



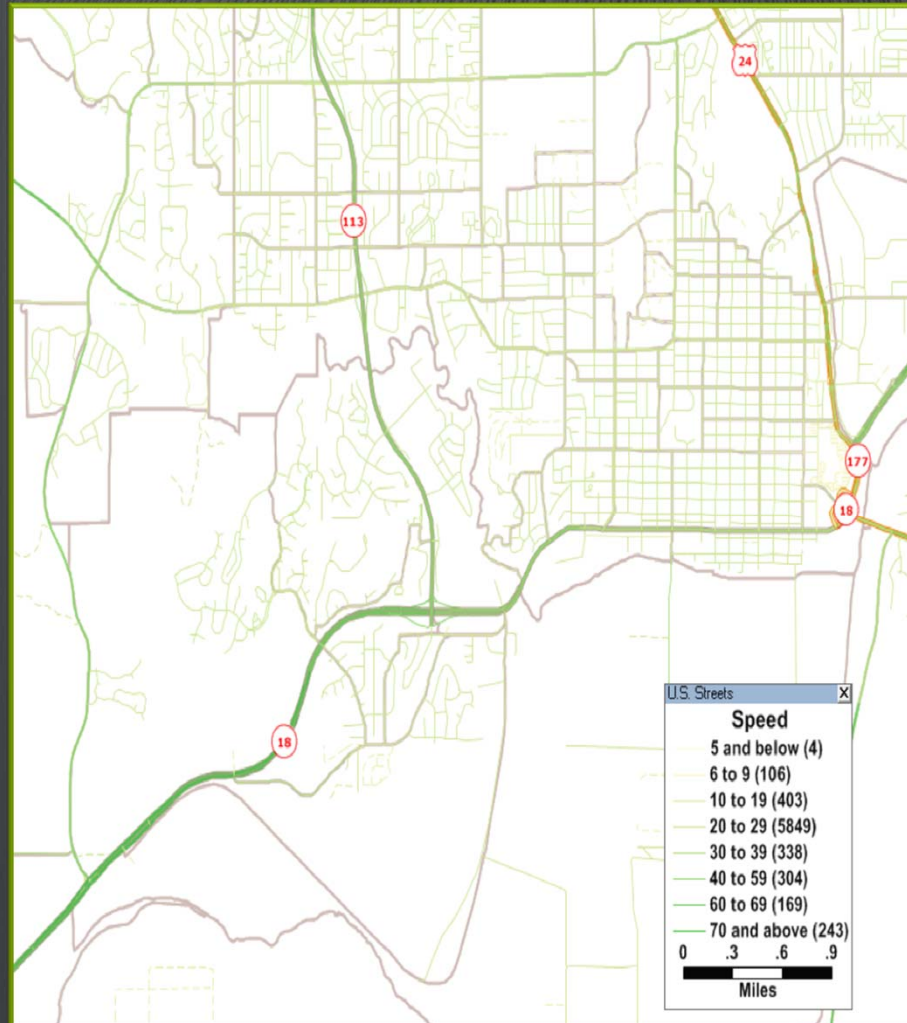
AirSage Data Application for External Travel

Using Technology in Travel Models

- AirSage – wireless phone technology
- NAVTEQ – navigation networks
- INRIX – travel time data (we ended up using Google Map data)
- LEHD – census product that provides employment, or from a vendor

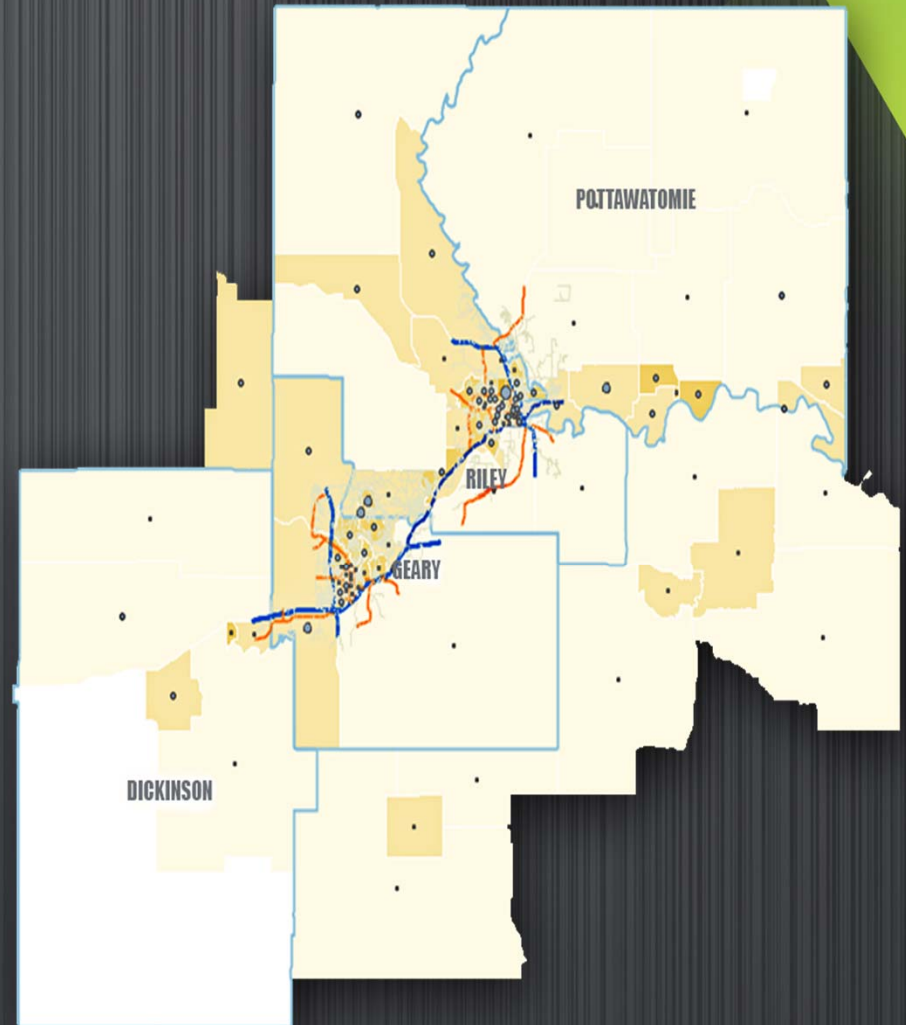
Detailed Network

- GIS
- NAVTEQ
- INRIX



Travel Into and Through the Region

- Cell phone information
- Track movement
- Update external zones



AirSage

- AirSage, an Atlanta based **wireless** information and data provider, has developed an approach to gathering data about **population mobility** throughout a region

AirSage

- Wireless Signal Data
- Census

Technology

- Active Pattern
 - Home, Work
- Active Point
 - Home, Work, Other
- Population Synthesis (expansion)
 - Population Synthesis, Device Quality

Trip Purposes :

3-class or 9-class

- HBW, HBO and NHB
- HH, HO, OH, HW,WH,WW,WO,OW and OO

Time of day and Day of Week

- Midnight to 6 AM, 6 AM to 10 AM, 10 AM to 3 PM, 3 PM to 7 PM and 7 PM to Midnight
- Weekday or weekend day

Time of Day	The Time of Day Periods are defined as follows: 1. One of 5 pre-defined Day Parts (DP): a. Early AM (DP1) = 12:00:01AM to 6:00:00AM; b. AM Peak (DP2) = 6:00:01AM to 10:00:00AM; c. Mid-Day (DP3) = 10:00:01AM to 3:00:00PM; d. PM Peak (DP4) = 3:00:01PM to 7:00:00PM; e. Late PM (DP5) = 7:00:01PM to 12:00:00PM. 2. Any contiguous window of time three or more hours in length defined by the customer and identified by Hx(n) where x is the hour of the day which is the beginning of the n hour window. 3. A single 24 hour day (Day) Note: If the Time Period is null, then the Time Period is for the entire Date Range.
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AirSage External Trips

