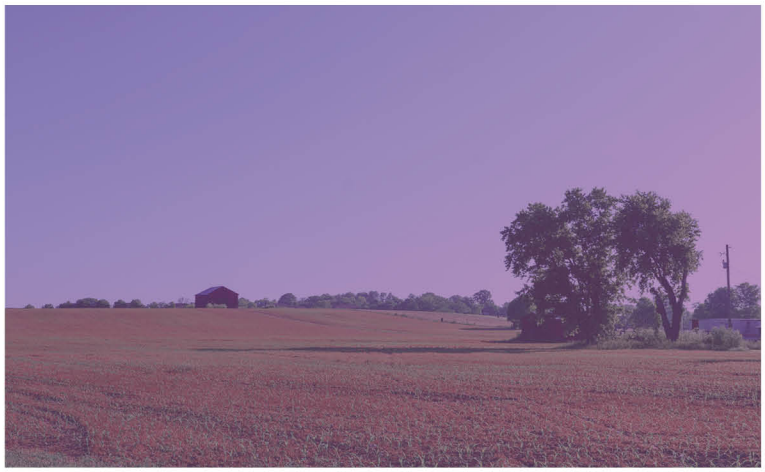
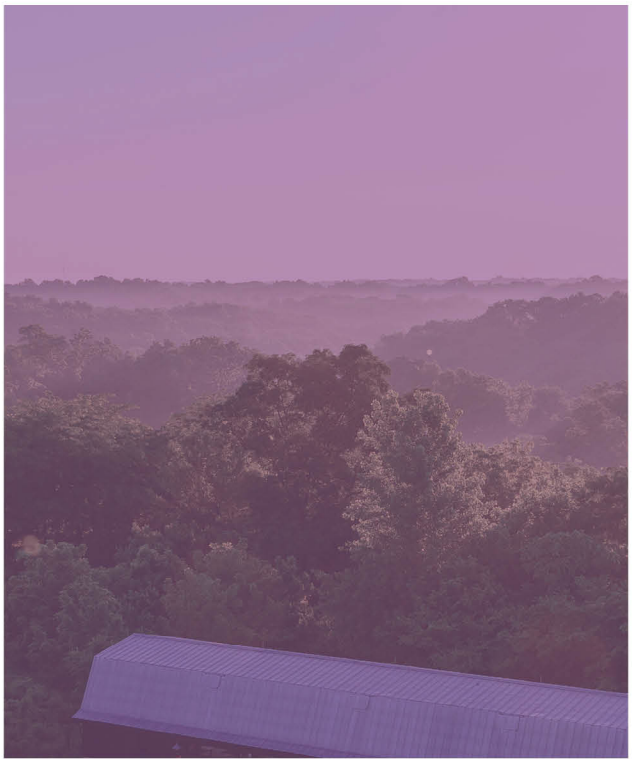
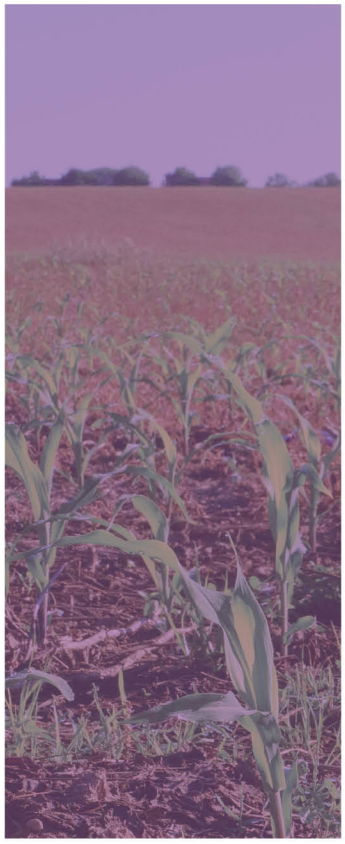
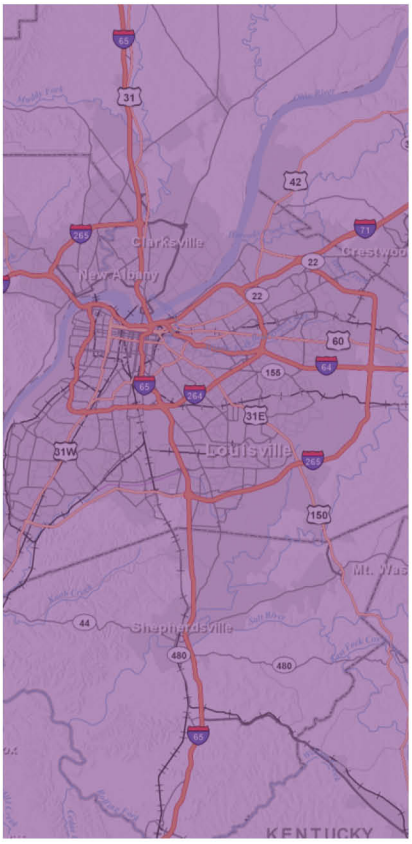


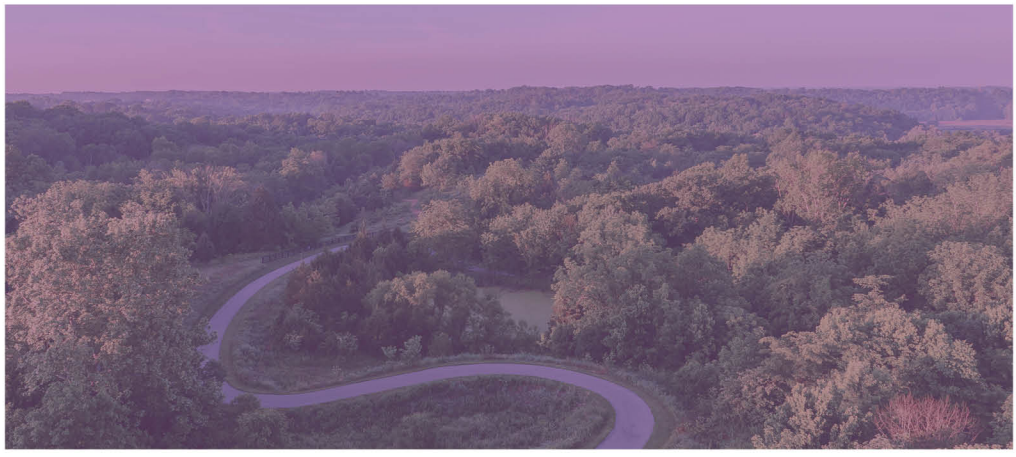


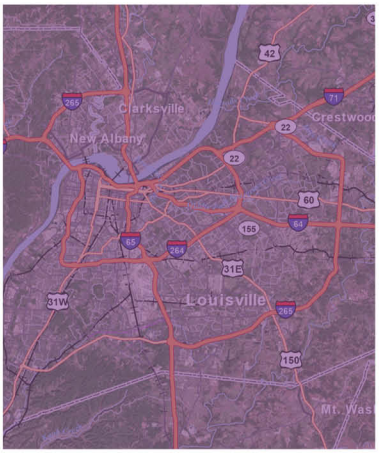




Appendix C

Traffic and Safety Analyses



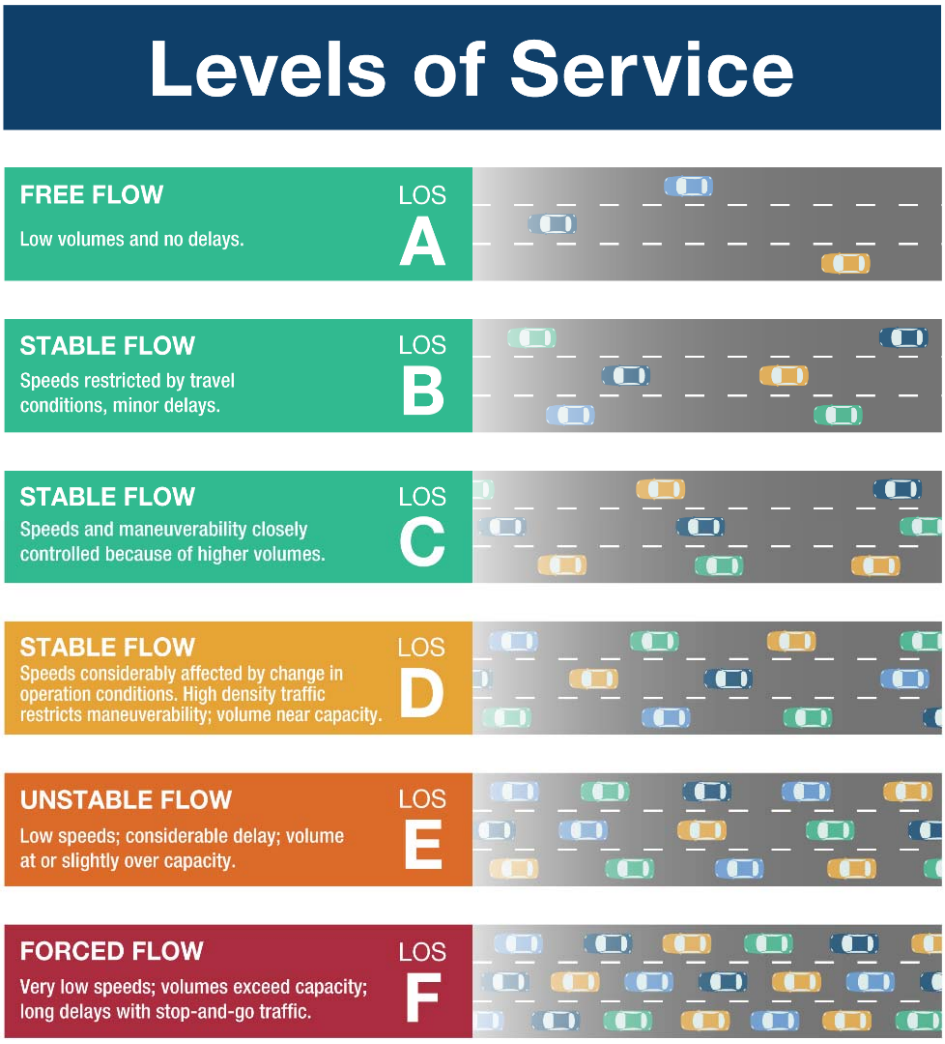


Traffic Analysis Methodology

Existing Conditions

Level of Service (LOS)
Level of Service (LOS) is a qualitative measure describing operational conditions within a traffic stream based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. There are six levels of service ranging from A through F. LOS A is associated with free-flow conditions, high freedom to maneuver, and little or no delay. Conditions at or near capacity are typically associated with LOS E. At LOS F, traffic conditions are oversaturated and beyond capacity, with low travel speeds, little or no freedom to maneuver, and high delays. **Figure C-1** describes and depicts each level of service in more detail.

Figure C-1. Level of Service ratings



Source: https://www.parleyseis.com/assets/images/Parleys%20LOS%20Levels_rev2.pngetail

To evaluate LOS and roadway segment performance throughout the 65-71 Regional Connector study area network, a methodology was developed based on the *Highway Capacity Manual – Sixth Edition* (HCM6) methods. HCM6 provides guidance with regard to the evaluation criteria and parameters for which different facility types (two-lane, multi-lane) roadways of differing contexts (rural, urban) should be evaluated. To conduct a cursory analysis of the existing roadway performance within the study area network, the HCM6 methods in conjunction with the 2018 draft Florida Department of Transportation (FDOT) LOS guidelines, and the use of the accompanying Highway Capacity Software (HCS7) were implemented.

The FDOT LOS guidelines are planning level thresholds to establish the LOS performance criteria for various facility and context situations. The threshold values in the FDOT guides were developed through the application of the HCM methods with specified parameters to develop threshold values which are more accurately aligned with the localized roadway network base conditions. Using the FDOT LOS guides as a base reference point, the project team developed and adapted input parameters to best reflect the localized roadway conditions. These parameters were input and tested using HCS7 iteratively to derive a similar set of base condition LOS thresholds for the Kentucky roadway network.

The developed LOS volumetric threshold values were then compared against the existing roadway facility data (volume, cross-section, context, facility type) for the roadways within the study area to determine the applicable LOS for the existing operational conditions. The developed volume threshold values for the various roadway types are shown in **Table C-2**. The base parameters assumed consistent across all roadway types are shown in **Table C-1.**

Table C-1. Roadway parameters

Parameter	Value
Peak hour factor (PHF)	0.92
Directional distribution	0.55
K factor	0.098
Heavy vehicle percentage	0.10
Terrain type	Rolling

Table C-2. Volume Threshold Values by Roadway Type

Facility Type	Lanes	Median	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Freeway	4	Divided	20,000	32,600	46,000	56,000	63,300	
	6	Divided	29,900	48,900	69,000	84,000	95,100	
	8	Divided	40,000	65,500	91,800	112,000	126,700	
Arterial	2	Divided	5,300	7,500	12,000	16,100	28,400	
	2 3	Undivided	5,300	7,500	12,000	16,100	28,400	
		Divided	5,300	7,500	12,000	16,100	28,400	
	3 4	Undivided	5,300	7,500	12,000	16,100	28,400	
		Divided	17,300	28,200	40,600	50,600	57,200	
	4 5	Undivided	16,800	27,400	39,500	49,700	56,400	
		Undivided	17,300	28,200	40,700	50,600	57,200	
	6	Divided	25,900	42,300	61,000	76,000	85,900	
Collector	2	Divided	4,500	7,500	12,000	16,100	28,400	
	2 3	Undivided	4,500	7,500	12,000	16,100	28,400	
		Divided	4,500	7,500	12,000	16,100	28,400	
	3 4	Undivided	4,500	7,500	12,000	16,100	28,400	
		Divided	14,300	23,300	33,600	44,400	52,000	
	4 5	Undivided	13,700	22,500	32,500	43,200	52,300	
		Undivided	14,200	23,300	33,600	44,400	52,000	
	6	Divided	21,400	34,900	50,400	66,700	77,900	
Local	2	Undivided	4,500	7,500	12,000	16,100	28,400	
	2	Undivided	4,500	7,500	12,000	16,100	28,400	

Color-coded LOS maps are shown in **Figures C-2, C-3, and C-4**; the study area is broken into thirds for ease of viewing. For the most part, many of the roadways operate in the range of LOS A – C. Although, as would be expected, roadways with higher volumes typically have lower levels of service. Segments showing poor levels of service include sections of I-65 and KY 44 through Bullitt County, KY 53 south and east of Shelbyville, I-71 through part of Oldham County, and the majority of the I-265 loop on the east side of Louisville.

