Dynameq: The Next Generation in Traffic Forecasting and Analysis

I-70 STEIS in Kansas City Case Study

February 28, 2014

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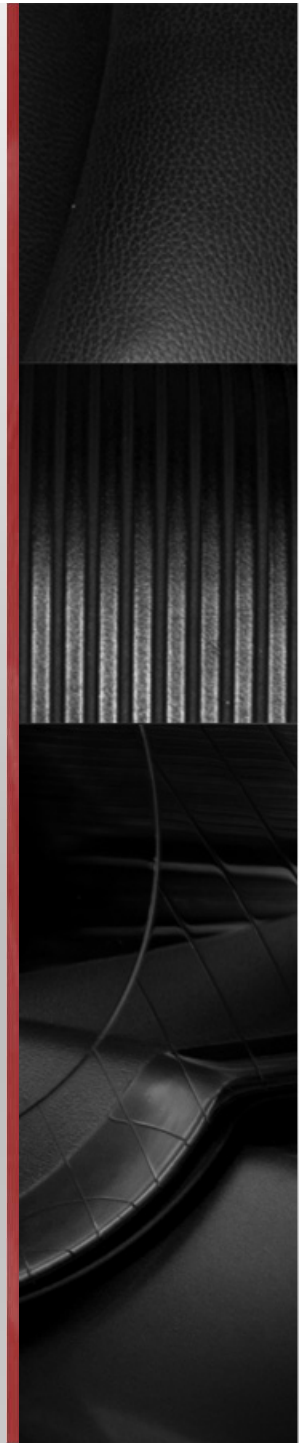


Presentation Overview

1. Project Background
2. What is Dynameq? Why Did We Use It?
3. Using Dynameq
4. Reasonable and Preferred Alternatives
5. Results and Conclusions
6. Future Possibilities

Project Map

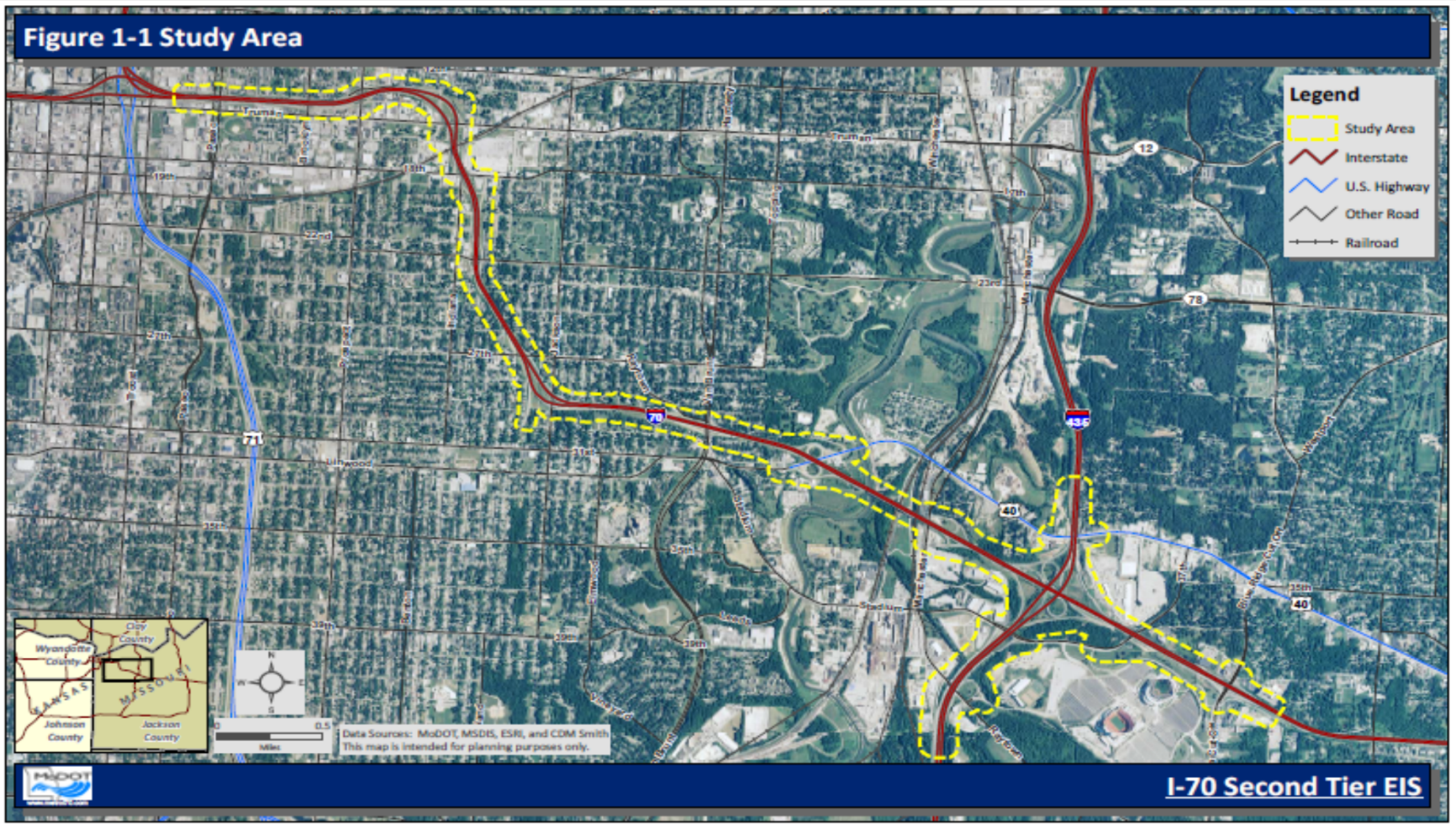


Figure 1-1 Study Area
Legend
Study Area
Interstate
U.S. Highway
Other Road
Railroad
Wyandotte County
Clay County
Johnson County
Jackson County
KANSAS
MISSOURI
Data Sources: MoDOT, MSDIS, ESRI, and CDM Smith
This map is intended for planning purposes only.
I-70 Second Tier EIS

Purpose and Need

- **Improve Safety** - From 2008 to 2012, there were:
  - 2,017 crashes
  - 10 fatal and 28 disabling injuries crashes
  - Majority of the corridor exceeds the statewide average crash rates for urban interstates by more than 100 percent.

Section	Section Name	Length	Average 2008-2012 Crash Rate Versus Statewide Average Crash Rate (109.61)	
			Eastbound	Westbound
Section 1	Paseo Interchange	0.87	101%	124%
Section 2	Benton Curve	1.20	168%	140%
Section 3	23rd Street Interchange	0.67	88%	123%
Section 4	Jackson Curve	0.90	203%	100%
Section 5	Van Brunt	0.73	174%	125%
Section 6	US-40	0.59	146%	163%
Section 7	Manchester	0.57	208%	178%
Section 8	I-435	0.96	247%	201%
Section 9	Blue Ridge Cutoff	1.28	144%	112%

Purpose and Need

- **Reduce Congestion**
  - Congestion is not directly linked to traffic volumes (current AADT between 75,000 and 115,000)
  - Congestion occurs at spot locations where there are substandard merge, diverge, and weave areas.

Purpose and Need

- **Restore and Maintain Existing Infrastructure**
  - I-70 is more than 50 years old
  - Deteriorating pavement and bridges
  - Geometric issues (Benton and Jackson Curves)
  - Closely spaced interchanges (15 partial or full interchanges in 6.8 miles)
  - Ramp issues (short and/or steep on- and off-ramps)

Purpose and Need

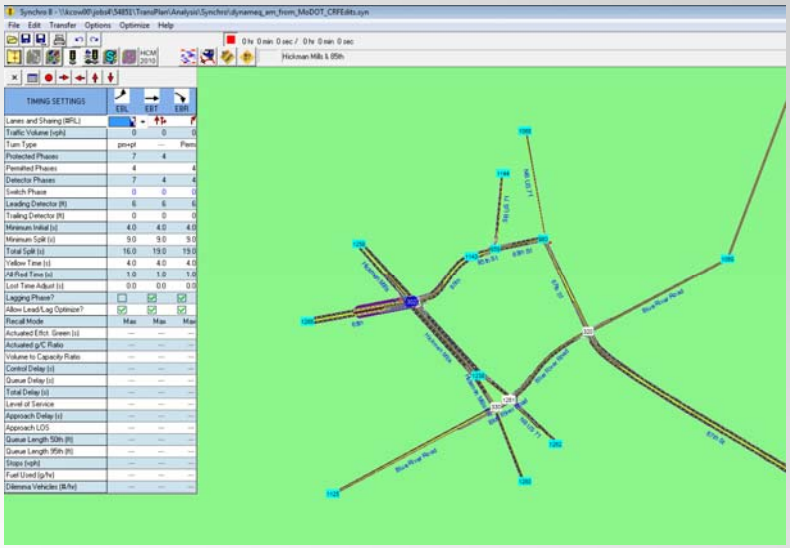
- **Improve Accessibility**
  - There are 19 street crossings and 2 pedestrian bridges to enable non-motorized access across I-70
  - To assist non-motorized travel across I-70, there are currently 9 bus routes that cross I-70
  - There are 4 bus routes that travel on I-70

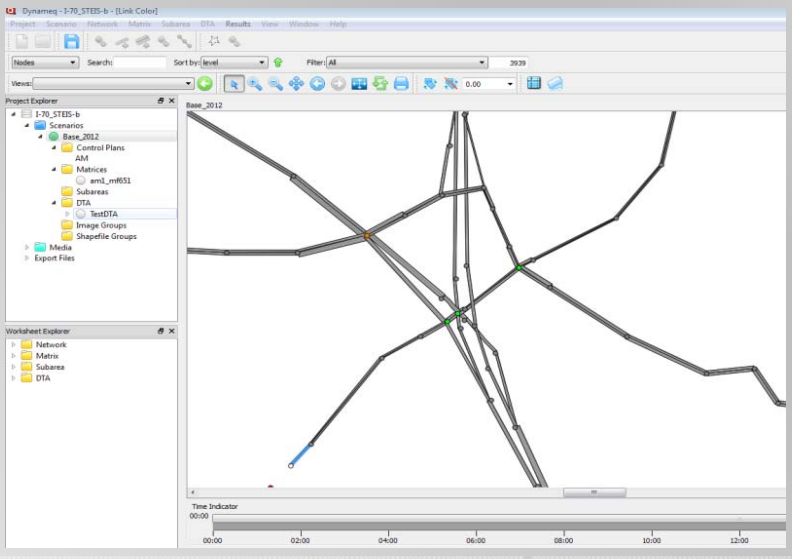
Purpose and Need

- **Improve Goods Movement**
  - Trucks are 11% of the daily volume
  - I-70 provides access to several major truck facilities along the corridor and region.

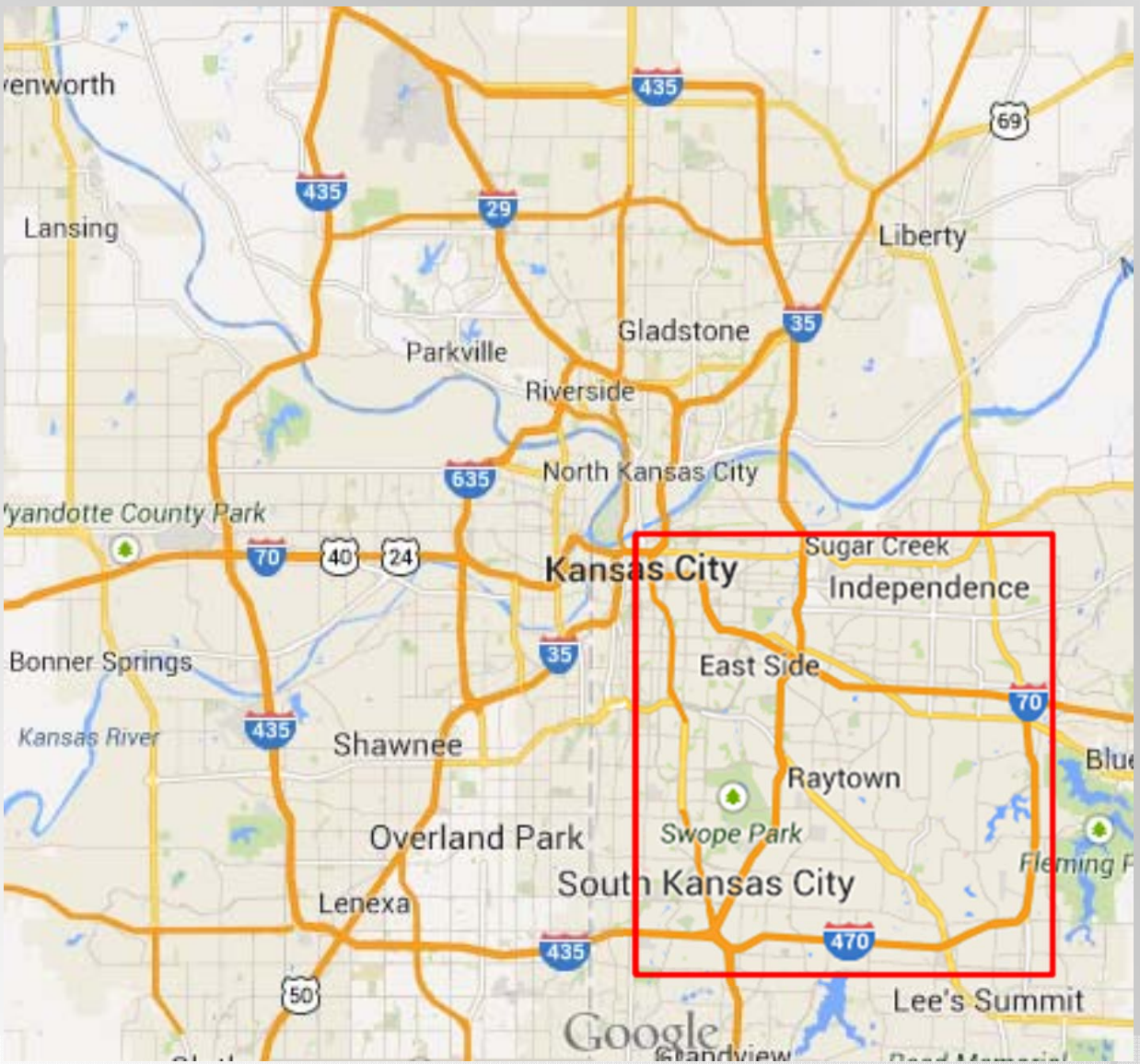
What Is Dynameq and Why Use It?

