


Appendix D – GEOTECHNICAL OVERVIEW

MEMORANDUM

TO: John Moore, PE
Director, Division of Planning

FROM: Bart Asher, PE, PLS
Geotechnical Branch Manager
Division of Structural Design

BY: Erik Scott, PE 
Geotechnical Branch

DATE: September 30, 2015

Subject: Hancock County
FD04 046 0069 000-013
Mars No. 9011901D
Item No. 2-8708.00
Phase 1 Scoping Study for KY-69
Mileposts 0.000 to 13.043
Preliminary Geotechnical Assessment

The preliminary geotechnical assessment report for the subject project has been completed by Stantec Consulting Services, Inc. This report was prepared in conjunction with a Scoping Study for Phase 1 Design for the subject project. The project involves reconstruction and widening of KY 69 from the Ohio/Hancock County line to the KY 69 / US 60 Intersection east of Hawesville, KY. Additional geotechnical exploration and analyses will be required for the final design phase of the project. The report has previously been provided to the Design Consultant (also Stantec) and will be made available on ProjectWise. We have reviewed and concur with the recommendations as presented in the report.

If you have any questions or need additional information, please contact the Geotechnical Branch at 502-564-2374.

cc: **TEBM for Project Development (District)**
Project Manager (District)
Division of Highway Design
Division of Planning
Stantec Consulting Services, Inc.

Attachment

Report of Geotechnical Overview

KY 69
Hancock County, Kentucky
Item No. 2-8708.00



Prepared for:
Stantec Consulting Services Inc.

Prepared by:
Stantec Consulting Services Inc.

June 1, 2015



Stantec Consulting Services Inc.
1409 North Forbes Road, Lexington KY 40511-2024

June 1, 2015
File: let_001_178554021

Attention: Len Harper, P.E.
Stantec Consulting Services
400 East Vine Street, Suite 300
Lexington, Kentucky 40507

**Reference: Report of Geotechnical Overview
KY 69
Hancock County, Kentucky
Item No. 2-8708.00**

Dear Len,

Enclosed is the geotechnical overview for the proposed Scoping Study and Environmental overview for KY 69 located in Hancock County. The overview is based upon research of available published data and preliminary data for the study area provided by your office. The scope of work performed and results of the overview are presented in the accompanying attachment.

Regards,

STANTEC CONSULTING SERVICES INC.

A handwritten signature in blue ink, appearing to read "Donald Blanton".

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A handwritten signature in blue ink, appearing to read "Mark A. Litkenhus".

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/hnh

Design with community in mind

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REPORT OF GEOTECHNICAL OVERVIEW

Project Description
June 1, 2015

1.0 PROJECT DESCRIPTION

The Kentucky Transportation Cabinet (KYTC) is proposing to widen and reconstruct a portion of KY 69 in Hancock County, Kentucky. The reconstruction will generally utilize the existing corridor. The corridor will begin near the Ohio/Hancock County line and extend north and end at the intersection of KY 69/US 60 east of Hawesville, KY. The project corridor generally follows the existing alignment of KY 69 and is approximately 2000 feet wide. This project will improve safety by: addressing geometric deficiencies in the roadway, and adjusting the alignment, improve sight distances and improve roadside design. This overview will be utilized to identify geotechnical considerations for the study area. The project location and corridor is presented on the drawings provided in Appendix A.

REPORT OF GEOTECHNICAL OVERVIEW

Scope of Work
June 1, 2015

2.0 SCOPE OF WORK

The scope of work for this study consists of performing a geotechnical overview for the proposed corridor based upon research of available published data and Stantec's experience with highway design and construction within the region. General geotechnical and geologic characteristics of the study area have been identified and are discussed in this report. Stantec personnel, using a variety of sources, performed a literature search that included reviews of the following sources:

- Available topographic and geologic mapping of the project area published by the United States Geological Survey (USGS) and the Kentucky Geological Survey (KGS);
- The Geologic Map of Kentucky, published by the USGS and the KGS (1988);
- Kentucky Geologic Map Information Service
<http://kgs.uky.edu/kgsmmap/kgsgeserver/viewer.asp>;
- KYTC Geotechnical Data, published by the KGS and KYTC,
<http://kgs.uky.edu/kgsmmap/kytcLinks.asp>;
- Prior Projects Nearby:
 - R-006-1990
 - R-012-1994
 - S-066-1990
 - S-081-1993
 - S-082-1993
- United States Department of Agriculture, Soil Conservation Service (SCS) Soil Survey Publications for affected counties;
- Physiographic Regions, published by KGS, <http://kgs.uky.edu/kgsweb>.

