INRCOG ISMS Model Development and Calibration

May 2, 2018

INRCOG
Iowa Northland Regional Council Of Governments

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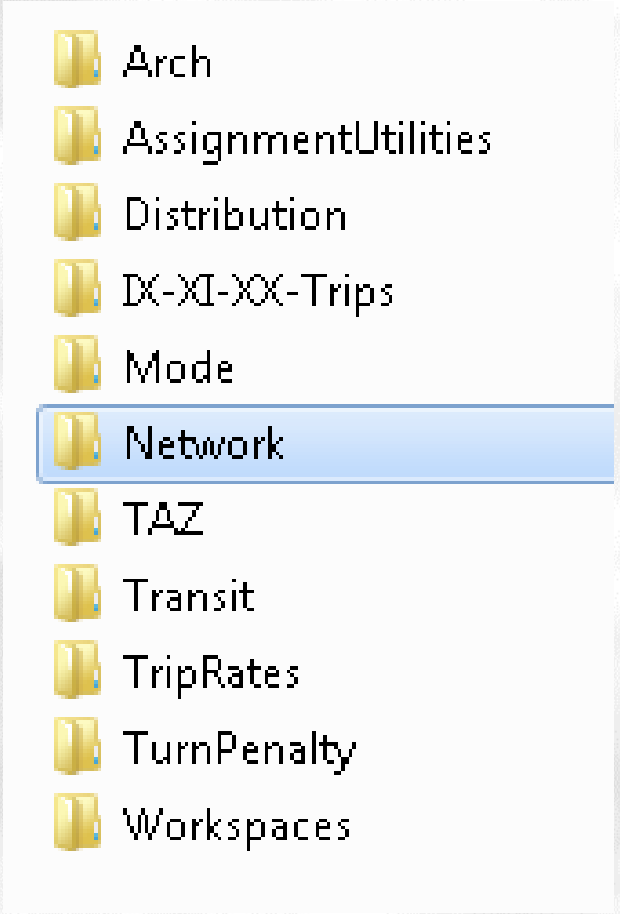
Outline

- Development
  - Network
  - Parcels
  - TAZ
  - Externals
  - University Sub-model
  - NHTS Add-on inputs
- Calibration
  - Error checking
  - Trip Rates
  - EI/IE parameters
  - Gravity Model Gamma Coefficients
  - Intersection Delay penalties
  - Mode Split percentages
  - Gravel road speeds
  - Connector Loadings
  - Speed Adjustments (+/- 5 mph)
- Final Validation Results
- Forecast Model
  - Methodology
  - Results

Development

- Structure input files similar to prototype
  - Network
  - TAZ
  - Parcels
  - Externals
  - University sub-model
  - Etc.



Development – NHTS Add-on

- Production Trip Rates
- Attraction Trip Rates
- Future Land Use Category Group Trip Attraction Rates
- Auto Occupancy Factors
- Time of Day Percentage Factors

	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG
1	whytrp1s	o_locno	HouseLoc_o	HouseLoc_d	O_ISMS_LUC	D_ISMS_LUC	longitude:1	latitude:1	ISMS_P	ISMS_A	ISMS_SP_P	ISMS_SP
2	50	100	300016110000100	300016111000000	10	94	-92.40973	42.534473	HBO			
3	1	1000000	300016111000000	300016110000100	94	10	-92.419269	42.517509		HBO		
4	50	100	300016110000100	300016111000000	10	94	-92.40973	42.534473	HBO			
5	1	1000000	300016111000000	300016110000100	94	10	-92.419269	42.517509		HBO		
6	20	100	300019980000100	300019981000000	10	68	-92.356291	42.478974	HBO			
7	50	1000000	300019981000000	300019981000001	68	70	-92.346031	42.461057		NHB		HOSP
8	1	1000001	300019981000001	300019980000100	70	10	-92.363221	42.487547		HBO	HOSP	
9	50	100	300019980000100	300019981000002	10	0	-92.350235	42.51313	HBO			
10	80	1000002	300019981000002	300019981000003	0	57	-92.385546	42.500352		NHB		
11	50	1000003	300019981000003	300019981000004	57	0	-92.376078	42.671744		NHB		
12	50	1000004	300019981000004	300019981000005	0	10	-92.383123	42.490883		NHB		
13	40	1000005	300019981000005	300019981000006	10	65	-92.376191	42.485003		NHB		
14	1	1000006	300019981000006	300019980000100	65	10	-92.363221	42.487547		HBSH		
15	40	100	300019980000100	300019981000007	10	69	-92.303478	42.471274	HBO			
16	1	1000007	300019981000007	300019980000100	69	10	-92.363221	42.487547		HBO		
17	10	100	300019980000100	300019980000202	10	32	-92.378023	42.501742	HBW			
18	1	202	300019980000202	300019980000100	32	10	-92.363221	42.487547		HBW		
19	70	100	300019980000100	300019981000009	10	20	-92.32833	42.427619	HBO			
20	80	1000009	300019981000009	300019981000010	20	57	-92.330128	42.462467		NHB		
21	40	1000010	300019981000010	300019981000011	57	20	-92.374449	42.466835		NHB		
22	1	1000011	300019981000011	300019980000100	20	10	-92.363221	42.487547		HBO		
23	1	100	300037310000100	300037310000100	10	10	-92.450259	42.403707	HBO			
24	10	100	300037310000100	300037310000102	10	63	-92.455422	42.406602	HBW			
25	1	102	300037310000102	300037310000100	63	10	-92.450259	42.403707		HBW		
26	40	100	300037310000100	300037311000000	10	64	-92.455693	42.405851	HBO			
27	40	1000000	300037311000000	300037311000001	64	52	-92.328428	42.46569		NHB		
28	40	1000001	300037311000001	300037311000002	52	51	-92.331569	42.462269		NHB		
29	70	1000002	300037311000002	300037310000100	51	10	-92.450259	42.403707		NHB		
30	40	100	300037310000100	300037311000003	10	50	-92.448988	42.409886		NHB		
31	40	1000003	300037311000003	300037311000004	50	96	-92.474663	42.392302		NHB		
32	1	1000004	300037311000004	300037310000100	96	10	-92.450259	42.403707		HBSH		

