Traffic Forecasting Technical Memorandum

US 60 Connectivity Study

Item 1-80250

Prepared for:

TEAM KENTUCKY®
TRANSPORTATION CABINET

Prepared by:

Stantec

April 2024

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1. Project Description

As part of the US 60 Connectivity Study, Stantec was tasked with developing traffic forecasts to assist in the development and evaluation of improvement concepts. Historical traffic data, population trends, and a subarea model developed from the Kentucky Statewide Travel Demand Model (KYSTM) were used to develop the forecasts. Figure 1 displays the study area in red, which includes the area between Barlow, Kentucky and Cairo, Illinois.

The objective of the US 60 Connectivity Study is to examine the feasibility, costs, and impacts of extending US 60 from Barlow, KY west to I-57 near Future City, IL over the Ohio River. This memorandum presents the methodology and assumptions used in the development of the traffic forecasts for the study area.

1.1. Study Area

Mostly focused in Kentucky, the study area encompasses 16,167 acres as shown in **Figure 1**. This feasibility study was legislatively added to Kentucky's current 2022-2028 enacted highway plan with the description of "conduct a planning study for extending US 60 from Barlow, KY west to I-57 near Future City, Illinois."[1]

[1] https://transportation.ky.gov/Program-Management/2022%20Enacted%20Highway%20Plan/2022%20Enacted%20Highway%20Plan%20Combined%20Book%20June%2028%202022.pdf

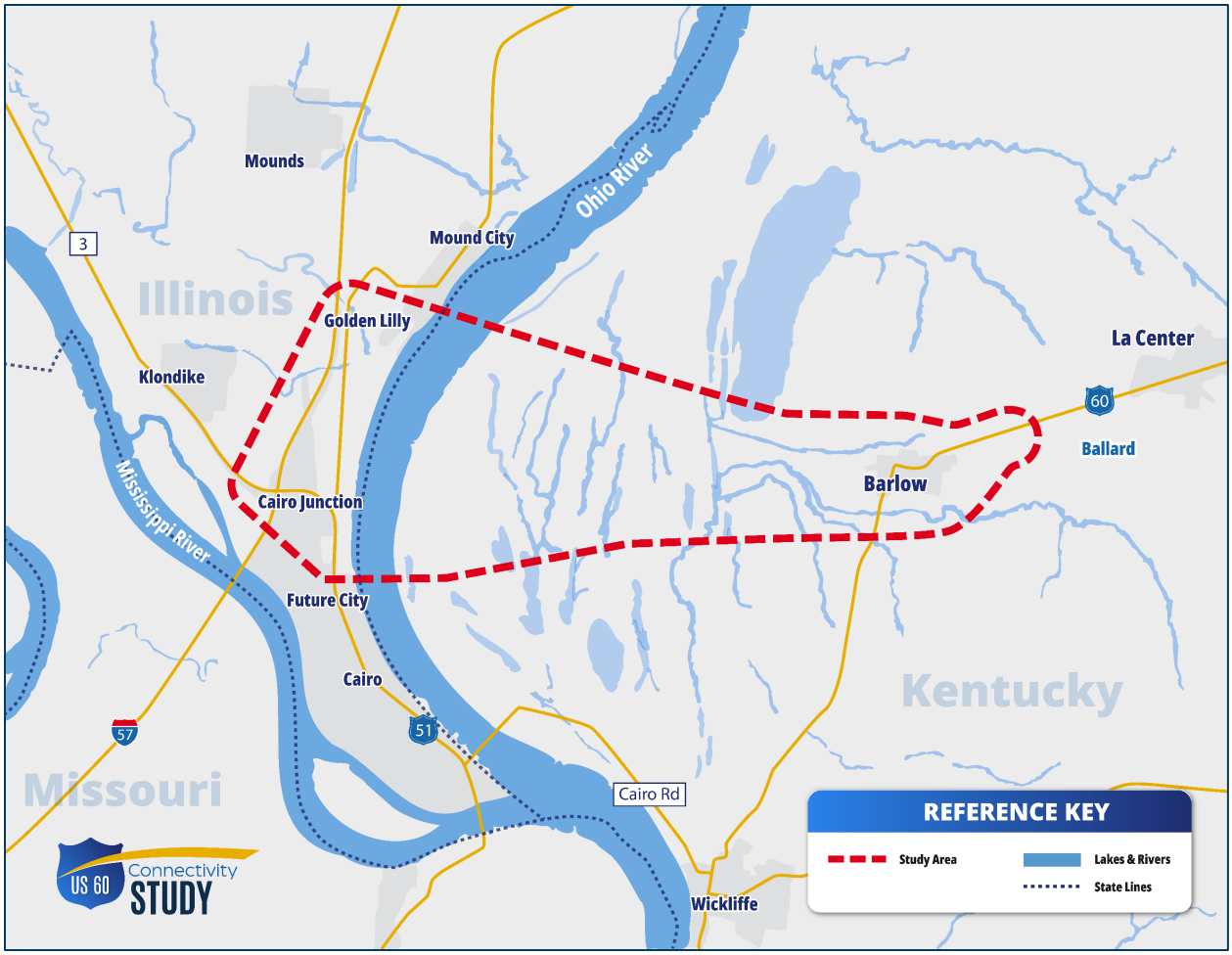

Figure 1. Study Area

1.2. Historical Daily Traffic Volumes

Historical counts from KYTC traffic count stations in Ballard County were analyzed to estimate trends in the study area. The most recent existing traffic data for the study area is displayed in **Figure 2**. The US 51 bridge currently carries 5,300 vehicles per day (VPD) across the Ohio River. Daily traffic on US 60 ranges between 2,900 VPD in Ballard County to 11,600 VPD in McCracken County.

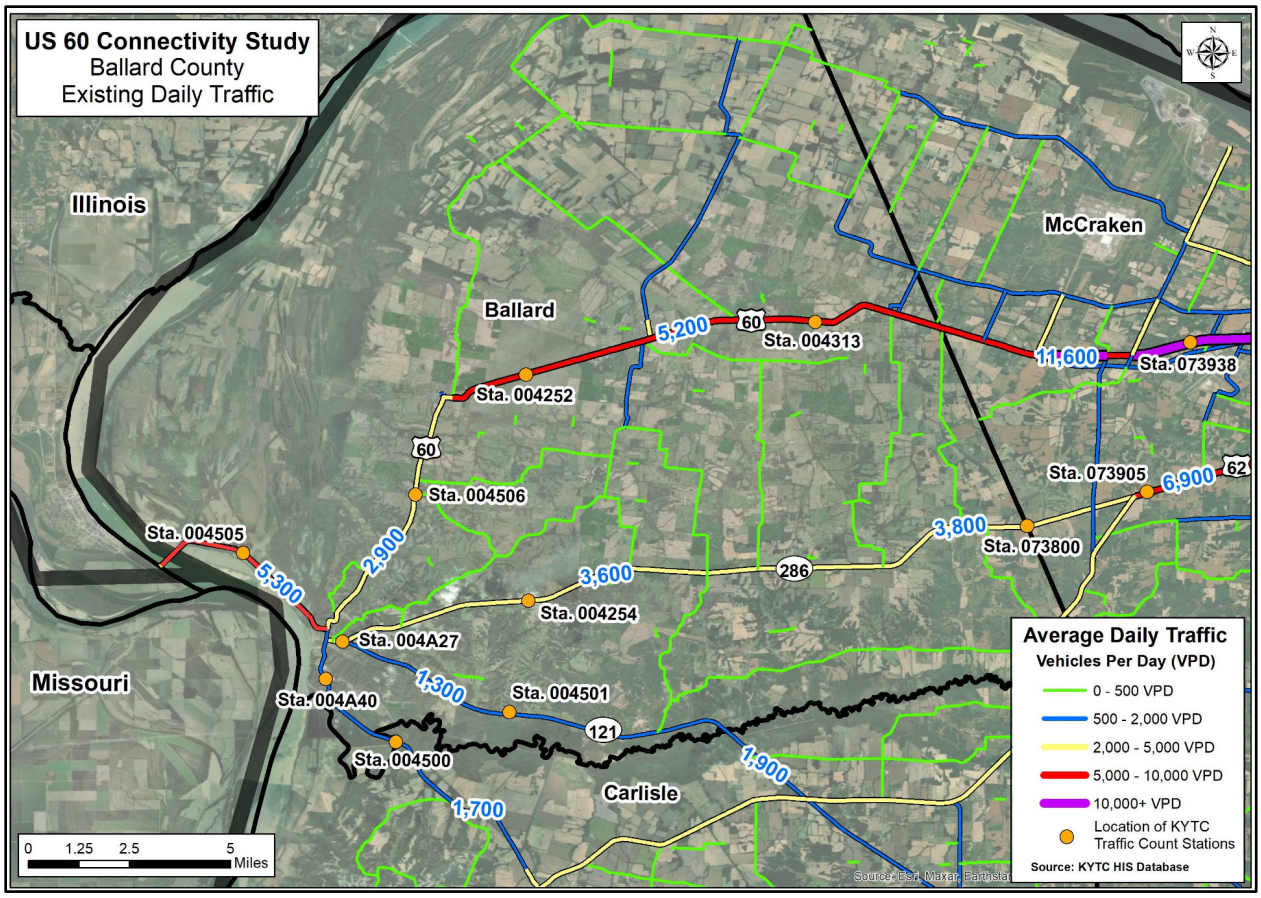

Figure 2. Study Area Existing ADT (Average Daily Traffic) Volumes

Historical ADT volumes and annual growth rates, between 2010 and 2022, for the study area are summarized in **Table 1**. **Figure 3** shows the US 60 counts graphically and **Figure 4** shows counts on US 51. The red text in **Table 1** represents traffic counts from 2020 which may not be an accurate representation of traffic patterns due to COVID shutdowns in 2020; these volumes were not used to calculate the compound annual growth rates.

Stantec collected new counts in February 2023, which are *italicized* in **Table 1** and not used in the annual growth rate calculations. These counts were converted to AADT values using KYTC's seasonal adjustment factors. Additionally, KYTC collected a new traffic count at the Kentucky approach to the US 51 crossing in August 2023, also *italicized* in **Table 1** and not used in the annual growth rate calculations. The Annual Average Daily Traffic (AADT) estimated from these counts was 6,600 VPD, compared to the previous estimates of 4,600 VPD earlier in 2023, 5,300 VPD in 2022, and 5,800 VPD in 2020. The difference in AADT values between 2020 and 2023 demonstrates significant variability in the counts collected at this

fundamental location. The significant variability in the counts indicates a potentially broader range of future crossing traffic.

There are four US 60 count stations in Ballard County, all of which have shown a decline in daily traffic since 2010. In McCracken County (Sta. 073938), US 60 showed a daily traffic increase of two percent per year. Approaching the US 51 51 Ohio River crossing, daily traffic counts on KY 121 in Ballard County have slightly increased while counts on KY 286 have increased significantly, by over five percent per year. The US 51 count stations in Ballard County showed decreases in traffic up to ten percent per year, however, the 2020 and 2023 counts show less severe declines. At the US 51 Ohio River crossing, the 2022 count did not significantly change from 2010. However, as previously mentioned, the August 2023 count shows an increase up to 6,600 VPD.

Table 1. KYTC Historical ADT Summary

Year	US 60	US 60	US 60	US 60	US 60	KY 121	KY 121	KY 286	KY 286	US 51	US 51	US 51	US 62
	Sta. 004A03	Sta.004252	Sta.004313	Sta. 004506	Sta.073938	Sta.004A27	Sta. 004501	Sta.004254	Sta.073800	Sta.004505	Sta.004A40	Sta.004500	Sta. 073905
2010				3,960			1,220			5,350			
2011			7,740		12,800			1,970	2,920		3,500		
2012	4,213											1,875	5,623
2013				3,562			1,148			4,711			
2014									3,224		3,314		
2015	4,051					4,806		2,568				1,765	6,114
2016		6,066		3,175			1,367						
2017			7,187		14,442	4,835			3,292		1,847		
2018	3,818							3,084				1,250	6,047
2019		5,547		2,923			1,303			4,840			
2020					11,649				3,836	5,800	2,488		
2021	3,794							3,609				1,707	6,858
2022		5,181								5,344			
February 2023		*4,313*		*3,185*			*1,475*	*3,359*		*4,624*	*2,294*		
August 2023										*6,596*			
Annual Growth Rate (%)	**-1.2%**	**-2.6%**	**-1.2%**	**-3.3%**	**2.0%**	**0.3%**	**0.7%**	**5.4%**	**5.2%**	**0.0%**	**-10.1%**	**-1.0%**	**2.2%**

Source: Kentucky Transportation Cabinet (KYTC)

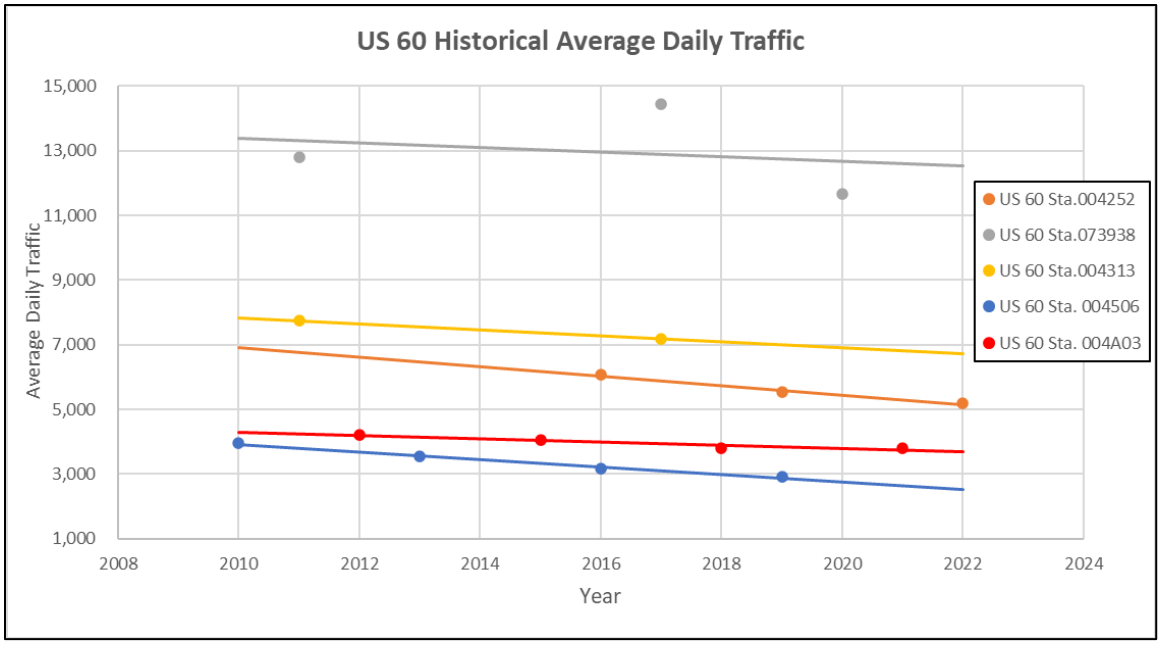

Figure 3. KYTC Historical ADT (US 60)

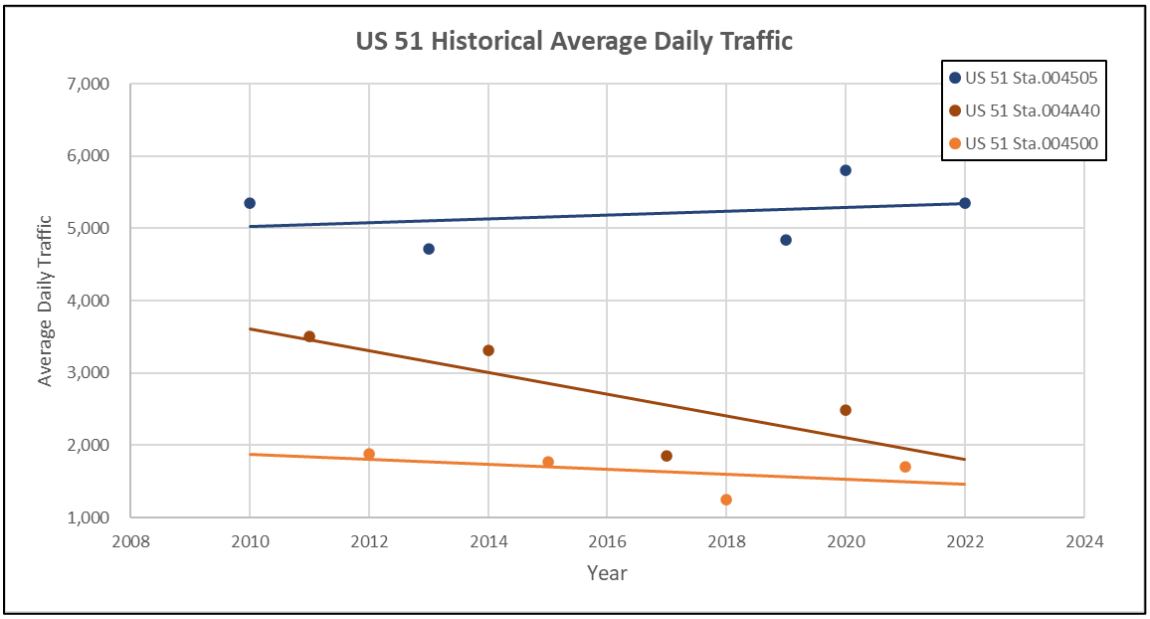

Figure 4. KYTC Historical ADT (US 51)

1.3. Population Trends

Population data, including data from the 2020 Census, were obtained from the Kentucky State Data Center (KSDC) at the University of Louisville, Kentucky's official clearinghouse for Census data. Population estimates for the state of Kentucky, Ballard County, Wickliffe, Kevil, and LaCenter are summarized in **Table 2**. Between 2000 and 2020, population in Wickliffe and LaCenter decreased, while population in Kevil has grown slightly, as shown in **Figure 5.** During the same period, population in Ballard County has declined at a Compound Annual Growth Rate (CAGR) of -0.35 percent and is projected to decrease at a CAGR of -0.90 percent per year between 2020 and 2050, as shown in **Figure 6**.

