borings      |
| <b>GT-302-4</b> | Thin-Walled Tube Samples    |
| <b>GT-302-5</b> | Standard Penetration Tests  |
| <b>GT-302-6</b> | Field Vane Shear Tests      |
| <b>GT-302-7</b> | Rock Core Drilling          |
| <b>GT-302-8</b> | Cone Penetration Testing    |

**DOCUMENTATION:** The following subjects explore necessary documentation:

- |                 |   |
|-----------------|---|
| <b>GT-303-1</b> | Subsurface Logs and Field Notes                     |
| <b>GT-303-2</b> | Handling and Labeling of Soil Samples               |
| <b>GT-303-3</b> | Identification, Storage, and Delivery of Rock Cores |



**FIELD**


**INSTRUMENTATION:** The following subjects deal with field instrumentation:

- GT-304-1**      Slope Inclinerometers
- GT-304-2**      Observation Wells and Piezometers
- GT-304-3**      Settlement Platforms

**SITE**

**RESTORATION:**      **GT-305** covers the requirements relating to the sealing of geotechnical borings and site reclamation.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">PRELIMINARY CONSIDERATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Permission to Drill</p>

**OBTAINING PERMISSION TO DRILL:**

It is the responsibility of the drill crew supervisor to obtain permission from the property owner or government agency prior to any drilling operations on the affected property. The drill crew supervisor shall contact the property owner and receive individual permission even when right of access has been granted to others who may have preceded drilling operations. This permission should cover right of access to conduct the work and any special provisions required by the property owner, such as working hours, avoidance of croplands and wet areas, and cleanup operations.

**LETTERS OF REQUESTS FOR BORING LOGS:**

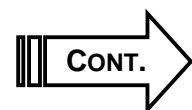
To request copies of boring logs obtained on their properties, property owners are to send a letter of request addressed to the following:

Commissioner  
 Department of Administrative Services  
 Transportation Cabinet Office Building  
 200 Mero Street  
 Frankfort, KY 40622

The department's phone number is **(502) 564-3670**.

The letter of request should state the following:

- Ø Information being requested (copies of core logs, etc.)
- Ø Location of project
- Ø Property name from which borings are obtained
- Ø Location of borings (station, offset, and hole number, when applicable)



**LOG OF CONTACTS:**

The supervisor shall maintain a log of property owner contacts. The log shall include:

- Ø Dates and names of persons contacted
- Ø Synopsis of each discussion
- Ø Names, addresses, and telephone numbers of property owners along the proposed route whenever possible

**DENIAL OF ACCESS:**


If a property owner denies the drill crews access to his or her property, the drill crew supervisor shall contact the District Branch Manager for Preconstruction for guidance. The District Branch Manager may seek legal assistance in negotiations with the property owner if the Geotechnical Branch deems necessary. The drill crew supervisor should provide a letter (or an e-mail) to the Geotechnical Branch, stating boring locations affected and reasons for denial (crops, etc.).

**SPECIAL PERMITS & INSURANCE**

Certain public and private property—such as navigable waters, railroad property, and public streets—may require special permits for right of entry. These working permits may require a fee or special insurance. Obtaining the permits is the responsibility of the organization performing the drilling. However, prior approval by the department is required before these costs can be reimbursed.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p style="text-align: center;">PRELIMINARY CONSIDERATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Locating &amp; Protecting Utilities</p>

**PROCEDURE FOR  
LOCATING  
UTILITIES:**

It is the responsibility of the drill crew supervisor to ascertain the locations of any utilities on the project site before proceeding with drilling operations. The drill crew supervisor shall contact Kentucky Underground at **1-800-752-6007** and the appropriate utility companies and meet with their representatives at the project site to physically locate all utilities in the field prior to any drilling operations on the affected property. The district utility agent may be consulted for assistance in meetings with utility companies.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PRELIMINARY CONSIDERATIONS</p>
	<p><i>Subject</i></p> <p>Hazardous Waste</p>

**SIGNS OF HAZARDOUS WASTE:**


To protect drilling personnel from potentially adverse effects of hazardous waste, field personnel should always be on the alert for any deposits of material or for sites that could be potentially hazardous. These deposits or sites may show signs of any of the following:

- Ø Liquid breakouts
- Ø Soil discoloration
- Ø Odors
- Ø Abnormalities in vegetation
- Ø Dead animals or vegetation

**PROCEDURE FOR EVALUATING SUSPICIOUS MATERIALS:**

No one should attempt to investigate or identify the contents of trash dumps, old barrels, and containers of either liquid or dry material other than professionals qualified to evaluate or handle hazardous materials. Upon encountering areas that appear to contain hazardous waste, crews shall immediately halt all drilling in the affected areas and report their findings to the District Branch Manager for Preconstruction. Work shall not recommence in the affected areas until the department grants approval.

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<b>GEOTECHNICAL</b> 	<i>Section</i> PRELIMINARY CONSIDERATIONS
	<i>Subject</i> Underground Storage Tanks


**PROCEDURE FOR INVESTIGATING**

**USTs:**

An underground storage tank (UST) is a tank system, including its piping, that has at least 10 percent of its volume underground.

No one other than qualified professionals should attempt to investigate or identify the contents of a UST. Upon encountering a UST whose existence was previously unknown, crews shall immediately halt all drilling in the affected area and report their findings to the District Branch Manager for Preconstruction. Work shall not recommence in the affected areas until the department grants approval.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Defining Refusal on Bedrock</p>

**DEFINITIONS:**      *Refusal (R)*, as used in this manual, is generally defined as “the top of bedded material.” Bedded materials are rock formations (including shale) that show well-defined planes of separation, divisional lines, or layers.

*No refusal (NR)* is a term used to indicate that bedded material was not encountered.

*Refusal (R)* or *no refusal (NR)* shall be indicated on all boring logs.


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Rockline Soundings</p>

**METHODS USED  
FOR ROCKLINE  
SOUNDINGS:**

Power augers shall be used for rockline soundings unless the Geotechnical Branch in advance of the work approves other methods. Any preapproved alternative methods used to obtain rockline soundings shall be indicated on the drill logs. Rockline soundings will be advanced to varying depths depending on the situation. (The subjects in **GT-400, Scope of Field Investigations**, provide details.)

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Disturbed Soil Borings</p>

**TEST METHODS:** Disturbed soil borings shall be made in accordance with the *Standard Method of Progressing Auger Borings for Geotechnical Explorations, AASHTO T 306*, with the following exceptions/additions:

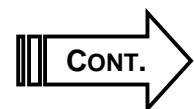
**Exceptions/Additions:** Power-driven equipment shall be used for soil borings unless the Geotechnical Branch in advance of the work approves other methods. Any preapproved alternative methods used to obtain disturbed soil borings shall be indicated on the drill logs. The following points must be considered before the auger boring is made:

- ∅ All sod or organic material must be removed from the surface before advancing a hole.
- ∅ Auger rotation and down feed must be slow.
- ∅ Augers must be cleaned from previous borings so as not to contaminate or mix soil types.
- ∅ The material withdrawn must be checked constantly for changes in soil types.

**RECORD  
KEEPING:**

The procedure for record keeping is as follows:

1. Withdraw the augers at depth intervals small enough to accurately define the boundaries of different soil types.
2. Record the depth, color, texture, and consistency of each soil horizon.
3. Record the immediate water table elevation in each boring.



**BAG SAMPLES:** Bag samples are obtained with conventional drilling equipment after checking the soil types or soil horizons. The soil depths and soil horizon intervals are noted at each boring location and recorded on the TC 64-515 form, *Subsurface Log (Exhibit 03)*. Once the number of soil horizons has been determined (maximum 1,000-foot [300-meter] lengths), a representative bag sample of each soil horizon is obtained. A sampling site shall be chosen within the 1,000-foot (300-meter) area, preferably where the soil horizons are thickest. After all sod or organic material is removed from the surface, a sample hole is drilled, and representative bag samples are obtained.

Bag samples are difficult to obtain in areas where the soil horizons are thin. More than one sampling hole may be necessary to get the required weight of sample.

Sample Sizes: Bag samples for cuts and fills shall be at least 30 pounds (15 kilograms). Bag samples of bank gravel and similar material shall be at least 60 pounds (30 kilograms).

**PACKAGING OF  
BAG SAMPLES:**

Bags shall be of clear polyethylene with a minimum wall thickness of 7 mils and shall be dustproof and of a sufficient size to contain the sample.


**IDENTIFICATION**

**OF BAG SAMPLES:** Bag samples shall be tied securely and identified with reinforced identification tags showing the following information:

- Ø County name
- Ø Project number
- Ø Item number
- Ø MARS number
- Ø Road name
- Ø Hole number (if applicable)
- Ø Sample number
- Ø Depth, station, and offset of sample
- Ø Whether sample represents a cut or fill

**MOISTURE  
SAMPLES:**

A moisture sample shall be obtained from each 5-foot (1.5-meter) interval in disturbed soil borings. Moisture samples shall be at least one pint and shall be hermetically sealed in glass or plastic jars with screw lids. Identification tags showing information as previously listed for bag samples shall be taped or glued to the jars of samples.


<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Thin-Walled Tube Samples</p>

**PROCEDURE FOR  
OBTAINING THIN-  
WALLED TUBE  
SAMPLES:**

Thin-walled tube samples shall be obtained in accordance with the *Standard Method for Thin-Walled Tube Sampling of Soils, AASHTO T 207*. The diameter of thin-walled tubes shall be 3 inches (76 millimeters) unless otherwise approved by the Geotechnical Branch. Tube samples shall be obtained from each 5-foot (1.5-meter) interval of depth in cohesive soil starting 2 to 3 feet (0.6 to 0.9 meter) below the surface, unless continuous samples are specified. A standard penetration test shall be obtained immediately below the elevation of the tube sample if sample recovery is less than 50 percent or if the material in the tube sample is granular.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Standard Penetration Tests</p>

**TESTING METHOD & FREQUENCY:**

Standard penetration tests shall be performed in accordance with the *Standard Method for Penetration Test and Split Barrel Sampling of Soils, AASHTO T 206*. Standard penetration tests shall be performed and samples obtained from each 5-foot (1.5-meter) interval of depth in granular soil starting 2 to 3 feet (0.6 to 0.9 meter) below the surface, unless continuous samples are specified. If the sample is cohesive, a thin-walled tube sample shall be obtained immediately below the elevation of the standard penetration test. Drill rigs equipped with automatic hammers shall be used on all structure projects to obtain standard penetration tests.


**DENSE MATERIALS:**

In very dense material a test may be terminated prior to completion because of excessive blow counts as described in **AASHTO T 206, Sections 7.2.1 to 7.2.3**. If this occurs, the depth of penetration for the last increment shall always be recorded in the drill log. The "N-Value" shall be reported as the sum of the blow counts beyond the seating increment over the depth of penetration beyond the seating increment. If termination occurs in the seating increment, the "N-Value" shall be reported over the depth of penetration. Examples are presented below.

**REPORTING RESULTS OF TERMINATED TESTS:**

Reason for Termination	Recorded in Drill Log	Reported "N-Value"
50 Blows in Seating Increment	50/4 in. (50/0.10 m)	R/0.33 ft (R/0.10 m)
50 Blows in 2nd Increment	25-50/4 in. (25-50/0.10 m)	50/0.33 ft (50/0.10 m)
50 Blows in 3rd Increment	25-25-50/4 in. (25-25-50/0.10 m)	75/0.83 ft (75/0.25 m)
Total of 100 Blows	20-40-40/4 in. (20-40-40/0.10 m)	80/0.83 ft (80/0.25 m)


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Field Vane Shear Tests</p>

**TESTING METHOD:** Field Vane Shear Tests are a type of in-situ test and shall be performed in accordance with the *Standard Method for Field Vane Shear Test in Cohesive Soil, AASHTO T 223*.

Field Vane Shear Tests are made in conjunction with drill hole explorations in soft clays and are performed when adequate tube samples are unobtainable or the laboratory test results from samples obtained provide inadequate or inconclusive data. The Geotechnical Branch requires prior approval for performing Vane Shear Tests.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DRILLING, SAMPLING, &amp; IN-SITU TESTING</p>
	<p><i>Subject</i></p> <p>Rock Core Drilling</p>

**TESTING METHOD:** Rock core drilling shall be performed in accordance with the *Standard Method of Diamond Core Drilling for Site Investigation, AASHTO T 225*, except as noted below. The use of wire line drilling equipment will be permitted. The diameter of the core should preferably not be less than approximately 2 inches (50 millimeters).

**POOR RECOVERY:** When soft materials are encountered in a coring run that produces less than 85 percent recovery, changes in the type of barrel or drilling procedure or a change to soil sampling shall be made. When consecutive coring runs produce less than 85 percent recovery, the interval with less than 85 percent will not be acceptable and shall be re-cored, or soil samples shall be obtained from an adjacent boring, as outlined in the section on undisturbed sampling. This requirement may be waived if the Geotechnical Branch determines that subsurface conditions are such that 85 percent recovery is not feasible.


**SAMPLES FOR UNCONFINED COMPRESSION:**

The length of the rock core required for an unconfined sample shall be a minimum of one continuous 5-inch (125-millimeter) piece with no breaks or fractures. A piece of PVC pipe the same length of the unconfined sample will replace the unconfined sample that is removed from the core box. The PVC pipe shall be labeled "sample" and shall show the beginning and ending depths.

Rock cores for unconfined compression tests shall be wrapped with two layers to protect the sample and to prevent loss of moisture, as follows:


1. The first layer is a plastic film wrap. Secure the core by wrapping lengthwise around the core with masking tape. The plastic film wrap shall be taped with masking tape at ends, middle, and all seams.
2. The second layer is aluminum foil. Wrap this layer at ends and middle.
3. Label the sample with the beginning and ending depths. Also label on sample "top" and "bottom" of the core.
4. Place the sample in a resealable plastic bag with a label showing the station, offset, elevation, project number, and depth.

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<b>GEOTECHNICAL</b> 	<b>Section</b> DRILLING, SAMPLING, & IN-SITU TESTING
	<b>Subject</b> Cone Penetration Testing

**TESTING METHOD:** Cone Penetration Testing (CPT) shall be performed in accordance with **ASTM D 3441**, *Mechanical Cone Penetration Tests of Soil*.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>DOCUMENTATION</p>
	<p><i>Subject</i></p> <p>Subsurface Logs &amp; Field Notes</p>

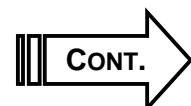
**POLICY:** A typed subsurface log shall be completed for every hole. For any boring location moved, a reason for moving the boring shall be provided in the log. For any boring holes that are deleted or not drilled, a reason for deleting or not drilling the borings shall be provided in the log. Using the TC 64-515 form, *Subsurface Log (Exhibit 03)*, or equivalent, the drill crew chief shall log disturbed sample borings, undisturbed sample borings, and rock core borings. A qualified geologist or geotechnical engineer shall also log rock cores.

**DRILL LOG:** The typed subsurface log shall contain information about drilling the hole and descriptions of the materials encountered. (Refer to **Exhibit 04.**) Additional information shall include, but is not limited to, the following items as applicable:

- Ø Loss of water
- Ø Voids
- Ø Broken zones
- Ø Material color and type (brown clay, gray shale, etc.)
- Ø Elevations where above items were encountered
- Ø Sample or core type
- Ø Sample depths or core runs
- Ø Core or sample recovery
- Ø SPT (Standard Penetration Test) blow counts and hammer type

**GEOLOGIST'S OR  
GEOTECHNICAL  
ENGINEER'S  
LOG:**

The geologist's typed log shall describe engineering characteristics of the rock, using numerical values. Slake Durability Index (SDI) numbers and Jar Slake Test (JS) results replace terms such as *soft, medium, or hard* for describing shales or siltstones. Rock Quality Designation (RQD) numbers replace *thin, medium, or massive* for referring to bedding thickness. Joints or fractures are measured in degrees from horizontal, using a goninometer, and may be defined as continuous or discontinuous. The Geologic Quadrangle and the name of the Formation (including the member when applicable) for the boring hole shall be shown in the log. (Refer to **Exhibits 05 and 06.**)



**RDZ:** Rock Disintegration Zone (RDZ) is the subsurface materials that are composed of weathered and decomposed bedrock. RDZ on roadway projects is simply defined as material deemed “rippable” with a D-9 dozer. The depth to the base of RDZ is generally indicated on the core log. The elevations of the top of rock and base of weathered rock, along with the “Scour to Elevation” and “Allowable Bearing Capacity,” are indicated in the core log for structures.

**RQD, KENTUCKY METHOD:**

Rock Quality Designation (RQD), Kentucky Method, is an estimate of in-situ rock quality and is determined by considering only pieces of core that are at least 4 inches (100 millimeters) long, hard, and reasonably difficult to break by hand. Judgment is required, and breaks obviously caused by drilling are ignored. The percentage ratio between the total length of pieces 4 inches (100 millimeters) or longer and the length of core drilled in a given run is the RQD.

**PROFILE BORINGS:**

A typed disturbed soil boring log shall be completed on each boring (**Exhibit 09**). Each log shall contain:

- Ø Points of interest: locations and magnitudes of sinkholes, ponds, creeks, wet areas, springs, wells, talus deposits, existing landslides, limits of wooded areas, crop intervals, etc.
- Ø Description of soil type for each soil horizon by identifying the soil type with the bag sample number corresponding to that specific soil type


**Note:** If the soil type did not change from a previous boring (that is, within the 1,000-foot interval), a bag is not required; however, the driller shall note each soil type encountered on every boring by referencing the corresponding bag sample number taken from a previous boring as shown in **Exhibit 09**.

**ROCKLINE SOUNDINGS:**

Results of all rockline soundings shall be typed and submitted on the form TC 64-516, *Summary of Rockline Soundings* (**Exhibit 07**). The Remarks column on this form may be used to indicate the presence of boulders above the refusal depth or the suspicion of refusal on a boulder. It may also be used to provide information on observation wells, structure identification on large projects, or various other comments. The coordinates for each rockline sounding hole shall be shown in the log, if requested by the Geotechnical Branch. (Refer to **Exhibit 08**.)

**SUBMITTALS:**

Copies of the typed subsurface logs shall be submitted along with all soil samples and rock cores when delivered to the Geotechnical Branch, Division of Materials, Frankfort, Kentucky.

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>DOCUMENTATION</p>
	<p><i>Subject</i></p> <p>Handling &amp; Labeling of Soil Samples</p>

**POLICY:** Care shall be taken during handling, labeling, storage, and transportation of soil samples to prevent disturbance of the samples. Refer to **AASHTO T 306, T 206, and T 207** for applicable procedures for handling and labeling soil samples.


Labels shall contain the following information:

- Ø County name
- Ø Project number
- Ø Item number
- Ø MARS number
- Ø Boring number
- Ø Boring location
- Ø Date sampled
- Ø Sample depth
- Ø Sample number

Thin-walled tube samples shall not be kept or stored where the temperature is expected to get below freezing. The thin-walled tube samples shall be stored and transported in an upright position.

**Note:** A unique sample number shall be given for each sample per project on moisture-content jars and profile bags.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>DOCUMENTATION</p>
	<p><i>Subject</i></p> <p>Identification, Storage, &amp; Delivery of Rock Cores</p>

**INFORMATION  
ON CORE BOX:**

The outside top of a core box shall include the following information printed with a permanent marker:

- Ø County name
- Ø Project number
- Ø MARS number
- Ø Item number
- Ø Core location (station, offset, and hole number, as applicable)
- Ø Surface elevation
- Ø Box number

The inside of the lid shall contain the above information plus the total depth of the core.

The end of the box shall be labeled with the following information:

- Ø County name
- Ø Project number
- Ø MARS number
- Ø Core location (station, offset, and hole number, as applicable)
- Ø Date

Refer to **Exhibit 10**.

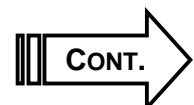
**ORIENTATION  
OF CORE:**

Core samples shall be placed in the boxes, beginning with the upper left corner compartment and working toward the right. When this compartment is filled, additional samples are placed in the next upper left hand compartment, etc.

Each core run shall be separated by a 1-inch wooden block showing depth.

Cores from different holes shall not be placed in the same core box.

The beginning and ending depths of the core sample in each box shall be marked on the edge of the box.






**DRILL LOG:** Two typed logs on the TC 64-515 form, *Subsurface Log* (**Exhibits 04 and 05 or 06**), are required in Box 1 for each hole. One log will be completed by the driller, and the other by a qualified geologist or geotechnical engineer, unless otherwise specified by the Geotechnical Branch.


**DELIVERY:** Rock cores shall be delivered to the Geotechnical Branch, Division of Materials, Frankfort, Kentucky, unless otherwise directed.

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<b>GEOTECHNICAL</b> 	<i>Section</i> FIELD INSTRUMENTATION
	<i>Subject</i> Slope Inclinerometers


**POLICY:** Slope inclinometers shall be installed in accordance with **AASHTO T 254**, *Installing, Monitoring, and Processing Data of the Traveling Type Slope Inclinometer*.

2 2 2

<b>GEOTECHNICAL</b> 	<i>Section</i> FIELD INSTRUMENTATION
	<i>Subject</i> Observation Wells & Piezometers


**POLICY:** Observation wells (refer to **Exhibit 11**) and piezometers shall be installed in accordance with **KM 64-503-03**, *Measurement of Pore Pressure in Soils*.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>FIELD INSTRUMENTATION</p>
	<p><i>Subject</i></p> <p>Settlement Platforms</p>

**POLICY:** Settlement platforms shall be installed and monitored in accordance with **Section 216** of the current *Standard Specifications for Road and Bridge Construction*. See *Standard Drawing RGX-015-02*.

2 2 2


<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>DRILLING, SAMPLING, &amp; INSTRUMENTATION</p>
	<p><i>Subject</i></p> <p>Site Restoration</p>

**POLICY:** All geotechnical borings shall be backfilled in such a manner as to meet the requirements of the *Groundwater Protection Plan for the Kentucky Transportation Cabinet's Central Office Division of Materials, Part IIIB, Plan for Sealing Geotechnical Borings*. This also covers installation requirements relating to observation wells and slope inclinometer casings.

All subsurface borings shall be backfilled or covered upon their completion to prevent damage to property or injury to people or animals.

Reclamation of drill sites and dozer or track-hoe operations shall be protected from erosion by utilizing grass seed and straw. Cutoff trenches, water bars, or ditches may be required for long, steep grades of dozer or track-hoe roads to prevent excessive erosion.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>SCOPE OF SUBSURFACE &amp; FIELD INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p>Introduction</p>

**OVERVIEW:** This chapter addresses the scope of drilling for individual projects. It presents guidelines relating to the number and locations of borings typically obtained for roadway projects, landslides, or bridges with various numbers of spans, etc. Information relating to submitting a request to have a subsurface investigation performed is covered in **Chapter GT-200**.

**PLANNING STUDIES:** **GT-401** discusses the scope of field investigations for planning studies.

**ROADWAYS:** The following subjects explore the scope of subsurface investigations for roadways:

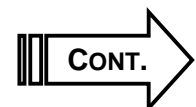
- GT-402-1** Boring Plan
- GT-402-2** Soil Profiles
- GT-402-3** Rock and Soil Cuts
- GT-402-4** Embankments
- GT-402-5** Special Geologic Considerations
- GT-402-6** Preapproved Borrow Sites
- GT-402-7** Preapproved Excess Material Sites

**STRUCTURES:** The following subjects explore the scope of subsurface investigations for all structures, including bridges, culverts, retaining walls, and noise-barrier walls:

- GT-403-1** All Structures
- GT-403-2** Bridges
- GT-403-3** Culverts
- GT-403-4** Retaining Walls
- GT-403-5** Noise Barrier Walls

**INVESTIGATIONS ON MAINTENANCE PROJECTS:** The following subjects cover the scope of investigations on maintenance projects:

- GT-404-1** Preliminary Landslide Investigations
- GT-404-2** Comprehensive Landslide Investigations
- GT-404-3** Unstable Rock Slope Investigations



**INVESTIGATIONS ON  
CONSTRUCTION  
PROJECTS:**

The following subjects explore the scope of investigations on construction projects:


- GT-405-1**      Landslide Investigations
- GT-405-2**      Rock Cut Investigations
- GT-405-3**      Investigations of Excess Material Sites
- GT-405-4**      Subgrade Stabilization Investigations
- GT-405-5**      Field Instrumentation

**PERMITS:**

The following subjects explore investigations and reviews of encroachment permits:

- GT-406-1**      Right-of-Way Encroachments
- GT-406-2**      Mining

2 2 2


<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p style="text-align: center;">SCOPE OF SUBSURFACE &amp; FIELD INVESTIGATIONS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Planning Studies</p>

**PRELIMINARY OVERVIEWS:**

Preliminary geotechnical overviews are performed on project areas or corridors for proposed roadway projects. In this preliminary stage of project development, site conditions are evaluated by field reconnaissance of surface conditions along with review of available surface and geologic mapping. Other information, such as previous geotechnical studies or investigations, may also be used to supplement the available data.

2 2 2



<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Boring Plan</p>

**FORMAT &  
CONTENT OF  
BORING PLAN:**


A boring plan for roadways consists of the following:

- Ø 1 inch = 2,000 feet (1:24,000) scale topographic map showing the alignment with stations indicated on maximum 1,000-foot (300-meter) intervals

Beginning and ending project stations shall also be shown (refer to **Exhibit 02**).

- Ø All proposed boring locations identified by the appropriate symbol and depicted on plan or manuscript sheets
- Ø Rock core boring locations showing top and bottom elevations plotted on cross-sections and profiles
- Ø Rockline sounding locations and maximum depths plotted on cross-sections
- Ø A tabular summary showing station, offset, and maximum depth of proposed boring

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Soil Profiles</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made. Frequencies or intervals of investigation, hereinafter specified, are to be considered typical and may be adjusted to fit the conditions for individual projects with prior approval by the Geotechnical Branch.

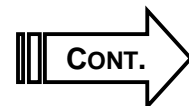
**SOIL PROFILES:** Soil profiles are vertical sections showing the nature and sequence of the various soil horizons as developed by deposition or weathering. A soil horizon is one of the layers of the soil profile distinguished principally by its texture, color, and structure.

**DISTURBED SOIL BORINGS:** Disturbed soil borings shall typically be obtained at 200- to 400-foot (60- to 122-meter) intervals. Borings typically will be offset to the ditchline in cut areas or near the toe in fill areas. Side-hill conditions with both cut and fill sections may have offset borings on both sides.

Disturbed soil borings shall typically be obtained for all ramps, frontage roads, crossroads, channel changes, etc., that are over 500 feet (150 meters) in length.

**DEPTH IN CUT SECTIONS:** Disturbed soil borings in cut sections shall extend to the top of bedded material or to 5 feet (1.5 meters) below the proposed ditchline, whichever occurs first.

**DEPTH IN FILL SECTIONS:** Disturbed soil borings in fill sections shall extend to the top of bedded material or to the depth equal to the maximum vertical fill thickness on the cross-section, whichever occurs first. The minimum depth shall extend 5 feet (1.5 meters) or to the top of bedded material, whichever occurs first.



**UNDISTURBED  
SAMPLES:**

Thin-walled tube samples shall be obtained in any anticipated wet areas where subgrade occurs at or near original ground. Also, thin-walled tube samples shall be obtained under the existing pavement on projects in which the old pavement is to be removed, replaced, or overlaid at approximately the same grade. These undisturbed samples shall be obtained directly below the dense grade aggregate or at the anticipated elevation of the proposed subgrade.

**SAMPLE  
FREQUENCY:**

One sample is obtained per 500-foot (150-meter) interval—minimum of five samples per project shall be obtained—alternating from one side of the roadway typical section to the other. This spacing may be increased for projects exceeding 5,000 feet (1,500 meters) in length.


**SURVEYING:**

Centerline stakes with stationing are preferred; however, an alternative method is to stake individual borings for soil profile drilling. The district shall perform the surveying unless contract provisions call for the design consultant to provide the service. “Freshening up” the survey may be necessary immediately prior to drilling operations.

**SUBMITTAL OF  
COORDINATE  
DATA:**

The designer shall submit latitude and longitude coordinates for all holes drilled on the project. It should be noted that some holes could be moved during the drilling operations. These holes may need to be either resurveyed or possibly adjusted in the field. The designer will receive new station and offset data for field adjusted holes for calculating new coordinates.

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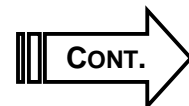
<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Rock &amp; Soil Cuts</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made. Frequencies or intervals of investigation, hereinafter specified, are to be typical and may be adjusted to fit the conditions for individual projects with prior approval by the Geotechnical Branch.

**GATHERING INFORMATION:** Cut investigations consist of rock core sampling, open-face logs, undisturbed-soil sampling, rockline soundings, and other drill data necessary to develop the cut stability sections. A sufficient number of sample and core borings shall be made to define the geologic section completely from the highest elevation to the lowest elevation in the cut for the purpose of determining a recommended cut slope configuration.

**ROCKLINE SOUNDINGS:** Rockline soundings are utilized in cut sections to determine overburden depths in flat or rolling terrain. Generally, rockline soundings are not performed in mountainous terrain except in landslide areas. Typically, soundings are drilled to the top of bedded material or to 5 feet (1.5 meters) below grade at intervals of 100 feet (30 meters) along the ditchlines. Additional soundings may be required to define the rockline where conditions warrant.

**CORES:** Cuts less than 30 feet (9 meters) high (measured from ditchline to groundline) and less than 500 feet (150 meters) in length normally require a single core boring. The boring is usually placed in the ditchline of the deepest part of the cut and extends to a minimum of 5 feet (1.5 meters) below the ditchline. A core boring may be drilled a maximum depth of 15 feet (4.5 meters) below the ditchline in lieu of drilling an additional core boring to cover the cut interval where steep roadway grades are encountered in mountainous or rolling terrain. Core borings may be placed on the centerline or the ditchline where the groundline is relatively flat.



**OVERLAPPING  
CORES:**

Cuts in side-hill conditions that are greater than 30 feet (9 meters) high (measured from ditchline to groundline intercept of a 1H:1V slope) may require two or more core borings per stability section. The first core should be placed in the ditchline. If the ditchline core boring does not cover the anticipated cut interval, a second core should be placed at the top of projected 1H:1V slope or at the top of the anticipated cut slope. The second core boring should overlap the top of the ditchline core hole a minimum of 15 feet (4.5 meters).

**STABILITY  
SECTIONS:**

Cuts that exceed 500 feet (150 meters) in length will normally require more than one cut-stability section. These stability sections should be spaced no more than 500 feet (150 meters) apart. The core borings should overlap a minimum of 15 feet (4.5 meters) on the cross-section and along the profile. It may be necessary to space the stability sections closer when steep grades are encountered.

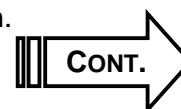
**DEFINING TOP  
OF BEDDED  
MATERIAL:**

Standard penetration tests at 5-foot (1.5-meter) intervals may be necessary to locate the top of bedded material whenever the top of the formation is difficult to determine. If rock is not encountered within a minimum of 5 feet (1.5 meters) above the bottom of the hole as specified in the boring plan, the rock core is to be omitted.

**OBSERVATION  
WELLS:**

The policy regarding observation wells is as follows:

- ∅ When the overburden depth in the core hole exceeds 10 feet (3 meters) an undisturbed sample boring with an observation well is required.
- ∅ Observation wells shall never be placed in core holes. These borings are to be drilled uphill and perpendicular to centerline a minimum of 25 feet (8 meters) away from the core hole.
- ∅ The ideal offset of the cased observation well is a distance corresponding to twice the overburden depth in the core hole.
- ∅ These borings shall extend to the top of bedded material or 20 feet (6 meters) below proposed ditchline, whichever is less.
- ∅ An initial water table reading shall be recorded on the drill log.
- ∅ Another water table reading shall be obtained no sooner than seven days after completion of the boring.
- ∅ The initial water table depth, the seven day water table depth, and the dates of the readings shall be recorded on the subsurface logs.
- ∅ Observation wells may be installed, where necessary, in sounding holes with prior approval from the Geotechnical Branch.



**OPEN-FACE LOGS:** The policy regarding open-face logs is as follows:

- Ø Open-face logging of rock exposures shall be performed in lieu of and/or as a supplement to rock coring where rock outcrops are visible.
- Ø Individual lithologic units shall be described in terms of rock type, unit thickness, and range of individual bed thickness (in feet [meters]).
- Ø Elevations of lithologic units are plotted on the cross-sections.
- Ø Direction and dip of fractures and joints should be measured and noted.
- Ø Joints and fractures should be described as continuous or discontinuous, with water staining or mineralization noted.
- Ø Spring lines, cross-bedding, channel features, etc., are also to be indicated.
- Ø Representative samples for Slake Durability Index (SDI) and Jar Slake (JS) tests may be taken from the cut section, with elevations noted on the cross-section of each sample location.


**SURVEYING:**

The district shall survey the core hole locations unless contract provisions call for the design consultant to provide the service. The surveyor shall mark the hole number, station, offset, and elevation on the stake and provide a list of all surveyed core holes to the Geotechnical Branch. The list shall include the above data, along with the accompanying latitude and longitude coordinates for each core hole.

**SUBMITTAL OF  
COORDINATE  
DATA:**

The designer shall submit latitude and longitude coordinates for all holes drilled on the project. It should be noted that some holes could be moved during the drilling operations. These holes may need to be either resurveyed or possibly adjusted in the field. The designer will receive new station and offset data for field adjusted holes for calculating new coordinates.

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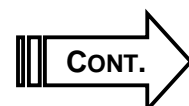
<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Embankments</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made. Frequencies or intervals of investigation, hereinafter specified, are to be considered typical and may be adjusted to fit the conditions for individual projects with prior approval by the Geotechnical Branch.

**GATHERING INFORMATION:** Embankment investigations consist of all soundings, disturbed borings, and undisturbed borings necessary to develop the embankment stability sections. Undisturbed sample borings shall be drilled to the top of bedded material or to a depth as otherwise specified in the boring plan. Generally, undisturbed borings should penetrate to approximately twice the anticipated embankment height unless bedded material is encountered above that depth. The depth of embankment investigation borings may be decreased to approximately the height of the embankment if very suitable bearing material, such as dense sand or gravelly soils, is encountered.

**OBSERVATION WELLS:** Cased observation wells shall be installed in undisturbed sample borings that exceed 5 feet (1.5 meters) in depth. Water table readings shall be obtained no sooner than seven days after completion of the boring and recorded on the subsurface log.

**STABILITY:** Embankment stability borings are generally obtained for each embankment over 20 feet (6 meters) in height (elevation from toe to grade). However, stability borings may not be needed in embankment areas in which shallow foundations (5 feet [1.5 meters] or less) are encountered. Embankments of lesser height should be investigated if unusual conditions are encountered during preliminary drilling. Typically, one cross-section shall be investigated for stability analysis from each 1,000 feet (300 meters), or fraction, of such embankment. The cross-section to be investigated shall generally consist of the highest embankment in the area represented.



**UNDISTURBED  
SAMPLE  
BORINGS:**

One or more undisturbed sample borings shall be made for each stability section. Normally, one boring shall be drilled near the shoulder and another at the toe of the embankment. A rockline sounding or a disturbed soil boring may be substituted for one of the undisturbed sample borings for narrow sections on flat terrain or for embankments less than 30 feet (9 meters) in height on suitable foundation soils. Additional offset borings may be necessary for wide or side-hill sections.

**DISTURBED SOIL  
BORINGS:**

Disturbed soil borings and rockline soundings used to develop embankment stability sections should extend to top of bedded material or a distance equal to twice the embankment height, whichever occurs first.

**STRUCTURES:**


Undisturbed sample borings and/or rockline soundings shall also be drilled for embankment stability and settlement analysis for structures (bridges, culverts, walls) during the roadway investigation. Disturbed soil borings from roadway soil profile investigations shall be used as appropriate. To facilitate embankment stability and settlement analyses, borings should be drilled at the approximate locations of:

- Ø Abutments
- Ø Piers
- Ø Wingwalls
- Ø Culvert inlets/outlets
- Ø Wall faces

These borings shall also be used in developing the structure foundation recommendations when appropriate.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Special Geologic Considerations</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made. Frequencies or intervals of investigation, hereinafter specified, are to be considered typical and may be adjusted to fit the conditions for individual projects with prior approval by the Geotechnical Branch.

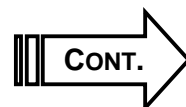
Special geologic considerations typically consist of structurally controlled problems, karst terrain, mines, and poor quality rock.

**PROBLEMS RELATING TO GEOLOGIC STRUCTURE:**

Structurally controlled problems may include channel deposits, slump blocks, dipping rock, faults, and joints with unfavorable orientations to the roadway. When applicable, an investigation of these problems includes the following:

- Ø Field reconnaissance to determine the type of structurally controlled problems
- Ø Rock cores and soundings
- Ø Observation wells
- Ø Detailed open-face logs locating all joints and lithologies and identifying the structural domains
- Ø Study of any available maps or reports


**KARST TERRAINS:** Karst terrains include sinkholes, closed drainage basins, sinking streams, caves, and geohydrological conditions, which pose problems to roadways and related facilities. An investigation of these problems may include several field reconnaissances (during both wet and dry weather) and a study of available maps and reports to determine the geohydrological conditions. Soundings are generally used in closed drainage basins and open-throat sinkholes. In order to help define sinkhole boundaries and/or limits, rockline soundings shall be obtained around the outer edges of the sinkhole and as near as possible to any apparent opening (throat). These borings typically extend to refusal or to a depth as specified by the Geotechnical Branch. Geophysical methods may be employed as a supplemental method of information collection.



**MINES:**

Mine investigations are dependent on the type of mining operation (underground longwall, underground room and pillar, contour strip, mountaintop removal, auger, or pit). Field reconnaissance is required to determine the type of mining operation that was performed and existing site conditions. If available, mine production maps and mine plans are helpful in determining the extent of the mining activity and orientation in the roadway corridor. Drilling to determine the extent of surface and/or subsurface disturbances usually consists of observation wells and disturbed soil borings. Coring for underground mines is performed to determine the exact elevation of the mine, associated lithologies, the present condition of the floor and roof, and whether or not subsidence has occurred or is anticipated.


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Preapproved Borrow Sites</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made.

**POLICY:** Areas that are designated borrow sites in the design phase shall be investigated during the roadway drilling operations. All necessary borings required to properly analyze the proposed site for the classification of materials and slope configuration shall be in accordance with **GT-402-2, Soil Profiles**, and **GT-402-3, Rock and Soil Cuts**.


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Preapproved Excess Material Sites</p>

**OVERVIEW:** All investigations necessary to adequately represent existing conditions and to furnish information for engineering recommendations shall be made.

**POLICY:** Areas that are designated excess material sites in the design phase shall be investigated during the roadway drilling operations. Undisturbed borings and/or soundings shall be obtained as outlined in **GT-402-4, Embankments**. Adequate samples shall be obtained and engineering analyses performed to determine the acceptability of the proposed excess material site and slope configurations.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>All Structures</p>

**OVERVIEW:** The scope of field investigation items applicable to all structures is discussed in this section. Subsequent subjects address various items relating to specific types of structures.

**LAYOUT & SCOPE:** Once a request to perform a geotechnical investigation is received (refer to **GT-203**), the Geotechnical Branch shall prepare or approve a boring plan to facilitate making geotechnical design recommendations. This plan shows the locations and types of all proposed borings. (Detailed guidelines as to type and number of borings to obtain for specific types of structures are addressed in subsequent subjects.) Borings that will essentially duplicate drilling previously performed for the roadway investigation or other phase of project development shall be deleted. Each boring will have its own unique hole number on the entire project (no duplicate numbers).

**FIELD**

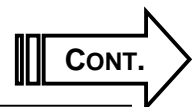
**RECONNAISSANCE:** A representative of the Geotechnical Branch may visit the site to determine whether access problems (physical obstructions as opposed to denial of access by property owners) will force the relocation or elimination of some borings. District drillers and/or design personnel may participate in this meeting. Centerline of survey shall be staked prior to this meeting as requested by the Geotechnical Branch.

**UTILITIES/  
PERMISSION  
TO DRILL:**

The driller is responsible for locating utilities and obtaining permission from the property owner. If permission to drill is denied, the drill crew supervisor will request that the district obtain property clearance.

**OFFSETTING  
BORING  
LOCATIONS:**

In situations where borings cannot be drilled at the staked locations, the driller may offset the hole as much as 5 feet (1.5 meters) without prior approval. It should be noted on the drill log that the boring location was moved and the revised location and revised elevation presented. The driller shall also note on the log the reason for moving the boring location. A log shall be provided for any boring hole that is deleted or not drilled, along with a reason for not drilling the boring hole. Prior approval is required to move boring locations more than 5 feet (1.5 meters).



**SURVEYING:** The approved boring plan will be forwarded to the district or consultant, requesting that the boring locations be staked by a certain date. The district shall perform the surveying for structures unless contract provisions call for the design consultant to provide the surveying. The surveyor shall stake all boring locations and mark the hole number, station, offset, and surface elevation on the stakes. Hole locations using a “with skew” designation should not be used. A copy of the survey notes, including the type of datum used (sea level, crossroads [refer to **GT-203**], or assumed), shall be forwarded to the Geotechnical Branch.


**SUBMITTAL OF  
COORDINATE  
DATA:**

The designer shall submit latitude and longitude coordinates for all holes drilled on the project. It should be noted that some holes could be moved during the drilling operations. These holes may need to be either resurveyed or possibly adjusted in the field. The designer will receive new station and offset data for field-adjusted holes for calculating new coordinates.

**SCOUR ANALYSIS:** Scour analysis is not typically required when a shallow footing on scour-resistant (nonerodible) rock is anticipated. In such cases, if the drilling indicates the possibility of deep foundations, or shallow foundations on scour-prone bedrock, scour analysis is required. The Geotechnical Branch, or geotechnical consultant, shall then request this information from the district or the design consultant. The geotechnical engineer (branch or consultant) will provide  $D_{50}$  and  $D_{95}$  values to the designer at the time this request is made.

**CBR VALUE:** The Geotechnical Branch will provide a CBR (California Bearing Ratio) value for pavement design, if requested, on small projects where a geotechnical roadway report will not be performed.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Bridges</p>

**UNDISTURBED SAMPLES:**

One undisturbed sample boring shall be drilled at each abutment and each pier. These borings shall extend to the top of bedded material or to the depth of 100 feet (30 meters), whichever is less. Undisturbed samples shall be obtained to the depth of 80 feet (24 meters). If bedded material is not encountered, augering shall continue to the depth of 100 feet (30 meters).

**CORES:**

Unless longer cores are required for special conditions, 10-foot (3-meter) cores are required at each abutment and pier when bedded material is encountered at less than 60 feet (18 meters). Cores shall be taken in the same boring where the undisturbed samples were obtained.

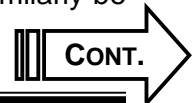
**ROCKLINE SOUNDINGS:**

Rockline soundings are also taken to better define the rockline. Taking one core and one rockline sounding at the opposite ends of each abutment and pier is adequate for structures 30 feet (9 meters) wide or less. Additional soundings are typically required for wider structures.

One additional sounding shall be obtained at or near the centerline for structures that have widths greater than 30 feet (9 meters). Structures greater than 50 feet (15 meters) in width shall have three soundings at each substructure element to supplement information from the core hole. These soundings are intended to facilitate making recommendations for spread footings on rock. The determination of pile lengths for end-bearing piles is less critical for bridge foundation design. Therefore, in areas where the depth to bedrock is too great to allow the use of spread footings, the additional soundings can be omitted provided the rockline is thought to be relatively level (sloping less than 4H:1V along the centerline of bearing).

**STEEPLY SLOPING ROCKLINE:**

Additional soundings are also required in areas where the bedrock is shallow enough to allow the use of spread footings and the rockline is steeply sloping parallel to the roadway centerline. In situations where a steeply sloping rockline is anticipated, each sounding should be replaced by a pair of soundings taken along the front and back edges of the footing (10 feet [3 meters] ahead and back station from the replaced boring location, if the footing width is not known). Each core should similarly be replaced by one core and one sounding.



**DRILLED-SHAFT  
CORES:**

Drilled shaft foundations can be an alternative to driven piles or spread footings and should be considered if one or more of the following situations are present:

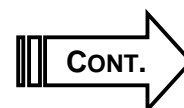
- ∅ The ground surface at a pier location is below the 100-year flood elevation, and the depth to bedrock is more than 20 feet (6 meters), unless the results of preliminary scour analyses are available and show that less than 10 feet (3 meters) of scour is anticipated.
- ∅ A pier is located in water.
- ∅ Karstic processes have produced a highly irregular rock surface, and/or there is the possibility of voids beneath the rock surface.
- ∅ Another foundation type would result in a cofferdam depth exceeding 20 feet (6 meters).
- ∅ A proposed pier location is within 10 feet (3 meters) of a highway where a lane closure cannot be allowed, or an active railroad and another foundation alternative would result in a cofferdam depth exceeding 5 feet (1.5 meters).
- ∅ A substructure unit is located in close proximity to another structure such that another foundation type would result in a cofferdam depth exceeding 10 feet (3 meters), and/or vibrations associated with pile-driving cannot be tolerated.

Drilled shafts on cabinet projects are typically socketed into bedrock, and the guidelines below were developed for that situation. If drilled shafts are to be founded in soil, then special project specific considerations will be necessary.

**PHASE 1  
EXPLORATION:**

if drilled shafts are being considered at the time the geotechnical exploration is being performed, a phase 1 drilled shaft exploration is conducted as defined below:

- ∅ Obtain a 30-foot (9-meter) minimum core at the exterior of each substructure element.
- ∅ If piers over 50 feet (15 meters) tall or spans longer than 150 feet (46 meters) are anticipated, obtain a 40-foot (12-meter) minimum core at the exterior of each substructure element.
- ∅ *Exterior* is defined as the two outermost shafts along the centerline of the substructure unit. If information is available that indicates a shaft group may be used, *exterior* is defined as the four corner shafts in a group. If specific shaft locations are not known, locate the holes 5 feet (1.5 meters) inside the substructure limits shown on the bridge layout.





**PHASE 2****EXPLORATION:**

if the decision has been made to use drilled shaft foundations, a phase 2 drilled shaft exploration may be necessary if sufficient information to complete the foundation design was not obtained in a phase 1 exploration. Prior to performing a phase 2 drilled shaft exploration, the geotechnical engineer should obtain basic design information such as drilled shaft layout, anticipated shaft diameters, and axial and lateral loading information from the structural designer. A phase 2 drilled shaft exploration is defined below:

- ∅ Obtain a core extending to a minimum of two shaft diameters below the anticipated shaft tip elevation at each drilled shaft location.
- ∅ If the geology is consistent, it may be necessary to obtain cores only at the exterior shafts of each row or the exterior corners of each group of shafts. This will be evaluated on a project specific basis.

It is preferable to complete the drilled shaft explorations during design. However, if a phase 2 drilled shaft exploration is needed and cannot be performed prior to the completion of plans due to accessibility problems or time constraints, then the phase 2 exploration should be performed during construction. This exploration may be included in the construction contract or may be performed by the geotechnical branch or under a statewide drilling contract.

**OBSERVATION  
WELLS:**

Water-table readings shall be obtained from observation wells in selected borings at the abutments no sooner than seven days from completion of the boring. Observation wells shall not be placed in rock core borings.

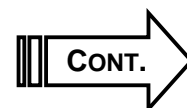
**STABILITY &  
SETTLEMENT:**

Structure borings shall also be utilized in the development of approach embankment stability sections and for settlement computations, whenever possible.

**BREASTWALL  
ABUTMENTS:**

Special requirements are applicable for bridges incorporating breastwall abutments because these walls require rock foundations at shallow depths. Borings as described above shall be obtained at the proposed abutment locations.

If rock is encountered within 20 feet (6 meters) of roadway grade, no additional drilling is required. If rock is not encountered within this interval, additional rockline soundings shall be obtained 20 to 30 feet (6 to 9 meters) behind the originally proposed abutment locations to facilitate revised design (that is, conversion from a single-span to a three-span structure).




**SPECIAL  
CONDITIONS:**

In some instances, it may not be possible to get all the requested cores and soundings. Additional cores and soundings may be required in other cases if the elevation of the rock surface is erratic. Deeper cores may be necessary due to various conditions, including the following examples:

- Ø Large foundations (piers over 50 feet [15 meters] tall, or long spans) are anticipated
- Ø Large boulders may be present
- Ø Rock quality is poor
- Ø The rock is karstic
- Ø Drilled shafts are anticipated

The Geotechnical Branch shall be contacted for instructions in these instances.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Culverts</p>

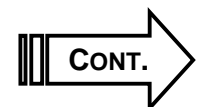
**NUMBER & LOCATIONS**

**OF BORINGS:** The number and locations of borings for culverts are dependent upon the size and type of structure and the bedrock type. In general, the number of core borings obtained in karstic areas will be approximately double the number required for nonkarstic areas, although the total number of borings (cores plus soundings) will be the same. **Exhibit 37** is intended to be used as a general guideline in determining the number and spacing of borings to be obtained for box or arch culverts. Borings shall be obtained along the culvert centerline for single-barrel box culverts 8 feet (2 meters) or less in width. Borings shall be located along each bearing line for culverts more than 8 feet (2 meters) wide and for multibarrel box culverts.

**ROCK CORES:** Rock cores designated on the boring layout may be eliminated if the rock surface is more than 5 feet (1.5 meters) below flowline. If necessary, rock cores, shall extend to 5 feet (1.5 meters) below flowline; however, a minimum of 5 feet (1.5 meters) of core shall be obtained.


**SAMPLES FOR ALLOWABLE BEARING OF WINGWALLS:** Continuous undisturbed samples shall be obtained from one boring at each end of box culverts from flowline to 6 feet (2 meters) below flowline or to the top of bedded material, whichever is shallower. Rockline soundings shall extend to 5 feet (1.5 meters) below design flowline or to the top of bedded material, whichever is shallower. Borings from roadway design (embankments and soil profile) shall be incorporated into the culvert boring layout whenever possible.

**SAMPLES FOR STABILITY & SETTLEMENT ANALYSES:** An undisturbed-sample boring under the highest part of the fill is required if the fill is 20 feet (6 meters) or more in height. Samples shall be obtained at 5-foot (1.5-meter) intervals to twice the embankment height or to the top of bedded material, whichever is shallower. This boring and a rockline sounding(s) shall be obtained to allow an evaluation of settlement and slope stability.



**PIPE CULVERTS:** The roadway designer may request subsurface investigations for pipe culverts whenever the fill height at the pipe location, the depth of foundation soils, and the size of pipe are sufficient to indicate possible development of settlement or stability problems. If the Geotechnical Branch deems a geotechnical investigation for a pipe culvert necessary, drilling shall be the same as for small box culverts.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Retaining Walls</p>

**STANDARD GRAVITY**

**WALLS:** Standard gravity walls may be constructed at locations requiring small walls, less than 6 feet (2 meters) in height, which meet the requirements of Standard Drawing RGX-002 “Retaining Wall, Gravity Type, Non-Reinforced.” Standard gravity walls less than 6 feet (2 meters) in height do not require site-specific designs, and no subsurface investigation is required for these structures. Gravity walls with heights in excess of 6 feet (2 meters) will be evaluated on a case-by-case basis to determine if a site-specific design and a subsurface investigation is needed.

**ALL OTHER WALLS:**

All other walls, including cantilever, mechanically stabilized earth (MSE), tieback, and soil nail walls, do require site-specific designs.

**ROCKLINE SOUNDINGS:**

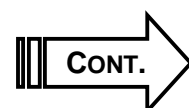
Rockline soundings shall be obtained along the wall face at 50-foot (15-meter) intervals of retaining wall length and at a distance of 70 percent of the wall height (0.7H) behind the wall at 100-foot (30-meter) intervals. The borings behind the wall will indicate whether the rockline is rising from the wall face. This information can be used to facilitate stability analysis and to ensure that the design does not require rock excavation to construct the wall.

**UNDISTURBED SAMPLES**

Undisturbed borings shall be obtained at 100 to 300-foot (30 to 100-meter) intervals. The undisturbed borings shall extend to twice the wall height below the base of the footing or to the top of bedded material, whichever is less.

**CORES:**

Core to 5 feet (1.5 meters) below the proposed footing elevation (5 feet [1.5 meters] minimum) at 100 to 150-foot (30 to 45-meter) intervals if bedded material is encountered 5 feet (1.5 meters) below footing elevation or higher. Greater core intervals shall be used for projects where core information is available from nearby structures. Closer core spacing may be required in karst terrain.



**OBSERVATION**


**WELLS:**

An observation well shall be installed if the water table has not been established from previous drilling.

**USE OF  
PREVIOUSLY  
OBTAINED  
BORINGS:**

Borings from roadway design (embankments and soil profile) and other structures in the area shall be incorporated into the layout of the retaining wall boring plan whenever possible.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Noise Barrier Walls</p>

**OVERVIEW:** Noise barrier walls require site-specific foundation designs.

**ROCKLINE SOUNDINGS:** The following guidelines are applicable to the development of an investigation plan:


- Ø Rockline soundings shall be obtained along the wall face at 100-foot (30-meter) intervals of wall length.
- Ø The cutoff depth for a sounding where no rock is encountered is about 40 feet (12 meters).
- Ø In areas where it is likely that no bedrock will be encountered within 40 feet (12 meters), soundings are not needed.

**UNDISTURBED BORINGS:** Undisturbed borings shall be obtained at 300-foot (90-meter) intervals. The undisturbed borings shall extend to 50 feet (15 meters) or to the top of bedded material, whichever is less.

**CORES:** If bedrock is encountered within 40 feet (12 meters), obtain a 5-foot (1.5-meter) core.

**USE OF PREVIOUSLY OBTAINED BORINGS:** Borings from roadway design (embankments and soil profile) and other structures in the area shall be incorporated into the wall boring layout whenever possible.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON MAINTENANCE PROJECTS</p>
	<p><i>Subject</i></p> <p>Preliminary Landslide Investigations</p>

**SCOPE OF INVESTIGATION:**


A preliminary field inspection shall be made and, if necessary, preliminary drilling performed. A preliminary landslide investigation shall determine whether a:

- Ø Simple solution exists, such as drilled-in railroad rails or revised drainage, etc.
- Ø Comprehensive investigation is required

Preliminary landslide investigations typically include rockline soundings, observation wells, and rock cores. Representatives from the district and the appropriate divisions shall be invited to attend the field inspection. Boring plans shall be approved by the Geotechnical Branch prior to beginning the fieldwork.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON MAINTENANCE PROJECTS</p>
	<p><i>Subject</i></p> <p>Comprehensive Landslide Investigations</p>


**SCOPE OF INVESTIGATION:**

The following site information may be necessary for a comprehensive landslide investigation:

- Ø Cross-sections showing all visible scarps, toe bulges, and notable topographic features should be taken every 25 feet (8 meters) unless otherwise requested.
- Ø A plan sheet showing visible scarps, toe bulges, all known utilities, property owners, and prominent landmarks should be developed.
- Ø Where possible, stations shall be referenced to permanent landmarks and roadway mile markers for future identification.
- Ø Disturbed and/or undisturbed samples shall be taken in the failure area and in areas requiring stability analyses for the slide correction. Major soil types shall be identified and any apparent "weak" materials shall be noted.
- Ø The rockline shall be profiled, and rock cores should be taken where applicable.
- Ø Slope inclinometers and observation wells may be installed where information is necessary for project correction.
- Ø After completion of the drilling operations, the district performs the surveying to determine boring locations unless contract provisions call for a consultant to provide this service.
- Ø The designer shall submit latitude and longitude coordinates for all holes drilled on the project. It should be noted that some holes could be moved during the drilling operations. These holes may need to be either resurveyed or possibly adjusted in the field. The designer will receive new station and offset data for field adjusted holes for calculating new coordinates.

The Geotechnical Branch shall approve boring plans prior to beginning the drilling.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON MAINTENANCE PROJECTS</p>
	<p><i>Subject</i></p> <p>Unstable Rock Slope Investigations</p>

**SCOPE OF INVESTIGATION:**

The preliminary field inspection will determine whether a simple solution exists or a detailed investigation is required. If a detailed investigation is required, the district is responsible for providing plans and cross-sections, staking core hole locations, and obtaining permission to drill on private property. The following site information shall be obtained for a detailed investigation:

- Ø A survey of the failure area, including manuscripts, cross-sections, plan sheets, and maintenance records, shall be made. These drawings shall depict the roadway, top of cut, any breaks or failures, right of way, property owners, and utilities.
- Ø All lithologies, structural discontinuities, wedges, blocks, and areas of instability shall be mapped on an oblique photomosaic of the cut face when structural domains cannot be completely interpreted using cross-sections.
- Ø Rock cores are to be used to supplement open-face logs and identify conditions not apparent from mapping (mines, deep overburden above the cut, or locations where reworking of the slope will expose previously covered terrain).

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON CONSTRUCTION PROJECTS</p>
	<p><i>Subject</i></p> <p>Landslide Investigations</p>

**SCOPE OF INVESTIGATION:**

A field inspection shall be made to determine what type of geotechnical investigation is necessary. Prior to beginning any investigation, the Geotechnical Branch shall approve scope of work and boring plans.

Borings shall extend to bedded material or to an elevation below the anticipated failure surface. The district may be requested to obtain cross-sections prior to drilling operations. Locations and surface elevations will be obtained after the holes are located or drilled. Slope inclinometers may be required to determine depths of failure surfaces. Cores, undisturbed samples, and observation wells may be required. Additional water level readings are recommended to determine any change in groundwater elevation. Stability analysis may be necessary to determine the most economical solution.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON CONSTRUCTION PROJECTS</p>
	<p><i>Subject</i></p> <p>Rock Cut Investigations</p>


**SCOPE OF INVESTIGATION:**

Rock cuts made during construction by blasting are intended to produce a specific template as specified in the roadway plans. Numerous characteristics may all affect how the rock will respond to blasting. Characteristics include:

- Ø Faulting
- Ø Joint frequency and joint spacing
- Ø Localized or extensive fracturing of the rock
- Ø Various other conditions

In design, an attempt is made to determine a slope configuration, which can be realistically constructed. However, after blasting, some rock cuts may be determined unsafe. Measures to correct deficiencies vary too greatly to attempt to provide a set of generic directions. Each condition must be evaluated independently, and a correction that takes into account site-specific conditions must be developed.


