

# **REPORT OF GEOTECHNICAL OVERVIEW**

## **SEGMENT 1B**

### **MOUNTAIN PARKWAY EXTENSION / KY 114 PROGRAMMING STUDY (CAMPTON TO PRESTONBURG) IN WOLFE COUNTY**

**KYTC ITEM NO. 10-126.01 and 12-001.00**



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Prepared for:

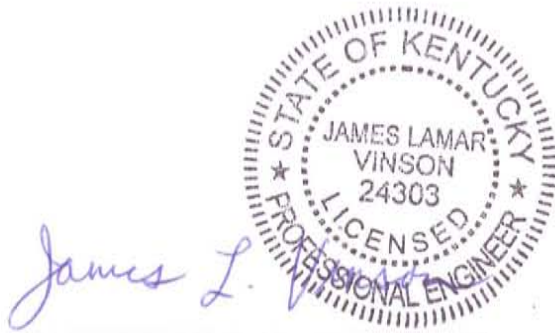
KENTUCKY TRANSPORTATION CABINET  
DIVISION OF PLANNING

Prepared by:

WILBUR SMITH ASSOCIATES

WSA Project No. 103888

January 20, 2010



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James L. Vinson, PE  
Geotechnical Engineer

A handwritten signature in blue ink that reads "Sanjoy Chakraborty".

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Sanjoy Chakraborty, PE (South Carolina)  
Geotechnical Engineer

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## **1.0 INTRODUCTION**

Approximately 10.4-miles of the Mountain Parkway Extension between the Campton and Helechewa communities (Segment 1B) are currently being studied by WSA. The study limits for the corridor are shown on the “Segment 1B Study Area” drawing in Appendix A. In general, the study area extends 1,000 feet on each side of the existing Mountain Parkway Extension.

The primary goal of the study is to identify alternatives for adding lanes to create a 4-lane facility as this portion of the Extension has 2-lanes with an occasional truck climbing lane. The addition of lanes adjacent to the existing roadway is being evaluated, but a bifurcated roadway will also be considered.

The primary objectives of this geotechnical study were to review geological and geotechnical considerations presented by the Geotechnical Branch of the Kentucky Transportation Cabinet Division of Materials, to review readily available site data, and to identify potential geotechnical and geological features that could impact the planning, design, and/or construction of a new or modified roadway along the proposed corridor.

## 2.0 SITE CONDITIONS

### 2.1 SITE VISIT OBSERVATIONS

A site visit was made on January 4, 2010 by Mr. James Vinson, a Professional Engineer with WSA. The visit included a visual survey of public and private properties that were observed from Mountain Parkway Extension within the study area.

In the study area, the Mountain Parkway Extension tends to parallel or intersect several creeks in valleys between hilltops; therefore, grades along the Extension are typically flat and gently sloping. See Photograph 1 below. Slopes extending up from the valleys are generally rather steep and with irregular rock outcropping. Several of the cut slopes adjacent to the roadway have exposed rock as shown in Photograph 2 below. Based on observed rock fragments in roadside ditches, localized areas of the existing cut slopes along Segment 1B may be excessively steep. The land use along existing Mountain Parkway Extension was observed to primarily be open pasture or undeveloped woodlands.



Photograph 1 –Looking Southeast Near Western End of Segment 1B



Photograph 2 – Rock Cut Slope along Southern Side of Segment 1B at Mile Marker 49

Very few, if any, structures or dwellings appear to be within the study area limits adjacent to the Extension. Many of the steeper rock cuts adjacent to the Extension have multiple benches, and the toes of these slopes are often within 15 feet of the roadway.

## 2.2 TOPOGRAPHY

As mentioned above, much of the land adjacent to Mountain Parkway Extension is characterized by rolling hills. The Mountain Parkway Extension and Stillwater Creek are in close proximity to each other in a valley over the western half of Segment 1B. From the middle of the study area and extending near the eastern terminus, the Mountain Parkway Extension is within low lying areas without parallel creeks or streams. However, the Extension crosses Gillmore Creek about one mile from the eastern terminus.

The roadway of the Mountain Parkway Extension has gentle grade transitions and lies within an elevation range bounded by a minimum of  $\pm 920$  feet at the western end of the study area to a maximum elevation of  $\pm 1,100$  feet about 1 mile west of the intersection with KY Highway 1010. The slopes between the valleys and hilltops are typically steep (measured perpendicular to the Extension) with significant elevation differences, typically about 100 to 200 feet. The relief of the study area, shown with 20-foot contour intervals, is depicted in the “Segment 1B Topographic Overview” drawing in Appendix A.

## **3.0 GEOLOGIC CONDITIONS**

### **3.1 GEOLOGIC OVERVIEW**

Based on published data by the U.S. Geological Survey, the study area is located in the Pennsylvanian System of the Eastern Kentucky Coal Field physiographic province. The Pennsylvanian System consists largely of sandstone, siltstone, and shale. Coal beds and thin marine shale and limestone units are widespread and occur in most parts of the stratigraphic section. These deposits indicate that in Pennsylvanian time, Kentucky was near sea level and alternately covered by lakes, extensive swamps, shallow bays, and estuaries.

An identified fault extends approximately northeast-southwest near the community of Stillwater (i.e., near the western end of the study area). This fault dips to the southeast.

