WARNER TRANSPORTATION CONSULTING
177 Riverside Drive, Northampton, MA 01062 413 585-5026 warnertransportation.com

To: Jared Tremblay, FHMPO

From: Marc Warner

Date: September 28, 2023

Re: Status of the updated regional transportation and land use model

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The FHMPO regional transportation and land use model has had numerous upgrades in the last few months. Some of these have dealt with refinements to the model processes, but mostly they have aimed at establishing a new base year. The previous base year—the year for which the model is calibrated, and which is the jumping off point for testing future changes—was 2017. The model upgrade aims for a new base year of 2022.

Here is a summary of the new data inputs:

Modeled area and TAZs	The modeled area (the urbanized parts of Riley, Geary, Pottawatomie, and part of Wabaunsee Counties) remains unchanged, but the new model now has 667 internal zones, up from 655 in the 2017 model. The new zones allow for smaller neighborhood definition in the developing areas of Blue Township and the area southwest of Junction City. Other changes to TAZ boundaries are around St. George, Wamego, and Milford. These largely aim to add consistency with municipal boundaries, key natural features, or the boundary of Fort Riley. The updated model also renumbers all TAZs for ease of association with individual counties and minor civil divisions.
External stations	The model uses the same 31 external stations, but with new numbering.
Road network	I used the current center line files from the FHMPO as the basis for the modeled road network. The network now includes all local roads, and accounts for new roads and re-alignments since 2017. The new alignments include the introduction of double-diamond interchanges, such as US-77 and I-70 in Junction City, and the separate lanes by direction on Hwy 24, Tuttle Creek, and parts of Bluemont. The road network also updates the functional classification to match the FHMPO 2023 functional classification map. (One exception to this is for KS-18 between I-70 and KS-113; the 2013 map lists this as FCC 3, “major arterial”; my sense was that this should remain as FCC 2, “non-interstate freeway.”) I also checked that the model correctly represented each road segment’s number of lanes by direction, one-way streets, and the presence of center turn lanes. Other network changes include revising the centroids and centroid connectors to more closely match the true locations of each zone’s activity center (or big parking lot), and revising the representation of inbound and outbound lanes by the Fort Riley gates.
Area types	Area types—CBD, urbanized, suburban, rural—are a proxy for intersections and curb cuts. These affect free-flow and congested travel speeds in ways that the general application of the road performance function based only on a road’s functional class would not otherwise reflect. The updated model uses the same four

	area types, but modifies them in a few areas to more closely align with posted speed limits.
Population	This is entirely updated to 2022 conditions. The demographic and occupied housing information comes from the 2020 US census at the census block level, with adjustments to 2022 based on the American Community Survey population forecasts at the census tract level. (This also required assumptions about the share of population for a few census tracts that extended beyond the modeled region in a few peripheral areas such as Madison or Kaw Townships. I made a small adjustment for Fort Riley to reflect the 2nd Quarter, FY23 "Demographic Snapshot" from the base. I assume this is more accurate than the ACS estimate for the population of zones on the base. The model also includes updates for group quarters, primarily college dormitories and military barracks.
Households by household size and number of vehicles	This is updated to 2022 conditions, and divides each TAZ s households into 16 groups based on 1, 2, 3, or 4+ occupants and 0,1, 2, or 3+ vehicles. This is a key determinant of the number of household trips by various home-based trip purposes. (The model uses separate calculations for trips generated by group quarters or other non-home-based purposes.) The data comes from the 2020 census table B08201, household size by vehicles available at the tract level, and then adjusted for the 2021 ACS distribution of households by income group at the block group level and then iterative proportionally fitted to the TAZ population and households along with the NHTS 2017 table of vehicles by as a function of household size and income for metropolitan areas with populations under 250,000.
Employment	The model continues to calculate each zones trip attractions for work and certain non-work trip purposes based on (among other things) the number of jobs in each of four categories: basic, service, retail, and health care. The data for this comes from the Workplace Area Characteristics at the block level as compiled by the Bureau of Labor Statistics (LODES 7), and then aggregated up to the TAZ. Note that the model uses the data from 2019, as the block-level data from 2022 was not available, and the 2020 and 2021 data showed the effects of Covid. According to the Fed Reserve, St. Louis, the 2022 employment level in Manhattan was less than 4 percent below that for 2019. The 2019 data thus seemed like a good starting point for the updates to 2022. Subsequent adjustments included the addition of 238 service jobs in TAZ 600 for the new bio facility at KSU, and the distribution of Manhattan and Junction City school jobs to individual schools rather than as reported in the LODES 7 data as being at the school district office. Note that the model uses employment to determine the *distribution* of certain trip ends, but not the total number of trips, not ever for the journey to work. That total number comes from the number of residents in each zone who work outside the home. We assume this to be more accurate.

Fort Riley employment	This is updated to match the base's 2nd Quarter, FY23 Demographic Snapshot
University enrollment	Updated for KSU, Manhattan Christian College, and Manhattan Technical College based on internet search of each college's fall 2022 enrollment.
School enrollment	Updated based on student count data from school districts for 2022 at individual schools. This accounts for relocated Junction City High School, Oliver Brown School, and enlarged Eisenhower and Anthony Middle Schools. Enrollment at St. Xavier Catholic School, Manhattan Catholic School, and Flint Hills Christian School assumed as unchanged from 2017 (and that might have been a guess).
Lodging	Updated list of lodging rooms by TAZ based on the current lists maintained by the visitor bureaus in Manhattan and Junction City.
Traffic counts	**These still need work**. The model includes 348 counts but 292 of these are "raw"counts from 2021 and 2022 without adjustments for seasonality or multi-axle vehicles up to AADT, and 34 others are from 2019. The KDOT website now shows the 2023 traffic flow map with AADT for 2022. These are the right counts for validating the model, but the website provides only maps at a scale that does not show the count's exact location. For example, there's a count of 5160 on the Junction City inset map north of I-70 on South Washington Street (alt 77), but I can't tell if that's north of Madison, or maybe even north of Ash. I sent a note to Bill Hughes at KDOT to get a table with a more precise location for those counts. So far, I haven't heard back.

The model process changes that I've made to the 2017 model include the following:

- Structural model changes to allow for the larger set of internal macros, and renumbered Fort Riley TAZs;
- Changing the expedited mode choice coefficients for college students, to shift more short distance trips (especially for less than .6 miles) to non-auto modes;
- Eliminating the hard coding of expedited mode choice parameters; the model now looks these up in the background model parameters file.

I expect that I will make more model process changes during the validation and recalibration in the next stage of model development.

The rest of this memo shows maps of various inputs, and the comparison of model results with observed traffic counts.

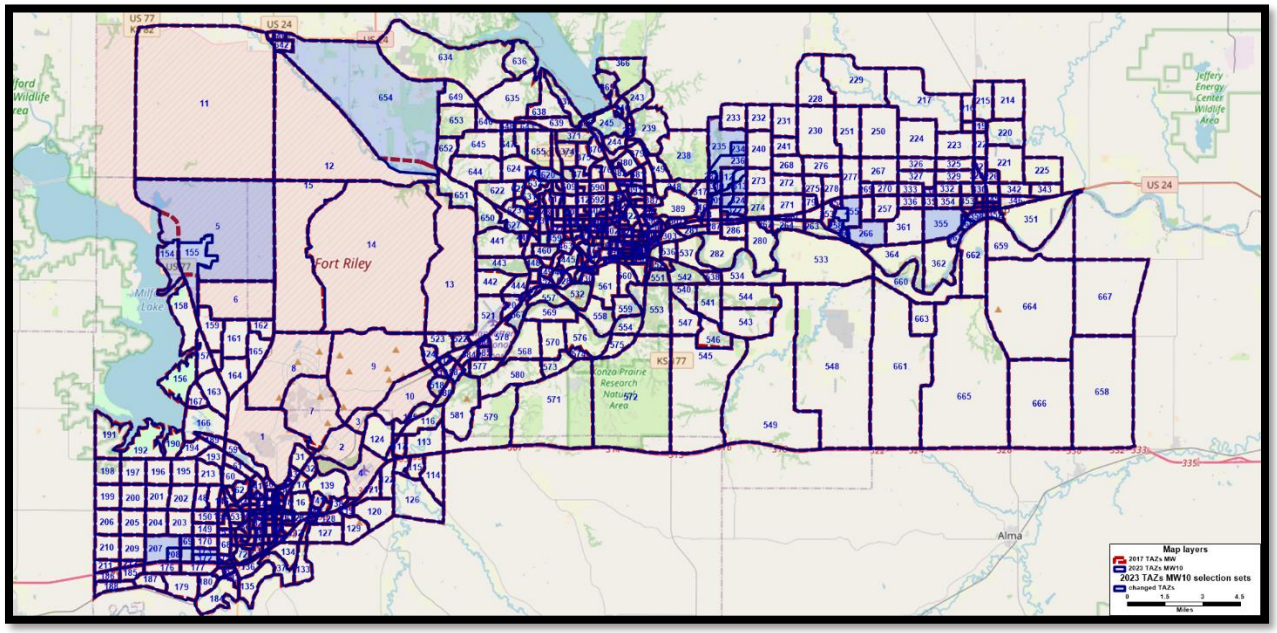
Revised TAZ structure

The modeled region is the same size as in 2017, but we have slightly modified the TAZ divisions.

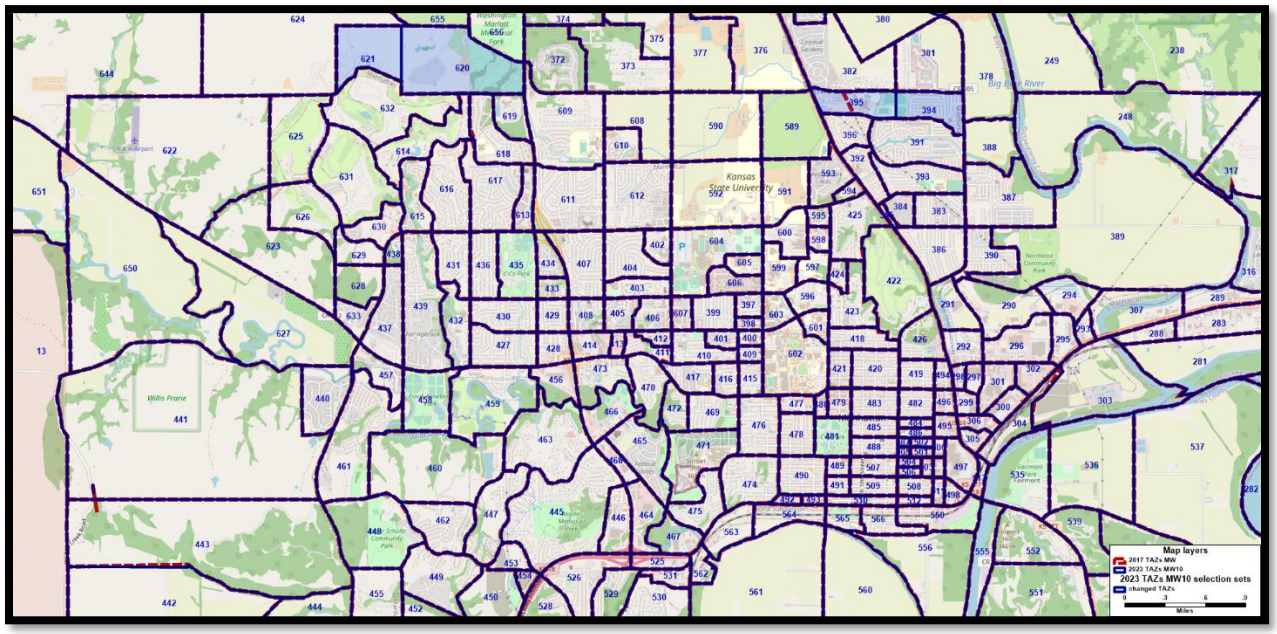
County/Fort	minor civil division	TAZs		TAZs numbered from	to
Fort Riley		**15**		**1**	**15**
Geary (not Fort Riley)		**198**		**16**	**213**
	Jefferson township	35		16	145
	Junction City city	103		18	183
	Lyon township	1		137	137
	Milford township	13		154	167
	Smoky Hill township	46		31	213
Pottawatomie		**153**		**214**	**366**
	Blue township	50		232	366
	Louisville township	12		214	325
	Manhattan city	18		289	306
	Pottawatomie township	2		228	229
	St. George township	36		224	364
	Wamego township	35		225	363
Riley (not Fort Riley)		**291**		**367**	**657**
	Ashland township	12		557	580
	Grant township	5		634	638
	Madison township	3		640	642
	Manhattan city	168		372	633
	Manhattan township	54		367	656
	Ogden township	23		442	588
	Wildcat township	18		441	657
	Zeandale township	8		533	549
Wabaunsee		**10**		**658**	**667**
	Kaw township	1		667	667
	Newbury township	1		658	658
	Wabaunsee township	8		659	666

TAZs—areas shaded in blue are revisions from the 2017 TAZs.

