

Appendix J:

GEOTECHNICAL OVERVIEW

P-008-2014

cc: S. Ross
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MEMORANDUM

TO: John Moore, P.E.
Division of Planning

BY: Bart Asher, P.E., P.L.S.
Geotechnical Branch Manager

DATE: September 22, 2014

**SUBJECT: Madison, Clark, Powell and Estill Counties
I-75 to Mountain Parkway Corridor Study
12FO C35 D625 10 FH02 0410 C033 E143
Mars 8807407P
Preliminary Geotechnical Assessment**

The Division of Planning is conducting a corridor study for the existing routes (KY 52 / KY 499 / KY 89 / KY 82) as well as looking at feasible alternate new corridors between I-75 and the Mountain Parkway. The study area is within Madison, Clark, Powell and Estill Counties. This abbreviated review will discuss some general geotechnical concerns with the area.

The study area is located primarily in the Knobs Physiographic Region. The study area is on the periphery of both the Outer Bluegrass region and the Eastern Kentucky Coal Field. The Kentucky Geological Survey web site states that:

"The Knobs" is the physiographic region that borders the Outer Bluegrass. It consists of hundreds of isolated, steep sloping, often cone-shaped hills. Many of the knobs are still capped by erosionally-resistant limestones or sandstones. The sharp slopes of the Knobs are mostly composed of shales of the Mississippian-age Borden Formation, which are less resistant to erosion than the overlying limestones and sandstones. The base of the Knobs commonly contain Devonian black shales.



Typical Knob seen from KY 499

The approximate coordinates for the center of this site are: 37.745761 degrees North and

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-84.151178 degrees West. The site is located in the Ford, Winchester, Hedges, Levee, Richmond North, Richmond South, Moberly, Panola, Union City, Palmer and Clay City Geologic Quadrangles.

Available geologic mapping indicates that the project is underlain by numerous rock formations. These include the Calloway Creek Limestone, Garrard Siltstone, Tanglewood Limestone, Grier and Curdsville Limestone, Clays Ferry Formation, Crab Orchard Formation, Brassfield Dolomite, Ashlock Formation, New Albany Shale, Irvine Formation, Calloway Creek Limestone, Drakes Formation, Boyle Dolomite, and Borden Formation. Competent limestone and dolomite are available in varying quantities throughout the study area. Most of the shales will be problematic for construction as they can be highly weatherable. Mitigation of some type will likely be required in cut and fill areas where shale is encountered, which is most of the project. Some of the shales are prone to increasing issues with slope stability problems.



Landslide repair on relatively flat slope underlain by poor shales on KY 89 near Clay City.

There are a number of existing rock cuts on the project which should be evaluated for remediation due to excessive weathering of shales underlying a more resistant cap bedrock. Some remediation has already taken place on numerous slopes in the project area.



Shale weathering under weather resistant dolomite.

Some of the most problematic shales are:

New Albany (Black or Pyritic) Shale: Although this material tends to be more durable than some of the other shales in this area, it is known to produce acidic runoff. Mitigation is often required in cuts and this mitigation can be a major design concern. The potential to encounter New Albany Shale will be prevalent through a large part of the project, especially in the east.



New Albany Shale in Cut
near Clay City

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Box Culvert under Mountain Parkway Ramp near Kiddville showing staining due to Acidic runoff from New Albany Shale Backfill.

Crab Orchard Shales: At KY 499 near Irvine the Crab Orchard Formation was encountered during construction. Special Shale Compaction was utilized for construction of the fills. The fills appear to be stable. Shortly after construction it was noted that the roadbed was heaving in the cut sections. Through investigation it was found that the Crab Orchard Shale at this location, due to its material characteristics, was prone to swelling. It would appear that this swelling continues to this day as the roadbed appeared wavy upon inspection. Any cuts in this vicinity that encounter the Crab Orchard Formation should warrant particular attention. Fills should utilize Special Shale Compaction.



Irregular (wavy) Pavement due to swelling shales on KY 499

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For estimation of right of way for rock cuts in this area it is typical to assume from a 1V:1H to 1.5V:1H for cut slopes. It may be necessary to lay some of the rock cut slopes back on a 2H:1V slope where acidic runoff mitigation may be required or extremely poor, soil-like, shales are encountered.

Numerous mapped faults are indicated in the project area. Among the most prevalent are those located near Route #3. These faults are part of the KY River Fault System. Bedrock in the faulted areas may be dipping in such a manner that road construction and drainage issues related to the bedrock could be problematic. This bedrock could be highly fractured from the faulting as well.

A review of available mapping indicates that no known coal mining has taken place in this area. Some of the bedrock in the study area is suitable for road metal and has and is being mined. Karst can be an issue in the western portion of the study area and can require remediation during design and construction.