### **3.2 GEOLOGIC FORMATIONS**

The study area is underlain by several geologic formations, including the Upper and Lower Members of the Breathitt Formation, the Lee Formation and associated quaternary alluvium along the valleys. The approximate locations of these formations are shown on the “Segment 1B Geologic Map” in Appendix A and on a similar map prepared by the KYTC Geotechnical Branch (see Appendix B). These maps are derived from the original geologic quadrangles which were produced in the 1960’s and 1970’s. A more recently prepared geologic map, “Segment 1B Standard Geology” in Appendix A, provides a more refined mapping of the subunits of the Breathitt and Lee Formations. Further descriptions of these formations are given in the attached memorandum from the KYTC Geotechnical Branch.

According to available geologic mapping, the existing Mountain Parkway Extension is predominantly underlain by alluvium and the Breathitt Formation. The bedrock of the slopes adjacent to the Mountain Parkway Extension is almost entirely comprised of the Breathitt Formation. Current mapping indicates

that the Lee Formation is only within a localized area about 1 mile east of the study area's western terminus.

Coal seams have been identified at irregular locations throughout the study area. Coal thicknesses reportedly vary from approximately a few inches to nearly 4 feet.

### **3.3 UNDERGROUND OPENINGS AND SPRINGS**

Available mapping indicates no sinkholes are present within the study area. Obvious signs of sinkhole activity were not observed during the site visit by Mr. Vinson. According to published mapping of the Kentucky Geological Survey, the study area has a very low karst potential (i.e., karst features are rare or absent).

### **3.4 SOIL SURVEY**

Available soil survey mapping from the United States Department of Agriculture indicates three predominant soil units within the study area, including the Shelocta-Gilpin complex, Latham-Gilpin-Alticrest complex, and Grigsby-Orrville complex. Of the aforementioned complexes, the Grigsby-Orrville complex is comprised of alluvium in the low-lying areas while the other complexes consist of residual and colluvial soils along the hillsides.

According to the Unified Soils Classification System, the study area's soils are a mix of fine-grained clays/silts (CL-ML, CL, ML) and coarse-grained sands/gravels (SM, SC, SC-SM, GC). The plasticity ranges of these soils are often within the range of 3 to 20 percent. Along the hillsides, the depth to weathered rock is often no more than 3 feet, but groundwater can be significantly deeper. According to the USDA, the depth to weathered rock or competent bedrock in the lower elevations is over 6 feet, but the depth to a water table in the valleys is often about 1 to 6 feet.

The soils along Segment 1B appear to typically be suitable for use as roadway fill. As noted by the USDA, the most notable feature of these soils may be their pH values which are often between 4.5 and



6.5. While receiving a low rating relative to potential steel corrosion, the USDA notes that the slightly acidic nature of these soils may create an environment that can be aggressive towards concrete structures.

## **4.0 MISCELLANEOUS FEATURES**

### **4.1 SURFACE OR DEEP MINING ACTIVITIES**

No surface or deep mining activities were observed within the study area during our site visits or in published digital maps or reports reviewed by WSA for this study. However, as shown on the “Segment 1B Corridor Features” drawing in Appendix A, a few areas of past mining have occurred near both ends of the study area. This past activity appears to be related to the shallow coal seams.

### **4.2 OIL, GAS AND WATER WELLS**

An oil well and an abandoned (oil?) well are documented within the study area near the western terminus of Segment 1B in/near Stillwater, Kentucky. According to the Kentucky Geologic Map Information Service, these wells are approximately 1,250 feet deep.

Five water wells are present within the study area. Three of the wells are in proximity of Stillwater while the other two are near the middle portion of the study area. The recorded depths of these wells reportedly vary from 15 to 245 feet deep.

The locations of the aforementioned wells are shown on the “Segment 1B Corridor Features” drawing in Appendix A.

### **4.3 UNDERGROUND STORAGE TANKS**

Based on published maps, a single underground storage tank is present near the western terminus of the study area. Additional information regarding this UST was not found during research efforts. The location of the UST is indicated on the “Segment 1B Corridor Features” drawing in Appendix A.

## 5.0 GEOTECHNICAL ISSUES AND RECOMMENDATIONS

We generally agree with the geotechnical concerns cited by the KYTC Geotechnical Branch in their memorandum attached in Appendix B. In our opinion, the most significant of these challenges are as follows:

**Slope stability:** Stability of major cuts into hillsides would require close scrutiny before and during construction to minimize risk of failure due to groundwater seepage, unfavorably jointed bedrock, and layers of weak materials.

**Unidentified coal mines:** While not anticipated per available information, there is some unquantifiable risk of new alignments intersecting undocumented mine activity in the study area.

**Water, oil and gas wells:** Avoidance of routes that would pass in close proximity to water, oil, and/or gas wells is strongly recommended.

The depth to bedrock will be relatively shallow across the study area, except at roadway embankment fills. Deeper cuts will extend into bedrock and may require potentially mixed face (i.e., soil/rock) slope designs and/or special consideration for mitigating localized weathered rock. Where shale is more prevalent, ripping by larger equipment may be feasible. We anticipate that areas comprised mostly of limestone will require blasting to allow efficient excavation.