Table 2. Population Estimates and Projections

Area	Census Estimates			Annual Growth	2050 Projection	Annual Growth
	2000	2010	2020	2000-2020		2020-2050
Kentucky	4,041,769	4,339,367	4,505,836	0.54%	4,785,233	0.20%
Ballard County	8,286	8,249	7,728	-0.35%	5,891	-0.90%
Wickliffe	739	689	654	-0.61%	N/A	
Kevil	421	613	595	1.74%	N/A	
LaCenter	1048	1009	863	-0.97%	N/A	

Source: Kentucky State Data Center (KSDC)

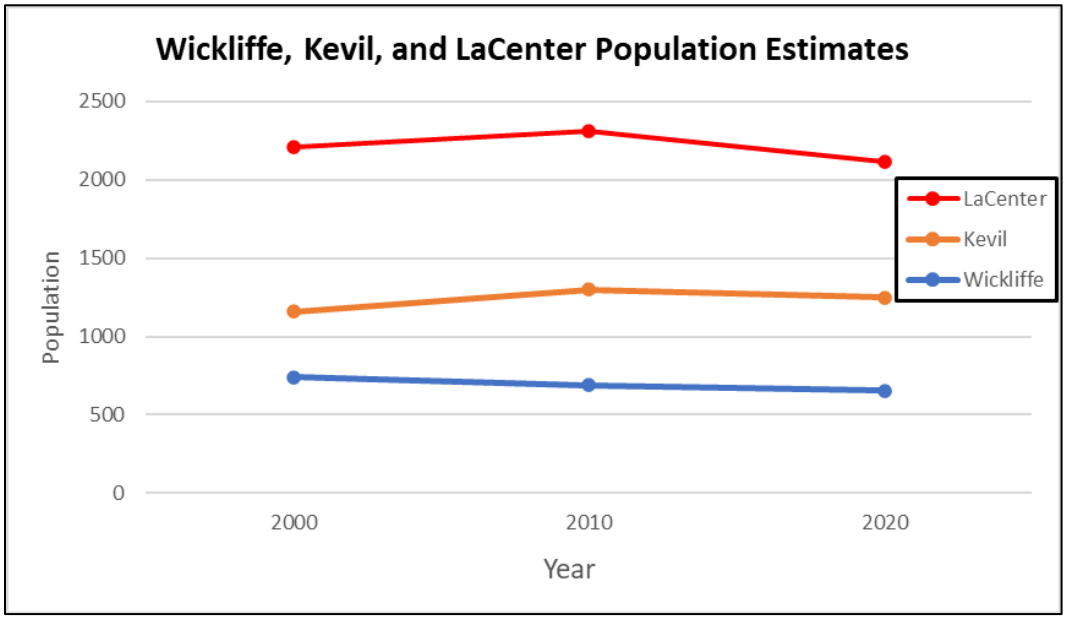

Figure 5. Wickliffe, Kevil, and LaCenter Population Trends

Source: Kentucky State Data Center (KSDC)

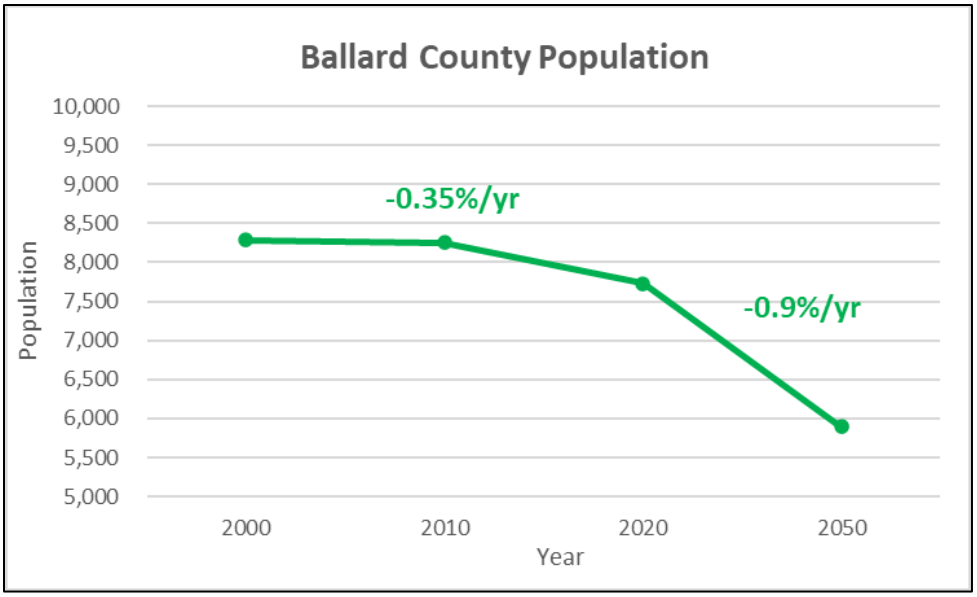

Figure 6. Ballard County Population Trends

Source: Kentucky State Data Center (KSDC)

Historically, the population in Illinois has increased each decade, except between 1980 and 1990, and again between 2010 and 2020, when it experienced no growth, a trend anticipated to continue through 2030. In contrast, the population in Alexander and Pulaski counties experienced a decline in all but one of the decades (1970 to 1980) reviewed. Alexander County experienced a steep decline in population from 2010 to 2020, when it experienced nearly a 40% decline in population. The population in the area is estimated to continue to decline through 2030, with a sharp 23% decline estimated in Pulaski County, and minor 1% decline predicted for Alexander County, as shown in **Table 3.**

Table 3. Illinois Population Trends & Projections

	Illinois		Alexander County		Pulaski County	
Date	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**
1960	10,081,158	-	16,061	-	10,490	-
1970	11,113,976	10%	12,015	-25%	8,741	-17%
1980	11,426,518	3%	12,264	2%	8,840	1%
1990	11,430,602	0%	10,626	-13%	7,523	-15%
2000	12,419,293	9%	9,590	-10%	7,348	-2%
2010	12,830,632	3%	8,238	-14%	6,161	-16%
2020	12,812,508	0%	5,240	-36%	5,193	-16%
2030	12,789,999	0%	5,201	-1%	3,980	-23%
2040	-	-	-	-	-	-
2050	-	-	-	-	-	-

**Source: U.S. Census Bureau through 2020; Illinois Department of Public Health 2030*

1.4. Subarea Assignment Model Development

The location of the study area in a rural part of the region at the state border presents a specific challenge for the Kentucky Statewide Traffic Model, Version 19 (b.20220912) (KYSTMv19), a large model intended to provide traffic assignments for the entire state. Further, because it was developed to prioritize the accuracy of in-state traffic, cross border trip assignments are supplemented with special trip generation stations located outside state boundaries to ensure reasonable traffic assignments are reflected at the state lines (particularly at river crossings where traffic demand tends to be more concentrated). For these reasons, the project team determined that the development of a subarea assignment model using a small subsection of the KYSTM model network and trip tables estimated from observed traffic counts was the preferred option for developing build traffic forecasts.

Unlike a conventional four-step demand model like the KYSTM, a subarea assignment model does not independently generate nor distribute trips. Base year trip tables are estimated using an algorithm that uses observed traffic counts to iteratively adjust an initial "seed matrix" until the trip assignments produced by the final iteration of the trip table best matches observed counts. The following steps were used to create the base year subarea model.

1. A subarea of the KYSTMv19 network covering an expanded area around the project study area was extracted. The network includes the existing Ohio River crossing and the next competing crossing, I-24 in Paducah. The network includes the interstates, US highways, and major state routes in the following counties:

Ballard County, KY	Graves County, KY (Northwest of Mayfield)
Carlisle County, KY	Pulaski County, IL
McCracken County KY (west of I-24/ US 45)	Johnson County, IL
Alexander County, IL	Massac County, IL
Mississippi County, MO	Pope County, IL

Figure 7 presents a map of the subarea model network.

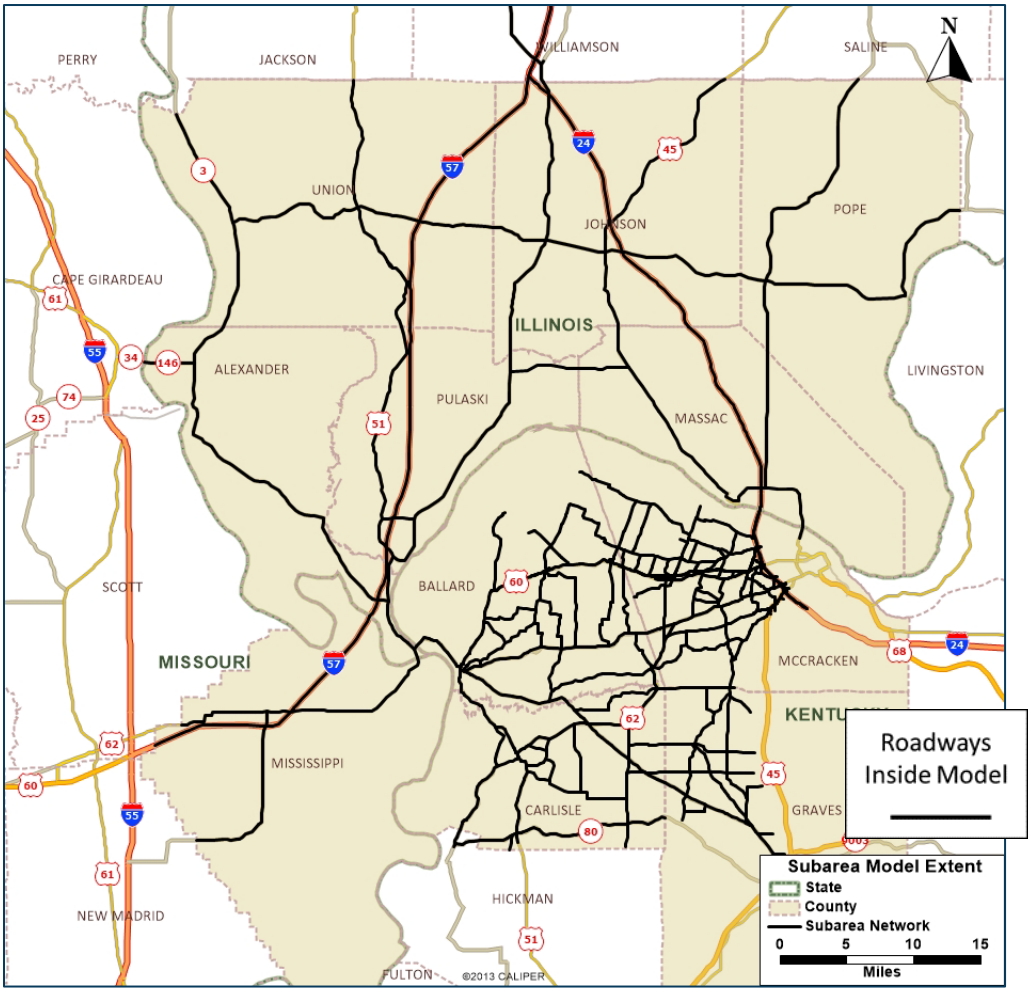

Figure 7. Subarea Model Network

2. In addition to the subarea network, an assigned trip matrix correlating to this network was also extracted from the KYSTM. This matrix includes 158 rows and columns, with each row and column pair representing either an external node or internal centroid where trips assigned by the KYSTM begin or end within the subarea. This matrix served as the seed matrix for estimating the base year subarea model trip table.

3. Using count data for locations throughout subarea network and the seed matrix, TransCAD's ***Origin-Destination Matrix Estimation*** (ODME) function was employed to estimate the most precise trip table possible for matching observed traffic counts. For this model, the ODME estimated trip assignments resulted in the validation statistics presented in **Table 4.** Typical validation targets for a conventional model assignment are for aggregate flow volumes to be within five percent of aggregate count volumes (Volume-to-count ratio) and a Percent Root Mean Square Error (%RMSE) under 35 percent. These validation targets were satisfied.

Table 4. Subarea Model Statistics

Count Class	Count Locations	Aggregate Count Volume	Flow Volume	Volume-to-Count Ratio	%RMSE
> 10,000	33	589,040	594,811	1.01	5.9%
5,000-10,000	43	307,169	290,780	0.95	16.7%
in Kentucky	150	885,067	873,808	0.99	16.7%
Subarea - All	195	1,194,052	1,211,294	1.01	34.8%

1.5. Future Tear Trip Table Growth

Based on a review and comparison of future year socioeconomic projections between the KYSTM and the Illinois Statewide Travel Demand Model (ISTDM), it was determined that the ISTDM was best suited for reflecting future year forecast trends outside Kentucky while the KYSTM was best suited for reflecting future year forecast trends inside Kentucky. **Figure 8** shows the number households and **Figure 9** shows the employment numbers estimated between the years 2015 and 2045. Socioeconomic data from the KYSTM was used for the Kentucky zones and data from the ISTDM was used for the Illinois and Missouri zones.

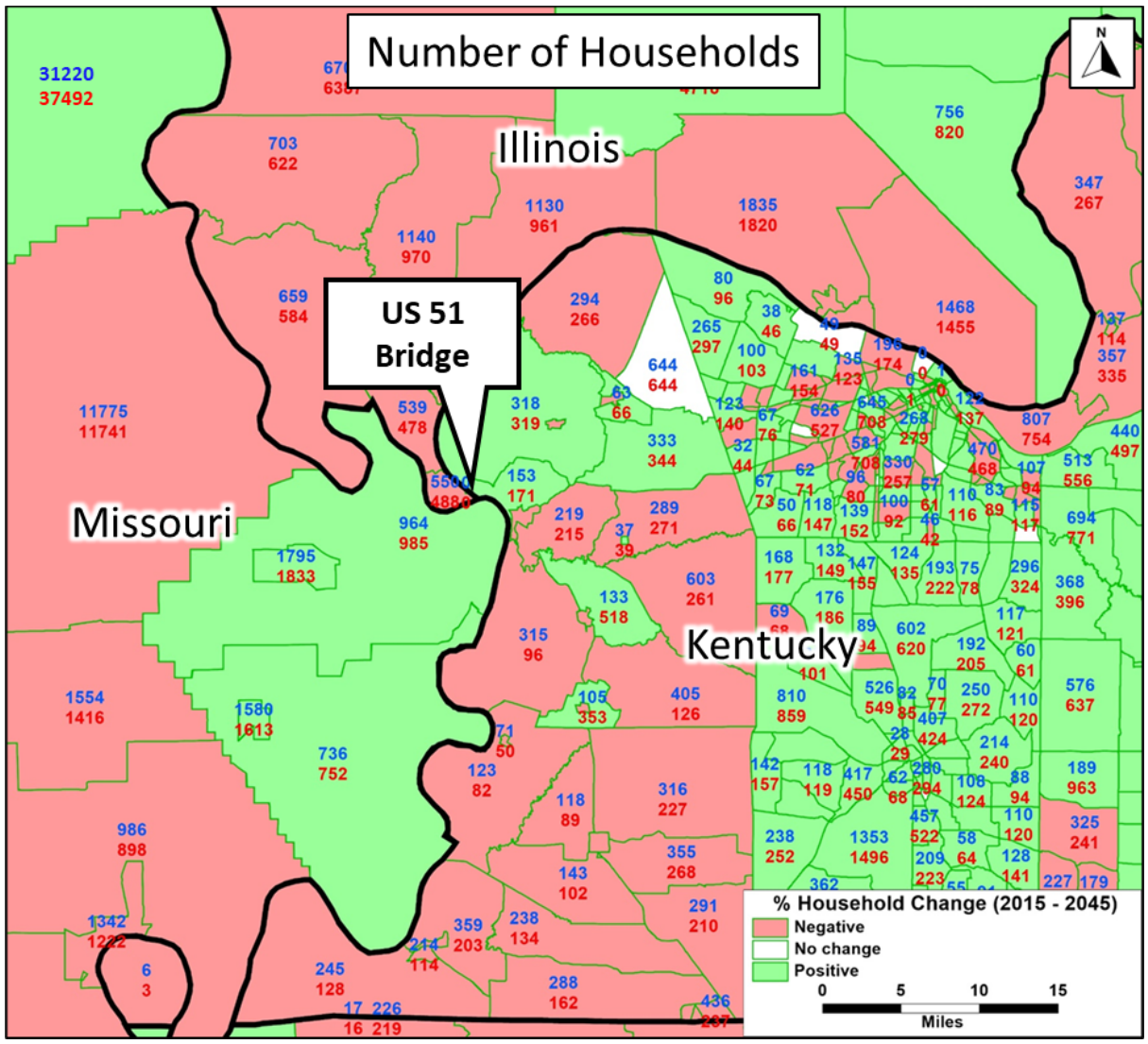

Figure 8. Change in Household between 2015 and 2045

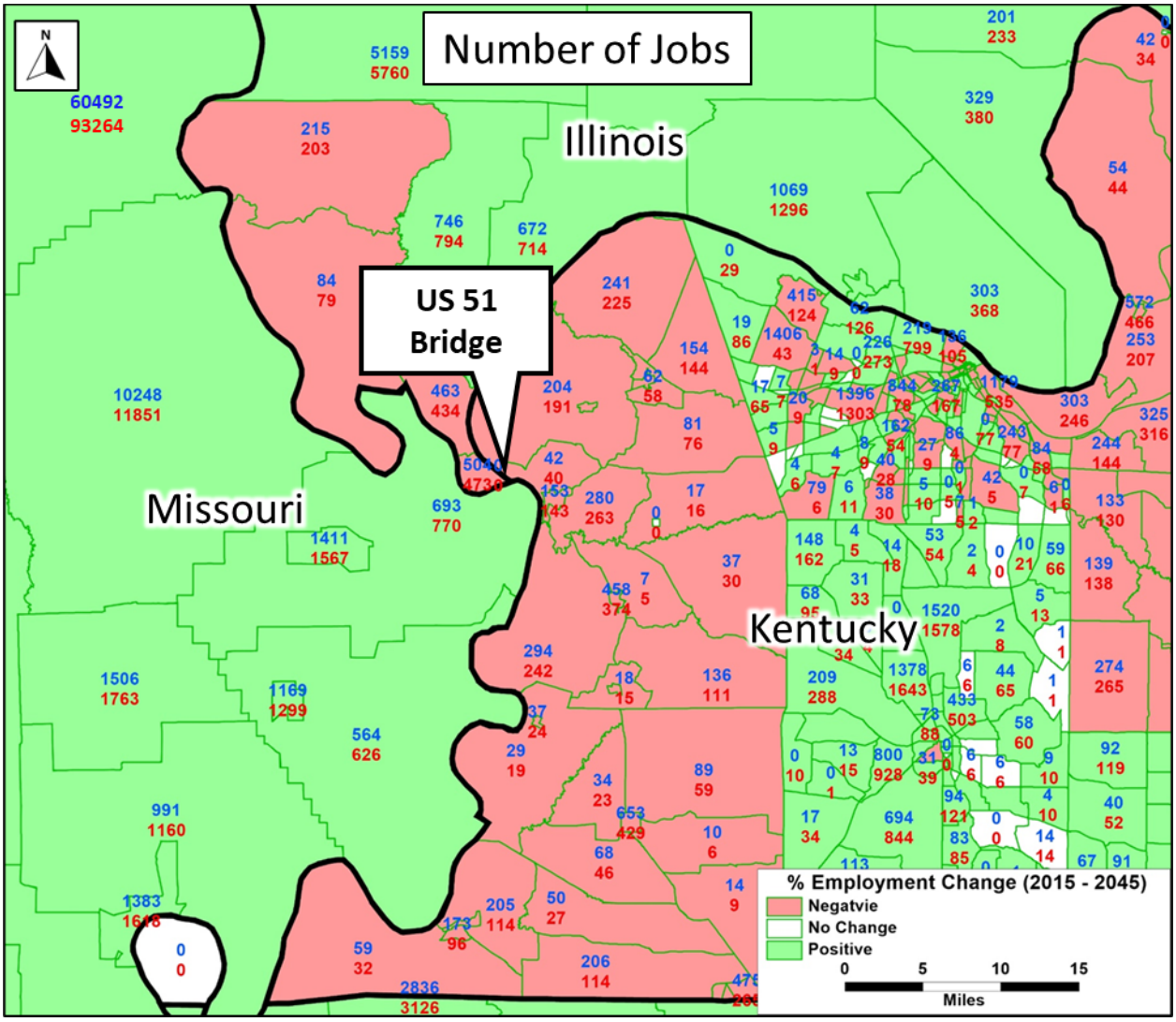

Figure 9. Change in Employment between 2015 and 2045

The following steps were taken to combine the two respective model analyses and apply them to develop future year trip tables for the sub area model.