- External to External
- XI and IX Trips types

Traditional Method:

- Household Activity/Travel survey (IE but not EI)
- External Station Survey

External Analysis

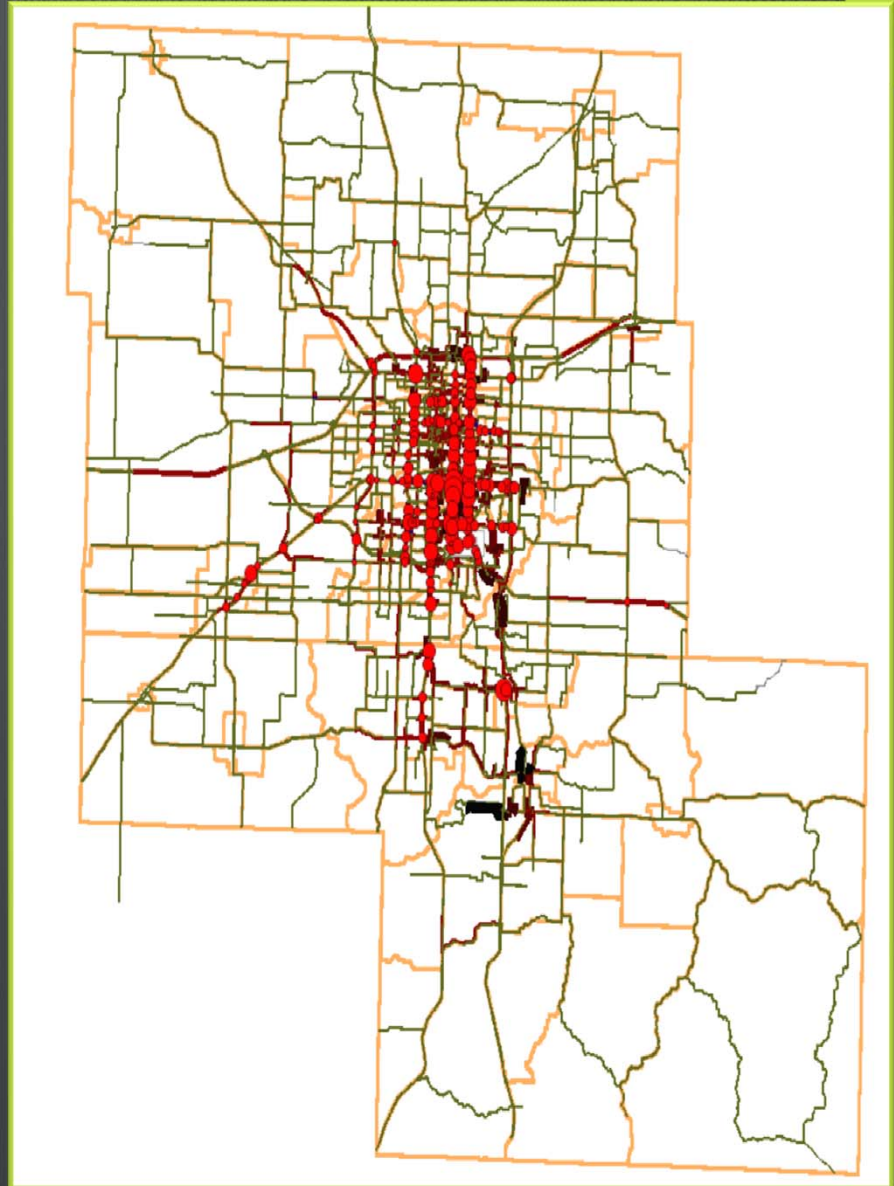
- Region identification (30 to 45 min)
- External – Internal, Internal-External and External-External

Olsson Modeling Projects Using AirSage

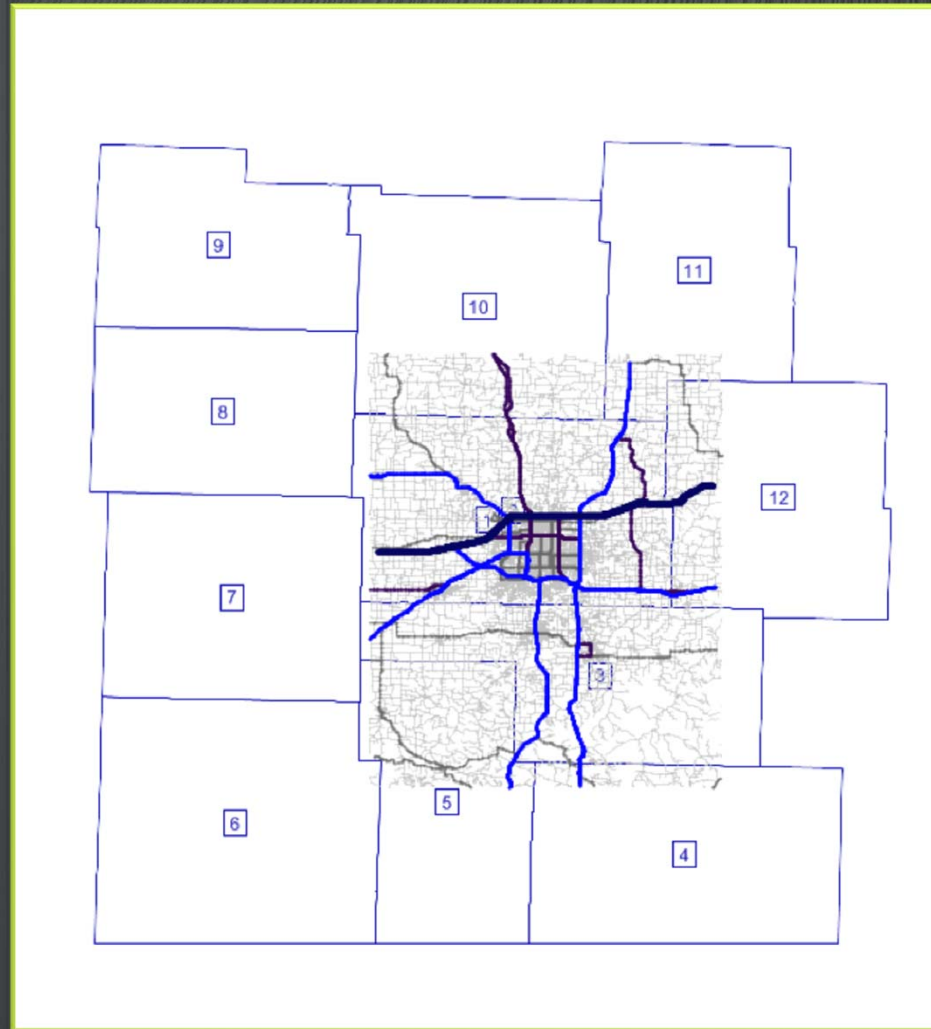
- Springfield OTO Travel Demand Model
- Flint Hills MPO Travel Demand Model