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>INVESTIGATIONS ON CONSTRUCTION PROJECTS</p>
	<p><i>Subject</i></p> <p>Investigations of Excess Material Sites</p>

**SCOPE OF INVESTIGATION:**

The most critical section of an excess material site shall be investigated for slope stability. Additional stability sections may be necessary due to topography of the area, embankment height, and foundation conditions. Rockline soundings, rock cores, and/or undisturbed sample borings shall be obtained along the section typically at 100-foot (30-meter) intervals. This material may need to be sampled and tested to determine its strength parameters. Prior to beginning any investigation, the Geotechnical Branch shall approve the scope of work and boring plans.

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<p style="text-align: center;"><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p style="text-align: center;">INVESTIGATIONS ON CONSTRUCTION PROJECTS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Subgrade Stabilization Investigations</p>

**SCOPE OF INVESTIGATION:**

The extent of the field investigation for unstable subgrade may vary depending on the magnitude of the problem. As necessary, tests using a hand-operated dynamic cone penetrometer shall be performed (in accordance with the manufacturer's procedure), or thin-walled tube samples shall be obtained to determine the undrained shear strength of the soil. Soil classifications shall be obtained on the tested material.

Pavement and subbase (DGA, rock roadbed, etc.) thicknesses for projects involving overlaying existing subgrade shall be obtained. These procedures shall be completed along with sampling of the existing subgrade.

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<p style="text-align: center;"><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p style="text-align: center;">INVESTIGATIONS ON CONSTRUCTION PROJECTS</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Field Instrumentation</p>

**INSTALLING &  
READING FIELD**

**INSTRUMENTATION:** The Geotechnical Branch is responsible for determining the locations and depths of all field instrumentation to be installed. Locations may need to be changed from those indicated on the plans due to construction constraints.

The Project Engineer is responsible for reading the instrumentation upon request by the Geotechnical Branch. Construction shall be halted and the Geotechnical Branch notified immediately if any instrumentation is damaged.

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<b>GEOTECHNICAL</b> 	<i>Section</i> PERMITS
	<i>Subject</i> Right-of-Way Encroachments


**SCOPE OF INVESTIGATION:**

The reviews for right-of-way encroachment permits may consist of:

- Ø Site inspections
- Ø Subsurface investigation
- Ø Laboratory tests
- Ø Research of available subsurface data for the surrounding area

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PERMITS</p>
	<p><i>Subject</i></p> <p>Mining</p>


**SCOPE OF INVESTIGATION:**

The reviews of mining permits may consist of:

- Ø Site visits
- Ø Additional core drilling
- Ø Rock-mechanics tests
- Ø Research of available subsidence records
- Ø Related geological data for the area

A review of other underground crossings with similar geologic conditions may be studied to determine whether the proposed encroachment adversely affects the highway. A review of mine maps is invaluable in determining multiple seam mining conditions or potential subsidence problems for the area. The controlling factors for stability are structural discontinuities such as faults, joints, and fractures. All information on local and regional geological features is utilized. Generally accepted subsidence factors for the different coal basins are utilized to determine the magnitude of potential subsidence. Average draw angles are used to determine safe distances that mining operations shall maintain in order to protect roadway facilities.

2 2 2

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p>
	<p><i>Subject</i></p> <p>Introduction</p>

**OVERVIEW:** Laboratory testing and classification of soil and rock samples are important elements in geotechnical engineering. Testing, however, can be expensive and time consuming. The complexity of testing required for a particular project may range from a simple moisture-content determination to specialized strength-testing. Geotechnical engineering experience is needed to determine certain considerations regarding laboratory testing, such as when, how much, and what type. The project manager must schedule or review all testing requests before implementation so as to optimize testing, particularly strength and consolidation testing. Subjects explored in this chapter are as follows:

**SOIL SAMPLE PREPARATION:** **GT-501** discusses sample preparation of disturbed soils and of undisturbed soils.

**STANDARD TEST METHODS FOR SOILS:** **GT-502** explores testing procedures and types of tests for soils.

**CLASSIFICATION OF SOILS:** **GT-503** states the policy for classifying soils.


**STANDARD TEST METHODS FOR ROCKS:** **GT-504** explores three standard methods for testing rocks.

**ROCK TYPES:** **GT-505** discusses three types of rocks.

**TYPICAL TESTING FREQUENCIES:** The following subjects explore testing frequencies of soils and rocks.

- GT-506-1** Disturbed Soil Samples
- GT-506-2** Undisturbed Soil Samples
- GT-506-3** Rock Samples

2 2 2

<p style="text-align: center;"><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p style="text-align: center;">LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Soil Sample Preparation</p>


**DISTURBED SOIL SAMPLES:**

Preparation of samples received from the field for mechanical analysis, physical tests, moisture/density relationship tests, and other tests shall be prepared in accordance with **AASHTO T 87**, "Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test."

**UNDISTURBED SOIL SAMPLES:**

Extruded thin-walled tube samples and Standard Penetration Test (SPT) sample jars shall be classified and recorded on the TC 64-531 form, *Thin-Walled Tube and SPT Sample Log (Exhibits 12 and 13)*. Pocket penetrometer or Torvane tests shall be performed on tube samples, as appropriate, and the results recorded on the request form. Representative samples shall be waxed or otherwise preserved to prevent loss of moisture. A copy of the request form shall be forwarded to the engineer for the purpose of assigning appropriate laboratory tests.

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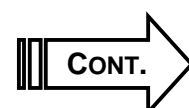
<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p>
	<p><i>Subject</i></p> <p>Standard Test Methods for Soils</p>

**OVERVIEW:** Many engineering tests that the Department of Highways performs on soil and rock samples follow the procedures of the American Association of State Highway and Transportation Officials (AASHTO). In other instances the department requires modification of the AASHTO procedures, or tests not addressed by AASHTO. The Division of Materials has produced the companion manual *Kentucky Methods* (KM [not reproduced herein]), which presents specifications for the modified testing procedures.

#### REQUIRED TESTING

**PROCEDURES:** The table on the following page shows the required testing procedures applicable to soil samples:

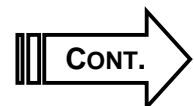
- ∅ Where only an AASHTO standard is designated, the AASHTO procedure is followed in full.
- ∅ Where both KM and AASHTO standards are designated, the KM procedure is required, but this procedure represents a relatively minor modification of the AASHTO procedure.
- ∅ Where only the KM standard is designated, either the modification is very significant or there is no AASHTO procedure relating to this test.



**REQUIRED TESTING PROCEDURES (cont.):**

TEST PROCEDURE	APPLICABLE STANDARDS	
	AASHTO*	KM**
<i>DISTURBED SOIL TESTS</i>		
Wash and sieve analysis	***	
Dry preparation of disturbed soil samples	T 87	
Particle size analysis of soils	T 88	64-519
Determining the liquid limit of soils	T 89	
Determining the plastic limit and plasticity index of soil	T 90	
Moisture-density relations of soils using a 5.5 lb (2.5 kg) rammer and a 12 in. (305 mm) drop	T 99	64-511
Specific gravity of soils	T 100	
Laboratory determination of moisture content of soils	T 265	
The California Bearing Ratio of laboratory compacted soils and soil aggregate mixtures		64-501
Subgrade chemical stabilization		64-520
<i>UNDISTURBED SOIL TESTS</i>		
Unconfined compressive strength of cohesive soil	T 208	64-522
One-dimensional consolidation properties of soils	T 216	
Unconsolidated, undrained compressive strength of cohesive soils in triaxial compression	T 296	64-521
Consolidated, undrained triaxial compression test on cohesive soil	T 297	64-502
*AASHTO—American Association of State Highway and Transportation Officials **KM—Kentucky Methods ***Performed according to ASTM D 1140		

The following pages provide brief descriptions of the tests.



**WASH & SIEVE****ANALYSIS:**

The wash and sieve analysis is used to determine the amount of material finer than the number 200 (75 $\mu$ m) sieve. The material remaining on the number 200 (75  $\mu$ m) sieve shall be passed over a sieve stack, as appropriate, to provide better knowledge of the particle size distribution. This test shall be in accordance with ASTM D 1140.

**PARTICLE SIZE****ANALYSIS:**

Particle size analysis is used in the classification of soils and includes sieve, hydrometer, and wash gradation tests. These tests shall be performed in accordance with **KM 64-519**.

**ATTERBERG****LIMITS:**

Atterberg limits are commonly used for classification of soils. These tests shall be performed in accordance with **AASHTO T 89 and T 90**.

**MOISTURE/****DENSITY TEST:**

The moisture/density or "Proctor" test is used to determine the relationship between water content and dry density for a given compactive effort. This test shall be in accordance with **KM 64-511**.

**SPECIFIC****GRAVITY TEST:**

Specific gravity is used to compute the void ratio when unit weight and water content are known. This test shall be in accordance with **AASHTO T 100**.

**MOISTURE CONTENT****DETERMINATION:**

Laboratory determination of moisture content of soils is a routine test to measure the amount of water present in a quantity of soil in terms of dry soil weight. This test shall be in accordance with **AASHTO T 265**.

**CALIFORNIA****BEARING RATIO:**

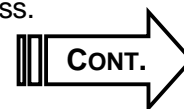
The California Bearing Ratio (CBR) test is used as a means of determining the properties of a soil for use in designing pavement structures. This test shall be in accordance with **KM 64-501**.

**SUBGRADE****STABILIZATION****TESTS:**

The subgrade stabilization tests using chemicals are performed to determine the type of chemical that will be added to the soil subgrade. The percentage of chemical to be added to soil is 6 percent. A standard Proctor test will be run on the chemical soil mixture to determine the optimum moisture and maximum dry density of the chemically stabilized soil. These tests shall be in accordance with **KM 64-520**.

**UNCONFINED****COMPRESSION****TEST:**

The unconfined compression test is typically used to evaluate the undrained shear strength (total stress) of cohesive soils. This test shall be in accordance with **KM 64-522**. Pocket Penetrometer and/or Torvane tests shall be performed on each sample prior to testing and recorded on the data sheets. Torvane tests shall indicate the size of the vane used. The Pocket Penetrometer and/or Torvane tests shall be performed on a portion of the sample that will be removed during the sample trimming process.



**ONE-DIMENSIONAL CONSOLIDATION****TEST:**

The results of the consolidation test are used to estimate the magnitude and time rate of consolidation settlement of cohesive soils. This test shall be in accordance with **AASHTO T 216**.


**UNCONSOLIDATED-UNDRAINED TOTAL STRESS TRIAXIAL****TEST:**

The unconsolidated-undrained triaxial test is used to evaluate the undrained shear strength (total stress) of cohesive soils. It is typically used for samples with blocky structure, below the water table, fissures, high silt contents, silt seams, sand seams, or other defects. It may also be used for samples where in-situ confining pressures are relatively large (that is, below 20 feet [6 meters] depth) or for samples obtained below the water table. Confining pressure applied to a sample is typically equal to the approximate in-situ effective overburden pressure. This test shall be in accordance with **KM 64-521**. Pocket Penetrometer and/or Torvane tests shall be performed on each sample prior to testing and recorded on data sheets. Torvane tests shall indicate the size of the vane used. The Pocket Penetrometer and/or Torvane tests shall be performed on a portion of the sample that will be removed during the sample trimming process.

**CONSOLIDATED-UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE****MEASUREMENT:**

The consolidated-undrained triaxial test with pore pressure measurement is typically used to determine the effective shear strength of a soil. This test shall be in accordance with **KM 64-502**. Pocket Penetrometer and/or Torvane tests shall be performed on each sample prior to testing and recorded on the data sheets. Torvane tests shall indicate the size of the vane used. The Pocket Penetrometer and/or Torvane tests shall be performed on a portion of the sample that will be removed during the sample trimming process.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p>
	<p><i>Subject</i></p> <p>Classification of Soils</p>


**POLICY:** Soils shall be classified in accordance with **AASHTO\* M 145**, *The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes*, and **ASTM\*\* D 2487**, *Standard Test Method for Classification of Soils for Engineering Purposes*, commonly referred to as the Unified Soil Classification System.

\*AASHTO—American Association of State Highway and Transportation Officials

\*\*ASTM—American Society for Testing and Materials

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p>
	<p><i>Subject</i></p> <p>Standard Test Methods for Rocks</p>

**SLAKE  
DURABILITY  
INDEX TEST:**

The Slake Durability Index (SDI) test is used to classify shale and other sedimentary rocks according to durability. The test shall be performed on samples of shale and may be used on friable sandstone where there is a question of durability. The test shall be performed in accordance with **KM 64-513**.


**JAR SLAKE  
TEST:**

The Jar Slake (JS) test is used to supplement the SDI test. The test shall be performed in accordance with **KM 64-514**.

**UNCONFINED  
COMPRESSION  
TEST:**

The unconfined compression test is a standard method for testing rock cores. The test is used to evaluate the compressive strength of rock. The test shall be performed in accordance with **KM 64-523**.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p style="text-align: center;">LABORATORY TESTING &amp; MATERIAL CLASSIFICATION</p> <hr/> <p><i>Subject</i></p> <p style="text-align: center;">Rock Types</p>
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**OVERVIEW:** Sedimentary rock classification is based upon physical and chemical properties. Several geologic rock types may have the same properties and, thus, are grouped together. It should be understood that the terminology presented here might vary from other commonly used classification schemes. Included in each grouping is a list of generally recognized equivalents.

**LIMESTONE:** Limestone is bedded sedimentary rock consisting chiefly of carbonates, including dolomites and dolostones. Limestones containing notable proportions of shale may be noted as argillaceous.

**SANDSTONE:** A cemented or otherwise compacted detrital sedimentary rock composed primarily of quartz grains larger than .075 millimeters in diameter, including conglomerates. Sandstone should be described as durable or nondurable (friable) for engineering purposes.


**SHALE:** Shale is a cemented or noncemented sedimentary deposit of various chemical compositions in which the constituent particles are smaller than .075 millimeters in diameter and include siltstone, claystone, and mudstone.

Shale is classified according to Slake Durability Index (SDI) results; however, sedimentary-shale deposits are frequently interbedded with thin sections of carbonates or arenaceous (sandy) partings that can produce distorted SDI values. Jar Slake tests are typically performed to provide additional information about rock disintegration to compare with SDI test results. SDI test results in conjunction with Jar Slake test results must be considered when classifying shale and preparing recommendations.

Results of slaking tests will be used to classify shale as durable (SDI ≥ 95) or nondurable (SDI < 95). Nondurable shale will be subdivided into classes for design purposes only. Classification of shale and typical correlation with Jar Slake test results are in the table below:

CLASSIFICATION	SDI RANGE	SLAKE CATEGORY
Durable	≥ 95	6
Nondurable		
Class I	80 to 94	4 or 5
Class II	50 to 79	3 or 4
Class III	≤ 49	1 or 2

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>TYPICAL TESTING FREQUENCIES</p>
	<p><i>Subject</i></p> <p>Disturbed Soil Samples</p>

**OVERVIEW:** The following are recommended for laboratory testing of disturbed soil samples for geotechnical purposes. These tests and frequencies do not preclude engineering judgment.

**TESTS ON ALL BAG SAMPLES FROM FILL SECTIONS:** The following laboratory tests shall be performed on bag samples from fill sections:

- Ø Specific Gravity Test
- Ø Particle Size Analysis
- Ø Atterberg Limits
- Ø Natural Moisture Content (on jar samples only)


**ADDITIONAL TESTS ON BAG SAMPLES FROM CUT SECTIONS:** The following laboratory tests, in addition to the tests listed above for bag samples from fill sections, shall be performed on bag samples from cut sections:

- Ø Moisture/Density Test
- Ø CBR

**FILL SECTIONS OF BORROW PROJECTS:** If the project is anticipated to be borrow, bag samples from fill sections may need to be tested, with prior approval of the Geotechnical Branch, as if they were bag samples representing soils from cut sections.

Bag samples shall be classified as outlined in **GT-503, Classification of Soils.**

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Section</i> TYPICAL TESTING FREQUENCIES
	<i>Subject</i> Undisturbed Soil Samples

**OVERVIEW:** The following are recommended for laboratory testing of undisturbed soil samples for geotechnical purposes. These tests and frequencies do not preclude engineering judgment.

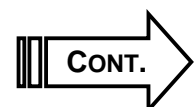
**UNDISTURBED SOIL SAMPLES:** These tests and frequencies are in regard to samples obtained from Standard Penetration Tests (SPT) and thin-walled tubes. In cases where either there is a scarcity of samples or there is a quantity of apparently identical tube samples, representative samples shall be chosen for testing.

### LABORATORY TESTING

**ON SPT SAMPLES:** Testing for Standard Penetration samples:

- ∅ Wash and Sieve Gradation Tests
- ∅ Soil Classification Tests
  - ◆ Specific Gravity Test
  - ◆ Particle Size Analysis
  - ◆ Atterberg Limits

Samples obtained by SPT shall be classified in accordance with **GT-503, Classification of Soils**. In some cases a single sample may not provide sufficient material to perform a complete classification of the soil; however, samples from different depths may be combined, when appropriate, to provide adequate quantities of material for testing. Samples shall be tested by performing wash and sieve gradation tests when sufficient quantities of soil are not available or cannot be combined to provide adequate amounts of material for complete classification testing.



**LABORATORY  
TESTING ON THIN-WALLED****TUBE SAMPLES:** Thin-Walled Tube Samples:

- ∅ Soil Classification Tests
  - ◆ Specific Gravity Test
  - ◆ Particle Size Analysis Test
  - ◆ Atterberg Limits Test
- ∅ Moisture Content Test
- ∅ Unconfined Compression Test
- ∅ Unconsolidated-Undrained Triaxial Test
- ∅ Triaxial Test (consolidated-undrained with pore-pressure measurements)
- ∅ Consolidation Test

**CLASSIFICATION  
& MOISTURE****CONTENT TESTS:** Classification and moisture content tests shall be performed on each thin-walled tube sample. Normally, only one natural moisture test needs to be performed on sample trimmings from each thin-walled tube unless significant material changes are noticed within the tube.**TESTS FOR  
SHORT-TERM  
ANALYSES:**


Unconfined compression or unconsolidated-undrained triaxial tests shall be performed for short-term analyses. The unconsolidated-undrained triaxial method is typically performed on soils with low cohesion (high silt and low clay content), blocky structure, samples obtained from depths greater than 20 feet (6 meters) and/or samples obtained below the water table. Normally one test per tube sample is sufficient unless shallow, variable soils are encountered.

**TESTS FOR  
LONG-TERM  
ANALYSES:**

Unconfined compression or unconsolidated-undrained triaxial tests shall be performed, saving adequate samples (if required) for triaxial and consolidation tests. Consolidated-undrained triaxial tests with pore-pressure measurements or drained triaxial tests with pore pressure measurements or drained triaxial tests may be performed for long-term analyses. Representative unconfined compression and triaxial tests shall be performed for each different soil type or horizon when required.

**CONSOLIDATION  
TEST:**

One-dimensional consolidation tests shall be performed for all bridge approaches greater than 20 feet (6 meters) in height unless the foundation is shallow or granular and for other embankment situations where controlled loading is deemed necessary. A minimum of one consolidation test per soil type per situation shall be performed. Soil horizons exceeding 20 feet (6 meters) in thickness may require more than one test.

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>TYPICAL TESTING FREQUENCIES</p>
	<p><i>Subject</i></p> <p>Rock Samples</p>

**OVERVIEW:** The following are recommended for laboratory testing of rock samples for geotechnical purposes. These tests and frequencies do not preclude engineering judgment.

**ROCK SAMPLES:** These tests shall be performed on rock cores that contain a significant quantity of shale and/or friable sandstone.

- Ø Jar Slake (JS)
- Ø Slake Durability Index (SDI)

**TYPICAL TESTING FREQUENCY:** Typical testing frequency in rock cut sections shall be one test for each 5 feet (1.5 meters) in shale or one test for each 10 feet (3 meters) of friable sandstone. These tests shall also be performed on the interval just below the footing elevation for structures on which spread footings are anticipated. Jar Slake tests need not be performed on friable sandstone.

**UNCONFINED-COMPRESSION TEST:** Unconfined compression tests on rock shall be performed when needed for the design of drilled shafts in rock. A typical testing frequency is approximately one sample per 10-foot (3-meter) core run, subject to the availability of suitable samples and/or the judgment of the project engineer or geologist.

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**TRANSMITTAL MEMORANDUM 19-02**

To: Division of Structural Design Staff  
Design Consultants  
KYTC Staff


From: Bart Asher  
Director  
Division of Structural Design

Date: June 21, 2019

Subject: KYTC Division of Structural Design  
Geotechnical Guidance Manual  
Chapter 600 Engineering Analysis

With this memorandum the attached Chapter 600 Engineering Analysis and accompanying exhibits from the Kentucky Transportation Cabinet's Division of Structural Design's Geotechnical Guidance Manual replaces and supersedes the referenced section in the most current (publication date June 2005) manual.

BA/MC

<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Introduction</p>

**OVERVIEW:** This chapter describes the purpose, content, and conduct of meetings typically held in conjunction with a project. During the course of a project, additional meetings may be required to deal with problems that arise.

**PRELIMINARY MEETINGS & SUBMITTALS:** GT-701 explores the following subjects:

- GT-701-1 Preliminary Meetings
- GT-701-2 Laboratory Testing Plan
- GT-701-3 Engineering Analysis Plan

**INTERIM MEETINGS:** GT-702 discusses the purpose of meeting during progress of project.


**ROCK CORE MEETINGS:** GT-703 discusses the scheduling of rock core meetings.

**FINAL GEOTECHNICAL MEETINGS:** GT-704 explains the purpose of final geotechnical meetings.

**LANDSLIDE OR UNSTABLE ROCK SLOPE MEETINGS:** GT-705 addresses the need for landslide or unstable rock slope meetings.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PRELIMINARY MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Preliminary Meetings</p>


**PURPOSE OF A  
PRELIMINARY  
MEETING:**

If necessary, the Geotechnical Branch may schedule a preliminary meeting for roadway/structure projects by notifying representatives of the design consultant, Division of Highway Design, and District Design. The branch may conduct this meeting at the project site. The meeting may consist of a discussion of the scope of work, with an anticipated completion date, and a field/office review of the preliminary boring plan plotted on the plan/profile and cross-sections. The Geotechnical Branch may request that the centerline of survey be staked prior to the meeting. The minutes of the meeting, prepared or approved by the Geotechnical Branch, shall constitute the approved boring plan and authority to begin the subsurface investigation.

**SERVICES  
PROVIDED BY  
GEOTECHNICAL  
CONSULTANT:**

The above procedures, along with the following additions, shall also apply when a geotechnical consulting engineer provides the geotechnical services. The geotechnical consultant shall submit to the Geotechnical Branch for review a preliminary boring plan for roadway/structure projects, along with a request for a preliminary meeting upon approval of the engineering agreement or contract modification. If necessary, the Geotechnical Branch will schedule the preliminary meeting after reviewing the boring plan.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PRELIMINARY MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Laboratory Testing Plan</p>

**SCOPE OF PLAN:**


Prior to conducting any laboratory tests, the geotechnical consultant shall submit a laboratory testing plan to the Geotechnical Branch for review. The branch will review the plan and take appropriate action. The laboratory testing plan (for large projects with significant field work) may be submitted in several sections in order to facilitate the laboratory work.

The laboratory testing plan shall consist of:

- Ø County name
- Ø Project number
- Ø MARS number
- Ø Station
- Ø Hole number
- Ø Item number
- Ø Date
- Ø Sample numbers
- Ø Visual descriptions
- Ø Numbers of samples of various lengths
- Ø Borings logs (unless previously submitted)
- Ø Proposed laboratory tests

Refer to the TC 64-531 form, *Thin-Walled Tube and SPT Sample Log (Exhibit 13)*.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PRELIMINARY MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Engineering Analysis Plan</p>

**SCOPE OF PLAN:**

After laboratory testing is complete and prior to beginning any analyses, the geotechnical consultant shall submit an engineering analysis plan to the Geotechnical Branch for review. The branch will review the plan and take appropriate action. For large projects with significant work, the consultant may submit the engineering analysis plan in stages in order to facilitate the engineering analyses.

The engineering analysis plan shall consist of:


- ∅ Soil profile and stability sheets showing all relevant borings and laboratory data for roadways and structures (refer to **GT-701-2, Laboratory Testing Plan**)

**Note:** The consultant need not submit laboratory test data sheets unless the Geotechnical Branch requests them.

- ∅ A tabular summary indicating:
  - ◆ Station limits
  - ◆ Critical analysis station (with appropriate offsets, locations, etc., as applicable)
  - ◆ Type of analysis to be performed
- ∅ A tabular summary of areas that were anticipated to require analyses in the preliminary stage but did not undergo analysis as a result of the information obtained from the field and laboratory work

**Note:** This summary should indicate station limits, critical analysis station (with appropriate offsets, locations, etc., as applicable), type of analysis previously thought to be necessary, and a very brief statement explaining why analysis is not necessary.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Interim Meetings</p>

**PURPOSE OF MEETING:**

If deemed necessary, the Geotechnical Branch will schedule an interim meeting to discuss progress of the project or address any complications that have developed. The branch will invite, as applicable, any or all of the following:


- Ø Design consultant
- Ø Division of Highway Design
- Ø District Design
- Ø Division of Construction
- Ø District Construction

The minutes of the meeting shall reflect discussions that occurred.

**SERVICES PROVIDED BY GEOTECHNICAL CONSULTANT:**

The consultant will be responsible for the completed minutes.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Rock Core Meetings</p>

**PURPOSE OF MEETING:**

If deemed necessary, the Geotechnical Branch will schedule a rock core inspection after rock coring and open-face logging have been completed and cut slope recommendations have been prepared. The branch will invite to the meeting representatives of the:

- Ø Design consultant
- Ø Division of Highway Design
- Ø District Design
- Ø Division of Construction
- Ø District Construction

The purpose of the meeting is to:


- Ø Review the rock cores and open-face logs
- Ø Recommend rock cut slope configurations
- Ø Resolve questions as to the type and thickness of rock to be considered for select quantities

The minutes of the meeting shall constitute the recommended rock cut slope configurations. Slope stability analyses may be necessary prior to final design of cut slopes in the overburden; however, the analyses need not be completed prior to the rock core meeting.

If deemed necessary, the Geotechnical Branch may hold a rock core meeting for structures.

**SERVICES PROVIDED BY GEOTECHNICAL CONSULTANT:**

When a consulting engineer provides geotechnical services, the consultant shall submit a written summary of the cut slope recommendations with cut limits defined to the Geotechnical Branch prior to the rock core inspection. The consultant shall plot the recommendations with lithology divisions on the critical cross-sections. If necessary, the Geotechnical Branch will schedule a rock core meeting after reviewing the cut slope recommendations.

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Chapter</i></p> <p>MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Final Geotechnical Meetings</p>

**PURPOSE OF MEETING:**

If deemed necessary, the Geotechnical Branch will schedule a final meeting. The branch shall invite to the meeting representatives of the:

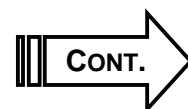
- Ø Design consultant
- Ø Division of Highway Design
- Ø Division of Construction
- Ø District Design
- Ø District Construction

The purpose of this meeting is to discuss and recommend geotechnical plan notes for roadway/structure projects.

**SUBMITTAL BY A CONSULTANT:**

When a geotechnical consultant provides services, the consultant shall submit the following information to the Geotechnical Branch for review prior to the final geotechnical meeting:


- Ø Roadway Projects:
  - ◆ Cut stability sheets
  - ◆ Embankment stability sheets
  - ◆ Soil profile sheets
  - ◆ Other sheets depicting special procedures
  - ◆ Draft copy of the geotechnical recommendations
  
- Ø Structure Projects
  - ◆ Single copy of the letter portion of the report
  - ◆ Copies of the subsurface data and other sheets (one each)
  - ◆ Copies of the geotechnical design calculations and test results (pile capacities, stabilities, triaxial failure envelopes, e-log p-curves, settlement calculations, negative skin friction, axial loads on drilled shafts, etc.)



**SUBMITTAL OF  
REPORT:**

If necessary, the Geotechnical Branch will schedule the final geotechnical meeting after reviewing the submittals. Following the final geotechnical meeting/review, the consultant will make any necessary revisions and submit the finalized report (with required copies) along with electronic files. The Geotechnical Branch will then distribute the report as outlined in **GT-807, Report Distributions**.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>MEETINGS &amp; SUBMITTALS</p>
	<p><i>Subject</i></p> <p>Landslide or Unstable Rock Slope Meetings</p>

**PURPOSE OF MEETING:**


The Geotechnical Branch will notify either the Chief District Engineer or the Director of the Division of Maintenance that the proposed methods of correction and the accompanying cost estimates have been completed. The branch will arrange a meeting of the appropriate representatives to discuss the project. Representatives may include those of the:

- Ø State Highway Engineer's Office
- Ø Division of Maintenance
- Ø Office of Rural and Secondary Roads
- Ø Division of Highway Design
- Ø Division of Construction
- Ø Geotechnical Branch
- Ø Chief District Engineer
- Ø Others

The purpose of the meeting is to select a method for correction. Representatives will discuss approximate quantities and estimated costs for each alternative. The Geotechnical Branch will prepare a final report upon approval by the requesting party.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Chapter</i> REPORT DEVELOPMENT
	<i>Subject</i> Introduction

**OVERVIEW:** This chapter presents recommendations and guidelines relating to the development of various types of geotechnical engineering reports and the distribution of those reports. Many of the exhibits referenced in the text are example subsurface data sheets similar to the drawings, which should accompany the plans in the roadway and structure reports.

**PLANNING:** **GT-801** discusses geotechnical overviews for planning.

**ROADWAYS:** The following subjects pertain to the development of a geotechnical engineering roadway report:

- GT-802-1** Design of Report
- GT-802-2** Soil Profiles
- GT-802-3** Rock and Soil Cuts
- GT-802-4** Embankments
- GT-802-5** Special Geologic Considerations

**STRUCTURES:** The following subjects provide guidelines for preparing reports of the various types of structures commonly encountered on highway projects:


- GT-803-1** General Project Information
- GT-803-2** Bridges
- GT-803-3** Culverts
- GT-803-4** Retaining Walls
- GT-803-5** Noise Barrier Walls

**MAINTENANCE:** **GT-804** discusses the development of reports on various investigations for maintenance projects.

**CONSTRUCTION:** **GT-805** discusses the submission of reports applicable to construction projects.

**PERMITS:** **GT-806** addresses the reports for both utility and mining encroachment permits.

**REPORT DISTRIBUTIONS:** **GT-807** provides the distribution lists of the various reports.

<h1>GEOTECHNICAL</h1> 	<i>Chapter</i> REPORT DEVELOPMENT
	<i>Subject</i> Planning

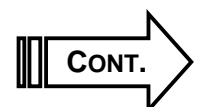
## GEOTECHNICAL OVERVIEWS:

Geotechnical overviews for planning should address issues that may affect transportation decisions within the project area. The geotechnical overviews should present a description of the topography of the project area, including regional and structural geology. The geotechnical overviews should also include discussion concerning the impacts of the various features and any potential mitigation actions, including cost, that would be necessary if the feature is encountered. This information will be utilized to help determine whether or not to impact a feature, particularly in the situation when there are competing issues (that is, historic, environmental, cultural, etc.) and it is not possible to avoid impacting a resource of the feature. The issues discussed may include:

- ∅ Problematic geologic formations
- ∅ Presence of springs, landslides, mines, karst, faulted strata, acidic shale, mineral deposits, or other topographic or subsurface features that could affect construction and maintenance of a roadway
- ∅ Foundation types for structures
- ∅ Possible issues with cut and fill slopes resulting from the known soil and rock conditions

**Note:** This should be in a broad sense, that is, flatter or steeper slopes than normal so that the impacts to cost resulting from the need for more earthwork or right of way can be considered.)

- ∅ Possible issues with pavement subgrade and the need for modification
- ∅ Seismic zones for earthquake design and possible mitigation actions
- ∅ Availability of suitable materials from excavation (that is, rock from excavation) to use in the subgrade and embankments




**GEOTECHNICAL  
OVERVIEWS****(cont.):**

Maps of the project areas should be included with as many as possible of the above features noted. Areas of particular concern should be clearly noted on the maps. When possible, this information should be provided in GIS (Geographic Information System) layers so that they can be incorporated with other features for visual display as well as to aid in the determination of the recommended corridors. If alternatives are available, then an evaluation of each alternative discussing the geologic conditions, both beneficial and adverse, should be included.

Whenever possible the report should be presented in layman's terms, since the overview will be included in the reports or other displays that will be available to the general public.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Design of Report</p>

**TYPICAL FORMAT:** The following typical table of contents illustrates the general format for developing a geotechnical engineering roadway report.

**Chapters:**

- I. Location and Description
- II. Topography and Drainage
- III. Geology
- IV. Drilling and Sampling
- V. Laboratory Testing
- VI. Engineering Analyses
- VII. Recommendations

**APPENDICES:**

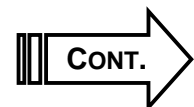
- A. Location on a 1-inch = 2,000-foot (1:24,000) scale topographic map
- B. Triaxial test failure envelopes\*
- C. Void ratio and coefficient of consolidation/log pressure curves, settlement versus time curves, and settlement calculation sheets\*
- D. Geotechnical symbol sheet  
Geotechnical note sheet  
Soil profile sheets  
Cut stability sections  
Embankment stability sections  
Applicable sheets for wick drains, stone columns, slope reinforcement, etc.

\* Included only in the three paper copies submitted to the Geotechnical Branch

**FORMAT**

**REQUIREMENTS:**

Reports shall be typed and drawings made on 8.5-inch x 11-inch (215-millimeter x 278-millimeter) sheets, with the exception of those specified in Appendix D. The roadway alignment shall be depicted on a 1-inch = 2,000-foot (1:24,000) scale topographic map, with stations indicated at a minimum of 1,000-foot (300-meter) intervals (refer to **Exhibit 2**). The sheets in Appendix D shall be reduced to scale on 11-inch x 17-inch (278-millimeter x 432-millimeter) sheets and included in the report.



**COVER &****TITLE SHEET:**

The cover and title sheet shall include the following project identification:

- Ø County name
- Ø Project number
- Ø Route number and/or road name
- Ø Stations of termini
- Ø Section number
- Ø MARS number
- Ø Item number
- Ø Date

**GENERAL REPORT****REQUIREMENTS:**

The following paragraphs outline general report requirements; however, additional chapters may be needed to fully document a project:

**Chapter I—Location and Description** provides specific and detailed information such as project termini, major stream crossings, and intersections referenced to landmarks. The design objectives of the proposed roadway will be described.

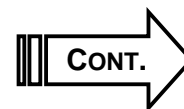
**Chapter II—Topography and Drainage** presents a discussion of the major terrain features. A short general discussion will be followed by significant details giving approximate stations of anomalies.

**Chapter III—Geology** discusses the major geologic features. Items requiring special consideration—faults, sinkholes, landslides, mines, etc.—will be discussed.

**Chapter IV—Drilling and Sampling** provides a complete description of the drilling and sampling program, including drill equipment, drilling and sampling methods, and dates. Observations will be made concerning soil types, depths, water tables, springs, etc., with reference to stations.

**Chapter V—Laboratory Testing** presents the number of each type of laboratory test along with the test methods. A discussion of the test results, including averages and range of values, will be presented. Approximate station limits of areas with unusual soil conditions shall be discussed. The significance of the test values, especially unusual values, should be discussed and referenced in the appropriate appendices. A summary of all test data shall be shown on soil profile and stability section sheets.

**Chapter VI—Engineering Analyses** includes discussions of each stability, settlement analysis, etc. References should be made to appropriate stability sections and calculation sheets in appendices. Derivations of strength parameters as well as safety factors, special analysis procedures (that is, wick drains, stone columns, slope reinforcement), etc., and their significance will be discussed.



**GENERAL REPORT  
REQUIREMENTS****(cont.):**

**Chapter VII—Recommendations** consists of a list of geotechnical recommendations. These recommendations shall become the geotechnical notes after departmental approval. The CBR design value and any subgrade modification are included as design recommendations and shall not be shown on the geotechnical note sheet. The geotechnical notes will be placed on a geotechnical note sheet and included in the roadway plans (refer to **Exhibit 30**). Appropriate notations making reference to specific geotechnical notes and stability section sheets will be made on the soil profile at the applicable locations. Geotechnical considerations applicable to structures on the project shall be incorporated into the roadway report whenever possible.


**Appendices** include triaxial test failure envelopes, void ratio, coefficient of consolidation/log pressure curves (refer to **Exhibits 27 and 28**), and settlement calculation sheets, paper copies only.

**ABBREVIATED  
FORMAT:**

An abbreviated geotechnical engineering roadway report, with prior approval by the Geotechnical Branch, may be used when conditions warrant. This format shall include:

- Ø Brief discussion of detrimental soil and subsurface conditions
- Ø Geotechnical recommendations
- Ø Roadway alignment depicted on a 1-inch = 2,000-foot (1:24,000) scale topographic map showing 1,000-foot (300-meter) minimum station intervals
- Ø Symbol sheet, geotechnical note sheet, soil profile sheets, cut and embankment stability sections, and special application sheets (that is, wick drains, stone columns, slope reinforcement). These drawings shall be reduced to scale on 11-inch x 17-inch (278-millimeter x 432-millimeter) sheets.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Soil Profiles</p>

**SYMBOL SHEET:** The soil profile sheets shall be prefaced with a symbol sheet (refer to **Exhibit 29**).

**GEOTECHNICAL NOTES:** A geotechnical note sheet is to be included. All pertinent notes shall be listed along with any applicable stations and/or station limits (refer to **Exhibit 30**). The department disclaimer note shall be placed on the first sheet of the soil profile (refer to **Exhibit 31**).

**DISTURBED SOIL BORINGS:** All disturbed soil borings shall be plotted on the soil profile. Offset borings shall be identified as to offset distance and drawn at the proper station and elevation, whenever possible. Where offset borings left and right of the same station would overlap, both borings shall be plotted at the proper station, one at the proper elevation, and the surface elevation of the other boring shall be identified. Channel changes and special ditches shall be shown on the same sheet with the mainline profile when space permits.


**NONDURABLE SHALES:** In special cases where nondurable shales (soil-like shales that are soft and may be drilled easily with an auger) were sampled and tested, the nondurable shale symbol shall be used when plotting, and the samples shall be identified by the same procedure as those used for soil.

**PRESENTING TEST RESULTS:** All applicable laboratory test results shall be depicted on the soil profile sheets (refer to **Exhibit 31**). Laboratory test data sheets (except those specified in **GT-802-1**) and subsurface logs shall not be included in the geotechnical engineering report.

**MINIMUM PROJECT IDENTIFICATION:** The following information shall be on all soil profile sheets, as applicable:

- Ø County name
- Ø Road name
- Ø MARS and item numbers
- Ø Stream crossings and roadway intersections identification
- Ø Reference to any applicable geotechnical notes and critical stability sections

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Rock &amp; Soil Cuts</p>


**POLICY:**

The proposed slope configuration for all critical rock and soil cuts shall be depicted on a cut stability section. Included on the section shall be all relevant borings and data necessary to develop this configuration. A tabulation of rockline soundings through the entire referenced cut shall be included when necessary. All applicable subsurface information shall be shown on the cut stability section (refer to **Exhibits 25, 26, and 32**).

Any special recommendations and construction requirements necessary to obtain a stable cut slope design shall be depicted on the cut stability section, that is, soil nailing, rock bolts, special rock fall ditches, horizontal drains, etc.

2 2 2



<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>ROADWAYS</p>
	<p><i>Subject</i></p> <p>Embankments</p>


**STABILITY:** The critical section(s) for each embankment with the proposed slope configuration shall be plotted on an embankment stability section sheet. All relevant borings, data, and results of analyses shall be shown on these sheets (refer to **Exhibit 33**).

**SETTLEMENT:** In situations where settlement magnitudes are critical, a note addressing settlement should be included on the embankment stability sheet. For example:

*NOTE: Settlement analysis indicates 24 inches of settlement with 90 percent consolidation in 6 years.*


**SPECIAL RECOMMENDATIONS:** Any special recommendations and construction requirements necessary to obtain a stable embankment slope design shall be depicted on the section, that is, slope reinforcement, rock toe drains, wick drains, horizontal drains, geotextile fabric, etc. (Refer to **Exhibits 35 and 36** for example of wick drains).

2 2 2

<b>GEOTECHNICAL</b> 	<i>Section</i> ROADWAYS
	<i>Subject</i> Special Geologic Considerations

**POLICY:** Special geologic considerations shall be presented on sheets depicting procedures (that is, mine subsidence treatment, rock bolts, dipping rock, etc.). Additional information in the form of special notes, special provisions, and/or specifications shall be attached to the report.

2 2 2

<h1>GEOTECHNICAL</h1> 	<i>Section</i> STRUCTURES
	<i>Subject</i> General Project Information

**OVERVIEW:**

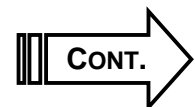
Structure foundation investigations consist of all functions necessary to develop the subsurface data sheets and the geotechnical report. A separate report shall be written for each structure on the project, except for twin bridges and bridges with short attached wingwalls. The following instructions shall be used as guidelines in preparing reports for the various types of structures commonly encountered.

**GUIDELINES FOR REPORTS:**

Structure reports shall consist of a letter containing the recommendations, site map, latitude and longitude coordinates for each hole, and accompanying drawings (if applicable), most of which are intended to be included in the structure plans. The final recommendations are to be placed at the end of the body of the report in a numbered format. The body of the report should be in the following format:

- Ø Brief description of the proposed structure location
- Ø Identification of the name and number of the 7.5-minute geologic quadrangle in which the structure is located, along with the rock formation and geologic member
- Ø List of the entities that performed the drilling and the soil testing
- Ø Brief discussion of the conclusions pertaining to the overall site geology and in-situ soils, along with any irregularities encountered during the investigation
- Ø Brief discussion of the criteria, results, and conclusions of any stability analyses

**Note:** If stability analyses are not warranted, an explanation of why this is the case (for example, low embankment heights or shallow foundation soils) should be included in the report.



**GUIDELINES  
FOR REPORTS  
(cont.):**

- Ø Brief discussion of the criteria, results, and conclusions of any settlement analyses


**Note:** If settlement analyses are not warranted, an explanation of why this is the case (for example, low embankment heights or shallow foundation soils) should be included in the report.

- Ø Where applicable, scour data and a brief discussion of possible solutions if scour is excessive
- Ø Where applicable, a brief description of pile driveability or drilled shaft analyses and conclusions

**COORDINATE  
DATA:**

Latitude and longitude coordinates for each boring location should be submitted in tabular form in the appendix of the report (refer to **Exhibit 41**).

2 2 2

<h1>GEOTECHNICAL</h1> 	<i>Section</i> STRUCTURES
	<i>Subject</i> Bridges

**OVERVIEW:** Foundation investigation reports for bridges shall meet the general requirements presented in **GT-803-1**, which are applicable to all structures. Additional requirements, below, are specific to bridges.

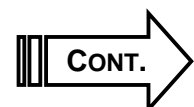
**MINIMUM REPORT  
RECOMMENDATION  
DEVELOPMENT:**

The recommendation portion of the report shall address, at a minimum, recommendations for the following items (where applicable):

- ∅ Foundation type with the anticipated bearing elevations (typically pile tip and/or base of footing elevations)
- ∅ Allowable bearing capacity for spread footings

**Note:** In cases where a deeper footing embedment will allow significantly higher bearing pressures, it may be advantageous to present allowable bearing for more than one elevation (for example, at the top and base of the weathered rock).

- ∅ Settlement
- ∅ Negative skin friction
- ∅ Scour
- ∅ Pile capacity
- ∅ Pile driveability (for example, minimum and maximum hammer size)
- ∅ Slope protection
- ∅ Drilled shaft foundations
- ∅ Any instrumentation or construction procedures necessary or advantageous to a safe and economical geotechnical design



**DEEP VS. SHALLOW**

**FOUNDATIONS:** Spread footings are generally recommended when suitable bedrock is encountered within 20 feet (6 meters) of finished grade. Deep foundations are generally more economical when the distance from finish grade to the bedrock surface is greater than 20 feet (6 meters). The approximate roadway grade at each abutment should be indicated on the subsurface data sheet to allow a comparison with the rock elevation (refer to **Exhibit 39**). Estimated pile tip elevations are specified in the recommendations but are not presented on the plan sheet.

**BEDROCK  
CONTOURS:**

It may be desirable to prepare a bedrock contour sheet for bridge sites where the bedrock surface is steeply sloping or where karst features have produced a highly irregular rock surface (refer to **Exhibit 40**).

**PRESENTING  
STABILITY  
ANALYSIS  
RESULTS:**

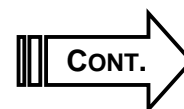
The results of stability analyses performed for the Geotechnical Engineering Structure Foundation Report may be shown and/or discussed in the report (refer to **Exhibit 42**). The soil strength parameters assumed for analyses and the safety factors determined from analyses shall be presented on the drawing. The stability analyses shall not be duplicated in cases where stabilities performed for investigation of the roadway are applicable to the embankment at the structures. However, if the stability analyses were performed and shown in the roadway report, a brief discussion of the results along with any mitigation procedures is required for the structure report.

**PRESENTING  
SETTLEMENT  
ANALYSIS  
RESULTS:**

The results of all settlement analyses (including those previously performed in the roadway phase of the investigation) indicating the estimated settlement magnitude and rate of settlement shall be presented in the roadway Geotechnical Note Sheet and the Geotechnical Engineering Structure Foundation Report. Where an existing embankment is being widened and significant differential settlements are anticipated, settlement analyses shall be performed across the width of the embankment.

**SPECIAL  
REQUIREMENTS:**

Procedures such as controlled loading, waiting periods, or wick drains may be necessary based upon the results of stability and/or settlement analysis. Instrumentation procedures may also be required. All of these items shall be called for specifically in the recommendation section of the report. The Division of Bridge Design will include the appropriate recommendations on a general note sheet. The reasons for the use of a waiting period, instrumentation, wick drains, etc., shall be discussed in the report. It may be necessary to also include these requirements in the geotechnical notes of the roadway plans (refer to **Exhibit 30**).



**LATERAL  
SQUEEZE:**

For bridges with moderate to large settlement magnitudes for which deep foundations are proposed, the geotechnical engineer shall determine, using the method presented in the *Soil and Foundations Workshop Manual*, if lateral squeeze is a potential problem. In such cases, the geotechnical engineer shall address the use of a waiting period between completion of embankment construction and the foundation installation, or other feasible methods of eliminating potential damage to the foundation. In addition to the abutments, foundations at piers immediately adjacent to the abutments could be affected by lateral squeeze.

**DRAGDOWN:**

Dragdown on the deep foundations may be a problem for structures with moderate or large settlement magnitudes and slow consolidation rates. The geotechnical engineer must suggest alternative methods of handling dragdown loads. The dragdown load without a waiting period, with a waiting period, and after treatment (with or without waiting period) shall be presented in the Geotechnical Engineering Structure Foundation Report.

**SETTLEMENT  
PLATFORMS:**

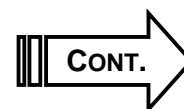
The geotechnical engineer shall instruct the designer to add a note to the plans specifying settlement platforms if a waiting period is selected as the method of handling dragdown loads or lateral squeeze. If settlement platforms are required, a note shall be added to the Geotechnical Note Sheet produced for the Geotechnical Engineering Roadway Report for inclusion in the roadway plans.

**METHODS OF  
HANDLING  
DRAGDOWN:**

The designer shall be instructed to indicate on the plan sheet (showing the piles and the pile-driving records) whether or not the foundations have been designed to support the dragdown loads. If the foundations cannot be designed to handle the dragdown loads, alternative methods may have to be employed to counteract any negative impact to the piles.

**ALTERNATIVE  
DESIGNS:**

The designer may submit alternative designs for a structure. A separate subsurface data sheet may be prepared for each alternative. All of the subsurface data obtained for all alternatives shall be presented on each sheet (refer to **Exhibit 39**). The sheets shall not be labeled as alternatives. The drawing for the rejected alternative can be discarded and that for the selected structure included in the plans. Subsurface data sheets for both single-span and three-span alternatives shall be developed when breastwall abutments are proposed (refer to **GT-403-1, "Bridges"**) and rock is in excess of 20 feet (6 meters) below proposed roadway grade.



**CBR DESIGN****VALUES:**

Bridge replacement projects in which a Geotechnical Roadway Report will not be issued shall include a recommended CBR design value for pavement in the Geotechnical Engineering Structure Foundation Report.

**SUBSURFACE  
DATA SHEETS:**

A subsurface data sheet presenting a plan view of the bridge and a profile view of the borings is necessary. Subsurface data sheets showing the relative positions of other structures and nearby borings may be developed. Additional drawings illustrating the results of analyses or locations of specialty items (wick drains, stone columns, geogrids, etc.) may be required (refer to **Exhibits 35 and 36** for examples involving wick drains).

**PLAN SCALE:**

Bridge plan views shall be drafted as follows:

- ∅ For English unit drawings, a scale of 1"=10', 1"=20', 1"=30', 1"=40', 1"=50', or 1"=60' should be used.
- ∅ For metric unit drawings, a scale of 1:100, 1:200, 1:300, 1:400, or 1:500 should be used.
- ∅ The largest of the scales that will conveniently fit on the plan sheet should be used.
- ∅ The plan view for large structures may be plotted on two or more sheets in lieu of using a smaller plan scale.
- ∅ The plan sheet shall present the following information:
  - ◆ Roadway bearing
  - ◆ North arrow
  - ◆ Location and station of each pier and abutment
  - ◆ Name (if known) of any roadway, railroad, or stream, etc., that the bridge crosses
  - ◆ Roadway skew (if any)
  - ◆ Types and locations of all borings
- ∅ The location of any borings specified in the boring layout but not drilled shall not be plotted on the plan sheet.

**PROFILE:**

A graphical depiction of the borings in profile view shall be presented beneath the bridge plan. The profile view vertical scale shall always be 1 inch = 10 feet for English unit drawings and 1:100 for metric unit drawings, regardless of the scale used for the plan. Use of horizontal scale on the profile view is not necessary.

**TYPE OF DATUM:**

The type of datum should always be indicated. (Refer to **Exhibit 43**, which indicates a "sea level datum." Alternatively, the drawing could indicate an "assumed datum.")





**REQUIRED  
INFORMATION****ON PROFILE:**

Headings for borings shall include hole number, station, offset, and surface elevation.

**CLASSIFICATION****DATA:**

The types and locations of undisturbed samples are shown with the holes plotted on the profile view, but the Unified Soil Classification symbols as presented on **Exhibit 29** need not be shown. "N-values" shall be indicated for all samples obtained through standard penetration testing. The following items shall be listed for all classified samples:

- ∅ S+C (silt plus clay) percentages from hydrometer or wash gradation tests
- ∅ AASHTO and Unified Soil Classifications
- ∅ Liquidity index
- ∅ Natural moisture contents
- ∅  $D_{50}$  and  $D_{95}$  (millimeters)—needed for bridges at wet crossing only

**WATER TABLE:**

Water table elevations accompanied by the date of the readings shall be depicted on the boring profile.

**REPORTING  
RESULTS****OF LAB TESTING:**

Results of unconfined compression and/or unconsolidated-undrained triaxial testing are typically plotted beside the sample tested (refer to **Exhibit 46, sheet 3**). Results of other types of tests such as consolidated-undrained triaxial testing are usually listed in a table (refer to **Exhibits 32 and 49**).  $D_{50}$  and  $D_{95}$  values should be presented for soil samples for structures at wet crossings (refer to **Exhibit 45**).

**ROCK****DESCRIPTIONS:**

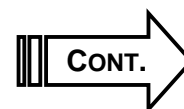
Rock descriptions from the geology logs shall be presented on the subsurface data sheets as illustrated in the exhibits.

**ROCK TEST****RESULTS:**

The Rock Quality Designation—Kentucky Method (KY-RQD) and the percentage of recovery (REC) (from the geologist's log, not the driller's log) are given for each core run. For some projects, including those incorporating drilled shafts, the Rock Quality Designation—Standard Method (Std-RQD) are also required (refer to **Exhibit 46, sheet 3**). Results of the Slake Durability Index tests and Jar Slake tests are also shown.

**REFUSAL****ELEVATIONS:**


Refusal elevations of rockline soundings shall be shown in parentheses. All core logs shall identify top of rock (bedded material) elevation and, if applicable, the elevation of the base of weathered rock. Subsurface data sheets shall state "no weathered rock" where geology logs indicate none is present (refer to **Exhibit 43**).



**USING PREVIOUSLY  
DEVELOPED****DATA:**

The subsurface data sheet presented in **Exhibit 44** is an example of existing data from a previous report being included in the Geotechnical Engineering Structure Foundation Report and in the Structure Plans.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Culverts</p>

**OVERVIEW:** Foundation investigation reports for culverts shall meet the general requirements presented in **GT-803-1**, which are applicable to all structures. Additional requirements, below, are specific to culverts.

**MINIMUM REPORT DEVELOPMENT:** Recommendations presented in the letter portion of the report shall include, at a minimum, the following items:

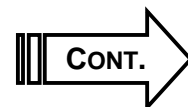
- Ø Whether the culvert is to be designed as yielding (soil bearing) or nonyielding (rock bearing)
- Ø Allowable bearing pressure for wingwalls
- Ø Settlement (for yielding culverts, if applicable)

**ALLOWABLE BEARING PRESSURE:** The allowable bearing pressure for yielding culverts is applicable only to the wingwalls since the barrel of the culvert is confined.

**EQUIVALENT FLUID PRESSURE:** The structure designer can use the equivalent fluid pressure values directly or use Soil Type 3 of **Exhibit 66-04-13** in the *Division of Bridge Design Guidance Manual*.

**SETTLEMENT:** Culverts on deep soil foundations, and also under high embankments, can be affected by large magnitudes of settlement. Assuming that the foundation conditions are uniform, settlement will be greatest near the center of the culvert, under the highest portions of the embankment. This differential settlement can adversely affect drainage through the culvert. Prior to settlement the flowline will fall continuously from culvert inlet to outlet. If the center of the culvert settles more than the outlet, the center of the culvert in its post-settlement configuration can be lower than the outlet, causing water to pond in the culvert.

**USE OF CAMBER:** To prevent ponding from occurring, a cambering (or arching) of the flowline is sometimes employed. In cases where settlements are anticipated to be a potential concern, the geotechnical engineer shall alert the structure designer to this condition to determine whether camber is necessary.



**CBR DESIGN****VALUES:**

Culvert replacement projects in which a Geotechnical Engineering Roadway Report will not be issued shall include a recommended CBR design value for pavement in the Geotechnical Engineering Structure Report.


**SUBSURFACE****DATA SHEET:**

A subsurface data sheet presenting a plan view of the culvert and a profile view of the borings (plotted to vertical scale) showing their position relative to flowline is preferred. The information on the plan view should be similar to that shown in **GT-803-2**. Flowline inlet and outlet elevations (including existing inlet and outlet elevations for extensions) shall also be indicated on the subsurface data sheet (refer to **Exhibit 47**).

**PRESENTING  
RESULTS OF  
SETTLEMENT &  
STABILITY****ANALYSIS:**

The results of settlement and stability analyses, if applicable, shall also be presented. Settlement shall be plotted along culvert centerline when nonuniform loading or nonuniform foundation conditions are anticipated to cause significant differential settlements (refer to **Exhibit 48**). The results can be presented as a note rather than in a graphic format if uniform loading conditions exist.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Retaining Walls</p>

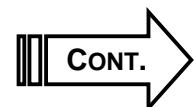
**OVERVIEW:** Foundation investigation reports for retaining walls shall meet the general requirements presented in **GT-803-1**, which are applicable to all structures. Additional requirements, below, are specific to retaining walls.

**MINIMUM REPORT DEVELOPMENT:** Recommendations presented in the letter portion of the report shall include, at a minimum, the following items:

- ∅ Wall types that were analyzed for this location
- ∅ Listing of parameters that can be utilized in the wall design

Each possible wall type analyzed for the location should have a separate list of parameters. This list shall include, where applicable:

- ◆ Effective stress friction angle of granular backfill
- ◆ Effective stress friction angle of in-situ soils
- ◆ Total stress cohesion of in-situ foundation soils
- ◆ Effective stress friction angle of backfill (internal backfill for MSE must conform to "Reinforced Fill Material" as specified in **Section 805** of the *Standard Specifications for Road and Bridge Construction*, current edition)
- ◆ Unit weight of backfill
- ◆ Unit weight of foundation material
- ◆ Unit weight of MSE internal backfill
- ◆ Allowable bearing capacity of granular replacement
- ◆ Allowable bearing capacity of bedrock
- ◆ Minimum strap length for MSE walls = greater of 8 feet or 70% of the wall height (0.7H)
- ◆ Friction angle for sliding calculation
- ◆ Equivalent depth of soil surcharge
- ◆ Allowable bearing capacity of spread footings founded on top of the MSE wall
- ◆ Any other geotechnical parameter necessary for the design of the wall



**MINIMUM REPORT  
DEVELOPMENT (cont.):**


- ∅ The required minimum factor of safety requirements for:
  - ◆ Sliding = 2 including passive pressures or 1.5 not including passive pressures
  - ◆ Overturning = 2
  - ◆ Bearing capacity = 2 to 3, depending on amount and credibility of test data
  - ◆ External slope stability analyses
- ∅ Whether or not the analyses performed meet the minimum required safety factors and any additional measures (shear key, granular replacement, granular backfill, etc.), if any, that had to be employed to meet those factors
- ∅ A plan view of the retaining wall, sample borings, rockline soundings, rock cores, observation well data, and laboratory test results on the subsurface data sheet for all walls where a subsurface investigation is performed

**Note:** Plotting the wall profile on the subsurface data sheet with the borings is not required for walls that obviously bear either on soil or on rock throughout. The profile shall be indicated on the subsurface data sheet if the rockline is near the proposed wall footing elevation, or if replacement of the foundation soils with granular materials (either partial replacement or replacement to bedrock) is required.