1. The base and future year traffic assignments for network links of both models on the respective sides of the subarea network (KYSTM assignments for Kentucky links, ISTDM assignments for Illinois and Missouri links) were used to estimate a CAGR for each respective link. The CAGRs for ISTDM links in Illinois and Missouri are positive and moderate, with almost all under one percent annual growth. In contrast, the CAGRs for KYSTM links in Kentucky range from negative values to annual rates as high as three percent, as shown in **Figure 10**.

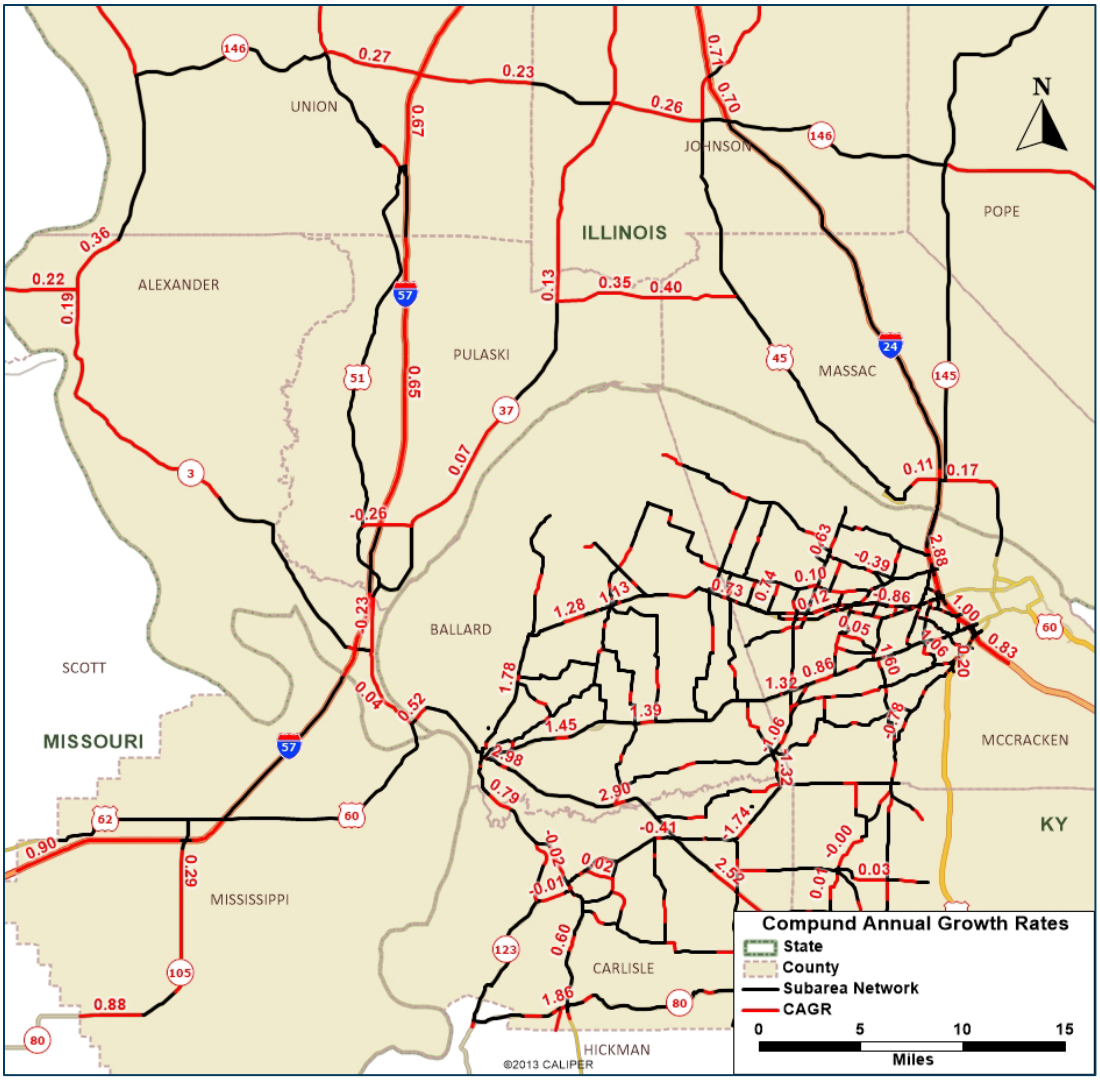

Figure 10. Subarea Model Compound Annual Growth Rates (CAGR)

2. The CAGR for each link with a traffic count over 1,000 VPD (195 links total) was applied to the observed counts to estimate a 2045 future volume.

3. A new ODME trip table was developed using the 2045 future volumes from Step 2, using the 2023 ODME base year trip table as the seed matrix.

1.6. Future Year Subarea Model Assignments

Using the 2045 ODME trip table, trip assignments were run for a network scenario with the existing crossing for US 51 remaining at its current location ("US 51") and for a network

scenario extending US 60 due west from Barlow to a new crossing connecting to US 51 near Future City, Illinois ("New Xing"). **Figure 11** presents the assignment volumes for these two scenarios, along with assignments from the 2023 base year. The 2023 assignments were developed using KYTC daily traffic counts collected in 2022 or earlier. The 2023 counts were considered in the development of the final traffic forecasts.

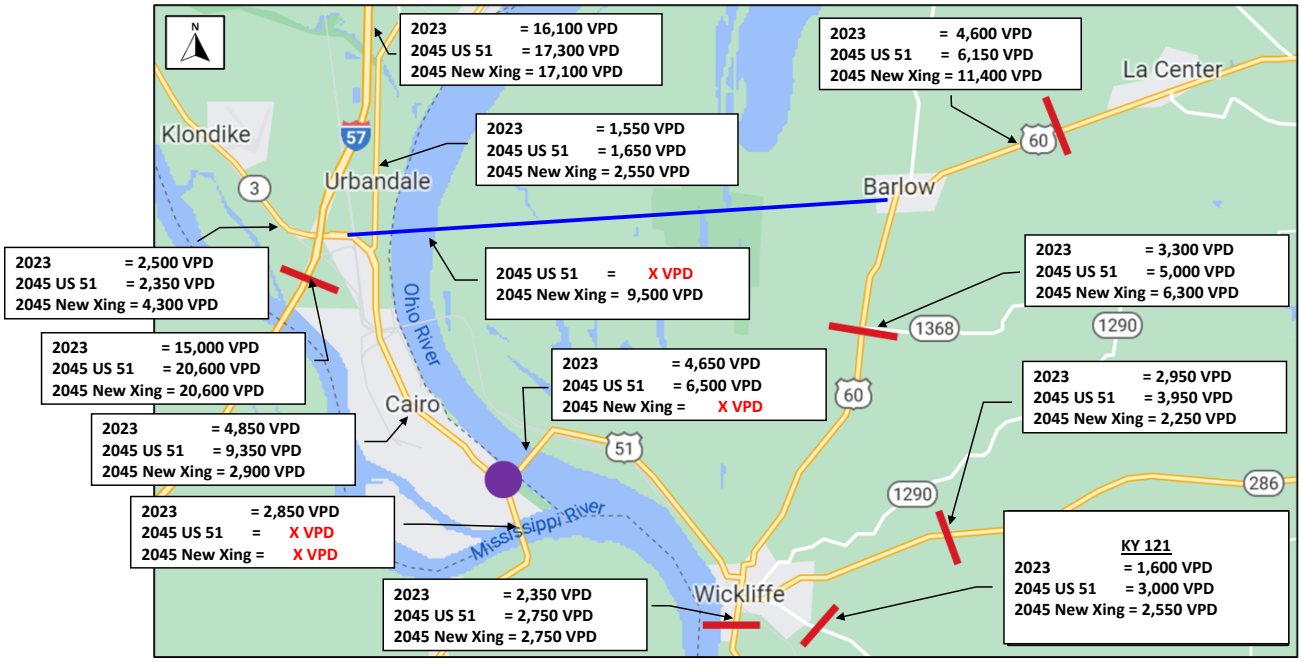

Figure 11. Subarea Model Assignment Volumes

1.7. Economic Analysis

In November 2023, Stantec completed an **Economic Analysis** to identify potential direct and indirect benefits to the local economies and population that would likely result from the proposed US 60 crossing and upgraded approach section of US 60 from Kevil to Barlow. This analysis considered regional trends and projections of population and employment, and differences between traffic assignments of the two crossing location scenarios from the subarea model. It also reviewed changes in the pattern of economic development near Maysville, Kentucky before and after the construction of the new US 68 Ohio River bridge in 2000. While the analysis provided estimated changes in population and employment for each of the Traffic Analysis Zones (TAZs) from the KYSTM in its analysis area, the overall assessment of the analysis is that by 2045, a conceptual new crossing in the US 60 corridor would result in an approximate four percent increase in population and employment in the

region, as compared to the baseline population and employment associated with the existing crossing location. The Economic Analysis report is attached as **Appendix A**.

1.8. Future Year Traffic Forecasts

2045 daily traffic forecasts were then developed based on available traffic counts, population trends, and results from the subarea model analysis. The variability in daily traffic counts at the US 51 river crossing suggests the future forecast volume at US 51 could be higher than the 2045 subarea model assignment of 6,500 VPD presented in **Figure 10**. Using the CAGR (1.5 percent) estimated from the 2023 and 2045 model assignments for the US 51 crossing presented in **Figure 10** as a growth rate, and existing counts ranging from 4,600 VPD to 6,600 VPD, the **2045 forecast year range for the US 51 crossing is 6,500 VPD to 9,200 VPD**.

Based on the economic development analysis, the 2045 baseline traffic forecast increases to 9,900 VPD at the proposed US 60 crossing. Factoring in the higher August 2023 traffic count pushes the upper limit of the 2045 traffic forecast to 12,700 VPD. **Given the variability of the traffic counts on the existing US 51 Bridge, the project team recommends a 2045 forecast range of 10,000 to 12,700 VPD at the proposed US 60 crossing.** These forecasts were developed to determine the number of lanes needed on the potential US 60 Ohio River crossing. While there is some variability in the number of existing and future daily river crossings, it was determined that two lanes will be sufficient in 2045.

Traffic forecast and economic development analysis estimates 10,000 to 12,700 VPD on the proposed US 60 crossing in the year 2045.

Appendix A:

Economic Analysis

Economic Analysis

US 60 Connectivity Study

Item 1-80250

Prepared for:

TEAM KENTUCKY®
TRANSPORTATION CABINET

Prepared by:

Stantec

April 2024

1. Introduction

KYTC Item Number 1-80250 US 60 Connectivity Study (the Project) is being completed as a Planning and Environmental Linkages (PEL) study.[1] Meaning it is taking a collaborative and integrated approach to the transportation decision-making process by considering potential environmental benefits and impacts during the planning phase. This PEL study examines the feasibility, costs, and impacts of a more direct linkage between US 60 at Barlow, Kentucky (Ballard County) and I-57 near Future City, Illinois (Alexander County) and determine if this new corridor and river crossing would offer a better long-term value to the Commonwealth than the ongoing US 51 bridge replacement project at Wickliffe (south of the study area)[2].

1.1. Study Area

Mostly focused in Kentucky, the study area encompasses 16,167 acres as shown in **Figure 1**. This feasibility study was legislatively added to Kentucky's current 2022-2028 enacted highway plan with the description of "conduct a planning study for extending US 60 from Barlow, KY west to I-57 near Future City, Illinois."[3]

[1] https://www.environment.fhwa.dot.gov/env_initiatives/PEL.aspx

[2] https://us51bridge.com/project-overview

[3] https://transportation.ky.gov/Program-Management/2022%20Enacted%20Highway%20Plan/2022%20Enacted%20Highway%20Plan%20Combined%20Book%20June%2028%202022.pdf

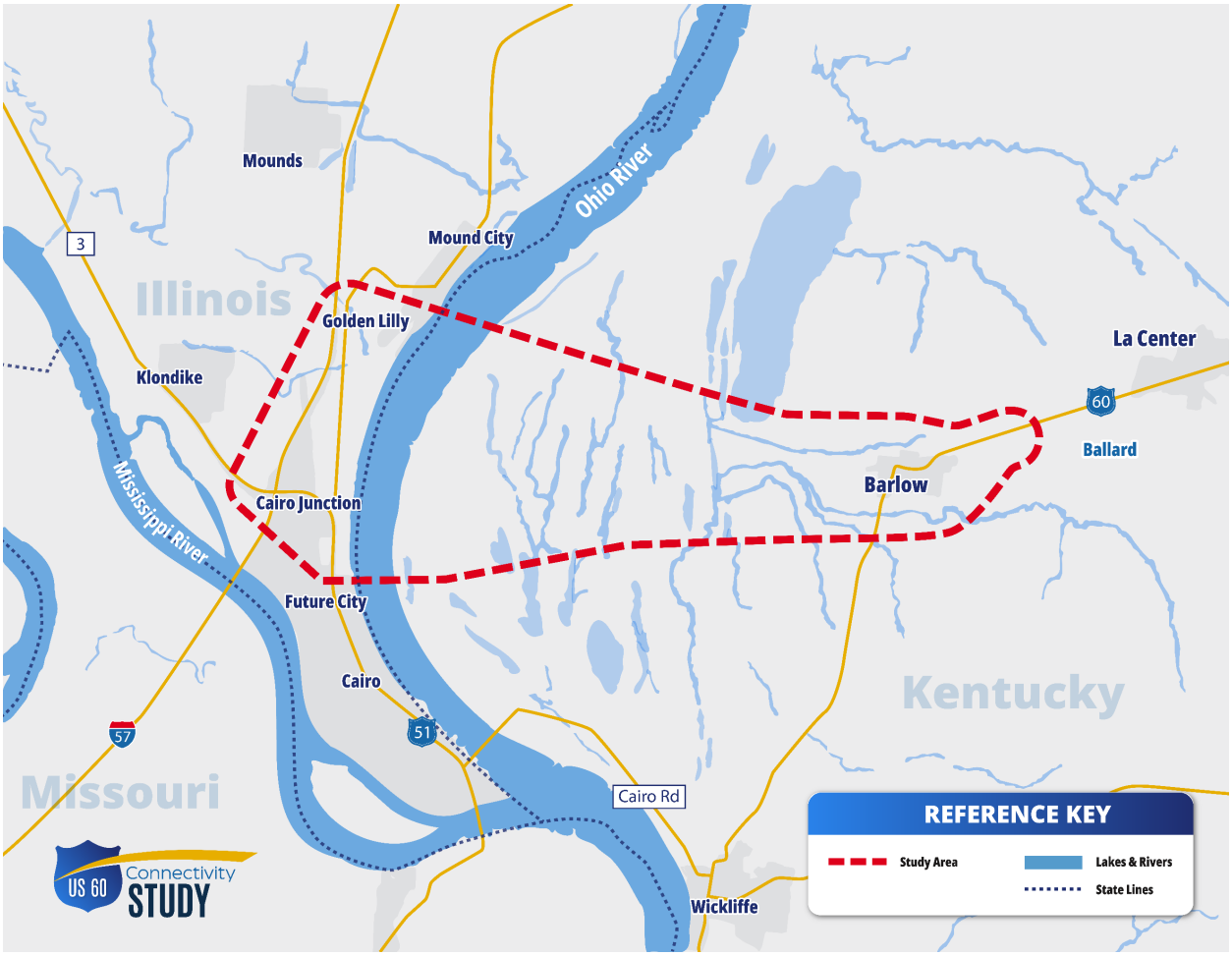

Figure 1. Study Area

1.2. Economic Analysis Overview

In order to assess the impacts to travel demand for this new crossing, a special "sub-area traffic assignment model: was developed from data derived from the Kentucky Statewide Traffic Model (KYSTM) and the Illinois Statewide Travel Demand Model (ISTDM). While his model reflects expected travel characteristics in this area in 2045, both with and without the Project, it does not account for changes in the size and geographical distribution of the population and employment base as a result of the Project. In other words, while the model estimates change in travel characteristics from the Project, it does not allow for the Project to induce any changes in population nor employment in the area. Available peer reviewed literature suggests that enhanced surface transportation networks can alter existing population and employment patterns. Therefore, the purpose of this economic analysis

study is to estimate the induced changes in population and employment that the Project will cause in 2045 relative to the "no build" existing crossing location scenario. All resulting estimates of this study are intended to be interpreted as increments of change to travel demand in the sub-area model.

1.3. Limitations of Study

Projections of economic development were based on the assumption that development patterns observed in the Maysville, Kentucky region following the 2000 construction of the US 68 bridge would be similar to those patterns that would be expected for the US 60 study area following the construction of a new US 60 bridge. Additionally, it was assumed that distribution of projected changes in population and employment are dependent upon influencing factors for residential development, retail development, services development, and non-service development. These assumptions have the following limitations to the accuracy and reasonableness of study results. Details on these assumptions are provided in the remainder of this appendix and its attachments.

Parity of Economic Growth Between US 68 and US 60 New Bridges

While both regions experienced the benefits of a new major river crossing, Maysville and the US 60 study area differ in urbanization, interstate access and intermodal transportation and other, and these differences may affect the reasonableness of related assumptions.

Methodology for Distributing Projected Growth

To estimate economic development across the landscape, we used a three-step process to distribute projected net growth (i.e., growth and losses by region). This process treated *Step 2* and *Step 3* as independent adjustments from Step 1, rather than incorporating estimates in *Step 1* as a starting-point or base for evaluating subsequent adjustments. This resulted in minor projection differences compared to an integrated method.