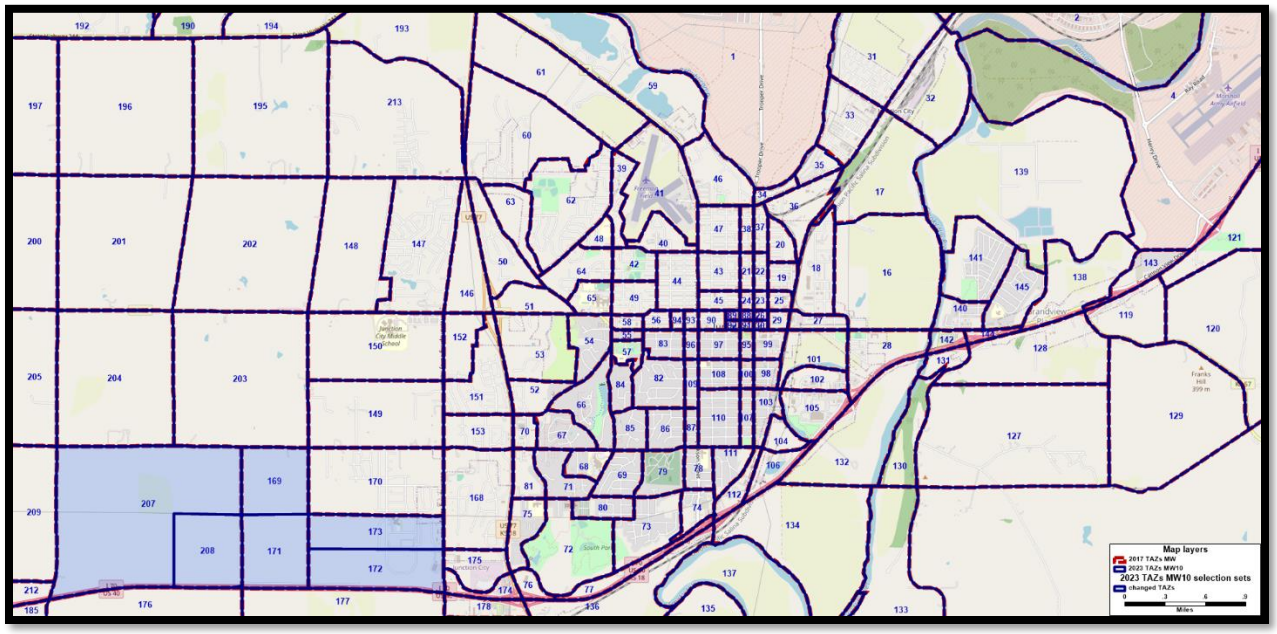
Full modeled region



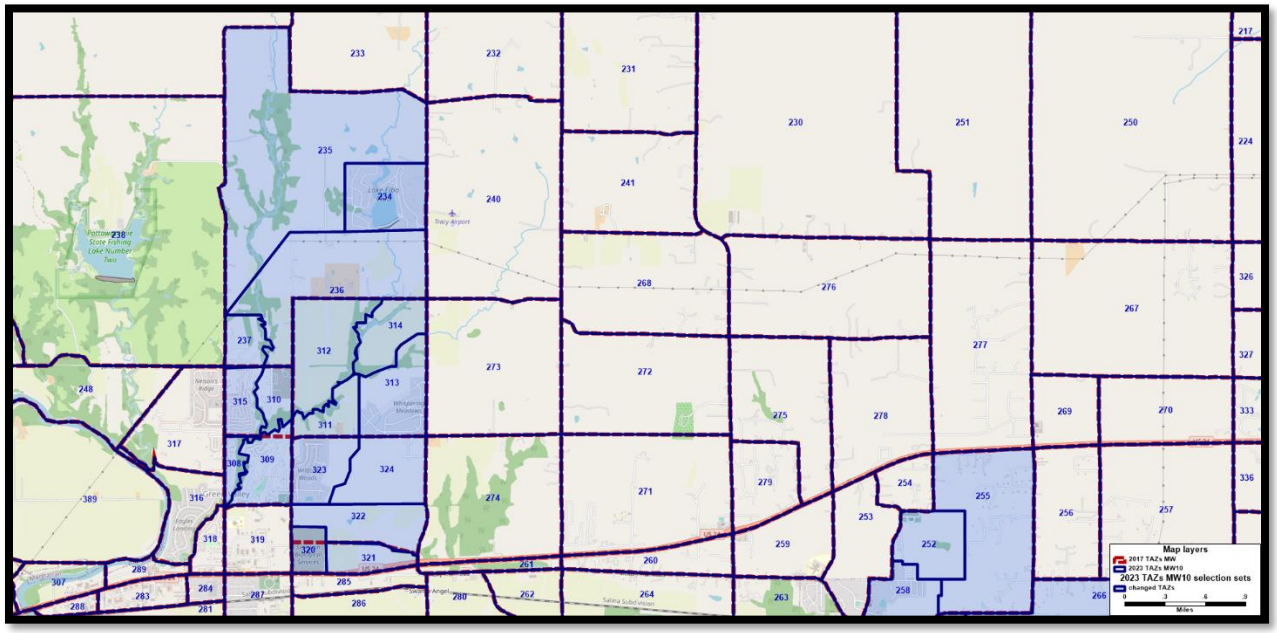
Manhattan area



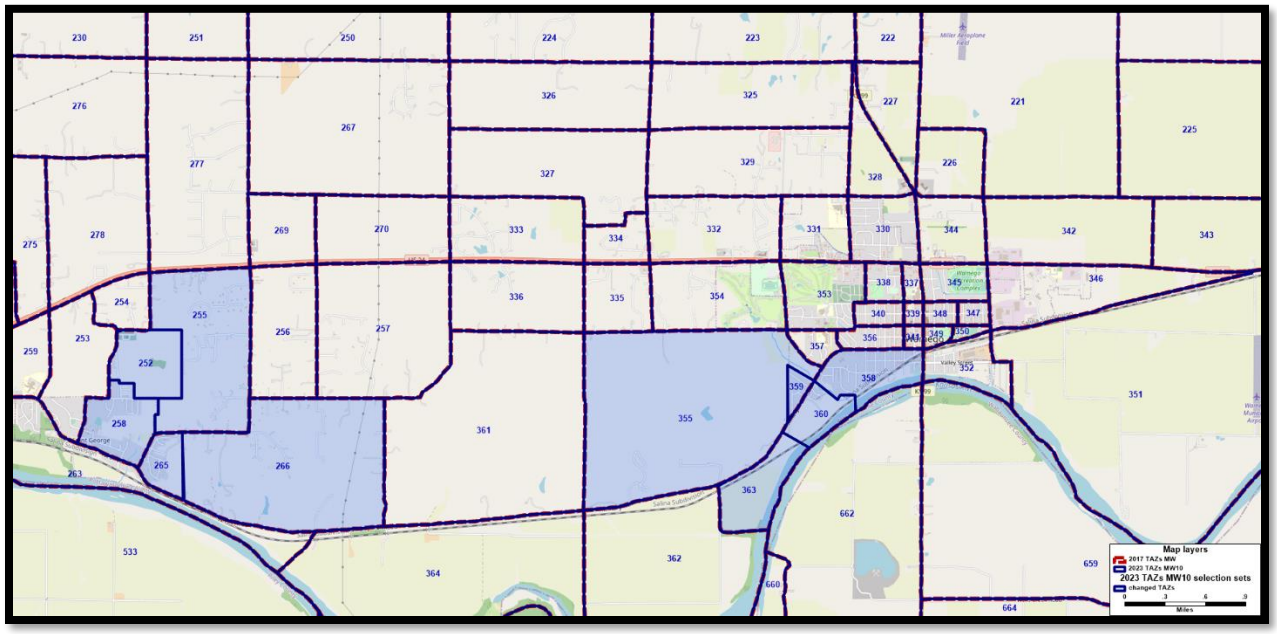
Junction City area



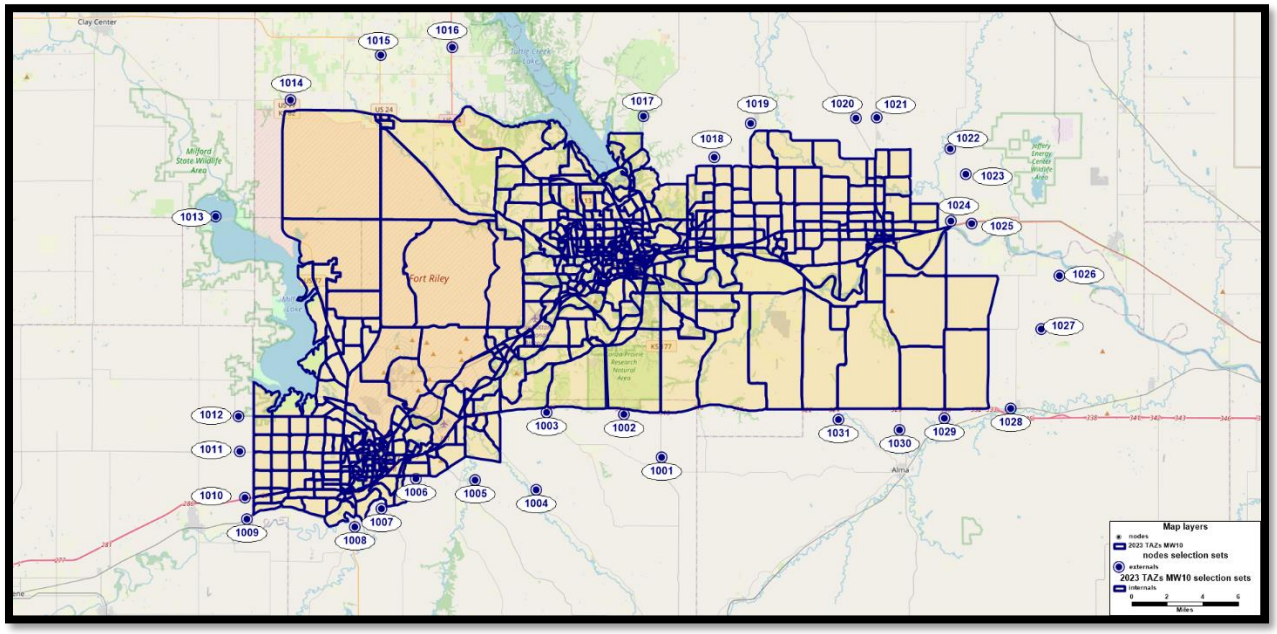
Blue Township area



Wamego area



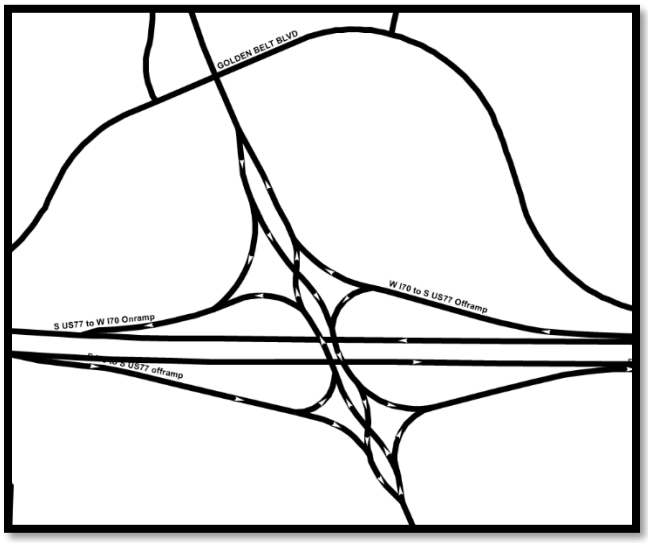
Extenrals



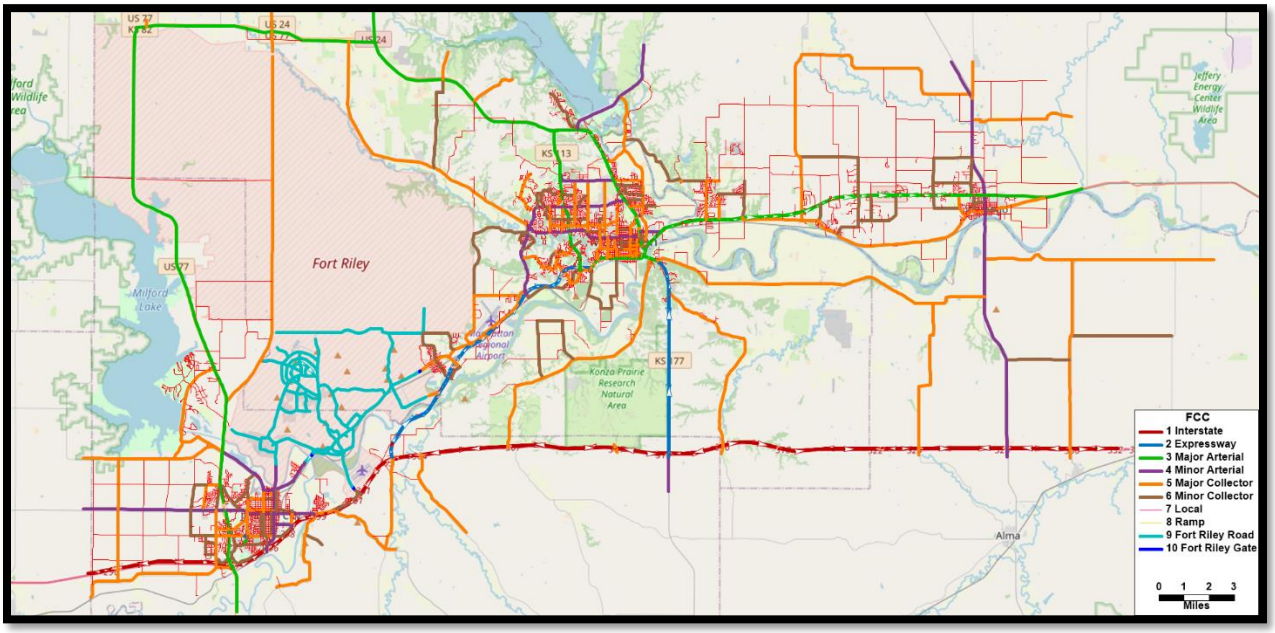
Road network changes

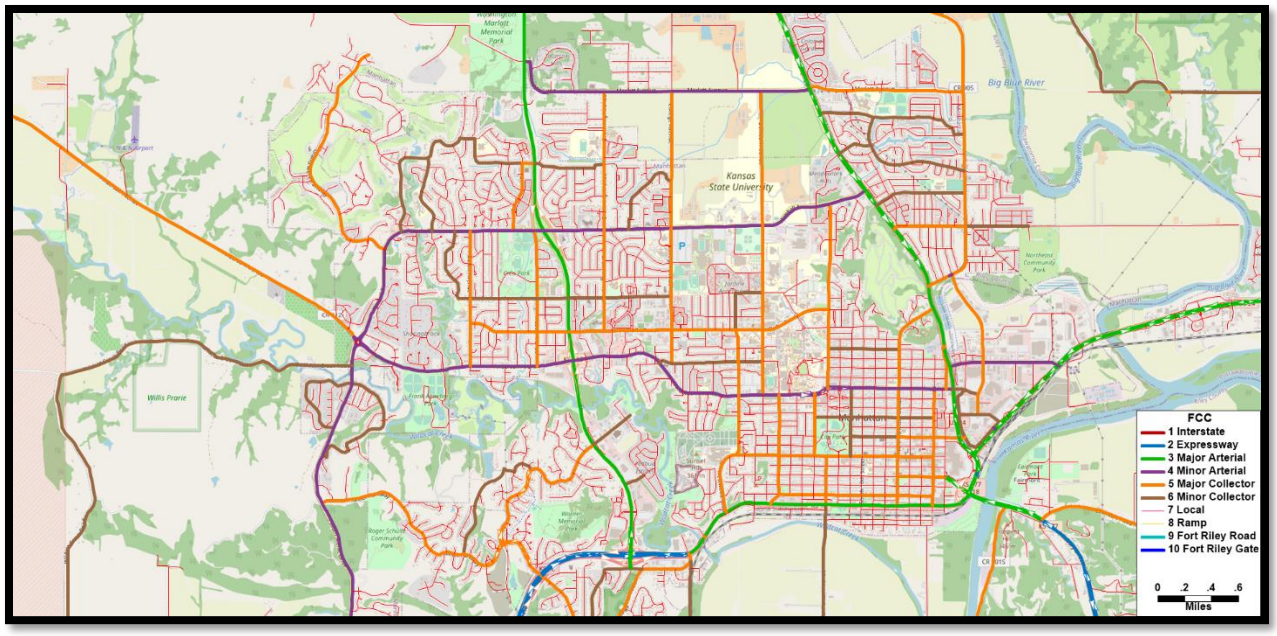
Coding of double diamond interchanges

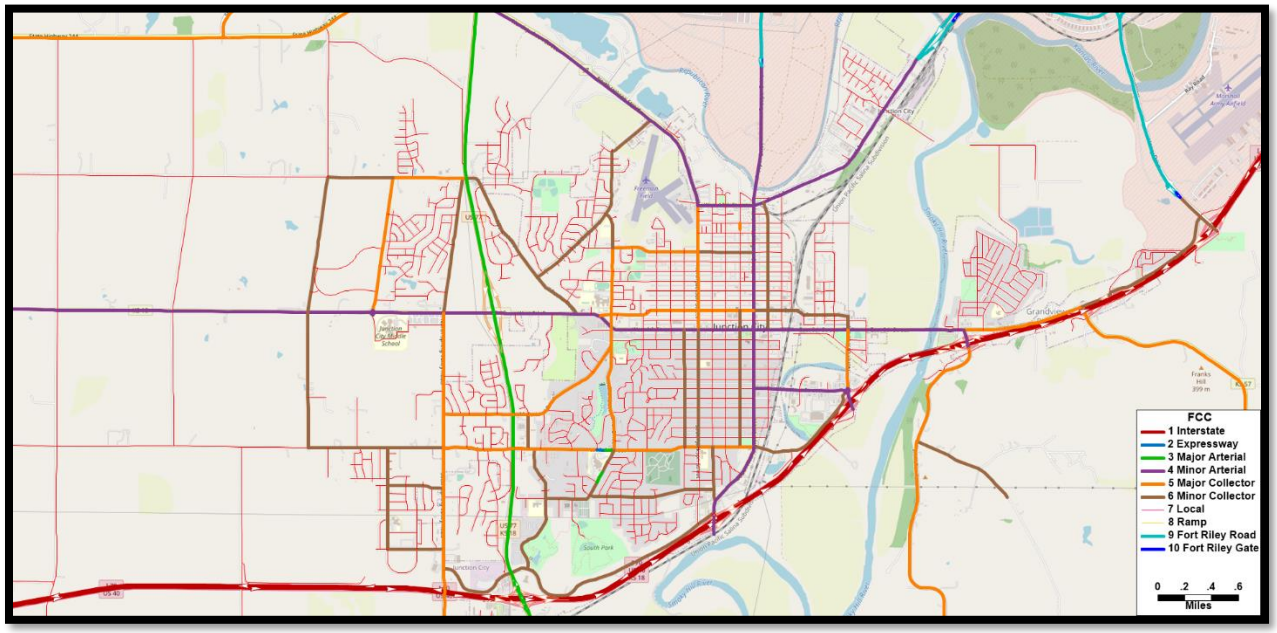
US-77 and I-70 in Junction City, as shown at right.