Springfield OTO

- 375 Zones
- 1241 square miles

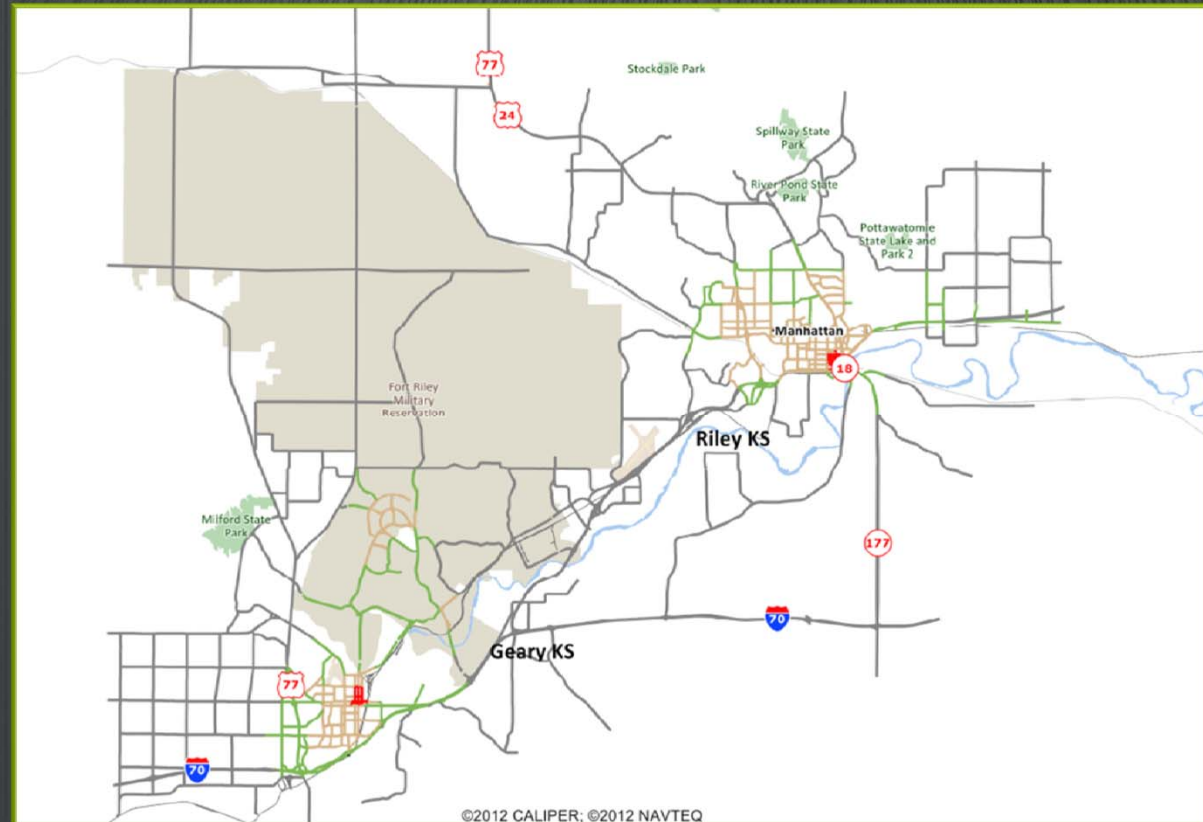


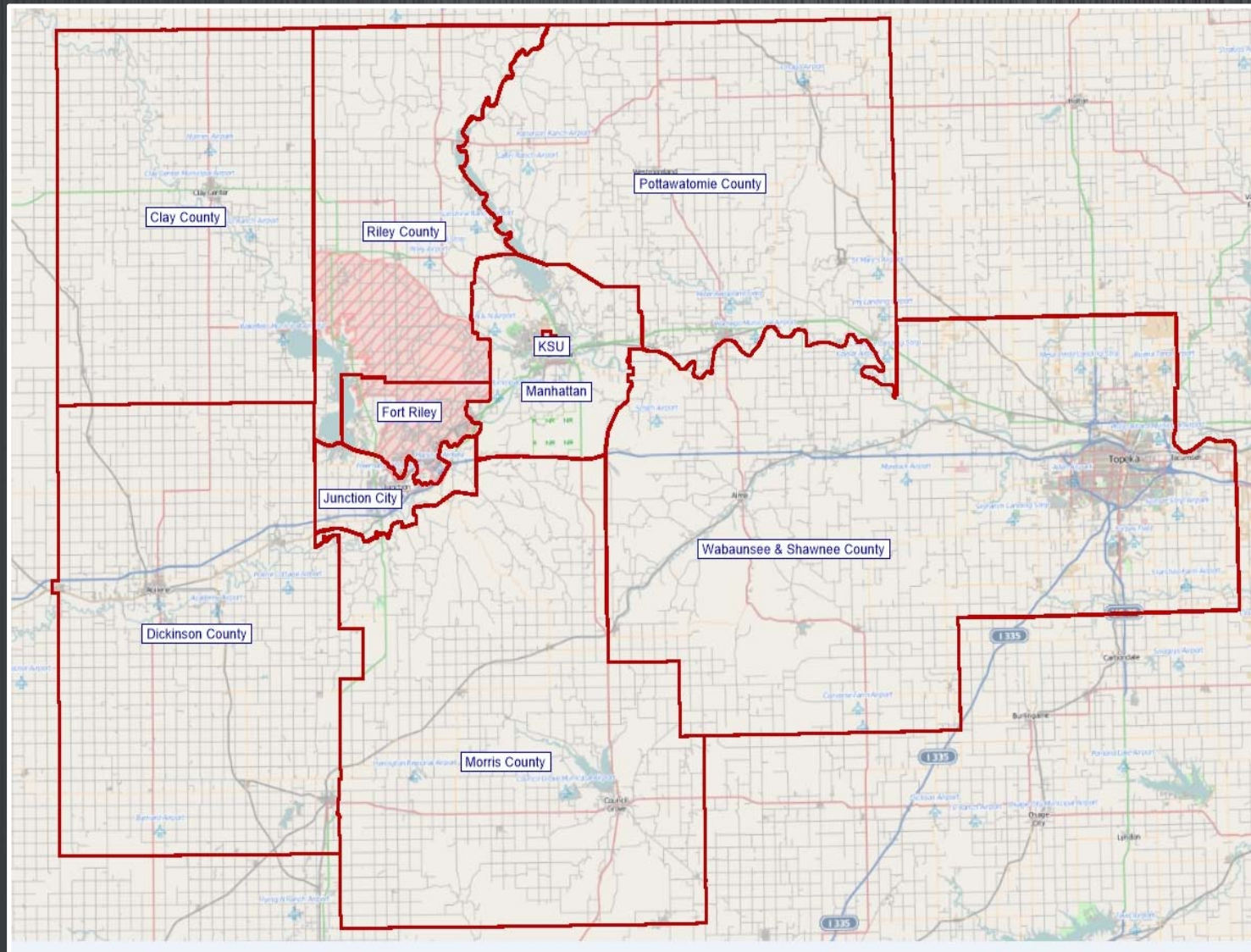
OTO AirSage Zones



Flint Hills Area Model

- 646 Zones
- 450 square miles





Original Data

Origin Zone	Destination Zone	Start Date	End Date	Aggregation	Subscriber Class	Purpose	Time of Day	Count
5	10	20130402	20130430	WD	Resident Worker	OW	H0:H24	1.04
6	7	20130402	20130430	WD	Short term visitor	OO	H0:H24	43.08
11	12	20130402	20130430	WD	Home Worker	HO	H0:H24	107.34
8	6	20130402	20130430	WD	Home Worker	OO	H0:H24	2.03
4	1	20130402	20130430	WD	Short term visitor	OO	H0:H24	8.59
6	12	20130402	20130430	WD	Resident Worker	HO	H0:H24	10.5
6	12	20130402	20130430	WD	Long Term Visitor	OO	H0:H24	27.86
11	9	20130402	20130430	WD	Resident Worker	OO	H0:H24	6.35
3	8	20130402	20130430	WD	Resident Worker	OO	H0:H24	6.83
7	7	20130402	20130430	WD	Resident Worker	OH	H0:H24	3823.95
10	4	20130402	20130430	WD	Resident Worker	OO	H0:H24	10.41
7	12	20130402	20130430	WD	Outbound Commuter	HO	H0:H24	3.63
11	1	20130402	20130430	WD	Resident Worker	HW	H0:H24	24.72
10	11	20130402	20130430	WD	Resident Worker	OW	H0:H24	121.25
3	7	20130402	20130430	WD	Home Worker	HO	H0:H24	238.98
2	3	20130402	20130430	WD	Outbound Commuter	OO	H0:H24	154.09
1	1	20130402	20130430	WD	Outbound Commuter	OO	H0:H24	4.19