- Dynamic Traffic Assignment (DTA)
- Benefits of Macro- and Micro-Simulation
- Medium-sized network
- Time Component
- Integration with MARC Model

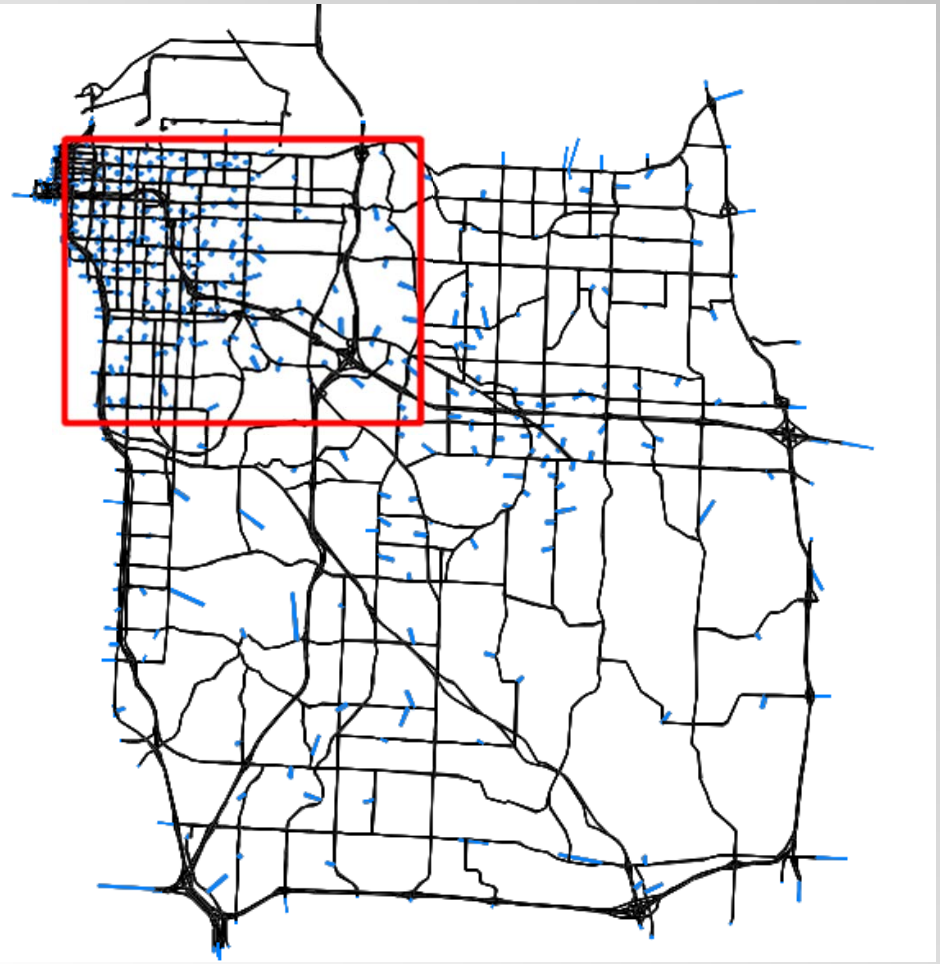


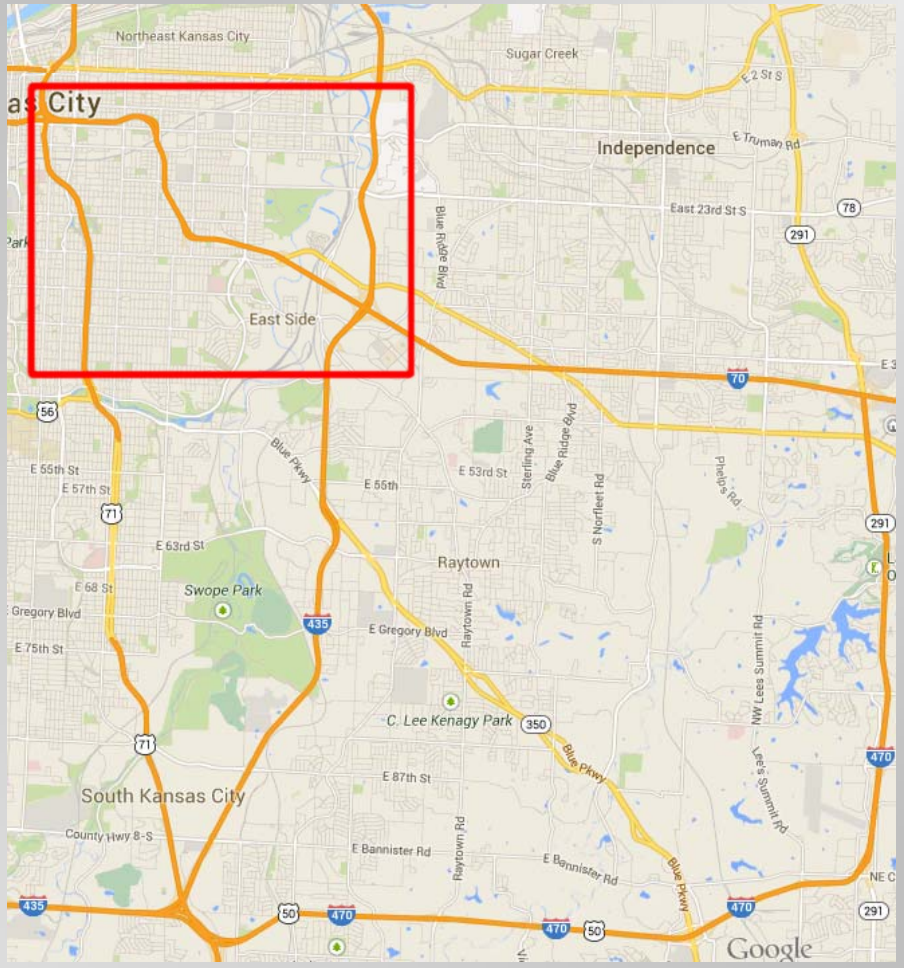


The Region

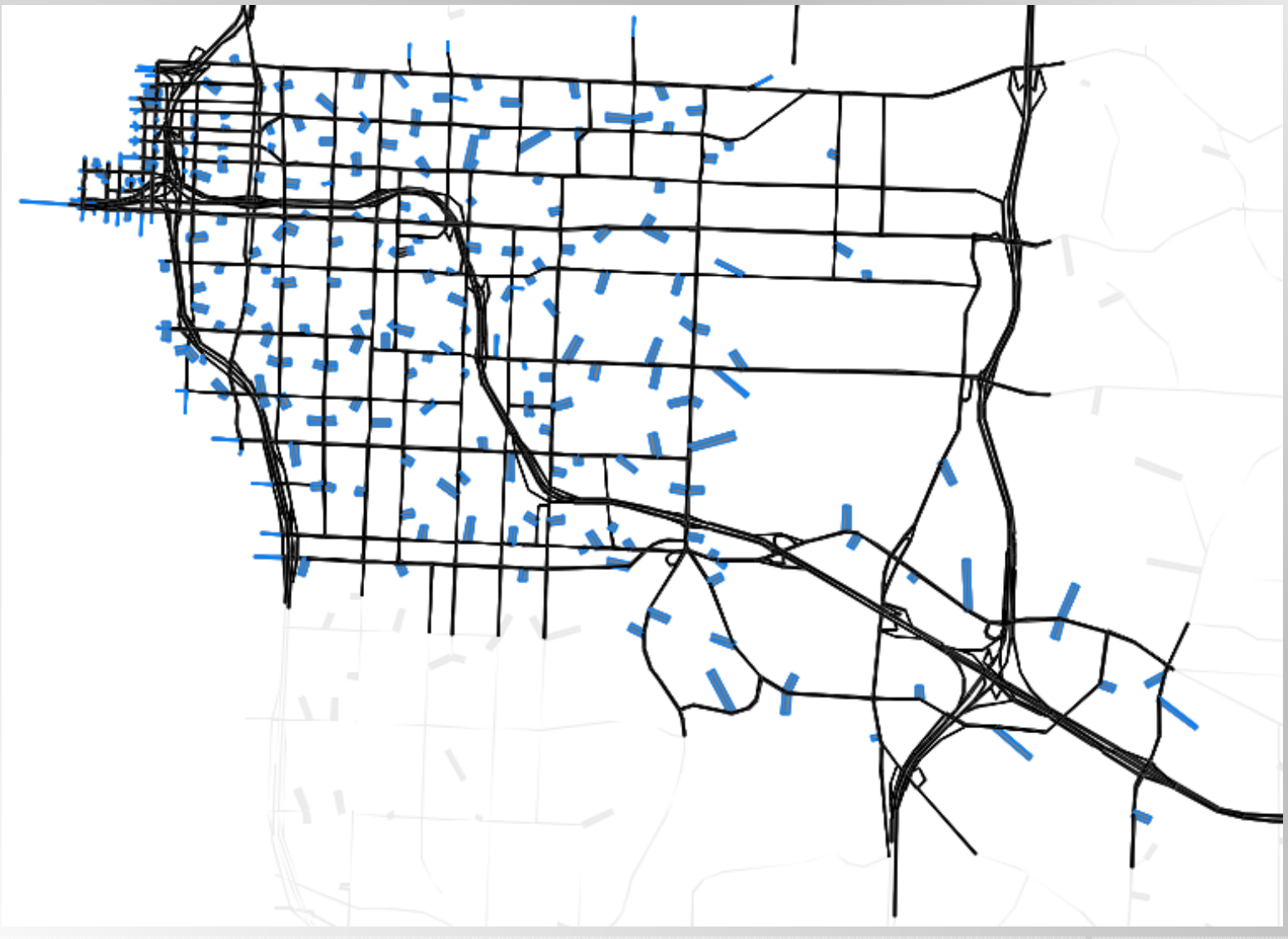

Lansing
Liberty
Gladstone
Parkville
Riverside
North Kansas City
Kansas City
Sugar Creek
Independence
East Side
Bonner Springs
Kansas River
Shawnee
Raytown
Swope Park
Overland Park
South Kansas City
Lenexa
Lee's Summit
Google
435
29
69
35
635
70
40
24
50
470

