



### Task 3.2 Documentation of Assistance Provided to CAMPO Modeling Team

Part of Task 3 of the contract with CTR is to assist CAMPO by identifying areas for model improvement. This effort was completed through a variety of means. Some of the assistance was provided as a result of direct requests from CAMPO leadership to examine CAMPO’s modeling practices as they relate to industry trends (e.g., technical memo on demographic allocation tools, or the technical memo on network coding). Other assistance provided was an output of the DTA modeling effort, and the result of CTR identifying improvements that could be made to the CAMPO base model through our work on DTA (e.g., base model demand discrepancy, or the new process for updating centroid connectors). Documented below are the items with which CTR provided assistance to CAMPO, which resulted in improvement to the CAMPO model.

#### 3.2.1 CAMPO 2015 Model Development Scope of Work

Dr. Jen Duthie provided significant input into the development of the CAMPO scope of work for solicitation of a consultant for the CAMPO 2015 Model Development. Our experience in working with the model, identifying areas with room for improvement, understanding the work flow, as well as our understanding of the history of issues surrounding prior model development efforts, gave Dr. Duthie unique insight to assist with this scope development. The final scope of work is attached for reference.

**Enclosure: “CAMPO 2015 Model Development Scope of Work”**

#### 3.2.2 Base Model Demand Discrepancy

Review of the CAMPO 2010 base model began with receiving a preliminary version in late 2013. During 2014, the team worked on refining models for the CAMPO region and developed a preliminary regional DTA model using the updated 2010 network and demand. It was discovered that the 2010 base model had a morning peak period (6 AM to 9 AM) demand that was substantially lower than that of the 2005 base (interim) model forecast for 2010. The estimate was even discovered to be far lower than the 2005 year estimate. Table 3.2.2 summarizes the differences in demand between the two base year models for 2010, the time-of-day proportions, and the percent change between them.

**Table 3.2.2 CAMPO Model Demand Comparison**

| Model Year              | Peak Demand (% of Total) |                    |                    |                    | 24-hour Demand |
|-------------------------|--------------------------|--------------------|--------------------|--------------------|----------------|
|                         | Morning                  | Midday             | Afternoon          | Nighttime          |                |
| 2010<br>(2005 Int Base) | 1,154,545<br>(23%)       | 1,802,112<br>(37%) | 1,230,667<br>(25%) | 734,836<br>(15%)   | 4,922,159      |
| 2010<br>(2010 base)     | 714,619<br>(14%)         | 1,992,507<br>(39%) | 1,128,547<br>(22%) | 1,265,677<br>(25%) | 5,101,348      |
| % Change                | -38%                     | 11%                | -8%                | 72%                | 4%             |



## FY16 Deliverables Submittal

Upon discovery, this discrepancy was communicated to the CAMPO modeling team. It was stated that at that time the model was still under development and subject to change, including the demand estimates. Later releases included adjusted, but similar demand estimates which contained the substantially lower morning peak value. This lower value for the morning peak carried through the base year and all subsequent forecast years for the 2010 base model.

Closer to the final release, it was noted by the CAMPO modeling team that the 2010 base model demand estimates were based on a new, more robust strategy for estimating demand for the region. This process resulted in a different distribution of demand across the individual time-of-day intervals (morning, midday, afternoon, and nighttime). Subsequently, the morning peak had a lower proportion of the daily demand. This explained the lower morning peak demand even though the 24-hour demand was higher for the same year (2010), as shown in in the table. The midday and nighttime periods gained proportionally, particularly the nighttime period. In all, multiple discussions were held with CAMPO staff to fully vet the discrepancies.

### 3.2.3 Developing a Strategy to Refine Centroid Connector Placement

In traffic assignment models, the placement of centroid connectors may have a significant impact on model performance and results. Centroid connectors are used to model the loading of vehicles into the network, and attention must be paid to their number and location in order to avoid unrealistic congestion or low utilization of minor roadways by local traffic. Given that the manual inspection of centroid connector placement may be too time consuming in large regional networks, including macroscopic static assignment models, the first attached paper proposes two simple automatic centroid connector placement strategies for model applications, and explores their impact on the resulting traffic flow patterns on lower functional class roadways. The purpose of these strategies was to overcome deficiencies in centroid connector placement resulting from the limitations of the most common techniques in practice. Sensitivity testing and field data comparisons suggest that the strategies achieve more realistic results when compared to traditional connector distribution.

Traditional centroid connector placement strategies may lead to excessive congestion and unrealistic traffic patterns, while manual network refinement is prohibitive in large regional models. The effort behind the second paper utilizes parcel-level data to inform an automated centroid connector placement methodology with the goal of producing more realistic network loading patterns. Parcel-level data is used to allocate travel demand between two sub-regions in each considered traffic analysis zone, and to select appropriate nodes for the centroid connector placement. Numerical experiments, conducted on a medium-size network in the Austin, TX region, suggest that the proposed approach better approximates both corridor travel times and traffic counts throughout the network, with improvements of more than 40 percent in travel time estimation accuracy, and 12 percent in traffic count estimation. While the application proposed is focused on dynamic traffic assignment models, the



methodologies can be extended to benefit other modeling approaches, including static traffic assignment models.

**Enclosure: “An Investigation of Centroid Connector Placement for Advanced Traffic Assignment Models with Added Network Detail” and “Using Parcel-level Data to Inform Centroid Connector Placement: A Dynamic Traffic Assignment Application”**

### 3.2.4 Demographic Allocation Tool

**Enclosure: Draft “Summary of Scan for MPO Best Practices: Demographic Allocation Tools,” January, 2016**

### 3.2.5 Network Coding

**Enclosure: Draft “Summary of Scan for MPO Best Practices: Network Coding,” November, 2015**

### 3.2.6 Active Transportation

**Enclosure: “Active Transportation Network Data Environment,” March, 2016**

### 3.2.7 Lessons Learned

**Submitted October, 2015. Available by request**



## **CAMPO 2015 MODEL DEVELOPMENT SCOPE OF WORK**

### **PROJECT FOR:**

Capital Area Metropolitan Planning Organization (CAMPO)

### **PROJECT TITLE:**

CAMPO 2015 Model Development

### **OBJECTIVES OF THE PROJECT:**

The Capital Area Metropolitan Planning Organization, hereinafter referred to as CAMPO, seeks offers in response to this Solicitation from engineering and/or planning firms qualified and experienced in travel demand modeling and TransCAD GISDK programming. The objective of the project is to develop the 2015 Base Year Model to be used for the CAMPO 2045 Long Range Plan in the six-county region (Bastrop, Burnet, Caldwell, Hays, Travis and Williamson counties). Specifically, CAMPO is seeking a consultant team to update its model networks, update its demographic assumptions and projections, and calibrate the model system to base year traffic counts and travel surveys.

The results of this work will benefit CAMPO staff, its Transportation Policy Board, its Technical Advisory Committee, local jurisdictions, and the public by providing a tool that can aid in regional transportation decision-making.

### **BACKGROUND:**

The 2010 Base Year CAMPO Travel Demand Model was updated to improve the mode choice component and implement a four (4) period traffic assignment, and the model was calibrated to the 2010 base year condition. CAMPO currently uses a customized demographic allocation tool, which is implemented in TransCAD. The demographic forecasting procedure was updated from grid-level allocation to parcel-level allocation tool in 2012. A CAMPO 2010 Planning Model Guide, documenting the details of demographic forecasting and travel demand modeling procedures, is available upon request.

### **ESTIMATED SCHEDULE:**

Jan 2016 – Dec 2017

### **TOTAL BUDGET:**

\$400,000

## **ANTICIPATED SERVICE:**

The following tasks identify the major work components that the consultant will undertake. CAMPO anticipates that the consultant will build upon the existing 2010 base year model, to the extent practicable. CAMPO will provide all necessary models and documentation.

### **Task 1. Project Management**

1.1 Prepare a project management plan.

*Deliverable: Project management plan.*

1.2 Prepare and submit monthly progress reports, invoices, and billings.

*Deliverable: Monthly reports, invoices, and billings. The report should detail hours worked by each team member, all expenses, progress made on each task, work to be performed for each task in the next month, and any issues that need to be resolved.*

1.3 Establish and maintain a project schedule with key milestones.

*Deliverable: Project schedule with milestones.*

1.4 Attend regular meetings with CAMPO staff.

*Deliverable: Meeting notes.*

### **Task 2. Network Coding**

2.1 Prepare a plan for how to build networks and conduct quality control.

*Deliverable: Document describing the network coding procedure, including a procedure to check for coding errors. The consultant may choose to use the current network coding procedure or improve upon it to develop a method that will lead to efficiencies in coding scenarios, efficiencies for future model updates, or will lead to better quality control.*

2.2 Develop the base year (2015) model network for roadways and transit.

*Deliverable: TransCAD network files for roadway and transit in year 2015. A separate file should also be provided that outlines any network coding decisions made by the consultant.*

2.3 Develop the future year (2025 and 2045) model networks for roadways and transit.

*Deliverable: TransCAD network files for roadway and transit in year 2015. A separate file should also be provided that outlines any network coding decisions made by the consultant.*

### **Task 3. Develop population and employment inputs to the travel demand model.**

3.1 Prepare a plan for how to develop population and employment inputs and conduct quality control.

*Deliverable: Document describing the demographic forecasting procedure, including a procedure quality assurance and control. The consultant may choose to improve upon the current parcel-based demographic allocation tool or propose a new method. The procedure should work with either county control totals or regional control totals. The consultant must explain how the proposed method is defensible and follows best practices.*

3.2 Develop base year (2015) population and employment inputs to the travel demand model.

*Deliverable: Model files describing population and employment inputs (e.g., at parcel-level, traffic analysis zone-level); Documentation on how the inputs were developed.*

3.3 Develop future year (2025 and 2040) population and employment inputs to the travel demand model.

*Deliverable: File containing population and employment inputs to the model; Documentation on how the inputs were developed.*

### **Task 4: Structural refinements to travel demand model.**

4.1 Update travel demand model code to accommodate any changes made to the existing model's network coding procedures or demographic forecasting, as described in Tasks 2 and 3.

*Deliverable: Documentation on all changes made, if any, to the code base to accommodate changes to procedures described in Tasks 2 and 3.*

4.2 Update travel demand model code to fix any problems found during the model update.

*Deliverable: Documentation on all problems found and all changes made to the code base.*

### **Task 5. Calibrate, validate, and test the CAMPO's 2015 base year model using the most recent travel survey and traffic data.**

5.1 Prepare a plan for how to conduct reasonableness checks on, calibrate, and validate the 2015 base year model.

*Deliverable: Document describing all reasonableness checking, calibration, and validation procedures. Describe how the proposed plan meets best practices.*

5.2 Conduct reasonableness checks on all model inputs and outputs.

*Deliverable: Report detailing results of all reasonableness checks.*

5.3 Calibrate and validate the 2015 base year model to the latest saturation counts, transit on-board survey, and household survey.

*Deliverable: Report detailing how the model was calibrated to match base year data, and the final calibration results.*

5.4 Test model for future scenarios.

*Deliverable: Documentation of results from running the future year models with the inputs developed in previous tasks, including all reasonableness checks performed and their results.*

## **Task 6. Training, Support, and Documentation**

6.1 Workshops to train staff and area model users

*Deliverable: Two half-day training sessions to give an overview of the 2015 base year model to CAMPO staff and to area model users. All training materials including presentations and hand-outs will be delivered.*

6.2 Support for scenario modeling

*Deliverable: CAMPO staff will conduct the model runs to evaluate future scenario conditions. The consultant will be on-call to provide support and additional one-on-one staff trainings as needed.*

6.3 Complete documentation

*Deliverable: Complete documentation of the 2015 base year model including network coding procedure, demographic forecasting procedure, and any other changes to the model system. All quality assurance and quality control procedures for each step should also be included.*

1           **AN INVESTIGATION OF CENTROID CONNECTOR PLACEMENT FOR**  
2           **ADVANCED TRAFFIC ASSIGNMENT MODELS WITH ADDED NETWORK**  
3           **DETAIL**

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|--------|-------|-------|
| Text   | -     | 5,310 |
| Table  | 5×250 | 1250  |
| Figure | 3×250 | 750   |
| Total  | -     | 7,310 |

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40          Submitted for Publication in the 2015 *Transportation Research Record* and Presentation at the  
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42          2015

## 1 **ABSTRACT**

2 Advanced traffic assignment models, such as simulation-based dynamic traffic assignment (DTA),  
3 typically incorporate more detailed network representations than traditional planning models, and often  
4 include traffic signals and lower functional class roadways. In this context, the placement of centroid  
5 connectors may have a significant impact on model performance and results. Centroid connectors are  
6 used to model the loading of vehicles into the network, and attention must be paid to their number and  
7 location in order to avoid unrealistic congestion or low utilization of minor roadways by local traffic.  
8 Given that the manual inspection of centroid connector placement may be too time consuming in large  
9 regional networks, this paper proposes two simple automatic centroid connector placement strategies for  
10 DTA applications, and explores their impact on the resulting traffic flow patterns on local streets. The  
11 first approach radially distributes the connectors to link centroids to the nearest nodes in order to account  
12 for added network detail, and is intended to exemplify some of the limitations of the most common  
13 techniques in practice. The second strategy involves dividing the centroid and subsequent demand into  
14 two parts and distributing the demand across one subcentroid linked to nearby nodes and one linked to the  
15 periphery, effectively establishing a bi-level distribution. A modification of this strategy involves  
16 eliminating nodes at signalized intersections as viable candidates for connection. As part of the evaluation  
17 of the methods, a new metric has been introduced, the locality factor, to describe the use of minor streets  
18 by local traffic. The numerical experiments, conducted on two real-world networks, exemplify the  
19 impacts of the incorporation of local streets and the placement of centroid connectors on model results.  
20 Sensitivity testing and limited field data comparisons suggest that the bi-level centroid connector  
21 placement strategy achieves more realistic results.

22  
23 **Keywords:** local streets, centroid connector, dynamic traffic assignment

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## 1. INTRODUCTION

Transportation planners are increasingly adopting advanced transportation models, including dynamic traffic assignment (DTA), to evaluate complex planning strategies in large areas. DTA models typically require a more detailed network representation than their static counterparts, given that they are simulation-based and capacity-constrained. The appropriate level of detail to be used for a model depends on the purpose of the analysis, the availability of network information, and the resources required to develop and run the model; lower functional class roadways are often relevant for corridor analyses and accessibility studies.

Due to time and cost limitations, aggregated demographic data is used to model the individuals. This aggregated data is carefully studied to define areas with homogeneous travel behavior called traffic analysis zones (TAZs). Traffic analysis zones can be used for modeling demand generation for each zone and demand distribution from zone to zone (1). One of the central assumptions in most traffic assignment models is that all TAZ activity is concentrated at the zone centroid. Connectors are dummy links used in many transportation applications to define the entry (exit) points of trips into (out of) the roadway network.

One of the challenges of incorporating local streets into planning models is to ensure an appropriate utilization pattern, particularly when centroid connectors are present. Centroid connectors play an important role in the observed traffic patterns on local streets. Because connectors offer a cost-free alternative to reach origins and destinations from specific roadway nodes, they may be used to bypass local streets, making these more likely to carry cut-through traffic.

The number and placement of centroid connectors can also significantly impact the congestion pattern in capacitated models. For a given travel demand value, fewer connectors result in a higher concentration of trip ends at specific locations, potentially creating congestion. This phenomenon may be more noticeable when centroid connectors are placed on local streets with low capacity values.

This paper discusses the impact of centroid connector placement on simulation-based dynamic traffic assignment models that include local streets, and proposes strategies to produce more realistic traffic flow patterns. It is trivial that changing network topology by adding detail to the network requires careful editing the connector structure. However, manual edition is not practical in large regional networks, and oversimplified automatic techniques that simply choose the nearest node may lead to unrealistic behaviors. The goal of this study is to exemplify the nature of the impacts of centroid connector placement on modeling results, and to propose an automated process to generate centroid connectors that improves upon the “nearest node” paradigm. By automating the process, the goal is to better enable the transition between static traffic assignment models and dynamic traffic assignment models. Numerical experiments are conducted using real transportation network information to assess the performance of the proposed methodologies, and to validate model results using field data. The proposed strategies are flexible and require minimal manual intervention making them appropriate for large-scale models.

The rest of the paper is organized as follows. Section 2 summarizes previous work studying the impact of centroid connectors and transportation analysis zone structure when modeling local streets. Section 3 exemplifies the interaction of centroid connectors and added streets using a real transportation network model, while Section 4 introduces two centroid connector placement strategies, along with a performance metric to assess their performance. The results of several sensitivity analyses conducted on a different transportation network are reported in Section 5, and conclusions are discussed in Section 6.

## 2. LITERATURE REVIEW

This research proposes to address several network modeling related issues in a dynamic environment. The definition of dynamic user equilibrium (DUE) is the extension of Wardrop’s rule in the static case (2). It states that all demand between the same origin-destination (O-D) pair and departing in the same time interval will experience the same travel cost, and no user can improve their travel time by unilaterally changing the route. Following the pioneering work of Merchant and Nemhauser (3, 4), many researchers

1 have contributed to developing this field (5, 6). A comprehensive discussion on DTA can be found in  
2 Chiu et al. (7).

3       Transportation models are commonly used to describe transportation systems and simulate traffic  
4 flow. The level of detail incorporated in the network representation greatly affects the outcome of the  
5 model. The significance of this detail with respect to model results has been investigated in previous  
6 studies (8, 9, 10, 11, 12). Specifically, Bovy and Jansen (13) studied networks with different levels of  
7 detail and found that increasing the detail of the roadway network modeled always yielded better results,  
8 but with a diminishing return; only marginal improvement was achieved after a point. This relationship  
9 was found to be influenced by the level of congestion. When the network is not congested, the effect of  
10 added detail is minor. Under congested conditions, however, the traffic flow pattern when only higher  
11 functional class roadways are included does not follow the distribution of a more detailed network (14).  
12 As a result, the effects of congestion may not be properly represented.

13       Khatib et al. (15) investigated the impact of disaggregating TAZs for use with a statewide model.  
14 The researchers found that the number and size of TAZs, as well as location of centroids can affect travel  
15 demand modeling, and showed that disaggregating TAZs yields modeled link volumes that are closer to  
16 field-collected traffic counts. They noted that although prior literature indicates that the level of TAZ  
17 aggregation should be consistent with the network detail, their study showed that more network detail  
18 yields better results regardless of TAZ structure (though smaller TAZs are generally better). The authors  
19 later broadened the scope of their research to look at the interaction between TAZ structure and network  
20 detail (16). Their findings are consistent with the previous study showing that smaller TAZs provide  
21 model link volumes that are closer to field-collected counts.

22       Jeon et al. (17) studied this relationship further by evaluating the change in model results when  
23 going from a detailed to more aggregate-level model. They identified that TAZ structure and network  
24 detail have a significant impact on the results and emphasized the importance of matching the level of  
25 network detail to the TAZ aggregation. When going to a less detailed network, traffic flow shifts from  
26 local streets to major streets, representing the main source of aggregation error. Other research by Muñoz  
27 and Laval (18) has shown that local streets can provide alternate routes for some users to bypass  
28 bottlenecks, and may affect other user behavior as well.

29       The majority of this paper addresses issues with the centroid connectors. The available literature  
30 provides minimal information about placing connectors. Some general guidance has been provided  
31 regarding connector placement and the importance of the network nodes to which they are connected  
32 (19). Several studies (e.g., 20) have proposed splitting TAZs into smaller subzones to achieve more  
33 disaggregation and assigning one centroid to each of them. However, this approach introduces computer  
34 memory and computational time concerns. Friedrich and Galster (21) developed three methods for  
35 placing connectors in static traffic assignment (STA) application. As the first approach, each zone is  
36 divided into sectors and a connector link is created for each sector. Nodes located in areas with a high link  
37 density were selected in the second approach. In the last method, nodes within a specific threshold from  
38 the zone centroid are chosen. Qian and Zhang (22) investigated the influence of different connector  
39 configurations on STA results. They showed that traffic volumes are impacted by the connector layout  
40 and proposed an optimization algorithm to reduce volume to capacity ratios.

41       Some DTA modeling approaches do not utilize centroid connectors to model the loading of  
42 vehicles onto the network. Instead, they rely on network links specifically designated to distribute travel  
43 demand over a transportation analysis zone (23). While these “generation links” present advantages from  
44 a traffic simulation standpoint, they also require more complex assumptions at different stages of the  
45 assignment process, including the route search. Many practical applications still model roadway network  
46 entry/exit via centroid connectors

47       The primary purpose of this study is to determine the importance of modeling local streets and to  
48 address issues related to including them in a dynamic framework. In the past, little attention has been  
49 given to the problem of modifying centroid connectors along with adding network detail. In this paper,  
50 two strategies to modify the centroid connector configuration when minor roadways are added into the

1 network are introduced. The proposed methodology is tested on two different networks and the results  
2 show that the approach is quite flexible and can be applied universally.

### 3 **3. MODELING LOWER FUNCTIONAL CLASS ROADWAYS IN DTA MODELS**

4 This section investigates network-wide changes to traffic flow patterns as a result of the incorporation of  
5 local streets, when no subsequent adjustments are made to the centroid connector configuration. The  
6 Visual Interactive System for Transportation Algorithms (VISTA) (24) is used here to model two  
7 networks representing the same area, one of which includes several local streets in addition to the base  
8 system of arterials and collectors. In both networks the travel demand is specified using an O-D matrix  
9 representing the trips between TAZs and their time of departure. TAZs are represented using dummy  
10 nodes (centroids), connected to the roadway network via centroid connectors with abundant capacity and  
11 speed attributes so that traversing them has a negligible impact on the route choice. The model  
12 convergence is measured by the gap value, which represents the proximity of a solution to dynamic user  
13 equilibrium conditions (7). A zero gap represents a perfectly stable system (details about the gap  
14 computation can be found in (25)). The following sections describe the utilized data and numerical  
15 results.

#### 16 **3.1. Network Data and Experimental Design**

17 The base network is a model of the Austin, Texas downtown area, obtained from the metropolitan  
18 planning organization and further refined for application purposes. The base network has 1,314 links, 585  
19 nodes, 34 zones, 329 centroid connectors, and a total demand of 62,676 vehicles distributed in a two-hour  
20 period. The complete network includes a number of local streets that are not modeled in the base network.  
21 Figure 1 shows the links used in both of these networks. For preliminary testing, no additional  
22 modifications were made to the complete network; all inputs including demand, number of TAZs,  
23 centroid location, number of connectors per centroid and connector nodes were the same as the base  
24 network. The initial placement of centroid connectors is consistent with what was used by the local  
25 metropolitan planning organization. The objective of this practical example is to showcase how adding  
26 local streets (those with low capacity) to the model can change the recurrent flow patterns predicted by a  
27 DTA model. The two selected networks were run for the same number of iterations, which led to an  
28 appropriate and consistent convergence level in the base case.

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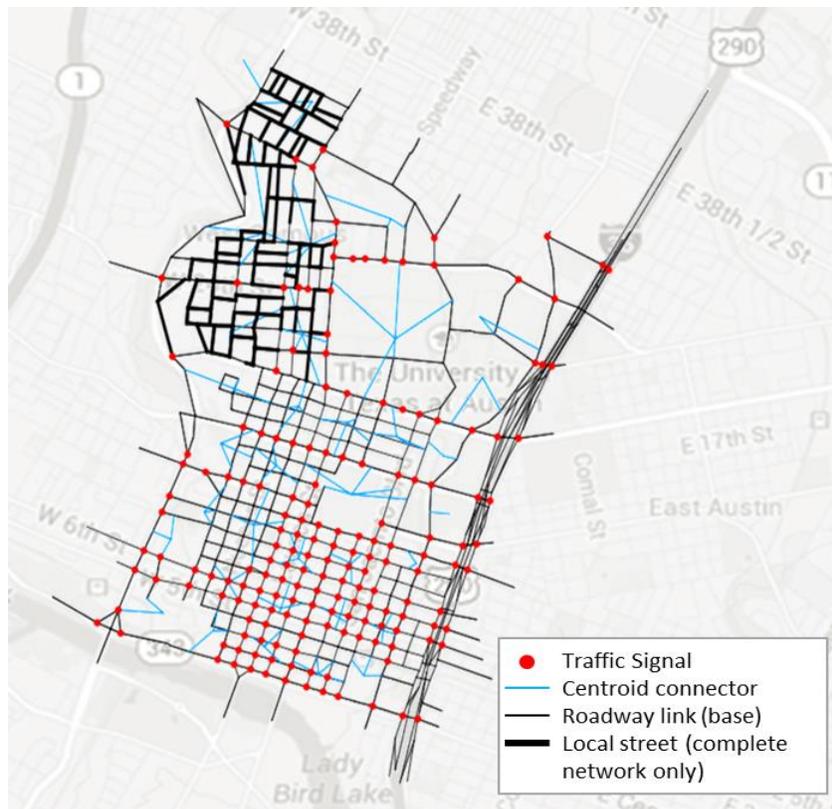


FIGURE 1 Downtown Austin base network and added local streets.

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### 3.2. The Impacts of Modeling Local Streets

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Does the addition of local streets significantly affect model performance and results? Such streets provide more routing alternatives for vehicles, and therefore can alter traffic flow patterns on adjacent roads. Prior research suggests that addition of network detail can improve model results, but should be accompanied with adjustments to the TAZ layout or how demand is loaded onto the network (15, 17). If the TAZ layout is already relatively disaggregate, but the connectors are not appropriately distributed, local traffic may still not use added minor roadways. This section further analyzes the impact of incorporating local streets on model performance and resulting traffic flow patterns, by comparing the DTA model results between the base and complete networks, without modifying the connector configuration.

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From the model performance standpoint, both networks reached near-equilibrium conditions within the specified number of iterations. Slightly better convergence was observed in the complete network (1.17 percent relative gap versus 1.47 percent), possibly as a result of reduced congestion due to the added capacity. This is consistent with conclusions from a study by Bovy et al. (13).

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The complete network yielded a total system travel time (TSTT) of 8,146 hours compared to 8,216 for the base network. Origin-destination travel time differences varied across the network, with some O-D pairs experiencing increased delays in the complete network. Most of the directly affected O-D pairs, defined as those that have at least one path utilizing the streets added in the complete network, were observed to experience travel time reductions, as anticipated. It is important to point out that not all of the vehicles traversing the new alternate routes experienced a lower travel time compared to the base case network, which is likely a result of the complex mechanisms that drive the equilibrium solution in assignment models.

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The simulation results show that the addition of local streets affected the route choice and experienced travel time for the modeled vehicles. However, since no additional modifications were made to the network, notably to the TAZ structure or configuration of centroids and connectors, local streets were observed to be bypassed by local traffic using the connector links, as the centroids were often

1 connected to nodes at the boundary of the TAZ (this is illustrated in Figure 2-b). With a zero travel cost  
 2 associated with the centroid connectors, there was no direct incentive for vehicles to take local streets  
 3 within the TAZs at the beginning or end of their trip. This connectivity issue can artificially lower the  
 4 amount of “local” traffic from nearby centroids on the local streets. As such, two modifications are  
 5 proposed here to handle this issue. Both strategies are based on reconfiguring the centroid connectors and  
 6 changing the way the demand is loaded onto, or unloaded from, the network.

## 7 **4. METHODOLOGY**

8 This study first seeks to verify the aforementioned findings using a customized performance metric, and  
 9 then investigates how the centroid connectors and associated demand should be distributed to further  
 10 improve model results. The aim is to more adequately execute the network loading process, to  
 11 appropriately distribute the demand across both existing and newly added roadways, and to ultimately  
 12 evaluate different strategies for completing this process automatically. If local streets are added without  
 13 reconsidering centroid connector placement, the results may not be realistic. For example, the connectors  
 14 may be linked to roadways along the periphery of the TAZ and thus, bypass added local streets that  
 15 residents are likely to use to leave their neighborhood and load them directly onto a boundary arterial.  
 16 This may limit the amount of local traffic assigned to local streets, making them more attractive for cut-  
 17 through traffic.

18 To address this issue, two modifications to the centroid connector placement are proposed in this  
 19 section. The first, more conventional approach redistributes the connectors in each TAZ by selecting the  
 20 closest nodes to link to the zone centroid, including those added with the new street segments. The second  
 21 strategy seeks to attain a more even distribution of entry/exit points throughout the TAZ by dividing each  
 22 zone into two concentric areas and generating a separate set of centroid connectors for each of them.  
 23 Further, a novel metric is introduced to assess the performance of centroid connector layout strategies  
 24 based on the corresponding traffic flow patterns on local streets.

### 25 **Strategy I: Closest Node Selection**

26 Assigning demand to nodes closer to the zone centroid, which represents the geographical center for each  
 27 TAZ, is anticipated to increase the share of local traffic on the local streets. To implement this strategy,  
 28 we first identify all nodes within each TAZ using ArcGIS software. A circular area of appropriate radius  
 29 is defined around the centroid of every zone  $i$ , and divided into  $N_i$  sectors, where  $N_i$  is the user-specified  
 30 number of desired centroid connectors. Each sector covers an area with central angle of  $2\pi/N_i$  and all the  
 31 corresponding zone nodes, and is associated with at most one centroid connector. The closest node to the  
 32 zone centroid is selected as the connector endpoint within a subarea. This strategy radially distributes  
 33 access and egress points around the centroid and within the zone.

### 34 **Strategy II: Bi-level Selection**

35 The bi-level centroid placement strategy is an extension of the approach described in Section 4.1, in  
 36 which two concentric areas are defined around each zone centroid. The radius of the inner area is defined  
 37 based on a threshold, computed as the average distance between each node in a TAZ and the  
 38 corresponding centroid, as shown in the equation below:

$$39 \quad th_i = \frac{1}{n_i} \sum_{j \in Z_i} d_j^i \quad (1)$$

40 where  $th_i$  is the threshold value for zone  $i$ ,  $n_i$  is the number of nodes in zone  $i$ , and  $d_j^i$  is Euclidean  
 41 distance from the zone  $i$  centroid to node  $j$ .  $Z_i$  defines the set of zone  $i$  nodes.

42 The outer area extends from the inner area to the boundaries of the TAZ. Travel demand from/to  
 43 the TAZ is split equally between both areas. Both areas are divided into sectors as described in Section  
 44 4.1, and at most one connector is generated for each of these sectors.

Figure 2 illustrates the centroid connector layout for both of the strategies described in this section, and for the case study described in Section 3. The green lines and points represent network links and nodes, respectively. Centroid connectors are differentiated using red lines, and the zonal boundary is shown in dark blue. Figure 2-b demonstrates how most of the added streets are bypassed by the centroid connectors when the zone centroid is not reconnected. The strategies proposed in this work generate entry points on the added roadway segments.

### Locality Factor

To explore the impact of each centroid connector configuration on network utilization, an appropriate performance measure is required. Intuitively, it is expected that local streets will carry mostly local traffic (i.e., trips destined to or originating from a nearby entry point), although some cut-through traffic is anticipated. The locality factor proposed in this work assesses the usage of local streets by local traffic in the model. Let  $d_{ij}$  be the path-link distance between a local street segment  $i$  and all vehicles traveling on path  $j$ :

$$d_{ij} = \min\{d_{b_i}^{O_j}, d_{b_i}^{D_j}, d_{e_i}^{O_j}, d_{e_i}^{D_j}\} \quad (2)$$

where:

$d_{b_i}^{O_j}$  Euclidean distance between link  $i$  beginning and path  $j$  origin

$d_{b_i}^{D_j}$  Euclidean distance between link  $i$  beginning and path  $j$  destination

$d_{e_i}^{O_j}$  Euclidean distance between link  $i$  end and path  $j$  origin

$d_{e_i}^{D_j}$  Euclidean distance between link  $i$  end and path  $j$  destination

A large path-link distance means that the origin and destination of vehicles on path  $j$  are far from link  $i$  and indicates that the corresponding trips are not “local”. The inverse of  $d_{ij}$  can be used as a measure of the proximity of path  $j$  to link  $i$ . We refer to the weighted average of such value as the locality factor:

$$\gamma_i = \frac{1}{f_i} \sum \frac{F_j}{d_{ij}} \delta_{ij} \quad (3)$$

where:

$\gamma_i$  link  $i$  locality factor

$f_i$  total flow on link  $i$

$F_j$  path  $j$  flow

$d_{ij}$  distance between link  $i$  and path  $j$

$\delta_{ij}$  1 if link  $i$  is on path  $j$ , 0 otherwise

Let  $L$  denote the set of added local streets. The total locality factor (TLF) for the network under study can be defined as:

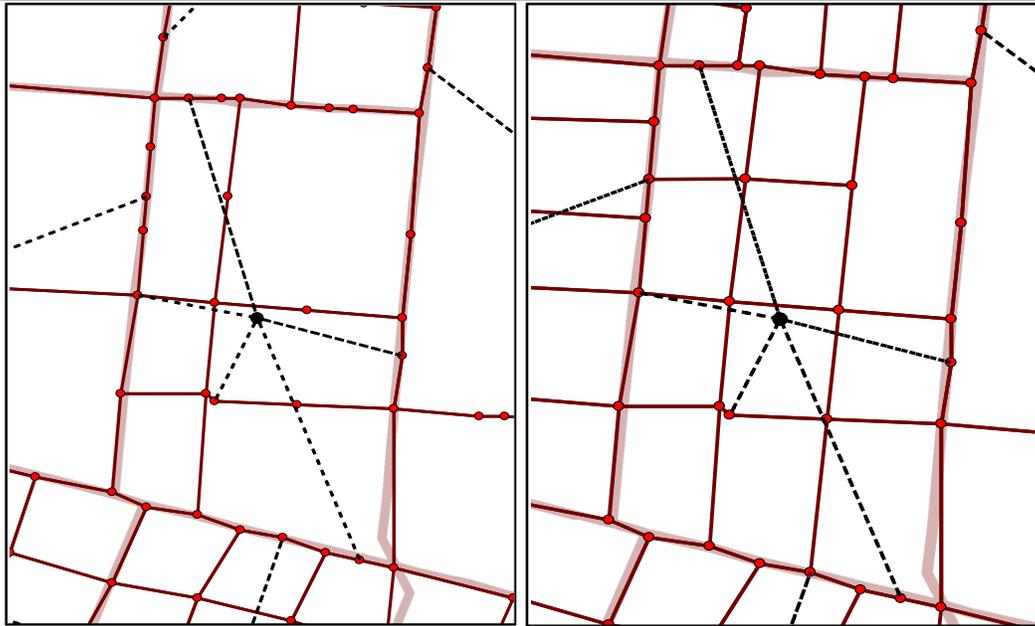
$$TLF = \sum_{i \in L} \gamma_i \quad (4)$$

The locality factor is designed to assess the utilization of added roadways by local traffic. This factor measures the ability of the model to account for additional network detail in the assignment process, thus facilitating an evaluation of the connector placement and demand distribution relative to the network layout. We note that there are alternative formulations of  $d_{ij}$ , such as the selection of an average value of all the considered distances, that may lead to different versions of the locality factor. The rationale behind our proposed definition can be explained through an example: consider a one-way street  $i$ , and a path  $j$  for which the origin is close to the end of the corresponding link  $e_i$ , and the destination is far from both,  $e_i$  and the start of the corresponding link  $b_i$ . Further, let's assume that link  $i$ , is long, and as a result the trip origin is also far from  $b_i$ . Flow on such path should be considered as local traffic, and the only metric that ensures such outcome is the minimum of the distances described above.

1

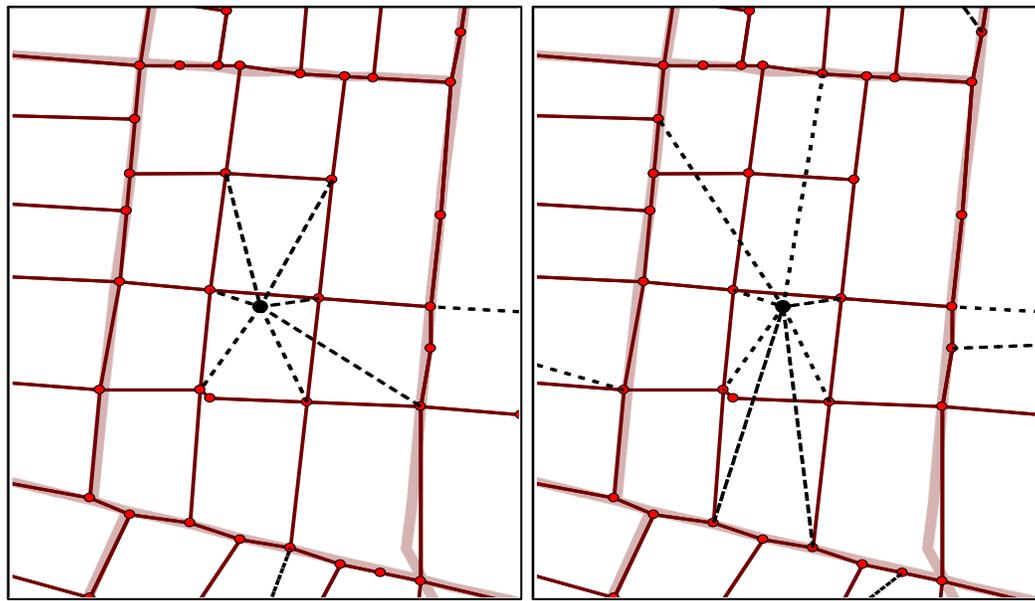


2  
3  
4



(a) Base Network Layout

(b) Complete Network Layout



(c) Closest Node Selection Layout

(d) Bi-Level Selection Layout

5  
6  
7  
8

FIGURE 2 Centroid connector layout for each tested network configuration for the same TAZ.

9 **5. RESULTS**

10 This section discusses the results obtained when implementing the strategies described in Section 4 to a  
 11 real transportation network. Most of the experiments described below are conducted on the network  
 12 described in Section 3.1, and additional sensitivity tests were run on a second network described in  
 13 Section 5.5.

14 For the Austin network, at most, eight connectors were added per TAZ under both reconfiguration  
 15 strategies (in case of bi-level, up to four inner connectors and four outer connectors) and all models were  
 16 run until reaching convergence. Table 1 reports the network parameters for each configuration. A

summary of the results for each tested strategy, including convergence levels and average system performance metrics, are presented in Table 2.

**TABLE 1 Characteristics of the studied networks**

| Network          | # of Links | # of Nodes | # of Zones | # of Connectors |
|------------------|------------|------------|------------|-----------------|
| Base Network     | 1314       | 585        | 34         | 329             |
| Complete Network | 1506       | 627        | 34         | 329             |
| Closest          | 1506       | 627        | 34         | 575             |
| Bi-level         | 1506       | 627        | 34         | 571             |

**TABLE 2 DTA results using the studied strategies**

| Network          | TSTT (hr) | Average Travel Time (min) | Cost Gap Percentage |
|------------------|-----------|---------------------------|---------------------|
| Base Network     | 8216.24   | 7.87                      | 1.47%               |
| Complete Network | 8146.46   | 7.80                      | 1.17%               |
| Closest          | 8121.08   | 7.77                      | 1.13%               |
| Bi-level         | 8206.61   | 7.86                      | 1.13%               |

The following sections describe the behavior of the locality factor in our numerical experiments, and present four more tests designed to assess the sensitivity of the proposed bi-level approach to various input parameters, and to compare model results to field data.

### 5.1. Locality Factor

The TLF (Equation 4) values were computed for the three network layouts incorporating the local streets; complete, closest node, and bi-level and are presented in Table 3.

**TABLE 3 Total locality factor**

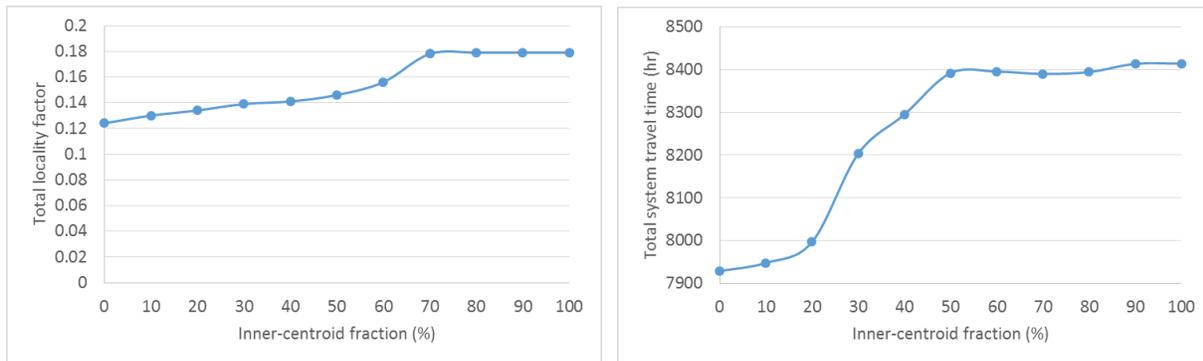
| Network  | Total Locality Factor |
|----------|-----------------------|
| Complete | 0.087                 |
| Closest  | 0.092                 |
| Bi-Level | 0.14                  |

As expected, the lowest locality factor is obtained from the model run of the complete network without redistribution of the centroid connectors. Again, since the connectors extending from nearby centroids often bypass the added street segments, much of the local traffic is not assigned to these links. Implementing the closest node selection process leads to a slight increase (less than 5 percent) of the locality factor. The small impact observed for this scenario is likely a result of the fact that much of the TAZ demand is assigned to the far-reaching connectors in the equilibrium solution, given the lack of additional constraints. The bi-level selection methodology, however, increases the TLF by a factor of 1.6. The increase is attributable to the division of the zone into two areas, which implicitly enforces a more even distribution of network entry/exit points across the TAZ. Clearly, redistributing vehicles over a new connector layout and constraining a portion of the demand to the inner area of the zone results in more usage of local streets by local traffic.

### 5.2. Sensitivity of the Bi-Level Approach to Demand Distribution

This section investigates the effects of applying different split ratios when distributing TAZ demand between the inner and outer areas associated with the bi-level approach. Figure 3 presents the effect of demand distribution, represented by the demand split ratio, on the locality factor (left) and TSTT (right). As expected, assigning a higher proportion of the demand to the inner area resulted in a larger share of

1 local demand on the added links. This is a result of forcing more trips to start or finish within the inner  
 2 TAZ area, which is where many of the local streets were added. Also, since accessing the zone's  
 3 boundary requires more travel time from inner subcentroids compared to outer subcentroids, we observe  
 4 an increase in the TSTT (Figure 3) with the inner-centroid fraction (the percentage of demand assigned to  
 5 the inner subcentroid), which eventually stabilizes. This increase may also reflect the impact of forcing  
 6 some trips to utilize streets with lower capacities and speed limits.