REPORT OF GEOTECHNICAL OVERVIEW

Physiographic and Stratigraphic Setting
June 1, 2015

3.0 PHYSIOGRAPHIC AND STRATIGRAPHIC SETTING

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is located in the Western Coal Fields physiographic region of Kentucky. Subsurface conditions are characteristic of Lower and Middle Pennsylvanian age bedrock, which typically consists of cyclic sequences of sandstones, siltstone, shale and coal with some limestone beds. The Hawesville coal bed is the predominate coal seam along the proposed corridor. Also, there are productive oil and gas fields in the vicinity of the corridor, primarily along the southern half of the project.

Surface drainage is directed towards named and unnamed tributaries of the North Branch of the South Fork of Panther Creek along the southern portion of the alignment, which flows into the Green River. The surface drainage along the remaining portion on the corridor is directed toward Horse Fork, Blackford Creek, Caney Creek and Lead Creek which ultimately flow into the Ohio River.

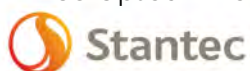
3.2 STRATIGRAPHY

Available geologic mapping indicates that the project corridor is underlain by bedrock consisting of the sandstone, siltstone, shale and coal with some limestone beds of the Tradewater and Caseyville Formations. These bedrock formations represent the Lower and Middle Pennsylvanian Geologic periods. The geologic mapping also indicates that portions of the project corridor are underlain by alluvium along major drainage courses. Based on USGS mapping, the underlying bedrock and soil deposits can be described as follows.

The sandstone consists of light- gray to yellowish-brown in color, fine to coarse-grained and is crossbedded and massive. Portions of the sandstone can be conglomeratic. The shale can be described as light to medium-gray. The shale grades to siltstone in areas. Zones are channel-filled sandstone. The coal is black, zones contain partings and vary from zero to about 5 feet in thickness.

Structure contours presented on the various USGS geologic maps (predominately drawn on the base of the Lead Creek Limestone of Crider) indicates that the bedrock to have a regional dip towards the west- southwest. The geologic mapping of the area is presented in Appendix B, along with a generalized geologic column.

In the vicinity of the project corridor, the Hawesville Coal Bed (up to 5 foot in thickness) has been both underground and surface mined. The seam was reportedly underground mined from the 1860's through the 1920's. Mine maps were not available through the Department of Mines and Minerals. Many mine adits depicted on the USGS geologic mapping indicates the adits have collapsed. The coal seam and mining is discussed further in Section 4.6 of this report.



REPORT OF GEOTECHNICAL OVERVIEW

Physiographic and Stratigraphic Setting
June 1, 2015

3.3 FAULTING IN THE AREA

Faults are depicted near the project vicinity, however, they do not intersect the proposed corridor and are not expected to have a detrimental effect on the project.

3.4 SOILS AND UNCONSOLIDATED MATERIALS

Residual soils are the predominate soil type found within this area. Soil descriptions contained herein are based upon SCS soil surveys and on Stantec's knowledge of the study area. Soils within the area of the roadway have derived in-place from a weathering process of the parent shale, siltstone and sandstone rock formations. These soils consist of silty clay and silt loam.

Alluvial deposits consisting of tributary stream alluvium are mapped within the flood plain of the major drainage courses. These deposits consist of clays, sands and gravels with varying thicknesses up to approximately 50 feet. Terrace deposits are shown on the geologic mapping, but does not impact the project corridor.