Soil strata in this area tend to be relatively thin except, at times, in the larger drainage basins such as the Kentucky River or in Talus areas. The soils encountered in the area are generally suitable for embankment construction. Generally, embankments built from the native soils and durable bedrock can be constructed to a height of 60 feet or more with 2H:1V side slopes if the foundation is suitable and proper compaction methods are used. Building embankments with non-durable shales will require special methods to obtain acceptable long term results. Soil cuts over approximately 10 feet often require analyses to design proper side slopes. In no case should soil cuts be steeper than 2H:1V. Suitable rock for embankment construction and rock roadbed is often readily available in this area of the state. Some of the soils in the area are considered erodible.

There are likely numerous potentially unstable Talus deposits and landslide prone locations in the study area. Numerous remediated and active slides were noted during the site visit. Some of the existing slopes have shown movement in the past and it is likely that many of the existing soil slopes range from marginally stable to unstable.

California Bearing Ratio (CBR) values used in pavement design generally range from 2-4 for soils subgrades in the area and 9-11 for a 2 foot durable rock road bed. Chemical modification of soil subgrades are often used in this area. Wet areas could require undercutting and replacement of soils.

Foundations for bridges in this area would typically be founded on shallow foundations (spread footings on bedrock) or deep foundations (steel H-piles driven to bedrock or drilled shafts socketed into bedrock). It is likely that drilled shafts could be utilized for a river crossing. Culverts and walls are typically supported on shallow (either yielding or non-yielding) foundations on soil or bedrock. Where acid producing shales are encountered, special design and construction considerations will be required for structures. This can include restrictions on backfill and the use of special concretes.

Previously completed Geotechnical Investigations within the vicinity of the study area are located in the appendix. The reports are located on the KYTC Geotechnical Branch Database

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which can be accessed through the KYTC Division of Structural Designs home page (Click on Geotech and Search KYTC Completed Projects).

Site specific Geotechnical investigations are critical in this region for design. Proper cut slope design and embankment construction control are crucial for project success.

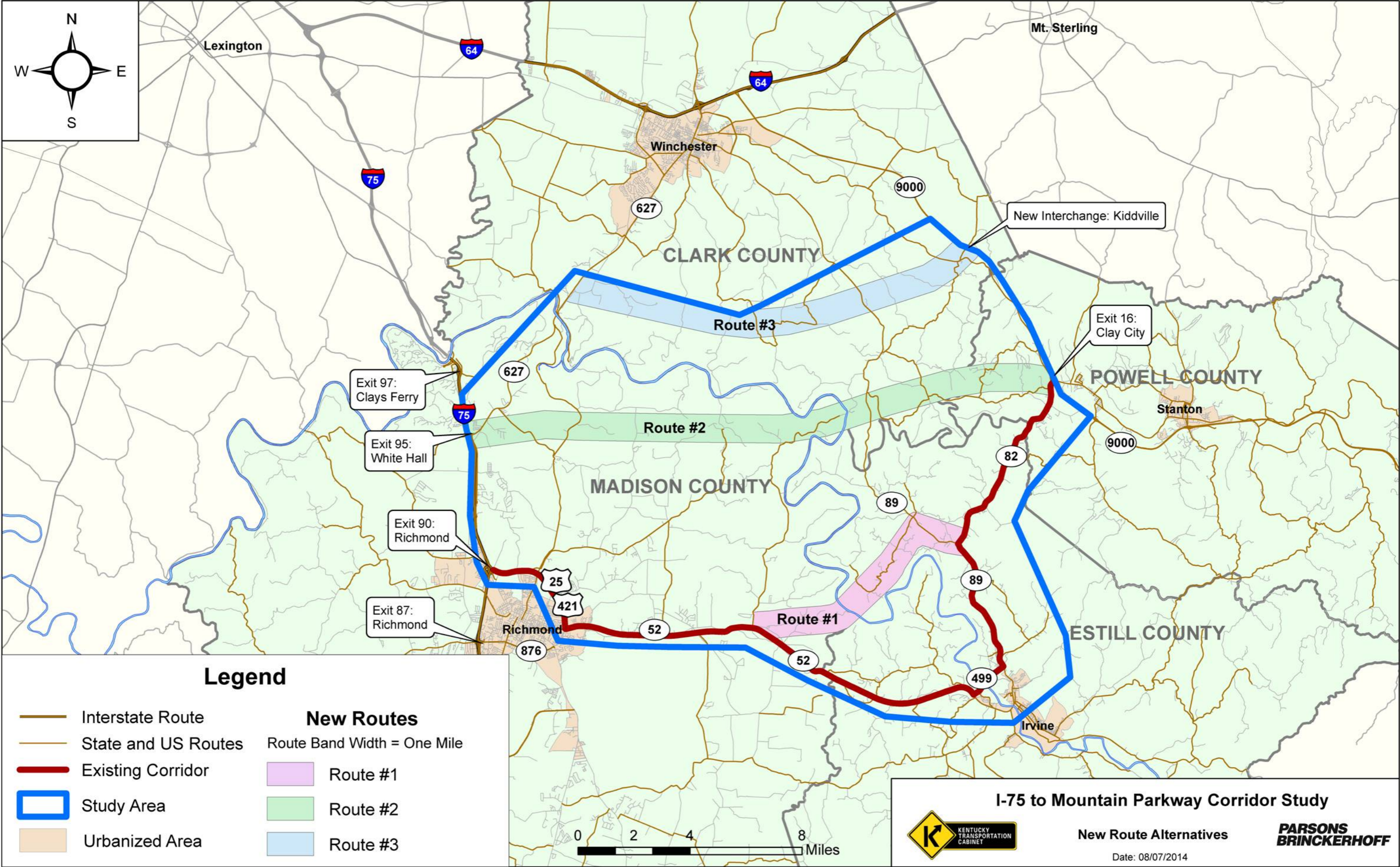
Please feel free to contact this office for additional information.