The Model Area

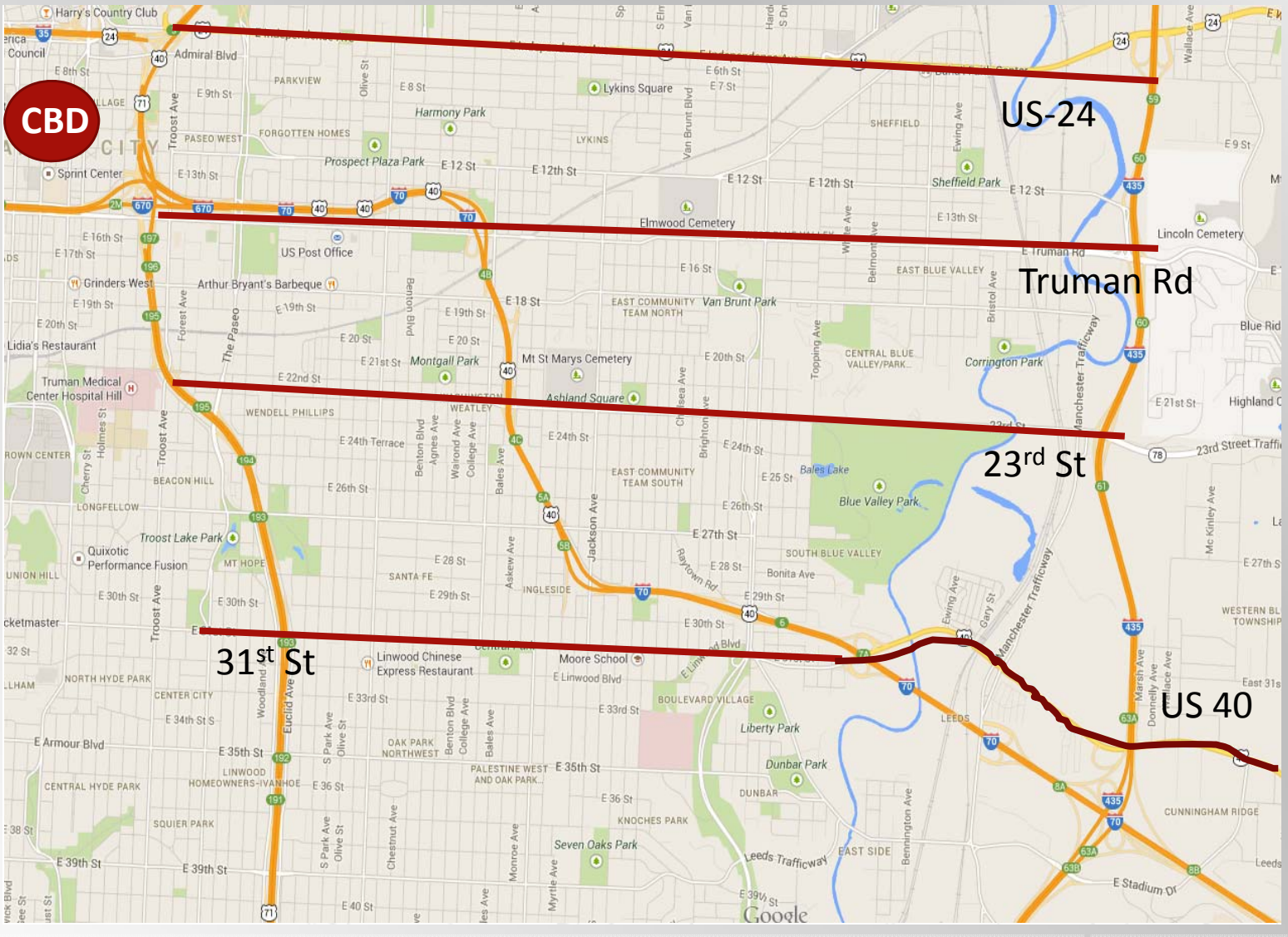




The Subarea



The Subarea



Steps to Get Network into Dynameq

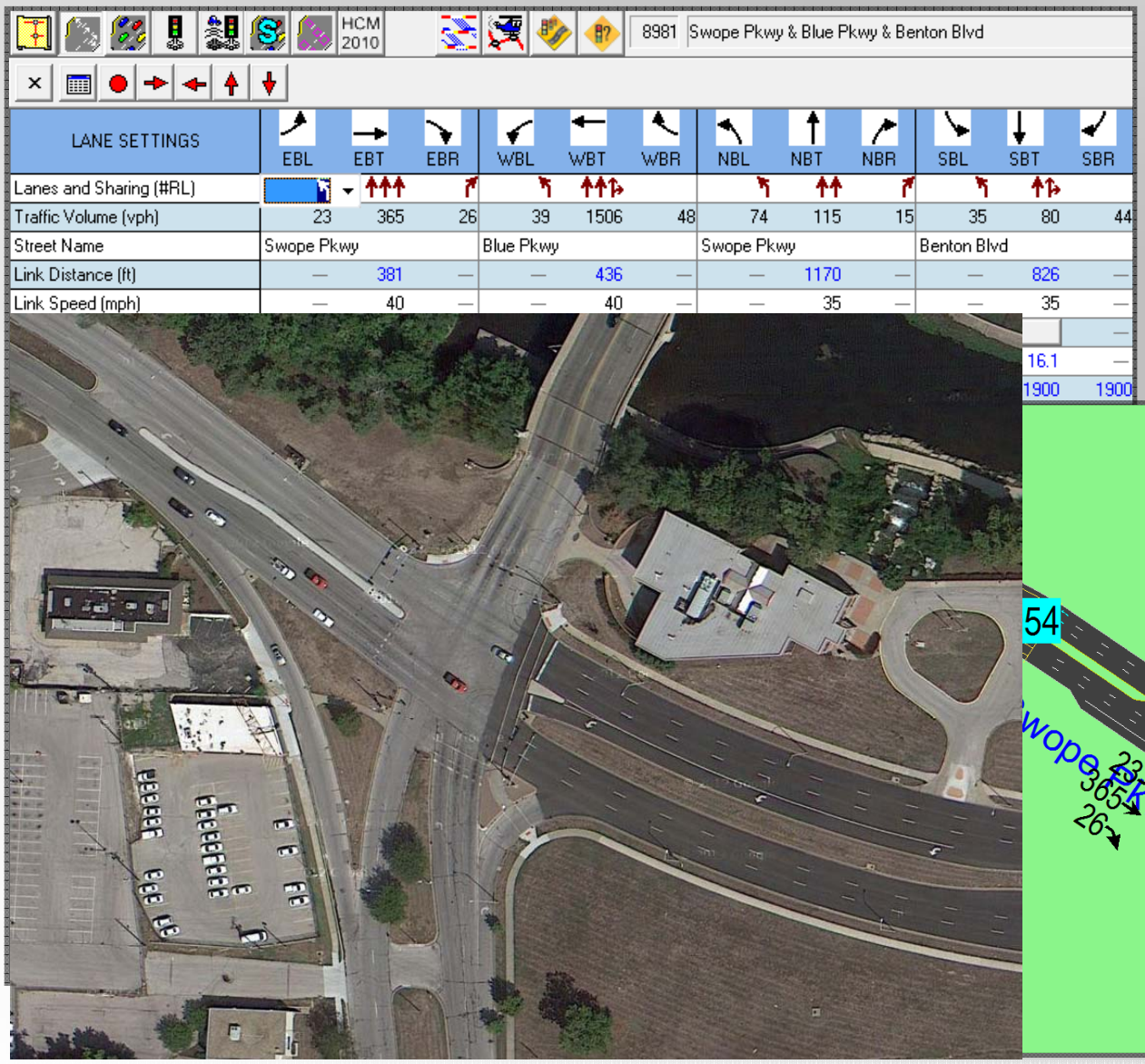
Updating Geometry in Synchro

HCM 2010 | 8981 Swope Pkwy & Blue Pkwy & Benton Blvd

LANE SETTINGS	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (#RL)												
Traffic Volume (vph)	23	365	26	39	1506	48	74	115	15	35	80	44
Street Name	Swope Pkwy			Blue Pkwy			Swope Pkwy			Benton Blvd		
Link Distance (ft)	—	381	—	—	436	—	—	1170	—	—	826	—
Link Speed (mph)	—	40	—	—	40	—	—	35	—	—	35	—
Set Arterial Name and Speed	—	EB	—	—	WB	—	—	NB	—	—	SB	—
Travel Time (s)	—	6.5	—	—	7.4	—	—	22.8	—	—	16.1	—
Ideal Satd. Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12			
Grade (%)	—	-4	—	—	0	—	—	0	—			
Area Type CBD	—	☐	—	—	☐	—	—	☐	—			
Storage Length (ft)	125	—	200	350	—	0	100	—	150			
Storage Lanes (#)	1	—	1	1	—	—	1	—	1			
Right Turn Channelized	—	—	Yield	—	—	None	—	—	Yield			
Curb Radius (ft)	—	—	250	—	—	—	—	—	50			
Add Lanes (#)	—	—	0	—	—	—	—	—	0			
Lane Utilization Factor	1.00	0.91	1.00	1.00	0.91	0.91	1.00	0.95	1.00			
Right Turn Factor	1.000	1.000	0.850	1.000	0.994	—	1.000	1.000	0.850			
Left Turn Factor (prot)	0.950	1.000	1.000	0.950	1.000	—	0.950	1.000	1.000			
Saturated Flow Rate (prot)	1805	5187	1615	1770	5052	—	1770	3539	1583			
Left Turn Factor (perm)	0.111	1.000	1.000	0.509	1.000	—	0.651	1.000	1.000			
Right Ped Bike Factor	1.000	1.000	0.987	1.000	0.999	—	1.000	1.000	1.000			
Left Ped Factor	1.000	1.000	1.000	0.999	1.000	—	1.000	1.000	1.000			
Saturated Flow Rate (perm)	211	5187	1593	947	5052	—	1213	3539	1583			
Right Turn on Red?	—	—	☑	—	—	☑	—	—	☑			
Saturated Flow Rate (RTOR)	0	0	145	0	8	—	0	0	145			
Link Is Hidden	—	☐	—	—	☐	—	—	☐	—			
Hide Name in Node Title	—	☐	—	—	☐	—	—	☐	—			

- Lanes and Sharing
- Storage Length
- Storage Lanes
- Right Turn Channelized
- Curb Radius
- Add Lanes
- Right Turn on Red?

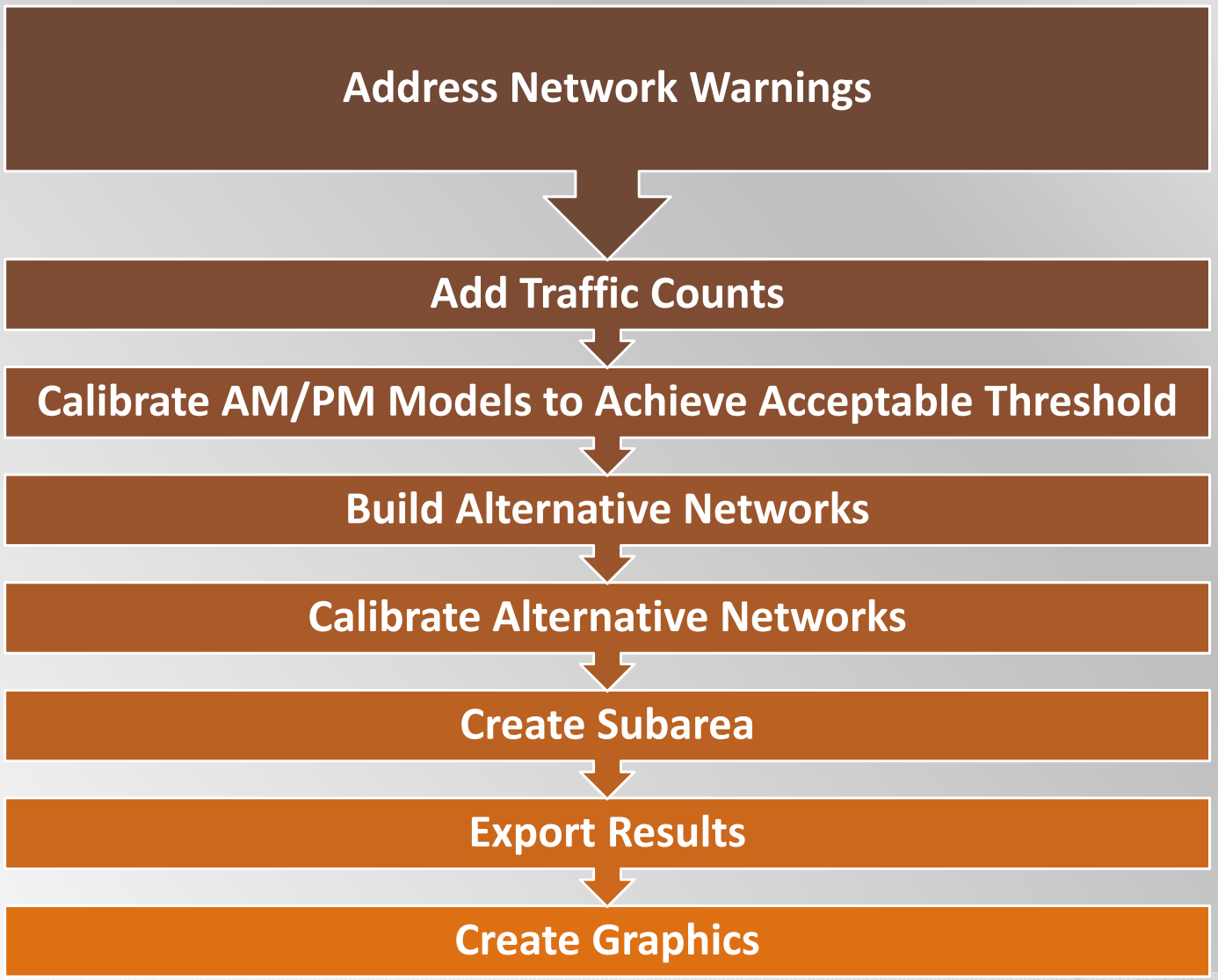
Updating Geometry in Synchro

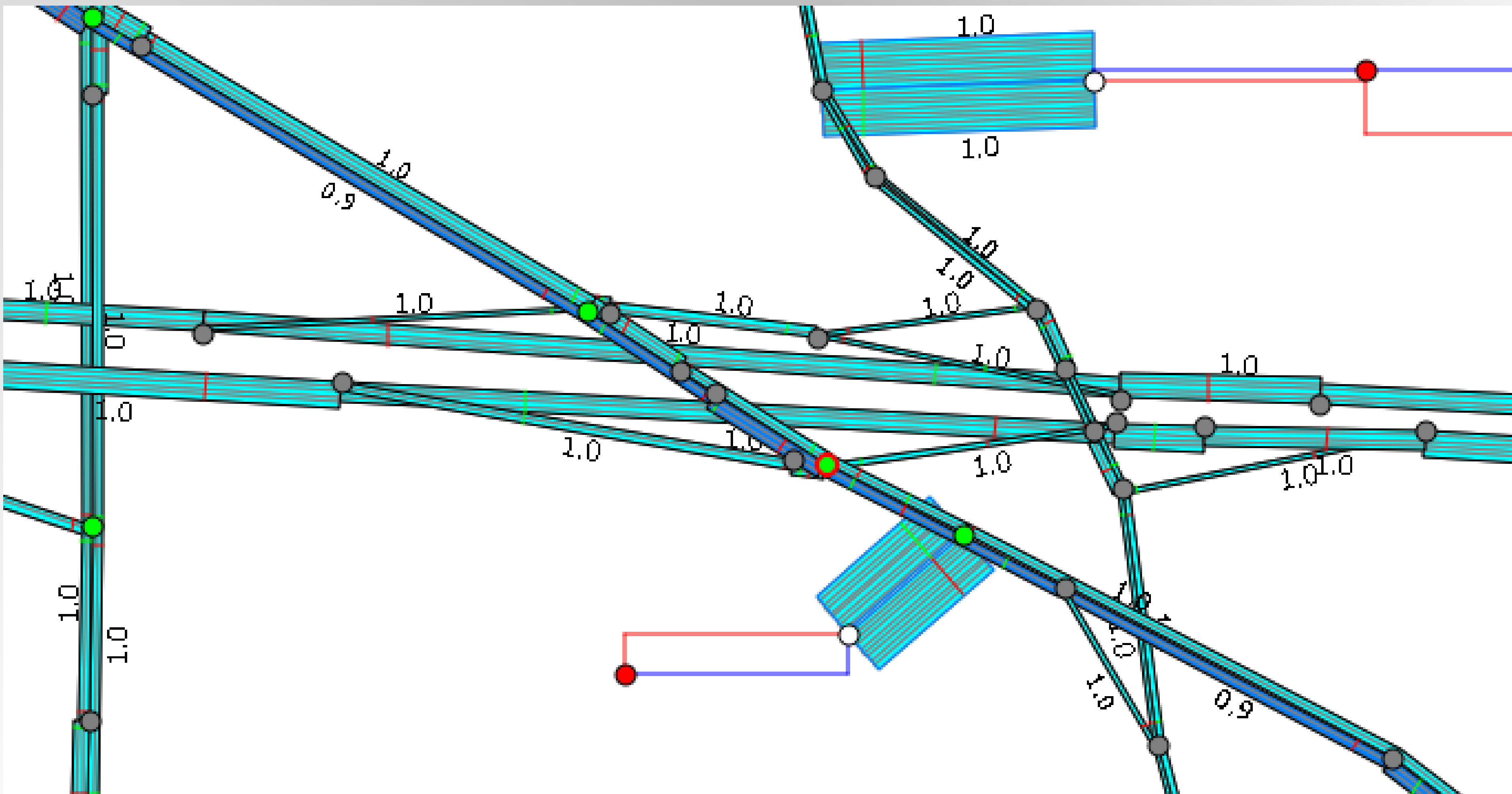


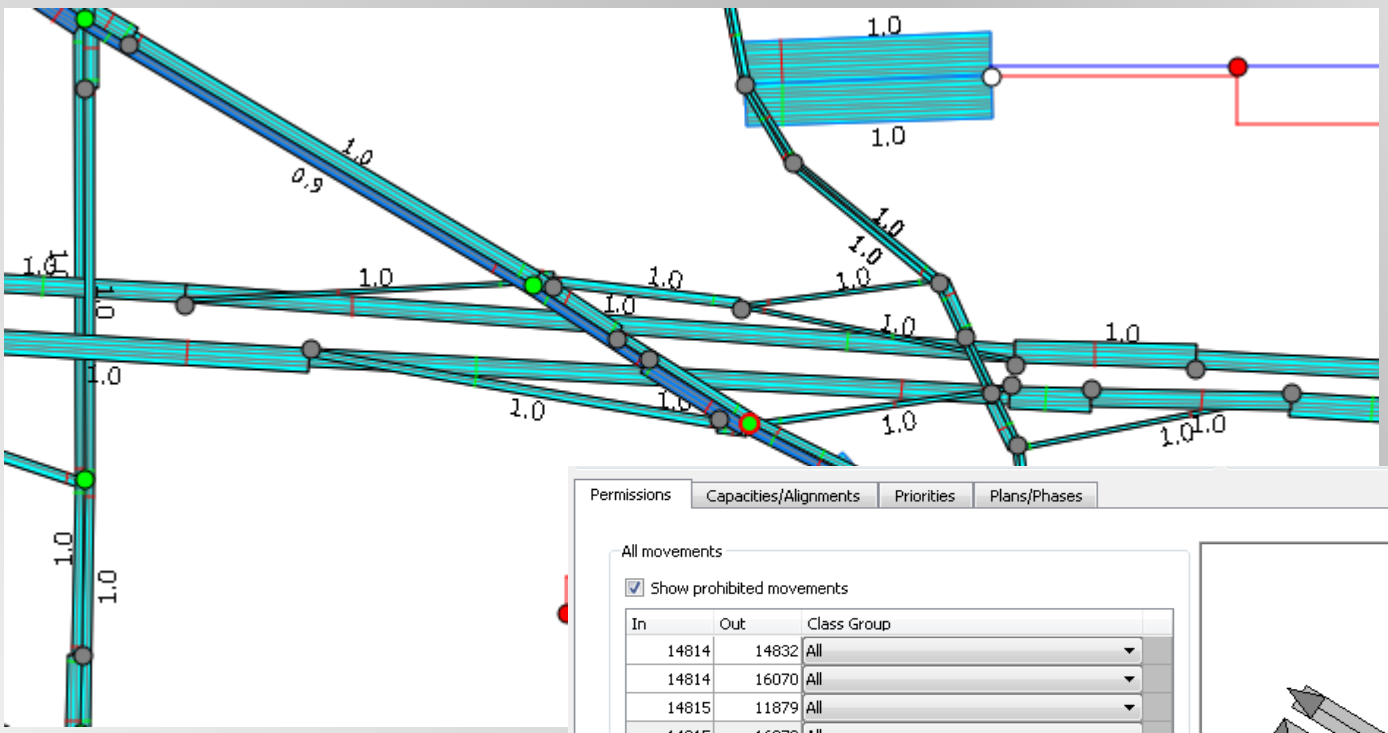
- Lanes and sharing
- Storage Length
- Storage Lanes
- Right Turn Channelized
- Curb Radius
- Add Lanes
- Right Turn on Red?