Olsson Data Analysis

File Edit View Lists Filters Calculate Graphics Network Demand Scripts Window Help Matrix editor

Matrix editor (Matrix '20 Total')

Matrices

Matrix editor (Matrix '20 Total')

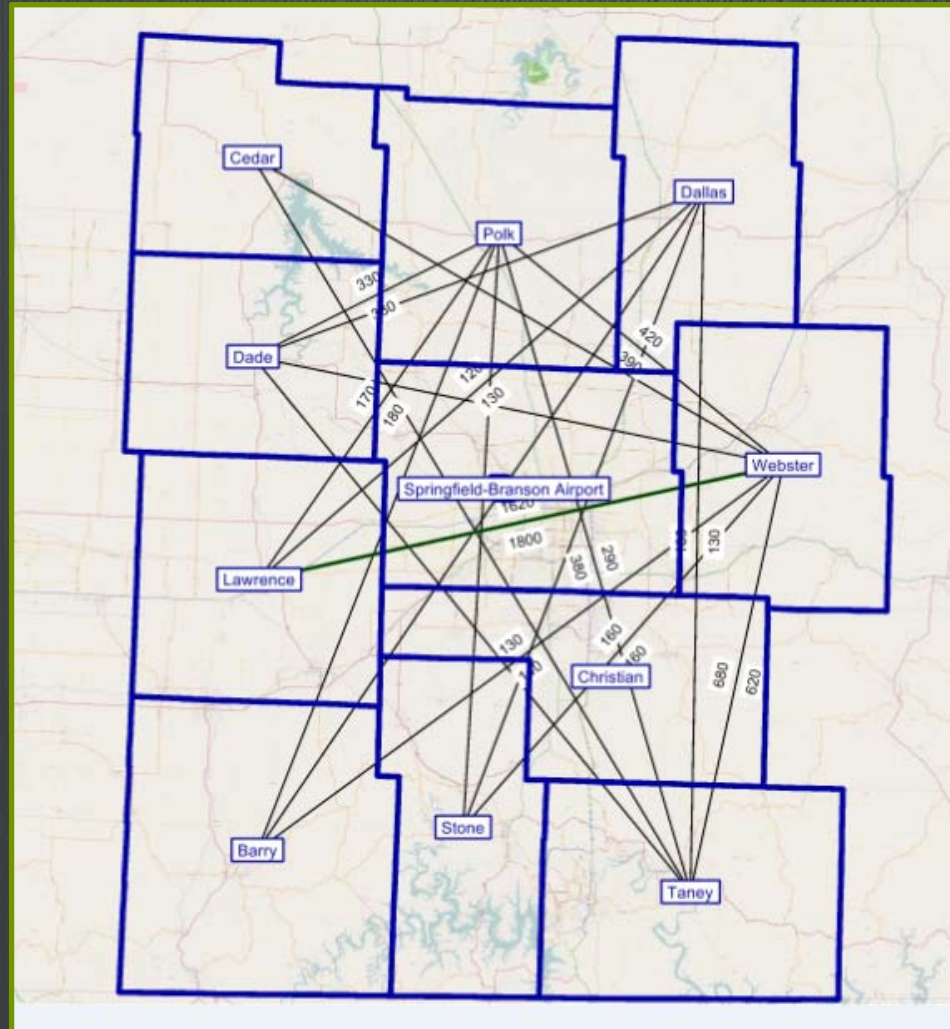
12 x 12

	Name		1	2	3	4	5	6	7	8	9	10	11	12
		Sum	6769.82	748671.21	200117.64	173944.65	84293.31	104997.52	93589.75	17528.55	33230.75	96283.67	40996.74	97660.03
1	Springfield-Branson Airport	7033.83	2046.02	3751.98	370.13	102.82	71.73	43.68	119.69	46.03	19.14	123.55	48.26	290.80
2	Greene	750106.73	3541.73	632949.37	47068.32	6240.43	4552.85	2624.21	10447.61	2183.74	1742.25	11122.62	6450.27	21183.33
3	Christian	199693.39	368.39	46373.60	137143.78	5064.90	4506.18	573.15	1892.15	101.96	90.29	456.11	250.29	2872.59
4	Taney	173129.62	80.72	6222.34	4833.11	149088.36	11046.25	434.57	295.23	35.08	45.53	294.23	129.85	624.35
5	Stone	84278.60	69.45	4567.42	4365.74	11319.36	58799.19	2784.01	2042.65	21.41	26.13	90.45	37.66	155.13
6	Bany	105170.98	42.75	2596.72	579.63	474.01	2848.75	87515.07	10682.92	149.69	31.94	64.33	46.92	138.25
7	Lawrence	93796.51	119.24	10352.60	1931.98	367.06	2124.11	10601.55	65107.70	974.68	108.80	181.45	125.19	1802.15
8	Dade	17524.83	44.20	2144.03	100.88	40.99	24.67	150.52	987.96	12777.34	848.87	328.89	21.55	54.93
9	Cedar	33286.56	24.21	1746.47	94.00	51.23	29.49	30.64	112.76	838.58	26903.85	3272.94	117.09	65.30
10	Polk	96087.29	114.26	10927.59	438.77	380.28	93.66	70.66	166.23	326.88	3242.11	75776.10	4157.07	393.68
11	Dallas	40789.30	46.93	6291.35	241.96	132.94	35.80	44.02	117.89	15.47	116.61	4150.83	28606.36	989.14
12	Webster	97186.00	271.92	20747.74	2949.34	682.27	160.63	125.44	1616.96	57.69	55.23	422.17	1006.23	69090.38