Functional classification




Kansas State University
Big Blue River
Wills Prarie
FCC
1 Interstate
2 Expressway
3 Major Arterial
4 Minor Arterial
5 Major Collector
6 Minor Collector
7 Local
8 Ramp
9 Fort Riley Road
10 Fort Riley Gate
0 .2 .4 .6
Miles


Junction City
FCC
1 Interstate
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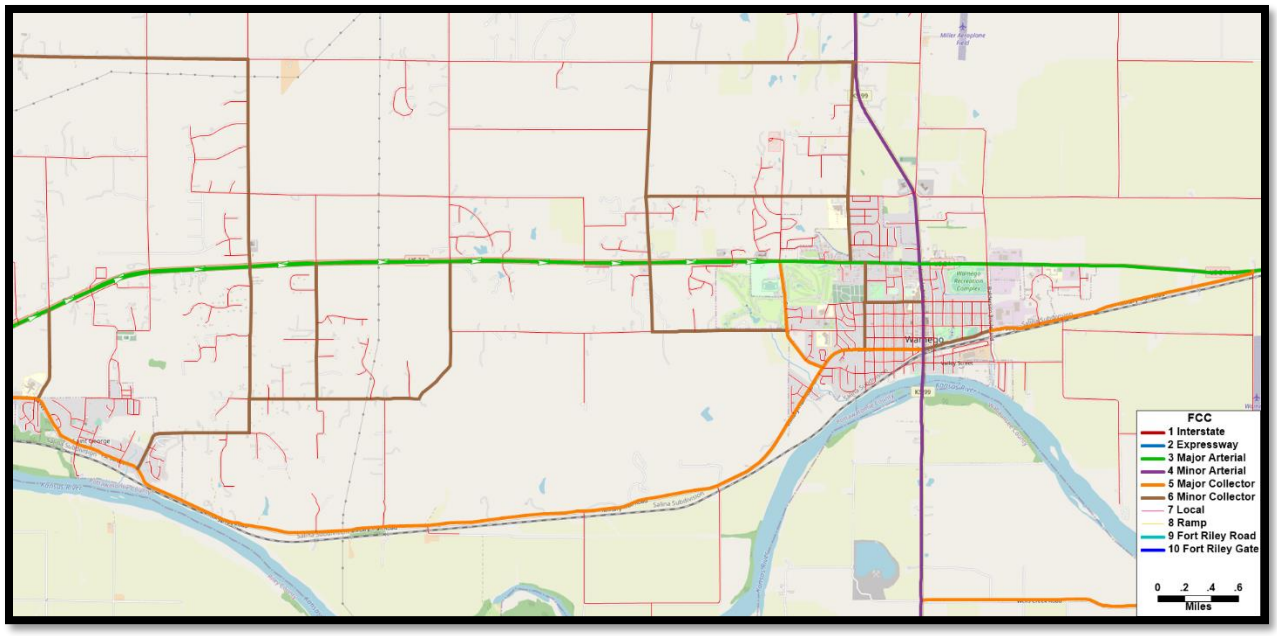
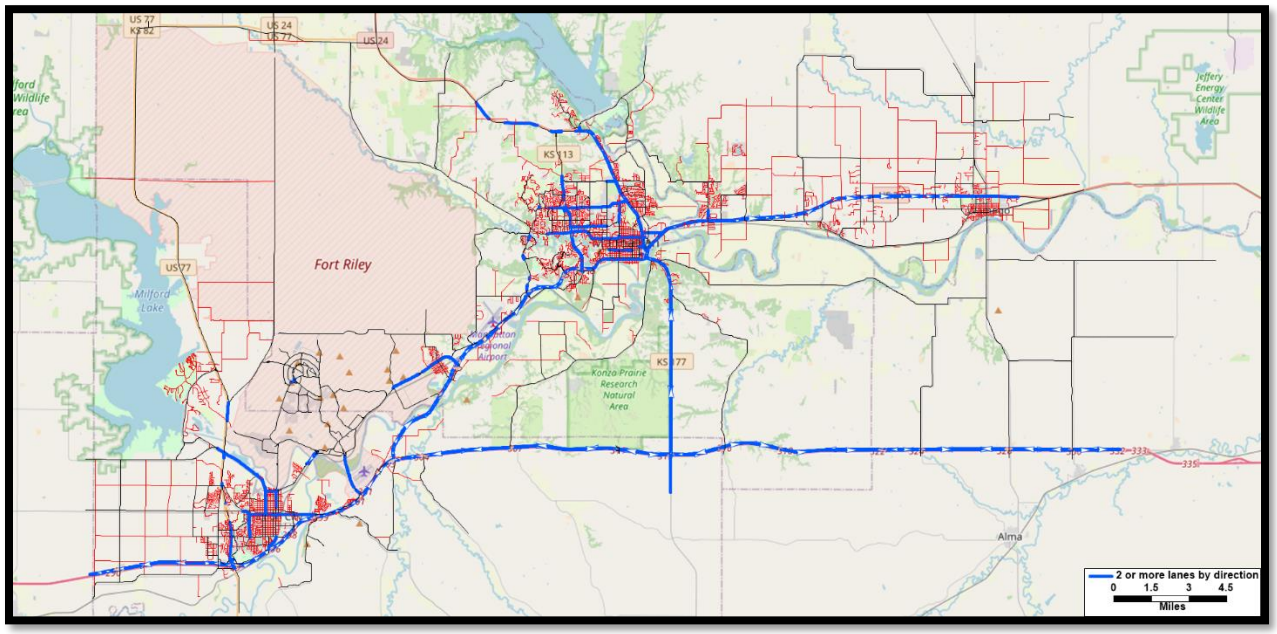
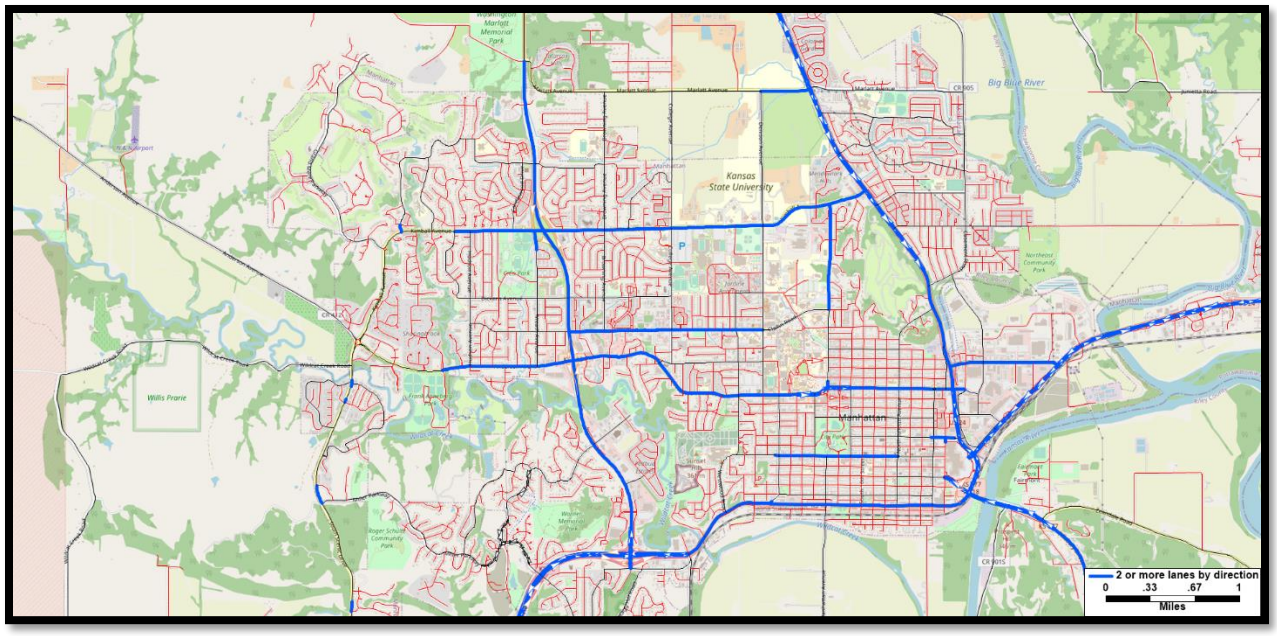
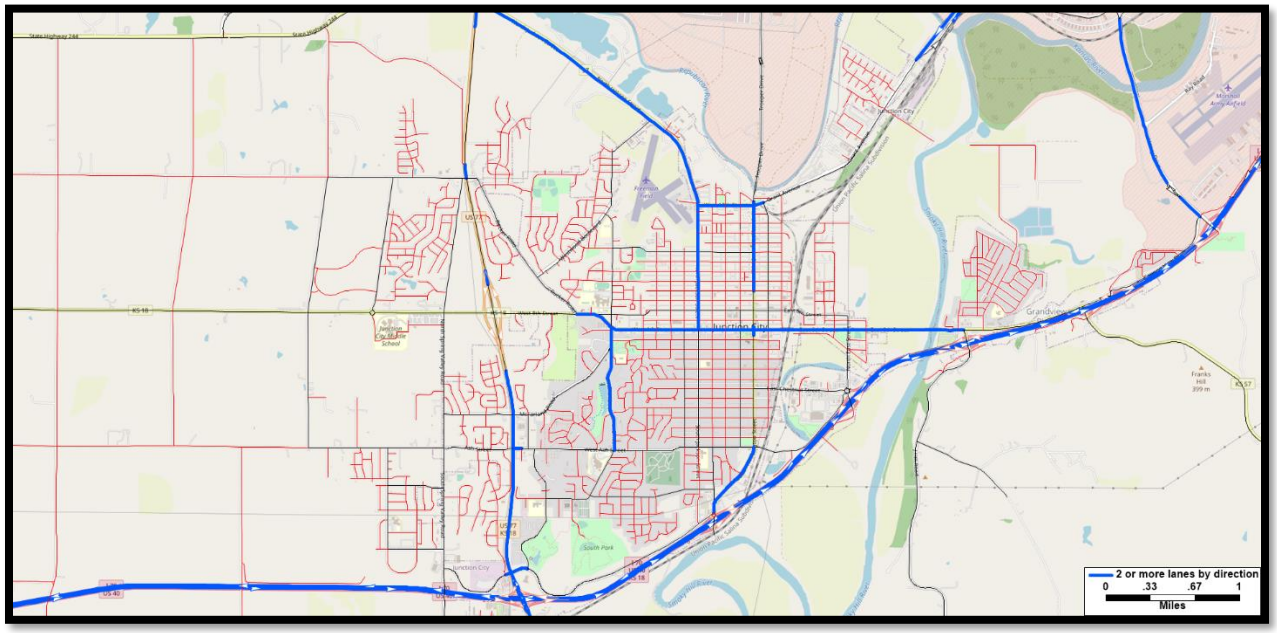
0 .2 .4 .6
Miles