It appears that likely alternatives for new additional travel lanes will involve construction of structures over stream crossings. While construction of these structures may be adversely impacted by shallow groundwater or weak bearing soils, the long-term impact of corrosion should also be considered. Concerns over corrosion can likely be mitigated by a complete geotechnical exploration and incorporating corrosion resistance measures into the design of structures.

When considering alternatives, the relocation of the roadway centerline to minimize cut slopes will be preferred. Minimizing the Mountain Parkway Extension's median width will also tend to limit excavation volume and high cuts. While cut slopes in competent bedrock is generally anticipated to be adequate at 0.5H:1V with periodic benches, it should be remembered that other issues may impact the final

construction cost, including rockfall protection barriers (or flattened slopes to ensure rockfall mitigation) and locally flatter slopes where weathered rock zones or adversely dipping discontinuities are found.

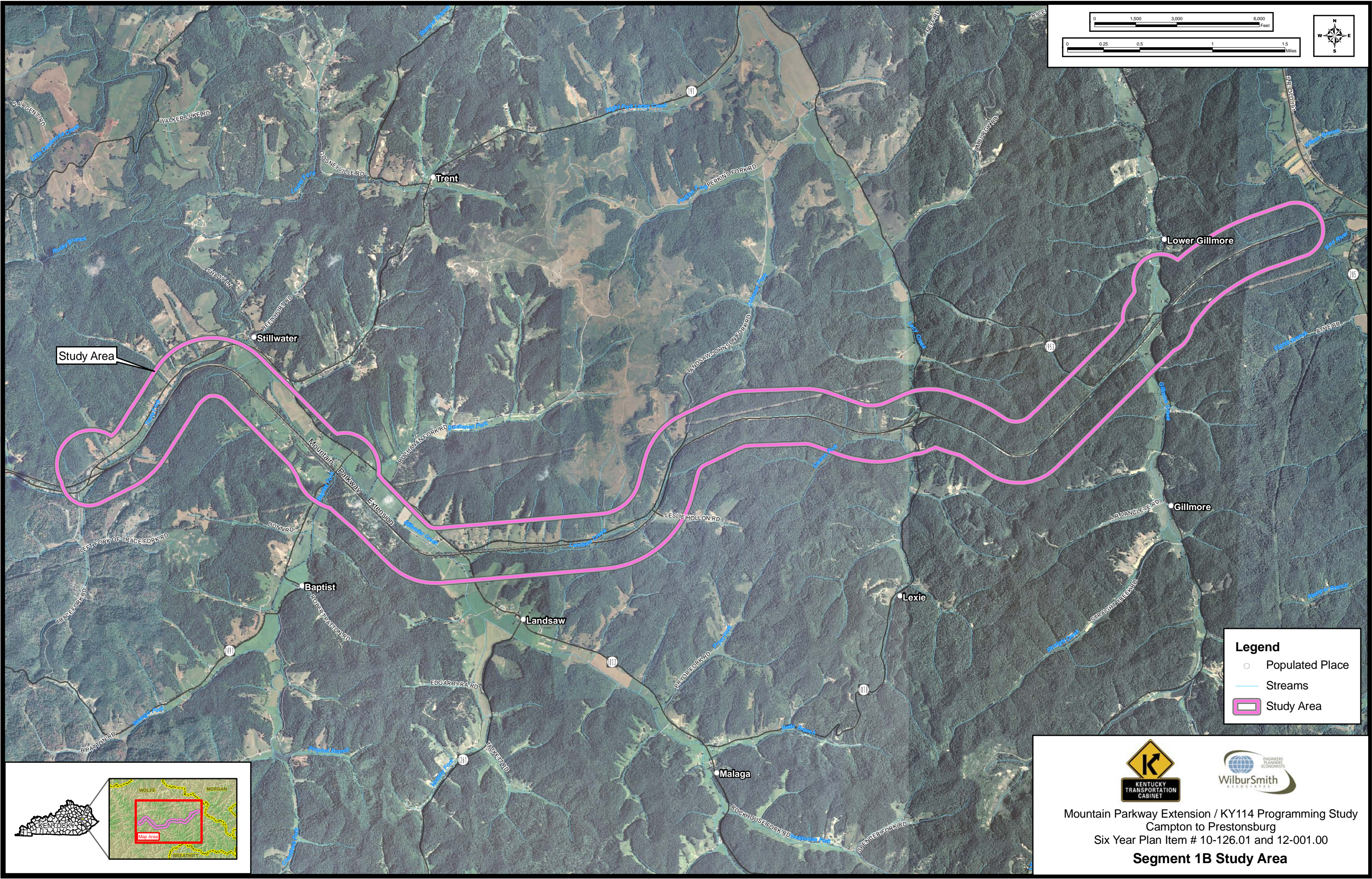
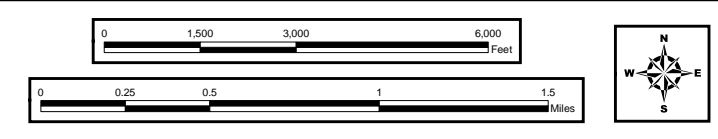
## **6.0 LIMITATIONS**

The evaluations within this report are based on review of available published information and limited site reconnaissance over a large study area. As such, the geotechnical recommendations are necessarily broad based and by no means comprehensively cover all potential geotechnical issues that may be associated with this project. Detailed geotechnical exploration should be performed for the final selected alignment in accordance with KYTC guidelines.