Calibration – Error Checking

- Parcels with incorrect year
- Roads with incorrect year
- Parcel square footage (grossbldgarea vs. commbldgarea)
- Check external station volumes close to count
- Shortest path checks
- Zero flow roads
- Miscellaneous coding errors

Calibration – Trip Generation

- Trip Attraction Rates adjusted to ITE trip rates by land use
- Trip Production Rates adjusted to match magnitude of attractions
- Adjusted external EI/IE production/attraction split parameters
- University Sub-Model trip rates adjusted to find best fit

		HBW	HBSC	HBSH	HBO	NHB	UNIV	HOSP	APRT	RREC	HOT	SU	COMBO	Total
Weighted Daily	Ps	103,904	24,373	227,567	159,484	326,993	32,275	11,399	1,994	6,699	4,108	7,052	5,497	911,345
	As	110,165	20,613	227,678	158,813	326,993	30,206	12,525	1,991	7,316	3,989	7,052	5,497	912,840
		0.943	1.182	1.000	1.004	1.000	1.068	0.910	1.001	0.916	1.030	1.000	1.000	0.998

Calibration – Trip Distribution

Intersection Delay & Gravity Model Gamma Coefficients

- Initially model resulted in too little flow compared to counts, despite trip generation rates being adjusted up
  - Model flow heavily favored limited access roads
- Also average trip times and trip lengths underestimated
- Changed default gamma coefficients to match survey trip times and lengths
  - Model flow favored limited access roads even more heavily
- Gamma coefficients from NCHRP for small and medium MPO
- Tested intersection delay defaults

Calibration – Trip Distribution

Default Intersection Delay Summary

Default - Full Delay								
	PEAK				OFF PEAK			
	Left	Right	Thru	Uturn	Left	Right	Thru	Uturn
Arterial/ramp	0.395	0.118	0.217	0.379	0.298	0.090	0.163	0.309
Collector	0.300	0.105	0.198	0.300	0.226	0.081	0.150	0.228
Local/CC	0.304	0.106	0.179	0.323	0.228	0.082	0.135	0.262
Signalized	0.444	0.150	0.294	0.456	0.333	0.113	0.223	0.325
AWSC	0.233	0.093	0.233	0.233	0.177	0.073	0.177	0.182
TWSC	0.317	0.117	0.263	0.317	0.240	0.090	0.198	0.235
Uncontrolled	0.337	0.078	0.000	0.330	0.252	0.060	0.000	0.282

Signalized arterial/ramp	Arterial/ramp	0.50	0.15	0.25	0.50	0.38	0.11	0.19	0.38
	Collector	0.50	0.15	0.25	0.50	0.38	0.11	0.19	0.38
	Local/CC	0.35	0.10	0.15	0.40	0.26	0.08	0.11	0.30
AWSC	Arterial/ramp	0.30	0.10	0.30	0.30	0.23	0.08	0.23	0.23
Arterial/ramp	Collector	0.25	0.10	0.25	0.25	0.19	0.08	0.19	0.19
	Local/CC	0.20	0.07	0.20	0.20	0.15	0.05	0.15	0.15
Two Way Stop Controlled (TWSC) arterial/ramp	Arterial/ramp	0.45	0.15	0.35	0.45	0.34	0.11	0.26	0.34
	Collector	0.30	0.10	0.25	0.30	0.23	0.08	0.19	0.23
	Local/CC	0.25	0.10	0.20	0.25	0.19	0.08	0.15	0.19

Calibration – Trip Distribution

Default Intersection Delay

Average Travel Time - Minutes					
	HBW	HBSC	HBSH	HBO	NHB
Survey	15.176	13.492	15.124	17.605	16.944
Model	16.278	13.510	13.750	13.250	11.340
Difference	1.103	0.018	-1.374	-4.355	-5.604

Facility Type	Modeled Volume: Count Volume
Interstate	102.50%
Principal Arterial	93.10%
Minor Arterial	84.00%
Major Collector	97.50%
Minor Collector	176.20%
Local	104.20%
Total	91.20%

Calibration – Trip Distribution

Default Intersection Delay vs. Partial Intersection Delay Summary

Default - Full Delay								
	PEAK				OFF PEAK			
	Left	Right	Thru	Uturn	Left	Right	Thru	Uturn
Arterial/ramp	0.395	0.118	0.217	0.379	0.298	0.090	0.163	0.309
Collector	0.300	0.105	0.198	0.300	0.226	0.081	0.150	0.228
Local/CC	0.304	0.106	0.179	0.323	0.228	0.082	0.135	0.262
Signalized	0.444	0.150	0.294	0.456	0.333	0.113	0.223	0.325
AWSC	0.233	0.093	0.233	0.233	0.177	0.073	0.177	0.182
TWSC	0.317	0.117	0.263	0.317	0.240	0.090	0.198	0.235
Uncontrolled	0.337	0.078	0.000	0.330	0.252	0.060	0.000	0.282

Partial Intersection Delay								
	PEAK				OFF PEAK			
	Left	Right	Thru	Uturn	Left	Right	Thru	Uturn
Arterial/ramp	0.132	0.063	0.097	0.750	0.100	0.049	0.074	0.500
Collector	0.135	0.062	0.096	0.750	0.099	0.049	0.074	0.500
Local/CC	0.132	0.063	0.097	0.750	0.100	0.048	0.074	0.500
Signalized	0.146	0.062	0.087	0.750	0.112	0.052	0.072	0.500
AWSC	0.112	0.062	0.112	0.750	0.087	0.047	0.087	0.500
TWSC	0.187	0.087	0.187	0.750	0.137	0.062	0.137	0.500
Uncontrolled	0.087	0.037	0.000	0.750	0.062	0.032	0.000	0.500

