This chapter defines and discusses the criteria used to evaluate the ten corridor alternates described in Chapter 3. Evaluation criteria have been constructed to meet the identified goal of this planning study: to evaluate options for an interstate transportation corridor while seeking to balance socioeconomic and traffic needs against environmental concerns and project costs. The evaluation is divided into three basic categories: traffic and socioeconomic analyses, environmental issues, and engineering and construction cost analyses.

A. TRAFFIC AND SOCIOECONOMICS

The following section provides an analysis of several traffic and socioeconomic issues related to travel benefits as well as social and economic considerations.

1. Travel Benefits

Travel benefits reflect the ability of corridor alternates to efficiently and safely serve travelers and to be effectively integrated with other transportation system components.

- *Projected Traffic Volumes*

Table 4.1 Average Traffic Volumes

Alternate	Year 2030 Volume (vpd)
KY 80	20,300
N-1	20,400
N-2	14,600
N-3	18,500
N-4	19,900
M-1	15,500
S-1	15,800
S-2	15,500
S-3	15,000
S-4	16,600

Projected traffic volumes were derived for each study alternate by segment using the Statewide Traffic Model as modified for the study area. **Table 4.1** shows the weighted (based on segment length) average annual daily traffic (AADT) for each alternate corridor in the design year 2030. **Table 4.2** (see next page) shows the anticipated volumes by corridor segment for the years 2010 and 2030. **Exhibits 4.1** and **4.2** graphically display the volumes for the same years. As shown, KY 80, N-1 and N-4 are expected to carry the largest average volumes with about 20,000 vehicles per day (vpd) for the design year 2030. Volumes along KY 80 are expected to be highest near the KY 461 intersection in Pulaski County and along the northern edge of London. Lower average traffic volumes, between 14,000 and 16,000 vpd, are expected along the middle and south corridors (M-1, S-1, S-2, S-3 and S-4), as well as the N-2 corridor. Worth noting is that new corridors passing south of London generally would carry 30 to 40 percent more traffic between I-75 and the Daniel Boone Parkway than do new corridors passing north of London.

Using traffic model output for the north, middle and south corridors, traffic volumes along the I-75 corridor were averaged, shown on Exhibits 4.1 and 4.2. Year 2030 volumes are expected to reach a maximum of about 66,000 vpd on the south side of London. When considered separately, the south alternates tend to increase volumes along I-75 by about 4,000 vpd. The estimated average volumes along I-75 are slightly lower than those projected for the route without the I-66 corridor.

- *Time and Distance Savings*

The most-traveled existing east-west route in the project area is KY 80. Therefore, time and distance savings can be approximated by comparing travel to and from the same terminus points for each alternate corridor and KY 80 (i.e., KY 80 is the benchmark for travel studies). The western limit of travel would begin at the Louie B. Nunn (Cumberland) Parkway interchange, where S-3 begins. The eastern terminus is at the proposed Daniel Boone Parkway interchange, where the S-1, S-2, S-3 and N-4 corridors end. Time savings represent the total travel time saved on a one-way trip along each alternate corridor (at 65 mph) when compared with travel along existing KY 80. Distance savings is the total distance saved on a one-way trip along each alternate corridor when compared with travel along existing KY 80.

Table 4.3 Time and Distance Savings for Year 2030

Alternate	Time Savings (M:S)	Distance Savings (miles)
KY 80	11:00	3.7
N-1	11:26	4.1
N-2	10:48	3.4
N-3	12:04	4.8
N-4	10:26	3.1
M-1	11:20	4.0
S-1	8:18	0.7
S-2	7:27	-0.2
S-3	8:24	0.8
S-4	7:49	0.2

KY 80, as it exists today, is 49.8 miles in length between termini with an approximate driving time of 53 minutes and 30 seconds. As shown in **Table 4.3**, this driving time would be reduced by all of the alternate corridors. Except for the S-2 corridor, all of the alternates would also reduce the total driving distance compared to the existing KY 80 route. The greatest time and distance savings can be expected for the KY 80, N-1, N-3 and M-1 corridors, ranging from 11 to 12 minutes. The greatest distance savings is anticipated for the same corridors, ranging from 3.7 to 4.8 miles. Overall, the south alternates result in the least time and distance savings, averaging 8 minutes in time savings and 0.4 miles in distance savings. It should be noted that the KY 80 alternate includes some corridor realignment and a northern Somerset bypass, which contribute to the time and distance savings provided by the KY 80 alternate relative to existing KY 80.

- *Daily VMT Served and VHT Saved*

Table 4.4 Daily VMT and VHT for Year 2030

Alternate	Daily VMT Served (veh-miles)	Daily VHT Saved (veh-hours)
KY 80	936,000	3,720
N-1	930,000	3,890
N-2	674,000	2,560
N-3	834,000	3,730
N-4	932,000	3,470
M-1	707,000	2,920
S-1	774,000	2,180
S-2	775,000	1,920
S-3	736,000	2,110
S-4	820,000	2,160

Typical output from a travel demand model includes Measures of Effectiveness (MOEs), used to identify regional traffic impacts. MOEs considered for this study include Vehicle Miles of Travel (VMT) and Vehicle Hours of Travel (VHT). The “Daily VMT Served” provides a measure of the total number of vehicle-miles (segment length x segment AADT) traveled along each alternate alignment by the Year 2030. The “Daily VHT Saved” represents the total number of vehicle-hours (average time savings x daily VMT) saved by each alternate by Year 2030.

Shown in **Table 4.4**, KY 80, N-1 and N-4 serve the highest average VMT for the design year 2030, around 930,000. The N-1 corridor saves the highest average VHT for the design year 2030, followed by N-3, KY 80 and N-4. Overall, N-2 and M-1 have the lowest VMT served and the south corridors have the lowest VHT saved.

Table 4.2 Projected Traffic Volumes for the Years 2010 and 2030

KY 80 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,300	13,600	18
New US 27* to KY 80*	10,900	17,900	16
KY 80* to KY 461*	16,200	26,500	21
KY 461* to Buck Creek*	15,000	24,600	21
Buck Creek* to County Line*	14,200	23,200	28
County Line* to CR 1454**	12,300	20,200	18
CR 1454** to I-75**	13,400	22,000	26
I-75** to Daniel Boone Pkwy**	16,500	27,000	26

N-1 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,300	13,600	18
New US 27* to KY 80*	10,900	17,900	16
KY 80* to Buck Creek*	13,600	22,300	22
Buck Creek* to County Line*	13,600	22,300	22
County Line* to CR 1475**	12,600	20,600	21
CR 1475** to KY 192**	12,600	20,600	21
KY 192** to I-75**	13,300	21,800	21
I-75** to US 25**	12,900	21,200	20
US 25** to Daniel Boone Pkwy**	8,700	14,300	20

N-2 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to .US 27*	8,600	14,200	18
New US 27* to KY 80*	10,900	17,900	16
KY 80* to Buck Creek*	8,400	13,800	22
Buck Creek* to KY 80*	8,400	13,800	22
KY 80* to County Line*	8,400	13,800	22
County Line* to County Line***	8,400	13,800	22
County Line*** to CR 1454**	8,400	13,800	24
CR 1454** to I-75**	8,400	13,800	28
I-75** to Daniel Boone Pkwy**	6,500	10,700	26

N-3 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,300	13,600	18
New US 27* to KY 80*	10,900	17,900	16
KY 80* to Buck Creek*	13,600	22,300	16
Buck Creek* to County Line*	13,600	22,300	23
County Line* to KY 80**	11,900	19,400	20
KY 80** to I-75**	11,100	18,200	20
I-75** to Daniel Boone Pkwy**	7,300	11,900	26

N-4 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,300	13,600	18
New US 27* to KY 80*	10,900	17,900	16
KY 80* to Buck Creek*	13,600	22,300	23
Buck Creek* to County Line*	13,600	22,300	23
County Line* to FS 781**	13,500	22,100	21
FS 781** to KY 192**	13,500	22,100	21
KY 192** to I-75**	13,300	21,800	24
I-75** to US 25**	12,700	20,800	20
US 25** to Daniel Boone Pkwy**	8,500	13,900	20

M-1 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	7,100	11,600	18
New US 27* to KY 80*	9,600	15,700	16
KY 80* to Buck Creek*	7,900	13,000	21
Buck Creek* to County Line*	7,300	12,000	21
County Line* to CR 1340**	7,300	12,000	21
CR 1340** to KY 192**	10,400	17,000	21
KY 192** to I-75**	10,400	17,000	20
I-75** to US 25**	12,900	21,200	20
US 25** to Daniel Boone Pkwy**	8,700	14,300	20

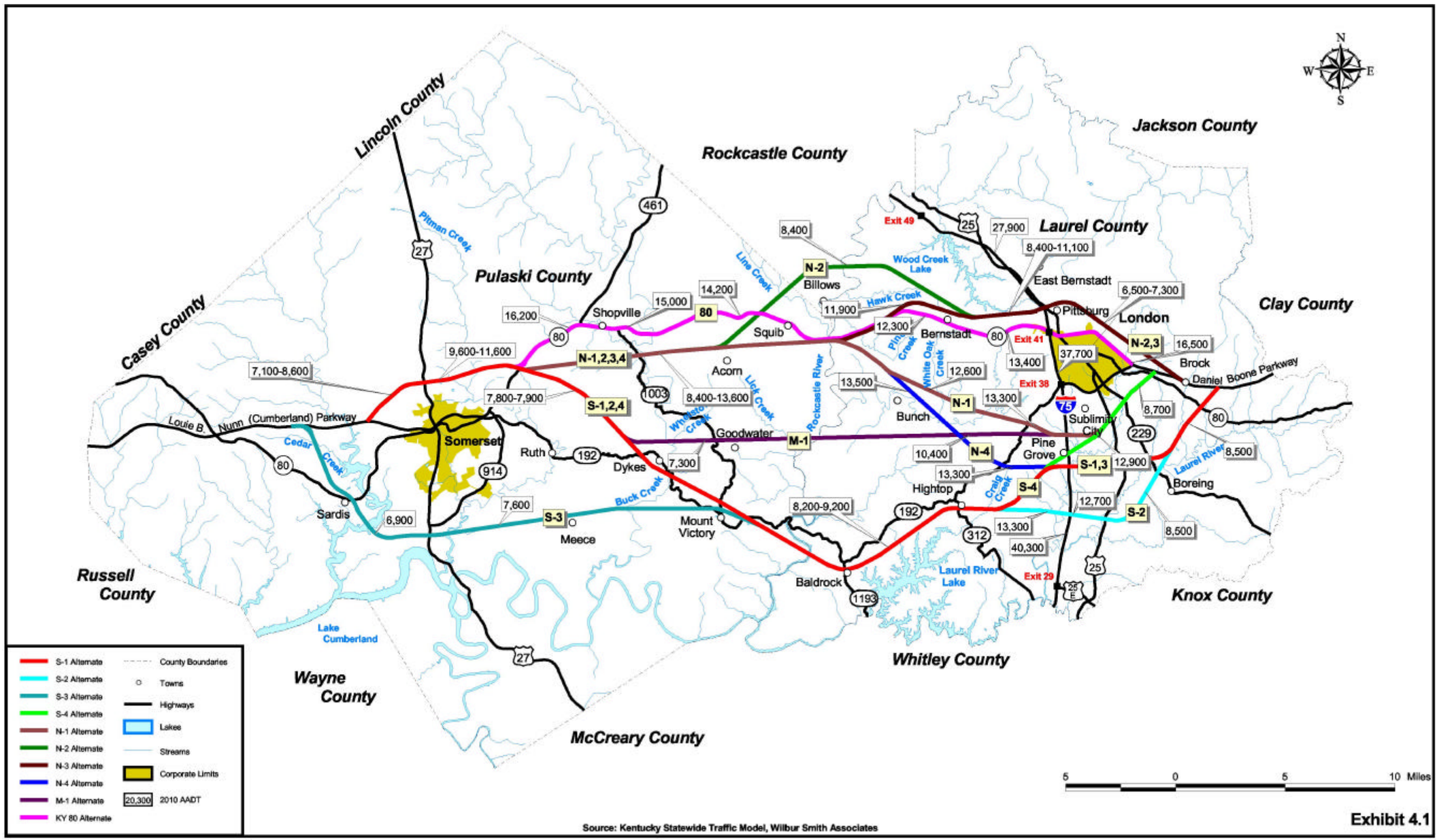
S-1 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,500	13,900	18
New US 27* to KY 80*	11,600	18,900	16
KY 80* to Buck Creek*	7,800	12,800	20
Buck Creek* to County Line*	8,200	13,400	21
County Line* to KY 312**	8,200	13,400	21
KY 312** to I-75**	13,300	21,800	21
I-75** to US 25**	12,700	20,800	20
US 25** to Daniel Boone Pkwy**	8,500	13,900	20

S-2 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to US 27*	8,500	13,900	18
New US 27* to KY 80*	11,600	18,900	16
KY 80* to Buck Creek*	7,800	12,800	20
Buck Creek* to County Line*	8,200	13,400	21
County Line* to KY 312**	8,200	13,400	21
KY 312** to I-75**	13,300	21,800	21
I-75** to US 25**	12,700	20,800	20
US 25** to Daniel Boone Pkwy**	8,500	13,900	20

S-3 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy* to KY 80*	6,900	11,400	23
KY 80* to US 27*	6,900	11,400	23
US 27* to KY 769*	7,600	12,500	23
KY 769* to Buck Creek*	7,600	12,500	23
Buck Creek* to County Line*	9,200	15,000	23
County Line* to KY 312**	9,200	15,000	21
KY 312* to I-75**	14,400	23,600	21
I-75** to US 25**	12,800	20,900	20
US 25** to Daniel Boone Pkwy**	8,500	13,900	20

S-4 Corridor			
Description	2010 AADT[1]	2030 AADT[1]	% Trucks
Louie B. Nunn (Cumb.) Pkwy to US 27*	8,500	13,900	18
New US 27* to KY 80*	11,600	18,900	16
KY 80* to Buck Creek*	7,800	12,800	20
Buck Creek* to County Line*	8,200	13,400	21
County Line* to KY 312**	8,200	13,400	21
KY 312** to I-75**	13,300	21,800	21
I-75** to US 25**	12,900	21,200	20
US 25** to Daniel Boone Pkwy**	8,700	14,300	20

Notes: * Pulaski County ** Laurel County *** Rockcastle County [1] Annual Average Daily Traffic