Talus and mine spoils may be encountered in valleys near areas of mining.

3.5 REGIONAL SEISMICITY

Seismicity within the Commonwealth of Kentucky varies widely depending on location. The western portion of the state is dominated by the New Madrid and Wabash Valley source zones. In general, these zones are fairly active with many documented historical seismic events. Central and eastern portions of the state experience less frequent earthquakes because the source zones are quite distant from these areas.

The seismic hazard at a bridge site shall be characterized by the acceleration response spectrum for the site and the site factors for the relevant site class. A comprehensive geotechnical investigation will be required to determine the site class. However, based on anticipated depths to bedrock at/near stream locations, Site Class C or D can be expected. The 2014 AASHTO LRFD Bridge Design specifications provide guidelines for selecting a seismic performance category and a soil profile type for bridge sites. This information establishes the elastic seismic response coefficient and spectrum for use in further structural design and analyses. Refer to Section 3.10.2 of the AASHTO guidelines for specifications. The corridor alignment will be likely affected by seismic activity from the New Madrid and Wabash Valley source zones; however, to determine the acceleration response spectrum and the site factors, a geotechnical exploration will be required.

REPORT OF GEOTECHNICAL OVERVIEW

Geotechnical Considerations
June 1, 2015

4.0 GEOTECHNICAL CONSIDERATIONS

4.1 GENERAL

Based on the project corridor and Stantec's roadway experience, it is anticipated that the new alignment/reconstruction will generally follow the existing alignment of KY 69. Therefore, it is anticipated that this portion of the alignment will consist more of widening and not have many new cuts or fills required along the existing highway. For improved safety within portions where the existing roadway may be widened, it appears that several intersections and structures will need to be reworked/realigned along the reconstructed roadway. The revisions to the interchanges will include: providing necessary clear zones, addressing geometric deficiencies in the roadway and adjusting the alignment. As the interchanges are reworked, the Project Team should keep in mind the geotechnical considerations that are included in Section 4 as they pertain to existing utilities, cut slopes, embankments and widened structures.

4.2 CUT SLOPE CONSIDERATIONS

Cut slope configurations in rock are generally controlled by bedrock lithology, bedrock quality, results of Slake Durability Index (SDI) tests in shales and siltstones, and by the presence of any fractures and/or joints. In general, if joint/fracture angles are high (as measured from horizontal), steeper cut slopes can be constructed and an acceptable level of stability can be maintained. If discontinuities exhibit low angles and steep cut slopes are utilized, large block failures may occur along the open cut face.

Slope configurations for rock cuts in durable or Type I non-durable rock generally range from 1H:4V to 1H:2V pre-split slopes on approximate 30-foot intervals of vertical height with 18 to 20-foot intermediate benches. These types of cuts could be anticipated within this alignment with rock cut slopes of 1H:2V being likely most common. Cuts in nondurable shales and shallow cuts in bedrock may be best handled on 2H:1V slopes. With old mine workings present in the area, mine voids encountered in cuts will require back-stowing. Based on observations of an existing cut, some of the sandstones may be friable and as such, may not be available for use as durable rock.

Slope configurations for soil cuts are generally constructed on a 2H:1V or flatter.



REPORT OF GEOTECHNICAL OVERVIEW

Geotechnical Considerations
June 1, 2015

4.3 EMBANKMENT CONSIDERATIONS

The anticipated excavated rock materials should be suitable for use in project embankments. Select rock types for use as rock embankment, rock road bed, channel lining, etc., would be durable shale. With the shales and siltstones present along the corridor, sufficient quantities of durable rock may not be generated during construction and the use of off-site sources should be considered. Foundation soils are likely to be silty clays and silt loam. Silt loam is considered a moderate to poor soil for use in roadway construction.

Embankments constructed of durable rock materials generally exhibit adequate stability at 2H:1V slope configurations. However, flatter embankment slopes may be required for tall embankments constructed from nondurable shales or in areas where embankments are founded on alluvial materials. Alluvial soils can be expected along major drainage courses.