Figure C-1. Level of Service

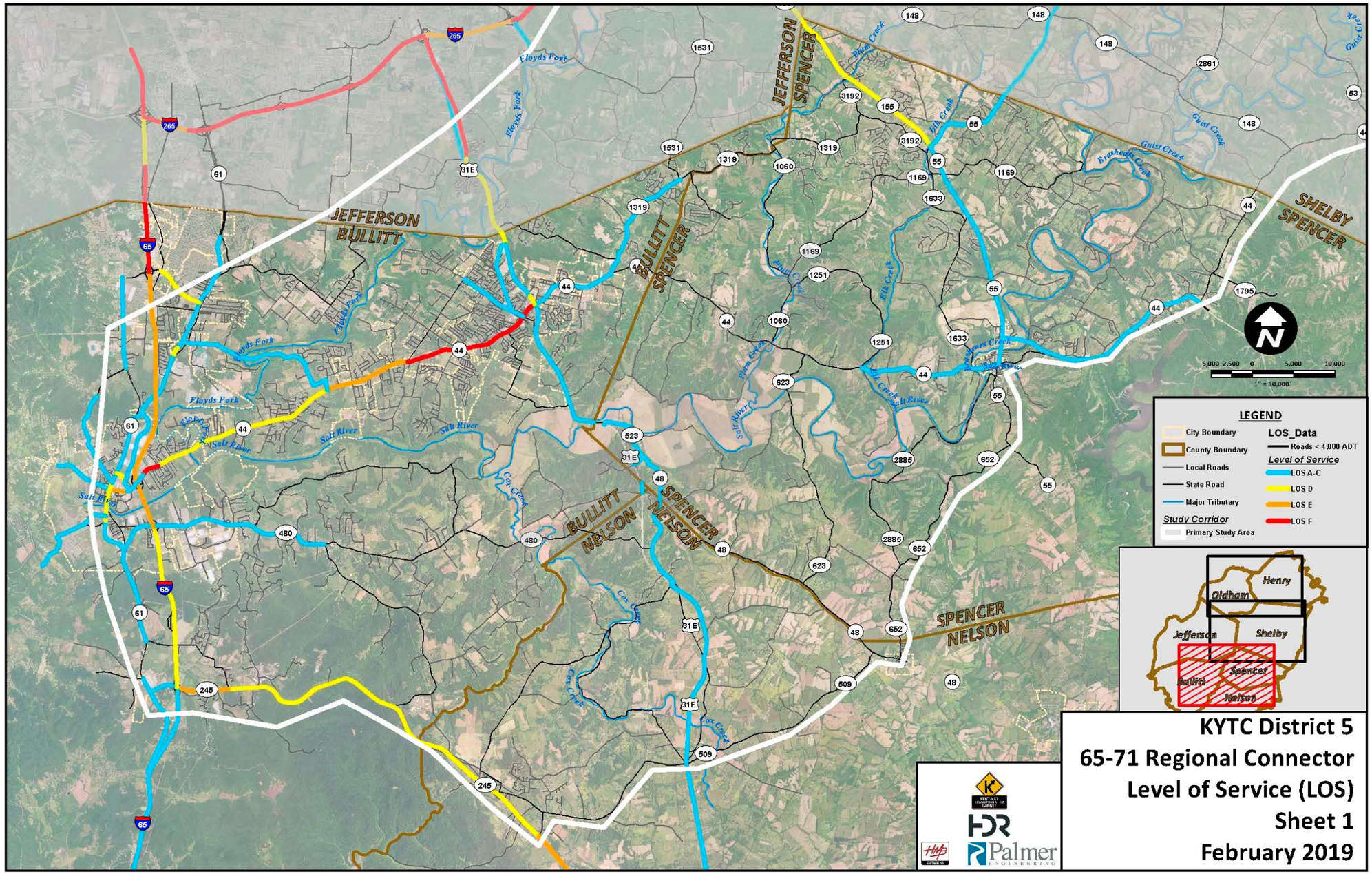


Figure C-2. Level of Service

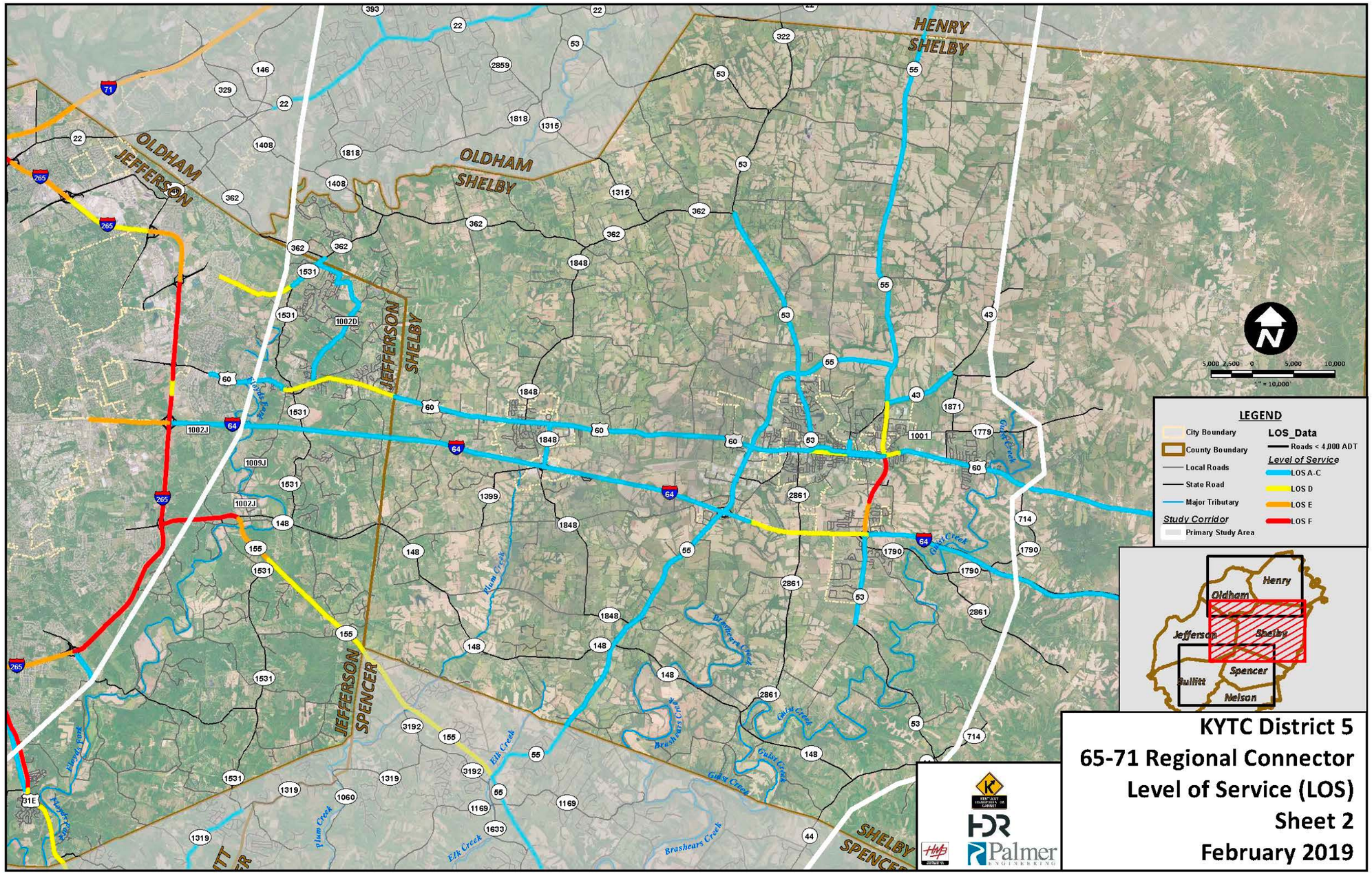
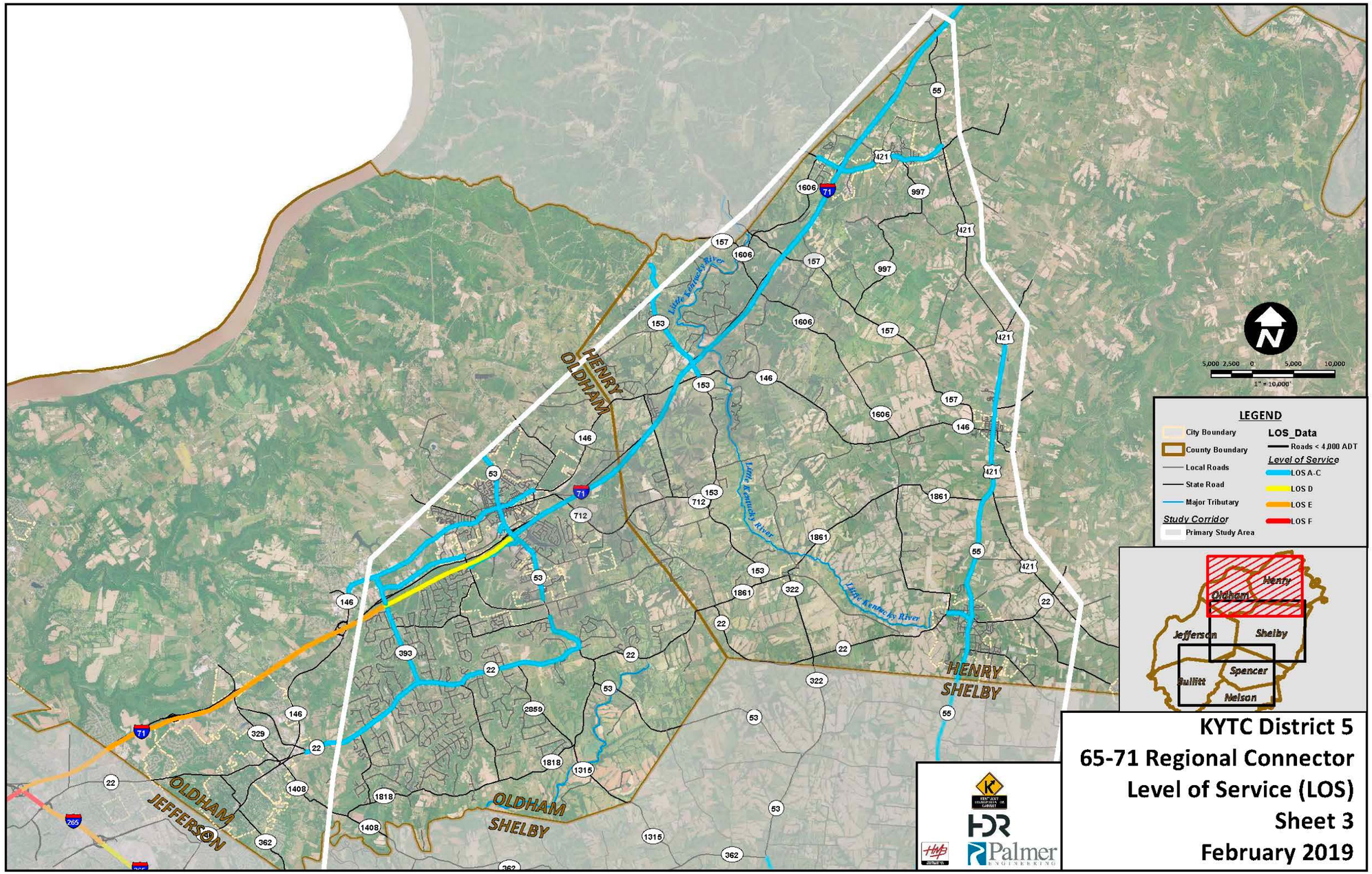


Figure C-3. Level of Service



Future No-Build and Level 2 Build Alternatives

Model Development
Traffic forecasts for the No-Build analysis were derived from the KYTC Statewide Travel Demand Model for the 2040 horizon year. Planned projects with a reasonable expectation of completion by 2040 were included in the model and No-Build forecasts. Those planned projects are discussed in Chapter 3.

Traffic forecasts for each of the Level 2 Build Alternatives were also developed using the KYTC Statewide Travel Demand Model by coding each alternative alignment into the 2040 horizon year network. To compare the performance of the No-Build and Build scenarios, 133 analysis locations were placed on the proposed alternative corridors (Alts. 1, 2E, 3C, and 5) and at locations along existing roadways near where the proposed alternatives would cross and connect utilizing an interchange or intersection.

Model Performance along New Alternative Alignments
Table C-3 shows the LOS results for each of the proposed Level 2 alignments. Mile points along each corridor are measured from 0.0 at I-65 to the endpoint along I-71. A representative average annual daily traffic (AADT) count is shown for each segment between major route crossings. The LOS thresholds developed for evaluating existing conditions were used for evaluation of No-Build and Build alternatives.

As shown, each of the “new construction” alternatives (1, 2E, and 3C) are expected to operate at LOS C or better along the entire length of those alignments. Alternative 5, which re-uses much existing roadway has a couple of spots that are forecasted to operate at LOS D or E. These segments are located within areas where heavy congestion already occurs today, including existing sections of KY 44 through Bullitt County, and KY 1848 between I-64 and US-60 near Simpsonville (Shelby County).