**STABILITY:**

Stability sections shall be prepared for retaining walls, where applicable. The wall designer shall check internal stability of retaining walls. The geotechnical engineer shall perform analyses necessary to ensure that safety factors for external stability are adequate. Analyses for external stability shall include, at a minimum, allowable bearing capacity, sliding, overturning, and overall slope stability.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>STRUCTURES</p>
	<p><i>Subject</i></p> <p>Noise Barrier Walls</p>

**OVERVIEW:** Foundation investigation reports for noise barrier walls shall meet the general requirements presented in **GT-803-1**, which are applicable to all structures. Additional requirements, below, are specific to the walls.

**MINIMUM REPORT DEVELOPMENT:** Recommendations presented in the letter portion of the report shall include, at a minimum, the following items:

∅ A listing of parameters that can be utilized in the wall design, including, where applicable:

- ◆ Effective stress friction angle of granular in-situ soils
- ◆ Total stress cohesion of in-situ soils
- ◆ Unit weight of foundation materials
- ◆ Allowable bearing capacity at bearing elevation for spread footing option

**Note:** The walls could be on rock, in-situ soils, or new embankment.


- ◆ Any information necessary to define the design criteria for drilled shafts (allowable end-bearing and allowable side friction capacities, allowable lateral resistance, etc.)

**Note:** The shafts could be founded in rock, in-situ soils, or new embankment.

∅ Any other geotechnical parameter necessary for the design of the wall

∅ A plan view of the wall, sample borings, rockline soundings, rock cores, observation well data, and laboratory test results on the subsurface data sheet for all walls where a subsurface investigation is performed

2 2 2

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Chapter</i> <b>REPORT DEVELOPMENT</b>
	<i>Subject</i> <b>Maintenance</b>

## PRELIMINARY LANDSLIDE

**INVESTIGATIONS:** The Geotechnical Branch shall prepare a report outlining possible correction methods, possible risks, and rough cost estimates after the preliminary investigation. The Geotechnical Branch may need assistance from the district and/or the appropriate divisions in developing cost estimates. The report may recommend a geotechnical investigation to examine possible alternatives. Preliminary borings may be necessary to determine whether a simple solution exists. An estimated cost to perform a comprehensive investigation will be included in the report.

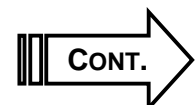
## COMPREHENSIVE LANDSLIDE

**INVESTIGATIONS:** The Geotechnical Branch shall issue a report based upon the method chosen to correct the landslide (refer to **GT-704, Landslide or Unstable Rock Slope Meetings**). The report shall consist primarily of data, analyses, estimated quantities, and costs with recommendations resulting from the comprehensive geotechnical investigation. Plans developed as part of the report should include the following:

- Ø Location map (1 inch = 2,000 feet [1:24,000]) showing project location
- Ø Plan sheets indicating extent of slide correction, boring layout, locations of scarps or breaks, right-of-way limits, property owners, and locations of all known utilities
- Ø Subsurface data sheet(s) including data from driller's and geologist's logs
- Ø Landslide stability sheet including cross-section(s) depicting assumed existing conditions and the landslide correction

**Note:** The assumed rockline, failure surface, water table, etc., shall be included on the cross-section(s) (refer to **Exhibit 34**).

- Ø Cross-sections of the slide correction area (usually on 25-foot or 50-foot [10-meter or 20-meter] centers) depicting the correction on each cross-section






**UNSTABLE  
ROCK****SLOPES:**

The Geotechnical Branch will be responsible for providing a report outlining the possible methods of correction, risks, and estimated costs. Plans developed as a part of this report should include the following:

- ∅ Location map (1 inch = 2,000 feet [1:24,000]) showing project location
- ∅ Plan sheet indicating the roadway, top of cut, any breaks or failures, right of way, property owners, and utilities
- ∅ Correction methods depicted on an oblique photomosaic as a supplement to the cross-sections when necessary
- ∅ Critical cut stability sections showing geotechnical data and proposed alternatives (one alternative per sheet)

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>REPORT DEVELOPMENT</p>
	<p><i>Subject</i></p> <p>Construction</p>

**LANDSLIDES:** A report outlining possible methods of correction, risks, and cost estimates will be furnished to applicable construction personnel after completion of the preliminary or comprehensive investigation, whichever applies.


**ROCK CUT REVISIONS:** A report outlining possible methods of correction, revisions to slopes, risks, and items to be considered in development of cost estimates will be furnished to applicable construction personnel after completion of the inspection or a completed investigation, whichever applies.

**EXCESS MATERIAL SITES:** The Geotechnical Branch will prepare a memo to the applicable construction personnel after reviewing the contractor's proposed excess material site design. The Geotechnical Branch shall concur with the proposal as presented or recommend changes and/or additions.

**SUBGRADE STABILIZATION:** The Geotechnical Branch will prepare a report to applicable construction personnel with recommendations for subgrade stabilization. The recommendations shall address the type of additive, percent of additive, length of treatment, and depth of treatment.

**FIELD INSTRUMENTATION:** The Geotechnical Branch will maintain a file of all field instrumentation data (settlement, piezometer and inclinometer readings).


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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>REPORT DEVELOPMENT</p>
	<p><i>Subject</i></p> <p>Permits</p>

**UTILITIES:** The report for utility encroachment permits shall describe the geology and known subsurface hazards in the area. Recommendations and/or comments shall address construction practices, hazards to roadway facilities, mitigation measures, risk to the traveling public, etc. The Geotechnical Branch may recommend that the party requesting the permit provide additional information or conduct a geotechnical investigation prior to permit approval.

**MINING:** The report for mining encroachment permits shall describe the geology, mining method, and any subsidence in the area. Recommendations shall address size of openings and pillars, number of crossings, maximum subsidence potential, draw angle, angle of crossing to highway, risk to the traveling public, and subsidence mitigation measures.

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<h1>GEOTECHNICAL</h1> 	<i>Chapter</i> REPORT DEVELOPMENT
	<i>Subject</i> Report Distributions

**REPORT****SUBMISSION:**

For consultant-produced reports the following will be submitted to the Geotechnical Branch:

- Ø Three paper copies of the completed report with attachments (maximum paper size of 11 inches x 17 inches)
- Ø Electronic copy of the report body and the site map, in a read-only format (that is, Adobe .pdf)
- Ø Electronic copy of the drawings in a Microstation format and a read-only format (that is, Adobe .pdf)

**REPORT****DISTRIBUTIONS:**

The Geotechnical Branch will distribute the reports as shown below:

**Planning Reports:**

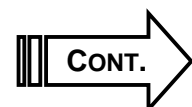
- Ø Division of Planning
- Ø District Branch Manager for Preconstruction
- Ø District Branch Manager for Planning
- Ø Consultant (if applicable)

**Roadway Reports:**

- Ø Division of Highway Design (Project Management Coordinator)
- Ø Division of Highway Design (Pavement Design)
- Ø Division of Highway Design (Plan Processing Section)
- Ø Division of Construction
- Ø District Branch Manager for Construction
- Ø District Branch Manager for Preconstruction
- Ø Kentucky Transportation Center
- Ø Design Consultant (if applicable)

**Permit Reviews:**

- Ø Permits Branch
- Ø Chief District Engineer



**REPORT  
DISTRIBUTIONS****(cont.):****Construction Reports:**

- Ø Division of Construction (Liaison)
- Ø District Branch Manager for Construction
- Ø Project Resident Engineer
- Ø Consultant (if applicable)


**Structure Foundation Reports:**

- Ø Division of Bridge Design
- Ø Division of Highway Design (Project Management Coordinator)
- Ø Division of Highway Design (Plan Processing Section)
- Ø Division of Highway Design (Pavement Design)
- Ø Division of Highway Design (Drainage Section)(if applicable)
- Ø Division of Construction
- Ø District Branch Manager for Construction
- Ø District Branch Manager for Preconstruction
- Ø District Project Manager
- Ø Design Consultant (if applicable)

**Landslide and Unstable Rock Slope Reports:**

- Ø Chief District Engineer
- Ø Division of Maintenance
- Ø District Branch Manager for Maintenance
- Ø District Branch Manager for Construction (if applicable)
- Ø District Branch Manager for Preconstruction (if applicable)
- Ø Division of Bridge Design (if applicable)
- Ø Division of Construction (if applicable)
- Ø Division of Highway Design (if applicable)
- Ø Office of Rural and Secondary Roads (if applicable)

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>CONSULTANT SERVICES</p>
	<p><i>Subject</i></p> <p>Introduction</p>

**OVERVIEW:** This chapter addresses the various methods by which the department retains the services of geotechnical consulting engineers, including:

- Ø Prequalifications
- Ø Types of services provided
- Ø Scope of work
- Ø Payment structures
- Ø Compensation to consultants

**POLICY FOR GEOTECHNICAL CONSULTANTS:**

The department may retain prequalified geotechnical consultants to provide geotechnical drilling, engineering, or laboratory testing services. **GT-901** discusses the Policy for Geotechnical Consultants.

**PREQUALIFICATION:** The following subjects pertain to prequalification:

- GT-902-1**      General Requirements
- GT-902-2**      Geotechnical Drilling Services
- GT-902-3**      Geotechnical Engineering Services
- GT-902-4**      Geotechnical Laboratory Testing Services

**AGREEMENT TYPES:**

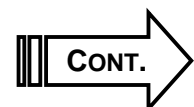
Agreements for services provided by geotechnical consulting engineers and drilling firms may be one of the following:

- Ø Agreement for Design Engineering Services with Provisions for Geotechnical Services

- GT-903-1**      Prenegotiation Conference
- GT-903-2**      Consultant Invoice
- GT-903-3**      Compensation

- Ø Agreement for Statewide Geotechnical Engineering and Laboratory Testing Services

- GT-904-1**      Announcement for Engineering Services
- GT-904-2**      General Specifications
- GT-904-3**      Explanation for Tabulation of Quantities for Invoices



**AGREEMENT  
TYPES (cont.):**


Ø Agreement for Statewide Geotechnical Drilling Services

- GT-905-1**           Regions
- GT-905-2**           Vendor Acceptance of Project
- GT-905-3**           General Specifications

**PERFORMANCE  
EVALUATION:**

**GT-906** discusses the procedure for evaluating geotechnical consultants.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>CONSULTANT SERVICES</p>
	<p><i>Subject</i></p> <p>Policy for Geotechnical Consultants</p>

**SUBCONTRACTING:** Services performed by consulting engineers shall be in accordance with the engineering agreement for the particular project. All work under an agreement shall at all times be subject to the general supervision and direction of the engineer and shall be subject to his or her review and approval. The term *engineer* shall mean and include the State Highway Engineer or an authorized representative. Work can be subcontracted only to prequalified vendors or firms (unless in areas not covered by prequalification), and then only with prior approval from the department.


Geotechnical consultants are responsible for monitoring services performed by their subconsultants to the same extent that they monitor their own services and for ensuring that all services performed conform to Cabinet policies and project-specific requirements.

**POLICY & PROCEDURE:**

The policy and procedures for geotechnical investigation as set forth in this manual will be followed by geotechnical consulting engineers unless otherwise instructed by contract or written instructions signed by an authorized representative of the department. Even though a paragraph may not be addressed directly to a consultant, the instructions still apply.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PREQUALIFICATION</p>
	<p><i>Subject</i></p> <p>General Requirements</p>

**OVERVIEW:** Departmental policy requires all geotechnical engineering firms that desire to be considered for work with the Transportation Cabinet be prequalified in accordance with **Chapter 15-03** of the *Professional Services Guidance Manual*. Consultants may be prequalified to perform one or more of the following geotechnical services:

- Ø Drilling
- Ø Engineering
- Ø Laboratory testing


Firms must be prequalified with the Cabinet at the time they respond to an announcement.

**FORMS:** In order to apply for prequalification, the firm must submit the applicable forms, listed below, which may be obtained from the Division of Professional Services:

- Ø TC 64-540, *Prequalification Requirements for Geotechnical Drilling Services (Exhibit 51)*
- Ø TC 64-541, *Prequalification Requirements for Geotechnical Engineering Services (Exhibit 52)*
- Ø TC 64-542, *Prequalification Requirements for Geotechnical Laboratory Testing Services (Exhibit 53)*

**SUBMITTALS:** Firms are required to provide their submittals to the Division of Professional Services. In addition to the forms above, firms are to submit any other forms required by the Division of Professional Services.

The department requires prequalified firms to submit updated qualifications and performance data annually or they will be removed from the prequalified list. Firms must advise the department within 30 days of any changes in the firm's status that affect the type of work and capacity of the firm.

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PREQUALIFICATION</p>
	<p><i>Subject</i></p> <p>Geotechnical Drilling Services</p>

**REQUIREMENTS:** This section presents prequalification requirements relating to Geotechnical Drilling Services. Firms must submit the TC 64-540 form, *Prequalification Requirements for Geotechnical Drilling Services (Exhibit 51)*, to the Division of Professional Services to document that they meet these requirements.

**EXPERIENCE:** The vendor must provide evidence of experience in the last five years performing drilling services for highway projects (roadways and bridges). The evidence shall include a listing of:

- Ø Projects illustrating this type of experience
- Ø References (agency, project engineer, or consultant) with addresses and phone numbers


**EQUIPMENT:** The vendor must provide a list of available equipment (drill rigs and accessories) for soil sampling and rock coring. The vendor must have at least one drill rig equipped with an automatic hammer in order to be prequalified.

**PERSONNEL:** Drill crew supervisors must be experienced in the following:

- Ø Obtaining rock cores for rock cut slope and bridge foundation design
- Ø Performing a soil profile
- Ø Performing rock line soundings
- Ø Performing standard penetration tests
- Ø Obtaining thin-walled tube samples
- Ø Installing cased observation wells

Evidence must be provided that the drill crew supervisors have a minimum of three years' experience in the above-mentioned operations for highway projects (roadways and bridges). A drill crew supervisor is defined as the person on the drill crew field party who is responsible for the drilling operations mentioned above.

**INSURANCE:** Vendors must have Workers' Compensation and Liability Insurance as required by the Division of Professional Services.

<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>PREQUALIFICATION</p>
	<p><i>Subject</i></p> <p>Geotechnical Engineering Services</p>

**GENERAL**

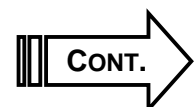
**REQUIREMENTS:** Firms must submit the TC 64-541 form, *Prequalification Requirements for Geotechnical Engineering Services (Exhibit 52)*, to the Division of Professional Services to document that they meet the requirements of having:

- ∅ A firm permit issued by the Kentucky Board of Licensure for Professional Engineers and Land Surveyors
- ∅ Sufficient geotechnical engineering experience as demonstrated by having performed geotechnical engineering on a minimum of three transportation projects (or other projects where related engineering tasks were performed) in the last five years
- ∅ MicroStation CADD software

**PERSONNEL**

**REQUIREMENTS:** The firm must have personnel meeting the following requirements:


- ∅ At least one professional engineer licensed in Kentucky with a minimum of three years of geotechnical engineering experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of the TC 64-541 form). The firm will be required to assign at least one person meeting these requirements to actively participate in KYTC geotechnical projects in the capacity of project manager, project engineer, etc.
- ∅ At least one professional geologist licensed in Kentucky with a minimum of three years of engineering geology experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of the TC 64-541 form).



**PERSONNEL  
REQUIREMENTS  
(cont.):**

- Ø Staff with sufficient experience to perform geotechnical engineering tasks for KYTC, as demonstrated by experience in a minimum of 9 of the 12 areas of "conventional" experience included on Page 3 of the TC 64-541 form. (Seismic experience is not required.)
- Ø A minimum of one CADD operator proficient with MicroStation.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>PREQUALIFICATION</p>
	<p><i>Subject</i></p> <p>Geotechnical Laboratory Testing Services</p>

**GENERAL**

**REQUIREMENTS:** Firms must submit the TC 64-542 form, *Prequalification Requirements for Geotechnical Laboratory Testing Services (Exhibit 53)* to the Division of Professional Services to document that they meet these requirements.

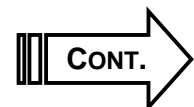
**ACCREDITATION:** Accreditation by the AASHTO Materials Reference Laboratory (AMRL) is required for the following AASHTO Test Methods:

- a T87
- a T88
- a T89
- a T90
- a T99
- a T100
- a T193
- a T208
- a T265

The Geotechnical Branch will verify accreditation on the AMRL Web site during the prequalification review.

**PERSONNEL:** Management and staff are to meet the requirements for AASHTO R18 accreditation and have experience performing all the above-referenced tests.

**LOADING DEVICE:** Vendors are required to have a loading device with a movable head or base such that it is capable of applying a compressive load up to 60,000 pounds (267 kilonewtons), as required for the compaction portion of **KM 64-501** (Kentucky Method for performing the California Bearing Ratio Test).



**ADDITIONAL TEST****METHODS:**

In addition to the above-referenced test methods, the Geotechnical Branch considers the following to be highly desirable:

Ø AMRL accreditation for the following tests:

a T216

a T296

a T297

Ø Capability to perform the following tests:

a Unconfined Compressive Strength of Rock

a Slake Durability

a Jar Slake

Although these tests are not required for prequalification, the Geotechnical Branch strongly recommends that labs be accredited for and/or have the ability to perform these tests.

**ADDITIONAL  
DOCUMENTS:**

Although the Geotechnical Branch does not always require that additional documents be submitted for prequalification, the vendor is to be prepared to provide such documents upon request. Accreditation documents that may be requested include:


Ø *Quality Manual*

Ø On-Site Assessment Reports

Ø Proficiency Sample Test Results

Ø Other applicable documentation

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>AGREEMENT FOR DESIGN ENGINEERING WITH PROVISIONS FOR GEOTECHNICAL SERVICES</p>
	<p><i>Subject</i></p> <p>Prerenegotiation Conference</p>

**PURPOSE:** A prenegotiation conference with representatives of the design and geotechnical consulting engineering firms may be held when deemed necessary by the Geotechnical Branch. The design engineering firm's agreement may include geotechnical services or it may be added by contract modification. The purpose of this conference shall be to review the following:

- Ø Scope of the project
- Ø Estimated unit items of work
- Ø Scheduling requirements
- Ø Pertinent procedures


**SCHEDULING:** The geotechnical consultant shall contact the Geotechnical Branch to schedule a conference. Preferably, the conference shall be held in the appropriate district office or at a location near the project. Invited to this meeting will be representatives of:

- Ø Geotechnical consultant
- Ø Division of Highway Design
- Ø District Design Office
- Ø Geotechnical Branch
- Ø Design consultant

**PLANS, PROFILES, & CROSS-SECTIONS:** The geotechnical consultant shall be provided with copies of all available plans, profiles, and cross-sections prior to the meeting. The geotechnical consultant shall use this information to develop estimated unit items of work, which will be reviewed and revised during the meeting.

**COST ESTIMATE SUBMITTAL:** The consultant shall complete the TC 64-521 form, *Unit Cost Items for Geotechnical Services (Exhibit 54)*, using the unit items of work developed during the prenegotiation conference, and submit it with supportive calculations to the design engineering consultant and the Geotechnical Branch. The Geotechnical Branch will review the submittal and provide comments to the Division of Professional Services for negotiation purposes.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>AGREEMENT FOR DESIGN ENGINEERING WITH PROVISIONS FOR GEOTECHNICAL SERVICES</p>
	<p><i>Subject</i></p> <p>Consultant Invoice</p>

**SUBMITTALS:** Invoices for geotechnical investigations that are included in the *Agreement for Design Engineering Services* shall be submitted directly to the Geotechnical Branch.

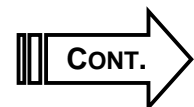
**ITEMS REQUIRED  
FOR INVOICE  
SUBMITTAL:**

The following information shall be submitted with each invoice:

- Ø TC 64-521 form, *Unit Cost Items for Geotechnical Services (Exhibit 54)*
- Ø TC 64-525 form, *Tabulation of Quantities for Invoices (Exhibit 55)*

The location (station, offset, and hole numbers), sheet totals, invoice totals, and accumulated totals for all invoices shall be shown for all items where applicable. Each drafting sheet shall also be listed by station on this form.


- Ø Invoices that have been signed and assigned an invoice number
- Ø Typed drilling logs, laboratory test data, embankment and cut slope stability sheets, soil profile sheets, subsurface data sheets, and foundation and/or structure analyses
- Ø Documentation of time records for the bulldozer and/or trackhoe working time or an invoice of subcontracted bulldozer and/or trackhoe working time
- Ø Documentation of time records for the working time of a company-owned barge or the invoice of a subcontracted towboat and/or barge
- Ø Documentation of time records for traffic-control working time or an invoice of working time from a subcontracted traffic control firm





**VERIFICATION:** Sufficient information shall be submitted with the invoice to verify the quantities prior to payment. Failure to follow these instructions will delay approval of the invoice. If the invoice is unsatisfactory, the geotechnical consultant shall be notified. In order to expedite the invoice, unit items in question may be omitted and will be reconsidered if the questions are resolved. A memo and a copy of the approved TC 64-521 form, *Unit Cost Items for Geotechnical Services (Exhibit 54)*, will be submitted to the department's design engineer responsible for approving the consultant's invoice. Copies will also be submitted to the design and geotechnical engineering consultant, when applicable.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">AGREEMENT FOR DESIGN ENGINEERING WITH PROVISIONS FOR GEOTECHNICAL SERVICES</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Compensation</p>

**METHOD OF PAYMENT:**

The method of payment shall be based on cost per unit of work or lump sum. Each unit of work or lump sum item is included on the TC 64-521 form, *Unit Cost Items for Geotechnical Services (Exhibit 54)*. Unless otherwise specified, the price per unit of work or lump sum item shall include all engineering, labor, personnel, equipment, materials, etc., necessary to complete that unit of work. Failure to follow the procedures as stated in this manual will result in nonpayment of the unit price item.

**UTILITY & RIGHT OF ENTRY:**

Compensation for obtaining utility locations and right of entry from property owners shall be included in the following units of work for drilling operations.

**DRILLING PRICES:**

The ceiling price (maximum allowable unit price) for drilling items on land shall be calculated using the average of accepted bids within one standard deviation plus 15 percent from the Statewide Geotechnical Drilling Services Agreements for the applicable region. Drilling items on floating equipment shall be calculated using the average of accepted bids on land within one standard deviation plus 50 percent. These ceiling prices for drilling items will be provided to the vendor on negotiated agreements.

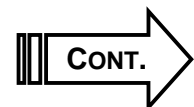
**Note:** Drilling operations on property of the railroad, Forest Service, Corps of Engineers, etc., may require additional time and effort. Any required costs or fees (i.e., flagmen) shall be invoiced as charged. Also, an administrative fee will be allowed for the time of dealing with these entities as specified in the Statewide Geotechnical Drilling Services Agreements.

**LABORATORY TESTING:**

Production rates (maximum unit hours) for laboratory testing items have been established and are specified in the announcement to bid for Statewide Geotechnical Engineering and Laboratory Testing Services.

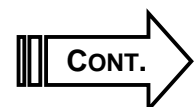
**ENGINEERING ANALYSIS:**

The ceiling rates (maximum allowable hours) for engineering analysis items have been established and can be found in the announcement to bid for the Statewide Geotechnical Engineering and Laboratory Testing Services Agreements.



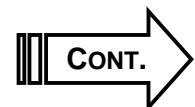
**ENGINEERING  
ANALYSIS (cont.):**

1. **Rock Coring** will be paid at a unit price per vertical foot for English unit projects (or per vertical meter for metric unit projects) from the top of the rock core to the bottom of the rock core. Drilling and sampling in the overburden as specified by the department will be paid at the contract unit price for:
  - ◆ Standard penetration tests
  - ◆ Thin-walled tube samples
  - ◆ Soil borings
  - ◆ Rock soundings
2. **Rock Coring on Floating Equipment** shall be paid as specified in Item 1, Rock Coring. Compensation for drilling through water (from the water surface elevation down to the top of soil or rock) shall be paid at 50 percent of the established unit price for rock sounding on floating equipment.
3. **Rock Sounding** shall be paid from the top of ground to the bottom of the hole or a change in drilling operations at a unit price per vertical foot for English unit projects (or per vertical meter for metric unit projects).
4. **Rock Sounding on Floating Equipment** shall be paid as specified in Item 3, Rock Sounding. Compensation for drilling through water (from the water surface elevation down to the top of soil or rock) shall be paid at 50 percent of the established unit price for rock sounding on floating equipment.
5. **Visual Inspection and Logging of Rock Exposure** shall be paid from the top to the bottom of the rock exposure at a unit price per vertical foot for English unit projects (or per vertical meter for metric unit projects). Task shall include the cost of a geologist and laborer based on an eight-hour day plus expenses, equipment, and travel time.
6. **Disturbed Soil Borings** shall be paid from the top of ground to the bottom of the hole at a unit price per foot for English unit projects (or per meter for metric unit projects).
7. **Bag Samples** shall be paid at a unit price per sample.



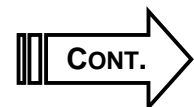
**ENGINEERING  
ANALYSIS (cont.):**

8. **Standard Penetration Tests** shall be paid at the unit price per test. If more than one standard penetration test or thin-walled tube sample is necessary per 5-foot (1.5-meter) interval, each extra test or tube will be paid at one-half the contract unit price per test or tube. The unit price per test includes all drilling to advance the hole to the required depth. Payment depth intervals are from 0 to 5 feet, 5 to 10 feet, 10 to 15 feet, (0 to 1.5 meters, 1.5 to 3 meters, 3 to 4.5 meters) etc. The depth of the top of the test will be used to determine the payment interval of the test. If continuous sampling is requested for a boring, the tests will be paid at the unit price per each standard penetration test.
9. **Standard Penetration Tests on Floating Equipment** shall be paid as specified in Item 8, Standard Penetration Tests. Compensation for drilling through water (from the water surface elevation down to the top of soil or rock) shall be paid at 50 percent of the established unit price for rock sounding on floating equipment.
10. **Thin-Walled Tube Samples** shall be paid at a unit price per tube. If more than one thin-walled tube sample or standard penetration test is necessary per 5-foot (1.5-meter) interval, each extra tube or test will be paid at one-half the contract unit price per tube or test. The unit price per tube includes all drilling to advance the hole to the required depth. Payment depth intervals are from 0 to 5 feet, 5 to 10 feet, 10 to 15 feet, (0 to 1.5 meters, 1.5 to 3 meters, 3 to 4.5 meters) etc. The depth of the top of the tube will be used to determine the payment interval of the tube. If continuous sampling is requested for a boring, the samples will be paid at the unit price per each thin-walled tube.
11. **Thin-Walled Tube Samples on Floating Equipment** shall be paid as specified in Item 10, Thin-Walled Tube Samples. Compensation for drilling through water (from the water surface elevation down to the top of soil or rock) shall be paid at 50 percent of the established unit price for rock sounding on floating equipment.
12. **Field Vane Shear Tests** shall be paid at a unit price per test. The unit price includes all drilling and equipment necessary per 5-foot interval.
13. **Field Vane Shear Tests on Floating Equipment** shall be paid as specified in Item 12, Field Vane Shear Tests. Compensation for drilling through water (from the water surface elevation down to the top of soil or rock) shall be paid at 50 percent of the established unit price for rock sounding on floating equipment.



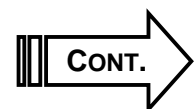
**ENGINEERING  
ANALYSIS (cont.):**

14. **Cased Observation Wells** shall be paid at a unit price per well. The unit price does not include drilling. Drilling and/or sampling shall be paid at the contract unit price for standard penetration tests, thin-walled tube samples, soil borings, or rock soundings as specified by the department. The unit price includes a water table reading obtained no sooner than seven days after installation of the well.
15. **Slope Inclinerometer Casing Holes** shall be paid at a unit price per foot for English unit projects (or per meter for metric unit projects) for drilling the hole. The drilling includes costs for hollow stem augers, drill casing, and/or roller bits and shall include cost of "down time" for a drill and drill crew while the department or consultant installs the slope inclinometer casing. The department will furnish the slope inclinometer casing. An open hole (minimum 6-inch [150-millimeter] diameter) shall be maintained by casing or hollow stem augers until the slope inclinometer casing is installed. Payment interval is from the top to the bottom of the 6-inch (150-millimeter) diameter hole. Samples and/or rock cores requested by the department will be paid for at contract prices, and they are in addition to the price of the slope inclinometer casing hole.
16. **Pavement Cores** shall be paid at a unit price per foot for English unit projects (or per meter for metric unit projects). Unit bid price covers all diameter-size samples (4-inch, 6-inch, 8-inch, and 10-inch). The price shall include back-filling the hole with asphalt or concrete.
17. **Grouting of Six-Inch Auger Holes** shall be paid at a unit bid price per foot for English projects (or unit bid price per meter for metric unit projects). Unit bid price includes all labor and materials necessary to seal the hole.
18. **Grouting of Four-Inch Auger Holes** shall be paid at a unit bid price per foot for English projects (or unit bid price per meter for metric unit projects). Unit bid price includes all labor and materials necessary to seal the hole.
19. **Grouting of Rock Core** shall be paid at a unit bid price per foot for English projects (or unit bid price per meter for metric unit projects). Unit bid price includes all labor and materials necessary to seal the hole.
20. **Moisture Content Sample** shall be paid at a unit price per sample. The price shall include all operations and materials necessary to obtain the sample.



**ENGINEERING  
ANALYSIS (cont.):**

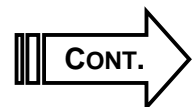
21. **Moisture Content Tests** shall be paid at a unit price per test. The price shall include all operations and materials necessary to perform the test. Cost for obtaining the sample shall be reimbursed as stated in Item 20. Moisture contents required for other tests such as unconfined compression, etc., will be reimbursed under those test costs and will not be paid under this item.
22. **Logging Rock Cores** shall be paid at a unit price per foot for English projects (or unit bid price per meter for metric unit projects). Task shall include the costs of a geologist based on an eight-hour day (no payment if an engineer or geologist is assigned to the field during drilling operations).
23. **Soil Classifications** shall be paid at a unit price per sample. The following will be required on each sample:
  - Ø Gradation
  - Ø Specific Gravity
  - Ø Atterberg Limits
  - Ø Liquidity Index
  - Ø Activity Index
  - Ø AASHTO Classification
  - Ø Unified Classification
24. **Wash and Sieve Analyses** shall be paid at a unit price per test. This item applies when adequate material was not available to perform a full soil classification or the sample material is nonplastic. Samples classified in accordance with **GT-505** shall be paid for under Item 23, Soil Classifications, and shall not also receive payment under this item.
25. **Moisture/Density Test, CBRs, and Soil Classifications** (as previously specified) shall be paid at a unit price per sample.
26. **Moisture/Density Test** shall be paid at unit price per sample as necessary to determine a moisture density curve.
27. **Slake Durability Index and Jar Slake Tests** shall be paid at a unit price per test. The unit price includes performing both a Jar Slake and a Slake Durability Index test on each sample.
28. **Unconfined Compression Tests on Soil** shall be paid at a unit price per test.
29. **Unconfined Compression Tests on Rock** shall be paid at a unit price per test.



**ENGINEERING  
ANALYSIS (cont.):**

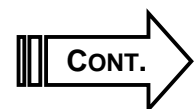
30. **One-Dimensional Consolidation Tests** shall be paid at a unit price per test.
31. **Consolidated-Undrained Triaxial Tests with Pore Pressure Measurements** shall be paid at a unit price per test.
32. **Unconsolidated-Undrained Triaxial Tests** shall be paid at a unit price per test.
33. **Slope Stability Analyses** shall be paid at a unit price per stability section. This shall be in addition to drafting at the unit price per sheet.
34. **Settlement Analyses** shall be paid at a unit price per analysis. Each analysis shall include, if applicable, the following for a particular subsurface profile in question:
  - Ø Ultimate settlements, differential settlements, and rate of settlement calculations for:
    - a A given embankment profile
    - a Embankment cross-section
    - a Approach embankment
    - a Substructure unit
    - a Culvert
    - a Retaining wall
  - Ø Calculations for ultimate settlement at different locations along the profile or cross-section for the purpose of defining differential settlements
  - Ø All calculations necessary to adjust the footing size for spread footings

Analyses may be presented in the form of a drawing showing the embankment, footing, or retaining wall as well as the soil layers, parameters, and calculations. All necessary drafting will be paid at the contract unit price per sheet. Wick drain analyses, if applicable, shall be paid at the unit price for settlement analysis in addition to the initial settlement analysis.



**ENGINEERING  
ANALYSIS (cont.):**

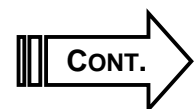
35. **Deep Foundation Analyses** shall be paid at a unit price per static analysis. Each static analysis shall include calculations for all applicable sizes and/or types of piles or shafts, for a particular subsurface profile in question. It may represent one or more bents depending on the variability of subsurface conditions, etc. Static analyses performed for evaluation of driveability or wave equation analysis shall be paid as a separate analyses from that for design pile capacity. Drilled shaft analyses in soil or rock will be paid for under this item and shall be paid for as separate analyses from that for piles. Recommendations for H-piles driven to rock will not be paid for under this item, but any static analyses necessary for evaluating driveability (wave equation analyses) of H-piles to rock will be paid for under this item. Conclusions from analyses shall be presented in the form of a table depicting allowable capacity (with appropriate factors of safety applied) as a function of pile/shaft tip elevation and size.
36. **Wave Equation Driveability Analyses** shall be paid at a unit price per analysis. Each analysis shall include calculations for several different sizes of pile hammers and for several sizes and/or types of piles driven into a particular soil profile. Static analyses required for evaluation of driveability shall be paid for at the contract unit price for deep foundation analyses.
37. **Negative Skin Friction Analyses** shall be paid at a unit price per analysis. The analysis shall include all pile sizes and/or types that might be selected. It should also indicate, if applicable, the amount of negative skin friction remaining after a waiting period or after the use of sleeves, bitumen coating, etc. The analysis shall be presented in the form of a table indicating the magnitude of negative skin friction on each pile size and/or type at various spacings.
38. **Bearing Capacity Analyses** for spread footings on soil shall be paid at a unit price per analysis. Each analysis shall include calculations for all sizes considered and may represent one or more abutments or piers (or culverts) depending on the variability of soil conditions, etc. Analyses shall be presented in the form of a calculation sheet showing safety factor calculations for the recommended footing. Bearing capacity determinations for retaining walls shall be included in the unit price for retaining wall analyses.





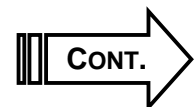
**ENGINEERING  
ANALYSIS (cont.):**

39. **Retaining Wall Analyses** shall be paid at a unit cost per wall stability section. Retaining wall analyses shall include all pressure calculations and overturning, sliding, and bearing capacity safety factor determinations sufficient to size the wall and recommendations regarding granular backfill, foundation modification, etc. Analyses of additional wall sections, if approved by the Geotechnical Branch, shall be paid for as separate analyses. Settlement and slope stability analyses required for a retaining wall shall be paid for at the contract unit price for those items. The consultant shall prepare a drawing of each wall stability section on a standard size plan sheet. This drawing will show boring logs, test results, layer boundaries, and soil parameters, along with safety factors. As many sections as practical shall be placed on each sheet. All necessary drafting will be paid at the contract unit price per sheet.
40. **Drafting** for sheets to be included in the roadway and/or structure plans shall be paid at a unit price per sheet.
41. **Dozer Working Time (John Deere 450 or equivalent), Including Operator**, shall be paid at a unit price per hour of actual dozer working time at the job site.
42. **Trackhoe Working Time, Including Operator**, shall be paid at a unit price per hour of actual trackhoe working time at the job site.
43. **Mobilization (including demobilization) of Drill Equipment** to (and from) the project site shall be paid at a lump sum price per drill. This lump sum price shall include all equipment necessary to perform drilling operations except dozer, trackhoe, and floating equipment. This task shall be paid as follows: an administrative fee plus a set per-mile dollar amount (to be established by the Geotechnical Branch at the start of each contract fiscal year) as specified in the Statewide Drilling Contracts. Mileage shall be calculated from the company's nearest drilling equipment facility using the state mileage map and is not to exceed a maximum of 500 miles (round trip). The consultant must have written permission from the Geotechnical Branch prior to mobilization of each drill in order to authorize payment.
44. **Mobilization (including demobilization) Costs for a Subcontracted Dozer or Trackhoe and Operator** shall be paid at the hourly rate for a total of two hours for each project.



**ENGINEERING  
ANALYSIS (cont.):**

45. **Mobilization (including demobilization) Costs for a Company-Owned Dozer or Trackhoe and Operator** shall be paid at a lump sum price per dozer or trackhoe. This lump sum price shall include all equipment necessary to perform required operations. This task shall be paid as follows: an administrative fee plus a set per-mile dollar amount (to be established by the Geotechnical Branch at the start of each contract fiscal year) as specified in the Statewide Drilling Contracts. Mileage shall be calculated from the company's nearest drilling equipment facility using the state mileage map and is not to exceed a maximum of 500 miles (round trip). The consultant must have written permission from the Geotechnical Branch prior to mobilization of each dozer or trackhoe in order to authorize payment.
46. **Mobilization (including demobilization) Costs for Company-Owned Floating Equipment** shall be paid at a lump sum price per "floating plant." This lump sum price shall include all equipment necessary to provide a mobile working platform for the drill and its crew. The consultant must have written permission from the Geotechnical Branch prior to mobilization of each "floating plant" in order to authorize payment.
47. **Subcontracted Towboat and/or Barge and Crew** shall be paid for at cost (include invoiced billing[s]). Time shall not be included for drill or drill crew. Cost of floating equipment shall include mobilization and demobilization, insurance, layover time, and working time for all equipment and personnel necessary to provide a working platform for the geotechnical drill and crew. An administrative fee (to be established by the Geotechnical Branch at the start of each contract fiscal year) shall be allowed to cover communications with the towboat/barge contractor and all necessary coordination, permits, etc., required with the Corps of Engineers and/or others.
48. **Company-Owned Towboat and/or Barge and Its Crew** shall be paid at a unit price per working day at the job site. This price shall include insurance, layover time, and working time for all equipment and personnel necessary to provide a working platform for the drill and crew. An administrative fee (to be established by the Geotechnical Branch at the start of each contract fiscal year) shall be allowed to cover all necessary coordination, permits, etc., required with the Corps of Engineers and/or others.
49. **Reclamation** of disturbed sites by drilling operations shall be paid at a daily (eight-hour) rate for two laborers including expenses, equipment, and travel time plus the cost of materials as listed below in Item 50. Any other materials are incidental. Reclamation activity includes all labor and equipment required to reclaim the site.



**ENGINEERING  
ANALYSIS (cont.):**

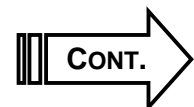
50. **Reclamation Materials** are paid for at actual cost (with receipts for materials) plus 10 percent markup to account for any overhead or administrative expenses. These materials include:

- Ø Seed
- Ø Straw
- Ø Rock (crushed aggregate #57)

The following materials or others may also be used when necessary but require written approval from the department. Materials are paid for at actual cost plus 10 percent (with receipts for materials).

- Ø Temporary silt fence
- Ø Bagged topsoil
- Ø Sheets of plywood
- Ø Pipe

51. **Traffic Control (in-house)** requires that personnel meet all applicable rules and regulations and shall be paid at a daily (eight-hour) rate/price for two laborers, including expenses, equipment, and travel time.
52. **Traffic Control (subcontracted)** shall be paid as invoiced by the vendor, plus an administrative fee of 10 percent to account for any overhead or administrative expenses.
53. **Preliminary Plans** preparation shall be paid at a lump sum price. This price shall include preliminary exploration, laboratory testing, and engineering analysis plans for all roadways and structures.
54. **Preliminary Meetings** attendance shall be paid at a lump sum price. This price shall include all meetings with the department, both field and office, necessary to review and discuss the boring plan for all roadways and structures.
55. **Rock Core Meetings** attendance shall be paid at a unit price per meeting. This price shall include all meetings with the department, both field and office, necessary to design, review, and discuss cut slopes for roadways or review rock cores for structure foundations.
56. **Interim Meetings** attendance shall be paid at a unit price per meeting. The unit price shall include all items and personnel to conduct the meeting.
57. **Final Meetings** attendance shall be paid at a lump sum price. This price shall include any meetings with the department necessary to review and discuss the subsurface investigation and recommendations for the design of structures and roadways.




**ENGINEERING  
ANALYSIS (cont.):**

58. **Report Writing** shall be paid at a lump sum price. The price shall include all items not included in other units or work that are necessary for preparing recommendations (design, construction, rock slope, etc.), reports (draft, interim, final, etc.), letters, correspondence, etc., for roadways and structures. This item shall also include all work necessary for project coordination and project team interaction not covered under items for “Meetings.”
59. **Publication** of geotechnical engineering reports for roadway shall be paid at a lump sum price.

**Note:** All aforementioned unit descriptions of service pay items apply to most projects; however, there may be exceptions, and those will be handled on a project-by-project basis.

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<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">AGREEMENT FOR STATEWIDE GEOTECHNICAL ENGINEERING &amp; LABORATORY TESTING SERVICES</p> <hr/> <p><i>Subject</i></p> <p style="text-align: center;">Announcement for Engineering Services</p>
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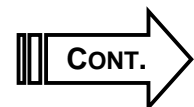
**OVERVIEW:** The department may select firms for statewide geotechnical engineering and laboratory testing services in accordance with **Chapter 4** of the *Professional Services Guidance Manual*. Firms responding to announcements for statewide geotechnical engineering and laboratory testing services are evaluated by a consultant selection committee. Normally, up to four firms are selected for the department to negotiate with for their services. These services consist of geotechnical engineering and laboratory testing.

**ANNOUNCEMENT FOR ENGINEERING SERVICES:** Pursuant to Kentucky Revised Statute (KRS) 45A.205, a public announcement will be made that the Transportation Cabinet intends to contract for engineering services.

**SCOPE OF WORK:** Consultant agreements will be negotiated to provide complete geotechnical engineering and laboratory testing services on a statewide basis. These services may include:

- Ø Conventional geotechnical engineering analyses
- Ø Seismic geotechnical engineering analyses
- Ø Drafting
- Ø Preliminary exploration plans
- Ø Attending meetings
- Ø Logging rock cores
- Ø Designing rock cut slopes
- Ø Writing geotechnical reports
- Ø Geotechnical laboratory testing
- Ø Rural roadway design and surveying

A prequalified subconsultant may be used to perform roadway design and surveying. The work cannot be subcontracted without prior written approval from the Division of Professional Services and the Geotechnical Branch. In addition, special engineering services may be required, depending on the department's needs. The contract period is one year with the option of extending the period for an additional year.



**EVALUATION  
FACTORS:**

The evaluation factors are as follows:

- Ø Project approach and proposed procedures to accomplish the services for the project
- Ø Relative experience of consultant personnel assigned to project team with highway projects for KYTC and/or for federal, local, or other state governmental agencies
- Ø Capacity to comply with project schedule
- Ø Past record of performance on project of similar type and complexity
- Ø Consultant offices in Kentucky where work is to be performed

**SUBMITTALS:**

Engineering firms that are prequalified for Geotechnical Engineering and Geotechnical Laboratory Testing and desire to provide these statewide services should submit seven copies (or the number specified in the advertisement) of the TC 40-15 form, *Response for Engineering/Related Services as Prime Consultant*, to the Kentucky Transportation Cabinet, Division of Professional Services, Frankfort, Kentucky 40622, by the time and date specified in the announcement.

**PREQUALIFICATION  
SUBMITTALS**

Firms must be prequalified with the Cabinet at the time they respond to the announcement. In order to apply for prequalification, the firm must submit the following forms:


- Ø TC 64-541 form, *Prequalification Requirements for Geotechnical Engineering Services (Exhibit 52)*
- Ø TC 64-542 form, *Prequalification Requirements for Geotechnical Laboratory Testing Services (Exhibit 53)*

**PROFESSIONAL  
LIABILITY**

**INSURANCE:**

Firms must provide proof of \$1 million of professional liability insurance in order to receive a statewide geotechnical engineering and laboratory testing contract.

2 2 2

<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>AGREEMENT FOR STATEWIDE GEOTECHNICAL ENGINEERING &amp; LABORATORY TESTING SERVICES</p>
	<p><i>Subject</i></p> <p>General Specifications</p>

**SPECIFICATIONS:** The general specifications for Statewide Geotechnical Engineering Services are as follows:

**SUBCONTRACTING:** The work cannot be subcontracted without prior written approval from the Division of Professional Services and the Geotechnical Branch. The work can be subcontracted only to a prequalified vendor.

**PROJECT INITIATION:** Geotechnical work shall begin on a project within 10 calendar days after the consultant accepts the work unless otherwise noted.

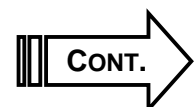
**GEOTECHNICAL MANUAL**  
Geotechnical analyses, recommendations, lab testing reports, drafting, and engineering reports shall be in general conformance with the *Geotechnical Manual*, unless differences are agreeable to the Geotechnical Branch and the consultant.

**COMPLETION DATE:** A time or date of completion will be established for each project.

**TERM:** The agreement is effective for one year, and the expiration date may be extended for up to one additional year if agreeable to the department and the firm.

**PAYMENT STRUCTURE:** Payment for engineering and laboratory testing services will be based on the current audited hourly average rates, including overhead and applicable escalation factors, for the personnel classifications approved by the Geotechnical Branch, plus 10 percent. The production rates (hours per unit of work) will be specified in the Announcement for Statewide Geotechnical Engineering and Laboratory Testing Services.

- Ø For engineering services, the department will pay the actual hours worked, up to the specified ceiling rates (maximum allowable hours). Time records will be required.
- Ø For laboratory testing services, the department will pay the specified production rates per test. Time records will not be required.



**PAYMENT  
STRUCTURE**

**(cont.):** The department will reimburse expenses at the actual cost (with receipts) plus 10 percent markup.

**INVOICE  
SUBMITTAL:**

Invoices for the work shall be submitted directly to the Geotechnical Branch, Division of Materials. The following requirements apply:

- ∅ Invoice shall include:
  - ◆ TC 64-527 form, *Summary of Cost Items for Statewide Geotechnical Engineering Services (Exhibit 59)*
  - ◆ TC 64-526 form, *Tabulation of Quantities for Cost Items for Statewide Geotechnical Engineering Services (Exhibit 60)*
  - ◆ Time records with task identified for hourly labor items
- ∅ Separate signed and appropriately numbered invoices and forms shall be submitted for each project.
- ∅ The invoices may be submitted monthly if desired.
- ∅ A percent of retainage will not be applicable to this contract.
- ∅ Payment for lab testing, engineering analyses, reports, and drafting will be permitted only after review and approval by the Geotechnical Branch.

**ROADWAY PLANS,  
CROSS-SECTIONS,  
& DATA:**

The department will provide the consultant with electronic files or hard copies of roadway plans, cross-sections, and (if applicable) lab and field logs.

**MONITORING:**

The Geotechnical Branch will monitor work under this agreement through procedures in accordance with the *Geotechnical Manual*.

**PERSONNEL  
CLASSIFICATION:**


The department may specify classifications of personnel on a project-by-project basis.

**OVERHEAD:**

Overhead rate will be determined by an external audit and as agreed by the Division of Professional Services. The overhead rate used in the negotiations will be acceptable for the invoicing until the final audit is conducted after the work has been completed. Payment may be adjusted in accordance with this final audit.

**Note:** Terms and conditions stated in the announcement for services will supersede terms and conditions stated herein. Terms and conditions stated in the actual agreement will supersede terms and conditions stated herein or in the announcement for services.



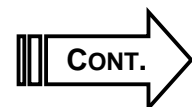
<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p style="text-align: center;">AGREEMENT FOR STATEWIDE GEOTECHNICAL ENGINEERING &amp; LABORATORY TESTING SERVICES</p>
	<p><i>Subject</i></p> <p style="text-align: center;">Explanation for Tabulation of Quantities for Invoices</p>

**EXPLANATION OF FORM:**

The explanations listed below refer to the TC 64-526 form, *Tabulation of Quantities for Cost Items for Statewide Geotechnical Engineering Services (Exhibit 60)*.

**Note:** Preliminary plans, meetings, report-writing, and publication shall include all labor costs including overhead plus 10 percent. Payment of laboratory items shall include all labor including overhead, materials, and expenses necessary to complete the tests.


- ∅ **Analysis** (Items 13 through 19) shall represent total hours for all engineering time necessary to perform and review the analysis not to exceed the ceiling production rates specified in the Statewide Geotechnical Engineering and Laboratory Testing Services advertisement. Estimating the time for each analysis to the nearest one-half hour may be necessary when working on several analyses in certain phases. The total hours shall equal the number of hours reported for payment.
- ∅ **Drafting** (Item 20) shall include hours for drafting sheets (soil profile, structures, and analyses) and review not to exceed the ceiling production rates specified in the Statewide Geotechnical Engineering and Laboratory Testing Services advertisement. Miscellaneous drafting man-hours not covered under Item 20 shall be included under the appropriate operation (preliminary plans, etc.).
- ∅ **Laboratory Testing** shall be the total number of tests times the established hourly rates necessary to perform each test, as noted in the advertisement for Statewide Geotechnical Engineering and Laboratory Testing Services.
- ∅ **Preliminary Plans** (Item 21) shall include all hours necessary to perform the operation. Hours may include draftsperson's and engineer's time necessary to prepare a preliminary set of exploration plans.



**EXPLANATION OF  
FORM (cont.):**

- Ø **Preliminary Meetings** (Item 22) shall include all hours necessary to prepare for and conduct a preliminary meeting.
- Ø **Rock Core Meetings** (Item 23) shall include all hours necessary to prepare for and conduct a meeting.
- Ø **Interim Meetings** (Item 24) shall include all hours necessary to prepare for and conduct an interim meeting.
- Ø **Final Meetings** (Item 25) shall include all hours necessary to prepare for and conduct a final meeting.
- Ø **Publication of Reports** (Item 27) shall include all man-hours necessary to publish a report.
- Ø **Report Writing** (Item 26) shall incorporate all items not included in other units, including all work that is necessary for preparation of recommendations, reports, letters, correspondence, etc., for roadway and/or structure projects. This shall also include all necessary work associated with project coordination and/or project correspondence not previously covered.
- Ø **Direct Cost** (expenses) shall be itemized as applicable.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>AGREEMENT FOR STATEWIDE GEOTECHNICAL DRILLING SERVICES</p>
	<p><i>Subject</i></p> <p>Regions</p>

**POLICY:** The Division of Professional Services will let and award the Agreements for Statewide Geotechnical Drilling Services.


**REGIONS:** The state is divided into three regions that include various highway districts. The regions' boundaries are based upon general topography and geology. (Refer to **Exhibit 56.**)

REGION	TERRAIN	DISTRICTS
I	Level	1, 2, 3, 4
II	Level to rolling	5, 6, 7, 8, 9
III	Mountainous	10, 11, 12

Prequalified firms are invited to bid on the region or regions of their choice. The Announcement for Statewide Geotechnical Drilling Services is published on the Division of Professional Services Web site. The proposal sheets with estimated units are shown in the announcement for each region.

Floor (lowest allowable) bids will be established by the Geotechnical Branch to prevent skewed bids in each region. These will be included in the announcement. Bids below these rates will be deemed unacceptable, and vendors' bids will not be accepted.

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<h1>GEOTECHNICAL</h1> 	<p><i>Section</i></p> <p>AGREEMENT FOR STATEWIDE GEOTECHNICAL DRILLING SERVICES</p>
	<p><i>Subject</i></p> <p>Vendor Acceptance of Project</p>

**VENDOR  
ACCEPTANCE:**

The following policies apply to vendor acceptance of a project:

- Ø The drilling firm with the number-one agreement in each region will have the first option for all projects within that region.
- Ø If the drilling firm ranked first in any region declines a project or does not respond to an invitation to perform service within two working days from the date the department offers the project, the drilling firm with the number-two contract in that region will have the option, and so forth, until a firm is found that can begin and complete the project within the required time.
- Ø The TC 64-523 form, *Notification for Drilling Services (Exhibit 57)*, must be signed indicating acceptance or rejection of vendor's option and returned to the Geotechnical Branch.
- Ø Failure to follow this procedure within the time limit established by the department in the *Notification of Drilling Services* constitutes rejection of vendor's option for that project.

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<p><b>GEOTECHNICAL</b></p> 	<p><i>Section</i></p> <p>AGREEMENT FOR STATEWIDE GEOTECHNICAL DRILLING SERVICES</p>
	<p><i>Subject</i></p> <p>General Specifications</p>

**RESPONSIBILITY OF DEPARTMENT & CONSULTANTS:**

Unless otherwise noted, the department will be responsible for traffic control, the boring plan, and staking of holes for the projects. If the department cannot provide traffic control, the drilling firms shall provide their own traffic control. The traffic control shall be provided by traffic control personnel (either in-house or from an outside firm) that can meet all established rules and regulations. This shall be paid as either:

- Ø A pass-through cost (with billing receipts from the traffic control firm) plus 10 percent to account for any overhead or administrative expenses. The drilling firm must obtain written permission from the department prior to retaining a traffic control firm.
- Ø As a daily eight-hour rate for two laborers, including expenses, equipment, and travel time. All established rules and regulations must be met.

Requests for traffic control by the department require a minimum of two days' advance notice.

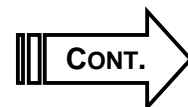
The drilling firm will be responsible for obtaining all utility locations.

The drilling firm shall be responsible for obtaining right of entry from property owners; however, in cases of refusal by the owner, the drilling firm should request assistance from the department.

**SUBCONTRACTING:** The work cannot be subcontracted without prior written approval from the Division of Professional Services and the Geotechnical Branch. The work can be subcontracted only to a prequalified vendor.

**PROJECT INITIATION:** Drilling shall begin on a project within 10 calendar days from the date of notification unless otherwise agreed to by the department.

**USE OF MULTIPLE CREWS:** If the vendor and the department are agreeable, more than one drill crew may be utilized at the same time on larger projects. A minimum crew is considered two people, drill, and all equipment needed to perform drilling operations.



**GEOTECHNICAL  
MANUAL:**

Drilling and sampling procedures, materials, and all items necessary to complete the work shall meet the specifications as outlined in the *Geotechnical Manual* or agreements.

**TIME OF  
COMPLETION:**

A time or date of completion will be established in writing for each project, and vendors are responsible for completing the scope of work on time. If the department delays drilling operations six months beyond the expiration date of the contract, the vendor is not obligated to complete the scope of work.

**LENGTH OF  
CONTRACT:**

The contract is effective for one year. However, the expiration date may be extended one additional year if agreeable to the department and vendor.

**METHOD OF  
PAYMENT**

Drilling unit prices will be calculated from the applicable region as established in the statewide drilling contract. Refer to **GT-902-3, Compensation**, for additional description of unit work items.

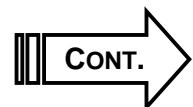
**SAMPLE  
DELIVERY:**

Rock cores and samples with typed logs shall be delivered to the Geotechnical Branch in Frankfort no later than seven calendar days after the completion of the project unless otherwise specified by the Geotechnical Branch.

**INVOICES:**

The following applies to submission of invoices:

- Ø Invoices for the work shall be submitted directly to the Geotechnical Branch, Division of Materials.
- Ø The invoice may be submitted monthly if desired.
- Ø Invoices must be signed and numbered.
- Ø Final payment will be permitted only after delivery of all cores, samples, logs, and observation well data and a field review of the project site by the Geotechnical Branch.
- Ø The Geotechnical Branch shall be contacted by the drilling firm one week before drilling operations end. This will allow the Geotechnical Branch to review the project in the field with the consultant prior to the vendor's departure.



**INVOICES (cont.):**

- ∅ The invoices shall include the following where applicable:
  - ◆ TC 64-525 form, *Tabulation of Quantities for Invoices (Exhibit 55)*
  - ◆ TC 64-521 form, *Unit Cost Items for Geotechnical Services (Exhibit 54)*, signed by authorized personnel
  - ◆ Typed subsurface logs
  - ◆ Cased observation well data
  - ◆ Summary of mobilization/demobilization, including miles (kilometers), drill rig(s), dozer, trackhoe, and dates
  - ◆ Documentation of time records for the dozer and/or trackhoe working time or an invoice of subcontracted dozer and/or trackhoe working time

**WORK**

**QUANTITIES:**

The department does not guarantee the amount of work that will be drilled under this contract. The unit quantities listed for the proposal are only estimates, and the department does not guarantee their accuracy. The quantities may overrun or underrun.

**UNIT PRICE**

**METHOD:**

Payment for labor, materials, equipment, and all items necessary to complete the work shall be made only through the contract unit price.

**RESTRICTION ON  
RELOCATING  
BORINGS**

Hole locations cannot be moved more than five feet without prior approval from the Geotechnical Branch. Hole locations moved more than five feet without prior approval of the Geotechnical Branch are subject to be redrilled. The unapproved hole location will not be eligible for payment.