Subjective Importance Among Factors

Methodology developed for *Steps 1, 2 and 3* in the absolute growth and distribution of growth depend upon best professional judgement, the identification of a proper counterfactual (Maysville, KY) location, and the relative importance placed on various factors influencing decisions among population and business entities. Resulting gearings and scores used for each of the influencing factors could be revised, resulting in different growth distribution among regions.

Simplification of Employment Projections for use by Travel Demand Model

Results from this analysis needed to be usable in the travel demand model for the region, which identifies only retail, non-retail, and service employment. Assumptions were made on the types of NAICS Sectors that are included in each of these three labor categories. Aggregation of NAICS sectors overlooks inherent complexity within each of the three average labor categories.

2. Trends and Existing Conditions

2.1. Business and Employment

2.1.1 MORCEA Data

Mississippi Ohio River Confluence Economic Alliance (MORCEA) is a non-governmental organization with representatives from IL, KY, MO, TN with a purpose of, "facilitating growth of the economy and marketing the region's unique assets…" (MORCEA.com).

MORCEA JobsEQ data identify this area's relative regional employment strengths in the following industry sectors, with actual employment numbers closely aligned to these relative regional strengths:

- Food Manufacturing
- Agriculture
- Wood/Paper
- Chemical
- Textile/Leather
- Coal/Oil/Power

MORCEA's industry spotlight, also provided by JobsEQ, underscores the relative importance of industry competitiveness to the loss of jobs in the region between 2011 and 2021. Local competitiveness is estimated to be related to 53% of all job losses when compared to national trends and the mix of industrial growth in the region. While not stated in that document, local competitiveness can be associated with many factors, including site location relative to both product/service markets and workforce, proximity to uncongested highway travel (e.g., interstates, and four-lane highways), regional economic/tax incentives, proximity to Class I rail and port facilities, new-site permitting ease, available and reasonably priced land, among other factors.

This industry spotlight forecasts continued employment losses, with only the "Accommodations and Food Services" sector expected to experience modest growth beyond

2023. All of the following sectors are projected to decline in employment.

- Health Care and Social Assistance
- Services other than Education, Public Admin and Health Care/Social Asst.
- Construction
- Manufacturing
- Retail Trade
- Educational Services

Discussions with MORCEA and regional leaders reveals identified the importance of the agriculture and transportation sectors in the region, as well as general east-west commercial mobility to support existing industry. Recent development has been observed in the outskirts of major regional centers including Jackson and Cape Girardeau, Illinois and Scott City, Missouri. Cape Girardeau is a regional location for health services, education, and other sectors. Paducah, Kentucky is also an area with relatively high urbanized attraction. A more efficient Paducah to Cape Girardeau route, and generally improved east-west mobility, were noted by several stakeholders as critical for workforce and goods movement in the region.

2.1.2 Travel Demand Model and Census Data

Employment and population data were obtained from the KYSTM and the ISTDM for the base 2015 and future 2045 years. Employment data estimates employment by place-of-work. Employment declines (red) and growth (green) in the Traffic Analysis Zones (TAZs) is presented in **Figure 2**, and generally reflects the trends projected in the MORCEA industry spotlight. However, the travel demand models do project modest increases in a number of the TAZs.

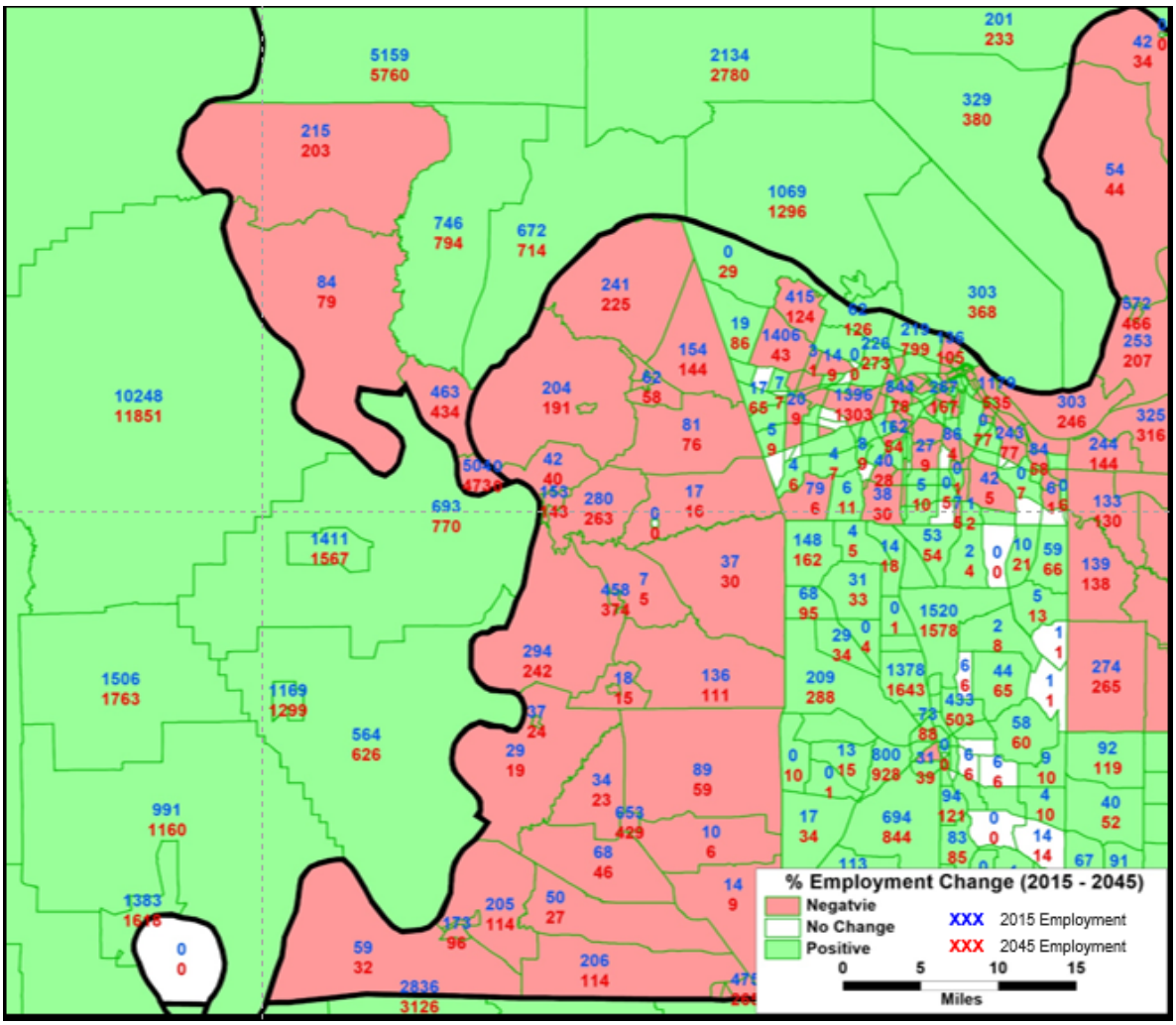

Figure 2. Estimated Employment Change in the Study Area (2015 and 2045) according to the Kentucky and Illinois Travel Demand Models

Both employment growth and decline are projected to be modest over the 2015-2045 period for the no action scenario, which assumes all committed future projects including the replacement US 51 bridge at its existing location southeast of Cario, Illinois.

Census data by place-of-domicile were also obtained for the study area, by Census Tract, for 2010 and 2020. The percentage change over that period of persons 16 years of age and older (i.e., those of working age) are shown in Figure 3. This graphic illustrates that the study area centered about Cairo and Mound City, exhibited a decline in the labor pool during that period. **Figures 4, 5, and 6** show changes in labor pool during that period in key industry sectors that may be most influenced by improvements in travel time. Again, these place-of-

domicile data illustrate labor pool changes as related to where people live – not where they work, so these data cannot be directly compared to the employment by place-of-work data provided in the TAZ. Nevertheless, these data do generally illustrate the general decline in the labor pool in most areas of the region over this period.

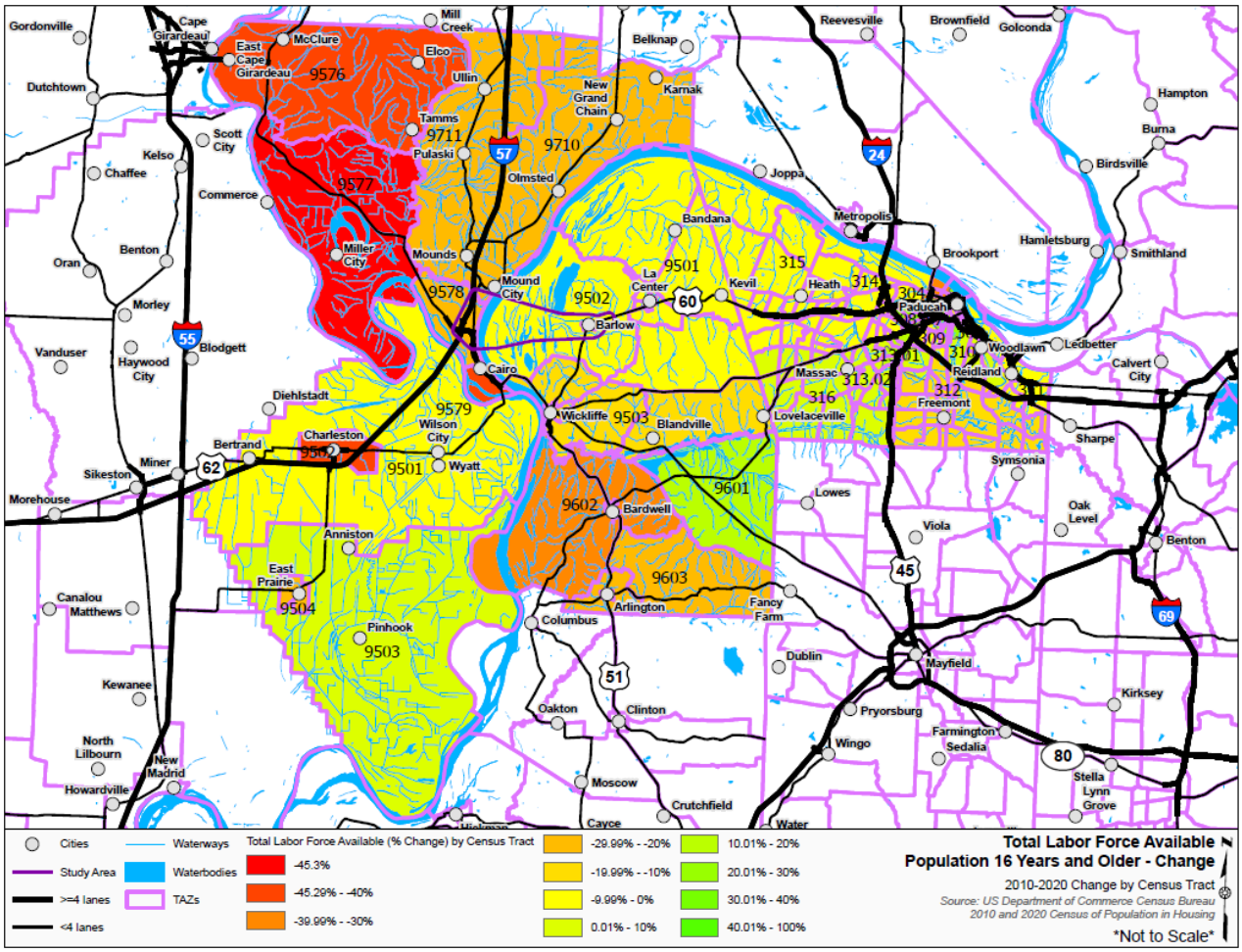

Figure 3. Change in Labor Force in the Study Area (2010 – 2020)

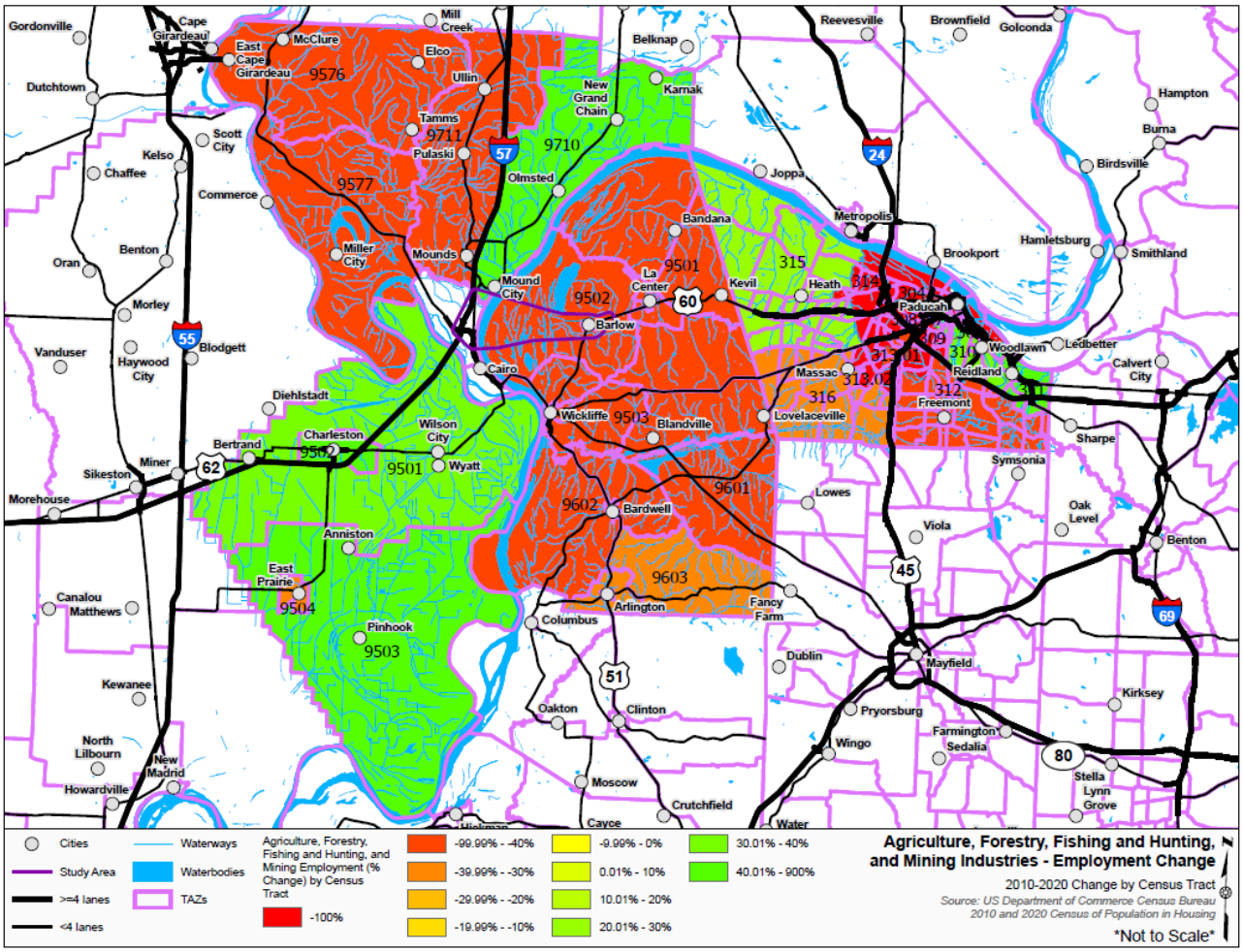

Figure 4. Change in Labor in Resource Extraction / Related Industries (2010 – 2020)

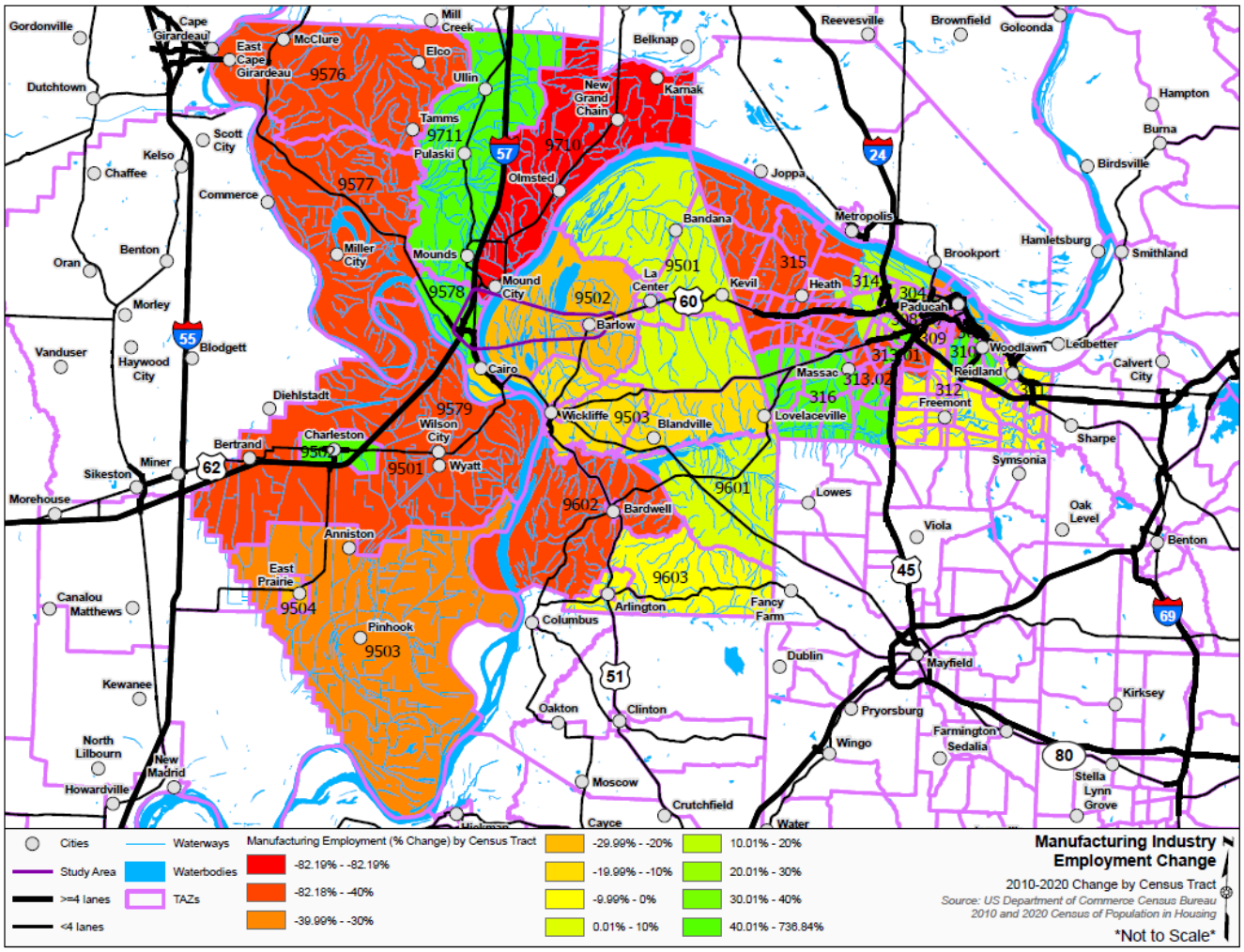

Figure 5. Change in Labor in Manufacturing Industries (2010 – 2020)