## **APPENDIX A**

### **DRAWINGS**

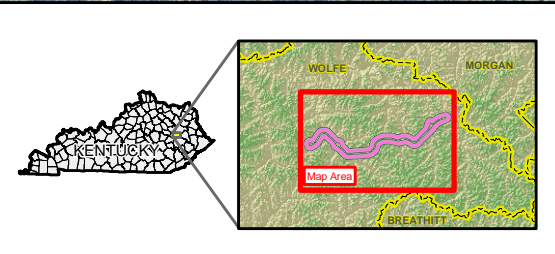
**STUDY AREA  
TOPOGRAPHIC OVERVIEW  
GEOLOGIC MAP  
STANDARD GEOLOGY  
CORRIDOR FEATURES**



Study Area

**Legend**

- Populated Place
- Streams
- Study Area

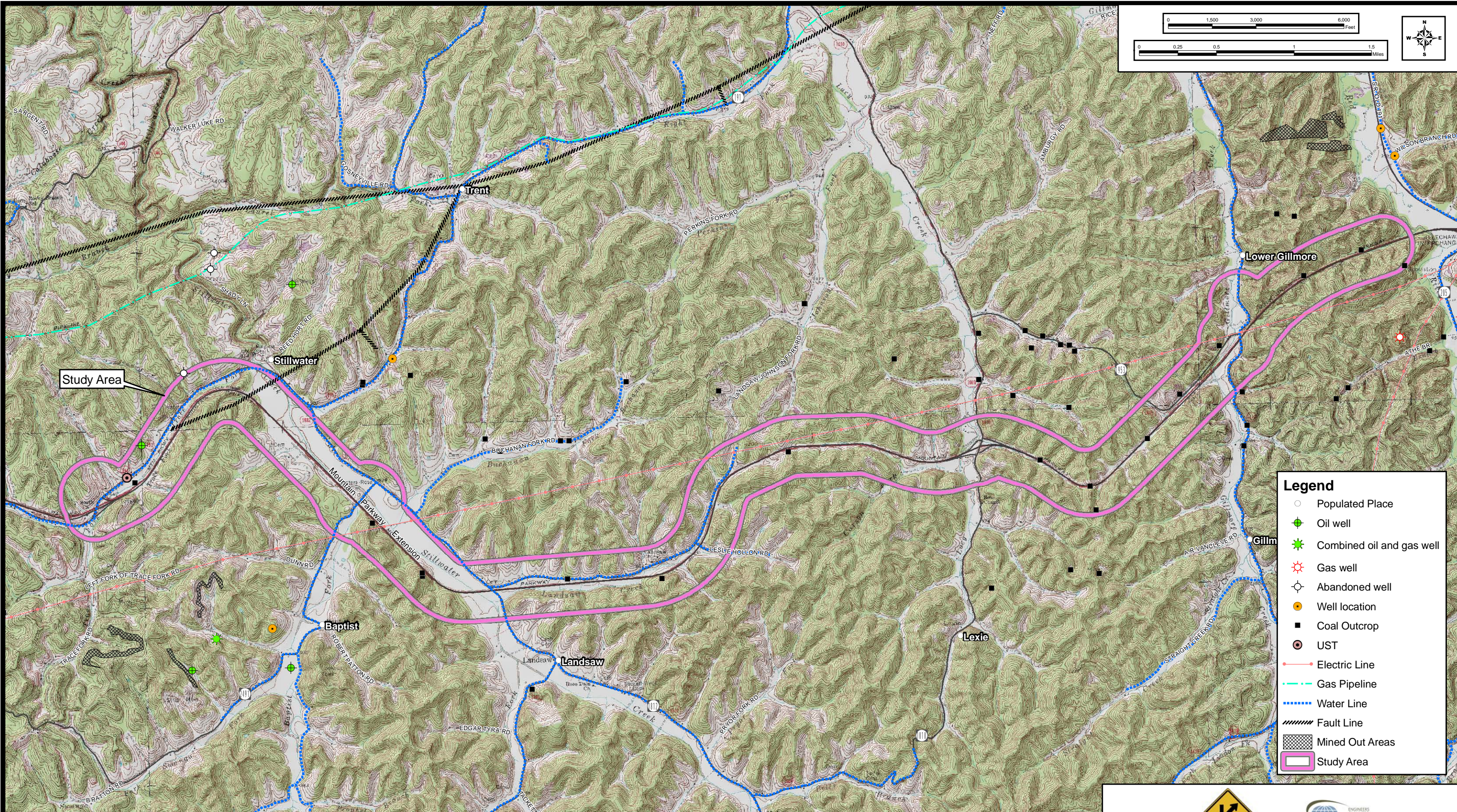
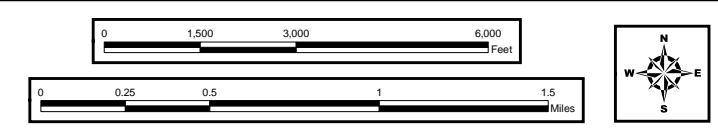


