THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

ArcGIS Tools for Subnetwork Analysis of Dynamic Traffic Assignment

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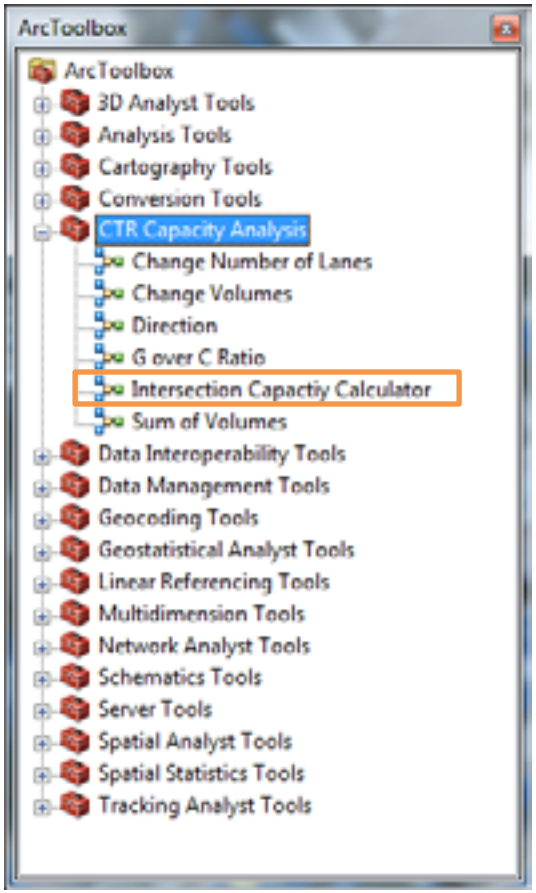
ArcGIS Transportation Modeling

- Transportation models aim to predict how people use the transportation system
- Network and traffic models simulate how vehicles use roadways
- Impacts of proposed alterations to the network can be estimated
- New models are more complex and need a method to simplify the problem

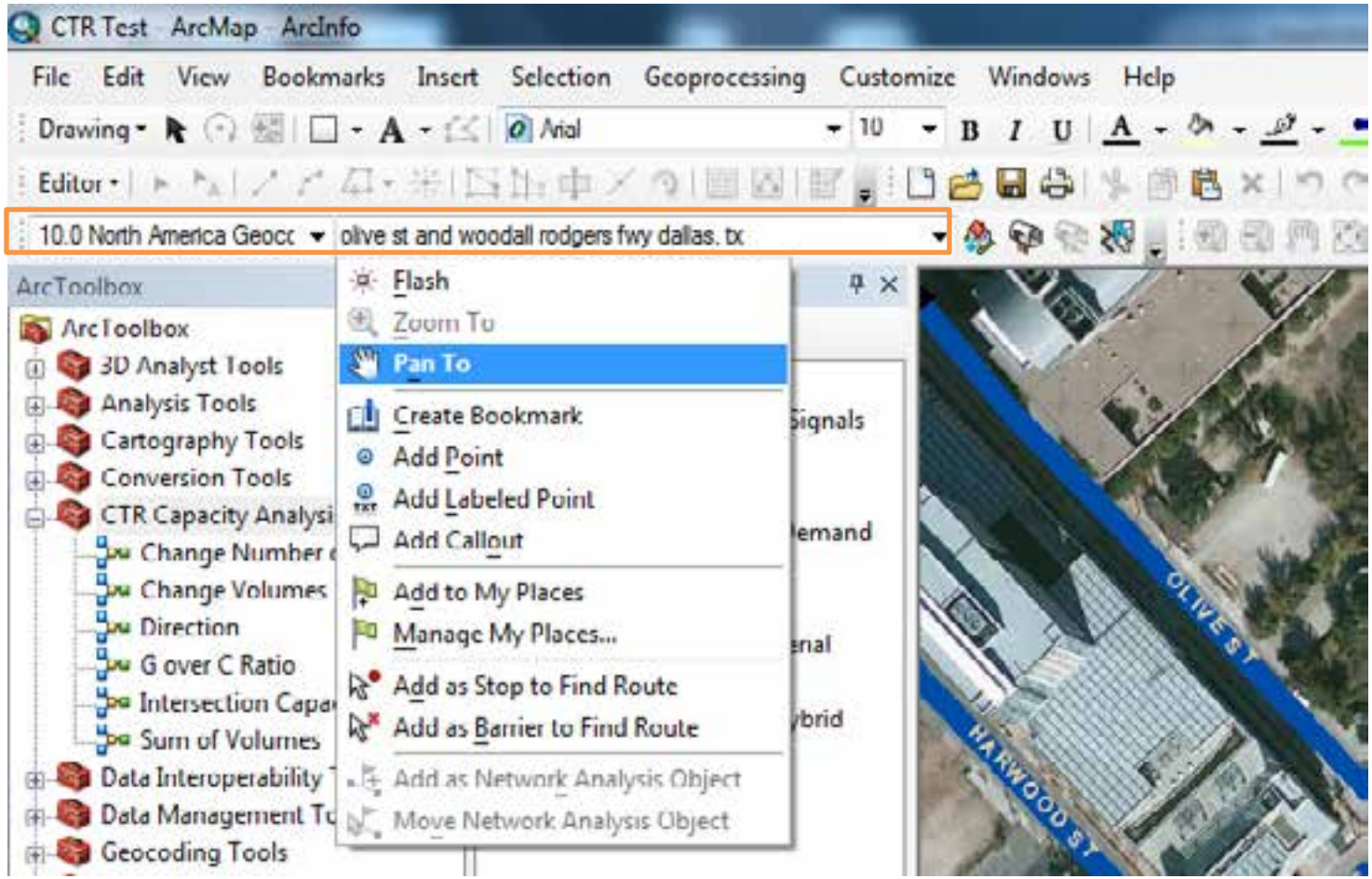
Transportation Network Analysis

Modelbuilder

- We built a tool inside ArcGIS using Modelbuilder
- Designed as a sketch planning tool to investigate static traffic assignment results
- Calculates intersection capacity



Geocoding


CTR Test - ArcMap - ArcInfo
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Cartography Tools
Conversion Tools
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Change Number
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Direction
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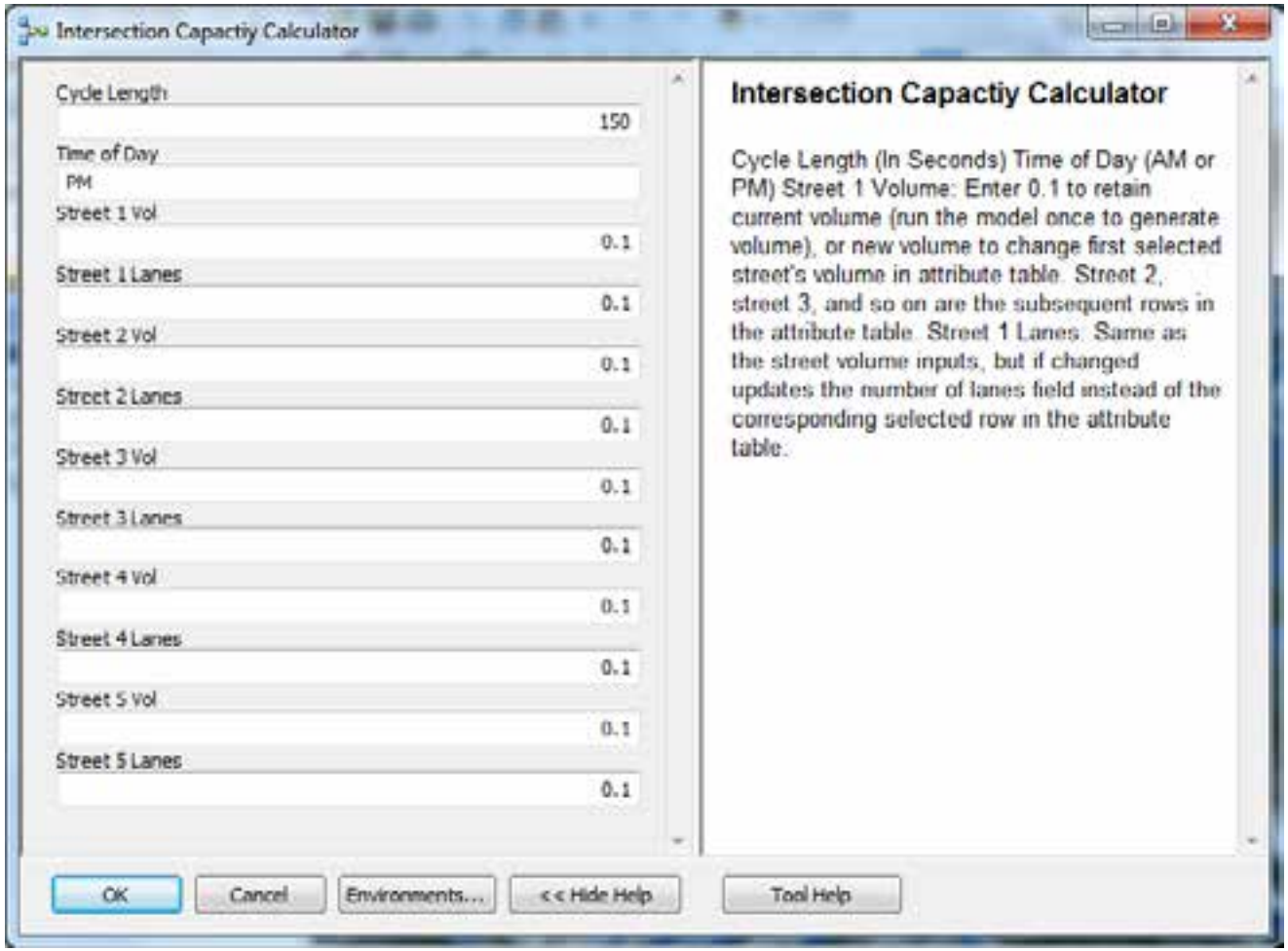
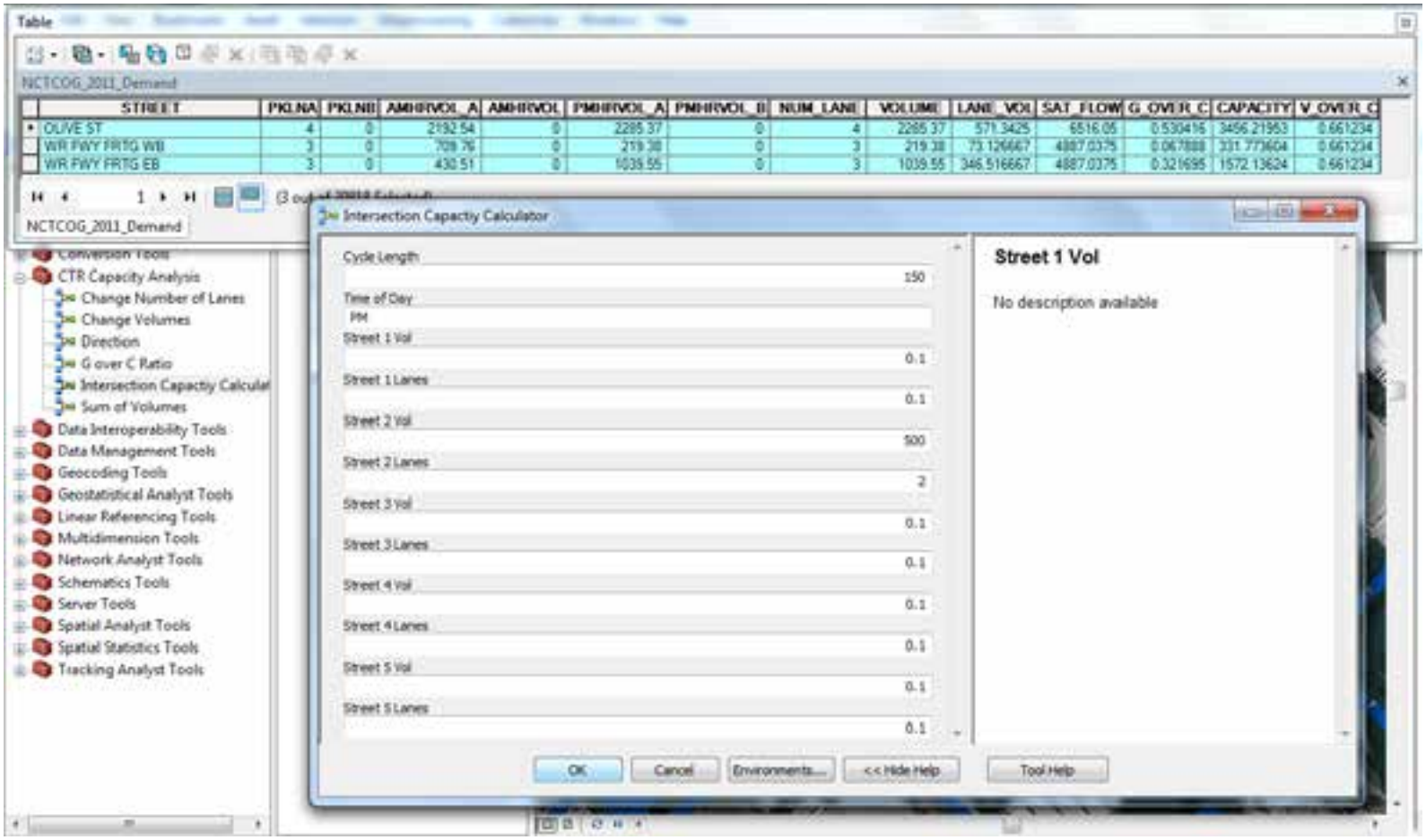
Intersection Capa
Sum of Volumes
Data Interoperability
Data Management To
Geocoding Tools
Flash
Zoom To
Pan To
Create Bookmark
Add Point
Add Labeled Point
Add Callout
Add to My Places
Manage My Places...
Add as Stop to Find Route
Add as Barrier to Find Route
Add as Network Analysis Object
Move Network Analysis Object
OLIVE ST
HARWOOD ST