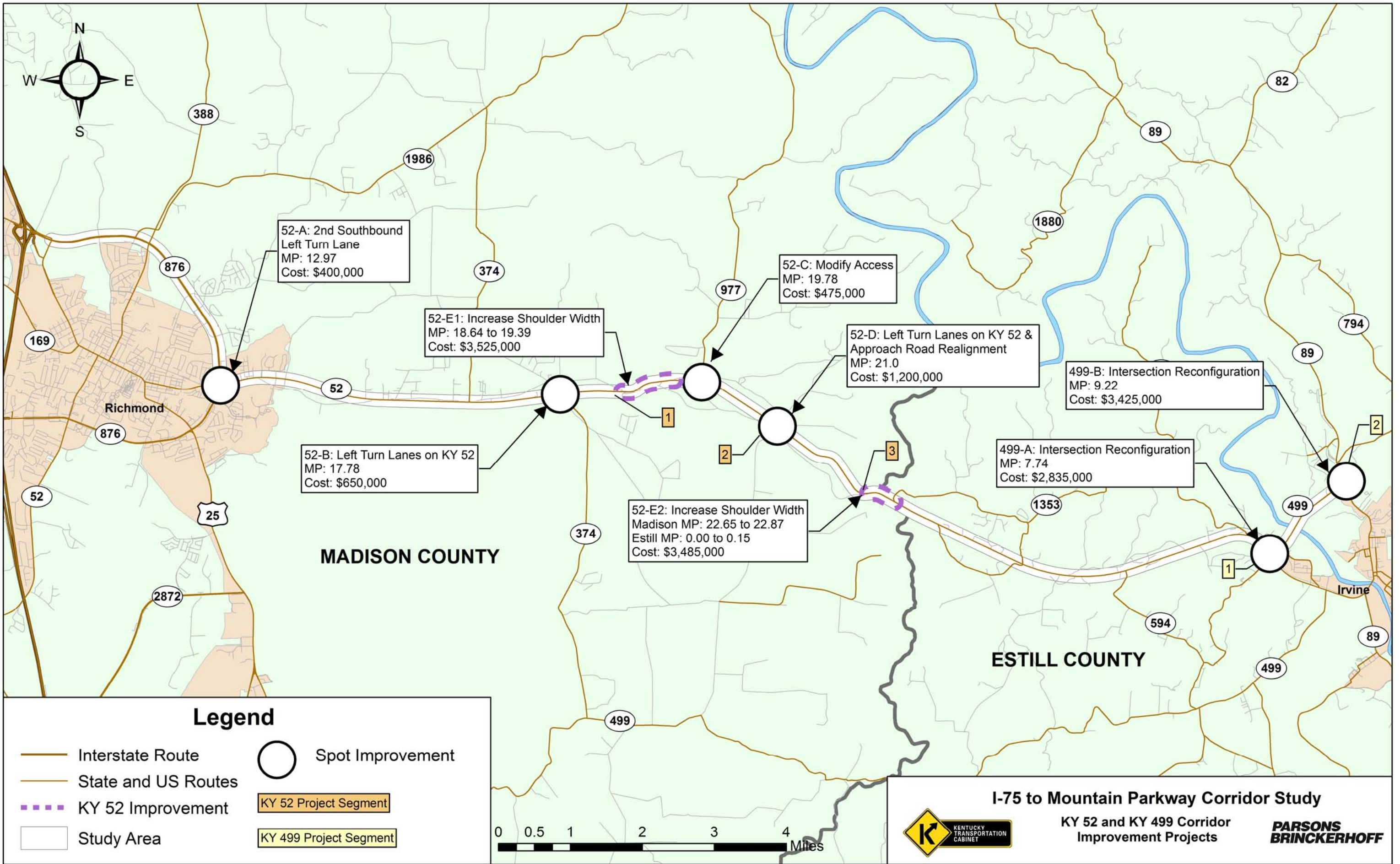
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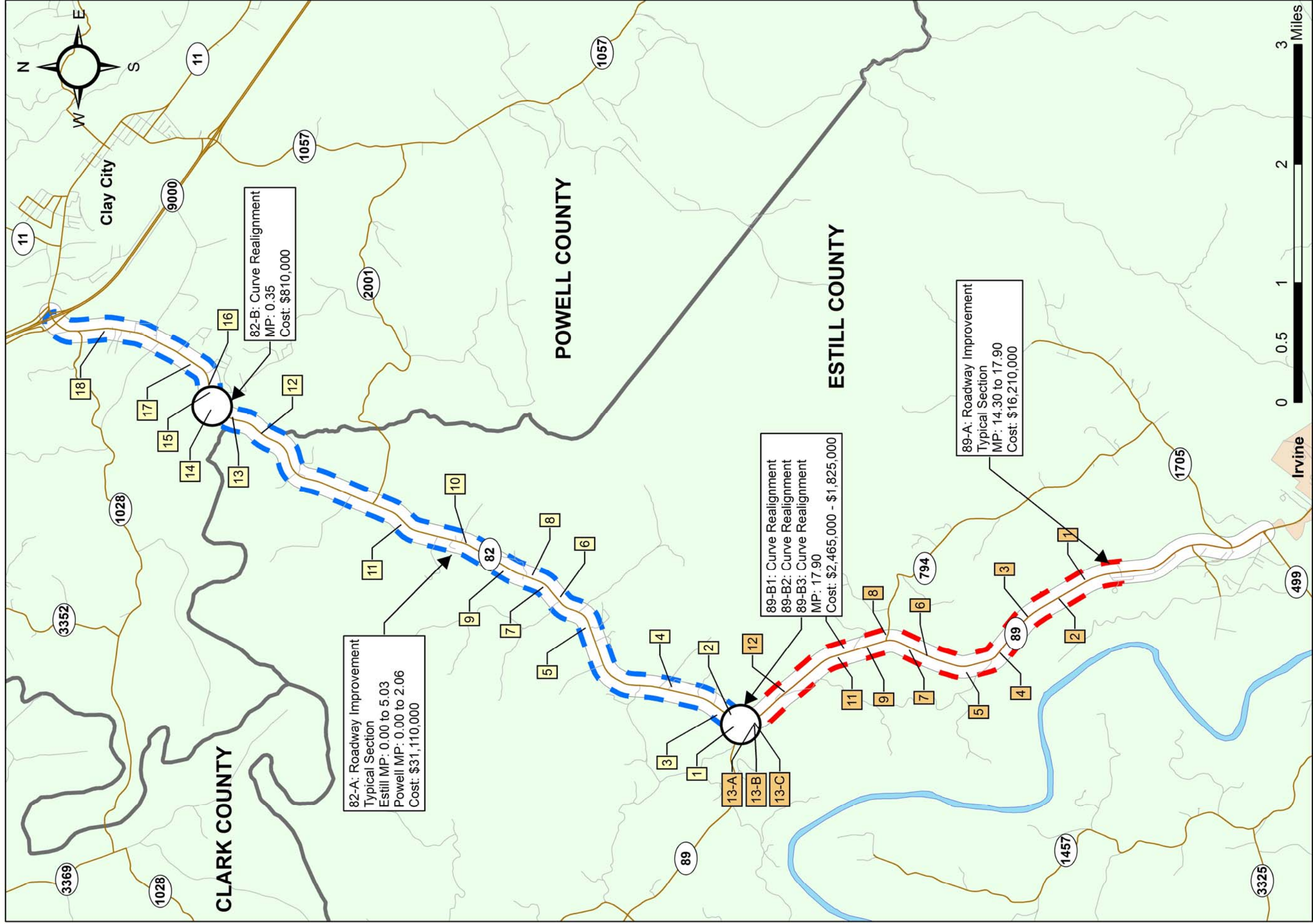
Site Maps