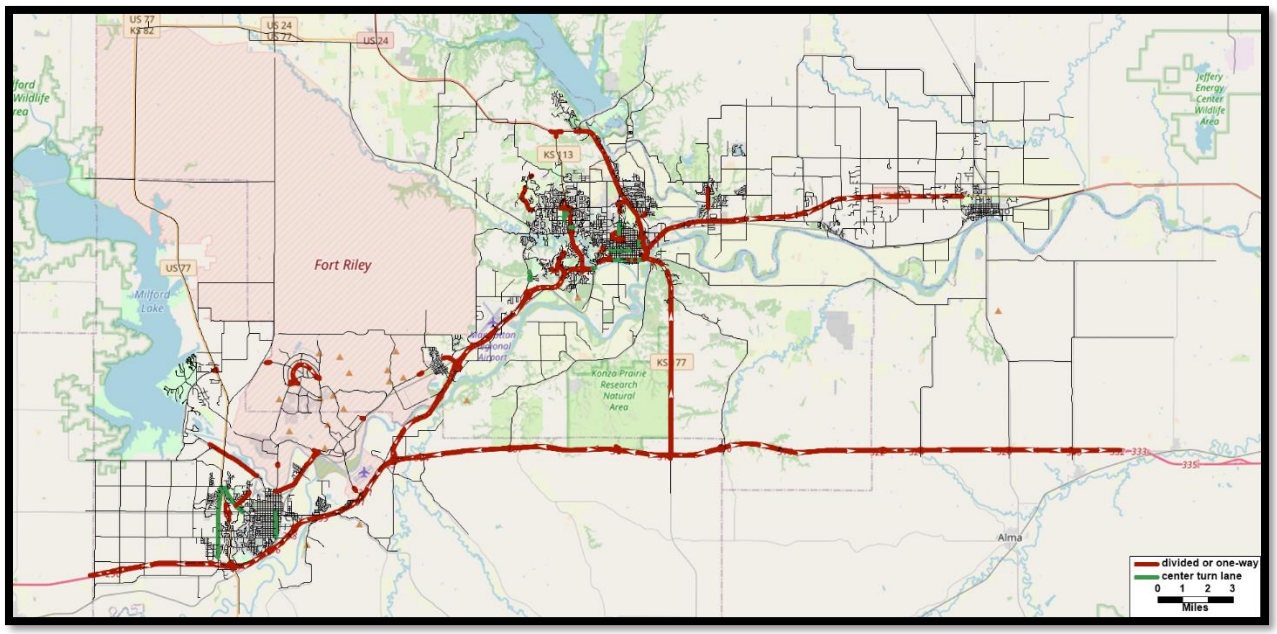
Multi-lane roads

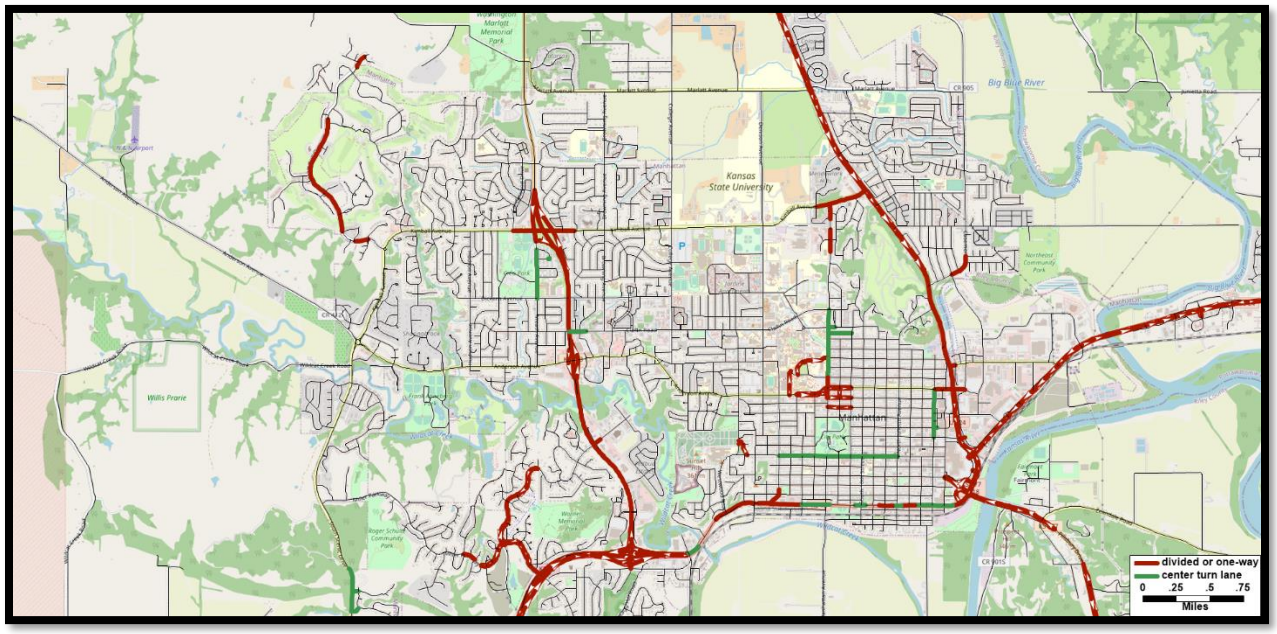


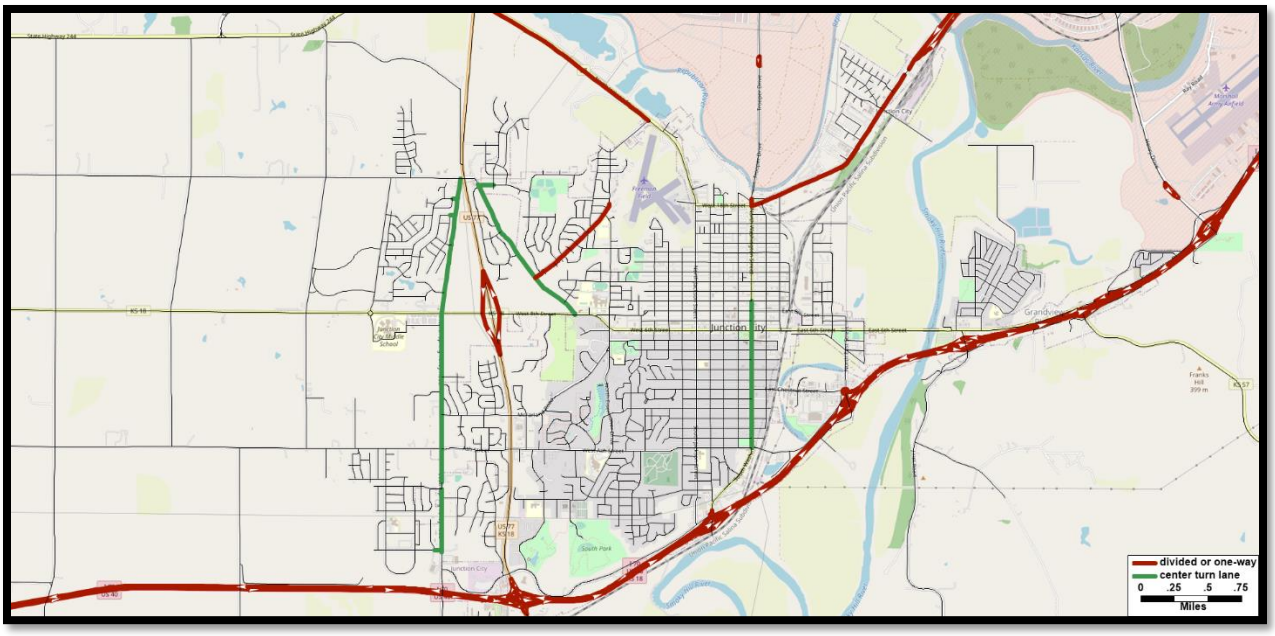

Kansas State University
Manhattan
Wills Prarie
Big Blue River
2 or more lanes by direction
0 .33 .67 1
Miles