Tool Interface



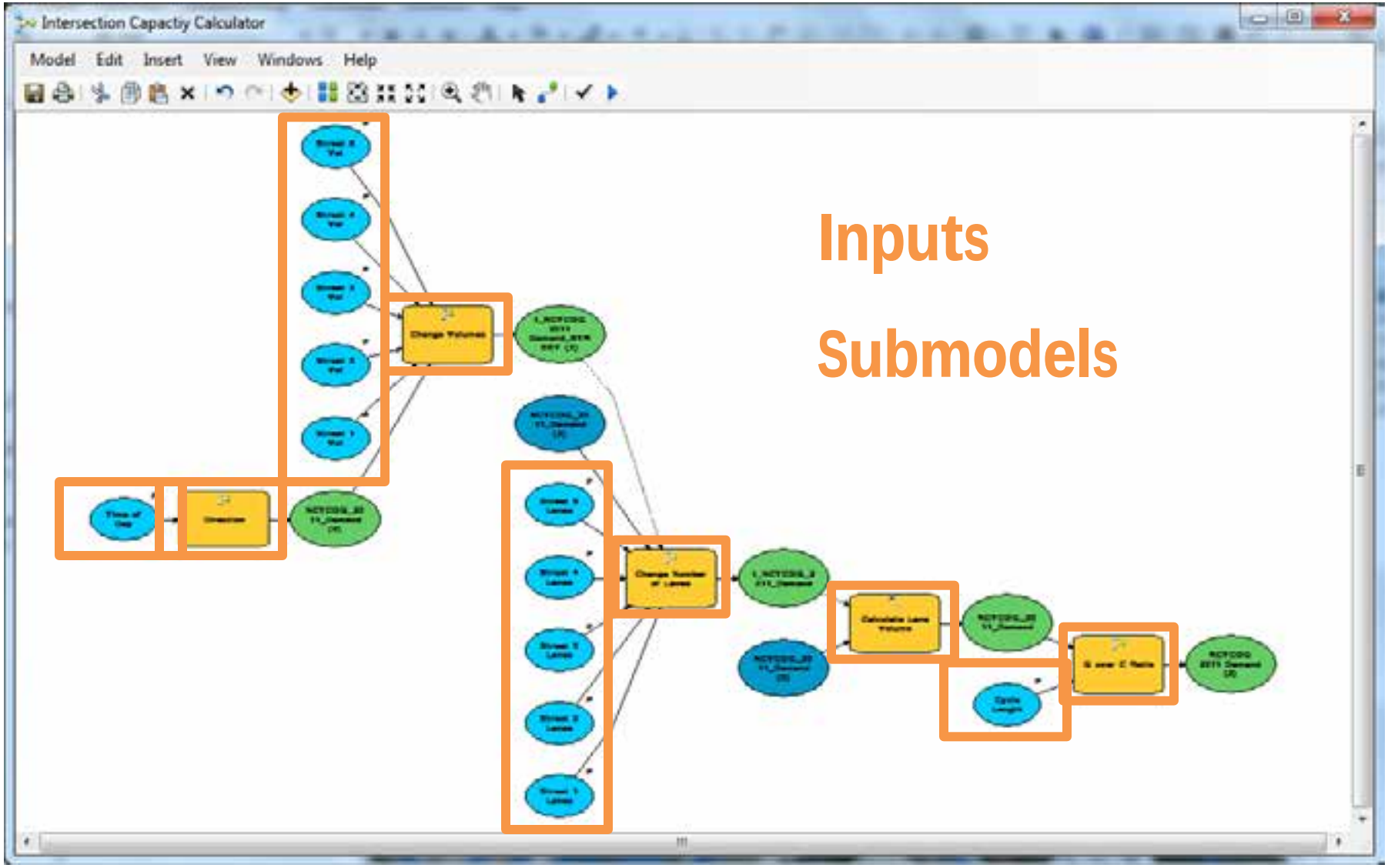
Network Database



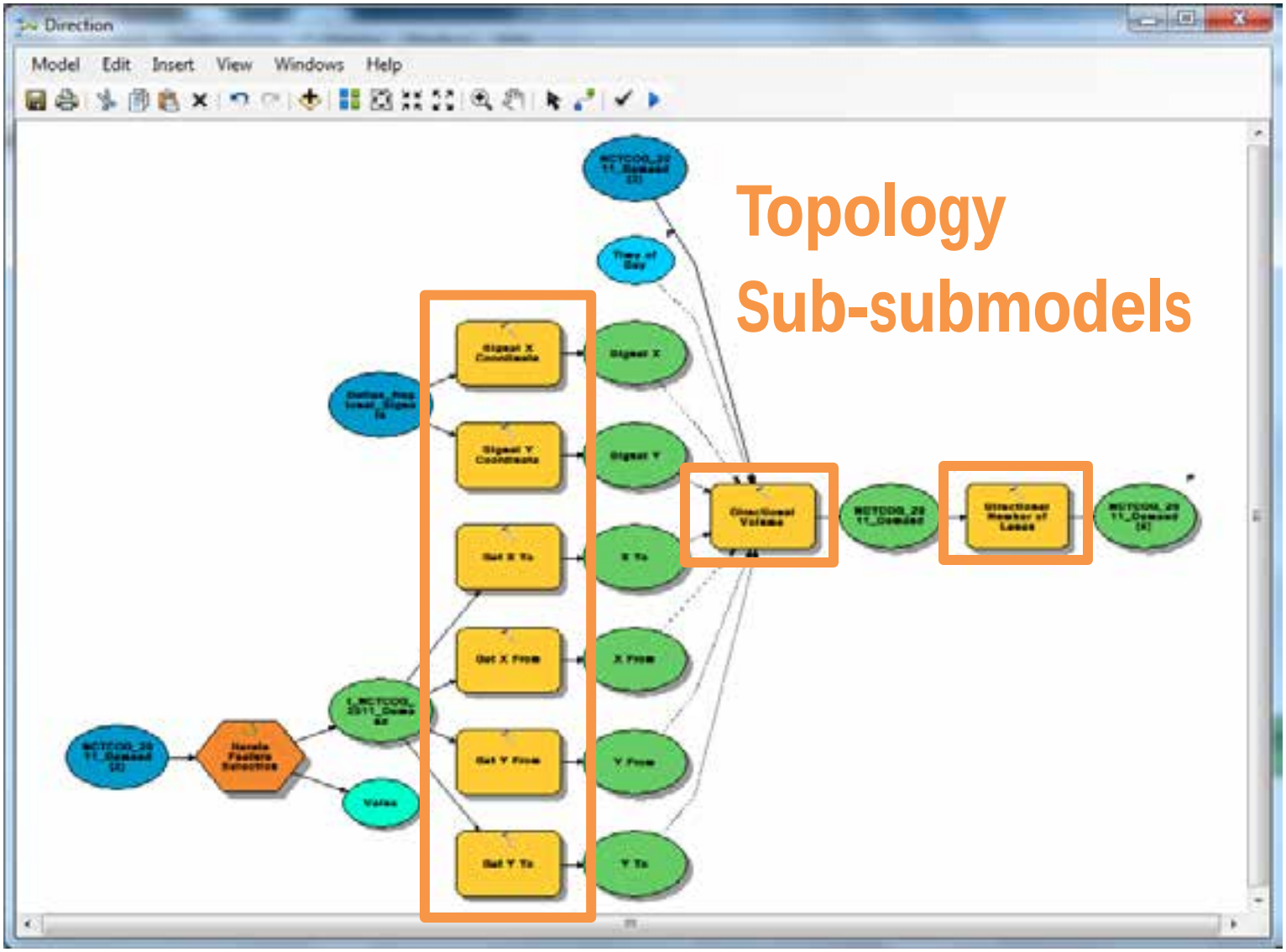
Model Structure

- Submodels built into a main model are called to:
  - Extract the appropriate data from the database
  - Update attributes for the network modification
  - Carry out calculations on the data
- Equations based on the Highway Capacity Manual (traffic engineering guidebook)

Main Model


Intersection Capacity Calculator
Model
Edit
Insert
View
Windows
Help
Inputs
Submodels

Submodel for Data Inputs



Data Extraction using Python

Directional Volume

Input Table

NCTCOG_2011_Demand (3)

Field Name

VOLUME

Expression

volume(%Signal X%, %Signal Y%, %X To%, %Y To%, %X From%, %Y From%, '%Time of Day%', !AMHRVOL_AB! , !AMHRVOL_BA!, !PMHRVOL_AB!, !PMHRVOL_BA!)