Table C-3: 2040 LOS Results along New Alternative Alignments

	County	Begin	End	MP	Classification	Type	Lanes	AADT	LOS
Alternative 1	Bullitt	I-65	KY 44	3.2	Freeway	Divided	4	24,700	B
	Bullitt	KY 44	US 31E	9.4	Freeway	Divided	4	26,800	B
	Bullitt	US 31E	KY 44	12.2	Freeway	Divided	4	28,600	B
	Spencer	KY 44	KY 155	18.3	Freeway	Divided	4	29,500	B
	Shelby	KY 155	I-64	23.5	Freeway	Divided	4	41,500	C
	Shelby	I-64	US 60	28.4	Freeway	Divided	4	40,500	C
	Shelby	US 60	KY 362	31.4	Freeway	Divided	4	31,800	B
	Oldham	KY 362	KY 22	37.1	Freeway	Divided	4	31,100	B
	Oldham	KY 22	I-71	40.1	Freeway	Undivided	4	37,100	C
Alternative 2E	Bullitt	I-65	KY 480	1.9	Freeway	Divided	4	24,100	B
	Bullitt	KY 480	US 31E	9.5	Freeway	Divided	4	37,500	C
	Bullitt	US 31E	KY 44	12.2	Freeway	Divided	4	36,100	C
	Spencer	KY 44	KY 155	18.4	Freeway	Divided	4	35,500	C
	Shelby	KY 155	I-64	23.6	Freeway	Divided	4	44,400	C
	Shelby	I-64	US 60	28.5	Freeway	Divided	4	40,400	C
	Shelby	US 60	KY 362	31.5	Freeway	Divided	4	31,200	B
	Oldham	KY 362	KY 22	37.6	Freeway	Divided	4	25,700	B
	Oldham	KY 22	I-71	42.2	Freeway	Undivided	4	21,100	B
Alternative 3C	Bullitt	I-65	KY 480	1.9	Freeway	Divided	4	14,700	A
	Bullitt	KY 480	US 31E	9.8	Freeway	Divided	4	21,700	B
	Spencer	US 31E	KY 44	15.9	Freeway	Divided	4	21,000	B
	Spencer	KY 44	KY 55	21.7	Freeway	Divided	4	24,100	B
	Spencer	KY 55	KY 55	24.5	Freeway	Divided	4	34,300	C
	Shelby	KY 55	I-64	32.2	Freeway	Divided	4	37,100	C
	Shelby	I-64	US 60	33.7	Freeway	Divided	4	25,800	B
	Shelby	US 60	KY 362	36.6	Freeway	Divided	4	24,800	B
	Oldham	KY 362	KY 22	43.4	Freeway	Divided	4	26,000	B
	Oldham	KY 22	I-71	47.3	Freeway	Divided	4	26,500	B
Alternative 5	Bullitt	I-65	CR1010	0.5	Arterial	Undivided	5	50,900	E
	Bullitt	CR1010	KY1526	4.2	Arterial	Undivided	5	40,900	D
	Bullitt	KY1526	Fisher Ln	5.3	Arterial	Undivided	5	45,200	D
	Bullitt	Fisher Ln	US 31E	9.3	Arterial	Undivided	2	10,600	C
	Bullitt	US 31E	KY 44	12.9	Arterial	Undivided	2	6,900	B
	Spencer	KY 44	Plum Ridge Rd	16.1	Arterial	Undivided	2	9,300	C
	Spencer	Plum Ridge Rd	KY 55	20.0	Arterial	Undivided	2	11,100	C
	Spencer	KY 55	KY 148	23.6	Arterial	Divided	4	30,600	C
	Shelby	KY 148	Buck Creek Rd	27.7	Arterial	Divided	4	29,200	C
	Shelby	Buck Creek Rd	I-64	29.8	Arterial	Undivided	5	29,500	C
	Shelby	I-64	US 60	30.9	Arterial	Undivided	5	44,300	D
	Shelby	US 60	KY 1848	32.5	Arterial	Divided	4	19,300	B
	Shelby	KY 1848	KY 362	35.1	Arterial	Divided	4	21,000	B
	Oldham	KY 362	KY 1315	38.6	Arterial	Divided	4	19,600	B
	Oldham	KY 1315	KY 22	41.5	Arterial	Divided	4	17,700	B
	Oldham	KY 22	KY 2857	43.3	Arterial	Divided	4	11,200	A
	Oldham	KY 2857	I-71	45.1	Arterial	Divided	4	26,000	B

Model Performance along Existing Facilities
Construction of a new regional connector between I-65 and I-71 is expected to have regional traffic impacts along existing facilities, including interstates and other, more minor facilities.

Interstates
Each of the major interstates serving (or adjacent to) the study area, including I-64, I-65, I-71, and I-265, were evaluated to show the traffic impacts, including the potential traffic diversion that could be provided by each new Build Alternative. For comparison purposes, the results of the 2018 Existing, 2040 No-Build, and each of the 2040 Build analyses along these interstates are provided in **Table C-4**. As the table indicates, base year volumes are expected to increase by 2040. The Build Alternatives create some fluctuation in 2040 volumes but in general do not improve levels of service along any of the study area (or adjacent) interstates.

Local Roadway Network
Within each of the study area counties, a number of other state and local facilities were selected and analyzed to determine the impacts of the various alternatives on those adjacent and parallel facilities. **Table C-5** provides a comparison of traffic conditions on these facilities for the 2018 Existing, 2040 No-Build, and 2040 Build scenarios. Some routes show decreases in traffic as volumes migrate to the new corridor while others show increases where the new corridor induces additional travel demand.

A significant increase in congestion is expected on some roadways by 2040 under the No-Build scenario. For build alternatives that further increase traffic on these routes operational performance could further worsen. Of particular note is projected volumes on KY 44 in Bullitt County, which necessitates its own improvements to address poor performance. Along other routes, the impact of the Connector varies between slight congestion mitigation and amplification.

Table C-4: Traffic Analysis Results along Study Area Interstates

Route	County	Mile point	Existing 2018			No-Build 2040			Alt. 1 2040			Alt. 2E 2040			Alt. 3C 2040			Alt. 5 2040		
			ADT	Lanes	LOS	ADT	Lanes	LOS	ADT	Lanes	LOS	ADT	Lanes	LOS	ADT	Lanes	LOS	ADT	Lanes	LOS
I-64	Jefferson	23.0	59,700	6	C	72,200	6	D	89,800	6	E	92,400	6	E	80,100	6	D	79,600	6	D
	Shelby	26.6	59,700	6	C	72,200	6	D	76,800	6	D	74,800	6	D	80,100	6	D	79,600	6	D
	Shelby	29.0	50,900	6	C	65,800	6	C	67,900	6	C	68,300	6	C	80,100	6	D	64,500	6	C
	Shelby	31.2	50,900	6	C	65,800	6	C	67,900	6	C	68,300	6	C	68,100	6	C	64,500	6	C
I-65	Bullitt	114.0	79,700	6	D	87,200	6	E	90,600	6	E	98,600	6	F	96,400	6	F	89,500	6	E
	Bullitt	115.0	92,000	6	E	92,300	6	E	95,300	6	F	80,000	6	D	85,500	6	E	94,500	6	E
	Bullitt	116.1	92,000	6	E	110,300	6	F	113,100	6	F	101,500	6	F	107,500	6	F	112,900	6	F
	Bullitt	118.4	95,000	6	E	114,500	6	F	107,000	6	F	106,600	6	F	112,500	6	F	111,300	6	F
	Bullitt	120.8	105,900	6	F	114,500	6	F	124,700	6	F	106,600	6	F	112,500	6	F	111,300	6	F
	Jefferson	124.6	105,900	8	D	122,000	8	E	122,300	8	E	114,200	8	E	120,000	8	E	118,200	8	E
I-71	Jefferson	10.8	63,700	4	F	100,300	6	F	93,700	6	E	95,100	6	F	97,500	6	F	97,800	6	F
	Oldham	15.5	41,400	4	C	84,800	6	E	78,600	6	D	76,600	6	D	83,400	6	D	83,800	6	D
	Oldham	17.8	60,100	4	E	77,700	6	D	74,400	6	D	72,500	6	D	76,200	6	D	76,800	6	D
	Oldham	19.3	49,200	4	D	66,500	4	F	77,200	4	F	62,800	4	E	67,200	4	F	67,300	4	F
	Oldham	23.0	45,300	4	C	33,800	4	C	42,400	4	C	34,900	4	C	41,700	4	C	41,400	4	C
	Henry	25.5	40,200	4	C	33,800	4	C	42,400	4	C	44,500	4	C	45,700	4	C	41,400	4	C
I-265	Jefferson	11.2	81,100	4	F	104,500	4	F	101,300	4	F	99,100	4	F	102,100	4	F	101,600	4	F
	Jefferson	13.0	74,200	4	F	84,600	4	F	82,100	4	F	80,400	4	F	83,700	4	F	82,500	4	F
	Jefferson	14.7	72,500	4	F	82,400	4	F	82,400	4	F	80,100	4	F	81,900	4	F	80,800	4	F
	Jefferson	16.3	75,200	4	F	79,100	4	F	77,200	4	F	75,100	4	F	77,800	4	F	76,900	4	F
	Jefferson	18.8	65,800	4	F	76,000	4	F	75,100	4	F	72,800	4	F	75,100	4	F	74,700	4	F
	Jefferson	21.3	70,900	4	F	81,700	6	D	76,100	6	D	75,900	6	D	78,400	6	D	79,500	6	D
	Jefferson	23.8	68,200	4	F	90,100	6	E	83,700	6	D	83,900	6	D	88,000	6	E	89,200	6	E
	Jefferson	26.1	90,000	6	E	116,900	6	F	109,800	6	F	110,700	6	F	114,300	6	F	114,400	6	F
	Jefferson	27.8	71,900	4	F	96,100	6	F	89,700	6	E	91,200	6	E	93,900	6	E	92,200	6	E
	Jefferson	32.0	68,200	4	E	84,500	6	E	79,100	6	D	80,100	6	D	80,700	6	D	82,200	6	D

Table C-5: Traffic Analysis Results along Other Study Area Roadways

County	Route	Mile point	Classification	Lanes	Type	Existing 2018		No-Build 2040		Alt. 1 2040		Alt. 2E 2040		Alt. 3C 2040		Alt. 5 2040	
						ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS
Bullitt	KY 1319	2.2	Collector	2	Undivided	2,800	A	7,400	B	5,600	B	5,600	B	6,700	B	9,800	C
	KY 1526	15.0	Arterial	2	Undivided	4,900	A	11,100	C	7,200	B	10,700	C	11,000	C	10,400	C
	KY 44	13.6	Arterial	2	Undivided	12,500	D	35,900	F	40,100	F	32,500	F	35,000	F	50,900	E*
	KY 44	17.0	Arterial	2	Undivided	15,200	D	25,000	E	38,400	F	20,500	E	23,600	E	40,900	D*
	KY 44	18.2	Arterial	2	Undivided	17,700	E	29,100	F	29,300	F	24,900	E	27,700	E	45,200	D*
	KY 44	21.1	Arterial	2	Undivided	17,700	E	19,900	E	15,900	D	19,300	E	19,600	E	35,100	F
	KY 44	26.0	Arterial	2	Undivided	3,200	A	9,500	C	14,700	D	15,800	D	9,200	C	9,800	C
	KY 480	1.3	Collector	4	Undivided	7,900	A	23,300	C	25,000	C	29,600	C	27,900	C	19,500	B
	KY 480	5.7	Collector	2	Undivided	2,400	A	8,700	C	7,200	B	3,900	A	23,600	B*	4,400	A
	KY 480	6.7	Collector	2	Undivided	2,400	A	7,900	C	6,400	B	4,200	A	22,800	B*	3,500	A
	Stringer Ln	1.0	Local Road	2	Undivided	400	A	2,800	A	2,100	A	9,000	C	3,300	A	1,700	A
	US 31E	0.7	Arterial	2	Undivided	8,700	C	19,900	E	23,600	E	18,500	E	20,700	E	16,400	E
	US 31E	1.2	Arterial	2	Undivided	8,700	C	19,200	E	15,300	D	20,000	E	19,300	E	17,700	E
	US 31E	4.7	Arterial	4	Undivided	20,800	B	24,400	B	18,700	B	24,300	B	24,000	B	31,300	C
Jefferson	Aiken Rd	N/A	Collector	2	Undivided	8,000	C	7,300	B	7,600	C	7,600	C	7,300	B	7,300	B
	Clark Station Rd	N/A	Local Road	2	Undivided	500	A	2,300	A	1,400	A	1,300	A	2,000	A	1,300	A
	English Station Rd	N/A	Collector	2	Undivided	3,900	A	5,100	B	4,000	A	4,100	A	4,600	B	4,100	A
	Gilliland Rd	N/A	Collector	2	Undivided	1,000	A	2,500	A	600	A	600	A	1,300	A	2,600	A
	KY 148	2.0	Collector	2	Undivided	2,400	A	4,000	A	4,600	B	4,900	B	6,500	B	2,900	A
	KY 1531	N/A	Collector	2	Undivided	2,300	A	7,400	B	5,600	B	5,600	B	6,700	B	9,800	C
	KY 1531	N/A	Collector	2	Undivided	1,500	A	9,100	C	8,100	C	7,500	C	10,100	C	8,500	C
	KY 155	3.4	Arterial	3	Undivided	17,000	E	35,400	F	18,500	E	19,000	E	21,200	E	21,500	E
	KY 155	5.7	Arterial	2	Undivided	19,100	E	41,800	D*	38,800	C *	39,600	D*	40,500	D*	39,500	D*
	KY 1819	2.7	Collector	2	Undivided	3,200	A	3,100	A	2,100	A	3,000	A	2,900	A	2,700	A
	Old Henry Rd	N/A	Collector	2	Undivided	N/A	N/A	10,000	C	9,200	C	9,400	C	9,800	C	9,900	C
	US 31E	3.0	Arterial	4	Divided	43,300	D	30,900	C	27,700	B	30,900	C	30,300	C	32,200	C
	US 60	13.6	Arterial	4	Undivided	18,900	B	21,000	B	24,100	B	23,500	B	21,500	B	21,100	B
Nelson	KY 480	0.1	Collector	2	Undivided	800	A	8,600	C	6,200	B	3,000	A	3,300	A	4,200	A
	KY 523	9.2	Collector	2	Undivided	6,900	B	10,500	C	11,000	C	7,800	C	6,900	B	6,600	B
	US 31E	25.9	Arterial	2	Undivided	7,100	B	9,600	C	10,600	C	9,000	C	8,700	C	8,500	C
	US 31E	26.8	Arterial	2	Undivided	7,100	B	9,600	C	10,600	C	9,000	C	12,700	D	8,500	C

Table C-5: Traffic Analysis Results along Other Study Area Roadways cont.