Calibration – Trip Distribution

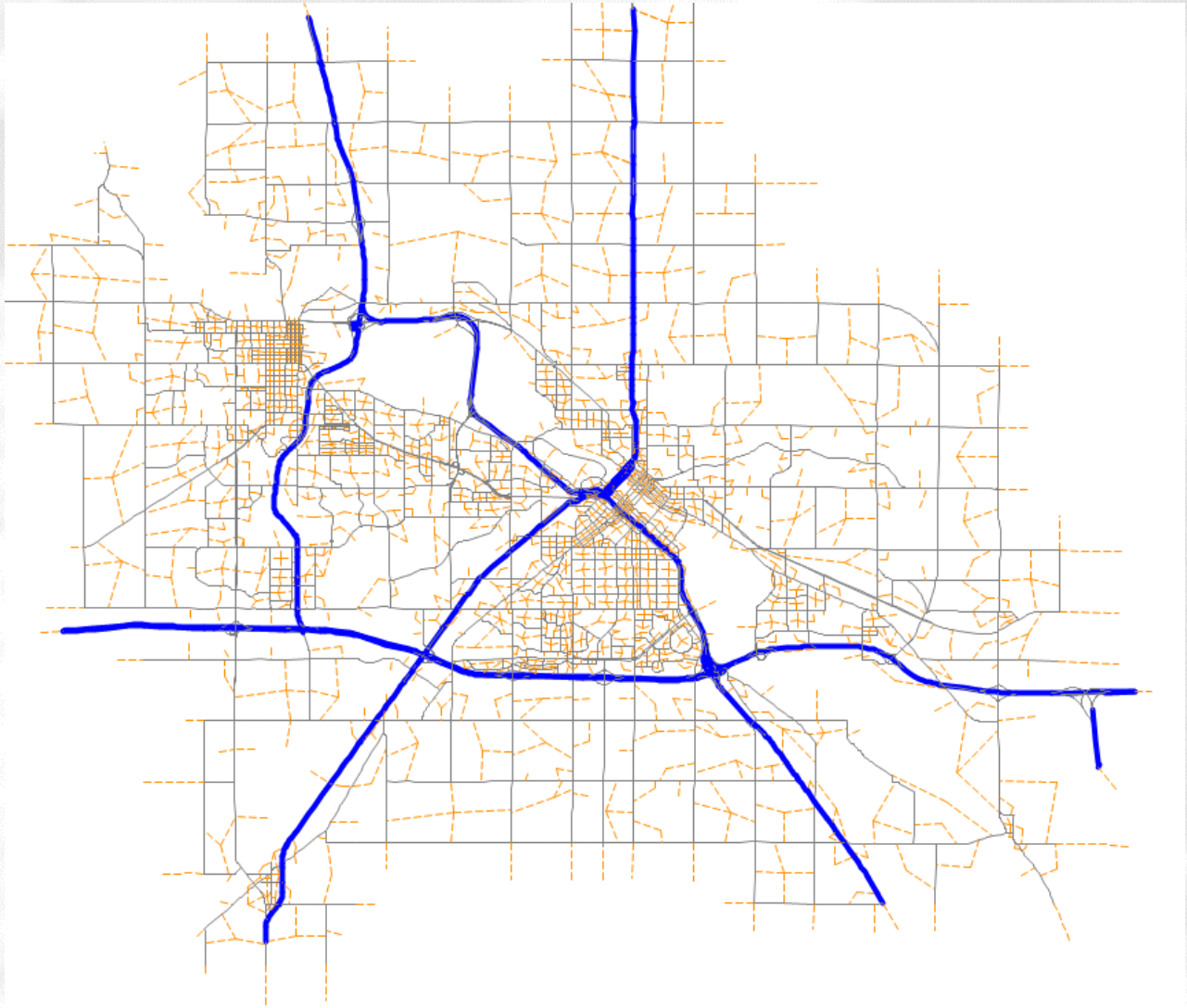
Partial Intersection Delay

Average Travel Time - Minutes					
	HBW	HBSC	HBSH	HBO	NHB
Survey	15.176	13.492	15.124	17.605	16.944
Model	14.807	12.340	12.575	12.155	10.775
Difference	-0.369	-1.152	-2.549	-5.450	-6.169

Facility Type	Modeled Volume: Count Volume
Interstate	99.20%
Principal Arterial	101.20%
Minor Arterial	93.70%
Major Collector	99.90%
Minor Collector	162.90%
Local	100.60%
Total	98.00%