8  
 9  
 10 **FIGURE 3** The effect of inner-centroid fraction on locality factor (left) and TSTT (right) using the bi-level  
 11 selection approach.

### 12 **5.3. Effect of Signalized Intersections at Entry Points**

13 The presence of traffic signals at network entry/exit points may affect the traffic flow patterns  
 14 resulting from simulation-based DTA models. The magnitude and mechanisms for this impact depend on  
 15 the characteristics of the corresponding traffic simulator. VISTA uses a cell-transmission-model approach  
 16 for traffic propagation (27), in which signalized intersection delay, queues and vehicular movements may  
 17 be affected by the presence of centroid connectors. In the context of our DTA implementation centroid  
 18 connectors are modeled as an additional leg at signalized intersections. The flow in and out of centroid  
 19 connectors is not restricted by traffic signals, which may increase the delay experienced by vehicles  
 20 performing “legitimate” turning movements at the intersection.

21 The network layout presented in this section is designed to avoid connecting centroids to nodes at  
 22 signalized intersections. This means that vehicles can enter/exit the simulated roadway network at an  
 23 unsignalized intersection only. It should be noted that the available node set is limited when avoiding  
 24 signalized intersection compared to previous scenarios where there was no restriction on a candidate  
 25 connector node. As a result, the number of centroid connectors generated under this scenario is 495 which  
 26 is 76 fewer than the case including signalized intersections. The locality factor was observed to increase  
 27 by 14 percent when signalized intersections were avoided. This reflects the fact that, in general, signals  
 28 are installed at the intersections of major streets rather than local streets with low volumes. Avoiding  
 29 signalized intersections implicitly favors the use of entry points on local streets, and the results follow a  
 30 similar trend to that described in the previous section. A similar analysis explains an observed increase in  
 31 TSTT.

### 32 **5.4. Sensitivity to the Number of Centroid Connectors**

33 This section analyzes the impacts of the maximum number of centroid connectors allowed per zone on the  
 34 locality factor and overall system performance. Table 4 presents the corresponding results, which exhibit  
 35 relatively minor variations in the locality factor, with the exception of the single centroid connector case.  
 36 The use of only one connector resulted in a high TSTT due to the limited accessibility in each sub-zone.  
 37 This limited connectivity also yielded a higher locality factor, as vehicles were forced to pass through the  
 38 closest node and subsequent links (representative of local streets) to access the centroid.

1 More alternative routes are provided for vehicles when a larger number of centroid connectors are  
 2 used, which leads to a reduction in the locality factor. Such decrease suggests a trend to avoid minor roads  
 3 when alternatives are present. The increased number of entry points was also observed to improve overall  
 4 system performance (TSTT), likely as a result of the congestion reduction achieved by avoiding excessive  
 5 concentration of trip ends at any particular locations.  
 6  
 7

**TABLE 4 Network statistics when varying the number of centroid connectors per sub-zone**

| Number of Connectors per Sub-Zone | Demand Split | # of Centroid Connectors | TLF  | TSTT (hr) |
|-----------------------------------|--------------|--------------------------|------|-----------|
| 1                                 | 50-50        | 239                      | 0.55 | 8748.87   |
| 2                                 | 50-50        | 371                      | 0.25 | 8310.6    |
| 3                                 | 50-50        | 471                      | 0.20 | 8318.21   |
| 4                                 | 50-50        | 571                      | 0.15 | 8317.08   |
| 5                                 | 50-50        | 653                      | 0.14 | 8153.54   |
| 6                                 | 50-50        | 691                      | 0.12 | 8071.98   |
| 7                                 | 50-50        | 773                      | 0.10 | 8057.52   |
| 8                                 | 50-50        | 811                      | 0.11 | 8010.96   |

8 **5.5. Comparison with Field Measurements**

9 As a final evaluation of the methodology, field travel times within the extent of a network model for  
 10 Williamson County, Texas were compared against estimated corridor travel times from DTA models.  
 11 Separate models were built to reflect each of the proposed centroid connector placement strategies. The  
 12 Williamson County base network has 1,281 nodes, 158 zones, 2,617 links, and a total demand of 134,896  
 13 vehicles for the analyzed AM peak period. Travel times along 9 corridors in each direction (covering 365  
 14 links) were collected in the field for a related project. The average error in the estimated travel times  
 15 throughout the AM peak period was used as a performance metric and are summarized in Table 5. The  
 16 best performance is achieved using the bi-level approach by assigning 90% of demand to the inner areas.  
 17

18 Even though the improvement in the average travel time error is marginal, the maximum error  
 19 shows a more significant improvement. These relatively minor changes reflect a positive trend in terms of  
 20 model behavior and are promising in reducing and bounding the error over the whole network. Also, it  
 21 should be noted that the base network was calibrated with hours of work and detailed study of population  
 22 distribution and by taking into account the geographic properties of the region. Placing the connectors  
 23 through the proposed bi-level approach is an easy and tractable task and requires small manual effort  
 24 while still being capable of observing the network and demand properties.

25 There are several reasons why models results do not reflect field conditions exactly. DTA model  
 26 are designed to capture the system performance on a typical day, and are not expected to exactly  
 27 reproduce observed conditions on a given day. Additionally, the validation data was collected using  
 28 relatively few runs of probe vehicles, and there may be biases introduced by lane choice or circumstantial  
 29 delays at intersections.  
 30

**TABLE 5 Validation results based on field data (Williamson County, Texas).**

| Network Layout          | Base Network |     |      | Closest Network |     |      | Bi-level Network |     |     |
|-------------------------|--------------|-----|------|-----------------|-----|------|------------------|-----|-----|
|                         | min          | max | avg  | min             | max | avg  | min              | max | avg |
| Travel Time Error (min) | 0.03         | 5.4 | 1.23 | 0.03            | 5.4 | 1.28 | 0.02             | 4.2 | 1.1 |

## 6. CONCLUSIONS

Advanced transportation models, such as DTA, often require adding detail to the network representation used for regional long-range planning. This paper explored the impacts of adding minor roadways on route choice and flow propagation in DTA models, and how traffic on these streets is affected by the layout of centroid connectors. Numerical experiments were used to show that incorporation of minor roadways without any changes to the centroid connector layout may lead to counterintuitive and possibly inaccurate usage patterns characterized by a high fraction of cut-through traffic on local facilities. To mitigate this issue, two strategies were proposed to redistribute the connectors emanating from each centroid in order to obtain a more realistic estimate of the proportion of local traffic using local streets. A new performance metric was also introduced, the locality factor, to quantify the utilization of roadway segments by demand generated from (or attracted to) nearby centroids. Numerical results, including sensitivity analyses and comparisons with field data using two real networks, indicate that the bi-level method and selection process results in the highest locality factor and generally achieves better model performance metrics. Overall, the results underscore the importance of enforcing a realistic distribution of trip entry/exit points throughout TAZs when simulation-based models are used. While other methodologies may be used to attain this goal, the strategies proposed in this paper are flexible and simple to implement within most existing large-scale assignment frameworks.

Future research will focus on the development of techniques to customize the demand allocation within a TAZ based on demographic and employment data. Roadway capacities and information at the parcel-level will be used to generate a radial distribution of the centroid connectors that better reflects the location of business and residences within the TAZ, and to revise the allocation of demand to the different buffer zones. The use of multi-level centroid connector placement strategies, and the use of novel data sources to compute the locality factor on real transportation networks will also be investigated.

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## 8. REFERENCES

- [1] Meyer, Michael D., and Eric J. Miller. *Urban transportation planning: a decision-oriented approach*. 2001.
- [2] Mahmassani, Hani, and Robert Herman. "Dynamic user equilibrium departure time and route choice on idealized traffic arterials." *Transportation Science* 18.4 (1984): 362-384.
- [3] Merchant, Deepak K., and George L. Nemhauser. "A model and an algorithm for the dynamic traffic assignment problems." *Transportation Science* 12.3 (1978): 183-199.
- [4] Merchant, Deepak K., and George L. Nemhauser. "Optimality conditions for a dynamic traffic assignment model." *Transportation Science* 12.3 (1978): 200-207.
- [5] Peeta, Srinivas, and Hani S. Mahmassani. "System optimal and user equilibrium time-dependent traffic assignment in congested networks." *Annals of Operations Research* 60.1 (1995): 81-113.
- [6] Peeta, Srinivas, and Athanasios K. Ziliaskopoulos. "Foundations of dynamic traffic assignment: The past, the present and the future." *Networks and Spatial Economics* 1.3-4 (2001): 233-265.
- [7] Chiu, Yi-Chang, et al. "Dynamic traffic assignment: A primer." *Transportation Research E-Circular* E-C153 (2011).
- [8] Cullen, D., H. Kuhn, and M. Frank. *Aggregation in Network Models for Transportation Planning*. No. DOT-TSC-RSPD-78-7 Final Rpt.. 1978.
- [9] Zipkin, Paul H. "Bounds for aggregating nodes in network problems." *Mathematical programming* 19.1 (1980): 155-177.

- 1 [10] Jansen, G. R. M., and P. H. L. Bovy. "The effect of zone size and network detail on all-or-nothing  
2 and equilibrium assignment outcomes." *Traffic Engineering & Control* 23.HS-033 448 (1982).
- 3 [11] Sbayti, H., M. El-Fadel, and I. Kaysi. "Effect of roadway network aggregation levels on modeling  
4 of traffic-induced emission inventories in Beirut." *Transportation Research Part D: Transport and  
5 Environment* 7.3 (2002): 163-173.
- 6 [12] Avineri, Erel. "Complexity theory and transport planning: Fractal traffic networks." (2010).
- 7 [13] Bovy, P. H. L., and G. R. M. Jansen. "Network aggregation effects upon equilibrium assignment  
8 outcomes: An empirical investigation." *Transportation Science* 17.3 (1983): 240-262.
- 9 [14] Friesz, Terry L. "Transportation network equilibrium, design and aggregation: key developments  
10 and research opportunities." *Transportation Research Part A: General* 19.5 (1985): 413-427.
- 11 [15] Khatib, Zaher, Kang-tsung Chang, and Yanmei Ou. "Impacts of analysis zone structures on  
12 modeled statewide traffic." *Journal of transportation engineering* 127.1 (2001): 31-38.
- 13 [16] Chang, Kang-tsung, Zaher Khatib, and Yanmei Ou. "Effects of zoning structure and network  
14 detail on traffic demand modeling." *Environment and Planning B* 29.1 (2002): 37-52.
- 15 [17] Jeon, Jea-Ho, et al. "Effects of spatial aggregation level on an urban transportation planning  
16 model." *KSCE Journal of Civil Engineering* 16.5 (2012): 835-844.
- 17 [18] Muñoz, Juan Carlos, and Jorge A. Laval. "System optimum dynamic traffic assignment graphical  
18 solution method for a congested freeway and one destination." *Transportation Research Part B:  
19 Methodological* 40.1 (2006): 1-15.
- 20 [19] de Dios Ortuzar, Juan, and Luis G. Willumsen. *Modelling transport*. Wiley, 1994.
- 21 [20] Mann, W. W. "B-node model: new subarea traffic assignment model & application." *Eighth TRB  
22 Conference on the Application of Transportation Planning Methods*. 2002.
- 23 [21] Friedrich, Markus, and Manuel Galster. "Methods for generating connectors in transport planning  
24 models." *Transportation Research Record: Journal of the Transportation Research Board* 2132.1  
25 (2009): 133-142.
- 26 [22] Zhang, H. M. "On centroid connectors in static traffic assignment: Their effects on flow patterns  
27 and how to optimize their selections." *Transportation Research Part B: Methodological* 46.10  
28 (2012): 1489-1503.
- 29 [23] Chiu, Yi-Chang, Xuesong Zhou, and Jessica Hernandez. "Evaluating urban downtown one-way  
30 to two-way street conversion using multiple resolution simulation and assignment  
31 approach." *Journal of Urban Planning and Development* 133.4 (2007): 222-232.
- 32 [24] Waller, S. T., and A. K. Ziliaskopoulos. "A visual interactive system for transportation  
33 algorithms." *78th Annual Meeting of the Transportation Research Board, Washington, DC*. 1998.
- 34 [25] Levin, Michael W., et al. "Improving the Convergence of Simulation-based Dynamic Traffic  
35 Assignment Methodologies." *Networks and Spatial Economics*(2014): 1-22.
- 36 [26] Daganzo, Carlos F. "The cell transmission model: A dynamic representation of highway traffic  
37 consistent with the hydrodynamic theory." *Transportation Research Part B: Methodological* 28.4  
38 (1994): 269-287.

39

# Using Parcel-level Data to Inform Centroid Connector Placement: A Dynamic Traffic Assignment Application

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|        |       |       |
|--------|-------|-------|
| Text   | -     | 4,820 |
| Table  | 4×250 | 1,000 |
| Figure | 4×250 | 1,000 |
| Total  | -     | 6,820 |

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**ABSTRACT**

Simulation-based dynamic traffic assignment (DTA) models are particularly sensitive to the topological detail of the traffic network, including the location of centroid connectors. Traditional centroid connector placement strategies may lead to excessive congestion and unrealistic traffic patterns, while manual network refinement is prohibitive in large regional models. This research effort utilizes parcel-level data to inform an automated centroid connector placement methodology with the goal of producing more realistic network loading patterns. Parcel-level data is used to allocate travel demand between two sub-regions in each considered traffic analysis zone (TAZ), and to select appropriate nodes for the centroid connector placement. Numerical experiments, conducted on a medium-size network in the Austin, TX region, suggest that the proposed approach better approximates both corridor travel times and traffic counts throughout the network, with improvements of more than 40 percent in travel time estimation accuracy, and 12 percent in traffic count estimation. While the application proposed in this paper is focused on DTA models, the methodologies can be extended to benefit other modeling approaches, including static traffic assignment models and DTA models that use generation links.

**Keywords:** dynamic traffic assignment, network modeling, network loading, centroid connectors

## 1. INTRODUCTION

The use of advanced transportation planning models allows decision makers to better understand the spatial and temporal aspects of transportation systems performance. Among these, dynamic traffic assignment (DTA) models (1) have been increasingly used in practice due to their ability to capture the propagation of congestion and the impact of a variety of traffic control and management strategies (see Appendix of (2) for case studies utilizing DTA in modeling efforts).

Advanced models often require more detailed inputs, including a more accurate representation of the transportation network. However, previous research suggests that improving the network representation without considering how travel demand is loaded onto the network may not yield the desired benefits; additionally, it's been shown numerically that the placement of centroid connectors plays a significant role in the results of both static and dynamic traffic assignment models (3, 4). While traditional centroid placement techniques may not suffice towards this end, manual refinement of centroid connectors may be prohibitive in large regional models.

This research effort utilizes parcel-level data to inform an automated centroid connector placement methodology with the goal of producing more realistic network loading patterns. We extend a technique observed to improve the usage pattern of local streets in DTA models (3) to account for built square footage in the centroid placement decision. Parcel-level data is used to allocate travel demand between two sub-regions in each considered traffic analysis zone (TAZ) and to select appropriate nodes for the centroid connector placements.

Numerical experiments, conducted on a medium-size network in the Austin, TX region, suggest that the proposed approach better approximates both corridor travel time and traffic counts. Though this research effort focuses on DTA implementations that utilize centroid connectors to load the network (e.g. VISTA, DTALite, Cube Avenue), it is hypothesized that the density of parcels could be utilized to inform static traffic assignment models, as well as modeling approaches that employ generation links (e.g. Dynus-T, DYNASMART.) .

The rest of this paper is organized as follows. Section 2 summarizes previous work concerning the loading of trips onto networks for traffic assignment models and the use of parcel data in planning. Section 3 details the proposed methodology. Section 4 provides detail on the experimental design. Section 5 presents the numerical analyses, while Section 6 describes the results. Lastly, Section 7 offers concluding remarks and outlines possible future research directions.

## 2. LITERATURE REVIEW

In dynamic traffic assignment there are generally two accepted methodologies for loading demand onto a network: centroid connectors and generation links (1). While centroid connectors are widely used, a review of available literature on how to load trips coded in origin-destination matrices onto a network shows that guidance on the placement of centroid connectors is largely overlooked. This is not unreasonable due to static assignment's rough abstraction of the real world network structure. Unfortunately, this appears to have carried over into dynamic traffic assignment, despite the increases in the fidelity of the network representations. In fact, in both the DTA primer (1) and the guidebook on the utilization of DTA in modeling (2), the main guiding remark on centroid connector placement is to avoid creating unrealistic congestion points. The primer and guidebook recommend accomplishing this via the intelligent placement of connectors and generation links and avoiding the placement of connectors at signalized locations. The following sections describe previous efforts concerning the placement of

centroid connectors in DTA applications, and the use of parcel data in the context of transportation planning.

## **2.1 Centroid Connectors in DTA Models**

Work by Qian and Zhang found that the placement of centroid connectors plays a significant role in the results of static traffic assignment (STA) models; their research suggests that the results become unstable when connectors are arbitrarily assigned (4). They also concluded that the observed issues did not improve by simply increasing the number of connectors; thus, they recommend future research into the optimization of connector placement. Other researchers have observed variability in DTA results as a function of changes to the centroid connector structure (3, 5).

The work conducted by Jafari et al. explores the impacts of centroid connector placement on the use of local streets, and proposes a methodology that increases the proportion of “local” traffic that utilize such facilities (3). This is accomplished by defining two zones within each TAZ and splitting the total demand to/from the corresponding zone using an arbitrary fraction that is constant across TAZs. The inner and outer subzones are concentric areas, where the inner subzone radius is a function of the average distance of the nodes in an individual TAZ. The demand for each subzone is assigned to the network at the  $n$  nodes within the subzone that are nearest to the zone centroid (based on the Euclidean distance). The target number of entry nodes in each subzone is pre-specified by the user when the new centroid connector structure is created. This research effort found that the 90/10 inner-to-outer subzone demand split resulted in the highest network locality factor, a performance indicator that measures how much of the traffic on lower functional class streets internal to the TAZ is local and not simply cutting through (3).

## **2.2 Parcel Data in Transportation Planning**

Another important aspect of this project is the use of parcel data as a proxy for demand. The use of parcel data in the planning process is relatively new; however, it has been utilized as a way to approximate demand in several fields including water resources (6) and transportation planning.

Activity based models are beginning to explore the use of parcel-level data for demand modelling efforts. Sacramento Area Council of Government was the first major metropolitan planning organization (MPO) to utilize parcel-level data in travel demand modeling efforts when they incorporated land-use policy and planning through its Preferred Blueprint Scenario in December 2004 (7). The SACOG activity based model (SACSIM) uses parcel-level data, instead of TAZs, in order to be able to answer questions about development patterns, street patterns, and proximity to transit services.

This research effort seeks to utilize parcel data in a new methodology for the data driven placement of centroid connectors. The goal is to advance prior work to develop guidance on the more accurate placement of centroid connectors without requiring visual inspection and excessive model calibration to ensure connectors are not placed in locations that will create artificial bottlenecks, and to ensure the generated connector structure results in data supported network flows. A review of available literature indicates that a process that achieves these objectives is largely absent. The methodologies proposed by this research are expected to facilitate producing more realistic network loading patterns across a variety of modeling approaches.

### 3. METHODOLOGY

The motivation of this research is to develop an automated centroid connector placement strategy that uses parcel data to generate network entry/exit points consistent with the likely location of activities within a TAZ, thus achieving more realistic traffic patterns on local and major streets.

In the proposed approach, two concentric areas are defined per TAZ, an inner and an outer subzone. The centroid splitting strategy was introduced by Jafari et al. in order to attain more realistic traffic patterns on networks with detailed representations of minor streets (3). This work extends previous efforts by using parcel data to automatically determine TAZ-specific inner-to-outer subzone demand splits, and to select appropriate entry nodes within each subzone.

The following sections provide further detail on the main components of the proposed approach, including initial data processing steps. The methodology was implemented in Java, while most of the pre-processing steps were accomplished using GIS software.

#### 3.1 Data Preprocessing

Data preprocessing was necessary for both parcel-level and traffic network data. For the latter, the proposed methodology requires distinguishing between centroid nodes and regular “eligible” nodes. The “eligible” list only includes the network nodes that are reasonable entry/exit points (e.g. excludes nodes on limited access facilities). GIS software was used to assign a TAZ ID to each eligible node through a one-to-many approach. This allows nodes along TAZ borders to be assigned to each neighboring zone, thus making them eligible for connector placement from each corresponding centroid. As such, the match operation selected in the software tool assigned nodes a particular TAZ ID if it was within a specified distance of the TAZ boundary. The authors found that a buffer distance of five feet led to the inclusion of nodes that lay along the border between TAZs without adding superfluous nodes.

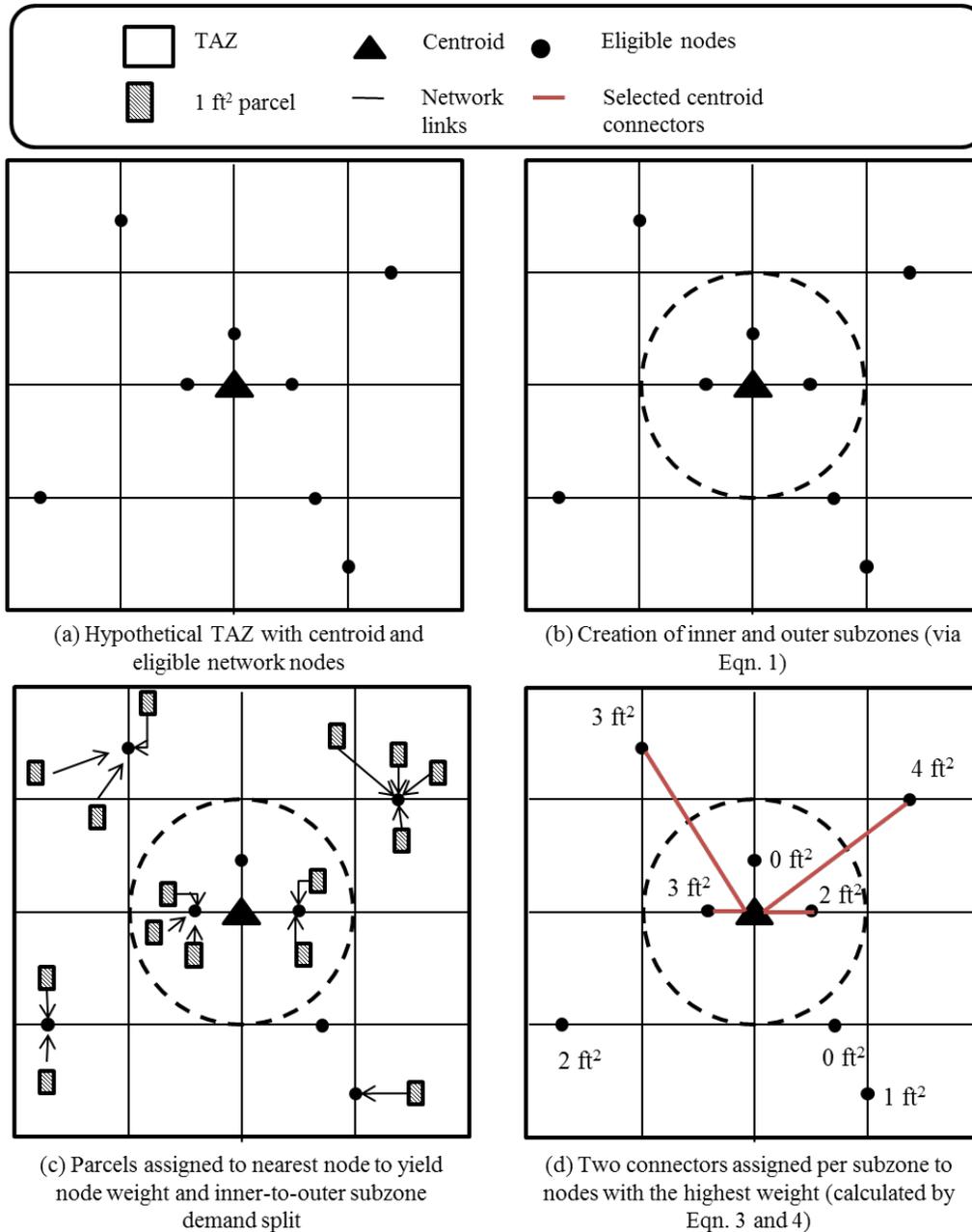
Parcels, originally geocoded as polygons, were translated into point data using GIS software to facilitate the algorithmic implementation of the proposed methodology. Relevant information for each parcel point includes coordinate data, square footage, corresponding TAZ ID, and an identification of the closest eligible node ID. The square footage of every residential and commercial land parcel located within a TAZ was then assigned to the node nearest to the center of the parcel, by Euclidean distance. Each parcel was assigned to a single node to avoid inappropriately biasing the demand distribution. This seeks to approximate reality, as the most densely developed areas in a TAZ are presumably going to generate the most demand on the real-world network.

#### 3.2 Dividing the TAZ into an Inner and Outer Subzone

The algorithm for the data driven placement of centroid connectors first divides the TAZ into two concentric areas: an inner subzone and an outer subzone (see Figure 1b). The motivation behind this decision was supported by previous research: having two subzones was found to achieve a more even distribution of entry/exit points throughout the TAZ (3). The inner subzone’s radius was computed as the average distance between each node in the selected TAZ (i.e. each potential entry location into the network) and the TAZ’s centroid, as shown in the following equation (3):

$$r_i = \frac{1}{n_i} \sum_{j \in Z_i} d_j^i \quad (1)$$

where  $r_i$  is the threshold value for zone  $i$ ,  $n_i$  is the number of nodes (potential entry locations) in zone  $i$ , and  $d_j^i$  is the Euclidean distance from zone  $i$ 's centroid to node  $j$ .  $Z_i$  defines the set of nodes that belong to zone  $i$ . In terms of implementation, the process effectively splits each centroid into two: a centroid for the inner subzone and a centroid for the outer subzone.



**FIGURE 1 Pictorial Representation of Methodology**

### 3.3 Determining the Demand Split for the Inner and Outer Subzones

Based on the data produced by the preprocessing described above, each parcel was assigned to the node it was nearest to in the network by Euclidean distance (see Figure 1c); note that a node  $n$  is considered

accessible to a zone  $z$  if a parcel belonging to zone  $z$  is assigned to node  $n$ . Parcels, especially at zone  $z$ 's boundary, may be assigned to a node  $n$  in a different zone  $z'$ , and in this way that node  $n$  is accessible from zone  $z'$  even though node  $n$  is outside the zone  $z'$ 's boundary; this is argued as an acceptable process as, in reality, zone boundaries do not exist.

The weight of each node  $n$  is equal to the total built square footage of parcels that were assigned to it. The demand split for each TAZ's inner and outer subzone was computed by summing the weight of all nodes that fall spatially within each subzone and dividing by the total weight of all parcels that are accessible to the TAZ. This is demonstrated mathematically in equations 2 and 3:

$$w_i = \frac{\sum_{i \in I} n_i}{\sum_{z \in Z} n_z} \quad (2)$$

$$w_o = 1 - w_i \quad (3)$$

where  $w_i$  is the weighted proportion of the demand that belongs to the inner subzone,  $n_i$  is the parcel weight assigned to node  $i$ ,  $n_z$  is the parcel weight assigned to node  $z$ ,  $w_o$  is the weighted proportion of the demand that belongs to the outer subzone,  $I$  is the set of nodes that belong to the inner zone, and  $Z$  is the set of nodes that belong to the TAZ where  $I$  is a subset of  $Z$ .

For example, if a TAZ housed parcels that summed to 100,000 square feet, where 75,000 square feet was assigned to nodes that fell spatially within the inner subzone, the demand ratio would be 3-to-1 inner-to-outer split. Thus, if the representative centroid for this TAZ had a demand of 100 vehicles, 75 vehicles would be assigned to enter the network within the inner subzone and the remaining 25 vehicles would enter through nodes in the outer subzone. This is explained mathematically in equations 4 and 5:

$$d_i = w_i * D \quad (4)$$

$$d_o = w_o * D \quad (5)$$

where  $d_i$  is the demand that is assigned to the network via connectors in the inner subzone,  $d_o$  is the demand that is assigned to the network via connectors in the outer subzone, and  $D$  is the total demand for the TAZ.

This represents an advancement of prior work, as the demand split is unique to each TAZ and not a "one-size-fits-all" approach. There are two exceptions to this rule: in the case of a subzone having no parcel information, or zero built square footage, 100 percent of the demand is assigned to the other subzone; in the case of no parcels residing in a TAZ, or zero built square footage, the demand is split 50/50 between the two subzones. The split of 50/50 was selected because it was argued that without additional network, demand, or development detail in the area, a rational case cannot be made to allocate demand asymmetrically.

### 3.4 Selecting the Entry/Exit Nodes

The number of centroid connectors ( $n$ ) per subzone is a user input variable requiring sensitivity analysis, which is consistent with prior studies. This project builds on the methodology identified in prior research for selecting entry/exit nodes. In work by Jafari et al.,  $n$  entry nodes are selected based on their distance to the TAZ centroid (3). In this experiment, the entry nodes for each subzone are the  $n$  highest weighted nodes in each subzone (see Figure 1d). In the case of a TAZ with no parcels, the entry nodes

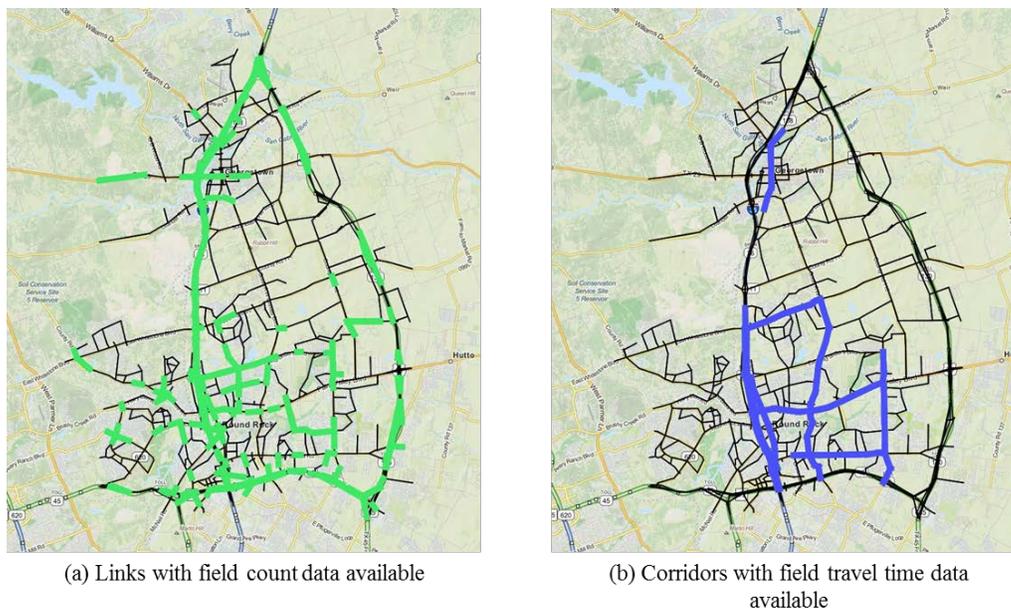
are selected using the previous method whereby the  $n$  nodes chosen in each subzone are the closest, defined by Euclidian distance, to the centroid of the parcel-less TAZ.

#### 4.0 NETWORK DATA AND EXPERIMENTAL DESIGN

This section describes the numerical experiments conducted to assess the performance of the methodology described in the previous section. The goal of these experiments is to explore whether using parcel data allows for a better approximation of vehicle entry/exit points, ultimately leading to more accurate models. Field counts and travel times along major corridors are used to assess model performance.

##### 4.1 Network Description

Experiments were conducted using a sub-area network in the Austin, TX region located in Williamson County. The network topology and attributes were extracted from the capital area metropolitan planning organization's (CAMPO) regional model, and refined to incorporate additional roadway detail throughout the network. The resulting base network includes 3,440 links, 1,680 nodes, 399 centroids, and 823 centroid connectors and supports a demand of 135,616 vehicles. Traffic signal data were provided by state and local agencies and entered into the model. Sub-area demand for the AM peak period (6 a.m. - 9 a.m.) was extracted from a regional DTA model. Available field data collected to calibrate the network includes counts on 1,305 network links and travel times along 18 corridors (Figure 2). Parcel data was obtained from GIS files provided by the Capital Area Council of Governments.



**FIGURE 2 Network and Validation Data**

##### 4.2 Scenario Description

A total of seven scenarios were modeled in this effort. The selected DTA software package, VISTA, is simulation-based and finds equilibrium solutions expected to represent recurrent congestion patterns (8).

The base scenario includes the original centroid connector structure provided in the CAMPO regional model.

For comparison purposes, two scenarios were built using the aforementioned bi-level approach developed by Jafari et al. (3). Two inner-to-outer demand split ratios, 50/50 and 90/10, were considered for this bi-level method based on their performance in previous research. The 90/10 inner-to-outer subzone demand split was selected because it was found to have the highest locality factor; the 50/50 inner-to-outer subzone demand split was selected because it was the ratio that marked a threshold of stability in the network total system travel time (3).

In order to test the data driven placement of centroid connectors presented in this study, the researchers developed four additional scenarios: two with two connectors per subzone and two with four connectors per subzone. Much of the available literature suggests that using signalized intersections as entry/exit points for centroids should be avoided as it may create artificial congestion at these locations. Thus, alternate scenarios for the two connector and four connector case studies were implemented where nodes at signalized intersections were eliminated from eligible demand entry points in the network.

## 5.0 RESULTS

This section describes the results from the subsequent numerical analyses in terms of the updated centroid connector structure and the corresponding model performance.

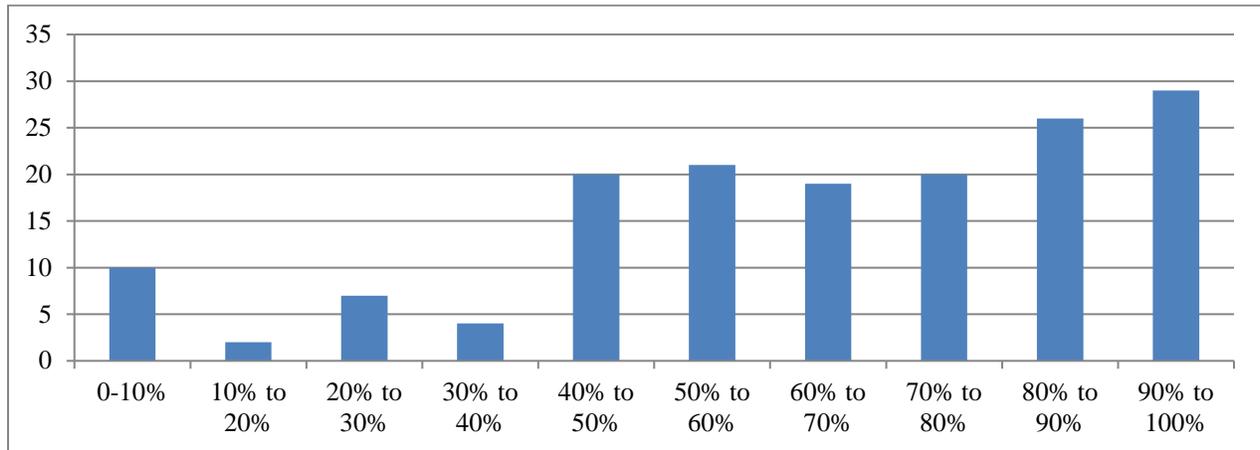
### 5.1 Centroid Connector Placement

Table 1 details the number of centroids and connectors created under each of the proposed scenarios. The number of regular links and nodes remained constant across scenarios. When the demand is split between an inner and outer subzone, additional centroids are required to redistribute the demand accordingly. This number is not quite doubled because subnetwork boundary centroids are not split as they represent flow across these points extracted from the regional model and not an associated TAZ.

**TABLE 1 Modeled Scenarios and Corresponding Centroid Connector Structure**

| Scenario  | No. of Centroids | No. of Connectors |
|---|------------------|-------------------|
| Base  | 399              | 823               |
| Bilevel, 50/50 Demand Split, Signals not Acceptable | 715              | 1545              |
| Bilevel, 90/10 Demand Split, Signals not Acceptable | 715              | 1545              |
| Parcel Based, 2 Connectors, Signals Acceptable      | 715              | 1117              |
| Parcel Based, 2 Connectors, Signals not Acceptable  | 715              | 1075              |
| Parcel Based, 4 Connectors, Signals Acceptable      | 715              | 1585              |
| Parcel Based, 4 Connectors, Signals not Acceptable  | 715              | 1443              |

One of the unique features of this research is that the demand is split according to parcel density for each individual TAZ. Figure 3 shows the inner demand ratio for all 158 TAZs in the network. This seems to indicate, at least for this test network, that it is more realistic to place the majority of demand at entry points closer to the zonal centroid. The relatively widespread distribution also suggests that is valuable to use an approach that is capable of endogenously selecting an appropriate split.



**FIGURE 3 Inner Demand Ratio Frequency Based on Parcel Data**

## 5.2 DTA Model Performance

Table 2 reports a summary of the average system level performance metrics. The lowest total system travel time, total vehicle miles traveled, average origin-destination (OD) travel time, and average path link and the highest average speed are achieved using the parcel data methodology with four connectors per subzone. This strongly suggests that this approach avoids artificial bottleneck creation. This is substantiated through the evaluation of model performance relative to field travel times.

**TABLE 2 Test Network Statistics after Convergence**

|   | TSTT (h) | VMT (veh mi) | Average OD Travel Time (min) | Average Speed (mph) | Average Path Length (mi) |
|---|----------|--------------|------------------------------|---------------------|--------------------------|
| Base  | 22858    | 830970       | 10.11                        | 36.80               | 6.24                     |
| Bilevel, 50/50 Demand Split, Signals not Acceptable | 23853    | 847555       | 10.56                        | 36.43               | 6.32                     |
| Bilevel, 90/10 Demand Split, Signals not Acceptable | 23911    | 848571       | 10.61                        | 36.25               | 6.34                     |
| Parcel Based, 2 Connectors, Signals Acceptable      | 21267    | 844503       | 9.41                         | 37.96               | 6.30                     |
| Parcel Based, 2 Connectors, Signals not Acceptable  | 21643    | 847728       | 9.58                         | 37.63               | 6.33                     |
| Parcel Based, 4 Connectors, Signals Acceptable      | 20463    | 820166       | 9.05                         | 38.44               | 6.14                     |
| Parcel Based, 4 Connectors, Signals not Acceptable  | 20703    | 826481       | 9.16                         | 38.21               | 6.18                     |

Table 3 shows minimum, maximum, and average corridor travel time error for each of the seven strategies. Field travel times were collected along select corridors during the peak periods, while model travel times along the same corridors are computed based on the travel time of simulated probe vehicles. The table also shows the percent change between the base methodology for allocating centroid connectors and the remaining six strategies.

**TABLE 3 Corridor Travel Time Validation Results**

| Network   | Min TT Error (min) | Max TT Error (min) | Average TT Error (min) | % Change Min | % Change Max | % Change Average |
|---|--------------------|--------------------|------------------------|--------------|--------------|------------------|
| Base  | 0.028              | 9.885              | 1.706                  | ---          | ---          | ---              |
| Bilevel, 50/50 Demand Split, Signals not Acceptable | 0.029              | 8.094              | 1.636                  | 5%           | -18%         | -4%              |
| Bilevel, 90/10 Demand Split, Signals not Acceptable | 0.029              | 10.933             | 1.656                  | 5%           | 11%          | -3%              |
| Parcel Based, 2 Connectors, Signals Acceptable      | 0.039              | 2.232              | 0.969                  | 40%          | -77%         | -43%             |
| Parcel Based, 2 Connectors, Signals not Acceptable  | 0.001              | 2.173              | 0.960                  | -95%         | -78%         | -44%             |
| Parcel Based, 4 Connectors, Signals Acceptable      | 0.010              | 2.235              | 0.982                  | -65%         | -77%         | -42%             |
| Parcel Based, 4 Connectors, Signals not Acceptable  | 0.004              | 2.213              | 0.973                  | -85%         | -78%         | -43%             |

As one can see, the approach that best matched the field data was the strategy that involved splitting demand and placing connectors via parcel data, with signalized intersections not selected and two connectors per subzone. This results in a 95 percent decrease from the base case in minimum corridor travel time error, a 78 percent decrease from the base case in maximum corridor travel time error, and a 44 percent decrease from the base case in average corridor travel time errors.

Table 4 shows the results of the error associated with link volume counts. The table also details the percent change between the calibrated base methodology and the remaining six strategies in terms of root mean squared error (RMSE) and mean absolute error (MAE). Field counts, available at various levels of temporal aggregation, were compared with model volumes aggregated in a consistent manner.

**TABLE 4: Field Traffic Count Validation Results**

| Network   | RMSE  | MAE   | % Change from Base |     |
|---|-------|-------|--------------------|-----|
| Base  | 413.9 | 256.5 | ---                | --- |
| Bilevel, 50/50 Demand Split, Signals not Acceptable | 440.6 | 258.5 | 6%                 | 1%  |
| Bilevel, 90/10 Demand Split, Signals not Acceptable | 424.3 | 253.0 | 2%                 | -1% |
| Parcel Based, 2 Connectors, Signals Acceptable      | 367.4 | 237.3 | -11%               | -7% |
| Parcel Based, 2 Connectors, Signals not Acceptable  | 362.6 | 232.8 | -12%               | -9% |
| Parcel Based, 4 Connectors, Signals Acceptable      | 372.2 | 239.5 | -10%               | -7% |
| Parcel Based, 4 Connectors, Signals not Acceptable  | 367.7 | 234.6 | -11%               | -9% |

Both error metrics are consistently lower using the parcel-data based approach when compared to the base model. It is interesting to note that the bi-level approach increased the RMSE of the link count errors, though it demonstrated improvement in terms of travel times. This is likely a consequence of the “one size fits all” approach to distributing demand between the inner and outer subzone. It was clearly shown that while the majority of TAZs support larger inner-to-outer demand split ratios, there is variability across the network. Much of the data used in this experiment were collected on major streets, and thus, comparatively accurate model results depend on proper allocation of demand along connecting roadways. Parcel level data seems to support a more realistic placement of centroid connectors; the subsequent distribution and loading of demand ultimately improves the observed errors.