County	Route	Mile point	Classification	Lanes	Type	Existing 2018		No-Build 2040		Alt. 1 2040		Alt. 2E 2040		Alt. 3C 2040		Alt. 5 2040	
						ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS
Oldham	KY 1315	4.6	Collector	2	Undivided	1,100	A	2,500	A	1,700	A	1,800	A	2,200	A	2,600	A
	KY 146	0.2	Arterial	2	Undivided	13,200	D	16,200	E	15,700	D	15,800	D	16,000	D	16,000	D
	KY 146	5.0	Arterial	2	Undivided	9,400	C	14,500	D	14,600	D	13,500	D	14,200	D	14,100	D
	KY 1818	3.3	Collector	2	Undivided	1,000	A	2,200	A	1,900	A	2,000	A	2,600	A	2,500	A
	KY 22	1.3	Arterial	2	Undivided	9,300	C	11,500	C	11,100	C	10,900	C	11,400	C	11,400	C
	KY 22	6.0	Arterial	2	Undivided	8,400	C	14,200	D	15,300	D	12,200	D	13,300	D	13,000	D
	KY 22	7.6	Arterial	2	Undivided	8,000	C	9,000	C	7,900	C	8,100	C	8,200	C	6,700	C
	KY 22	12.5	Collector	2	Undivided	2,100	A	5,900	B	6,000	B	9,700	C	7,200	B	6,300	B
	KY 22	13.8	Collector	2	Undivided	2,100	A	1,300	A	1,400	A	3,000	A	5,100	B	1,600	A
	KY 329	7.1	Arterial	4	Undivided	13,500	A	28,100	C	28,200	C	28,300	C	26,800	B	26,900	B
	KY 393	4.0	Arterial	2	Undivided	9,600	C	19,900	E	37,100	C*	17,200	E	18,100	E	17,200	E
	KY 53	0.6	Arterial	2	Undivided	2,000	A	4,300	A	3,200	A	4,100	A	1,900	A	3,500	A
	KY 53	2.4	Arterial	2	Undivided	2,000	A	4,300	A	3,200	A	8,100	C	1,900	A	3,500	A
	KY 53	3.5	Arterial	2	Undivided	6,700	B	10,300	C	9,700	C	10,500	C	7,700	C	6,400	B
	KY 53	6.3	Arterial	4	Divided	18,700	B	11,400	A	10,800	A	10,100	A	11,000	A	21,400	B
	Old Floydsburg Rd	N/A	Collector	2	Undivided	N/A	N/A	8,200	C	7,800	C	7,700	C	8,000	C	8,000	C
Shelby	Conner Station Rd	N/A	Local Road	2	Undivided	N/A	N/A	500	A	200	A	300	A	400	A	400	A
	KY 148	6.0	Collector	2	Undivided	900	A	4,700	B	3,400	A	3,500	A	6,800	B	2,900	A
	KY 148	7.0	Collector	2	Undivided	900	A	4,700	B	3,400	A	3,500	A	10,300	C	9,600	C
	KY 1848	5.3	Collector	4	Undivided	7,500	A	26,700	C	20,300	B	18,600	B	25,600	C	44,300	D**
	KY 362	4.7	Collector	2	Undivided	900	A	4,800	B	4,600	B	10,600	C	4,500	B	4,600	B
	KY 362	5.6	Collector	2	Undivided	900	A	1,700	A	5,200	B	1,700	A	1,900	A	1,600	A
	KY 362	6.4	Collector	2	Undivided	900	A	1,700	A	3,200	A	1,700	A	1,900	A	1,600	A
	KY 362	10.6	Collector	2	Undivided	2,000	A	2,500	A	2,400	A	1,900	A	2,600	A	2,600	A
	KY 362	11.1	Collector	2	Undivided	2,000	A	2,500	A	2,400	A	1,900	A	5,400	B	2,600	A
	KY 55	2.2	Arterial	2	Undivided	6,100	B	19,900	E	14,500	D	14,500	D	9,800	C	12,900	D
	KY 55	5.9	Arterial	2	Undivided	6,100	B	25,100	E	21,600	E	21,300	E	18,200	E	22,100	E
	KY 55	6.5	Arterial	4	Undivided	19,100	B	27,800	C	24,300	B	24,100	B	21,900	B	24,300	B
	US 60	1.4	Arterial	2	Undivided	6,300	B	11,600	C	18,400	E	19,500	E	11,600	C	12,200	D
	US 60	2.0	Arterial	2	Undivided	6,300	B	11,600	C	17,400	E	17,600	E	11,600	C	12,200	D
	US 60	5.4	Arterial	2	Undivided	8,000	C	9,500	C	9,300	C	9,500	C	11,000	C	9,000	C
	US 60	6.3	Arterial	2	Undivided	8,000	C	9,500	C	9,300	C	9,500	C	12,800	D	9,000	C

Table C-5: Traffic Analysis Results along Other Study Area Roadways cont.

County	Route	Mile point	Classification	Lanes	Type	Existing 2018		No-Build 2040		Alt. 1 2040		Alt. 2E 2040		Alt. 3C 2040		Alt. 5 2040	
						ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS	ADT	LOS
Spencer	KY 1169	5.4	Collector	2	Undivided	2,900	A	4,100	A	4,000	A	4,000	A	4,200	A	1,100	A
	KY 155	3.0	Arterial	2	Undivided	14,200	D	15,400	D	19,800	E	20,900	E	10,900	C	9,200	C
	KY 155	4.0	Arterial	2	Undivided	14,200	D	15,500	D	11,300	C	11,500	C	11,000	C	9,300	C
	KY 44	1.2	Arterial	2	Undivided	3,200	A	9,500	C	12,200	D	12,400	D	9,200	C	7,500	C
	KY 44	6.8	Arterial	2	Undivided	5,300	B	9,600	C	9,300	C	9,300	C	9,300	C	8,100	C
	KY 44	7.4	Arterial	2	Undivided	5,300	B	10,100	C	9,500	C	10,000	C	10,000	C	9,500	C
	KY 55	7.3	Arterial	2	Undivided	10,600	C	16,200	E	13,700	D	13,800	D	16,900	E	17,800	E
	KY 55	7.9	Arterial	2	Undivided	10,600	C	16,200	E	13,700	D	13,800	D	15,100	D	17,800	E
	KY 55	11.3	Arterial	2	Undivided	4,600	A	13,500	D	7,400	B	7,400	B	6,100	B	2,500	A
	KY 55	13.3	Arterial	2	Undivided	4,600	A	14,100	D	6,800	B	6,800	B	6,700	B	30,600	C*
	Plum Ridge Rd	2.8	Local Road	2	Undivided	1,600	A	1,200	A	600	A	600	A	200	A	400	A

Additional Model Development

Following the execution of the traffic analysis as described above, the Project Team conducted additional travel demand model runs which resulted in somewhat different, more aggressive, forecasted volumes. Despite these differences, it was determined that the incorporation of these revised volumes into the traffic analysis would not affect the final alignment recommendations, therefore they were not included.

KYSTM Modeling Process Documentation

65-71 Regional Connector

January 2, 2020

Introduction

As a part of the 65-71 Regional Connector Study, the project team was tasked with screening and evaluating a number of potential solutions for new roadway alignments connecting I-65 in Bullitt County and I-71 in Oldham County, through areas to the south and east of Louisville. It was determined that the best tool for evaluating potential travel-demand effects was the Kentucky Statewide Traffic Model (KYSTM), a travel demand model built within the TransCAD software platform. The project team was provided with version 17 (KYSTMv17) of the model, which was last updated in 2012 to include a base year of 2010 and future horizon year of 2040. Note that a more recent version of the model (KYSTMv18) exists, but was not used for this effort.

Figure 1 illustrates the extents of the model, with Traffic Analyses Zones (TAZs) shown in green and the roadway network shown in black. The model encompasses the entire United States, with added density in the region surrounding Kentucky, and even greater density within the Kentucky borders.

Figure 1: KYSTM Complete Model Extents

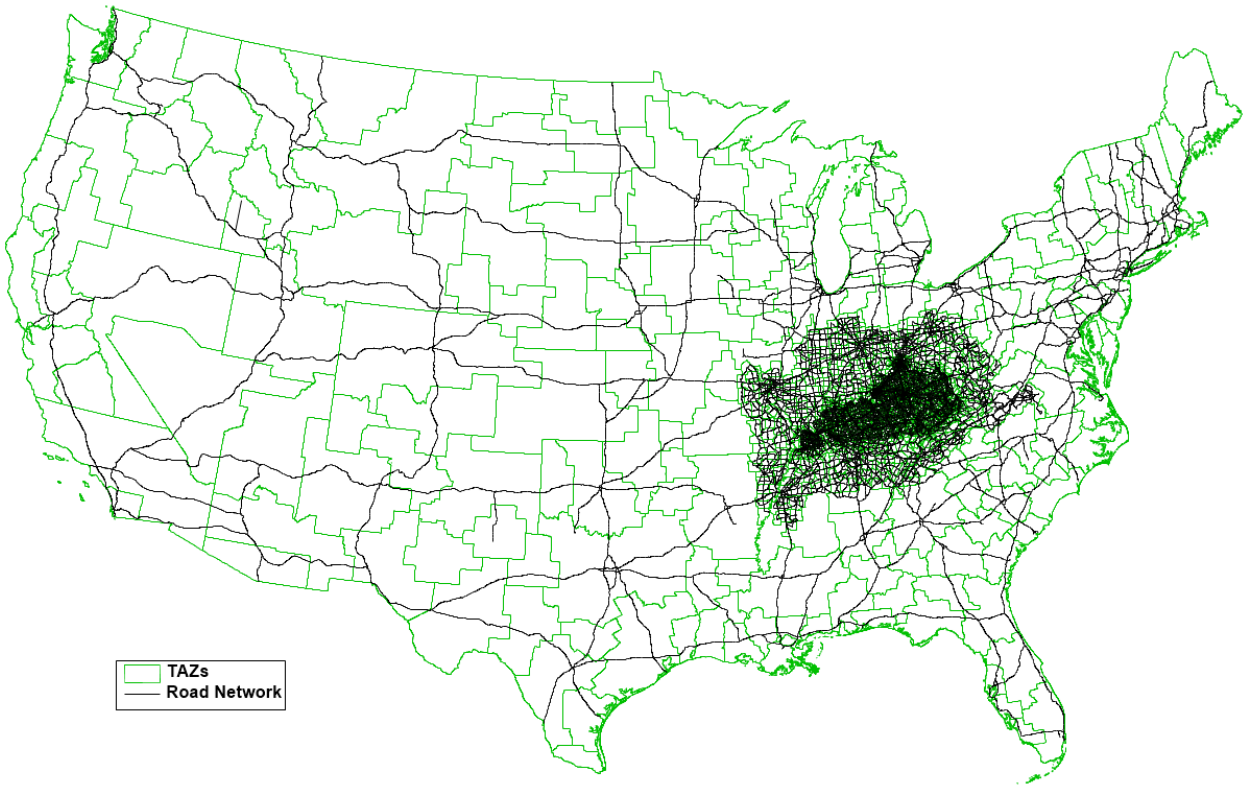
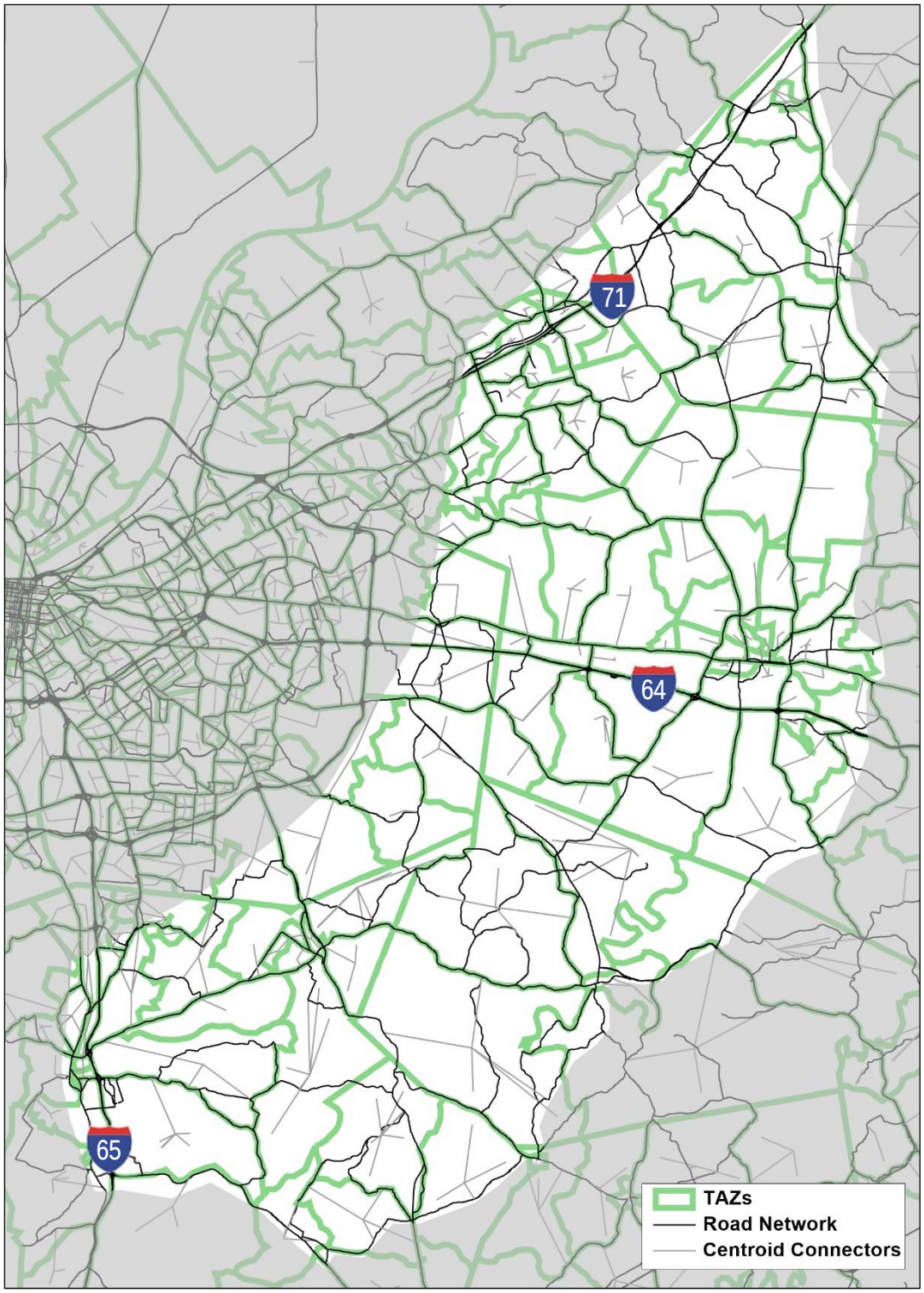


Figure 2 illustrates the TAZ and network density within the project study area, as originally provided.