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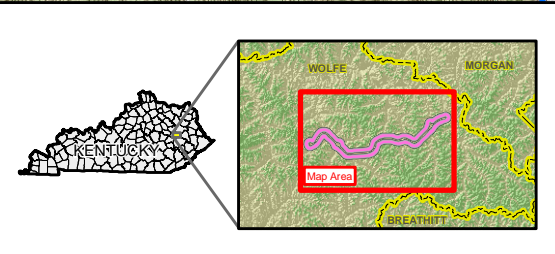
**WilburSmith**  
ASSOCIATES


Mountain Parkway Extension / KY114 Programming Study  
 Campton to Prestonsburg  
 Six Year Plan Item # 10-126.01 and 12-001.00  
**Segment 1B Study Area**




Study Area

- Legend**
- Populated Place
  - Oil well
  - Combined oil and gas well
  - ⊙ Gas well
  - ⊙ Abandoned well
  - Well location
  - Coal Outcrop
  - ⊙ UST
  - Electric Line
  - Gas Pipeline
  - Water Line
  - /// Fault Line
  - ▨ Mined Out Areas
  - ▭ Study Area





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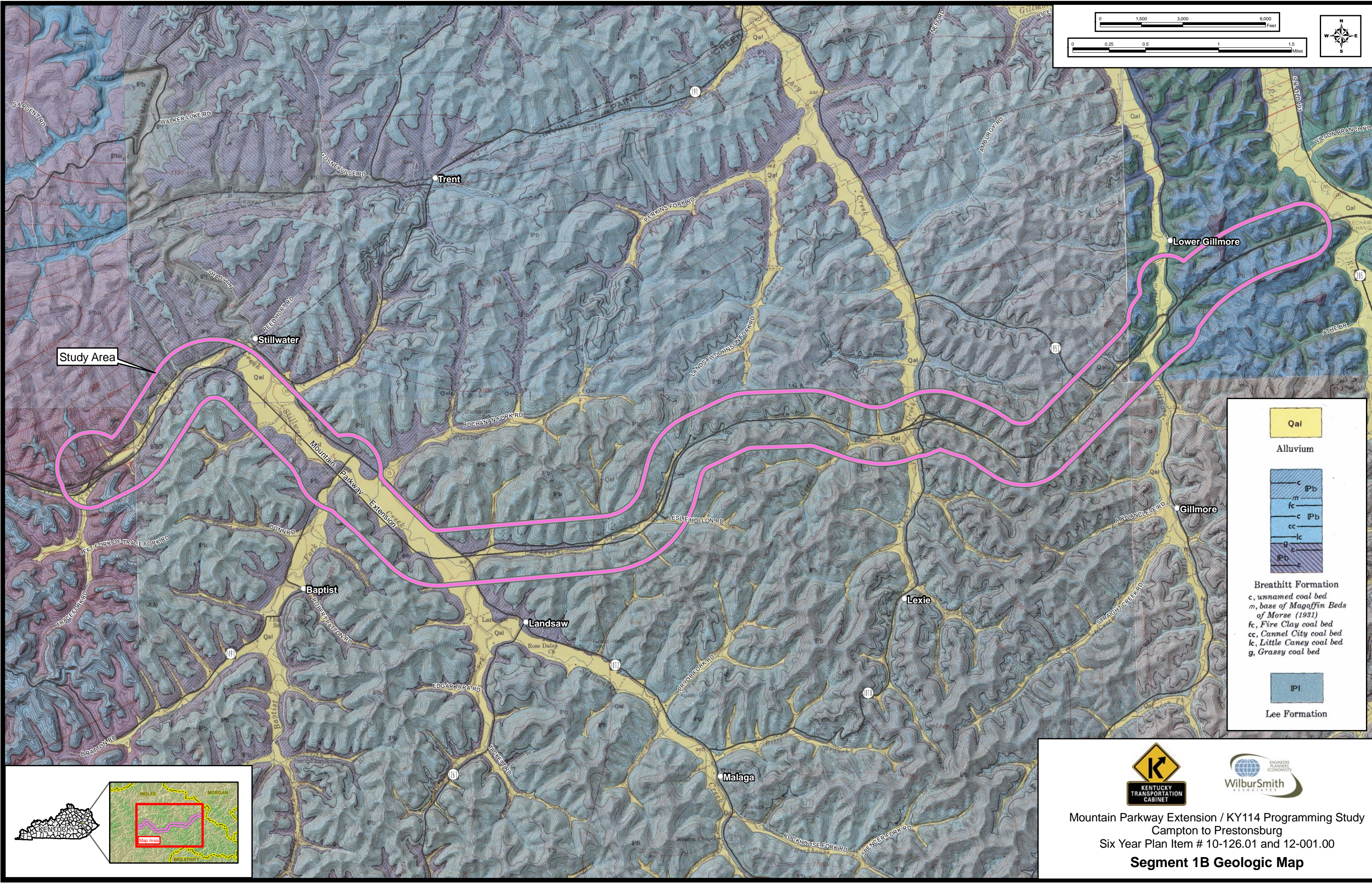
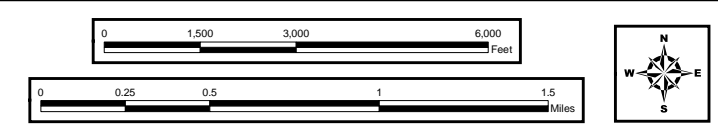