## 6.0 ADDITIONAL DISCUSSION

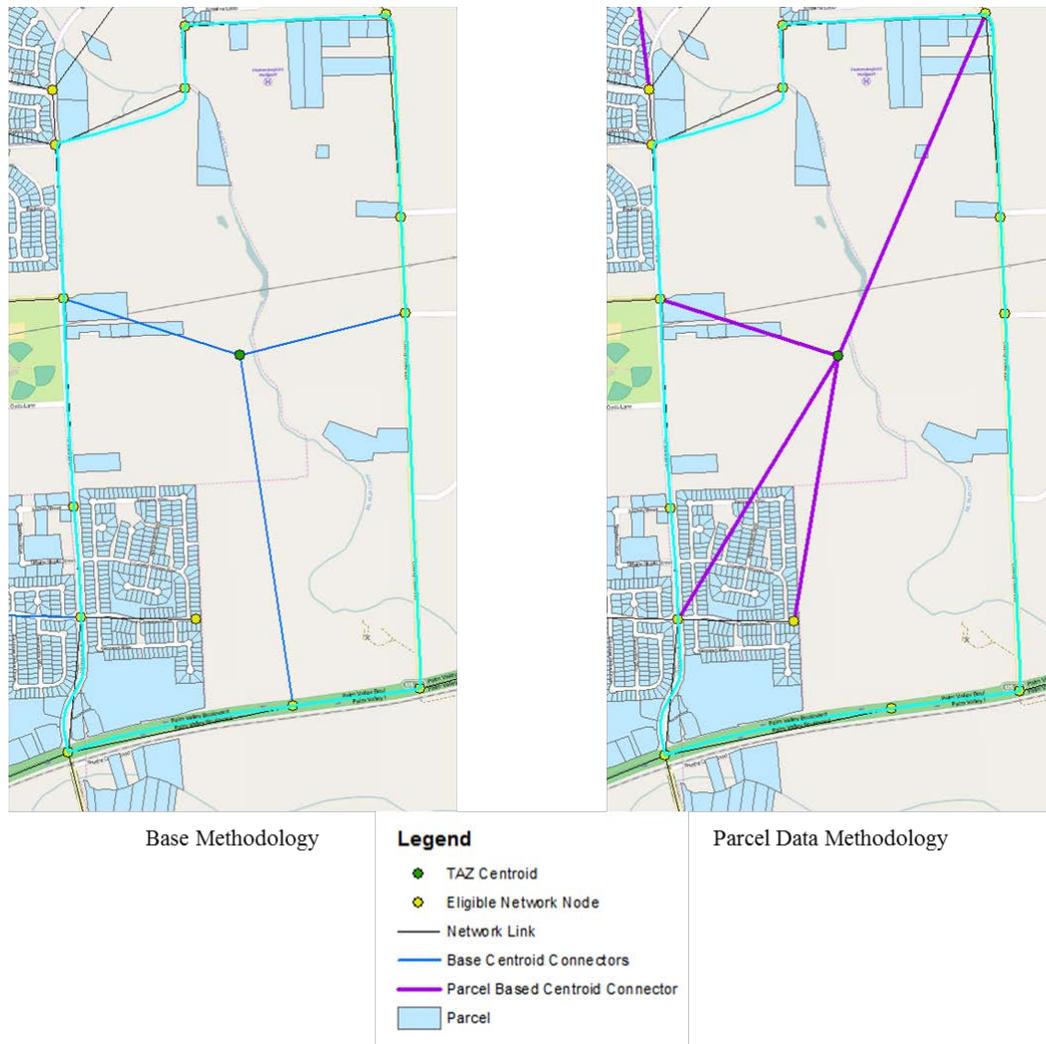
The results presented in the previous section suggest that parcel data may be used to produce more accurate DTA models. Additional insights from this research that may inform future model improvements and implementation are discussed below.

***Areas where most intersections are signalized require special attention.*** Signalized intersections were found to present a special challenge in the selection of nodes to load demand. In the modeled network there are 150 signalized intersections. When centroid connectors were linked via highest weighted node without excluding these intersections, 50 and 70 signalized intersections were selected as entry nodes for the two and four connector scenarios, respectively. Additional nodes may be created near signalized intersections as possible entry/exit nodes to address this issue; however, the simulation technique used in the selected model application is prone to generating artificial congestion along short links, particularly at signal approaches. Further research is needed to address this issue appropriately.

***More connectors do not necessarily mean better results.*** As noted in Table 2, though the four connector per subzone scenario seemed to yield the best system performance metrics—total system travel time, vehicle miles traveled, average OD travel time, average speed, and average length path—it was not the scenario that best matched field data. The two-connector-per-subzone scenario marginally outperformed

the four connector scenario. This supports similar conclusions that more connectors per TAZ does not necessarily mean better results, found to be true in static traffic assignment (4). However, as a whole, the results for the two and four connector scenarios were very similar and both showed improvements over traditional approaches.

***Splitting demand arbitrarily within TAZs may not provide accurate loading patterns.*** The work performed by Jafari et al. was an important step towards recognizing the importance of centroid connector placement on ensuring reasonable traffic patterns, and providing scalable solutions to improve large regional network models (3). However, the implemented one-size-fits-all demand split, along with the lack of information regarding the actual location of activities within a TAZ, resulted in limitations in the effectiveness of the approach. Figure 4 depicts the centroid connector structure resulting from both a typical placement strategy and the parcel-based approach, along with the location of built space based on parcel data within a TAZ in the Williamson County network. With the base methodology, two of the three connectors are placed at nodes in the network where there is likely no demand generated (no development indicated in the parcel map). Additionally, there is no connector servicing a residential development in the lower left quadrant of the TAZ. The use of parcel data helps to more accurately load/unload demand at appropriate locations.



**FIGURE 4 Centroid Connector Placement Before and After Parcel Data Utilization**

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

This paper proposes a parcel-data based methodology to automatically place centroid connectors in networks for DTA applications. Simulation-based DTA models are particularly sensitive to the topological detail of the traffic network, including the location of centroid connectors. Traditional centroid connector placement strategies may lead to excessive congestion and unrealistic traffic patterns, while manual network refinement is prohibitive in large regional models. This research uses parcel-level data to allocate travel demand between two sub-areas within each TAZ and to select appropriate network access points within each of these zones. It extends previous work by allowing the demand split among TAZ sub-areas to vary across zones, and by considering the parcel density when selecting network entry/exit locations.

Numerical experiments suggest that the proposed methodology leads to solutions that are more consistent with field data than both traditional centroid placement approaches and previous research findings. In numerical experiments conducted on a real-world network, the approach involving two connectors per subzone while avoiding signalized intersections produced the most realistic results. When compared against real world travel times on 18 corridors in the network, the maximum travel time error

was reduced to just 2 minutes and 11 seconds and the average travel time error dropped to under a minute (58 s). This was a 95 percent and a 44 percent improvement, respectively, when compared against the base network. Link counts were also found to be more consistent with real-world data when the data driven approach to centroid connector placement and demand split was used. The RMSE of the 1,305 links with field traffic counts was found to decrease by 12 percent compared to the base case.

The findings also suggest that a larger number of centroid connectors does not necessarily lead to better model results, which had already been suggested in the literature. The presence of traffic signals at intersections was observed to introduce additional challenges in the placement of connectors, which may motivate further research, though it was shown that avoiding the placement of connectors at these locations improved the results. In summary, the results are encouraging and highlight the value and importance of collecting, processing and understanding new data sources. While the application proposed in this paper is focused on DTA models, the methodologies can be extended to benefit other modeling approaches, including static traffic assignment models and DTA models that use generation links

The next steps in this research effort are to refine how demand is allocated across connectors and explore methods to endogenously determine an appropriate number of centroid connectors to generate per zone. It is speculated that using the parcel information assigned to nodes to proportionally assign demand to individual connectors may improve the accuracy of the loading pattern. Using parcel density to determine the appropriate number of connectors per TAZ, eliminating another user defined input, is anticipated to not only supplement this process, but to further automate the implemented procedure.

## **8.0 ACKNOWLEDGMENTS**

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**REFERENCES**

1. Chiu, Y. C., J. Bottom, M. Mahut, A. Pax, R. Balakrishna, T. Waller, and J Hick. *Dynamic Traffic Assignment: A Primer*. Transportation Research Circular, No. E-C153, 2011.
2. J. Sloboden, J. Lewis, V. Alexiadis, Y. C. Chiu, and E. Nava. *Traffic Analysis Toolbox Volume XIV: Guidebook on the Utilization of Dynamic Traffic Assignment in Modeling*. Publication No. FHWA-HOP-13-015, FHWA, U.S. Department of Transportation, 2012.
3. Jafari, E., M. Gemar, N. Ruiz Juri, and J. Duthie. An Investigation of Centroid Connector Placement for Advanced Traffic Assignment Models with Added Network Detail. In *Transportation Research Board 94th Annual Meeting* (No. 15-5122), 2015.
4. Qian, S. and H. M. Zhang. On Centroid Connectors in Static Traffic Assignment: Their Effects on Flow Patterns and How to Optimize Their Selections. *Transportation Research Part B: Methodological*, Vol. 46, No. 10, 2012, pp. 1489-1503.
5. Shah, R. J. Dynamic traffic assignment-based modeling paradigms for sustainable transportation planning and urban development (Master's Thesis). <http://repositories.lib.utexas.edu/handle/2152/25863>. 2014.
6. Morales, M. Parcel-level Methodology for Estimating Commercial, Industrial, and Institutional Water Use (Master's thesis). [http://www.conservefloridawater.org/publications/m.morales\\_thesis.pdf](http://www.conservefloridawater.org/publications/m.morales_thesis.pdf). 2010.
7. Griesenbeck, B. Preparing Parcel-Level Input Data for the Activity-Based Travel Model in Sacramento. In *Innovations in Travel Demand Modeling, Volume 1: Session Summaries*, 2006.
8. Waller, S. T., and A. K. Ziliaskopoulos. A Visual Interactive System for Transportation Algorithms. *78<sup>th</sup> Annual Meeting of the Transportation Research Board*, Washington, DC, 1998.

## **Demographic Allocation Tools**

### **Summary:**

The current CAMPO tool allocates projected growth in housing and employment, by type, to each county based on county control totals, and relies heavily on user input (more details below). A key point to address in the 2045 travel demand model is to allocate growth regionally, and check that county control totals are approximately met. Currently CAMPO is assigning growth by county, which can lead to odd results.

One interesting finding was that, in several areas, it is the COG staff that develops these forecasts, and the MPO staff uses these as input.

Several tools that do demographic allocation are described in the next section. There is a trade-off between having a behaviorally-based model, and having a model that is simple to use without considerable expertise. A key criticism of the current CAMPO Demographic Allocation tool is that it is grounded in theory to justify its allocations.

While many concerns have been raised about CAMPO's Demographic Allocation Tool, the MPO has invested a great deal of resources in the tool, so sticking with this tool and modifying it to address the concerns may be the best course forward for the 2045 planning process. Perhaps the most critical modification is creating default values for the curves so that results are replicable. Research may be needed to find these values. Parallel to this effort, other tools should be explored that can be transitioned to for the 2050 planning process. UrbanSim is one such tool, grounded in theory, which may meet CAMPO's needs. While billed as a very detailed parcel-level tool, several MPOs are using it at a more aggregate level.

### **Specifications for 2045 plan demographic allocation tool:**

- Consider intercounty impacts when assigning growth (i.e., not just county by county)
- Defensible basis for method used (e.g., calibrate using a previous year)
- **Considers recent growth patterns when allocating new growth**
- Does not require in-house programming expertise
- Does not require examining every parcel in the region
- Can be integrated (manually or automated) into the existing travel demand modeling process
- Can be built within the current timeline for plan development
- Tool is actively maintained and support is available

### **Summary by tool:**

Demographic Allocation Tool (used for CAMPO 2035 and 2040 planning)

- Allocates future households and employment by type given user-generated assumptions about future possible land development
- Developed specifically for CAMPO by TTI
- Parcel attractiveness is a function of user-specified “attractor points” and distance to all other TAZs
  - o User-specified “attractor points” can have user-specified weightings
  - o The weights on each variable in the attractiveness equation are user-specified
- Growth constrained using goal densities or limits
- Goal densities represent the expected level of development in a parcel.
- Limit method limits growth to a number of max allowable units
- In both cases, growth is assigned to highest ranking parcel until goal/limit is met, then proceed to next highest ranking parcel. A distribution curve is used to spread out the growth among parcels with varying levels of attractiveness. The user may vary the exponent of the curve.
- User inputs percent of households by type
- For county-level allocation, each county is allocated separately, so inter-county accessibility is not considered.
- Concerns have been raised about different results achieved by different people running it, and the lack of theoretical underpinning
- For now, we could develop default assumptions to make results replicable and do testing to improve defensibility.

UrbanSim (<http://www.synthicity.com/urbansim/>)

- Capable of modeling demographic processes, households’ long-term and short-term choices, impact of land use regulation, impact of changes to the transportation system, real estate development, and economic processes
- Very detailed model, though some MPOs are using only parts of it to meet their needs
  - o PSRC uses UrbanSim to represent comprehensive plans.
  - o ABAG determines county-level control totals and then uses UrbanSim to allocate further.
- Open-source so we know what the model is doing.
- Emailed with Paul Waddell, tried to schedule call, but haven’t heard back

TELUM (Transportation Economic Land Use Model <http://www.telus-national.org/products/telum.htm>)

- Gravity-based model that has been around since 1976 (previously called Dram/Empal). (A gravity model is one where population and employment grow in areas with higher accessibility.)
- Can handle up to 800 defined analysis zones (so CAMPO TAZs would need to be aggregated).
- Forecasts employment locations, then residential locations, then land use densities, which are fed into the next time period for forecasting employment locations, then residential locations, etc.
- Considers growth trends over the last 5 years when predicting future growth
- Useful for allocation at an aggregate level, e.g., districts

- NCTCOG uses this model for district-level allocation and then uses a more detailed model to allocate from districts to TAZs.
- Dr. Kara Kockelman at UT Austin developed a simpler version of this model that is available for free on her website.
  - [http://www.caee.utexas.edu/prof/kockelman/G-LUM\\_Website/homepage.htm](http://www.caee.utexas.edu/prof/kockelman/G-LUM_Website/homepage.htm)

#### UPlan (<http://ice.ucdavis.edu/project/uplan>)

- Simple, rule-based model that projects future land use patterns. Demand for land is converted to employment and households by applying factors.
- Allocates at the grid-level. Grid cells can be parcel-sized or larger, with a trade-off between run-time and detailed results.
- Grid-cells are given attractiveness values based on proximity to existing urban areas and transportation facilities, as well as to other attractions.
- Similar issues potentially as the Demographic Allocation Tool in terms of lack of theoretical underpinning.
- May be most useful to allocate within a district (smaller geographic unit than a county) or within each TAZ.
- Currently being revamped, change in developers, new version will be released

#### PECAS (Production, Exchange and Consumption Allocation System <http://www.hbaspecto.com/pecas/>)

- Based on economic theory, equilibrium of supply and demand
- Predicts flows of “exchanges” and then converts these to travel demand
  - Uses nested logit models
- Can be run at different levels: parcel, grid, zones
- Very detailed inputs required
- Used by ARC (switched from Dram/Empal due to lack of support and limited capabilities), SANDAG, others

#### **Summary of each conversation:**

##### Arash Mirzaei (NCTCOG)

- Use Dram/Empal for district-level allocation and then UPlan to allocate from districts to TAZs
- Isn't happy with current approach but doesn't know what they will do next

##### Stefan Coe (PSRC)

- PSRC uses UrbanSim, but doesn't use all of UrbanSim's functionalities. It is mostly used to represent comprehensive plans.
  - Mark Simonson is contact ([msimonson@psrc.org](mailto:msimonson@psrc.org))

### Drew Cooper (SFCTA)

- ABAG determines county-level control totals and then uses UrbanSim to allocate further
  - o Aksel Olsen is the contact for ABAG ([akselo@abag.ca.gov](mailto:akselo@abag.ca.gov) )
  - o They keep parcel data up to date?
- SF Planning Department re-allocates the county-level totals within a county every two years
  - o Scott Edmondson is contact at SF Planning Dept. ([Scott.Edmondson@sfgov.org](mailto:Scott.Edmondson@sfgov.org) )
- Scenario analysis is important

### Mike Schofield (formerly with TxDOT TPP)

- Demographic Allocation Tool should have default assumptions to make results replicable. It could be a useful tool if changes are made to it to make it defensible.

### David Kruse (formerly with AACOG)

- Used TELUM
- Expert input needed to correct forecasts that are off, add constraints and encourage development where appropriate
- Used data on development plans, looked at parcel growth
- Allocated to Census tracts and then had set of rules (adapted from NCTCOG?) to allocate to TAZs (expert opinion needed for this too)
- Had some ground rules, e.g., no losses
- NJIT team made TELUM Windows-based, but now it is more of a black box, harder to change parameters
- Need to have the trust and relationships with member agencies to know forecasts will be flawed and to work together to come up with the best forecast
- Got input from agencies as well as utilities

### Guy Rousseau (ARC)

“Our ABM and PECAS are now fully integrated as a transport & land use model that leverage a combined impedance measure across highway and transit modes, rather than just using travel time by one mode. This combined travel impedance measure comes from the ABM Work Location Mode Choice Log-sum skim matrices, which provide travel impedance between zones. The log sum matrices take into account the time and cost of travel by all modes of transportation, according to traveler perceptions about the importance of the attributes of each mode, as well as non-included attributes that affect the probability of taking each mode between each origin-destination pair.

The intent of our ABM & PECAS integration consists in accounting for zonal accessibility, and have the ABM feed PECAS with work location mode choice log-sum skims produced by the ABM at discrete time intervals, and in turn, use the PECAS land use forecasts to inform the ABM, in a data exchange iterative fashion, for each network-year.”

### Michael DuRoss (DeIDOT)

- (Brian Gardner recommended we look at this one)
- Developed LUTSAM
- It looks like LUTSAM is a way to look at model results in a more detailed way for a small area in a region. I'm not clear on how it allocates demographics at a regional level to TAZs, or if this is even done within LUTSAM.
- Also, I checked out CUBE Land, which they are moving to. It's not clear the method behind the allocation.

"...we have focused more on the allocation part of "land use modeling" than the more classical "how much" population and employment determined through classical land use models. For our DOT, a statewide committee determines annual statewide and countywide control totals of future housing and jobs and the MPO's then annually allocate to TAZ.

Our approach allows us to allocate TAZ "control totals" within the TAZ (to existing or hypothetical tax parcels), or allows a scenario of adjusted TAZ data to run through the same process.

I don't worry about statewide or countywide totals, like a traditional feedback land use model.

Having said that, we are adapting our approach to CUBE Land anyway."

- Switching to Cube Land...

#### Aksel Olsen (ABAG)

- Rule-based approach
- San Francisco is fairly simple because (sub-bullets are quotes from his email)
  - o It is one city which is all of 49 square miles
  - o \* The allocation from the regional government is not that much bigger than the list of already identified projects in the pipeline
  - o \* We had decent data on development capacity and could allocate the rest in proportion to capacity, weighted by the base year share.
- "I now work for ABAG, and the geographic area is probably two orders of magnitude different. It is easy to get it wrong, accordingly, and there are 100 jurisdictions who care deeply about whether housing and retail fall on one side of a jurisdictional line or not. People take these allocations rather seriously, to a point. We have the fiscalization of land use to thank for that."

"So during our last regional plan (before my time), a suite of models was used; here is the playbill version:

The regional forecasting model produces employment forecasts by industry that are, in turn, disaggregated into employment for individual counties. The county demographic component produces individual county-level population forecasts directly. County-level economic and demographic data serve as control totals for the subregional Projective Optimization Land Use Information System (POLIS) model. Finally, the results from the POLIS model are used as controls for the Subarea Allocation Model (SAM).

The potential for economic and demographic growth and its distribution are based on the availability of space (vacant land, under-utilized existing developed areas, and building sites that can

be reused or redeveloped). Space must be adequate to allow for the forecast levels, whether it is the total region, county, zone, or census tract. Therefore, because of the importance of available space, land use data are collected from all jurisdictions in the Bay Area through the information provided in their general and specific plans. Periodically, ABAG also receives information through county assessor's files and other sources.

For the tract-level and taz-level allocation, a spreadsheet model was used with basic weights. This doc describes the basic approach for employment and households, respectively, on pages 23 and 31. It is relatively short but informative.

[http://planbayarea.org/pdf/final\\_supplemental\\_reports/FINAL\\_PBA\\_Forecast\\_of\\_Jobs\\_Population\\_and\\_Housing.pdf](http://planbayarea.org/pdf/final_supplemental_reports/FINAL_PBA_Forecast_of_Jobs_Population_and_Housing.pdf)

That was last time. UrbanSim was used at the EIR stage (the spreadsheet was used for the actual plan), but our partner agency, MTC (they are actually the MPO; ABAG is the COG; the Bay Area is rather unique in that sense) now runs the land use model and have have like 2.5 FTE over several years to get it running, so it is an investment to be sure. But the infrastructure is pretty cool once it is there; allowing for on the fly visualization of results in a browser, explicitly accounting for all manner of relationships between urban agents, land markets, and policies, including development fees.

So that is definitely the Rolls Royce version. 10 years ago we got a fairly barebone version running in San Francisco for like \$60,000 contract money plus staff time. The main time and money allocation will be on getting the data compiled, cleaned and standardized for your region. If that is in good shape already you are in luck. That is usually a major bottle neck and time sink.

There are two camps within our agencies:

Those that trust the models to provide reasonable results that we can use to start a conversation, acknowledging that they are just model outputs and all the caveats, and those who think models are generally missing the key details and, if you will, the politics of where growth goes and where it doesn't, and what types. If your region is similar, and there is an overweight of the last type of folks, even the best model won't help you that much. Then something much simpler probably will need to suffice."

Pramod Sambidi (HGAC) (Dmitry no longer there)

- Developed SAS code based off of UrbanSim
- Update land use forecasts quarterly and post them here: <http://arcgis02.h-gac.com/RLUIS/>
- Willing to share SAS code, but don't think it is easily transferable

Cole Kitten (previously with CAMPO, now with City of Austin)

- The DAT worked well at the grid-level. The updates to bring it to parcel-level over-complicated the model.
- Would like to have household size represented differently by household, rather than by TAZ.
- Communications with jurisdictions is very important to get buy-in. Request preliminary site plans.
- Unincorporated areas are challenging.
- Ask Tom Williams for documentation on changes to the tool.
- Used 2005 911 data.
- Paul Frank at CoA Planning and Zoning has the city's data.

## **Network Coding**

### **Summary:**

The number one takeaway from talking to staff members at MPOs across the country is that network coding and the associated QAQC is resource-intensive. Here are other key takeaways.

- **Automating Common QAQC Checks:** Efficiency can be gained by developing scripts to automate the process of checking for common network coding errors. The main benefit in doing this is catching problems before starting a model run, which can waste time.
- **Documentation:** Many MPOs do not have clear documentation of their network-coding process and associated QAQC steps. Maintaining documentation on all aspects of the modeling process, including network coding, is important to ensure all model users use the model as intended.
- **Meta-Data:** Many MPOs keep meta-data on their network to track the person who added or edited a given segment, the date, and other key pieces of information. This is helpful for when there is a question about the way a network is coded.
- **Who codes the network?** Several agencies noted that it can be problematic to let non-modelers (e.g., agency staff) edit the network. They may not understand the process and why certain information is needed, and inconsistencies may be created. That said, it's important to have a visual way for the planning team to check the accuracy of the coding.
- **How often to update the network?** A protocol should be developed for when the network is updated. Plans in a region can change frequently and it can be very challenging, and possibly unproductive, for the regional MPO network to keep pace.
- **What is coded?** A protocol should be developed to ensure consistency throughout the region in how the model network is coded. Many travel demand models are not sensitive to changes in signal timings, adding a center left-turn lane, etc. The modeling network could be a subset of the list of regional improvements in the plan.
- **Model-Free Networks:** A few MPOs have created processes for automating the conversion of a network from GIS to a model. The primary benefit of doing this is that the person editing the network does not need to be familiar with the model software. Also, if you change software then the transition is easier. An open standard is being released on 11/15/15 by <http://modelfree.org/>.

### **Summary of each conversation:**

Ohio DOT (Greg Giamo)

“Our network coding manual is about 15 years out of date because nobody reads manuals. We have a training course we do once every 4-5 years, I've attached the zipped powerpoint (renamed from .zip to .zi\_ to get through our firewall) of the highway network coding portion (there is also a transit section and a section on conflating networks to true shape which I'm omitting due to size). But even better is the network metadata file I've attached, that serves as the primary point of reference for people. If you

compare them you will note some discrepancies because the training hasn't been done in 4 years and the network standard changed a little since then.”

Caliper Corporation (Howard Slavin)

“Caliper has developed a special master network application for TransCAD that stores multi-year and multi-scenario networks in a single database. The system supports both highway and transit networks. Projects can be coded in phases and turned on or off in specific scenarios and/or have their phases rescheduled. A 2025 scenario will automatically know the network that will be in effect.”

Dr. Mark Hickman at University of Queensland, Australia

“Some colleagues at the Smart Transport Research Centre in Australia, Prof Edward Chung and Dr. Marc Miska, have developed a "model-free" approach to network coding. This work grew out of a need to have networks that were compatible across different (simulation) software tools, without having to re-code the network every time.

The website for their work appears to be a bit dated, but you may wish to contact them for more recent information. Their work may be found at <http://modelfree.org> “

\*The website has been updated and the model-free network coding standard will be available November 15<sup>th</sup>.

Dr. Kara Kockelman at The University of Texas at Austin

“I happen to have a slideshow for a guest lecture by TTI's Kevin Hall (who manages much of TxDOT's networks & demand modeling) about network coding details, in case that's helpful to you. It was shared with all students, and I improved upon it as best I could (with his assistance), so I can deliver it myself in the future, or perhaps have him deliver the somewhat modified slides (which are on my office PC).”

Elizabeth Sall, Urban Labs (formerly with SFCTA)

“Drew gave a presentation on the SFCTA "network wrangler" at ITM during the "modeling meta" session. It is pretty awesome and I suggest you look into it / talk to him (or me or lisa or billy) about it. Billy also gave a presentation on it at the very beginning at a planning apps conference. There is some info on GitHub: <https://github.com/sfcta/NetworkWrangler> . We will be expanding and leveraging NetworkWrangler for our FastTrips project. You can see some glimpses of how it works in slide 10-15 of this slideshow

DTA Anyway can then take networks coded by NetworkWrangler and mix it up with signal timings, etc and spit out DTA networks. “

Scott Ramming, DRCOG

“One thing my agency (mostly me so far, but my colleagues are new) has found useful is to write a script (we use the TransCAD platform) to check for missing or invalid attribute values in network layers, and write the exceptions to a file, so you can make corrections as another round of the editing process before discovering the error as part of the actual run.

As we identify more things to check for, they can be added to the script.”

Yi-Chang Chiu, Arizona State University

“In our recent study with my former doctoral student Dr. Lei Zhu we found out that the network code practice is rather subjective based on some rule of thumb. Most agencies we interviewed may not have a systematic process to test different network coding/resolution alternatives due to various reasons. We looked into the desirable network resolution for traffic demand model and traffic assignment purpose.

A part of the research was published in recent TRR No 2528, the conference version is listed below.

<http://trid.trb.org/view.aspx?id=1339073>

The full dissertation is listed herein:

<http://arizona.openrepository.com/arizona/handle/10150/347053> “

Arash Mirzaei, NCTCOG

- FHWA reviews networks, so make sure to check with local FHWA person
- Human management - 1 coder, works manually, no master network
- A given year network includes all projects funded and started to be built in that year
- Start from previous year, code roadway updates
- Some meta-data is kept included who coded, etc
- All network coding done in TransCAD, not GIS
- TIP system can be updated every three months, based on projects, TIP code, no database behind it
- Doesn't make sense to have TIP and MTP linked exactly
- Brian is Master Network Coder and Mitzi Ward oversees process and is most familiar with it

Stefan Coe, PSRC

- Networks are coded in GIS and automatically converted to EMM model format. A lot of time went into designing the geodatabase twelve years ago. The application runs in EarthMap. It was built by consultants from Cambridge Systematic and improved upon by PSRC staff.
- He sent me a powerpoint that he gave at the TRB Innovations in Travel Modeling conference in 2014.



## Active Transportation Network Data Environment

### Scope of Work

*Prepared for: Capital Area Metropolitan Planning Organization (CAMPO)*

*Prepared by: Center for Transportation Research, The University of Texas at Austin*

*Date: March 28, 2016*

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The description of the 2045 Regional Active Transportation Plan included in the scope work detailed in RFP KP0001 includes several technological infrastructure components, in particular Task 1.2 (Data Development) and Task 3 (Update Online Regional Active Transportation Viewer). CTR will assist CAMPO by implementing or developing these technologies and assisting consulting agencies in making use of them to fulfill the objectives outlined in Task 1 (Discovery, Existing Conditions, and Needs Assessment).

### **METHODOLOGY**

CTR will create a data warehouse to manage the active transportation data, implement tools to interface with the data, and provide technical support and training for CAMPO in order to ensure full utilization of the technology. The layers of the active transportation GIS stack will include:

1. A relational database back-end (e.g. PostGIS)
2. Web-based user interface for working with GIS data (i.e. an updated interactive map)
3. Web-based administrative and database management interface
4. Version control and project history functionality
5. Backup and recovery system
6. Data conversion functionality for common GIS data formats (i.e. ETL)
7. Interfaces with other common GIS applications and data stores (e.g. ArcGIS, OSM)

We will use well-supported and open technologies wherever possible so that we or another party will be able to easily extend the component applications and which will facilitate CAMPO's objectives of targeted outreach and community engagement.

## **SCOPE OF WORK**

1. Install, configure and test software components (e.g. database, software clients, etc.) to ensure a fully functional and reliable GIS stack.
2. Deploy an initial working prototype on CTR servers supporting basic work-flows and run an introductory workshop and training session to demonstrate usage and functionality.
3. Collect feedback from CAMPO – debug and extend the prototype to provide requested features and support additional work-flows.
4. Deploy a second working prototype on CTR servers which includes added features.
5. Perform a second round of debugging.
6. Deploy the stable implementation on a dedicated server or cloud hosting service.
7. Provide training and consultation for CAMPO staff (including consultant and interns) in order to assist in the data collection effort.
8. Provide continuing IT support including consultation and minor development tasks.

## **DELIVERABLES**

1. Every two-week status updates via email or call.
2. Two training sessions for CAMPO staff and consultant team.
3. Online Regional Active Transportation Viewer.
4. GIS stack supporting CAMPO work-flows.
5. Continued support of the tool and team throughout the project duration.

## **TIMELINE**

1. Kick-off meeting with CAMPO and consultants (mid-April 2016)
2. Regular meetings/calls with CAMPO and consultants to ensure the data work flow is efficient (e.g., discuss file formats, schema, etc) (ongoing)
3. Initial prototype and training (early May 2016)
4. Final prototype and training (end of May 2016)
5. Stable deployment (June 2016)
6. Support data collection efforts (ongoing)



### Task 4.1 Fiscal year 2015 DTA Studies

In addition to updating the DTA model for the region, CTR was tasked with completing DTA sub-area studies for CAMPO and member agencies. This served to answer transportation-related planning questions, as well as provide an opportunity to apply the DTA model in the region and identify any necessary edits in the model prior to opening DTA model access to practitioners, member agencies, and local professionals.

This section of the report presents a schedule and short description of completed dynamic traffic assignment (DTA) studies since the prior contract submittal (January 2015). Four CAMPO sponsored studies were completed during this time frame. The following table summarizes the project information for each study.

**Table 4.1.1 DTA Project Application Study Schedule**

| Project Title   | Project Description   | Project Begin | Project End    |
|---|---|---------------|----------------|
| SH 71 Improvements: Analyzing the Impact of SH71 Interchange Construction on Traffic in the City of Bastrop   | The objective of this study was to analyze traffic impacts during and after the construction of a grade-separated interchange along SH 71 at Tahitian Drive (LP 150) and a grade-separated interchange along SH 71 at SH 95 (Jackson Street). The analysis, covering both morning (a.m.) and afternoon (p.m.) peak periods, was completed using two types of traffic models. DTA models were developed to estimate changes to area travel patterns during and after construction of the two interchanges. | July 2014     | February 2015  |
| Austin Avenue Bridge Improvements: Using Dynamic Traffic Assignment Modeling to Analyze the Traffic Impact of Modifications to the Austin Avenue Corridor | The objective of this study was to first determine the peak period impact of implementing a traffic control plan (TCP) to account for closing one lane in each direction on both Austin Avenue bridges for complete reconstruction in 2016 versus in 2035. Second, the study was used to determine the peak period traffic impact of providing a left-turn lane on the Austin Avenue bridges (for a total of five lanes) versus only providing four lanes in 2035.  | October 2014  | September 2015 |



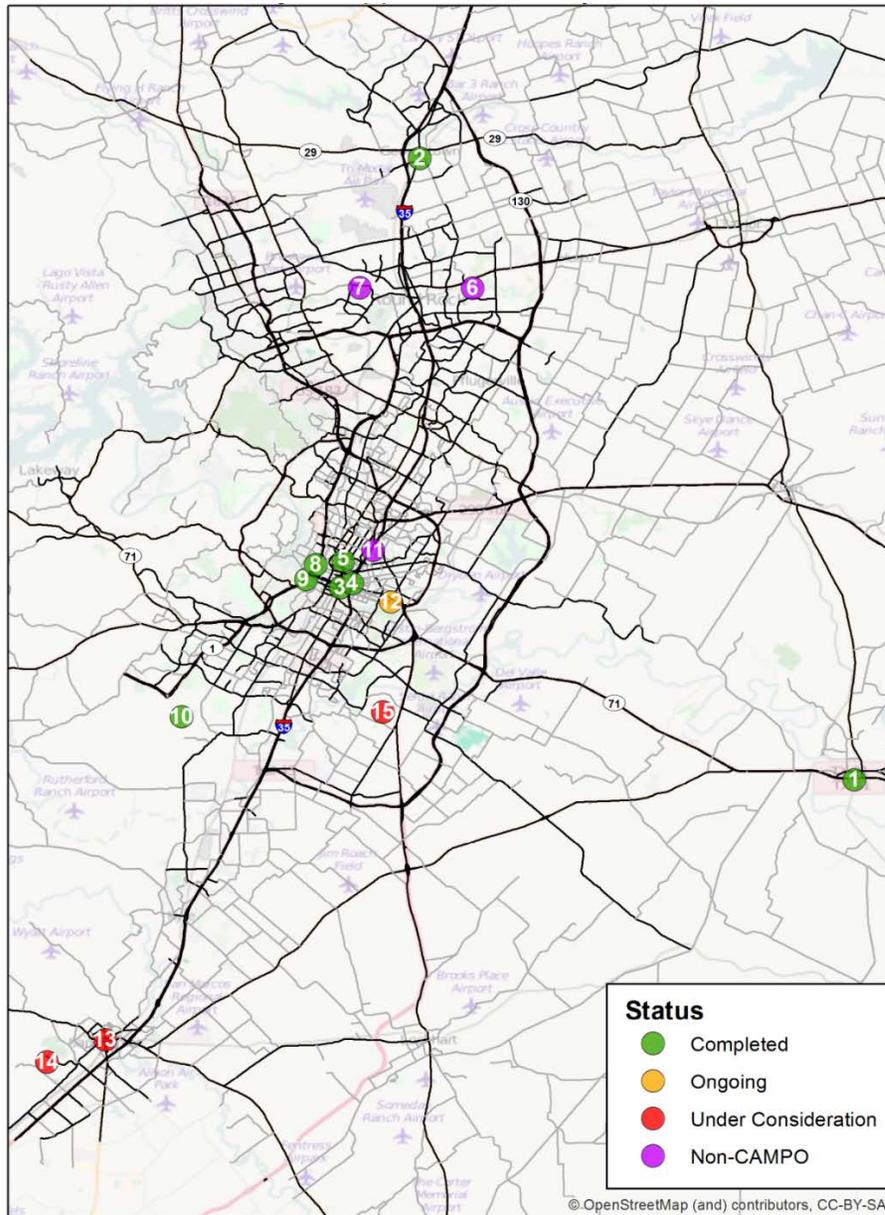


# CAMPO-CTR Dynamic Traffic Assignment Interlocal Agreement

## FY16 Deliverables Submittal

|  |  |                          |                          |
|--|--|--------------------------|--------------------------|
| <p>MoPac South: Impact on Cesar Chavez Street and the Downtown Network</p> | <p>The objective of this study was to analyze traffic impacts on Cesar Chavez Street and the downtown area resulting from adding express lanes to MoPac Expressway south of Cesar Chavez Street. Further, the study assessed the impact of proposed direct-connector ramps between the MoPac South express lanes and Cesar Chavez Street. The analysis included both morning and afternoon peak period travel demand for year 2020 traffic conditions.</p>   | <p>May<br/>2015</p>      | <p>November<br/>2015</p> |
| <p>Multimodal Traffic Study of the Guadalupe Corridor</p>                  | <p>The objective of this study was to predict route changes and travel time gain/loss by passenger cars, as well as improvements in bus operations and its effect on passengers' route choice relative to multiple configurations of the Guadalupe Street corridor along the University of Texas campus. The DTA model simulated cars and buses in a mixed traffic condition to incorporate the effect of each mode on the other. A schedule-based transit assignment model was used in integration with the DTA model to determine how transit users choose their paths and stops according to each scenario.</p> | <p>November<br/>2014</p> | <p>November<br/>2015</p> |

The location of the aforementioned studies is shown in Figure 4.1.1, which highlights CAMPO region studies, along with other area studies previously completed or identified as potential future applications of the DTA model.



### DTA Application Study Locations

1. CAMPO/City of Bastrop, SH 71 Improvements
2. CAMPO/City of Georgetown, Austin Avenue Bridge Reconstruction Analysis
3. CAMPO/City of Austin, 7th Street and 8th Street Conversion
4. CAMPO/City of Austin, Congress Avenue Corridor Analysis
5. CAMPO/City of Austin, Guadalupe Street Transit Routing Analysis
6. Williamson County, Round Rock Roadway Network Evaluation
7. Williamson County, Hairy Man Road Corridor Analysis
8. CAMPO/CTRMA, MoPac North Express Lanes
9. CAMPO/CTRMA, MoPac South Express Lanes
10. CAMPO, SH 45 SW
11. TxDOT Austin District, I-35 Central Austin Ramp Analysis
12. CMTA, MetroRail Long Range Plan
13. City of San Marcos, Downtown Street Conversion Analysis
14. Hays County, Roadway Extension Analysis
15. Travis County, Precinct 4 Project Analysis

**Figure 4.1.1 DTA Application Study Locations**



### Task 4.2 DTA Study Reports

In addition to updating the DTA model for the region, CTR was tasked with completing DTA sub-area studies for CAMPO and member agencies. This served to answer transportation-related planning questions, as well as an opportunity to apply the DTA model in the region, and identify any necessary edits in the model prior to opening DTA model access to practitioners, member agencies and local professionals. Following is a list of the enclosed DTA applications studies completed during this fiscal year.

#### Enclosures

- “SH 71 Improvements: Analyzing the Impact of SH 71 Interchange Construction on Traffic in the City of Bastrop” (Technical Report), February 2015
- “MoPac South: Impact on Cesar Chavez Street and the Downtown Network” (Executive Summary), November 2015
- “MoPac South: Impact on Cesar Chavez Street and the Downtown Network” (Technical Report), November 2015
- “Multimodal Traffic Study of the Guadalupe Corridor” (Draft Technical Report), November 2015
- “Austin Avenue Bridge Improvements: Using Dynamic Traffic Assignment Modeling to Analyze the Traffic Impact of Modifications to the Austin Avenue Corridor” (Draft Technical Report), September 2015



## **SH 71 IMPROVEMENTS:**

# **Analyzing the Impact of SH71 Interchange Construction on Traffic in the City of Bastrop**

## **TECHNICAL REPORT**

**Prepared by:**

**The University of Texas at Austin  
Center for Transportation Research**

**Prepared for:**

**CAMPO and The City of Bastrop**

**February 2015**



**THE UNIVERSITY OF TEXAS AT AUSTIN  
CENTER FOR TRANSPORTATION RESEARCH**

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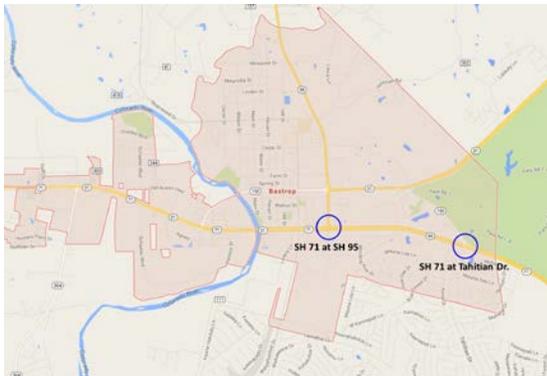
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## EXECUTIVE SUMMARY

The Capital Area Metropolitan Planning Organization (CAMPO) has funded the development of a dynamic traffic assignment (DTA) model for the metropolitan planning region. The University of Texas at Austin’s Center for Transportation Research (CTR) is tasked with development and application of this DTA model. Part of the funding provided by CAMPO enables CTR to apply the DTA model to various locations in the region. CAMPO’s support of its member agencies enabled this project to be completed for the City of Bastrop.



The objective of this study was to analyze traffic impacts during and after the construction of a grade-separated interchange along SH 71 at Tahitian Drive (LP 150) and a grade-separated interchange along SH 71 at SH 95 (Jackson Street). The analysis, covering both morning (a.m.) and afternoon (p.m.) peak periods, was completed using two types of traffic models. DTA models were developed to estimate changes to area travel patterns during and after construction of the two interchanges. More detailed microsimulation models were also used to examine the performance of four key intersections before, during, and after construction.



DTA models are designed to assign vehicles to a transportation network by adjusting route selection as simulated traffic conditions change over time. They are generally more detailed and can simulate the impact of congestion more appropriately than conventional travel demand models. Though not as refined as microsimulation models, they can be used to assess areas or regions more efficiently. The DTA model constructed for this study covers the Bastrop city limits and surrounding areas. It was extracted and uses demand estimates from the 2005 CAMPO travel demand model, updated to represent 2015 conditions.

Six DTA models were developed to simulate existing conditions, various stages of roadway construction, and full build-out conditions. The construction-scenario DTA models were designed to reflect “worst-case” scenario conditions based on the anticipated timeline for construction.

The DTA models estimated no routing impact on either east-west or west-east travel along SH 71, during or after construction. Between SH 71, east of Tahitian Drive, and the Bastrop downtown area and points north of the rail line (Hawthorne Street), some traffic was found to shift to LP 150 during construction. Some traffic was also found to shift to Chestnut Street west



of SH 95 during construction phasing. After build-out of the two interchanges, traffic using Chestnut Street, west of SH 95, was found to decrease significantly during the p.m. peak, but return to near existing conditions for the a.m. peak. This is part of a larger trend of traffic shifting to SH 71 after construction. While travel times were found to increase during construction, they were generally found to be lower after construction than before.