GQ Site Maps

List of Previous Reports in area







82-A: Roadway Improvement
 Typical Section
 Estill MP: 0.00 to 5.03
 Powell MP: 0.00 to 2.06
 Cost: \$31,110,000

82-B: Curve Realignment
 MP: 0.35
 Cost: \$810,000

89-B1: Curve Realignment
 89-B2: Curve Realignment
 89-B3: Curve Realignment
 MP: 17.90
 Cost: \$2,465,000 - \$1,825,000

89-A: Roadway Improvement
 Typical Section
 MP: 14.30 to 17.90
 Cost: \$16,210,000

Legend

- State and US Routes
- Study Area
- KY 89 Improvement
- KY 82 Improvement
- Spot Improvement
- KY 89 Project Segment
- KY 82 Project Segment

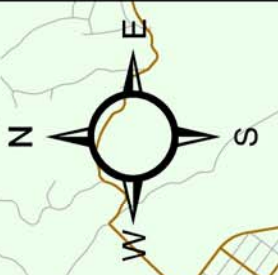
Note: See ROW
 Take spreadsheet
 for additional details

I-75 to Mountain Parkway Corridor Study

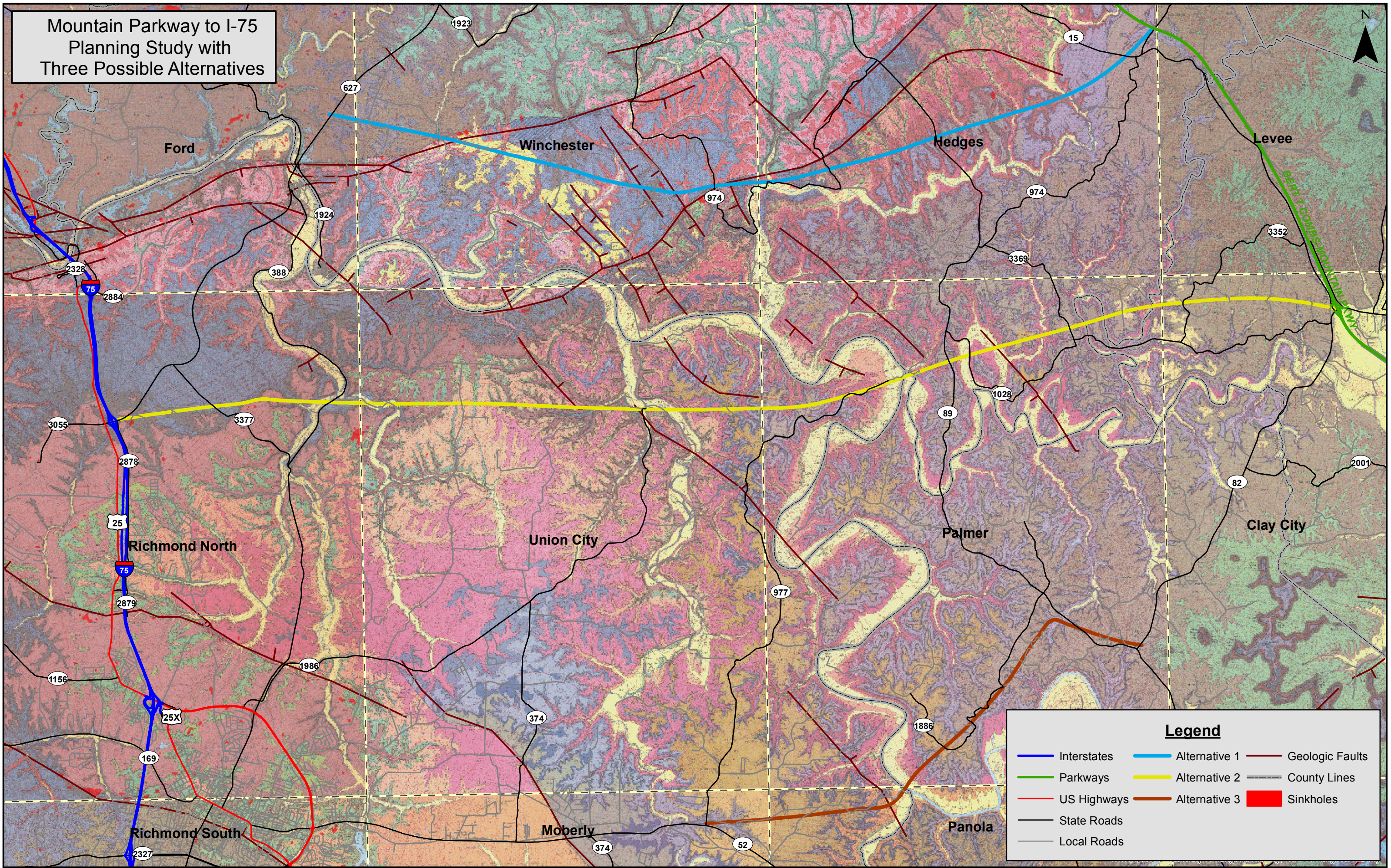
KY 82 and KY 89 Corridor
 Improvement Projects