Source: Kentucky Statewide Traffic Model, Wilbur Smith Associates

Exhibit 4.1

Projected Traffic Volumes for Year 2010

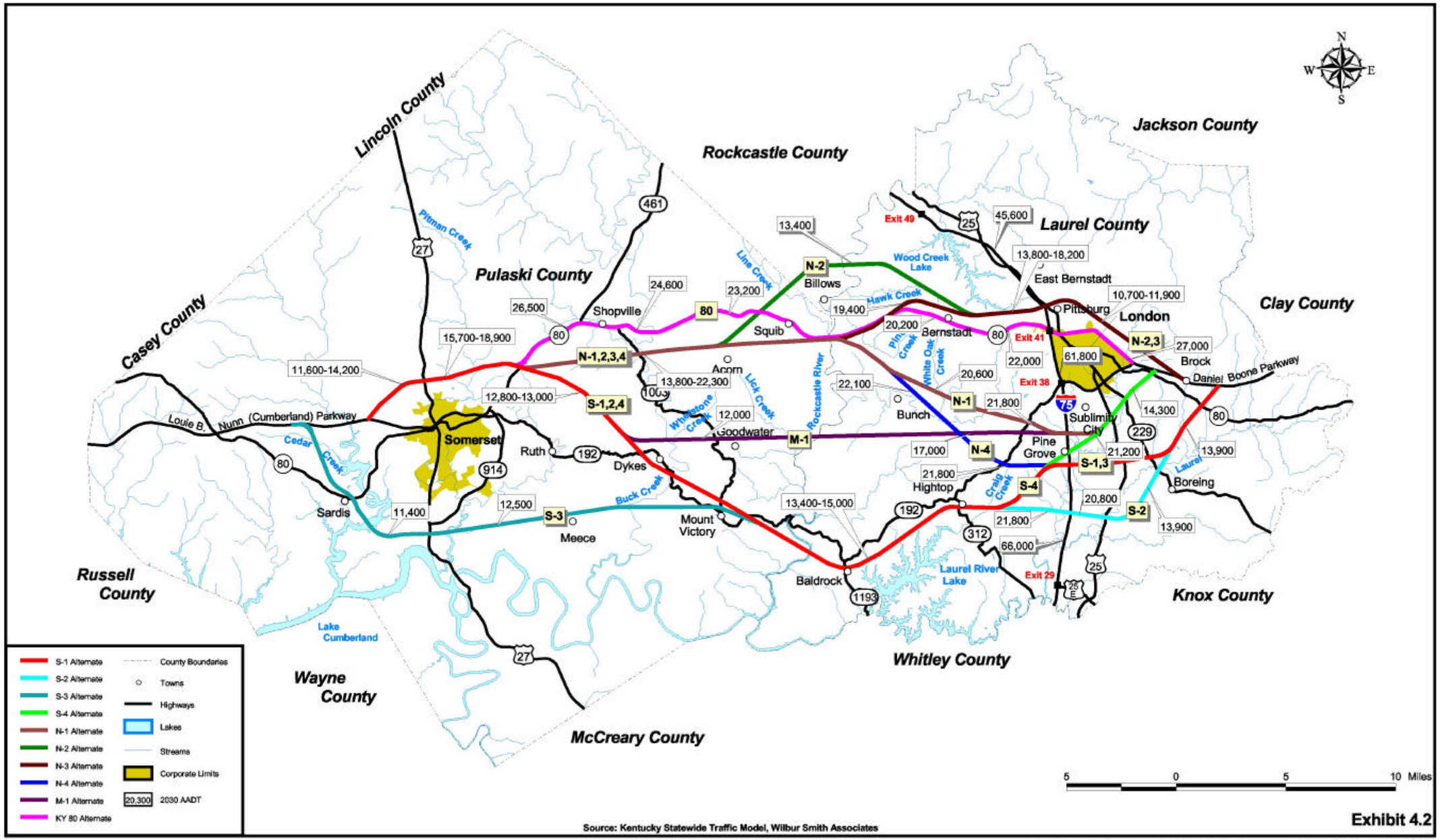


Exhibit 4.2

Projected Traffic Volumes for Year 2030

- *Accident Reductions*

  Considering the corridor alternates, an analysis of each roadway section was completed to determine the potential annual accident reduction and associated cost savings based on the daily vehicle miles traveled (VMT). For the analysis, it was assumed that the proposed improvements were completed for the Year 2010 and 2030 scenarios, with accident and cost reductions expected for the improved segments. Reduction factors for this analysis were derived from the Kentucky Transportation Center's *Analysis of Traffic Accident Data*[1] and the Kentucky State Police's *Traffic Accident Facts*[2]. The expected annual accident and cost savings for these years are shown in **Table 4.5** (see next page).

  Based on accident data presented in the KTC's report, interstate facilities have fewer accidents per vehicle-mile of travel than minor and major arterial and collector facilities in the Commonwealth of Kentucky. By diverting some of the existing area traffic to a new interstate corridor, all of the corridor alternates would provide significant accident reductions and cost savings on an annual basis. Based on the average accident rate per mile for interstates and the projected traffic volumes, corridor alternates KY 80, N-1 and N-4 would provide the greatest savings by the Year 2030, with about 500 fewer accidents and approximately $26 million less in total accident costs.

- *Transportation System Connectivity*

  System connectivity considers the relative accessibility of each alternate corridor to other transportation facilities in the region. Currently, there is not a controlled access facility across the study region that connects major routes in the Somerset and London/Corbin areas. Recognizing that each corridor provides access to I-75 as well as the Louie B. Nunn (Cumberland) and Daniel Boone Parkways, other facilities in the area are also considered, including the regional airports in Somerset and London.

  In the Somerset area, US 27 and KY 80 represent primary highway facilities north of town while US 27 and the Somerset Southeast Bypass (KY 914) represent primary facilities south of town. Additionally, the Somerset airport lies south of town. Considering these facilities, a transportation system connectivity advantage is provided by taking the corridor south of Somerset. This area will, however, be serviced by the Somerset southwest and southeast bypasses.

  Between Somerset and London, KY 80 and KY 461 represent primary highway facilities along the northern portion of the study area. Along the southern portion of the study area, several secondary facilities such as KY 192 exist. However, these south routes carry significantly less traffic and have a lower functional classification than the north routes. As a result, a system connectivity advantage exists for those alternate corridors passing through the northern portion of the study area near KY 80.

  In the London area, a number of highway facilities extend to the south of town, including US 25, which is a heavily traveled route between London and Corbin. US 25 also exists north of London, along with an additional secondary facility, KY 472. South of London, the London-Corbin airport and the City of Corbin present several important system connection issues. US 25E passes through Corbin and provides a key regional highway connection to the Cumberland Gap tunnel. Corbin is also home to a CSX TransFlo[SM] bulk transfer terminal for rail-to-truck self-service. Based upon these serviceability issues and the lack of a circumferential connection between I-75 and the Daniel Boone Parkway on the south side of London, a system connectivity advantage is provided by those corridors passing south of London.

  In summary, advantages for transportation system connectivity are provided for corridors passing north or south of Somerset, following a northern alignment between Somerset and London, and passing south of London. The following corridors meet some or all of these criteria as areas of transportation system advantages:

  - N-1: Passes north of Somerset, serves the KY 80 corridor between Somerset and London, connects between London and Corbin
  - N-4: Passes north of Somerset, serves the KY 80 corridor between Somerset and London, connects between London and Corbin
  - S-3: Connects south of Somerset and between London and Corbin

2. Social and Economic Issues

Social and economic issues account for the ability of corridor alternates to provide positive enhancements and minimize adverse impacts to people and economic resources within the study area.

- *Displacements*

  The displacement measure represents the number of primary structures (homes, businesses and other buildings) with the potential to be displaced for each corridor alternate and is estimated based on a general 500-foot zone within each corridor. This measure represents only approximate displacements and structure locations were estimated based on aerial photography.

  Based on the identified corridor zone, the M-1 alternate provides the least number of potential displacements, with approximately 140 structures impacted. As shown in **Table 4.6**, the KY 80 corridor would provide the greatest number of displacements with 480 structures, about 100 more potential displacements than the closest alternate, the S-3 corridor. Because KY 80 is an existing facility, commercial and residential development is considerably higher in certain areas, especially closer to the urban areas of Somerset and London.

Table 4.6 Potential Displacements

Alternate	Number of Structures (within a 500-foot corridor zone)
KY 80	480
N-1	300
N-2	240
N-3	270
N-4	330
M-1	140
S-1	300
S-2	280
S-3	380
S-4	310

[1] *Analysis of Traffic Accident Data in Kentucky (1993-1997)*, Kentucky Transportation Center, Research Report KTC-98-16, September 1998.

[2] *Kentucky Traffic Accident Facts 1998,* Kentucky State Police, prepared by the Kentucky Transportation Center.

Table 4.5 Accident Reduction and Cost Savings for Proposed Corridors

Corridor Alternate	Daily VMT Served	Annual Accident Reduction					Annual Accident Cost Savings				
		Fatal	Serious Injury	Minor Injury	PDO[1]	Total	Fatal	Serious Injury	Minor Injury	PDO[1]	**Total**
S-1 (Year 2010)	472,747	1.9	7	77	158	244	$6,168,763	$5,148,113	$1,820,691	$299,327	$13,436,894
S-1 (Year 2030)	773,651	3.1	11	127	258	399	$10,095,176	$8,424,883	$2,979,559	$489,849	$21,989,467
S-2 (Year 2010)	473,487	1.9	7	78	158	244	$6,178,417	$5,156,170	$1,823,540	$299,796	$13,457,924
S-2 (Year 2030)	774,798	3.1	11	127	258	399	$10,110,151	$8,437,380	$2,983,979	$490,576	$22,022,086
S-3 (Year 2010)	449,368	1.8	6.4	74	150	232	$5,863,684	$4,893,511	$1,730,648	$284,524	$12,772,367
S-3 (Year 2030)	736,033	3.0	10	121	245	379	$9,604,311	$8,015,234	$2,834,682	$466,031	$20,920,257
S-4 (Year 2010)	500,835	2.0	7	82	167	258	$6,535,271	$5,453,980	$1,928,865	$317,111	$14,235,227
S-4 (Year 2030)	820,250	3.3	12	134	273	423	$10,703,232	$8,932,334	$3,159,025	$519,354	$23,313,945
M-1 (Year 2010)	431,170	1.7	6	71	144	222	$5,626,235	$4,695,349	$1,660,565	$273,002	$12,255,151
M-1 (Year 2030)	707,360	2.8	10	116	236	365	$9,230,161	$7,702,989	$2,724,253	$447,876	$20,105,279
N-1 (Year 2010)	567,082	2.3	8	93	189	292	$7,399,706	$6,175,391	$2,184,000	$359,057	$16,118,154
N-1 (Year 2030)	929,710	3.7	13	152	310	479	$12,131,556	$10,124,335	$3,580,591	$588,660	$26,425,142
N-2 (Year 2010)	410,276	1.6	6	67	137	211	$5,353,582	$4,467,808	$1,580,093	$259,772	$11,661,256
N-2 (Year 2030)	674,288	2.7	10	111	225	348	$8,798,609	$7,342,839	$2,596,882	$426,936	$19,165,266
N-3 (Year 2010)	508,822	2.0	7	83	170	262	$6,639,487	$5,540,954	$1,959,624	$322,168	$14,462,233
N-3 (Year 2030)	833,723	3.3	12	137	278	430	$10,879,048	$9,079,060	$3,210,917	$527,885	$23,696,910
N-4 (Year 2010)	568,506	2.3	8	93	189	293	$7,418,287	$6,190,898	$2,189,484	$359,958	$16,158,628
N-4 (Year 2030)	931,741	3.7	13	153	310	480	$12,158,058	$10,146,452	$3,588,413	$589,946	$26,482,869
KY 80 (Year 2010)	571,256	2.3	8	94	190	294	$7,454,173	$6,220,846	$2,200,076	$361,699	$16,236,794
KY 80 (Year 2030)	935,933	3.8	13	153	312	482	$12,212,758	$10,192,102	$3,604,557	$592,601	$26,602,018
Factors[2]:		1.1	3.9	44.9	91.3		$3,250,000	$765,000	$23,500	$1,900	

[1]Property Damage Only

[2]Factors derived from *Analysis of Traffic Accident Data in Kentucky (1993-1997), Kentucky Transportation Center, Research Report KTC-98-16* and *Kentucky Traffic Accident Facts, 1998 Report, Kentucky State Police* and represent accidents reduced per 100 million vehicle miles of travel (VMT).

- *Recreational Facilities*

  Proximity to local recreational facilities was measured for each of the corridor alternates, and defined as the average distance (in miles) from the nearest proposed interchange along each corridor alternate to 116 recreational facilities in the two study counties and ten surrounding counties. The average distances are presented for each of the corridors in **Table 4.7**.

  As noted on Exhibit 2.6, Regional Tourism, most of the area's tourism and recreational facilities are located in the southern half of the study area, including boat ramps, campgrounds, trails, and parks. For this reason, all of the south alternates have lower average proximity measurements. On the other hand, the north routes of KY 80, N-2, and N-3 are situated farther from recreational facilities, resulting in greater proximity distances.

Table 4.7 Recreational Proximity

Alternate	Average Distance to Recreational Facilities (miles)
KY 80	36.0
N-1	33.1
N-2	36.3
N-3	36.1
N-4	31.8
M-1	32.5
S-1	27.7
S-2	27.7
S-3	27.3
S-4	27.9

- *Industrial Serviceability*

  Similar to the measurement for recreational facilities, industrial serviceability was measured by determining the average distance (in miles) from each corridor alternate to 203 industrial facilities in the study area. The largest concentration of facilities occurs close to the urban areas of Somerset and London. **Table 4.8** summarizes the average distance to industrial facilities for each corridor alternate.

  Due to its developed character and its existing service to many of the area industries, the KY 80 corridor provides the least average distance to industry. The M-1 and S-4 corridors share common segments north of Somerset and south of London, also providing good serviceability to local industry. The S-3 corridor has the greatest average distance to industrial facilities, partly due to its southern routing around Somerset. The difference in mileage between the best and worst in this category is relatively small.

Table 4.8 Industrial Serviceability

Alternate	Average Distance to Industrial Facilities (miles)
KY 80	5.2
N-1	5.6
N-2	5.7
N-3	5.7
N-4	5.7
M-1	5.4
S-1	5.9
S-2	6.2
S-3	6.6
S-4	5.4

- *Environmental Justice*

  An important consideration for highway reconstruction or new development is environmental justice. For this study, environmental justice is addressed by calculating the percentage of minority, elderly and low-income persons along the alternate corridors using 1990 U.S. Census block-level population counts. Values above zero (0) indicate the alternate is more favorable than the regional average, potentially causing fewer negative impacts to these populations groups. The environmental justice measure is shown for each alignment in **Table 4.9**.

  As shown in the table, all of the alternates are estimated to have fewer environmental justice concerns than the regional average, ranging between 13 and 30 percent. The N-1 and N-4 corridors have the lowest concentration of minority, elderly and low-income persons. On the other hand, the south corridors along with N-2 and N-3 appear to have the highest percentage of these sensitive population groups.