Calibration – Trip Distribution

Comparison with INRIX – Weekday Speeds



Method	Speed %RMSE
Default Delays	10.48%
No Delays	10.23%
Partial Delays	10.21%

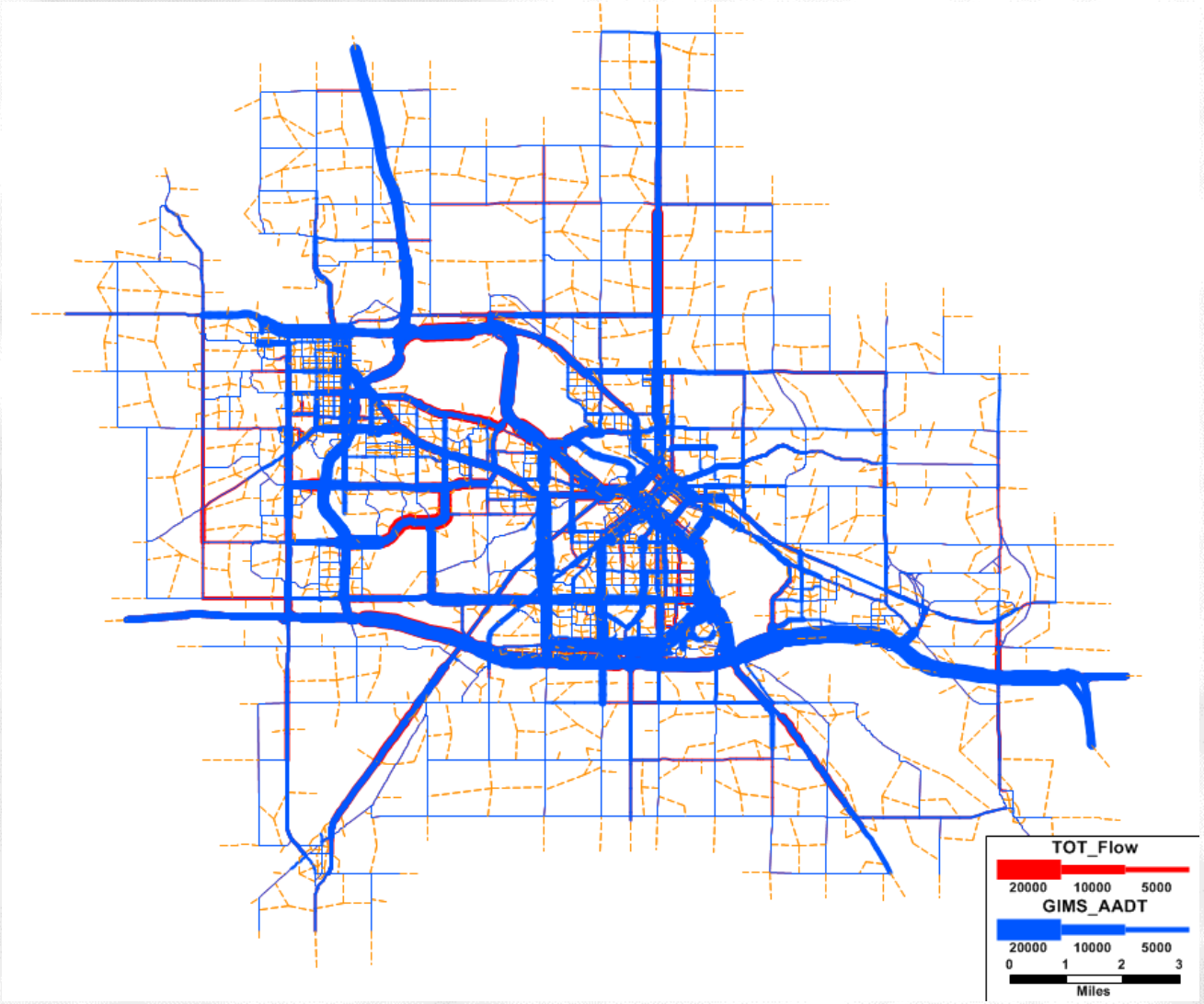
Calibration – Mode Split

Mode Split			
	Non-Motorized	Transit	Auto
CTPP (JTW)	6.65%	0.65%	92.70%
Model (total)	0.96%	0.67%	98.34%

Des Moines, IA – August, 2010

Calibration – Traffic Assignment

- Gravel road speeds (PSPEED = 35 mph)
- Connector loadings
- Speed adjustments (+/- 5 mph)