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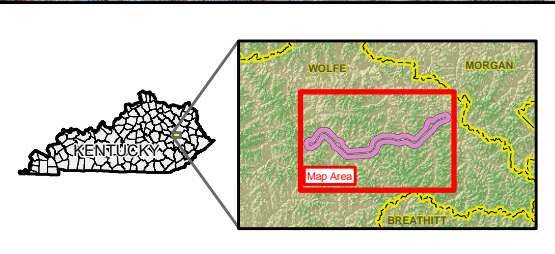
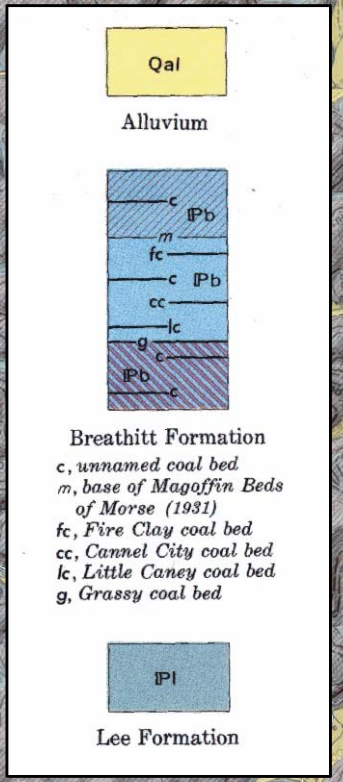
**WilburSmith**  
ASSOCIATES


Mountain Parkway Extension / KY114 Programming Study  
 Campton to Prestonsburg  
 Six Year Plan Item # 10-126.01 and 12-001.00  
**Segment 1B Topographic Overview**





Study Area





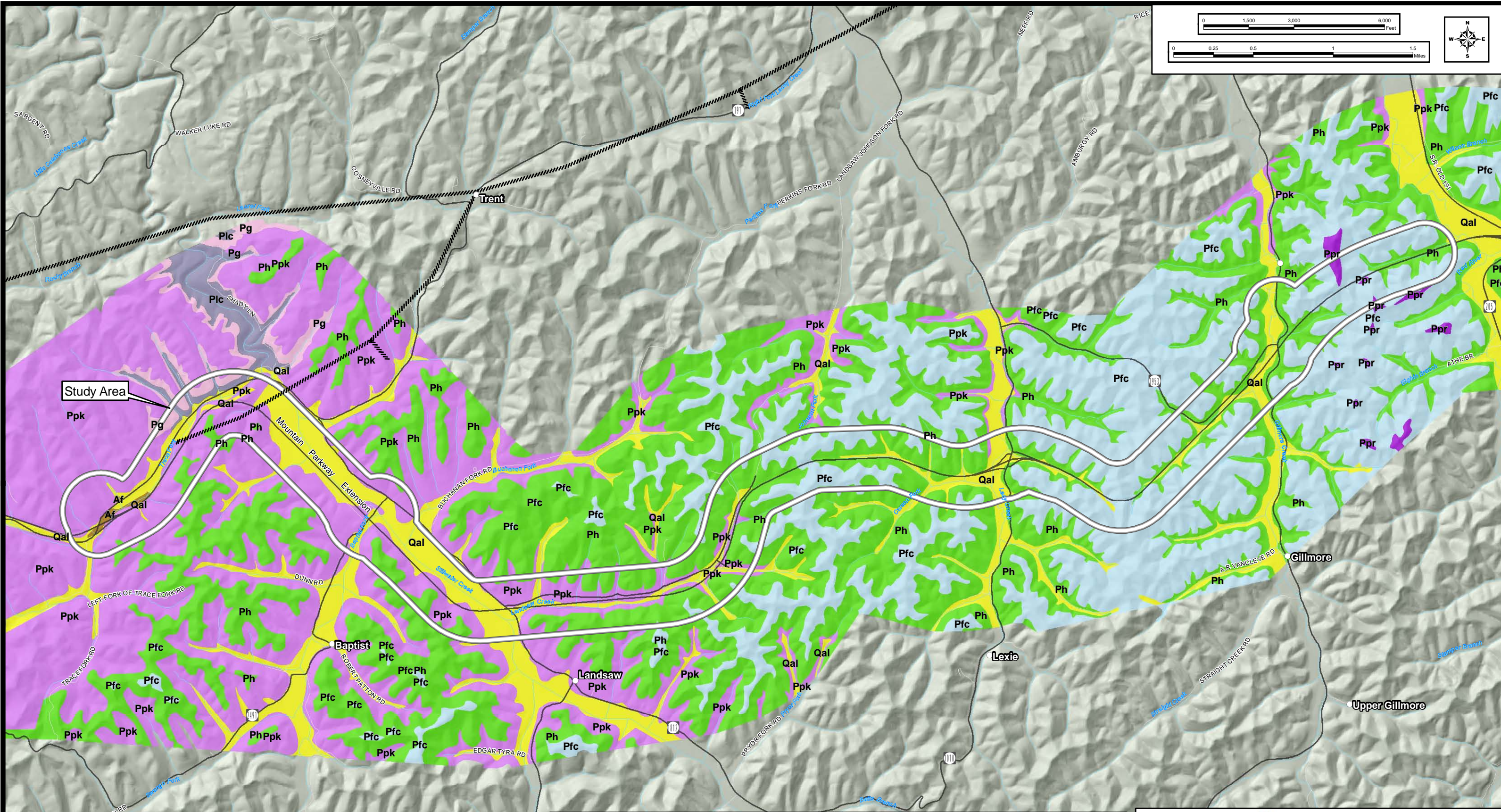
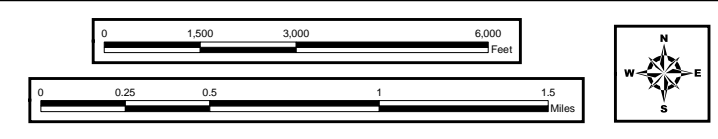
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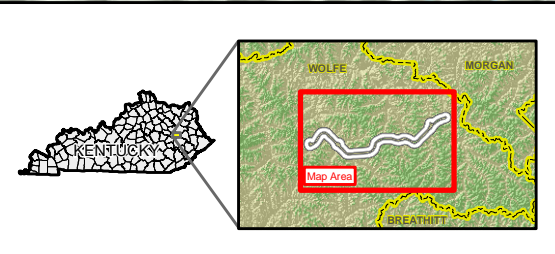
Mountain Parkway Extension / KY114 Programming Study  
Campton to Prestonsburg  
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**Segment 1B Geologic Map**