Expression Type (optional)

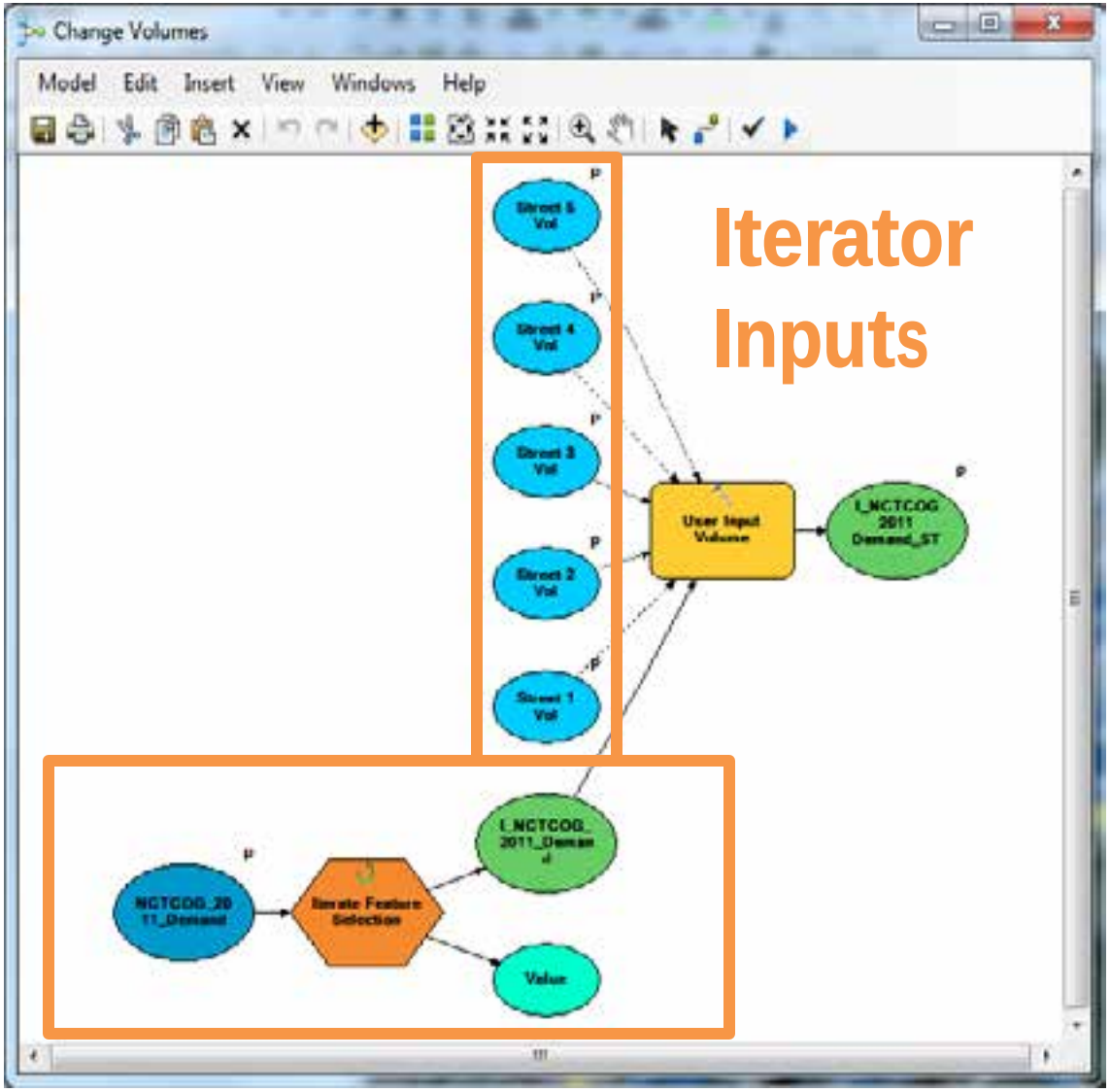
PYTHON_9.3

Code Block (optional)

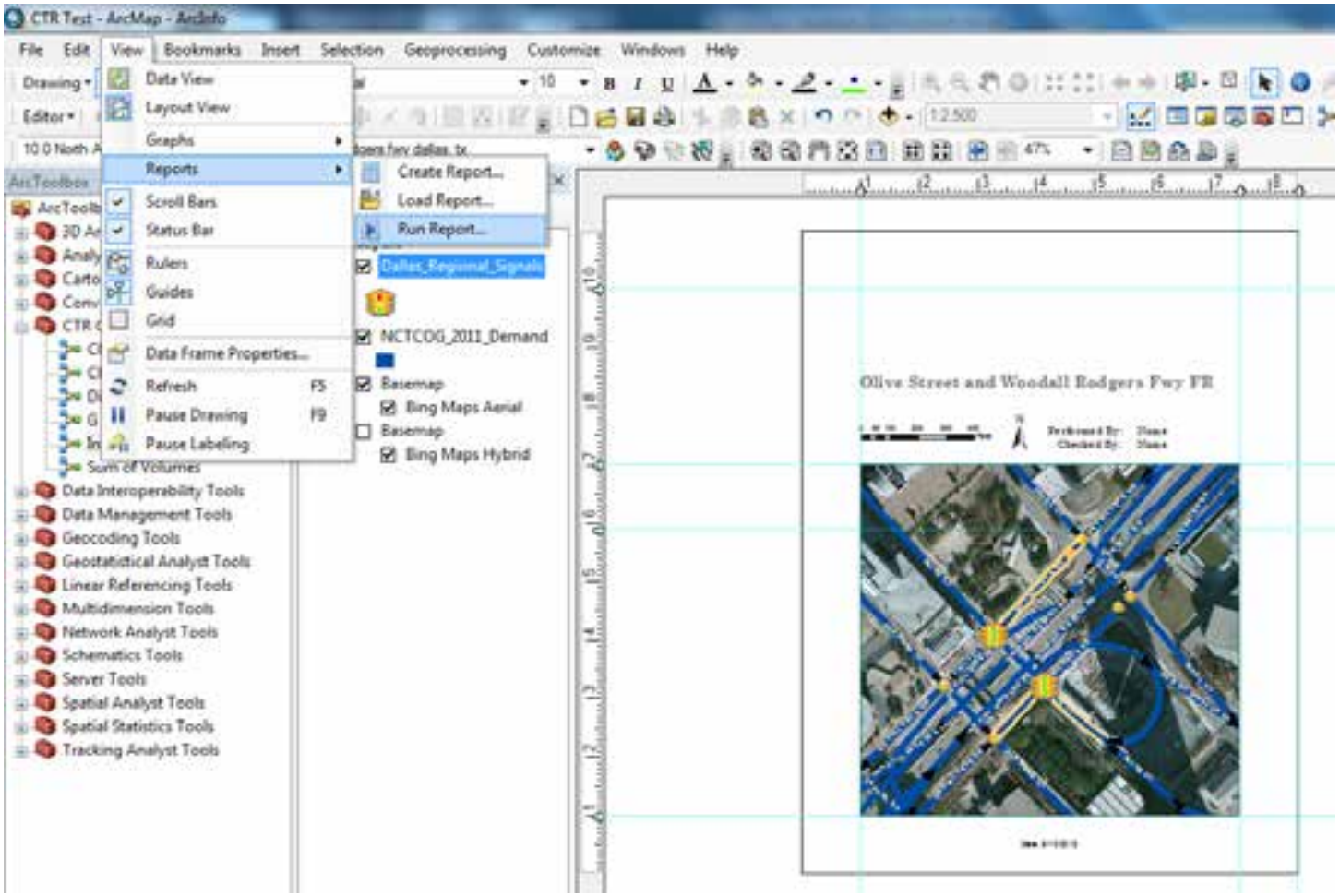
```
def volume(pointx, pointy, tox, toy, fromx, fromy, tod, amvolab, amvolba, pmvolab, pmvolba):
 if (math.fabs(pointx-tox)+math.fabs(pointy-toy)) <(math.fabs(pointx-fromx)+math.fabs(pointy-fromy)):
  if tod == 'AM':
   return amvolab
  elif tod == 'PM':
   return pmvolab
 else:
  if tod == 'AM':
   return amvolba
  elif tod == 'PM':
```

OK | Cancel | Apply | Show Help >>

Submodel for Changing Data Inputs



Report Layout



Sample Report

CTR Intersection Traffic Control Tool

STREET	TOTAL_LANE	TOTAL_VOL	LANE_VOL	SAT_FLOW	V_OVER_C	CAPACITY	V_OVER_C
OLIVE ST	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WB FWY EXIT EB	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WB FWY EXIT WB	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Olive Street and Woodall Rodgers Fwy FR