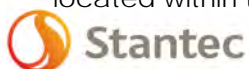
Low shear strengths and high settlement potentials are generally associated with alluvial deposits. Consolidation settlements and short-term embankment stability problems are common for roadway embankments in alluvial floodplains, and controlled embankment construction rates and/or flatter embankment side slopes should be anticipated for these areas.

4.4 STRUCTURES

It is anticipated that mainline bridges will need to be widened and or replaced to meet horizontal clearances with the new highway. At this time, it is unknown as to whether the proposed roadway would require new and/or widened substructure elements. Based on Stantec's knowledge of the area, it can be anticipated that the majority of the bridges within the project corridor are likely supported by rock bearing foundation systems, which could be a spread footing or steel H-piles driven to bedrock. Culverts along the proposed alignment may be replaced or widened. It can be anticipated the culverts within the project corridor are likely supported by either a non-yielding or yielding foundation system depending upon the location along the proposed alignment. A detailed geotechnical investigation will be required to determine the foundation support system.

4.5 SATURATED, SOFT OR UNSTABLE AREAS

Based on topographic mapping and literature reviewed, the alignment may be near ponds, drainage swales or stream channels. Any saturated, soft or unstable areas encountered within embankment foundation limits should be drained and stabilized utilizing non-erodible granular embankment. The coarse aggregate shall be underlain with Geotextile fabric. Ponds should be drained and any soft or saturated material should be removed and/or stabilized. For stabilization purposes, a sufficient thickness of non-erodible granular embankment should be placed over all soft / saturated foundation areas. Additional rock may be required to stabilize soft soils and to maintain positive drainage. Based on observations, several ponds exist within the project corridor. Depending on the project alignment, these ponds will require treatment if they are located within the construction limits.



REPORT OF GEOTECHNICAL OVERVIEW

Geotechnical Considerations
June 1, 2015

Also, standing water was observed in low lying areas adjacent to streams. Provisions for stabilizing such areas should be included as part of the project.

4.6 COAL SEAMS/MINING

As mentioned previously, within the vicinity of the project, the Hawesville Coal Bed (up to 5 foot in thickness) has been both underground and surface mined. The seam was reportedly underground mined from the 1860's through the 1920's. Mine maps were not available through the Department of Mines and Minerals. Many mine adits depicted on the USGS geologic mapping indicates the adits have collapsed. Based on the geologic mapping the Hawesville coal bed can be expected to be encountered between elevations 490 to 520 along the project corridor. Old mine works encountered in cuts will require back-stowing.

Mine adits/mining activity are depicted on the geologic mapping near/within the project corridor in the following general areas:

- Mine adits are noted east of existing KY 69 near Roseville.
- Mine adits noted east of existing KY 69 just north of Weberstown.
- Mine adits noted on both sides of existing KY 69 near Goering.
- Surface mining noted east of existing KY 69 north of Blackford Creek.
- Surface mining noted west of existing KY 69 south of Caney Creek.
- Mine adits noted on both sides of existing KY 69 north of Caney Creek.
- Abandoned gravel pit noted west of existing KY 69 north of Caney Creek.

Depending on roadway grade versus the anticipated coal seam elevation, some areas may require over excavation below the roadway to remove old mine workings in order to reduce the potential for collapse after roadway construction. Additional geotechnical drilling will be required to help define mine workings in these areas.

Seeps, springs and wet areas may be encountered on the down dip side of the coal outcropping and at mine adits.

4.7 GAS AND OIL WELLS

There are several oil and gas wells in the vicinity on the project corridor. Based on the geologic mapping, petroleum is produced from the Tar Springs Sandstone of the late Mississippian age near the alignment. The Jackson sand (Big Clifty Sandstone member of Golconda Formation) and the McClosky lime (in the Ste. Genevieve Limestone), both of the late Mississippian age, have also been sources of small production of oil and natural gas based on the information



REPORT OF GEOTECHNICAL OVERVIEW

Geotechnical Considerations
June 1, 2015

Stantec has reviewed. Well locations are shown on the geologic mapping in Appendix B. Recommendations are being provided in Section 5 to inventory the wells and verify what is active and what has been abandoned.