Figure 2: KYSTM Study Area Model Features



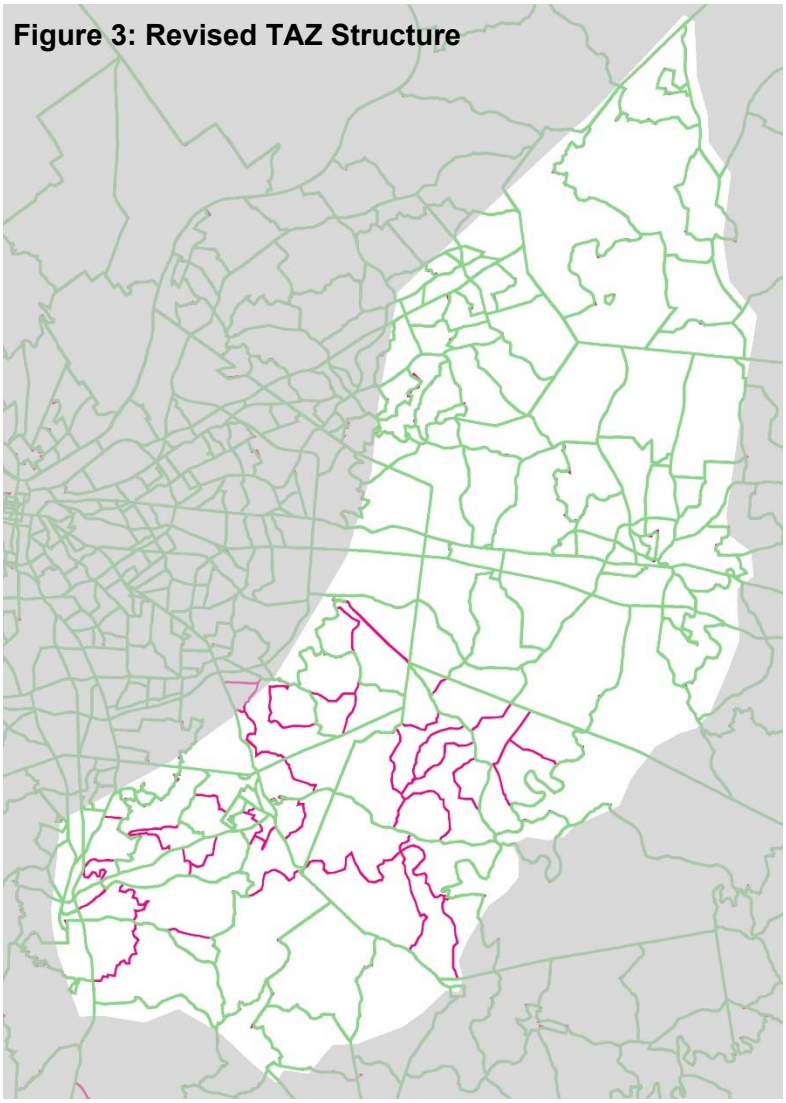
Modifications

The model was reviewed in detail and updated where necessary to improve forecasting accuracy in the project study area. The modifications are discussed in detail below.

Land Use

Based on a review of the project study area, it was determined that additional zonal detail was needed for a number of reasons. First, large Traffic Analysis Zones (TAZs) were split because they can cause problems: the modeled demand may be loaded using “all-or-nothing” or shortest-path assignments due to the size of the TAZ. Smaller TAZs generally result in better traffic assignment results, as loading of demand can be modeled more realistically. Second, TAZs were also disaggregated based on possible alignments of the 65-71 connector and the desire to have the flexibility in assuming future year land uses different from original assumptions in the “parent” TAZs. **Figure 3** shows the refined zonal boundaries, which are primarily located in Spencer, Oldham, and Bullitt Counties. In total, the final number of TAZs included in the model was 5952; an increase of 47 from what was originally provided.

Figure 3: Revised TAZ Structure



TAZ data were reallocated using the KYSTM’s utility for zone splitting. The process apportions the original estimate of households and employment from the “parent” TAZ to the “child” TAZs based on area of each split TAZ. It also updates the input POV and truck matrices (e.g. “HBW Trip Daily Person PA Matrix.mtx”, “Long Trip Daily Person PA Matrices.mtx”, Daily_OD_Trucks.201.mtx, and Daily_OD_Trucks_2040.mtx) by adding seed values that are calculated from input SE data factors.

KYTC modeling staff reviewed the allocation of SE data to the new zones for 2010 and updated them to more recent demographic data. It is worth noting that the total employment assumed for one of the new “child” TAZs (TAZ number 2015301) exceeded the sum of total employment for its

"parent" TAZ. The original TAZ assumed approximately 300 total employees, but when it was split, the revised estimate for one of its children TAZs was over 4,000 employees. When total employment for a new TAZ exceeds total employment for the original zone, this potentially creates seed values in the new TAZs that can be very large. This can be an issue, because the zone splitting/seed matrix creation script uses the total employment estimates to create vectors that are applied to the seed truck and HBW trip tables. In this case, a factor of 16.9 for truck productions/attractions and HBW attractions resulted. In a split TAZ, these scaling factors should never be greater than 1.0, assuming one maintains the original employment total for the parent zone. This factor of 16.9 was applied by the script to the input HBW Person production-attraction (PA) matrix and the Daily_OD_Trucks.2010.mtx, which resulted in HBW attractions in the seed matrix summing to an unusually large amount: 57,000 for that single TAZ. To compensate for this, the study team factored rows and columns for TAZ 2015301 in the seed matrix to make it more similar to its parent TAZ. The team also adjusted input socioeconomic data so that more reasonable factors would be calculated when performing a 2040 forecast, revising the household and employment values for the TAZs (parent and children) so that the total employment for any child TAZ wouldn't exceed the total employment for its parent zone. When the team ran 2040 models, the growth factors calculated from the input socioeconomic data were reasonable. Thus, the number of truck trips and home-based originating/destined to the "problem" TAZ were considered reasonable.

Data values in two TAZs were adjusted after being found to be "overly active" in the 2040 scenarios. These were both located outside of the actual study area, but close enough that they were determined to be impacting the results within the study area.

- TAZ 2056451 – A built-out area of downtown Louisville – was projected to increase from 6,805 employees in 2010 to 44,946 in 2040. The study team reduced employment to 11,909 in 2040.
- TAZ 2056471 – A built-out area south of downtown Louisville – was projected to increase from 2,054 base year employees to 23,017 employees in 2040. The study team reduced employment to 3,595 in 2040.

These modifications resulted in a total employment figure lower than the control total for Jefferson County by approximately 5%. This was deemed to be within a reasonable threshold.

One issue in developing future socioeconomic data was related to interpolation. The base year for this project was 2017. For the KYSTM, the user has two potential options for developing KYSTM's input socio-economic (SE) data needed for forecasting. Specific estimates can be developed for each TAZ for the appropriate year. Or KYSTM interpolates between its base year (2010) and horizon year (2040) estimates. The study team generally used the interpolation method. One particular challenge faced by the team was reconciling information gleaned from 2017 data sources, such as the American Community Survey (ACS) and KIPDA, compared with the estimates from the model's interpolation from the input SE data. To "force" the correct values for the project's base year, 2017, the team had to input negative values for some TAZs for 2010. Although this approach was unappealing from an intellectual perspective,

mathematically it provided the team with the appropriate estimates for TAZs within the project area for 2017.

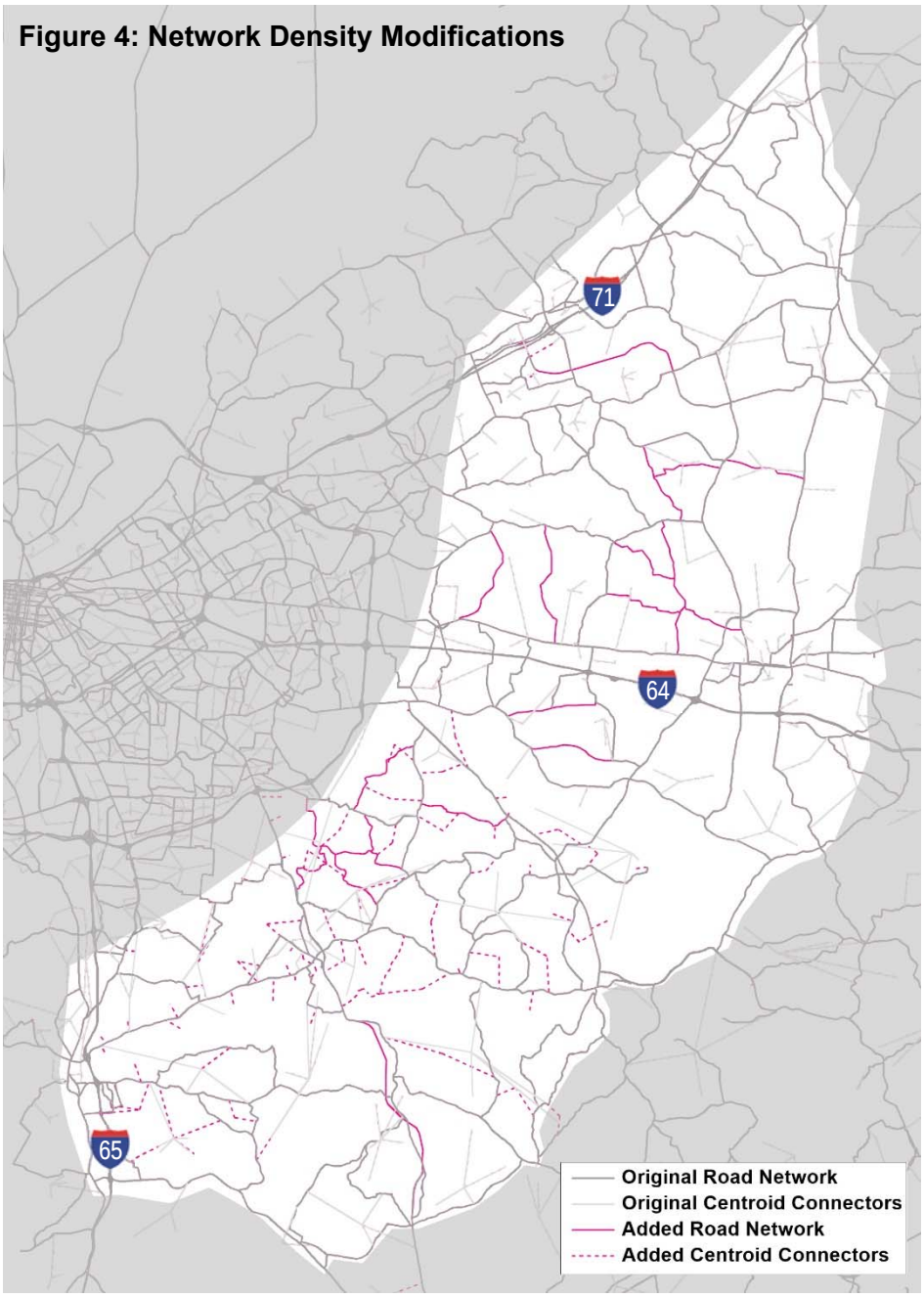
Network

Two major categories of network modifications were made to the original roadway network provided by the Cabinet; changes to improve network density within the study area, and changes to reflect near-term (and some longer-term) improvement projects expected to be constructed by 2040 within the study area.

Network Density

It was determined that better results could be obtained from the model if the network density were improved in certain parts of the study area. The roads that were added for density purposes were all existing facilities and were coded into the model along their existing alignments and with their existing configurations (number of lanes, classification, speed, etc.). **Figure 4** shows these roadways in the context of the original network. Also, as a result of disaggregating the TAZ structure, some modifications to centroid connectors were necessary, as shown on the map.

Figure 4: Network Density Modifications



Future Improvement Projects
Additional modifications were made to roadways along existing alignments where improvement projects are expected, in terms of number of lanes, speeds, or functional classification.

Both the current KYTC Highway Plan and the Louisville TIP were consulted, and projects that are “committed” to occur within the next 5 years, based on their project schedules and funding sources, were added to the 2040 model network.

- Construct a new I-65 interchange at Cedar Grove Business Park (south of existing KY-480 interchange).
- Widen KY-245 to four lanes from I-65 to the Bernheim Forest.
- Widen KY-53 to four lanes from I-64 to US-60.
- Construct a new I-71 interchange at La Grange Parkway.
- Widen I-71 to six lanes from I-265 to KY-329.
- Provide a collector-distributor (C-D) road along southbound I-71 to facilitate ramps at I-265.
- Reconstruct the I-265/I-64 interchange with northbound-to-westbound and eastbound-to-northbound flyover ramps.

Additionally, a number of projects currently planned for beyond 2024, which were determined to potentially have an impact on this new connector study, were also included in the future model network. Those projects were mainly identified by consulting the KYTC Highway Plan and the KIPDA Metropolitan Transportation Plan.

- Widen KY-480 from I-65 to Valley View Road.
- Widen I-64 to six lanes from KY-55 to east of the KY-1790 overpass.
- Widen I-71 to six lanes from KY-329 to KY-393.
- Widen I-265 to six lanes from Taylorsville Road to Old Henry Road.
- Widen Taylorsville Road to four lanes from I-265 to KY-148.

Lastly, there are a couple of projects that are not currently funded sufficiently enough to allow for a projected opening date, but that would be likely to have significant impacts on the study area when built. It is assumed that these projects will be strongly considered for full or partial funding by 2040, and they were therefore included in the model.

- Widen I-71 to six lanes from KY 393 to KY 53.
- Widen I-265 to six lanes from Old Henry Rd to I-71.

Alternatives

Once the future no-build network and land use were set, the study team developed and tested a series of alternative alignments for the new corridor. A Level 1 screening effort compared over 15 different alternative alignments, many of which were individually modeled and analyzed. Out of this exercise, four alignments were carried forward as feasible alternatives.

Alternative 1

Alternative 1 provides the westernmost alignment, nearest to the I-264 outer ring. It connects with I-65 at a new interchange south of the existing interchange at KY-1526 (Brooks Road). The alignment intersects I-64 at a new interchange west of KY-1848 (Buck Creek Road). At the north end, the new alignment terminates at the current junction of E State Hwy 22 and KY-393. Alternative 1 then continues along the existing KY-393 alignment to I-71.