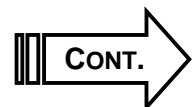
**DRILL CREW**

**SUPERVISORS:**

Drill crew supervisors shall be subject to the approval of the Geotechnical Branch. The company shall submit a completed "Drill Crew Supervisor Information" for each supervisor. (Refer to page 4 of the TC 64-540 form, **Exhibit 51**)

**PROJECT  
ACCEPTANCE  
OR REJECTION:**

The TC 64-523 form, *Notification for Drilling Services (Exhibit 57)*, must be signed indicating acceptance or rejection of the option and returned to the Geotechnical Branch within two working days from date the department offers the project to the firm.




**TERMS OF**

**CANCELLATION:** Failure to comply with the *General Specifications* may result in cancellation of the contract.

2 2 2



<p><b>GEOTECHNICAL</b></p> 	<p><i>Chapter</i></p> <p>CONSULTANT SERVICES</p>
	<p><i>Subject</i></p> <p>Performance Evaluation</p>

**PERFORMANCE EVALUATION:**

The Geotechnical Branch shall evaluate the performance of the geotechnical consultant after completion of the project. The TC 64-522 form, *Performance Evaluation for Geotechnical Services (Exhibit 50)*, shall be utilized for this evaluation. The Geotechnical Branch shall retain the evaluation, and a copy of the evaluation shall be submitted to the geotechnical engineering or drilling firm.

2 2 2


<h1 style="margin: 0;">GEOTECHNICAL</h1> 	<i>Chapter</i> EXHIBITS
	<i>Subject</i> Table of Exhibits

EXHIBIT NUMBER	FORM TITLE	FORM NUMBER
01	Geotechnical Branch Organizational Chart	<i>(none)</i>
02	Site Map	<i>(none)</i>
03	Subsurface Log (blank)	TC 64-515
04	Subsurface Log, Driller's Roadway (completed example)	TC 64-515
05	Subsurface Log, Geologist's Structure (completed example)	TC 64-515
06	Subsurface Log, Geologist's Roadway (completed example)	TC 64-515
07	Summary of Rockline Soundings (blank)	TC 64-516
08	Summary of Rockline Soundings (completed example)	TC 64-516
09	Subsurface Log, Profile (completed example)	<i>(none)</i>
10	Specifications for Core Box	<i>(none)</i>
11	Cased Observation Well	<i>(none)</i>
12	Thin-Walled Tube & SPT Sample Log (blank)	TC 64-531
13	Thin-Walled Tube & SPT Sample Log (completed example)	TC 64-531
14	Typical Slope Configuration: Class III Nondurable Shale	<i>(none)</i>
15	Typical Slope Configuration: Class II Nondurable Shale	<i>(none)</i>

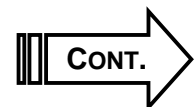


EXHIBIT NUMBER	FORM TITLE	FORM NUMBER
16	Typical Slope Configuration: Class I Nondurable Shale	(none)
17	Typical Slope Configuration: Durable Shale	(none)
18	Typical Slope Configuration: Massive Limestone or Sandstone	(none)
19	Typical Slope Configuration: Shaley Limestone or Sandstone	(none)
20	Typical Slope Configuration: Serrated Slopes	(none)
21	Roadside Ditch Catchment Area	(none)
22	Summary of Rock Quantities (blank)	TC 64-532
23	Summary of Rock Quantities (completed example)	TC 64-532
24	Typical Lithology Classification Sections	(none)
25	Cut Stability Section (typical)	(none)
26	Cut Stability Section (dipping bedrock)	(none)
27	CU Triaxial Tests	(none)
28	Consolidation Test Report	(none)
29	Geotechnical Symbol Sheet (Roadway)	(none)
30	Geotechnical Notes (Roadway)	(none)
31	Soil Profile	(none)
32	Cut Stability Section (soil)	(none)
33	Embankment Stability Section	(none)
34	Landslide Stability Section	(none)
35	Wick Drains Plan Showing Area Treated & Details	(none)
36	Wick Drains Plan Showing Individual Wick Locations & Details	(none)

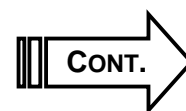
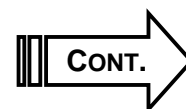


EXHIBIT NUMBER	FORM TITLE	FORM NUMBER
37	Typical Boring Layouts for Culverts	(none)
38	MSE Wall Detail Sheet & Cantilever Wall Detail Sheet	(none)
39	Subsurface Data Sheet: Two Alternate Positions for a Substructure	(none)
40	Subsurface Data Sheet: Interpolated Bedrock Contour Sheet	(none)
41	Coordinate Data Submission Form	(none)
42	Subsurface Data Sheet: Bridge Approach Slope Stability Schematic	(none)
43	Subsurface Data Sheet: Bridge	(none)
44	Sounding Layout Sheet: Old & New Data for a Bridge Replacement	(none)
45	Subsurface Data Sheet: D50 & D95 Values	(none)
46	Drilled Shaft Design Data	(none)
47	Subsurface Data Sheet: Culvert	(none)
48	Typical Settlement Plot for a Culvert	(none)
49	Subsurface Data Sheet: Stability Schematic for a Culvert	(none)
50	Performance Evaluation for Geotechnical Services	TC 64-522
51	Prequalification Requirements for Geotechnical Drilling Services	TC 64-540
52	Prequalification Requirements for Geotechnical Engineering Services	TC 64-541
53	Prequalification Requirements for Geotechnical Laboratory Testing Services	TC 64-542



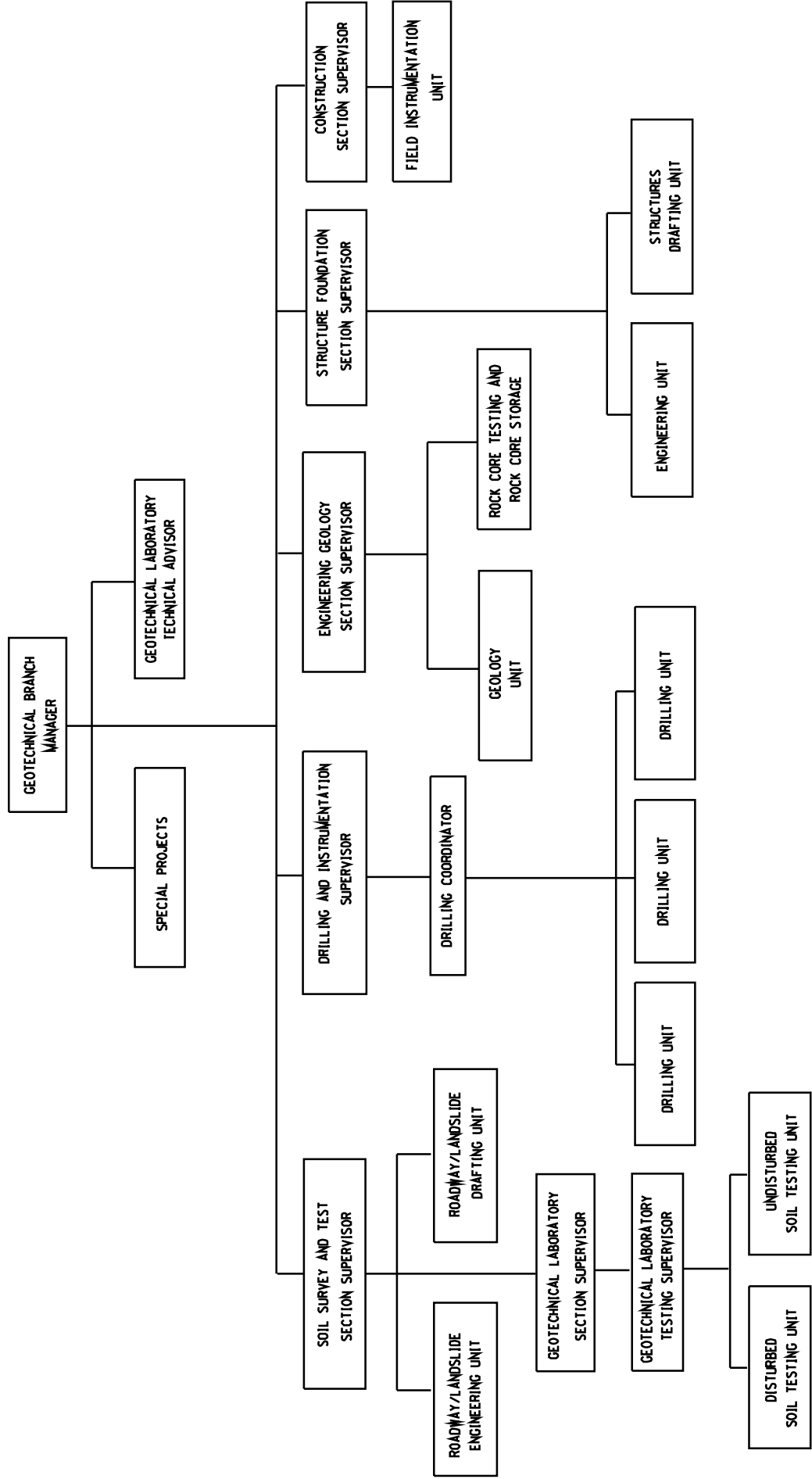
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EXHIBIT NUMBER	FORM TITLE	FORM NUMBER
54	Unit Cost Items for Geotechnical Services	TC 64-521
55	Tabulation of Quantities for Invoices	TC 64-525
56	Regions for Geotechnical Drilling Services	<i>(none)</i>
57	Notification for Drilling Services	TC 64-523
58	Checklist and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specifications (also called FHWA checklist)	<i>(none)</i>
59	Summary of Cost Items for Statewide Geotechnical Engineering Services	TC 64-527
60	Tabulation of Quantities for Cost Items for Statewide Geotechnical Engineering Services	TC 64-526

2 2 2

# Kentucky Transportation Cabinet - Division of Materials Organizational Chart For Geotechnical Branch

1236 Wilkinson Boulevard; Frankfort KY 40601-1200  
PH (502) 564-2374 FAX (502) 564-4839



# SPRINGFIELD CO ALBANY NW BYPASS

Exhibit 2



1" = 2000'

SPRINGFIELD COUNTY  
US 555 ALBANY NW BYPASS  
FD52 126 0555 005-023 009 D  
MARS # 68594 01D  
ITEM # 13-765.00

01/01/05











KENTUCKY TRANSPORTATION CABINET

Division of Materials  
Geotechnical Branch

TC 64-515

SUBSURFACE LOG

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 63+50, 25 Feet Left</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude _____ Longitude _____	
Mars No. <u>6859401D</u> Surface Elevation <u>956.3</u> Ft.		Hole Number <u>1A</u> Total Depth <u>35.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>02/02/75</u> Date Completed <u>02/02/75</u>	
Project Type <u>Roadway</u>		Depth to Water (Immediate) _____	
Driller's Name <u>B. Jones</u> Geologist _____		Depth to Water (7 Day) <u>N/A</u> Date _____	

Lithology		Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
	3.0	Brown, clayey-silt, sandy lenses, dry						
	7.5	Gray, silty-clay, moist, w/ sandstone boulders (Auger Refusal)	#1	5.0-6.5	1.5	5-7-4	SPT	
	11.6	Weathered brown sandstone		2.5	2.1	84		10.0
		Brown and gray sandstone w/ shale layers (Lost water @ 15.0')		5.0	4.7	94		15.0
	21.1			10.0	9.8	98		
		Gray sandy shale						25.0
	32.0			10.0	9.9	99		
	35.0	Gray sandstone (End of Core 35.0')						

## KENTUCKY TRANSPORTATION CABINET

Division of Materials  
Geotechnical Branch

TC 64-515

Springfield South Quadrangle  
GQ #4567  
Dakota Formation

### SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 415+06.52, 22.5 Feet Right</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude <u>85° 55' 28"</u> Longitude <u>38° 28' 46"</u>	
Mars No. <u>6859401D</u> Surface Elevation <u>469.5</u> Ft.		Hole Number <u>#13</u> Total Depth <u>36.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>04/01/04</u> Date Completed <u>04/01/04</u>	
Project Type <u>Bridge Over Buckhill River</u>		Depth to Water (Immediate) <u>11.0</u> Ft.	
Driller's Name <u>B. Jones</u> Geologist <u>A. Smith</u>		Depth to Water (7 Day) <u>N/A</u> Date _____	

Lithology		Description	Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core						
			Overburden						
				#1	2.0-4.0	1.4		ST	
				#2	5.0-7.0	1.7		ST	
				#3	10-11.5		21-22-10	SPT	
456.5	13.0								
		Limestone: light gray, coarse crystalline, w/ many shale laminations and limited partings		42	3.0	2.8	93		16.0
450.3	19.2								Clay Shale @ 17.5-18.4
		Limestone: light gray, fine to coarse crystalline, argillaceous with wavy to nodular bedding, fossiliferous		20	10.0	9.7	97		26.0
				31	10.0	10.0	100		
433.5	36.0								
		<p style="text-align: center;">Top of Rock = 13.0 Elevation 456.5</p> <p style="text-align: center;">Base of Weathered Rock = 13.5 Elevation 456.0</p> <p style="text-align: center;">The Allowable Bearing Capacity is 10 tons/square foot at Elevation 456.0</p>							

KENTUCKY TRANSPORTATION CABINET

Division of Materials  
Geotechnical Branch

TC 64-515

Springfield South Quadrangle  
GQ #5689 Nevada  
Formation, Elm member

SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 32+00, 80 Feet Right</u>							
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude <u>82° 34' 22"</u> Longitude <u>37° 48' 12"</u>							
Mars No. <u>6859401D</u> Surface Elevation <u>964.2</u> Ft.		Hole Number <u>2C</u> Total Depth <u>42.0</u> Ft.							
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>11/26/02</u> Date Completed <u>11/27/02</u>							
Project Type <u>Roadway</u>		Depth to Water (Immediate) <u>N/A</u>							
Driller's Name <u>B. Jones</u> Geologist <u>A. Smith</u>		Depth to Water (7 Day) <u>N/A</u> Date _____							
Lithology		Overburden		Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
		<i>Overburden w/ sandstone boulders</i>							
960.4	3.8								
		<i>Shale: brown to dark gray, clayey to silty, carbonaceous zones, occasional sandstone partings, slickensided throughout, highly fractured and weathered above 7.4'</i>		0	5.0	4.5	90		8.8
951.0	13.2								
		<i>Sandstone: gray, fine grain, numerous shale laminations, cross bedded, non-durable</i>		12	10.0	9.8	98		
947.2	17.0								<b>75° Joint @ 18.3-20.2</b>
		<i>Shale (siltstone): gray, sandy, with iron nodules, rooted, coal spars</i>							18.8
942.9	21.3								
		<i>Coal Seam w/ 0.5' shale parting (Recovered 2.3 Ft.)</i>		34	10.0	9.2	92		
940.1	24.1								
		<i>Shale (claystone): gray, plastic, slickensided</i>							<b>Shale zone @ 28.7-29.8</b>
938.1	26.1								28.8
		<i>Sandstone: light gray, medium to coarse grain, few shale laminations, shale clasts in zones, crossbedding, intermittent water stains, durable</i>		71	10.0	10.0	100		
									<b>Conglomerate @ 36.5-37.1</b>
									38.8
									<b>80° Water Stained Joint @ 40.3-42.0</b>
922.2	42.0			82	3.8	3.8	100		
		<i>RDZ = 7.4 Ft.</i>							

**KENTUCKY TRANSPORTATION CABINET**  
 Division of Materials  
 Geotechnical Branch

TC 64-516

## SUMMARY OF ROCKLINE SOUNDINGS

Page 1 of \_\_\_

County _____ Item No. _____ Project No. _____ Mars No. _____ Driller's Name _____	Road Number _____ Project Type _____ Date Started _____ Date Completed _____
---	--

Hole Number	Station	Offset	Depth to Refusal	Surface Elevation	Refusal Elevation	Latitude	Longitude	Remarks

KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

TC 64-516

## SUMMARY OF ROCKLINE SOUNDINGS

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>					Road Number <u>New Albany NW Bypass (US 555)</u>			
Project No. <u>FD52 126 0555 005-023 009 D</u>					Project Type <u>Bridge, Culvert and Wall</u>			
Mars No. <u>6859401D</u> Driller's Name <u>B. Jones</u>					Date Started <u>4/20/1991</u> Date Completed <u>4/27/1991</u>			
Hole Number	Station	Offset	Depth to Refusal	Surface Elevation	Refusal Elevation	Latitude	Longitude	Remarks
<i>Bridge @ 24+00</i>								
3	23+50	CL	5.7	526.1	520.4	85° 45'01"	38° 07'30"	
5	24+50	CL	5.2	522.0	516.8	85° 44'13"	38° 07'36"	
6	24+50	30' Rt.	6.6	522.6	516.0	85° 44'14"	38° 07'36"	
8	25+50	30' Lt.	8.6	529.2	520.6	85° 43'07"	38° 07'41"	<i>Boulders @ 1.5-2.0</i>
9	25+50	CL	9.0	528.4	519.4	85° 43'08"	38° 07'41"	
10	26+50	30' Rt.	7.2	530.1	522.9	85° 43'11"	38° 07'45"	
<i>Culvert @ 30+00</i>								
11	30+00	CL	7.6	530.2	522.6	85° 42'23"	38° 07'48"	
12	30+00	30' Rt.	32.0 NR	529.2	497.2	85° 42'24"	38° 07'48"	<i>O.W. installed Immediate - Dry</i>
<i>Wall right of Ramp 1</i>								
14	20+00	30' Rt.	10.9	537.1	526.2	85° 45'16"	38° 06'45"	
16	21+50	30' Rt.	9.2	535.3	526.1	85° 45'30"	38° 06'58"	



## KENTUCKY TRANSPORTATION CABINET

Division of Materials  
Geotechnical Branch

TC 64-515

### SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 61+00, 25 Feet Left</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude _____ Longitude _____	
Mars No. <u>6859401D</u> Surface Elevation _____ Ft.		Hole Number <u>#16</u> Total Depth <u>17.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>11/10/04</u> Date Completed <u>11/10/04</u>	
Project Type <u>Profile</u>		Depth to Water (Immediate) <u>N/A</u>	
Driller's Name <u>B. Jones</u> Geologist _____		Depth to Water (7 Day) <u>N/A</u> Date _____	

Lithology		Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
	11.0	Brown, silty clay, moist, firm <b>*Bag #4</b>					NMC #6 @ 4'	
	17.0	Gray, silty, wet, soft <b>**Soil Type #3</b>					NMC #7 @ 9'	
		(No Refusal)					NMC #8 @ 14'	
<p><b>Note:</b> Pond Located at station 61+20, 20 feet left. Pond is approximately 30 feet wide and runs to station 61+40.</p> <p><b>Note:</b> Possible landslide between stations 61+50 - 64+00.</p> <p>* Indicates bag was obtained in this boring.</p> <p>** References soil type from a bag sample obtained from a previous boring.</p>								

Format for Labeling Lid

COUNTY \_\_\_\_\_  
 PROJECT NO. \_\_\_\_\_  
 CORE LOCATION \_\_\_\_\_  
 SURFACE ELEV. \_\_\_\_\_  
 BOX \_\_\_ OF \_\_\_  
 STRUCTURE (HOLE #) ROADWAY \_\_\_\_\_

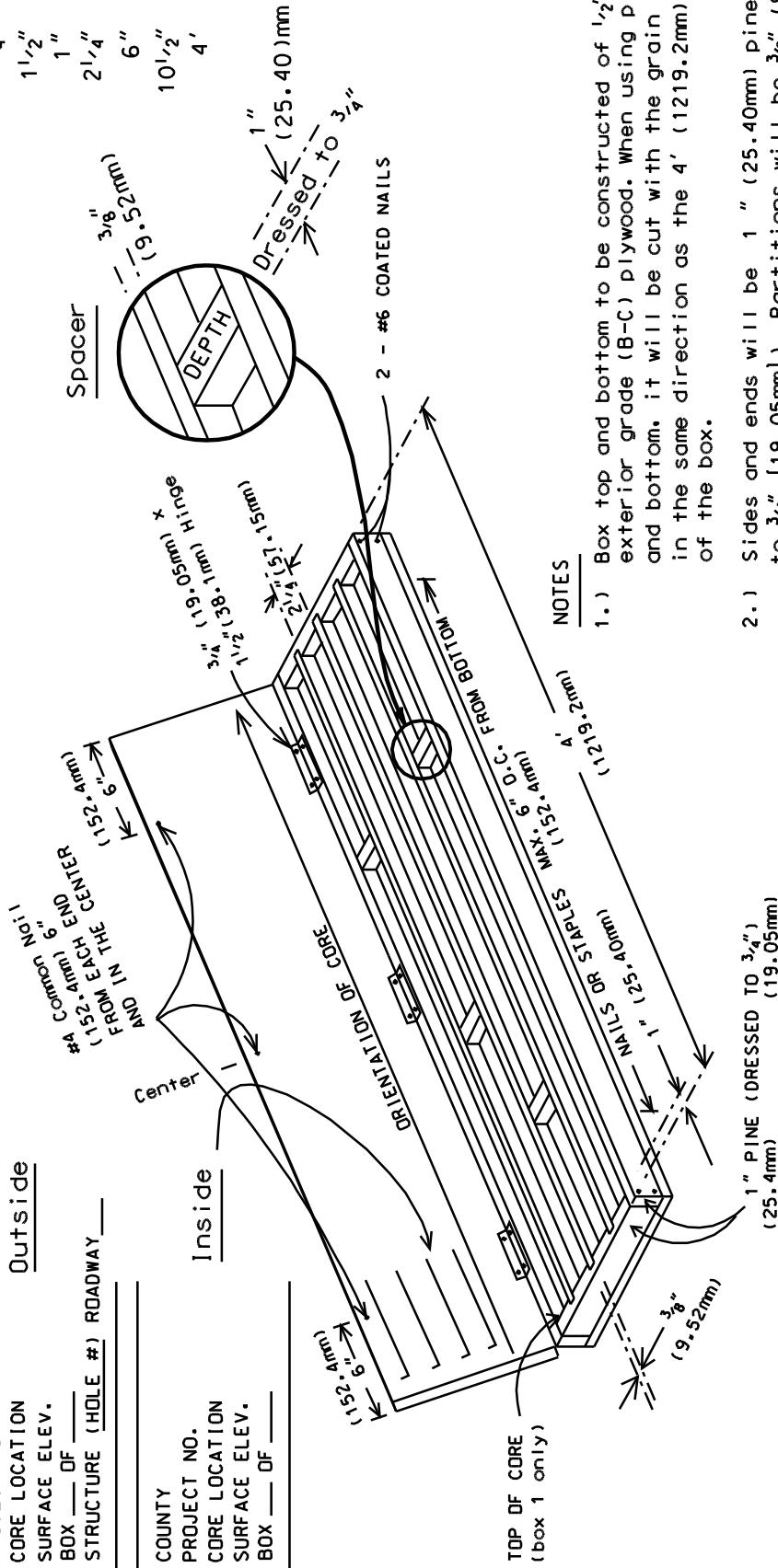
Outside

COUNTY \_\_\_\_\_  
 PROJECT NO. \_\_\_\_\_  
 CORE LOCATION \_\_\_\_\_  
 SURFACE ELEV. \_\_\_\_\_  
 BOX \_\_\_ OF \_\_\_

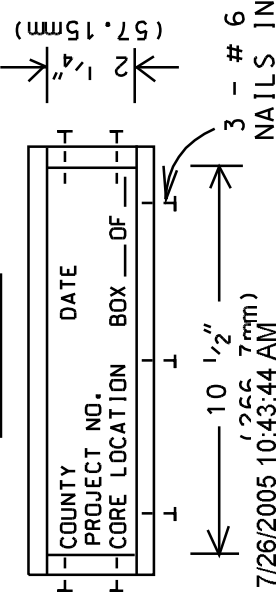
Inside

## KENTUCKY TRANSPORTATION CABINET SPECIFICATIONS FOR CORE BOX

English	Metric
3/8"	= 9.52mm
1/2"	= 12.70mm
3/4"	= 19.05mm
1 1/2"	= 38.1mm
1"	= 25.40mm
2 1/4"	= 57.15mm
6"	= 152.4mm
10 1/2"	= 266.7mm
4'	= 1219.2mm



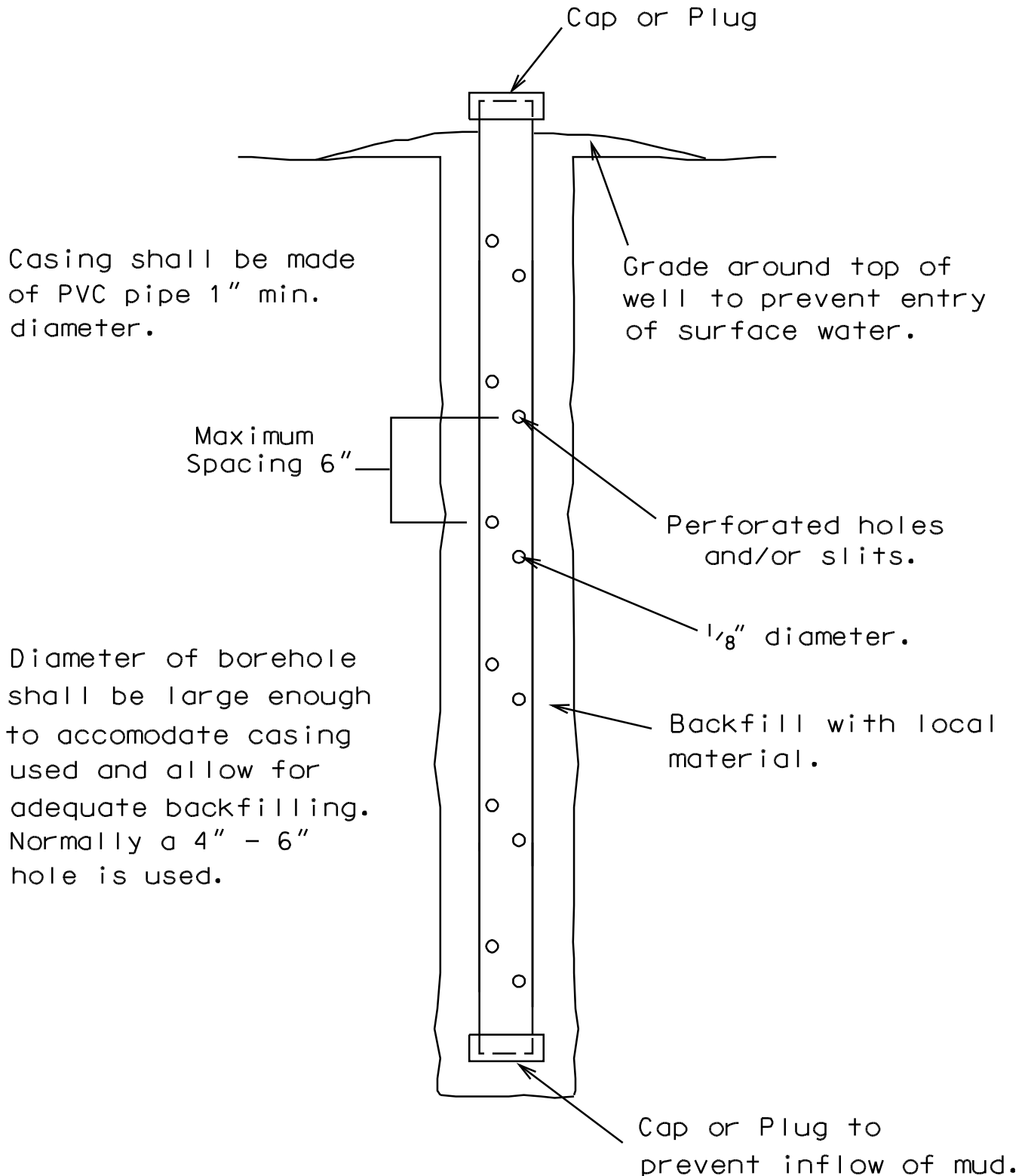
End View



### NOTES

- 1.) Box top and bottom to be constructed of 1/2" (12.70mm) exterior grade (B-C) plywood. When using plywood for top and bottom, it will be cut with the grain of plywood in the same direction as the 4' (1219.2mm) length of the box.
- 2.) Sides and ends will be 1" (25.40mm) pine; (dressed to 3/4" (19.05mm)). Partitions will be 3/8" (9.52mm) pine.
- 3.) #6 cc (penny) coated sinker nails or coated staples are required to assemble parts of the box.
- 4.) Top lid will have 3 hinges secured with 4 - #6 screws 1/2" (12.70mm) into lid and 3/4" (19.05mm) into sides.
- 5.) All partitions and spacers to be removable.
- 6.) Letter box as shown. Letters to be bold and indelible.
- 7.) Enclose copy of Geologist and Driller's log inside Box No. 1.
- 8.) Closure of lid shall be secured with 3 - #4 common nails.

# CASED OBSERVATION WELL





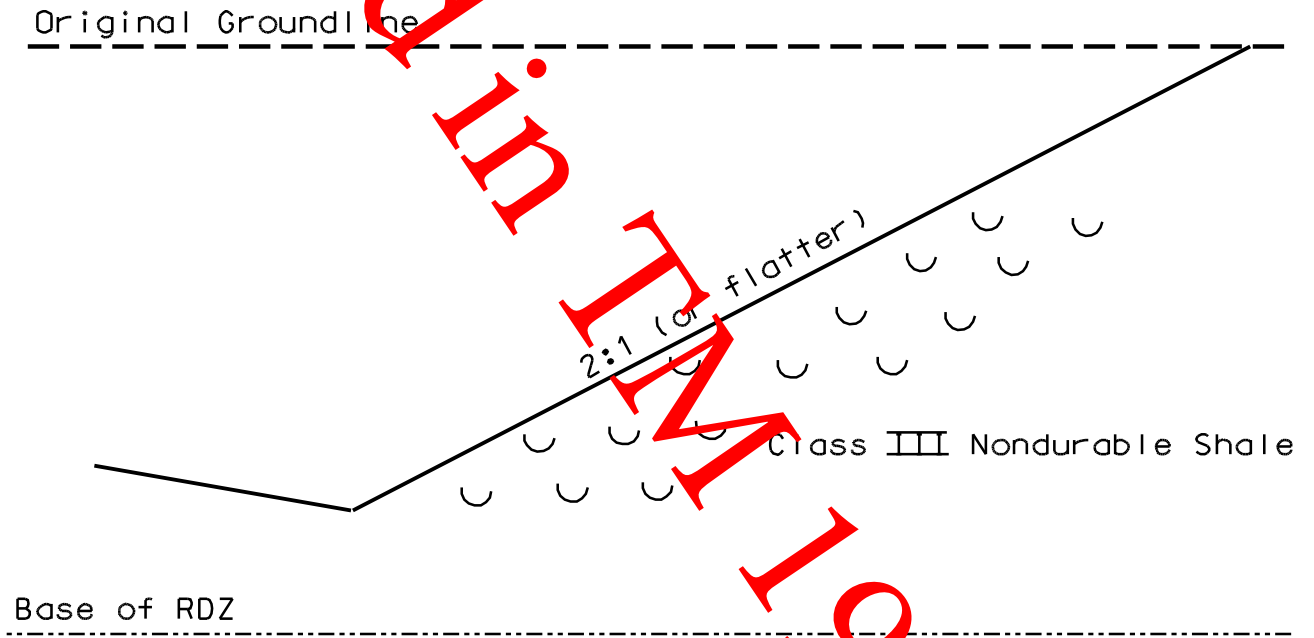
KENTUCKY TRANSPORTATION CABINET  
 Division of Materials  
 Geotechnical Branch

THIN-WALLED TUBE & SPT SAMPLE LOG

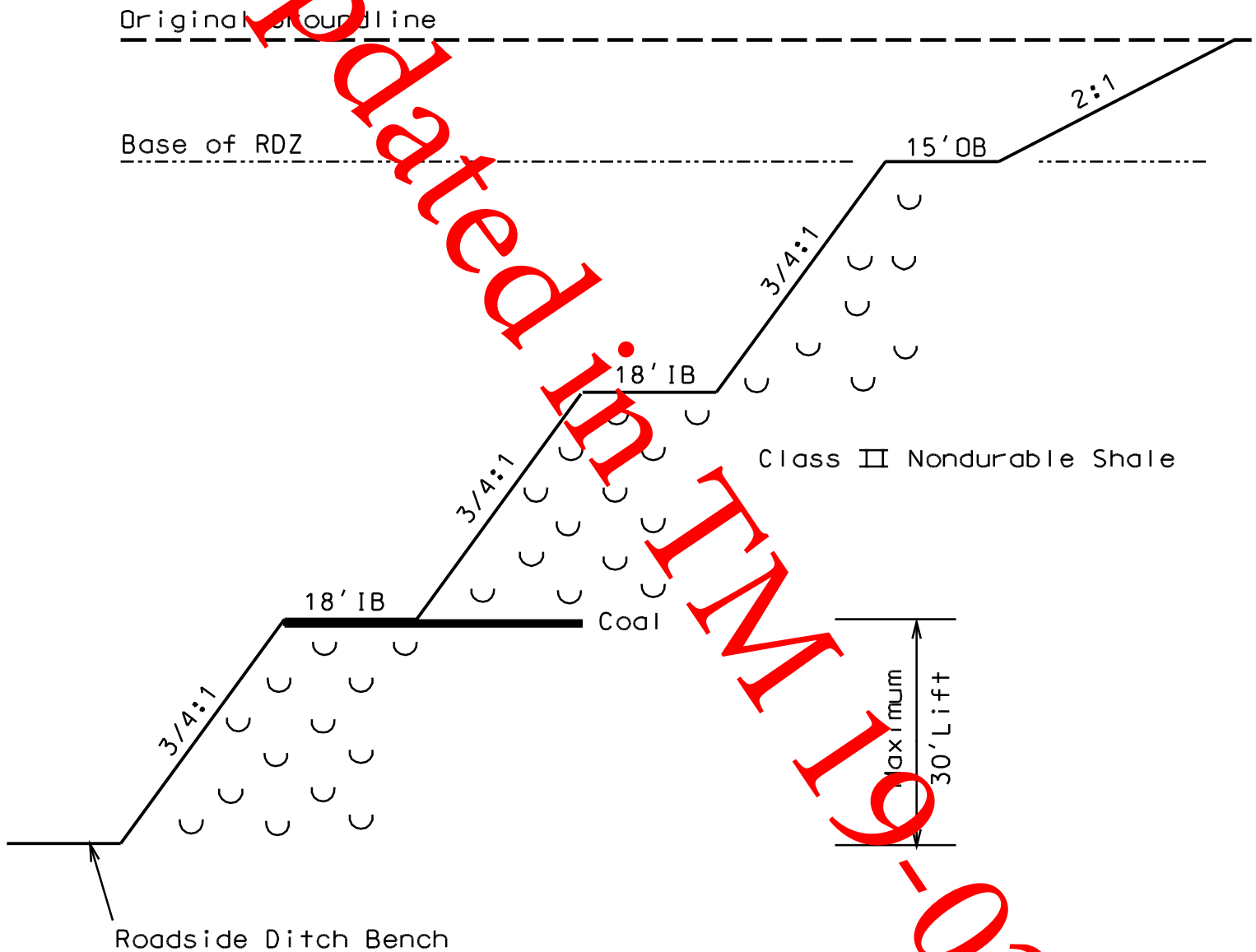
Assigned By: B. King      Logged By: R. McDonald      Date: 2/30/04  
 Date: 2/30/04      Mars # 6895401D      Item # 13-765.00      Page 1 of 1  
 County Springfield      Project # FD52 126 0555 005-023 009 D

Location	Hole No.	Sample No.	Depth	Moisture Content AASHTO T 265			Visual Description	No. of Samples	Pene- trometer /Tonvare	Uncon- fined	Consol- idation	Request for Testing		Classify / Wash		
				Can No.	Tare	Wet Weight + Tare						Dry Weight + Tare	% Water		Type of Test	No. of Samples
40+50, 20' Lt.	35	1	5-7.5	22	46.4	221.7	198.0	15.6	1	1.0	1			X		
		2	10-12.5	110	46.8	312.9	258.0	26.0	2	0.5		A-CU	2	25	X	
		3	15-17.5	105	46.3	336.2	286.9	20.5	1	0.5		B-CU	1	15	X	
40+00, CL	36	1	5-7.5	42	46.6	270.3	229.9	22.0	2	1.5	1			X		
		2	10-12.5	45	46.5	323.1	264.6	26.8	2	1.0	1	1		X		
		3	15-17.5	3	48.0	339.0	296.0	17.3	1	0.5		B-CU	1	25	X	
		4	20-22.5	25	46.4	283.2	245.0	19.2	1	0.5		B-CU	1	35	X	
40+50, 20' Rt.	37	1	5-7.5	K	46.5	198.9	175.8	17.9	Pan	1.0				X		
		2	10-12.5	107	47.4	283.1	241.7	21.3	1	0.5	1			X		
		3	15-17.5	104	47.3	264.2	236.0	14.9	2	0.5	1	UU	1	15	X	

Updated in: **III**  
Typical Slope Configuration  
Class III Nondurable Shale

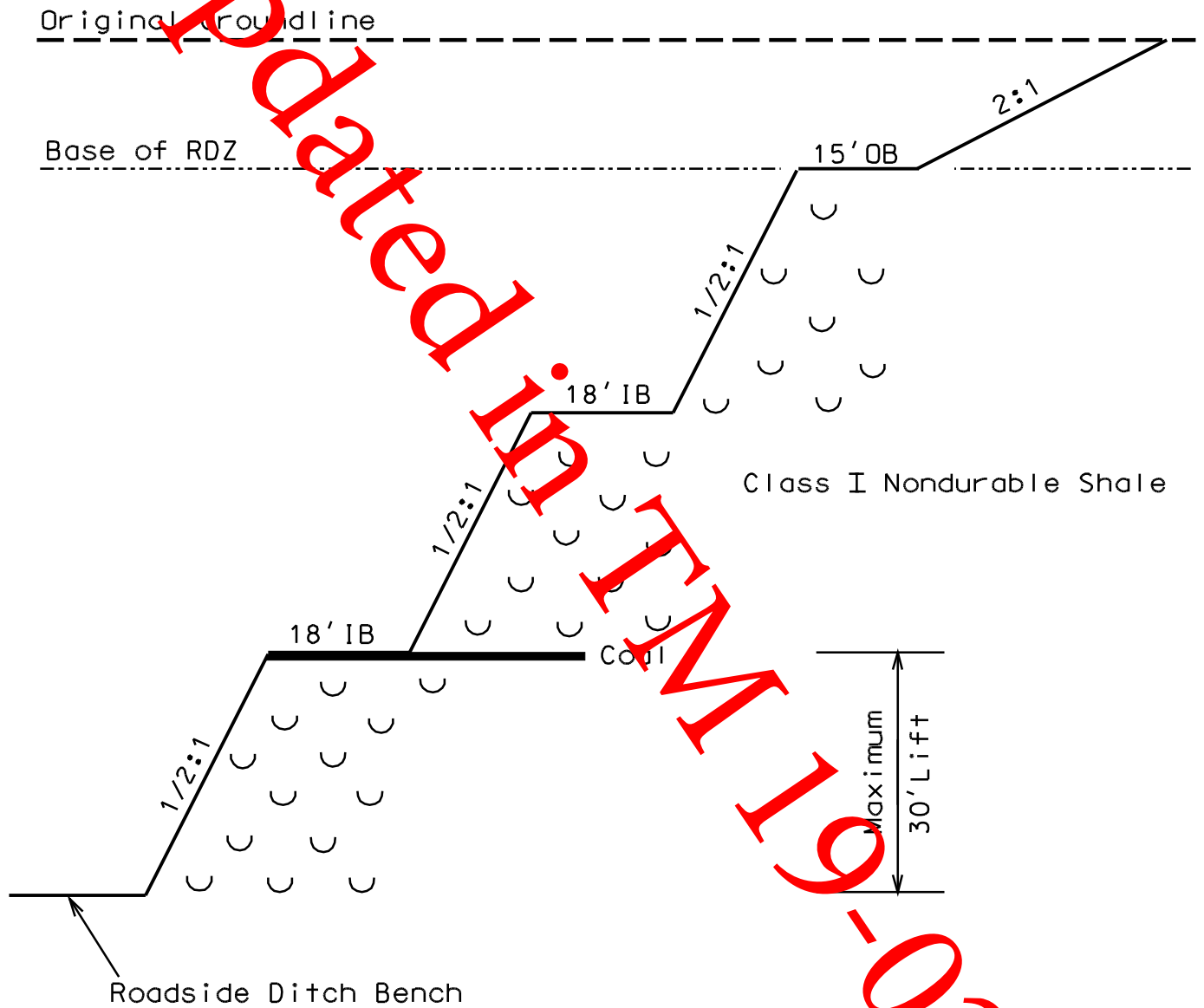


# Typical Slope Configuration Class II Nondurable Shale



NOTE :  
IB = Intermediate Bench  
OB = Overburden Bench

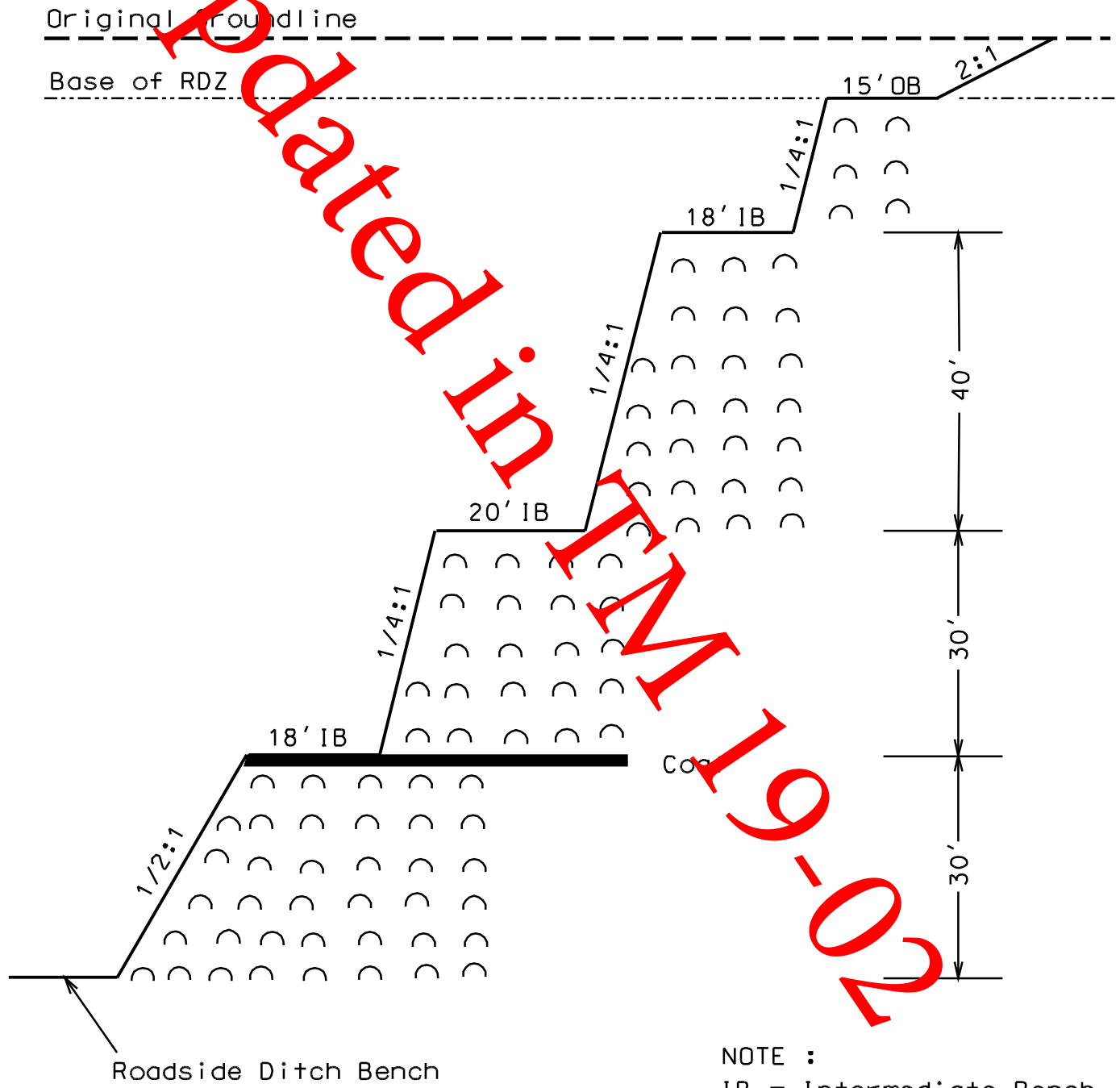
# Typical Slope Configuration Class I Nondurable Shale



NOTE :  
IB = Intermediate Bench  
OB = Overburden Bench



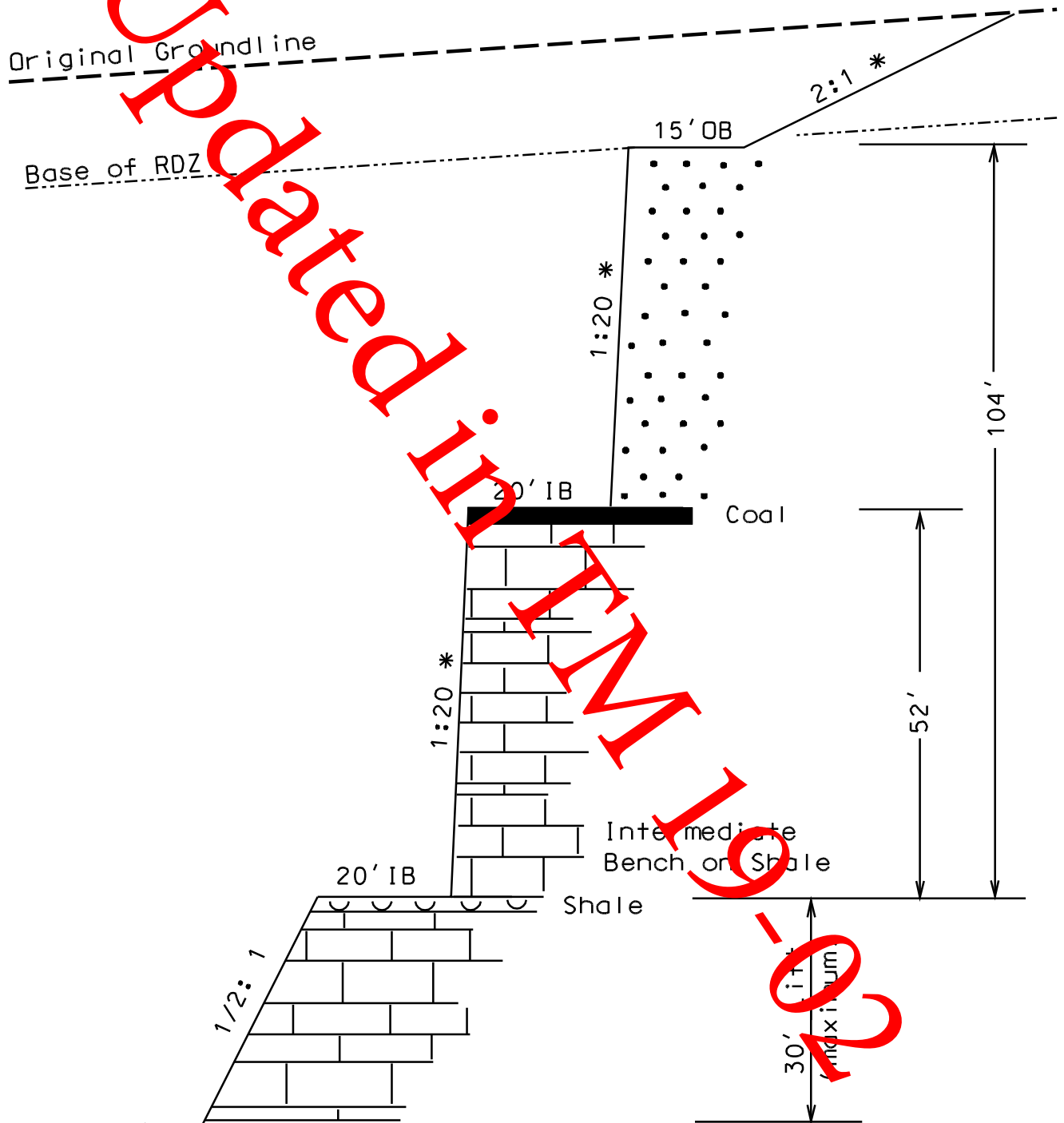
# Typical Slope Configuration Durable Shale



NOTE :  
IB = Intermediate Bench  
OB = Overburden Bench

# Typical Slope Configuration Massive Limestone or Sandstone

\* Slopes are shown at maximum steepness



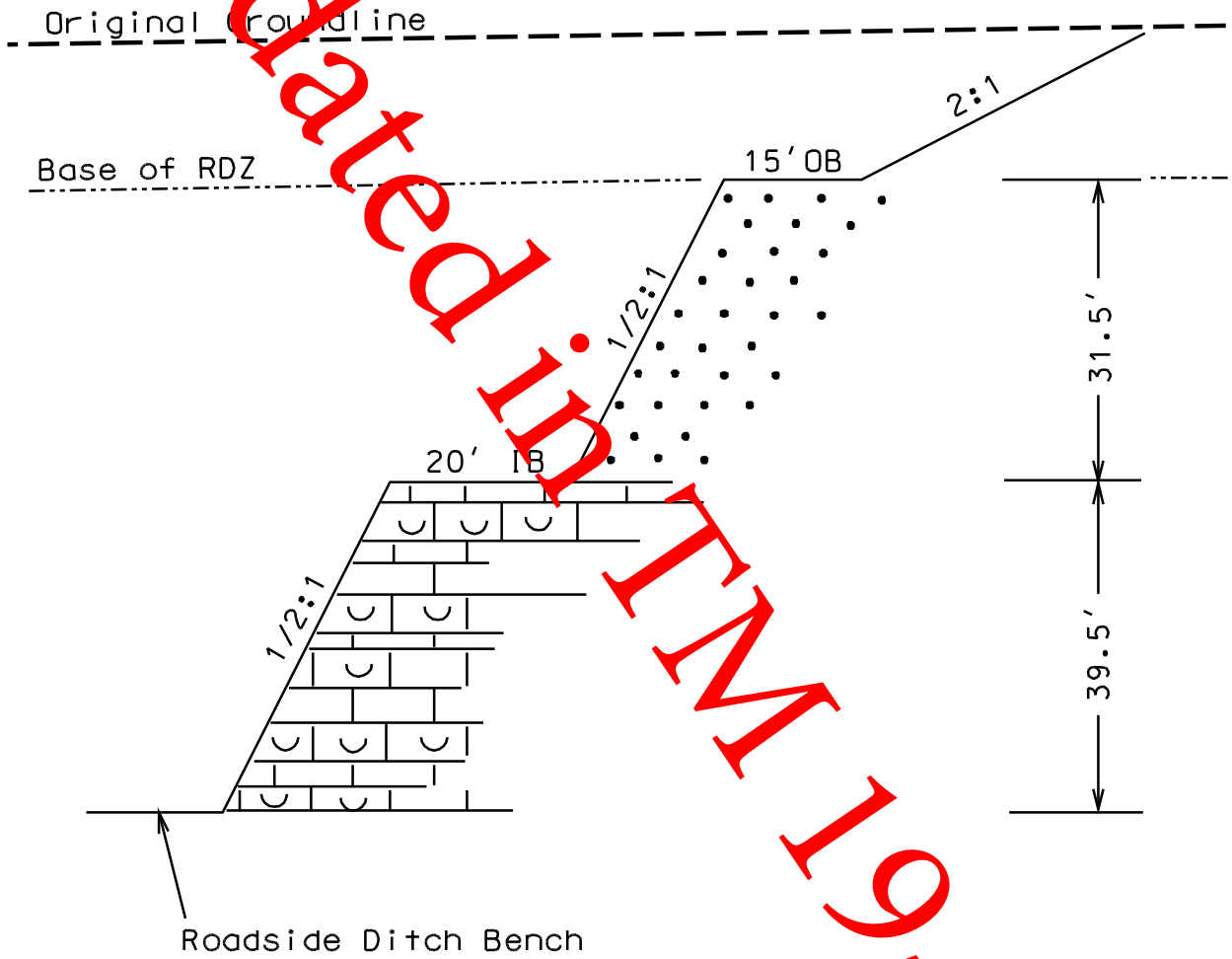
Roadside Ditch Bench

NOTE :

IB = Intermediate Bench

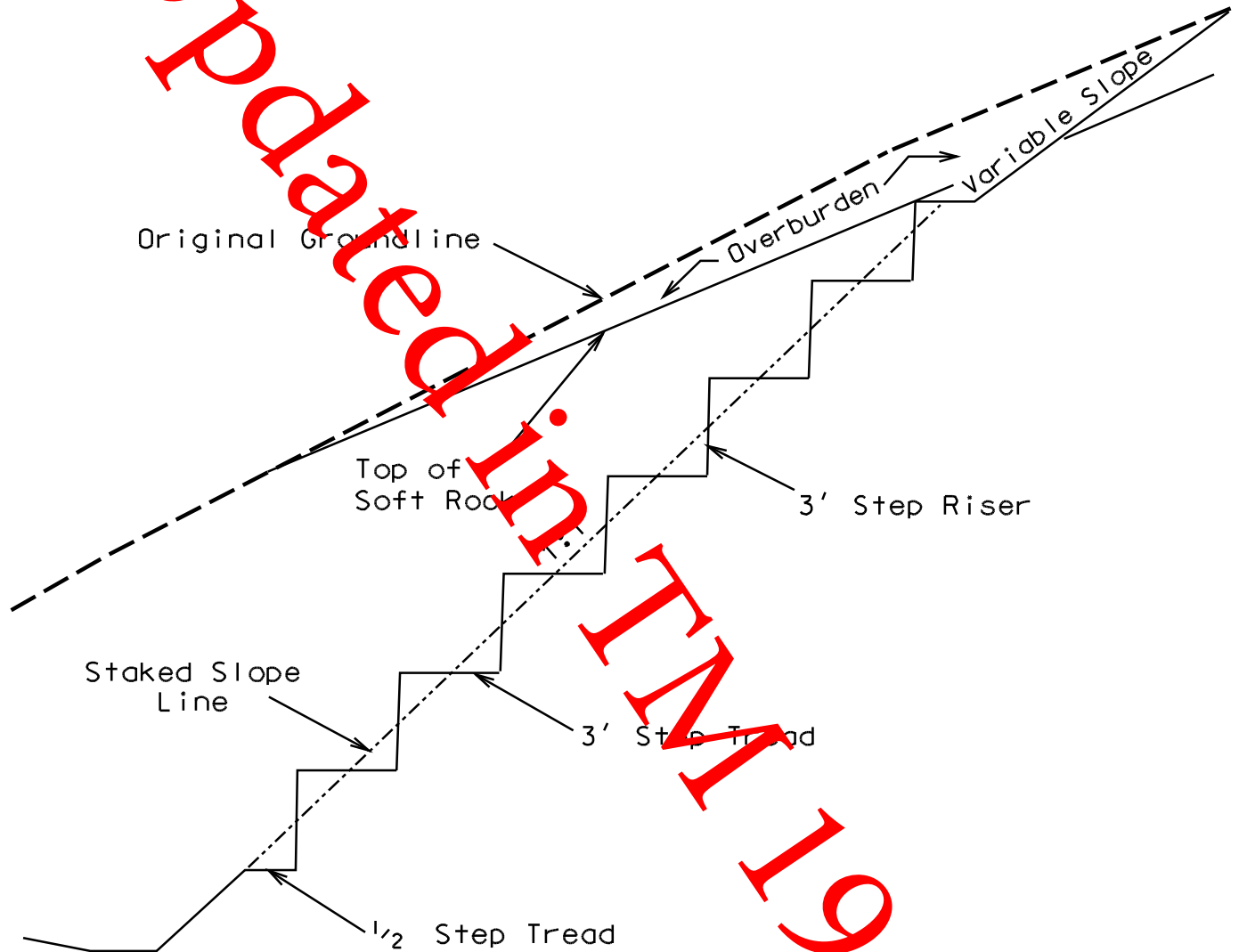
OB = Overburden Bench

# Typical Slope Configuration Shaley Limestone or Sandstone



NOTE :  
IB = Intermediate Bench  
OB = Overburden Bench

# Typical Slope Configuration 1:1 Serrated Slopes

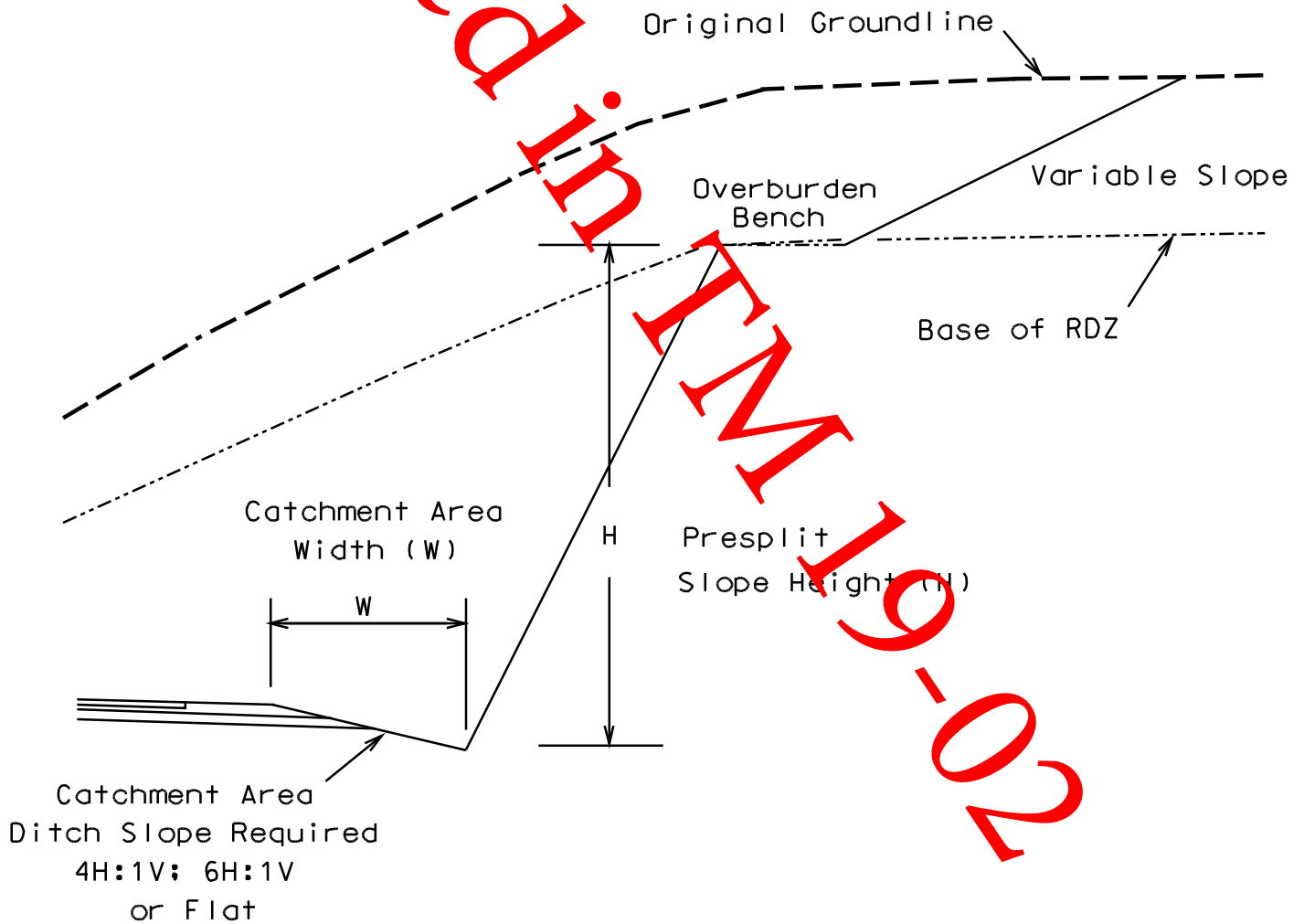


## NOTE :

1:1 slope configuration shown.  
For a 1 1/2:1 slope (not shown)  
use 2' riser with a 3' tread  
or 4' riser with a 6' tread.