REPORT OF GEOTECHNICAL OVERVIEW

Conclusions
June 1, 2015

5.0 CONCLUSIONS

5.1. The purpose of this overview was to provide a general summary of the bedrock, soil and geomorphic features likely to be encountered within the proposed alignment; and to identify geotechnical features that may have an adverse impact on the project alignment.

5.2. The potential exists for encountering old mine works. Mine voids encountered in cut sections will require back-stowing. In addition, depending on the roadway grade relative the coal seam/mine works elevation, over excavation of the coal seam/mine works may be required to reduce the potential for roadway collapse. Because of the age and limited available information concerning the mining, a detailed geotechnical exploration will be required to further investigate the old mining. Additional borings in conjunction with deepened borings will be required to help define the mine works.

5.3. Geotechnical drilling will be needed for replacement or widened culverts, bridges and retaining walls. It is anticipated that conventional spread footing and/or pile foundation systems can be utilized for these structures.

5.4. Because a portion of this project may be a widening project, information on pavement structure should be obtained to assist the team on pavement structure and California Bearing Ratio (CBR) information. Other projects in the vicinity have utilized rock roadbed and generally CBR values of approximately 6 or less.

5.5. Once alignment and sections are identified, then open faced logging of exposed cuts and/or drilling should be performed. Sampling of foundation soils should be performed for embankment situations of sufficient height to evaluate stability.

5.6. Several oil and gas wells have been drilled near/along the proposed corridor. Many have reportedly been abandoned. The Design Team should inventory and survey active wells. Additional costs could be incurred if the selected alignment disturbs a well site.

5.7. The information presented in this overview should be reviewed in the general nature in which it was intended. A thorough geotechnical exploration of the proposed alignment and grade will be required to properly anticipate and plan for special requirements necessary for the design and construction of the proposed alignment.