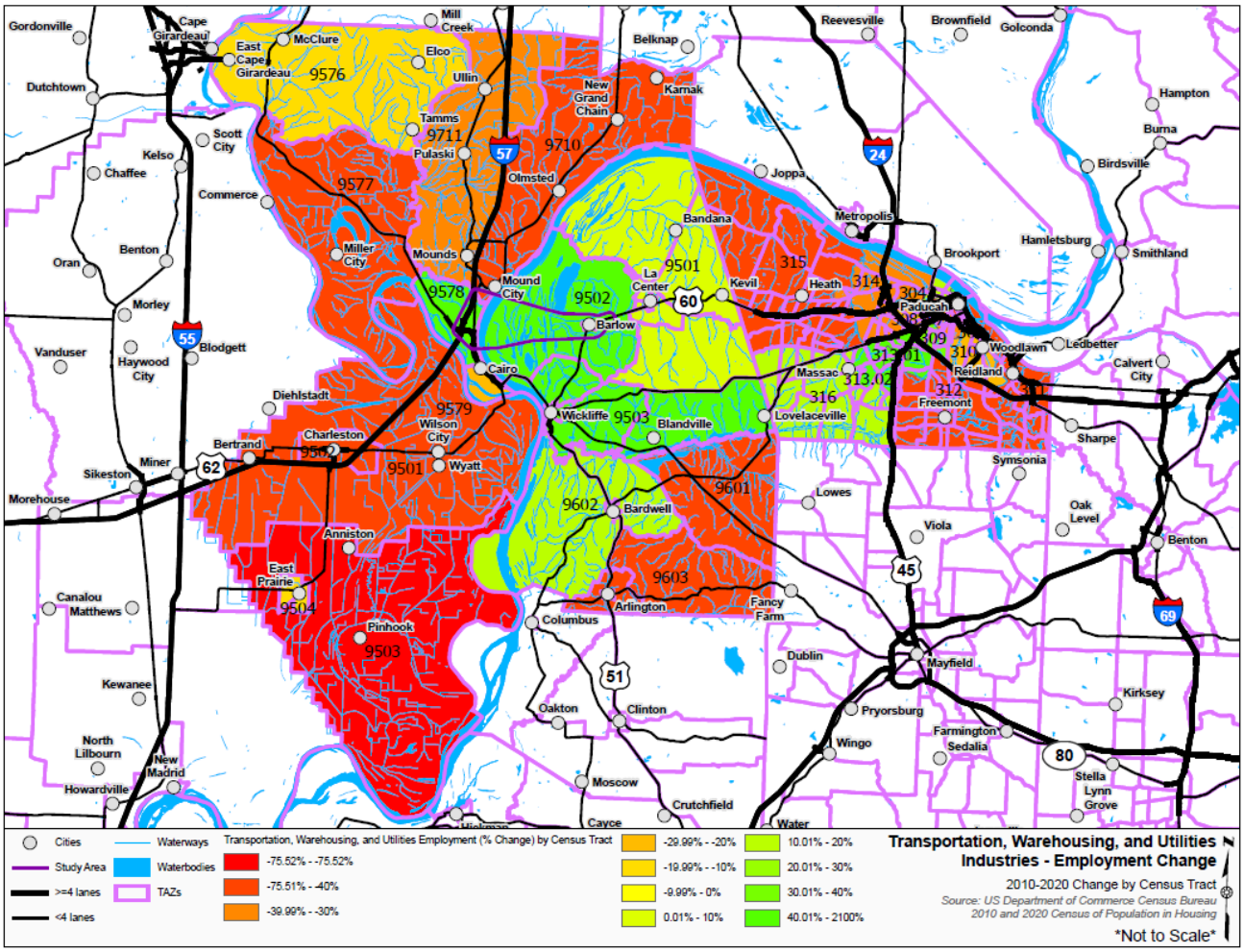

Figure 6. Change in Labor in Trans., Warehousing & Utilities Indust. (2010 – 2020)

2.2. Constraints to Development

Constraints to development (e.g., wetlands, federal lands, steep slopes, parks, flood zones) are illustrated alongside opportunities (discussed in Section 2.3) in **Figure 7**, with uncolored/unshaded regions having the fewest constraints to new development.

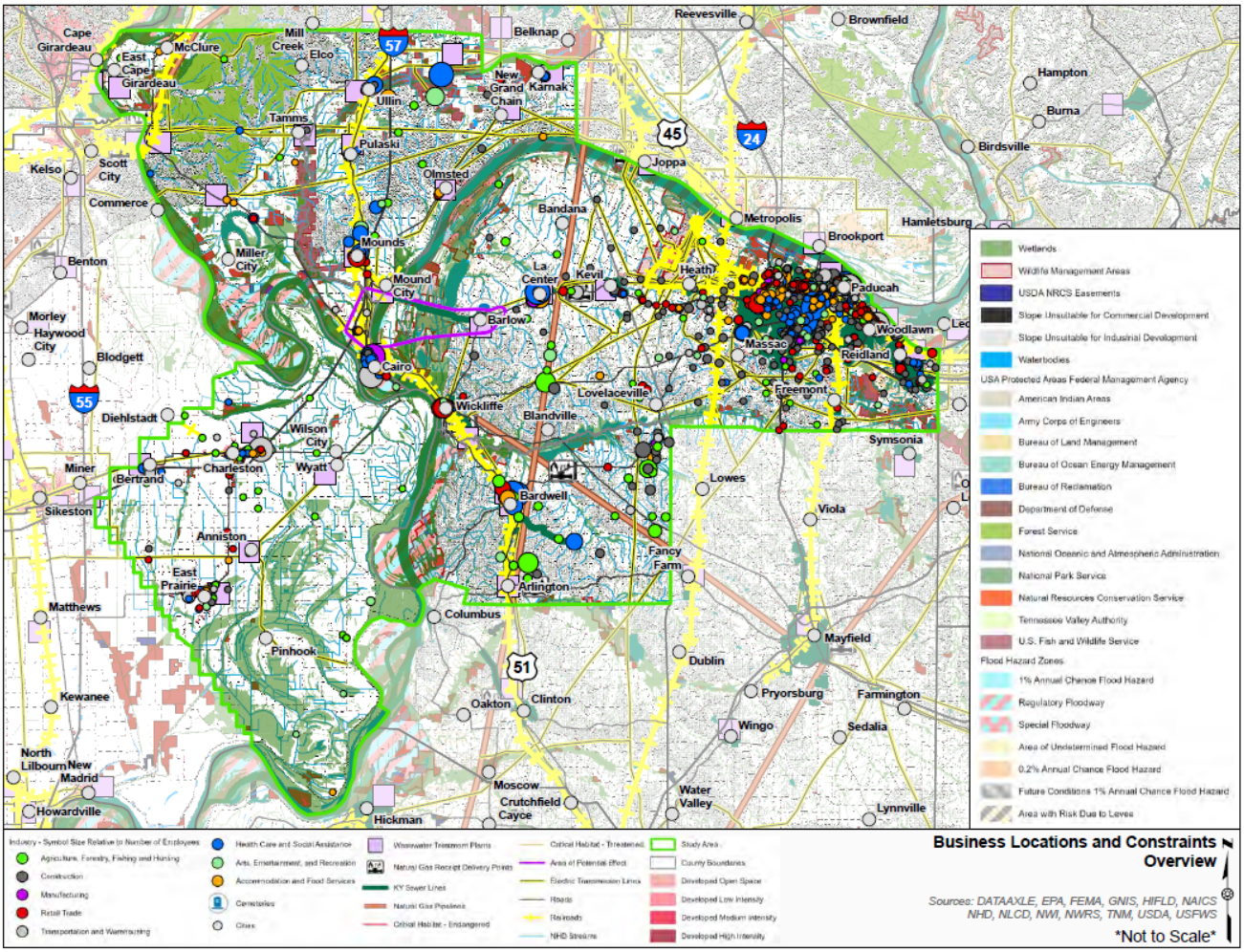

Figure 7. Overview of Business Locations and Constraints

2.3. Opportunities to Development

There are also clear regions of opportunity, as well. Economic development is a function of many things, but good infrastructure, skilled labor pools, and markets are top considerations for siting specialists along with local tax/economic incentives. Retention and expansion of existing businesses and industry likewise are affected by these factors. Figure 7 above illustrates some of these opportunities, which include wastewater treatment facilities and corresponding capabilities, major highways, rail, ports, navigable waterways, population centers and existing industry clusters.

2.3.1 Existing Infrastructure

The western side of the Ohio River in the Mounds Region provides the most regionally convenient access to I-57 providing westward connection to I-55. Likewise, this region is also located along the Canadian National rail line, which follows the western side of the Ohio River in this region from its crossing on the north side of Cairo. While only 2-lanes with little shoulder, both SR 3, SR 127 and SR 37 provide good connectivity to points west, north, and northeast of this region west of the Ohio. While Mounds has access to the Ohio River, Cairo has access to both the Ohio and Mississippi River and is located at the western approach location to the existing US 51 Ohio River bridge crossing of the Ohio River and the eastern approach to the US 62 bridge crossing over the Mississippi River. Cairo is also the location of a potential future Mississippi River Port for which funding and schedule is currently uncommitted and uncertain. Commercial ports that were included in our GIS mapping exercise and assumed in our estimation of results consist of the following: Mississippi County Port (east of Wyatt, MO); Hickman-Fulton County Riverport (Hickman, KY); New Madrid County Port (New Madrid, MO); Consolidated Terminals and Logistics (Mound City, IL); Southeast Missouri Port (Scott City, MO); Four Rivers Terminal (Paducah, KY); McCracken County Riverport (Paducah, KY); Calvert City Marine Terminal (Calvert City, KY).

East of the Ohio River, the cities of Barrow and La Center, Kentucky are provided east-west access via US 60, a two-lane highway facility which transitions to four-lanes approximately two miles east of Kevil, Kentucky. US 60 also provides connectivity to points south to Wickliffe. US 51, US 62, SR 121, and SR 286 provide access to points east, southeast and northeast from Wycliffe, respectively, via predominantly two-lane roadways.

2.3.2 Existing Businesses

Business location and employment data were obtained by DataAxle, a marketing database manager that surveys businesses and provides information on businesses that includes their physical location, employment size, North American Industrial Classification System (NAICS) and Standard Industrial Classification (SIC) codes, and other useful information. Select industrial sectors were identified and plotted based on insights provided by MORCEA. **Figure 7** illustrates clusters of businesses identified in key industry sectors discussed in Section 2.1.1. Color-coded to denote type and sized to denote employment, these circles illustrate concentrations of businesses within and in the vicinity of the study area region. Mounds, Cairo, Wickliffe, Barlow are locations of existing business clusters closest to the study area, with Charleston, Bardwell and Paducah illustrating clusters of the key sectors outside of the

immediate study area. Some industries will view existing industry businesses as synergistic and influence nearby new business development locations. It is useful to note where these industry clusters are located, as it may help refine results and planning efforts in the future. Detailed graphics of selected areas in the vicinity of the study area are shown in **Figure 8** through **Figure 13** below, with an overview displayed above in **Figure 7**.

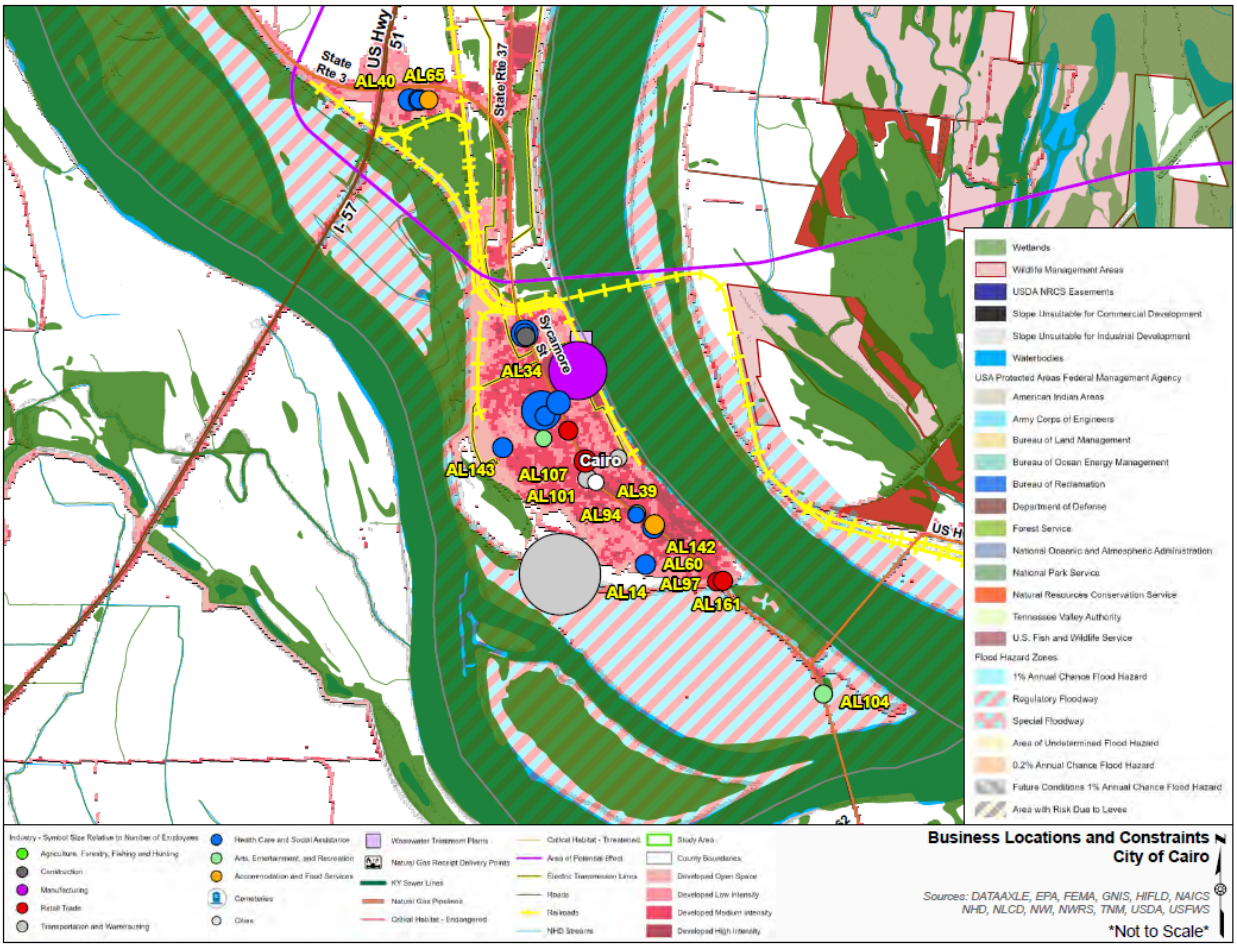

Figure 8. Business Locations and Constraints (Cairo, IL)

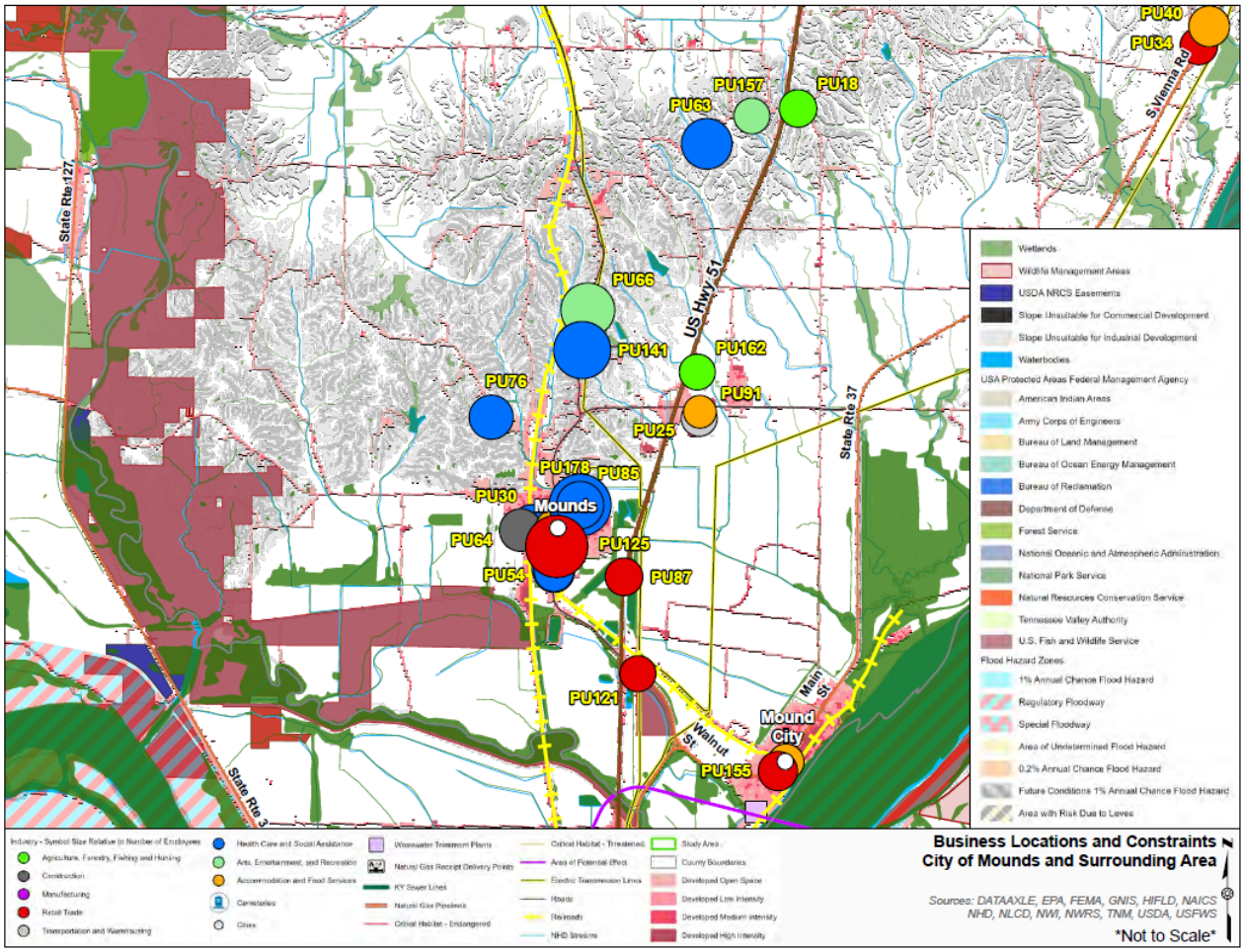

Figure 9. Business Locations and Constraints (Mounds, IL)