Four intersections were included in the microsimulation models built for this study: LP 150 at SH 95, LP 150 at SH 21, SH 71 at SH 95, and SH 71 at Tahitian Drive. The intersections were evaluated for peak hour conditions based on traffic counts conducted in August after the beginning of the school year. The unique configurations of the intersections were evaluated using the Synchro microsimulation software.

With existing signal timing plans, the operation of SH 71 at Tahitian Drive and SH 95 will experience diminished service during construction, in large part due to the minor approaches experiencing more delay. Some of this delay can be alleviated with signal timing optimization. Excessive queuing was not found from the construction scenario simulations, except for the southbound approach at SH 95. Provision of an exclusive right-turn lane during construction, and potentially enabling right turns from both approach lanes during part of construction, is important for operation of the signal. The full build-out of the two interchanges is anticipated to improve operation of the intersections along SH 71 significantly, though the large turning volumes at the SH 95 intersection will continue to be a concern.

Several recommendations have been devised based on the results of the study:

- Additional data should be collected to evaluate the two intersections along SH 71 during weekend conditions. A supplemental analysis should then be undertaken to assess differences in intersection operations as travel patterns change during the week.
- The traffic signals along SH 71 at Tahitian Drive and SH 95 should be optimized during construction; this will involve changing the signal plans as the configuration of the intersections is modified based on observed traffic conditions.
- The traffic control plan for SH 71 at SH 95 should be modified to maintain an exclusive right-turn lane for the southbound approach, possibly enabling right turns from both approach lanes during Phase 1 Stage 3.
- Additional data should be collected and conditions monitored along LP 150/Chestnut Street during construction. Additional optimization of the signals, notably at SH 95 at LP 150/Chestnut Street and Chestnut Street at Main Street, may improve operations along this corridor given the identified change in travel pattern (additional traffic using LP 150 during construction of the SH 95 interchange).
- The traffic signal at the intersection of LP 150 at SH 95 should be optimized during the p.m. peak, pending a review of the need for pre-timed signal operation.



## 1. INTRODUCTION

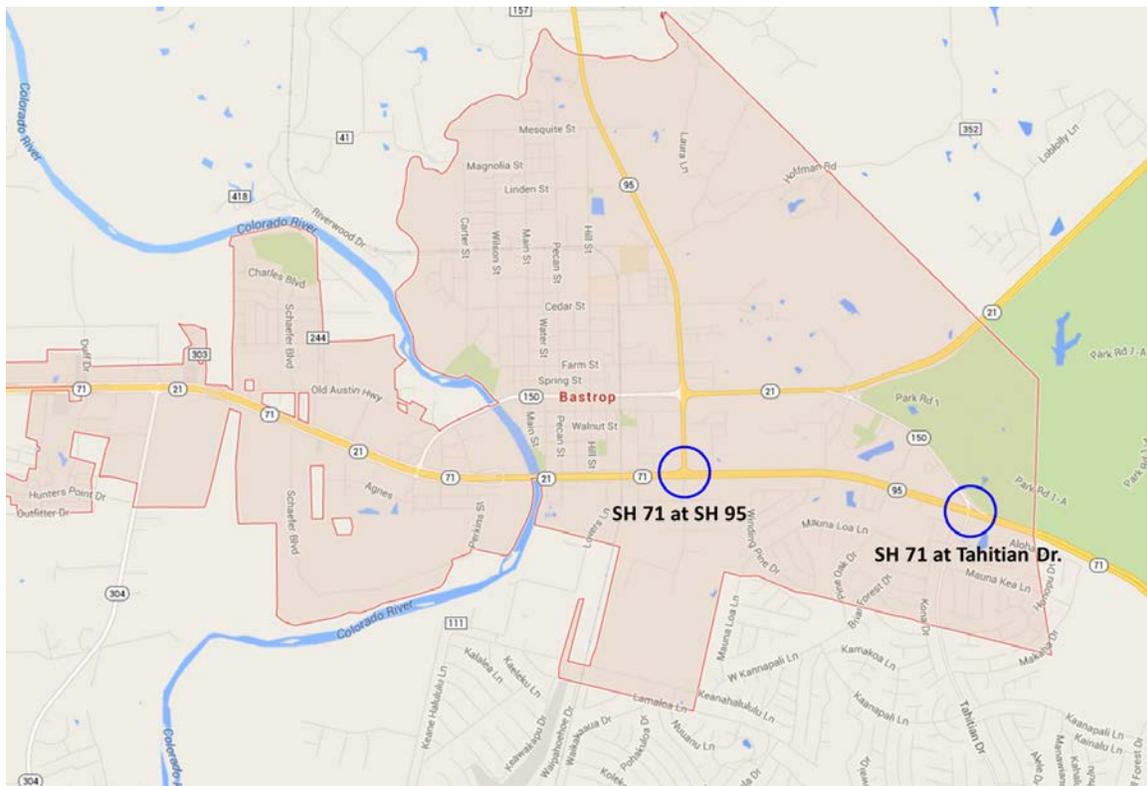
The objective of this study was to analyze traffic impacts during and after the construction of a grade-separated interchange along SH 71 at Tahitian Drive (LP 150) with frontage roads and a grade-separated interchange along SH 71 at SH 95 (Jackson Street). Two different types of traffic models were developed for the City of Bastrop area:

- 1) Dynamic traffic assignment (DTA) models, which were used to estimate route-changing behavior in response to the network modifications, and
- 2) Microsimulation models, which provided detailed performance measures at four key intersections.

This study was funded through a contract with the Capital Area Metropolitan Planning Organization (CAMPO) with the goal of providing transportation network modeling services to member agencies. This report summarizes the results observed from the DTA and microsimulation models and provides several recommendations based on the findings.

## 2. BACKGROUND

The Texas Department of Transportation (TxDOT) plans to upgrade the intersections of SH 71 at Tahitian Drive and SH 71 at SH 95 in the City of Bastrop from at-grade intersections to grade-separated interchanges (see Figure 1 for intersection locations). The objectives of this study are to determine if and how traffic may divert during and after the construction of these two interchanges and what impact the construction will have on area operations.



**Figure 1. Location of Intersections along SH 71 Designated for Improvement**

The first goal of this effort is to estimate traffic impacts due to construction of the interchanges along SH 71 at Tahitian Drive and SH 95. Specifically, this study will estimate whether traffic will divert through the downtown Bastrop area, notably along LP 150/Chestnut Street and north-south roadways connecting Chestnut Street and SH 71, as a result of the proposed traffic control plan configuration. The study was designed to assess existing conditions and compare these results to conditions during construction phasing for the intersections and after full build-out of the two interchanges. An update on the construction timeline for the corridor improvements indicated that the SH 95 interchange construction will let prior to completion of the interchange at Tahitian Drive. Therefore, the review of construction impacts includes simultaneous phasing of the two interchanges.

To study the impact of the traffic control plan (TCP) scenarios and proposed improvements, the research team carried out two modeling efforts. To assess route diversion in the area during construction of the two interchanges, the team created a DTA model for the City of Bastrop and surrounding vicinity. A microsimulation model was also created using Synchro software to assess the impact of the construction scenarios and full build-out on traffic operations along SH 71. The purpose of the microsimulation modeling effort was to evaluate traffic operations, including delays and queues at key intersections.



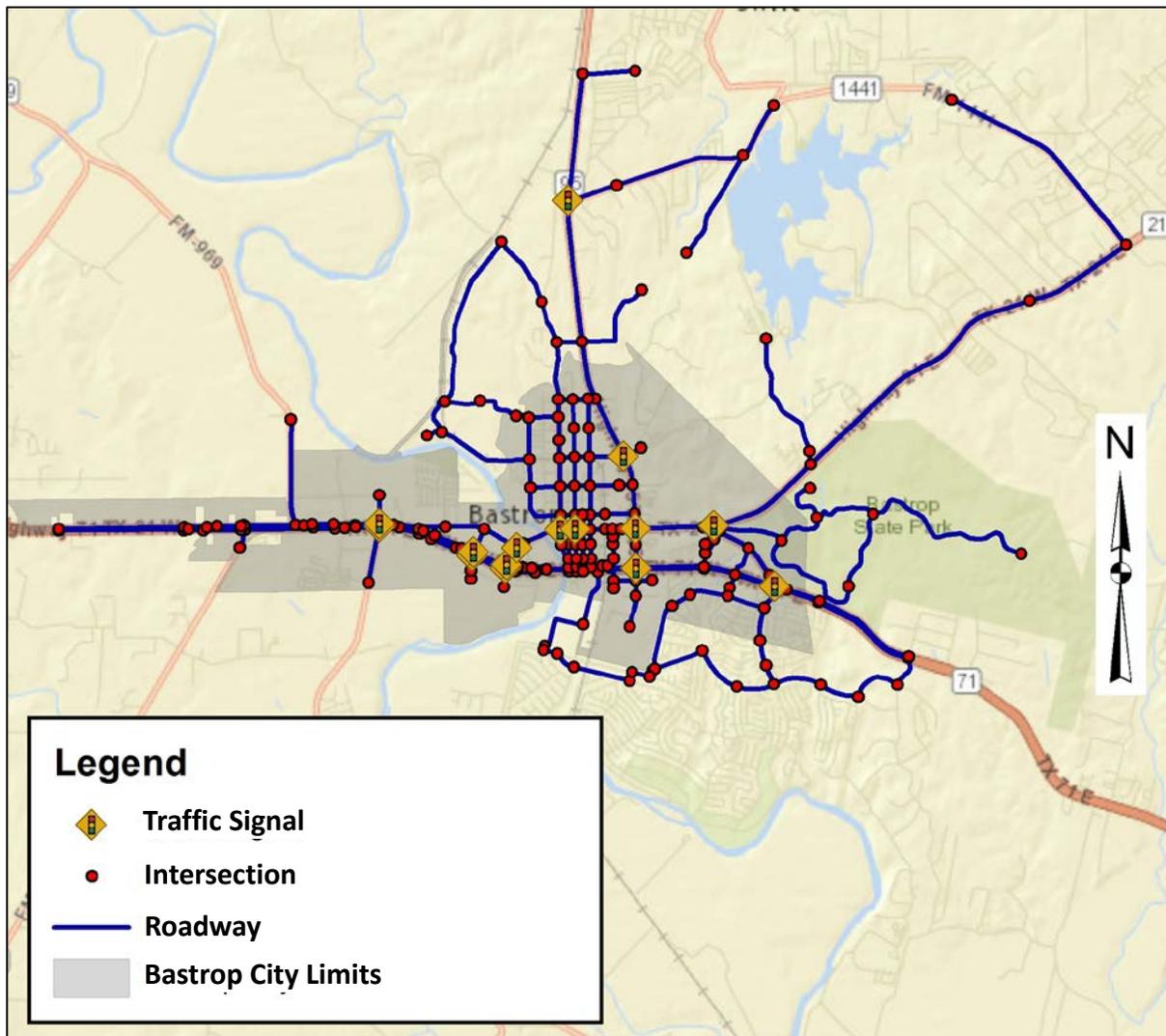
### 3. MODEL DEVELOPMENT

#### 3.1 DTA Model

A DTA model was used to investigate changes to travel patterns resulting from construction and full build-out of the interchanges along SH 71. The traffic assignment process involves routing vehicles between their points of origin and destination. This routing is based on assigning vehicles to their least cost path with the shortest travel time. The model evaluates routes and assigns vehicles across the network to achieve the lowest travel time for each individual vehicle modeled.

The DTA model applies changes to route selection as traffic conditions change over time, and can simulate the impact of congestion more appropriately. The ability of the model to adapt the routing assignment to congestion generally makes the model more accurate for evaluating network impacts during peak periods, particularly those involving changes to capacity, which are common in traffic control plan scenarios. The DTA model also enables one to investigate impacts throughout an area extending beyond a corridor or series of intersections where a microsimulation would be appropriate. The construction of interchanges along SH 71 lends itself to this type of application, where there is concern about rerouting of traffic along roadways throughout the downtown area.

The DTA model used in this analysis represents a subnetwork extracted from a regional DTA model. The model was constructed by combining the base CAMPO network with more detailed features, including traffic signals, added within the subnetwork boundaries. The subnetwork follows the limits of the one-mile extraterritorial jurisdiction for the City of Bastrop to the east and north, with the Colorado River as the boundary to the south, and includes the intersection of FM 20 and SH 71 to the west (see Figure 2). These limits extend beyond the area of concern for the project evaluation while encompassing several major route alternatives and travel productions within the region.



**Figure 2. Layout and Extent of DTA Model**

To represent existing conditions, the 2015 CAMPO morning and afternoon peak period models with forecasted demand tables were used. Demand for the subnetwork was extracted from the full CAMPO regional model using TransCAD and input into the DTA software.

The DTA models were developed to evaluate the route choice behavior of travelers before, during, and after the construction of grade-separated interchanges along SH 71 at Tahitian Drive and SH 95, and the impact on area traffic, especially in the downtown Bastrop area. Both the morning (a.m.) and afternoon (p.m.) peak periods were analyzed to review the impacts during typical weekday conditions when demand is at its highest. For the CAMPO travel demand model, the a.m. peak period represents 6:00 to 9:00 a.m. and the p.m. peak period represents 3:30 to 6:30 p.m. To date, the impact of four scenarios has been reviewed to assess the impact of construction of the interchange at Tahitian Drive and the full build-out of the two interchanges.

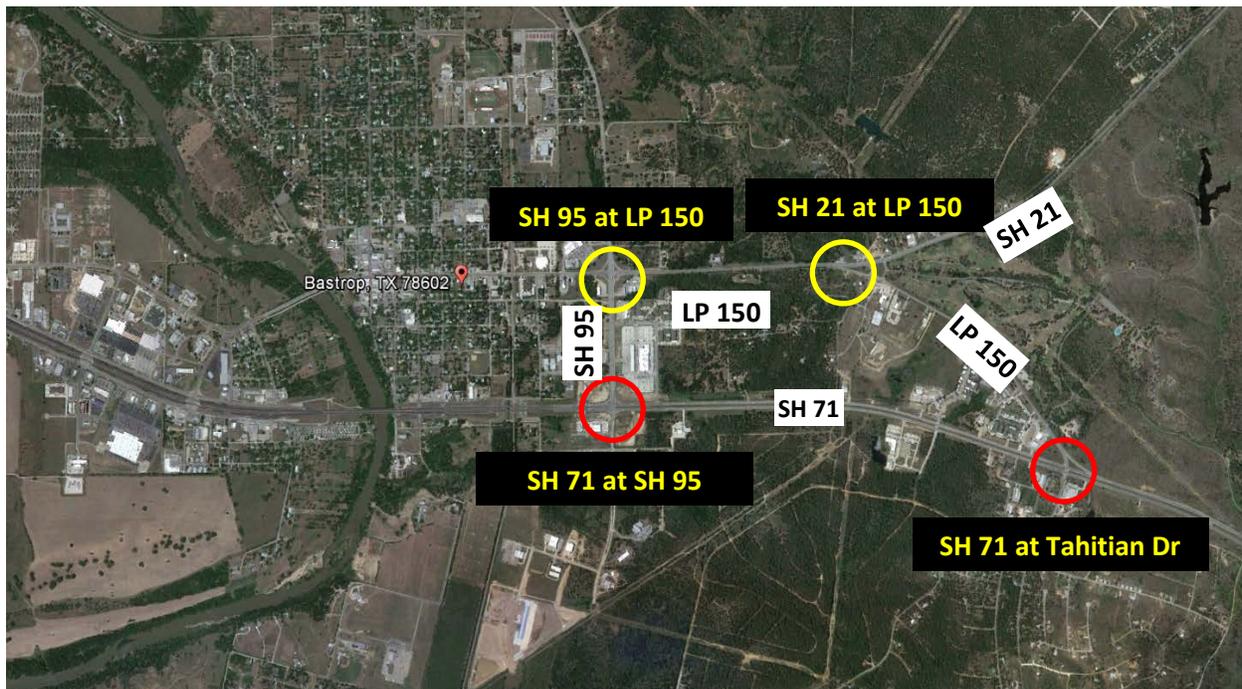
Six DTA models have been developed and analyzed for the a.m. and p.m. peak periods representative of the following scenarios:

- 1) Existing Conditions: At-grade intersections along SH 71 at Tahitian Drive and SH 95
- 2) Tahitian-1: Phase 1 Stage 3 of construction of the SH 71 at Tahitian Drive interchange
- 3) Tahitian-2: Phase 2 Stage 1 of construction of SH 71 at Tahitian Drive interchange
- 4) SH 95-1: Phase 1 Stage 3 of construction of SH 71 at SH 95 interchange (simultaneous with Phase 2 Stage 1 of construction of SH 71 at Tahitian Drive interchange)
- 5) SH 95-2: Phase 2 Stage 1 of construction of SH 71 at SH 95 interchange (simultaneous with Phase 2 Stage 1 of construction of SH 71 at Tahitian Drive interchange)
- 6) Full Build-out Conditions: Grade-separated interchanges at Tahitian Drive and SH 95

### 3.2 Microsimulation Model

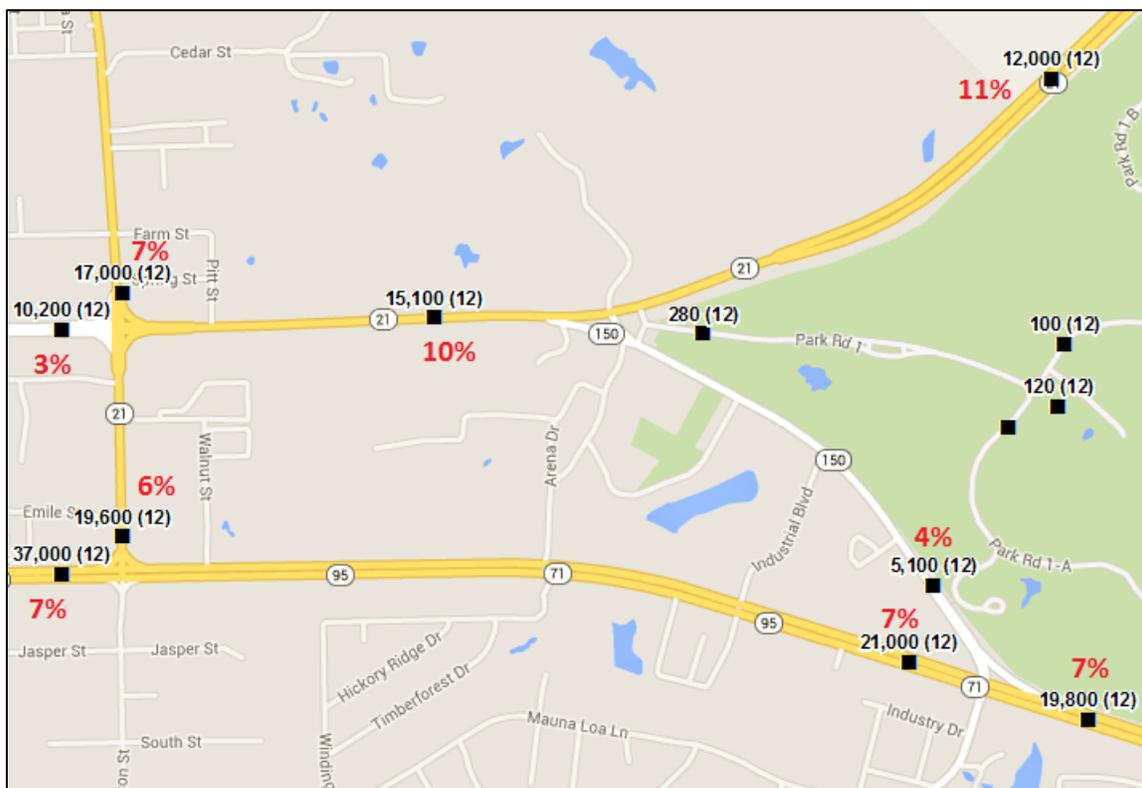
In addition to the DTA models, microsimulation was used to assess four key intersections in the vicinity of the project site (see Figure 3) for a.m. and p.m. peak periods. The following intersections were included in the analysis:

- 1) SH 95 at Loop 150/SH 21 (Chestnut Street)
- 2) SH 21 at Loop 150
- 3) SH 71 at SH 95 (Jackson Street)
- 4) SH 71 at Tahitian Drive (LP 150)



**Figure 3. Key Intersections Included in the Microsimulation Models (Google Earth)**

Traffic counts from the week of August 25, 2014, at these four intersections were obtained from GRAM Traffic. The traffic counts are cumulated into 15-minute intervals ranging from 7:00 a.m. to 9:00 a.m. for the morning peak period and from 4:00 p.m. to 6:00 p.m. for the afternoon peak. The traffic counts were assessed to determine a peak hour, or maximum count over four consecutive 15-minute intervals, for each peak period collected. The a.m. peak hour was determined to be 7:45 to 8:45 a.m. and the p.m. peak hour was found to be 5:00 to 6:00 p.m. Please refer to Appendix A for the traffic counts at these four intersections. To supplement the turning movement counts, 2012 TxDOT 24-hour counts were reviewed primarily to determine the percentage of heavy vehicles for the intersection approaches. Figure 4 shows the count locations with 2012 average annual daily traffic counts (AADTs) and the percentage of heavy vehicles from the TxDOT collection at each site.



**Figure 4. TxDOT 2012 AADTs and Percent Heavy Vehicles (Google Maps)**

In addition to traffic counts, current signal timing plans for each intersection were obtained from TxDOT. The traffic signals at all four intersections operate with at least semi-actuated timing plans with the exception of the signal at SH 95 at LP 150, which operates on a pre-timed plan during the p.m. peak period. Based on this information and the TCP drawings provided by the City, twelve scenarios were analyzed using Synchro for the a.m. and p.m. peak periods. The scenarios are summarized below:

- 1) Existing conditions/current roadway configuration
- 2) SH 71 at Tahitian Drive TCP scenarios



- a. SH 71 at Tahitian Drive TCP Phase 1 Stage 1
  - b. SH 71 at Tahitian Drive TCP Phase 1 Stage 2
  - c. SH 71 at Tahitian Drive TCP Phase 1 Stage 3a (no separate right-turn lane along westbound approach)
  - d. SH 71 at Tahitian Drive TCP Phase 1 Stage 3b (separate right-turn lane along westbound approach)
  - e. SH 71 at Tahitian Drive TCP Phase 2 Stage 1
- 3) SH 71 at SH 95 TCP scenarios
- a. SH 71 at SH 95 TCP Phase 1 Stage 1
  - b. SH 71 at SH 95 TCP Phase 1 Stage 2
  - c. SH 71 at SH 95 TCP Phase 1 Stage 3
  - d. SH 71 at SH 95 TCP Phase 2 Stage 1
  - e. SH 71 at SH 95 TCP Phase 2 Stage 2
- 4) Full build-out of all proposed improvements along SH 71 at SH 95 and SH 71 at Tahitian Drive (including frontage roads)

## 4. MODEL RESULTS

### 4.1 DTA Model Results

This section summarizes the DTA modeling results for the six scenarios described in Section 3.1. The findings are presented for the a.m. and p.m. peak periods, respectively.

#### 4.1.1 Morning Peak

##### Origin-Destination (OD) Path Analysis

The OD Path Analysis examines the paths taken by vehicles traveling between an origin (or set of origins) and a destination (or set of destinations). In addition to representing points within the network, origins and destinations may represent points of entry along the boundary of the network. In this section, the used paths for different OD pairs before, during, and after construction are presented for the a.m. peak period (6 to 9 a.m.). The pairings analyzed use the east end of SH 71 as a fixed origin to help demonstrate the typical westbound flow of commuter traffic in the area during the a.m. peak. The graphics in this section specifically show routing for the second hour of simulation as intended to represent the peak hour. The line weight and color is designated to indicate the relative amount of traffic on each roadway segment, as indicated in the figure legends. The color scale goes from dark blue (low volumes) to dark red (high volumes) with an increase in line thickness with higher relative volumes.

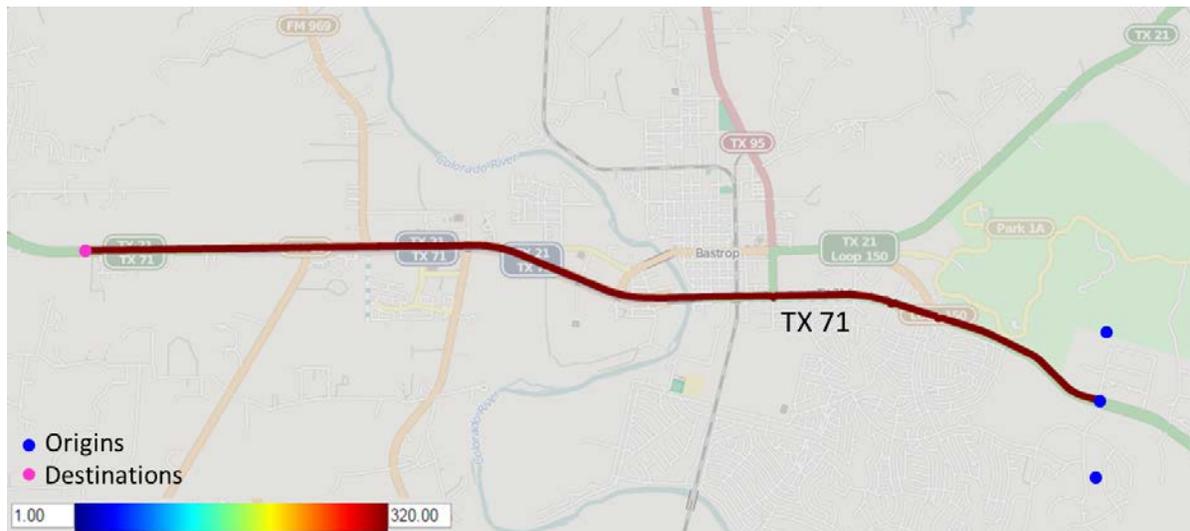
***OD Pair 1: SH 71 East End to SH 71 West End***

Origins: Boundary of study area at east end of SH 71

Destinations: Boundary of study area at west end of SH 71

Total demand: Approximately 950 vehicles for the peak period (~320 veh/hr)

Model results: No differences between the six scenarios in terms of route choice were found. Vehicles use only SH 71 in all six scenarios (see Figure 5).



**Figure 5. Travel Pattern from SH 71 East End to SH 71 West End**

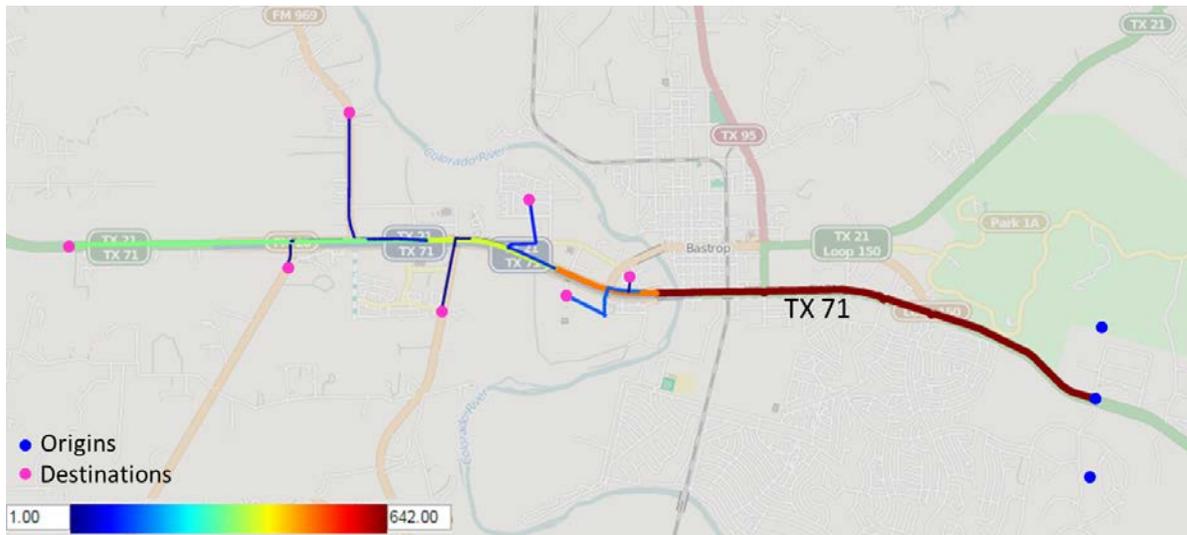
***OD Pair 2: SH 71 East End to West of the Colorado River***

Origins: Boundary of study area at east end of SH 71

Destinations: West of Colorado River

Total demand: Approximately 1,920 vehicles for the peak period (~640 veh/hr)

Model Results: No differences between the six scenarios in terms of route choice were found. Vehicles use only SH 71 in all six scenarios (see Figure 6).



**Figure 6. Travel Pattern from SH 71 East End to Destinations West of Colorado River**

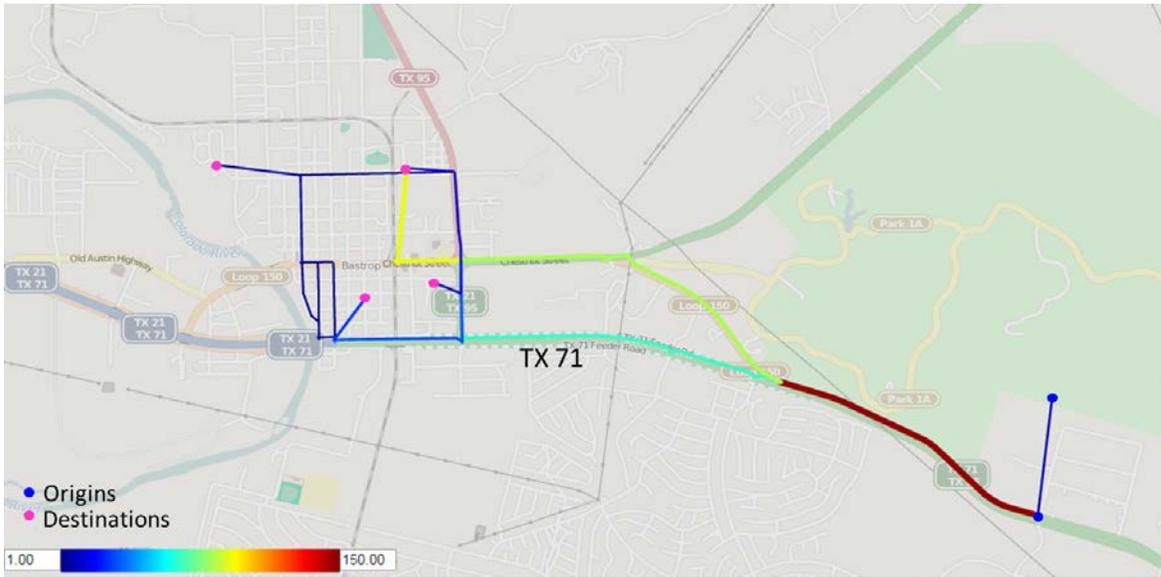
***OD Pair 3: SH 71 East End to Downtown Bastrop Area***

Origins: Boundary of study area at east end of SH 71

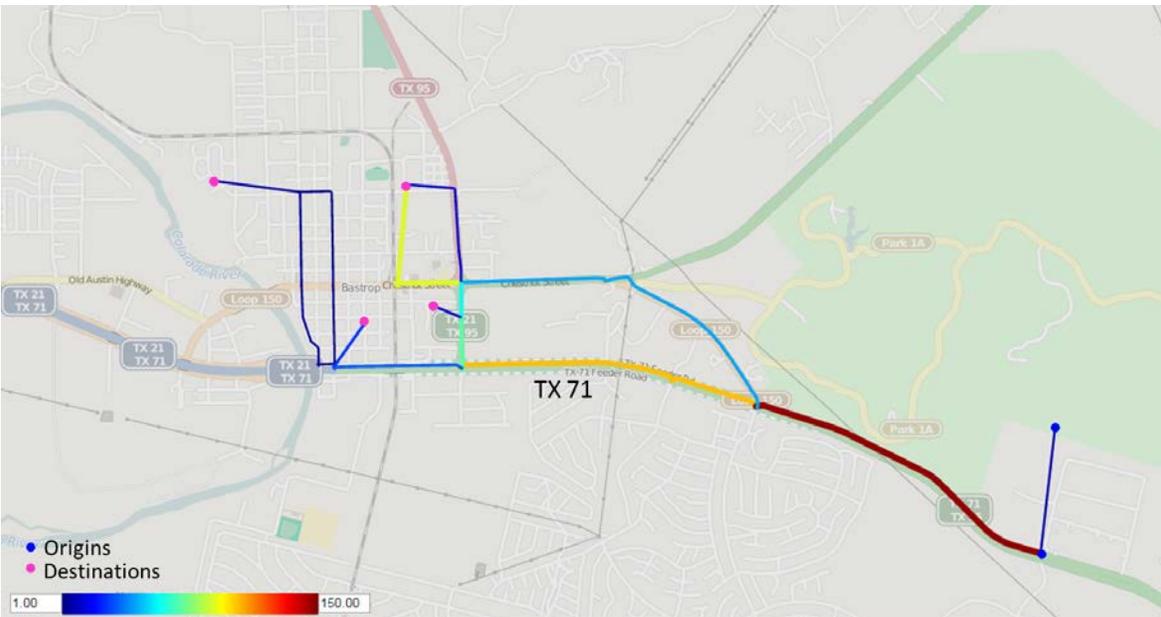
Destinations: Downtown Bastrop south of the rail line

Total demand: Approximately 445 vehicles for the peak period (~150 veh/hr)

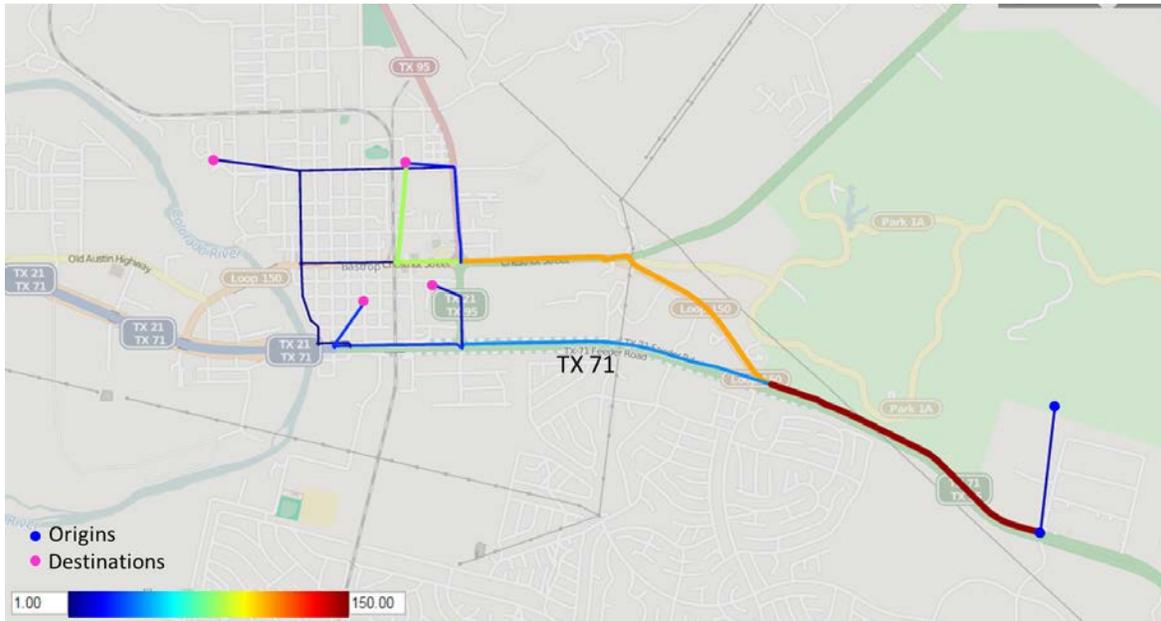
Model Results: In the existing scenario, travelers use both Loop 150 (57 percent) and SH 71 (43 percent) to reach their destinations (see Figure 7 (a)). For the Tahitian-1 scenario, the majority of vehicles are assigned to SH 71 (71 percent) (see Figure 7 (b)). This is likely due to the fact that the channelized right turn lane along the westbound approach at the Tahitian Drive intersection will be closed during this construction stage and the accessibility from SH 71 to Loop 150 will subsequently be reduced. For the Tahitian-2, SH 95-1, and SH 95-2 scenarios, more travelers are assigned to Loop 150 (about 73 percent) (see Figures 7 (c) and (d)). In the full build-out scenario, most of the vehicles are assigned to SH 71 (92 percent) (see Figure 7 (e)). It is worth noting that very little, if any, change to traffic along LP 150, west of SH 95, occurs between the existing, Tahitian-1, Tahitian-2, and full build-out scenarios. There does appear to be slightly less traffic using LP 150 (Chestnut Street) immediately west of SH 95 for the SH 95-1 and SH 95-2 scenarios for this pairing due to more use of SH 95 to the north (see Figure 7 (d)).



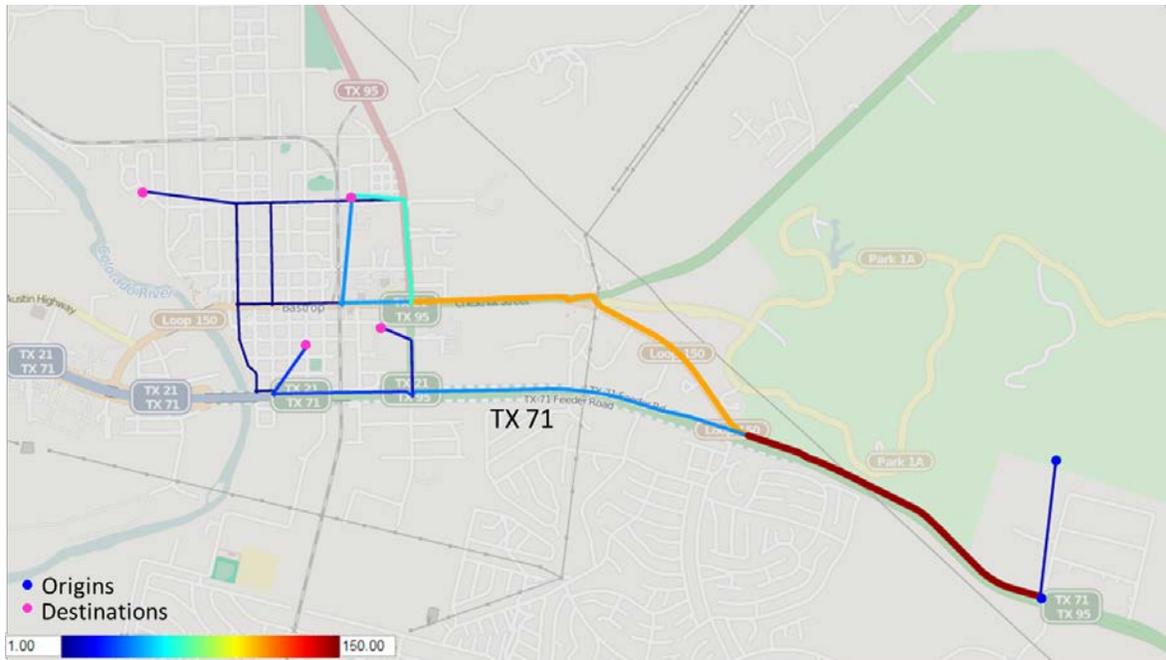
(a) Existing



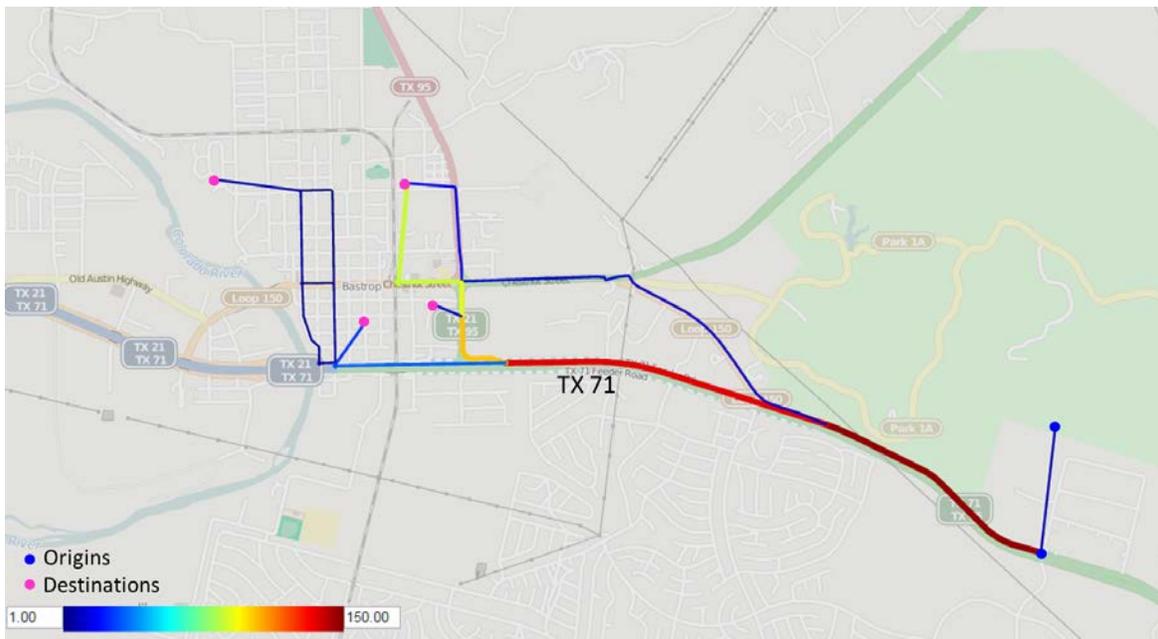
(b) Tahitian-1



(c) Tahitian-2



(d) SH 95-1 & SH 95-2



(e) Full Build-out

**Figure 7. Travel Patterns from SH 71 East End to Downtown Bastrop Area**

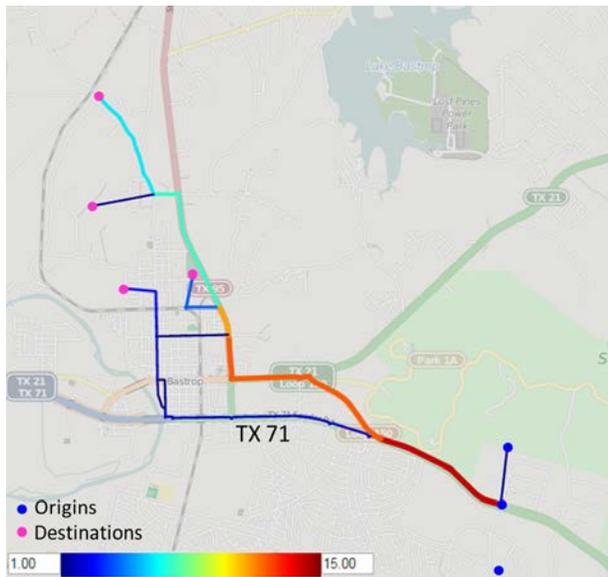
***OD Pair 4: SH 71 East End to North Side of Bastrop***

Origins: Boundary of study area at east end of SH 71

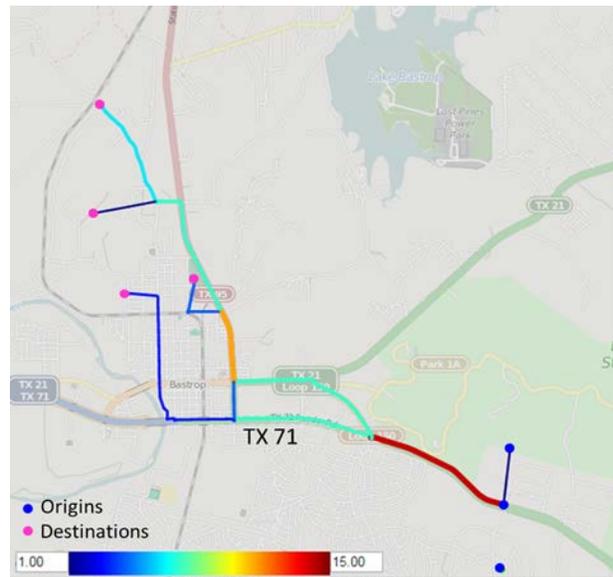
Destinations: Bastrop north of the rail line

Total demand: Approximately 40 vehicles for the peak period (~15 veh/hr)

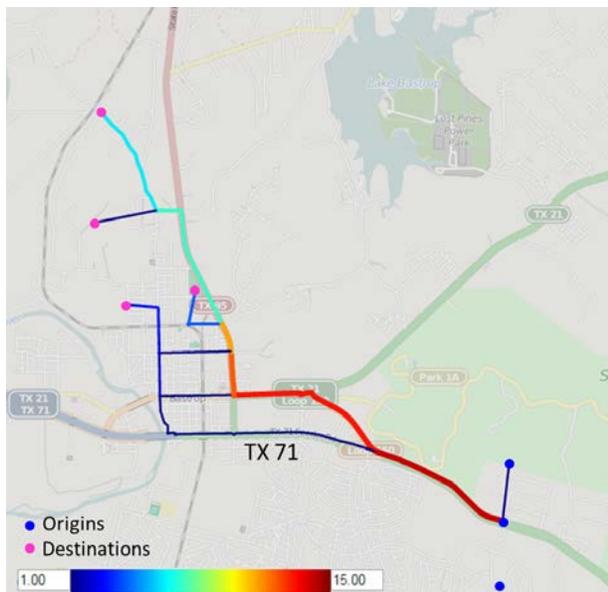
Model Results: In the existing scenario, vehicles mainly use Loop 150, with some traffic on SH 71 (14 percent) (see Figure 8 (a)). For the Tahitian-1 scenario, the numbers of vehicles using SH 71 and Loop 150 are approximately the same (see Figure 8 (b)). For the Tahitian-2 and SH 95-1 scenarios, less than 10 percent of the vehicles are assigned to SH 71 (see Figure 8 (c)). For the SH 95-2 scenario, all vehicles use LP 150 (see Figure 8 (d)). In the full build-out scenario, more travelers choose SH 71 (33 percent) (see Figure 8 (e)), indicating a clear shift to SH 71 with the new interchanges in place for these destinations. Travel west of SH 95 for this OD pairing is not significantly affected by the network changes. It should be noted that the demand for this OD pair is very low, at only approximately 15 vehicles per hour during the a.m. peak period.