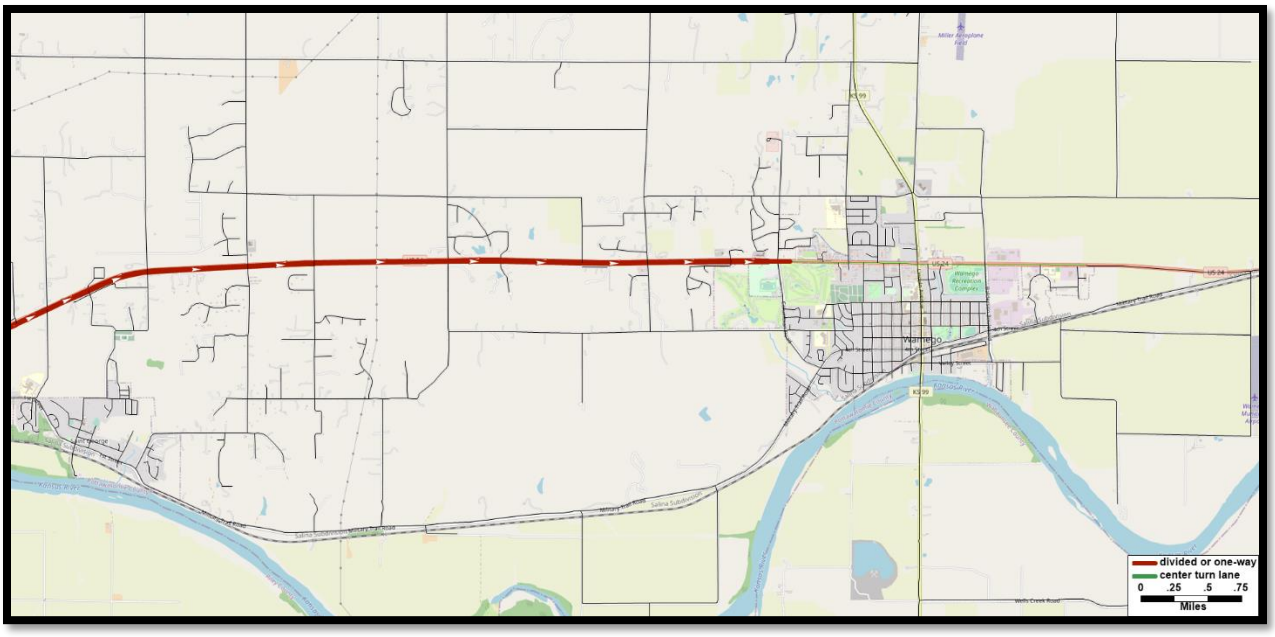

Junction City
Grandview
2 or more lanes by direction
0 .33 .67 1
Miles

One-way roads, divided roads and center turn lanes



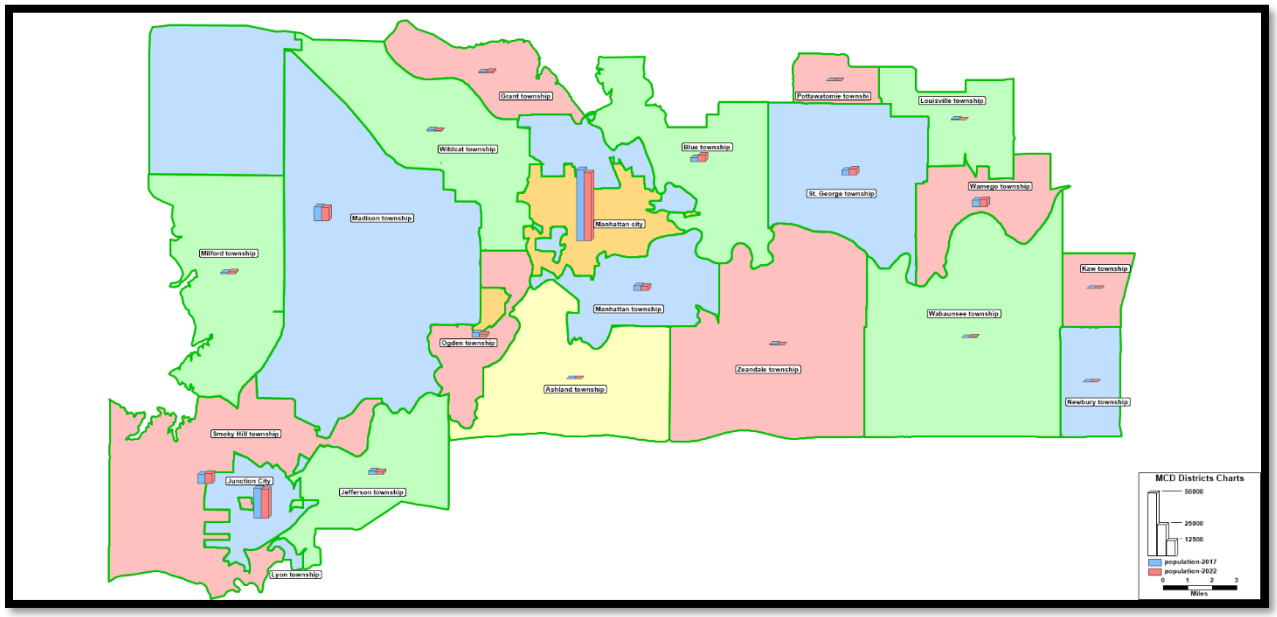



divided or one-way
center turn lane
0 .25 .5 .75
Miles

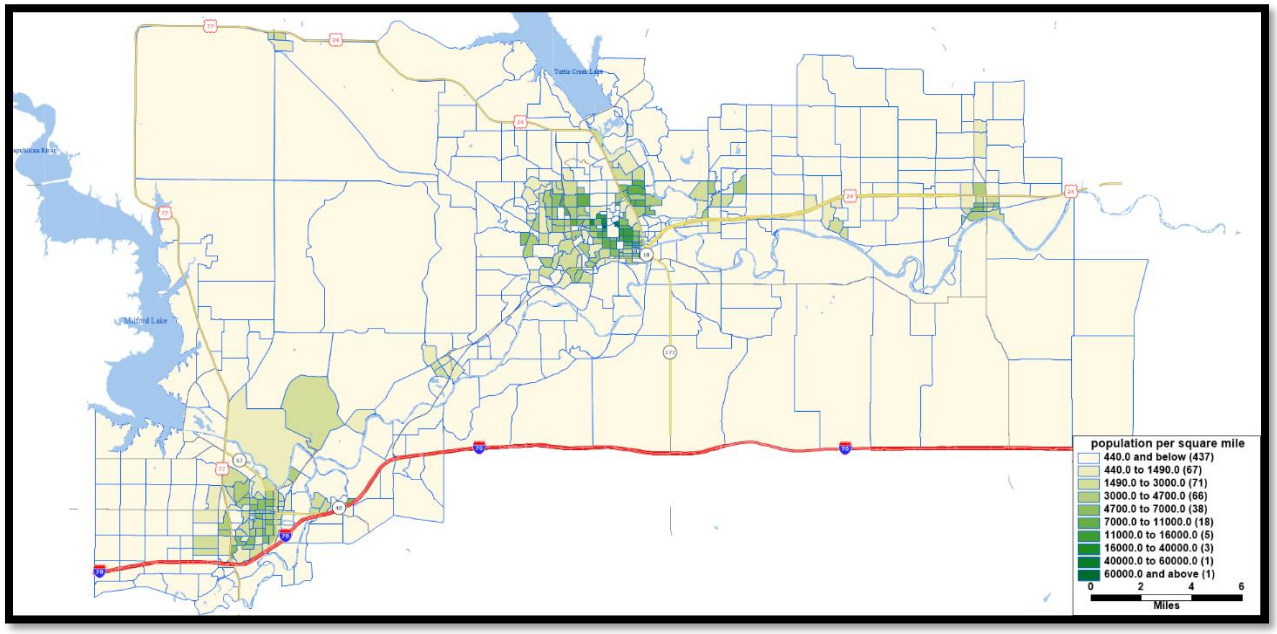

divided or one-way
center turn lane
0 .25 .5 .75
Miles

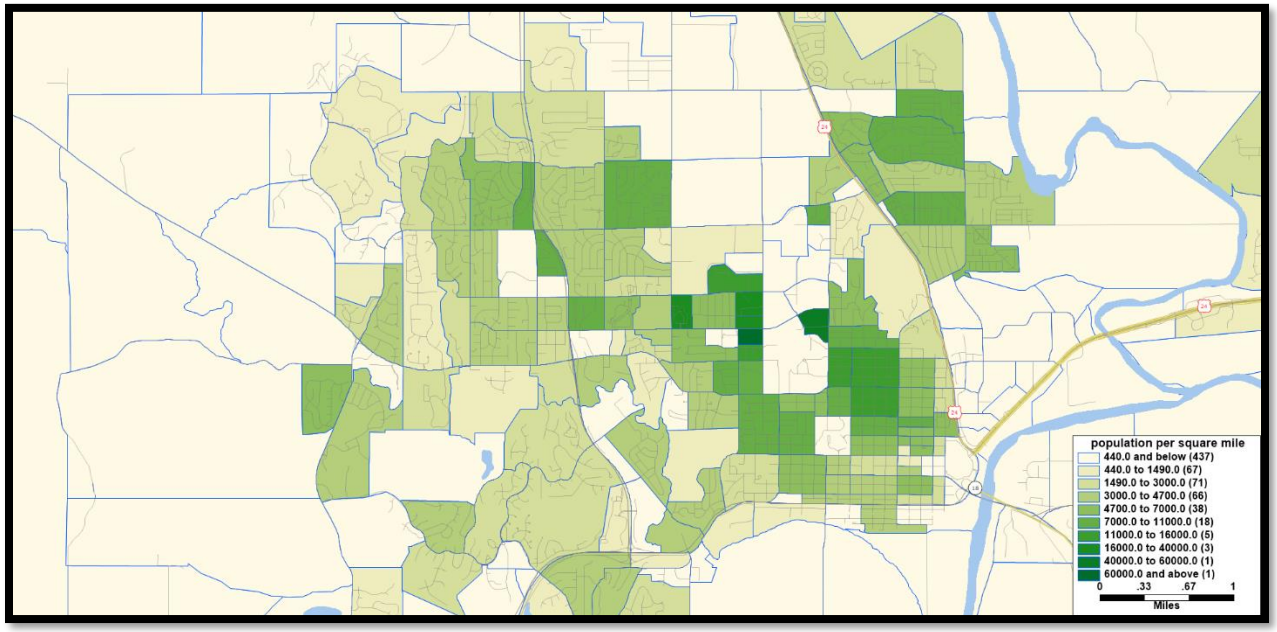
2022 Population and household data by TAZ

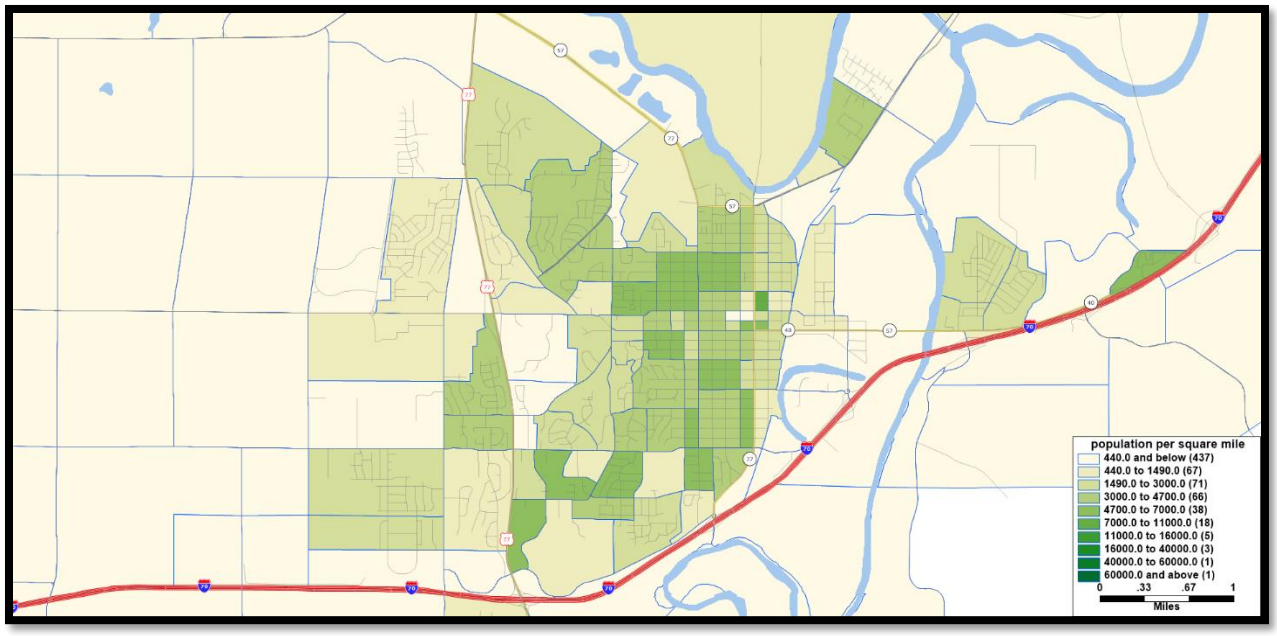
Geographic Area	Population Estimate (as of July 1) 2020	2021	2022	% of MCD pop in modeled region	adjusted 2022 pop based on ACS	Fort Riley adj	modeled pop 2022	modeled pop 2017	change 2017 to 2022
Ashland township	147	147	145	1	145		148	144	4
Blue township	4,962	5,082	5,198	0.97	5,042		5,144	3,316	1,828
Grant township	895	895	884	1	884		876	817	59
Jefferson township	2,138	2,104	2,082	1	2,082		2,068	2,552	-484
Junction City city	22,939	22,531	22,264	1	22,264		22,285	23,559	-1,274
Kaw township	244	249	250	0.24	60		60	37	23
Louisville township	1,023	1,047	1,070	0.7	749		768	765	3
Madison township	9,404	8,972	8,913	1	8,913	1,350	10,263	10,700	-437
Manhattan city/township	56,364	56,629	56,024	1	56,024		56,023	59,026	-3,003
Milford township	1,632	1,606	1,590	1	1,590		1,575	1,225	350
Newbury township	1,081	1,094	1,102	0.06	66		70	97	-27
Ogden township	2,068	2,064	2,034	1	2,034		2,034	2,873	-839
Pottawatomie township	653	666	676	0.14	95		94	78	16
Smoky Hill township	9,219	9,062	8,956	0.87	7,792		7,736	7,292	444
St. George township	4,569	4,689	4,813	0.97	4,669		4,816	3,684	1,132
Wabaunsee township	576	584	590	0.99	584		591	386	205
Wamego township	5,684	5,735	5,761	0.99	5,703		5,701	5,372	329
Wildcat township	843	846	839	1	839		840	889	-49
Zeandale township	334	335	331	1	331		329	355	-26
modeled region	124,775	124,337	123,522		119,866		121,421	123,167	-1,746