# Roadside Ditch Catchment Area

For a Copy of Guidelines Contact the  
Kentucky Department of Highways  
Division of Materials  
Geotechnical Branch





KENTUCKY TRANSPORTATION CABINET

Division of Materials  
Geotechnical Branch

TC 64-532

County Springfield Page 1 of 1

Item No. 13-765.00 Submittal No. 1

**SUMMARY OF ROCK QUANTITIES**

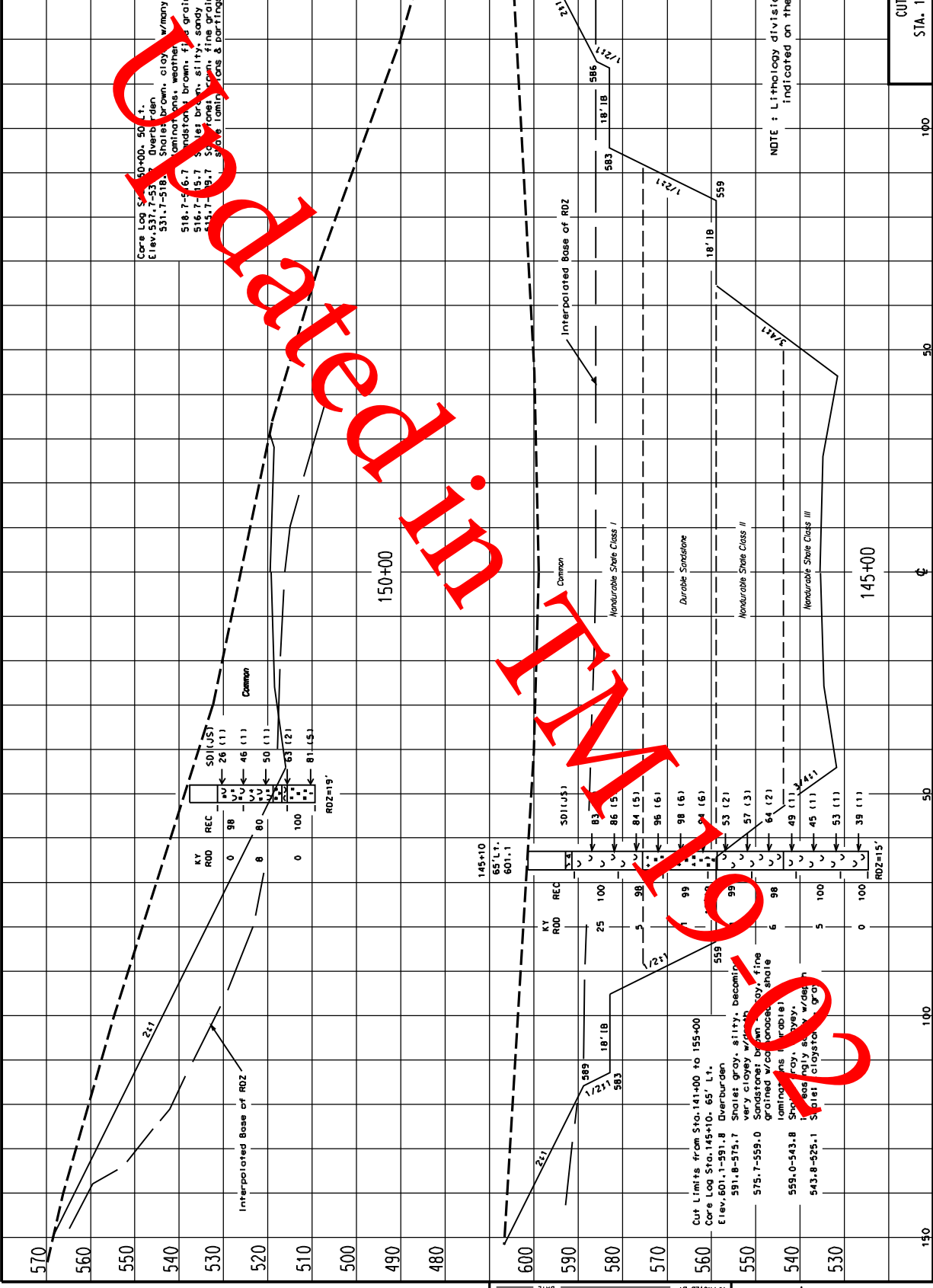
Project No. FD52 126 0555 005-023 009 D Date 5/6/2003

Sheet Totals STA: To STA:	2 Foot Rock Roadbed (Required)	Rock Embankment (Required)	Channel Lining (Required)	Type of Excavated Material		
				Sandstone or Limestone	Durable Shale Class I	Non-durable Shale Class II
391+00 - 395+00	1,704	17,000				
395+00 - 410+00	6,390	4,000	4,231	1,259		
410+00 - 425+00	6,390			32,241		
425+00 - 440+00	6,390	5,000		1,712		
440+00 - 455+00	6,390			1,209	5,923	17,933
455+00 - 470+00	6,390	4,000			194	1,023
470+00 - 485+00	6,390			128,247	172,935	59,525
485+00 - 500+00	6,390	45,000				
500+00 - 515+00	6,390	61,000				
515+00 - 530+00	6,390	72,000				
530+00 - 545+00	6,390	65,000	10,771			
545+00 - 560+00	6,390			17,484	556	10,841
560+00 - 575+00	6,390			2,232	7,023	10,086
575+00 - 590+00	6,390			17,364	73,640	4,052
590+00 - 605+00	6,390			53,158	56,582	25,245
<b>Sheet Total (Cubic Yards)</b>	91,164	273,000	15,202	90,238	332,468	282,000
<b>Accumulated Total</b>	91,164	273,000	15,202	90,238	332,468	282,000

COUNTY OF  
SPRINGFIELD

ITEM NO.  
15-7166.00

SHEET NO.



Core Log S-150-00, 50' L.T.  
 Elevation 537.7-537.8 Overburden  
 531.7-518.1 Shales, brown, clay w/many sandstone laminae, weathering to a brown silty clay  
 518.7-507.0 Sandstone, gray, silty, medium grained (Non-Durable)  
 514.7-45.7 Sandstone, gray, silty, medium grained, w/many laminae of clay shale  
 415.7-31.7 Sandstone, open, fine grained, w/many laminae of clay shale  
 30.0 Laminae of clay shale

Cut Limits from Sta. 141+00 to 155+00  
 Core Log Sta. 145+10, 65' L.T.  
 Elevation 601.1-591.8 Overburden  
 591.8-515.7 Shales, gray, silty, becoming silty clay shale  
 575.7-559.0 Sandstone, gray, silty, medium grained w/coal laminae  
 559.0-543.8 Shales, gray, silty, medium grained  
 543.8-525.1 Siltstone, clayey, w/dark gray clay shale

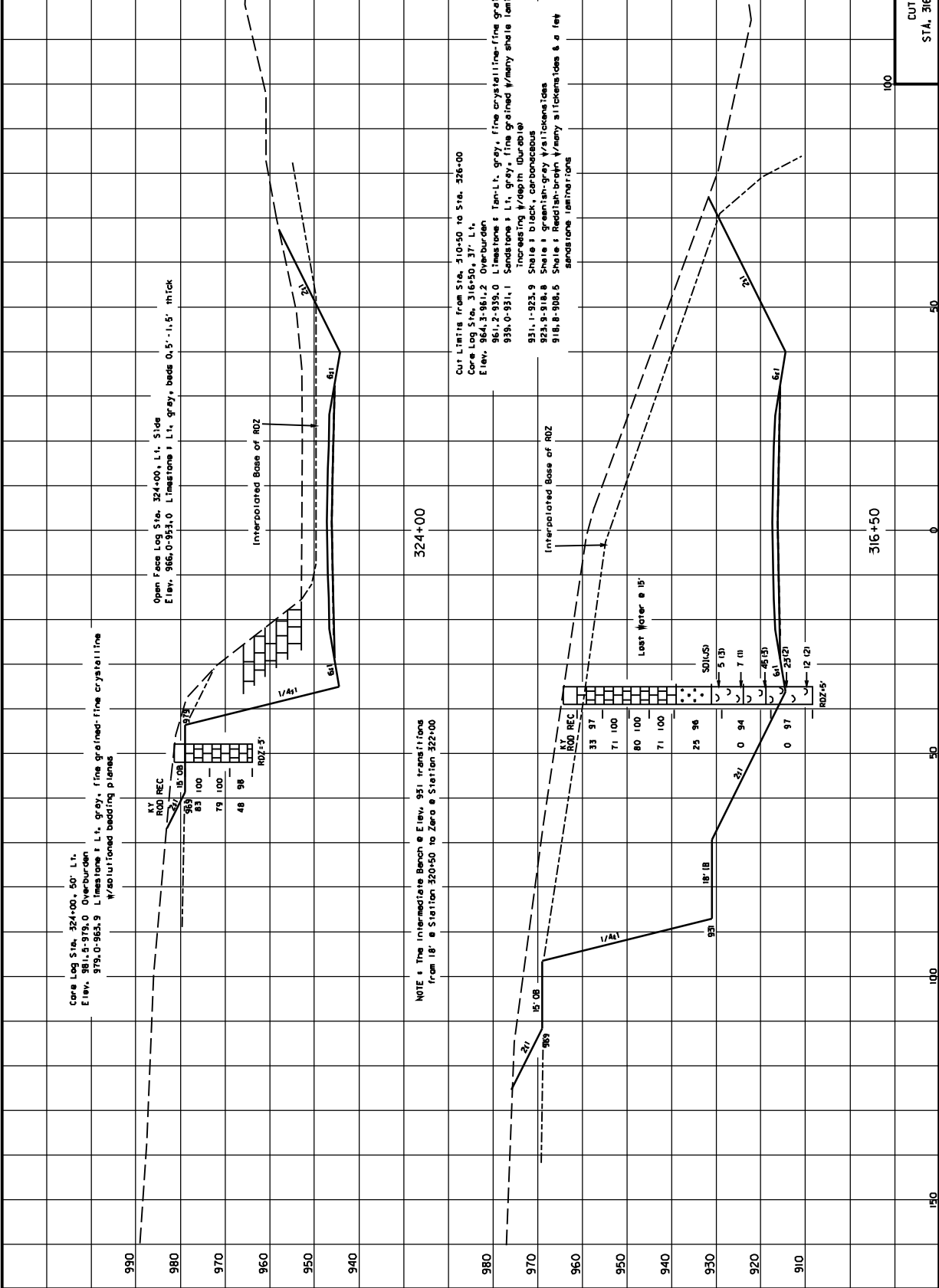
NOTE: Lithology divisions are not to be indicated on the roadway plans.

STABILITY SECTION  
 STA. 145+00 & 150+00, US 555

PREPARED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

Cell: R001, R002, R003, R004, R005, R006, R007, R008, R009, R010, R011, R012, R013, R014, R015, R016, R017, R018, R019, R020, R021, R022, R023, R024, R025, R026, R027, R028, R029, R030, R031, R032, R033, R034, R035, R036, R037, R038, R039, R040, R041, R042, R043, R044, R045, R046, R047, R048, R049, R050, R051, R052, R053, R054, R055, R056, R057, R058, R059, R060, R061, R062, R063, R064, R065, R066, R067, R068, R069, R070, R071, R072, R073, R074, R075, R076, R077, R078, R079, R080, R081, R082, R083, R084, R085, R086, R087, R088, R089, R090, R091, R092, R093, R094, R095, R096, R097, R098, R099, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, 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R996, R997, R998, R999, R1000.





Core Log Sta. 324+00, 50' L.T.  
 Elev. 979.0-985.9 Limestone f L.t. gray, fine grained-fine crystalline  
 w/solutioned bedding planes

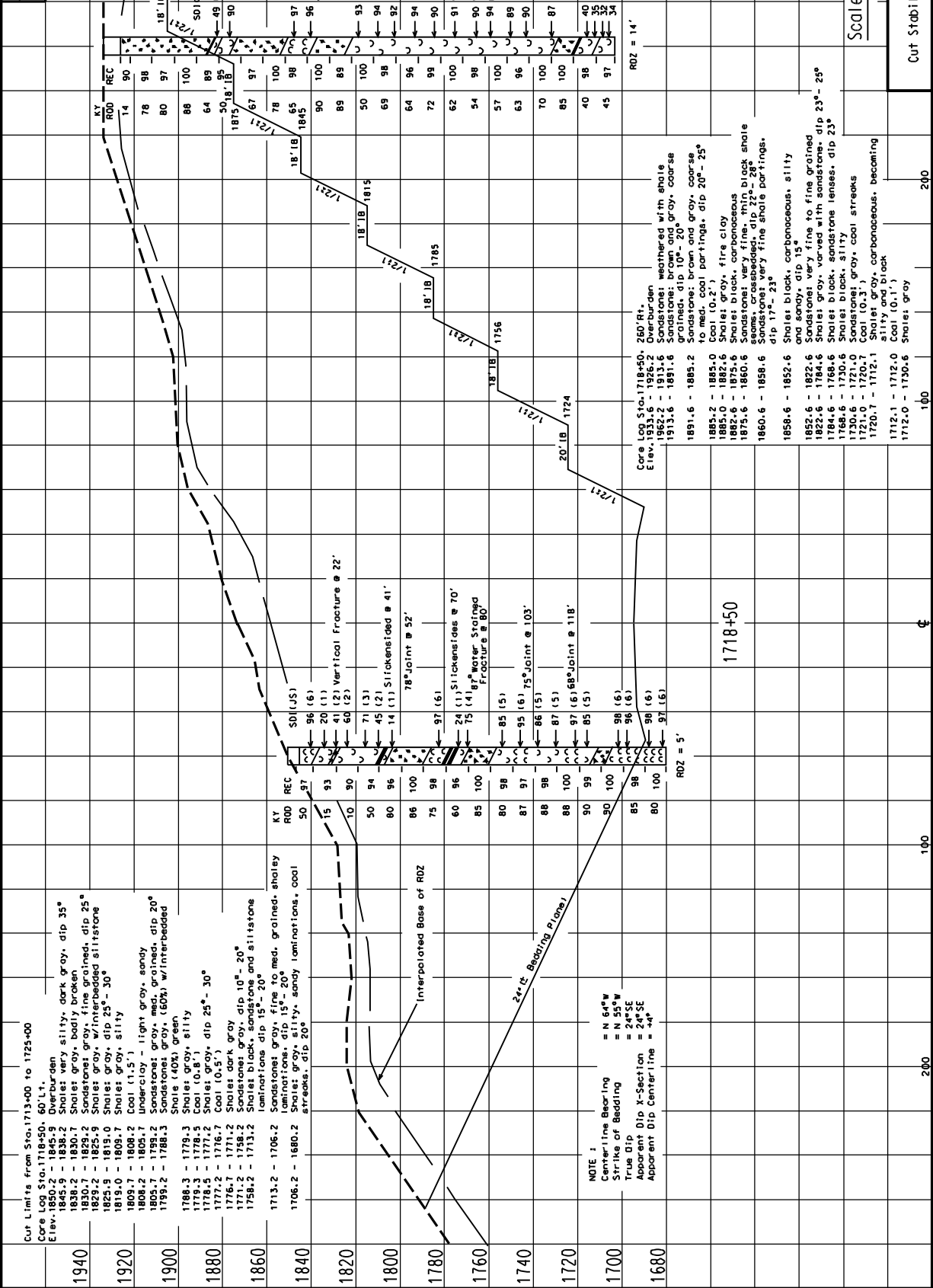
Open Face Log Sta. 324+00, L.T. Side  
 Elev. 966.0-951.0 Limestone f L.t. gray, beds 0.5'-1.5' thick

NOTE: The Intermediate Bench @ Elev. 951 transitions  
 from 18' @ Station 320+50 to Zero @ Station 322+00

Core Log Sta. 316+50, 37' L.T.  
 Elev. 964.2-961.2 Overburden  
 961.2-959.0 Limestone f Tan-Lt. gray, fine crystalline-fine grained  
 959.0-951.1 Sandstone f Lt. gray, fine grained /finely shaly laminations  
 increasing w/depth (durable)  
 951.1-925.9 Shale f black, carbonaceous  
 925.9-918.8 Shale f granular-gray w/silicaceous  
 918.8-908.5 Shale f reddish-brown /finely silicaceous & a few  
 sandstone laminations

PREPARED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

Celli Liborova, Kyril Celi  
 DC-MVA-YRYY HMM  
 Celli Kyril 380



Core Log Sta. 1718+50, 60' L.T.  
Elev. 1823.5 - 1845.2  
1838.2 - 1830.7  
1830.7 - 1829.2  
1829.2 - 1825.9  
1825.9 - 1819.0  
1819.0 - 1809.7  
1809.7 - 1808.2  
1808.2 - 1805.7  
1805.7 - 1798.2  
1798.2 - 1788.3  
1788.3 - 1778.3  
1778.3 - 1771.2  
1771.2 - 1771.2  
1771.2 - 1758.2  
1758.2 - 1713.2  
1713.2 - 1706.2  
1706.2 - 1860.2

1940  
1920  
1900  
1880  
1860  
1840  
1820  
1800  
1780  
1760  
1740  
1720  
1700  
1680

Vertical water  
Stained joint @ 62°  
Vertical Fractures @ 90-94°  
78° Joint @ 120°  
68° Joint @ 170°  
Stikesided @ 212°  
RDZ = 14'

Core Log Sta. 1718+50, 260' R.T.  
Elev. 1823.5 - 1845.2  
1838.2 - 1830.7  
1830.7 - 1829.2  
1829.2 - 1825.9  
1825.9 - 1819.0  
1819.0 - 1809.7  
1809.7 - 1808.2  
1808.2 - 1805.7  
1805.7 - 1798.2  
1798.2 - 1788.3  
1788.3 - 1778.3  
1778.3 - 1771.2  
1771.2 - 1771.2  
1771.2 - 1758.2  
1758.2 - 1713.2  
1713.2 - 1706.2

1718+50  
RDZ = 5'

Scale: 1"=20'  
300

Cut Stability Section Sta. 1718+50

APPROVED BY \_\_\_\_\_  
CHECKED BY \_\_\_\_\_  
DATE \_\_\_\_\_

PREPARED BY \_\_\_\_\_  
DATE \_\_\_\_\_

Cell: 1718+50, 260' R.T.  
DO: 11/17/17  
HR: HW

CU TRIAXIAL TEST

**Project Data:**  
 County: Springfield  
 Route: US 555  
 Date: 08/02/04  
 Operator: B. King  
 Project #: FD52 129 0555 005-023 009 D  
 Item #: 13-765.00

Failure Criterion: Maximum Obliquity

Circle Number	Time (min)	PWP (psi)	Cell Pressure (psi)	Δ L (in)	Piston Force (P) (lbs)	ε-Vertical Strain	Deviator Stress (psi)	σ <sub>1</sub> (psi)	σ <sub>3</sub> (psi)
1	150	68.37	75	0.3904	133.6348	0.069777	19.54	94.54	75
2	207	62.99	75	0.5342	207.9203	0.095838	29.68	104.68	75
3	210	56.8	75	0.5443	286.1745	0.098143	41.2	116.2	75

Calculated Values:

φ (deg)	a (psi)	% Difference PQ vs. Mohr:
25.7	1.9	
φ (deg)	c' (psf)	φ (deg)
28.8	305.7	0.31%
		c' (psf)
		0.21%

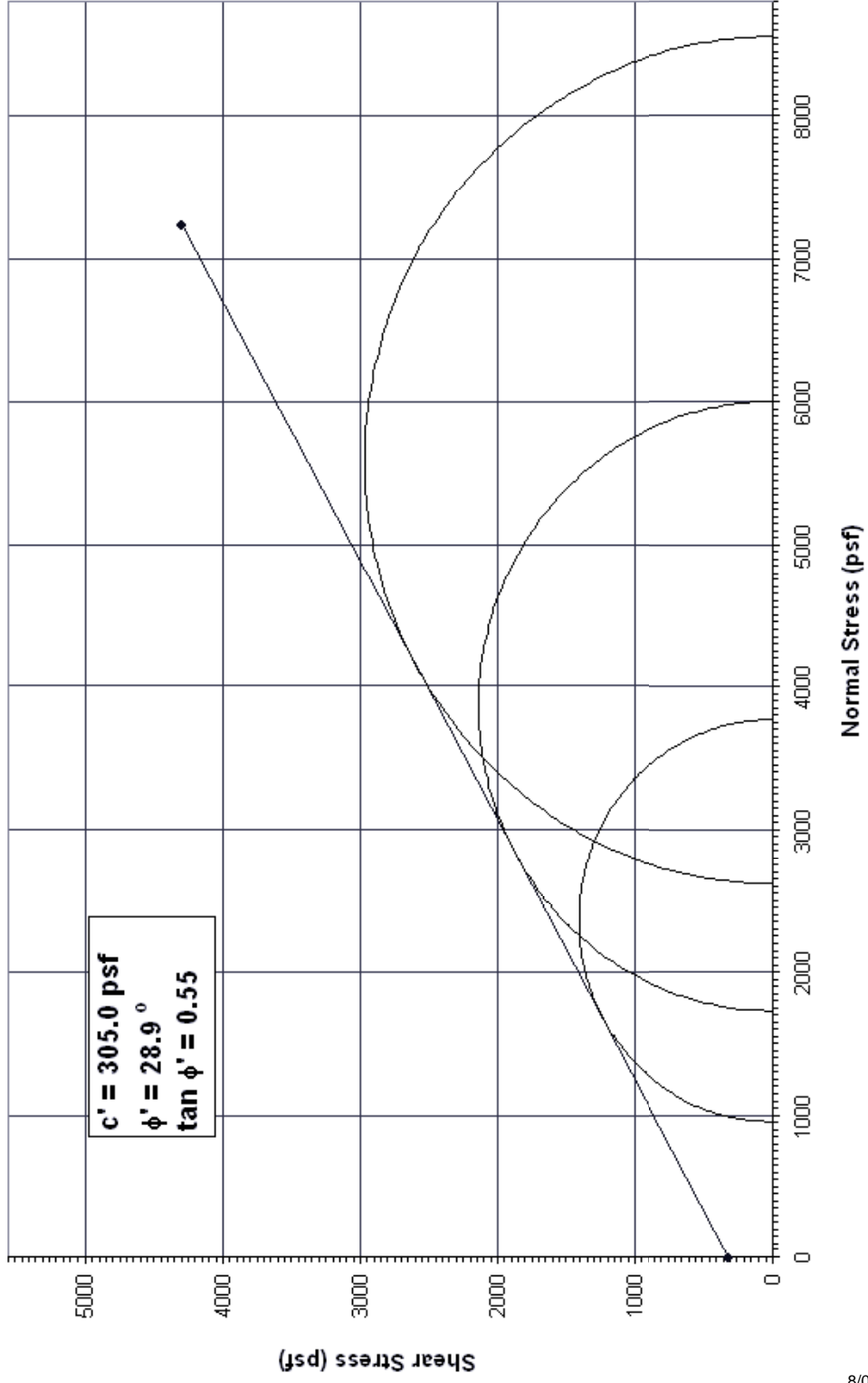
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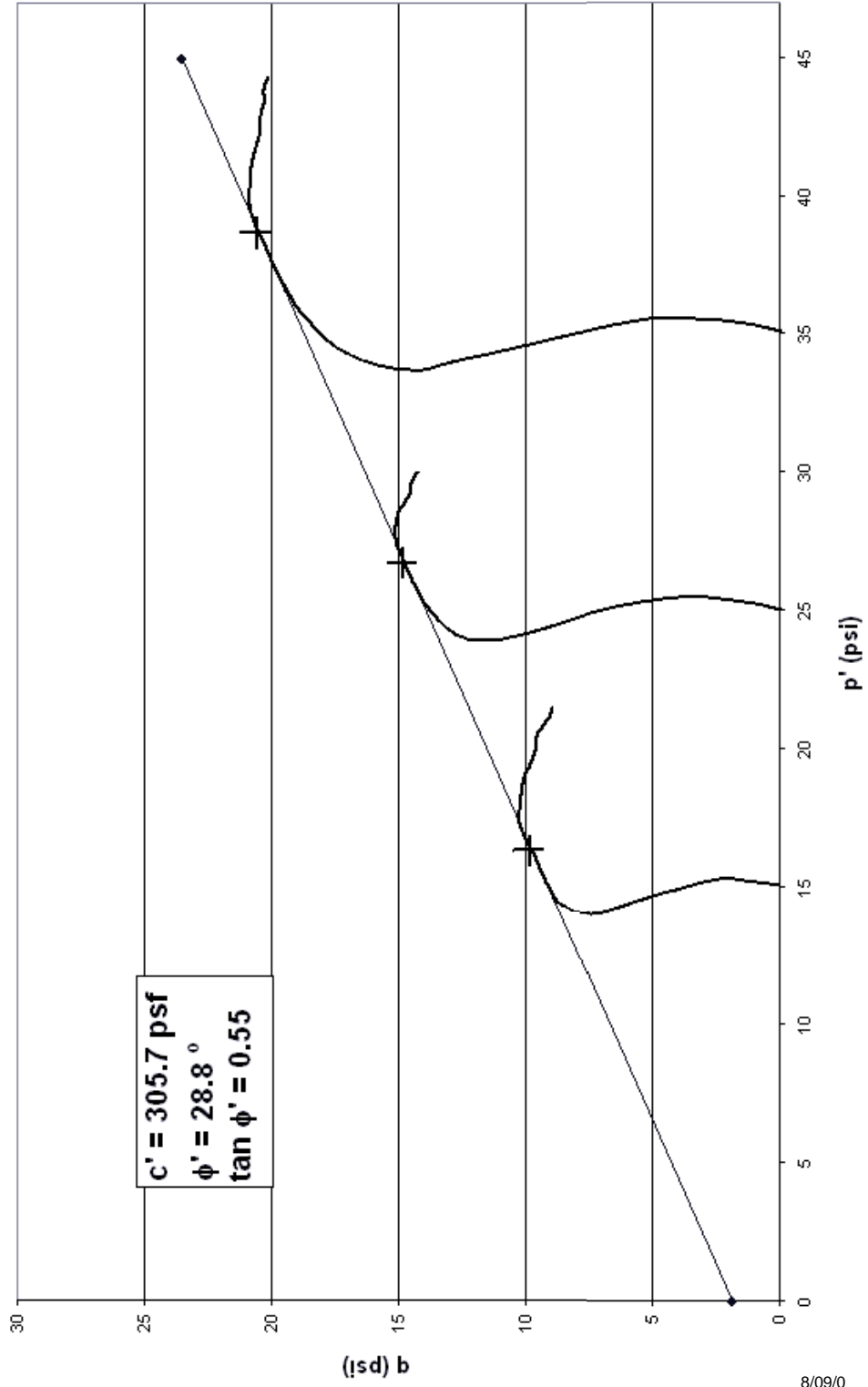
Test Results Based on

Mohr Circle Analysis:
φ (deg)
28.9
c' (psf)
305.0

Specimen Data:

Circle #	Station	Depth	Description	Initial Pressures:		Moisture Content
				Cell	Back	
1	40+50, 20 LT.	15-17.5'	Gray Clay	75	60	20.5%
2	40+50, CL	15-17.5'	Gray Clay	75	50	17.3%
3	40+50, CL	20-22.5'	Gray Clay	75	40	19.2%





**KENTUCKY TRANSPORTATION CABINET**  
 Division of Materials  
 Geotechnical Branch  
 1236 Wilkinson Blvd.  
 Frankfort, KY 40601

Tested by: Chris Groves  
 Technical Responsibility: Dean Clements  
 Consolidated, Undrained Triaxial Compression Test  
 AASHTO T 297-94

Date: 7/26/2004  
 Operator: B. King  
 File Name: Spring\_15  
 Item #: 13-765.00  
 Project #: FD52 129 0555 005-023 009 D  
 Mars #: 6895401D  
 Load Frame #: 1  
 Cell #: 1

County: Springfield  
 Station: 40+50  
 Offset: 20' LT.  
 Hole #: 35  
 Depth: 15-17.5'  
 Visual Description: Gray Clay  
 Panel #: 1

**Penetrometer/Torvane Readings:**

1.)	<u>0.5</u>
2.)	<u>0.7</u>
3.)	<u>0.4</u>
Average:	<u>0.5</u>

**Moisture Content:**

	Initial	Final
Can #:	<u>105</u>	<u>28</u>
Tare (g):	<u>46.3</u>	<u>55.12</u>
Wet Sample + Tare (g):	<u>336.2</u>	<u>113.96</u>
Dry Sample + Tare (g):	<u>286.9</u>	<u>102.63</u>
Moisture Content:	<u>20.5</u>	<u>23.8</u>

**Sample Diameter ( # . # # # in.):**

1.)	<u>2.723</u>
2.)	<u>2.891</u>
3.)	<u>2.798</u>
Average:	<u>2.804</u>

**Initial Weight (g):**

1238.4

**Sample Height ( # . # # # in.):**

1.)	<u>5.862</u>
2.)	<u>5.731</u>
3.)	<u>5.815</u>
Average:	<u>5.803</u>

**Saturation Pressure:**

Cell (psi):	<u>62</u>
Back (psi):	<u>60</u>

**B-Value Determination:**

Pressure, $u$ , before increasing $\sigma_3$ (psi):	<u>59.5</u>
Pressure, $u$ , after increasing $\sigma_3$ (psi):	<u>69.3</u>
B-Value ( $\Delta u / \Delta \sigma_3$ ):	<u>98</u> %

**Consolidation Pressure:**

Cell (psi):	<u>75</u>
Back (psi):	<u>60</u>

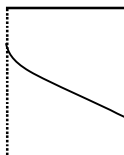
**Shear:**

20%  
0.0025 in./min.

**Piston Measurement (in.):**

5.176 (before saturation)

Failure Sketch:



Remarks:

**Consolidation Data:**

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	<u>49.3</u>	<u>5.190</u>
0.1	6 (sec)	<u>48.5</u>	
0.2	12 (sec)	<u>47.2</u>	
0.5	30 (sec)	<u>46.9</u>	
1	1 (min)	<u>46.5</u>	
2	2 (min)	<u>46.0</u>	
4	4 (min)	<u>45.3</u>	
8	8 (min)	<u>44.2</u>	
15	15 (min)	<u>42.8</u>	<u>5.126</u>
30	30 (min)	<u>41.1</u>	<u>5.109</u>
60	1 (hr)	<u>38.7</u>	<u>5.085</u>
120	2 (hr)	<u>36.1</u>	<u>5.060</u>
240	4 (hr)	<u>33.5</u>	<u>5.034</u>
480	8 (hr)	<u>31.2</u>	<u>5.011</u>
1440	24 (hr)	<u>29.6</u>	<u>4.995</u>

Start Date: 7/27/04  
 Start Time: 8:00 AM

**KENTUCKY TRANSPORTATION CABINET**  
 Division of Materials  
 Geotechnical Branch  
 1236 Wilkinson Blvd.  
 Frankfort, KY 40601

Tested by: Chris Groves  
 Technical Responsibility: Dean Clements  
 Consolidated, Undrained Triaxial Compression Test  
 AASHTO T 297-94

Date: 7/26/2004  
 Operator: B. King  
 File Name: Spring\_15  
 Item #: 13-765.00  
 Project #: FD52 129 0555 005-023 009 D  
 Mars #: 6895401D  
 Load Frame #: 1  
 Cell #: 2

County: Springfield  
 Station: 40+50  
 Offset: CL  
 Hole #: 36  
 Depth: 15-17.5'  
 Visual Description: Gray Clay  
 Panel #: 1

**Penetrometer/Torvane Readings:**

1.)	<u>0.8</u>
2.)	<u>0.3</u>
3.)	<u>0.4</u>
Average:	<u>0.5</u>

**Moisture Content:**

	Initial	Final
Can #:	<u>3</u>	<u>60</u>
Tare (g):	<u>48</u>	<u>54.52</u>
Wet Sample + Tare (g):	<u>339</u>	<u>116.01</u>
Dry Sample + Tare (g):	<u>296</u>	<u>102.27</u>
Moisture Content:	<u>17.3</u>	<u>28.8</u>

**Sample Diameter ( # . # # # in.):**

1.)	<u>2.753</u>
2.)	<u>2.855</u>
3.)	<u>2.796</u>
Average:	<u>2.801</u>

**Initial Weight (g):**

1210.5

**Sample Height ( # . # # # in.):**

1.)	<u>5.891</u>
2.)	<u>5.828</u>
3.)	<u>5.811</u>
Average:	<u>5.843</u>

**Saturation Pressure:**

Cell (psi):	<u>62</u>
Back (psi):	<u>60</u>

**B-Value Determination:**

Pressure, $u$ , before increasing $\sigma_3$ (psi):	<u>59.4</u>
Pressure, $u$ , after increasing $\sigma_3$ (psi):	<u>69.3</u>
B-Value ( $\Delta u / \Delta \sigma_3$ ):	<u>99</u> %

**Consolidation Pressure:**

Cell (psi):	<u>75</u>
Back (psi):	<u>50</u>

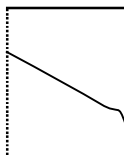
**Shear:**

20%  
 0.0025 in./min.

**Piston Measurement (in.):**

5.178 (before saturation)

Failure Sketch:



Remarks:

**Consolidation Data:**

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	<u>49.2</u>	<u>5.193</u>
0.1	6 (sec)	<u>47.7</u>	
0.2	12 (sec)	<u>47.4</u>	
0.5	30 (sec)	<u>47.0</u>	
1	1 (min)	<u>46.5</u>	
2	2 (min)	<u>46.0</u>	
4	4 (min)	<u>45.2</u>	
8	8 (min)	<u>44.3</u>	
15	15 (min)	<u>43.0</u>	<u>5.132</u>
30	30 (min)	<u>41.4</u>	<u>5.116</u>
60	1 (hr)	<u>39.4</u>	<u>5.096</u>
120	2 (hr)	<u>37.4</u>	<u>5.076</u>
240	4 (hr)	<u>36.0</u>	<u>5.062</u>
480	8 (hr)	<u>35.7</u>	<u>5.059</u>
1440	24 (hr)	<u>35.4</u>	<u>5.056</u>

Start Date: 7/28/04  
 Start Time: 8:00 AM

**KENTUCKY TRANSPORTATION CABINET**

Division of Materials  
 Geotechnical Branch  
 1236 Wilkinson Blvd.  
 Frankfort, KY 40601

Tested by: B. King

Technical Responsibility: R. McDonald  
 Consolidated, Undrained Triaxial Compression Test  
 AASHTO T 297-94

Date: 7/26/2004  
 Operator: C. Doe  
 File Name: Spring\_15  
 Item #: 13-765.00  
 Project #: FD52 129 0555 005-023 009 D  
 Mars #: 6895401D  
 Load Frame #: 1  
 Cell #: 3

County: Springfield  
 Station: 40+50  
 Offset: CL  
 Hole #: 36  
 Depth: 20-22.5'  
 Visual Description: Gray Clay  
 Panel #: 1

**Penetrometer/Torvane Readings:**

1.)	0.6
2.)	0.5
3.)	0.4
Average:	0.5

**Moisture Content:**

	Initial	Final
Can #:	25	63
Tare (g):	46.4	55.42
Wet Sample + Tare (g):	283.2	159.68
Dry Sample + Tare (g):	245	141.76
Moisture Content:	19.2	20.8

**Sample Diameter ( # . # # # in.):**

1.)	2.823
2.)	2.894
3.)	2.806
Average:	2.841

**Initial Weight (g):**

1227.3
--------

**Sample Height ( # . # # # in.):**

1.)	5.862
2.)	5.799
3.)	5.828
Average:	5.830

**Saturation Pressure:**

Cell (psi):	62
Back (psi):	60

**B-Value Determination:**

Pressure, $u$ , before increasing $\sigma_3$ (psi):	60.2
Pressure, $u$ , after increasing $\sigma_3$ (psi):	70.2
B-Value ( $\Delta u / \Delta \sigma_3$ ):	100 %

**Consolidation Pressure:**

Cell (psi):	75
Back (psi):	40

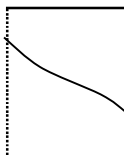
**Shear:**

20%  
 0.0025 in./min.

**Piston Measurement (in.):**

5.147 (before saturation)
---------------------------

Failure Sketch:



Remarks:

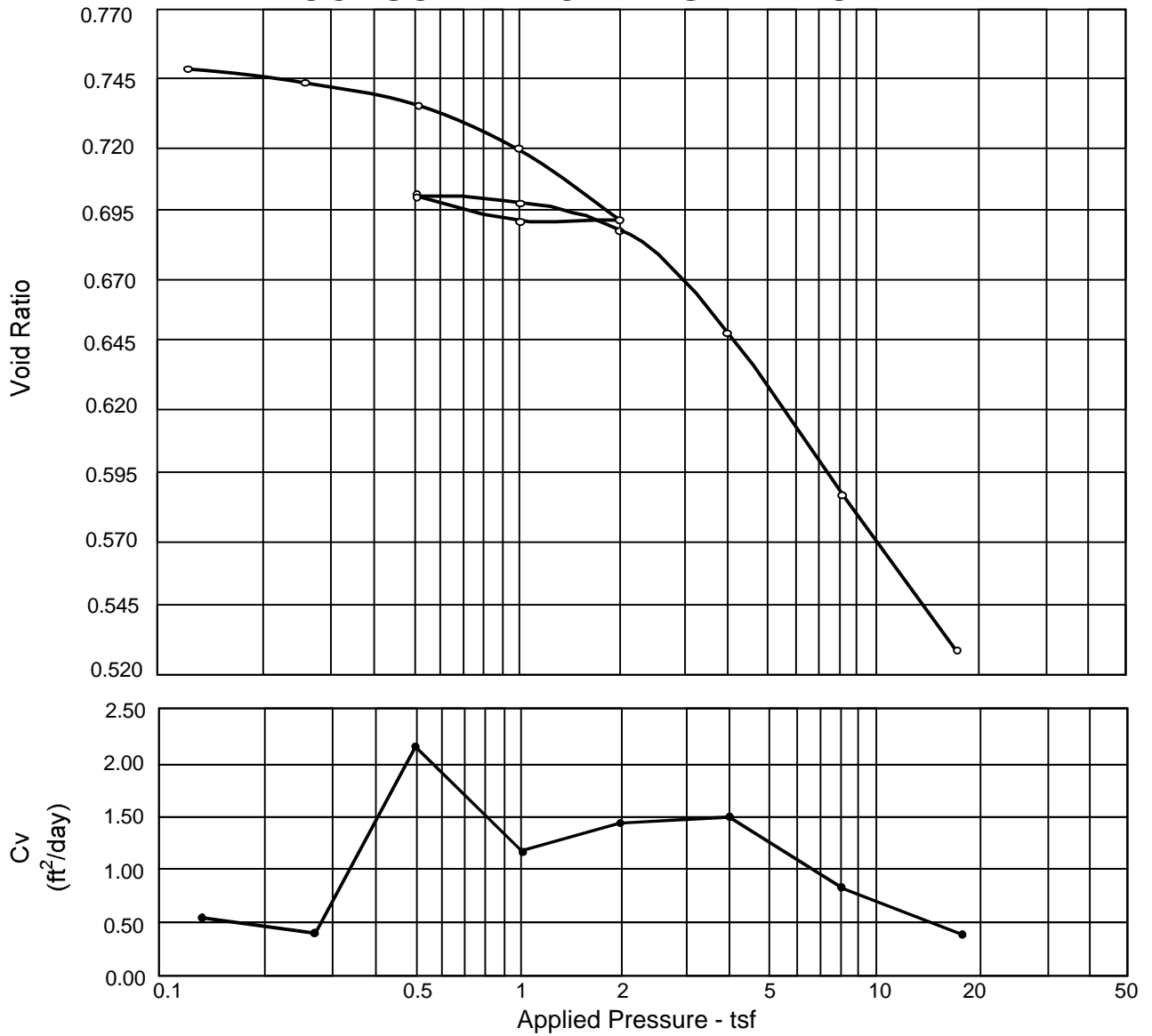
**Consolidation Data:**

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	49.3	5.161
0.1	6 (sec)	43.0	
0.2	12 (sec)	42.1	
0.5	30 (sec)	40.2	
1	1 (min)	38.5	
2	2 (min)	36.6	
4	4 (min)	34.8	
8	8 (min)	33.3	
15	15 (min)	32.5	4.999
30	30 (min)	32.1	4.995
60	1 (hr)	31.9	4.993
120	2 (hr)	31.7	4.992
240	4 (hr)	31.5	4.990
480	8 (hr)	31.4	4.989
1440	24 (hr)	31.4	4.989

Start Date: 7/29/04  
 Start Time: 8:00 AM



### CONSOLIDATION TEST REPORT



Natural	Dry Dens.	LL	PI	Sp. Gr.	Overburden	P <sub>c</sub>	C <sub>c</sub>	C <sub>r</sub>	Swell Press.	Swell %	e <sub>0</sub>
Sat.	(pcf)				(tsf)	(tsf)			(tsf)		
100.0%	78.6	43	19	2.75	0.6	1.7	0.26	0.02			0.7551

<b>MATERIAL DESCRIPTION</b>	<b>USCS</b>	<b>AASHTO</b>
Gray Silty - Clay	CL	A-7-6(19)

Project No. 0023      Client: Brown County  
 Project: FD52 121 0158 005-008 01 D

Location: 40+50 CL Hole No. 36

Consolidation Test Report

Kentucky Transportation Cabinet, Div. Of Materials

Remarks :

# GEOTECHNICAL SYMBOL SHEET

## AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (95% or less passing 0.075 mm)				Silt-Clay Materials (More than 95% passing 0.075 mm)			
	A-1	A-3	A-2	A-4	A-5	A-6	A-7	A-7.5
Group Classification	A-1-a A-1-b	A-3	A-2-4 A-2-5 A-2-6	A-4	A-5	A-6	A-7	A-7.5
Sieve Analysis, Percent Passing	50 max 30 max (No. 40) 15 max (No. 200)	51 max 25 max (No. 10)	35 max 35 max 35 max	35 max 35 min 35 min	35 min 36 min 36 min	36 min	36 min	36 min
Characteristics of Fraction Passing 0.425 mm (No. 40)	---	N.P.	40 max 10 max 10 max	40 max 10 min 10 max	40 max 10 min 10 max	40 max 10 min 10 max	40 max 10 min 10 max	40 max 10 min 10 max
Liquid Limit Plasticity Index	---	---	---	---	---	---	---	---

## Unified Soil Classifications

MAJOR DIVISIONS	SYMBOL	NAME
GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
	GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
	GM	Silty gravels, gravel-sand-silt mixtures.
	GC	Clayey gravels, gravel-sand-clay mixtures.
SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
	SP	Poorly graded sands or gravelly sands, little or no fines.
	SM	Silty sands, sand-silt mixtures.
	SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
	CL	Inorganic clays of low to medium plasticity, lean clays.
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, fat clays.
	CH	Inorganic clays of high plasticity, fat clays.
UNCLASSIFIED MATERIAL	NONE	Non-classified material (i.e. overburden, overburden, etc.) Includes visual description.

- PI Plasticity Index
- AJ Activity Index
- LI Liquidity Index
- S-C Silt + Clay (% finer than No. 200 Sieve)
- Rockline Soundings
- Disturbed Sample Boring
- Undisturbed Sample Boring
- Undisturbed Sample Boring & Rock Core
- Rock Core
- Slope inclinometer Installation
- typical applications:
- Observation Well
- Water Elevation
- Field Vane Shear Strength
- Thin-Walled Tube Sample
- Standard Penetration Test Sample
- Penetration Resistance
- Unconfined Compressive Strength
- Unconsolidated Undrained Triaxial Strength
- Moisture Content
- Rock Quality Designation (Kentucky Method)
- Rock Quality Designation (Standard Method)
- Slake Durability Index (Jar Slake Test)
- Core Recovery
- Angle of Internal Friction (Total Stress)
- Angle of Internal Friction (Effective Stress)
- Cohesion (Total Stress)
- Cohesion (Effective Stress)
- Total Unit Weight
- Rock Disintegration Zone
- Overburden Bench
- Intermediate Bench
- Refusal
- Refusal Not Encountered

- LIMESTONE
- SANDSTONE
- DURABLE SHALE (SDI ≥ 95)
- NONDURABLE SHALE (SDI < 95)
- COAL
- TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.
- GRANULAR EMBANKMENT
- STRUCTURE GRANULAR BACKFILL
- SLOPE PROTECTION

- GEOTECHNICAL SYMBOL SHEET

PREPARED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

# GEOTECHNICAL NOTES

COUNTY OF	SHEET NO.
SPRINGFIELD	97-765.00

10. The contractor shall conduct grading operations in such a manner that soil from roadway excavation be stockpiled separately or otherwise manipulated so that ample quantities are available for a chemically stabilized roadbed meeting the specifications in Section 208 of the current Standard Specifications for Road and Bridge Construction. No direct payment will be allowed for such necessary manipulating as stockpiling, hauling and/or handling the material.

11. Any saturated, unstable material encountered in existing creek beds and/or drainage swales within embankment foundation limits shall be drilled and stabilized with 3"-11" of limestone and/or durable shale from roadway excavation or as directed by the Engineer. Positive drainage shall be maintained to prevent trapping water within the roadway embankment. The placement of this material is incidental to the unit bid price for roadway excavation or embankment-in-place.

12. Some of the soil horizons and slopes on the project are subject to erosion. Necessary procedures in accordance with Sections 212 and 213 of the current Standard Specifications shall be followed on construction.

13. The following cut intervals shall be constructed with 2 1/2:1 or flatter slopes.

<b>MAINLINE</b>	Stations 268+50 to 276+50
Stations 247+50 to 263+00	Stations 342+50 to 346+50 Right Side
Stations 304+00 to 308+00 Left Side	Stations 310+50 to 313+50
Stations 361+50 to 368+50	Stations 424+00 to 443+50
Stations 412+50 to 422+00	

KY 67B West  
 Stations 46+50 to 50+00  
 Stations 44+50 to 56+50  
 John Eaton Rd.

14. The following cut intervals shall be constructed with 3:1 or flatter slopes. Stability Sheets are attached.

**MAINLINE**  
 Stations 225+00 to 238+50      Stations 316+50 to 331+50

15. Appropriate treatment, as outlined in the Standard Specifications, shall apply to all culverts, septic tanks, and associated lateral lines within the construction limits.

16. A possible spring and or pump house was noted during the field investigation at the following approximate locations. A spring box with a pipe outlet at the toe of slope shall be constructed if the Engineer determines that a defined area of flow can be located. If not, a 1'-0" (2) foot thick drainage blanket wrapped in Geotextile fabric, Type IV shall be placed approximately 12 feet wide to the toe of the embankment to assure positive drainage. The fabric shall be in accordance with Section 214 & 842, Type IV of the current edition of Standard Specifications for Road and Bridge Construction. The drainage blanket material shall consist of Coarse Aggregate for Rock Drainage Blanket in accordance with the current edition of Section 805 of the Standard Specifications for Road and Bridge Construction, except natural sand will not be permitted.

**MAINLINE**  
 Station 264+50 25' Rt.      Station 346+65 Centerline      Station 425+75 Centerline

17. The ponds at the following approximate locations are within roadway cut limits and shall be drained. Any soft, saturated material excavated from this cut area may not be suitable for use in embankments. Use of this material shall be limited to final dressing of roadway slopes, as directed by the Engineer.

**MAINLINE**  
 Station 235+50 100' Rt.      Station 252+30 40' Lt.

1. In accordance with Section 206 of the current Standard Specifications, the moisture content of embankment material shall not vary from the optimum moisture content as determined by M 64-511 by more than +2 percent or less than -2 percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment construction. Refer to the Family of Curves for moisture/density correlation.

2. All soils, whether from roadway or borrow, may require manipulation to obtain proper moisture content prior to compaction. Direct payment shall not be permitted for rehandling, hauling, stockpiling, and/or manipulating soils.

3. Excavation of surface ditches and channel changes adjacent to embankment areas shall be performed prior to the placement of the adjacent embankments. The material excavated for the channel changes and surface ditches is suitable for embankment construction if dried to proper moisture content in accordance with Section 206 of the current Standard Specifications.

4. The contractor is responsible for conducting any operations necessary to excavate the cut areas to the required typical section. These operations shall be incidental to the roadway price.

5. Perforated pipe for subgrade drainage shall be placed in vertical sags in accordance with R0P-005 at the following approximate locations and/or where designated by the Engineer.

<b>MAINLINE</b>	Station 292+00      Station 374+00
Bushong Rd.	KY 67B West
Station 52+50	Station 47+00
Connection to	
Station 50+50	

6. The contractor shall construct foundation embankment benches and transverse benches as indicated on the plans and/or as directed by the Engineer, prior to placement of embankments in areas requiring such benches.

7. Transverse benching and/or perforated pipe underdrains shall be installed at the following approximate locations and any others designated by the Engineer. Underdrains shall be placed on both the upgrade and downgrade cut to fill transitions.

<b>MAINLINE</b>	Station 247+50      Station 263+00
Station 224+90	Station 218+00
Station 268+40	Station 282+80
Station 303+90	Station 307+75
Station 342+80	Station 316+80
Station 368+75	Station 352+00
Station 393+75	Station 374+60
Station 443+70	Station 412+50      Station 433+80

Backbridge School Rd.  
 Station 49+50      KY 67B East  
 Station 56+25

8. Foundation embankment benches shall be placed in accordance with Standard Drawing R0X-010 at the locations listed below and/or as directed by the Engineer.

<b>MAINLINE</b>	Stations 243+75 to 246+75 Lt.
Stations 242+75 to 245+25 Rt.	Stations 316+25 to 317+25 Lt.
Stations 264+75 to 266+75 Rt.	Stations 348+75 to 354+75 Rt.
Stations 330+75 to 334+75 Lt.	Stations 409+25 to 412+75 Rt.
Stations 373+25 to 374+25 Lt.	Stations 432+75 to 433+75 Lt.
Stations 426+25 to 431+75 Rt.	Stations 443+75 to 444+25 Rt.

9. The contractor shall conduct grading operations in such a manner that limestone and/or durable shale (SD) > 95) from roadway excavation be stockpiled separately or otherwise manipulated so that ample quantities are available for those areas requiring said material. No direct payment will be allowed for such necessary manipulating as stockpiling, hauling and/or handling the material.

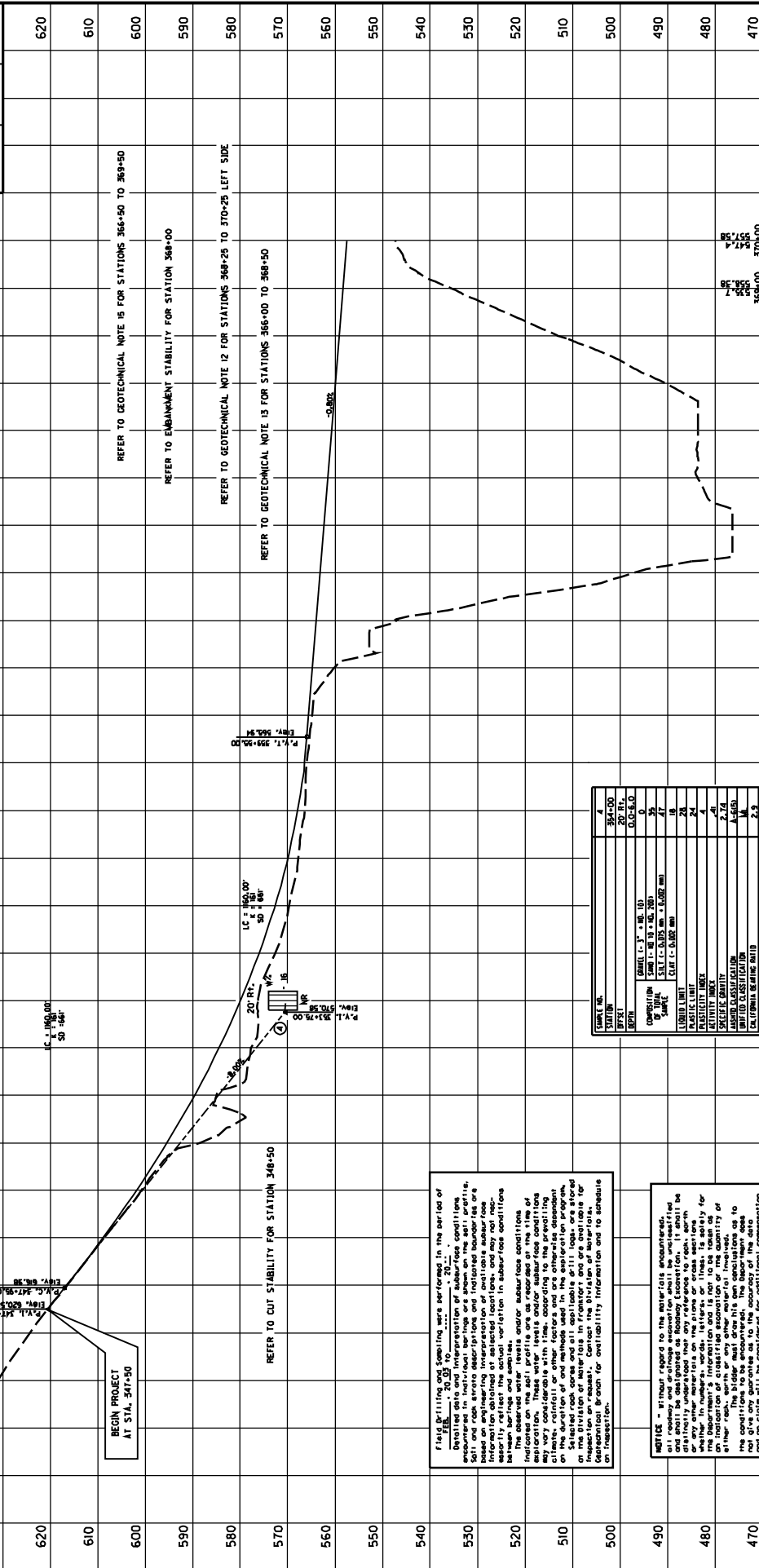
**KENTUCKY**  
**DEPARTMENT OF HIGHWAYS**  
**COUNTY OF**  
**SPRINGFIELD**

PROJECT  
 NUMBER

GEOTECHNICAL NOTES

PREPARED BY	APPROVED BY
DATE	DATE
CHECKED BY	DATE
DATE	

Cell: Liberty, Ky, Inc.  
 800-444-1177  
 FAX: 502-223-1177



Field drilling and sampling was performed in the vicinity of the ... 20+00 to ... 20+00. Detailed data and interpretation of subsurface conditions, soil and rock strata descriptions and indicated boundaries are based on engineering interpretation of available subsurface data. The actual variation in subsurface conditions between borings and samples and/or subsurface conditions indicated on the soil profiles are as recorded on the site of separation. These water levels and/or subsurface conditions are not to be used for design purposes. All other factors and data are subject to change and are not to be used in the design of and methods used in the excavation program. The Division of Materials in Lexington and to schedule inspection on request. Contact the Division of Materials in Lexington for additional information and to schedule an investigation.

NOTICE - without regard to the materials encountered, all roadway and drainage excavation shall be unclassified and shall be backfilled with approved borrow material. No other materials on the site or from other sources shall be used for backfilling. The Department's information and is not to be taken as an indication of classification or the quantity of material. The bidder must draw his own conclusions as to the nature and extent of the subsurface conditions and no claim will be considered for additional compensation or time considered or not in connection with the classification shown.