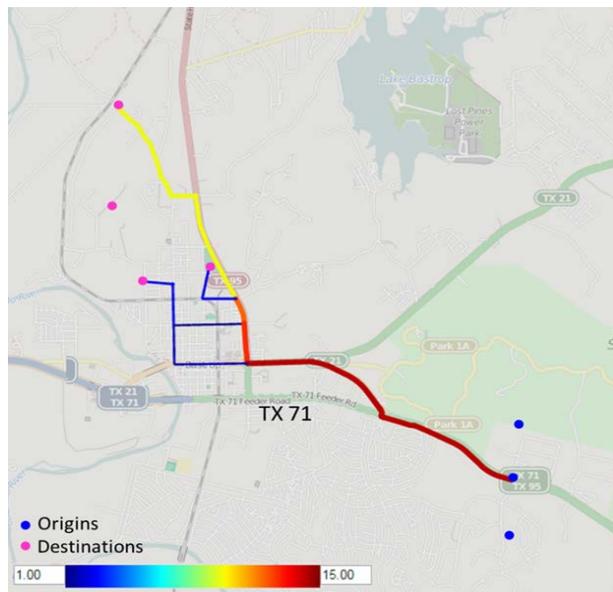
(a) Existing



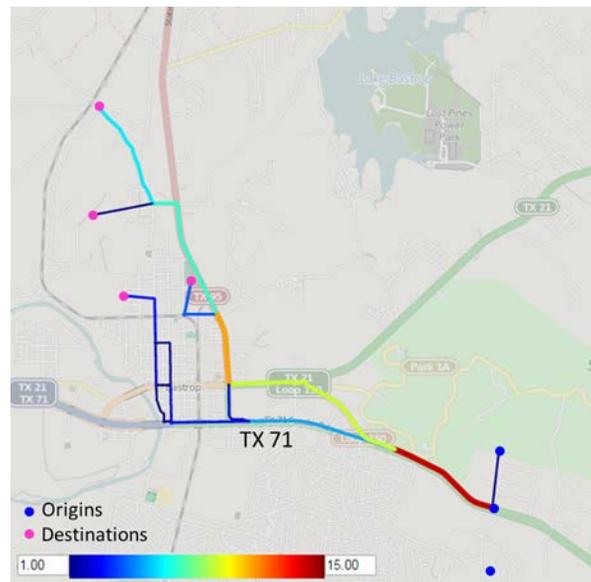
(b) Tahitian-1



(c) Tahitian-2 & SH 95-1



(d) SH 95-2



(e) Full Build-out

**Figure 8. Travel Patterns from SH 71 East End to North Side of Bastrop**

***OD Pair 5: SH 71 East End to North End of SH 95***

Origins: Boundary of study area at east end of SH 71

Destinations: Boundary of study area at north end of SH 95

Total demand: Approximately 145 vehicles for the peak period (~50 veh/hr)

Model Results: For the existing, Tahitian-2, SH 95-1, and SH 95-2 scenarios, all vehicles for this OD pair use only Loop 150 (see Figure 9 (a)). For the Tahitian-1 scenario, some travelers switch to SH 71 (24 Percent) (see Figure 9 (b)). In the full build-out scenario, a few travelers choose SH 71 (12 percent) (see Figure 9 (c)). No impact west of SH 95 is visible for the scenarios. It should be noted that the demand for this OD pair is relatively low, at approximately 50 vehicles per hour during the a.m. peak period.



(a) Existing, Tahitian-2, SH 95-1, & SH 95-2



(b) Tahitian-2



(c) Full Build-out

**Figure 9. Travel Patterns from SH 71 East End to North End of SH 95**

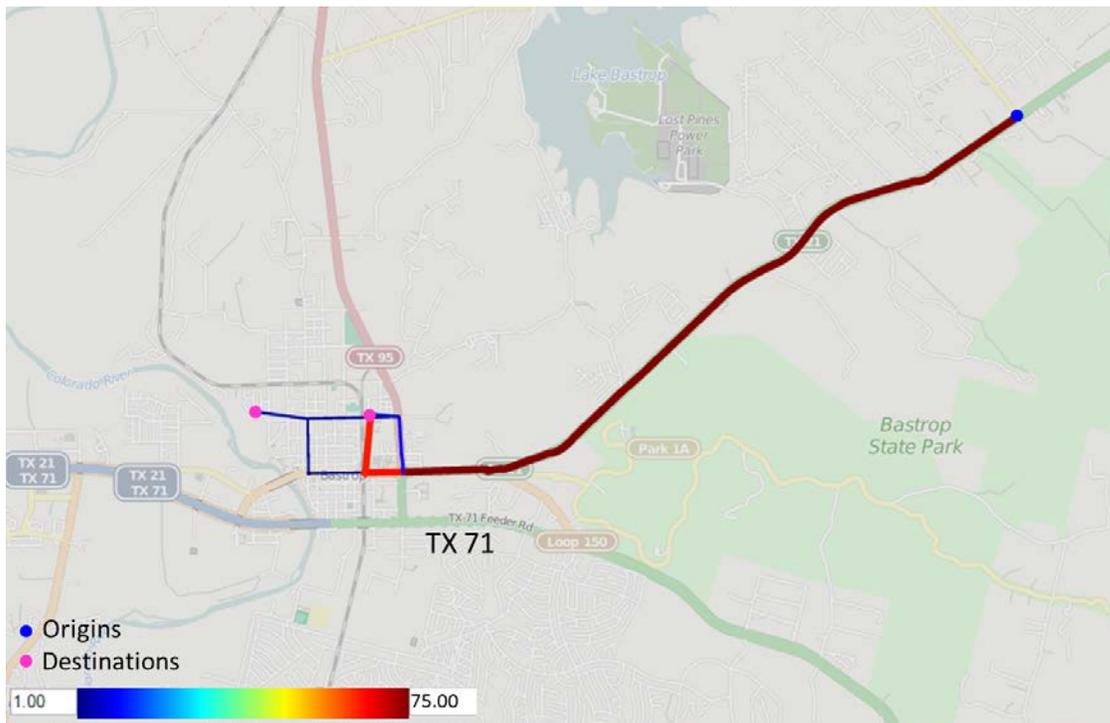
**OD Pair 6: SH 21 East End to Downtown Bastrop Area**

Origins: Boundary of study area at east end of SH 21

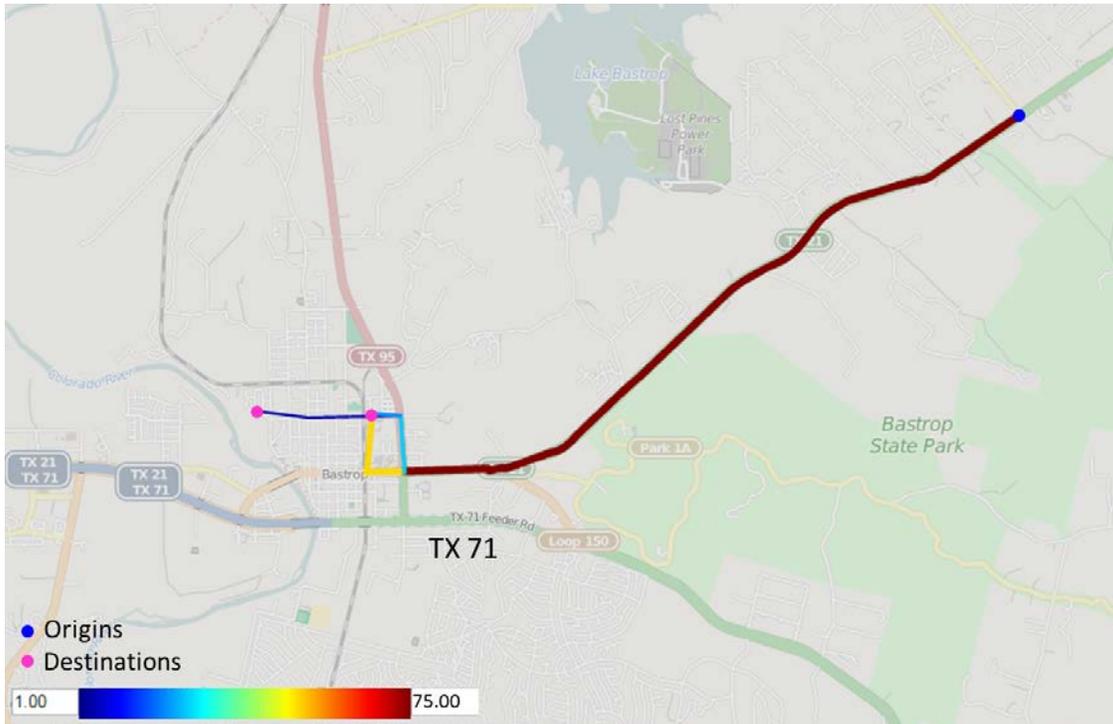
Destinations: Downtown Bastrop south of the rail line

Total demand: Approximately 225 vehicles for the peak period (~75 veh/hr)

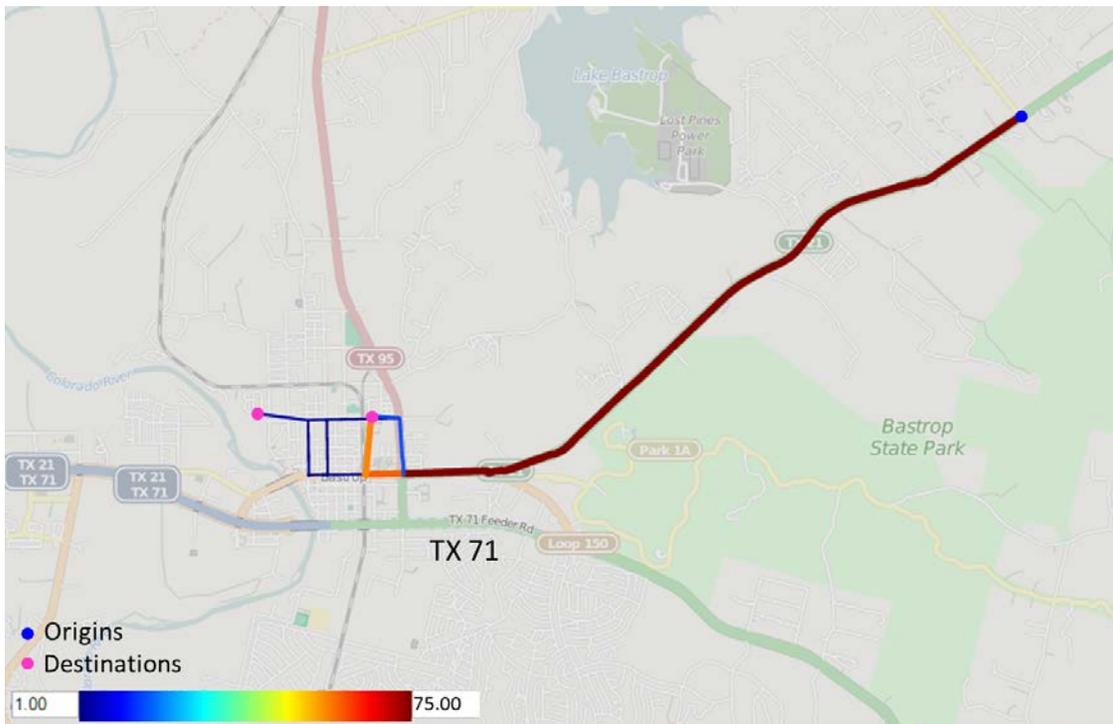
Model Results: In the existing scenario, most vehicles coming from SH 21 use LP 150 to travel to the two downtown destinations north of LP 150. In all other scenarios (during construction and after full build-out), some vehicles originally using LP 150 adjust their route to head north along SH 95 and then west along east-west connections, such as Cedar Street, to make their way to their destination. This trend is most obvious in the SH 95-1 scenario as more vehicles take the route using SH 95 (See Figure 10 (e)). This shift off of LP 150 is likely a result of other vehicles adjusting their route to use LP 150 instead of SH 71.



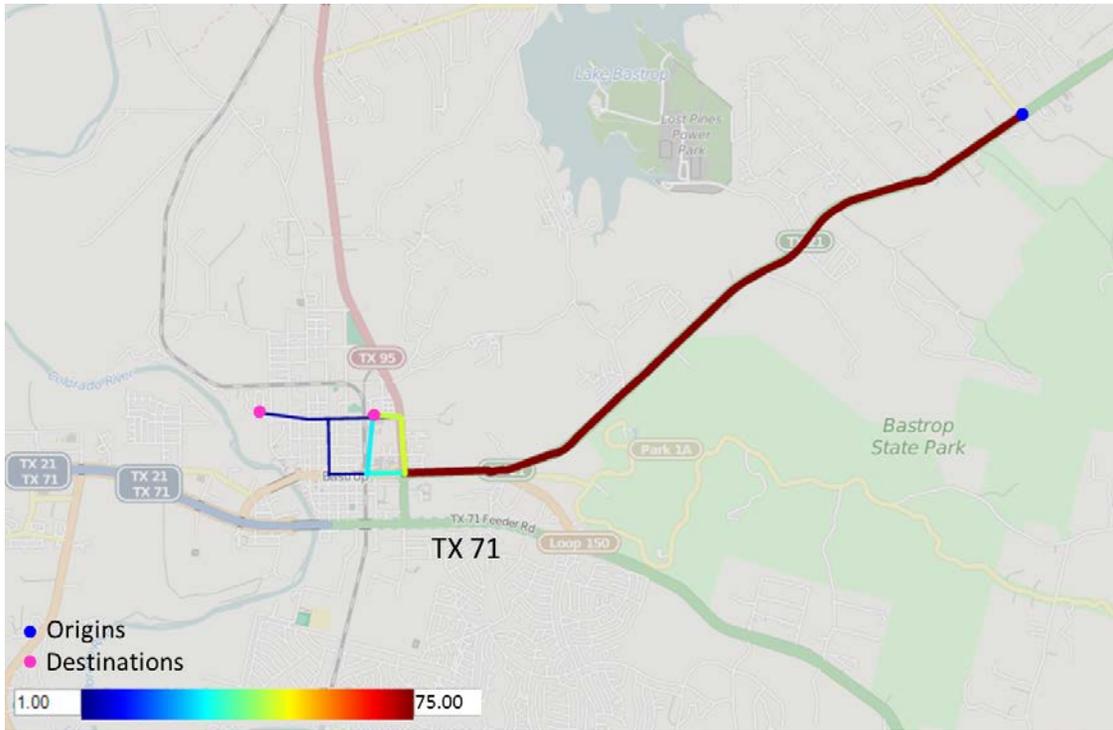
(a) Existing



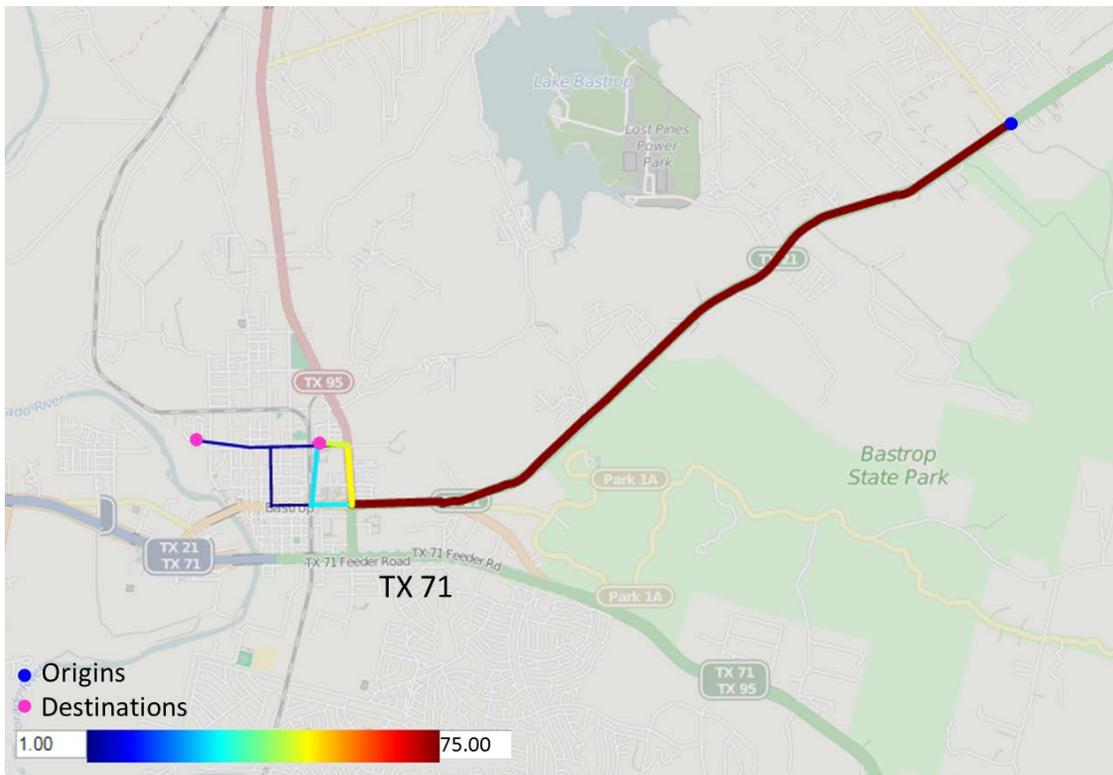
(b) Tahitian-1



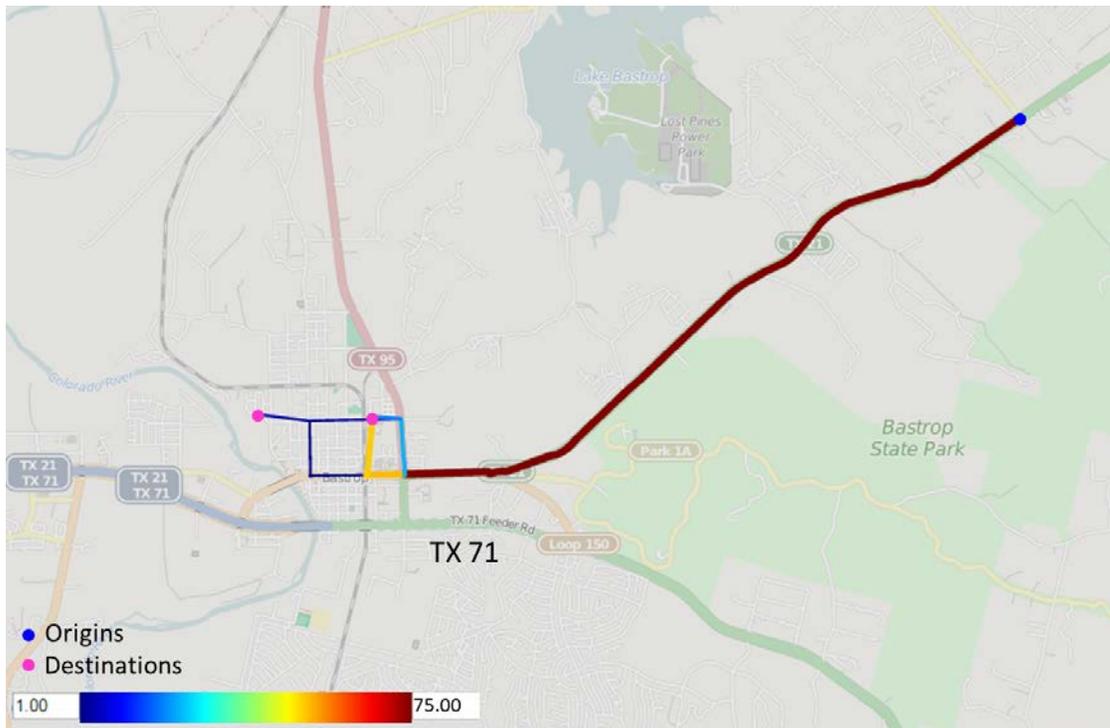
(c) Tahitian-2



(d) SH 95-1



(e) SH 95-2



(f) Full Build-out

**Figure 10. Travel Patterns from SH 21 East End to Downtown Bastrop Area**

***OD Pair 7: Downtown Bastrop Area to West of Colorado River***

Origins: Downtown Bastrop south of the rail line

Destinations: West of Colorado River

Total demand: Approximately 700 vehicles for the peak period (~235 veh/hr)

Model Results: No significant change in route choice is observed between scenarios for this OD pair during the morning peak period. The majority of vehicles use SH 71, as shown in Figure 11. Note that approximately 100 vehicles use Pecan Street to access SH 71 from LP 150.





**Table 1. Morning Travel Time Analysis (Minutes)**

| Origins                     | Destinations            | Existing | Tahitian-1 | Tahitian-2 | SH 95-1 | SH 95-2 | Full Build-out |
|-----------------------------|-------------------------|----------|------------|------------|---------|---------|----------------|
| SH 71 at Bastrop State Park | West end of SH 71       | 10.5     | 9.5        | 10.0       | 10.0    | 10.0    | 8.0            |
|                             | West of River           | 9.0      | 8.5        | 9.0        | 9.0     | 9.0     | 7.0            |
|                             | Bastrop S. of rail line | 5.0      | 5.0        | 5.0        | 5.0     | 5.0     | 4.0            |
|                             | Bastrop N. of rail line | 10.5     | 11.0       | 11.0       | 11.0    | 11.0    | 10.5           |
|                             | North end of SH 95      | 10.0     | 10.5       | 10.0       | 10.0    | 10.0    | 10.0           |

**Selected Roadway Segment Analysis**

This part of the analysis helps identify which travelers are using a selected roadway segment in the network by illustrating the paths of all vehicles that use the segment. To evaluate if traffic will shift to LP 150/Chestnut Street during construction phasing, roadway segments along LP 150—one west of SH 95 and one east of SH 95—were selected for analysis.

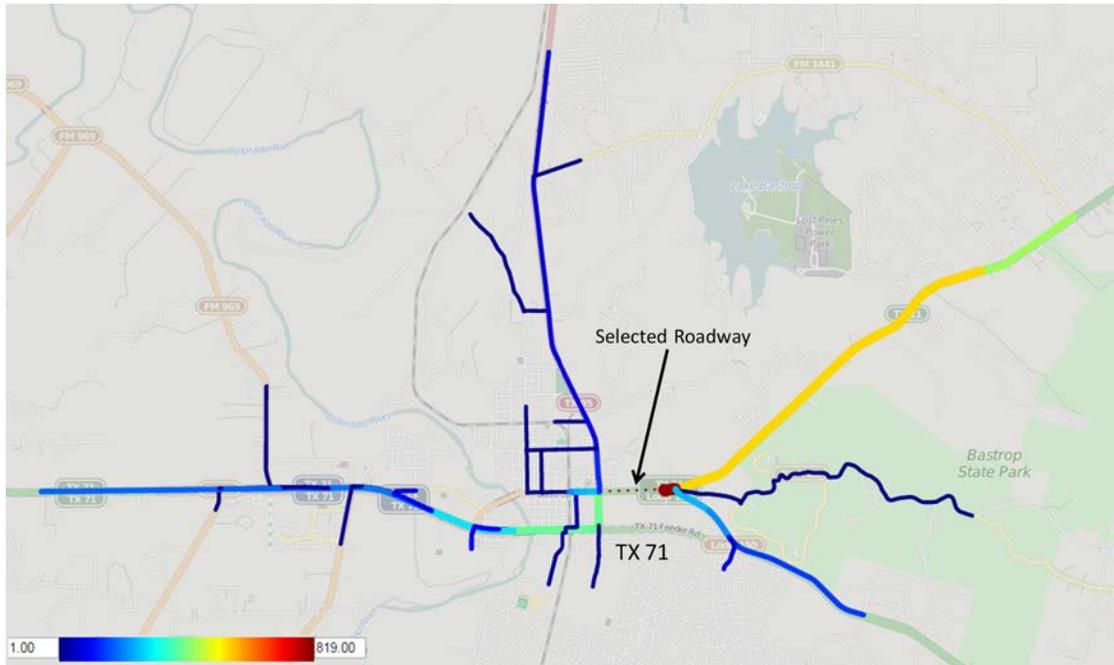
**Loop 150 between SH 21 and SH 95, Westbound Direction**

In the full build-out scenario, the number of vehicles assigned to this section of roadway decreases by approximately 170 vehicles during the peak hour compared with the existing scenario (see Table 2). The travel pattern remains largely unchanged between the existing scenario and the construction scenarios (see Figure 12 (a)). After full build-out, among all the travelers using this section of roadway, the proportion of vehicles coming from the southeast is lower (see Figure 12 (b)), indicating more vehicles from that direction will use SH 71 with the intersection upgrades. The figure also indicates that a higher proportion of vehicles use SH 95 from LP 150 to the east to gain access to SH 71 after full build-out of the interchange, but the absolute number is approximately the same.

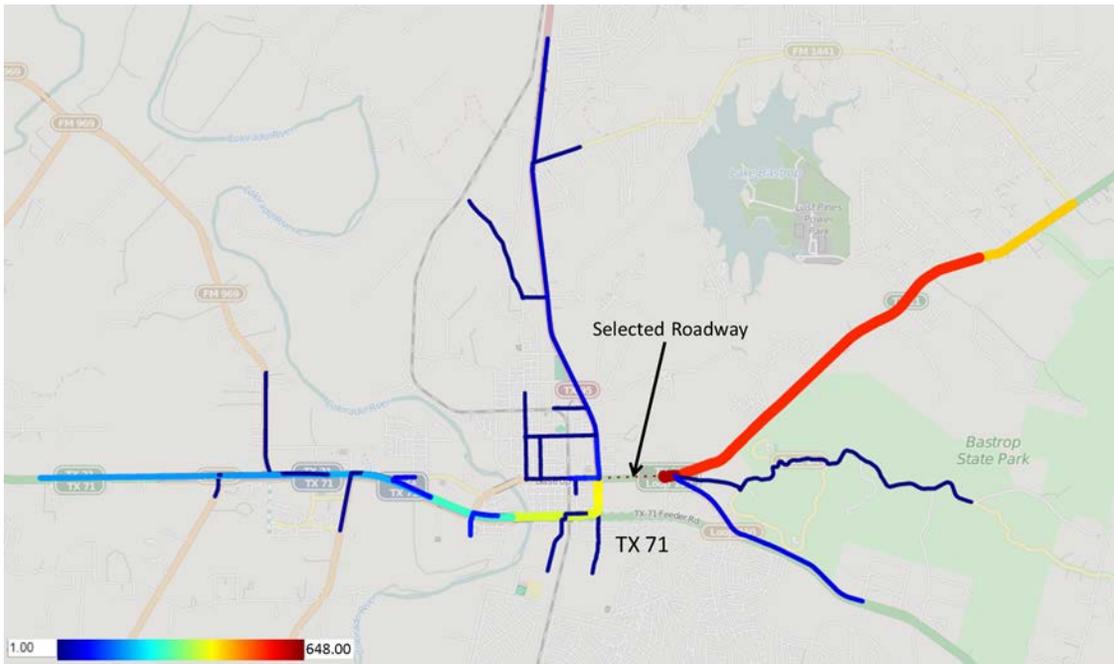
Table 2 shows that the number of vehicles using this roadway segment decreases during most construction phases. This is due to some travelers that originally use LP 150 switching to other routes. For example, vehicles leaving the neighborhood south of SH 71 at Tahitian Drive use both LP 150 and SH 71 when heading toward downtown Bastrop. However, during construction phasing, as more traffic from areas to the east diverts to LP 150, some of these vehicles reroute to SH 71 as a result.

**Table 2. Number of Vehicles Using Loop 150 between SH 21 and SH 95, Westbound**

|                                     | Existing | Tahitian-2 | Tahitian-3 | SH 95-1 | SH 95-2 | Full Build-out |
|-------------------------------------|----------|------------|------------|---------|---------|----------------|
| Number of vehicles during peak hour | 820      | 760        | 750        | 740     | 830     | 650            |



(a) Existing, Tahitian-1, Tahitian-2, SH 95-1, & SH 95-2



(b) Full Build-out

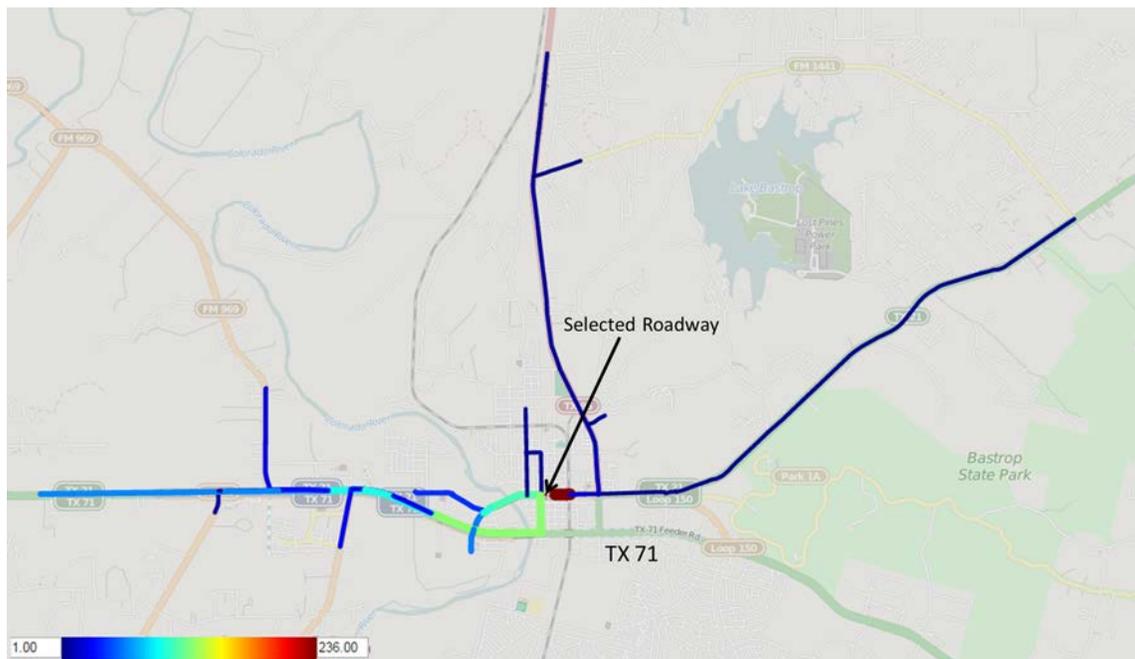
**Figure 12. Paths of Vehicles Using Loop 150 between SH 21 and SH 95, Westbound Direction**

**Loop 150 (Chestnut Street) between Hill Street and Pecan Street, Westbound Direction**

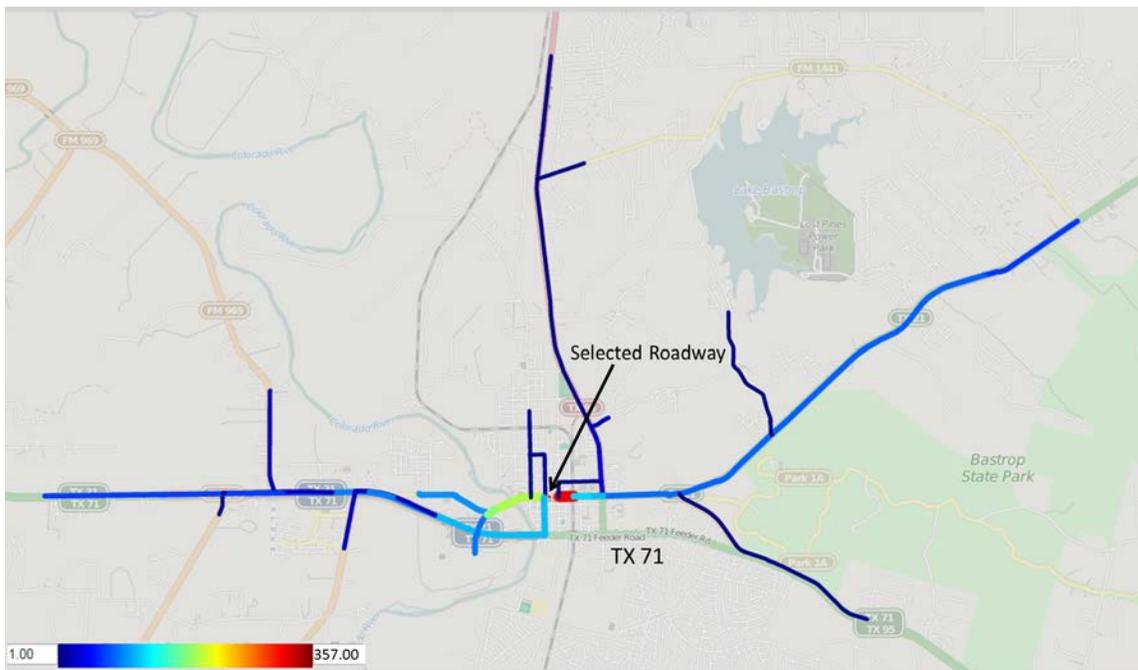
The majority of traffic identified on the segment of LP 150 (Chestnut Street) west of SH 95 through the downtown Bastrop area, originates from the east along SH 21 or north along SH 95. This traffic is primarily destined to points west of the river along LP 150 or SH 71, with some destinations in the downtown area. Much of the traffic crossing this section bound for SH 71 uses Pecan Street to gain access to the highway. Traffic destined for points along LP 150 continue along the roadway to the west (see Figure 13). This pattern of traffic splitting in this area, depending on the destination, is consistent between scenarios. During construction, the total number of vehicles using this section of roadway increases by approximately 8 percent in the Tahitian-1 and Tahitian-2 scenarios, 17 percent in the SH 95-1 scenario, and 52 percent in the SH 95-2 scenario (see Table 3). The significant increase in traffic during the SH 95-1 and SH 95-2 scenarios comes from SH 21 (see Figure 13 (b)). This traffic otherwise uses SH 95 to access SH 71, but during reconstruction of the SH 95 intersection, these vehicles divert to Chestnut Street. After construction, with the full build-out, the volume on this section of roadway returns to approximately its original value.

**Table 3. Number of Vehicles Using Loop 150 between Hill Street and Pecan Street, Westbound**

|                                     | Existing | Tahitian-2 | Tahitian-3 | SH 95-1 | SH 95-2 | Full Build-out |
|-------------------------------------|----------|------------|------------|---------|---------|----------------|
| Number of vehicles during peak hour | 230      | 250        | 250        | 360     | 330     | 240            |



(a) Existing, Tahitian-1, Tahitian-2, & Full Build-out



(b) SH 95-1 & SH 95-2

**Figure 13. Paths of Vehicles Using Loop 150 between Hill Street and Pecan Street, Westbound Direction**

#### 4.1.2 Afternoon Peak

##### OD Path Analysis

In this section, the used paths for different OD pairs before, during, and after construction are presented for the p.m. peak period (3:30 to 6:30 p.m.). The pairings analyzed use the east end of SH 71 as a fixed destination to help demonstrate the typical eastbound flow of commuter traffic in the area during the p.m. peak. The graphics in this section specifically show routing for the second hour of simulation as intended to represent the peak hour.

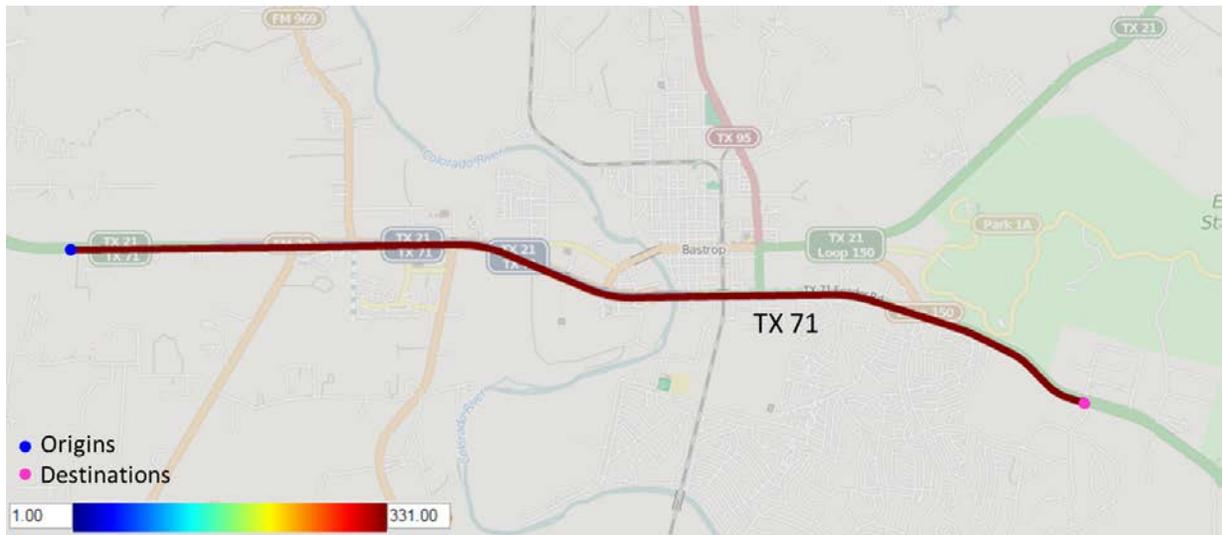
##### ***OD Pair 1: SH 71 West End to SH 71 East End***

Origins: Boundary TAZs at west end of SH 71

Destinations: Boundary TAZs at east end of SH 71

Total demand: Approximately 990 vehicles for the peak period (~330 veh/hr)

Model Results: No differences between the six scenarios in terms of route choice were found. Vehicles use only SH 71 in all six scenarios (see Figure 14).



**Figure 14. Travel Pattern from SH 71 West End to SH 71 East End**

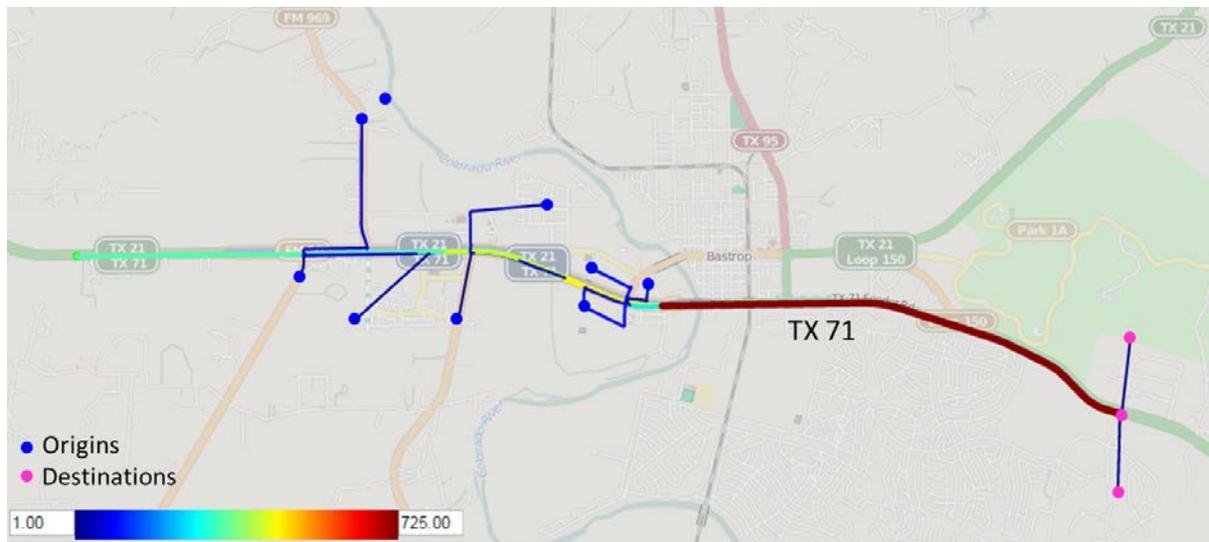
***OD Pair 2: West of the Colorado River to SH 71 East End***

Origins: TAZs west of Colorado River

Destinations: Boundary TAZs at east end of SH 71

Total demand: Approximately 2,170 vehicles for the peak period (~725 veh/hr)

Model Results: No differences between the six scenarios in terms of route choice were found. Vehicles use only SH 71 in all six scenarios (see Figure 15).