Table 4.9 Environmental Justice

Alternate	Percent Fewer than Regional Average
KY 80	23
N-1	30
N-2	13
N-3	15
N-4	29
M-1	23
S-1	15
S-2	14
S-3	17
S-4	16

3. Summary of Traffic and Socioeconomics

In the areas of travel benefits and social/economic issues, each of the alternates has different strengths and weaknesses. A summary of the traffic and socioeconomic issues related to each corridor are as follows:

- *KY 80 Alternate*

  Because of its use of an existing highway corridor, the KY 80 corridor provides some variation in the advantages and disadvantages it offers in comparison to the other alternatives that generally follow new corridors. KY 80 offers high traffic service levels, accident reductions, and serviceability. However, widening the KY 80 corridor is likely to cause more property displacements and create more social disruption to developed areas along the corridor. If the properties are not displaced by the reconstructed highway, many businesses and properties could still lose their existing access points along KY 80 due to the need to develop the I-66 corridor as a controlled access highway. A summary of the key findings related to this alternate include:

  – High traffic service levels, accident reduction and serviceability;

  – More property displacements; and,

  – Disruption to existing highway access points.

- *North Alternates*

  Most of the north alternates, with the exception of N-2, provide for high traffic service levels, time savings and accident reductions. The N-1 alternate is the best corridor alternate relative to the travel benefits. Key findings related to these alternates include:

  - High traffic service levels, time savings and accident reductions for the N-1, N-3 and N-4 alternates;
  - Traffic and highway system service advantages for north alternates passing south of London (N-1 and N-4);
  - Lowest concentration of minority, elderly and low-income persons for N-1 and N-4 corridors;
  - Indirect routing between Somerset and London makes N-2 less desirable; and,
  – Relatively average social and economic issues for all alternates.

- *Middle Alternate*

  The M-1 corridor provides the most direct routing of all the alternates and therefore offers good time and distance savings. Because it passes through a relatively unpopulated area between London and Somerset, the corridor has minimal property displacements, but it also has lower traffic service levels and connectivity advantages. A summary of key findings related to this alternate include:

  – Good time and distance savings;
  – Minimal property displacements;
  – Lower traffic service levels; and,
  – Less transportation system and community access.

- *South Alternates*

  The south alternates provide for improved service connections to recreational facilities and the S-3 corridor offers good transportation system connectivity. Drawbacks to these alternates are that they generally have lower traffic service levels, less proximity to industrial facilities and increased potential for environmental justice issues. A summary of key findings related to these alternates include the following:

  – Good proximity to recreational facilities;
  – Lower traffic service levels;
  – Less proximity to industrial facilities; and,
  - Increased potential for adverse social and environmental justice impacts.

B. ENVIRONMENTAL ISSUES

An environmental overview of each corridor alternate was completed using Geographic Information System (GIS) databases and other technical resources available in-house and through various agency and private resources. The overview is intended to provide known and potential environmental issues that can be reasonably identified to allow a conservative analysis of corridors. Appropriate detailed environmental work will be conducted during subsequent phases of project development that will entail, where appropriate, NEPA evaluation of alignment alternatives. These future study efforts will provide for more detail and site-specific field evaluations of the environmental issues identified in this study, along with consideration of other important environmental concerns not known or documented at this planning phase.

The following analyses identify "potential" issues within buffer zones of either 500 or 2,000 feet in width, along each of the defined corridors. All items identified in this analysis will not necessarily be impacted if an alignment is ultimately designed within one of these corridors. These identified issues will be avoided as much as possible during future design phases. Environmental issues considered for this study include cultural and historic features, native species, natural areas and other issues. Data for this analysis was provided by:

- Kentucky Heritage Council: historic and archaeological sites
- United States Geological Survey: cemeteries, churches and schools
- Kentucky Natural Resources and Environmental Protection Cabinet: wildlife management areas and Wild River boundaries
- Daniel Boone National Forest: National Forest boundaries and property, threatened and endangered species, potential threatened and endangered species, cave routes and cliff lines
- Kentucky State Nature Preserves Commission: threatened and endangered species, and potential threatened and endangered species
- Department of Natural Resources: blue-line stream crossings
- Kentucky Department of Fish and Wildlife: wetland locations
- Kentucky Geological Survey: wells and underground storage tanks, geologic features
- U.S. Environmental Protection Agency: hazardous waste data, toxics release inventory, water discharge permits, and superfund sites
- Local Cave Society: cave routes and cliff lines
- National Speleological Society: karst and cave data

Many of these contributing agencies have volunteered services for future phases of this study.

1. Cultural / Historic Features

When this project advances into the NEPA process, historic and cultural resources likely to require further consideration include prehistoric and historic period archaeology sites and historic buildings. Such resources require identification and evaluation to determine their significance in terms of the National Register of Historic Places. Non-historic cultural resources such as schools, cemeteries and churches are also issues that must be considered. Information about the historic and non-historic cultural resources within Pulaski and Laurel counties generally, and within specific corridors, was compiled from the Kentucky Heritage Council (KHC) site files, historic and modern county maps, and local and regional histories. These data were entered into the project GIS, then used to identify the frequency and types of resources that have been documented within each of the ten corridors. The resulting occurrences by resource type are shown in **Table 4.10**, and their locations mapped in associated exhibits.

Table 4.10 Identified Cultural and Historic Features (within a 2,000-foot corridor)

Alternate	Archaeology Sites	Historic Sites	Cemeteries	Churches	Schools
KY 80	30	7	9	4	5
N-1	21	1	8	13	6
N-2	16	1	4	7	0
N-3	22	1	4	8	3
N-4	26	1	6	9	4
M-1	9	1	5	3	0
S-1	6	1	7	8	4
S-2	6	1	6	11	5
S-3	10	1	9	7	2
S-4	6	1	9	10	4

Source: Kentucky Heritage Council, U.S. Geological Survey

The documented sites represent a portion of the total cultural resources likely to be present within each corridor. Other sites may be discovered when base studies are conducted. The discovery of additional archaeological sites and the documentation of historic structures may result from further studies. The number of resources documented within a region is strongly related to the number of detailed studies that have been conducted and documented. The enumeration of archaeological sites shown in Table 4.10 reflects the total count of recorded sites, not the number that are still extant, as the Kentucky Heritage Council does not remove destroyed sites from its registry. It is difficult to use existing records to determine if all of the 30 sites documented on KY 80 are still present.

- *Archaeology Sites*

  Analysis of the available data demonstrate significant variation in the frequency of recorded historic cultural resources within each of the 2,000-foot corridors. KY 80 has the greatest number of recorded archaeological sites, while alternates S-1, S-2 and S-4 have the smallest number. These differences among corridors reflect the amount of cultural resource survey that has been conducted within the area of each corridor. While archaeological sites were considered during the study process, they are not mapped in the report in order to protect sensitive locations.

  A cultural resource survey will likely be needed to assess the type and frequency of different resources within a preferred corridor. The existing data are insufficient to accurately model the likely locations of cultural resources. A review of the KHC data files indicates that Pulaski and

Laurel counties have a total of 670 recorded archaeological sites. Of these, only 23 are on the National Register of Historic Places, and only five additional sites are considered potentially eligible. The remaining sites were either not evaluated for the National Register or are of unknown potential.

Given the diversity of resource types already recorded in the two counties as a whole, any of the ten corridors is likely to contain prehistoric camp sites, villages, burial mounds and rock shelters. Historic archaeological sites are also likely to be present, but so few are documented it is not currently possible to assess their likely type. At the present time, no petroglyph sites are documented in Pulaski or Laurel County, although numerous examples are reported elsewhere in the Daniel Boone National Forest. It is likely that some occur within the project corridor, particularly in areas where sandstone escarpments are exposed. Prehistoric petroglyph sites present unique problems in terms of management, as they are immovable cultural features of likely religious significance and under the terms of the National Register are linked indelibly to their location. Careful planning to avoid such sites is likely to be needed.

- *Historic Structures*

  A total of 129 known historic buildings are presently reported in the two-county area, and 17 are considered potentially eligible. As shown in Table 4.10 and illustrated in **Exhibit 4.3**, the number of historical structures in proximity to each alternate is limited, with the exception of KY 80. This alternate could potentially involve 7 structures, only one of which is determined to be eligible for the National Register of Historic Places. The other alternates could involve as few as one structure each.

  In a previous study conducted by Wilbur Smith Associates for the Kentucky Transportation Cabinet, the state-maintained highway bridges were evaluated to determine their National Register significance. Bridges currently maintained by the Kentucky Transportation Cabinet were included in the assessment for Pulaski and Laurel County. An initial review of these findings indicates that there are no historically significant bridges in the project corridor within Pulaski or Laurel County. Since the state records only include actively maintained highway bridges, additional research may have to be conducted to assess if any National Register eligible, non-maintained bridges are within the project corridor.

- *Cemeteries*

  Although historic cemeteries are cultural resources, at the present time the Kentucky Transportation Cabinet does not consider them to be archaeological sites; however, they are considered to be sensitive in nature and present a right-of-way issue. Federal legislation is unclear on appropriate treatments. These resources may require documentation as cultural resources, and any adverse effects to them may require mitigation measures or realignment. There are also likely to be unmarked or poorly recorded family cemeteries within the project corridor. During subsequent studies of design and alignment options, additional research should be conducted to identify all potential cemetery sites using old maps, state records, local historic records or informants. Further archaeological surveys may also result in their discovery.

  As shown in Table 4.10 and Exhibit 4.3, the alternates that could potentially affect the greatest number of known cemeteries would be the KY 80, S-3 and S-4 alternates, passing through or near 9 documented cemeteries. The N- 2 and N-3 alternates would potentially affect the least number (4) of cemeteries.

- *Churches*

  Each alternate was evaluated to determine the number of known church facilities within a 2,000-foot wide corridor. According to Table 4.10 and Exhibit 4.3, the N-1 corridor contains 13 churches followed closely by the S-2 and S-4 corridors, with 11 and 10 churches, respectively. The KY 80 and M-1 corridors potentially impact the least number of churches, with 4 and 3 facilities, respectively.

- *Schools*

  Shown in Table 4.10 and illustrated on Exhibit 4.3, the number of known schools contained in the 2,000-foot study corridors ranges between zero and 6. The N-2 and M-1 corridors do not contain any identified school facilities. The N-1 corridor could potentially impact the greatest number of schools (6), followed by KY 80 and S-2, with 5 schools each.

2. Native Species

The data summarized in this analysis represents known occurrences of federal and state species within the defined corridors. This allows for a generalized comparison to be made of the advantages or disadvantages of corridors relative to each other. It does not necessarily imply that a specific number of impacts would occur within a corridor. The ultimate number of threatened or endangered species impacted could be more or less than the reported number of known occurrences. In such cases as stream crossings, species downstream of the crossing could fall outside of the designated corridors but would still require consideration for environmental impacts.

- *Threatened and Endangered Species*

  The potential number of threatened and endangered species in each 2,000-foot corridor was estimated based on state and federal GIS data, along with information provided by local resource agencies. As shown in **Table 4.11**, the south and middle alternate corridors encompass the greatest number of known species locations with the exception of the S-3 corridor. The north corridors are expected to have the least degree of potential impact, with zero to two known native species; however, according to local specialists, the Cumberland Bean and Pearly Mussel are inherent throughout the corridor, although locations may not be specifically mapped. Threatened and endangered species data are not mapped in this report in order to protect their locations. A full listing of the identified species in Pulaski and Laurel counties is located in Appendix D.

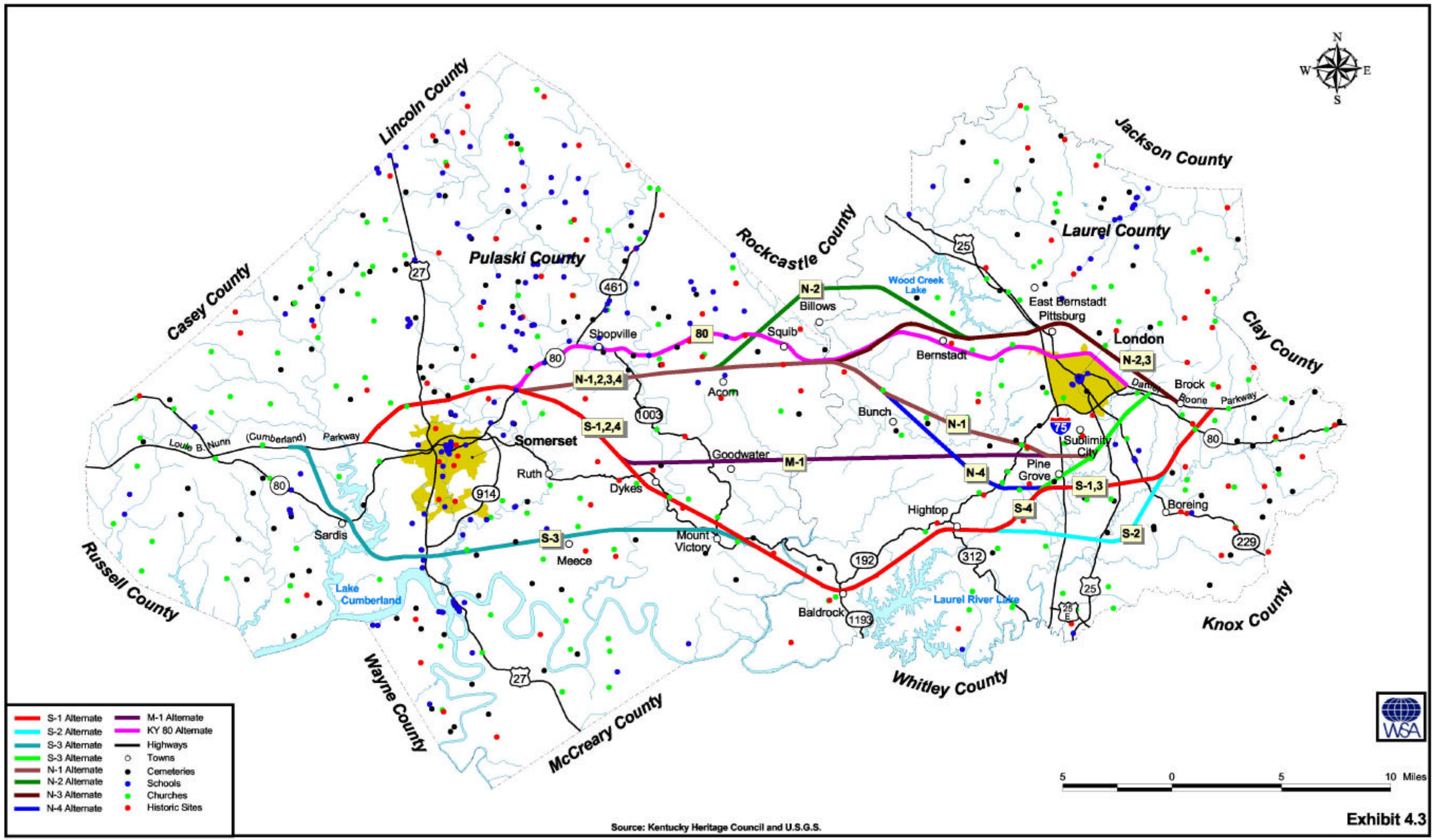


Exhibit 4.3

Historic Sites, Cemeteries, Churches & Schools

Table 4.11 Identified Native Species

Alternate	Number of Identified Occurrences (within a 2,000-foot corridor)	
	Threatened and Endangered Species	Potential Threatened and Endangered Species
KY 80	9	1
N-1	2	2
N-2	0	0
N-3	2	1
N-4	2	1
M-1	16	16
S-1	14	23
S-2	16	23
S-3	7	22
S-4	14	23

Source: Kentucky State Nature Preserves Commission, Daniel Boone National Forest

- *Potential Threatened and Endangered Species*

Similar to threatened and endangered species, the south and middle alternates encompass the greatest number of known locations of potential threatened and endangered species. This data is provided by the Daniel Boone National Forest. The south alternates potentially include more than 22 known locations of species and M-1 contains 16 known locations of species within its corridor. The north corridors were identified as having two or fewer areas of occurrence of potentially threatened and endangered species. The number of identified occurrences of potential threatened and endangered species is summarized for each alternate in Table 4.11.