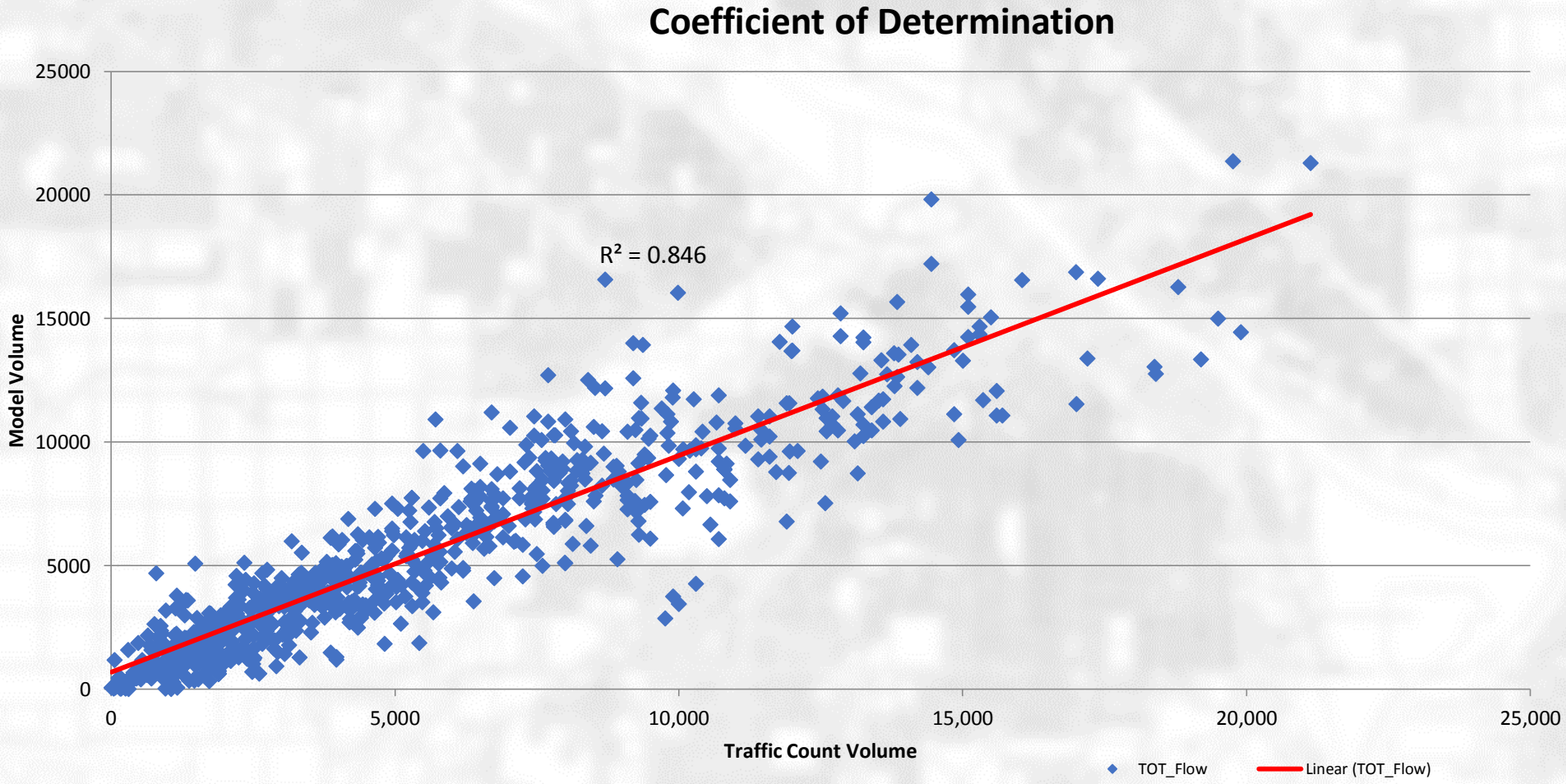
Calibration - Traffic Assignment

Percent Volume Error - AADT							
	Central Business District	Fringe Business District	Outlying Business	Residential	Rural	**Total**	**ISMS Goal**
Interstate	--	--	0.8%	--	-1.4%	**0.5%**	**+/- 7%**
Principal Arterial	--	-1.3%	-7.3%	1.8%	12.2%	**1.4%**	**+/- 10%**
Minor Arterial	-0.2%	-3.4%	-12.1%	-8.2%	18.0%	**-3.4%**	**+/- 10%**
Major Collector	7.8%	31.8%	1.3%	-15.2%	22.9%	**0.7%**	**+/-15%**
Minor Collector	--	--	--	--	59.1%	**59.1%**	**+/- 25%**
Local	0.8%	-9.8%	16.7%	-7.8%	-52.3%	**0.8%**	**N/A**
Ramp	--	34.0%	-1.9%	--	8.0%	**4.3%**	**+/- 25%**
Total	3.5%	3.3%	-5.8%	-7.2%	14.1%	**-0.5%**	**+/- 5%**

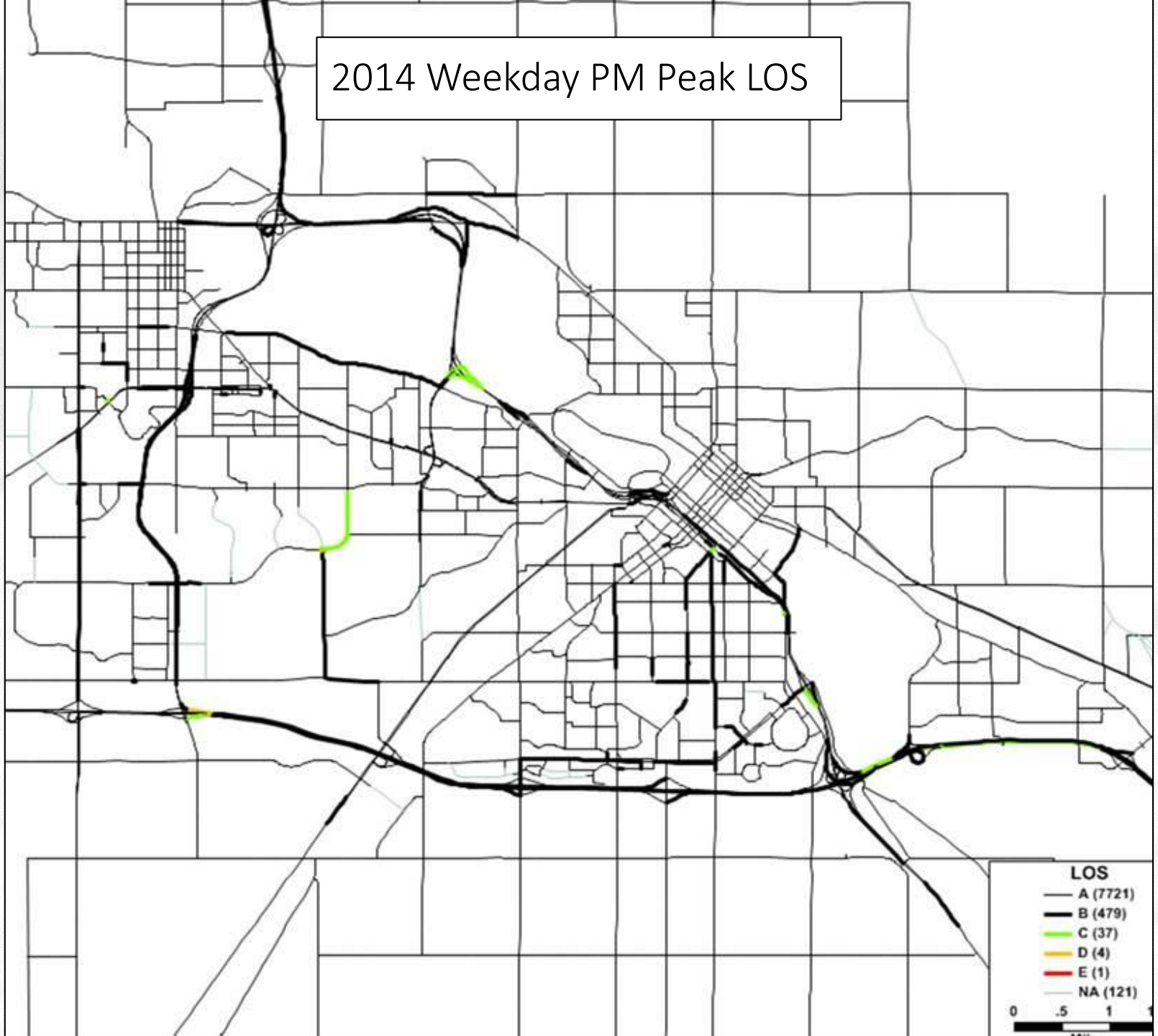
Calibration - Traffic Assignment

% Root Mean Square Error - AADT							
	Central Business District	Fringe Business District	Outlying Business	Residential	Rural	**Total**	**ISMS Goal**
Interstate	--	--	8.8%	--	2.0%	**8.2%**	**< 30%**
Principal Arterial	--	14.1%	22.7%	24.1%	23.3%	**22.6%**	**< 40%**
Minor Arterial	19.9%	26.8%	29.5%	27.2%	38.3%	**30.4%**	**< 40%**
Major Collector	33.0%	52.9%	21.0%	50.0%	78.6%	**45.7%**	**N/A**
Minor Collector	--	--	--	--	--	**--**	**N/A**
Local	14.1%	27.0%	48.4%	45.1%	117.3%	**45.4%**	**N/A**
Ramp	--	43.3%	43.3%	--	22.1%	**40.6%**	**N/A**
Total	24.5%	25.5%	26.4%	31.4%	31.8%	**29.2%**	**< 40%**