Steps to Get Network into Dynamaq

Steps Taken once our network was in Dynameq




1.0
0.9

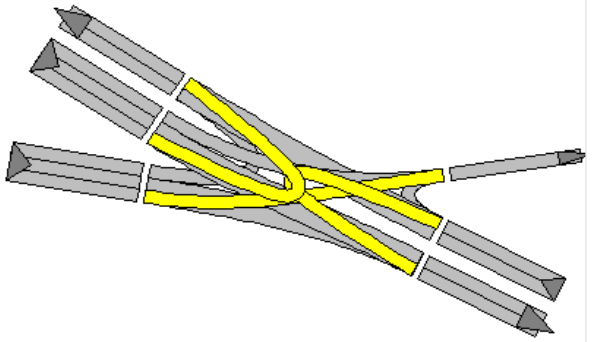


Permissions | Capacities/Alignments | Priorities | Plans/Phases

All movements

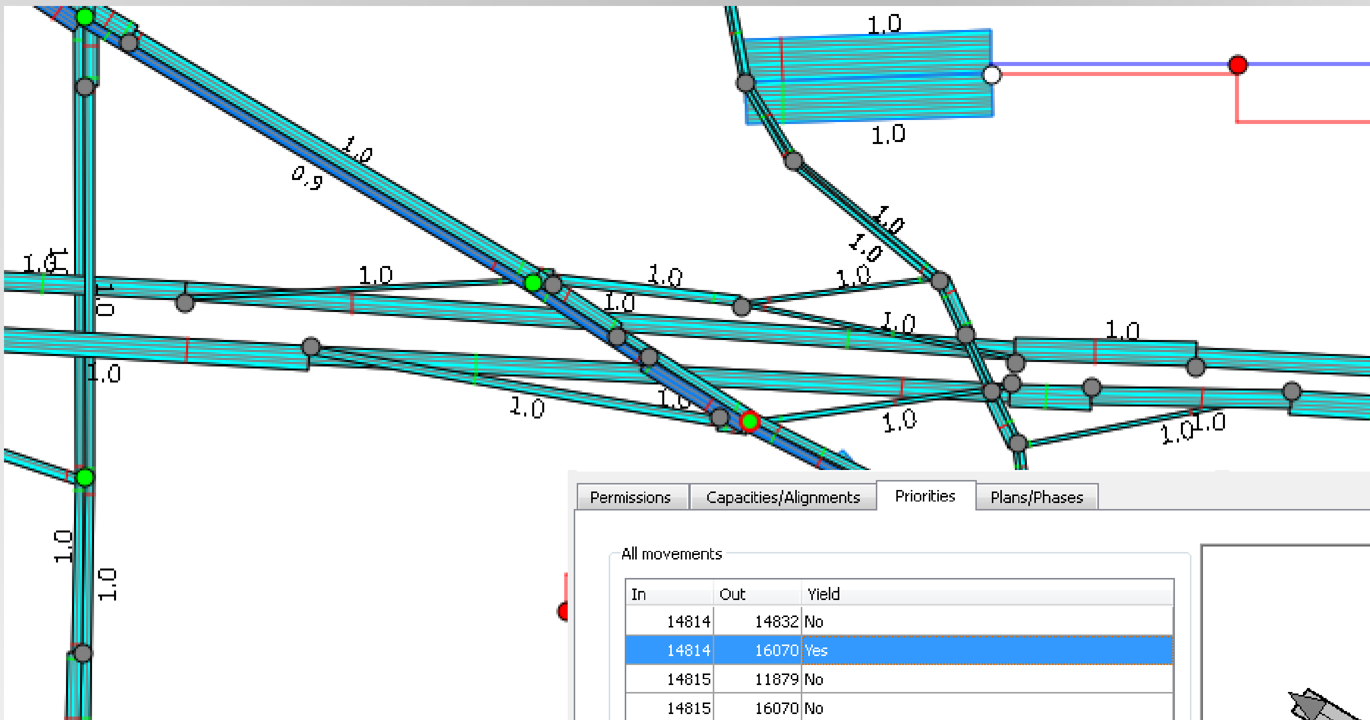
Show prohibited movements

In	Out	Class Group
14814	14832	All
14814	16070	All
14815	11879	All
14815	16070	All
14816	11879	All
14816	14832	All
14814	11879	Prohibited
14815	14832	Prohibited
14816	16070	Prohibited



View options

Prohibited
All
Transit
Default_Transit
Default



Permissions | Capacities/Alignments | Priorities | Plans/Phases

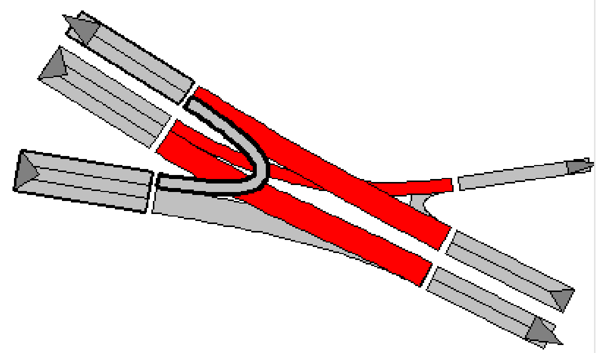
All movements

In	Out	Yield
14814	14832	No
14814	16070	Yes
14815	11879	No
14815	16070	No
14816	11879	No
14816	14832	No

Higher priority movements

Add | Delete

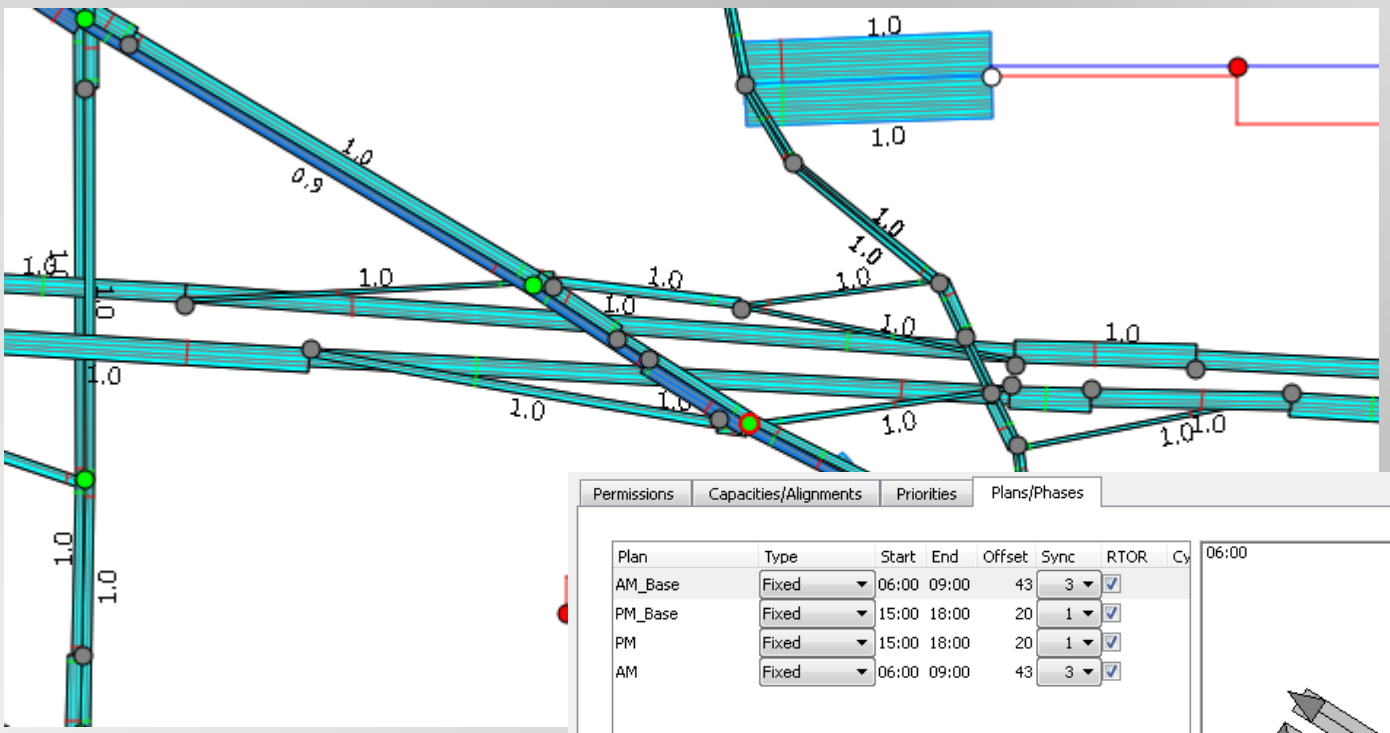
In	Out	Critical Gap	Critical Wait
14816	11879	4.50	60.00
14816	14832	4.50	60.00
14815	16070	6.50	60.00



View options

Higher priority movement

Lower priority movement

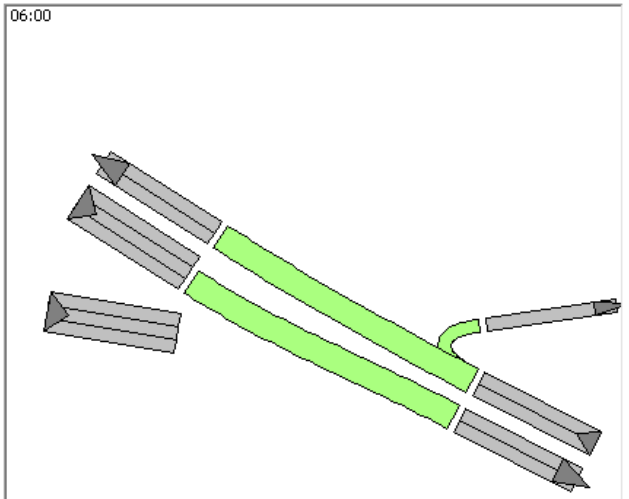


Permissions | Capacities/Alignments | Priorities | Plans/Phases

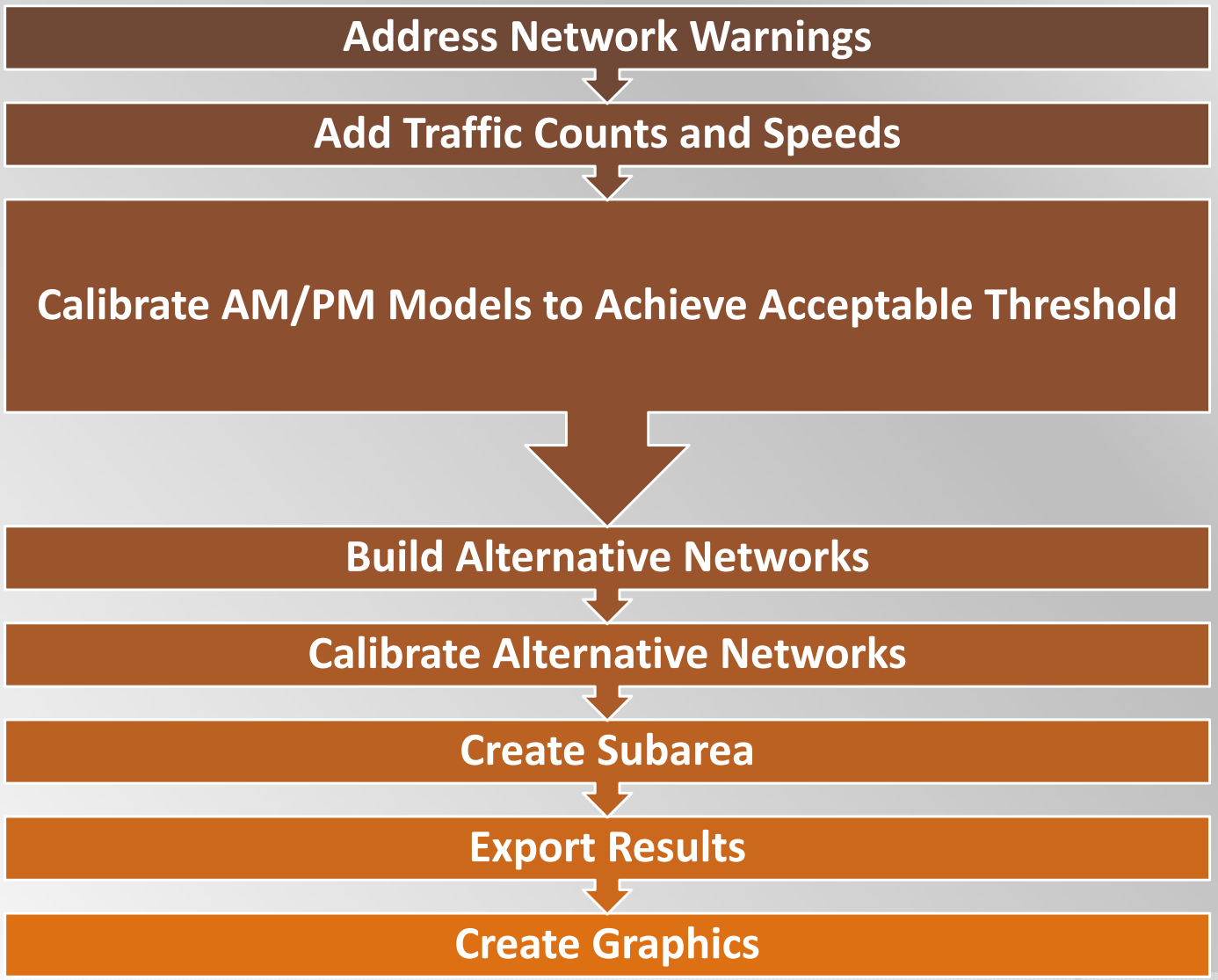
Plan	Type	Start	End	Offset	Sync	RTOR	Cy
AM_Base	Fixed	06:00	09:00	43	3	☑	
PM_Base	Fixed	15:00	18:00	20	1	☑	
PM	Fixed	15:00	18:00	20	1	☑	
AM	Fixed	06:00	09:00	43	3	☑	

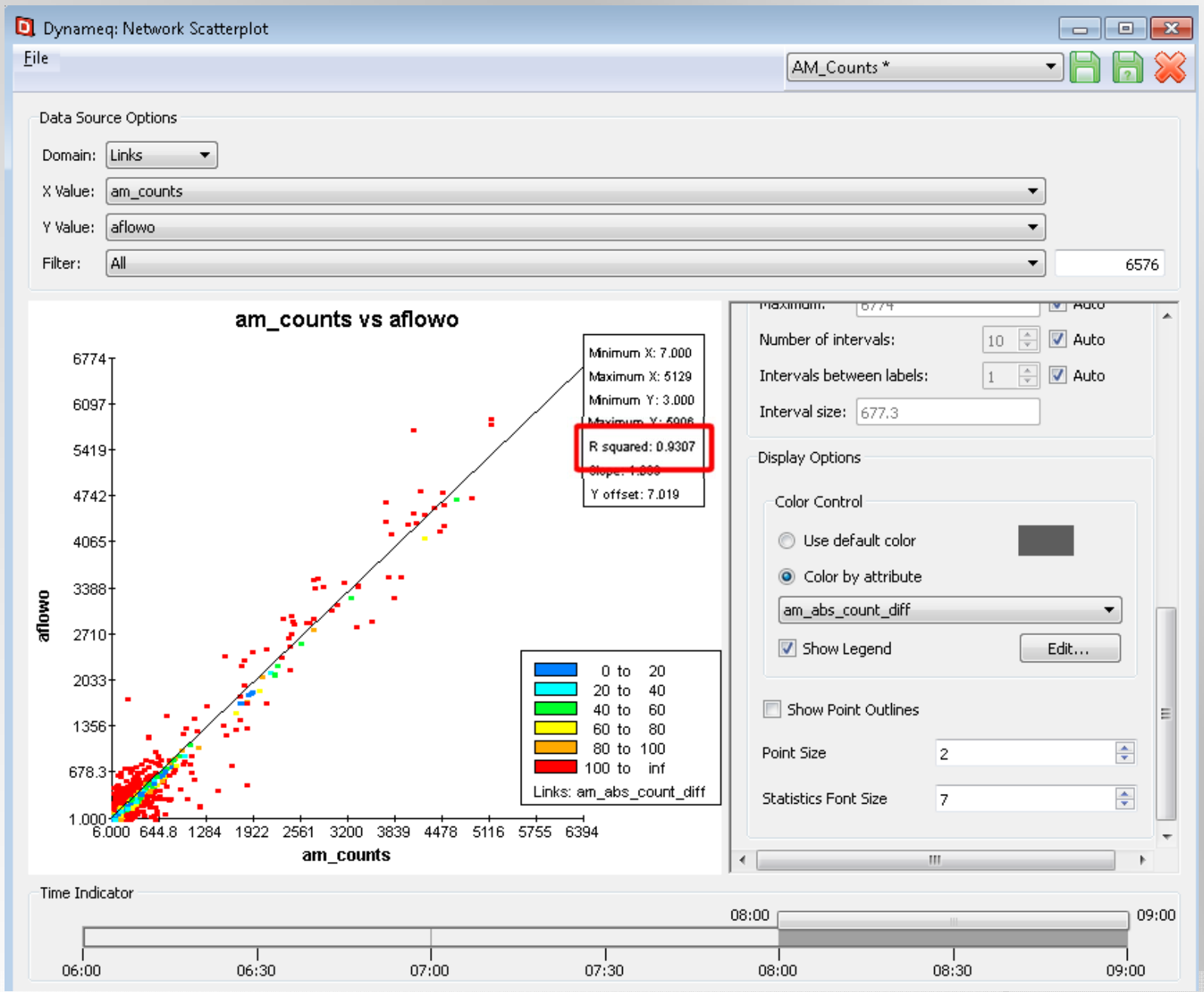
Phases: Add | Delete | Copy | « | »

	1	2	3	4
Green	33.2	7.8	5.2	8.2
Yellow	4.1	3.5	4.1	4.1
All Red	3.7	3.7	3.7	3.7
Type	Standard	Standard	Standard	Standard