0 50 100 200 300 400 feet

N

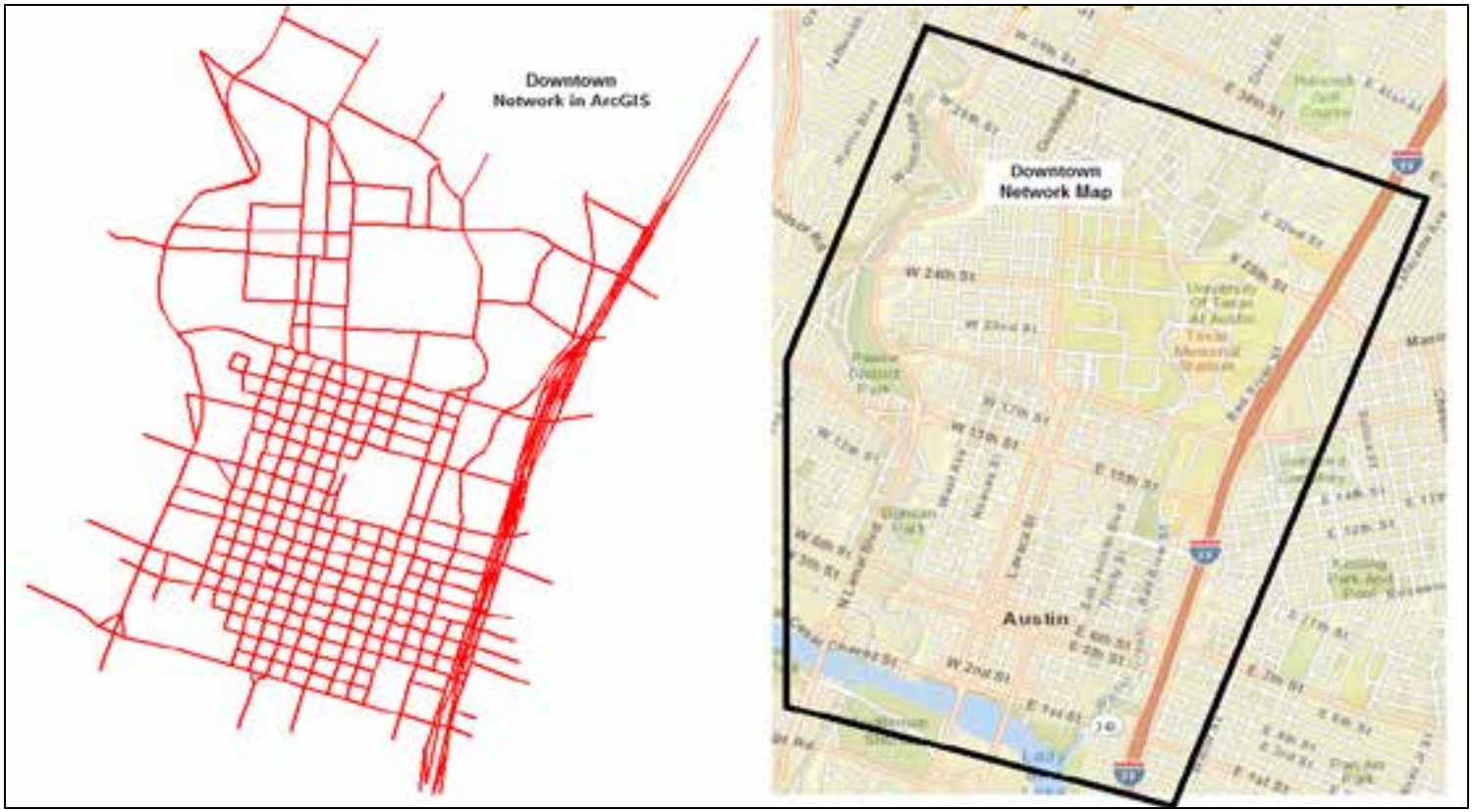
Performed By: Name
Checked By: Name

Date: 9/10/2012

Dynamic Traffic Assignment

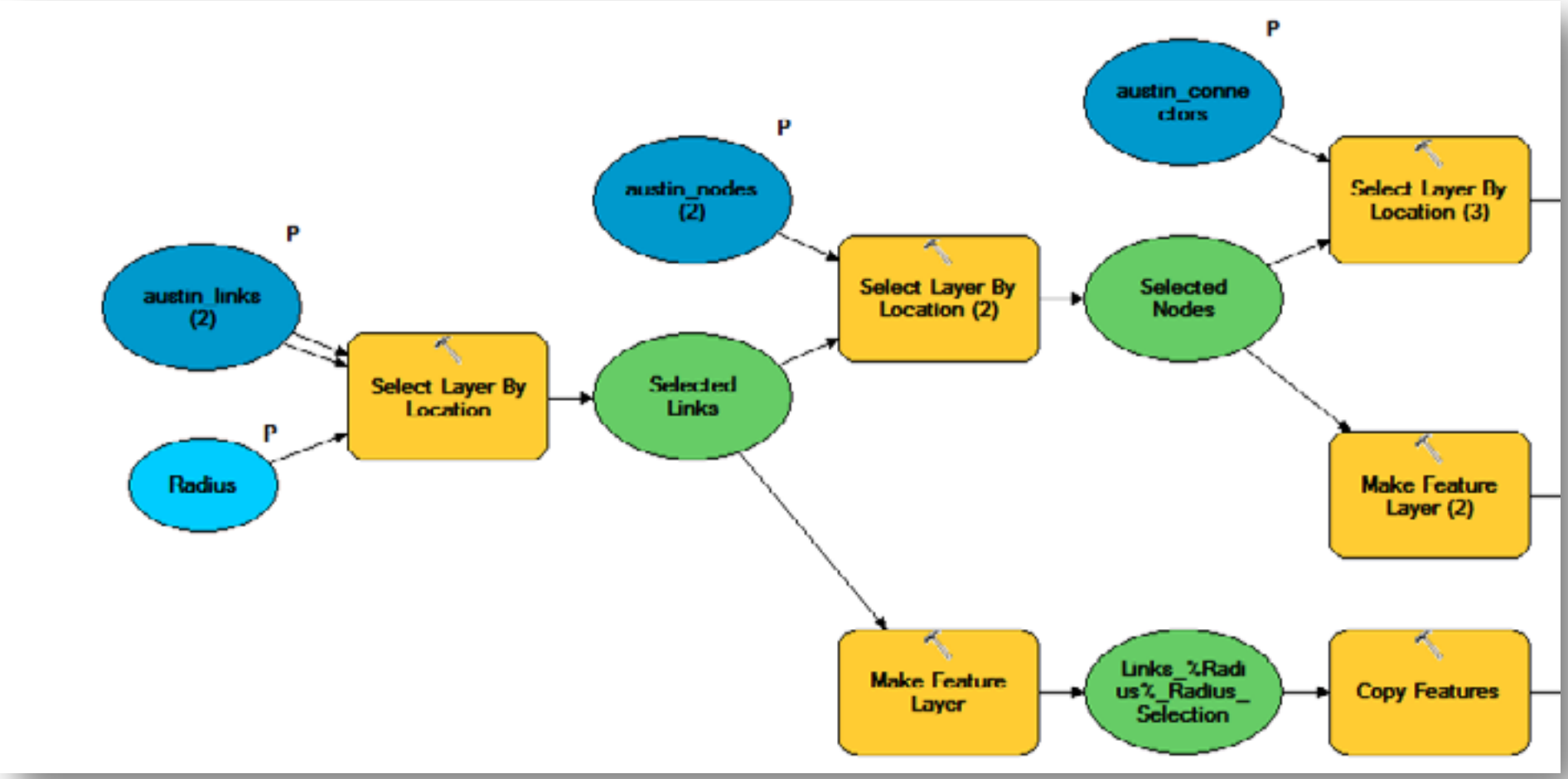
- Traffic planners and engineers have developed dynamic traffic assignment (DTA) models
- Time dependent rerouting provides a much better prediction of traffic operations
- The added detail in DTA models requires much more time to compute results
- Extracting a subarea of the network can drastically reduce model run times

Dynamic Traffic Assignment

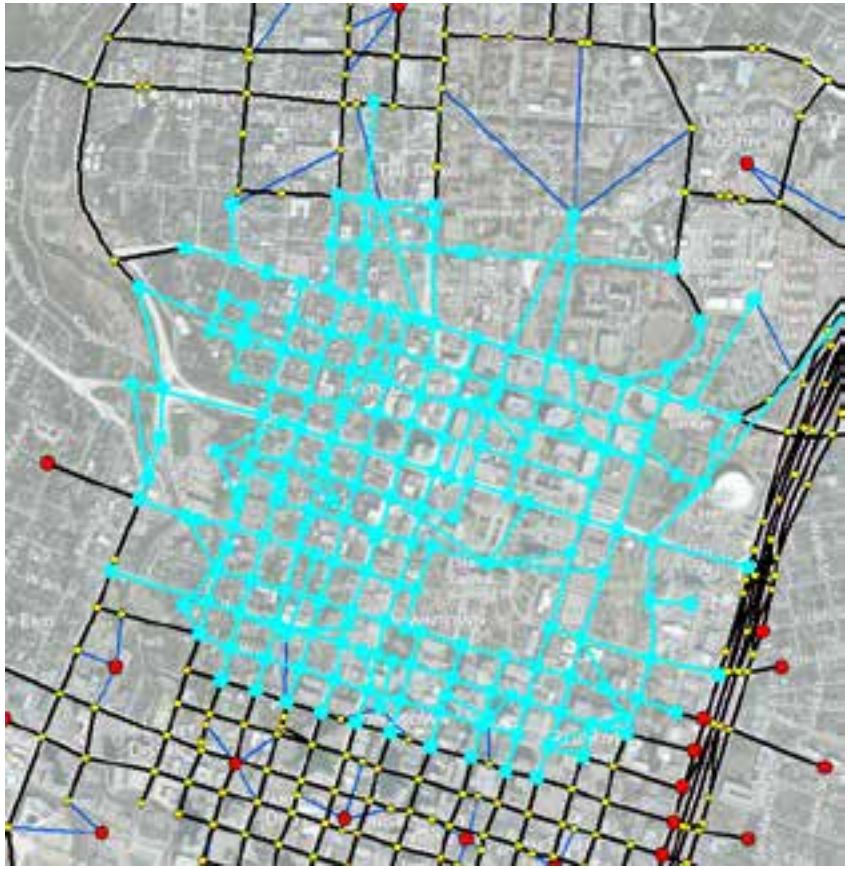


Source: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, METI, TomTom, 2013

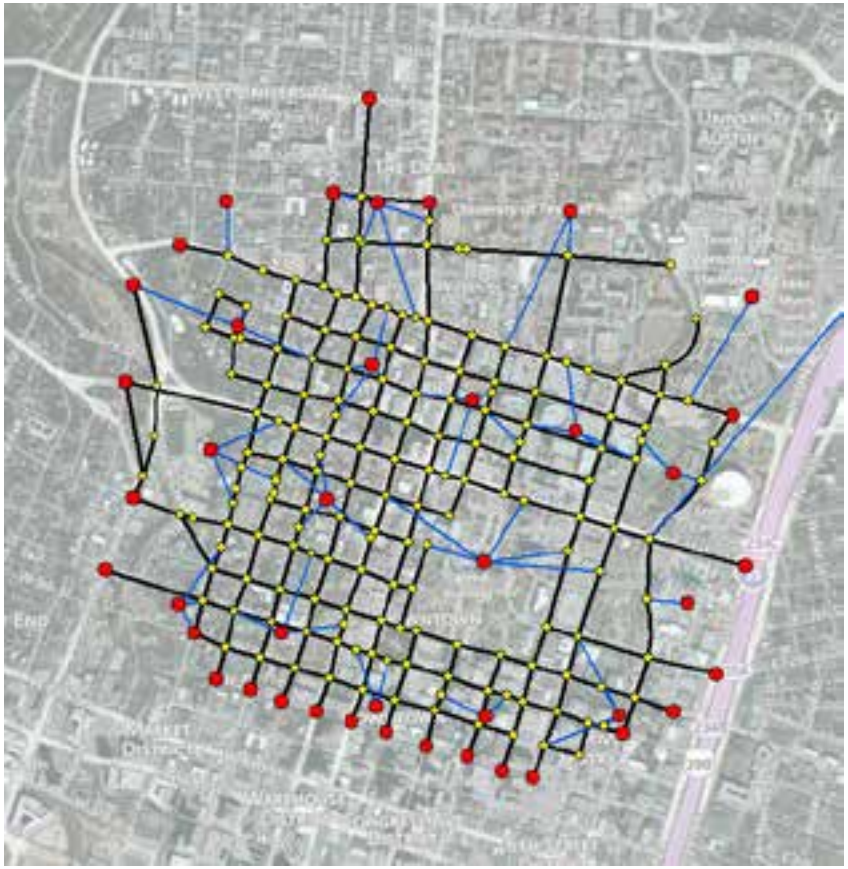
Initial Subnetwork Testing



Initial Subnetwork Testing



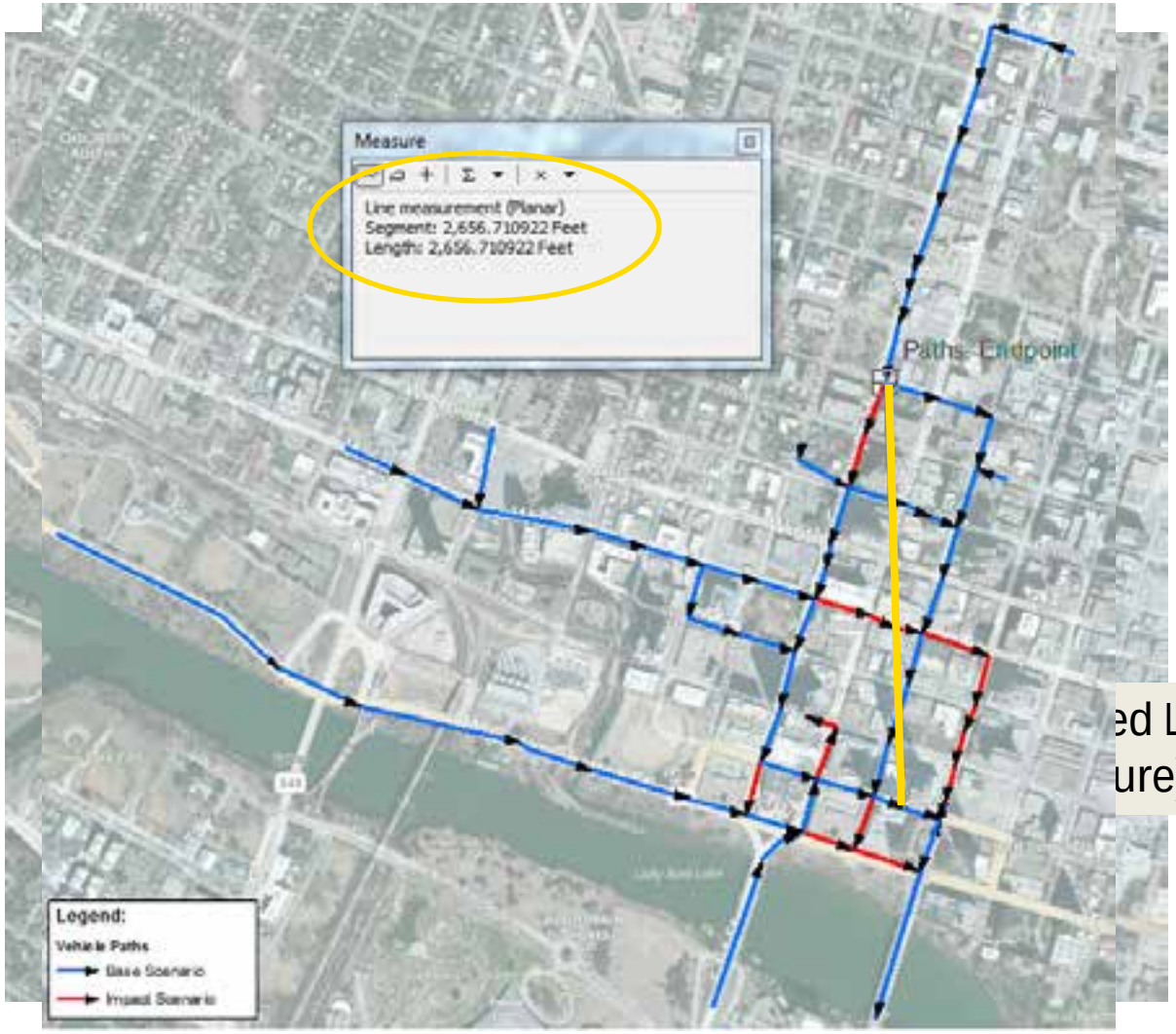
Subnetwork Selection (1/2 Mile) Before VISTA