Calibration - Traffic Assignment

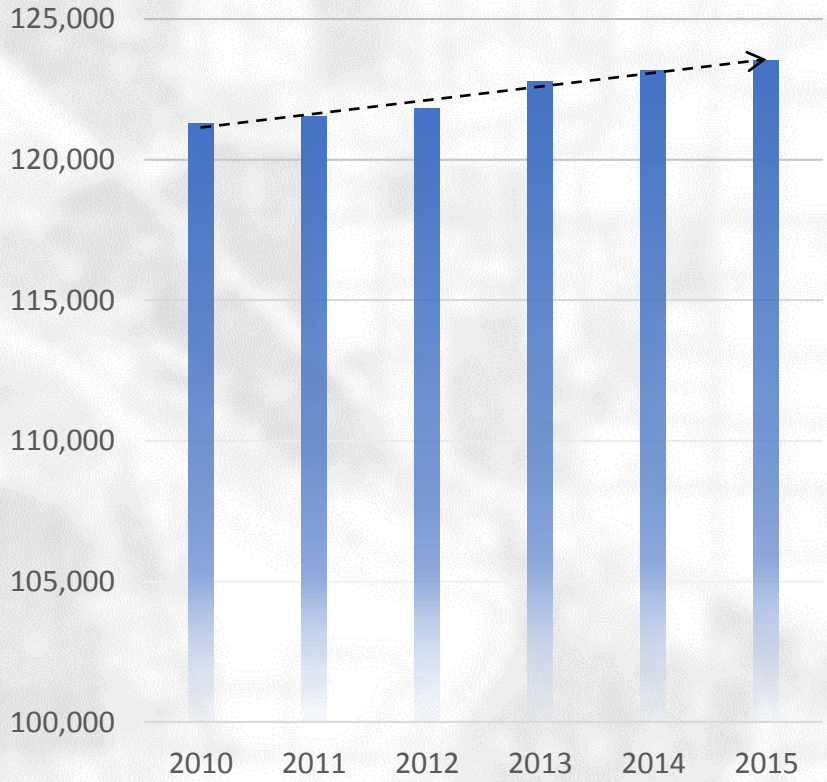


2014 Weekday PM Peak LOS



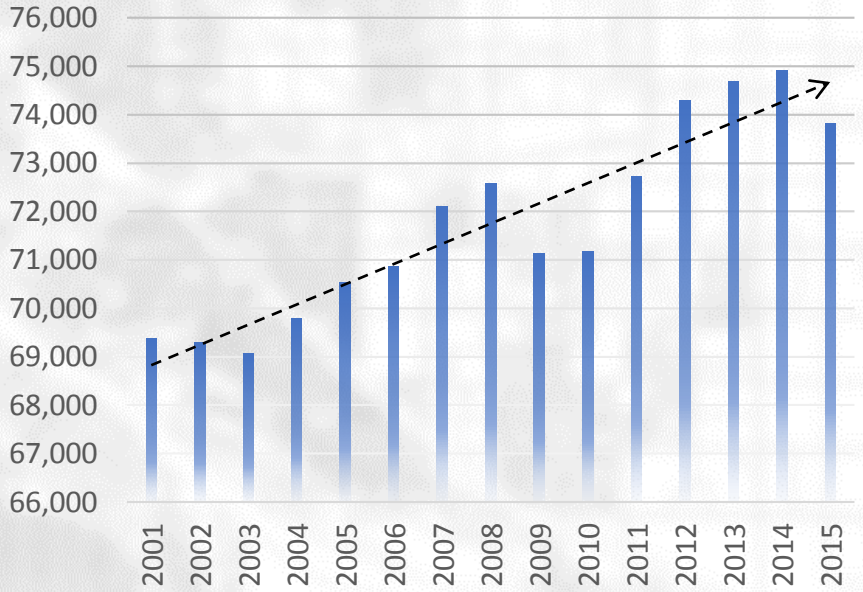
Forecast Methodology - Residential

- Estimate population growth for the MPO as a whole
- Estimate each jurisdiction's share of the total
- Determine base year number of households and population
- Distribute each jurisdiction's forecasted population growth to the TAZs
- Review by jurisdictions



Forecast Methodology – Non-Residential

- Estimate employment growth for the MPO as a whole
- Estimate each jurisdiction's share of the total
- Determine the number of jobs per TAZ
- Distribute each jurisdiction's forecasted employment growth to the TAZs
- Review by jurisdictions