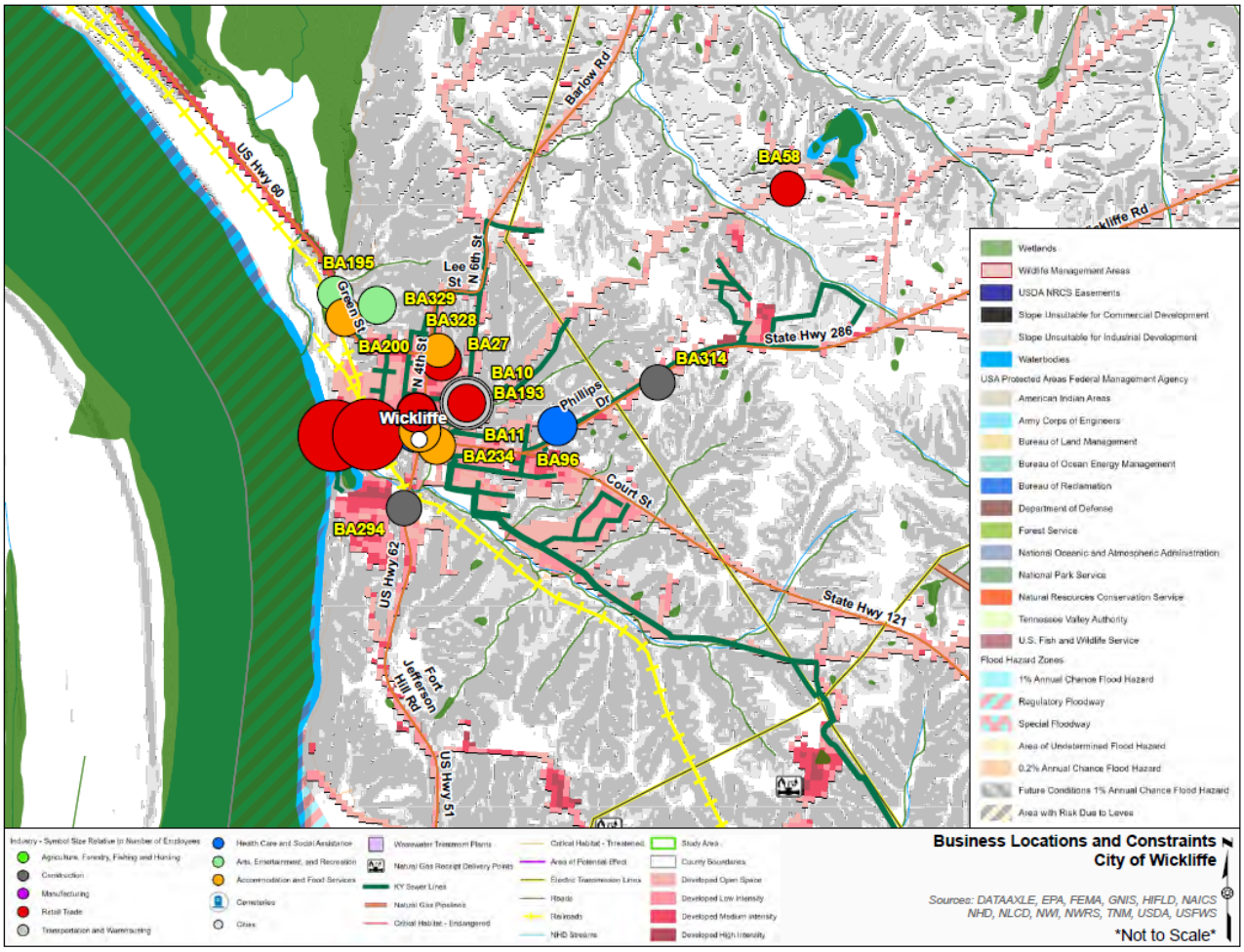

Figure 10. Business Locations and Constraints (Wickliffe, KY)

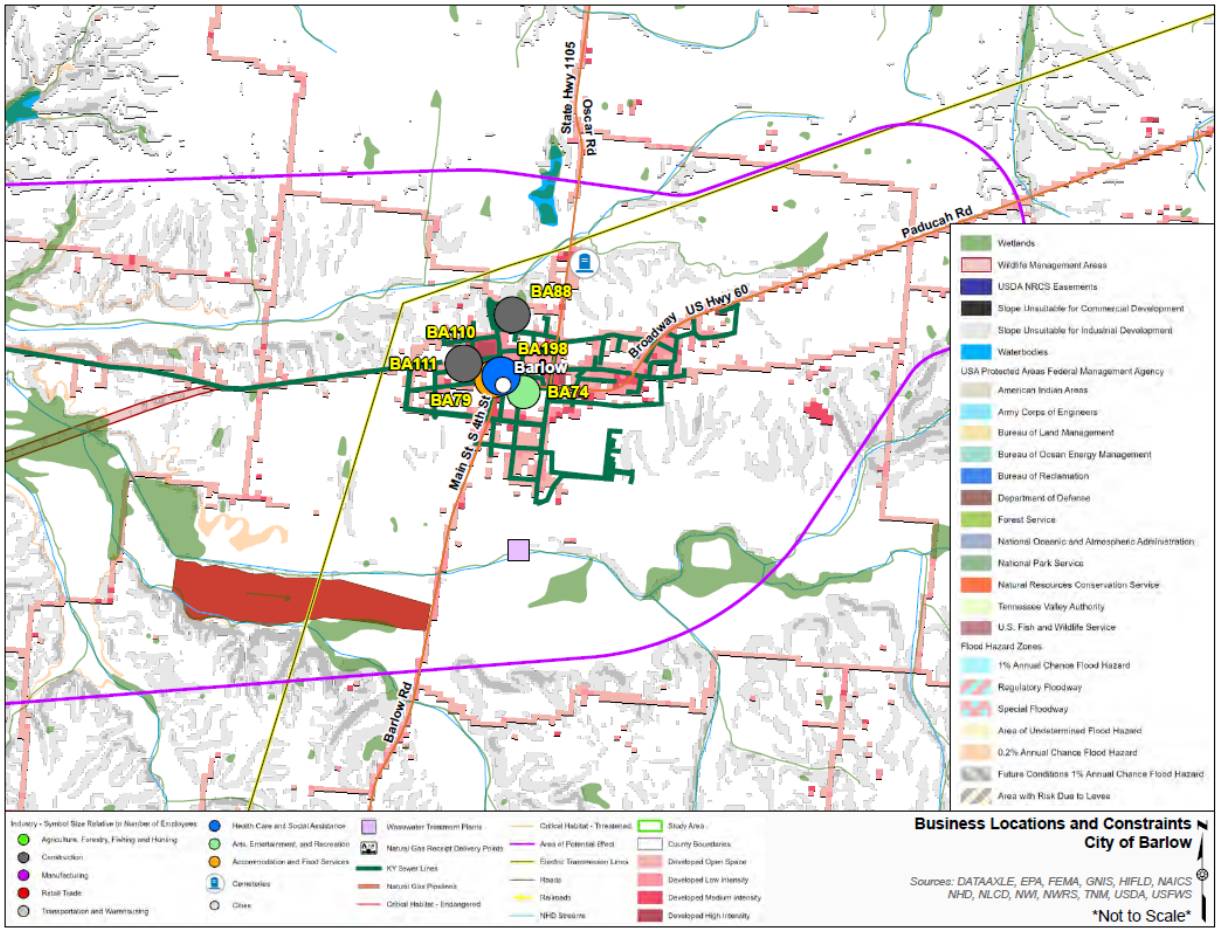

Figure 21. Business Locations and Constraints (Barlow, KY)

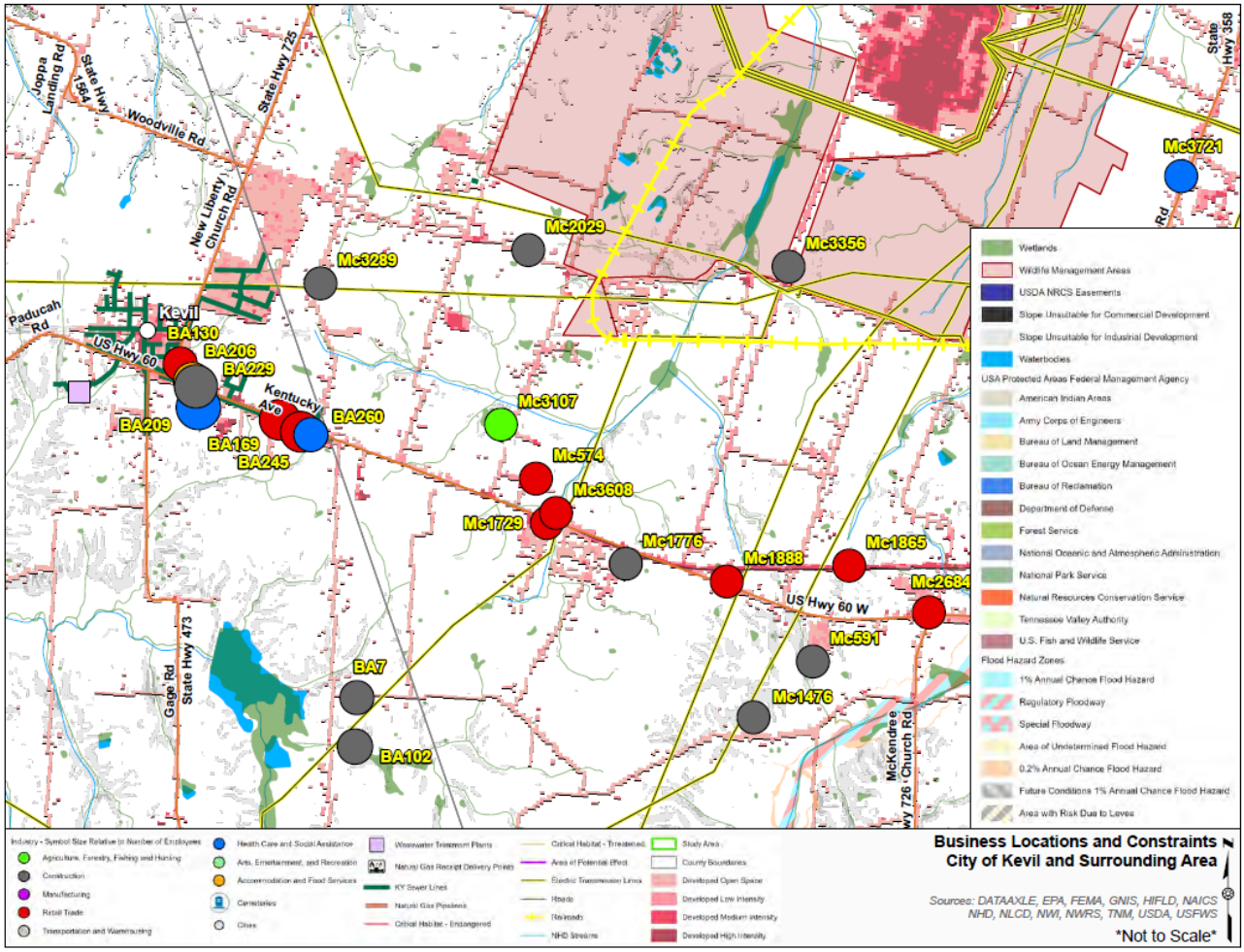

Figure 32. Business Locations and Constraints (Kevil, KY)

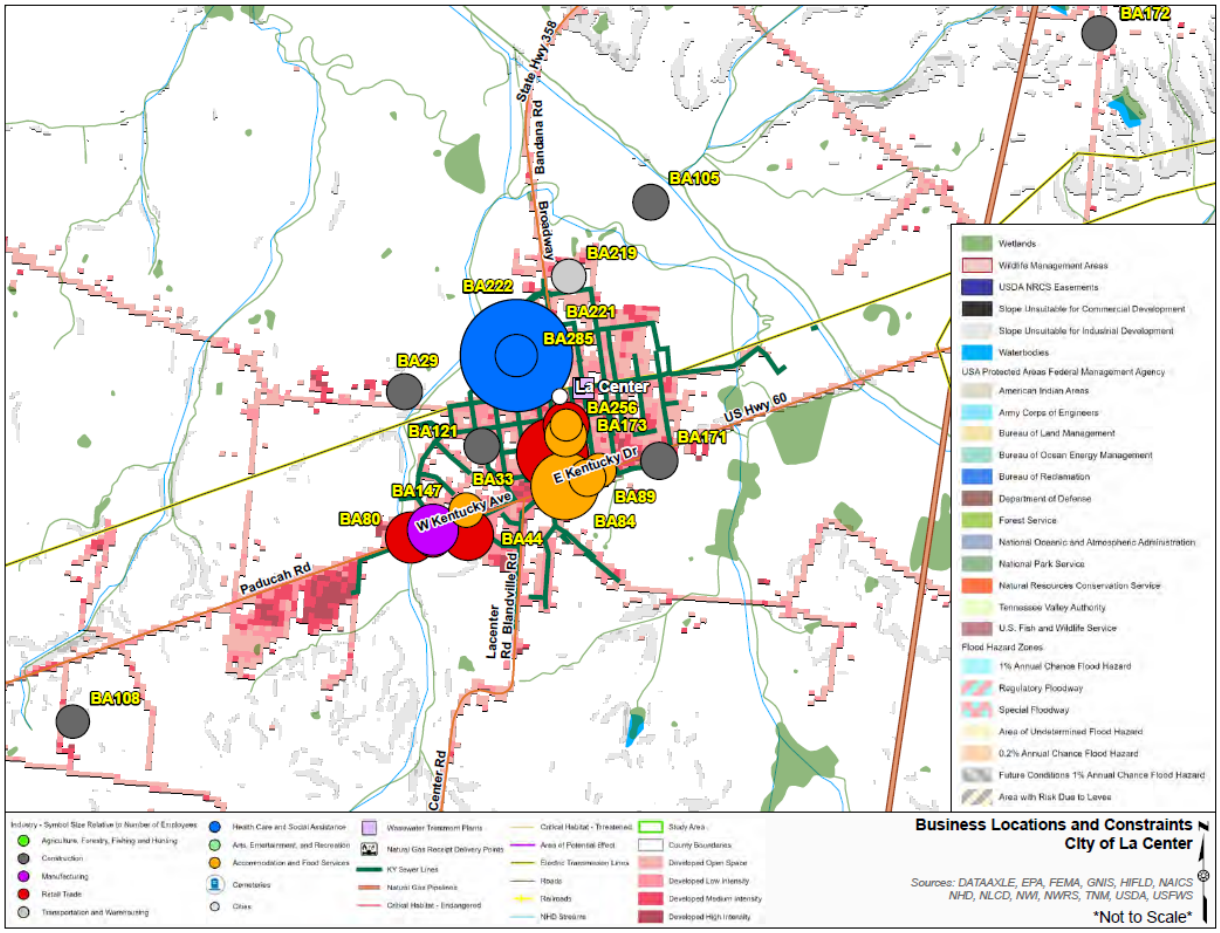

Figure 43. Business Locations and Constraints (La Center, KY)

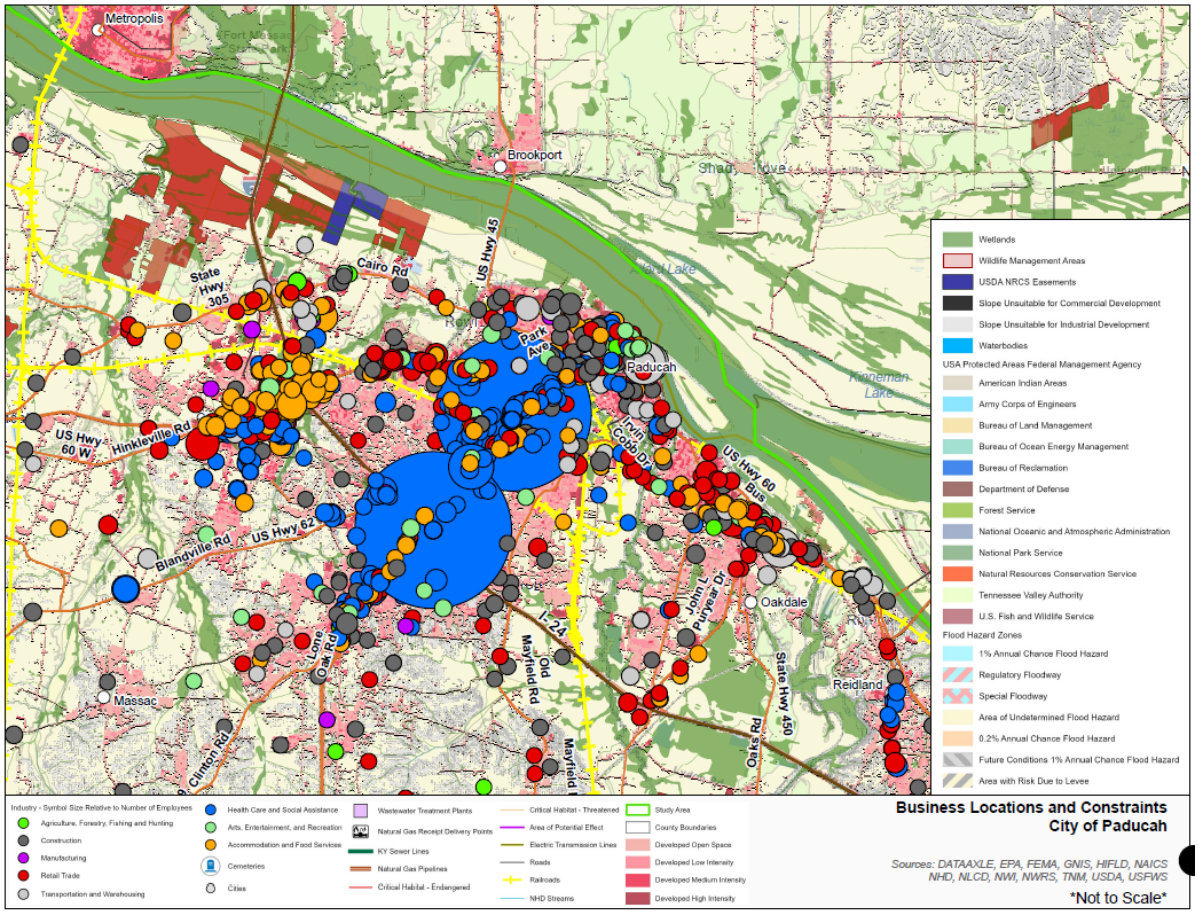

Figure 54. Business Locations and Constraints (Paducah, KY)

3. Estimating Population and Employment Changes

In order to determine the induced changes to population and employment from the Project within each TAZ in the Region of Inquiry (ROI), we employed several distinct, but linked steps. Each of the three steps followed a specific line of inquiry."