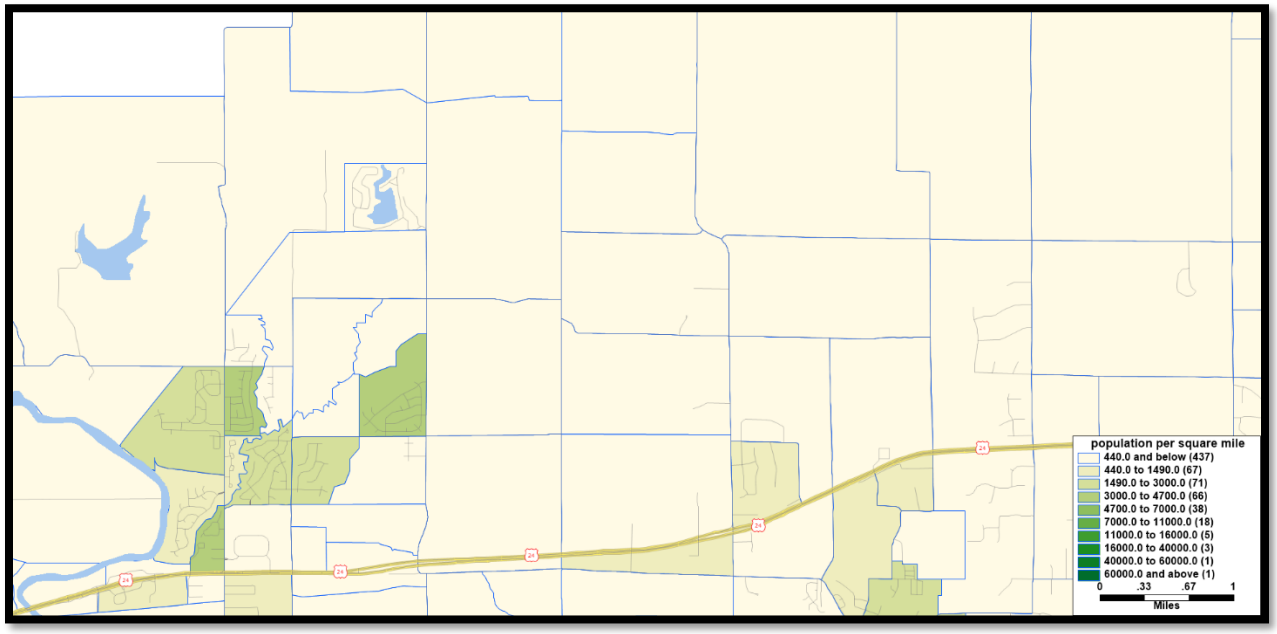


Population density 2022 by TAZ






population per square mile
440.0 and below (437)
440.0 to 1490.0 (67)
1490.0 to 3000.0 (71)
3000.0 to 4700.0 (66)
4700.0 to 7000.0 (38)
7000.0 to 11000.0 (18)
11000.0 to 16000.0 (5)
16000.0 to 40000.0 (3)
40000.0 to 60000.0 (1)
60000.0 and above (1)
0 .33 .67 1
Miles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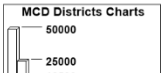
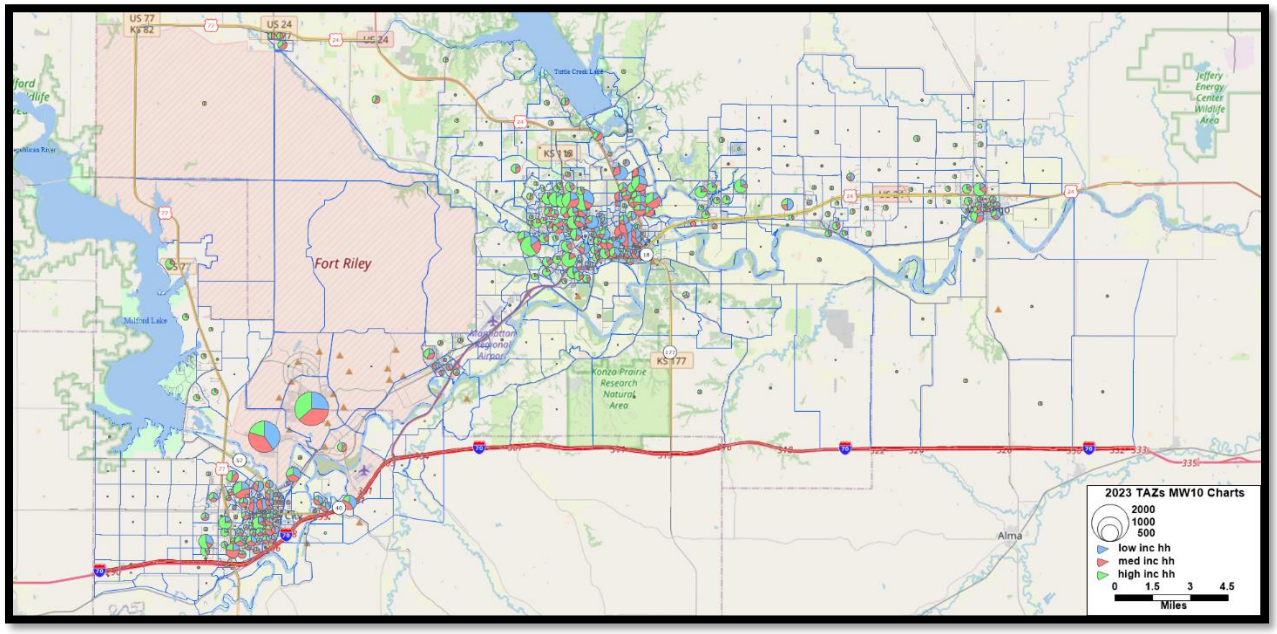
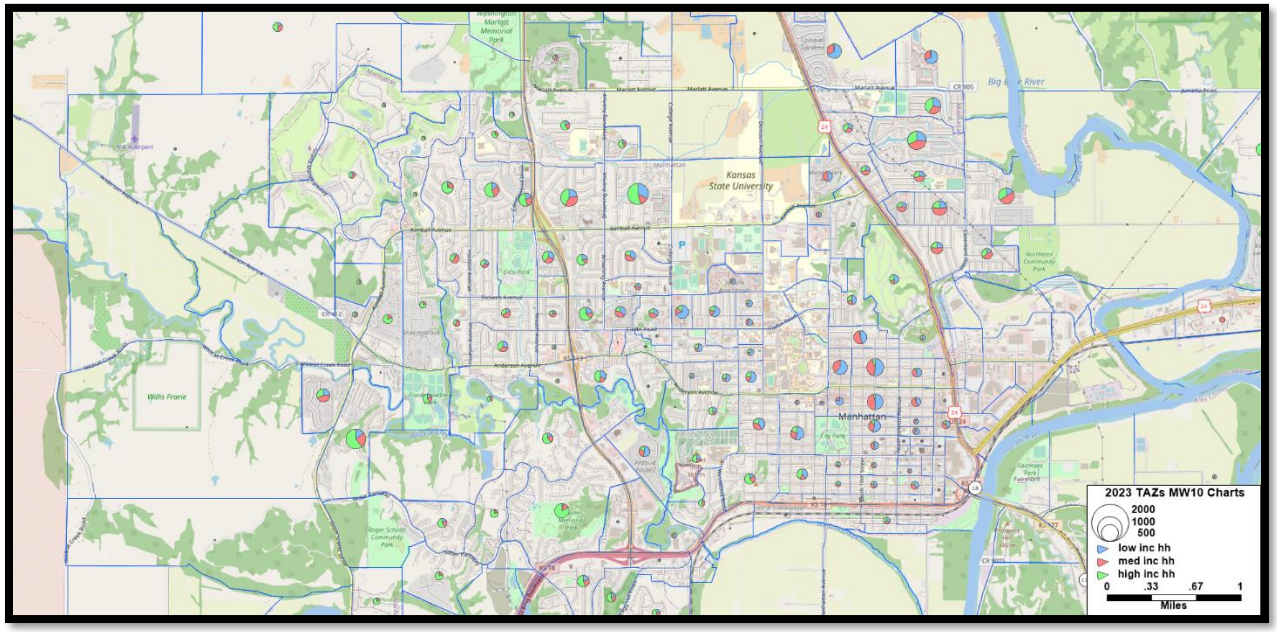
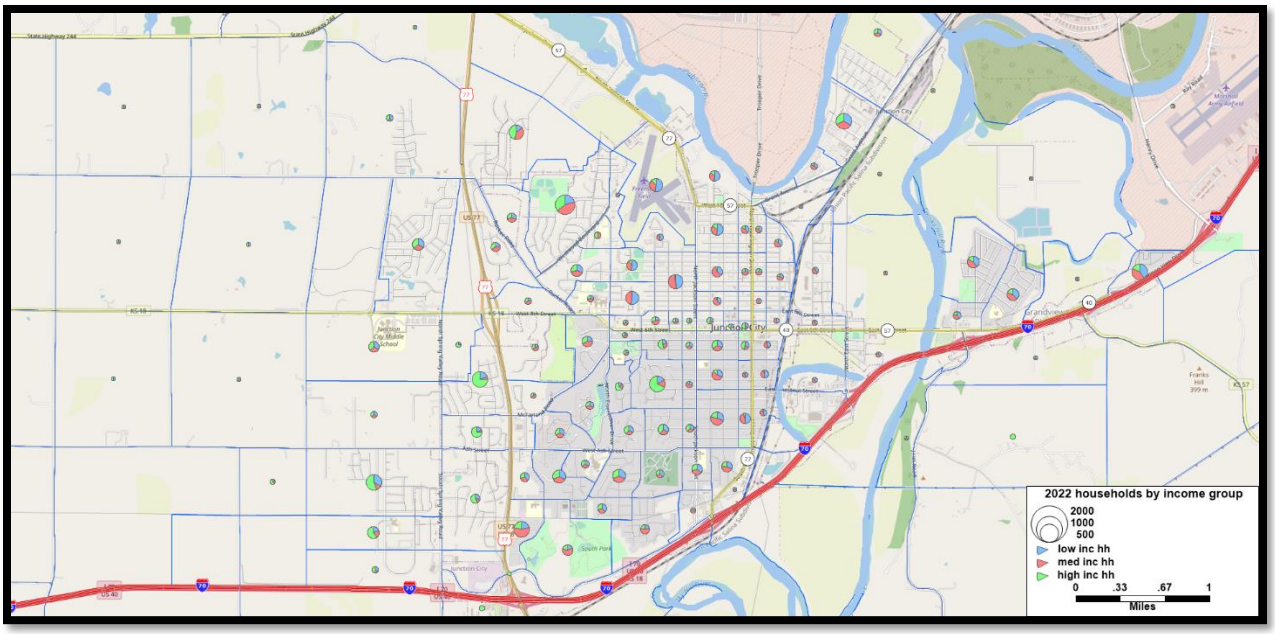
40000.0 to 60000.0 (1)
60000.0 and above (1)
0 .33 .67 1
Miles