DEPTH	SOIL CLASSIFICATION	WATER CONTENT (%)	FLUID LIMIT (%)	PLASTIC LIMIT (%)	SHRINKAGE (%)	UNIFORMITY COEFFICIENT	PERCENT FINER THAN NO. 200 SIEVE
0.00-0.50	CL	20	28	18	10	2.0	65
0.50-1.00	CL	20	28	18	10	2.0	65
1.00-1.50	CL	20	28	18	10	2.0	65
1.50-2.00	CL	20	28	18	10	2.0	65
2.00-2.50	CL	20	28	18	10	2.0	65
2.50-3.00	CL	20	28	18	10	2.0	65
3.00-3.50	CL	20	28	18	10	2.0	65
3.50-4.00	CL	20	28	18	10	2.0	65
4.00-4.50	CL	20	28	18	10	2.0	65
4.50-5.00	CL	20	28	18	10	2.0	65
5.00-5.50	CL	20	28	18	10	2.0	65
5.50-6.00	CL	20	28	18	10	2.0	65
6.00-6.50	CL	20	28	18	10	2.0	65
6.50-7.00	CL	20	28	18	10	2.0	65
7.00-7.50	CL	20	28	18	10	2.0	65
7.50-8.00	CL	20	28	18	10	2.0	65
8.00-8.50	CL	20	28	18	10	2.0	65
8.50-9.00	CL	20	28	18	10	2.0	65
9.00-9.50	CL	20	28	18	10	2.0	65
9.50-10.00	CL	20	28	18	10	2.0	65

PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
 APPROVED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

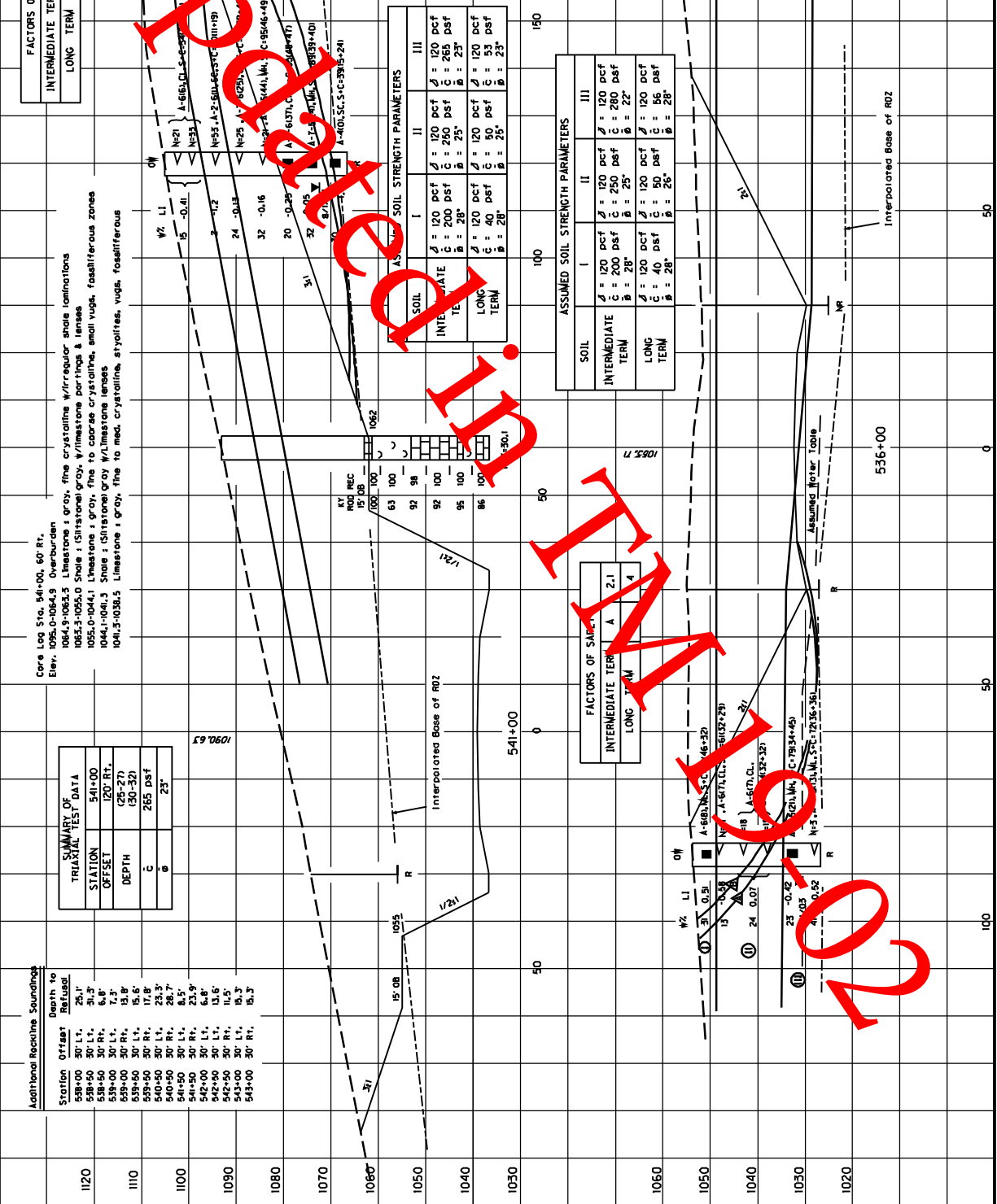


FACTORS OF SAFETY	
INTERMEDIATE TERM	A 1.9
LONG TERM	B 1.5

Core Log Sta. 541+00, 60' RT.  
 Elev. 1095.0-1064.3 Overburden  
 1084.9-1063.3 Limestone i. gray, fine crystalline w/irregular sande laminations  
 1083.3-1055.0 Shale i. (S)stratone gray, w/limestone partings & lenses  
 1055.0-1044.1 Limestone i. gray, fine to coarse crystalline, small vugs, fossiliferous zones  
 1044.1-1041.3 Shale i. (S)stratone gray w/limestone lenses  
 1041.3-1036.5 Limestone i. gray, fine to med. crystalline, sylvites, vugs, fossiliferous

SUMMARY OF TRIAXIAL TEST DATA	
STATION	541+00
OFFSET	120' RT.
DEPTH	(20-37)
	(50-57)
C	285 DSF
B	23'

Station	Offset	Depth to Refused
538+00	30' Lt.	25.1'
538+50	30' Lt.	31.3'
539+00	30' Rt.	6.8'
539+50	30' Lt.	7.5'
539+00	30' Rt.	13.8'
539+50	30' Lt.	15.6'
540+00	30' Lt.	21.3'
540+50	30' Lt.	23.3'
541+50	30' Lt.	8.5'
541+50	30' Rt.	23.9'
542+00	30' Lt.	6.8'
542+50	30' Lt.	13.6'
542+50	30' Rt.	11.5'
543+00	30' Lt.	15.3'
543+00	30' Rt.	15.3'



SOIL	I	II	III
INTERMEDIATE TERM	$\phi = 120$ dcf $c = 200$ dsf $b = 28'$	$\phi = 120$ dcf $c = 265$ dsf $b = 25'$	$\phi = 120$ dcf $c = 225$ dsf $b = 23'$
LONG TERM	$\phi = 120$ dcf $c = 40$ dsf $b = 28'$	$\phi = 120$ dcf $c = 50$ dsf $b = 25'$	$\phi = 120$ dcf $c = 33$ dsf $b = 23'$

SOIL	I	II	III
INTERMEDIATE TERM	$\phi = 120$ dcf $c = 200$ dsf $b = 28'$	$\phi = 120$ dcf $c = 260$ dsf $b = 25'$	$\phi = 120$ dcf $c = 220$ dsf $b = 22'$
LONG TERM	$\phi = 120$ dcf $c = 40$ dsf $b = 28'$	$\phi = 120$ dcf $c = 50$ dsf $b = 25'$	$\phi = 120$ dcf $c = 56$ dsf $b = 28'$

FACTORS OF SAFETY	
INTERMEDIATE TERM	A 2.1
LONG TERM	B 4

Additional Resistive Soundings

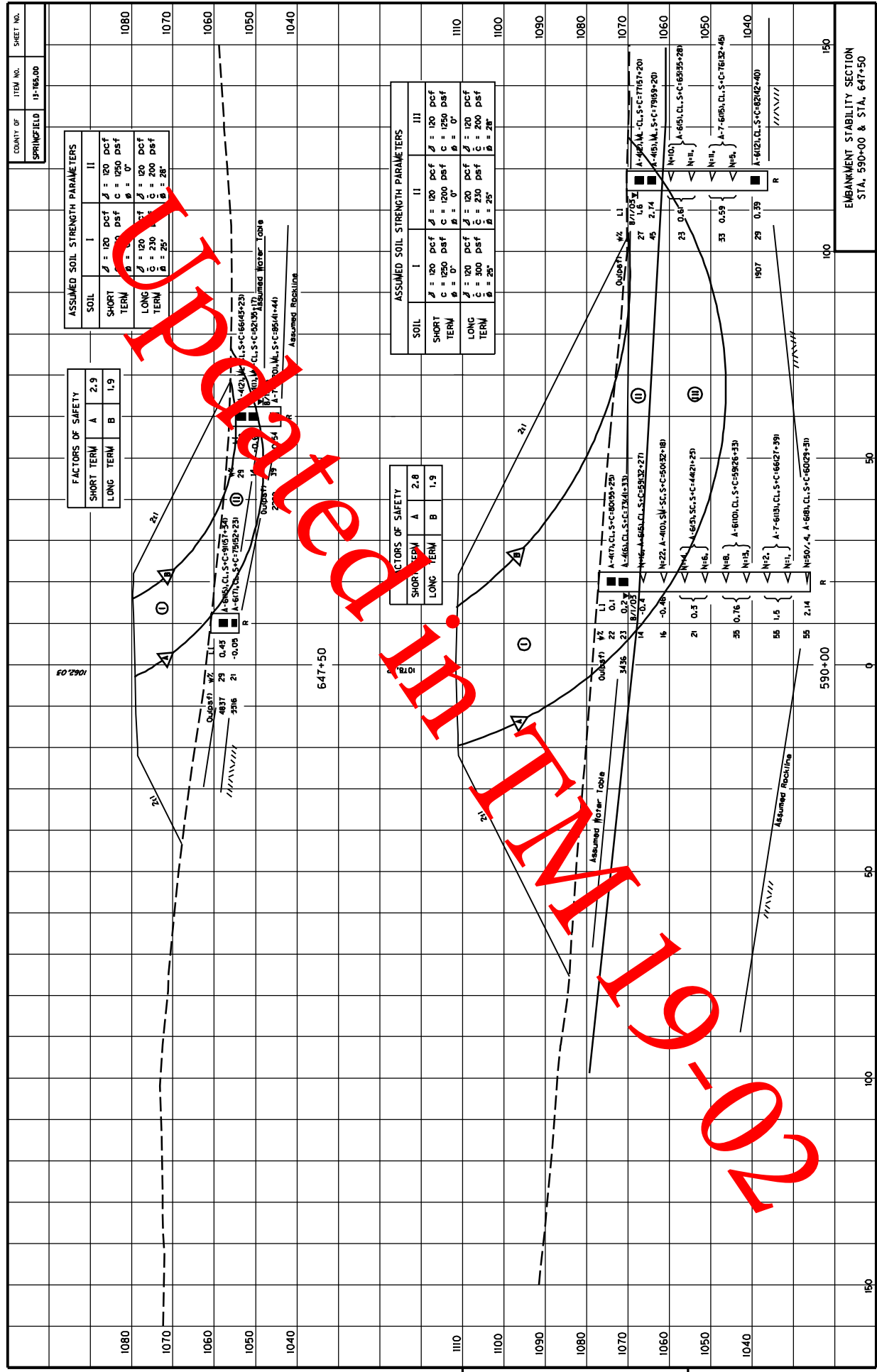
Station	Offset	Depth to Refused
533+00	30' Lt.	9.3'
533+00	30' Rt.	16.3'
533+50	30' Lt.	15.0'
534+00	30' Lt.	16.2'
534+50	30' Rt.	14.4'
534+50	30' Lt.	24.8'
535+00	30' Lt.	14.4'
535+50	30' Lt.	21.5'
535+50	30' Rt.	26' NR
536+50	30' Lt.	32' NR
536+50	30' Rt.	29' NR
537+00	30' Lt.	32' NR
537+50	30' Lt.	31.6'
537+50	30' Rt.	28.1'

ASSUMED SOIL STRENGTH PARAMETERS	
SOIL	II
SHORT TERM	$\phi = 120$ pcf $c = 1250$ psf $\beta = 0^\circ$
LONG TERM	$\phi = 120$ pcf $c = 200$ psf $\beta = 28^\circ$

FACTORS OF SAFETY	
SHORT TERM	A
LONG TERM	B

ASSUMED SOIL STRENGTH PARAMETERS		
SOIL	I	III
SHORT TERM	$\phi = 120$ pcf $c = 1200$ psf $\beta = 0^\circ$	$\phi = 120$ pcf $c = 1250$ psf $\beta = 0^\circ$
LONG TERM	$\phi = 120$ pcf $c = 200$ psf $\beta = 25^\circ$	$\phi = 120$ pcf $c = 200$ psf $\beta = 28^\circ$

FACTORS OF SAFETY	
SHORT TERM	A
LONG TERM	B

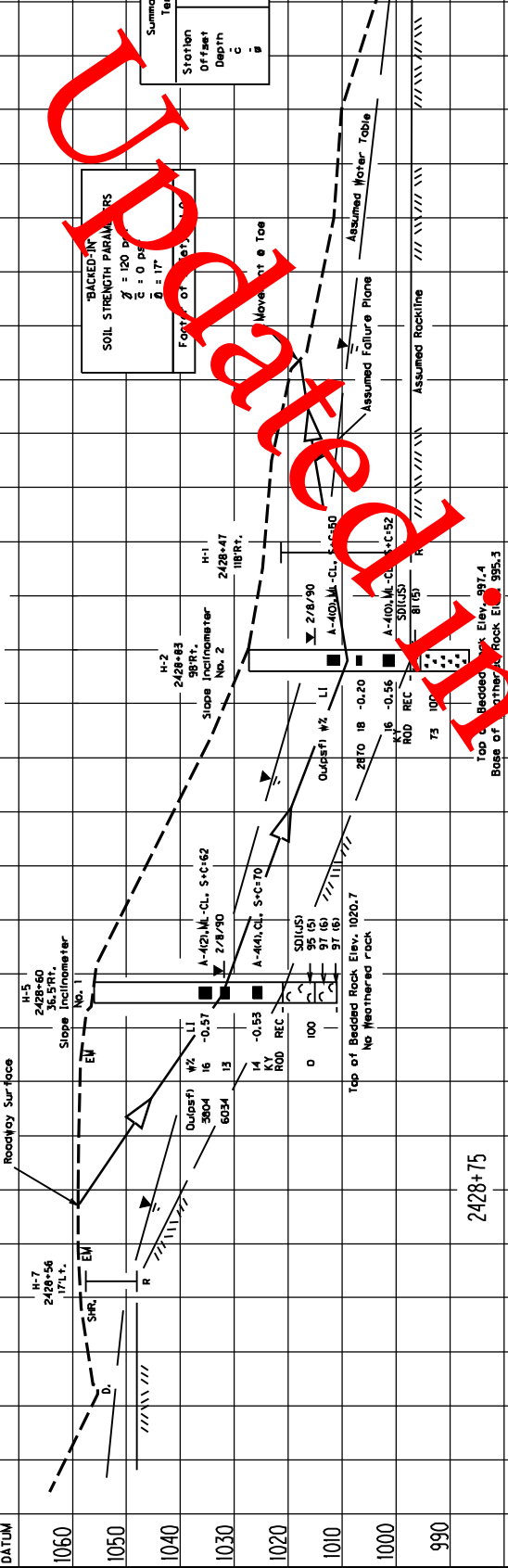


EMBRANKMENT STABILITY SECTION  
STA. 590+00 & STA. 647+50

PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
APPROVED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

Cell: Lbr/ryr hyl.co.il  
DW: h44-1774 h44.m4

TYPICAL SECTION  
EXISTING CONDITIONS



SOIL STRENGTH PARAMETERS

Backed up  
 $\phi = 120$  psf  
 $c = 0$  psf  
 $\delta = 17^\circ$

Forty feet  
 Station 2428+83  
 Offset 98 RR1  
 Depth 200 psf  
 $\phi = 30^\circ$

ASSUMED SOIL STRENGTH PARAMETERS

SOIL I	SOIL II
$\phi = 120$ psf	$\phi = 120$ psf
$c = 0$ psf	$c = 0$ psf
$\delta = 17^\circ$	$\delta = 38^\circ$

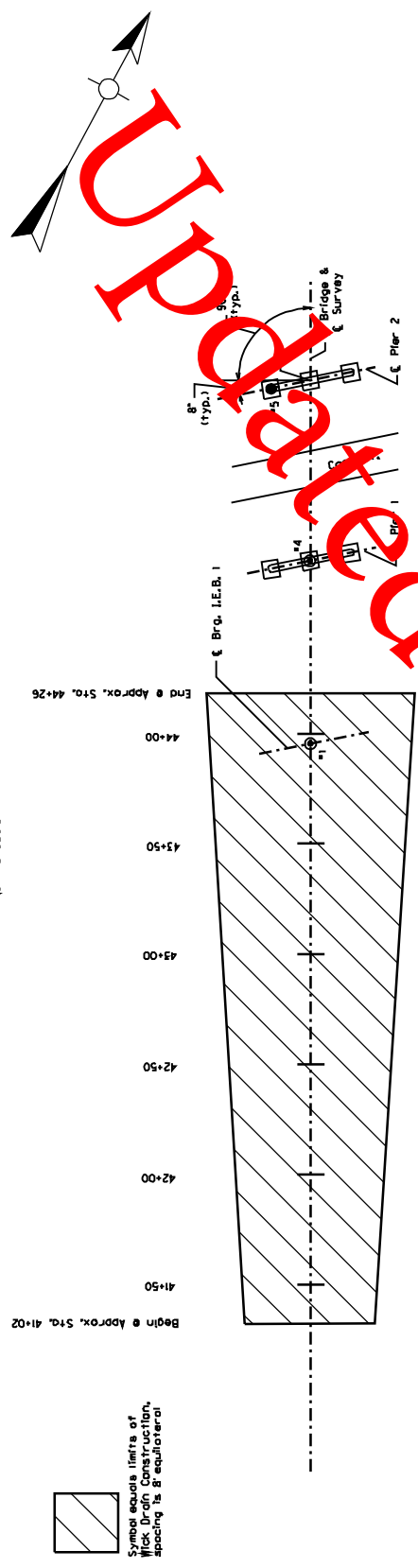
ROCK BERM CORRECTION  
F.S. = 1.5

DRAFT



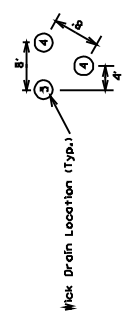
COUNTY OF	ITEM NO.	SHEET NO.
SPRINGFIELD	13-765.00	

**WICK DRAIN LAYOUT**  
Not To Scale

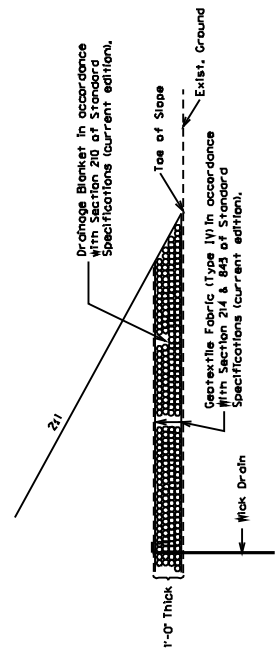


Symbol equals limits of Wick Drain Construction, spacing is 8' equilateral

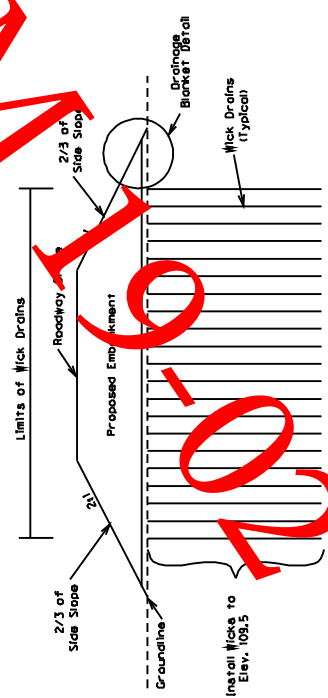
**PLAN VIEW - WICK DRAIN LOCATIONS**  
DETAIL - TRIANGULAR SPACING  
NOT TO SCALE



**DRAINAGE BLANKET DETAIL**  
Not To Scale



**TYPICAL SECTION - WICK DRAINS**  
Not To Scale



**KENTUCKY DEPARTMENT OF HIGHWAYS**  
**COUNTY OF SPRINGFIELD**

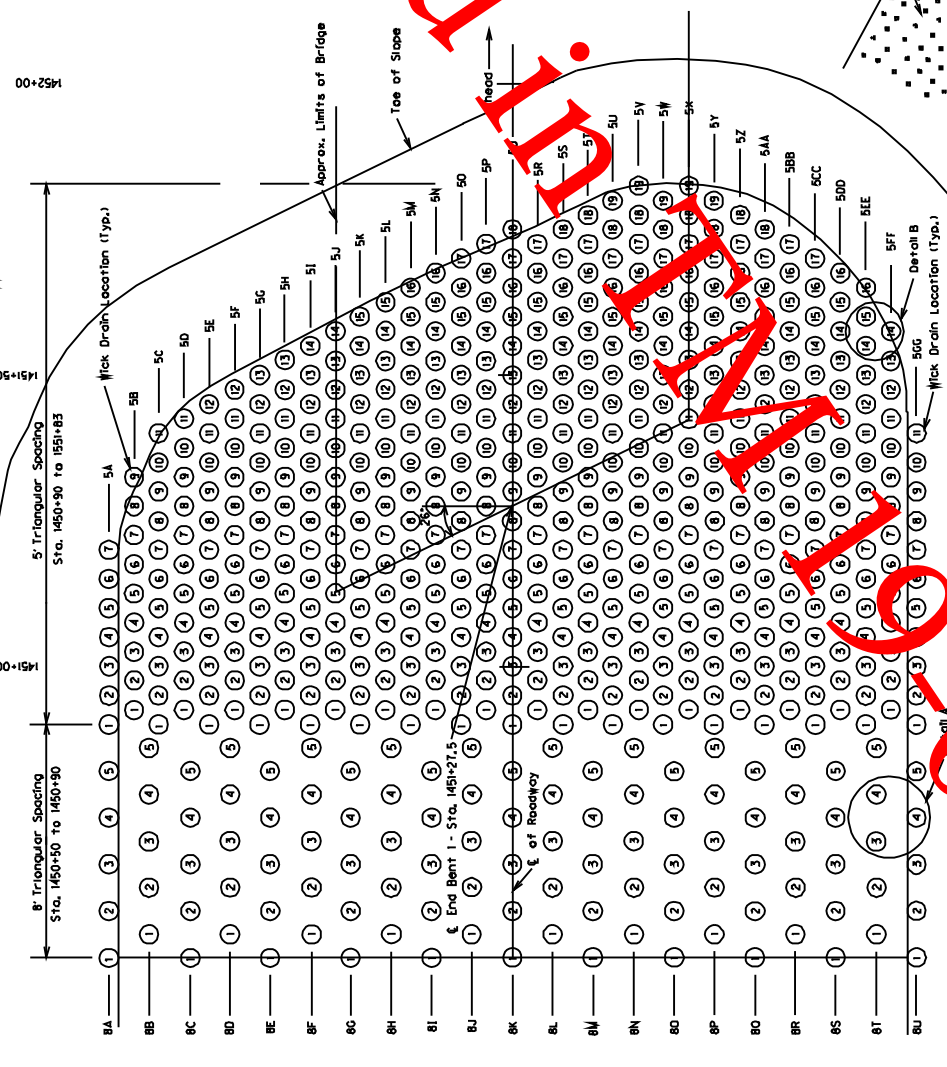
PROJECT NUMBER: \_\_\_\_\_

**WICK DRAIN DETAILS**

APPROVED BY	DATE
CHECKED BY	DATE
PREPARED BY	DATE

Cell: Lb'vry1 Kyo.cw  
D0-M-N-1777 H4M  
D01-Nom 550

**WICK DRAIN LOCATIONS**

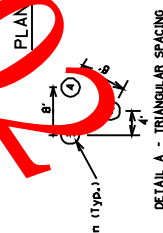
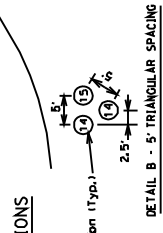
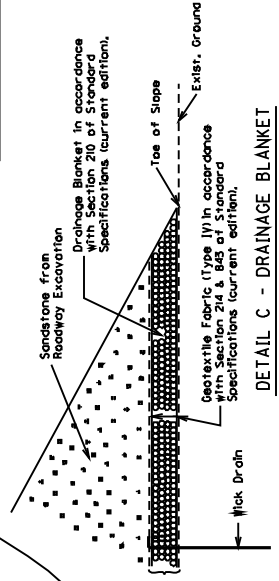
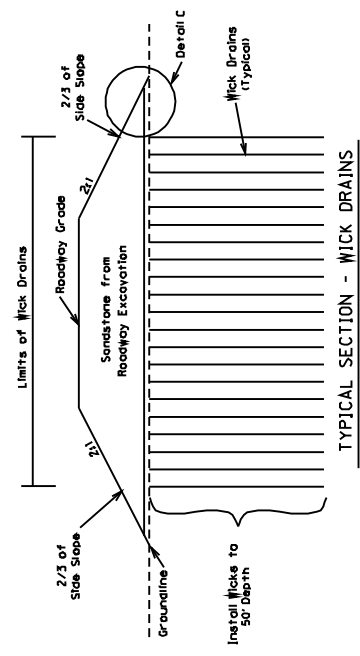


5' TRIANGULAR WICK DRAIN SPACINGS

ROW	OFFSET LEFT OF $\frac{1}{2}$ (FT.)	ROW	OFFSET RIGHT OF $\frac{1}{2}$ (FT.)
5A	69.3	5R	4.3
5B	65.0	5S	8.7
5C	60.6	5T	13.0
5D	56.3	5U	17.3
5E	52.0	5V	21.7
5F	47.6	5W	26.0
5G	43.3	5X	30.3
5H	39.0	5Y	34.6
5I	34.6	5Z	38.9
5J	30.3	5AA	43.3
5K	26.0	5AB	47.6
5L	21.7	5AC	52.0
5M	17.3	5AD	56.3
5N	13.0	5AE	60.6
5O	8.7	5AF	65.0
5P	4.3	5AG	69.3
5Q	0.0	5AH	-
5R	-	5AI	-
5S	-	5AJ	-

8' TRIANGULAR WICK DRAIN SPACINGS

ROW	OFFSET LEFT OF $\frac{1}{2}$ (FT.)	ROW	OFFSET RIGHT OF $\frac{1}{2}$ (FT.)
8A	69.3	8L	6.9
8B	62.4	8M	13.8
8C	55.4	8N	20.8
8D	48.5	8O	27.7
8E	41.6	8P	34.6
8F	34.6	8Q	41.6
8G	27.7	8R	48.5
8H	20.8	8S	55.4
8I	13.8	8T	62.4
8J	6.9	8U	69.3
8K	0.0	8V	-



**KENTUCKY**  
**DEPARTMENT OF HIGHWAYS**  
**COUNTY OF**  
**SPRINGFIELD**

PROJECT  
Mileage

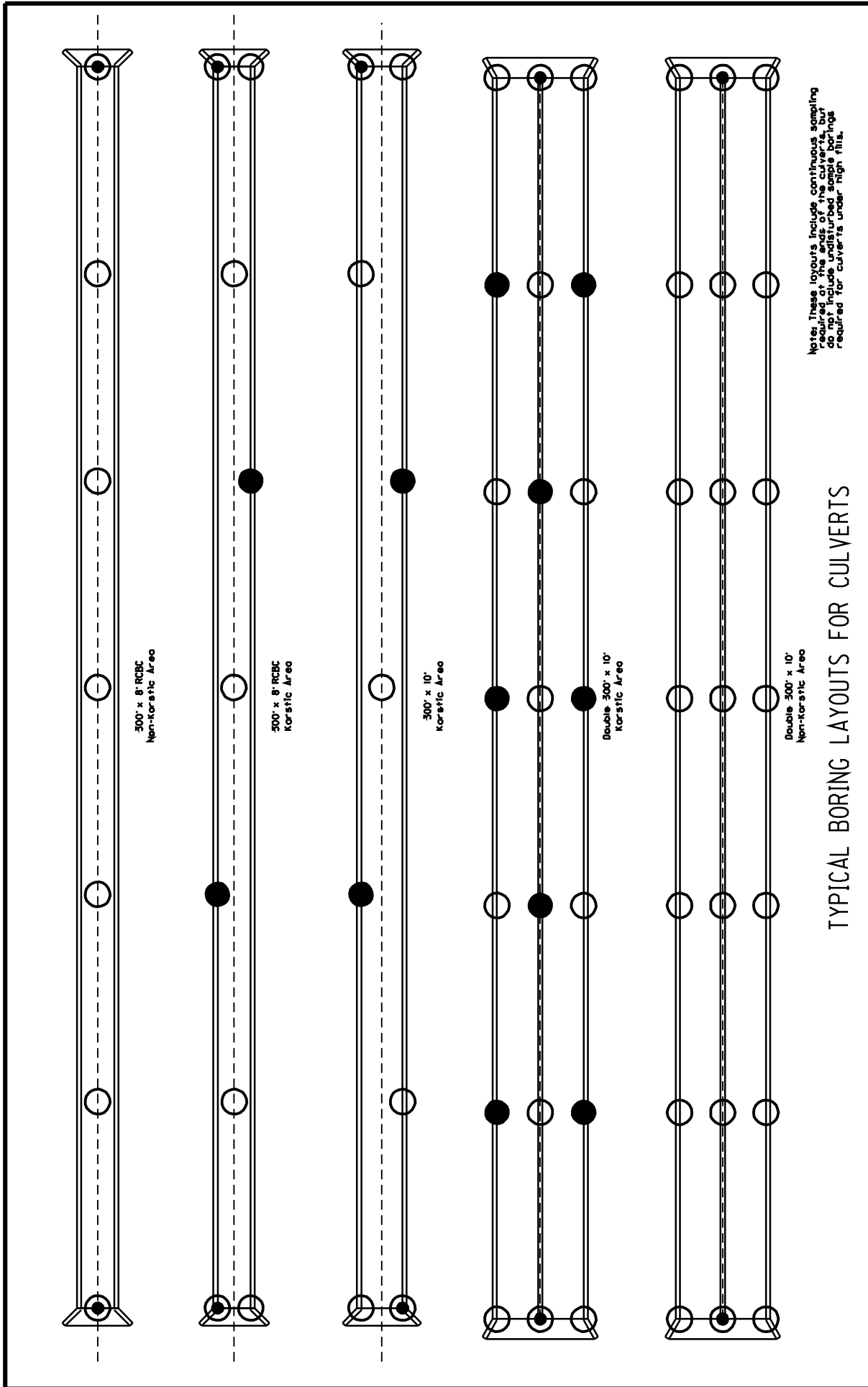
WICK DRAIN DETAILS

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

PREPARED BY \_\_\_\_\_ DATE \_\_\_\_\_

Cell Library: Kyr/col  
DD: MHA/ryr/sap  
Cell: MHA/ryr/hk/m



TYPICAL BORING LAYOUTS FOR CULVERTS

GEOTECHNICAL NOTES  
for MSE Walls

If the Contractor elects to use an MSE Wall as allowed by the Contract Documents, design the wall (or walls) in accordance with the AASHTO Standard Specifications for Highway Bridges. The Contract Documents control where a requirement which is not covered by, or is contrary to, AASHTO exists.

Use only MSE Walls with inextensible reinforcement.

Granular replacement depths (D) versus wall height (H):  
For  $H \leq 10$  ft,  $D = 0$   
For  $H > 10$  ft and  $\leq 20$  ft,  $D = 2.0$  ft.

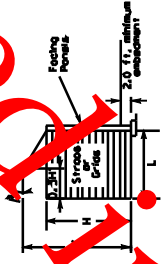
Station Interval	Bearing Surface	Allowable Bearing Capacity
10+20 - 11+15	Soil	- ksf
11+15 - 12+15	Gran. Repl.	- ksf

Use the following soil strength parameters for design

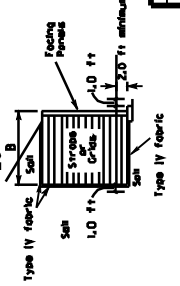
Internal Backfill (in reinforced volume)	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)
External Backfill	0	34	115
Soil Embankment	-	-	-
Granular Embankment	-	-	-
Foundation Soils	-	-	-
Existing	-	-	-
Granular Replacement	-	-	-

where granular replacement of existing foundation materials is required, excavate the existing foundation soil and replace with granular material as shown below. Use granular material meeting the requirements of granular embankment in Section 805 of the Standard Specifications, current edition, except that the maximum size is 4 inches. Use material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 24 and 843 of the Standard Specifications, current edition, as shown below.

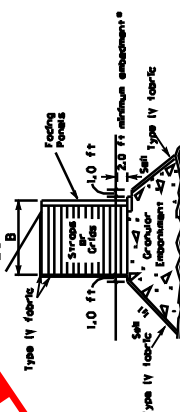
where external granular backfill is required, the granular material shall be placed in layers of 6 inches maximum thickness. The minimum reinforcement length (L) shall be the greater of:  
 $L > 0.7 H$  (where H is the effective wall height)  
 $L > 8$  ft  
 $L = H \times 0.3$  for  $\beta > 1$  for sloping backfill  
 $H = 1$  ft for level backfill



MSE WALL ON SOIL  
Mechanically Stabilized Earth



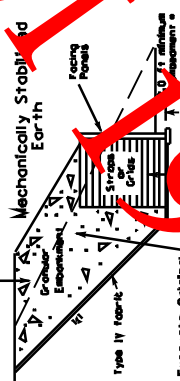
EXCAVATION AND GRANULAR FOUNDATION REPLACEMENT  
Mechanically Stabilized Earth



Type IV fabric required only where there is a soil-granular material interface.

- Unless Otherwise Noted

EXCAVATION AND GRANULAR BACKFILL REPLACEMENT  
Mechanically Stabilized Earth



REVISION	DATE
25-SEPTEMBER-2004	CHECKED BY
DESIGNED BY: D. CONNLY	J. MOLEN
DEPARTMENT OF HIGHWAYS Commonwealth of Kentucky	
PROJECT: SPRINGFIELD	
SHEET NO. 000000	

ITEM NUMBER	S-005-04
13-765.00	

**GEOTECHNICAL NOTES**

for Granular Replacement at Reinforced Concrete Cantilever Retaining Walls

The minimum embedment shall be 2 ft. to the bottom of footing for cast in place walls.

As required by AASHTO, footings constructed on slopes shall be embedded sufficiently to provide the minimum horizontal distance of 4.0 ft., measured at top of footing, between the rear face of the footing and the face of the finished slope.

The minimum factor of safety for sliding shall be either 1.5 neglecting passive resistance or 2.0 considering passive resistance.

Granular replacement depths (D) versus wall height (H):  
 For  $H \leq 10$  ft.,  $D = 0$   
 For  $H > 10$  ft and  $\leq 20$  ft.,  $D = 2.0$  ft.

Station Interval	Bearing Surface	Allowable Bearing Capacity
10+20 - 11+15	Soil	- ksf
11+15 - 12+15	Gran. Repl.	- ksf

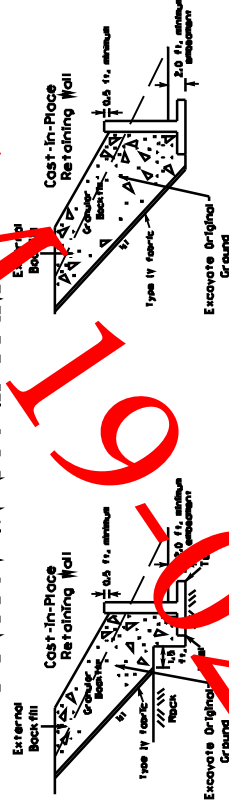
Use the following soil strength parameters for design

	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)
External Backfill	-	-	-
Soil Embankment	-	-	-
Granular Embankment	-	-	-
Foundation Soils	-	-	-
Existing Granular Replacement	-	-	-

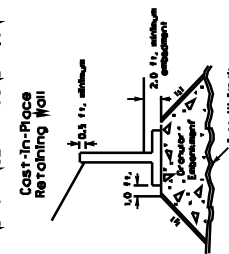
Where granular replacement of existing foundation materials is required, excavate the existing foundation soil and replace with granular material as shown below. Use granular material meeting the requirements of 'granular embankment' in Section 805 of the Standard Specifications, current edition, except that the maximum size is 3/8 in. Use a material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric accordance with Sections 214 and 843 of the Standard Specifications, current edition, as shown below.

Where external granular backfill is required, use granular material as shown below. Use granular material meeting the requirements of 'granular embankment' in Section 805 of the Standard Specifications, current edition, except that the maximum size is 3/8 in. Use a material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 214 and 843 of the Standard Specifications, current edition, as shown below.

EXTERNAL EXCAVATION AND BACKFILL REPLACEMENT

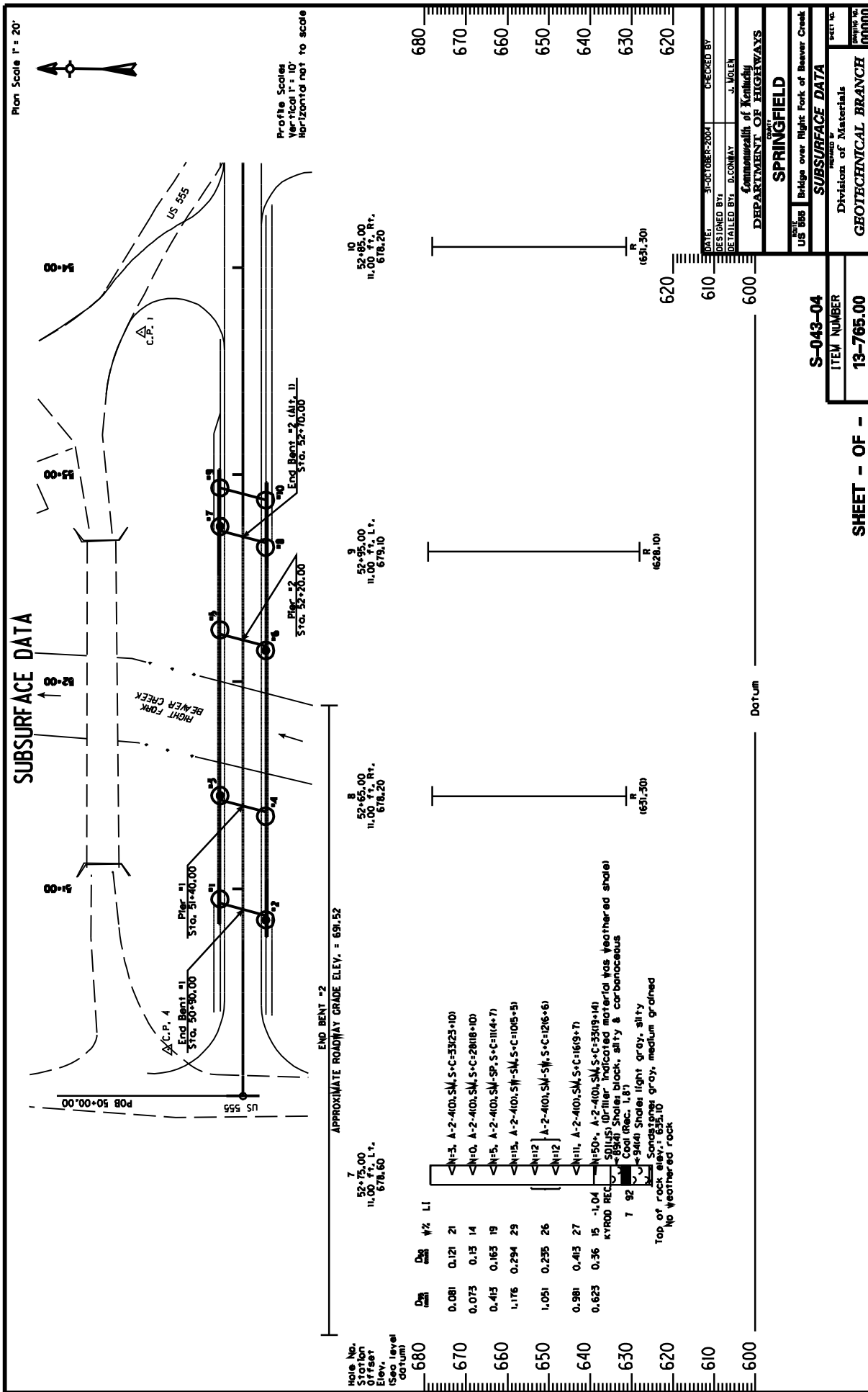


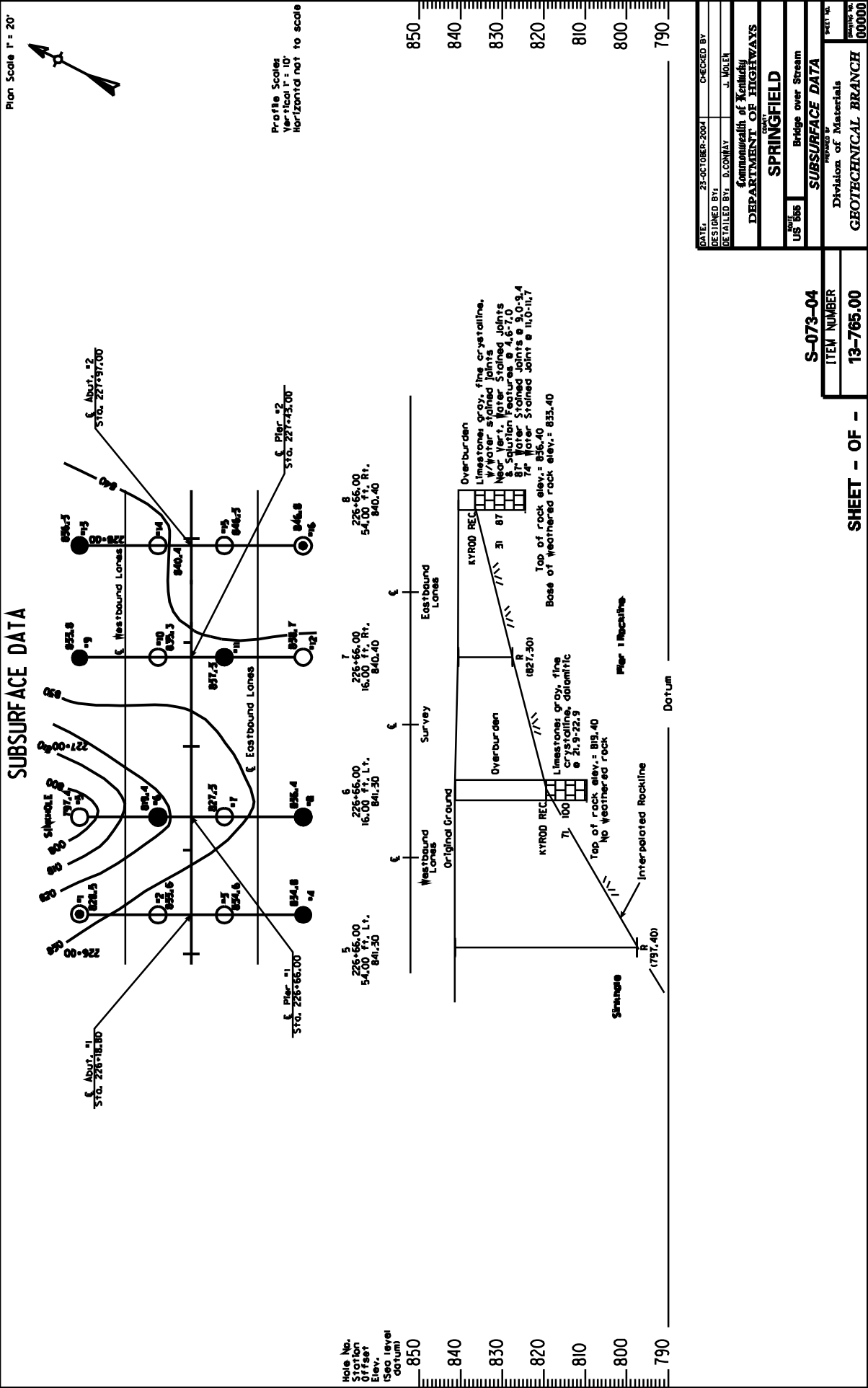
EXCAVATION AND GRANULAR FOUNDATION REPLACEMENT



REVISION	CHECKED BY	DATE
25-SEPTEMBER-2004	J. MOLEN	
DESIGNED BY		
DETAILED BY		
DEPARTMENT OF HIGHWAYS		
Commonwealth of Kentucky		
DIVISION		
SPRINGFIELD		
PROJECT		
US 856		
DRAWN BY		
DIVISION OF MATERIALS		
Geotechnical Branch		
SHEET NO.		
000000		

S-005-04
ITEM NUMBER
13-765.00





DATE:	23-OCTOBER-2004	CHECKED BY:	
DESIGNED BY:	D. CONWAY	DR. WOLEN	
Commonwealth of Kentucky DEPARTMENT OF HIGHWAYS			
COUNTY <b>SPRINGFIELD</b>			
PROJECT <b>SUBSURFACE DATA</b>			
LOCATION Bridge over Stream			
DIVISION Division of Materials			
SHEET NO. <b>000000</b>			

<b>S-073-04</b>
ITEM NUMBER
<b>13-765.00</b>

SHEET - OF -







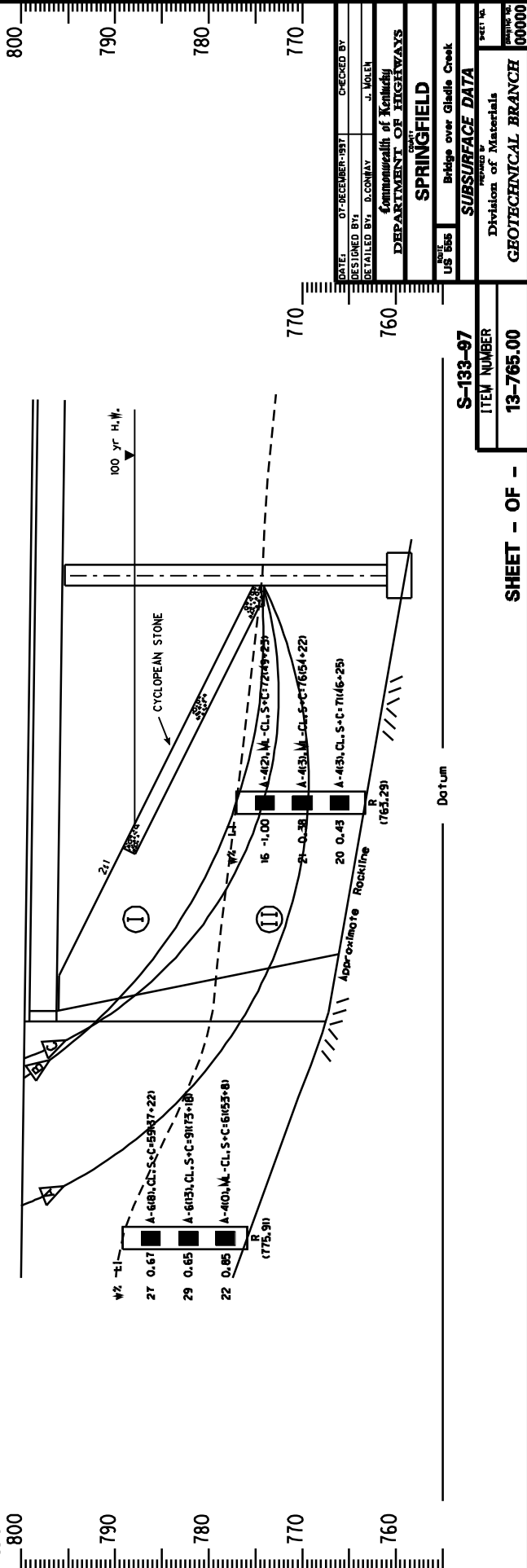
SUBSURFACE DATA

FACTORS OF SAFETY			
SHORT TERM	A	B	2.4
LONG TERM	B	C	1.3
RAPID DRAWDOWN	C	L4	

ASSUMED SOIL STRENGTH PARAMETERS			
SOIL	I	II	
SHORT TERM	$\phi$ : 125 pcf c : 1500 psf g :	125 pcf 1500 psf 0'	
LONG TERM	$\phi$ : 125 pcf c : 250 psf g :	125 pcf 250 psf 200 psf	
RAPID DRAWDOWN	$\phi$ : 125 pcf c : 250 psf g :	125 pcf 250 psf 200 psf	28' 28'

7  
52+75.00  
785.20

7  
53+21.00  
777.03

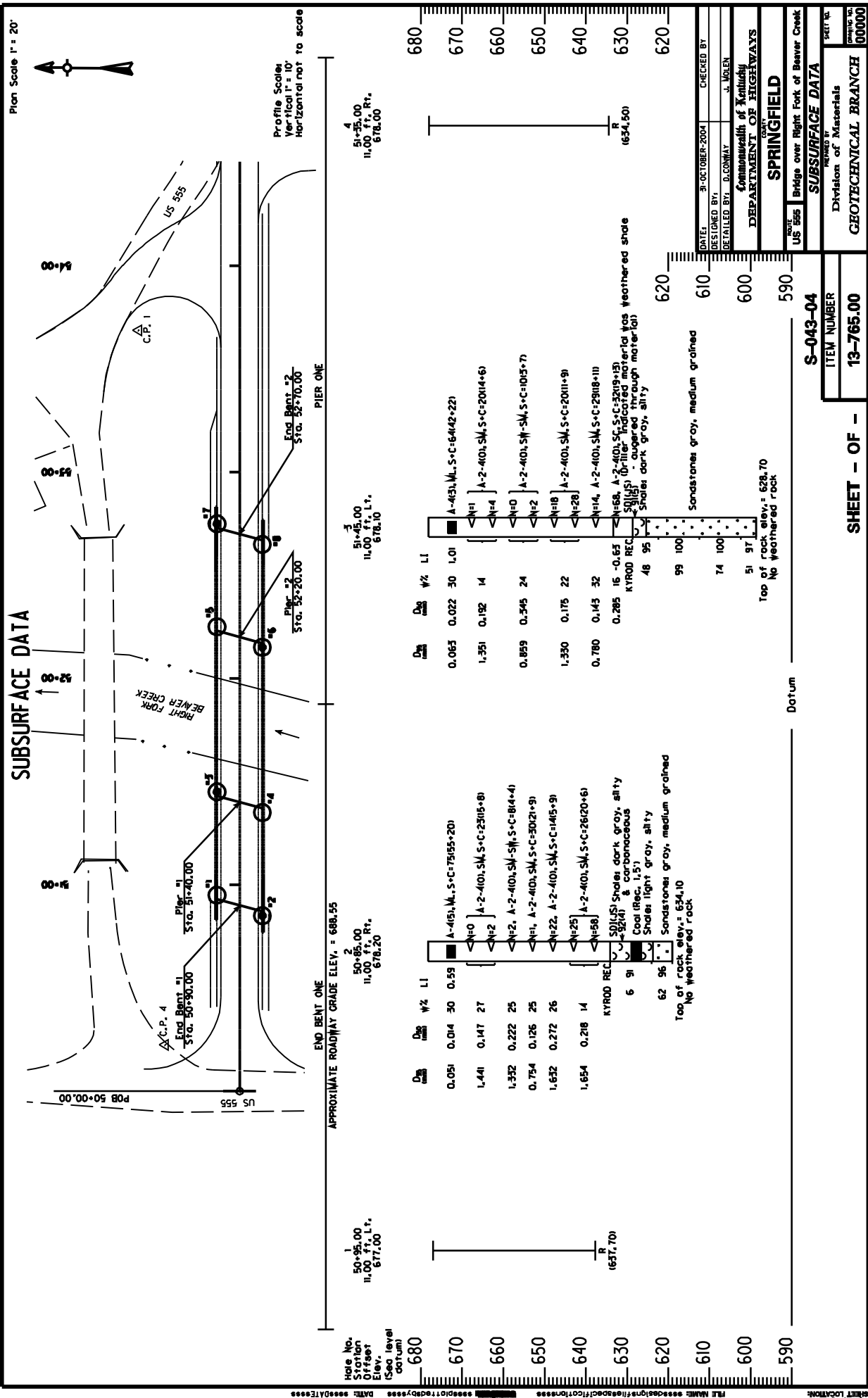


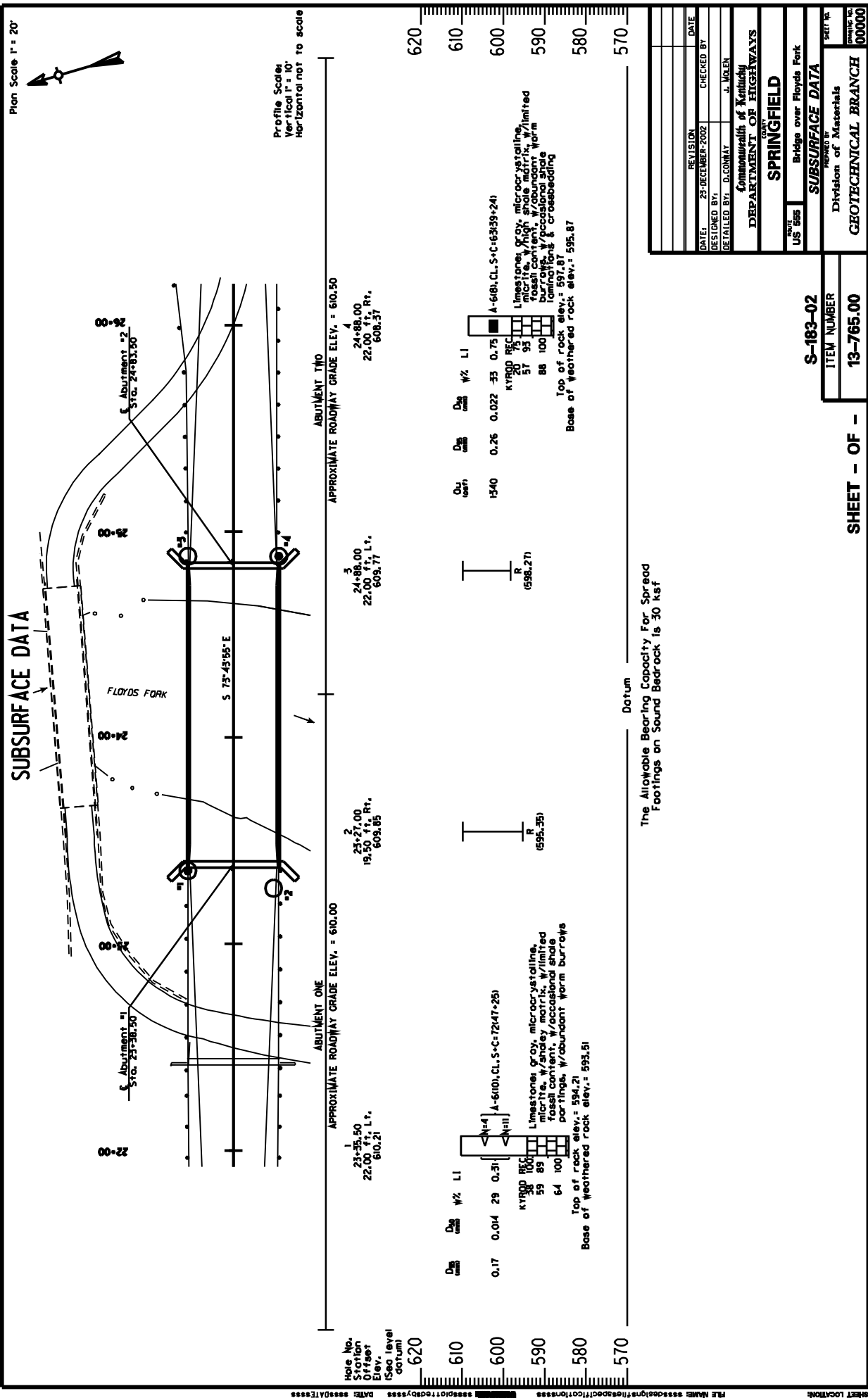
DATE: 07-18-1987  
DESIGNED BY: O. CONWAY  
CHECKED BY: J. MOLEN  
DEPARTMENT OF HIGHWAYS  
COMMUNWEALTH OF KENTUCKY  
DIVISION OF MATERIALS  
PREPARED BY: SPRINGFIELD  
BRIDGE OVER GLADE CREEK  
SUBSURFACE DATA  
DIVISION OF MATERIALS  
GEOTECHNICAL BRANCH