Appendix A

USGS Topographic Map

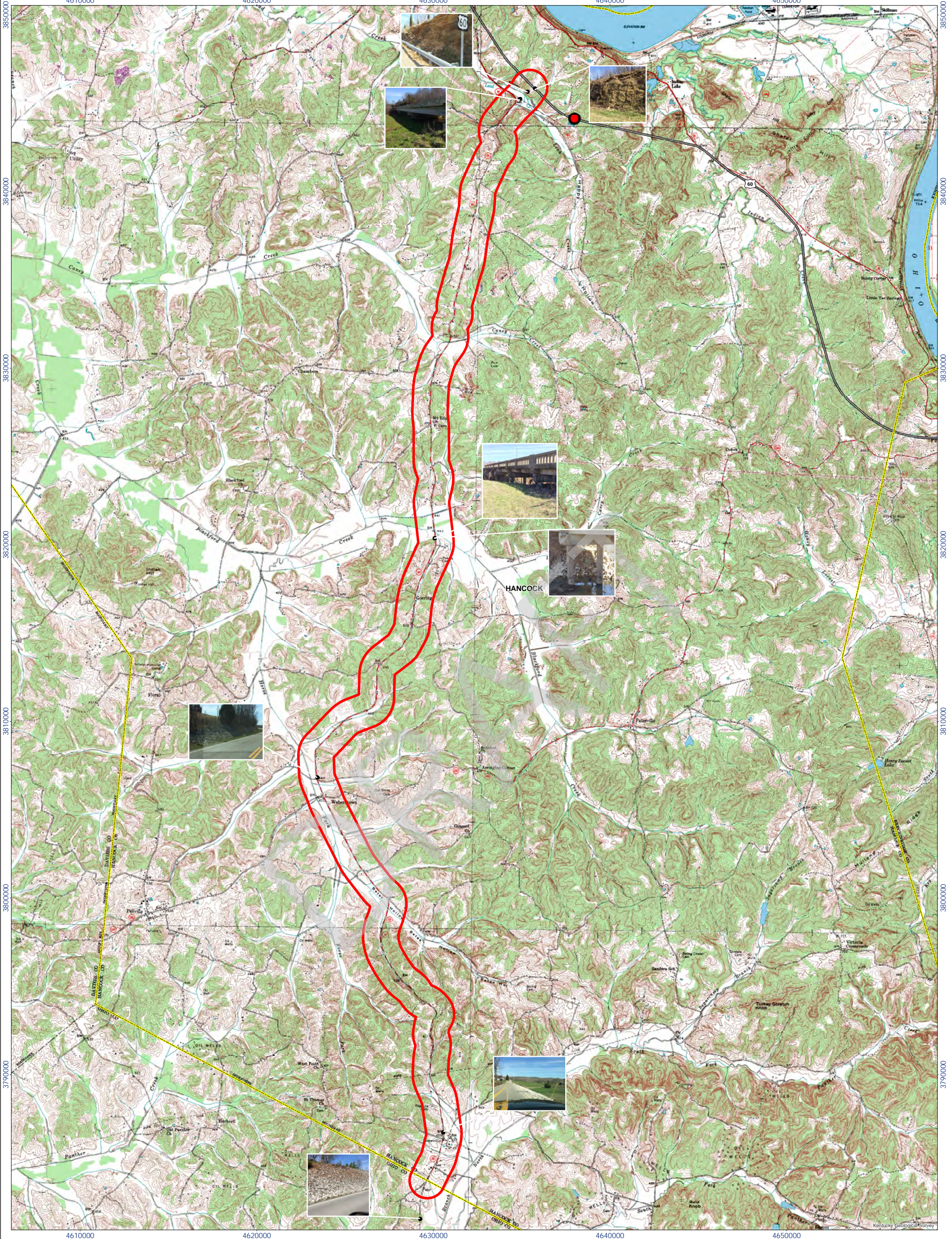
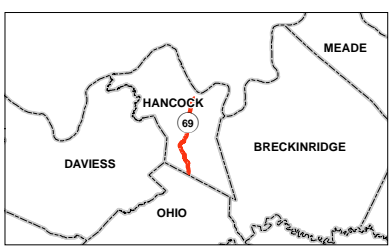
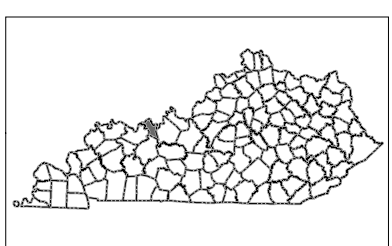


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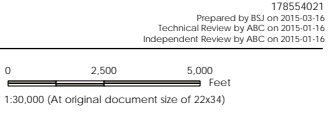
Title
**KY 69 Geotechnical Overview
Topographic Information**

Client/Project
Stantec



- GPS Photo Point
- KGS landslide inventory data
- ▭ Study Area
- ▭ County Boundary

Notes
1. Landslide and Topographic Quadrangle Data Source: Kentucky Geological Survey
2. Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet



Appendix B

USGS Geologic Map

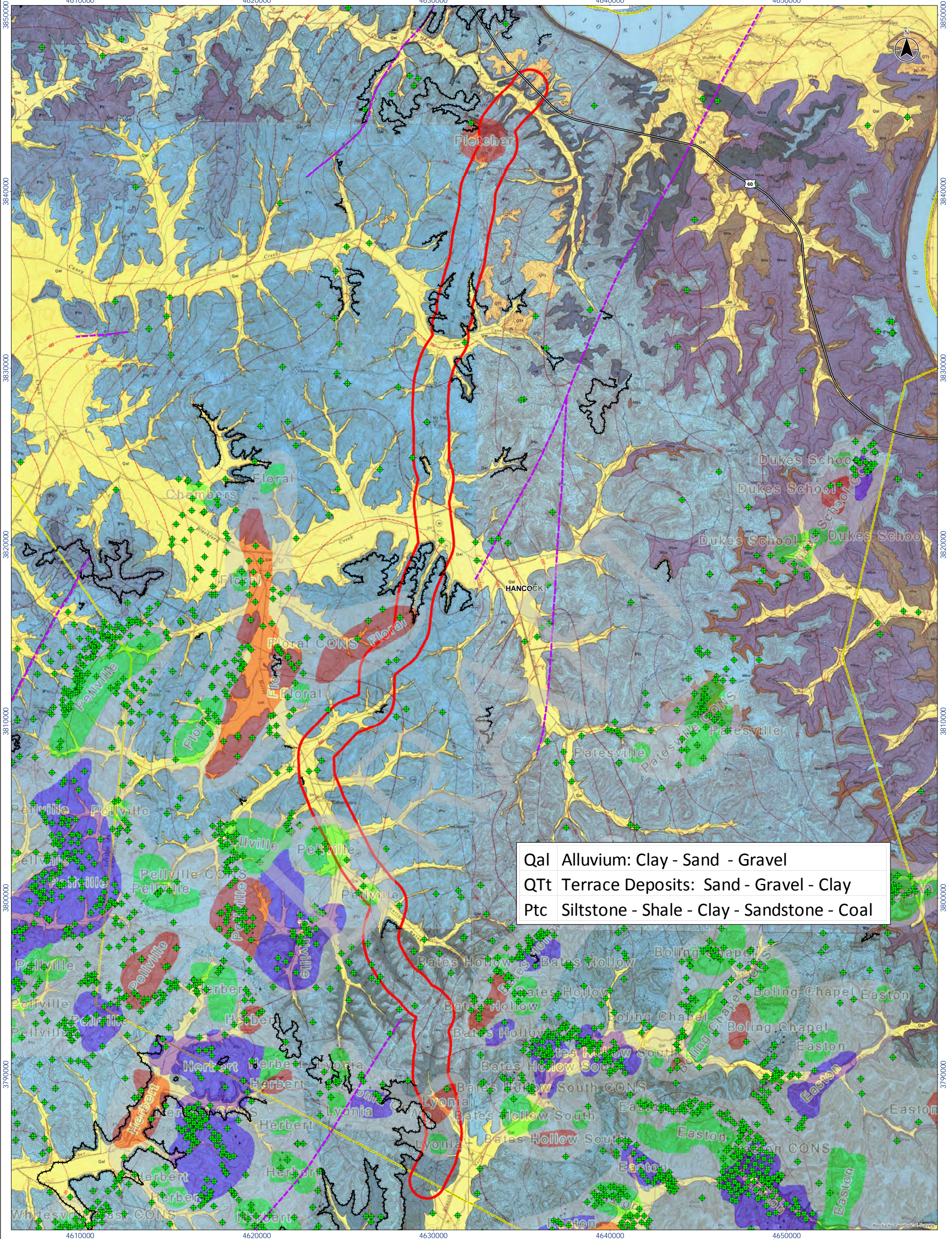
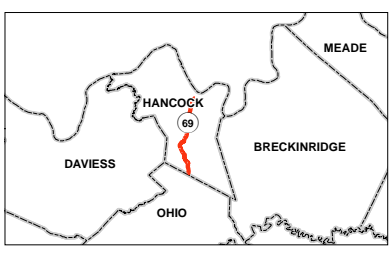
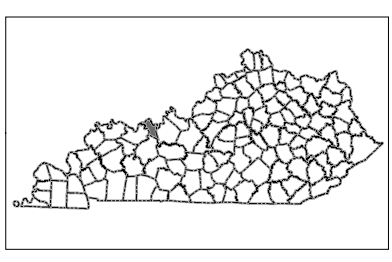
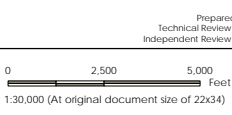


Figure No.
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Title
KY 69 Geotechnical Overview
Geology Information
Client/Project
Stantec



- ◆ Oil and Gas Wells
- Oil
- Gas
- Waterflood
- Consolidated
- Coal Bed
- Fault
- Study Area
- County Boundary

Notes
1. Oil/Gas/Coal, Fault and Geologic Quadrangle Data Source: Kentucky Geological Survey
2. Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet



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