**PARSONS
 BRINCKERHOFF**



Mountain Parkway to I-75
 Planning Study with
 Three Possible Alternatives

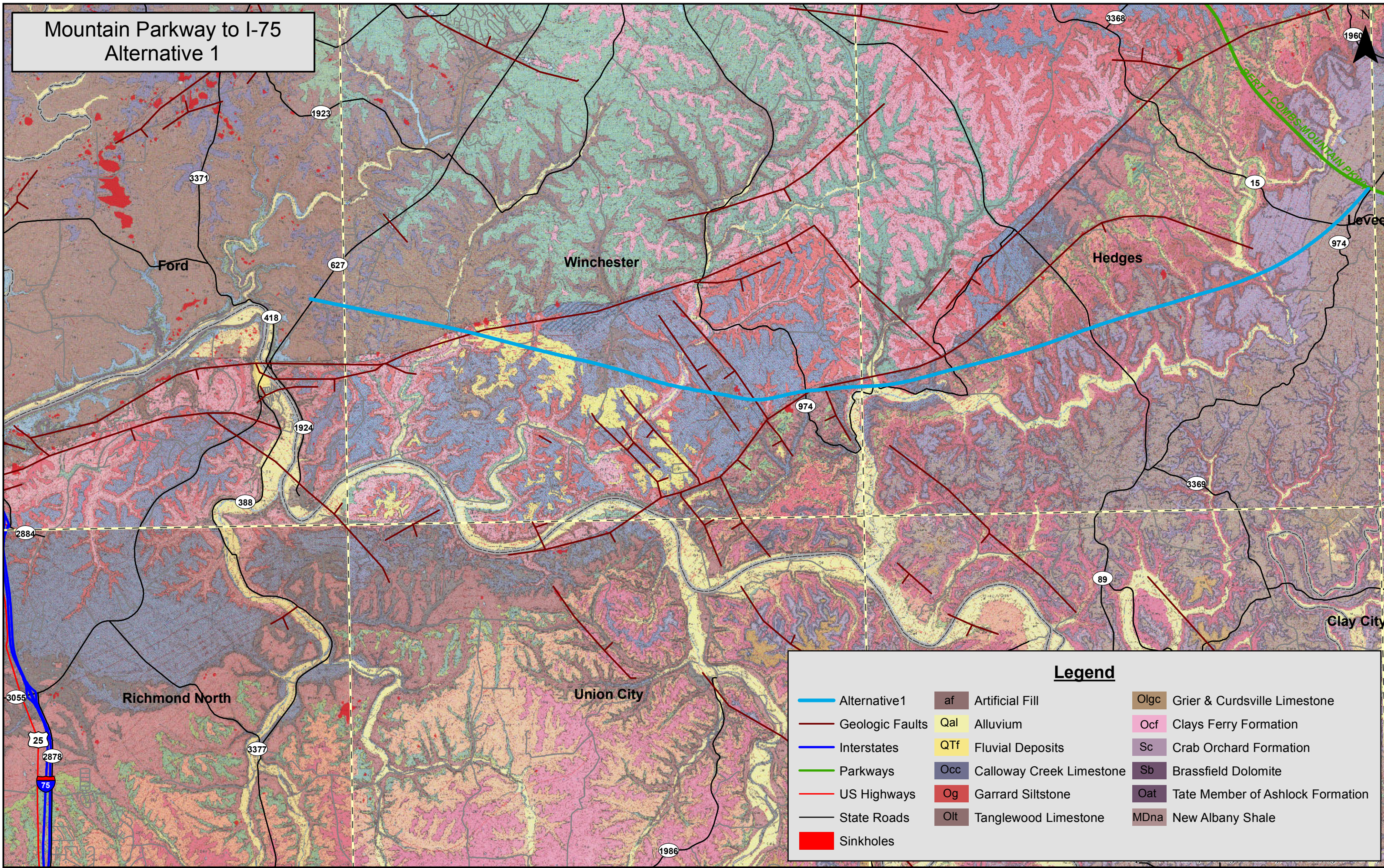


Legend

Interstates	Alternative 1	Geologic Faults
Parkways	Alternative 2	County Lines
US Highways	Alternative 3	Sinkholes
State Roads		
Local Roads		