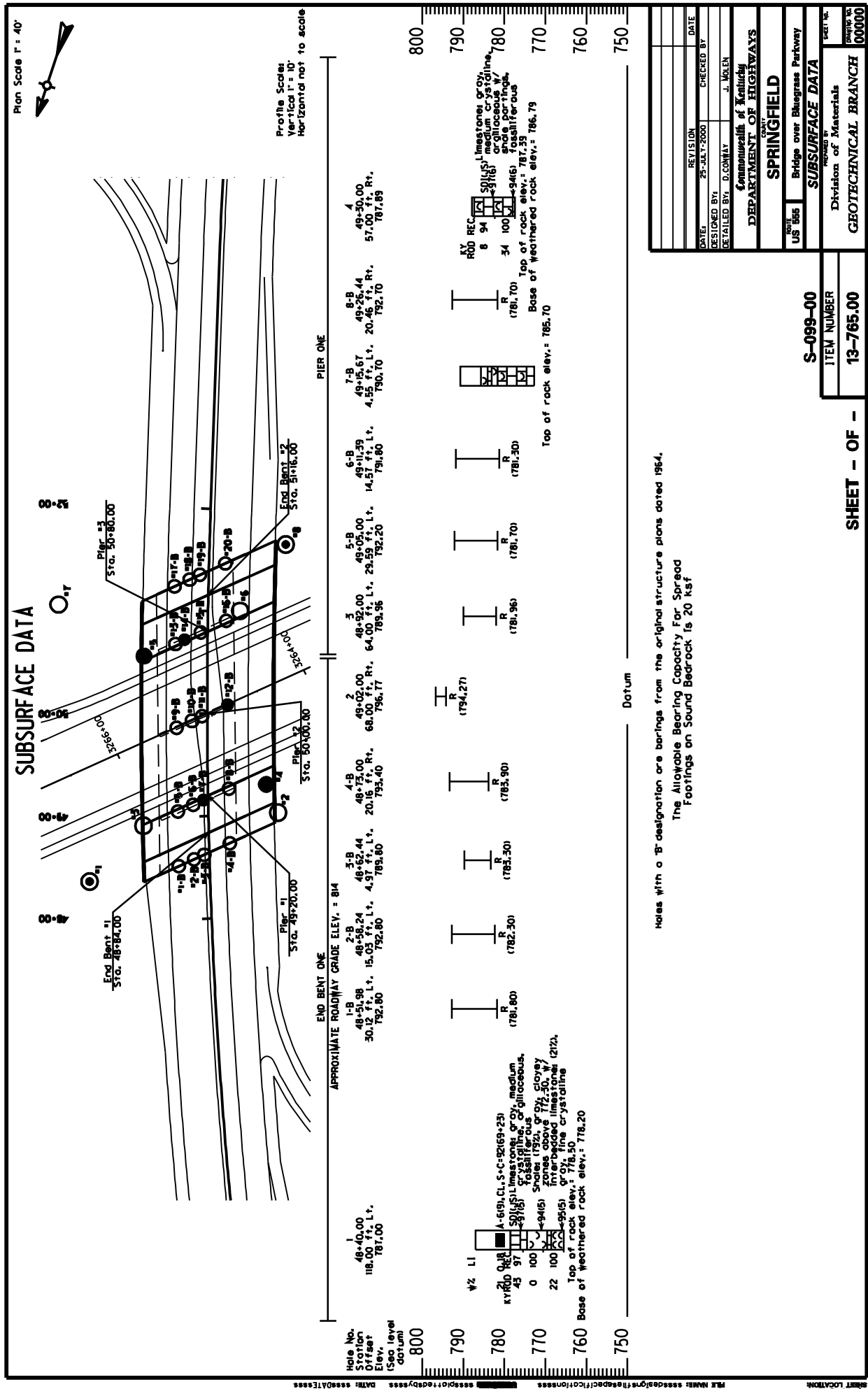
S-133-97  
ITEM NUMBER  
13-765.00  
SHEET NO. 00000

SHEET -- OF --









**SUBSURFACE DATA**

Plan Scale 1" = 40'

Profile Scale:  
Vertical 1" = 10'  
Horizontal not to scale

Hole No.	Station	Offset	Elev. (Sea level datum)	Remarks
1	48+40.00			
	118.00 ft. L.			
	787.00			
2	48+58.24			
	48+58.24			
	15.03 ft. L.			
	4.97 ft. L.			
	789.80			
3	48+52.44			
	48+52.44			
	20.16 ft. R.			
	793.40			
4	48+32.00			
	48+32.00			
	64.00 ft. L.			
	28.59 ft. L.			
	792.20			
5	49+05.00			
	49+11.39			
	14.57 ft. L.			
	791.80			
6	49+26.44			
	49+26.44			
	4.55 ft. L.			
	20.46 ft. R.			
	792.70			
7	49+15.67			
	49+15.67			
	790.70			
8	49+30.00			
	57.00 ft. R.			
	787.89			

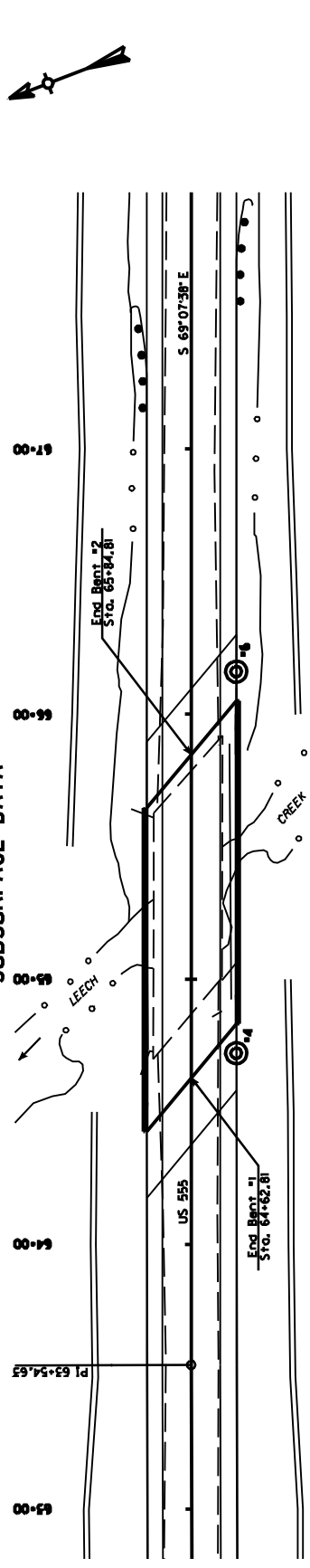
Holes with a 'B' designation are borings from the original structure plans dated 1964. The Allowable Bearing Capacity For Spread Footings on Sound Bedrock is 20 ksf

DATE	REVISION	CHECKED BY	DATE
29-JULY-2000			
DESIGNED BY:	D. COMLEY		
DETAILED BY:	J. VALEN		
DEPARTMENT OF HIGHWAYS COMMUNALITY OF KENTUCKY COUNTY <b>SPRINGFIELD</b> Bridge over Bluegrass Parkway PROJECT NO. US 555 SUBSURFACE DATA DIVISION OF MATERIALS GEOTECHNICAL BRANCH SHEET NO. 000000			

S-099-00  
ITEM NUMBER  
13-765.00  
SHEET - OF -

**SUBSURFACE DATA**

Plan Scale 1" = 20'



Profile Scale:  
Vertical 1" = 10'  
Horizontal not to scale

END BENT ONE  
APPROXIMATE ROADWAY GRADE ELEV. = 495.81  
64+72.07  
17.00 ft. RT.  
495.07

END BENT TWO  
APPROXIMATE ROADWAY GRADE ELEV. = 495.31  
66+16.07  
17.00 ft. RT.  
489.90

Station (Elev. datum)	Dist. (ft.)	%	LI	Notes
490	0.70	0.02	25	1.38
480	0.32	0.015	19	-0.15
470	3.895	1.872	12	-0.28
460	17.643	5.821	19	-0.04
450	1.865	0.322	19	
440	3.671	0.733		
430	2.680	0.679		
420	3.595	0.719		
410	2.350	0.470		
400	1.999	0.648		
390	1.865	0.621		

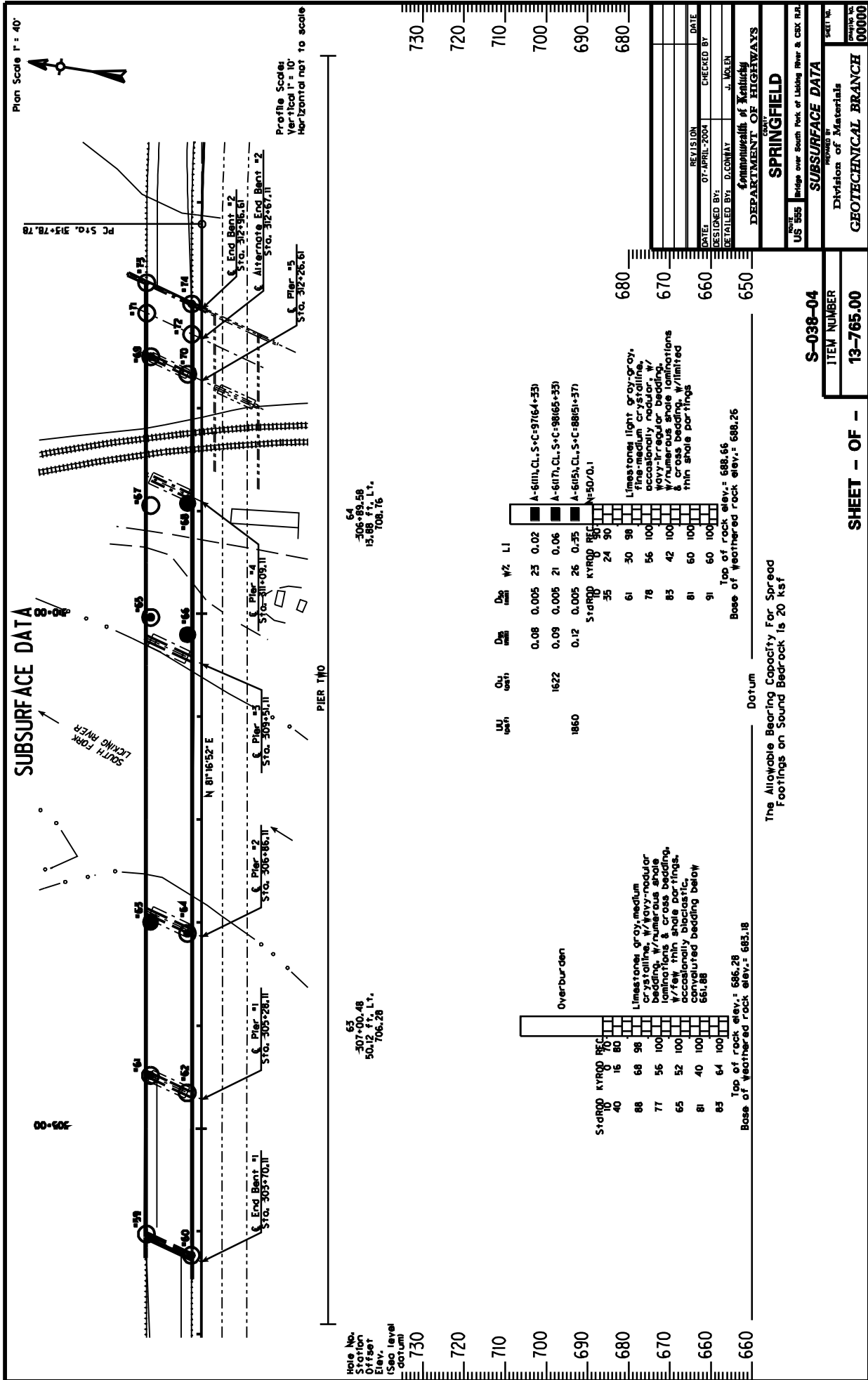
  

Dist. (ft.)	%	LI	Notes
0.659	0.01	23	0.20
3.867	2.129	22	0.58
15.930	4.942	14	-0.30
17.645	4.897	10	-0.83
2.103	0.158	25	
0.966	0.166	21	
2.140	0.143	20	
2.740	0.598	21	
1.944	0.48	9	
1.763	0.231	24	

Station	Notes
64+72.07	A-411, ML-CL, S+C=69(52+17)
64+84.81	A-411, ML-CL, S+C=78(62+16)
64+96.61	A-2-4(10), SC, S+C=15(6+9)
65+08.41	A-2-6(10), CP, S+C=7(1+7)
65+20.21	A-2-4(10), SM, S+C=12(2+10)
65+32.01	A-2-4(10), SM, S+C=14(1+13)
65+43.81	A-2-4(10), SM, S+C=12(2+10)
65+55.61	A-2-4(10), SM, S+C=23(11+12)
65+67.41	A-2-4(10), SM, S+C=8(3+5)
65+79.21	A-2-4(10), SP, S+C=10(5+5)
65+91.01	A-2-490(1), SP, S+C=5(1+4)
66+02.81	A-2-490(1), SP, S+C=5(1+4)
66+14.61	A-1-1(10), SP, S+C=5
66+26.41	A-1-1(10), SP, S+C=4
66+38.21	A-1-1(10), SP, S+C=7
66+50.01	A-1-1(10), SP, S+C=2
66+61.81	A-1-1(10), SP, S+C=3
66+73.61	A-2-4(10), SM, S+C=25
66+85.41	A-1-1(10), SM, S+C=14
66+97.21	A-1-1(10), SP, S+C=4

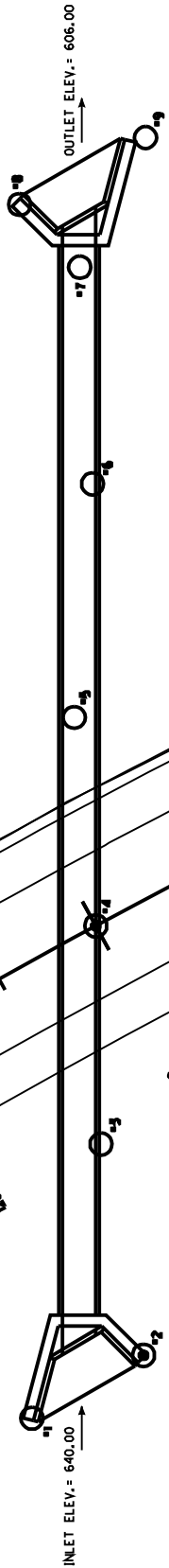
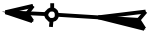
DATE: 08-MAY-2004 CHECKED BY: J. VALEN  
 DESIGNED BY: D. CONWAY  
 COMMUNITY OF KENTUCKY  
 DEPARTMENT OF HIGHWAYS  
 COUNTY: SPRINGFIELD  
 PROJECT: Bridge over Leech Creek  
 SUBSURFACE DATA  
 DIVISION OF MATERIALS  
 GEOTECHNICAL BRANCH  
 SHEET - OF -  
 ITEM NUMBER: 13-765.00  
 DRAWING NO.: 000000



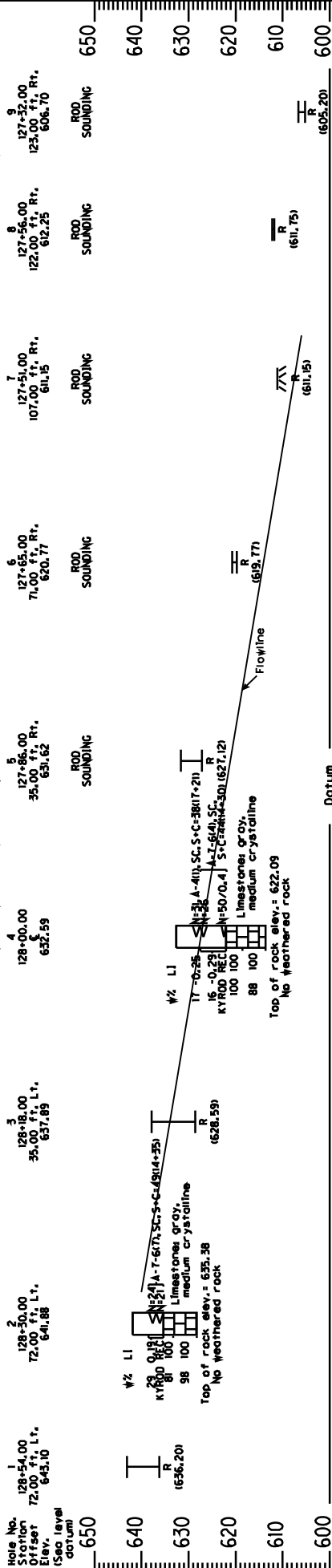


SUBSURFACE DATA

Plan Scale 1" = 10'



Profile Scales:  
Vertical 1" = 10'  
Horizontal not to scale



The Allowable Bearing Capacity For Spread Footings on Sound Bedrock is 50 ksf

DATE	21-AUGUST-2008	CHECKED BY	J. MALEN
DESIGNED BY	D. COMLEY	DEPARTMENT OF HIGHWAYS	
COUNTY			
SPRINGFIELD			
PROJECT			
6' x 4' RCBC @ Sta. 128+00.00			
SUBSURFACE DATA			
Division of Materials			
GEOCHEMICAL BRANCH			
PROJECT NO. 000000			

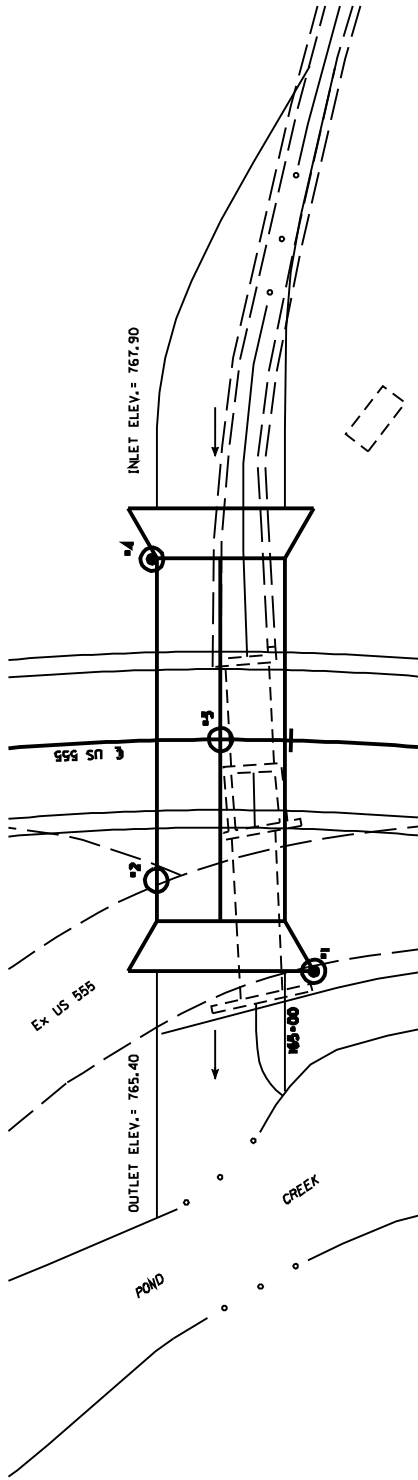
S-062-01  
ITEM NUMBER  
13-765.00  
SHEET - OF -

**SUBSURFACE DATA**

Plan Scale 1" = 10'



Profile Scales  
Vertical 1" = 10'  
Horizontal not to scale



1  
164-94.57  
39.19 ft. L.T.  
Elev. 776.60  
(Sea level datum)

2  
165-23.62  
23.85 ft. L.T.  
Elev. 776.00

3  
165-12.00  
778.10

4  
165-23.00  
31.00 ft. R.T.  
Elev. 777.50

W2 LI  
15  
0-1.50  
KYROD REC  
Top of rock elev.: 762.20  
Base of weathered rock elev.: 762.10

R  
(761.00)

R  
(762.60)

W2 LI  
KYROD REC  
15  
0-1.50  
A-2-400, SM, S-C-1710-71  
16 96  
No weathered rock



Datum

The Allowable Bearing Capacity For Spread Footings on Unweathered Bedrock Is 20 Ksf

DATE	00-SEPTEMBER-2004	CHECKED BY	
DESIGNED BY	D. CONLAY		
DETAILED BY	J. MOLEN		
Commonwealth of Kentucky			
DEPARTMENT OF HIGHWAYS			
<b>SPRINGFIELD</b>			
PROJECT	Double 11' x 6' RCBC @ Sta. 165+12.00		
<b>SUBSURFACE DATA</b>			
REVIEWED BY			
Division of Materials			
GEOTECHNICAL BRANCH			
SHEET NO.			00000

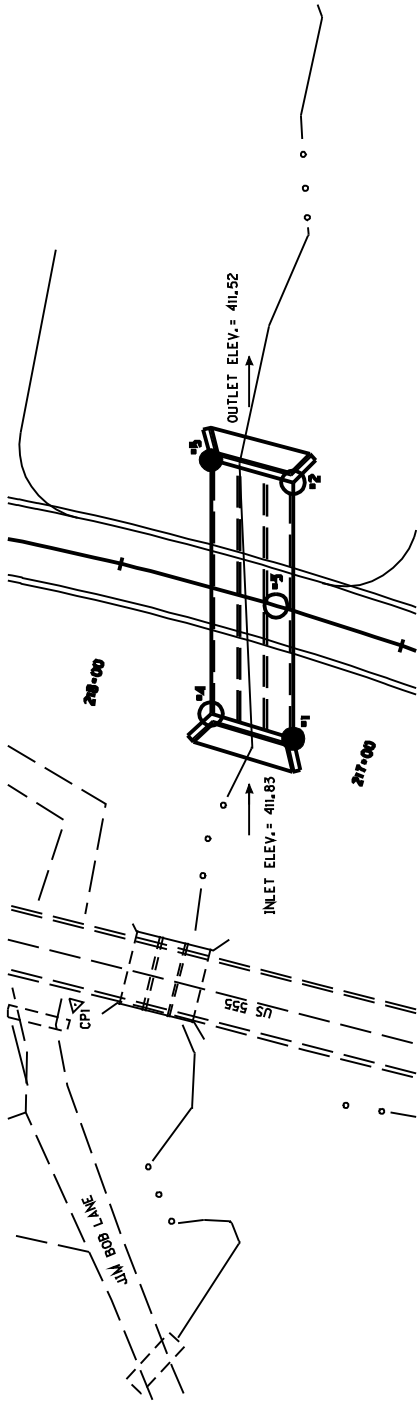
S-073-04  
ITEM NUMBER  
13-765.00  
SHEET - OF -

**SUBSURFACE DATA**

Plan Scale 1" = 20'



Profile Scales  
Vertical 1" = 10'  
Horizontal not to scale



Station	Offset	Elev.	(See level datum)
277+25.67	41.55 ft. L.t.	415.68	
277+55.12	41.50 ft. L.t.	416.29	
277+44.91	41.54		
277+51.01	41.38 ft. Rt.	417.11	
277+78.95	41.95 ft. Rt.	414.80	

Qd	W2	L1
3172	16	1
	21	0.39
	20	0.61
	21	0.61

A-412 M - CL-S-C-1749+239  
 A-413 M - CL-S-C-1764+223  
 A-414 M - CL-S-C-1765+223  
 A-415 M - CL-S-C-1765+223  
 A-416 M - CL-S-C-1765+223  
 N.R. (404.68)

Qd	W2	L1
	16	1
	21	0.50
	21	0.55

A-401 M - CL-S-C-1744+171  
 A-402 M - CL-S-C-1744+171  
 A-403 M - CL-S-C-1744+171  
 N.R. (405.62)  
 N.R. (405.68)  
 N.R. (405.53)

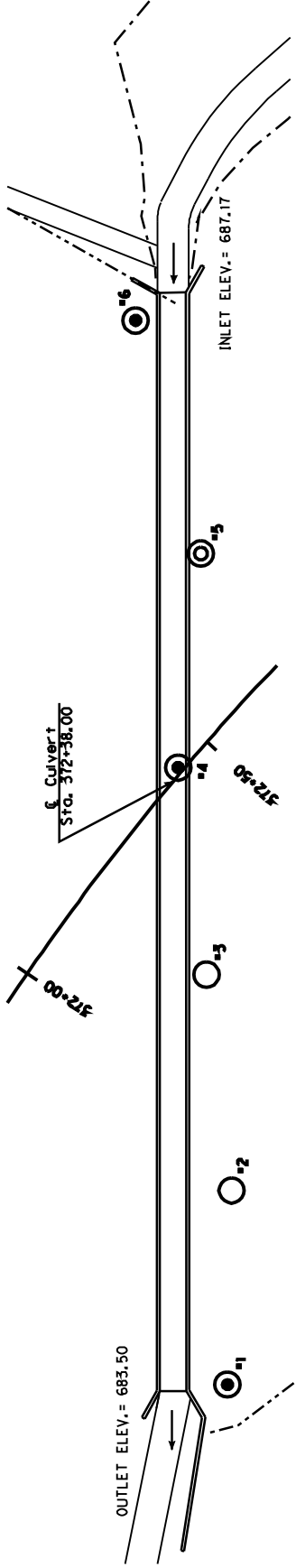
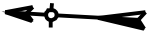


DATE:	31-OCTOBER-2004	CHECKED BY:	
DESIGNED BY:	D.COMWAY	DETAILED BY:	J. MOLEN
Commonwealth of Kentucky DEPARTMENT OF HIGHWAYS			
<b>SPRINGFIELD</b>			
PROJECT NO.:	US 555	TRIPLE 8' X 8' RCBC @ Sta. 217+53.41	
PREPARED BY <b>SUBSURFACE DATA</b>			
DIVISION OF MATERIALS			
GEOTECHNICAL BRANCH			
S-033-04 ITEM NUMBER		13-765.00	
SHEET NO.		00000	

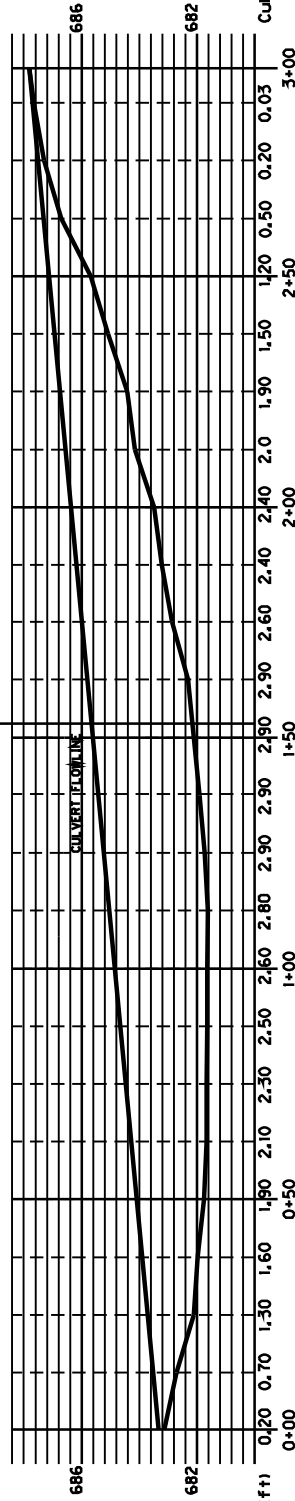
SHEET - OF -

TYPICAL SETTLEMENT PLOT

Pion Scale 1" = 10'



ξ Proposed Embankment



DATE:	06-MAY-1998	CHECKED BY:	
DESIGNED BY:	D.COMBAY	DETAILED BY:	J. MOLEN
Commonwealth of Kentucky			
DEPARTMENT OF HIGHWAYS			
COUNTY			
SPRINGFIELD			
PROJECT	US 555	11' x 8' RCBC @ Sta. 372+38.00	
SETTLEMENT PLOT			
PREPARED BY			
Division of Materials			
GEOTECHNICAL BRANCH			
SHEET NO.			
000000			

S-082-98
ITEM NUMBER
13-765.00

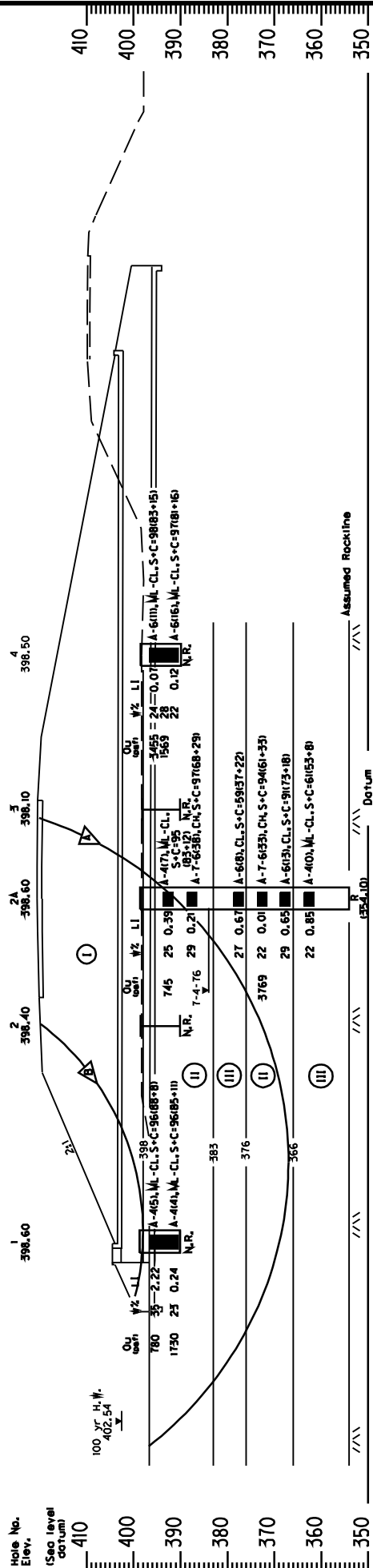
SHEET -- OF --

SUBSURFACE DATA

FACTORS OF SAFETY		
A	Short Term	2.8
B	Long Term	2.2

ASSUMED SOIL STRENGTH PARAMETERS					
Soil	I	II	III	IV	V
Unit Weight	125	120	120	120	120
Short Term	c = 1500	c = 1200	c = 1800	c = 1800	c = 1800
Term	φ = 0°	φ = 0°	φ = 0°	φ = 0°	φ = 0°
Long Term	c = 200	c = 400	c = 200	c = 200	c = 200
Term	φ = 28°	φ = 28°	φ = 28°	φ = 28°	φ = 32°

Profile Scales:  
Vertical 1" = 10'  
Horizontal not to scale



SUMMARY OF CONSOLIDATED UNDRAINED TRIAXIAL TEST			
HS/B	2A	4	4
Depth	5'-7"	2'-4"	6'-6"
	29'-7"	6'-8"	0
c	407	35.3'	
φ	27.8°		

DATE: 31-OCTOBER-2004 CHECKED BY: J. MOLEN  
 DESIGNED BY: D. COMYAK  
 Commonwealth of Kentucky  
 DEPARTMENT OF HIGHWAYS  
 COUNTY: SPRINGFIELD  
 ROUTE: 8' x 8' RCBC @ Sta. 09+196.41  
 SUBSURFACE DATA  
 Division of Materials  
 GEOTECHNICAL BRANCH

S-028-04  
 ITEM NUMBER  
 13-765.00  
 SHEET - OF -

KENTUCKY TRANSPORTATION CABINET  
 Division of Materials  
 Geotechnical Branch

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**PERFORMANCE EVALUATION FOR GEOTECHNICAL SERVICES**

County \_\_\_\_\_ Roadway Name \_\_\_\_\_ Mars No. \_\_\_\_\_  
 Project No. \_\_\_\_\_ Item No. \_\_\_\_\_  
 Drilling Company \_\_\_\_\_ Geotechnical Engr. Consultant \_\_\_\_\_

Contract Completion Date \_\_\_\_\_  
 Actual Completion Date \_\_\_\_\_

*INSTRUCTIONS: Check one of the three boxes. Unless the "not applicable" box is checked, circle one of the relative performance numbers, where 5 is the best performance and 1 is the worst.*

	Satisfactory	Relative Performance Scale					Unsatisfactory	Not Applicable
		5	4	3	2	1		
Drilling and Sampling	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Laboratory Testing	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Engineering Analysis	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Engineering Report	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Time of Completion	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Amount of State Supervision Required	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>

**WORK CRITIQUE:** (Explain any reasons for rating below 3)

Evaluated By (Please Print)  
 Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Signature \_\_\_\_\_ Date \_\_\_\_\_

CC: Geotech (Project File)  
 Geotech (Consultant File)

KENTUCKY TRANSPORTATION CABINET  
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**PREQUALIFICATION REQUIREMENTS  
FOR GEOTECHNICAL DRILLING SERVICES**

**I. Experience**

The vendor must provide evidence of experience in the last 5 years performing drilling services for highway projects (roadways and bridges). The evidence shall include projects illustrating this type of experience, with references (agency, project engineer, or consultant) with addresses and phone numbers.

**II. Equipment**

The vendor must provide a list of available equipment (drill rigs and accessories) for soil sampling and rock coring. The vendor must have at least one drill rig equipped with an automatic hammer in order to be prequalified.

**III. Personnel**

Drill crew supervisors must be experienced in obtaining rock cores for rock cut slope and bridge foundation design, performing rock line soundings, performing standard penetration tests, obtaining thin-walled tube samples, obtaining disturbed soil samples, and installing cased observation wells. Evidence must be provided that the drill crew supervisors have a minimum of 3 years experience in the above-mentioned operations for highway projects (roadways and bridges). A drill crew supervisor is defined as the person on the drill crew field party who is responsible for the drilling operations mentioned above.

**IV. Insurance**

Worker's Compensation and Liability Insurance as required by the Division of Professional Services.

**Notes:**

1. Complete Pages 2 - 4 of this form. Pages 3 and 4 should reflect equipment and personnel that will be used on Kentucky highway projects. Provide personal history statements for drill crew supervisors included on Page 4.
2. Attach proof of the above-referenced insurances.





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**SUMMARY OF DRILLING EQUIPMENT**

**1. Drill Rigs**

Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year

**2. Core Barrels**

Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length

**3. Standard Penetration Hammers**

Type (standard, safety, or automatic)
Type (standard, safety, or automatic)
Type (standard, safety, or automatic)
Type (standard, safety, or automatic)

**4. Split Barrel Samplers**

Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe

**5. Thin-Walled Tube Samplers**

Diameter	Length
Diameter	Length
Diameter	Length
Diameter	Length

**6. List other equipment such as pumps, augers (hollow or solid), casing, floating equipment (barge), etc. Please use additional sheets as necessary.**



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**PREQUALIFICATION REQUIREMENTS  
FOR GEOTECHNICAL ENGINEERING SERVICES**

**I. Firm Requirements**

- A. A firm permit issued by the Kentucky Board of Licensure for Professional Engineers and Land Surveyors.
- B. Sufficient geotechnical engineering experience by the firm, as demonstrated by having performed geotechnical engineering on a minimum of 3 transportation projects (or other projects where related engineering tasks were performed) in the last 5 years.
- C. MicroStation CADD Software.

**II. Personnel Requirements**

- A. At least one Professional Engineer licensed in Kentucky with a minimum of 3 years of geotechnical engineering experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of this form). The firm will be required to assign at least one person meeting these requirements to actively participate in KYTC geotechnical projects in the capacity of Project Manager, Project Engineer, etc.
- B. At least one Professional Geologist licensed in Kentucky with a minimum of 3 years of engineering geology experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of this form).
- C. Staff with sufficient experience to perform geotechnical engineering tasks for KYTC, as demonstrated by experience in a minimum of 9 of the 12 areas of "conventional" experience included on Page 3 of this form. (Seismic experience is not required.)
- D. A minimum of one CADD operator proficient with Microstation.

**Notes:**

- 1. Complete Page 2 of this form and provide detailed project descriptions for a minimum of 3 of the projects completed by the firm included in the summary.
- 2. Complete Page 3 of this form and provide resumes of personnel needed to meet the personnel requirements above. All personnel experience need not be with the current employer.
- 3. A firm may subcontract laboratory testing and/or field drilling operations to firms prequalified in the applicable area(s). A firm may also subcontract speciality work in areas not covered by prequalification. All subcontracting is subject to the prior approval of the Division of Professional Services and the Geotechnical Branch.
- 4. For details regarding Licensure and Firm Permits, refer to:  
KY Board of Licensure for Professional Engineers and Land Surveyors <http://kyboels.ky.gov/>  
KY Board of Registration for Professional Geologists <http://finance.ky.gov/ourcabinet/caboff/OAS/op/progeo/>

KENTUCKY TRANSPORTATION CABINET  
 Division of Materials  
 Geotechnical Branch

**SUMMARY OF TRANSPORTATION (OR RELATED) PROJECTS COMPLETED  
 IN THE LAST 5 YEARS FOR WHICH THE FIRM PROVIDED GEOTECHNICAL ENGINEERING SERVICES**

Project Name	Project Location (County & State)	Description of Work Performed	Dates Performed	Key Personnel	Client (Include Address & Phone)	Approximate Fee

Provide detailed project descriptions for a minimum of 3 project



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**PREQUALIFICATION REQUIREMENTS  
FOR GEOTECHNICAL LABORATORY TESTING SERVICES**

- A. Accreditation by the AASHTO Materials Reference Laboratory (AMRL) for the following AASHTO Test Methods: T87, T88, T89, T90, T99, T100, T193, T208, and T265. The Geotechnical Branch will verify accreditation on the AMRL website during the prequalification review.
- B. Management and staff meeting the requirements for AASHTO R18 accreditation and with experience performing all the above-referenced tests.
- C. A loading device with a movable head or base such that it is capable of applying a compressive load up to 60,000 lb. (267 kN), as required for the compaction portion of KM 64-501 (the Kentucky Method for performing the California Bearing Ratio Test).

**NOTES:**

- 1. Complete Page 2 of this form and provide resumes of key personnel identified in the laboratory's Quality Manual (e.g. Technical Manager, Supervising Laboratory Technician, and Quality Manager).
- 2. Identify the location(s) of lab(s) to be used on KYTC projects.
- 3. Provide a description and laboratory location of the above-referenced loading device. Include the make, model, load capacity, etc., and a statement that it meets the requirements above. This device must be located at a laboratory that is accredited for AASHTO T193.
- 4. In addition to the above-referenced test methods, the Geotechnical Branch considers AMRL accreditation for T216, T296, and T297, and the capability to perform the Unconfined Compressive Strength of Rock, Slake Durability, and Jar Slake tests to be highly desirable. Although these tests are not required for prequalification, the Geotechnical Branch strongly recommends that labs be accredited for and/or have the ability to perform these tests.
- 5. Although not generally required to be submitted for prequalification, the Geotechnical Branch may request accreditation documents such as the Quality Manual, On-Site Assessment Reports, Proficiency Sample Test Results, etc. Please be prepared to provide such documents upon request.
- 6. For details regarding laboratory accreditation, refer to:  
AASHTO Materials Reference Laboratory <http://www.amrl.net/>

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**SUMMARY OF GEOTECHNICAL LABORATORY PERSONNEL EXPERIENCE**

Name	AREAS OF EXPERIENCE (Indicate all that apply):																																																																																																																																																																																																																																																																																																																																																													
		Slake Durability & Jar Slake													UC Strength of Rock													AASHTO T297													CU Trx w/ PP Measurements													AASHTO T296													UU Triaxial													AASHTO T216													1-D Consolidation													AASHTO T265													Moisture Content													AASHTO T208													UC Strength of Soil													AASHTO T193													California Bearing Ratio													AASHTO T100													Specific Gravity													AASHTO T99													Moisture-Density													AASHTO T89, T90													Liquid and Plastic Limits													AASHTO T88													Particle Size Analysis													AASHTO T87													Dry Preparation of Samples													Lab Technician													Supervising Lab Technician													Years of Geotech and/or Construction Materials Testing Experience										
	UC Strength of Rock													AASHTO T297													CU Trx w/ PP Measurements													AASHTO T296													UU Triaxial													AASHTO T216													1-D Consolidation													AASHTO T265													Moisture Content													AASHTO T208													UC Strength of Soil													AASHTO T193													California Bearing Ratio													AASHTO T100													Specific Gravity													AASHTO T99													Moisture-Density													AASHTO T89, T90													Liquid and Plastic Limits													AASHTO T88													Particle Size Analysis													AASHTO T87													Dry Preparation of Samples													Lab Technician													Supervising Lab Technician													Years of Geotech and/or Construction Materials Testing Experience																								
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Include only personnel in lab(s) to be used on KYTC project.  
Provide the resumes of key personnel identified in the lab's Quality Manual.

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Rev. 5/05

KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

**UNIT COST ITEMS FOR GEOTECHNICAL SERVICES**

COUNTY	ITEM #	MARS #	
REGION #	CONTRACT #	ESTIMATE #	
RANK	UNIT PRICE	UNITS	TOTAL
	1. Rock Coring	\$ _____ per foot	x _____ = \$ _____
	2. Rock Coring on Floating Eq.	\$ _____ per foot	x _____ = \$ _____
	3. Rock Sounding	\$ _____ per foot	x _____ = \$ _____
	4. Rock Sounding on Floating Eq.	\$ _____ per foot	x _____ = \$ _____
	5. Visual Inspection & Logging Rock Exposure	\$ _____ per foot	x _____ = \$ _____
	6. Disturbed Soil Boring	\$ _____ per foot	x _____ = \$ _____
	7. Bag Sample	\$ _____ per sample	x _____ = \$ _____
	8. Standard Penetration Test	\$ _____ per test	x _____ = \$ _____
	9. Standard Penetration Test on Floating Eq.	\$ _____ per test	x _____ = \$ _____
	10. Thin-Walled Tube Sample	\$ _____ per tube	x _____ = \$ _____
	11. Thin-Walled Tube Sample on Floating Eq.	\$ _____ per tube	x _____ = \$ _____
	12. Field Vane Shear Test	\$ _____ per test	x _____ = \$ _____
	13. Field Vane Shear Test on Floating Eq.	\$ _____ per test	x _____ = \$ _____
	14. Cased Observation Well	\$ _____ per well	x _____ = \$ _____
	15. Drill Hole for Slope Incliner Casing	\$ _____ per foot	x _____ = \$ _____
	16. Pavement Cores	\$ _____ per foot	x _____ = \$ _____
	17. Grouting Intervals, 6 Inch Auger	\$ _____ per foot	x _____ = \$ _____
	18. Grouting Intervals, 4 Inch Auger	\$ _____ per foot	x _____ = \$ _____
	19. Grouting Intervals, Rock Core	\$ _____ per foot	x _____ = \$ _____
	20. Moisture Content Sample	\$ _____ per sample	x _____ = \$ _____
	21. Moisture Content Test	\$ _____ per test	x _____ = \$ _____
	22. Logging Rock Core	\$ _____ per foot	x _____ = \$ _____
	23. Soil Classifications	\$ _____ per sample	x _____ = \$ _____



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Rev. 5/05

KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

UNIT COST ITEMS FOR GEOTECHNICAL SERVICES

COUNTY _____	ITEM # _____				
24. Wash and Sieve Gradations	\$ _____	per test	x _____	=	\$ _____
25. Moisture/Density/CBR/Soil Classification	\$ _____	per sample	x _____	=	\$ _____
26. Moisture/Density Test	\$ _____	per sample	x _____	=	\$ _____
27. Slake Durability Index & Jar Slake Test	\$ _____	per test	x _____	=	\$ _____
28. Unconfined Compression Tests on Soil	\$ _____	per test	x _____	=	\$ _____
29. Unconfined Compression Tests on Rock	\$ _____	per test	x _____	=	\$ _____
30. One-Dimensional Consolidation Tests	\$ _____	per test	x _____	=	\$ _____
31. Consolidated-Undrained Triaxial Test with Pore Pressure Measurements	\$ _____	per test	x _____	=	\$ _____
32. Unconsolidated-Undrained Triaxial Test Total Stress Method	\$ _____	per test	x _____	=	\$ _____
33. Slope Stability Analyses	\$ _____	per analysis	x _____	=	\$ _____
34. Settlement Analyses	\$ _____	per analysis	x _____	=	\$ _____
35. Deep Foundation Analyses	\$ _____	per analysis	x _____	=	\$ _____
36. Wave Equation Driveability Analyses	\$ _____	per analysis	x _____	=	\$ _____
37. Negative Skin Friction Analyses	\$ _____	per analysis	x _____	=	\$ _____
38. Bearing Capacity Analyses	\$ _____	per analysis	x _____	=	\$ _____
39. Retaining Wall Analyses	\$ _____	per section	x _____	=	\$ _____
40. Drafting	\$ _____	per sheet	x _____	=	\$ _____
41. Dozer Working Time	\$ _____	per hour	x _____	=	\$ _____
42. Track Hoe Working Time	\$ _____	per hour	x _____	=	\$ _____
43. Mobilization/Demobilization of Drill Eq.	\$ _____	per mile	x _____	=	\$ _____
			+ (FIXED FEE)	+	\$ _____
44. Mobilization/Demobilization of Subcontracted Dozer or Track Hoe	\$ _____	per hour	x 2	=	\$ _____
45. Mobilization/Demobilization of Company Owned Dozer or Track Hoe		per mile	x _____	=	\$ _____
			+ (FIXED FEE)	+	\$ _____

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KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

**UNIT COST ITEMS FOR GEOTECHNICAL SERVICES**

COUNTY	ITEM #				
	46. Mobilization/Demobilization of Company Owned Floating Equipment	\$ _____	lump sum	x _____	= \$ _____
	47. Towboat and /or Barge & its crew (Subcontracted)	\$ _____	per invoice	x _____	= \$ _____
				+ (FIXED FEE)	+ \$ _____
	48. Towboat and /or Barge & its crew (In-House)	\$ _____	per day	x _____	= \$ _____
				+ (FIXED FEE)	+ \$ _____
	49. Reclamation : Activity	\$ _____	per day	x _____	= \$ _____
	50. Reclamation : Material Cost	\$ _____	per invoice	+ 10%	= \$ _____
	51. Traffic Control (In-House)	\$ _____	per day	x _____	= \$ _____
	52. Subcontracted Traffic Control	\$ _____	per invoice	+ 10%	= \$ _____
	53. Preliminary Plans	\$ _____	lump sum	x _____	= \$ _____
	54. Preliminary Meetings	\$ _____	lump sum	x _____	= \$ _____
	55. Rock Core Meetings	\$ _____	lump sum	x _____	= \$ _____
	56. Interim Meetings	\$ _____	lump sum	x _____	= \$ _____
	57. Final Meetings	\$ _____	lump sum	x _____	= \$ _____
	58. Report Writing	\$ _____	lump sum	x _____	= \$ _____
	59. Publication of Reports	\$ _____	lump sum	x _____	= \$ _____
				<b>TOTAL THIS ESTIMATE</b>	<b>= \$ _____</b>
<b>ACCUMULATED TOTAL ESTIMATES</b>			<b>THROUGH</b>		<b>= \$ _____</b>

FIRM NAME \_\_\_\_\_  
SIGNED \_\_\_\_\_  
DATE \_\_\_\_\_



KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

TABULATION OF QUANTITIES FOR INVOICES

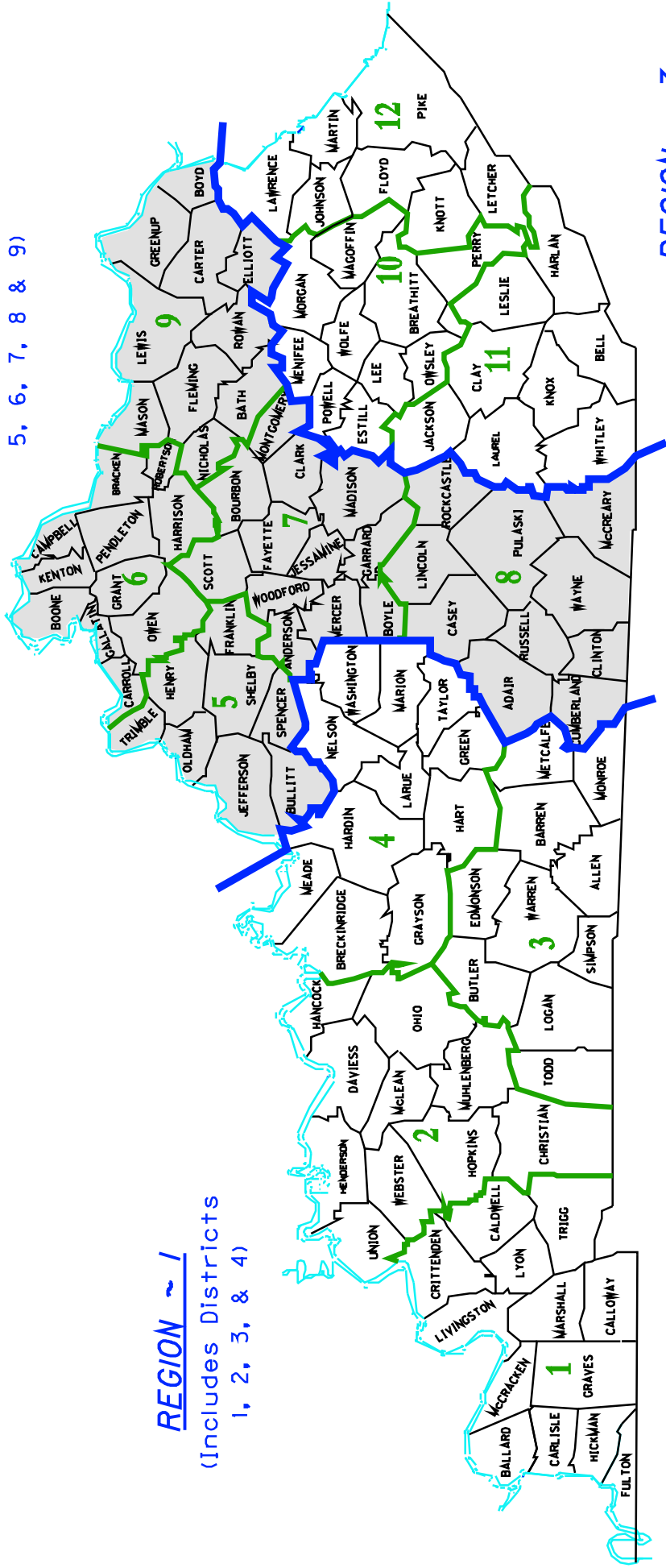
County _____		Page _____ of _____	
HOLE NO.	STATION	Item #	Description
		21	MOISTURE CONTENT TEST
		22	LOGGING ROCK CORE
		23	SOIL CLASSIFICATION
		24	WASH AND SIEVE GRADATIONS
		25	MOISTURE / DENSITY, CBR, SOIL CLASSIFICATION
		26	MOISTURE / DENSITY TEST
		27	SLAKE DURABILITY AND JAR SLAKE TEST
		28	UNCONFINED COMPRESSION TEST ON SOIL
		29	UNCONFINED COMPRESSION TEST ON ROCK
		30	ONE-DIMENSIONAL CONSOLIDATION TEST
		31	CONSOLIDATED-UNDRAINED TRIAXIAL TEST
		32	UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST
		33	SLOPE STABILITY ANALYSES
		34	SETTLEMENT ANALYSES
			Sheet
			This Estimate
			All Estimates



# REGIONS FOR GEOTECHNICAL DRILLING SERVICES

## REGION ~ 2

(Includes Districts  
5, 6, 7, 8 & 9)



## REGION ~ 1

(Includes Districts  
1, 2, 3, & 4)

## REGION ~ 3

(Includes Districts  
10, 11, & 12)

KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

TC 64-523

## NOTIFICATION FOR DRILLING SERVICES

VENDOR:

SUBJECT: **Drilling Services**

Region #  
Agreement #  
Contract Rank:

COUNTY:

PROJECT #:

MARS #:

ITEM #:

ROAD NAME:

Type of Drilling Services:

DATE OF NOTIFICATION:

DATE TO COMPLETE: \_\_\_\_\_

TIME TO COMPLETE: \_\_\_\_\_ Calendar Days from Date of Notification

Signed:

\_\_\_\_\_

*Department Representative*

\_\_\_\_\_

*Date*

Project Accepted:

Yes

No

Signed:

\_\_\_\_\_

*Vendor Representative*

\_\_\_\_\_

*Date*

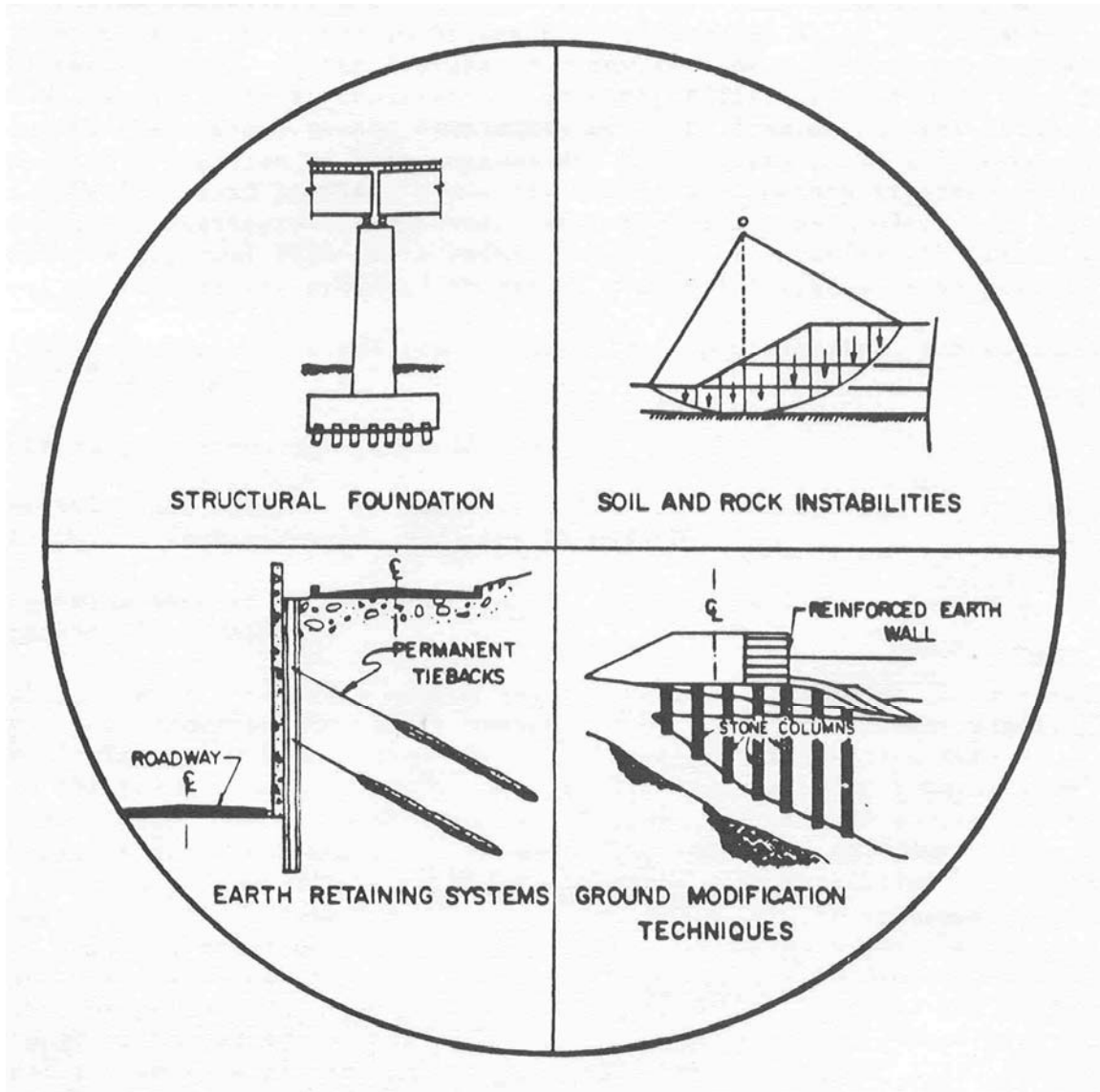


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# CHECKLIST AND GUIDELINES FOR REVIEW OF GEOTECHNICAL REPORTS AND PRELIMINARY PLANS AND SPECIFICATIONS





## PREFACE

A set of review checklists and technical guidelines has been developed to aid engineers in their review of projects containing major and unusual geotechnical features. These features may involve any earthwork or foundation related activities such as construction of cuts, fills, or retaining structures, which due to their size, scope, complexity or cost, deserve special attention. A more specific definition of both unusual and major features is presented in Table 1. Table 1 also provides a description of a voluntary program by which FHWA generalists engineers determine what type and size projects may warrant a review by a FHWA geotechnical specialist. The review checklists and technical guidelines are provided to assist generalist highway engineers in:

- Reviewing both geotechnical reports and plan, specification, and estimate (PS&E)\* packages;
- Recognizing cost-saving opportunities
- Identifying deficiencies or potential claim problems due to inadequate geotechnical investigation, analysis or design;
- Recognizing when to request additional technical assistance from a geotechnical specialist.

At first glance, the enclosed review checklists will seem to be inordinately lengthy, however, this should not cause great concern. First, approximately 50 percent of the review checklists deal with structural foundation topics, normally the primary responsibility of a bridge engineer; the remaining 50 percent deal with roadway design topics. Second, the general portion of the PS&E checklist is only one page in length. The remaining portions of the PS&E checklist apply to specific geotechnical features – such as pile foundations, embankments, landslide corrections, etc., and would only be completed when those specific features exist on the project. Third, the largest portion of the checklists deals with the review of geotechnical reports, with a separate checklist for each of eight geotechnical features. The checklist for each geotechnical feature is only one to two pages in length. Therefore, on most projects, reviewers will find that only a small portion of the total enclosed checklist needs to be completed.

\* For purposes of this document, PS&E refers to a plan and specification review at any time during a project's development. Hence, the review may be at a preliminary or partial stage of plan development.

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# GEOTECHNICAL REVIEW CHECKLISTS AND TECHNICAL GUIDELINES

## Introduction

The following review checklists and technical guidelines have been developed to aid engineers with review of geotechnical reports, plans and special provisions on projects containing major and unusual geotechnical features. These may involve any earthwork or foundation related activities such as construction of cuts, fills, or retaining structures, which due to their size, scope, complexity or cost, deserve special attention. A more specific definition of both major and unusual features is presented in Table 1. The checklists and review guidelines are intended to serve four primary purposes.

First, for projects that are submitted to a FHWA geotechnical specialist, the checklists and technical guidelines are provided to aid FHWA generalist engineers in making a quick review of the geotechnical report and accompanying support data provided by the State, to insure that the information provided by the State is complete enough to allow adequate technical review by the FHWA geotechnical specialist.