1. (Step #1) - How the existing population and employment would redistribute across TAZs within the ROI in an approximately net-zero growth manner as a result of the Project
2. (Step #2) - The magnitude of net population and net employment growth that would move into the ROI as a result of the Project
3. (Step #3) - How the extra population and employment from Step #2 would distribute across TAZs in the ROI as a result of the Project

3.1. Redistribution of existing Population and Employment (*Step 1*)

In 2045, the existing travel demand model estimates that a total population of 101,000 and 48,000 jobs distributed across all the TAZs in the ROI. Some small fraction of these population and jobs will geographically redistribute within the ROI as a result of the Project as certain TAZs become more favorable in certain respects, while other TAZs become less favorable in certain respects. Redistribution was estimated across the four categories of interest as described below. For all calculations, the source for quantitative inputs was the subarea assignment model developed for this study. The specific quantitative gearing that links changes in inputs, such as percent change in Vehicle Hours Traveled (VHT) to and from the TAZ, and changes in outputs (percent change in population) are described in *Supplementary Information*.

- *Population*: TAZs that experience changes in VHT are assumed to experience changes in population. Within each TAZ, lower VHT, an indication of better accessibility, result in positive changes to population, while increases in average VHT result in negative changes in population.

- *Retail employment*: TAZs that experience changes in Annual Average Daily Traffic (AADT) are assumed to experience changes in retail employment. Within each TAZ,

positive changes in AADT result in positive changes to retail employment, while negative changes in AADT result in negative changes in retail employment.

- *Non-Retail employment*: TAZs that experience changes in implied average travel speeds are assumed to experience changes in non-retail employment. Within each TAZ, positive changes in average travel speed result in positive changes to non-retail employment, while negative changes in average implied travel speed result in negative changes in non-retail employment.

- *Service employment*: TAZs that experience changes in AADT are assumed to experience changes in service employment. Within each TAZ, positive changes in AADT result in positive changes to service employment, while negative changes in average AADT result in negative changes in service employment.

One key data source used in the above exercises was changes in link volumes and travel time as determined by the subarea model. The "No Build" and "Build" subarea model assignments for 2045 were reviewed to determine which roadway segments experience increases and losses in AADT if the existing US 51 bridge were closed and replaced with a new bridge in the US 60 study area. **Figure 15** shows the results of this change with roadway link volume losses shown in red and gains shown in green.

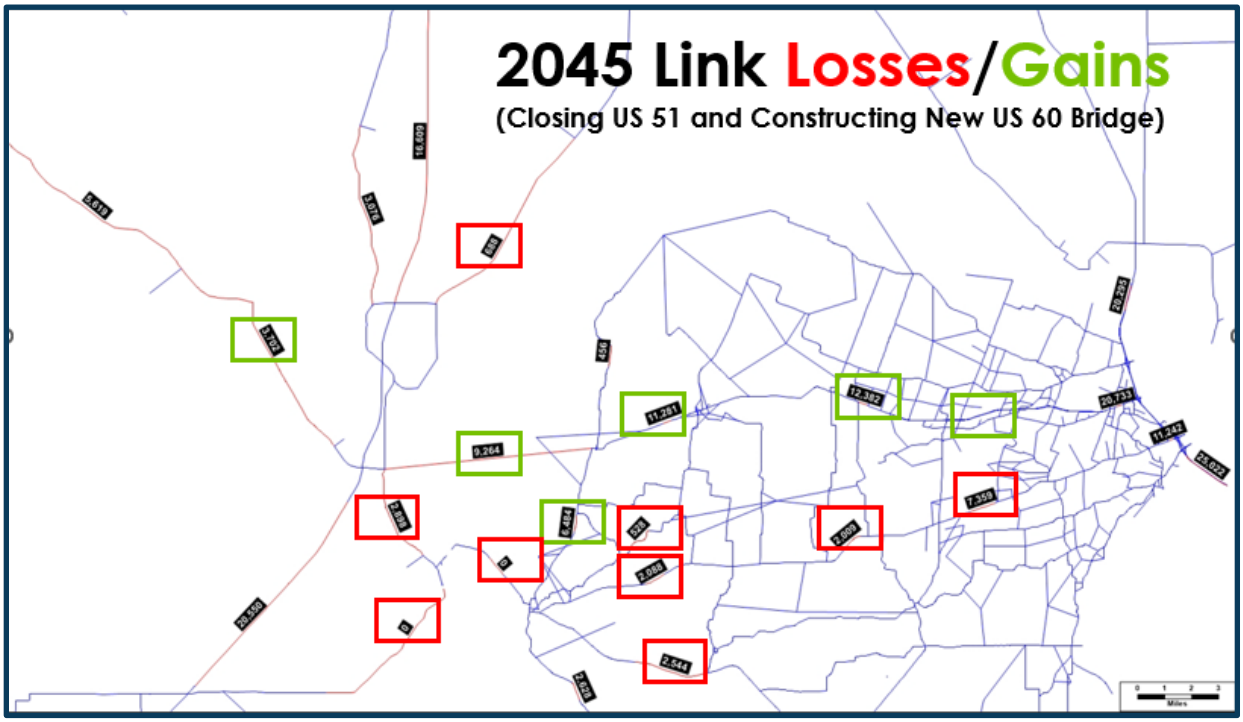

Figure 65. Subarea Model Traffic Assignments by Crossing Scenario

Based on this assessment, the existing US 60 corridor and travel from the Mounds region to points northwest will become more highly traveled, and the existing routes to and from the existing US 51 bridge will experience rerouted travel patterns, increased travel times, and decreased overall travel. Select travel time changes are shown **Table 1**, which support the traveler choices and link volume changes illustrated in the 2045 future travel demand model scenario above.

Table 1. Select Travel Times by Crossing Scenario

Point A	Point B	US 51 Crossing (Minutes)	New Crossing (Minutes)	Change (Minutes)
US 60 @ I-24	I-55 @ I-61	66.1	55.1	-11.0
	IN 146 @ SR 74	70.5	67.7	-2.8
	US 51 @ US 62	42.1	40.1	-2.0
	I-57 @ old US 51	50.3	39.4	-11.0
US 60 @ US 51	I-55 @ I-61	30.0	36.2	6.2
	IN 146 @ SR 74	42.5	48.8	6.2

Point A	Point B	US 51 Crossing (Minutes)	New Crossing (Minutes)	Change (Minutes)
	US 51 @ US 62	6.3	21.2	14.9
	I-57 @ old US 51	14.4	20.4	6.1

3.2. Estimation of Excess Growth (*Step 2*)

After redistributing small fractions of existing population and employment within the ROI, the next step estimated the additional growth in the ROI that the Project would induce. This estimation of excess growth employed a difference-in-difference analysis from a suitable reference site. This difference-in-difference analysis compares the population growth that happened in the ROI over a specified historic period against the population growth that happened in a reference area over the same historic period. Importantly, the reference area includes a new river crossing scenario similar to that envisioned in the current Project. In this manner, the incremental impact of the action (in percentage terms from baseline) can be isolated from other factors, given that the reference site and action taken in the reference site are sufficiently similar to those for the Project. Determining the extra growth that happened in the reference area over the period relative to the ROI can produce a meaningful estimate of the impact that a new crossing would have on the ROI.

A suitable reference site was found in the region of Maysville, Kentucky. Maysville is located in northeast Kentucky on the west bank of the Ohio River approximately 60 miles southeast of Cincinnati, Ohio and approximately 60 miles northeast of Lexington, Kentucky. Like the US 60 ROI, Maysville had only one bridge crossing across the Ohio River (US 62) far from any other crossing in either direction up or downstream. The existing crossing consisted of two narrow lanes with narrow shoulders. The Maysville area gained a new bridge crossing (US 68) in 2000, located several miles downstream from the existing bridge. This new bridge also consisted of two travel lanes but included wide shoulders in each direction, similar in width to the travel lanes.

Counties making up the Maysville area include the following:

- Adams County, Ohio
- Brown County, Ohio
- Bracken County, Kentucky
- Fleming County, Kentucky

- Lewis County, Kentucky
- Mason County, Kentucky
- Robertson County, Kentucky

In many relevant qualitative respects, the Maysville area and the ROI are deemed suitably similar. However, one major difference exists. Whereas the Maysville area *added* a second bridge crossing, the Project will *replace* the older crossing with a newer one. Therefore, we believe the excess growth in the ROI will be smaller than that observed in Maysville. We apply an adjustment factor of 0.5, based on best professional judgement, to adjust Maysville excess growth to the ROI.

Table 2 summarizes the population growth for Maysville and the ROI with and without the new bridge. **Table 3** summarizes the resulting impact on employment in the ROI.

Table 2. Adjusted Excess Population Growth in the ROI

Year	Population		Implied Excess Growth over 10-year Period
	ROI	Maysville	
2000	109,516	124,786	n/a
2010	107,675	129,874	5.86%
2020	103,439	127,028	1.81%
Total excess growth over 20-year Period			7.78%
Estimated population in ROI in 2045 without Project			100,763
Total Excess Population in ROI by 2045			7,836
Adjusted Excess Population in ROI by 2045			3,918

Table 3. Excess Employment Growth in the ROI

	Percent in Baseline Scenario	Implied Growth in 2045 relative to without Project
Adjusted Excess Population in the ROI	(N/A)	3,918
Population that is Employed	47%	1,858
Employees in Retail	45%	840

	Percent in Baseline Scenario	Implied Growth in 2045 relative to without Project
Employees in Non-Retail	15%	288
Employees in Service	39%	730

3.3. Distributing Excess Growth Across the ROI (*Step 3*)

The final step in the overall process is allocating excess growth for each of the four categories of interest into discrete TAZs across the ROI. A multi-layered GIS tool was built to accomplish this allocation process. The tool included spatially explicit features, including the location of ports, highways, and rail lines. It also contained information to determine if any parcel of land is constrained from future development due to the presence of existing development, floodplains, protected lands, etc.

A single algorithm incorporating relevant GIS information was developed to score the relative merit of each TAZ for each of the four categories of interest. Each TAZ received a numerical score based on a variety of attributes either contained within the TAZ or proximal to the TAZ.

The top 20 percentile of TAZs receiving the highest score in each algorithm were flagged as a highly desirable TAZs. The excess growth in population or employment was allocated across these top 20 percentile TAZs proportional to the baseline of the same metric in the TDM for year 2045.

For example, the scores for all TAZ's for the *Population* Algorithm ranged from -2.5 to 9.0. Any TAZ receiving a score of 6.0 or greater was flagged as a highly desirable TAZ for new population. The projected 2045 population from the TDM of all flagged TAZs was summed. Finally, each flagged TAZ received a share of the 3,918 excess population based on its share of the 2045 population for all flagged TAZs.

The particular geographic attributes used to define the algorithms are described below (in order of descending relative importance). Precise scoring weights used for the algorithm scoring process are provided in *Supplementary Information*.

- Population:
    - Number of population-focused businesses in proximity to the TAZ
    - Quantity of developable acres within the TAZ
    - Proximity to four-lane highways.
- Retail Employment:

    - Number of vehicle trips through the TAZ
    - Population within three miles of the TAZ
    - Quantity of developable acres within the TAZ
- Non-Retail Employment:
    - Proximity to Interstate
    - Proximity to four lane highway
    - Proximity to a port
    - Proximity to rail line
    - Quantity of developable acres within the TAZ
    - Population within 15 miles of the TAZ
- Service Employment:
    - Number of service-focused businesses in proximity to the TAZ
    - Population within three miles of the TAZ

4. Results – Induced Project Impacts on Population and Employment

When the methodology described above is applied to the ROI, population, and employment levels in the TAZs are adjusted. Some TAZs experience no change, others experience a decrease in population or employment, while other TAZs experience an increase in population or employment.

All adjustments are relative to a baseline defined by the 2045 Scenario of the travel demand model. With few exceptions, these adjustments are relatively modest in percent changes terms, mostly ranging within plus or minus 10 percent.

Overall results for the ROI are presented in **Table 4**.

Table 4. Aggregate Changes Across the ROI in 2045 Induced by the Project

	Population	Service Employment	Retail Employment	Non-Retail Employment
Without Induced Effects	100,763	18,771	21,612	7,407
Step #1 Change	32	42	100	(4)
Step #2 Change	3,918	730	840	288
With Induced Effects	104,713	19,543	22,553	7,691

Figure 15 through **Figure 18** illustrate the percent change in each TAZ within the ROI for each of the categories of interest. Data for all four figures are provided in tabular form as an Excel file alongside this Appendix.

As shown in **Figure 16**, population is estimated to decrease in southwest McCracken County and southeast Carlisle and Ballard counties, while other areas are estimated to experience increases. Increases in Charleston and certain TAZs around Paducah are especially notable for their estimated population increase equal to or exceeding 8 percent.

As shown in **Figure 17,** retail employment is estimated to decrease in northeast Carlisle County, south Ballard County, and north Mississippi County. Other areas are generally estimated to experience increases or no change in retail employment. Increases in Alexander

County and central Ballard County are especially notable for their estimated increase exceeding 10 percent.

As shown in **Figure 18,** non-retail employment is estimated to decrease in west and southwest McCracken County, northeast Carlisle County, and southeast Ballard County. Other areas are generally estimated to experience increases in non-retail employment. Increases in Pulaski County and those TAZs along the Ohio River in McCracken County are especially notable for their estimated increase equal to or exceeding 4 percent.

As shown in **Figure 19,** service employment is estimated to decrease northeast Carlisle County, south Ballard County, and North Mississippi County. Other areas are generally estimated to experience increases or no change in service employment. Increases in Alexander County and central Barlow are especially notable for their estimated increase equal to or exceeding 8 percent.

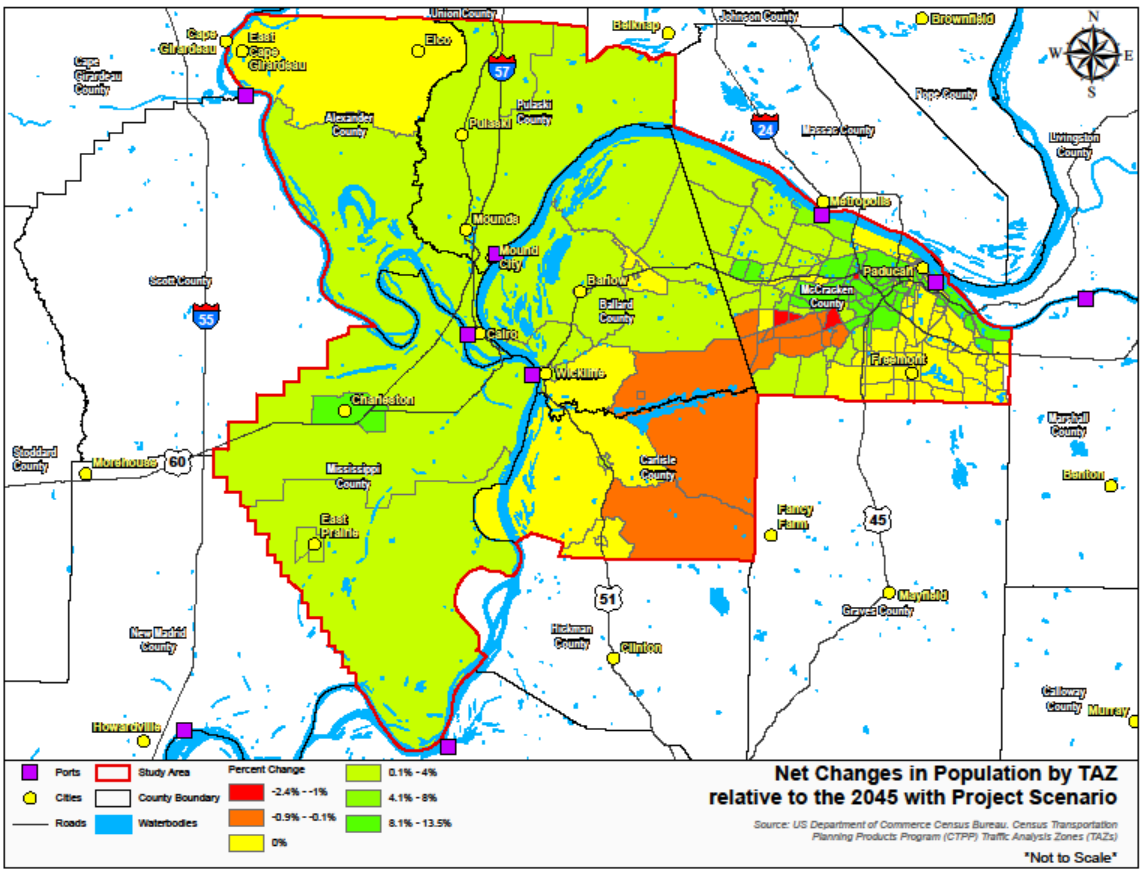

Figure 76. Net Projected Changes in Population by TAZ

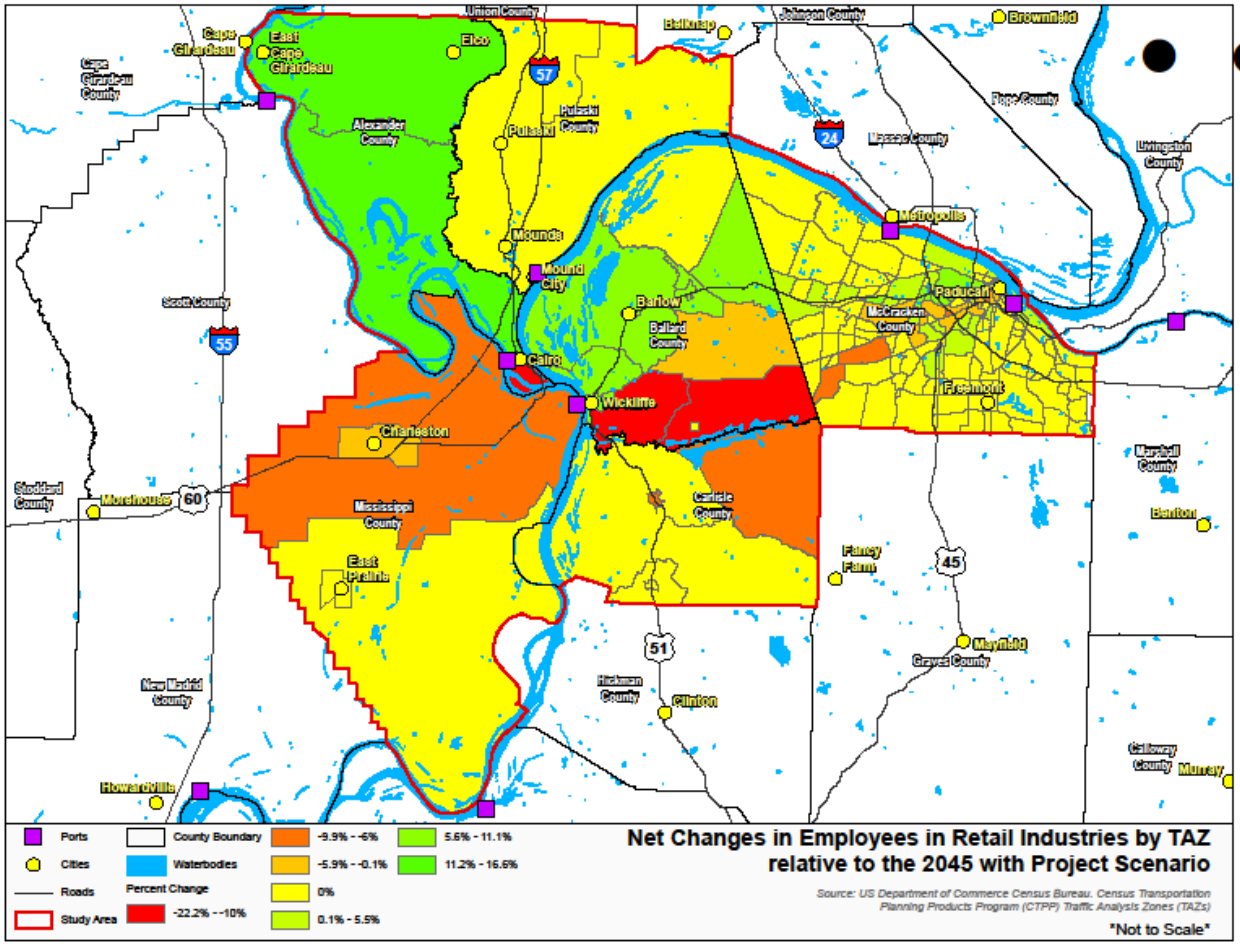

Figure 87. Net Projected Changes in Retail Employment by TAZ (click on map to enlarge)