0 7,500 15,000 30,000 Feet

Mountain Parkway to I-75
Alternative 1

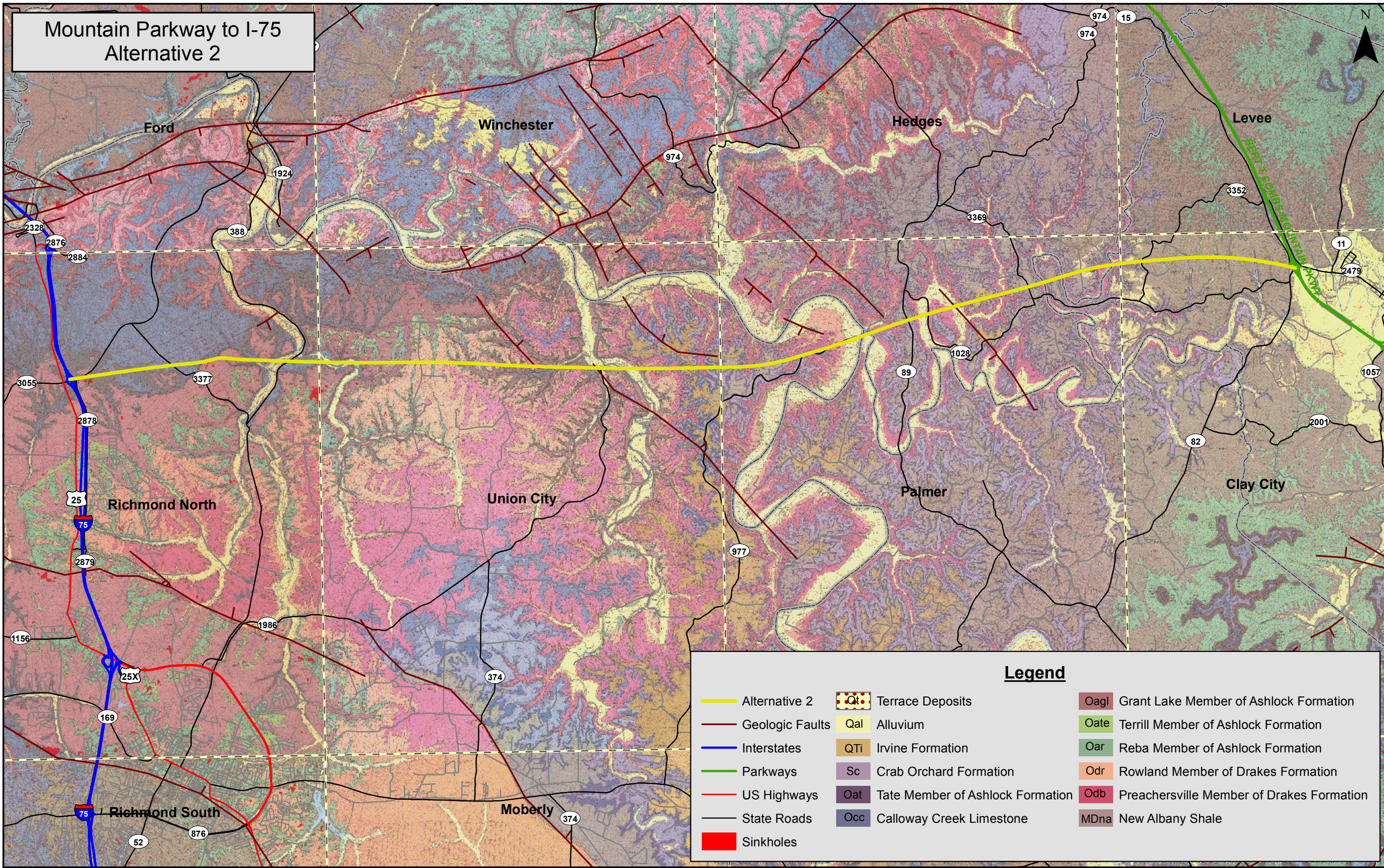


Legend

Alternative 1	af Artificial Fill	Olgc Grier & Curdsville Limestone
Geologic Faults	Qal Alluvium	Ocf Clays Ferry Formation
Interstates	QTf Fluvial Deposits	Sc Crab Orchard Formation
Parkways	Occ Calloway Creek Limestone	Sb Brassfield Dolomite
US Highways	Og Garrard Siltstone	Oat Tate Member of Ashlock Formation
State Roads	Olt Tanglewood Limestone	MDna New Albany Shale
Sinkholes		