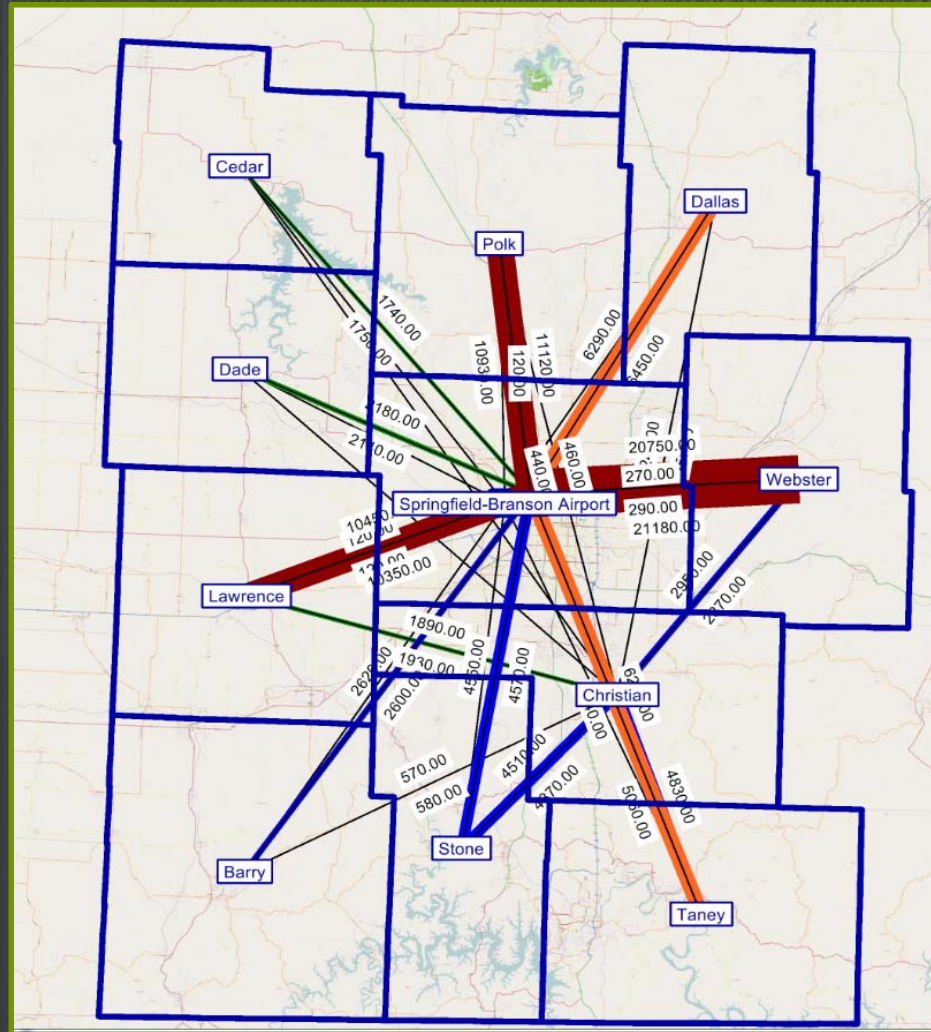
All matrices

- Demand matrices
- Zone matrices
- Data matrices
 - 1 HW-HH
 - 2 HW-HH
 - 3 HW-OH
 - 4 HW-OO
 - 5 LVisit-OO
 - 6 outbound-HH
 - 7 outbound-HO
 - 8 outbound-OH
 - 9 outbound-OO
 - 10 ResidentW-HH
 - 11 ResidentW-HO
 - 12 ResidentW-HW
 - 13 ResidentW-OH
 - 14 ResidentW-OO
 - 15 ResidentW-OW
 - 16 ResidentW-WH
 - 17 ResidentW-HO
 - 18 ResidentW-WW
 - 19 ShortVisit-OO
 - 20 Total

Total External to External Movement



Total External to Internal Trips



“Mask” X-X Matrix

Matrix editor (Matrix '10100 External-External Mask')

12 x 12			1	2	3	4	5	6	7	8	9	10	11	12
	Name		Springfield-Branson	Greene	Christian	Taney	Stone	Barry	Lawrence	Dade	Cedar	Polk	Dallas	Webster
	Sum		0.00	0.00	0.00	5.00	2.40	3.00	3.00	3.00	2.00	5.30	4.30	6.80
1	Springfield-Branson Airport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Greene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Christian	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Taney	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
5	Stone	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.80
6	Barry	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
7	Lawrence	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
8	Dade	3.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.50	0.50	1.00	1.00
9	Cedar	2.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
10	Polk	5.30	0.00	0.00	0.00	1.00	0.80	1.00	1.00	0.50	0.00	0.00	0.00	1.00
11	Dallas	4.30	0.00	0.00	0.00	1.00	0.80	1.00	1.00	0.50	0.00	0.00	0.00	0.00
12	Webster	6.80	0.00	0.00	0.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00	0.00	0.00

Network editor Procedure sequence List (Zones) List (Link types) Junction editor Matrix editor (Matrix '10100 External-External Mask')

Disaggregate to External Stations

Disaggregate matrix

Input data

Main zone matrix
 $(a_{ij}) =$ 2 Adjusted X-X

Disaggregation weights
 $w_{ij}^{(1)} =$ From zone\ADT_2010
 $w_{ij}^{(2)} =$ To zone\ADT_2010

Result

Zone matrix
 $(b_{ij}) =$ 1 Temp XX Seed

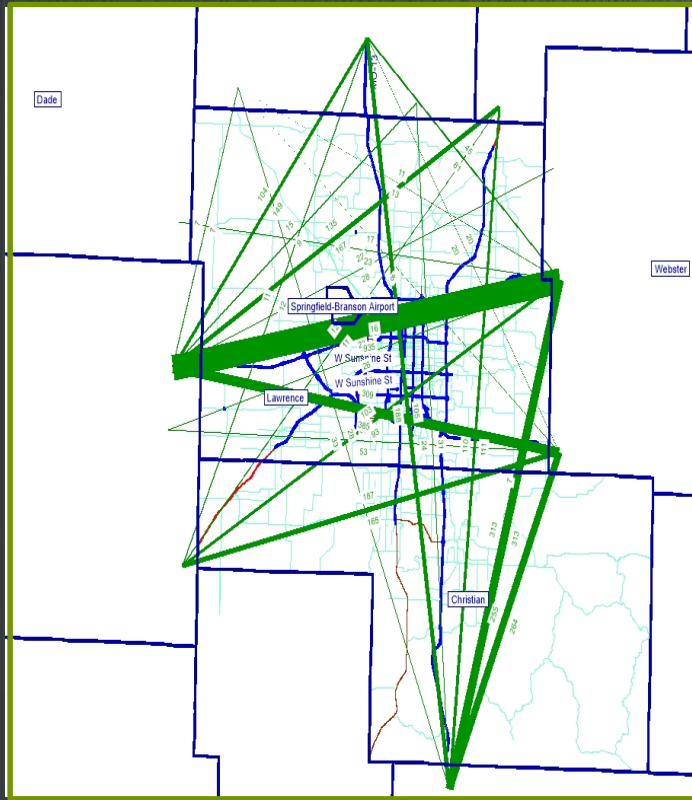
Formula:

$$b_{ij} = \frac{w_{ij}^{(1)} w_{ij}^{(2)}}{\sum_{k \in I} \sum_{l \in J} w_{kl}^{(1)} w_{kl}^{(2)}} \cdot a_{ij}$$

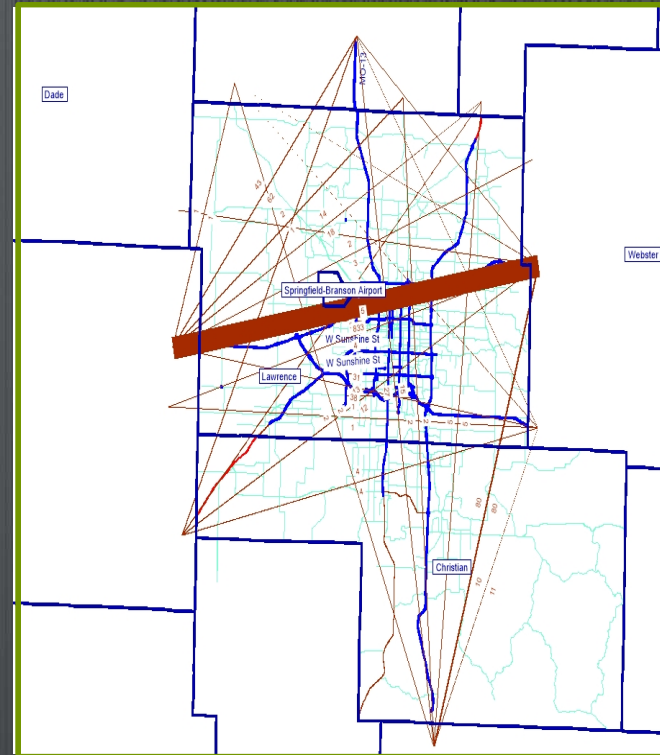
OK Cancel

Externals	Road	Location	Facility Type	ADT
10001	Route V	NW Greene Co. Line	Rural Collector	998
10002	Mo-123	NW Greene Co. Line	Secondary Arterial	3030
10003	Mo-13	N Central Greene Co. Line	Freeway	16646
10004	Route H	North of Springfield City Boundary	Primary Arterial	4908
10005	US-65	NE Greene Co. Line	Freeway	7627
10006	Route EE	NE Greene Co. Line	Rural Collector	634
10007				0
10008	I-44	East Central Greene Co. Line	Interstate	32590
10009	Route OO	East Central Greene Co. Line	Secondary Arterial	3212
10010	US-60	SE Greene Co. line	Freeway	18962
10011	Mo-14	NE Christian Co. Line	Primary Arterial	1080
10012	US-65	South Christian Co. Line	Freeway	22835
10013	US-160	South Christian Co. Line	Expressway	7204
10014	Route K	West Christian Co. Line	Primary Arterial	1140
10015	US-60	NW Christian Co. Line	Primary Arterial	9326
10016	Route MM	NW Christian Co. Line	Rural Collector	180
10017	Mo-174	SW Greene Co. Line	Primary Arterial	2670
10018	I-44	West Greene Co. Line	Interstate	31853
10019	Mo-266	West Greene Co. Line	Secondary Arterial	506
10020	Mo-160	NW Greene Co. Line	Expressway	1998