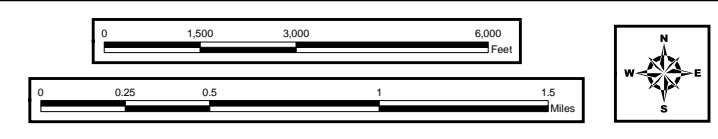
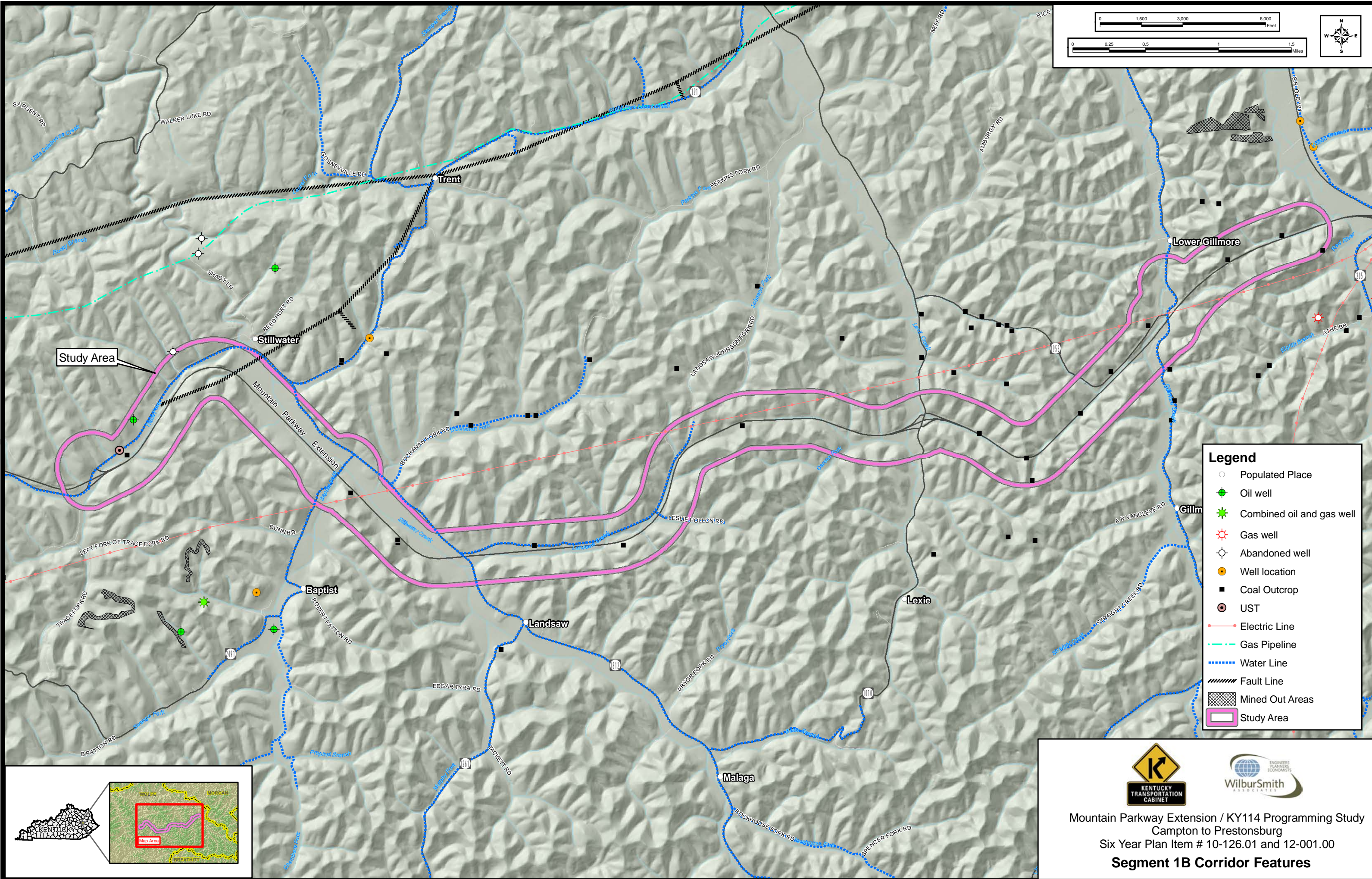
Study Area