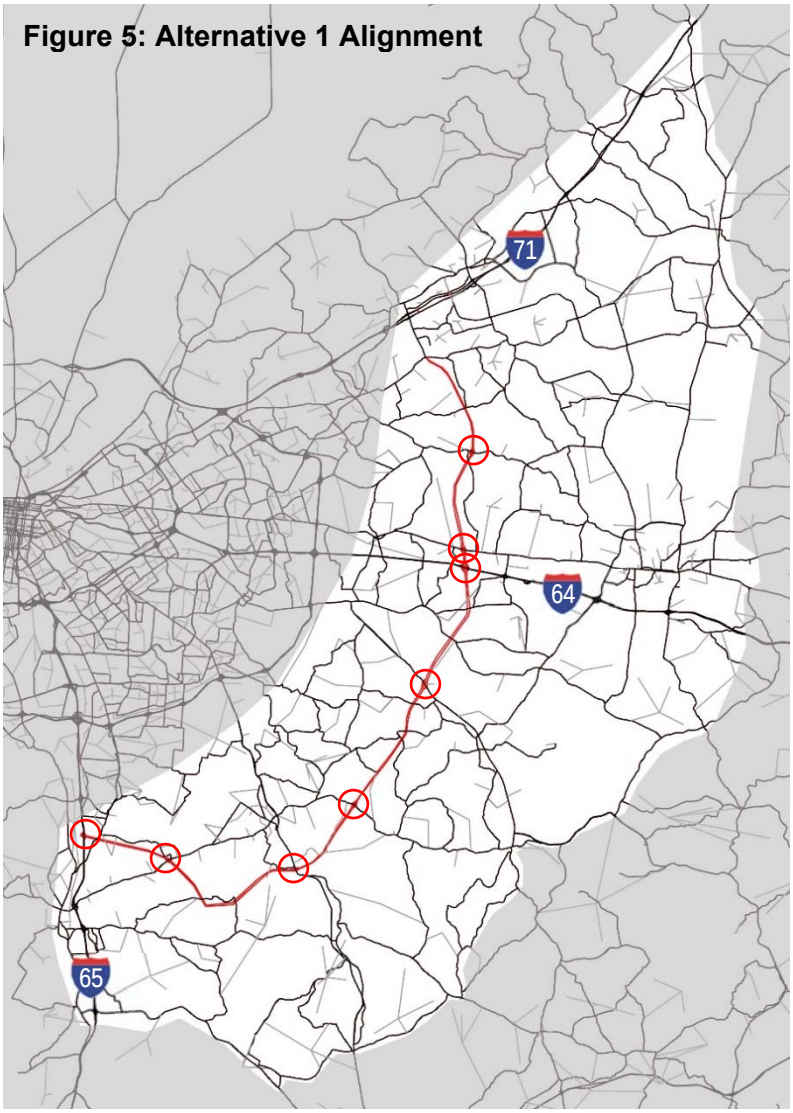


Figure 5: Alternative 1 Alignment

With the exception of the last 2 miles along KY-393, the alignment consists of entirely new roadway. The segment along KY-393 is expected to be retained in its existing configuration as a two-lane highway with a center turn lane, and a reduced speed limit of 55 mph. All new portions of roadway are assumed to be designed as a four-lane freeway with a 65 mph speed limit. Alternative 1 includes 8 new interchanges, at the cross-streets listed below and circled in **Figure 5**.

Interchange Locations

- I-65
- KY-44 (Old Mill Rd)
- US-31E (Bardstown Rd)
- KY-44 (Mt. Washington Rd)
- KY-155 (Taylorsville Rd)
- I-64
- US-60 (Shelbyville Rd)
- KY-362 (Aiken Rd)

Alternative 2E

Alternative 2E is the final iteration of several Alternative 2 alignments. It follows a path very similar to that of Alternative 1, except at the northern and southern ends of the corridor. At the south end, the alignment connects with I-65 at a new interchange south of KY-480 (Cedar Grove Rd). The new alignment then tracks north and meets KY-480 (Cedar Grove Rd), following its alignment to the east for a short distance before splitting off to the north on a new alignment. From there it closely follows the Alternative 1 alignment, including all the same new interchanges between US-31E (Bardstown Rd) and KY-362 (Aiken Rd). The Alternative 2E alignment then shifts to the east, intersecting with KY-53 before terminating at a new I-71 interchange to the east of the existing interchange at KY-53 (1st Street).

At the southern end of the corridor, from the new I-65 interchange to where the alignment deviates from the existing KY-480 alignment, the roadway will be new and/or improved to include 2 lanes in each direction, but will be designed for a slower, 45-mph speed limit. This section will also allow for direct access (non-interstate section).

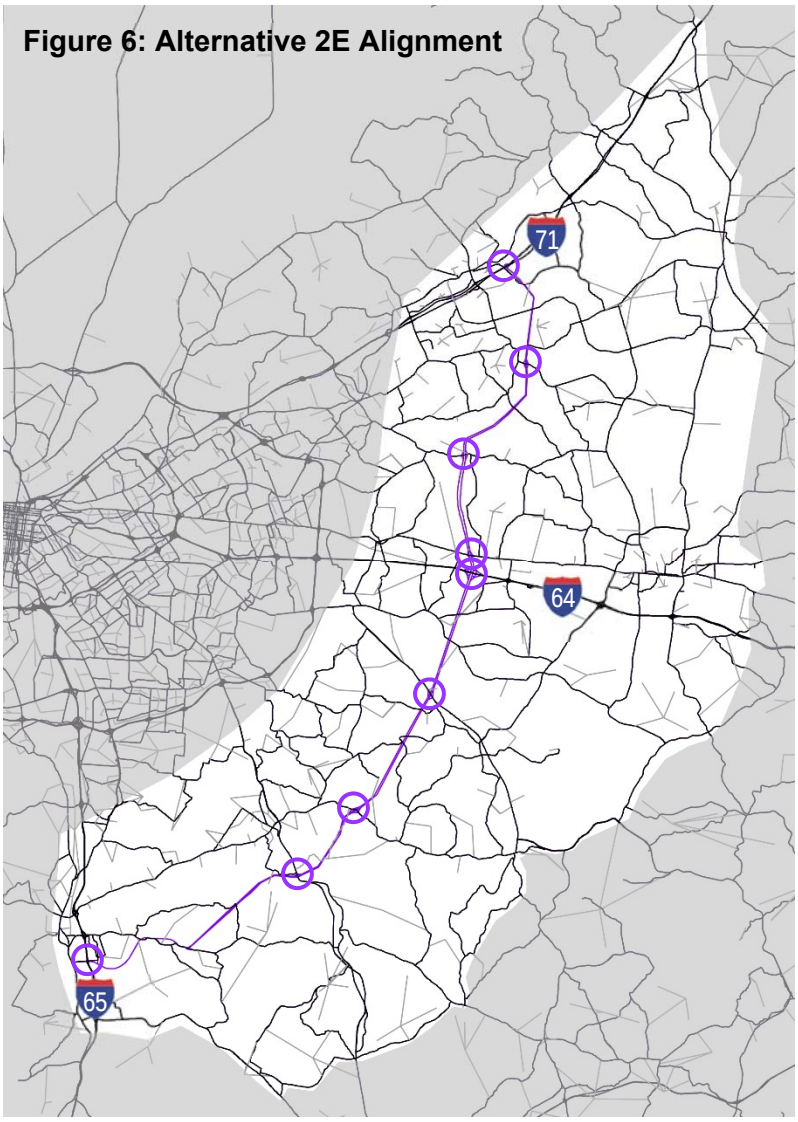


Figure 6: Alternative 2E Alignment

From KY-480 north to the new I-71 interchange, the new alignment will be designed as a 4-lane interstate, with a 65-mph speed limit. The entire alignment will include 9 new interchanges, as shown in **Figure 6**.

Interchange Locations

- I-65
- US-31E (Bardstown Rd)
- KY-44 (Mt. Washington Rd)
- KY-155 (Taylorsville Rd)
- I-64
- US-60 (Shelbyville Rd)
- KY-362 (Aiken Rd)
- KY-53
- I-71

Alternative 3C

Alternative 3C provides the easternmost alignment; farthest from the I-264 outer ring, although the tie-in points at both I-65 and I-71 match the locations along the Alternative 2E alignment (south of KY-480 along I-65 at the south end, and east of KY-53 along I-71 at the north end). Also similarly to Alternative 2E, this alignment follows the existing KY-480 alignment for some distance. At the junction of KY-480 and Brownington Road, however, this alignment continues more directly east, before turning north and eventually intersecting I-65 to the west of KY-55 (Taylorsville Rd).

As with Alternative 2E, Alternative 3C is expected to be designed as a new and/or improved 4-lane section from I-65 to the point where it splits from the existing KY-480 alignment. It will have a posted speed of 45 mph, and will allow direct driveway access. Beyond the KY-480 alignment, the roadway will be a new 4-lane interstate, with a 65 mph posted speed. A total of 10 new interchanges are included in this alternative, as shown in **Figure 7**.

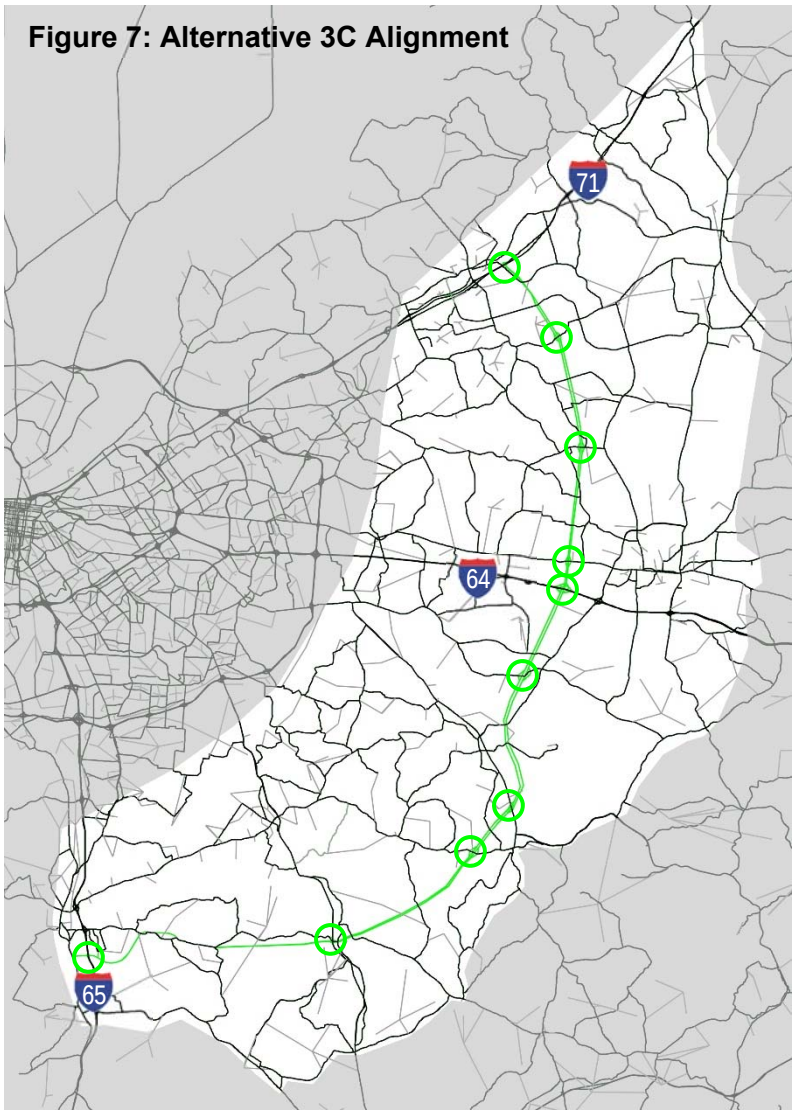


Figure 7: Alternative 3C Alignment

Interchange Locations

- I-65
- US-31E (Louisville Rd)
- KY-44 (Mt. Washington Rd)
- KY-55 (Taylorsville Rd)
- KY-148 (Fisherville Rd)
- I-64
- US-60 (Shelbyville Rd)
- KY-362 (Aiken Rd)
- E State Hwy 22
- I-71

Alternative 5

Alternative 5 is the only proposed solution that does not include any new freeway segments. More of this alternative follows existing alignments compared to the other three alternatives. At the south end, the alignment follows KY-44 from I-65 over to the west side of Mt. Washington. A new bypass road is proposed to divert the alignment to the south around the City. From there, the roadway would be mostly new, with a short segment aligning with existing KY-55 near the Spencer/Shelby County line. At the existing junction of Clark Station Road with Bear Creek Road, the alignment follows Bear Creek Road to I-64 where there is an existing interchange. North of I-64, there are various sections of new alignment and improved roads on existing alignments up to the newly built La Grange Parkway. Alternative 5 follows La Grange Parkway to I-71 where a new interchange is expected to be built. This proposed interchange was included as a no-build improvement, and is included in all of the alternatives.

Along all sections of Alternative 5, whether new alignment or improved existing alignments, the roadway is expected to be designed as a 4-lane highway, with direct access allowed. The posted speed along the corridor will be 55 mph.