3. Natural Areas

Natural areas encompass a broad range of features within the study area. These areas include National Forest property, geologic and cave features, cliff lines, streams, wetlands, lakes and rivers.

- *Daniel Boone National Forest Property*

The Daniel Boone National Forest (known as the Cumberland National Forest prior to 1966) comprises over 692,000 acres within a 2 million-acre proclamation boundary in 21 counties of Kentucky. Within the project area, there are approximately 37,000 acres of forest land in Pulaski County; 62,000 acres in Laurel County; and 14,000 acres in Rockcastle County. The Forest offers a variety of opportunities for outdoor recreation. Notable activities include camping, picnicking, hiking, nature study, fishing, boating and swimming. In addition, logging activities are managed for upland hardwood, cove hardwood and yellow pine.

The Forest also has many varieties of wildlife. There are more than 100 species of birds, 46 kinds of mammals, and 67 types of reptiles and amphibians. Endangered species, including plants, are resident in the Forest. The Forest is comprised of both public and private land, as illustrated in **Exhibit 4.4**. It should be noted that the National Forest land involved with these corridor alternates would not qualify as Section 4(f) property because of the Forest's multi-purpose usage.

One area of impact to the Daniel Boone National Forest (DBNF) is measured in the number of acres of property owned by the DBNF located within a generalized, 500-foot zone within each corridor alternate. As shown in **Table 4.12**, the KY 80, N-2 and N-3 corridors encompass the least number of acres, crossing less than 200 acres each. Because the N-1 and N-4 corridors cross the forest at an angle, they impact a much greater acreage. The south alternates impact between 380 acres and 390 acres, similar to the N-4 corridor. Because the M-1 corridor crosses one of the wider sections of the DBNF, it impacts the largest area, about 500 acres.

Table 4.12 Daniel Boone National Forest Property

Alternate	DBNF Property (acres) (within a 500-foot corridor)
KY 80	190
N-1	310
N-2	180
N-3	180
N-4	390
M-1	500
S-1	390
S-2	390
S-3	380
S-4	390

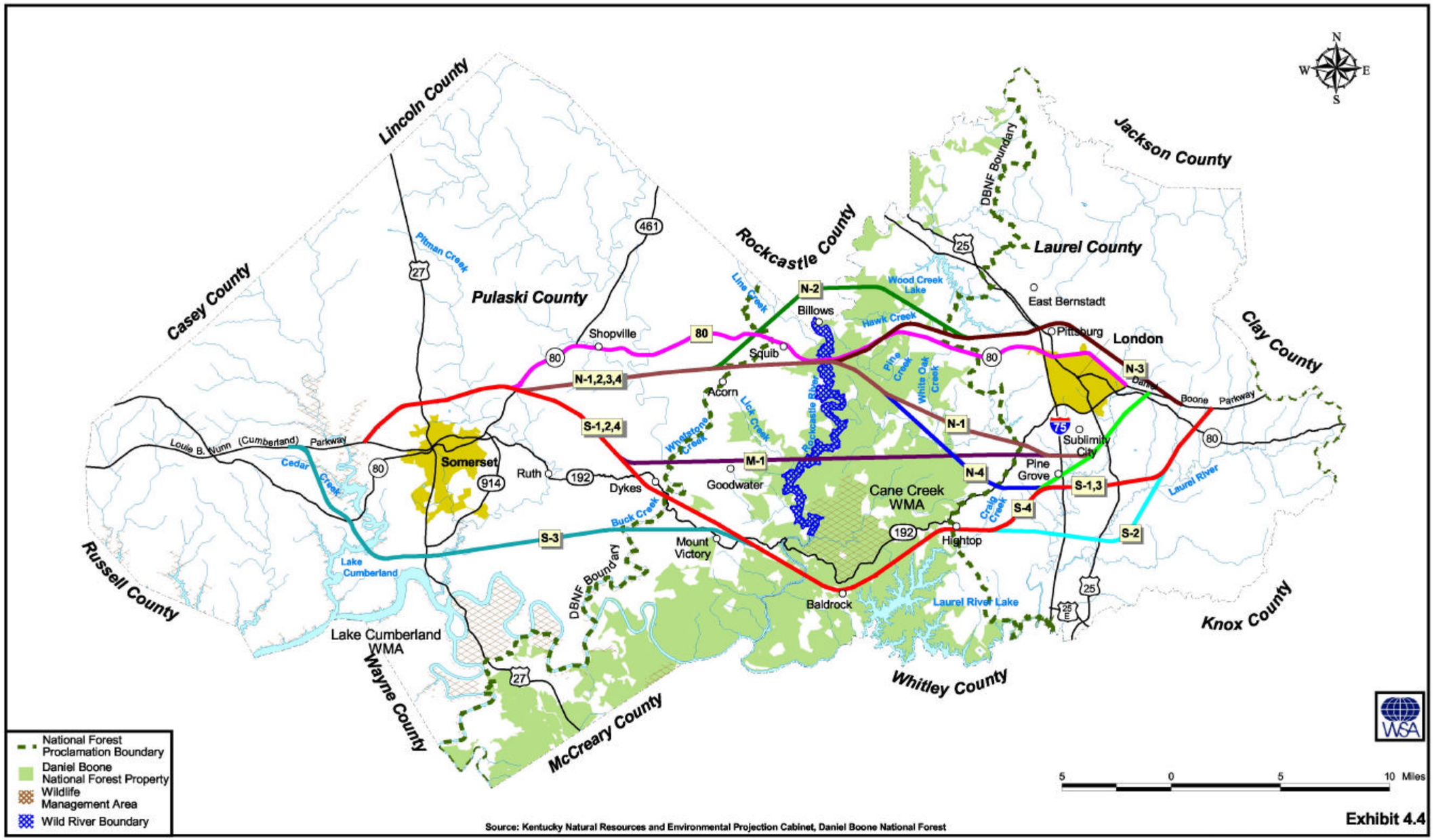
Source: Kentucky Natural Resources and Environmental Protection Cabinet, Daniel Boone National Forest

While the number of acres of national forest property potentially impacted by the alternate corridors provides one means of assessment, this measure does not account for some of the qualitative character of the forest property that is being encompassed. Much of the national forest property along the south and middle alternatives is a more pristine area of the forest with a greater concentration of areas with older and taller trees, sensitive animal and plant habitats, and recreational facilities.

Conversely, the KY 80 and north alternatives have a lesser degree of these features and a greater number of areas where mining and logging activities have occurred. Permit locations were obtained from the Kentucky Division of Surface Mining with Pulaski and Laurel Counties and these locations are illustrated on **Exhibit 4.5**. As shown, alternates such as N-1 and N-4 pass along these areas within the National Forest that have been impacted by previous surface mining activities. Given these factors, the U.S. Forest Service has noted that the KY 80 corridor alternate would likely have the least degree of impact to the forest, followed by N-2, N-1 and N-4.

Every alternate will impact the Forest and it will be necessary to implement guidelines and other prudent measures in order to comply with all of the potential impacts to National Forest land associated with various highway construction methods. This could include items such as clearing and grubbing, blasting, erosion control and waste disposal sites.

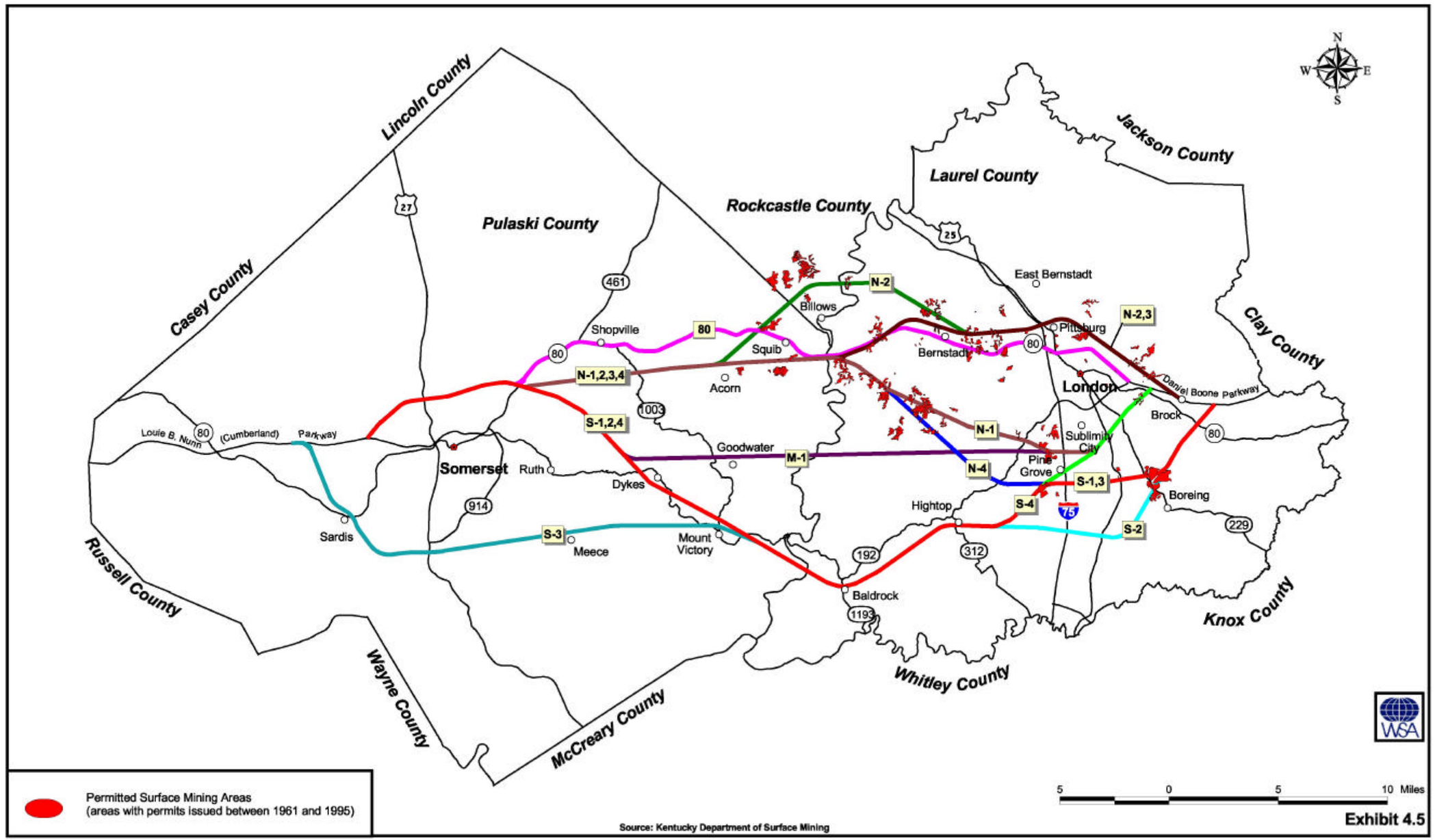
Forest service officials and citizens have also expressed a desire to seek opportunities to incorporate or enhance desired recreational activities through the accommodation of bike and pedestrian facilities as part of the highway construction process. While bicycle and pedestrian facilities are not permitted along the interstate highway right-of-way, bridges and other linkages to these types of facilities should be examined where practical.



Source: Kentucky Natural Resources and Environmental Projection Cabinet, Daniel Boone National Forest

Exhibit 4.4

National Forest Issues


Lincoln County
Casey County
Pulaski County
Rockcastle County
Laurel County
Jackson County
Clay County
Russell County
Wayne County
McCreary County
Whitley County
Knox County
N
W
E
S
27
461
80
914
25
1003
75
192
312
1193
229
Louie B. Nunn (Cumberland) Parkway
Somerset
Ruth
Dykes
Sardis
Meece
Mount Victory
Shopville
Billows
Squib
Acorn
Goodwater
Baldrock
Hightop
East Bernstadt
Bernstadt
Pittsburg
London
Sublimity City
Pine Grove
Brock
Boreing
Daniel Boone Parkway
N-1,2,3,4
N-2
N-2,3
N-1
M-1
N-4
S-1,2,4
S-1,3
S-2
S-3
S-4
Permitted Surface Mining Areas
(areas with permits issued between 1961 and 1995)
5 0 5 10 Miles
Source: Kentucky Department of Surface Mining
Exhibit 4.5
Permitted Surface Mining Areas

- *Geotechnical and Geologic Features*

  A review of the geology of the region indicates a diversity of formations and features that support a preference for certain corridor alternates and present design considerations for future project development activities. This review includes input and recommendations received from the Kentucky Geological Survey (KGS), with a copy of the KGS report provided in **Appendix E**. Input was also received from other geologic experts, who offered comments through the public involvement phase of study. The following discussion summarizes considerations related to the geotechnical and geologic features and issues of the area.

  General Topography and Geologic Structure - The eastern part of the study area is located along the western edge of the Eastern Kentucky coalfields, while the western part of the study area is located along the eastern edge of the Mississippi plateau. Topography in the area consists of ridges and valleys with the vertical relief varying from 100 to 450 feet above mean sea level. **Exhibit 4.6** provides a generalized relief map illustrating the topographic elevations throughout the area. The KGS noted that the overall geologic structure of the area dips gently to the southeast. High-dip zones are present within the area and may be associated with subsurface faults or fracture zones, requiring additional geotechnical studies to verify the presence of these features.

  Geologic Formations - The geologic formations within the area are generally composed of limestone, dolomite or shale with beds of coal, sandstone and conglomerates, as illustrated in **Exhibit 4.7**. The KGS reported several items of consideration relative to geologic formations of the area and future design considerations for alignment options within the corridors. Alignment adjustments should be provided to take advantage of sandstone ridges and to avoid multiple crossings of steep valleys and hollows adjacent to these ridges. Alignments should minimize crossing units of Grundy and Lee sandstone formations due to their resistance to cliff formers. Road cuts in the Paragon shale formations should be minimized in areas of steep slope or where there will be overlying ledges of hard sandstone.

  Karst and Cave Considerations - A specific concern involves limestone formations within the region, particularly within Pulaski County and the Somerset area. Valley bottoms within this area underlain by St. Louis, St. Genevieve or Kidder limestone formations are karstic and contain significant sinkhole and cave features that should be avoided in order to minimize environmental and construction difficulties. Throughout the public involvement process, several citizens with interest and expertise in cave and geologic issues offered comments and input to this issue. These citizens included members of the National Speleological Society (NSS), who expressed broad concerns relative to corridor impacts on karst and cave features of the area.