Steps Taken once our network was in Dynameq

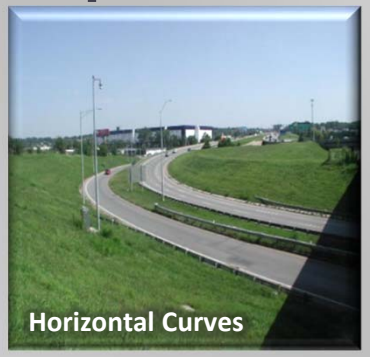



Dynameq: Network Scatterplot
File
AM_Counts *
Data Source Options
Domain: Links
X Value: am_counts
Y Value: aflowo
Filter: All
6576
am_counts vs aflowo
Minimum X: 7.000
Maximum X: 5129
Minimum Y: 3.000
R squared: 0.9307
Y offset: 7.019
aflowo
6774
6097
5419
4742
4065
3388
2710
2033
1356
678.3
1.000
6.000 644.8 1284 1922 2561 3200 3839 4478 5116 5755 6394
am_counts
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to inf
Links: am_abs_count_diff
Number of intervals: 10 Auto
Intervals between labels: 1 Auto
Interval size: 677.3
Display Options
Color Control
Use default color
Color by attribute
am_abs_count_diff
Show Legend
Edit...
Show Point Outlines
Point Size 2
Statistics Font Size 7
Time Indicator
08:00
09:00
06:00
06:30
07:00
07:30
08:00
08:30
09:00

Potential Improvements

Short-Term Action Items

- Mowing
- Maintenance
- Bridge Replacement


Horizontal Curves


Low Clearance Bridge (14’3”)


Short Weave Areas

Rebuild I-70 to last 30 years

Support Lanes and Roads

- Auxiliary Lanes
- Collector Distributor Lanes
- Frontage/Parallel Roads
- Reversible Lanes

Improve Bike and Pedestrian Crossings


Short Merge/Diverge Areas


Bus on Shoulder

Dave Gonzalez, Mn/DOT

Flexible Work Hours

Interchange Options

- Consolidation
- Modification
- Elimination

Add Park and Ride lot

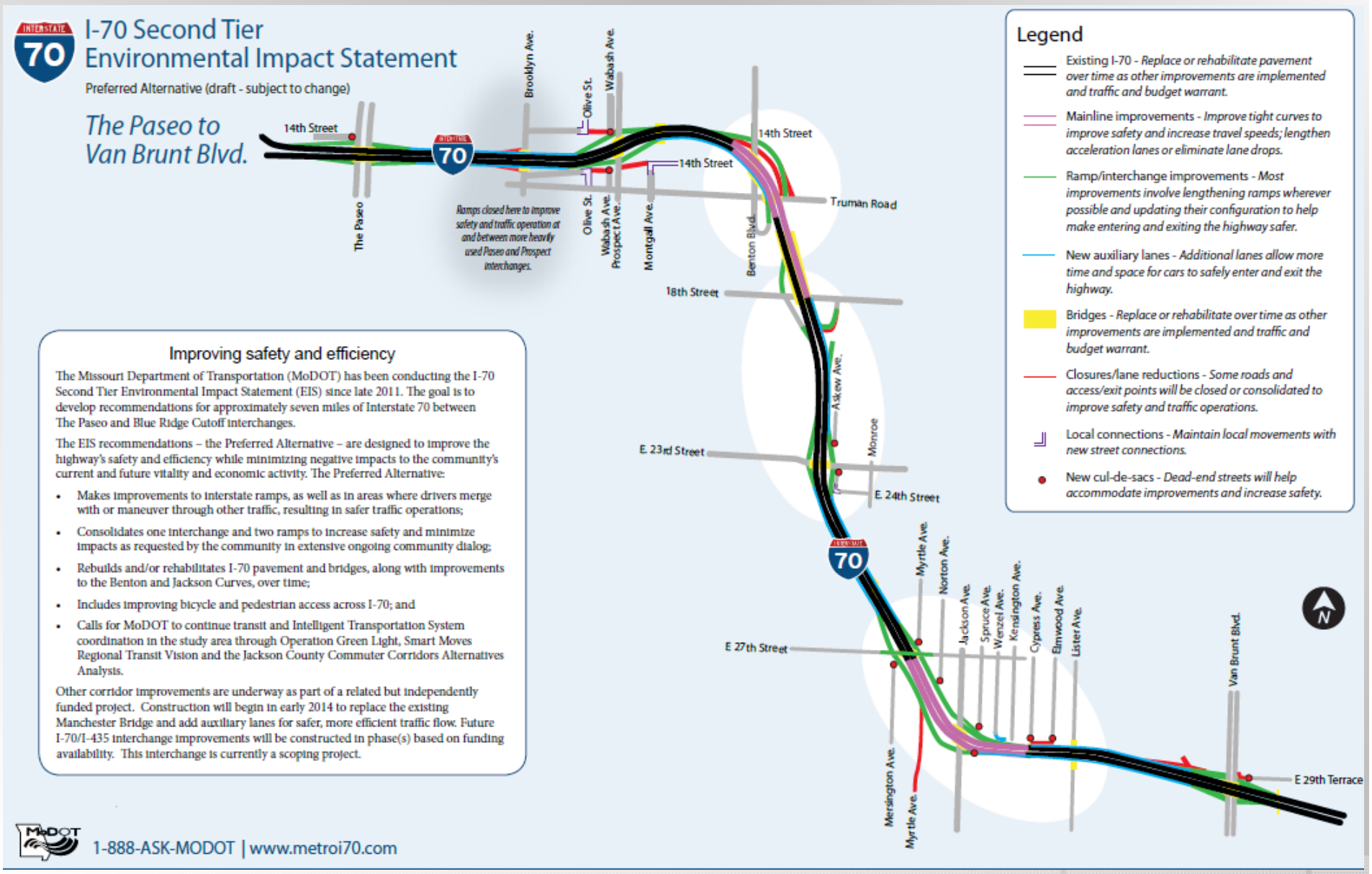
Ramp Metering

Second Tier Alternatives

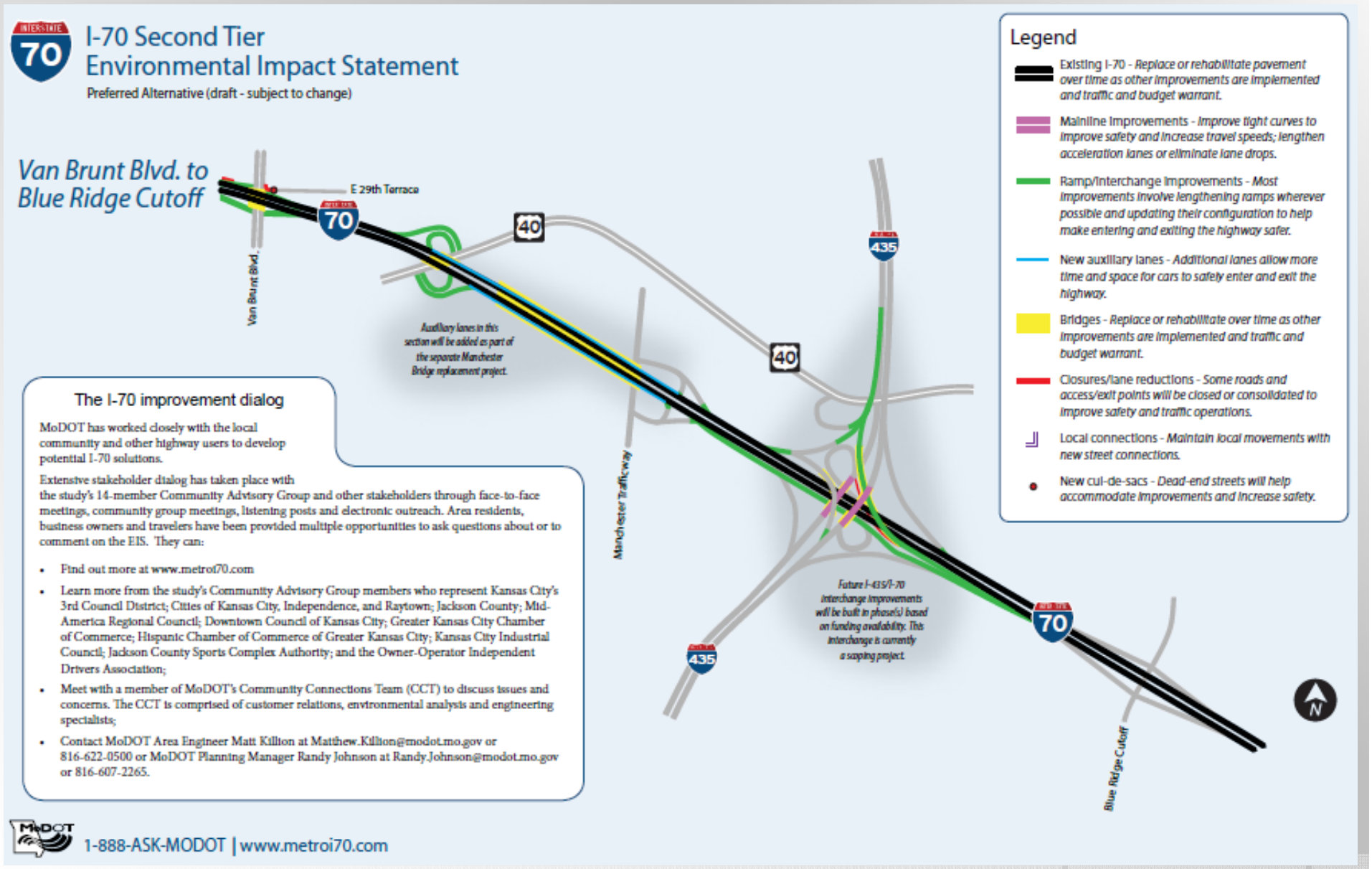
- Three Second Tier Alternatives
  - No-Build Alternative
  - Geometric Improvements Alternative
  - Interchange Consolidations Alternative

- Second Tier Screening
  - Purpose and Need
  - Social and Natural Environmental Issues
  - Engineering Issues
  - Public Comment