0 5,000 10,000 20,000 Feet

Mountain Parkway to I-75
Alternative 2

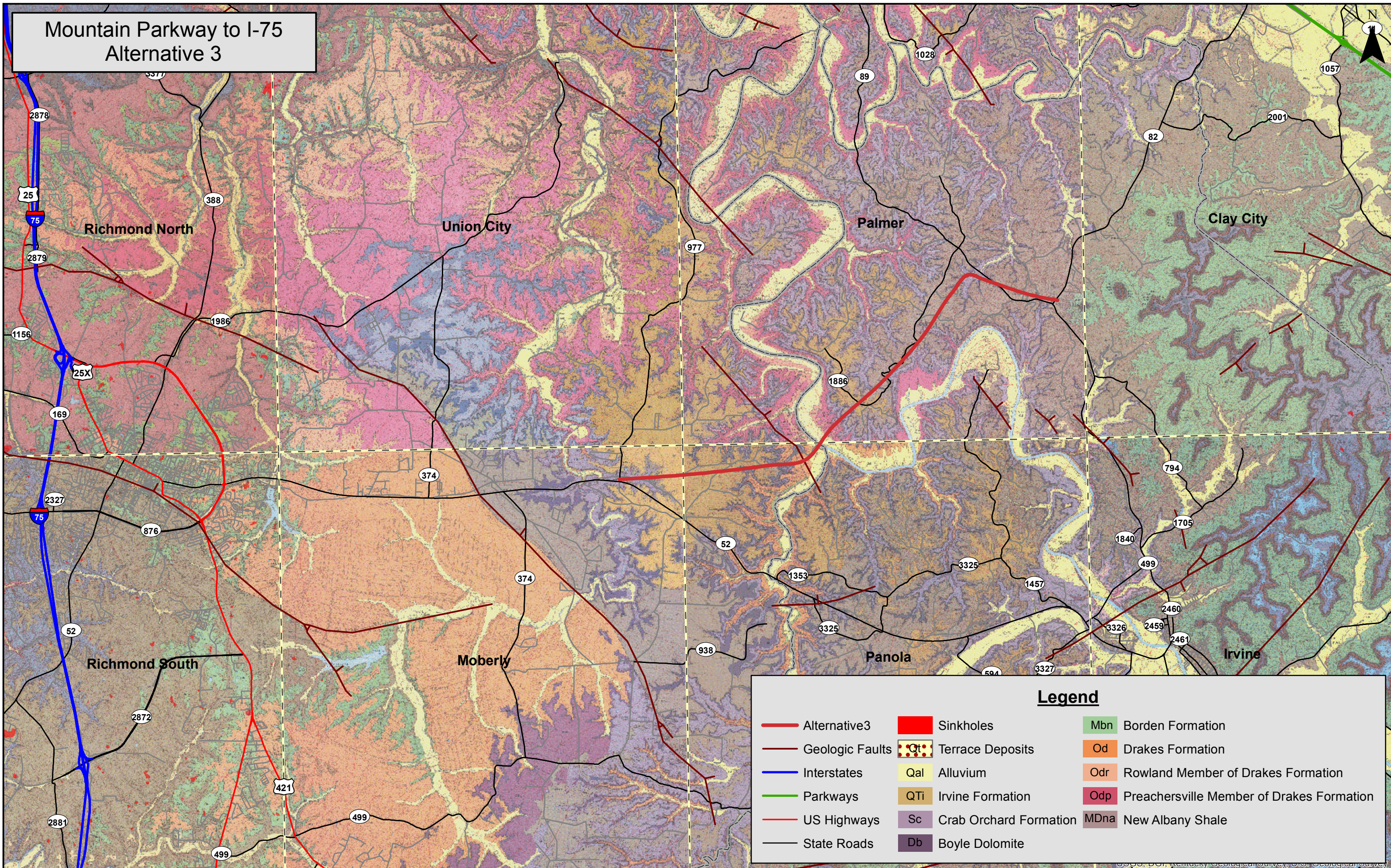


Legend

Alternative 2	Terrace Deposits	Grant Lake Member of Ashlock Formation
Geologic Faults	Alluvium	Terrill Member of Ashlock Formation
Interstates	Irvine Formation	Reba Member of Ashlock Formation
Parkways	Crab Orchard Formation	Rowland Member of Drakes Formation
US Highways	Tate Member of Ashlock Formation	Preachersville Member of Drakes Formation
State Roads	Calloway Creek Limestone	New Albany Shale
Sinkholes		

0 7,500 15,000 30,000 Feet

Mountain Parkway to I-75 Alternative 3



Legend						
	Alternative3		Sinkholes		Mbn	Borden Formation
	Geologic Faults		Terrace Deposits		Od	Drakes Formation
	Interstates		Alluvium		Odr	Rowland Member of Drakes Formation
	Parkways		Irvine Formation		Odp	Preachersville Member of Drakes Formation
	US Highways		Crab Orchard Formation		MDna	New Albany Shale
	State Roads		Boyle Dolomite			

0 7,500 15,000 30,000 Feet

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<u>Report No.</u>	<u>Route</u>	<u>Structure Over</u>	<u>Project Type</u>	<u>Description</u>
S-028-1998	CR-1210	Two Mile Creek	Bridge	1.4 miles E of KY 1924
S-101-1980	KY-974	Upper Howards Creek	State Bridge	Bridge is located 0.4 miles southwest of the junction of KY-974 and CR-1124
S-019-2001	KY-974	Howards Creek	State Bridge	White-Conkwright Rd. over Howards Creek