**Legend**

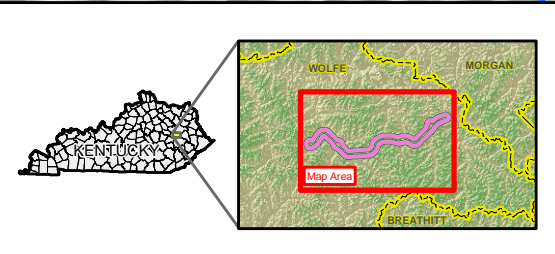
○ Populated Place	Pfc - Four Corners Formation
▬▬▬▬ Fault Line	Pg - Grundy Formation
▭ Study Area	Ppk - Pikeville Formation
■ Af - Artificial Fill	Ppr - Grundy Formation (contains Lee-type sandstone of the former Lee Formation)
■ Ph - Hyden Formation	Plc - Corbin Limestone Member of Lee Formation
■ Qal - Alluvium	



Kentucky Transportation Cabinet  
 WilburSmith Associates  
 Mountain Parkway Extension / KY114 Programming Study  
 Campton to Prestonsburg  
 Six Year Plan Item # 10-126.01 and 12-001.00  
**Segment 1B Standard Geology**



- Legend**
- Populated Place
  - Oil well
  - Combined oil and gas well
  - ⊙ Gas well
  - ⊙ Abandoned well
  - Well location
  - Coal Outcrop
  - ⊙ UST
  - Electric Line
  - Gas Pipeline
  - Water Line
  - Fault Line
  - ▨ Mined Out Areas
  - ▭ Study Area





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 Campton to Prestonsburg  
 Six Year Plan Item # 10-126.01 and 12-001.00  
**Segment 1B Corridor Features**

## **APPENDIX B**

### **MEMORANDUM FROM KYTC GEOTECHNICAL BRANCH**

MEMORANDUM

**TO: Keith Damron, PE**  
**Director**  
**Division of Planning**

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

**BY: Brad Williams**  
**Geotechnical Branch**

**DATE: January 11, 2010**

**SUBJECT: Wolfe County**  
**Mountain Parkway**  
**Starting MP 46-Ending MP 56.8**  
**Scoping Study – Geotechnical Review**

The Geotechnical Branch has completed a review of the project study area and has the following comments. The study area is located within the Campton #1502, Hazel Green #266, and Landsaw #201 Geologic Quadrangle Maps.

**Geologic Overview**

The Study area is underlain by Quaternary Alluvium, Upper and Lower Members of the Breathitt Formation, and the Corbin sandstone member of the Lee Formation. The Alluvium consists of silt, sand, gravel and clay deposits and is located along streams and valleys. The thickness of the deposits range from 0-50 feet.

The Breathitt Formation consists of shale, silty shale, siltstone, sandstone, under clay, and coal. The Upper Member is over 200 feet thick, and the Lower Member ranges in thickness from 110 to 250 feet. The majority of the project will be founded on the Breathitt Formation. Shales make up a major portion of the formation and have various engineering properties.

The Corbin Sandstone of the Lee Formation consists of sandstone. It is generally poorly cemented to friable and is cross-bedded. It is not to be considered of sufficient quality for use as roadbed material. The Corbin Sandstone ranges in thickness from 70-250 feet.

These formations are shown on the attached Geological map.

**Geotechnical Concerns**

1. Oil and gas wells are present within the study area as identified on the attached Geologic Quadrangle Map. The wells should be avoided if possible within any corridor. Any wells encountered will add additional cost to the project. A more detailed evaluation should be completed to identify all wells within the study area.
2. Flatter than normal cut slopes are likely in the shales of the Breathitt Formation.
3. Embankments less than 30 feet high should be stable on normal fill slopes (2:1). Embankments over 30 feet high may be required to have flatter than normal slopes and require additional right of way. Embankment foundations in Alluvium and along streams may be soft, saturated, and require flatter fill slopes or foundation improvement methods. Structures located on alluvial plains should be founded in bedrock with spread footings. Deep foundations are not anticipated.
4. Existing cut slopes will likely need to be redesigned for corridors that follow the existing alignment. This may require additional right of way.
5. The following coal seams are present in the existing corridor the Canny City Coal Bed, Fire Clay Coal Bed, Grassy City Coal Bed, Haddix Coal Bed, Coal Bed in the Prather Coal Zone, and a Coal Bed in the Peach Orchard Coal Zone. No surface or underground mines were identified along the existing corridor.

**cc: John Michael Johnson D-12**  
**Corbett Caudill D-10**  
**Amanda Spencer, Wilbur Smith Associates**

Wolfe County  
Mountain Parkway  
Planning Study



End of Project

Start of Project

BERT T COMBS-MOUNTAIN PKWY EXT

### Legend

Pb	Breathitt Formation	Study Area	Oil Well
Pl	Lee Formation	Parkways	Oil & Gas Well
Qal	Alluvium	State Roads	Gas Well
		Local Roads	Well Location
		County Lines	Dry & Abandoned Well

0 2,500 5,000 10,000 Feet