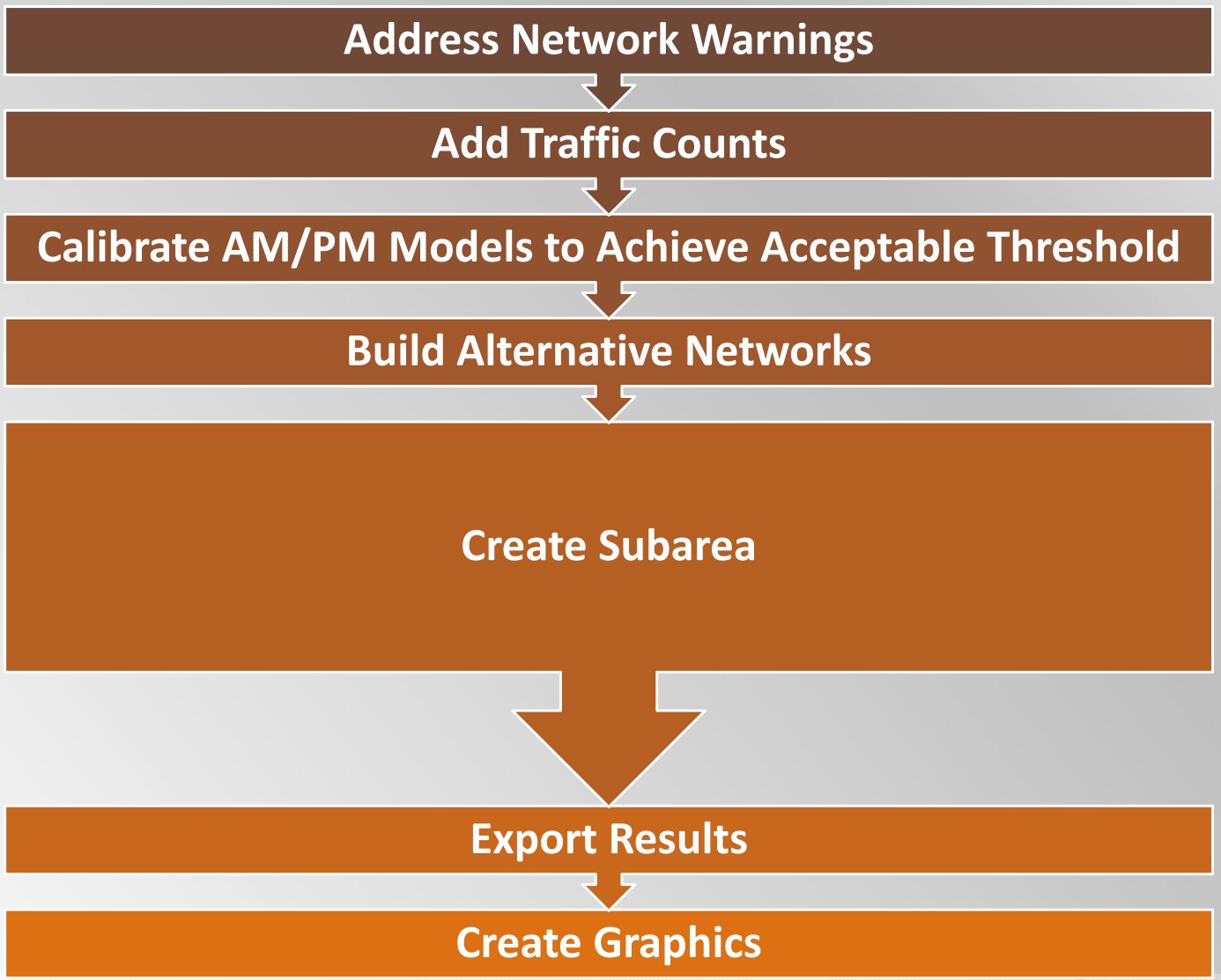
Preferred Alternative

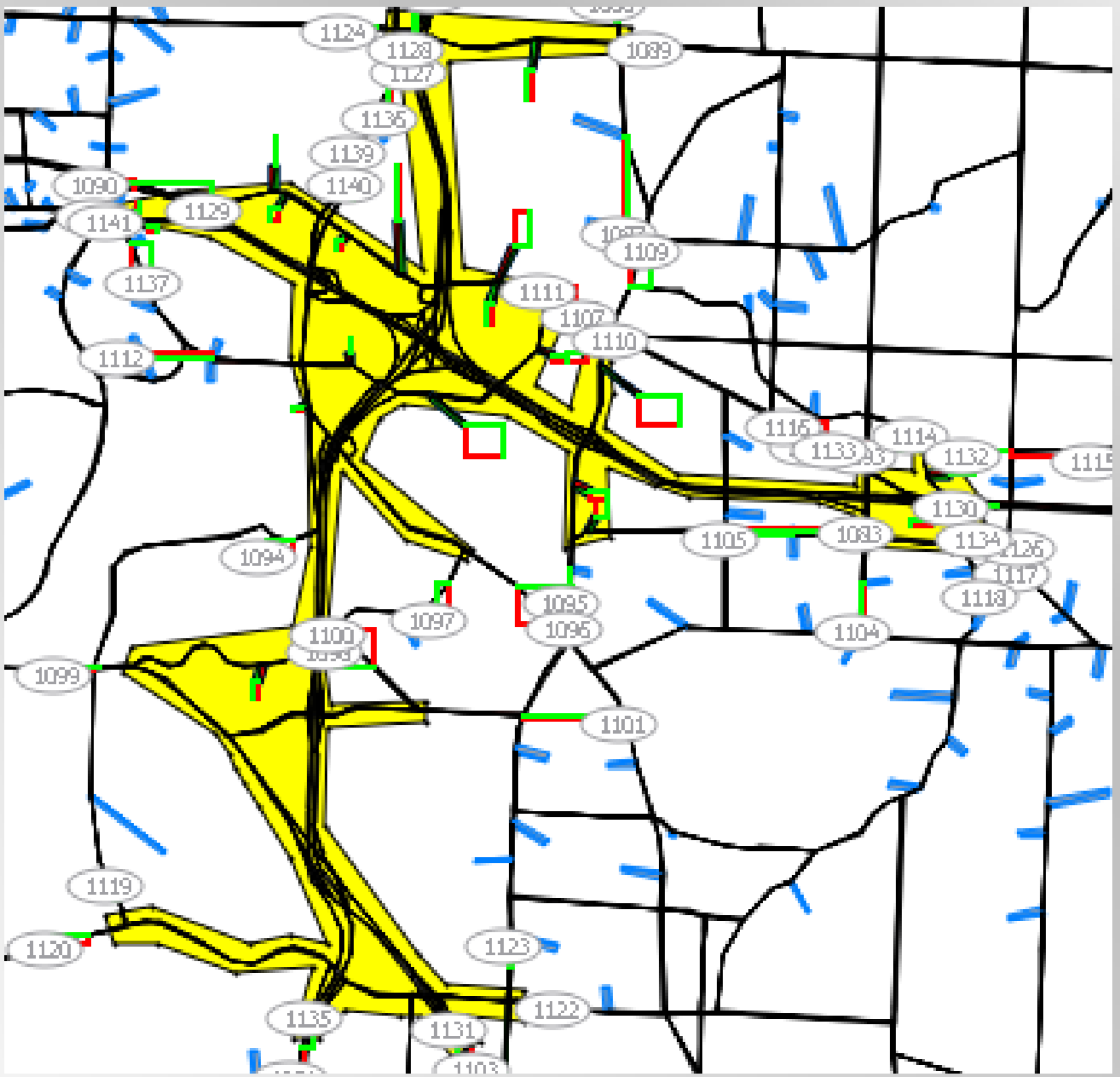


Preferred Alternative



Steps Taken once our network was in Dynameq

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1089
1127
1136
1139
1090
1140
1129
1141
1109
1137
1111
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1110
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1114
1133
1132
1115
1130
1105
1083
1134
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1100
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1101
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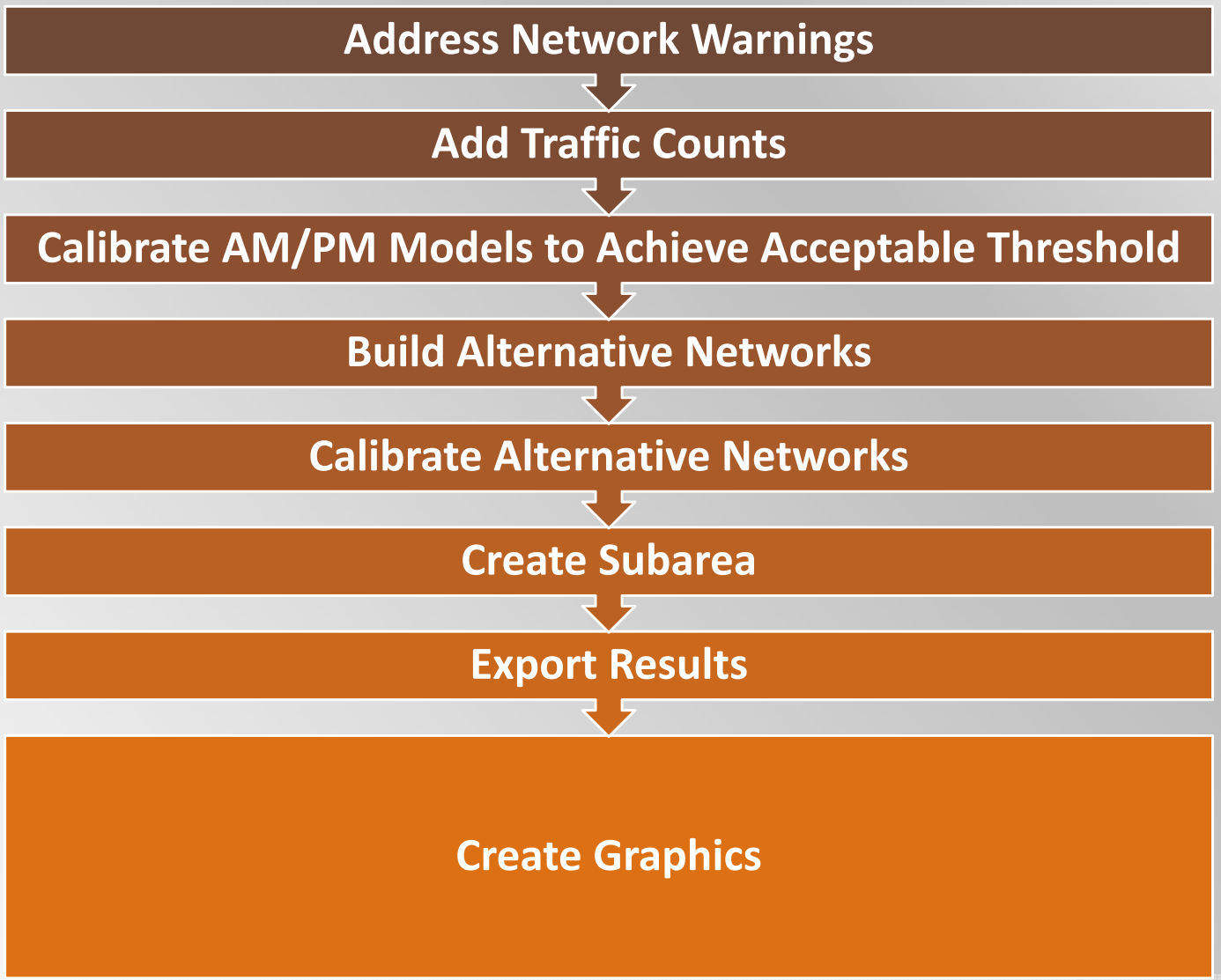
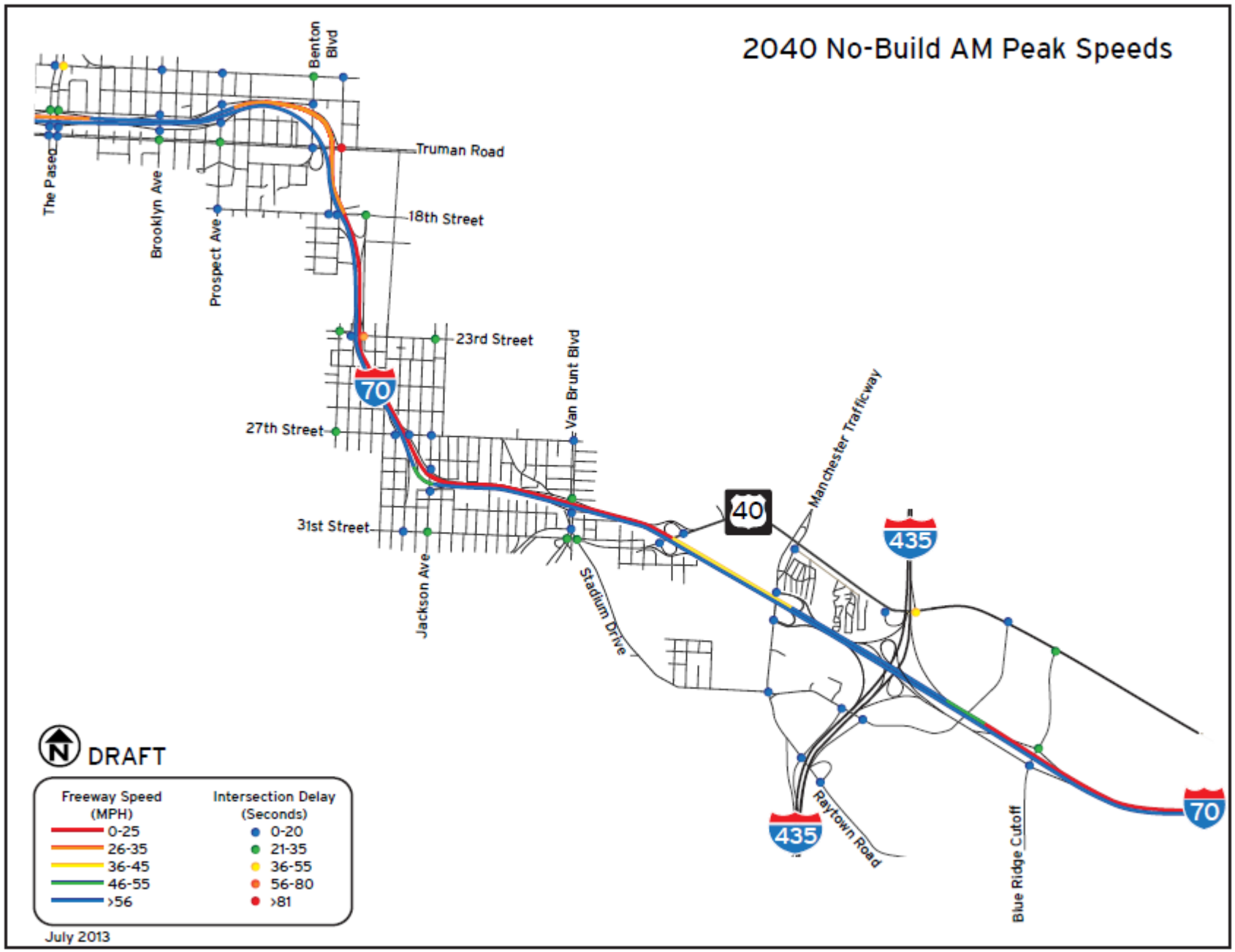
1120
1123
1135
1131
1122

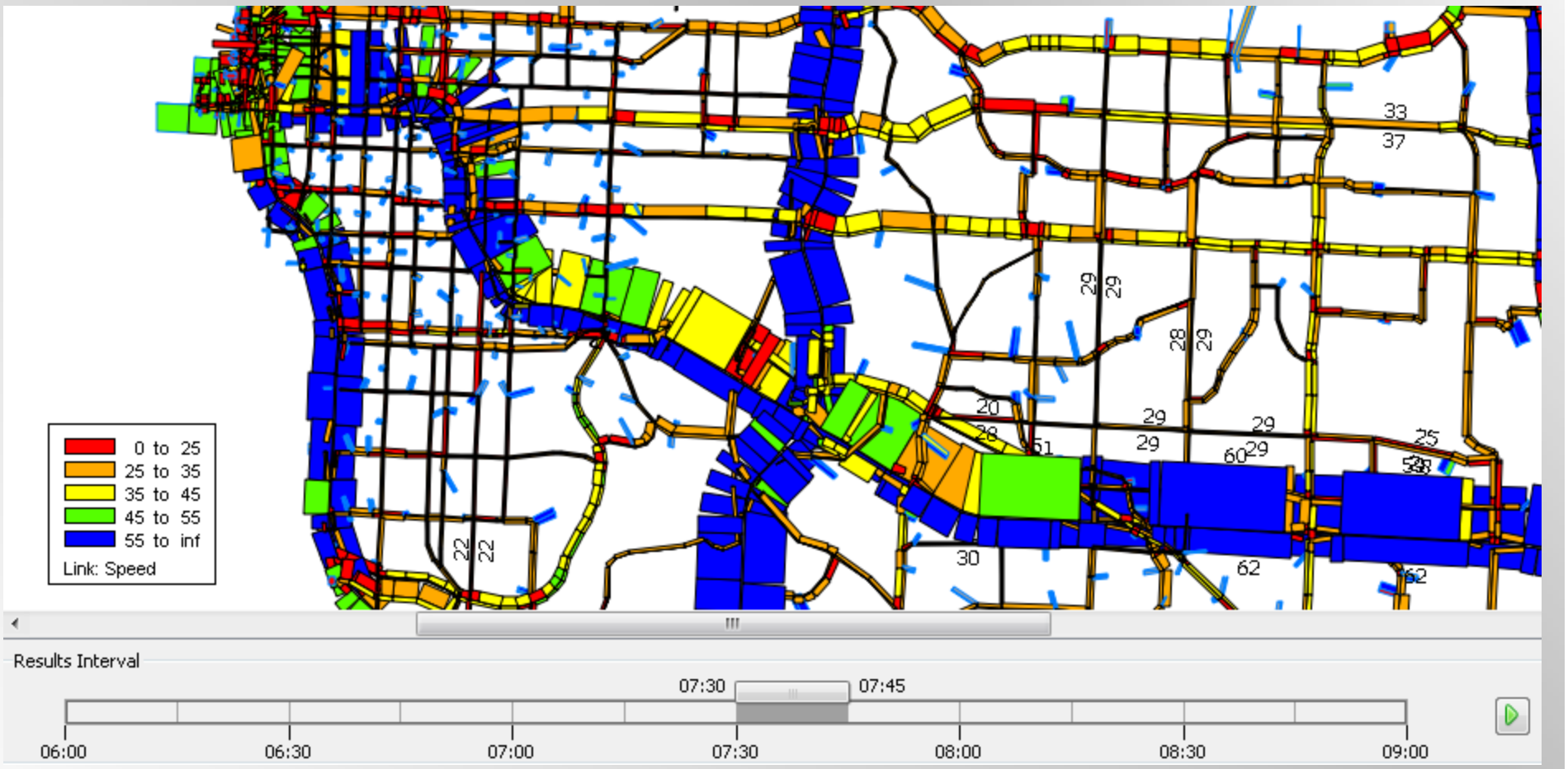
Steps Taken once our network was in Dynameq

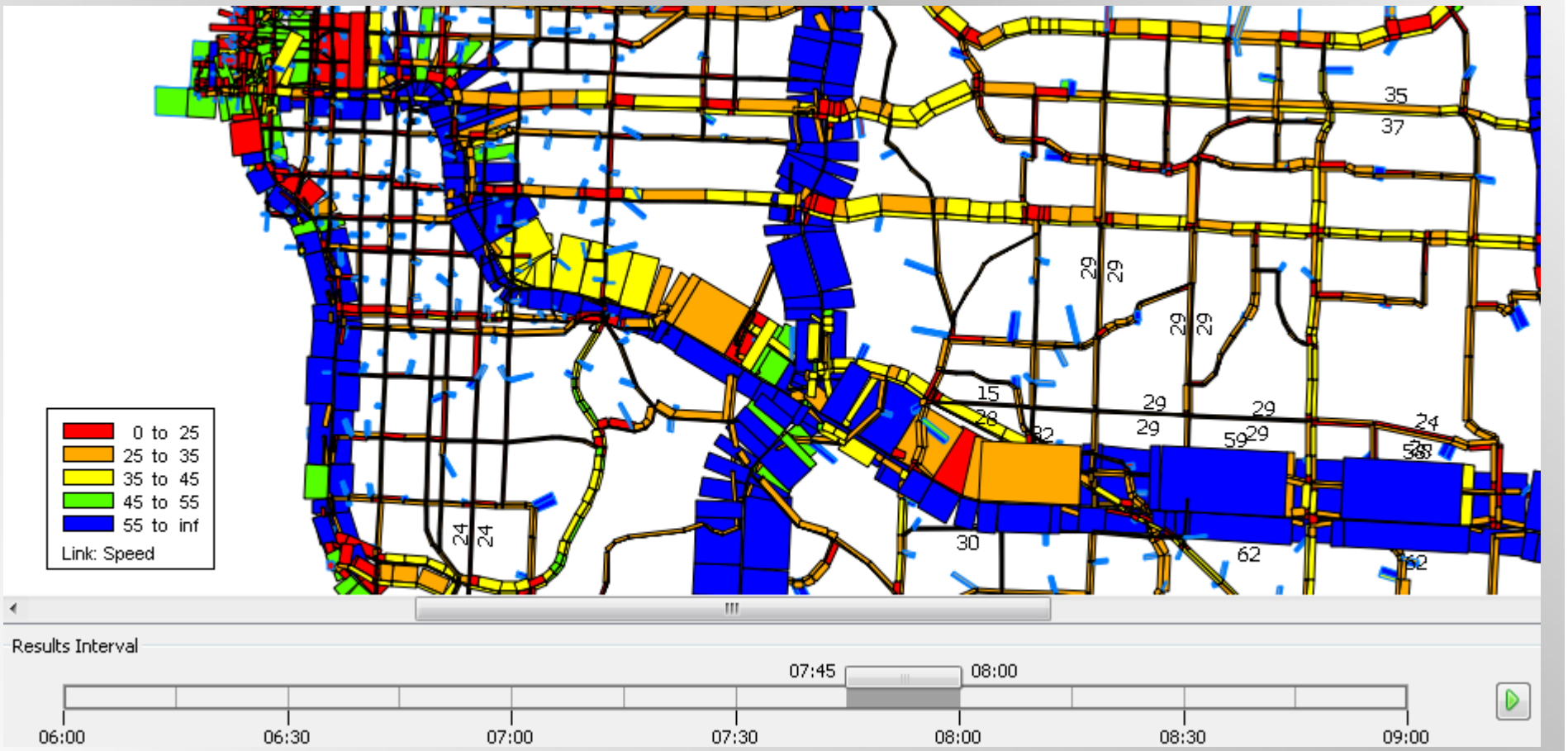



2040 No-Build AM Peak Speeds
Benton Blvd
Truman Road
The Paseo
Brooklyn Ave
Prospect Ave
18th Street
23rd Street
70
27th Street
Van Brunt Blvd
Manchester Trafficway
40
435
31st Street
Jackson Ave
Stadium Drive
435
Raytown Road
Blue Ridge Cutoff
70
DRAFT
Freeway Speed (MPH)
0-25
26-35
36-45
46-55
>56
Intersection Delay (Seconds)
0-20
21-35
36-55
56-80
>81
July 2013