MCD Districts Charts
50000
25000

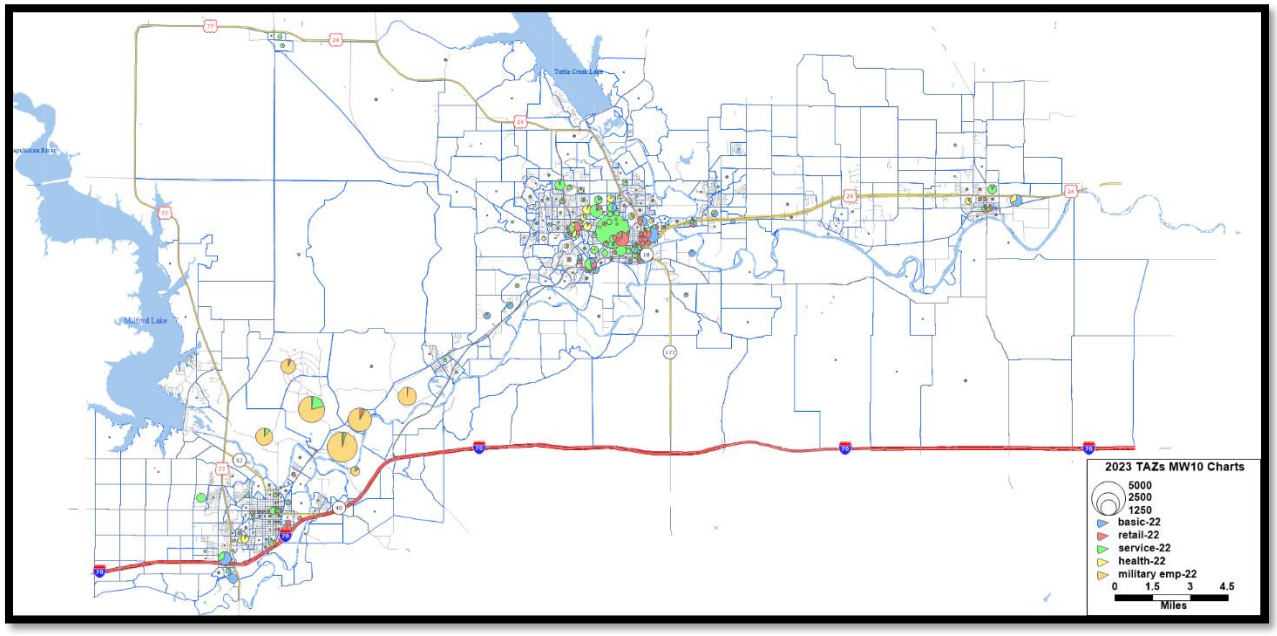
Households by income group

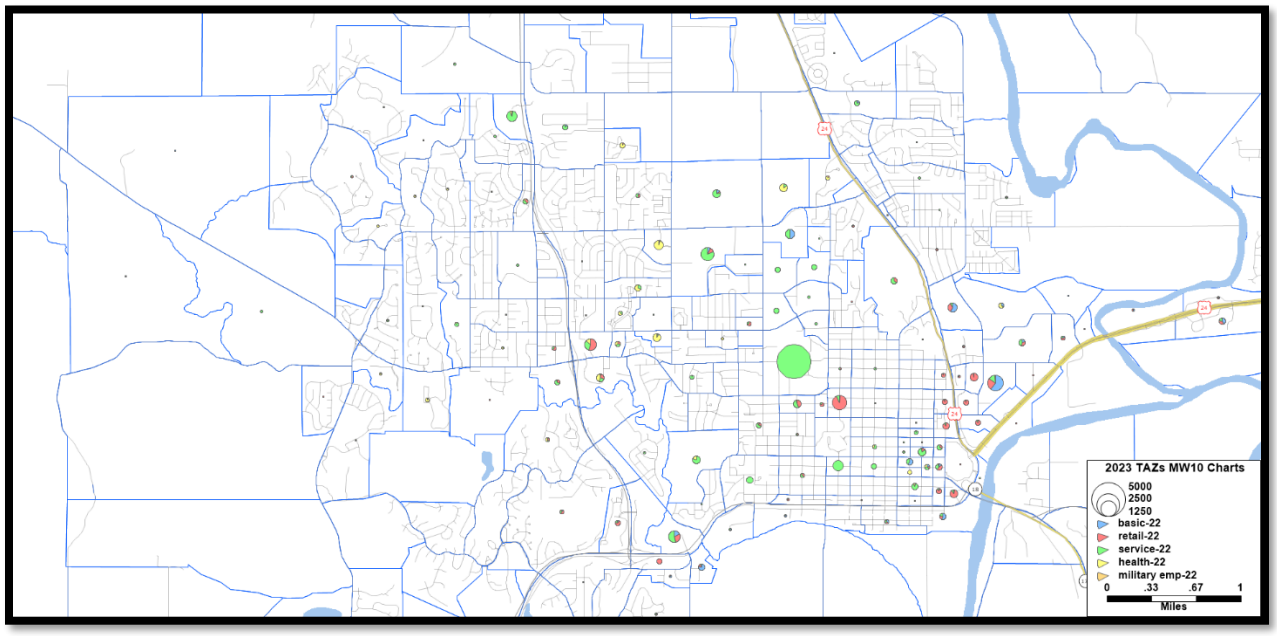


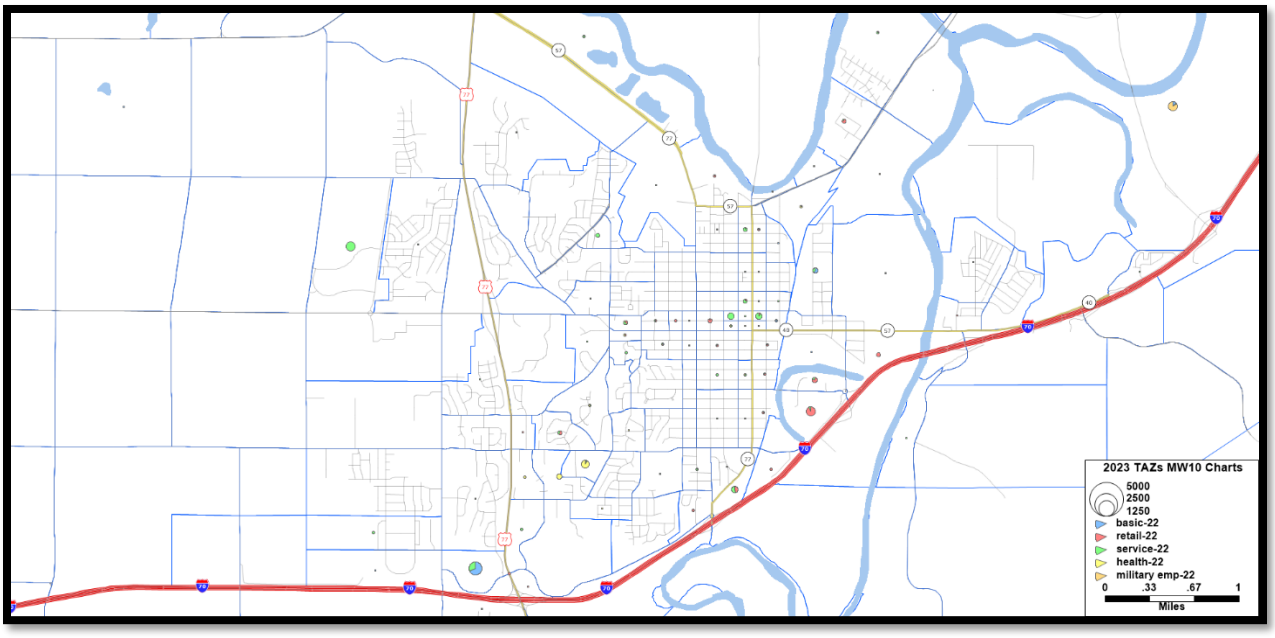



2022 households by income group
2000
1000
500
low inc hh
med inc hh
high inc hh
0
.33
.67
1
Miles

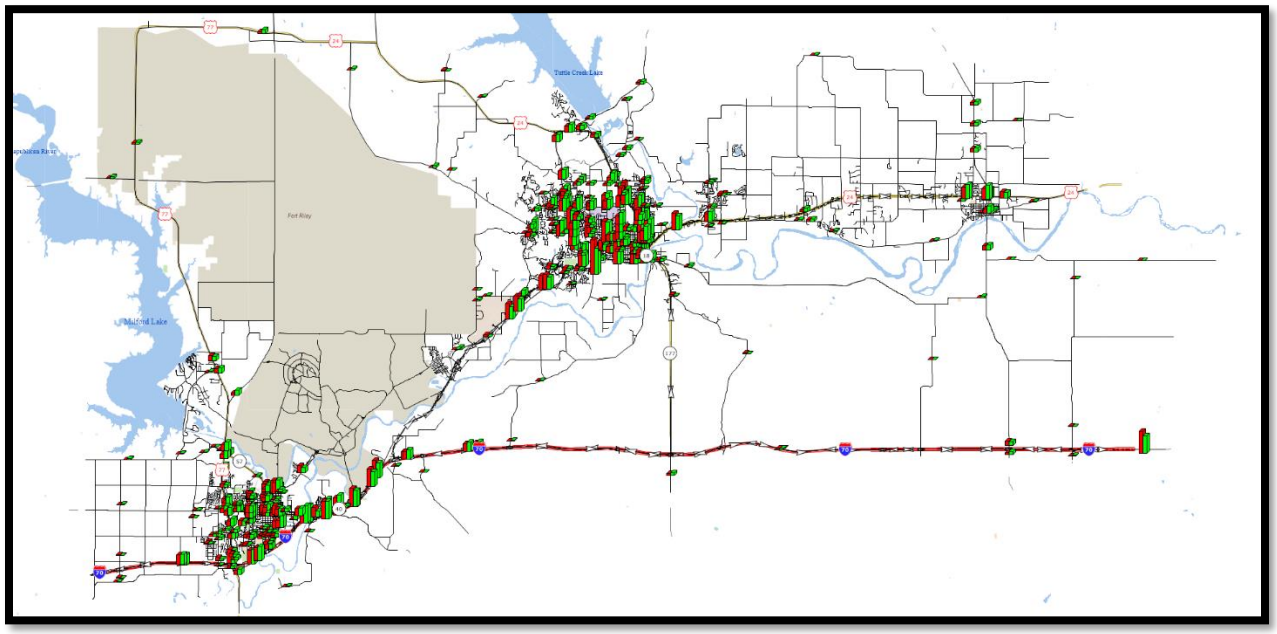
Employment by type

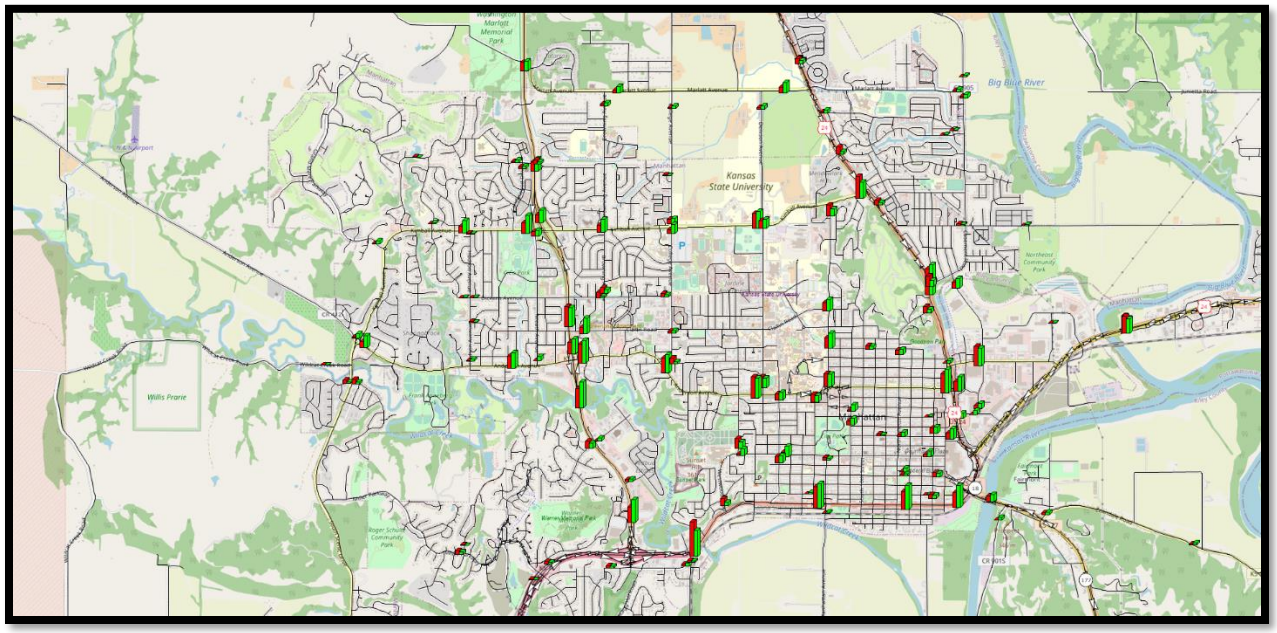


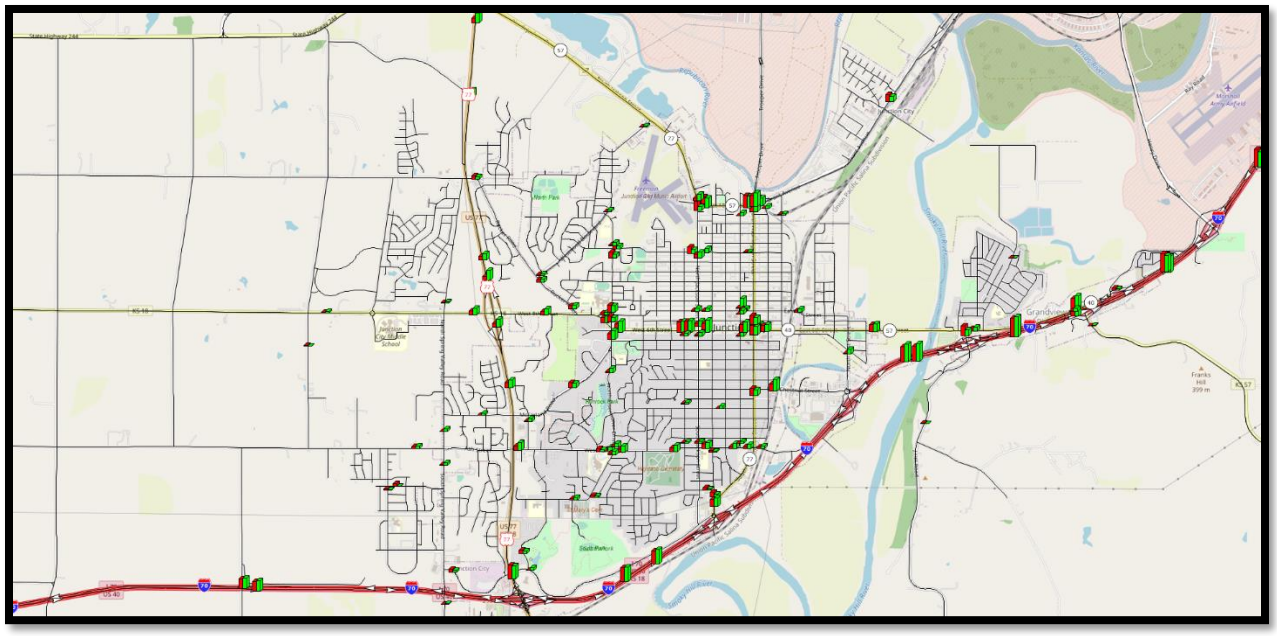


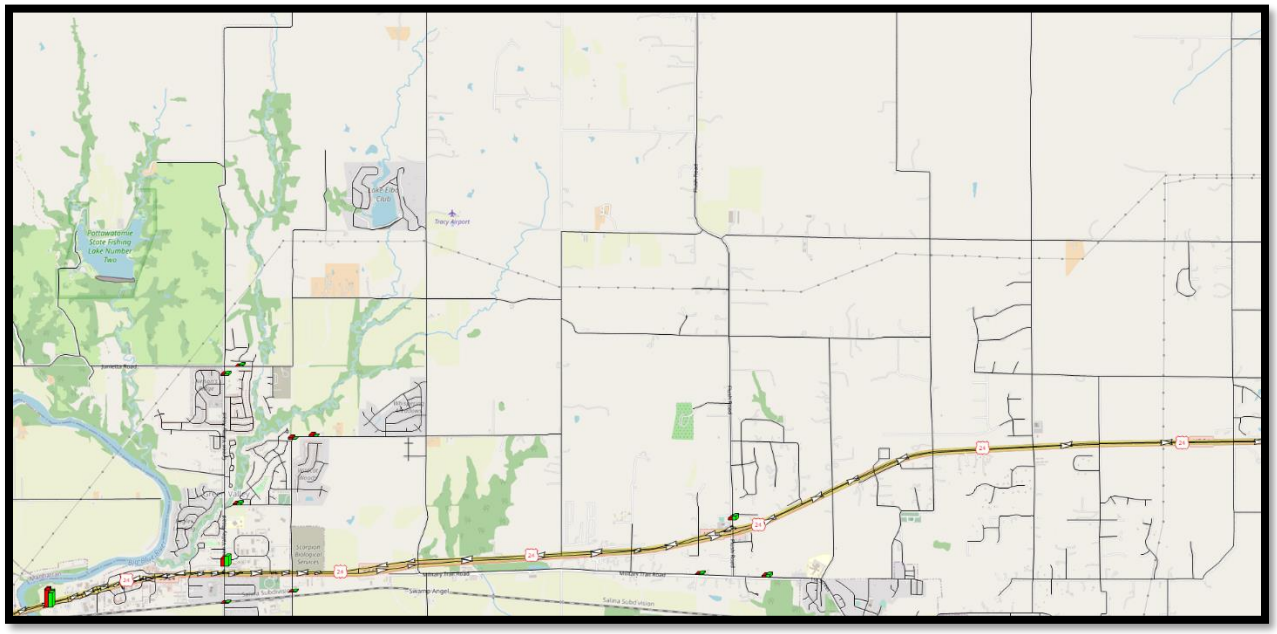

2023 TAZs MW10 Charts
5000
2500
1250
basic-22
retail-22
service-22
health-22
military emp-22
0
.33
.67
1
Miles

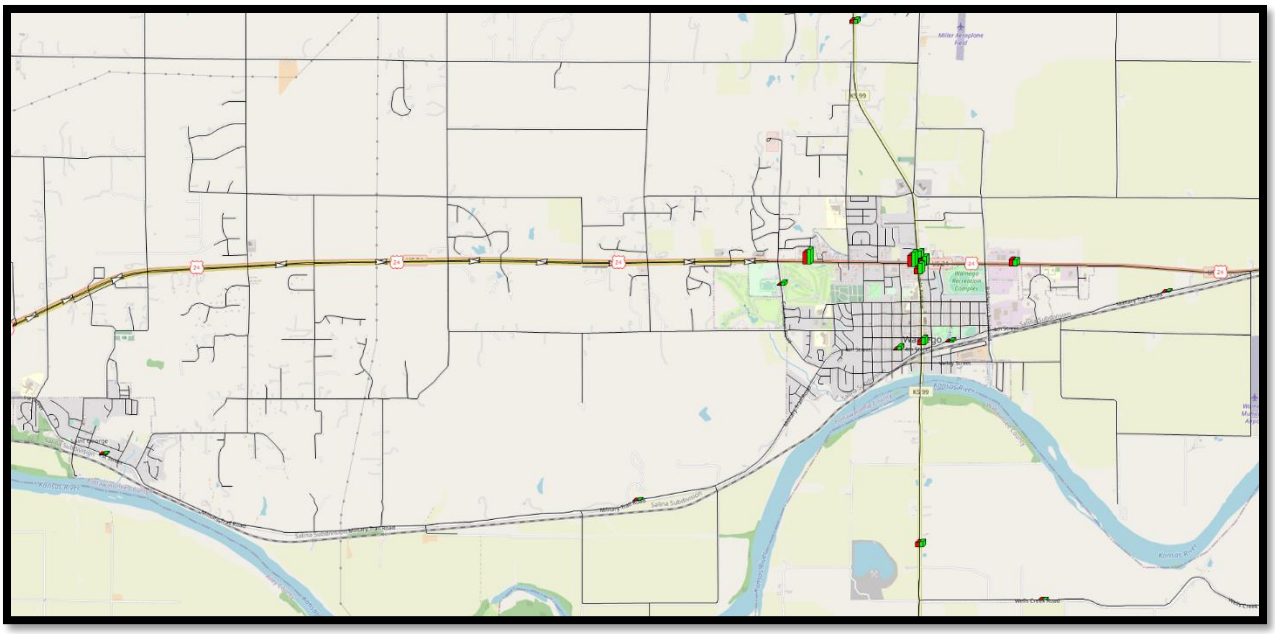
Comparison of modeled (red) and observed (green) traffic counts—run 12 (nowhere near final validation!)