  An NSS representative submitted data to KYTC identifying digitized sink holes and known cave conduit areas within Pulaski County.[3] While it is noted that this data is not all inclusive and only represents known features, it is valuable in comparing the relative merits of the proposed corridor alternates. The NSS documentation appears to substantiate the KGS information that the north alternates would likely have the least adverse impact on the active karst/cave systems of the area. Significant concerns were expressed relative to the potential cave impacts of the south and middle alternates.

  Regardless of the corridor ultimately recommended for I-66, further design and environmental considerations will need to be provided related to the karst and cave impacts of project development. Structural impacts associated with crossing these features should be minimized through route alignments and mitigation measures. Drainage issues also need to be addressed, as karst and cave features and the associated biological communities within them are sensitive to changes in water flow and the introduction of groundwater contaminants. Addressing these issues will be an important part of subsequent investigations of design alternatives.

  Mineral Resources and Mining - Mineral resources of the region are confined mainly to coal, clay shale, sandstone and limestone. The KGS reports that coal beds in the Pikeville and Grundy formations are usually thin and of poor quality with minimal economic value and also with the potential for acid production in unmined beds. Springs are common at coal and shale contacts. Strip mines and underground mines exist throughout the study area. The KGS also notes that many of these mines are abandoned, as active coal mining in the area is insignificant; but abandoned underground mines could be present along the eastern end of the alignments passing north of London.

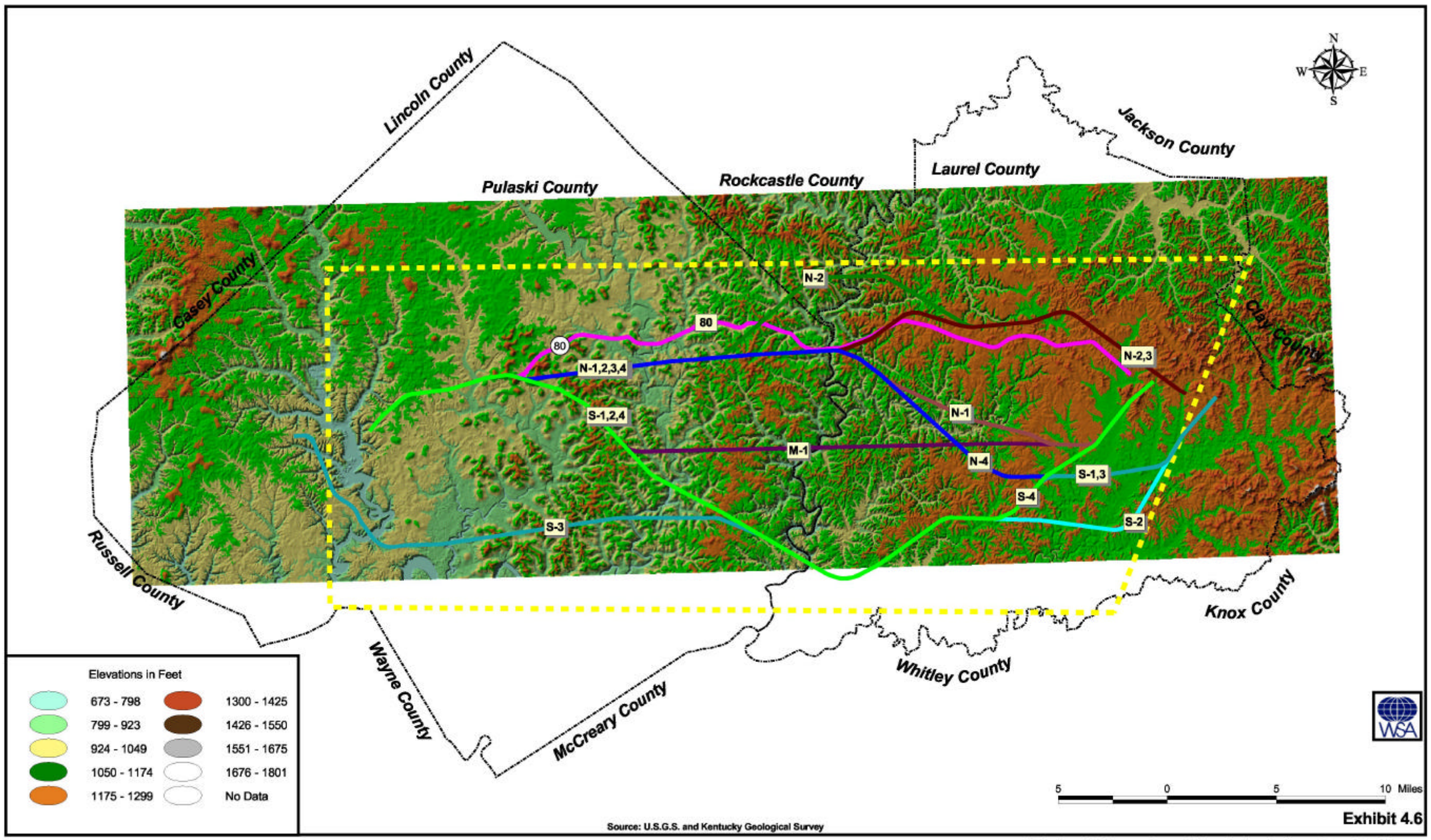
  Within the KGS analysis, no specific reference was made to advantages or disadvantages of any of the corridor alternatives. Among all of the alternates, the KGS analysis suggested that future adjustments could be made to alignments within each corridor to take advantage of positive geologic features, such as sandstone ridges and limestone areas less prone to karst formations, and to minimize undesirable geologic features, such as crossing different geologic units and problematic karst areas with sinkhole and cave features.

- *Cliff Lines*

  Documentation on the length and location of cliff lines through the Daniel Boone National Forest is available. Cliff lines are prevalent throughout the project area and dependent upon the terrain and geology, represent areas where rock overhangs or ridges form. In addition to their aesthetic qualities, cliff lines often provide shelter and habitation for various species of plant and animal life. Future design and development of highway alignments should be developed to minimize adverse aesthetic and structural impacts to cliff lines.

  Cliff line areas are predominantly located in the southern end of Laurel County between the Rockcastle River and Laurel River Lake. Additional concentrations are located on upper Sinking Creek in Laurel County and within the Cane Creek Wildlife Management Area. Within Pulaski County, cliff lines are located between Buck Creek and the Rockcastle River. Quantifying the length of cliff lines that fall within a generalized 500-foot buffer zone within each corridor alternate indicates the potential length of cliff lines that may be crossed by a highway developed within each corridor. The length of cliff lines estimated to be encompassed by each alternate corridor is summarized in **Table 4.13**. As represented by this summary, the middle and south alternates are anticipated to cross a far greater length of cliff lines within the region than are the KY 80 or north alternates.

[3] Florea, L.J., 2000, Karst Atlas of Pulaski County, I-66 Special Project of the National Speleological Society, GIS CD, Copyright pending, All Rights Reserved.



Digital Elevation Model of the Study Area

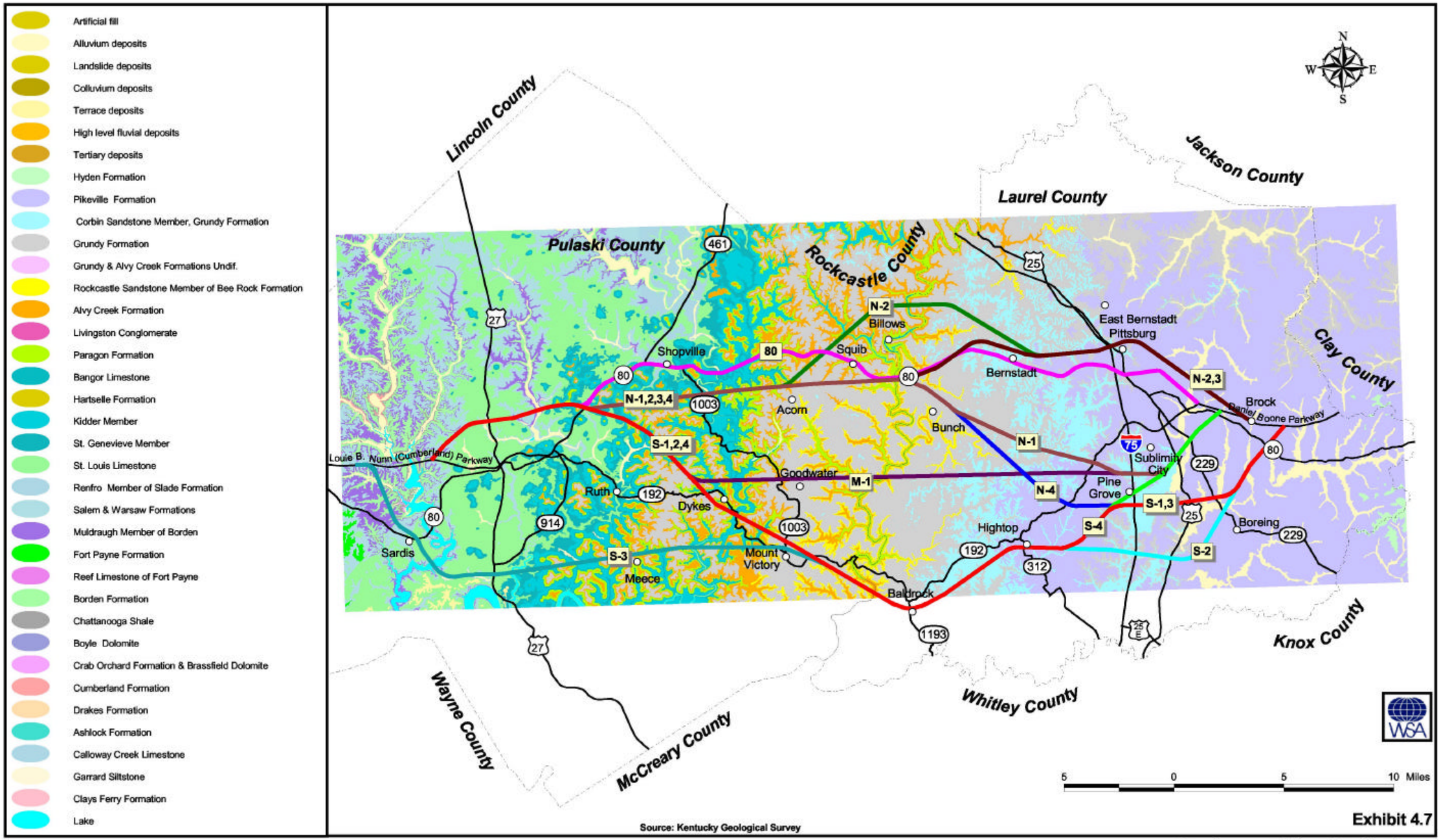


Exhibit 4.7

Geology of the Study Area

- *Lakes and Stream Crossings*

  All of the corridor alternates will involve potential issues related to water quality and other environmental considerations associated with impacts to rivers and streams throughout the study area. Construction activities and accidental spills or releases related to highway and related facilities pose areas of potential impacts to rivers and steams. Bridges, culverts and structural supports associated with water crossings may involve construction impacts, potentially alter water drainage patterns, and affect plant and animal species. As such, it is desirable that the potential alternatives for I-66 are situated in locations that would not adversely impact area lakes and rivers and minimize the required number of stream crossings. Water resources, including lakes, rivers and blue-line streams are illustrated in **Exhibit 4.8**.

  Several large lake and river systems are located with the study area, and these serve as recreational resources, offer plant and animal habitats, and provide sources for drinking water. Lake Cumberland and the Cumberland River are located south and west of Somerset and are crossed or near to the S-3 corridor. The Laurel River and Laurel River Lake are located in southern Laurel County and fall within the Daniel Boone National Forest. All of the south corridors fall in close proximity to this lake, and citizens and Forest Service officials have indicated concerns over adverse impacts to this feature. Wood Creek Lake also lies within the Daniel Boone National Forest and is situated in Laurel County north of London. The N-2, N-3 and KY 80 corridors fall within proximity to this lake. Citizens have expressed concerns related to corridor locations in proximity to this lake. The Rockcastle River is a state-designated Wild River and bisects the study area from north to south. Further discussion of alternative impacts to this water resource is provided in the *Wild River Systems* section of this report.

  Blue-line stream crossings are located throughout the study area with the greatest concentration in the southern areas of Pulaski and Laurel counties. These streams feed the vast waterway system within the study area. As shown in **Table 4.14**, the south corridors contain the greatest number of streams, ranging from 57 to 69 stream crossings. The north alternates, KY 80 and the M-1 corridor contain a fewer number of blue-line streams, ranging between 41 and 53 stream crossings.

- *Wetland Sites*

  For the scope of this project, the type and size of waters and wetlands within the project area were identified to provide information needed to evaluate the potential impacts of I-66 corridor alternates. A Geographic Information System (GIS) database of the National Wetlands Inventory (NWI) for Pulaski and Laurel Counties was used to account for designated areas within the corridor alternates, including both “shallow” and “deepwater” wetlands sites.

  The GIS database indicates the greatest concentration of wetland sites along the S-3 corridor with 220 acres, double the size of any other alternate. KY 80 and the M-1 corridor have potential impacts to the least number of acres, with 50 and 70 acres, respectively. As seen in Table 4.14, the remaining alternate alignments range between 87 and 110 acres impacted. Wetland sites in the study area are illustrated on **Exhibit 4.9**. If the wetlands identified are indeed affected, alternative alignments within a corridor will have to be examined to avoid these wetlands. If avoidance is not possible, there must be identification of practical measures to minimize harm to waters and wetlands.

- *Wild River Systems*

  The Rockcastle River, the boundary line for Pulaski and Laurel counties, is one of nine rivers in Kentucky that is included in the state’s Wild River system. Part of the Wild Rivers Act of 1972, the Wild River system recognizes those rivers that retain many of their natural attributes and protects them from unwise use and development. This designation applies to the Rockcastle River, from just north of the KY 192 bridge, near Bee Rock Campground, to the Old KY 80 bridge at Billows. The total length between Bee Rock and Billows is 15.9 miles. Approximately 3,550 acres of land are included within the lateral boundaries of this corridor, and the entire Wild River stream segment is within the proclamation boundary of the Daniel Boone National Forest.

  Of the corridor alternates studied, the KY 80, N-1, N-3, N-4 and M-1 corridors intersect the Rockcastle River within the designated Wild River area, shown in Exhibit 4.4. Investigation of the Kentucky Wild River statutes (KRS 146) indicates that relocation of the KY 80 corridor from Billows to its current location was not prohibited, and that an additional bridge at this new location would be allowed. However, there are continuing considerations that should include items such as buffer zones, erosion control, view sheds, and potential enhancement projects, which may accompany any bridge improvements at this important location.