Features We Liked

- **Network Warnings**
- **Scatterplot for R-Square**
- **Time Slide Bar**
- Graphical Capabilities Make Calibration Easy
- DTA
  - Creating user defined attributes → Displaying them in simulation results
  - Filters
  - Creating Select Links
- Creating Subareas → Exporting results


0 to 25
25 to 35
35 to 45
45 to 55
55 to inf
Link: Speed
Results Interval
07:30
07:45
06:00
06:30
07:00
07:30
08:00
08:30
09:00


0 to 25
25 to 35
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55 to inf
Link: Speed
Results Interval
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08:00
06:00
06:30
07:00
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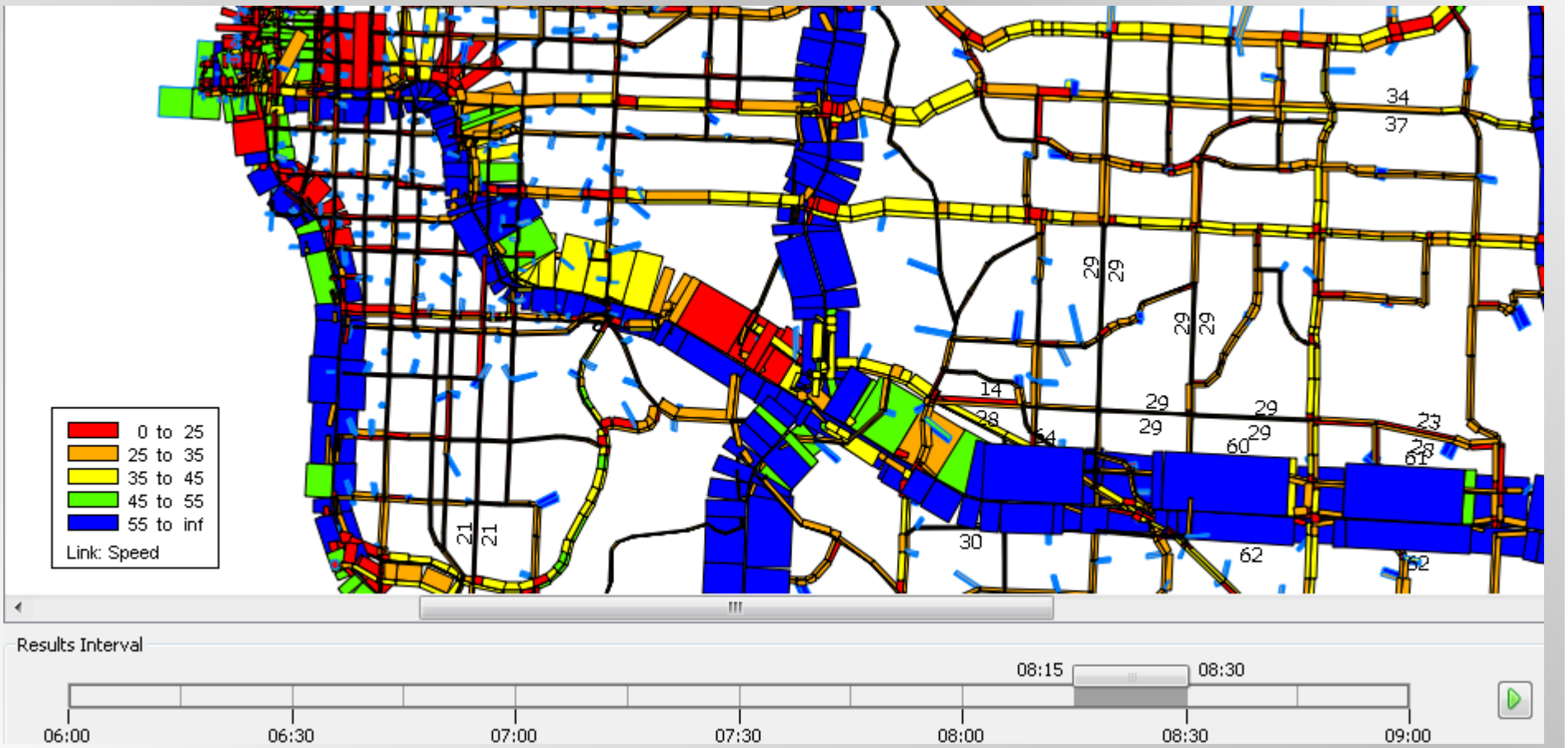
09:00


0 to 25
25 to 35
35 to 45
45 to 55
55 to inf
Link: Speed
Results Interval
08:15
08:30
06:00
06:30
07:00
07:30
08:00
08:30
09:00

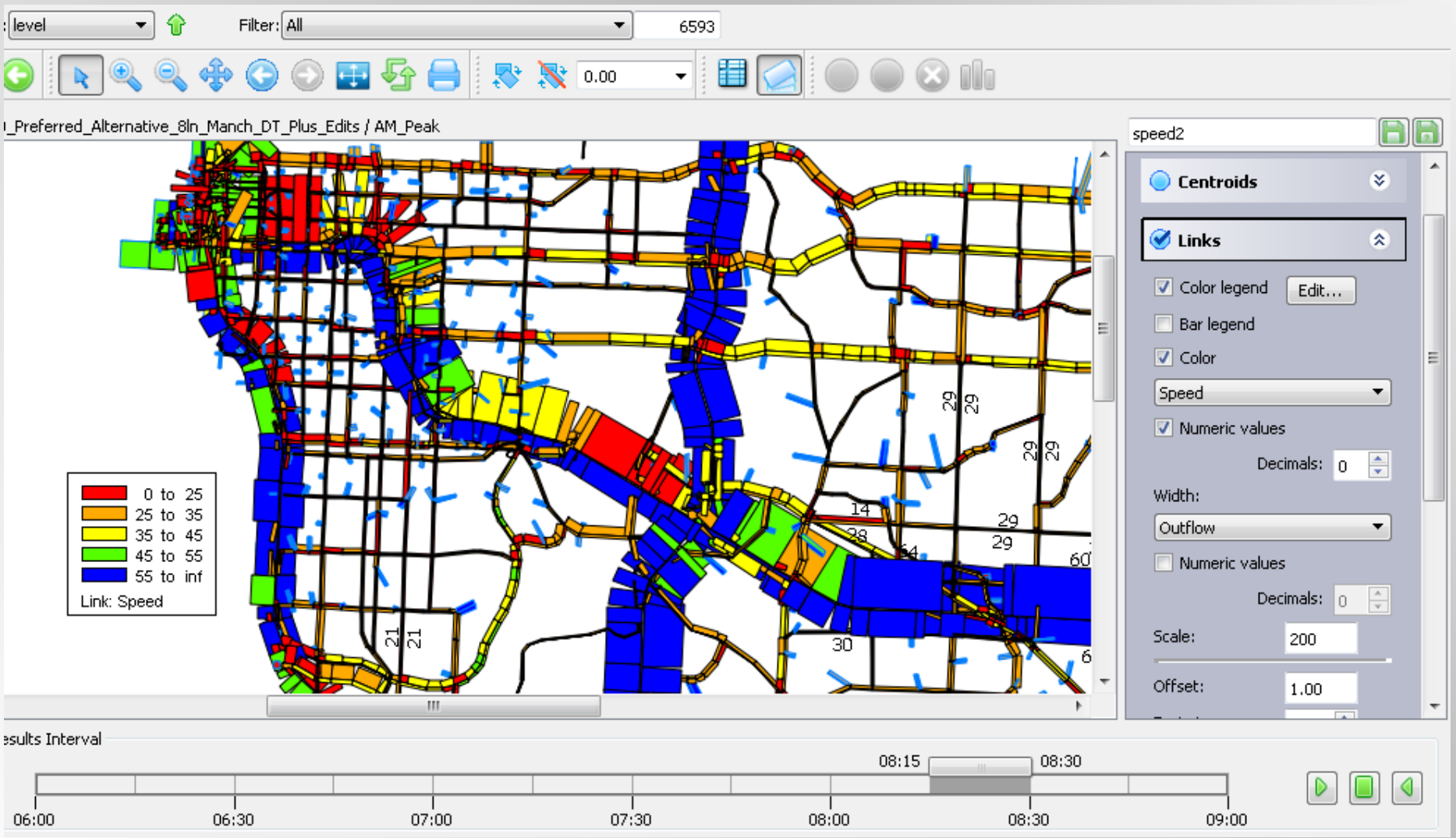
Features We Liked

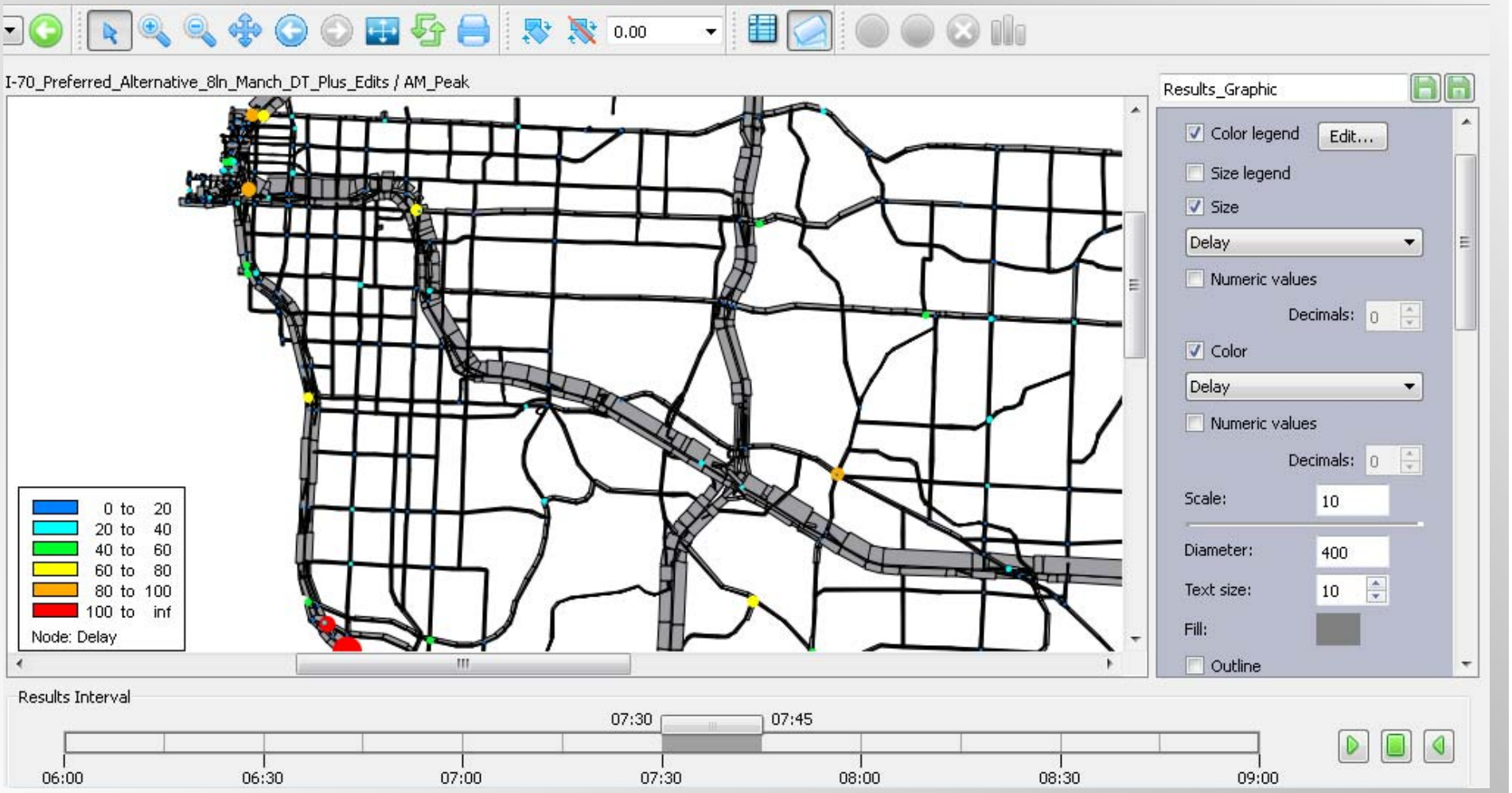
- Network Warnings
- Scatterplot for R-Square
- Time Slide Bar
- **Graphical Capabilities Make Calibration Easy**
- DTA

  Creating user defined attributes → Displaying them in simulation results

  Filters

  Creating Select Links
- Creating Subareas → Exporting results


level
Filter: All
6593
0.00
_Preferred_Alternative_8ln_Manch_DT_Plus_Edits / AM_Peak
0 to 25
25 to 35
35 to 45
45 to 55
55 to inf
Link: Speed
speed2
Centroids
Links
Color legend
Edit...
Bar legend
Color
Speed
Numeric values
Decimals: 0
Width:
Outflow
Numeric values
Decimals: 0
Scale: 200
Offset: 1.00
esults Interval
08:15
08:30
06:00
06:30
07:00
07:30
08:00
08:30
09:00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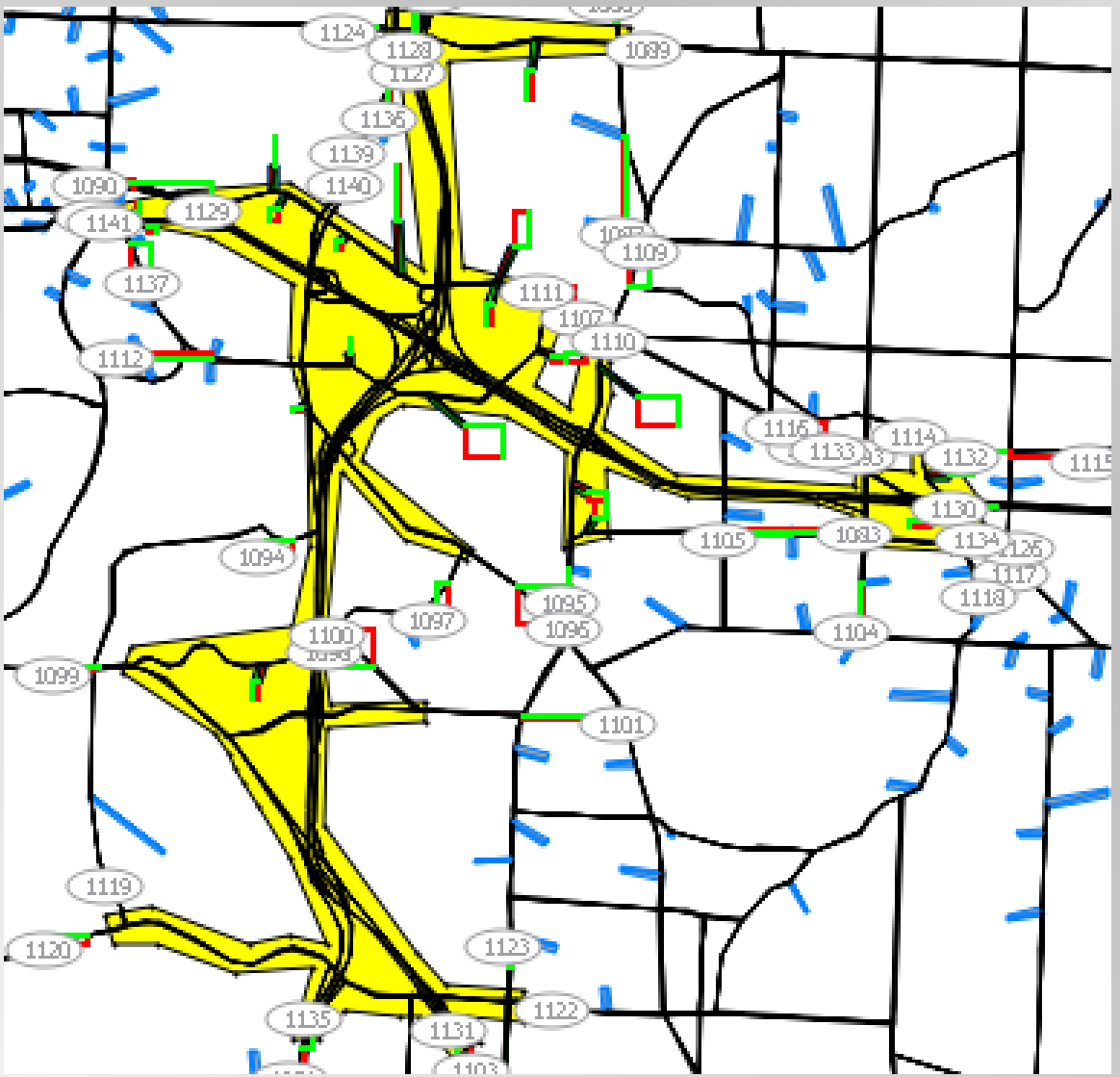
I-70_Preferred_Alternative_8ln_Manch_DT_Plus_Edits / AM_Peak
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to inf
Node: Delay
Results_Graphic
Color legend
Edit...
Size legend
Size
Delay
Numeric values
Decimals: 0
Color
Delay
Numeric values
Decimals: 0
Scale: 10
Diameter: 400
Text size: 10
Fill:
Outline
Results Interval
07:30
07:45
06:00
06:30
07:00
07:30
08:00
08:30
09:00