Subnetwork Selection (1/2 Mile) After VISTA

Basemap Source: BING © 2010 Microsoft and its Data Suppliers

Determine Rerouting

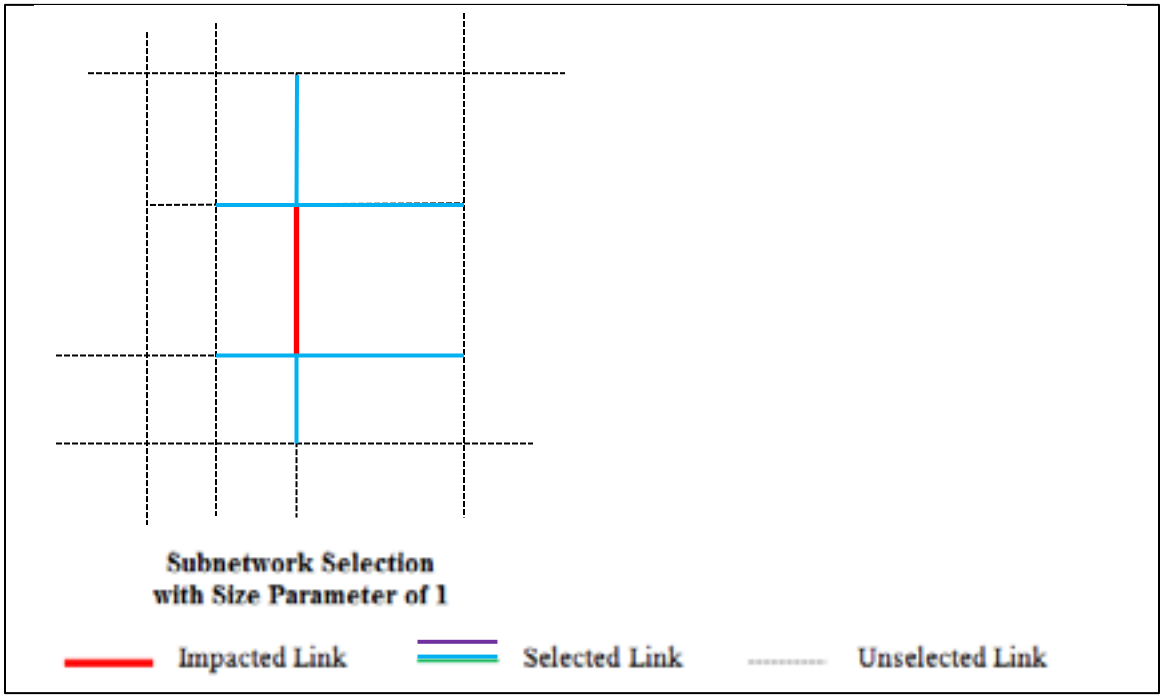


ed Link (3rd Street
ure)

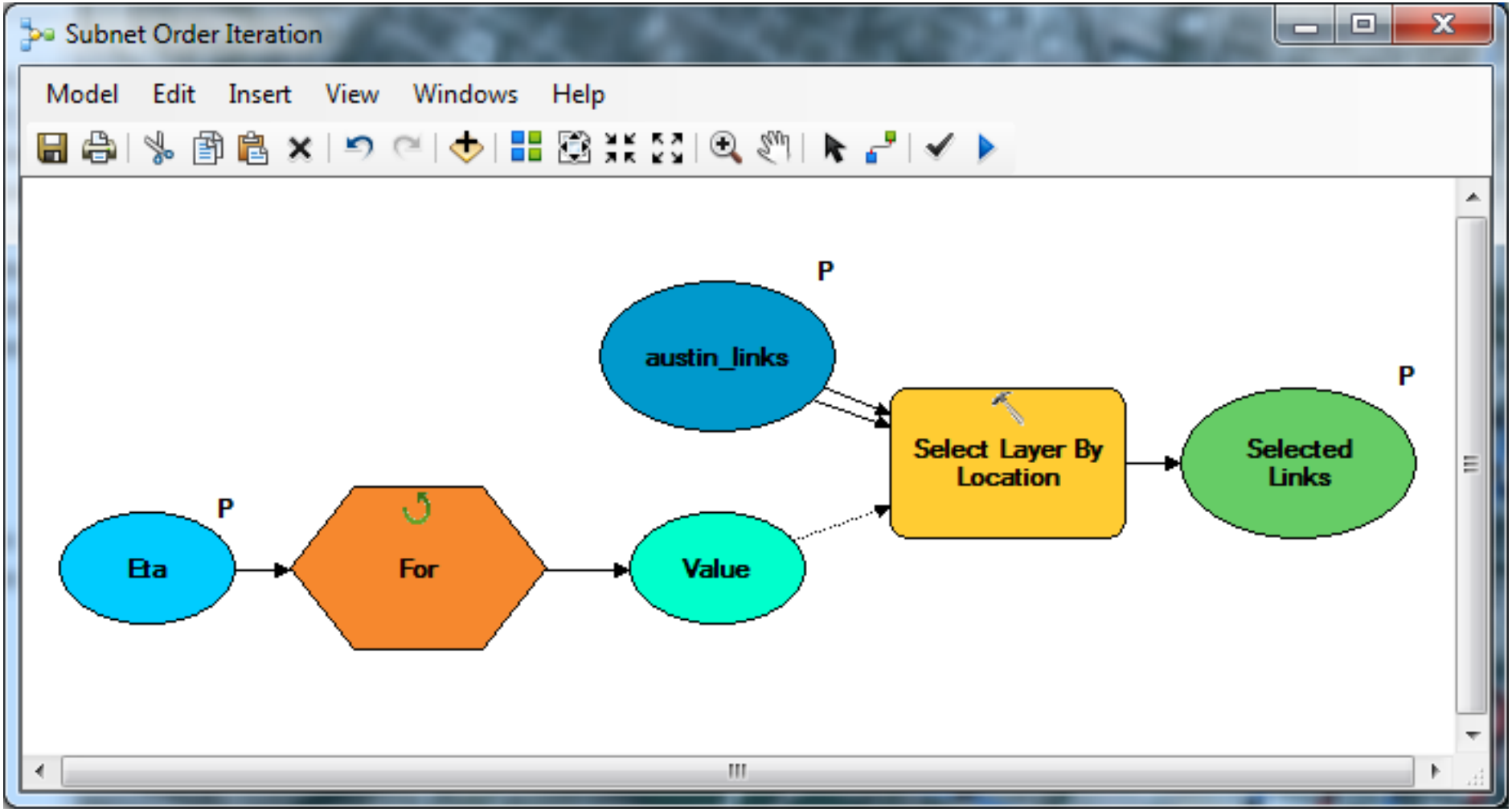
What is a Sufficient Subnetwork?

- After preliminary tests we found that changes to the network are limited to a local area
- We decided to use statistics on the full network run outputs and subnetwork inputs
- This analysis allowed us to identify a size of subnetwork that contained traffic congestion
- We developed a means to standardize testing of subnetwork selection and performance