Table 4.13 Cliff Lines Locations

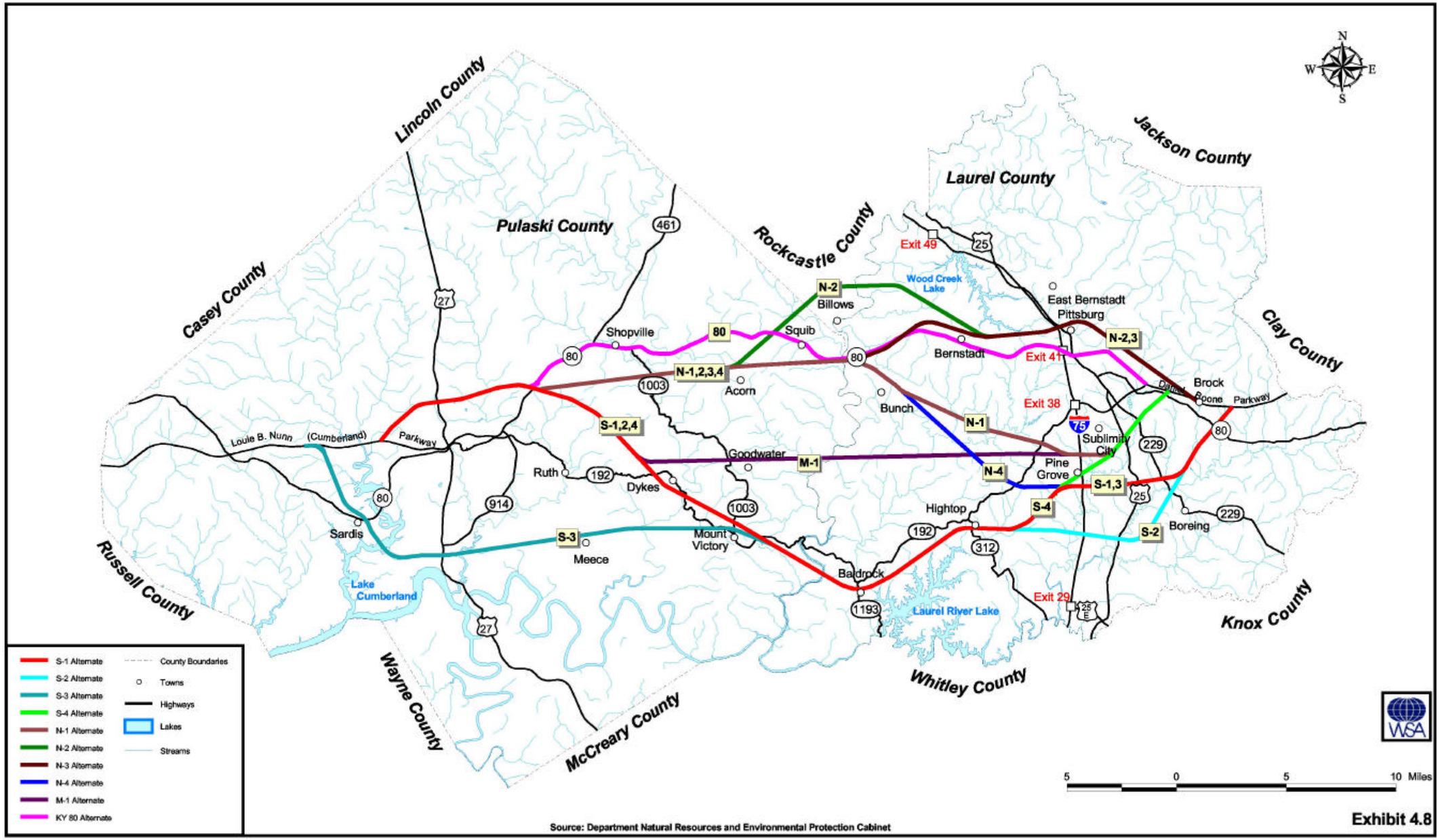
Alternate	Length of Cliff Lines (feet) (within a 500-foot corridor)
KY 80	7,500
N-1	11,800
N-2	10,200
N-3	8,800
N-4	9,000
M-1	25,000
S-1	25,200
S-2	25,200
S-3	28,200
S-4	25,200

Source: Local Cave Society, Daniel Boone National Forest

Table 4.14 Water Resources (within a 2,000-foot corridor)

Alternate	Number of Stream Crossings	Wetland Areas (acres)
KY 80	43	50
N-1	41	101
N-2	52	87
N-3	48	93
N-4	53	90
M-1	51	70
S-1	63	110
S-2	58	110
S-3	69	220
S-4	57	90

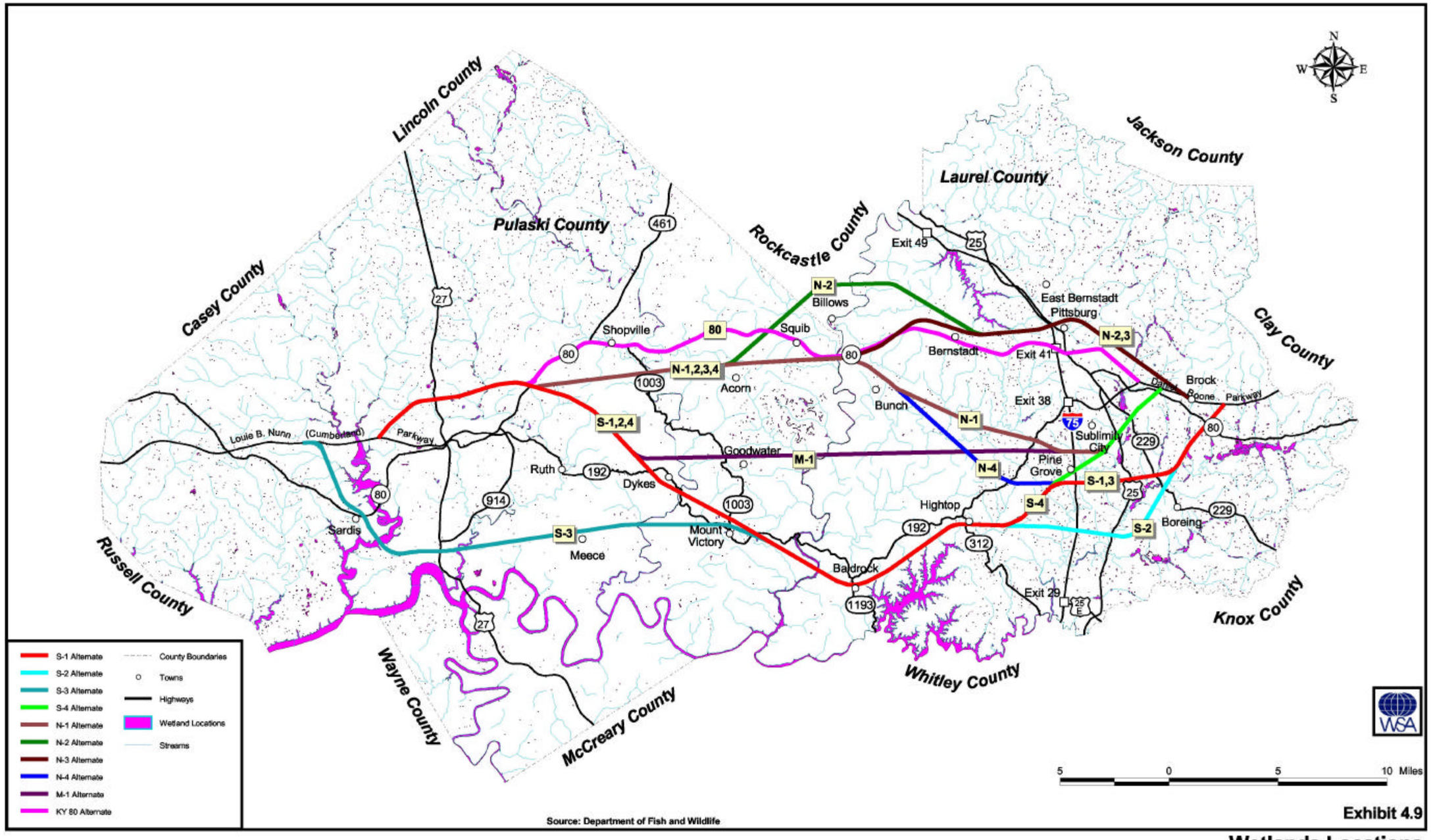
Source: Department of Natural Resources, Kentucky Department of Fish and Wildlife



Source: Department Natural Resources and Environmental Protection Cabinet

Exhibit 4.8

Blue-Line Stream Crossings



Source: Department of Fish and Wildlife

Exhibit 4.9

Wetlands Locations

4. Other Issues

Other issues of concern for the analysis of study corridor alternates include oil and gas well sites and hazardous site locations, as well as noise and air quality issues.

- *Oil and Gas Wells*

  Oil and gas well locations are prevalent throughout both counties. Most of these wells can probably be avoided with alignment modifications in the future design process and further environmental documents should outline any possible mitigation for these locations. The number of known well locations within a 2,000-foot corridor is shown for each corridor alternate in **Table 4.15.** As shown, the S-3 corridor contains the least number of known occurrences, with 3 oil and gas wells. The KY 80 and M-1 corridors have the potential to impact the greatest number of wells, with 28 and 24 known locations, respectively. Countywide oil and gas well locations are illustrated in **Exhibit 4.10**

Table 4.15 Wells and Hazardous Sites (within a 2,000-foot corridor)

Alternate	Oil and Gas Wells	EPA and UST Sites
KY 80	28	17
N-1	20	5
N-2	19	0
N-3	20	0
N-4	23	0
M-1	24	4
S-1	19	0
S-2	20	0
S-3	3	0
S-4	19	4

Source: Kentucky Geological Survey, U.S. Environmental Protection Agency

- *Hazardous Sites*

  Hazardous waste sites and landfills are known to exist within the two-county area. The Laurel Ridge landfill is located near Lily in Laurel County, approximately one (1) mile northwest of Lily and just east of I-75. There are no Superfund sites within either county; however, there are three (3) Superfund NFA (No Further Action) sites in Pulaski County and four (4) of these sites in Laurel County. Underground storage tanks (USTs) are more likely within the urban sections of Somerset and London, where existing and abandoned gas stations and storage facilities are more prevalent. Future alignment modifications and design options should probably avoid this hazard altogether.

  The number of known Environmental Protection Agency (EPA) monitored sites and UST sites within a 2,000-foot zone is shown for each corridor alternate in Table 4.15. As shown in the table, the KY 80 corridor contains the greatest number of known hazardous sites, more than the other alternates combined. Countywide EPA and UST locations are illustrated in Exhibit 4.12.

- *Air and Noise Quality*

  Air and noise quality concerns routinely exist for most types of highway improvements. For the I-66 corridor alternates, air and noise quality issues are of particular concern relative to where alternates fall in close proximity to sensitive land uses, such as population centers, natural areas, recreational facilities, and cultural sites. Sensitive areas exist within the vicinity of all the alternate corridors and future examination of alignment alternatives will require more detailed, site-specific analyses.

  For air quality, both Pulaski and Laurel Counties are designated as in attainment for all transportation-related pollutants (i.e., carbon monoxide, hydrocarbons, oxides of nitrogen and inhalable particulates). In future studies of alignment alternatives, receptors should be modeled at sensitive locations that could have potential air quality impacts, such as schools, churches, parks, recreation areas, historic buildings, subdivisions, motels, and intersections or interchanges.

  Projected traffic volumes for the Year 2030 along existing routes in the study area range from 2,200 vpd along KY 192 to 86,000 vpd on US 27 near KY 80. For the I-66 corridor alternates, maximum future traffic volumes are expected to reach 27,000 vpd along the KY 80 alternate near I-75. These traffic volumes are not expected to cause carbon monoxide concentrations to exceed the one-hour standard of 35 parts per million (ppm) or the eight-hour standard of 9 ppm. Future levels of transportation-related pollutants are not expected to impact the attainment status of either Pulaski or Laurel counties.

  From a population standpoint, the middle alternate is believed to offer the greatest potential of minimizing direct noise and air quality impacts on concentrations of people or other sensitive sites. However, the M-1 alternate does raise concerns related to air and noise impacts on a large amount of undisturbed forest area. As an existing highway corridor, the KY 80 alternate would produce incremental impacts related to air and noise, but this corridor has the highest direct concentration of people and sites potentially impacted. All of the south alternates and several of the north alternates are in close proximity to lake areas that would be impacted by the increased noise levels.

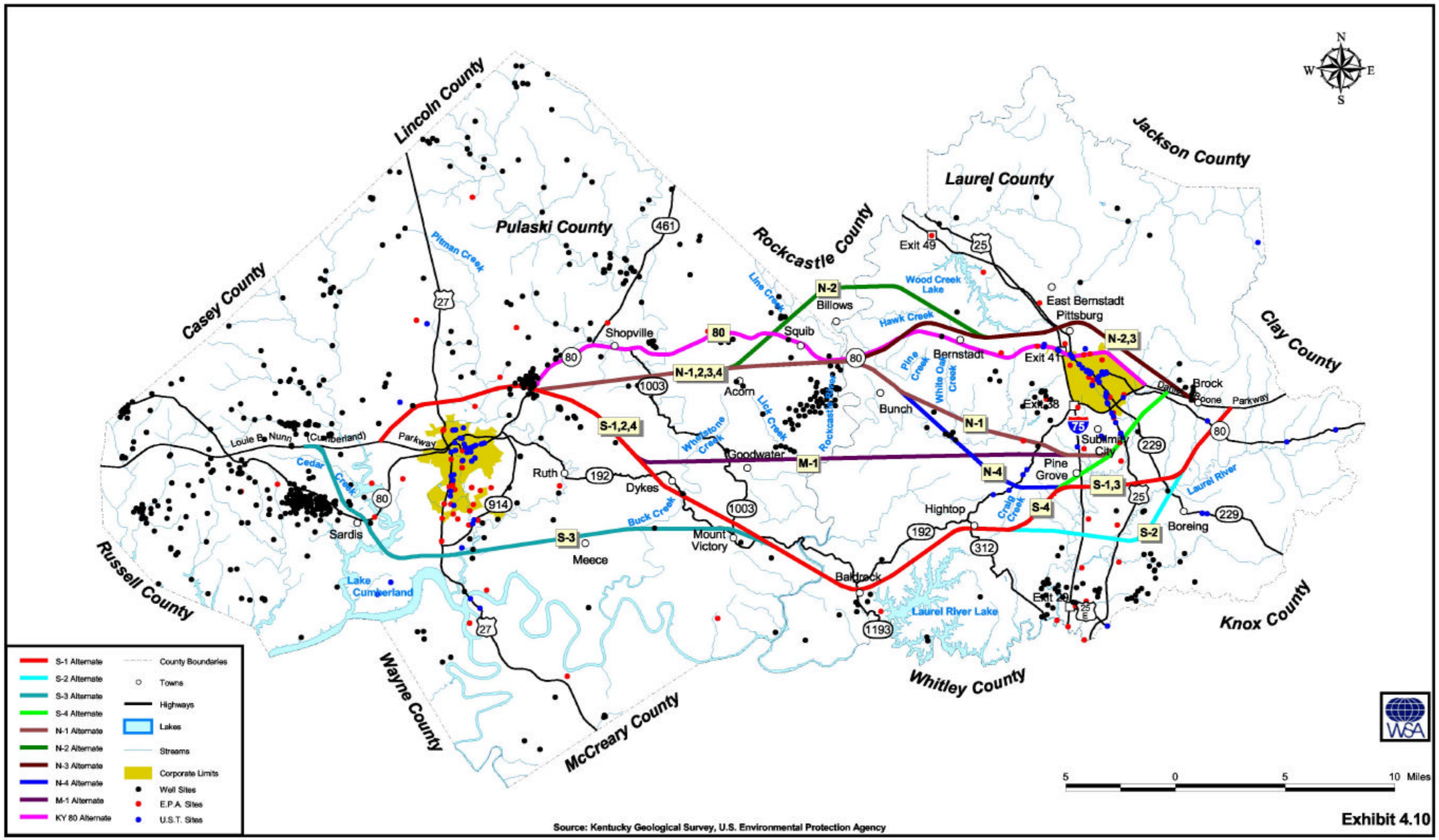
5. Summary of Environmental Issues

Environmental implications can be anticipated with highway development within any of the alternate corridors. More detailed assessments will be required on future alignment alternatives. A summary of findings related to environmental issues and the proposed corridor alternates are as follows:

- *KY 80 Alternate*

  Because it seeks to reconstruct and widen an existing highway corridor, the KY 80 alternate is expected to have the least impacts to natural areas than any of the other options. Typical for a developed corridor, the KY 80 alternate is expected to have greater impacts to cultural sites, archeological sites and developed land uses. A summary of the key findings related to this alternate include:

  - The least impacts to the natural environment and wildlife; but,
  - Greater potential impacts to cultural sites and sensitive land uses.