Features We Liked

- Network Warnings When Loading a Project
- Scatterplot for R-Square
- Time Slide Bar
- Graphical Capabilities Make Calibration Easy
- **DTA**
  - **Creating user defined attributes → Displaying them in simulation results**
  - **Filters**
  - **Creating Select Links**
- **Creating Subareas → Exporting results**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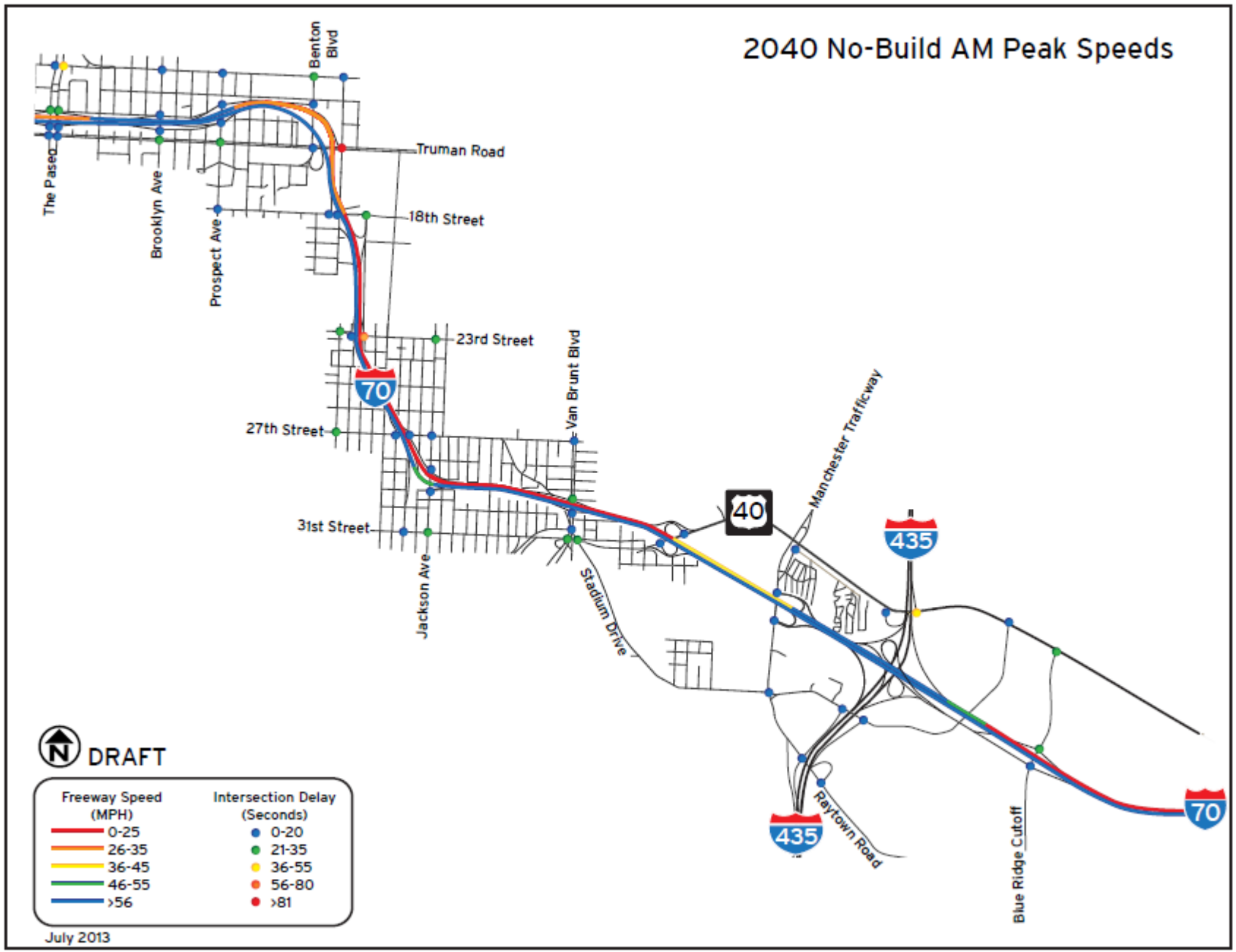
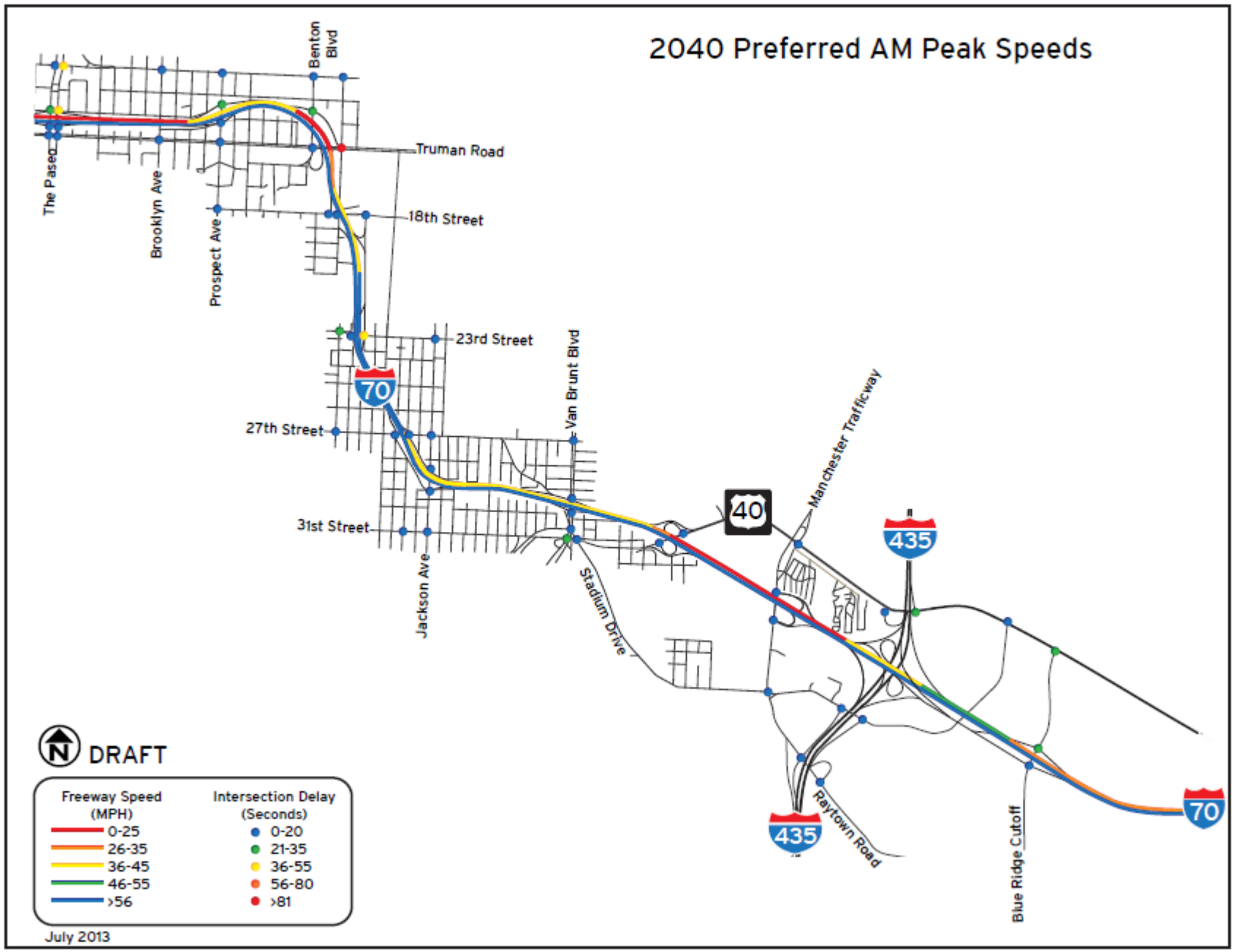

2040 No-Build AM Peak Speeds
Benton Blvd
Truman Road
The Paseo
Brooklyn Ave
Prospect Ave
18th Street
23rd Street
70
27th Street
Van Brunt Blvd
Manchester Trafficway
40
435
31st Street
Jackson Ave
Stadium Drive
435
Raytown Road
Blue Ridge Cutoff
70
DRAFT
Freeway Speed (MPH)
0-25
26-35
36-45
46-55
>56
Intersection Delay (Seconds)
0-20
21-35
36-55
56-80
>81
July 2013


2040 Preferred AM Peak Speeds
Benton Blvd
Truman Road
18th Street
23rd Street
27th Street
31st Street
The Paseo
Brooklyn Ave
Prospect Ave
Jackson Ave
Van Brunt Blvd
Stadium Drive
Manchester Trafficway
Raytown Road
Blue Ridge Cutoff
70
40
435
435
70
DRAFT
Freeway Speed (MPH)
0-25
26-35
36-45
46-55
>56
Intersection Delay (Seconds)
0-20
21-35
36-55
56-80
>81
July 2013

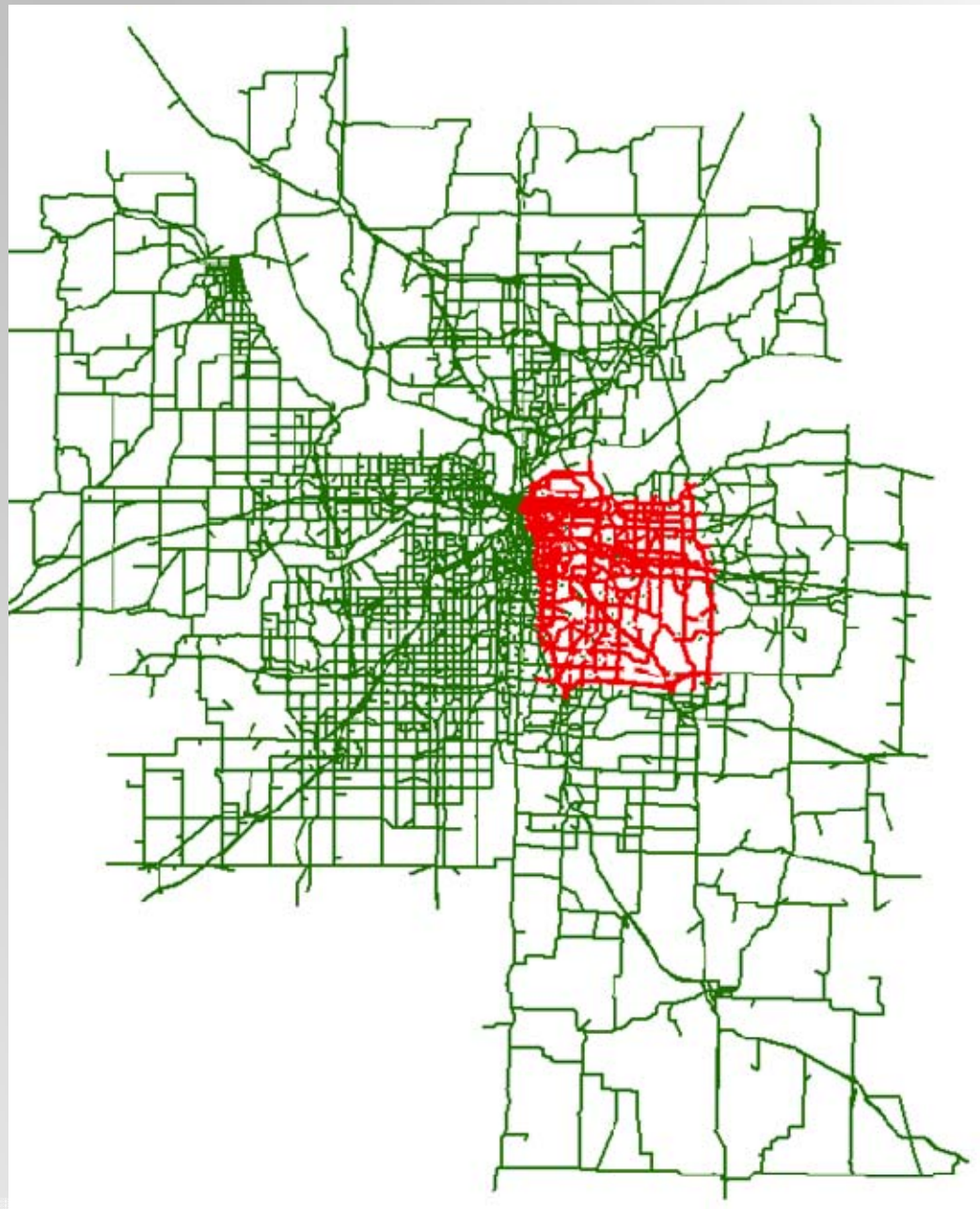
Deliverable

		Existing (2012)	No-Build (2040)	Improve Geometrics (2040)	Interchange Consolidation (2040)	Preferred (2040)
AM Peak / Westbound	Vehicle Miles Traveled	442,887.89	549,038.60	554,409.45	554,373.83	555,511.82
	Vehicle Hours Traveled	10,650.77	15,623.16	15,834.69	15,849.85	15,025.01
	Vehicle Hours of Delay	1,788.45	4,342.64	4,477.04	4,375.54	3,732.77
	Average Speed (MPH)	41.58	35.14	35.01	34.98	36.97
PM Peak / Eastbound	Vehicle Miles Traveled	482,803.52	615,721.30	616,211.00	621,499.91	619,783.86
	Vehicle Hours Traveled	12,113.33	17,878.10	18,057.09	17,912.19	17,937.81
	Vehicle Hours of Delay	2,187.52	5,078.87	5,258.78	4,900.66	5,047.88
	Average Speed (MPH)	39.86	34.44	34.13	34.70	34.55

Conclusions about Dynameq

- Strengths of the program
  - Graphics
  - Time Dimension
- Challenges
  - Editing network
  - Detailed operations (e.g. merging/weaving)
  - Subarea extraction could be improved
- Opportunities
  - Maintenance of Traffic Analysis
  - Expand model to regional level?

Future Steps



Thank You. Questions?

HNTB Corporation

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