Connected Order

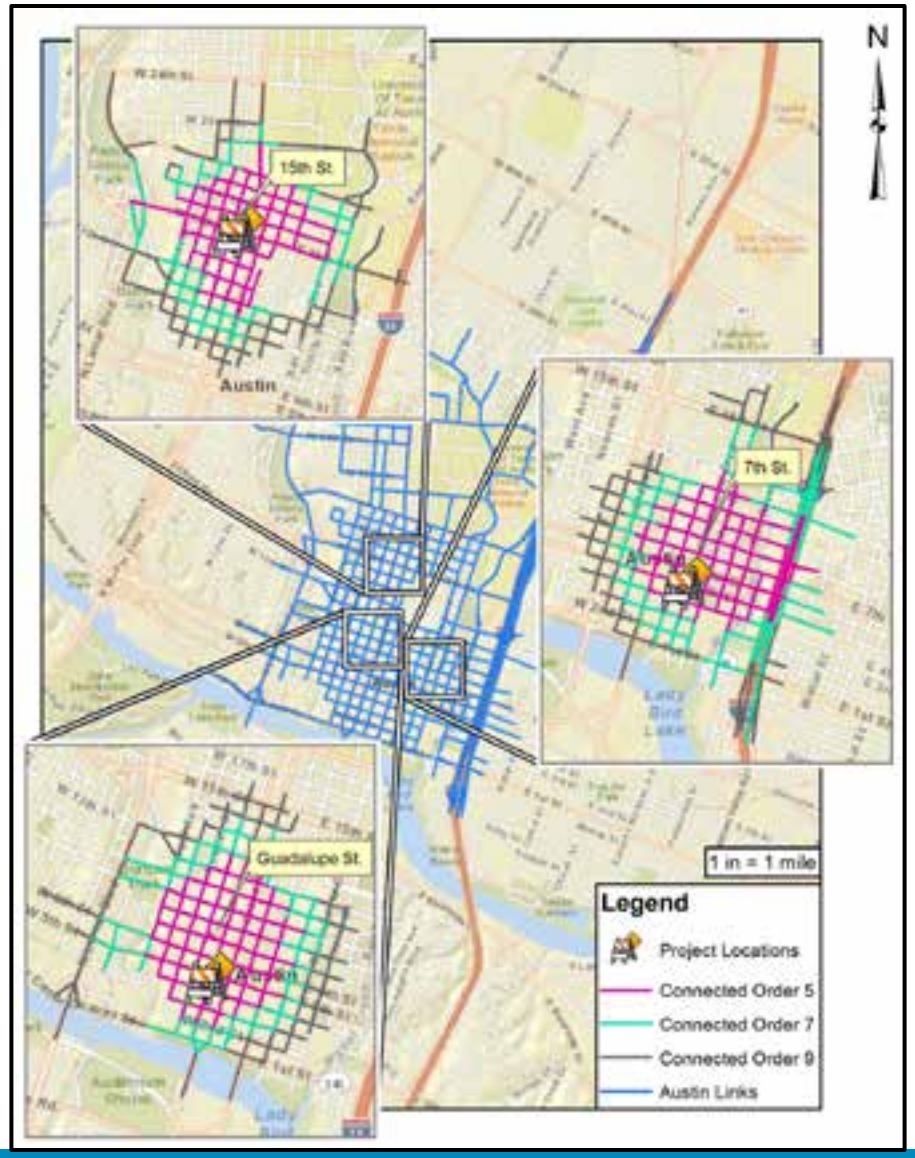


Further Subnetwork Testing

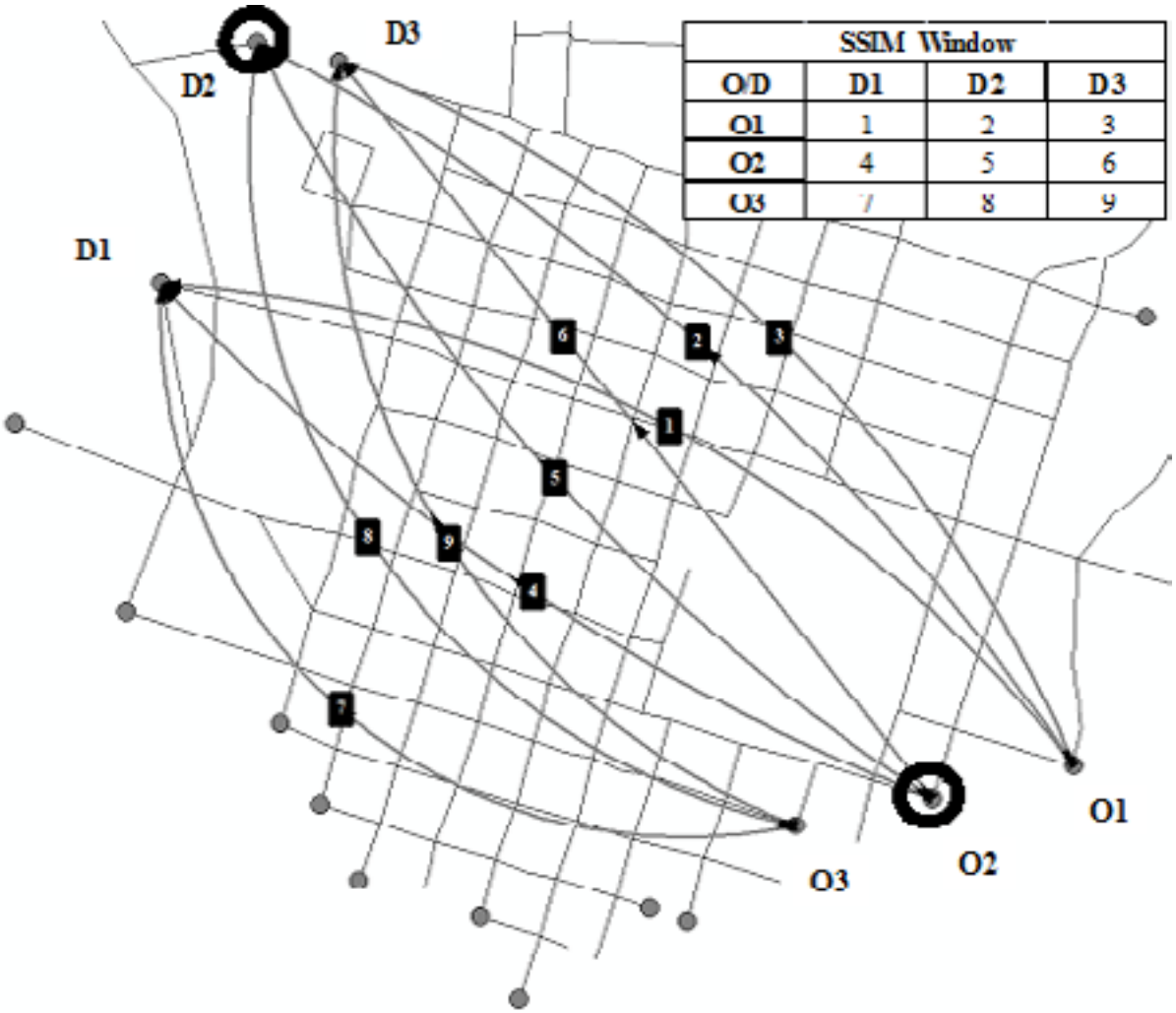


Further Subnetwork Testing

Subnetwork Case Study

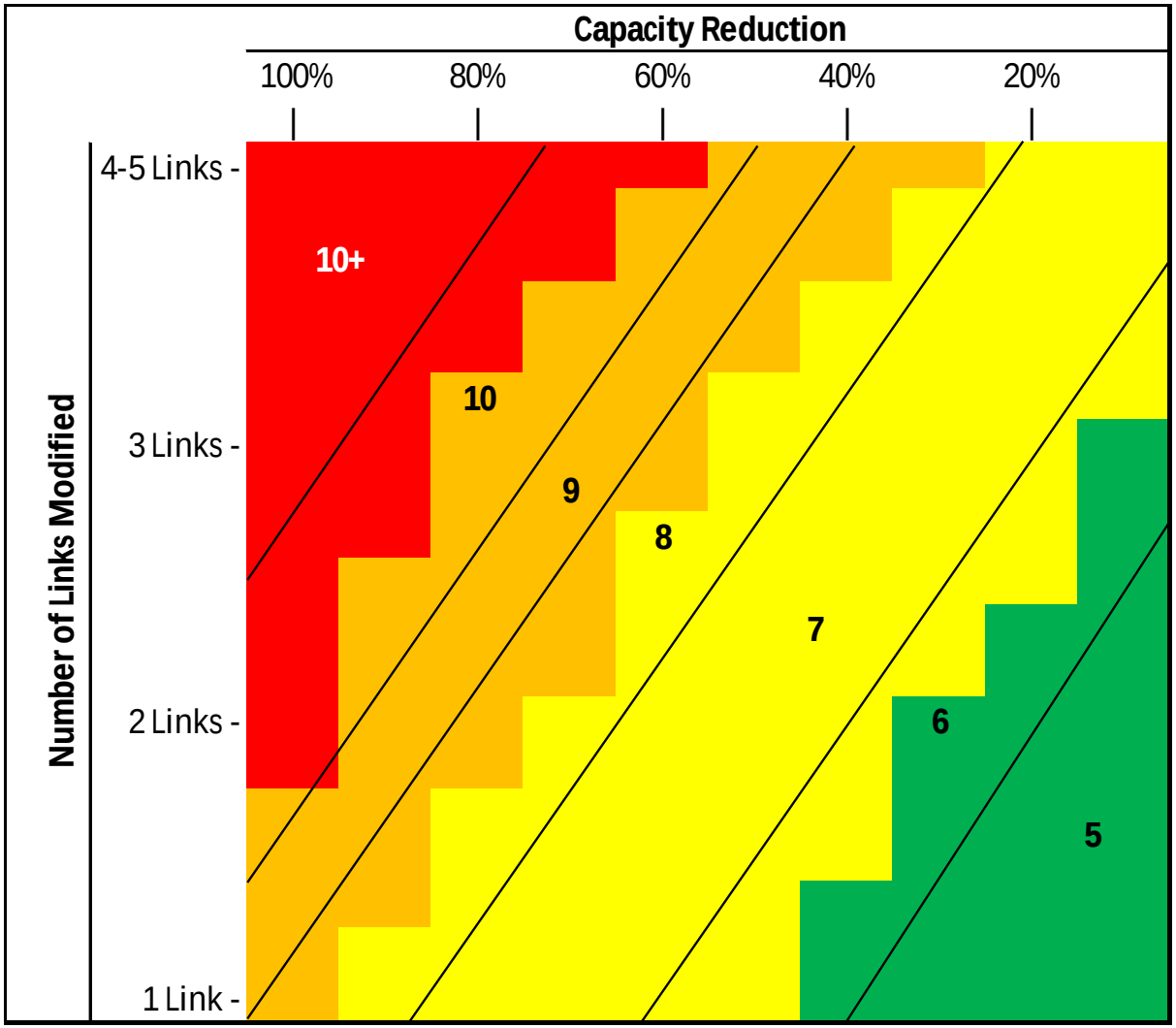


Measuring Error of Subnetworks



SSIM Window			
O/D	D1	D2	D3
O1	1	2	3
O2	4	5	6
O3	7	8	9

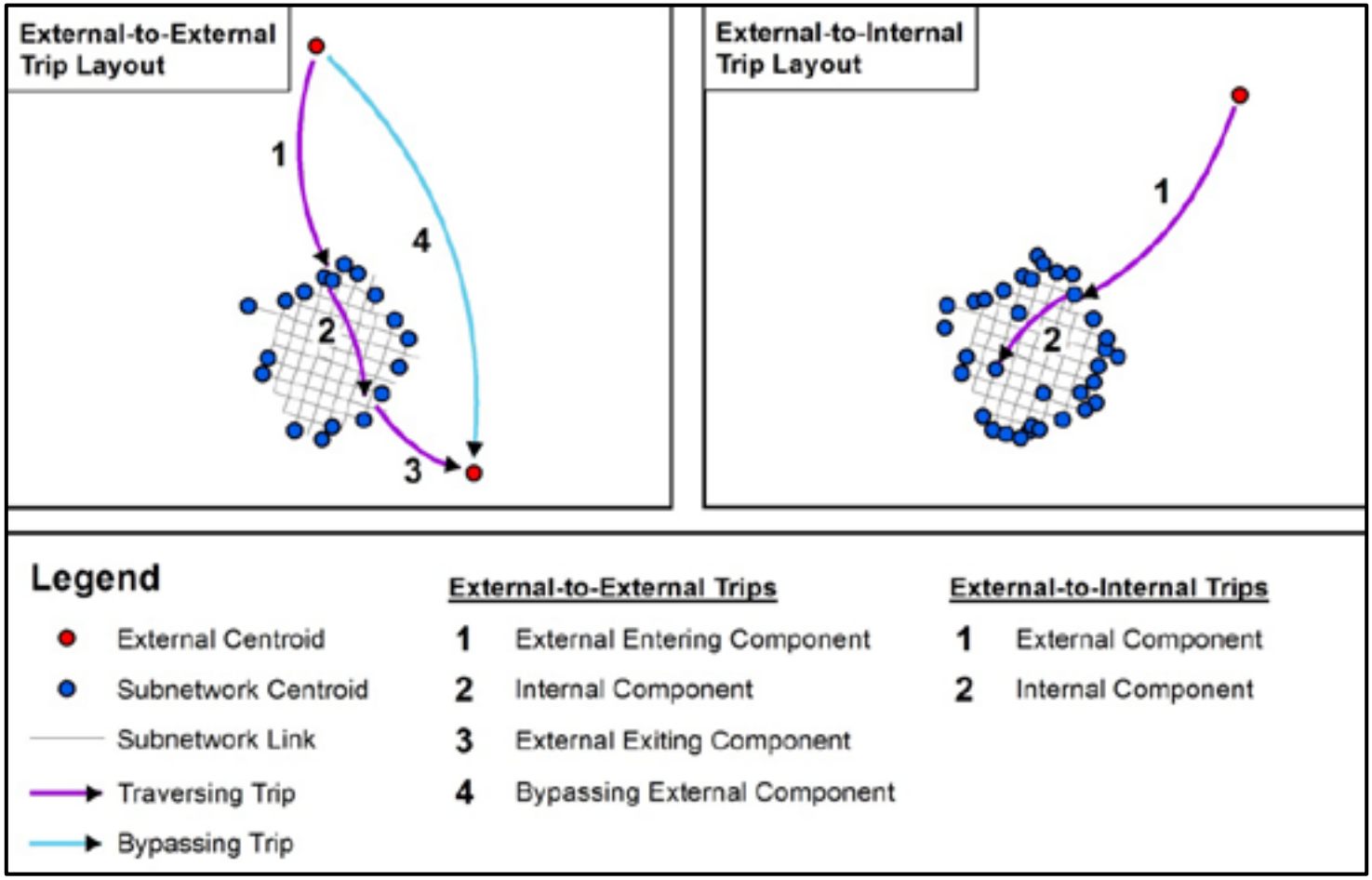
Statistical Results



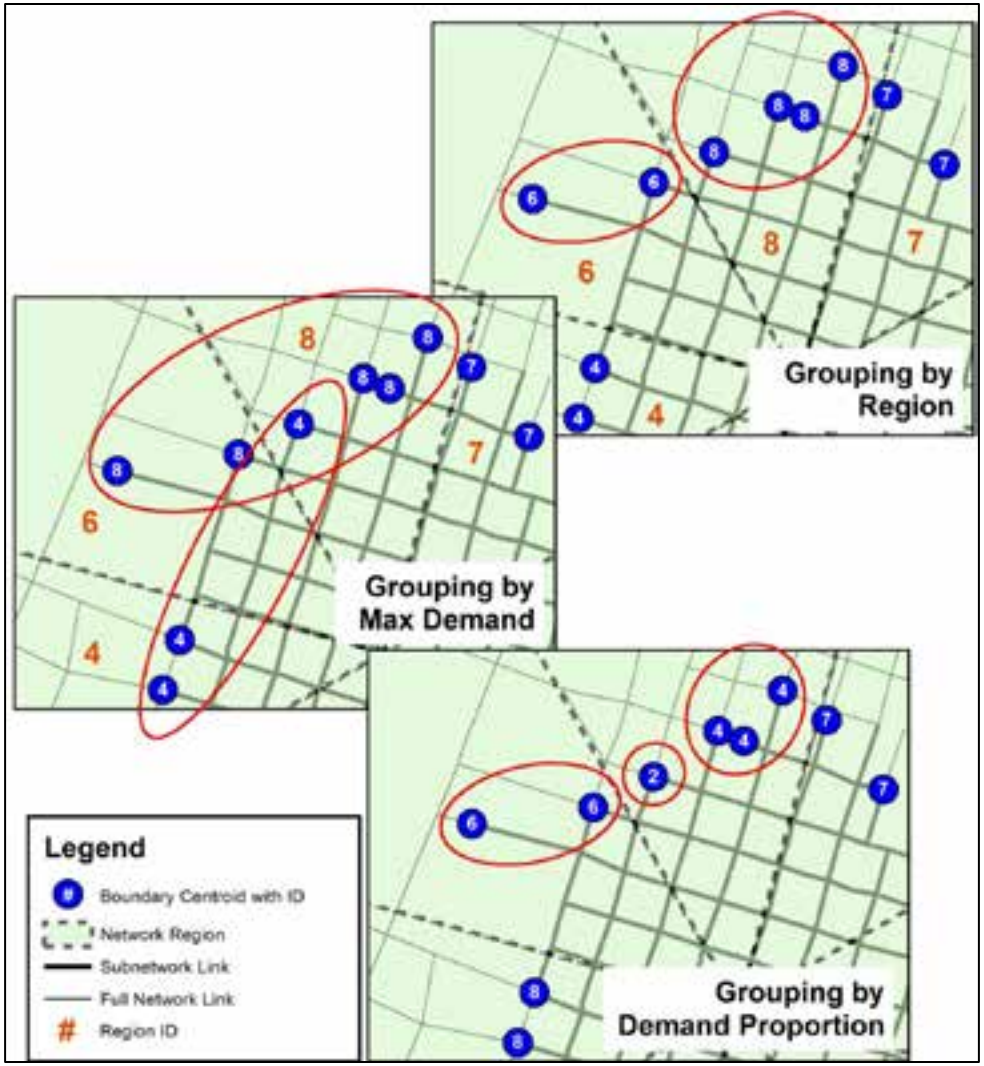
Accounting for Error

- Once we had a better understanding of what causes the error when extracting a subarea, we attempted methods to correct for it
- A few methods were tested to predict changes outside the subnetwork