R-024-1989	KY-89		Roadway	From Station 383+00 to Station 453+50
R-004-2008	Ky-9000		Roadway	INTERCHANGE AT MOUNTAIN PARKWAY AND KY-974 (KIDDDVILLE RD.)
S-072-2012	Ky-9000		Culvert	INTERCHANGE AT MOUNTAIN PARKWAY AND KY-974 (KIDDDVILLE RD.). (02CCN)(04CCN) DBL 7'x6' RCBC at Ramp A Sta. 115+66.79
S-073-2012	Ky-9000		Culvert	INTERCHANGE AT MOUNTAIN PARKWAY AND KY-974 (KIDDDVILLE RD.). (02CCN)(04CCN) DBL 7'x8' RCBC at Ramp B Sta. 206+04.19
S-074-2012	Ky-9000		Culvert	INTERCHANGE AT MOUNTAIN PARKWAY AND KY-974 (KIDDDVILLE RD.). (02CCN)(04CCN) DBL 5'x6' RCBC at Ramp D Sta. 403+77.00
S-071-2012	Ky-9000	Mountain Parkway	State Bridge	INTERCHANGE AT MOUNTAIN PARKWAY AND KY-974 (KIDDDVILLE RD.). (02CCN)(04CCN) 3-Span Bridge (108'-78'-108') at KY-974 Sta. 174+61.19
S-106-1980	KY-11	Red River	State Bridge	Bridge is just east of the intersection of KY-11 and KY-15
S-023-1994	KY-1028	Snow Creek	Culvert	16' X 6' X 69' RCBC @ Sta. 450+00
S-004-1982	KY-1028	Lulbegrud Creek	State Bridge	Bridge is east of the junction of KY-1028 and KY-3369 at the Clark/Powell county line
S-130-1996	KY-1028	Log Lick Creek	County Bridge	KY 1028 (Mina-Log Lick Rd.) Single Span Bridge over Log Lick Creek; Approx. 1.3 miles SE of Mina
S-052-1983	KY-388	Stony Run	Culvert	Culvert @ Stony Run
R-046-2011	KY-2878		Roadway	IMPROVE EXISTING ALIGNMENT OF I-75 FRONTAGE ROADS WITH KY-627 BOONESBORO ROAD.
S-067-1990	I-75		Culvert	4' x 4' @ Station 325+20, SB Lanes