**Figure 15. Travel Pattern from West of Colorado River to SH 71 East End**

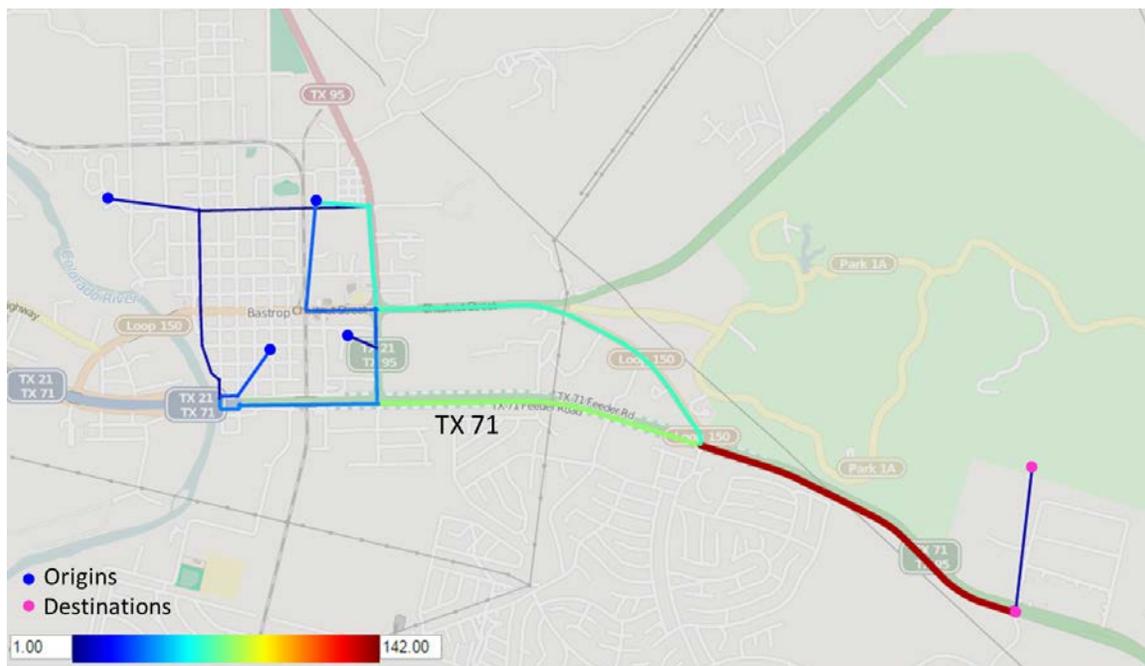
**OD Pair 3: Downtown Bastrop Area to SH 71 East End**

Origins: Downtown Bastrop south of the rail line

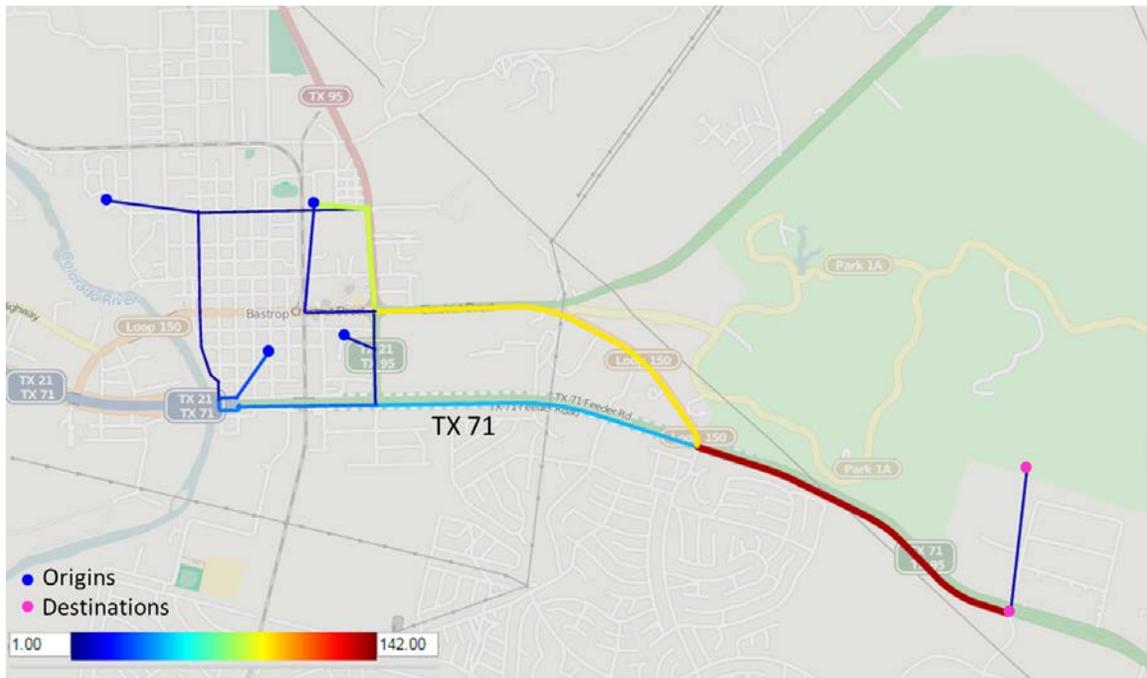
Destinations: Boundary of the study area at east end of SH 71

Total demand: Approximately 420 vehicles for the peak period (~140 veh/hr)

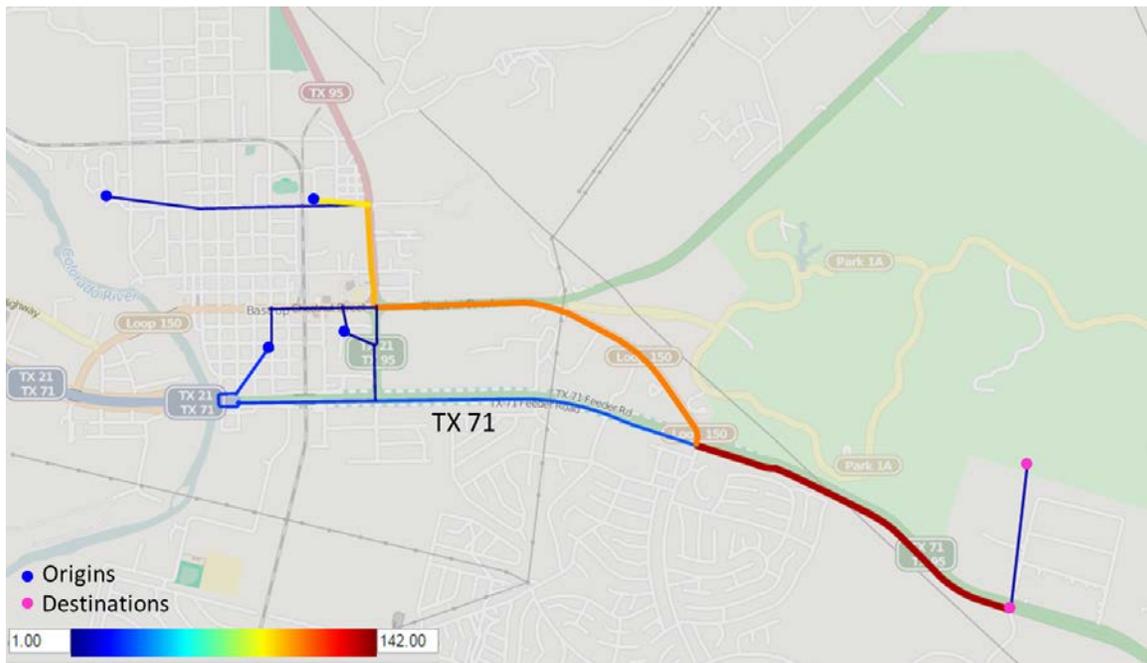
Model Results: In the existing scenario, travelers use both Loop 150 (44 percent) and SH 71 (56 percent) (see Figure 16 (a)). For the Tahitian-1 scenario, the trend begins to shift with a higher proportion of vehicles using LP 150 (69 percent) than SH 71 (31 percent) (see Figure 16 (b)). For the Tahitian-2, SH 95-1, and SH 95-2 scenarios, the majority of vehicles for this OD pairing continue to use LP 150 (69 percent for Tahitian-2, 76 percent for SH 95-1, and 94 percent for SH 95-2) (see Figure 16 (c)). In the full build-out scenario, nearly all travelers use SH 71 (93 percent) via SH 95 (see Figure 16 (d)).



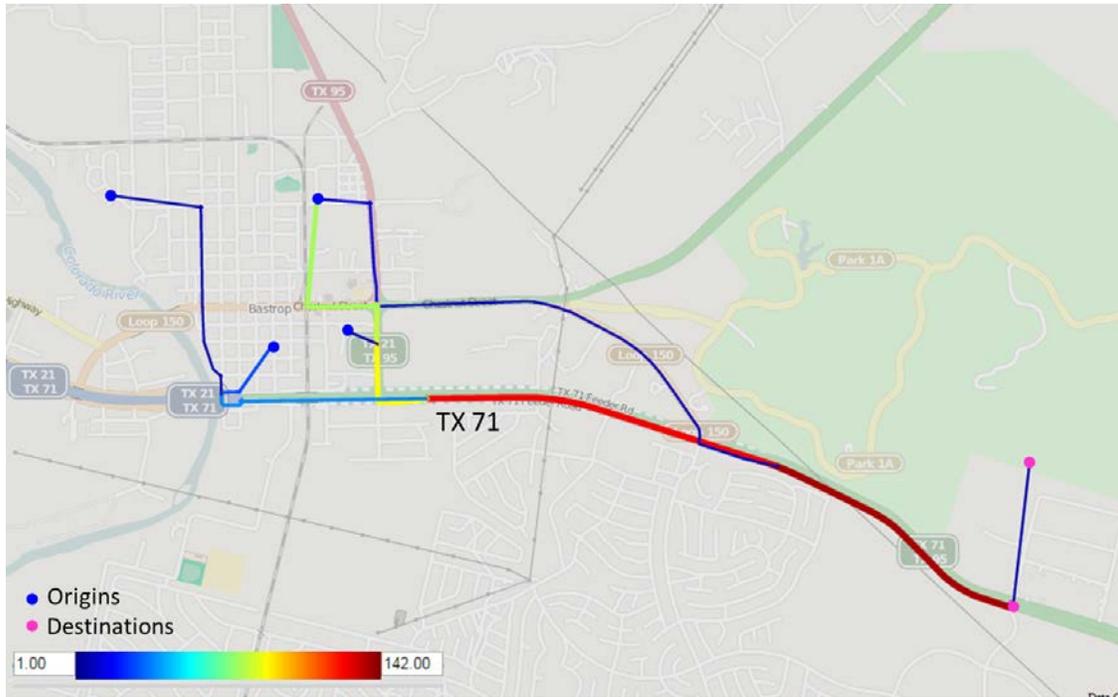
(a) Existing



(b) Tahitian-1



(c) Tahitian-2, SH 95-1, & SH 95-2



(d) Full Build-out

**Figure 16. Travel Patterns from Downtown Bastrop Area to SH 71 East End**

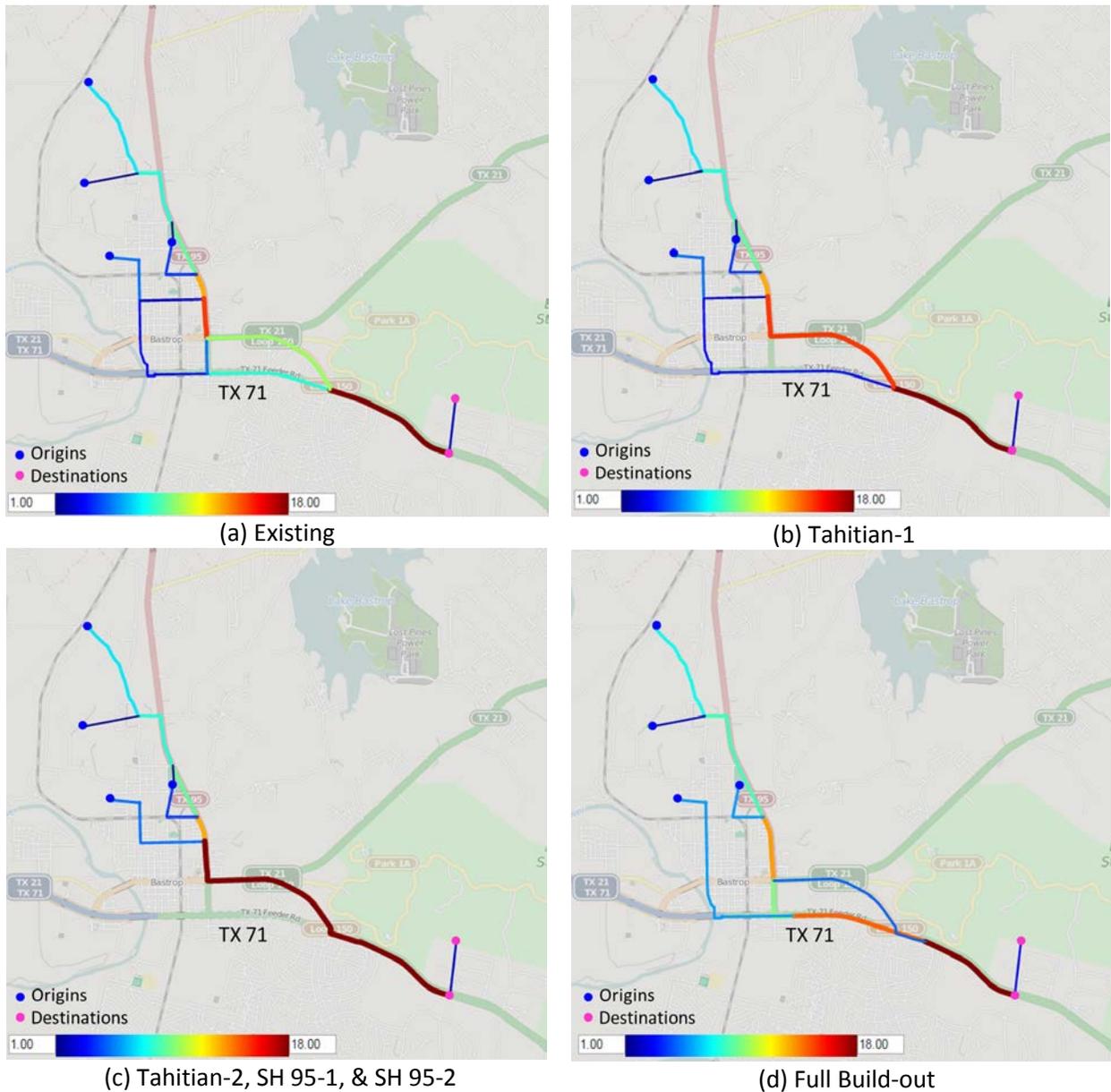
***OD Pair 4: Downtown Bastrop Area to SH 71 East End***

Origins: Bastrop north of the rail line

Destinations: Boundary of the study area at east end of SH 71

Total demand: Approximately 50 vehicles for the peak period (~15 veh/hr)

Model Results: In the existing scenario, travelers use both LP 150 and SH 71, with slightly more vehicles (55 percent) using LP 150 (see Figure 17 (a)). For the Tahitian-1 scenario, due to the construction, only a few vehicles are found using SH 71 (17 percent) (see Figure 17 (b)). For the Tahitian-2, SH 95-1, and SH 95-2 scenarios, all vehicles for this OD pairing use LP 150 (see Figure 17 (c)). In the full build-out scenario, the majority of vehicles are assigned to SH 71 (83 percent), primarily via SH 95 (see Figure 17 (d)). It should be noted that the demand for this OD pair is very low; only approximately 15 vehicles per hour during the p.m. peak period.



**Figure 17. Travel Patterns from North Side of Bastrop to SH 71 East End**

***OD Pair 5: North End of SH 95 to SH 71 East End***

Origins: Boundary TAZs at north end of SH 95

Destinations: Boundary TAZs at east end of SH 71

Total demand: Approximately 150 vehicles for the peak period (~50 veh/hr)

Model Results: In the existing scenario, both LP 150 and SH 71 are used. The proportions of traffic using these two paths are similar, with 48 percent using SH 71 and 52 percent using LP

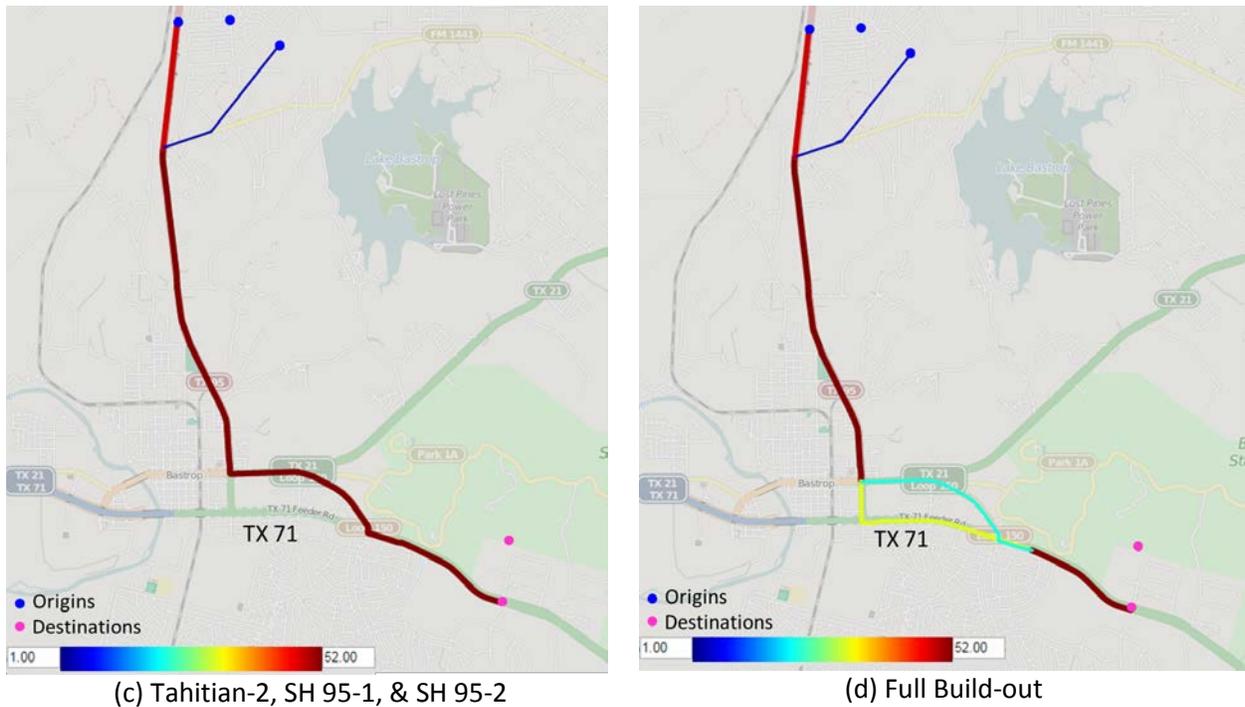
150 (see Figure 18 (a)). For the Tahitian-1 scenario, both roadways are still used but a much higher proportion of traffic is assigned to LP 150 (94 percent) to avoid the construction impact at the SH 71 at Tahitian Drive intersection to SH 71 (see Figure 18 (b)). For the Tahitian-2, SH 95-1, and SH 95-2 scenarios, all vehicles for this OD pair use only LP 150 (see Figure 18 (c)). In the full build-out scenario, the majority of vehicles use SH 71 (60 percent) (see Figure 18 (d)), which demonstrates the attractiveness of the route after the intersection improvements. It should be noted that the demand for this OD pair is relatively low, approximately 50 vehicles per hour during the p.m. peak period.



(a) Existing



(b) Tahitian-1



**Figure 18. Travel Patterns from North End of SH 95 to SH 71 East End**

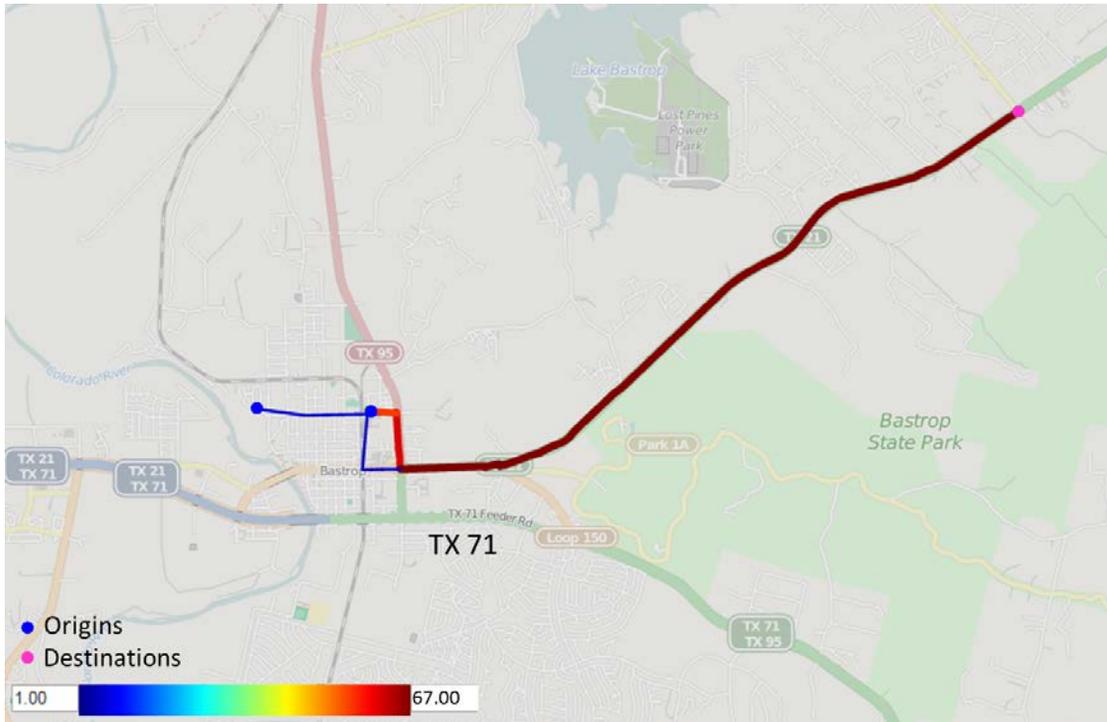
**OD Pair 6: Downtown Bastrop Area to SH 21 East End**

Origins: Downtown Bastrop south of the rail line

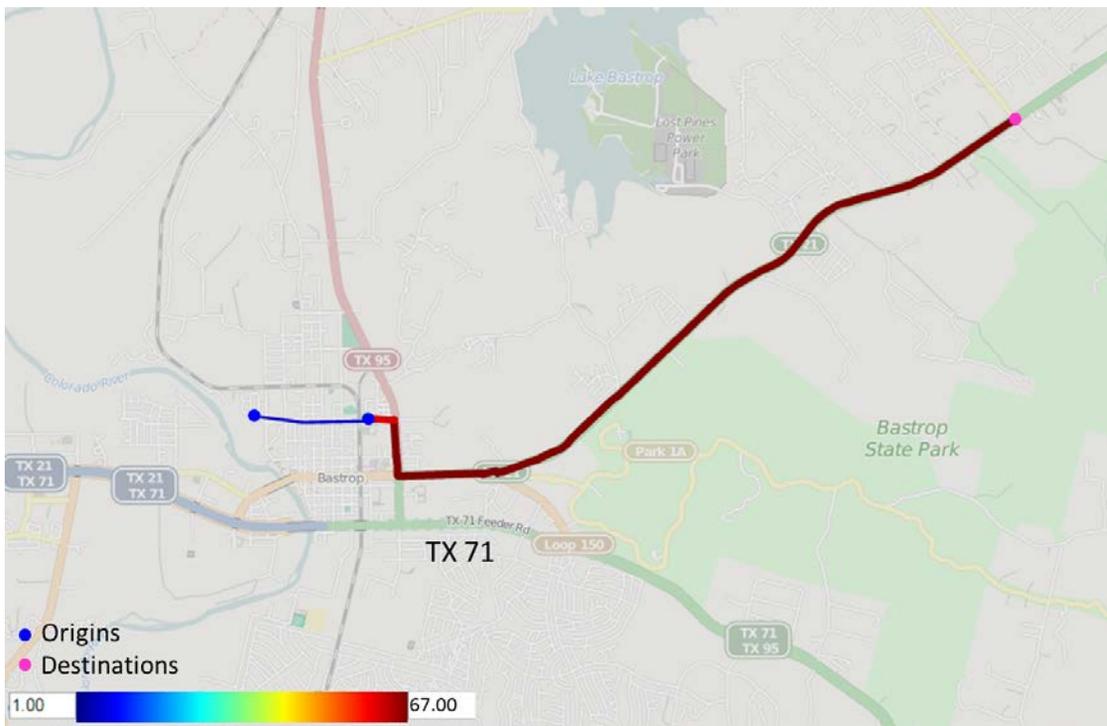
Destinations: Boundary of study area at east end of SH 21

Total demand: Approximately 190 vehicles for the peak period (~65 veh/hr)

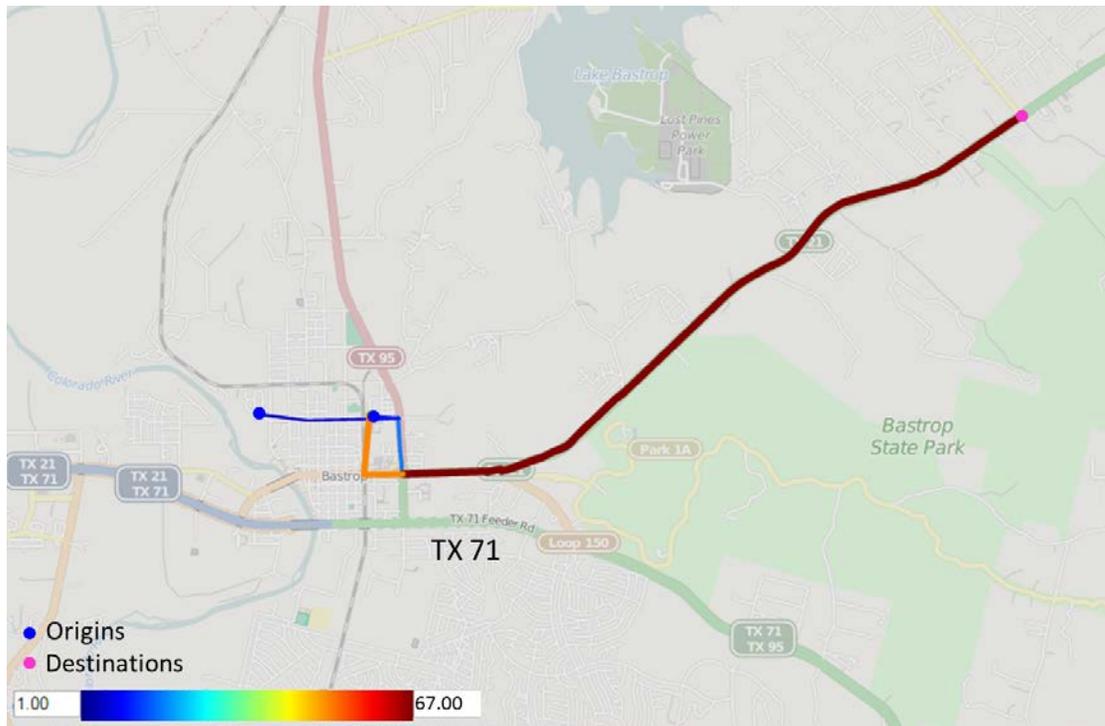
Model Results: In the existing and Tahitian-1 scenarios, most of vehicles from these origins heading to SH 21 use SH 95 to access LP 150 (see Figure 19 (a)). During the other three construction phases analyzed, all vehicles use only SH 95 to gain access to LP 150 to travel east (see Figure 19 (b)). It is likely that this occurs during these three scenarios as a result of more vehicles switching from SH 71 to LP 150 and forcing these vehicles to reroute. In the full build-out scenario, more vehicles access LP 150 earlier in their route than in the existing scenario (see Figure 19 (c)). The results show that after full build-out of the two interchanges, SH 71 is more attractive and fewer vehicles are assigned to LP 150/Chestnut Street which, consequently, makes this road more appealing to those traveling between these OD pairs.



(a) Existing & Tahitian-1



(c) Tahitian-2, SH 95-1, & SH 95-2



(d) Full Build-out

**Figure 19. Travel Patterns from Downtown Bastrop Area to SH 21 East End**

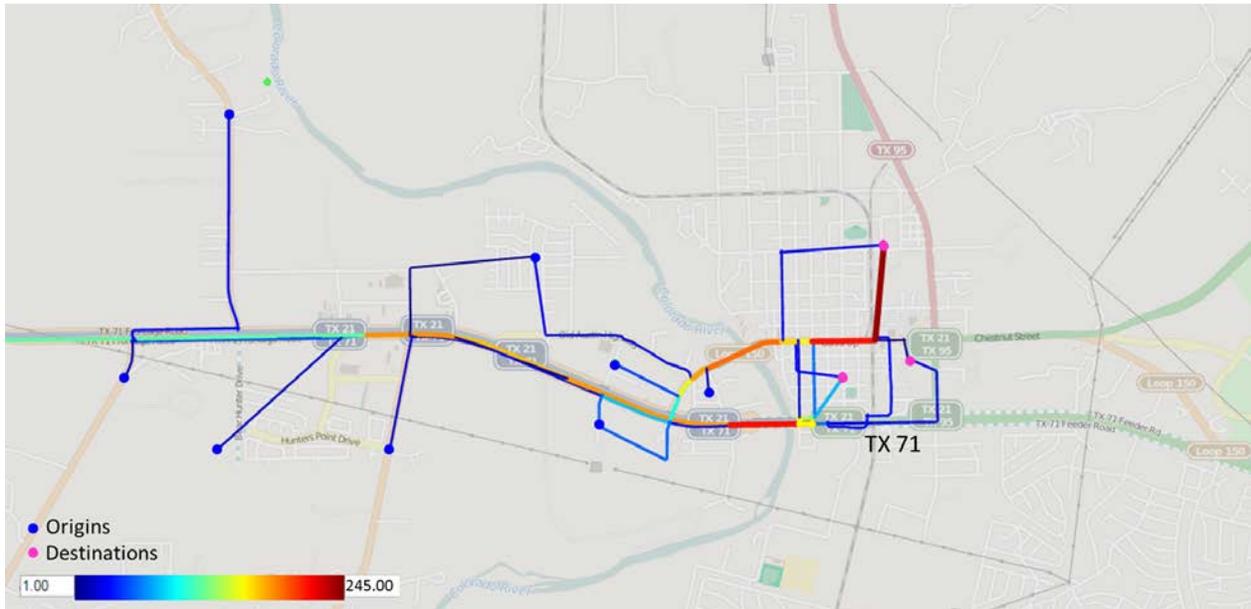
***OD Pair 7: West of Colorado River to Downtown Bastrop Area***

Origins: Areas west of Colorado River

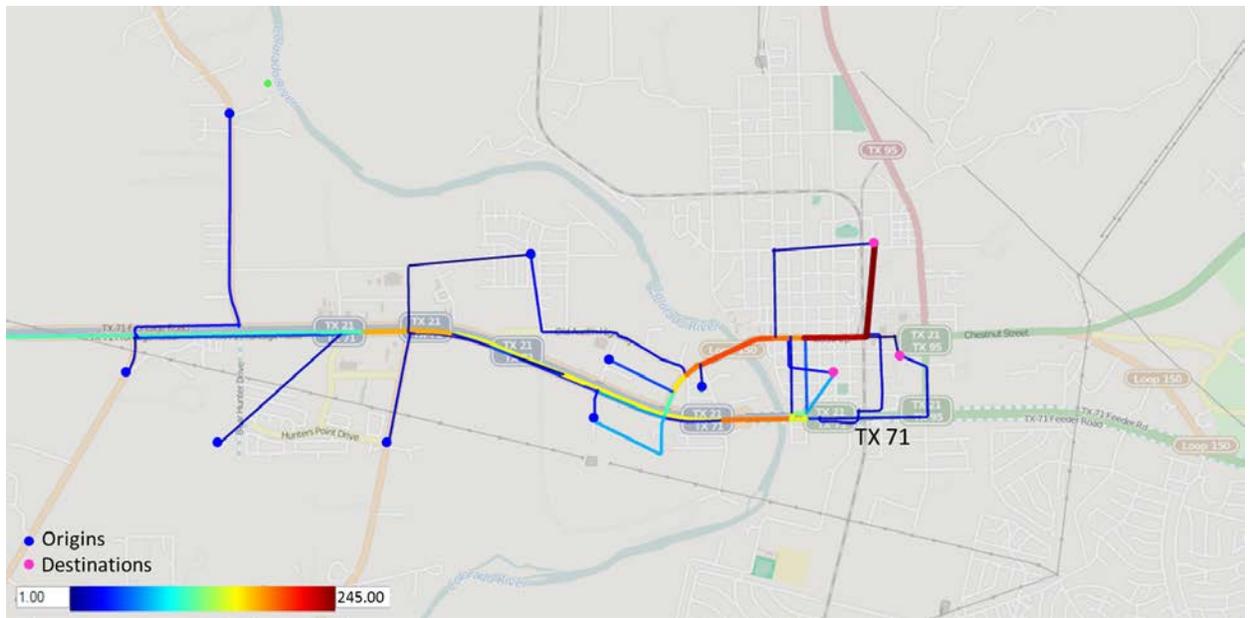
Destinations: Downtown Bastrop south of the rail line

Total demand: Approximately 715 vehicles for the peak period (~240 veh/hr)

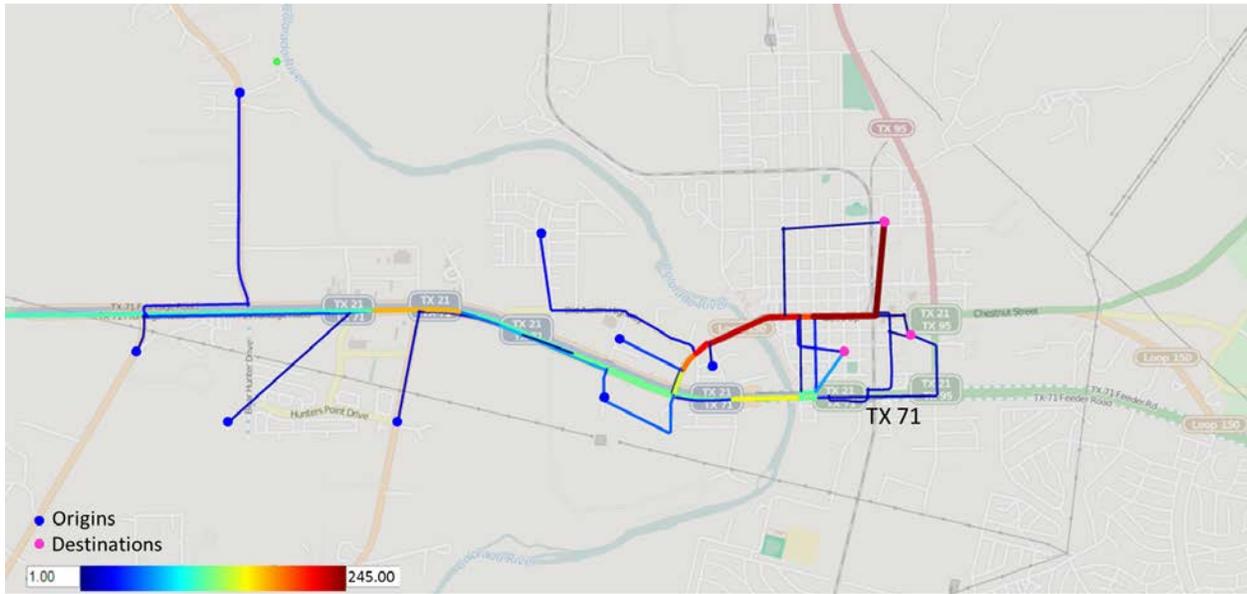
Model Results: In the existing scenario, more vehicles from west of the Colorado River use SH 71 to reach destinations in the downtown area (see Figure 20 (a)). For the Tahitian-1 scenario, the proportions of vehicles using SH 71 and LP 150 are similar, with a slightly higher number using SH 71 (see Figure 20 (b)). During the other three construction phases analyzed, the proportion of vehicles using LP 150 is much higher (see Figure 20 (c)). This is consistent with observations from other OD pairs, which indicate that many vehicles move from SH 71 to LP 150 to avoid construction on SH 71 during these phases. In the full build-out scenario, more people use SH 71 (see Figure 19 (d)). This again demonstrates that SH 71 is more attractive after the upgrade at these two intersections.



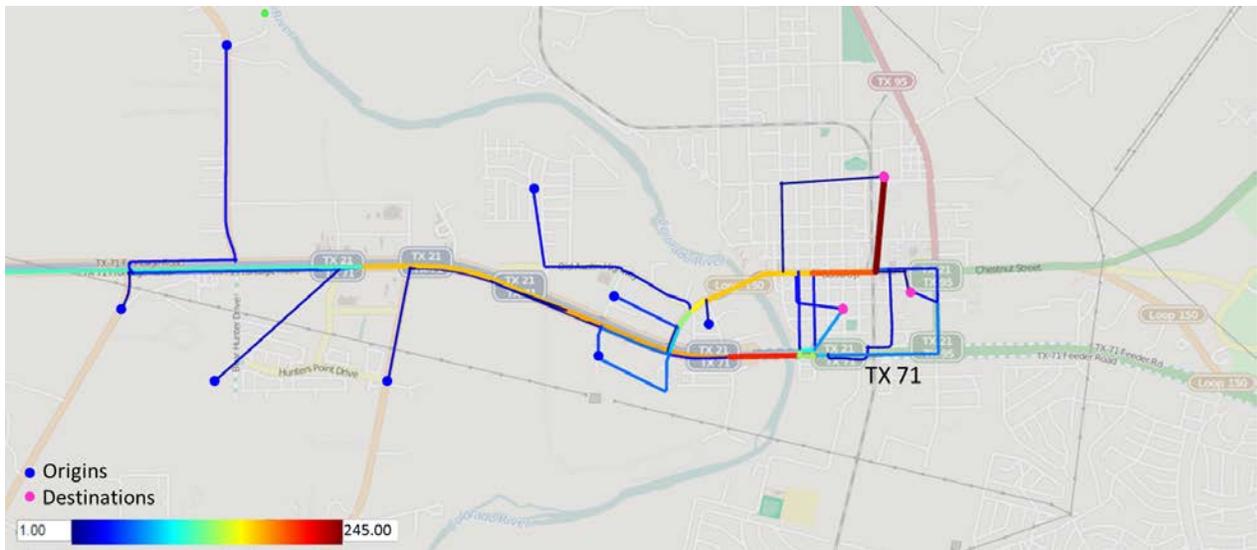
(a) Existing



(b) Tahitian-1



(c) Tahitian-2, SH 95-1, & SH 95-2



(d) Full Build-out

**Figure 20. Travel Patterns from West of Colorado River to Downtown Bastrop Area**

### Travel Time Analysis

The average travel time during the p.m. peak period between those aforementioned OD pairs in different scenarios are presented in Table 4. The estimated travel time doesn't change substantially between the base and TCP scenarios. However, the scenarios involving construction phasing at SH 95 perform the poorest. As previously noted, the construction scenarios incorporate optimized signal timing plans for the SH 71 intersections during construction phasing based on the results of the microsimulation analysis. By comparing the

travel time between the existing and full build-out scenarios, we can see that the intersection upgrade improves the travel time for nearly all OD pairs.