Source: Kentucky Geological Survey, U.S. Environmental Protection Agency

Exhibit 4.10

Well and Hazardous Sites

- *North Alternates*

  The north alternates are expected to result in fewer impacts to natural areas, threatened/endangered species and historic structures than any of the alternates that require the development of new highway corridors. All of the north alternates either avoid the Wild River area of the Rockcastle River or cross at the existing KY 80 bridge. The N-2 and N-3 alternates present concerns due to their close proximity to Wood Creek Lake. As for cultural sites, mixed impacts are seen with the north alternates, with generally higher than average impacts to potential archeological sites. A summary of the key findings related to these alternates include:

  - The least impacts to natural areas and wildlife among new corridor alternates;
  - Fewer impacts to caves;
  - Potential impacts to Wood Creek Lake by the N-2 and N-3 alternates; and,
  - Mixed impacts to cultural sites for all alternates.

- *Middle Alternate*

  This corridor provides the least anticipated impact to known cultural and social land uses but may have some of the highest impacts to forested and sensitive areas among all of the corridor alternates. In particular, this corridor would pass through the largest portion of National Forest property and would create a new crossing of the Wild River portion of the Rockcastle River. This issue alone could make the middle alternate environmentally prohibitive. A summary of the key findings related to this alternate include:

  - Lesser impacts to cultural and social land uses;
  - Greater impacts to caves and karst features;
  - Greater impacts to National Forest areas; and,
  - Potentially environmentally prohibitive crossing of the Rockcastle River.

- *South Alternates*

  The south alternates are anticipated to create lesser impacts to archaeological sites and historic structures but show potential for the highest impacts to natural areas, threatened/endangered species, and area lakes. All of the alternates pass in close proximity to Laurel River Lake and the S-3 alternate also creates a new crossing of Lake Cumberland. These alternates fall in close proximity to the Cane Creek Wildlife Management Area and pass through some sensitive and pristine areas of the National Forest. A summary of the key findings related to these alternates include:

  - Lesser potential impacts to archaeological sites and historic structures;
  - Greater impacts to caves and karst features;
  - Greater impacts to natural areas and threatened/endangered species;
  - Greater impacts to more pristine areas of the National Forest; and,
  - Potential concerns related to close proximity to Cane Creek Wildlife Management Area and Laurel River Lake.

C. ENGINEERING AND CONSTRUCTION COSTS

The initial step in the evaluation of engineering and cost impacts was to develop preliminary layouts of a generalized interstate highway within each alternate corridor based upon assumed typical sections (see **Appendix F**). Geometrics for the I-66 route are based on interstate-type highway design standards for a 4-lane facility. All geometric criteria used in the preparation of this project is in accordance with the American Association of State Highway and Transportation Officials (AASHTO) "Green Book", *A Policy on Geometric Design of Highways and Streets. 1990*; AASHTO's *Roadside Design Guide*, 1989; and AASHTO's *A Policy on Design Standards – Interstate System, July 1991*. Standard geometric criteria utilized for cost estimation comparisons for the proposed improvements include:

- 70 mph design speed;
- Moderate horizontal and vertical curvature;
- Access available at interchanges only; and,
- Four lanes, twelve-feet wide each.

However, due to the sensitive nature of the study area, it may be possible to utilize flexible design standards in future phases of the I-66 project to facilitate environmental concerns while maintaining safety.

Access will be provided only at designated interchange locations. Interchange locations will be determined using several factors, including traffic volumes within the network, existing or potential area development, spacing limitations and public needs. The preferred minimum spacing for interchanges is one mile in urban areas and three miles in rural areas. Horizontal curvature is limited to a 1,910-foot minimum radius. Vertical grade is proposed to be within a range of plus or minus 4 percent. Approximately 125 to 500-foot wide right-of-way is expected depending on the area terrain.

Rural and urban typical sections are considered for the interstate-type design of the I-66 corridor. It is anticipated that two basic sections would be utilized for the purpose of cost estimation. A four-lane depressed median section, consisting of 12-foot lanes with a 60-foot median, is considered for rural sections. For the urban sections, a four-lane, flush median section with a barrier wall consisting of 12-foot lanes is utilized. An example of such a section is provided in **Exhibit 4.11**.

Future phases of the I-66 corridor project may involve further geometric criteria and issues, at which point it would be appropriate to begin consideration of potential flexible design components. The purpose of flexible design methods is to aid designers in the design and construction of a roadway while preserving or enhancing scenic, historic, environmental and community resources in the vicinity of the project. In recent years, flexible highway design methods have been encouraged through federal legislation (ISTEA and TEA-21), as well as research and publications, such as the Federal Highway Administration's *Flexibility in Highway Design* guidebook[4]. The guidebook works as a supplement to AASHTO's Green Book, showing readers how to expand on traditional design methods while maintaining the safety and mobility of the roadway.

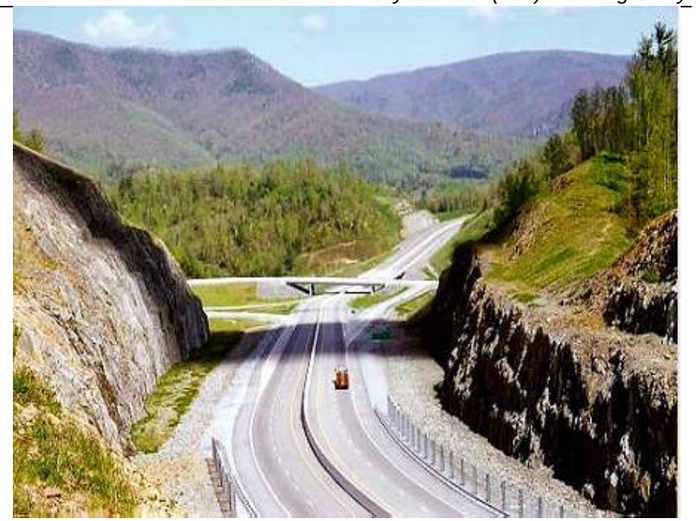


Exhibit 4.11 Divided Highway Section

Potential engineering and construction issues, along with overall costs for each alternate are evaluated based upon these standard criteria. The following sections detail the engineering and construction considerations and cost estimate components considered for each alternate.

1. Engineering Challenges

A wide range of engineering challenges exist within the study area and along each of the alternate corridors related to both new highway construction or reconstruction of existing highway facilities to provide an interstate highway. The following summary highlights some of the general study area challenges associated with both new corridor construction and reconstruction of existing highway facilities such as KY 80.

- *General Study Area Engineering Challenges*
  - Topography
  - Cave and Karst Issues
  - Access Points and Interchange Challenges
  - I-66/I-75 Interchange Location
  - Right-of-way Acquisition
  - Natural/Sensitive Areas
  - Water Crossings
  - Threatened/Endangered Species

North alternates N-2 and N-3 that pass north of London would present particular challenges with respect to the construction of the proposed interchange between I-66 and I-75, illustrated in **Exhibit 4.12**. As shown, a number of bridge sections would be required to not only cross I-75, but to also cross the CSX railroad and US 25. Because of the close proximity of US 25 to this interchange, a separate, direct interchange with US 25 could not be provided. Engineering challenges also exist for the I-66/I-75 interchange location associated with the alternate corridors passing south of London. Airspace restrictions associated with the London-Corbin Airport's runway approach and spacing requirements associated with the new I-75 weigh stations are two particular challenges for interchanges in this area.

[4] *Flexibility in Highway Design*, Federal Highway Administration, Publication # FHWA-PD-97-0062.

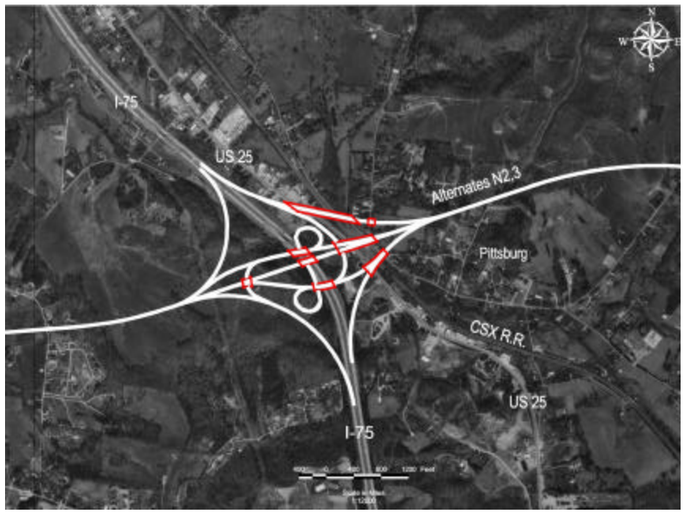


Exhibit 4.12 I-66/I-75 Interchange for N-2 and N-3

Engineering and construction issues associated with reconstruction to upgrade an existing highway to interstate standards would be facilitated in many sections with available right-of-way and highway sections that could be efficiently upgraded. However, many other sections present serious engineering challenges, as identified below:

- *Highway Reconstruction Challenges (KY 80)*
  - Approximately 100 existing access points along KY 80 could be altered or eliminated;
  - Numerous (1800) property parcels could be affected:
    - 540 in Pulaski County, and
    - 1260 in Laurel County;
  - Difficulty with interchange reconstruction of Exit 41 to accommodate new interchange between I-66 and I-75;
  - Many sections would require major reconstruction efforts to moderate grades and curves if geometric criteria are to be achieved:
    - Vertical grade changes from ± 4 % to ± 6 %, and
    - Horizontal curve changes from 3° to 4° (near Shopville and Squib); and,
  - Maintenance of traffic during reconstruction activities will be complicated and costly.

Exhibits 4.13 and **4.14** are provided to illustrate some of the challenges associated with reconstructing KY 80. The existing properties and roadways in the vicinity of the KY 80 interchange with I-75 (Exit 41) are illustrated in Exhibit 4.13. If KY 80 were reconstructed as I-66, this interchange would be completely reconstructed to only permit direct access between the two interstate facilities. Access to all of the properties in the area would either be eliminated or severely affected and some properties would have to be acquired. Exhibit 4.14 illustrates how frontage roads and additional interchanges would be required in the vicinity of KY 1675 and an existing rock quarry in Pulaski County to accommodate access to roadways and property in this area.

Exhibit 4.13. Existing KY 80 and I-75 Interchange (Exit 41)

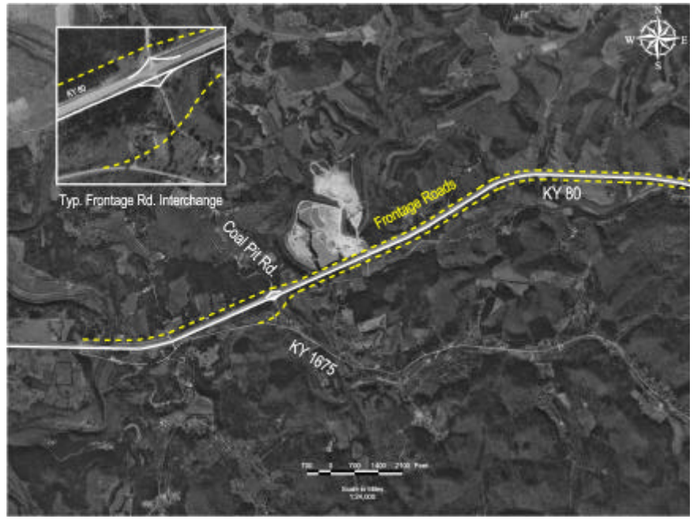


Exhibit 4.14. Potential Frontage Roads and Interchange along KY 80

2. Cost Estimates

Costs for each alternate were evaluated using basic unit cost estimates formulated by the Kentucky Transportation Center as part of the 1997 Economic Feasibility Study of the I-66 corridor. Cost components for design, right-of-way, utilities, bridges, interchanges and construction were calculated based upon the cost factors outlined in the report. The report's 1995 unit costs were increased by 10 percent to account for inflation, and to more closely match Year 2000 dollars.

For KY 80, alternate cost estimates were based upon two generalized options. The first option involves the acquisition of approximately 1800 parcels on property along the entire route. This additional property is required since current access to the proposed interstate will be either eliminated or severely restricted. Property Valuation Administration (PVA) maps were used to estimate the number of affected parcels. It should be noted that some of these parcels would be located near an interchange and would not require purchase. An estimated cost per parcel of $155,000 was given by the KYTC's Division of Right-of-Way. Costs for various businesses, especially near Exit 41 at London, would only include the property value. The second KY 80 option would use frontage roads to minimize property purchases. Frontage roads would provide parallel access routes along the interstate corridor where needed. These roads would terminate at each interchange location. An estimate of approximately 52.2 miles was used to arrive at this cost ($7.5 million per mile).

For the remaining nine alternates, cost estimates were calculated based on the previously noted design criteria. Illustrated in **Exhibit 4.15** is a generalized comparison of the proportion of overall construction costs that are represented by each cost component for each alternate. Estimated costs by component for the study corridors are presented in **Table 4.16** and discussed for each of the prescribed cost components. The discussion also provides additional information regarding the assumptions and methods used to estimate costs for each of these factors.