Divide to Cars and Trucks by %

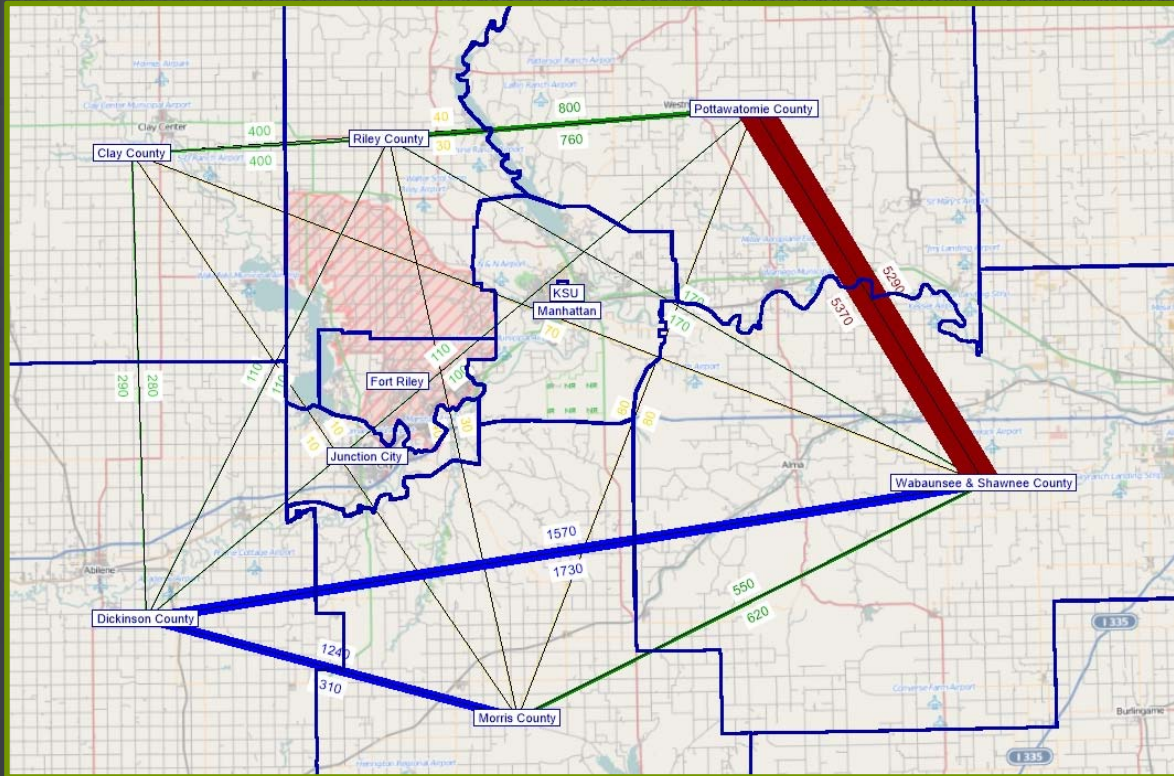


Car X-X Matrix at
Zone Level

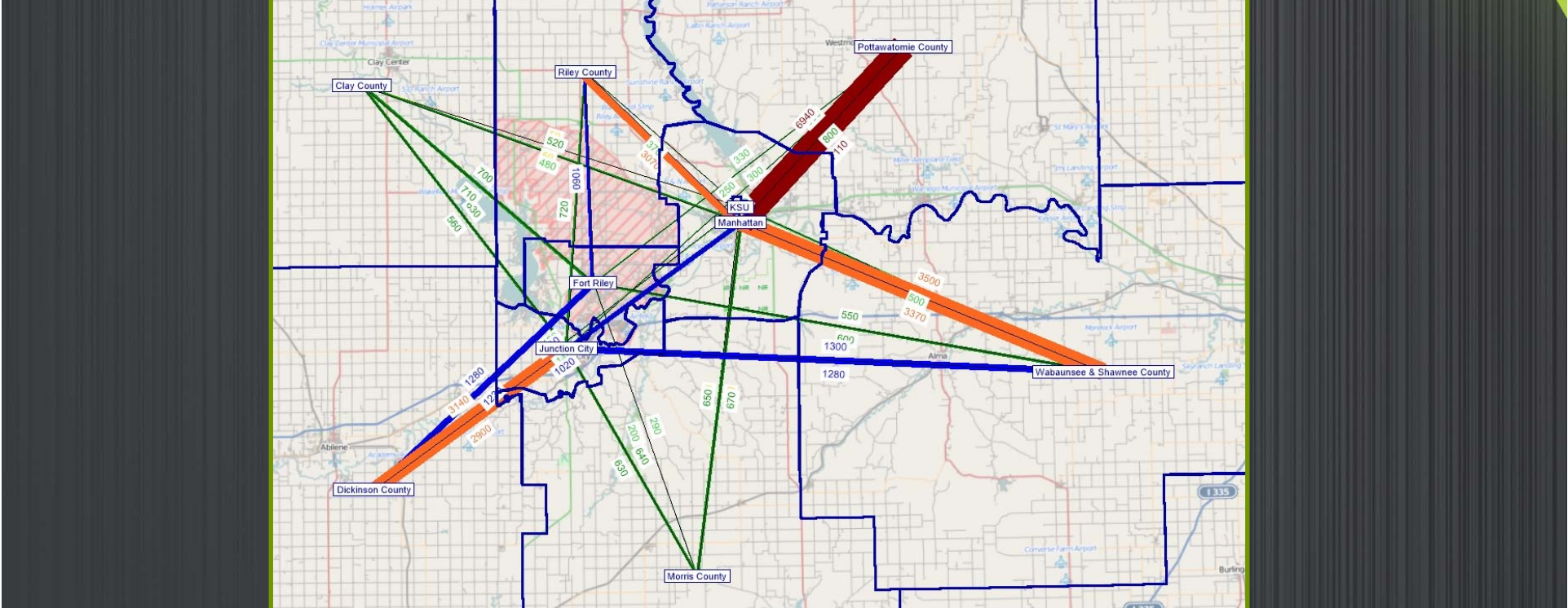


Truck X-X Matrix at Zone
Level

Total External to External Movement



Total External to Internal Trips



“Mask” X-X Matrix

Diagram showing connections between Riley County and Pottawatomie County.

Matrix editor (Matrix '10127 Total Mask')

10 x 10			1	2	3	4	5	6	7	8	9	10
	Name		KSU	Manhattan	Junction City	Fort Riley	Riley County	Pottawatomie County	Abbaunsee & Shawnee County	Morris County	Dickinson County	Clay County
		Sum	5.60	5.60	5.60	5.60	4.80	6.35	6.80	6.25	6.80	6.50
1	KSU	5.60	0.00	0.00	0.00	0.00	0.60	1.00	1.00	1.00	1.00	1.00
2	Manhattan	5.60	0.00	0.00	0.00	0.00	0.60	1.00	1.00	1.00	1.00	1.00
3	Junction City	5.60	0.00	0.00	0.00	0.00	0.60	1.00	1.00	1.00	1.00	1.00
4	Fort Riley	5.60	0.00	0.00	0.00	0.00	0.60	1.00	1.00	1.00	1.00	1.00
5	Riley County	4.80	0.60	0.60	0.60	0.60	0.00	0.60	0.60	0.60	0.60	0.00
6	Pottawatomie County	6.35	1.00	1.00	1.00	1.00	0.60	0.00	0.00	0.25	1.00	0.50
7	Abbaunsee & Shawnee County	6.80	1.00	1.00	1.00	1.00	0.60	0.00	0.00	0.20	1.00	1.00
8	Morris County	6.25	1.00	1.00	1.00	1.00	0.60	0.25	0.20	0.00	0.20	1.00
9	Dickinson County	6.80	1.00	1.00	1.00	1.00	0.60	1.00	1.00	0.20	0.00	0.00
10	Clay County	6.50	1.00	1.00	1.00	1.00	0.00	0.50	1.00	1.00	0.00	0.00

Network editor List (Matrices) List (Zones) Matrix editor (Matrix '10127 Total Mask') × Procedure sequence M: < ▶

Diagram showing connections between Morris County and other nodes.