Second, for projects which will not be submitted to a FHWA geotechnical specialist for formal review (which will be the majority of projects handled by the FHWA division office) the checklists and technical guidelines are provided to assist generalist engineers in (1) reviewing geotechnical reports and preliminary plan and specification packages; (2) recognizing cost-saving opportunities; (3) spotting deficiencies or potential claim problems due to inadequate geotechnical investigations, analysis, or design; (4) recognizing when to request technical assistance for a FHWA geotechnical specialist.

Third, it should be noted that the checklists and technical guidelines also include coverage of structure foundations. These review checklists and technical guidelines have been developed to fill an existing need in this area.

Fourth, this document sets forth minimum geotechnical standards or criteria to show transportation agencies and consultants the basic geotechnical information which FHWA recommends be provided in geotechnical reports and PS&E packages.

TABLE 1  
PROJECT REVIEW GUIDELINES

The following project review guidelines are given to assist FHWA generalist engineers in determining what type and size projects may warrant review by a FHWA geotechnical specialist.

A FHWA geotechnical specialist should review Geotechnical reports and supporting data for major or unusual geotechnical features, described below. The FHWA division office should also request FHWA geotechnical specialist review for any project that is considered to involve geotechnical risk or excessive expense in its design or construction. Supporting data for these reviews include preliminary plans, specifications, and cost estimates (if available at the time of geotechnical report submittal). Emphasis will be placed on review of these projects in the preliminary stage in order to optimize cost savings through early identification of potential problems or more innovative designs. To be of maximum benefit geotechnical reports and supporting data should be forwarded for review as soon as available, and at least 60 days prior to the scheduled project advertisement date. The review by the FHWA geotechnical specialist should be completed within 10 working days.

A. “Major” Geotechnical Features

Geotechnical reports and supporting data for major geotechnical project features should be submitted to the FHWA geotechnical specialist for review if the following project cost and complexity criteria exist:

	<u>Cost Criteria</u>
1. Earthwork – soil or rock cuts or fills where (a) the maximum height of cut or fill exceeds 15 m (50 ft), or (b) the cuts or fills are located in topography and/or geological units with known stability problems.	Greater than \$1,000,000
2. Soil and Rock Instability Corrections – cut, fill, or natural slopes which are presently or potentially unstable.	Greater than \$ 500,000
3. Retaining Walls (geotechnical aspects) - maximum height at any point along the length exceeds 9 m (30 ft). Consideration of bidding cost-effective alternatives and geotechnical aspects (bearing capacity, settlement, overturning, sliding, etc.) are of prime concern. Structural design of and footings is beyond the scope of these reviews.	Greater than \$ 250,000

B. “Unusual” Geotechnical Features

Geotechnical reports and supporting data for all projects containing unusual geotechnical features should be submitted to the FHWA geotechnical specialist for review.

An unusual geotechnical project feature is any geotechnical feature involving: (1) difficult or unusual problems, e.g. embankment construction on a weak and compressible foundation material (difficult) or fills constructed using degradable shale (unusual); (2) new or complex designs, e.g. geotextile soil reinforcement, permanent ground anchors, wick drains, ground improvement technologies; and (3) questionable design methods, e.g. experimental retaining wall systems, pile foundations where dense soils exist.

## What is a Geotechnical Report?

The geotechnical report is the tool used to communicate the site conditions and design and construction recommendations to the roadway design, bridge design, and construction personnel. Site investigations for transportation projects have the objective of providing specific information on subsurface soil, rock, and water conditions. Interpretation of the site investigation information, by a geotechnical engineer, results in design and construction recommendations that should be presented in a project geotechnical report. The importance of preparing an adequate geotechnical report cannot be overstressed. The information contained in this report is referred to often during the design period, construction period, and frequently after completion of the project (resolving claims). Therefore, the report should be as clear, concise, and accurate. Both an adequate site investigation and a comprehensive geotechnical report are necessary to construct a safe, cost-effective project. Engineers need these reports to conduct an adequate review of geotechnical related features, e.g., earthwork and foundations.

The State or their consultant should prepare “Preliminary” geotechnical reports for submittal to the design team whenever this information will benefit the design process. Early submittal of geotechnical information and recommendations or engineering evaluation of preliminary data may be necessary to establish basic design concepts or design criteria. This is commonly the case on large projects or projects containing complex or difficult geotechnical problems where alignment and/or grade changes may be appropriate based on geotechnical recommendations. The development of a “Final” geotechnical report will not normally be completed until design has progressed to the point where specific recommendations can be made for all of the geotechnical aspects of the work. Final alignment, grade, and geometry will usually have been selected prior to issuance of the final geotechnical report.

While the geotechnical report content and format will vary by project size and highway agency, all geotechnical reports should contain certain basic essential information, including:

- Summary of all subsurface exploration data, including subsurface soil profile, exploration logs, laboratory or in situ test results, and ground water information;
- Interpretation and analysis of the subsurface data;
- Specific engineering recommendations for design;
- Discussion of conditions for solution of anticipated problems; and
- Recommended geotechnical special provisions.

It is suggested that the State routinely include this minimum information in the geotechnical report for Federal-Aid highway projects and that a copy of this report be supplied to the FHWA division office at the time when the report is internally distributed in the State.

For brevity in this document, the term geotechnical report will be used as a general term to cover all types of geotechnical reports, e.g., foundation report, centerline soils report, landslide study report, etc.

## Use of Review Checklists and Technical Guidelines

Review checklists have been prepared for review of geotechnical reports and review of the geotechnical aspects of preliminary plans, specification and estimate (PS&E)\* packages. To simplify their use, the checklists are set up in a question and answer format. The geotechnical report checklists (pages 11 through 27) cover the important information that should be presented in project geotechnical reports. The PS&E review checklists (pages 28 through 33) cover the geotechnical aspects, ranging from assuring continuity between the project geotechnical report and contract documents to avoiding common claim pitfalls. Items that are identified with an asterisk (\*) are considered to be of major importance. A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

Groups of related questions and, in some cases, individual questions have been cross referenced to the “Soils and Foundations Workshop Manual”\*\* so as to provide the generalist engineer user a reference on basic geotechnical items. Technical guidelines are presented in Tables 1 through 4. Since it is not possible to establish strict criteria for all geotechnical information that should be obtained or geotechnical analysis that should be performed for a particular project, only general or minimum guidelines can be established. Table 1 provides definitions of both major and unusual features and guidelines as to which projects may be appropriate for review by the FHWA geotechnical specialist. Table 2 presents guideline minimum boring, sampling, and testing criteria for subsurface investigations that should be conducted for major or unusual geotechnical features. Table 3 presents general guidelines on the major types of geotechnical engineering analyses that are normally required for embankments and cut slopes, structure foundations, and retaining structures. Guidance is given for all major soil types. Table 4 presents a list of technical support data that should be provided for correction of soil and rock instabilities (landslides). Due to the unique situation that landslides present in terms of a major expenditure of funds for rehabilitation, a concise and specific list of necessary support information is warranted.

The enclosed review checklists and technical guidelines cover the following geotechnical features:

- Centerline Cuts and Embankments
- Embankments Over Soft Ground
- Landslide Corrections
- Retaining Structures
- Structure Foundations (spread footings, piles, drilled shafts)
- Ground Improvement Techniques
- Material Sites

\*For the purposes of this document, PS&E refers to a plan and specification review at anytime during a project’s development. Hence, the review may occur at a preliminary or partial stage of plan development.

\*\* “Soils and Foundations Workshop Manual”, Publication # FHWA NHI-00-045

Reviews made during the preliminary stage of project development will commonly consist of reviewing the geotechnical report only, since detailed plans and specifications may not yet be prepared.

When reviewing the PS&E, the plans, special provisions, and final geotechnical report should be examined together. A major aspect of the PS&E review of project geotechnical features is to verify that the major design and construction recommendations given in the geotechnical report have been properly incorporated into the plans and specifications. The practice of most highway agencies is to prepare a single geotechnical report that includes subsurface information, interpretations, and design and construction recommendations. However, some agencies prepare two separate reports; one report that only presents the factual subsurface data (made available to bidders), and a separate report or design memorandum (not made available to bidders) which contains the interpretation of subsurface conditions and the design and construction recommendations. These reports not only form the basis of technical reviews but should also be the agency's basis for design and construction of earthwork and foundation features.

The review checklists should be used as the working document while the guidelines in Tables 1 through 4, and the indicated sections of the "Soils and Foundations Workshop Manual" should be used as references. The checklist questions should be completed by referring to the geotechnical report and contract documents, the appropriate sections of the tables, and by use of engineering judgement. For each question, the reviewer should indicate a yes, no, or unknown or non-application response. Upon completion of the checklists, the reviewer should summarize the negative responses and discuss these with the appropriate geotechnical engineers to determine if additional follow-up is appropriate.

Seismic design of geotechnical features has not been considered in this document. For guidance the reader is referred to "Geotechnical Engineering Circular No. 3, Design Guidance: Geotechnical Earthquake Engineering for Highways, Volume I – Design Principles", FHWA SA-97-076. Seismic loads represent an extreme loading condition therefore relatively low factors of safety are generally considered acceptable in a pseudo-static analysis. Factors of safety on the order of 1.1 to 1.15 are typically used in practice for both bearing capacity and sliding resistance. The choice of the factor of safety and of the seismic coefficient are intimately linked. For instance, of a seismic coefficient equal to the PGA (divided by g) has been used in the pseudo-static analysis because the foundation cannot tolerate large movements, a factor of safety of 1.0 may be used. Alternatively, if the seismic coefficient is one-half the PGA and the soil is susceptible to a post-peak strength decrease, a factor of safety of 1.1 to 1.15 should be used.



TABLE 2

GUIDELINE “MINIMUM” BORING, SAMPLING, AND TESTING CRITERIA

The most important step in geotechnical design is to conduct an adequate subsurface investigation. The number, depth, spacing and character of borings, sampling, and testing to be made in an individual exploration program are so dependent upon site conditions and the type of project and its requirements, that no “rigid” rules may be established. Usually the extent of work is established as the site investigation progresses in the field. However, the following are considered reasonable “guidelines” to follow to produce the minimum subsurface data needed to allow cost-effective geotechnical design and construction and to minimize claim problems. (Reference: “Subsurface Investigations” FHWA HI-97-021)

Geotechnical Feature	Minimum Number of Borings	Minimum Depth of Borings
Structure Foundation	<p>1 per substructure unit under 30 m (100 ft) in width 2 per substructure unit over 30 m (100 ft) in width</p> <p>Additional borings in areas of erratic subsurface conditions</p>	<p>Spread footings: 2B where <math>L &lt; 2B</math>, 4B where <math>L &gt; 2B</math> and interpolate for L between 2B and 4B Deep foundations: 6m (20ft) below tip elevation or two times maximum pile group dimension, whichever is greater If bedrock is encountered: for piles core 3 m (10 ft) below tip elevation; for shafts core 3D or 2 times maximum shaft group dimension below tip elevation, whichever is greater. Extend borings to depth of 0.75 to 1.5 times wall height When stratum indicates potential deep stability or settlement problem, extend borings to hard stratum</p>
Retaining Structures	<p>Borings spaced every 30 to 60 m (100 to 200 ft). Some borings should be at the front of and some in back of the wall face.</p>	<p>Extend borings into competent material and to a depth where added stresses due to embankment load is less than 10% of existing effective overburden stress or 3 m (10 ft) into bedrock if encountered at a shallower depth Additional shallow explorations (hand auger holes) taken at approach embankment locations to determine depth and extent of unsuitable surface soils or topsoil.</p>
Bridge Approach Embankments over Soft Ground	<p>When approach embankments are to be placed over soft ground, at least one boring should be made at each embankment to determine the problems associated with stability and settlement of the embankment. Typically, test borings taken for the approach embankments are located at the proposed abutment locations to serve a dual function.</p>	<p>Cuts: (1) in stable materials extend borings minimum 5 m (15 ft) below depth of cut at the ditch line and, (2) in weak soils extend borings below grade to firm materials or to twice the depth of cut whichever occurs first. Embankments: Extend borings to a hard stratum or to a depth of twice the embankment height.</p>
Centerline Cuts and Embankments	<p>Borings typically spaced every 60 m (200 ft) (erratic conditions) to 120 m (400 ft) (uniform conditions) with at least one boring taken in each separate landform. For high cuts and fills, should have a minimum of 3 borings along a line perpendicular to centerline or planned slope face to establish geologic cross-section for analysis.</p>	<p>Extend borings to an elevation below active or potential failure surface and into hard stratum, or to a depth for which failure is unlikely because of geometry of cross-section. Slope inclinometers used to locate the depth of an active slide must extend below base of slide.</p>
Landslides Minimum	<p>3 borings along a line perpendicular to centerline or planned slope face to establish geologic cross-section for analysis. Number of sections depends on extent of stability problem. For active slide, place at least on boring each above and below sliding area</p>	<p>Varies widely depending in the ground improvement technique(s) being employed. For more information see “Ground Improvement Techniques” FHWA SA-98-086R.</p>
Ground Improvement Techniques	<p>Varies widely depending in the ground improvement technique(s) being employed. For more information see “Ground Improvement Techniques” FHWA SA-98-086R.</p>	<p>Extend exploration to base of deposit or to depth required to provide needed quantity.</p>
Material Sites (Borrow sources, Quarries)	<p>Borings spaced every 30 to 60 m (100 to 200 ft). Extend exploration to base of deposit or to depth required to provide needed quantity.</p>	<p>Extend exploration to base of deposit or to depth required to provide needed quantity.</p>

TABLE 2 (Continued)  
GUIDELINE “MINIMUM” BORING, SAMPLING, AND TESTING CRITERIA

<p><u>Sand or Gravel Soils</u> SPT (split-spoon) samples should be taken at 1.5 m (5 ft) intervals or at significant changes in soil strata. Continuous SPT samples are recommended in the top 4.5 m (15 ft) of borings made at locations where spread footings may be placed in natural soils. SPT jar or bag samples should be sent to lab for classification testing and verification of field visual soil identification.</p>
<p><u>Silt or Clay Soils</u> SPT and “undisturbed” thin wall tube samples should be taken at 15 m (5 ft) intervals or at significant changes in strata. Take alternate SPT and tube samples in same boring or take tube samples in separate undisturbed boring. Tube samples should be sent to lab to allow consolidation testing (for settlement analysis) and strength testing (for slope stability and foundation bearing capacity Analysis). Field vane shear testing is also recommended to obtain in-place shear strength of soft clays, silts and well-rotted peat.</p>
<p><u>Rock</u> Continuous cores should be obtained in rock or shales using double or triple tube core barrels. In structural foundation investigations, core a minimum of 3 m (10 ft) into rock to insure it is bedrock and not a boulder. Core samples should be sent to the lab for possible strength testing (unconfined compression) if for foundation investigation. Percent core recovery and RQD value should be determined in field or lab for each core run and recorded on boring log.</p>
<p><u>Groundwater</u> Water level encountered during drilling, at completion of boring, and at 24 hours after completion of boring should be recorded on boring log. In low permeability soils such as silts and clays, a false indication of the water level may be obtained when water is used for drilling fluid and adequate time is not permitted after boring completion for the water level to stabilize (more than one week may be required). In such soils a plastic pipe water observation well should be installed to allow monitoring of the water level over a period of time. Seasonal fluctuations of water table should be determined where fluctuation will have significant impact on design or construction (e.g., borrow source, footing excavation, excavation at toe of landslide, etc.). Artesian pressure and seepage zones, if encountered, should also be noted on the boring log. In landslide investigations, slope inclinometer casings can also serve as water observations wells by using “leaky” couplings (either normal aluminum couplings or PVC couplings with small holes drilled through them) and pea gravel backfill. The top 0.3 m (1 ft) or so of the annular space between water observation well pipes and borehole wall should be backfilled with grout, bentonite, or sand-cement mixture to prevent surface water inflow which can cause erroneous groundwater level readings.</p>
<p><u>Soil Borrow Sources</u> Exploration equipment that will allow direct observation and sampling of the subsurface soil layers is most desirable for material site investigations. Such equipment that can consist of backhoes, dozers, or large diameter augers, is preferred for exploration above the water table. Below the water table, SPT borings can be used. SPT samples should be taken at 1.5 m (5 ft) intervals or at significant changes in strata. Samples should be sent to lab for classification testing to verify field visual identification. Groundwater level should be recorded. Observations wells should be installed to monitor water levels where significant seasonal fluctuation is anticipated.</p>
<p><u>Quarry Sites</u> Rock coring should be used to explore new quarry sites. Use of double or triple tube core barrels is recommended to maximize ore recovery. For riprap source, spacing of fractures should be carefully measured to allow assessment of rock sizes that can be produced by blasting. For aggregate source, the amount and type of joint infilling should be carefully noted. If assessment is made on the basis of an existing quarry site face, it may be necessary to core or use geophysical techniques to verify that nature of rock does not change behind the face or at depth. Core samples should be sent to lab for quality tests to determine suitability for riprap or aggregate.</p>

TABLE 3

## REQUIRED GEOTECHNICAL ENGINEERING ANALYSIS

Soil Classification Embankment and Cut		Slopes Structure Foundations			(Bridges and Retaining Structures)		Retaining Structures (Conventional, Crib and MSE)	
Unified AASHTO	<sup>1</sup> Soil Type Slope	Stability Analysis	Settlement Analysis	Bearing Capacity Analysis	Settlement Analysis	Lateral Earth Pressure	Stability Analysis	
GW	A-1-a	Generally not required if cut or fill slope is 1.5H to 1V or flatter, and underdrains are used to draw down the water table in a cut slope.	Generally not required except possibly for SC soils.	Required for spread footings, pile or drilled shaft foundations.	Generally not needed except for SC soils or for large, heavy structures.	GW, SP, SW & SP soils generally suitable for backfill behind or in retaining or reinforced soil walls.	All walls should be designed to provide minimum F.S. = 2 against overturning & F.S. = 1.5 against sliding along base.	
GP	A-1-a							
GM	A-1-b							
GC	A-2-6							
A-2-7								
SW	A-1-b							
SP	A-3	Erosion of slopes may be a problem for SW or SM soils.		Spread footings generally adequate except possibly for SC soils	Empirical correlations with SPT values usually used to estimate settlement	GM, GC, SM & SC soils generally suitable if have less than 15% fines.	External slope stability considerations same as previously given for cut slopes & embankments.	
SM	A-2-4							
A-2-5								
SC	A-2-6							
A-2-7								
ML A-4 SILT		Required unless non-plastic. Erosion of slopes may be a problem.	Required unless non-plastic.	Required. Spread footing generally adequate.	Required. Can use SPT values if non-plastic.	These soils are not recommended for use directly behind or in retaining or reinforced soil walls.		
CL A-6 CLAY		Required Required						
		Inorganic Lean Clay						
OL A-4 SILT		Required Required						
		Organic						

<sup>1</sup> This is an approximate correlation to Unified (Unified Soil Classification system is preferred for geotechnical engineering usage, AASHTO system was developed for rating pavement subgrades).

<sup>2</sup> These are general guidelines, detailed slope stability analysis may not be required where past experience in area is similar or rock gives required slope angles.

TABLE 3 (Continued)

Soil Classification Embankment and Cut Slopes Structure Foundations		(Bridges and Retaining Structures)		Retaining Structures (Conventional, Crib and MSE)	
Unified AASHTO	Soil Type	Slope Stability Analysis	Settlement Analysis	Bearing Capacity Analysis	Settlement Analysis
MH A-5 SILT	Inorganic	Required. Erosion of slopes may be a problem.	Required.	Required. Deep foundation generally required unless soil has been preloaded.	These soils are not recommended for use directly behind or in retaining walls. All walls should be designed to provide minimum F.S. = 2 against overturning & F.S. = 1.5 against sliding along base.
CH A-7 CLAY	Inorganic Fat Clay	Required. Required.	Required.		
OH A-7 CLAY	Organic	Required. Required.	Required.	Deep foundation required unless peat excavated and replaced.	External slope stability considerations same as previously given for cut slopes & embankments
PT ---- PEAT	Muck	Required. Required.	Long term settlement can be significant		
Rock	Fills – not required for slopes 1.5H to 1V or flatter. Cuts – required but depends on spacing, orientation and strength of discontinuities and durability of rock			Required for spread footings or drilled shafts. Empirically related to RQD <sup>3</sup>	Required. Use rock backfill angle of internal friction.

**REMARKS:**  
 Soils – temporary ground water control may be needed for foundation excavations in GW through SM soils.  
 Backfill specifications for reinforced soil walls using metal reinforcements should meet the following requirements in insure use of non-corrosive backfill:  
 pH range = 5 to 10; Resistivity > 3000 ohm-cm; Chlorides < 100 ppm; Sulfates < 200 ppm; Organic content 1% maximum

Rock – Durability of shales (siltstone, claystone, mudstone, etc.) to be used in fills should be checked. Non-durable shales should be embanked as soils, i.e., placed in maximum 0.3 m (1 ft) loose lifts and compacted with heavy sheepfoot or grid rollers.

<sup>1</sup> This is an approximate correlation to Unified (Unified Soil Classification system is preferred for geotechnical engineering usage, AASHTO system was developed for rating pavement subgrades).

<sup>2</sup> These are general guidelines, detailed slope stability analysis may not be required where past experience in area is similar or rock gives required slope angles.

<sup>3</sup> RQD (Rock Quality Designation) = sum of pieces of rock core 4' or greater in length divided by the total length of core run.

TABLE 4  
CORRECTION OF SOIL AND ROCK-RELATED INSTABILITIES

Each year hundreds of millions of dollars are spent to correct soil or rock-related instabilities on highways. The purpose of this technical note is to advise field engineers what technical support information is essential such that a complete evaluation can be performed. For the purpose of this technical note, soil and rock-related instabilities are defined as follows: "A condition that currently or threatens to affect the stability or performance the stability or performance of a highway facility and is the result of the inadequate performance of the soil or rock components." This includes major instabilities resulting from or associated with: landslides, rockfalls, sinkholes, and degrading shales. Technical support data needed are:

1. Site plan and typical cross-section(s) representing ground surface conditions prior to failure, along with subsurface configuration after failure. Photographs, including aerials, if available, would also be beneficial.
2. Cross-section(s) showing soil and/or rock conditions and water bearing strata as determined by drilling and possibly geophysical surveys.
3. Description of the latent state of the unstable mass, whether movement has stopped or is still occurring, and if so, at what rate.
4. Boring logs.
5. Instrumentation data and/or other information used to define the depth and location of the failure zone. The underground location of the failure zone should be shown on the cross-section(s).
6. Shear strength test data and a description of the testing method utilized on the materials, through which failure is occurring. Where average shear strength is calculated using an assumed failure surface and a factor of safety of 1.0, the complete analysis should be provided and location of assumed water table(s) shown.
7. Proposed corrective schemes including: estimated costs, final safety factors, and design analysis for each alternative solution.
8. Narrative report containing instability history; record of maintenance costs and activity, and preventative measures taken, if any; reasons for inadequacy of the original design; description and results of subsurface investigation performed; summary and results of stability analysis performed; and recommendations for correction.

## GEOTECHNICAL REPORT REVIEW CHECKLISTS

The following checklists cover the major information and recommendations that should be addressed in project geotechnical reports.

Section A covers site investigation information that will be common to all geotechnical reports for any type of geotechnical feature.

Sections B through I cover the basic information and recommendations that should be presented in geotechnical reports for specific geotechnical features: centerline cuts and embankments, embankments over soft ground, landslides, retaining structures, structure foundations and material sites.

<u>Subject</u>	<u>Page</u>
SECTION A, Site Investigation Information .....	12
SECTION B, Centerline Cuts and Embankments .....	14
SECTION C, Embankments Over Soft Ground .....	16
SECTION D, Landslide Corrections .....	18
SECTION E, Retaining Structures .....	20
SECTION F, Structure Foundations – Spread Footings .....	21
SECTION G, Structure Foundations – Driven Piles .....	22
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SECTION I, Ground Improvement Techniques .....	27
SECTION J, Material Sites .....	28

In most sections and subsections the user has been provided supplemental page references to the “Soils and Foundations Workshop Manual” FHWA NHI-00-045. These page numbers appear in parentheses ( ) immediately adjacent to the section or subsection topic. Generalist engineers are particularly encouraged to read these references. Additional reference information on these topics is available in the Geotechnical Engineering Notebook, a copy of which is kept in all FHWA Division offices by either the Bridge Engineer or the engineer with the geotechnical collateral duty.

Certain checklist items are of vital importance to have been included in the geotechnical report. These checklist items have been marked with an asterisk (\*). A negative response to any of these asterisked items is cause to contact the geotechnical engineer for clarification of this omission.

## GTR REVIEW CHECKLIST FOR SITE INVESTIGATION

### A. Site Investigation Information

Since the most important step in the geotechnical design process is to conduct an adequate site investigation, presentation of the subsurface information in the geotechnical report and on the plans deserves careful attention.

<u>Geotechnical Report Text</u> (Introduction) (Pgs. 10-1 to 10-4)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Is the general location of the investigation described and/or a vicinity map included?	___	___	___
2. Is scope and purpose of the investigation summarized?	___	___	___
3. Is concise description given of geologic setting and topography of area?	___	___	___
4. Are the field explorations and laboratory tests on which the report is based listed?	___	___	___
5. Is the general description of subsurface soil, rock, and groundwater conditions given?	___	___	___
*6. Is the following information included with the geotechnical report (typically included in the report appendices):			
a. Test hole logs? (Pgs. 2-24 to 2-32)	___	___	___
b. Field test data?	___	___	___
c. Laboratory test data? (Pgs. 4-22 to 4-23)	___	___	___
d. Photographs (if pertinent)?	___	___	___
 <u>Plan and Subsurface Profile</u> (Pgs. 2-19, 3-9 to 3-12, 10-13)			
*7. Is a plan and subsurface profile of the investigation site provided?	___	___	___
8. Are the field explorations located on the plan view?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

A. <u>Site Investigation Information</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*9. Does the conducted site investigation meet minimum criteria outlined in Table 2?	___	___	___
10. Are the explorations plotted and correctly numbered on the profile at their true elevation and location?	___	___	___
11. Does the subsurface profile contain a word description and/or graphic depiction of soil and rock types?	___	___	___
12. Are groundwater levels and date measured shown on the subsurface profile?	___	___	___
 <u>Subsurface Profile or Field Boring Log</u> (Pgs. 2-14, 2-15, 2-24 to 2-31)			
13. Are sample types and depths recorded?	___	___	___
*14. Are SPT blow count, percent core recovery, and RQD values shown?	___	___	___
15. If cone penetration tests were made, are plots of cone resistance and friction ratio shown with depth?	___	___	___
 <u>Laboratory Test Data</u> (Pgs. 4-6, 4-22, 4-23)			
*16. Were lab soil classification tests such as natural moisture content, gradation, Atterberg limits, performed on selected representative samples to verify field visual soil identification?	___	___	___
17. Are laboratory test results such as shear strength (Pg. 4-14), consolidation (Pg. 4-9), etc., included and/or summarized?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.



GTR REVIEW CHECKLIST FOR CENTERLINE CUTS AND EMBANKMENTS

B. Centerline Cuts and Embankments (Pgs. 2-2 to 2-6)

In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report.

Are station-to-station descriptions included for:	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Existing surface and subsurface drainage?	___	___	___
2. Evidence of springs and excessively wet areas?	___	___	___
3. Slides, slumps, and faults noted along the alignment?	___	___	___

Are station-to-station recommendations included for the following?

General Soil Cut or Fill

4. Specific surface/subsurface drainage recommendations?	___	___	___
5. Excavation limits of unsuitable materials?	___	___	___
*6. Erosion protection measures for back slopes, side slopes, and ditches, including riprap recommendations or special slope treatment.	___	___	___

Soil Cuts (Pgs. 5-23, 5-24)

*7. Recommended cut slope design?	___	___	___
8. Are clay cut slopes designed for minimum F.S. = 1.50?	___	___	___
9. Special usage of excavated soils?	___	___	___
10. Estimated shrink-swell factors for excavated materials?	___	___	___
11. If answer to 3 is yes, are recommendations provided for design treatment?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

B. <u>Centerline Cuts and Embankments</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
<u>Fills</u> (Pgs. 5-1 to 5-3)			
12. Recommended fill slope design?	___	___	___
13. Will fill slope design provide minimum F.S. = 1.25?	___	___	___
<u>Rock Slopes</u>			
*14. Are recommended slope designs and blasting specifications provided?	___	___	___
*15. Is the need for special rock slope stabilization measures, e.g., rockfall catch ditch, wire mesh slope protection, shotcrete, rock bolts, addressed?	___	___	___
16. Has the use of “template” designs been avoided (such as designing all rock slopes on 0.25:1 rather than designing based on orientation of major rock jointing)?	___	___	___
*17. Have effects of blast induced vibrations on adjacent structures been evaluated?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

**GTR REVIEW CHECKLIST FOR EMBANKMENTS OVER SOFT GROUND**

**C. Embankments Over Soft Ground**

Where embankments must be built over soft ground (such as soft clays, organic silts, or peat), stability and settlement of the fill should be carefully evaluated. In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?

<u>Embankment Stability</u> (Pgs. 5-1 to 5-3, 5-20 to 5-22)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Has the stability of the embankment been evaluated for minimum F.S. = 1.25 for side slope and 1.30 for end slope of bridge approach embankments?	___	___	___
*2. Has the shear strength of the foundation soil been determined from lab testing and/or field vane shear or cone penetrometer tests?	___	___	___
*3. If the proposed embankment does not provide minimum factors of safety given above, are recommendations given or feasible treatment alternates, which will increase factor of safety to minimum acceptable (such as change alignment, lower grade, use stabilizing counterberms, excavate and replace weak subsoil, lightweight fill, geotextile fabric reinforcement, etc.)?	___	___	___
*4. Are cost comparisons of treatment alternates given and a specific alternate recommended?	___	___	___
 <u>Settlement of Subsoil</u> (Pgs. 6-7 to 6-20)			
5. Have consolidation properties of fine-grained soils been determined from laboratory consolidation tests?	___	___	___
*6. Have settlement amount and time been estimated?	___	___	___
7. For bridge approach embankments, are recommendations made to get the settlement out before the bridge abutment is constructed (waiting period, surcharge, or wick drains)?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

C. <u>Embankments Over Soft Ground</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
8. If geotechnical instrumentation is proposed to monitor fill stability and settlement, are detailed recommendations provided on the number, type, and specific locations of the proposed instruments?	—	—	—

Construction Considerations (Pgs. 10-8, 10-9)

9. If excavation and replacement of unsuitable shallow surface deposits (peat, muck, top soil) is recommended, are vertical and lateral limits of recommended excavation provided?	—	—	—
10. Where a surcharge treatment is recommended, are plan and cross-section of surcharge treatment provided in geotechnical report for benefit of the roadway designer?	—	—	—
11. Are instructions or specifications provided concerning instrumentation, fill placement rates and estimated delay times for the contractor?	—	—	—
12. Are recommendations provided for disposal of surcharge material after the settlement period is complete?	—	—	—

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

## GTR REVIEW CHECKLIST FOR LANDSLIDE CORRECTIONS

### D. Landslide Corrections (Pgs. 5-1 to 5-4, 5-17 to 5-20)

In addition to the basic information listed in Section A, is the following information provided in the landslide study geotechnical report? (Refer to Table 4 for guidance on the necessary technical support data for correction of slope instabilities.)

		<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1.	Is a site plan and scaled cross-section provided showing ground surface conditions both before and after failure?	___	___	___
*2.	Is the past history of the slide area summarized, including movement history, summary of maintenance work and costs, and previous corrective measures taken, if any?	___	___	___
*3.	Is a summary given of results of site investigation, field and lab testing, and stability analysis, including cause(s) of the slide?	___	___	___

#### Plan

4.	Are detailed slide features, including location of ground surface cracks, head scarp, and toe bulge, shown on the site plan?	___	___	___
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#### Cross-section

*5.	Are the cross-sections used for stability analysis included with the soil profile, water table, soil unit weights, soil shear strengths, and failure plane shown as it exists?	___	___	___
6.	Is slide failure plane location determined from slope indicators?	___	___	___
*7.	For an active slide, was soil strength along the slide failure plane back-calculated using a F.S. = 1.0 at the time of failure?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

	<u>Yes</u>	<u>No</u>	Unknown or N/A
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D. Landslide Corrections (Cont.)

Text

- |  |     |     |     |
|--|-----|-----|-----|
| *8. Is the following information presented for each proposed correction alternative (typical correction methods include buttress, shear key, rebuild slope, surface drainage, subsurface drainage-interceptor, drain trenches or horizontal drains, etc.). |     |     |     |
| a. Cross-section of proposed alternative?  | ___ | ___ | ___ |
| b. Estimated safety factor?  | ___ | ___ | ___ |
| c. Estimated cost?   | ___ | ___ | ___ |
| c. Advantages and disadvantages?   | ___ | ___ | ___ |
| 9. Is recommended correction alternative(s) given that provide a minimum F.S. = 1.25?  | ___ | ___ | ___ |
| 10. If horizontal drains are proposed as part of slide correction, has subsurface investigation located definite water bearing strata that can be tapped with horizontal drains?   | ___ | ___ | ___ |
| 11. If a toe counter berm is proposed to stabilize an active slide has field investigation confirmed that the toe of the existing slide does not extend beyond the toe of the proposed counter berm?   | ___ | ___ | ___ |

Construction considerations

- |  |     |     |     |
|--|-----|-----|-----|
| 12. Where proposed correction will require excavation into the toe of an active slide (such as for buttress or shear key) has the “during construction backslope F.S.” with open excavation been determined? |     |     |     |
| 13. If open excavation F.S. is near 1.0, has excavation stage stage construction been proposed?  | ___ | ___ | ___ |
| 14. Has seasonal fluctuations of groundwater table been considered?  | ___ | ___ | ___ |
| 15. Is stability of excavation backslope to be monitored?  | ___ | ___ | ___ |
| 16. Are special construction features, techniques and materials described and specified?   | ___ | ___ | ___ |

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

**GTR REVIEW CHECKLIST FOR RETAINING STRUCTURES**

**E. Retaining Structures (See “Earth Retaining Structures” FHWA NHI-99-025)**

In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?

	Yes	No	Unknown or N/A
*1. Recommended soil strength parameters and groundwater elevations for use in computing wall design lateral earth pressures and factor of safety for overturning, sliding, and external slope stability.	___	___	___
2. Is it proposed to bid alternate wall designs?	___	___	___
*3. Are acceptable reasons given for the choice and/or exclusion of certain wall types?	___	___	___
*4. Is an analysis of the wall stability included with minimum acceptable factors of safety against overturning (F.S. = 2.0), sliding (F.S. = 1.5), and external slope stability (F.S. = 1.5)?	___	___	___
5. If wall will be placed on compressible foundation soils, is estimated total, differential and time rate of settlement given?	___	___	___
6. Will wall types selected for compressible foundation soils allow differential movement without distress?	___	___	___
7. Are wall drainage details, including materials and compaction, provided?	___	___	___

**Construction Considerations**

8. Are excavation requirements covered including safe slopes for open excavations or need for sheeting or shoring?	___	___	___
9. Fluctuation of groundwater table?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

Top-down Construction Type Walls (See “Manual for Design & Construction Monitoring of Soil Nail Walls”, FHWA SA-96-069R and “Ground Anchors and Anchored Systems”, FHWA IF-99-015)

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*10. For soil nail and anchor walls are the following included in the geotechnical report?			
a. Design soil parameters ( $\phi$ , $c$ , $\gamma$ )	___	___	___
b. Minimum bore size (soil nails)?	___	___	___
c. Design pullout resistance (soil nails)?	___	___	___
d. Ultimate anchor capacity (anchors)?	___	___	___
e. Corrosion protection requirements?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.



**GTR REVIEW CHECKLIST FOR SPREAD FOOTINGS**

**F. Structure Foundations – Spread Footings (Pgs. 7-1 to 7-17)**

In addition to the basic information listed in Section A, is the following information provided in the project foundation report?

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Are spread footing recommended for foundation support? If not, are reasons for not using them discussed?	___	___	___
If spread footing supports are recommended, are conclusions and recommendations given for the following:			
*2. Is recommended bottom of footing elevation and reason for recommendation (e.g., based on frost depth, estimated scour depth, or depth to competent bearing material) given?	___	___	___
*3. Is recommended allowable soil or rock bearing pressure given?	___	___	___
*4. Is estimated footing settlement and time given?	___	___	___
*5. Where spread footings are recommended to support abutments placed in the bridge end fill, are special gradation and compaction requirements provided for select end fill and backwall drainage material (Pgs. 6-1 to 6-4)	___	___	___

**Construction Considerations**

6. Have the materials been adequately described on which the footing is to be placed so the project inspector can verify that material is as expected?	___	___	___
7. Have excavation requirements been included for safe slopes in open excavations, need for sheeting or shoring, etc.?	___	___	___
8. Has fluctuation of the groundwater table been addressed?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR DRIVEN PILES

G. Structure Foundations – Driven Piles (Pgs. 8-1 to 8-29, 9-1 to 9-35)

In addition to the basic information listed in Section A, if pile support is recommended or given as an alternative, conclusions/recommendations should be provided in the project geotechnical report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Is the recommended pile type given (displacement, non-displacement, steel pipe, concrete, H-pile, etc.) with valid reasons given for choice and/or exclusion? (Pgs. 8-1 to 8-3)	___	___	___
2. Do you consider the recommended pile type(s) to be the most suitable and economical?	___	___	___
*3. Are estimated pile lengths and estimated tip elevations given for the recommended allowable pile design loads?	___	___	___
4. Do you consider the recommended design loads to be reasonable?	___	___	___
5. Has pile group settlement been estimated (only of practical significance for friction pile groups ending in cohesive soil)? (Pgs. 8-20 to 8-22)	___	___	___
6. If a specified or minimum pile tip elevation is recommended, is a clear reason given for the required tip elevation, such as underlying soft layers, scour, downdrag, piles uneconomically long, etc.?	___	___	___
*7. Has design analysis (wave equation analysis) verified that the recommended pile section can be driven to the estimated or specified tip elevation without damage (especially applicable where dense gravel-cobble-boulder layers or other obstructions have to be penetrated)?	___	___	___
8. Where scour piles are required, have pile design and driving criteria been established based on mobilizing the full pile design capacity below the scour zone?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

G. <u>Structure Foundations – Driven Piles (Cont.)</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
9. Where lateral load capacity of large diameter piles is an important design consideration, are p-y curves (load vs. deflection) or soil parameters given in the geotechnical report to allow the structural engineer to evaluate lateral load capacity of all piles?	—	—	—
*10. For pile supported bridge abutments over soft ground:			
a. Has abutment downdrag load been estimated and solutions such bitumen coating been considered in design? Not generally required if surcharging of the fill is being performed. (Pgs. 8-21, 8-23)	—	—	—
b. Is bridge approach slab recommended to moderate differential settlement between bridge ends and fill?	—	—	—
c. If the majority of subsoil settlement will not be removed prior to abutment construction (by surcharging), has estimate been made of abutment rotation that can occur due to lateral squeeze of soil subsoil? (Pgs. 5-25, 5-26)	—	—	—
d. Does the geotechnical report specifically alert the structural designer to the estimated horizontal abutment movement?	—	—	—
11. If bridge project is large, has pile load test program been recommended? (Pgs. 9-23 to 9-26)	—	—	—
12. For major structure in high seismic risk area, has assessment been made of liquefaction potential of foundation soil during design earthquake (only loose saturated sands and silts are susceptible to liquefaction)? (See GEC No. 3, FHWA SA-97-076)	—	—	—

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

G. Structure Foundations – Driven Piles (Cont.)

<u>Construction Considerations</u> (Pgs. 9-4 to 9-35)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
13. Pile driving details such as: boulders or obstructions which may be encountered during driving; need for preaugering, jetting, spudding; need for pile tip reinforcement; driving shoes, etc.?	_____	_____	_____
14. Excavation requirements: safe slope for open excavations; need for sheeting or shoring; fluctuation of groundwater table?	_____	_____	_____
15. Have effects of pile driving operation on adjacent structures been evaluated such as protection against damage caused by footing excavation or pile driving vibrations?	_____	_____	_____
16. Is preconstruction condition survey to be made of adjacent structures to prevent unwarranted damage claims?	_____	_____	_____
17. On large pile driving projects, have other methods of pile driving control been considered such as dynamic testing or wave equation analysis?	_____	_____	_____

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR DRILLED SHAFTS

H. Structure Foundations – Drilled Shafts (Pgs. 8-23 to 8-29)

In addition to the basic information listed in Section A, if drilled shaft support is recommended or given as an alternative, are conclusion/recommendations provided in the project foundation report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Are recommended shaft diameter(s) and length(s) for allowable design loads based on an analysis using soil parameters for side friction and end bearing?	___	___	___
*2. Settlement estimated for recommended design loads?	___	___	___
*3. Where lateral load capacity of shaft is an important design consideration, are p-y (load vs. deflection) curves or soils data provided in geotechnical report that will allow structural engineer to evaluate lateral load capacity of shaft?	___	___	___
4. Is static load test (to plunging failure) recommended?	___	___	___
<u>Construction Considerations</u>			
5. Have construction methods been evaluated, i.e., can less expensive dry method or slurry method be used or will casing be required?	___	___	___
6. If casing will be required, can casing be pulled as shaft is concreted (this can result in significant cost savings on very large diameter shafts)?	___	___	___
7. If artesian water was encountered in explorations, have design provisions been included to handle it (such as by requiring casing and a tremie seal)?	___	___	___
8. Will boulders be encountered? (If boulders will be encountered, then the use of shafts should be seriously questioned due to construction installation difficulties and resultant higher cost to boulders can cause.)	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

## GTR REVIEW FOR GROUND IMPROVEMENT TECHNIQUES

### I. Ground Improvement Techniques

In addition to the basic information listed in Section A, if ground improvement techniques are recommended or given as an alternative, are conclusion/recommendations provided in the project foundation report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. For wick drains, do recommendations include the coefficient of consolidation for horizontal drainage, $c_h$ , and the length and spacing of wick drains?	—	—	—
2. For lightweight fill, do recommendations include the material properties ( $\phi$ , $c$ , $\gamma$ ), permeability, compressibility, and drainage requirements?	—	—	—
3. For vibro-compaction, do the recommendations include required degree of densification (e.g., relative density, SPT blow count, etc.), settlement limitations, and quality control?	—	—	—
4. For dynamic compaction, do the recommendations include required degree of densification (e.g., relative density, SPT blow count, etc.), settlement limitations, and quality control?	—	—	—
5. For stone columns, do the recommendations include spacing and dimensions of columns, bearing capacity, settlement characteristics, and permeability (seismic applications)?	—	—	—
6. For grouting, do the recommendations include the grouting method (permeation, compaction, etc.), material improvement criteria, settlement limitations, and quality control?	—	—	—

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR MATERIAL SITES

J. Material Sites

In addition to the basic information listed in Section A, is the following information provided in the project Material Site Report.

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Material site location, including description of existing or proposed access routes and bridge load limits, if any?	___	___	___
*2. Have soil samples representative of all materials encountered during pit investigation been submitted and tested?	___	___	___
*3. Are laboratory quality test results included in the report?	___	___	___
4. For aggregate sources, do the laboratory quality test results (such as L.A. abrasion, sodium sulfate, degradation, absorption, reactive aggregate, etc.) indicate if specification materials can be obtained from the deposit using normal processing methods?	___	___	___
5. If the lab quality test results indicate that specification material cannot be obtained from the pit materials as they exist naturally, has the source been rejected or are detailed recommendations provided for processing or controlling production so as to ensure a satisfactory product?	___	___	___
*6. For soil borrow sources, have possible difficulties been noted, such as above optimum moisture content for clay-silt soils, waste due to high PI, boulders, etc.?	___	___	___
*7. Where high moisture content clay-silt soils must be used, are recommendations provided on the need for aeration to allow the materials to dry out sufficiently to meet compaction requirements?	___	___	___
8. Are estimated shrink-swell factors provided.	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

I. <u>Material Sites</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*9. Do the proven material site quantities satisfy the estimated project quantity needs?	___	___	___
10. Where materials will be executed from below the water table, have seasonal fluctuations of the water table been determined?	___	___	___
11. Are special permit requirements been covered?	___	___	___
12. Have pit reclamation requirements been covered adequately?	___	___	___
13. Has a material site sketch (plan and profile) been provided for inclusion in the plans, which contains:	___	___	___
a. Material site number?	___	___	___
b. North arrow and legal subdivision?	___	___	___
c. Test hole or test pit logs, locations, numbers and date?	___	___	___
d. Water table elevation and date?	___	___	___
e. Depth of unsuitable overburden, which will have to be stripped?	___	___	___
f. Suggested overburden disposal area?	___	___	___
g. Proposed mining area and previously mined areas?	___	___	___
h. Existing stockpile locations?	___	___	___
i. Existing or suggested access road?	___	___	___
j. Bridge load limits?	___	___	___
k. Reclamation details?	___	___	___
14. Are recommended special provisions provided?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.



## PS&E REVIEW CHECKLISTS

Plans and specifications (PS&E)\*\* reviews of projects with major or unusual geotechnical features<sup>1</sup> should preferably be made by examining the plans, special provisions, and geotechnical report together.\*\*\*

<u>Subject</u>	<u>Page</u>
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Certain checklist items are of vital importance to have been included in the PS&E. These checklist items have been marked with an asterisk (\*). A negative response to any of these asterisked items is cause to contact the geotechnical engineer for clarification of this omission.

The information covered in Section A, General will apply to all geotechnical features. The rest of the sections cover additional important PS&E review items that pertain to specific geotechnical features.

\*\* For purposes of this document, PS&E refers to a plan and specification review at any time during a project's development. Hence, the review may be at a preliminary or partial stage of plan development.

\*\*\*When plan reviews are conducted at a partial stage the final geotechnical report may not be available.

<sup>1</sup>Major and unusual geotechnical features are defined in Table 1.

PS&E REVIEW CHECKLIST – GENERAL

A. <u>General</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Has the appropriate geotechnical engineer reviewed the PS&E to ensure that the design and construction recommendations have been incorporated as intended and that the subsurface information has been presented correctly? <u>This is absolutely necessary.</u>	___	___	___
2. Are the finished profile exploration logs and locations included in the plans?	___	___	___
*3. Have geotechnical designs prepared by region or district offices or consultants been reviewed and approved by the State Headquarters’ geotechnical engineer?	___	___	___
4. Do the contract documents contain the special provisions as provided in the project geotechnical report?	___	___	___
5. Have the following common pitfalls been avoided:			
a. Has an adequate site investigation been conducted (reasonably meeting or exceeding the minimum criteria given in Table 2)?	___	___	___
b. Has the use of “subjective” subsurface terminology (such as relatively soft rock or gravel with occasional boulders) been avoided?	___	___	___
c. If alignment has been shifted, have additional subsurface explorations been conducted along the new alignment?	___	___	___
d. Has a note been included in the contract indicating all subsurface information is available to bidders?	___	___	___
e. Do you think the wording of the geotechnical special provisions are clear, specific and unambiguous?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

B. <u>Centerline Cuts and Embankments</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Where excavation is required, are excavation limits and description of unsuitable organic soils shown on the plans?	—	—	—
2. Are plan details and special provisions provided for special drainage details, such as lined surface ditches, drainage blanket under sidehill fill, interceptor trench drains, etc.?	—	—	—
3. Are special provisions included for fill materials requiring special treatment, such as nondurable shales, lightweight fill, etc.?	—	—	—
4. Are special provisions provided for any special rock slope excavation and stabilization measures called for in plans, such as controlled blasting, wire mesh slope protection, rock bolts, shotcrete, etc.?	—	—	—
C. <u>Embankments Over Soft Ground</u>			
*1. Where subexcavation is required, are excavation limits and description of unsuitable soils clearly shown on the plans?	—	—	—
*2. Where settlement waiting period will be required, has estimated settlement time been stated in the special provisions to allow bidders to fairly bid the project?	—	—	—
*3. If instrumentation will be used to control the rate of fill placement, do special provisions clearly spell out how this will be done and how the readings will be used to control the contractor's operation?	—	—	—
4. Do special provisions state that any instrumentation damage by contractor personnel will be repaired at the contractor's expense?	—	—	—

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

D. <u>Landslide Corrections</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Are plan details and special provisions provided for special drainage details, such as lined surface ditches, drainage blankets, horizontal drains, etc.?	___	___	___
*2. Where excavation is to be made into the toe of an active slide, such as for a buttress or shear key, and stage construction is required, do the special provisions clearly spell out the stage construction sequence to be followed?	___	___	___
*3. Where a toe buttress is to be constructed, do the special provisions clearly state gradation and compaction requirements for the buttress material?	___	___	___
*4. If the geotechnical report recommends that slide repair work not be allowed during the wet time of the year, is the proposed construction schedule in accord with this?	___	___	___
E. <u>Retaining Structures</u>			
*1. Are select materials specified for wall backfill with gradation and compaction requirements covered in the specification?	___	___	___
2. Are limits of required select backfill zones clearly detailed on the plans?	___	___	___
3. Are excavation requirements specified, e.g., safe slopes for excavations, need for sheeting, etc.?	___	___	___
*4. Where alternative wall types will be allowed, are fully detailed plans included for all alternatives?	___	___	___
5. Were designs prepared by the wall supplier?	___	___	___
6. Were wall supplier's design calculations and specifications reviewed and approved by the structural and geotechnical engineers?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

E. <u>Retaining Structures</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*7. Where proprietary retaining walls are bid as alternates, does bid schedule require bidders to designate which alternate their bid is for, to prevent bid shopping after contract award?	___	___	___
8. Have FHWA guidelines for experimental designations for certain proprietary wall types been followed?	___	___	___
9. Is ROW limit or easements shown on plans and mentioned in specifications where anchors are to be installed?	___	___	___
 <u>Top-down Construction Type Walls</u> (See “Manual for Design & Construction Monitoring of Soil Nail Walls”, FHWA SA-96-069R and “Ground Anchors and Anchored Systems”, FHWA IF-99-015)			
*10. For soil nail and anchor walls are the following included in the provisions:			
a. Construction tolerances?	___	___	___
b. Minimum drill-hole size?	___	___	___
c. Material requirements?	___	___	___
d. Load testing procedures and acceptance criteria?	___	___	___
e. Construction monitoring requirements?	___	___	___

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

F. <u>Structure Foundations – Spread Footings</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1.    Where spread footings are to be placed on natural soil, is the specific bearing strata in which the footing is to be founded clearly described, e.g., placed on Br. Sandy GRAVEL deposit, etc.?	_____	_____	_____
*2.    Where spread footings are to be placed in the bridge end fill, are gradation and compaction requirements, for the select fill and backfill drainage material, covered in the special provisions, standard specifications, or standard structure sheets?	_____	_____	_____
G. <u>Structure Foundations – Driven Piles</u>			
1.    Do plan details adequately cover pile splices tip reinforcement, driving shoes, etc.?	_____	_____	_____
*2.    Where friction piles are to be driven in silty or clayey soils, significant setup or soil freeze affecting long-term capacity may occur. Do specifications require retapping the piles after 24 to 48 hour waiting period when required bearing is not obtained at estimated length at the end of initial driving?	_____	_____	_____
3.    Where friction piles are to be load tested, has a reaction load of four times design load been specified to allow load testing the pile to plunging failure so that the ultimate soil capacity can be determined?	_____	_____	_____
4.    Where end bearing steel piles are to be load tested, has load test been designed to determine if higher than 62 MPa (9 ksi) allowable steel stress can be used, e.g., 83 to 103 MPa (12 – 15 ksi)?	_____	_____	_____
*5.    Where cofferdam construction will be required, have soil gradation results been included in the plans or been made available to bidders to assist them in determining dewatering procedures?	_____	_____	_____

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

G. <u>Structure Foundations – Driven Piles (Cont.)</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*6. If a wave equation analysis will be used to approve the contractor’s pile driving hammer, has a minimum hammer energy or estimated soil resistance in kN (tons) to be overcome to drive the piles to the estimated length, been given in the special provisions?	_____	_____	_____
*7. Has the appropriate safety factor, based on construction control method (static load test, dynamic load test, wave equation, etc.) been included? Have the specifications for the applicable construction control method been included?	_____	_____	_____
H. <u>Structure Foundations – Drilled Shafts</u>			
*1. Where drilled shafts are to be placed in soil, is the specified bearing stratum in which the drilled shaft is to be found clearly described, e.g., placed on Br. Sandy GRAVEL deposit, etc.?	_____	_____	_____
2. Where end bearing drilled shafts are to be founded on rock, has the rock elevation at the shaft pier locations been determined from borings at the pier locations?	_____	_____	_____
3. Where drilled shafts are to be socketed some depth into rock, have rock cores been extracted at depths to 3 m (10 ft) below proposed socket at location within 3 m (10 ft) of the shaft?	_____	_____	_____
*4. Are shafts equipped with PVC access tubes to accommodate non-destructive testing (gamma/gamma logging, cross-hole sonic logging) of the shaft? Are provisions for the appropriate non-destructive testing methods included?	_____	_____	_____

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

I. <u>Ground Improvement Techniques</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. For wick drains, are contractor submittals required that include proposed equipment and materials, method(s) for addressing obstructions, and method(s) for splicing wick drains.	_____	_____	_____
2. For lightweight fill, are minimum/maximum densities, gradation, lift thickness, and method of compaction specified?	_____	_____	_____
3. For vibro-compaction, are contractor submittals required that include proposed equipment and materials? Are methods of measurement and acceptance criteria specified?	_____	_____	_____
4. For dynamic compaction:			
a. If method specification is used, are the following specified: tamper mass and size; drop height, grid spacing; applied energy; number of phases or passes; site preparation requirements; subsequent surface compaction procedures?	_____	_____	_____
b. If performance specification is used, are the following specified: minimum soil property value to be achieved and method of measurement; maximum permissible settlement?	_____	_____	_____
5. For stone columns, are the following specified: site preparation, backfill materials, minimum equipment requirements, acceptance criteria and quality assurance procedures?	_____	_____	_____
6. For grouting, are contractor submittals required that include proposed equipment and materials. Are methods of measurement and acceptance criteria specified?	_____	_____	_____

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.



PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

J. <u>Material Sites</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Is a material site sketch, containing the basic information listed on page 27, included in the plans?	—	—	—
*2. Has the material site investigation established a proven quantity of material sufficient to satisfy the project estimated quantity needs?	—	—	—
3. Where specification material cannot be obtained directly from the natural deposit, do the special provisions clearly spell out that processing will be required?	—	—	—
4. Are contractor special permit requirements covered in the special provisions?	—	—	—
5. Are pit reclamation requirements clearly spelled out on the plans and in the special provisions?	—	—	—

\*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

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KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

**SUMMARY OF COST ITEMS FOR STATEWIDE GEOTECHNICAL ENGINEERING SERVICES**

County _____ ROAD NAME _____	ITEM # _____ CONTRACT # _____	MARS # _____ ESTIMATE # _____		
	Hourly Rate	Units/Hours	No. of Test/Samples	TOTAL
1. Moisture Content Test	\$ _____	x _____	x _____	= \$ _____
2. Logging Rock Core *	\$ _____	x _____	x _____	= \$ _____
3. Soil Classifications	\$ _____	x _____	x _____	= \$ _____
4. Wash and Sieve Gradations	\$ _____	x _____	x _____	= \$ _____
5. Moisture/Density/CBR/Soil Classifications	\$ _____	x _____	x _____	= \$ _____
6. Moisture/Density Test	\$ _____	x _____	x _____	= \$ _____
7. Slake Durability Index & Jar Slake Tests	\$ _____	x _____	x _____	= \$ _____
8. Unconfined Compression Tests on Soil	\$ _____	x _____	x _____	= \$ _____
9. Unconfined Compression Tests on Rock	\$ _____	x _____	x _____	= \$ _____
10. One-Dimensional Consolidation Tests	\$ _____	x _____	x _____	= \$ _____
11. Consolidated-Undrained Triaxial Tests with Pore Pressure Measurements	\$ _____	x _____	x _____	= \$ _____
12. Unconsolidated-Undrained Triaxial Tests, Total Stress Method	\$ _____	x _____	x _____	= \$ _____
13. Slope Stability Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
14. Settlement Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
15. Deep Foundation Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
16. Wave Equation Driveability Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
17. Negative Skin Friction Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
18. Bearing Capacity Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____
19. Retaining Wall Analyses	\$ _____	x _____		= \$ _____
	\$ _____	x _____		= \$ _____

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Rev. 5/05

KENTUCKY TRANSPORTATION CABINET  
Division of Materials  
Geotechnical Branch

**SUMMARY OF COST ITEMS FOR STATEWIDE GEOTECHNICAL ENGINEERING SERVICES**

COUNTY _____	ITEM No. _____				
20. Drafting	\$ _____	X	_____	=	\$ _____
	\$ _____	X	_____	=	\$ _____
21. Preliminary Plans *	\$ _____	X	_____	=	\$ _____
22. Preliminary Meetings *	\$ _____	X	_____	=	\$ _____
23. Rock Core Meetings *	\$ _____	X	_____	=	\$ _____
24. Interim Meetings *	\$ _____	X	_____	=	\$ _____
25. Final Meetings *	\$ _____	X	_____	=	\$ _____
26. Report Writing *	\$ _____	X	_____	=	\$ _____
27. Publication of Reports *	\$ _____	X	_____	=	\$ _____
			<b>Subtotal</b>	=	\$ _____
			<b>Plus 10 percent</b>	=	\$ _____
28. Direct Cost					\$ _____
<b>TOTAL THIS ESTIMATE</b>					\$ _____
<b>ACCUMULATED TOTAL ESTIMATES</b>	_____	<b>THROUGH</b>	_____	=	\$ _____

\* Please provide additional justification for these items.

\_\_\_\_\_  
**FIRM NAME**  
\_\_\_\_\_  
**SIGNED**  
\_\_\_\_\_  
**DATE**  
\_\_\_\_\_