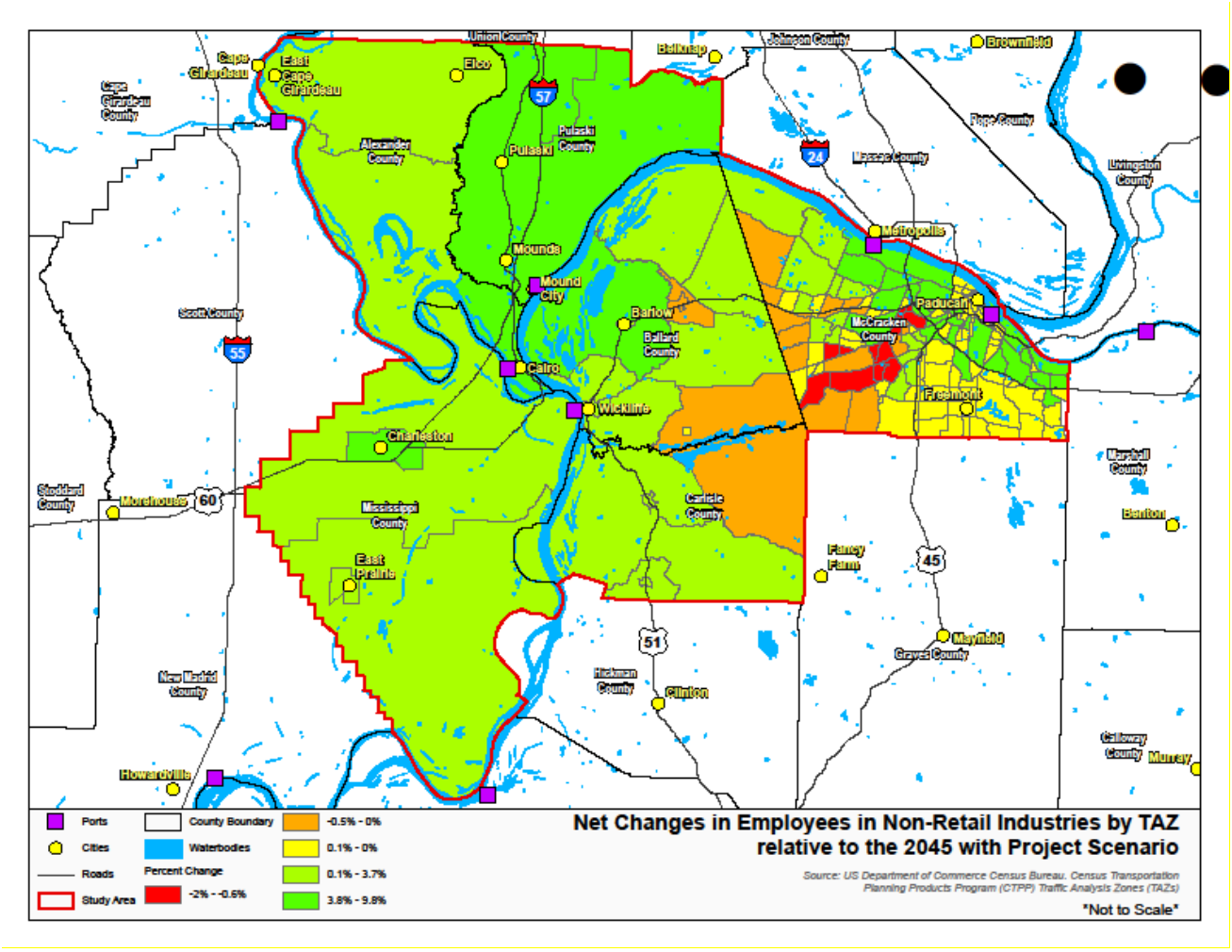

Figure 98. Net Projected Changes in Non-Retail Employment by TAZ

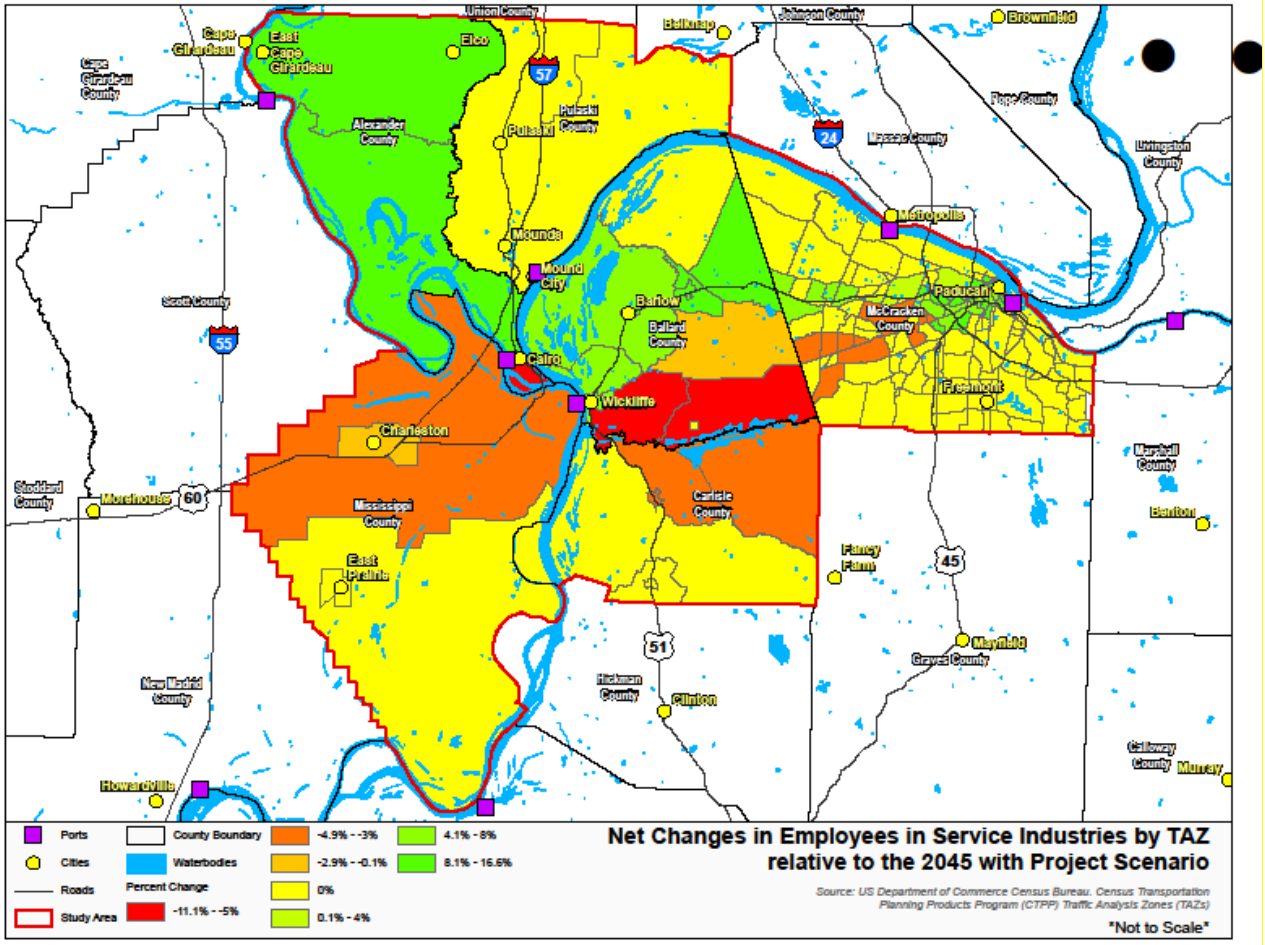

Figure 109. Net Projected Changes in Service Employment by TAZ

In addition to graphical representations, nine municipalities are listed in the **Table 5** to highlight estimated changes in population and employment within each community. Select notable changes estimated in these communities are identified and discussed in the following bullets:

- Barlow, Kevil, and La Center all experiences growth in service employment and retail employment. This growth results primarily from *Step 1* related to an increase in AADT along US 60 resulting from the new crossing.
- Cairo, IL experiences loss in retail employment. This loss results primarily from *Step 1* related to a decrease in AADT along US 51 resulting from the new crossing.

- Cairo, IL experiences growth in non-retail employment. This growth results primarily from *Step 2/3* related to proximity to factors favorable to non-retail business like ports, rail lines and highways.
- Charleston, MO experiences loss in retail and service employment. This loss results primarily from *Step 1* related to a decrease in AADT along US 62 resulting from the new crossing.
- East Cape Girardeau, IL experiences growth in service and retail employment. This growth results primarily from *Step 1* related to expected increase in AADT resulting from the new crossing.
- Mounds City, IL experiences growth in non-retail employment. This growth results primarily from *Step 2/3* related to proximity to factors favorable to non-retail business like ports, rail lines and highways.
- Wickliffe, KY experiences loss in retail employment. This loss results primarily from *Step 1* related to a decrease in AADT along US 51 and KY 286 resulting from the new crossing.

Table 5. Percent Increase (Decrease) Compared to Existing Travel Demand Model

Municipality	Population	Service Employment	Retail Employment	Non-Retail Employment
Barlow, KY	1.4%	7.8%	6.9%	6.6%
Cairo, IL	1.1%	-0.4%	-3.3%	7.7%
Charleston, MO	6.0%	-3.2%	-6.4%	5.7%
Kevil, KY	1.7%	9.9%	6.7%	0.0%
La Center, KY	0.9%	10.6%	10.6%	0.0%
Mounds City, IL	1.2%	0.7%	1.4%	8.5%
Paducah, KY	6.8%	6.3%	4.7%	3.2%
Wickliffe, KY	0.2%	-1.5%	-4.7%	0.4%
East Cape Girardeau, IL	0.0%	16.6%	16.6%	0.1%

5. Further Study

Use of the output of this economic development study is limited to adjusting the travel demand model's socioeconomic data for use in future scenario model runs only. Given this narrow scope, the corresponding study focused on only high-level projection targets of population; and retail, non-retail, and service employment totals. However, the research needed in the development of the associated model used for projections resulted in a rich mine of data that could be used to both refine results and supplement marketing efforts of economic development entities in the region. The following are areas of additional study that may be beneficial using this effort as a base.

Refinement of Growth Distribution by Refining Relative Importance among Development-Influencing Factors

- *Step 3* of the three-step growth adjustment model developed made a series of assumptions on the relative importance of factors for population growth and growth in retail, non-retail, and service employment. (See attached *Supplementary Information*). Collaboration with local developers, economic development entities, and government planning and permitting staff may result in different relative "scores" that reflect local/regional priorities and needs. The revises scores would affect projections and distributions and also help to identify areas of greatest demand by type of development.

Use of DataAxle Business Data for Future Business Employment Size Estimates and identification of Industrial Clusters

- The DataAxle business data contained in the accompanying Excel workbook includes a snapshot of businesses in the region, providing North American Industrial Classification System (NAICS) and Standard Industrial Classification (SIC) codes for businesses along with employment size, business latitude/longitude location, and numerous other data fields. Industry clusters and employment concentrations can easily be mapped with these data to help identify areas of industrial synergy and facilitate marketing efforts by regional economic development entities and siting specialists.

Supplementary Information

***Step 1* Gearing**

The table below is a quantitative description of the specific gearing used to estimate changes in population and employment levels as part of *Step 1*. These gearings (or in economic jargon, 'elasticities'), describe how one metric changes as a function of a change in a different metric. The changes described for step 1 gearing are based on changes between the With Action model for 2045 and Without Action Model for 2045.

For example, this table shows that the gearing used for estimating percent change in the Population for a specific TAZ was 0.5 multiplied by the percent change in VHT for that TAZ, assuming the TAZ had a negative change in VHT (leading to population growth). If the change in VHT was positive (leading to population reduction), the gearing used was 0.1.

For a quantitative example, if VHT decreased by 1.0 percent in a given TAZ, population was assumed to increase by 0.5 percent. Alternatively if VHT increased by 1.0 percent in a given TAZ, population was assumed to decrease by 0.1 percent.

	Population	**Service Employment**	**Retail Employment**	**Non-Retail Employment**
Metric for Gearing	Change in VHT	Change in AADT	Change in AADT	Change in average travel speed
Gearing for growth	0.5	0.2	0.2	0.5
Gearing for loss	0.1	0.2	0.4	0.1

***Step 3* Algorithms**

The four algorithms used in *Step 3* are detailed below. First, we list the individual GIS queries that each algorithm was composed of. For example, the algorithm *Population* was determined by three queries, whereas *Non-retail employment* was determined by six queries. Each query listed below Is also assigned a number in parentheses. The associated frequency and scoring of each bin within each numbered query is detailed further below in tables with the respective identification numbers. For each query, each TAZ was assigned in a bin. The edges of each bin were defined by the values in the column labelled *Boundary*. The number of TAZs in each bin are denoted in the column, *Frequency*. Each TAZ was given a score in each query according to the bin in which it fell, and the associated value provided in the column, *Points*. For each algorithm, the total score for each TAZ was determined by the sum of all points earned in each query. For example, the total score for a TAZ in the Population algorithm is equal to the points earned from Query #1, Query #2a, and Query #3a.

- *Population*:
    - Number of population-focused businesses in proximity to the TAZ (**1**)
    - Number of developable acres within the TAZ (**2a**)
    - Proximity to four-lane highway (**3a**)
- *Retail Employment:*
    - Number of vehicle trips through the TAZ (**4**)
    - Population within three miles of the TAZ (**5a**)
    - Number of developable acres within the TAZ (**2a**)
- *Non-Retail Employment:*
    - Proximity to Interstate (**6**)
    - Proximity to four lane highway (**3b**)
    - Proximity to a port (**7**)
    - Proximity to rail line (**8**)
    - Number of developable acres within the TAZ (**2b**)
    - Population within fifteen miles of the TAZ (**9**)
- *Service Employment:*
    - Number of service-focused businesses in proximity to the TAZ (**10**)
    - Population within three miles of the TAZ (**5b**)

(**1**) Number of Population Focused Businesses

Points	Boundary	Frequency
0	<10	69
1	50	51
2	100	13
3	200	11
4	500	56
5	>500	31

(**2a**) Number of Open Acres

Points	Boundary	Frequency
-5	0	50
0	100	64
1	500	61
2	1000	20
2.5	>1000	36

(**2b**) Number of Open Acres

Points	Boundary	Frequency
-35	0	50
0	100	64
5	500	61
10	1000	20
15	>1000	36

(**3a**) Miles to Closest Four-Lane Highway

Points	Boundary	Frequency
3	0	91
2	0.5	54
1.5	1	17
1	2	23
0.5	4	30
0	>4	16

(**3b**) Miles to Closest Four-Lane Highway

Points	Boundary	Frequency
16	0	91
14	0.5	54
10	1	17
8	2	23
4	4	30
0	>4	16

(**4**) AADT through the TAZ

Points	Boundary	Frequency
0	<500	67
5	1000	40
10	5000	92
15	10000	21
20	>10000	11

(**5a**) Population within 3 miles

Points	Boundary	Frequency
0	<2000	48
3	5000	46
6	10000	39
9	20000	54
12	>20000	44

(**5b**) Population within 3 Miles

Points	Boundary	Frequency
0	<2000	48
1	5000	46
2	10000	39
3	20000	54
4	>20000	44

(**6**) Miles to Closest Interstate

Points	Boundary	Frequency
40	0	36
30	2	62
20	4	74
10	6	27
0	>6	32

(**7**) Miles to Closest Port

Points	Boundary	Frequency
12	0	5
8	1	23
6	2	42
4	6	98
2	10	59
0	>10	4

(**8**) Miles to Closest Railroad Line

Points	Boundary	Frequency
12	0	85
8	0.5	58
6	1	24
4	2	28
2	4	30
0	>4	6

(**9**) Population within 15 miles

Points	Boundary	Frequency
2	<30,000	29
3	70,000	15
4	85,000	76
5	90,000	111
6	>90,000	0

(**10**) Number of Service Focused Businesses

Points	Boundary	Frequency
0	<20	88
5	50	27
10	100	17
15	200	9
20	500	52
25	>500	38