Disaggregate to External Stations

Disaggregate matrix

Input data

Main zone matrix
 $(a_{ij}) =$ 10129 Total External Masked

Disaggregation weights
 $w_{ij}^{(1)} =$ From zone\ADT_2012
 $w_{ij}^{(2)} =$ To zone\ADT_2012

Result

Zone matrix
 $(b_{ij}) =$ 1 Total Zone

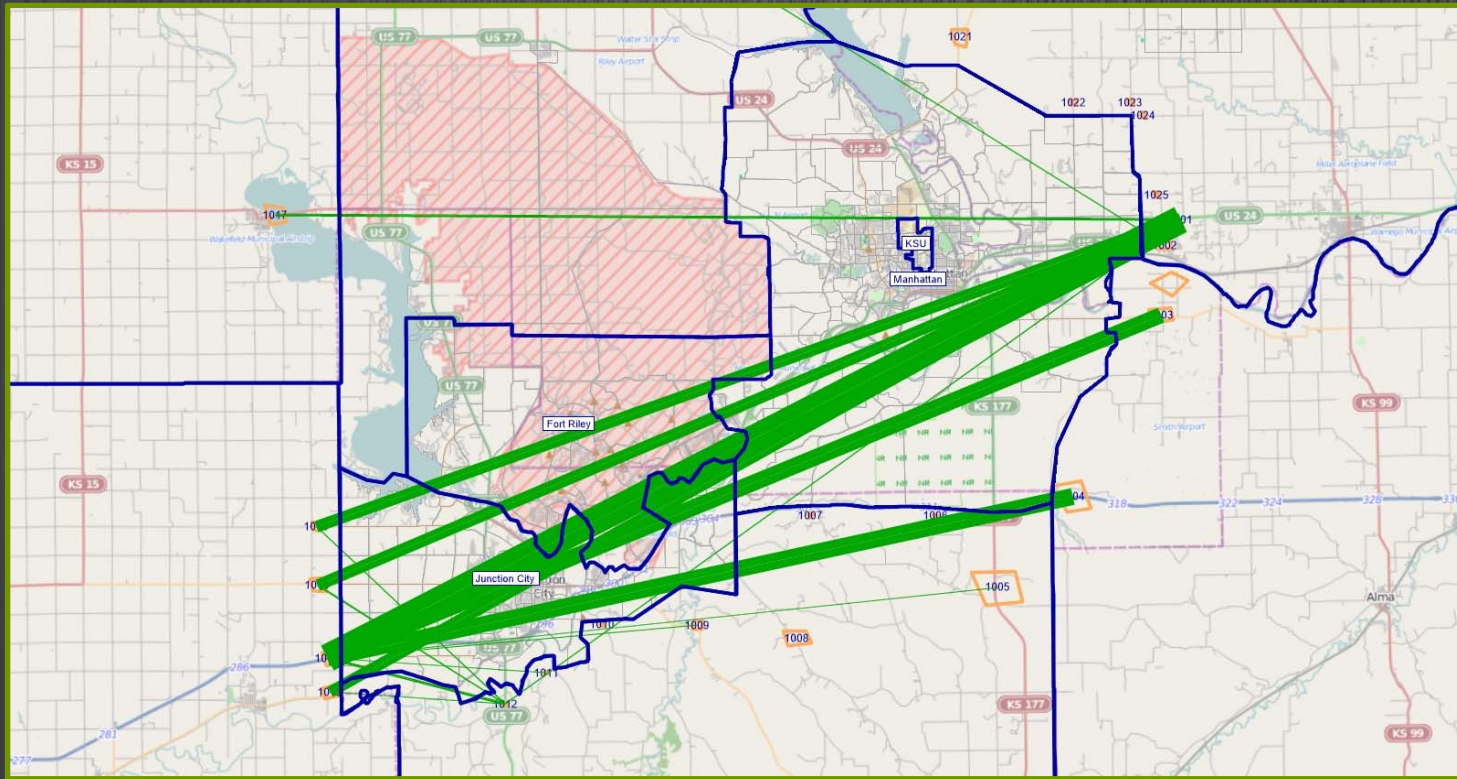
Formula:

$$b_{ij} = \frac{w_{ij}^{(1)} w_{ij}^{(2)}}{\sum_{k \in I} \sum_{l \in J} w_{kl}^{(1)} w_{kl}^{(2)}} \cdot a_{ij}$$

OK Cancel

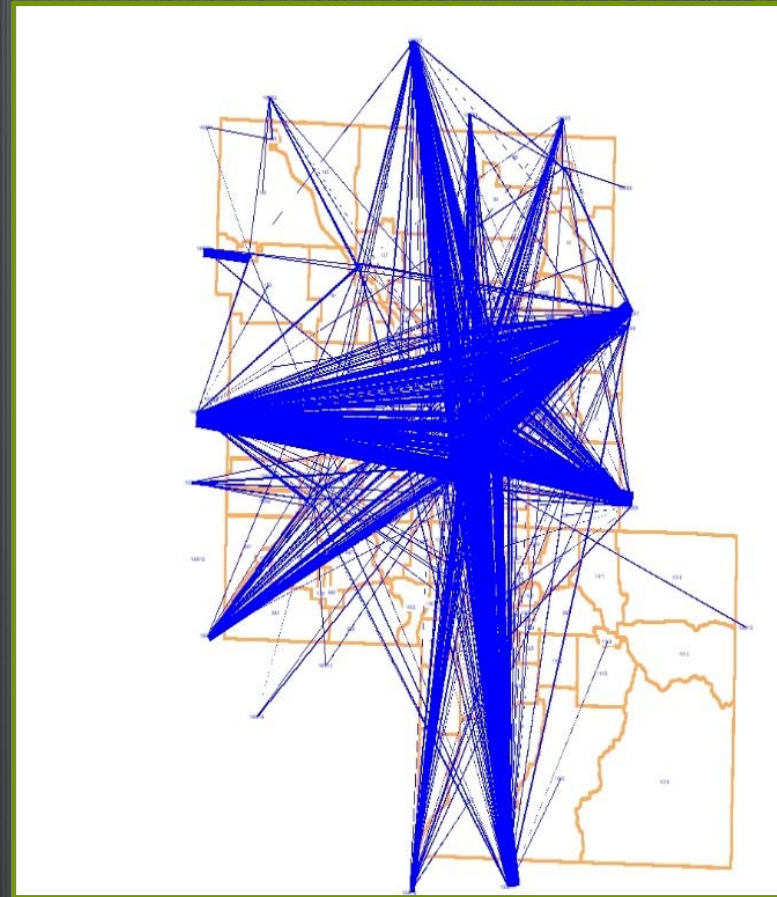
Number	Name	External	FC	ADT12
1001	State Hwy 24	16	Expressway/Freeway	22800
1002	Military Trail Road	17	Major Collector	1606
1003	Zeandale Rd	18	Major Collector	535
1004	US70	1	Expressway/Freeway	430
1005	KS177	2	Major Arterial	1610
1006	Moritz		County Road	50
1007	McDowell Creek Road			162
1008	HUMBOLDT CREEK RD	3	Major Collector	430
1009	S K-57 HWY	4	Major Collector	890
1010	Old Stage Rd			330
1011	J HILL RD	5	Major Collector	900
1012	S US-77 HWY S	6	Major Arterial	3860
1013	OLD HWY 40	7	Major Collector	665
1014	I-70 HWY	8	Interstate	15700
1015	K-18 HWY	9	Minor Arterial	980
1016	K-244 HWY	10	Major Collector	695
1017	K-82	11	Minor Arterial	975
1018	North KS82	12	Minor Arterial	1110
1019	FALCON	13		1020
1020	TURTL CREEK	14		2670
1021	State Hwy 13	15	Minor Arterial	1080
1022	Lake Elbo Rd			50
1023	Flush Rd			295
1024	Elizas			50
1025	School Creek Rd			100