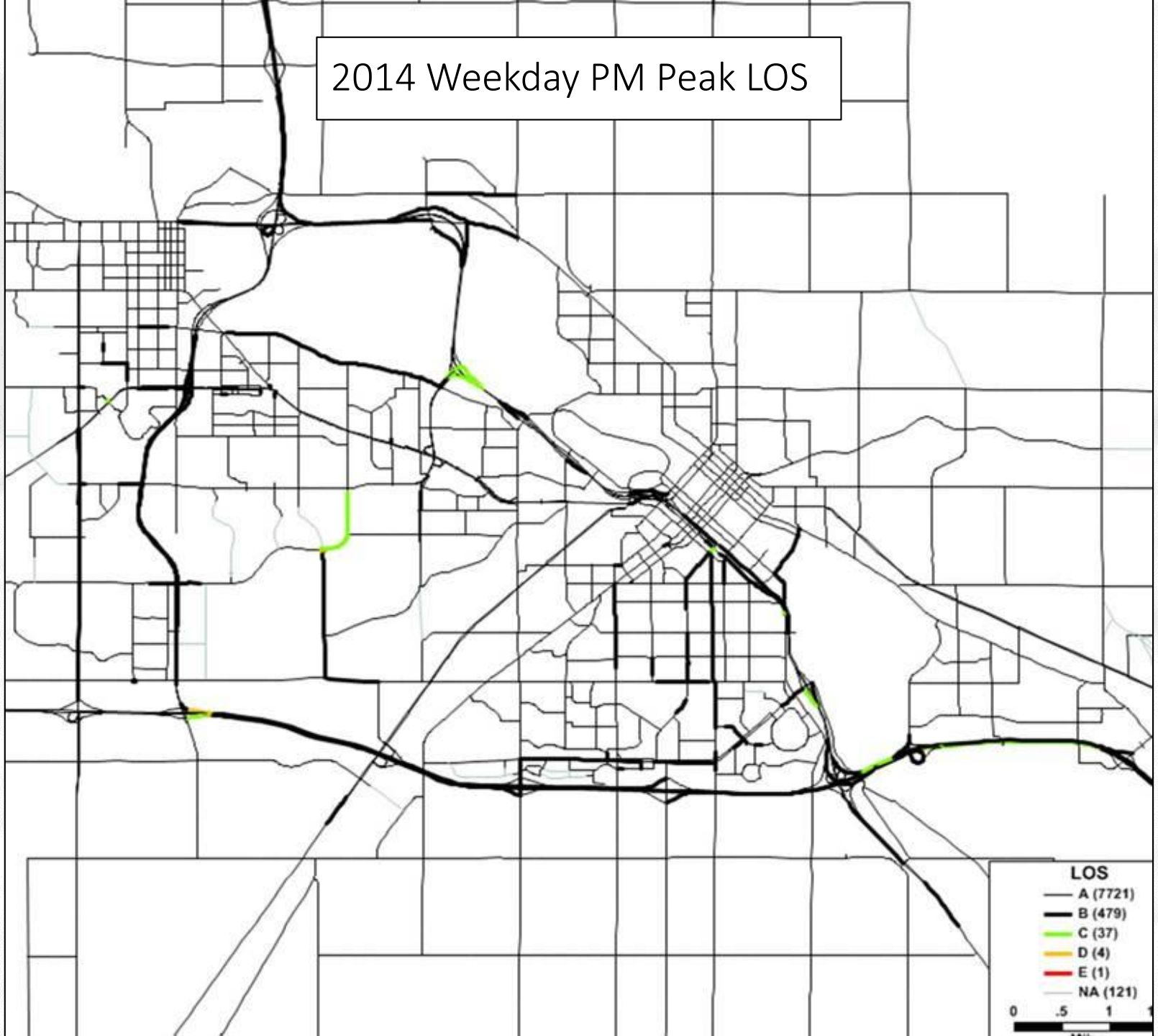
	2001	2005	2010	2015	Avg.
Waterloo	66.27%	65.15%	64.11%	63.64%	**64.88%**
Cedar Falls	29.27%	30.61%	31.76%	32.32%	**30.94%**
Evansdale	1.40%	1.31%	1.25%	1.25%	**1.28%**
Hudson	1.23%	1.14%	1.10%	1.06%	**1.14%**
Elk Run Heights	0.56%	0.52%	0.50%	0.50%	**0.51%**
Raymond	0.13%	0.12%	0.11%	0.13%	**0.13%**
Gilbertville	0.15%	0.16%	0.21%	0.15%	**0.17%**
Unincorporated Area	0.99%	0.98%	0.97%	0.94%	**0.96%**

Forecast Methodology – Non-Residential

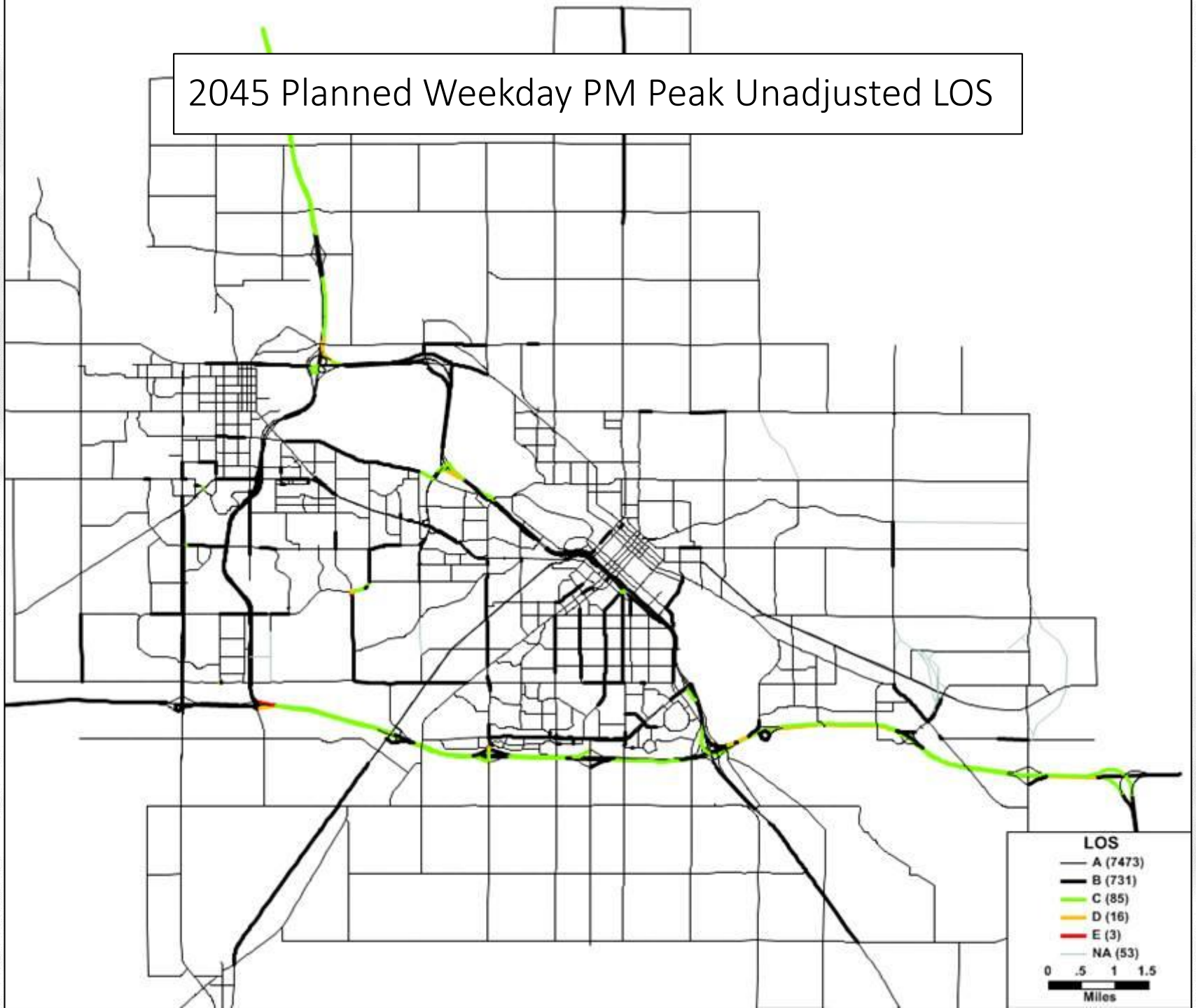
- Calculate employment density for 8 future land use category groups
- Convert employment growth into KSF/acres
- Calculate trip rates for the future land use groups using NHTS add-on
- Done for all TAZs that had employment growth and all future years