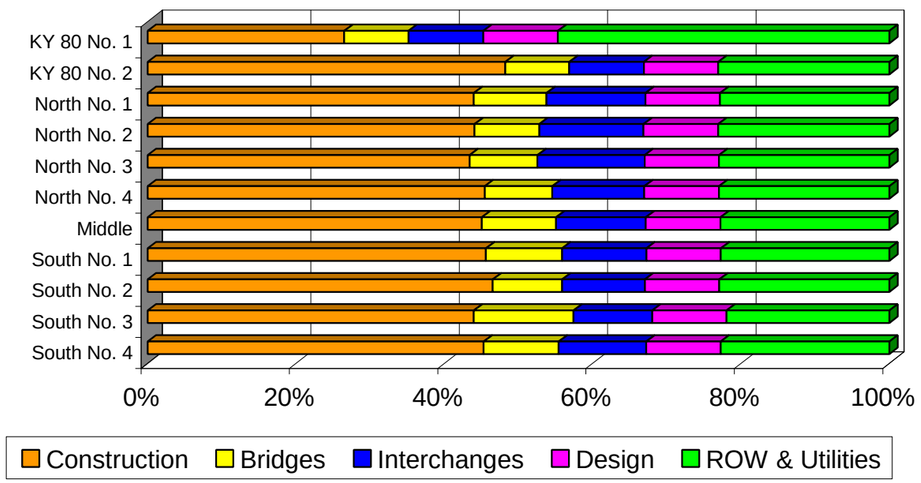


Exhibit 4.15. Estimated Construction Cost Components

Table 4.16 Cost Estimates

Alternate	Length (miles)	Cost Items (million $) [1]					Total Cost (million $) [1]	
		Const-ruction	Bridges[2]	Inter-changes[5]	Design	Right-of-Way and Utilities	Project	Per Mile
KY 80[3]	38.4	308.1	103.0	121.4	116.8	519.1	1,168.4	30.5
KY 80[4]	38.4	564.0	103.0	121.4	117.6	269.7	1,175.7	30.7
N-1	39.0	387.5	88.4	121.4	88.7	200.9	886.9	22.7
N-2	41.5	412.2	84.0	136.4	94.3	215.9	942.8	22.7
N-3	40.1	398.5	84.0	136.4	92.2	210.7	921.8	23.0
N-4	43.2	429.7	86.2	121.4	95.0	217.1	949.4	22.0
M-1	39.1	388.4	88.4	108.2	86.8	196.2	868.0	22.2
S-1	45.6	443.9	99.4	114.8	97.6	220.7	976.4	21.4
S-2	46.5	461.9	92.8	114.8	99.6	227.3	996.4	21.4
S-3	48.9	486.3	148.5	121.4	110.0	242.5	1,109.7	22.7
S-4	42.9	426.2	95.0	114.8	94.4	213.6	944.0	22.0

[1] Items have been rounded.
[2] Includes overpasses and railroad structures.
[3] Includes purchase of 1800 parcels @ $155,000 each and no frontage roads.
[4] Includes approximately 52.2 miles of frontage roads.
[5] Includes one rest area per alternate.

- *Construction*

  Digital terrain modeling (DTM) for each corridor, using digital USGS 7.5 minute quadrangle sheets and terrain modeling software, determined profile grades and excavation quantities. Use of this method allowed assessment of the alternate corridors for excavation quantities and estimated costs. Furthermore, profile grades were evaluated for balances of material throughout the corridor. An objective of the process is to minimize the amount of waste or borrow material that would be necessary to complete the project.

  Earthwork quantities and costs for each alternate corridor alignment were derived from the digital terrain model using a cost of $4.00 per cubic yard. Next, the square yards of pavement were determined for each alternate. A unit price of $45 per square yard was used based on historical data from previous KYTC projects within the region. This region is comprised of District 8 in Somerset and District 11 in Manchester.

  It was assumed that the summation of the earthwork and pavement were approximately 70 percent of the total highway construction cost of the project. Again, this is based on assessment of past data and trends from construction projects throughout the region.

  The estimated construction costs include earthwork, pavement, structures, traffic control, and contingencies. Generally, projects of longer length and greater complexity tend to have

increased costs associated with changes in equipment, labor and materials. Estimated construction costs for the corridor alternates range between $308.1 million and $564.0 million, both for KY 80. The first and lower value represents the construction costs if no frontage roads were built while the latter figure represents the cost to construct the interstate and necessary frontage roads. Outside of the KY 80 alternatives, N-1 and M-1 would be the least costly to construct. S-2 and S-3 would be the most expensive to build.

- *Bridges*

  Structures over "major" stream crossings (i.e., over 600 feet in length) were estimated at $150 per square foot. Structures over "average" stream crossings (i.e., under 600 feet in length) were estimated at $100 per square foot.

  Bridge cost estimates take into consideration interstate bridges, overpasses, and railroad structures. The S-3 alternate is the only alternate to go south of Somerset. Because of this route selection, Lake Cumberland and other collector rivers and creeks would need to be crossed, creating higher costs for this alternate estimated at $148.5 million. In general, there are more water crossings for the south routes than the north and middle alternates. As a result, the least expensive alternates would be N-2 and N-3, the two most northern routes, incurring bridge costs of $84.0 million each.

- *Interchanges*

  Interchanges were located at critical crossroad and route termination points, as illustrated in **Exhibit 4.16**. For cost estimation purposes, interchanges were classified as either "major" or "minor" types. Major interchanges are ones that connect major highways such as I-75 and the Louie B. Nunn (Cumberland) and Daniel Boone Parkways. These interchanges are likely to involve a *directional*, *cloverleaf* or *trumpet-type* design. Costs are estimated at $13.2 million each, except at I-75 where the estimated cost is $25 million. Minor interchanges are required at all of the remaining crossings over average routes. Interchanges of this type include a *diamond-type* design, estimated at $6.6 million each.

  Other minor roadways would have to pass over or under the I-66 corridor since I-66 is designed to be a fully-controlled access facility. These overpasses were estimated at $2.2 million for each structure. Also, it is assumed that the I-66 corridor will bridge existing railroad systems with structures estimated at $2.2 million each or $4.4 million for two structures.

  Criteria for this evaluation are based on the number of interchanges and overpasses present on each alternate corridor. Most of the alternates have approximately the same number of interchanges or access points. The M-1 corridor is planned for eight interchanges similar to other routes but would incur the least cost because it would interchange with fewer major facilities. The associated interchange cost totals $108.2 million. N-2 and N-3 would incur the greatest expense ($136.4 million). These two alternates incur the largest cost because of the difficulty in connecting with I-75 at such a congested area. The estimated cost for the I-75 interchange would be $40 million instead of the $25 million for the other alternate corridors.

- *Design*

  As discussed previously, the design cost is calculated as a percentage (10%) of the total project costs. The cost for design should range between $86.8 million and $117.6 million. The least expensive alternate would be M-1 while the most costly would be the two KY 80 alternates.

- *Right-of-Way and Utilities*

  Utilities within the region include gas lines, overhead power lines, overhead telephone and cable television lines, underground fiber optic lines and water lines. Because the corridors pass through urban areas as well as rural areas, right-of-way and utility relocation will be higher due to greater population densities and increased development.

  Right-of-way and utility cost items were evaluated using the potential amount of utility relocation, based upon the proposed construction of each alternate and how that alternate would impact the surrounding developed and undeveloped land areas. The respective costs associated with adjustment, relocation or removal of existing utilities or the costs incurred with the potential construction of new utilities to maintain the level of service currently in place were considered. All of the alternates are located within zones of high development throughout the urbanized portions of Somerset and London. Relocations will include high-transmission power lines, water lines, gas lines and telephone lines.

  The KY 80 alternative without frontage roads has cost estimates that double all other alternatives except the KY 80 alternate with frontage roads. The cost for the KY 80 alternative without frontage roads would be $519.1 million, while the KY 80 alternate with frontage roads would cost $269.7 million. The remaining alternatives have cost estimates ranging between $196.2 million and $242.5 million with the M-1 being the least expensive.

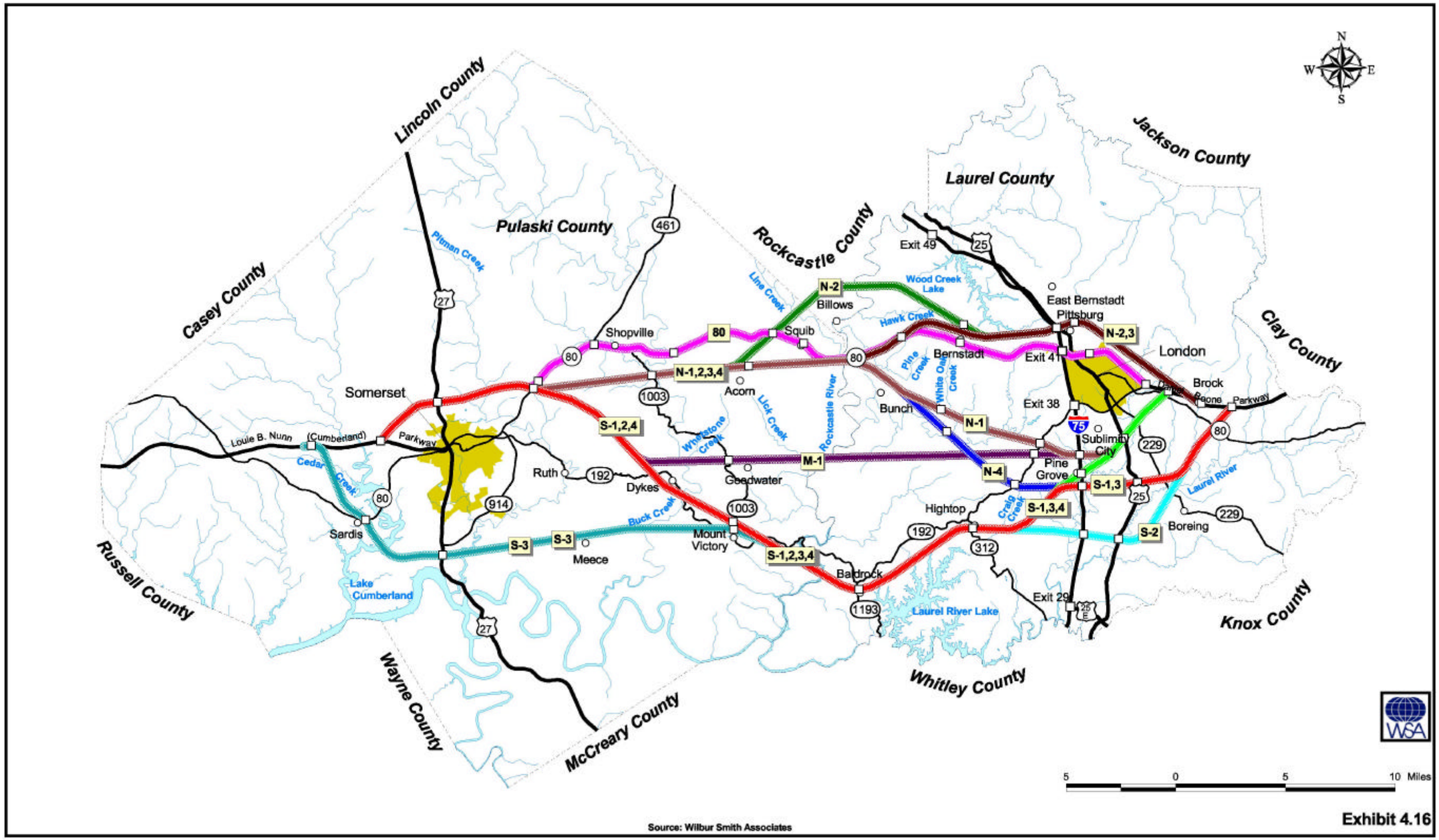
- *Total Project Costs*

  The total costs for the project combined the costs for construction, bridges, interchanges, design, right-of-way and utility relocation. The KY 80 alternatives would incur the largest total project costs at $1,168.4 million without frontage roads and $1,175.7 million with frontage roads. The only other alternate estimated to cost more than a billion dollars would be S-3 at $1,109.7 million. The least costly alternate would be M-1 at a total project cost of $868.0 million.

- *Project Costs Per Mile*

  Although the alternate lengths vary by as much as 10 miles, the total cost per mile figures are close to one another with the exception of the KY 80 alternates. The total cost per mile for KY 80 would be about $30.6 million while the other alternates range between $21.4 and $23.0 million.

These cost estimates are planning-level estimates and are based upon USGS topographic maps. As detailed mapping is developed, both the cost estimates and the corridors will be refined. Modifications that affect the typical highway cross-section or the number of interchanges, bridges or overpasses could increase or decrease the total cost of the project.



Source: Wilbur Smith Associates

Exhibit 4.16

Potential Interchange Locations

3. Summary of Engineering and Construction Costs

The following discussion summarizes the findings related to engineering challenges and construction costs for each of the corridor alternates.

- *KY 80 Alternative*

  The KY 80 Alternate is estimated to have the most expensive overall costs and per-mile costs of all the alternates. While a number of sections along KY 80 could be efficiently widened and reconstructed, other sections would prove very difficult. Options with and without frontage roads were considered for the KY 80 alternate, and although varying significantly within categories, the total project costs for the two KY 80 options are very close, with the alternate utilizing frontage roads being slightly higher. Access to local areas may be reduced depending on which KY 80 option is considered. A summary of findings associated with the KY 80 alternate include the following:

  - Most expensive overall costs;
  - Most expensive per-mile costs;
  - Numerous property impacts, particularly with I-66/I-75 interchange; and,
  - Options with and without frontage roads are comparable relative to total costs.

- *North Alternates*

  The north alternates generally provide lower overall and per-mile costs; however, alternates N-2 and N-3, which pass north of London, entail the highest interchange costs because of the I-66/I-75 interchange north of London. A summary of findings associated with the north alternatives include the following:

  - Lower overall and per-mile costs; and,
  - Highest interchange costs and construction difficulty for N-2 and N-3.

- *Middle Alternate*

  Of the alternates considered, the middle alternate offered the least expensive overall costs. This alternate provided the shortest and most direct routing and had a limited number of interchanges, due to the lack of crossroads between Somerset and London. Construction segmentation may be difficult with this option because of the lack of crossroads in the area that could carry traffic as the highway is partially constructed. A summary of findings associated with the middle alternate include the following:

  - Least expensive overall costs;
  - Lowest number of interchanges; and,
  - Shortest length.

- *South Alternates*

  The south alternates generally provide higher overall costs due to the length of their construction. However, these alternates provide the least expensive per-mile cost with the exception of S-3, which requires additional bridge construction at Lake Cumberland and additional right-of-way costs in the vicinity of Somerset. A summary of findings associated with the south alternates include the following:

  - More expensive overall costs;
  - Longer construction lengths; and,
  - Least expensive per-mile costs, except for S-3.