WARNER TRANSPORTATION CONSULTING
177 Riverside Drive, Northampton, MA 01062 413 585-5026 www.warnertransportation.com

To: David Maynard, KDOT

From: Marc Warner

Date: July 21, 2025

Re: FHMPO model files and use notes

The attached flash drive contains all the files you'll need to run the recently updated FHMPO transportation and land use model.

1) Copy all the files into some FHMPO-dedicated directory

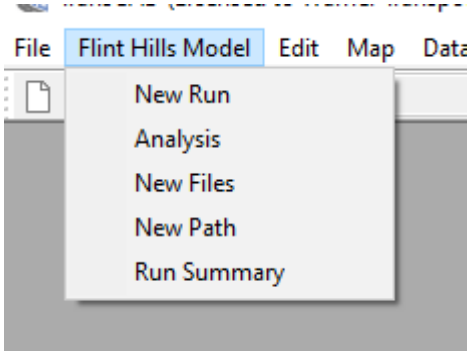
2) Set up the program as a TransCAD Add-in

   a. From the TransCAD main drop down menu, select Tools → GIS Developer's Kit → Setup Add-Ins
   b. At the dialog box, click Add and then apply the following settings:

      Type: Macro
      Description: FHMPO model 2023
      Name: Set Flint Hills Menu
      UI Database: [file directory]\fhmpo model 2023 r12.dbd
      In Folder: None

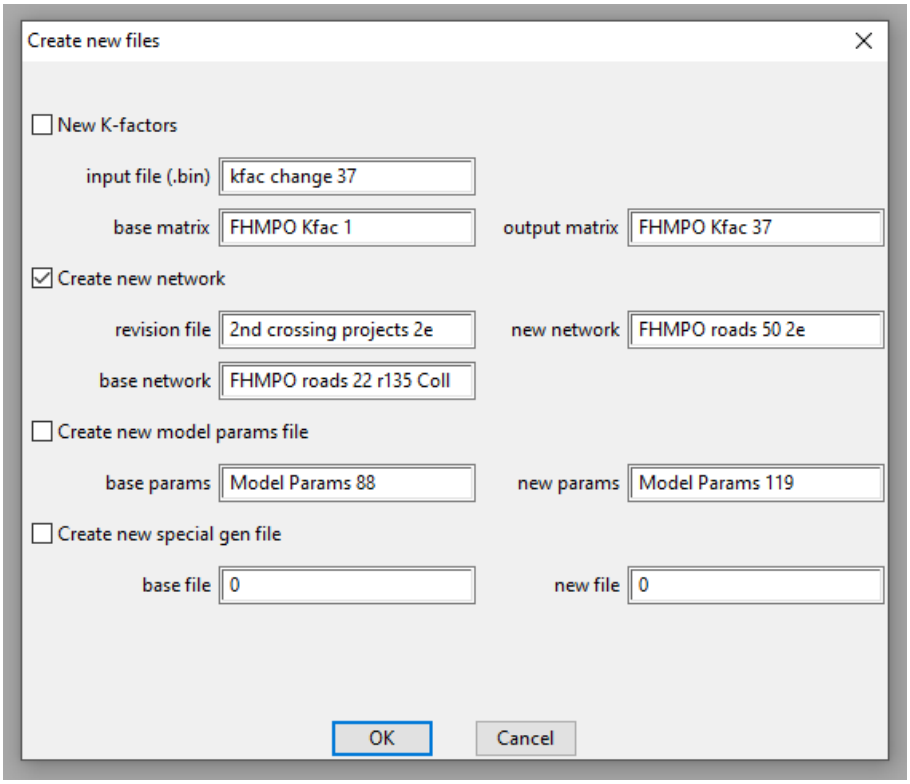
      Click the OK button

   c. From the TransCAD main drop down menu, select Tools → GIS Developer's Kit → Add-Ins
   d. **Flint Hills Model** will appear as a new drop down menu item.



3) Change the path for model files—Select **New Path** and choose the directory that has the model input files and where the program would save the model outputs. Note that I keep all of these in a single directory (the same as the file directory used for the UI Database in the Add-In). The model prefaces all output with a run number, and the Run Summary keeps track of the file inputs and description of what's in each run.

4) Create certain new files based on old ones—Select **New Files** to create the four types of files shown in the dialog box below. This approach ensures that the K-factors and network have only the change you want to test. This is particularly important for future year highway files, as all scenarios include only the particular changes applied to a base highway network. All of the files specified in the dialog box below are on the flash drive so you can use these as an examples of the format for the base and input files. Also, I tend to use a naming convention based on the first run where I use the file. Thus kfac change 37 and Model Params 119 are files I created for run number 37 and 119, respectively.

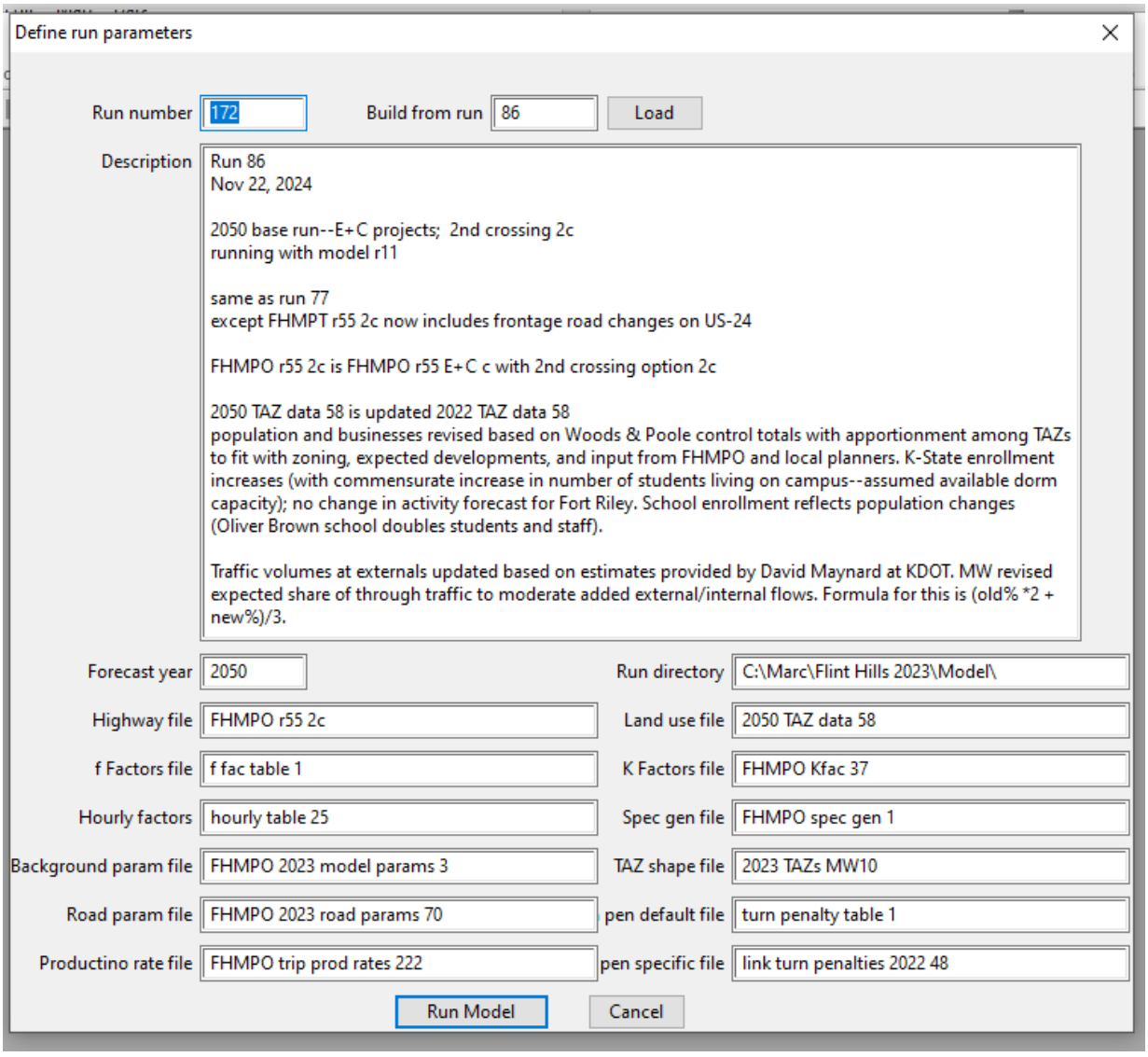


5) Get a summary of past runs and the *next number for a new run*—Select **Run Summary** to see a text file with a brief write-up of each run. The most recent is at the top. This is also the highest run number, so the next run should use that number plus one. The text file also shows the date of the run and a shortened description of what's in the run. Here's an example:

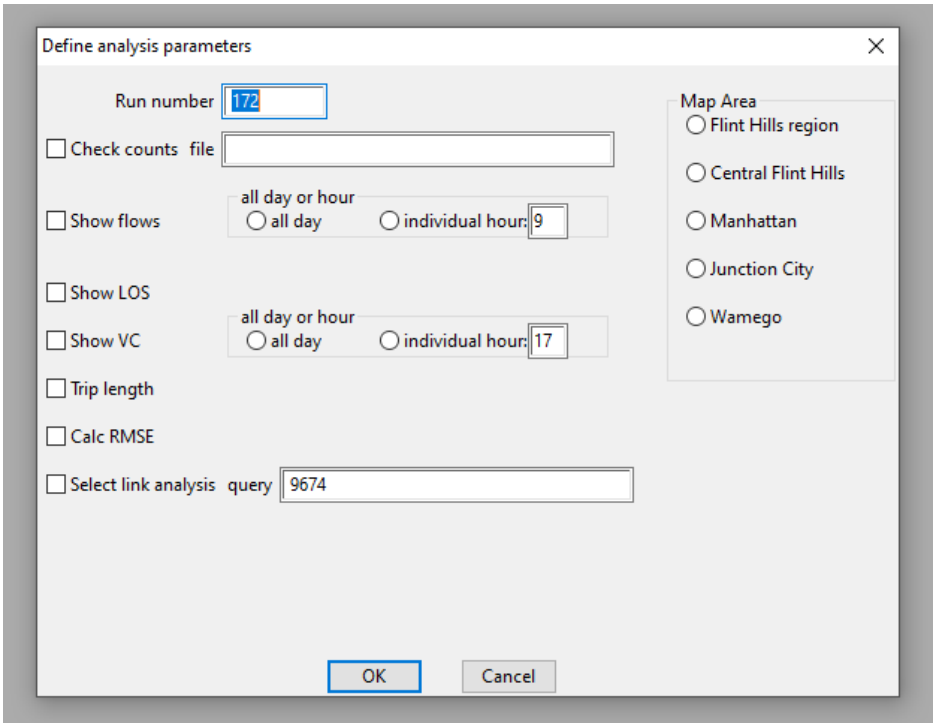
> Run 86
> Nov 22 2024
>
> 2050 base run--E+C projects; 2nd crossing 2c
> running with model r11
>
> same as Run 77
> except FHMPT r55 2c now includes frontage road changes on US-24
>
> FHMPO r55 2c is FHMPO r55 E+C c with 2nd crossing option 2c
>
> 2050 TAZ data 58 is updated 2022 TAZ data 58
> population and businesses revised based on Woods & Poole control totals with expected developments
>
> Traffic volumes at externals updated based on estimates provided by David Ma

6) Set up and conduct a new model run—Select **New Run** to set the input files, write a description, and run the model. Use the Build from run box at the top (and click **Load**) to copy the files from an earlier run. Modify as needed. I use the convention of writing a definition of any new file I use in the new run. The example on the next page is the full description of run 86 (the same run used in the example of the Run Summary.

   After you've updated any new file names, written in a description, and updated the new Run number, click **Run Model**.



7) Show various model results—Select **Analysis** to show various outputs for the run specified. Click one box at a time and then click OK. Ignore the file listed for Check counts. The count data is in a field in the highway file.



If you have any questions about model inputs or the use of the model, please don't hesitate to contact me by phone or email. I will respond promptly.

Marc Warner 413 588-6998 or marc@warnertransportation.com