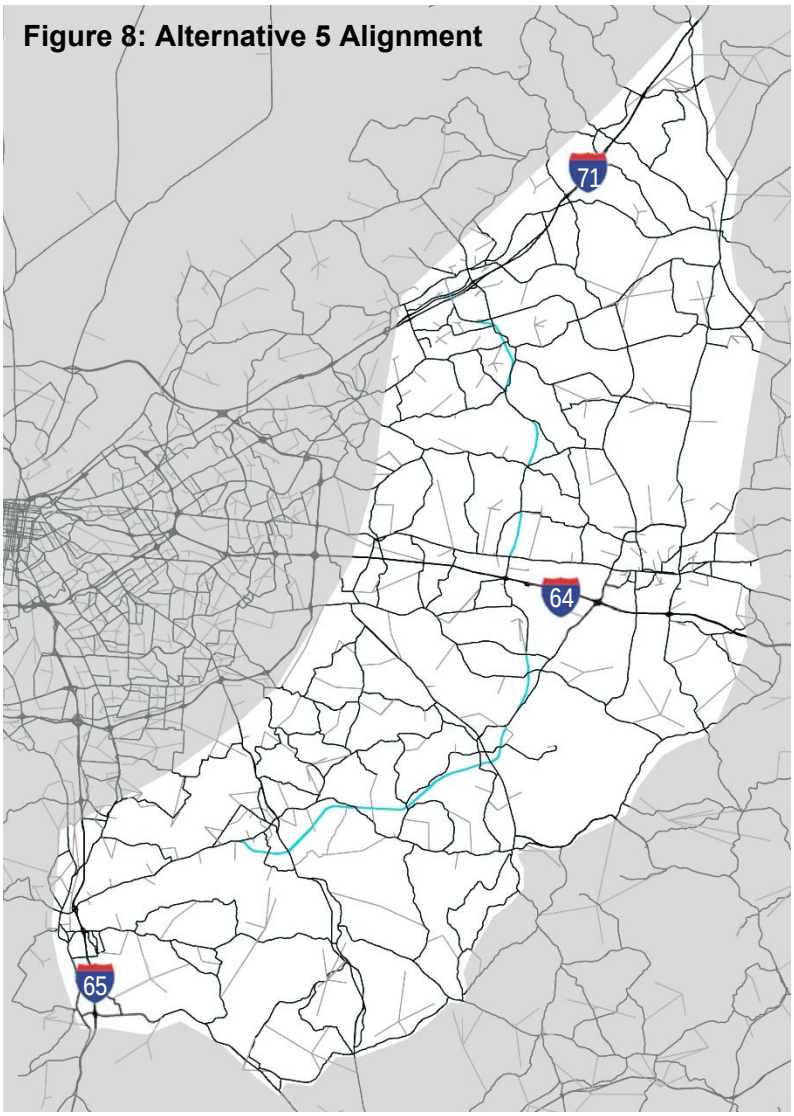
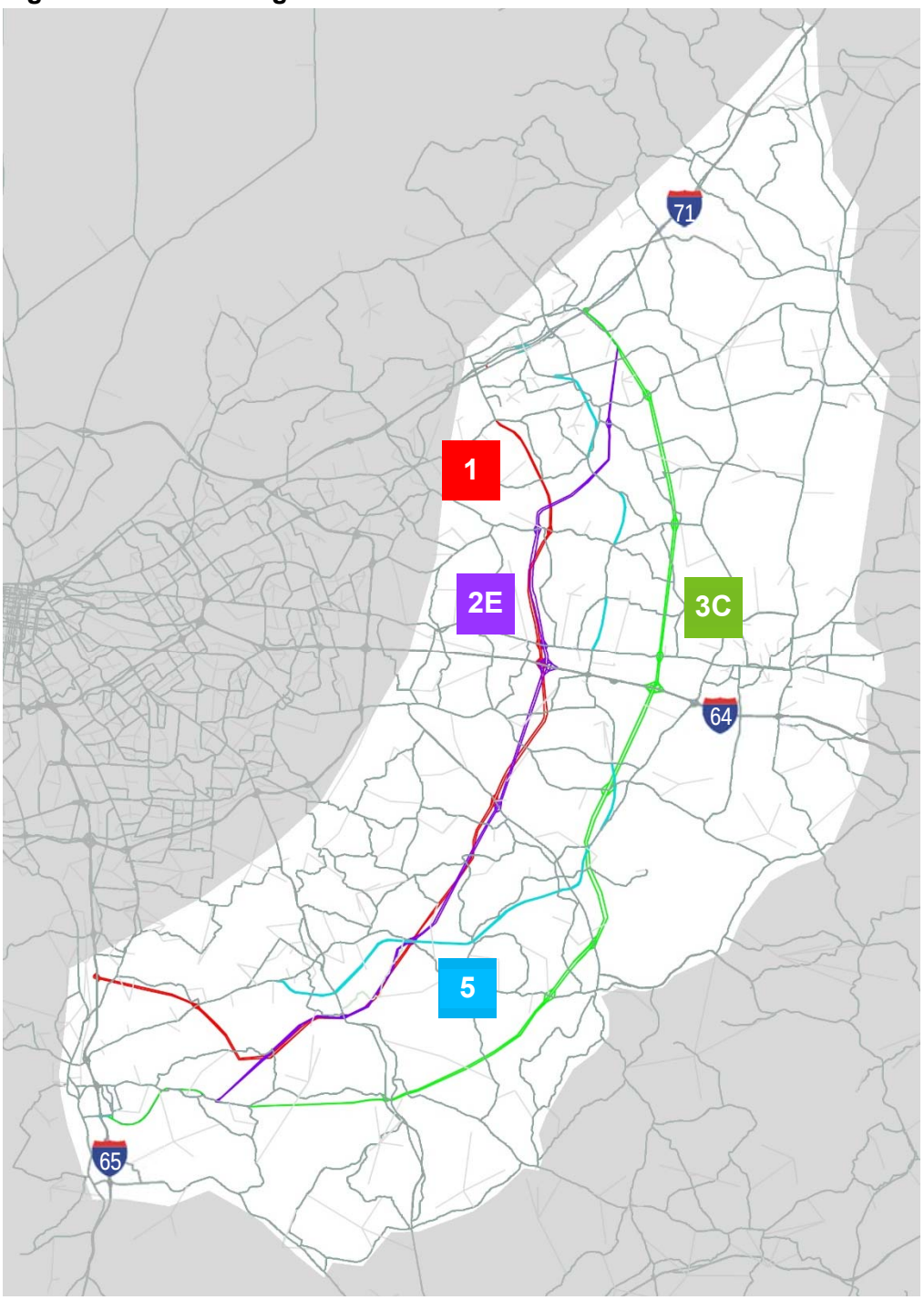


Figure 8: Alternative 5 Alignment

Comparison

For comparison purposes, **Figure 9** shows all four alternative alignments.

Figure 9: Feasible Alignment Alternatives



Land Use Shifts

For Alternatives 1, 2E, and 3C, it was presumed that future population and employment growth could have a tendency to migrate towards those new freeway alignments. Therefore, some additional land use adjustments were made among the different alternative runs. Alternative 5, because it does not contain any freeway segments, was analyzed using the same land use as the No Build Alternative.

Figure 10 shows each of the three freeway alignments and the assumed shift in households, as compared to the No Build. As shown, control totals were maintained by shifting households from TAZs falling outside the study area to TAZs within the study area along the new alignments. The same household shifts were incorporated into all three model run alternatives.

For employment, however, because retail growth (in particular) can be expected to occur in close proximity of the new interchanges, each of the three alternatives was adjusted differently, based on where those new interchanges would fall. **Figure 11** illustrates the different employment shifts for each of the freeway alternatives. Several TAZs outside the study area were adjusted to decrease employment, and several TAZs along the new alignments were adjusted to increase employment.

Figure 10: Future Household Shifts for Freeway Alignments

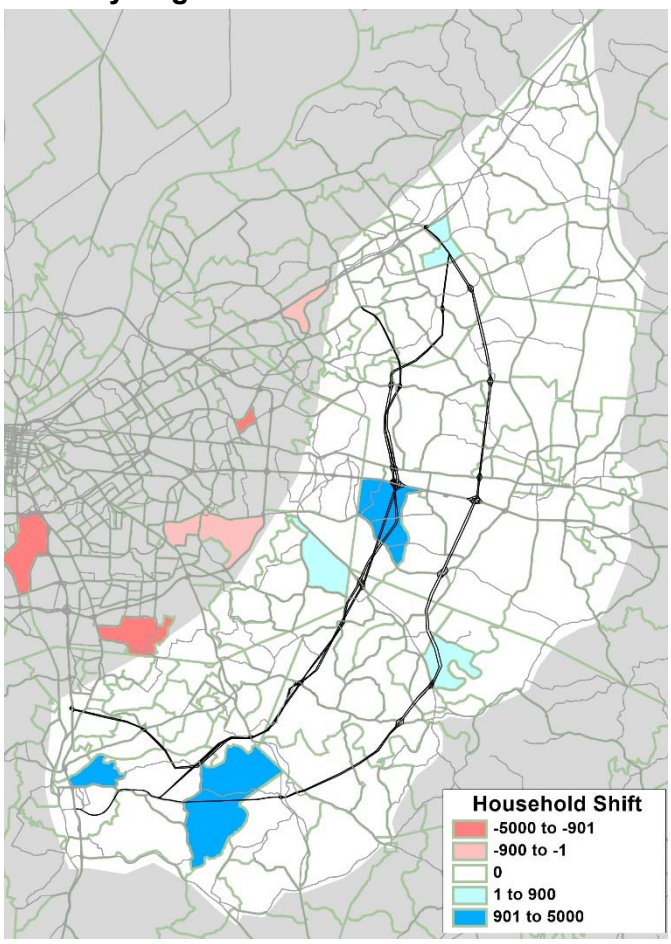
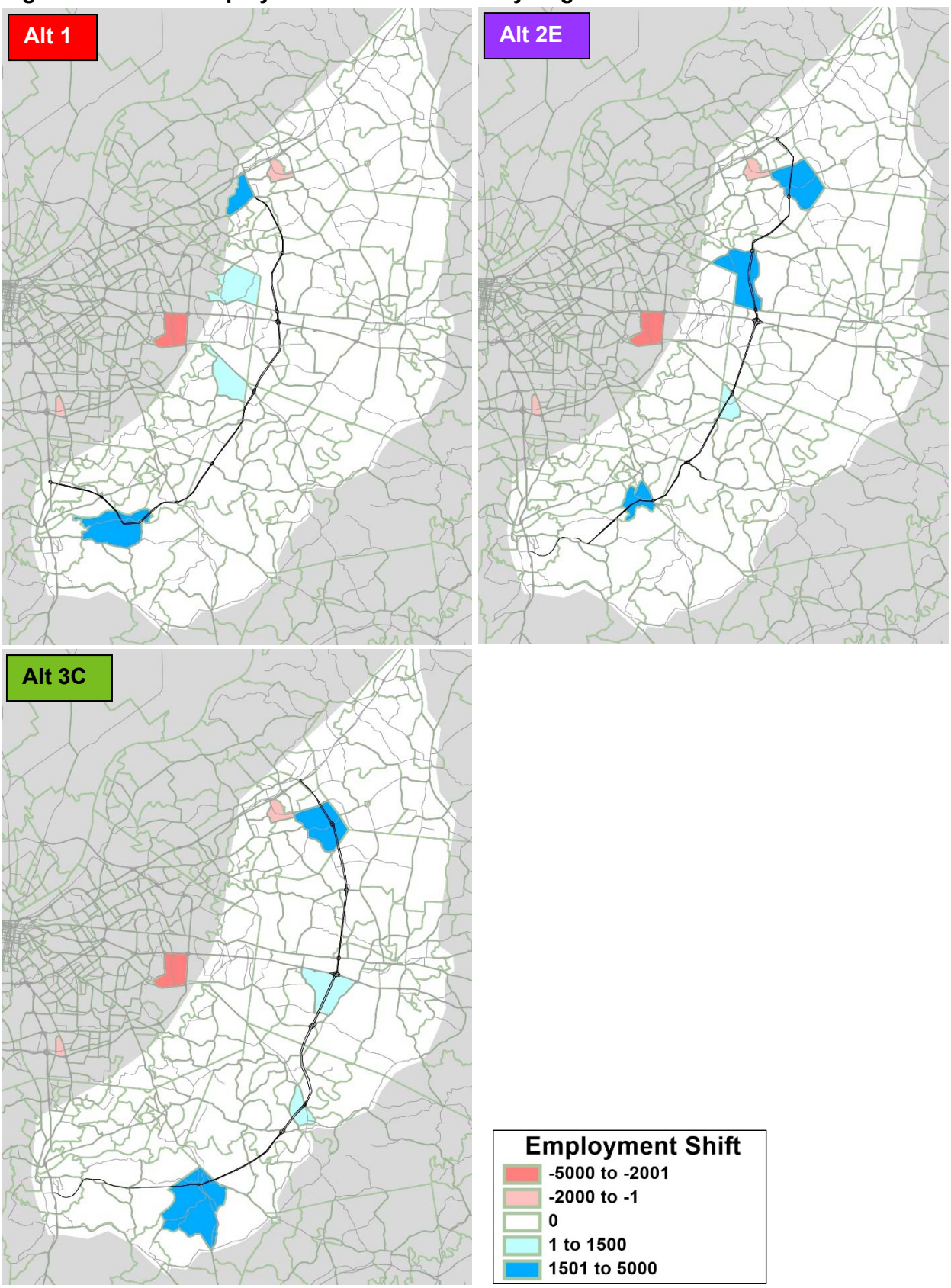


Figure 11: Future Employment Shifts for Freeway Alignments



Modeling Results

The travel demand model (TDM) outputs provide system metrics that can be used to compare the alternatives to each other. These include:

- **Total Daily Volume** – this enables comparison of which alternatives attract the most volume, and which reduce volumes the most on existing parallel facilities.
- **Change in Vehicle Hours Travelled (VHT)** – this essentially reports on the change in delay, and allows comparison of which alternatives reduce delay the most throughout the system.
- **Change in Vehicle Miles Travelled (VMT)** – this metric reflects both the capacity and the performance of the system; the alternatives that are better performing and have more capacity will generally result in more trips and higher VMT. Alternatively, VMT can also be an indicator of travel distance; vehicles having to travel farther out of direction to reach their destination may show an increase in VMT.
- **Level of Service** – this enables comparison of which alternatives perform better: which alternatives improve conditions along the most facilities.