Flint Hills EE Trips



Internal – External & External - Internal

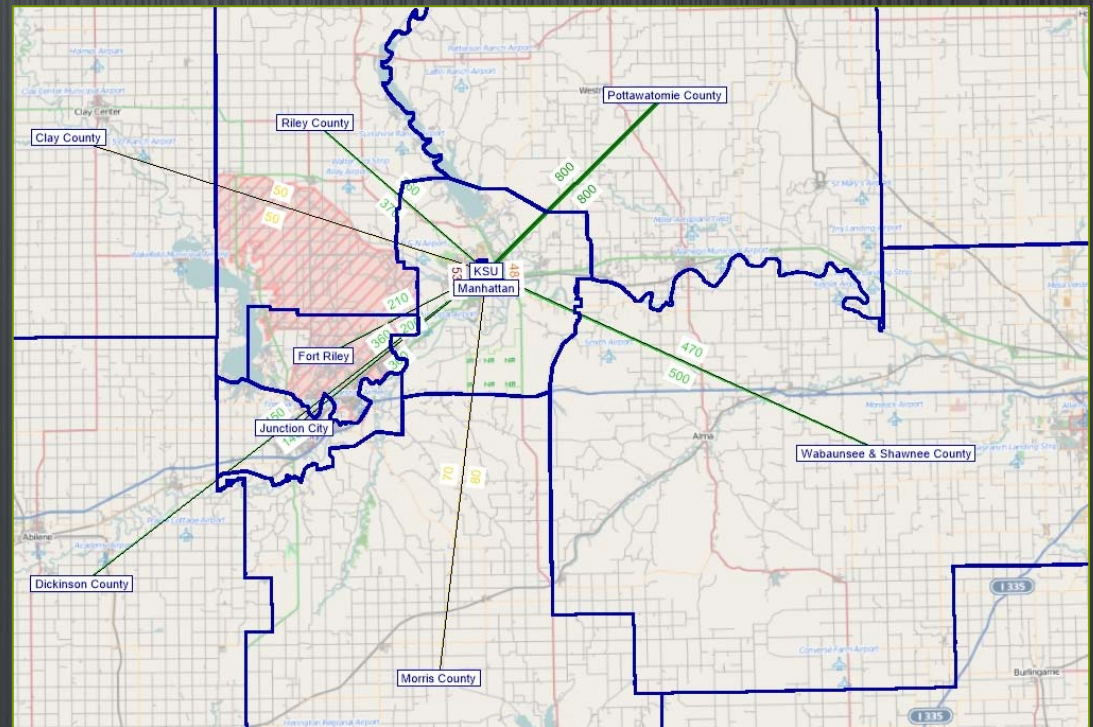
- $I-X$ and $X-I$ = Count minus $X-X$
- Percentages of HBW, HBO, & NHB
- Allocate to External Stations in County
- Set appropriate external travel length
- Distribute with Internal Trips



NHB I-X and X-I Trips

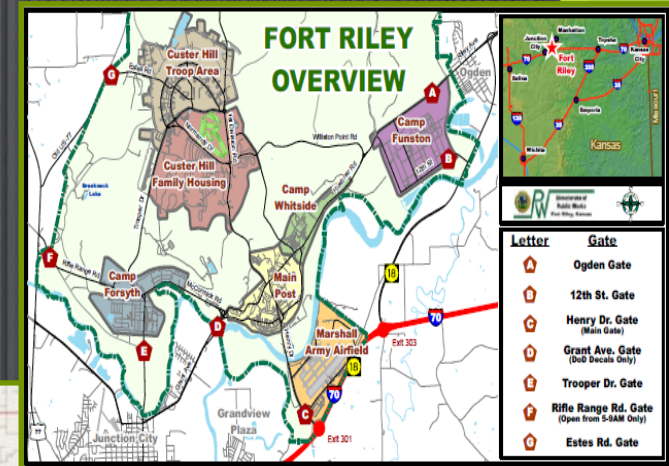
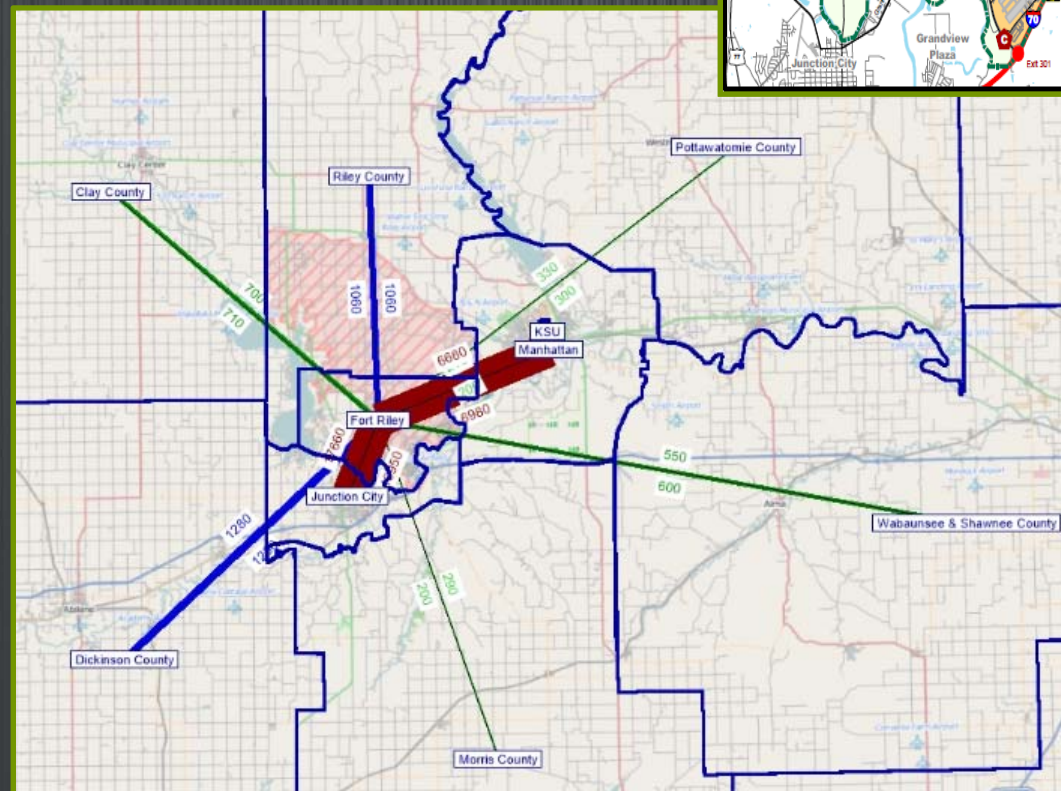
University Travel Patterns

- Students – On campus
- Students – Off campus
- Faculty
- Staff and Service
- Events



Fort Riley Travel Patterns

- Gate Access Patterns
- Gate Counts
- Internal Circulation Restrictions



Applications

- External Trip Table for Travel Demand Model when external survey is absent
- External to Internal, Internal to External Trips
- Special Trips (trips In/out to Campus, Airport...)
- But there are more applications, such as trip generation and trip type information, replacing the household survey.