- Spatial analysis was used to combine entry points to the subnetwork and simplify the assessment of traffic demand at the boundary

Identifying Trips using Subnetwork



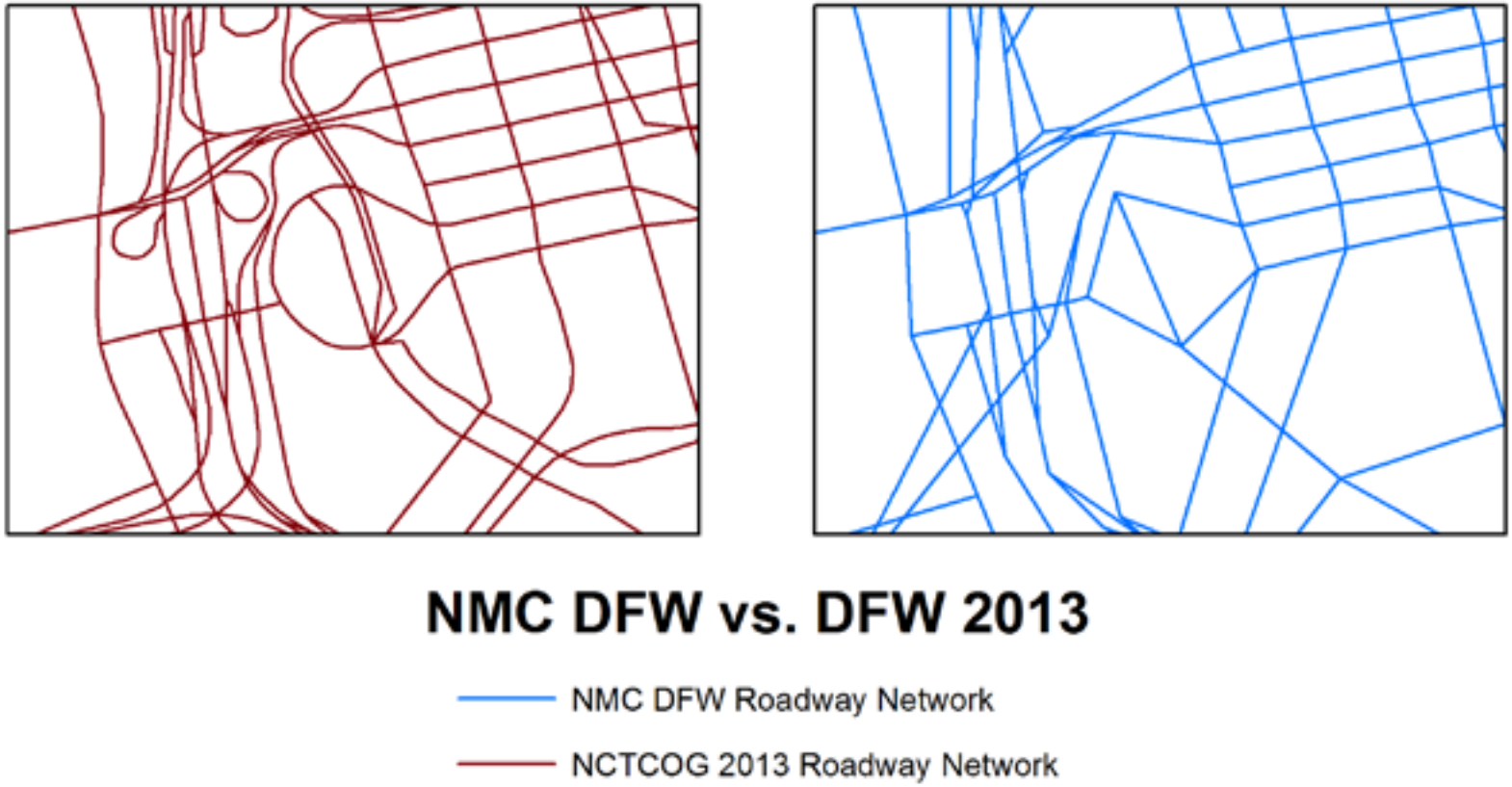
Spatial Analysis for Entry Points



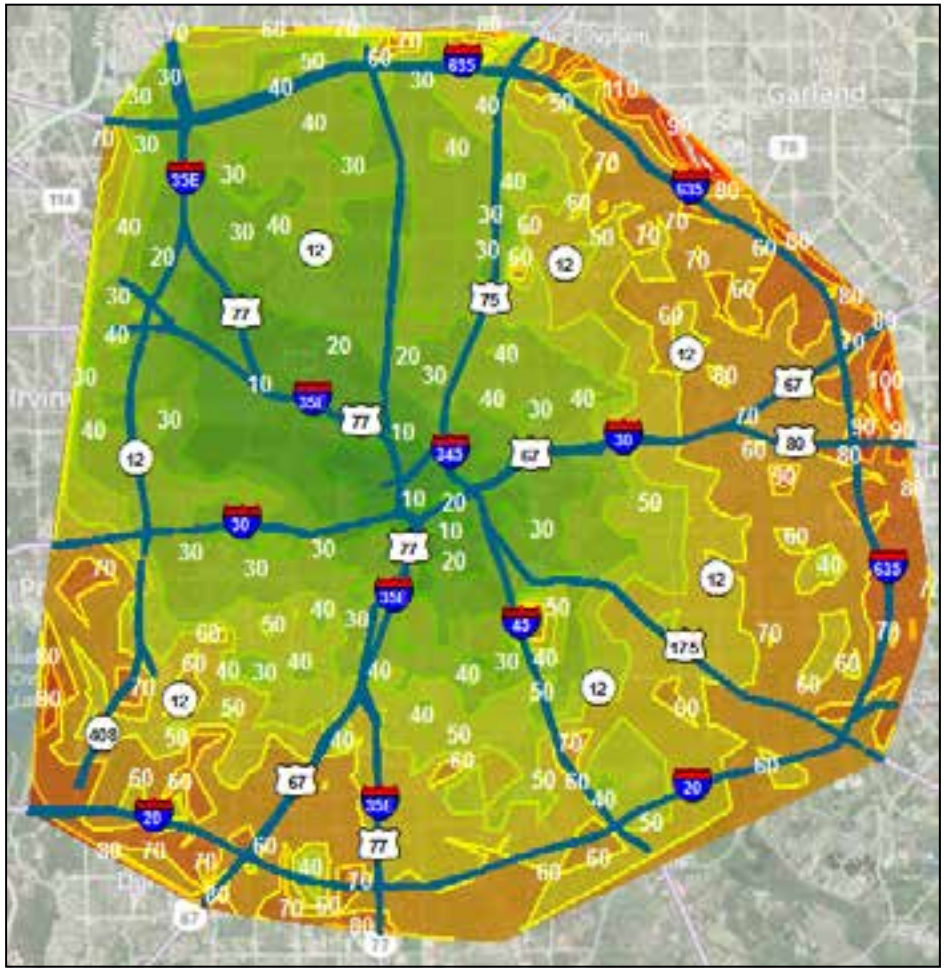
Visualizing Improved Network Data

- All of these methods were combined to produce the most accurate traffic predictions
- The data provided by the dynamic traffic assignment can be used to replace the less detailed static traffic assignment output
- This improved data can then be used to better evaluate changes to a transportation network efficiently and effectively