**Table 4. Afternoon Travel Time Analysis (Minutes)**

| Origins                  | Destinations                | Existing | Tahitian-1 | Tahitian-2 | SH 95-1 | SH 95-2 | Full Build-out |
|--------------------------|-----------------------------|----------|------------|------------|---------|---------|----------------|
| West end of SH 71        | SH 71 at Bastrop State Park | 9.5      | 9.0        | 9.0        | 9.5     | 10.0    | 8.0            |
| West of River            |                             | 12.0     | 12.5       | 12.0       | 13.5    | 14.0    | 12.0           |
| Downtown S. of rail line |                             | 5.5      | 5.5        | 5.5        | 5.5     | 5.5     | 5.0            |
| Downtown N. of rail line |                             | 11.0     | 11.0       | 11.0       | 11.0    | 11.0    | 10.5           |
| North end of SH 95       |                             | 10.5     | 10.0       | 10.0       | 10.0    | 10.0    | 10.0           |

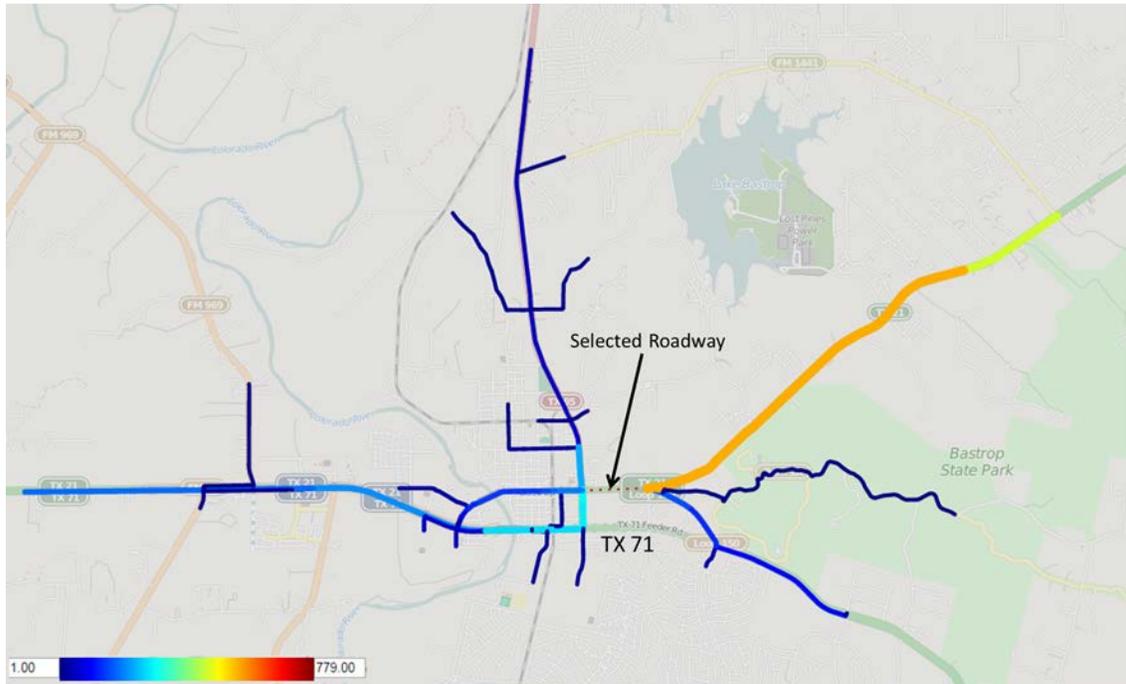
### Selected Roadway Segment Analysis

#### *Loop 150 between SH 21 and SH 95, Eastbound Direction*

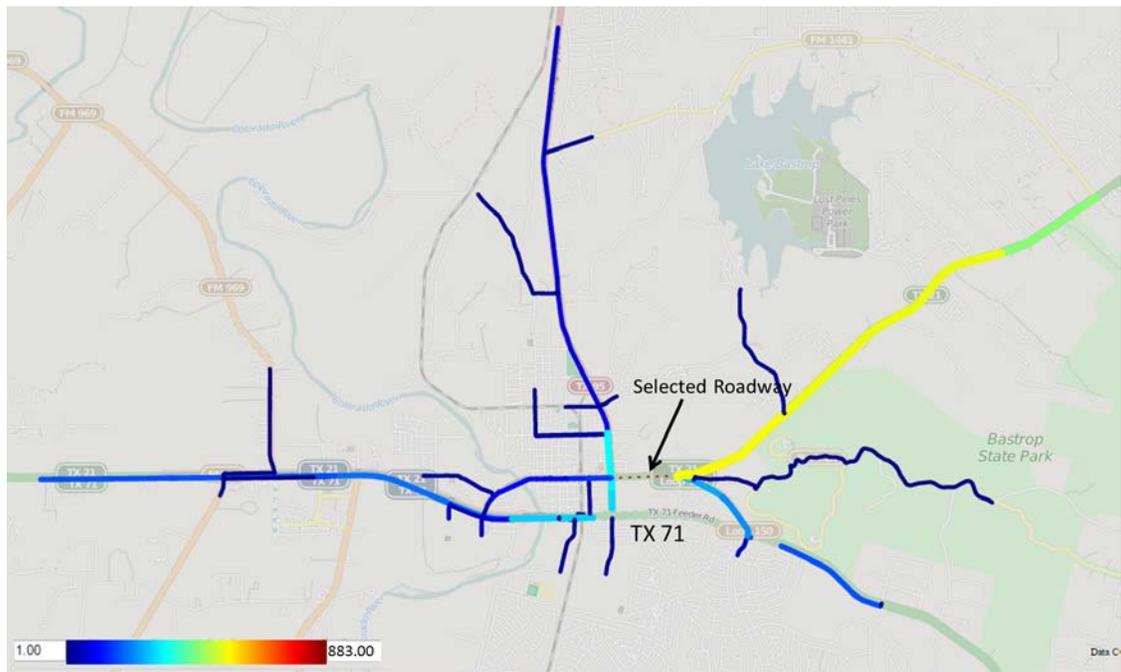
The majority of traffic using LP 150 east of SH 95 is destined for points east along SH 21 (see Figure 21). For the Tahitian-1 scenario, the number of vehicles using this segment of roadway increases slightly (see Table 5). For the Tahitian-2 and SH 95-1 scenarios, the number increases by approximately 100 vehicles, or 13 percent, during the peak hour (see Table 3). For the SH 95-2 scenario, the number of vehicles using this segment peaks at approximately 930 per hour, which is 20 percent more than that in the existing scenario. This traffic, destined southeast to SH 71 is diverted from SH 95. The flow patterns in the Tahitian-2, SH 95-1, and SH 95-2 scenarios are similar, as shown in Figures 21(b) and (c). After full build-out, among all the travelers using this link, the percentage of people going to the northeast is higher, as fewer vehicles destined to SH 71 use this route (see Figure 21 (d)). This indicates that vehicles are being assigned to SH 95 to gain upstream access to SH 71 with the new interchange system. As a result, the total number of people using this link is reduced by approximately 30 vehicles, or 4 percent, during the peak hour.

**Table 5. Number of Vehicles Using Loop 150 between SH 21 and SH 95, Eastbound**

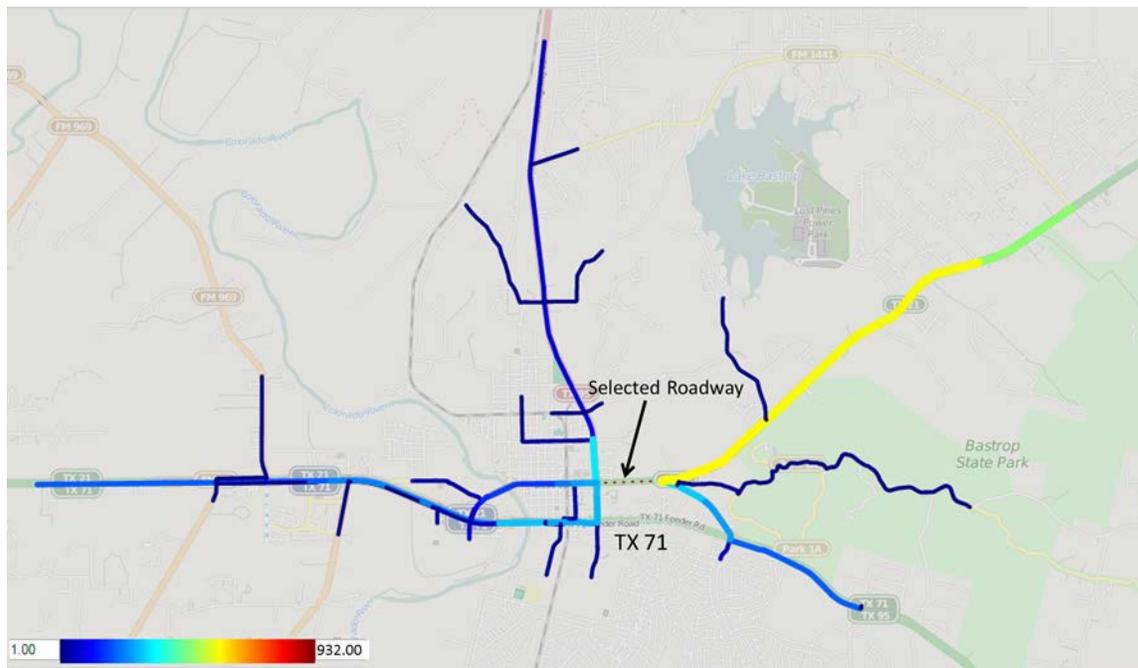
|                                     | Existing | Tahitian-2 | Tahitian-3 | SH 95-1 | SH 95-2 | Full Build-out |
|-------------------------------------|----------|------------|------------|---------|---------|----------------|
| Number of vehicles during peak hour | 780      | 810        | 880        | 880     | 930     | 750            |



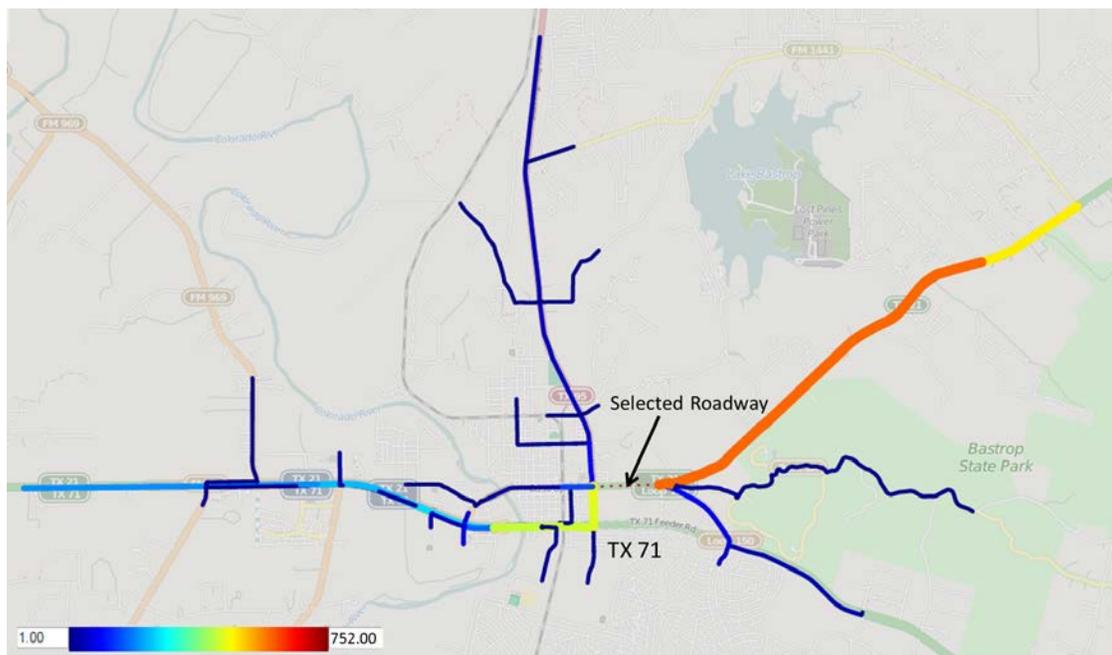
(a) Existing & Tahitian-1



(b) Tahitian-2 & SH 95-1



(c) SH 95-2



(d) Full Build-out

**Figure 21. Paths of Vehicles Using Loop 150 between SH 21 and SH 95, Eastbound Direction**

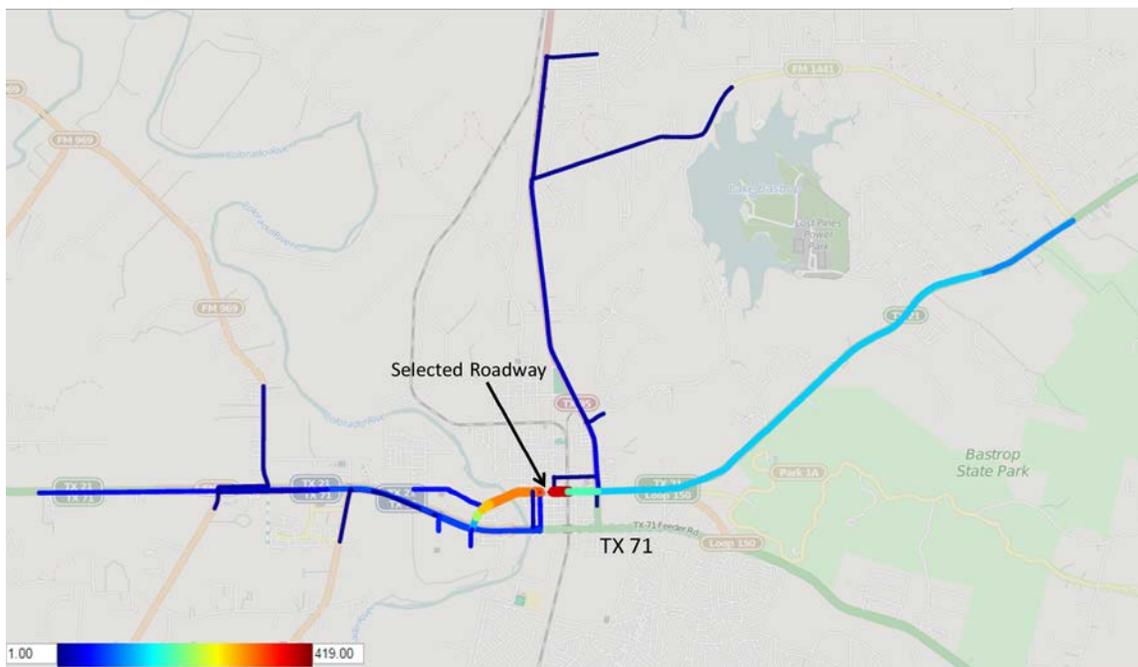
**Loop 150 (Chestnut Street) between Hill Street and Pecan Street, Eastbound Direction**

The majority of traffic identified on the segment of LP 150 (Chestnut Street) west of SH 95 through the downtown Bastrop area, originates from the west along LP 150 and SH 71 with destinations east along SH 21 or north along SH 95 (see Figure 22). This pattern is largely a reverse of that identified for the a.m. peak period (see Figure 13). However, due to limited access to north-south residential streets from eastbound SH 71, much less traffic is shown using these roadways in the p.m. peak period. Therefore, more traffic on this roadway segment, including that from SH 71, arrives from the west along LP 150. The numbers of vehicles using this roadway segment in all scenarios are summarized in Table 6.

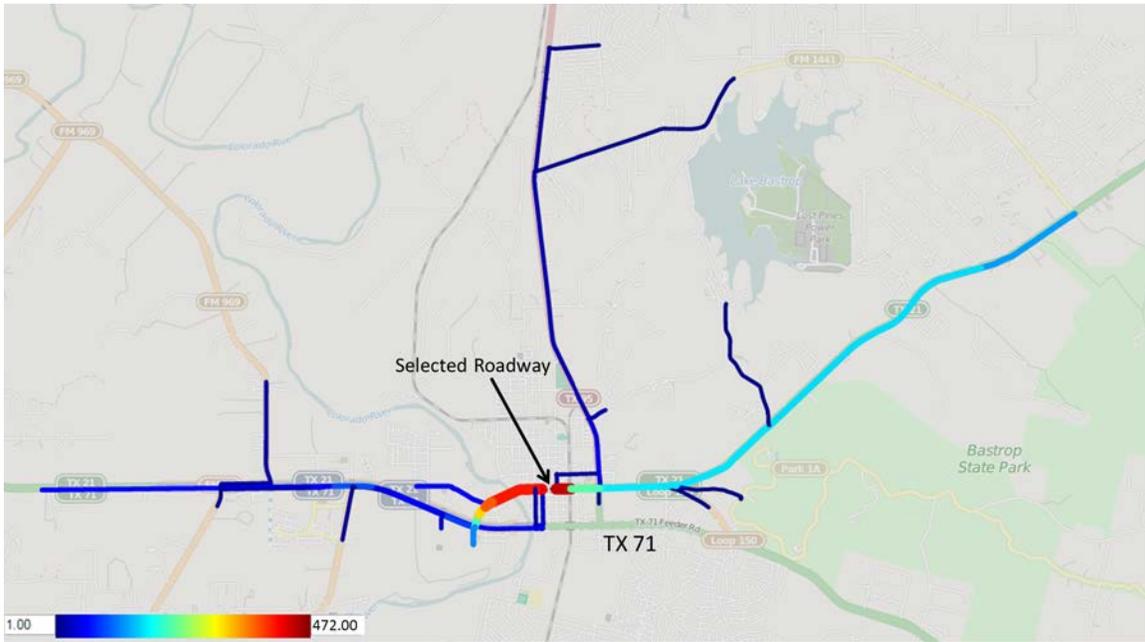
**Table 6. Number of Vehicles Using Loop 150 between Hill Street and Pecan Street, Eastbound**

|                                     | Existing | Tahitian-2 | Tahitian-3 | SH 95-1 | SH 95-2 | Full Build-out |
|-------------------------------------|----------|------------|------------|---------|---------|----------------|
| Number of vehicles during peak hour | 420      | 420        | 430        | 470     | 460     | 270            |

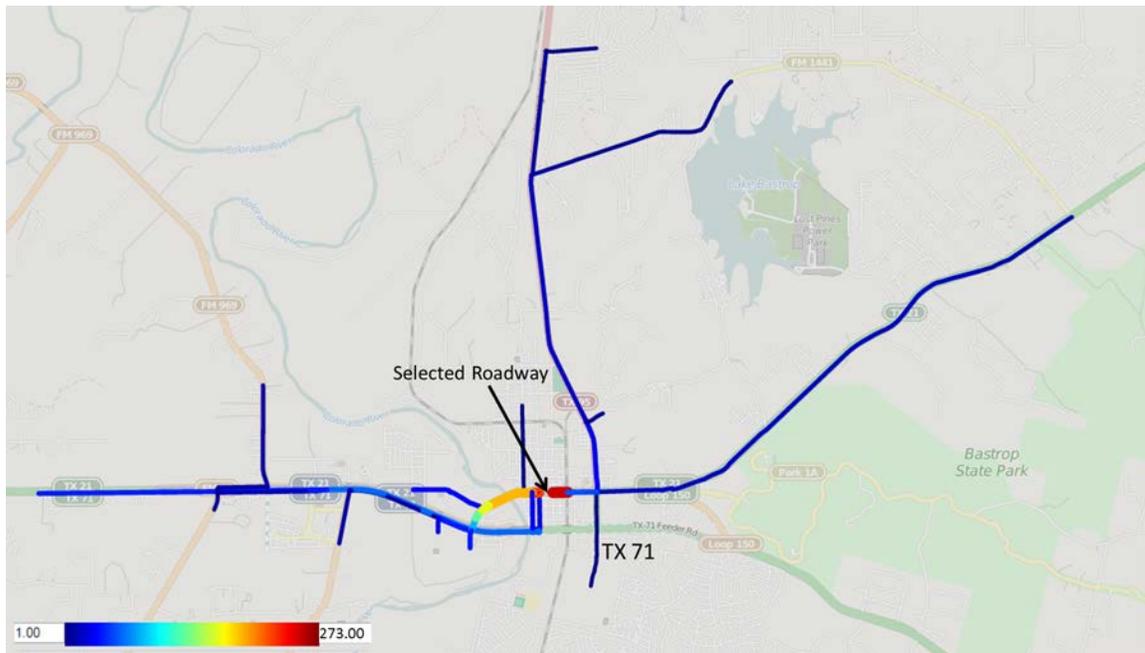
The traffic pattern appears consistent across all scenarios (see Figure 22 (a) and (b)). During construction, the total number of vehicles using this roadway segment increases marginally—about 3 percent for Tahitian-2, 13 percent for SH 95-1, and 7 percent for SH 95-2. After construction of the interchanges, the number of vehicles assigned to this roadway segment drops approximately 35 percent (see Table 6 and the volume scale in Figure 22 (c)), indicating a shift of traffic toward SH 95 at the new interchange.



(a) Existing, Tahitian-1, & Tahitian-2



(b) SH 95-1 & SH 95-2



(c) Full Build-out

**Figure 22. Paths of Vehicles Using Loop 150 between Hill Street and Pecan Street, Eastbound Direction**



## 4.2 Microsimulation Model Results

All four intersections evaluated as part of the microsimulation analysis are currently signalized. Assessing the performance of the signals was completed using intersection level-of-service (LOS), a quantitative performance measure representative of the quality of service provided, as rated on an A to F scale<sup>1</sup>. The LOS for signalized intersections is based on control delay, or the delay to traffic attributable to the signal, measured in seconds per vehicle using the scale provided in Table 7.

**Table 7. Automobile LOS Criteria for Signalized Intersections<sup>1</sup>**

| Control Delay (s/veh) | LOS |
|-----------------------|-----|
| 0-10                  | A   |
| >10-20                | B   |
| >20-35                | C   |
| >35-55                | D   |
| >55-80                | E   |
| >80                   | F   |

The LOS of each intersection under the different scenarios analyzed is discussed in the following sub-sections.

### 4.2.1 Existing Conditions

Table 8 displays the intersection LOS ratings for the a.m. and p.m. peak periods for existing conditions with existing signal timing plans.

**Table 8. Intersection LOS Summary\* – Existing Conditions**

| Intersection         | Peak Period |        |
|----------------------|-------------|--------|
|                      | AM          | PM     |
| SH 95 at LP 150      | C           | E      |
| SH 21 at LP 150      | A           | B      |
| SH 71 at SH 95       | F (119)     | F (87) |
| SH 71 at Tahitian Dr | D           | D      |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

The LOS varies by intersection and peak period. The signal at SH 95 at LP 150 appears to be performing well during the a.m. peak, but is at an unacceptable level during the p.m. peak. The following movements at the intersection are at LOS F during the p.m. peak and are hindering the overall intersection operation:

<sup>1</sup> *Highway Capacity Manual 2010*. Transportation Research Board, Washington, D.C., 2010.



- PM: Eastbound left turn (111 s/veh), westbound left turn (194 s/veh), and northbound through movement (111 s/veh)

The intersections at SH 21 at LP 150 and SH 71 at Tahitian Drive are functioning at an acceptable LOS (D or better). However, there are some problematic approaches, particularly at the SH 71 at Tahitian Drive intersection. The following approaches or movements are functioning at LOS E or worse:

- AM: Eastbound left turn and westbound left turn (LOS E)
- PM: Westbound left turn and northbound left turn (LOS E); southbound through-left is LOS F at 88 s/veh

The signal at SH 71 at SH 95 is failing (LOS F) during both peak periods. The following approaches or movements at this intersection are LOS F:

- AM: Westbound left turn, northbound left turn and through, southbound left and right turns (southbound approach is LOS F at 311 s/veh)
- PM: Northbound left turn and through, southbound right turn (northbound and southbound approaches are LOS F at 123 s/veh and 224 s/veh, respectively)

#### 4.2.2 SH 71 at Tahitian Drive during TCP Phasing

This sub-section summarizes the simulation results of the SH 71 at Tahitian Drive intersection at different TCP phases and stages. Table 9 displays the SH 71 at Tahitian Drive intersection LOS ratings for the a.m. and p.m. peak periods for the different TCP phases. The LOS ratings were compiled using the existing timing plan for the Phase 1 scenarios, prior to moving traffic to the frontage roads, versus an optimized timing plan. Since Phase 2 of construction will move traffic to the newly constructed frontage roads and split the intersection into two signals, only a new, optimized timing plan is considered. Note that the optimized timing plans are based on the traffic counts collected in August.

**Table 9. SH 71 at Tahitian Drive Intersection LOS Summary\* – TCP Scenarios**

| Peak Period | Signal Timing Plan | TCP    |        |         |         | Frontage Road Intersection | TCP   |
|-------------|--------------------|--------|--------|---------|---------|----------------------------|-------|
|             |                    | P1 S1  | P1 S2  | P1 S3a  | P1 S3b  |                            | P2 S1 |
| AM          | Existing           | D      | D      | E       | E       | Westbound                  | D     |
|             | Optimized          | D      | D      | D       | D       | Eastbound                  | D     |
| PM          | Existing           | F (84) | F (99) | F (108) | F (113) | Westbound                  | E     |
|             | Optimized          | E      | E      | E       | F (83)  | Eastbound                  | E     |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

The LOS varies across peak period and TCP scenario. For the a.m. peak period, the signal generally performs at an acceptable LOS except during Phase 1 Stage 3, which can be improved to an acceptable LOS D after signal optimization. During the p.m. peak period, the signal generally does not perform at an acceptable LOS. However, with signal optimization, the signal can maintain LOS E through most of the construction stages. The specific approaches that



appear especially problematic (LOS F) are summarized in Table 10. Note that the northbound and southbound approaches experience the most negative impact due to the TCP configuration, though the eastbound approach during the p.m. peak is also expected to experience delay.

**Table 10. SH 71 at Tahitian Drive Intersection Problematic Approaches\* – TCP**

| Peak Period | Signal Timing Plan | TCP                  |                       |                       |                       | Frontage Road Intersection | TCP                  |
|-------------|--------------------|----------------------|-----------------------|-----------------------|-----------------------|----------------------------|----------------------|
|             |                    | P1 S1                | P1 S2                 | P1 S3a                | P1 S3b                |                            | P2 S1                |
| a.m.        | Existing           | NB (111)             | NB (127)              | NB (150)              | NB (137)              | Westbound                  |                      |
|             | Optimized          |                      |                       | NB (90)               |                       | Eastbound                  | NB (115)             |
| p.m.        | Existing           | EB (107),<br>SB (97) | EB (131),<br>SB (117) | EB (125),<br>SB (189) | EB (134),<br>SB (178) | Westbound                  | SB (93)              |
|             | Optimized          | NB (93),<br>SB (96)  | NB (130),<br>SB (96)  | NB (145),<br>SB (158) | NB (145),<br>SB (158) | Eastbound                  | NB (128),<br>SB (91) |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

#### 4.2.3 SH 71 at SH 95 during TCP Phasing

This sub-section summarizes the simulation results of SH 71 at SH 95 intersection at different TCP phases and stages. Table 11 displays the SH 71 at SH 95 intersection LOS ratings for the a.m. and p.m. peak periods for the different TCP phases. Similarly, the LOS ratings were compiled using the existing timing plan for the Phase 1 scenarios and an optimized timing plan for both phases. For Phase 1 Stage 3 of construction, the provided lane designation for the southbound approach included one exclusive left-turn lane and one shared through-right lane. Due to the poor LOS and long queuing observed from the simulation for the construction stage, two alternate configurations were evaluated. These alternatives include implementing a shared left-through lane and an exclusive right-turn lane, and using a shared left-through-right lane and an exclusive right-turn lane. The LOS measures for these configurations are summarized in the tables below.



**Table 11. SH 71 at SH 95 Intersection LOS Summary\* – TCP Scenarios**

| Peak Period | Signal Timing Plan | TCP                    |         |         | Frontage Road Intersection | TCP   |       |
|-------------|--------------------|------------------------|---------|---------|----------------------------|-------|-------|
|             |                    | P1 S1                  | P1 S2   | P1 S3   |                            | P2 S1 | P2 S2 |
| a.m.        | Existing           | F (119)                | F (200) | F (205) | Westbound                  | D     | E     |
|             |                    | Designated RT Lane     |         | F (129) |                            |       |       |
|             |                    | RT and Shared RT Lanes |         | F (167) |                            |       |       |
|             | Optimized          | F (101)                | F (126) | F (128) | Eastbound                  | C     | D     |
|             |                    | Designated RT Lane     |         | F (109) |                            |       |       |
|             |                    | RT and Shared RT Lanes |         | F (99)  |                            |       |       |
| p.m.        | Existing           | F (86)                 | F (103) | F (126) | Westbound                  | D     | D     |
|             |                    | Designated RT Lane     |         | F (121) |                            |       |       |
|             |                    | RT and Shared RT Lanes |         | F (155) |                            |       |       |
|             | Optimized          | E                      | E       | F (96)  | Eastbound                  | C     | C     |
|             |                    | Designated RT Lane     |         | E       |                            |       |       |
|             |                    | RT and Shared RT Lanes |         | F (92)  |                            |       |       |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

The existing signal timing plans at this intersection fail (LOS F) during both peak periods in all Phase 1 scenarios. With signal optimization, the performance during Stages 1 and 2 of Phase 1 during the p.m. peak were shown to be improved to LOS E. Signals during all stages in Phase 1 in the a.m. peak period and Stage 3 of Phase 1 in the p.m. peak period were still performing at LOS F, but the estimated delays were reduced significantly with signal optimization. The delay was also reduced in Phase 1 Stage 3 with implementation of an exclusive right-turn lane.

During Phase 2, with traffic being moved to the frontage road, this intersection performs better. The frontage road intersections during both a.m. and p.m. peak periods were estimated to perform at LOS C or D except the westbound frontage road intersection with LOS E during the a.m. peak period in Stage 2. Similarly, the specific approaches that appear especially problematic (LOS F) are summarized in Table 12. Similar to the SH 71 at Tahitian Drive intersection, the northbound and southbound approaches experience the most delay. Signal optimization may not improve the performance of the intersection above LOS F; however, the delay for the worst performing movements can be reduced by changing the balance of green time between approaches (e.g., southbound approach during Phase 1 Stage 3 in the a.m. peak).



**Table 12. SH 71 at SH 95 Intersection Problematic Approaches\* – TCP**

| Peak Period | Signal Timing Plan | TCP                             |                                   |  | Frontage Road Intersection | TCP   |                         |
|-------------|--------------------|---------------------------------|-----------------------------------|--|----------------------------|-------|-------------------------|
|             |                    | P1 S1                           | P1 S2                             | P1 S3  |                            | P2 S1 | P2 S2                   |
| a.m.        | Existing           | SB (311)                        | SB (598)                          | NB (104),<br>SB (606)                          | Westbound                  |       | WB<br>(108),<br>SB (93) |
|             |                    | Designated RT Lane              |                                   | NB (104),<br>SB (331)                          |                            |       |                         |
|             |                    | RT and Shared RT Lanes          |                                   | NB (104),<br>SB (471)                          |                            |       |                         |
|             | Optimized          | EB (86),<br>WB (87)<br>SB (140) | EB (85),<br>WB (101),<br>SB (215) | EB (85),<br>WB (101),<br>NB (164),<br>SB (215) | Eastbound                  |       |                         |
|             |                    | Designated RT Lane              |                                   | EB (85),<br>WB (101),<br>NB (164),<br>SB (147) |                            |       |                         |
|             |                    | RT and Shared RT Lanes          |                                   | EB (85),<br>WB (101),<br>NB (164),<br>SB (111) |                            |       |                         |
| p.m.        | Existing           | NB (122),<br>SB (224)           | NB (142),<br>SB (290)             | NB (540),<br>SB (290)                          | Westbound                  |       |                         |
|             |                    | Designated RT Lane              |                                   | NB (540),<br>SB (271)                          |                            |       |                         |
|             |                    | RT and Shared RT Lanes          |                                   | NB (540),<br>SB (413)                          |                            |       |                         |
|             | Optimized          | SB (100)                        | WB (97),<br>SB (100)              | NB (285),<br>SB (134)                          | Eastbound                  |       |                         |
|             |                    | Designated RT Lane              |                                   | NB (229),<br>SB (129)                          |                            |       |                         |
|             |                    | RT and Shared RT Lanes          |                                   | NB (285),<br>SB (117)                          |                            |       |                         |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

The queuing at the two intersections was also reviewed as part of the microsimulation analysis. While excessive queuing wasn't observed at the Tahitian Drive intersection during construction phasing, it was observed at the SH 95 intersection. This was identified as being associated with the heavy right-turn volume at the intersection for the southbound approach. This condition motivated the review of alternative lane designations for the two-lane approach, particularly during Phase 1 Stage 3 of construction when the channelized right-turn lane will be closed.



Tables 11 and 12 show the LOS measures for the different configurations and Table 13 identifies information on the queue length for the southbound approach.

The reported queue length was extracted from both Synchro and the Synchro simulation package, Simtraffic. The Simtraffic software provides a more realistic assessment of the estimated queuing at the intersection based on simulated driver behavior. The simulation was used to identify the extent of the problem with queuing at the intersection. Using the provided configuration, consisting of one exclusive left-turn lane and one shared through-right lane as shown in the 90-percent TCP drawings, the queue at the intersection for the southbound right-turn extended to the upstream signalized intersection at SH 95 at LP 150/SH 21, disrupting operation.

This problem was observed even with optimization of the signal at SH 71. It was then attempted to alleviate both the queuing issue and the poor LOS for the approach by changing the configuration to a shared through-left lane and an exclusive right-turn lane. Although this configuration improved the LOS for the approach, as well as the intersection (as shown in Tables 11 and 12), it did not completely alleviate the issue with queuing, particularly evident during the a.m. peak. The Synchro and Simtraffic software reported smaller queues for the approach using this configuration (see Table 13); however, the problem with queues extending to the upstream signal remained. Therefore, a third configuration was examined.

Changing the inside lane on the approach to a shared left-through-right lane, effectively providing two available lanes for the right turn, was implemented as a third option. For the a.m. peak, which demonstrates the issue with the right-turn queue more so than the p.m. peak, this configuration was found to improve both the LOS and the queue when compared to the planned configuration. The average queue was significantly reduced and no problems with spillback to the upstream signal were observed. Table 13 identifies the 50<sup>th</sup> percentile queue length in feet obtained from Synchro and the average queue length reported from Simtraffic for each southbound approach lane for the lane designation identified (inside lane, outside lane). It is noteworthy that the LOS for the p.m. peak was slightly worse with this configuration versus the designation with a shared left-through lane, though the queue length improved substantially.



**Table 13. SH 71 at SH 95 Queuing Along Southbound Approach\* – TCP**

| Peak Period | Signal Timing Plan | SH 95 TCP Phase 1 Stage 3 |                       |   |  |
|-------------|--------------------|---------------------------|-----------------------|---|--|
|             |                    | SB Approach Configuration | LOS (avg. delay, sec) | 50th Percentile Queue Length (ft) - Synchro | Average Queue Length (ft) – Simtraffic |
| a.m.        | Existing           | Left, T+R                 | F (205)               | 141, ~1586                                  |  |
|             |                    | L+T, Right                | F (129)               | ~257, ~1140                                 |  |
|             |                    | L+T+R, Right              | F (167)               | ~1128, ~291                                 |  |
|             | Optimized          | Left, T+R                 | F (128)               | 100, ~1043                                  | 1068, 1213                             |
|             |                    | L+T, Right                | F (109)               | 168, ~829                                   | 542, 595                               |
|             |                    | L+T+R, Right              | F (99)                | ~720, 116                                   | 241, 228                               |
| p.m.        | Existing           | Left, T+R                 | F (126)               | 110, ~813                                   |  |
|             |                    | L+T, Right                | F (121)               | ~164, ~612                                  |  |
|             |                    | L+T+R, Right              | F (155)               | ~803, 0                                     |  |
|             | Optimized          | Left, T+R                 | F (96)                | 86, ~589                                    | 715, 1011                              |
|             |                    | L+T, Right                | E                     | 124, ~227                                   | 1225, 1266                             |
|             |                    | L+T+R, Right              | F (92)                | ~549, 2                                     | 199, 178                               |

\* The number in parenthesis is the intersection delay (seconds per vehicle)

~ Indicates that volume exceeds capacity and queue could, theoretically, extend indefinitely

#### 4.2.4 Full Build-out Conditions

Table 14 displays the intersection LOS ratings for the a.m. and p.m. peak periods for existing scenario with existing signal timing plans and full build-out scenarios with optimized signal timing plans.

**Table 14. Intersection LOS Summary – Existing and Full Build-out Conditions along SH 71**

| Intersection                                  | AM Peak  |           | PM Peak  |           |
|---|----------|-----------|----------|-----------|
|   | Existing | Future/Op | Existing | Future/Op |
| SH 71 Westbound Frontage Road at SH 95        | F        | A         | F        | A         |
| SH 71 Eastbound Frontage Road at SH 95        |          | B         |          | B         |
| SH 71 Westbound Frontage Road at Tahitian Dr. | D        | A         | D        | B         |
| SH 71 Eastbound Frontage Road at Tahitian Dr. |          | B         |          | A         |
| SH 95 at LP 150                               | C        | C         | E        | C         |

From Table 14, we can see that after both overpasses are built out, the intersection LOS improves significantly. The two SH 71 intersections are estimated to have a LOS of at least B.



Furthermore, if the signal at SH 95 at LP 150 is converted from pre-timed to actuated control during the p.m. peak period, the signal operation can be improved. Currently, the signal operates at LOS E during this period. If optimized using actuated control, the signal is estimated to be improved to LOS C, assuming that it does not require pre-timed phasing. Optimization can dramatically improve the operation of the eastbound, westbound, and northbound approaches incorporating a shortened cycle length and reallocation of green time.

## 5. NOTABLE ISSUES

From the microsimulation analysis, the intersection of SH 95 and LP 150 operates at a LOS of E during the p.m. peak period. This signal is on a pre-timed signal plan during this period. In addition, the intersection of SH 71 and SH 95 exhibits an unacceptable LOS F rating during both peak periods. The following individual approaches exhibit an unacceptable LOS under existing conditions:

- Northbound and southbound approaches at SH 71 and SH 95 (a.m. and p.m. peak)
- Northbound and southbound approaches at SH 71 and Tahitian Drive (p.m. peak)
- Eastbound, westbound, and northbound approaches at SH 95 and LP 150 (p.m. peak)

During construction, the following are important findings at the intersection of SH 71 and Tahitian Drive:

- The intersection varies between LOS D and E during the a.m. peak, though optimization may be able to help maintain the signal at an acceptable LOS.
- The intersection operates at an unacceptable LOS (E or F) during the p.m. peak during construction, though optimization may be able to improve operation.
- The northbound approach during the a.m. peak period and the eastbound, northbound, and southbound approaches during the p.m. peak are a concern; primary issues at the intersection are with the minor approaches.
- Some improvement in operation can be achieved using optimized signal timing plans during Phase 1, notably with the northbound approach; adjusted timing for each stage of construction may be necessary to improve operation and account for adjusted intersection configurations.
- The Phase 2 layout does not appear to cause any additional (beyond Phase 1) problems if both frontage road signals are timed appropriately, though the model does not account for the indirect impact of the construction zone on traffic flow.

During construction, the following are important findings at the intersection of SH 71 and SH 95:

- The intersection operates at an unacceptable LOS (E or F) during the a.m. and p.m. peaks through Phase 1 of construction, though optimization may be able to improve operation.



- During Phase 2, optimization of the frontage road intersection operation is estimated to help the intersection operate at an acceptable LOS (using the proposed frontage road configuration) with the exception of the westbound frontage road during the a.m. peak in Stage 2.
- The eastbound, northbound, and southbound approaches during the a.m. peak period and the northbound and southbound approaches during the p.m. peak are a concern, primarily during Phase 1; primary issues at the intersection are again with the minor approaches.
- Some improvement in operation can be achieved using optimized signal timing plans during Phase 1, notably with the southbound approach; adjusted timing for each stage of construction may be necessary to improve operation and account for adjusted intersection configurations.
- The Phase 2 layout does not appear to cause any additional (beyond Phase 1) problems if both frontage road signals are timed appropriately; the operation appears significantly improved with this configuration, though the model does not account for the indirect impact of the construction zone on traffic flow.

From the DTA analysis, some changes in travel patterns were identified between the existing condition, the TCP configurations for SH 71 at Tahitian Drive and SH 95 at SH 71, and the full build-out of the two interchanges. The following identifies some of the issues found from the analysis results:

- During construction, some increase in traffic along LP 150, including west of SH 95, was found during both the a.m. and p.m. peak periods. This increase was minimal during construction phasing at Tahitian Drive, but was found more substantial during construction phasing at the SH 95 intersection.
- During construction, an increase in travel time was found between many of the OD pairs reviewed for both the a.m. and p.m. peak periods.

## 6. SUMMARY OF FINDINGS

The following summarizes the findings and conclusions from the model results:

- 1) Some traffic shifting for OD pairs occurred between the Bastrop downtown area (including points north of the rail line) and the east end of SH 71, with traffic moving to LP 150; this trend is more pronounced during Tahitian TCP Phase 2 and SH 95 Phase 1 and Phase 2 than during Tahitian Phase 1.
- 2) Some traffic was found to shift to LP 150 west of SH 95 during construction phasing; this amount was small during the Tahitian TCP phases, but more substantial during the SH 95 TCP phases, especially SH 95 TCP Phase 1 Stage 3. After build-out, traffic using LP 150 west of SH 95 decreased significantly during the p.m. peak, but returned to near existing conditions for the a.m. peak.



- 3) Traffic shifted to SH 71 from LP 150 after full build-out of the interchanges, both east and west of SH 95.
- 4) A small increase in travel time was observed from model results for the OD pairs analyzed during all construction phases.
- 5) Travel times were generally found to decrease with full build-out of the two interchanges.
- 6) The intersections along SH 71, particularly at SH 95, are not currently performing well during the peak periods.
- 7) Using existing signal timings, the operation of SH 71 at Tahitian Drive and SH 95 will experience diminished service, in large part due to the minor approaches experiencing more delay; some of this delay can be alleviated with optimization.
- 8) Excessive queuing was not visible from simulation runs along SH 71 during construction phasing at Tahitian Drive.
- 9) Not maintaining the southbound designated right-turn lane at the SH 71 intersection at SH 95, in particular during construction Phase 1 Stage 3, was found to result in excessive queuing along the approach. Provision of an exclusive right-turn lane during construction of the SH 95 interchange, and potentially enabling right turns from both approach lanes during Phase 1 Stage 3, is important (with re-optimization) for operation of the signal.
- 10) The full build-out of the two interchanges is anticipated to improve operations of the intersections along SH 71 significantly.
- 11) The intersection of SH 95 at LP 150 is experiencing poor LOS during the p.m. peak period with pre-timed control and can be improved with optimization and actuated control
- 12) At full build-out, the westbound SH 71 frontage road west of the intersection at SH 95 may experience operational challenges due to weaving.
- 13) Large turning volumes at the SH 71 at SH 95 intersection hinder existing operation and will likely be a concern for construction phasing and potentially at the frontage road signals after full build-out of the interchange.
- 14) East-west routing along SH 71 between OD pairs on the east and west ends of the model limits was not affected during or after construction; the assigned route remained SH 71 for all scenarios.



## 7. RECOMMENDATIONS

Based on observations from the model results and subsequent conclusions, the following recommendations are provided:

- 1) Additional data should be collected to evaluate the two intersections along SH 71 during weekend conditions. A supplemental analysis should then be undertaken to assess differences in intersection operations as travel patterns change during the week.
- 2) Improvement in operation at SH 71 at Tahitian Drive and SH 71 at SH 95 can be achieved with signal optimization during construction. It is recommended that traffic be monitored at the beginning of each construction stage so that signal timings can be optimized based upon actual observation of driver behavior/traffic demands at that time. Special attention should be given to the SH 71 at SH 95 interchange during construction phasing due to the heavy turn volumes at this intersection.
- 3) The southbound approach of SH 71 at SH 95 should be reconfigured during TCP Phase 1 Stage 3 of construction. The current configuration (90-percent plans) identifies a lane designation with one exclusive left-turn lane and one shared through-right lane. Providing a shared through-left lane and a designated right-turn lane instead would greatly improve the level of service (LOS) for this approach and the intersection as a whole, due to the heavy southbound right-turn volume. The queue length for the southbound approach would also improve with an exclusive right-turn lane. Further modifying the lane designation to include a shared left-through-right lane and an exclusive right-turn lane would reduce the queue length substantially. Implementing a lane designation whereby both lanes accommodate right turns will require not only an update to the TCP signing, but should include temporary pavement markings to direct lane assignment into the intersection proper. Dotted line markings should be used to extend lane lines through the intersection and separate right-turning movements.