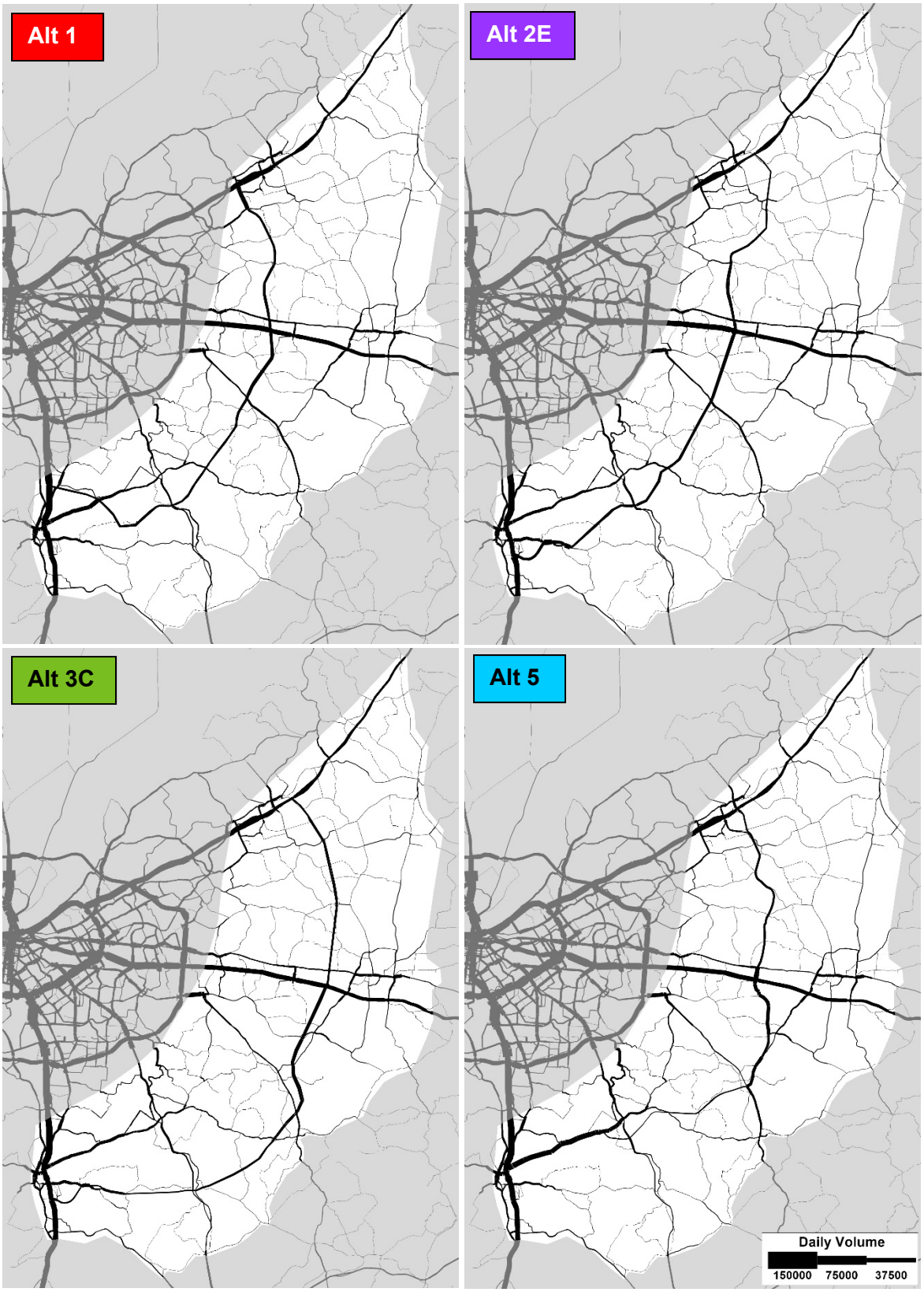
Total Daily Volume

Each of the alternatives would attract a significant amount of diverted traffic, although the amounts and locations along the corridor would vary. For instance, at the northern end, where the new alignments meet I-71, Alternative 1 would attract 35,000 vehicles, while each of the other alternatives would only carry 26,000 or fewer vehicles. Near the center of the corridor, in the vicinity of I-64, is where all of the alternatives would have their highest volumes; from 35,000 for Alternative 3C to 44,000 for Alternative 5.

The segment of KY-44 between I-65 and KY-1526, near the south end of the corridor, is an existing facility that is projected to carry 27-34,000 vehicles per day (vpd) under the 2040 No-Build conditions, which is above capacity. Both Alternatives 2E and 3C would provide some relief to this corridor by reducing the daily volumes to the range to 25-26,000. Alternative 1 would keep volumes at approximately the same level as the No Build scenario, and Alternative 5, which uses that segment of KY-44 as part of its alignment, shows large forecasted increases in volume; with a total ADT in the range of 40-41,000 vpd.

Figure 12 shows a bandwidth plot of daily volumes for all four future alignment scenarios. Variations in line widths between maps indicate volume differences between the alternatives, including those discussed above. For more detailed volume figures, see Appendix A.

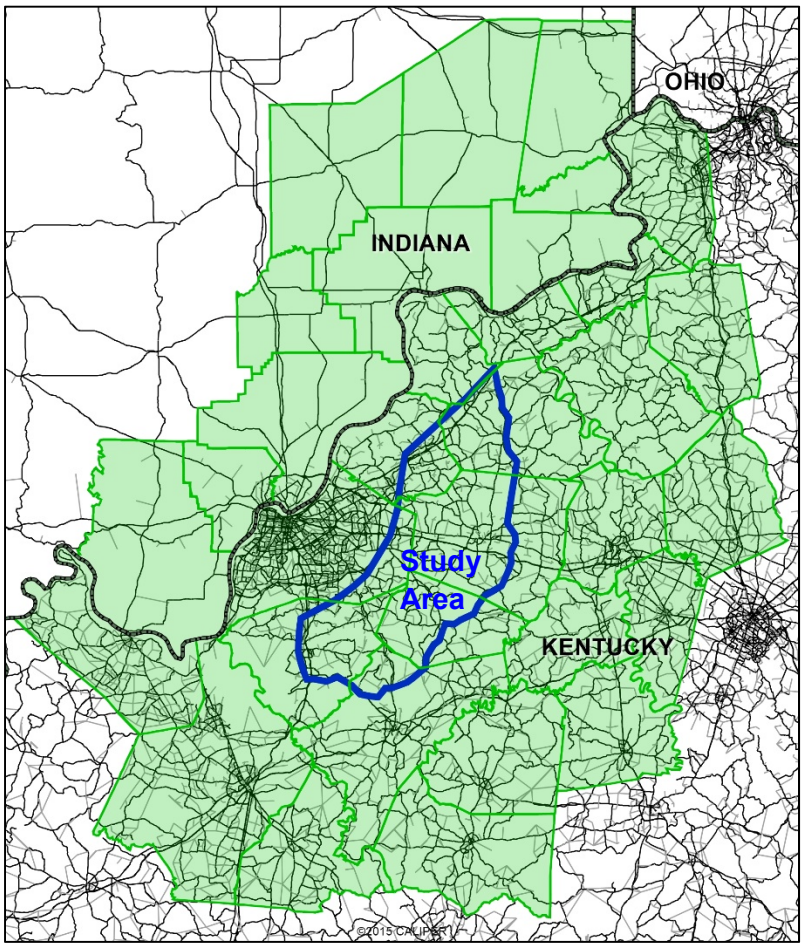
Figure 12: Daily Volume Bandwidth



Change in Vehicle Hours Travelled (VHT)

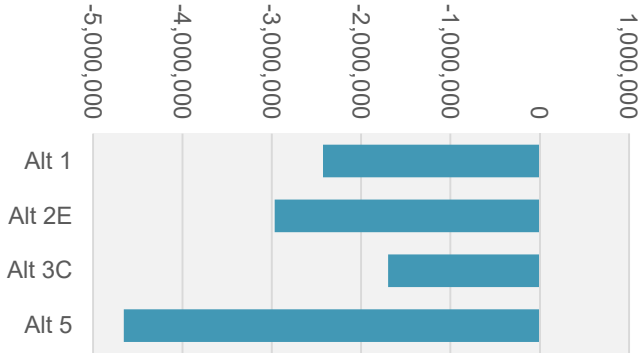
For this metric, a larger regional area was taken into account, rather than just the immediate study area. It includes 33 counties in total, within both Kentucky and Indiana. See **Figure 13** for extents of the regional area, shown in green.

Figure 13: Regional Area for System Metrics (shaded)



Within this regional area, each of the four alignment alternatives are expected to be successful in reducing delays. The total change in VHT, as compared to the future No-build scenario, are shown in **Figure 14**. As shown, Alternative 5 would have the biggest reduction (improvement) in VHT, while Alternative 3C would have the smallest reduction.

Figure 14: VHT Change from No-Build

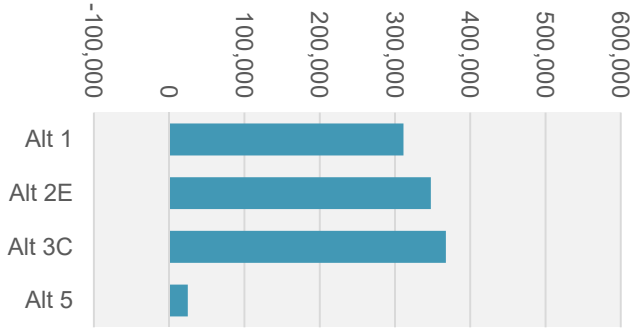


Change in Vehicle Miles Travelled (VMT)
Again, this metric considered the larger regional area shown in Figure 13.

Within the regional area, each of the four alignment alternatives are expected to have an increase in VMT. The alternative with the highest change in VMT is Alternative 3C, which is likely the result of the alignment being the farthest away from the City of Louisville. That placement may inherently be creating longer trips.

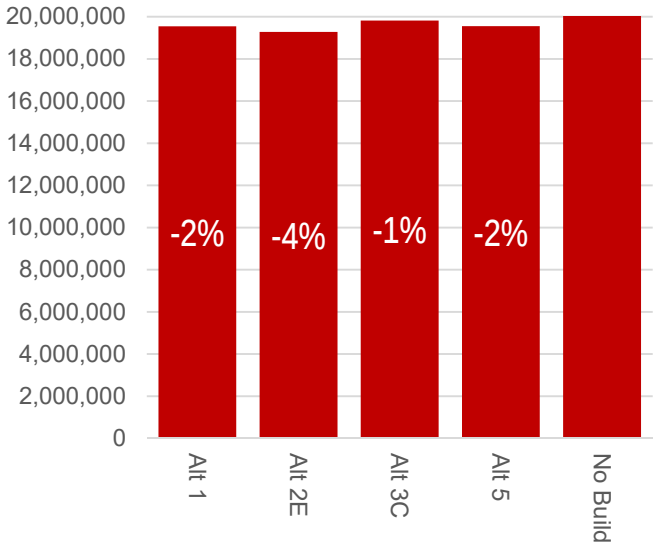
While an increase in VMT alone is not generally an improved condition, when coupled with a decrease in VHT it can be considered beneficial. Alternatives 1, 2E and 3C each have notable increases in VMT, coupled with decreases in VHT. Alternative 5 has a very modest increase in VMT, but has the largest decrease in VHT. **Figure 15** displays the comparison of each alternative alignment to the No-Build.

Figure 15: VMT Change from No-Build



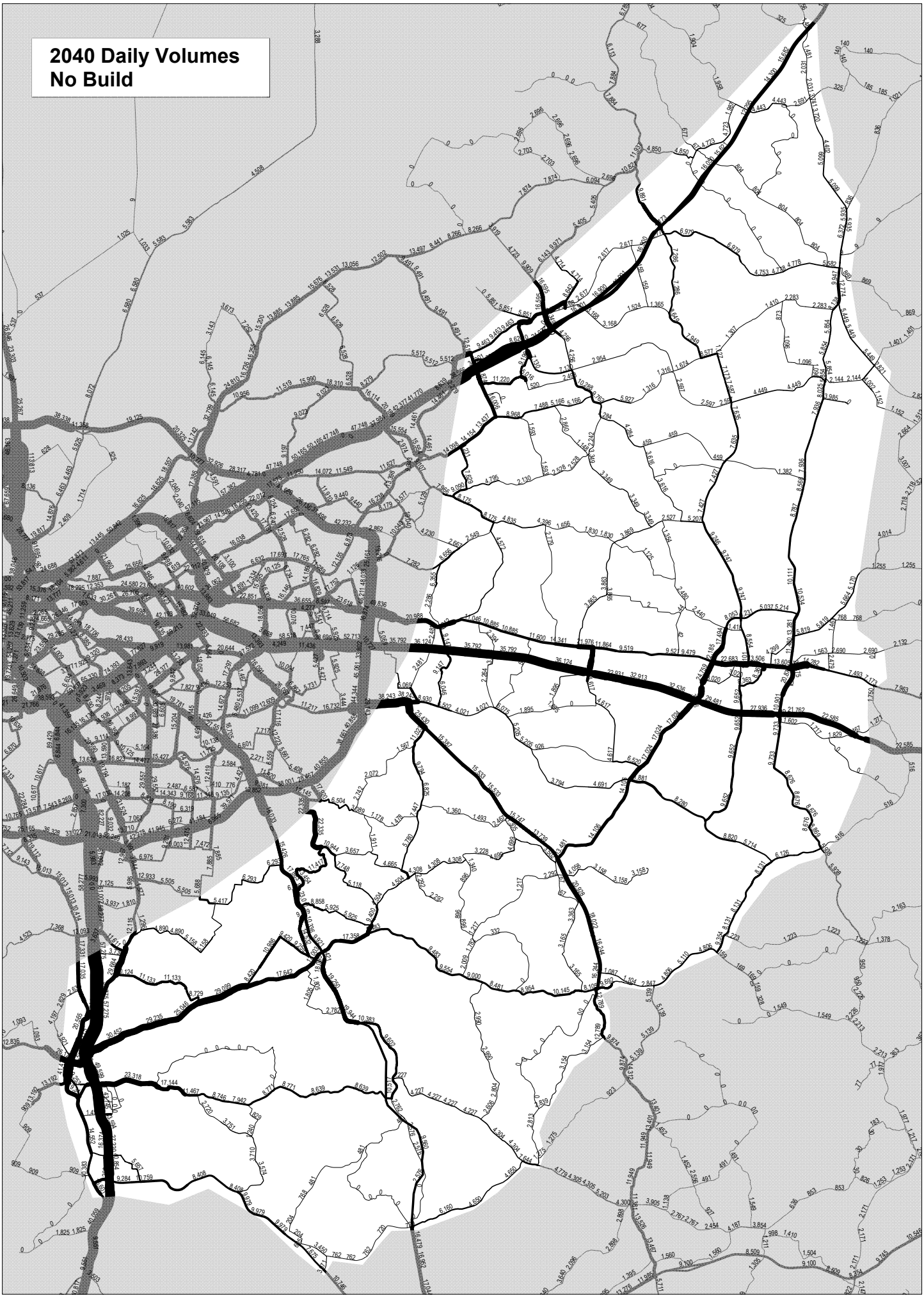
Level of Service
For this metric, the total VMT experiencing a poor level of service (LOS F), or volume-to-capacity ratio of greater than or equal to 0.9, was determined for each alignment alternative. Then those totals were compared to the No-Build scenario. **Figure 16** shows the percent change in VMT with LOS F compared to No-Build. As shown, each of the alignment alternatives shows a slight decrease in the amount of VMT at LOS F, with alternative 2E showing the greatest benefit.

Figure 16: Congested VMT (v/c >0.9) Compared to No-Build



Attachment A:

Model Forecast Volumes


2040 Daily Volumes
No Build


2040 Daily Volumes
Alternative 1


2040 Daily Volumes
Alternative 2E


2040 Daily Volumes
Alternative 3C


2040 Daily Volumes
Alternative 5