Updating Tools with New Networks

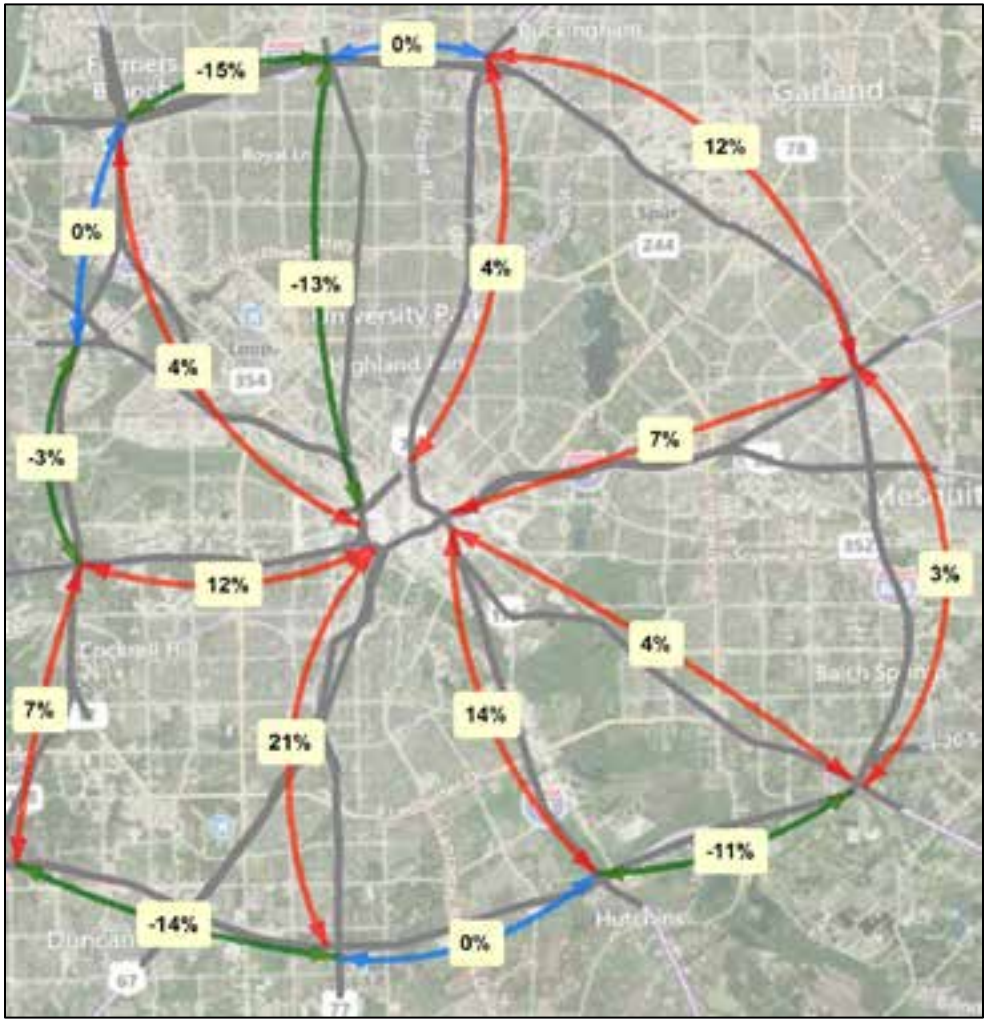


Visualizing Results



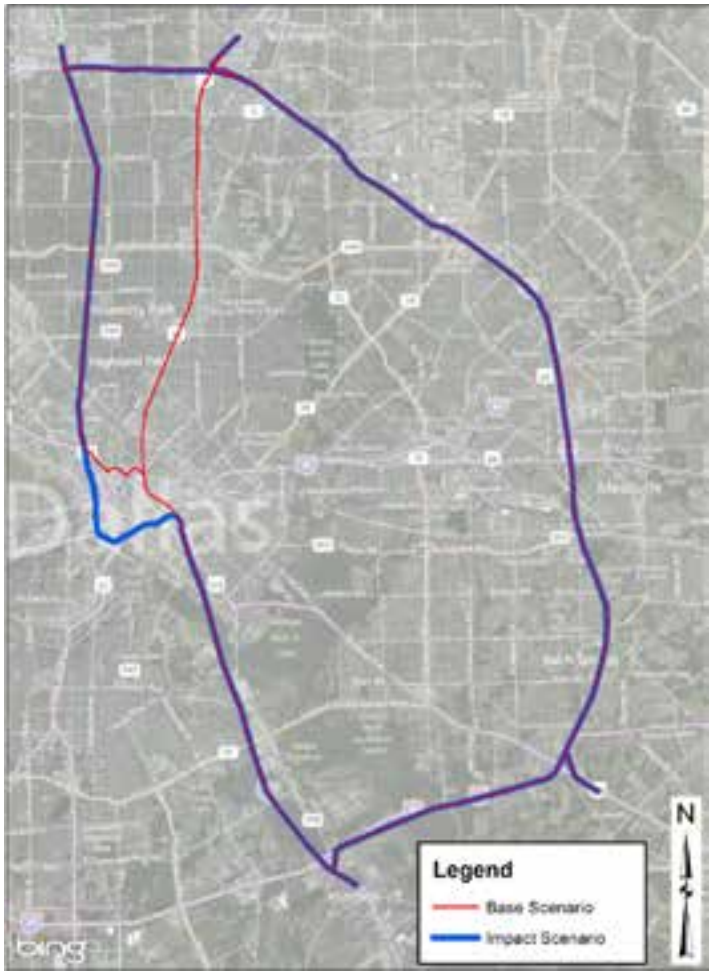
Travel Time Contour Map for Travel to Downtown CBD

Visualizing Results



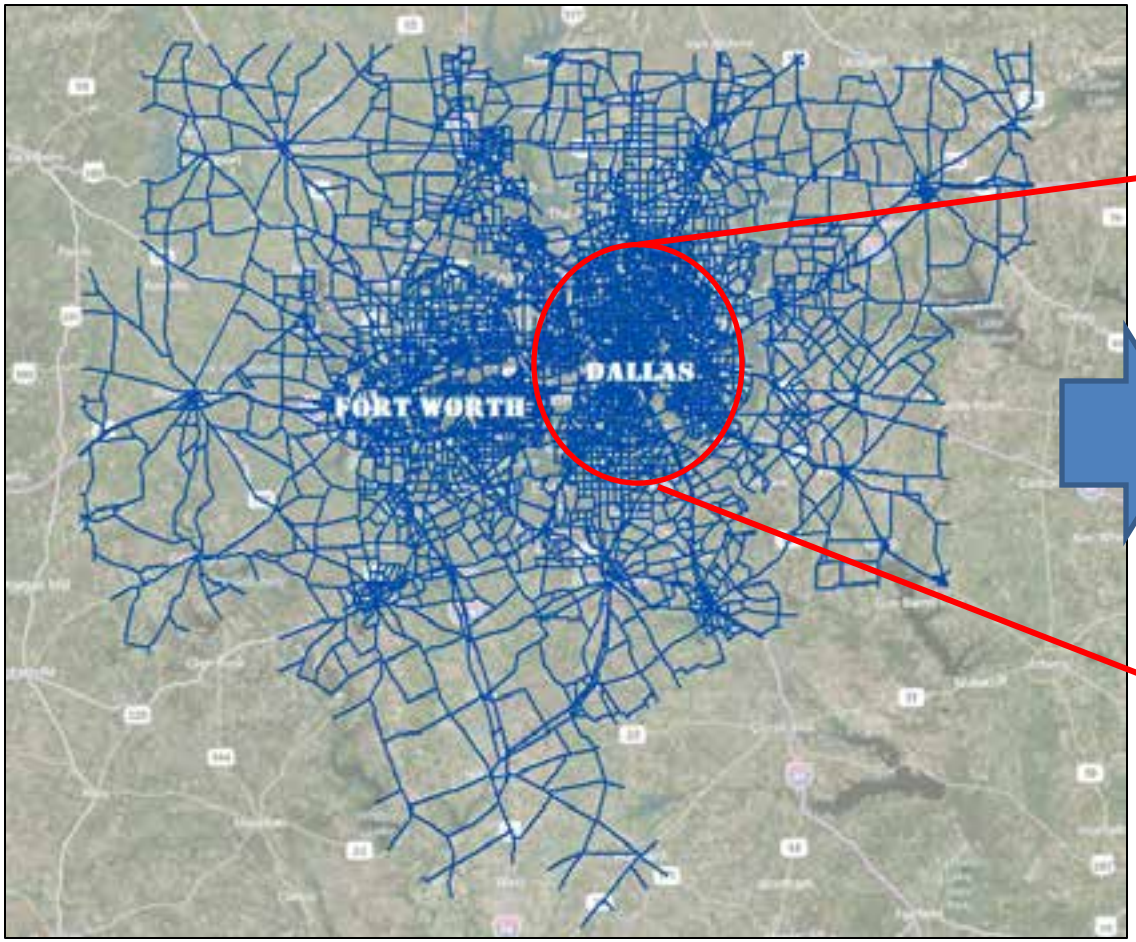
Percent Change in AM Peak Hour Travel Time for Major Corridors

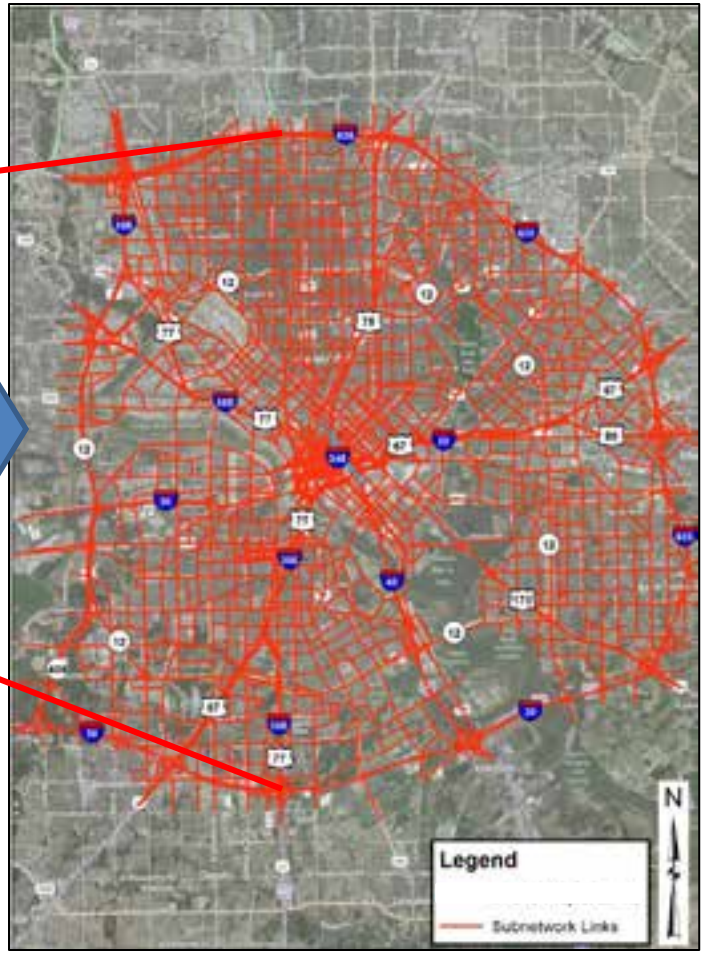
Visualizing Results



Rerouting of Trips Entering from NE Corner to SE Exit Points

Reducing the Network Intelligently





Conclusions

- ArcGIS was instrumental in manipulating and visualizing inputs and outputs for the traffic models
- Modelbuilder enabled the automation of multiple procedures used in sequence that needed to be standardized and used repeatedly
- Spatial analysis added a capability that would not have been possible without ArcGIS