INRCOG land use groups	AMT1	EMP	Tot EMP Density
Agriculture/Open (acres)	62190.52	535	0.009
Residential (KSF)	12965.27	2693	0.208
Public/Government/Church/Recreational (KSF)	3514.156	2007	0.571
Semi-Public/Institutional (KSF)	3510.635	9242	2.633
Mixed (Residential/Commercial) (KSF)	7247.934	15813	2.182
Commercial (KSF)	10289.77	17058	1.658
Commercial/Industrial (KSF)	23252.74	23822	1.024
Industrial (KSF)	22200.69	22005	0.991

2014 Weekday PM Peak LOS

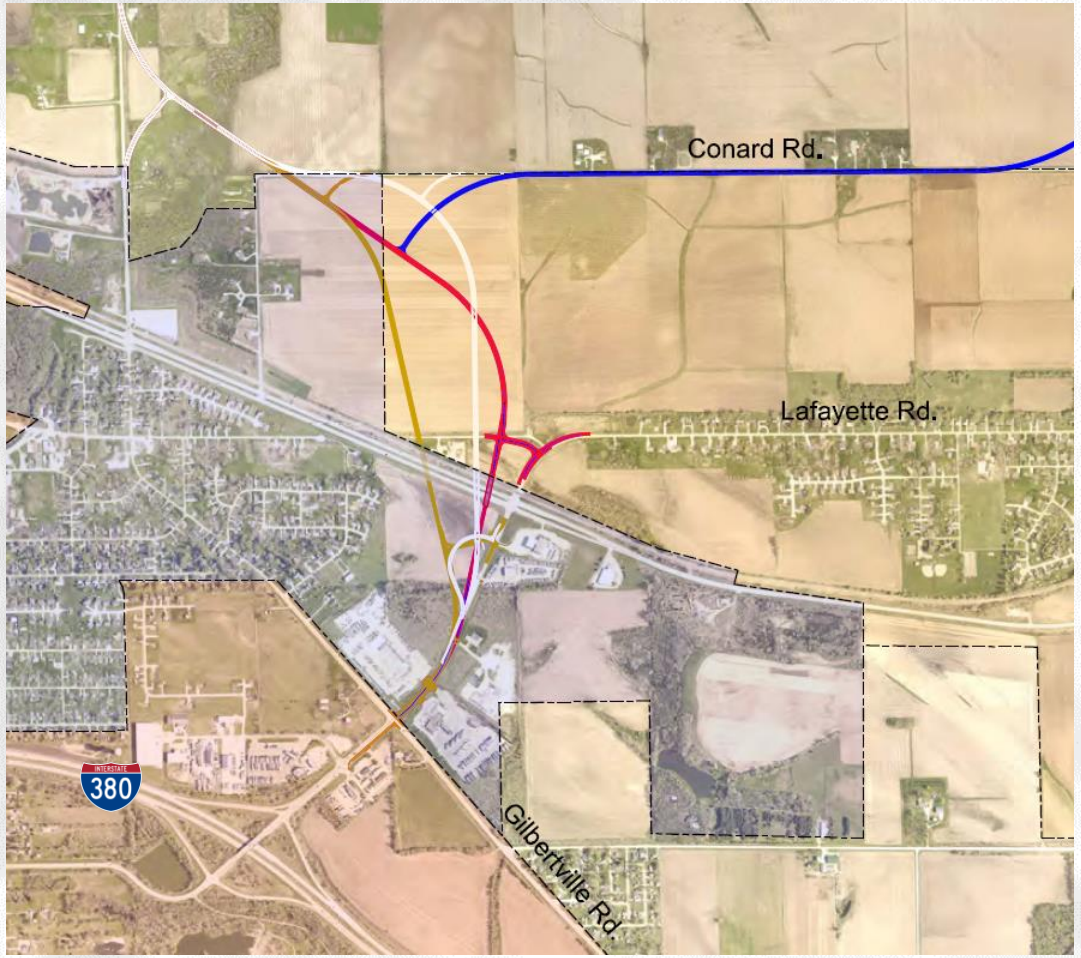


2045 Planned Weekday PM Peak Unadjusted LOS



Model Use & Application

- Northeast Industrial Access Study
- LRTP Project Comparison & Selection
  - VMT
  - VHT
  - Limited congestion; will use additional metrics for evaluation
- Consultant inquiries on future flow



Lessons Learned

- BE THINKING OF THIS NOW!
- Budget ample time to review parcel data
- Work with County Assessor(s) for data coordination
  - Provide County the ISMS parcel file list
- Backup work often (ProjectWise)

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