Implementing a configuration accommodating right turns from both approach lanes will require additional review by the design team. This should include determining if the geometry is sufficient to enable simultaneous right-turn movements with the construction configuration, while considering the design vehicle. Allowing right turns on red from both lanes should also be evaluated further. It may be necessary to prohibit these turns from the inside (left-hand) lane due to limited visibility of westbound traffic during construction (i.e., construction equipment or barricades along the road or vehicles in the inside lane blocking the view of drivers in the outside lane). Provision of dual right-turns on red is discouraged when the signal uses split timings and/or when conflicting U-turns (eastbound to westbound at this intersection) are allowed. Both of these provisions are currently in place at the intersection. Prohibition of right turns on red from the inside lane can be accommodated using an R10-11c sign, as shown in Figure 23.

If right turns cannot be accommodated from both lanes, it is recommended that the outside lane be made an exclusive right-turn lane and the inside lane a shared left-through lane. This will require updating the TCP signing for the southbound approach. Ultimately, this configuration represents a small, yet effective, change. An exclusive right-turn lane is needed at this approach, regardless of the inside lane designation.

- 4) Since additional traffic was found to use LP 150 and Chestnut Street during construction of the SH 95 interchange, additional data should be collected and conditions monitored along this roadway during construction. Additional optimization of the signals, notably at SH 95 at LP 150/Chestnut Street and Chestnut Street at Main Street, may improve operations along this corridor given the change in travel pattern.
- 5) Improvement in operation of the traffic signal at SH 95 at LP 150 during p.m. peak period conditions (currently LOS E) may be achieved with signal optimization, particularly if the signal is changed to actuated instead of pre-timed control during that time period. This will require reviewing the need for current pre-timed control during the p.m. peak period at the intersection.



**Figure 23. R10-11c: NO TURN ON RED EXCEPT FROM RIGHT LANE Sign<sup>2</sup>**

<sup>2</sup> *Texas Manual on Uniform Traffic Control Devices, Revision 1.* Texas Department of Transportation, 2012.



## **APPENDIX A**

### **GRAM TRAFFIC COUNTS**

# **MoPac South: Impact on Cesar Chavez Street and the Downtown Network**

## **EXECUTIVE SUMMARY**

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**Prepared for:**

**Central Texas Regional Mobility Authority and  
Capital Area Metropolitan Planning Organization**

**November 2015**



**THE UNIVERSITY OF TEXAS AT AUSTIN  
CENTER FOR TRANSPORTATION RESEARCH**

# 1. INTRODUCTION

The objective of this study was to analyze traffic impacts to downtown of adding express lanes along MoPac south of Cesar Chavez Street. Further, the project involves assessing the implementation of two direct-connect ramps between the express lanes and Cesar Chavez Street. The ramps provide direct connections between the MoPac South express lanes and Cesar Chavez Street, in both directions. The analysis, covering both morning (6:00-9:00 AM) and afternoon (3:30-6:30 PM) peak periods, was completed using dynamic traffic assignment (DTA) models. These models were used to estimate changes to area travel patterns for each scenario analyzed for year 2020 traffic conditions. The area included in this study is shown in Figure 1.

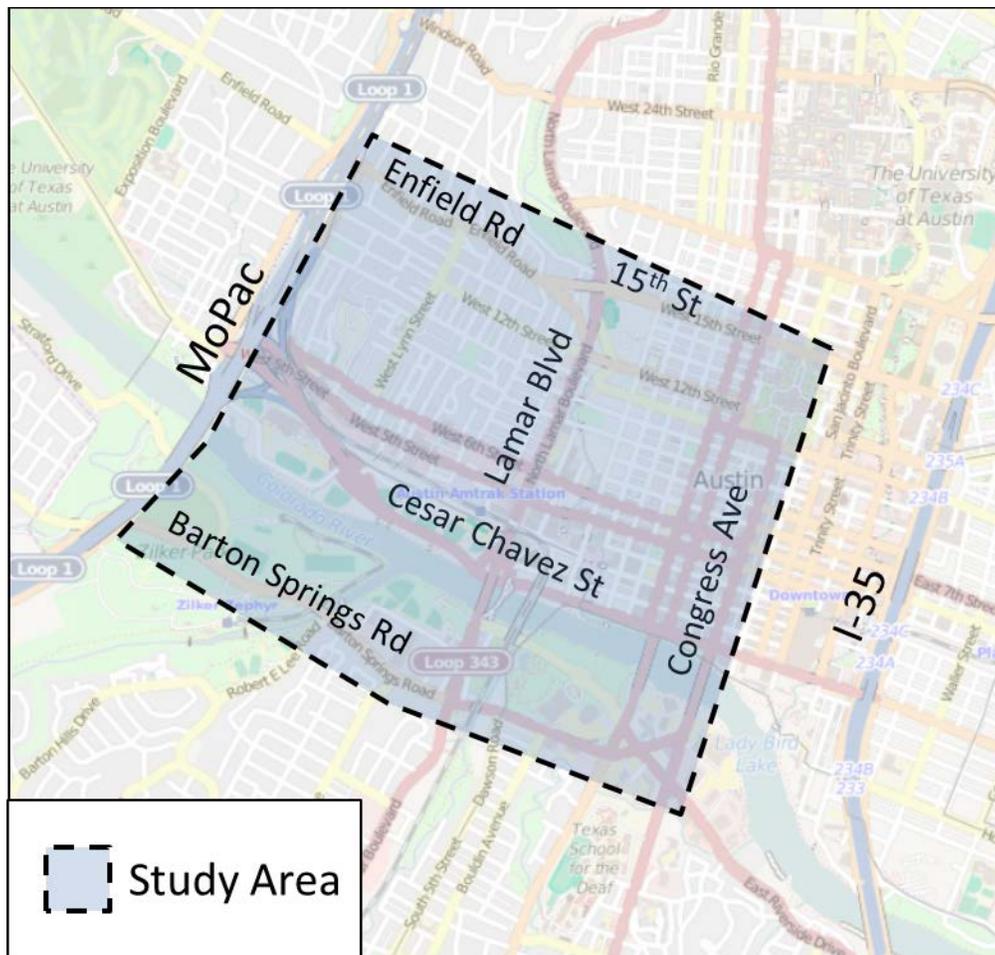


Figure 1. Study Area Boundaries

Five DTA models, described in Table 1, were developed representing variations of the MoPac South express lane plan.



Table 1. Scenario Definitions

| Scenario | Description   |
|----------|---|
| No-Build | No MoPac South express lanes; MoPac North express lanes included                                  |
| 1        | Two express lanes in each direction with a one-lane flyover direct-connect ramp in each direction |
| 2        | Two express lanes in each direction without direct-connect ramps                                  |
| 3        | One express lane in each direction with a one-lane flyover direct-connect ramp in each direction  |
| 4        | One express lane in each direction without direct-connect ramps                                   |

This study was funded by the Central Texas Regional Mobility Authority and the Capital Area Metropolitan Planning Organization (CAMPO). This memo summarizes the results observed from the DTA models and provides several recommendations based on the findings.

## 2. BACKGROUND

DTA models are useful for estimating changes to area travel patterns given changes in a roadway network. They are designed to assign vehicles to a transportation network by adjusting route selection as simulated traffic conditions change over time. They are generally more detailed and can simulate the impact of congestion more appropriately than conventional travel demand models. Though not as refined as microsimulation models, they can be used to assess areas or regions more efficiently.

The focus of the effort discussed herein was to analyze impacts of the MoPac improvements on Cesar Chavez Street and the nearby downtown area. This study area was shown in the previous section in Figure 1.

To properly analyze the impact of the MoPac South express lanes on the study area, the limits of the modeled area extend beyond the boundaries of the area under study. This is from the area north of SH 71 (Barton Skyway) to Enfield Road/15<sup>th</sup> Street, and from MoPac to Congress Avenue. Along MoPac, the model extends just south of Loop 360 to include the ingress/egress access between the express lanes and general purpose lanes south of Cesar Chavez Street. Figure 2 shows the layout of the model used for this study. The travel demand for this modeled network was extracted for each analyzed alternative from the 2020 CAMPO forecasted travel demand model with the existing plus committed network.

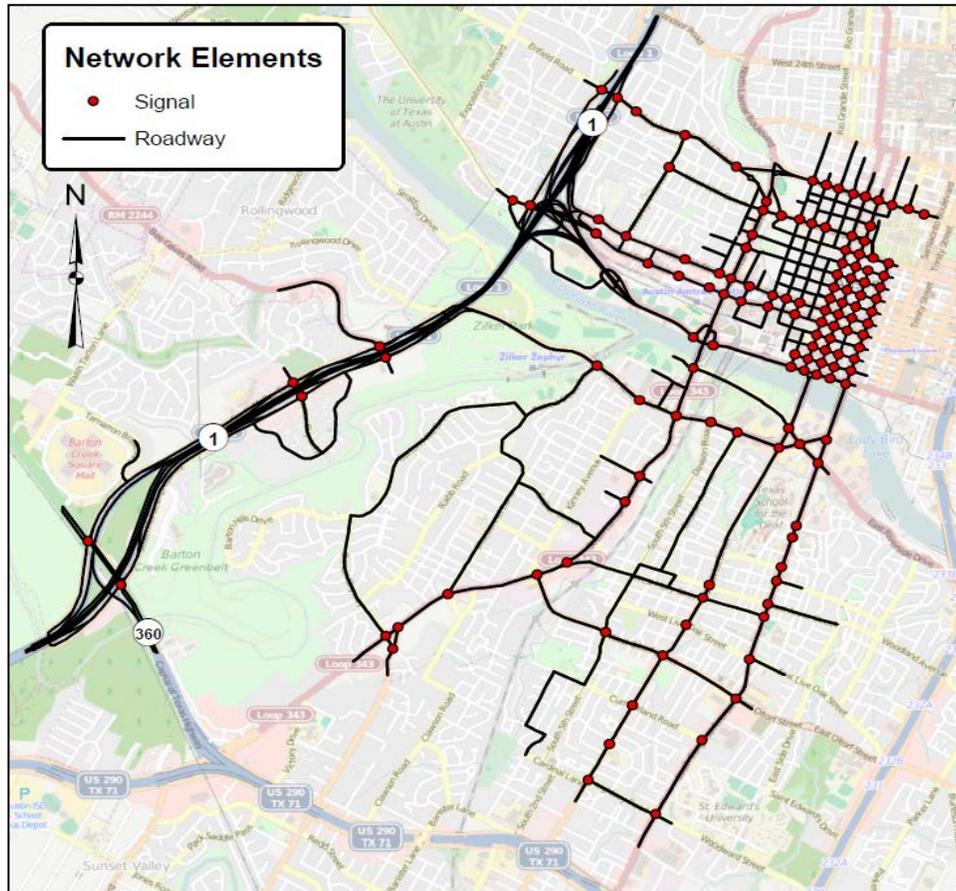


Figure 2. Layout and Extent of DTA Model

The CAMPO regional model used for this study covers six counties in the Austin area and establishes traffic routing throughout the region. Improvements along the MoPac corridor for each alternative were coded into the regional model to capture the full magnitude of impacts of the network changes. Therefore, route shifting that occurs beyond the DTA model boundaries, including those associated with nearby IH 35, are captured in this model and represented in the inputs used for the DTA models. Note that the IH 35 corridor modeled in the regional network does not incorporate the planned improvements as part of the Mobility 35 project since they are not expected to be complete by year 2020.

The five DTA models briefly described in Section 1 (Table 1) were developed to simulate a No-Build Scenario and four Build scenario models representing variations of the express lane plan. All scenarios were modeled for 2020 conditions and the travel demand table for each was extracted from independent runs of the CAMPO regional model with the corresponding MoPac South configuration. The scenarios with the direct-connect ramps (Scenarios 1 and 3) are intended to maximize use of the facility in 2020, allowing CTR to evaluate a worst-case assessment of the impact to congestion along Cesar Chavez Street. This involved removing the toll for the direct-connect ramps in the models.



### 3. MODEL RESULTS

The model results have been assessed on an aggregate level, as well as with respect to specific streets in the study area. The findings are presented for both the AM and PM peak periods.

#### 3.1 AGGREGATE PERFORMANCE

For trips beginning and ending within the designated study area, as outlined in Figure 1, the average travel times are given in Table 2. For all trips within the model area, shown in Figure 2, the average travel times are provided in Table 3. Morning peak period trips are shown in Figure 3 and afternoon peak period trips are illustrated in Figure 4.

Table 2. Study Area Average Internal Travel Times [minutes]

| Scenario   | Time Period |         |
|------------|-------------|---------|
|            | AM Peak     | PM Peak |
| No Build   | 3.3         | 15.7    |
| Scenario 1 | 3.3         | 9.5     |
| Scenario 2 | 3.4         | 8.8     |
| Scenario 3 | 3.3         | 7.4     |
| Scenario 4 | 3.3         | 8.9     |

Table 3. Model Area Average Travel Times [minutes]

| Scenario   | Time Period |         |
|------------|-------------|---------|
|            | AM Peak     | PM Peak |
| No Build   | 11.5        | 22.8    |
| Scenario 1 | 7.8         | 13.4    |
| Scenario 2 | 9.1         | 14.6    |
| Scenario 3 | 7.6         | 10.9    |
| Scenario 4 | 8.3         | 14.0    |

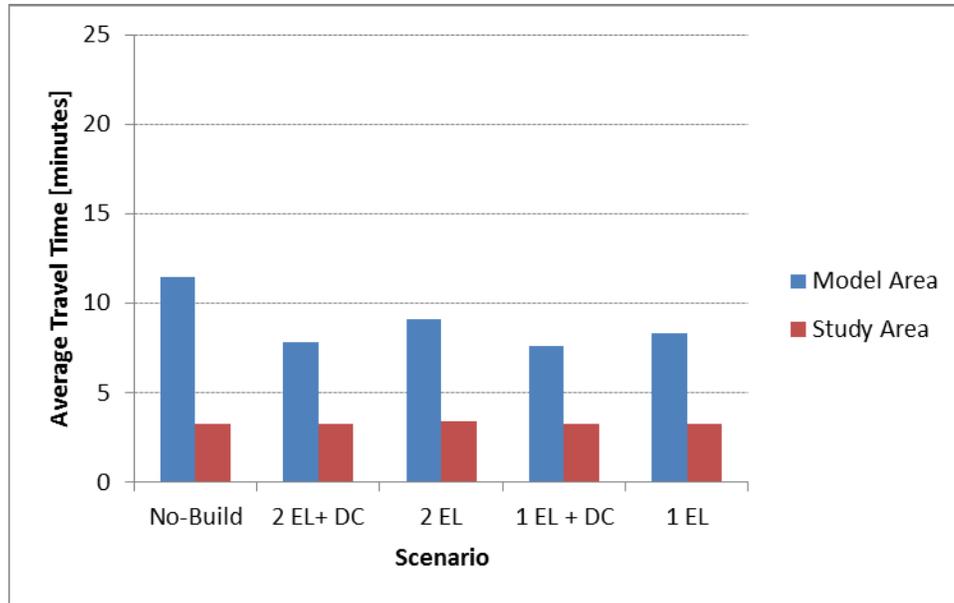


Figure 3. Comparison of AM Peak Period Average Travel Times

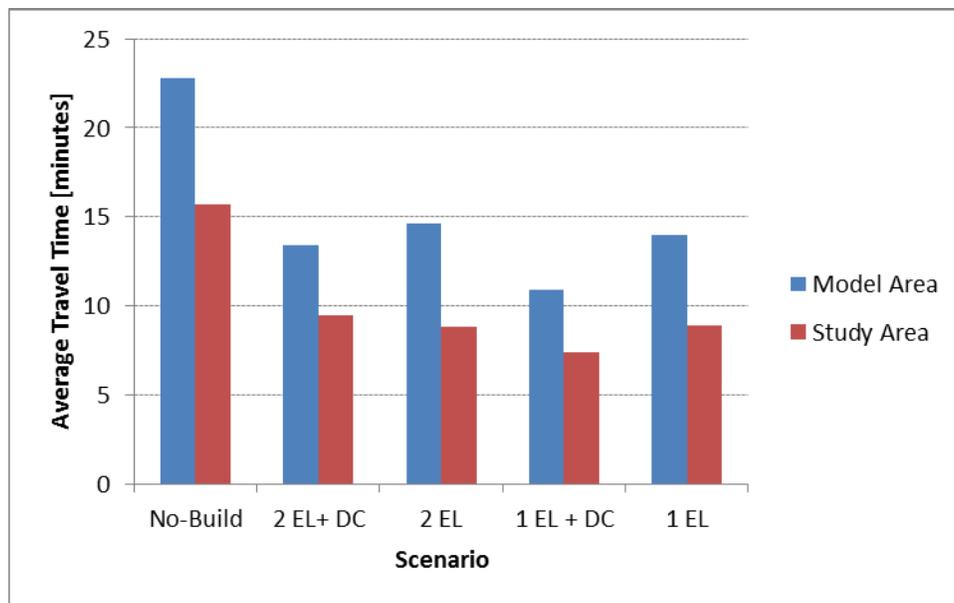


Figure 4. Comparison of PM Peak Period Average Travel Times

On average, travel time in the study area is approximately the same for all scenarios during the AM peak. For the PM peak, average travel times are lower in all of the Build scenarios than in the No-Build Scenario within the study area. The Build scenarios facilitate better access to the corridor and reduced congestion in the vicinity of the Cesar Chavez/Lake Austin Boulevard interchange. This leads to reductions in average downtown-area travel time relative to the No-Build scenario. Scenarios 2 through 4 see the largest improvement in downtown area travel

times. Scenario 1 changes area travel patterns the most, and leads to some higher travel times downtown than the other Build scenarios.

For the entire model area, the Build scenarios all consistently perform better than the No-Build Scenario. Better access to the MoPac corridor coupled with improved flow along MoPac result in the lower travel times. Scenario 3 performs the best overall.

### 3.2 IMPACT TO CESAR CHAVEZ STREET

In this section, travel times on Cesar Chavez Street are examined in the eastbound direction in the morning, and in the westbound direction in the afternoon. Figure 5 shows the limits of the corridor analyzed in the eastbound direction and Figure 6 shows the limits of the corridor analyzed in the westbound direction.



Figure 5. Travel Time Limits for Eastbound Cesar Chavez Street



Figure 6. Travel Time Limits for Westbound Cesar Chavez Street

As shown in Figure 7, travel times remain relatively constant on eastbound Cesar Chavez Street in the AM peak period across scenarios. This is largely due to the fact that traffic volumes do not fluctuate substantially across scenarios. It has also been determined through detailed operational analysis by consultants for the Mobility Authority that the merge area for the direct-connector ramps with Cesar Chavez Street does not significantly disrupt flow along the roadway.

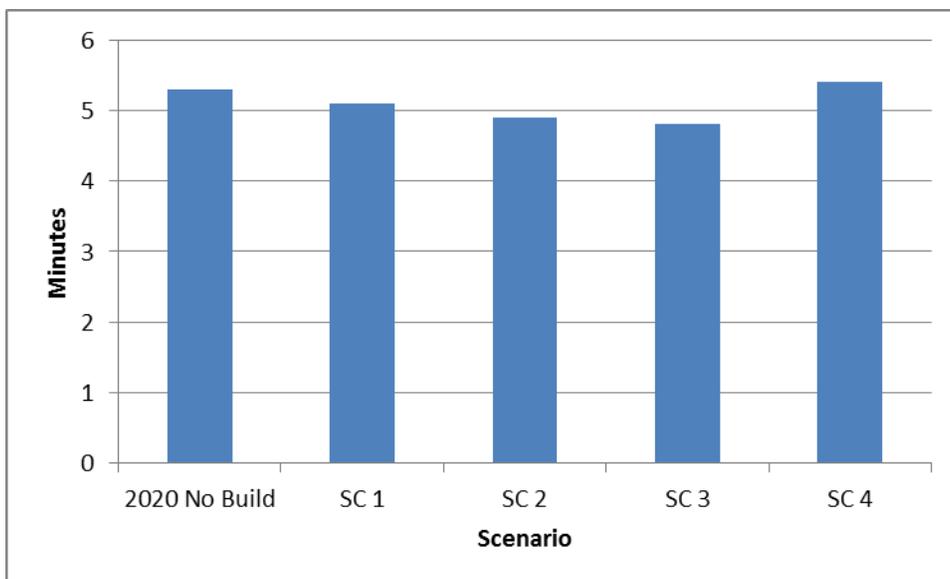


Figure 7. Eastbound Cesar Chavez Street AM Travel Time (From MoPac Merge to Congress Ave)

As shown in Figure 8, travel times on westbound Cesar Chavez Street in the PM peak period decrease in the Build scenarios relative to the No-Build Scenario. This decrease in travel time is due to less downstream congestion forming along the ramps connecting the roadway with MoPac, particularly those providing access to southbound MoPac. Scenarios 3 and 4 attract less traffic to westbound Cesar Chavez Street and as such, result in lower travel times than Scenarios 1 and 2.

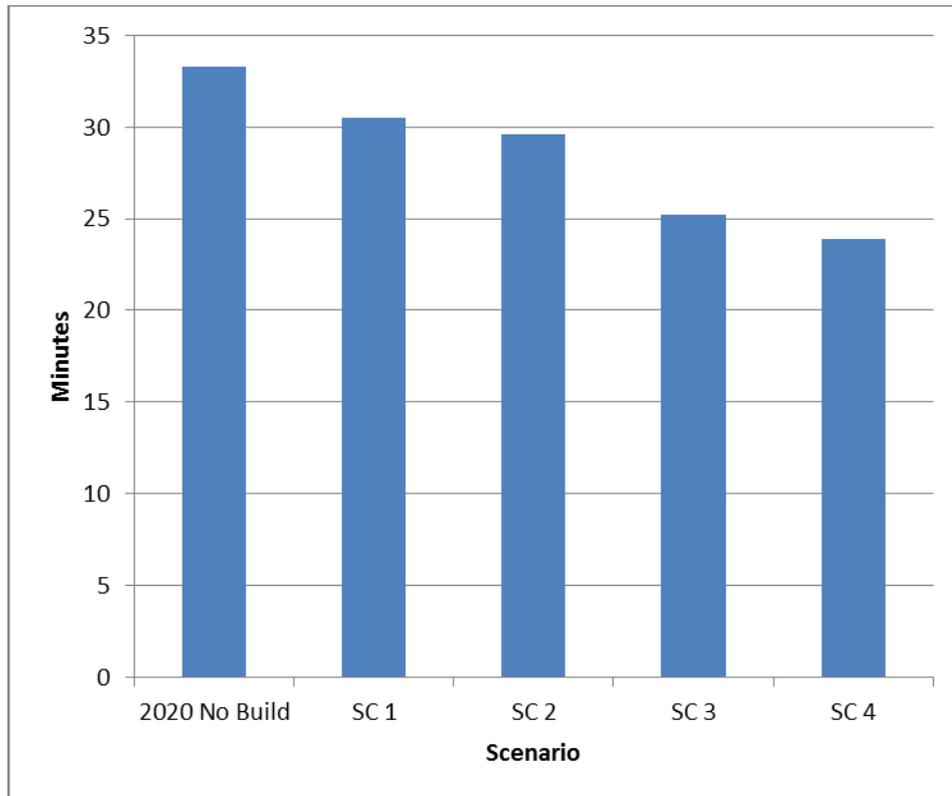


Figure 8. Westbound Cesar Chavez Street PM Travel Time (from Congress Avenue to MoPac Diverge)

### 3.3 IMPACT TO 6<sup>TH</sup> STREET

In this section, travel times on 6<sup>th</sup> Street, which is one-way in the westbound direction, are examined for the afternoon peak period. Figure 9 shows the limits of the corridor analyzed.



Figure 9. Travel Time Limits for 6<sup>th</sup> Street

As shown in Figure 10, travel times on 6<sup>th</sup> Street in the PM peak period decrease in the Build scenarios relative to the No-Build Scenario. Much of this improvement occurs east of Lamar Boulevard where a change in travel pattern has a positive effect. Compared to the No-Build Scenario, the Build scenarios all result in more traffic on 6<sup>th</sup> Street continuing straight through the intersection at Lamar Boulevard versus making a left turn to travel south. With improved conditions downstream at the interchange with MoPac, drivers have more incentive to use the roadway. The resultant reduction in the left-turn volume at the intersection improves conditions upstream along the roadway.

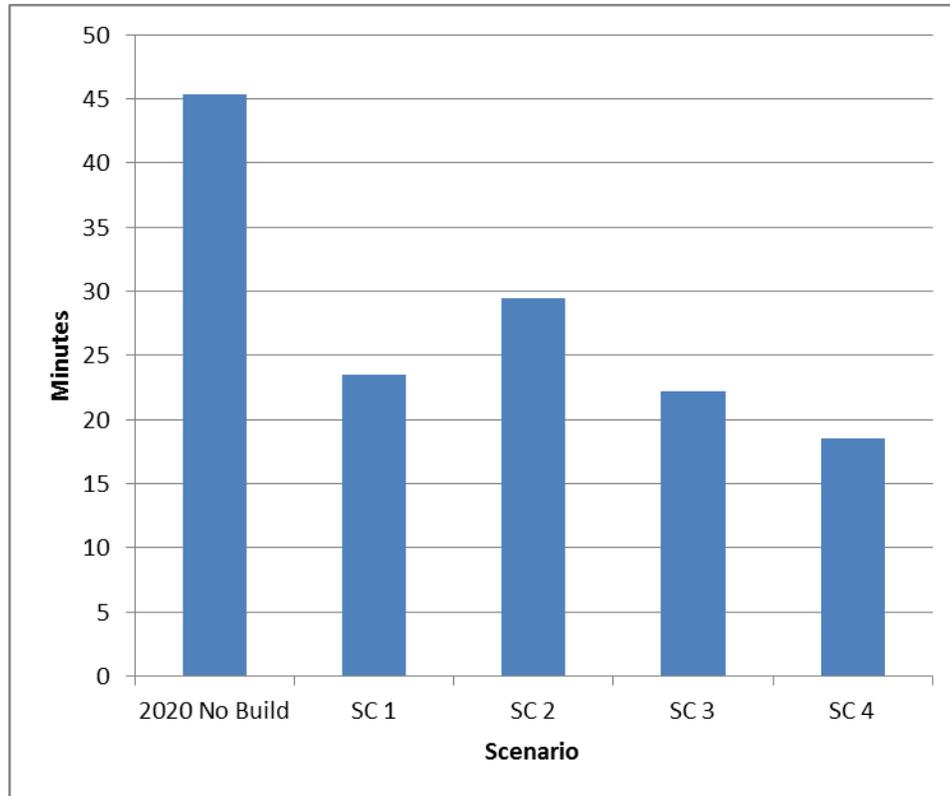


Figure 10. 6<sup>th</sup> Street PM Travel Time (Congress Avenue to MoPac)

### 3.4 IMPACT TO 5<sup>TH</sup> STREET

In this section, travel times on 5<sup>th</sup> Street, which is one-way in the eastbound direction, are examined for the morning peak period. Figure 11 shows the limits of the corridor analyzed.



Figure 11. Travel Time Limits for 5<sup>th</sup> Street

As shown in Figure 12, travel times on 5<sup>th</sup> Street in the AM peak period stay relatively constant across scenarios. Since there is available capacity along the corridor, and intersection control constrains flow, the changes in travel patterns do not lead to noticeable changes in travel time.

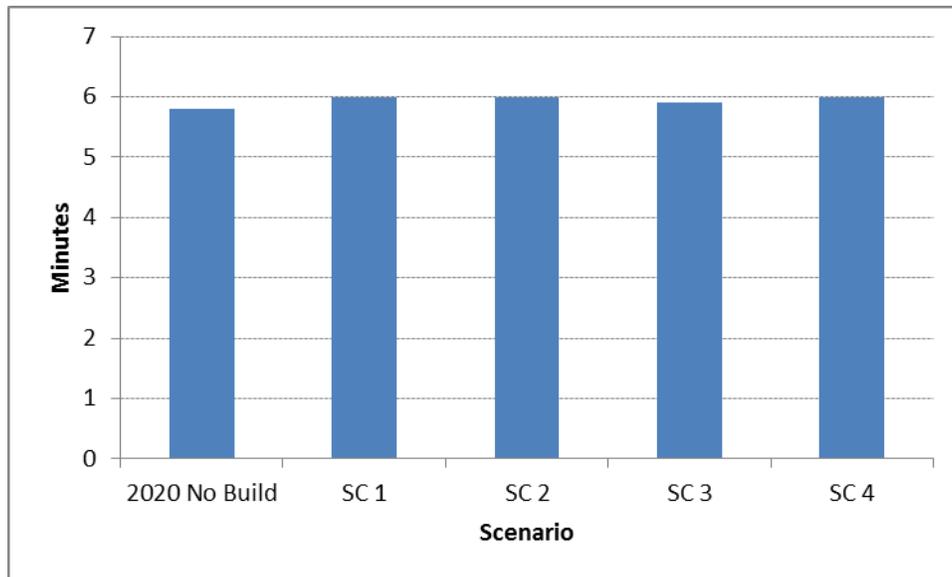


Figure 12. Eastbound 5<sup>th</sup> Street AM Travel Time (MoPac to Congress Avenue)

### 3.5 IMPACT TO LAMAR BOULEVARD

In this section travel times on Lamar Boulevard are examined in the northbound direction in the morning peak period and the southbound direction in the afternoon peak period. Figure 13 shows the limits of the corridor analyzed.

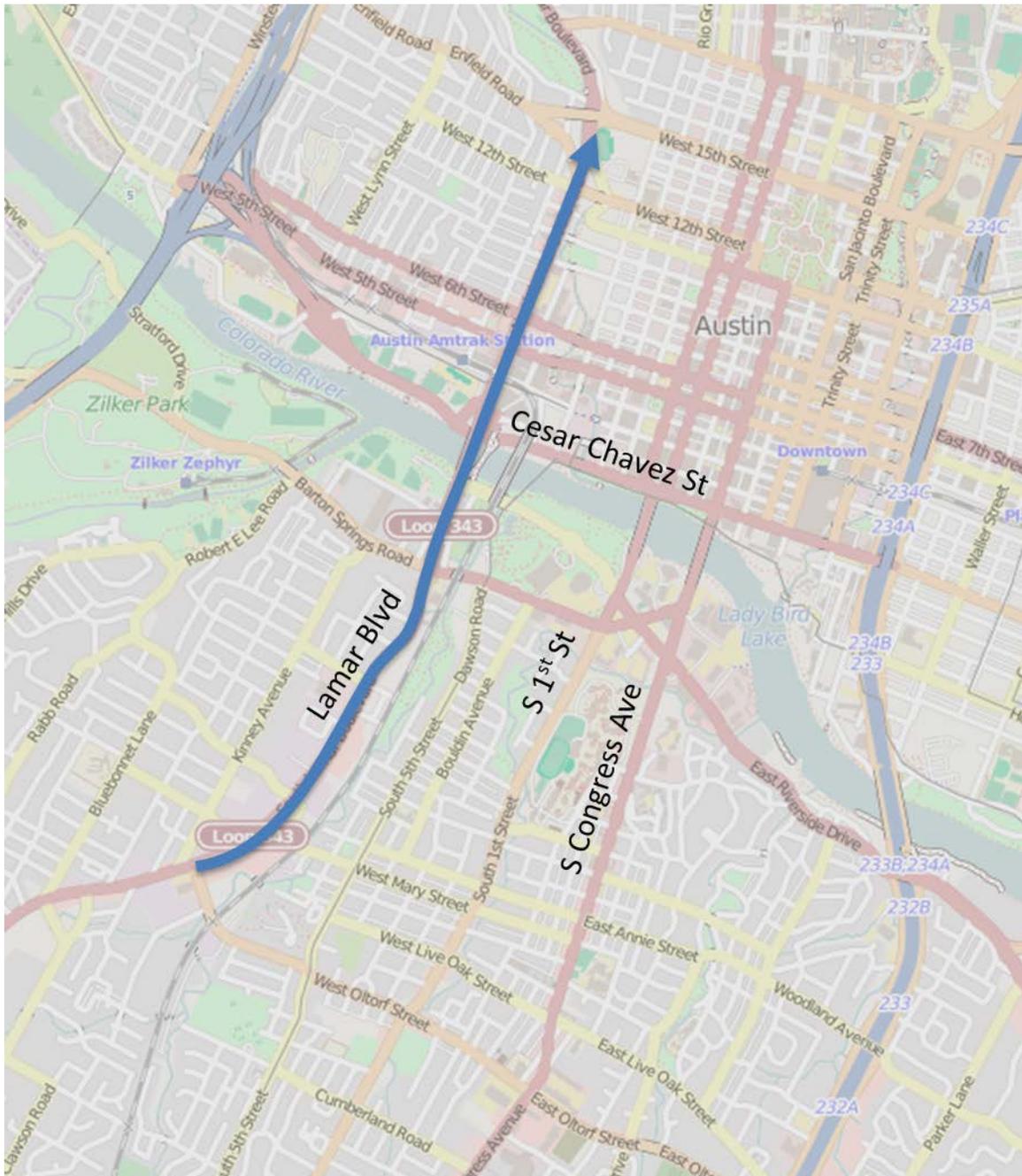


Figure 13. Travel Time Limits for Lamar Boulevard

As shown in Figure 14, travel times on northbound Lamar Boulevard in the AM peak period stay relatively constant across scenarios. This is largely a result of the fact that travel patterns remain consistent along this corridor across scenarios in the AM peak period.

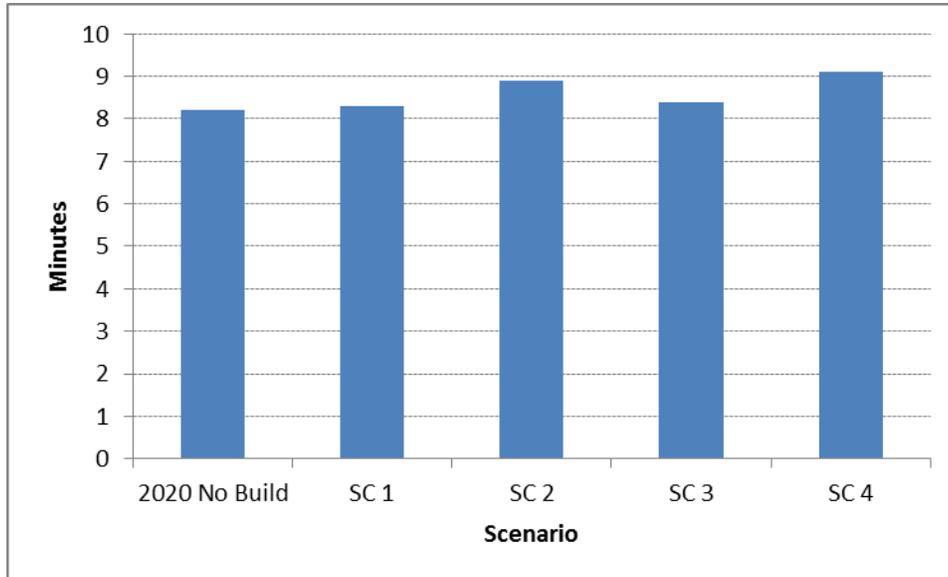


Figure 14. Northbound Lamar Boulevard AM Travel Time (Oltorf Street to 15<sup>th</sup> Street)

As shown in Figure 15, travel times on southbound Lamar Boulevard in the PM peak period decrease significantly in the Build scenarios versus the No-Build Scenario. This improvement is a result of a decrease in traffic using the Lamar Boulevard corridor south of 6<sup>th</sup> Street as the travel pattern shifts toward more utilization of 6<sup>th</sup> Street for access to MoPac. This change is the least in Scenario 4.

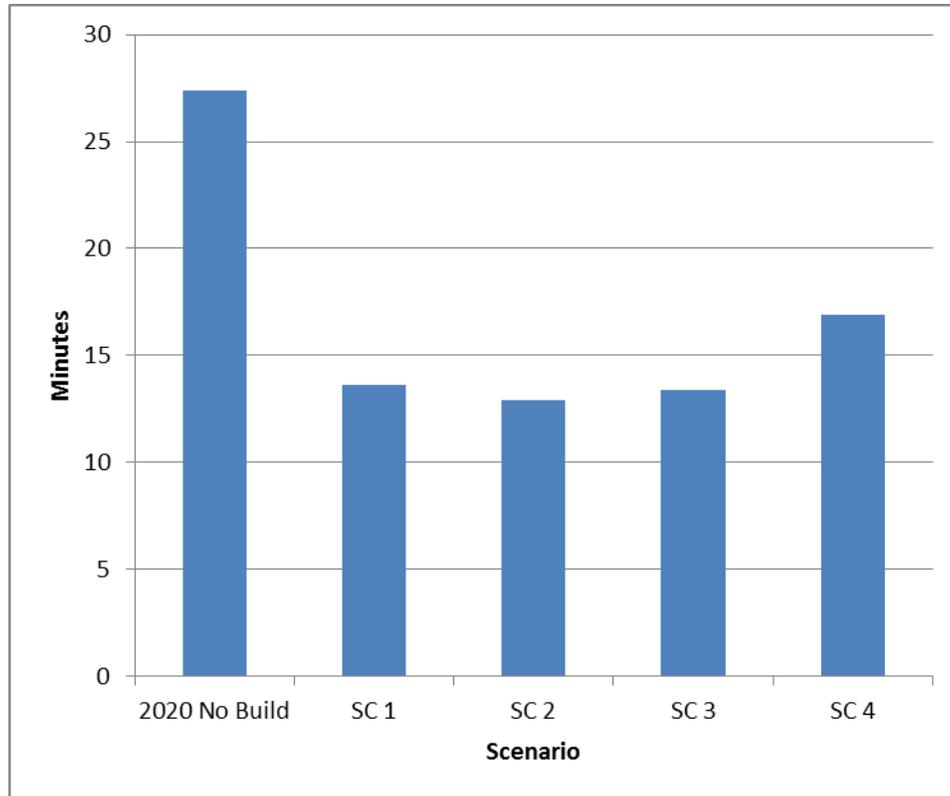


Figure 15. Southbound Lamar Boulevard PM Travel Time (15<sup>th</sup> Street to Oltorf Street)

### 3.6 IMPACT TO S. 1<sup>ST</sup> STREET AND GUADALUPE/LAVACA STREETS

In this section, travel times on S. 1<sup>st</sup> Street to Lavaca Street in the northbound direction in the morning peak period, and Guadalupe Street to S. 1<sup>st</sup> Street in the southbound direction in the afternoon peak period are examined. Figure 16 shows the limits of the corridor analyzed.

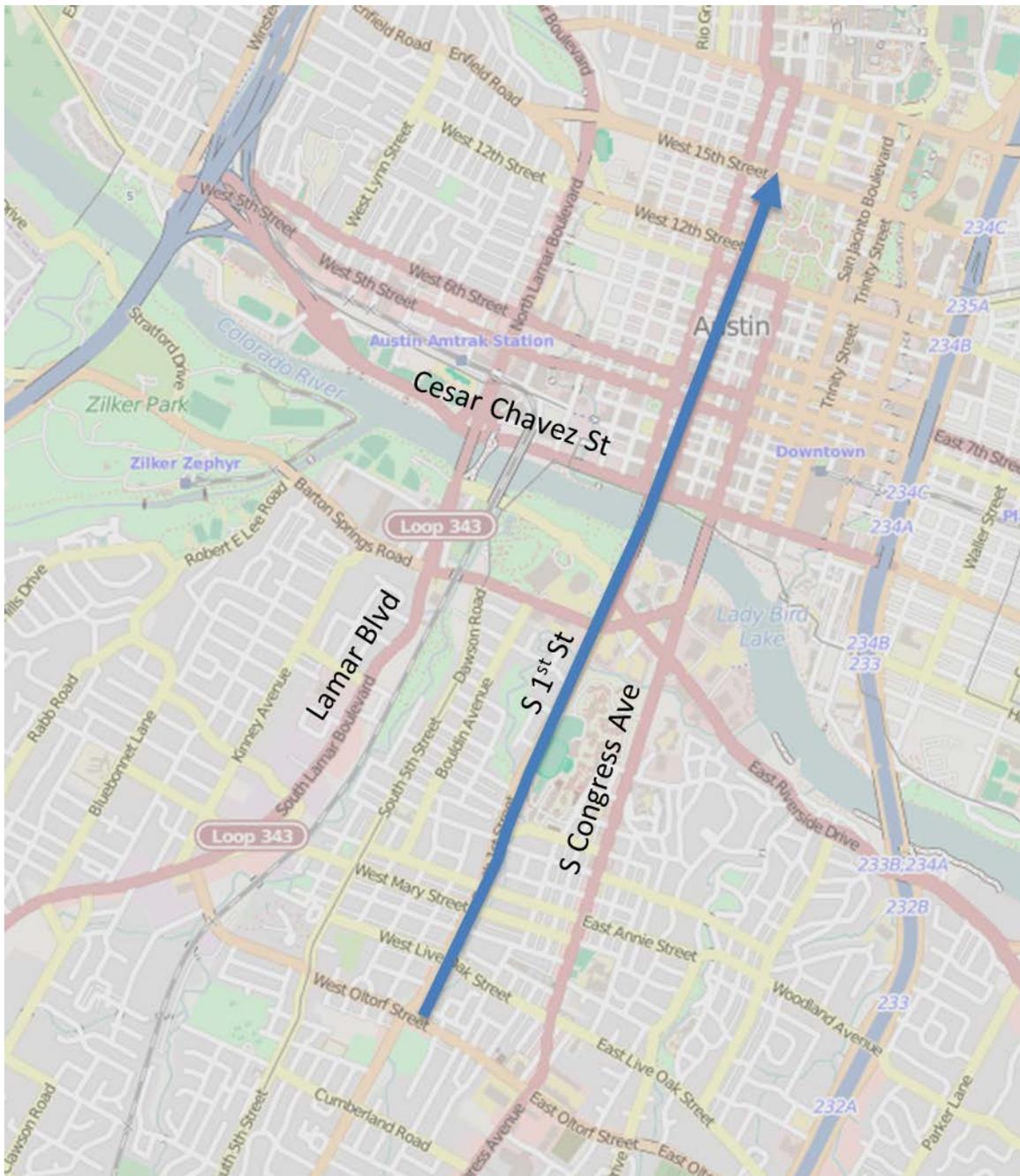


Figure 16. Travel Time Limits for S. 1<sup>st</sup> Street

As shown in Figure 17, travel times on northbound S. 1<sup>st</sup> Street to Lavaca Street in the AM peak period stay relatively constant across scenarios. Similar to northbound Lamar Boulevard, this result is largely due to travel patterns remaining consistent along this corridor across scenarios in the AM peak period.

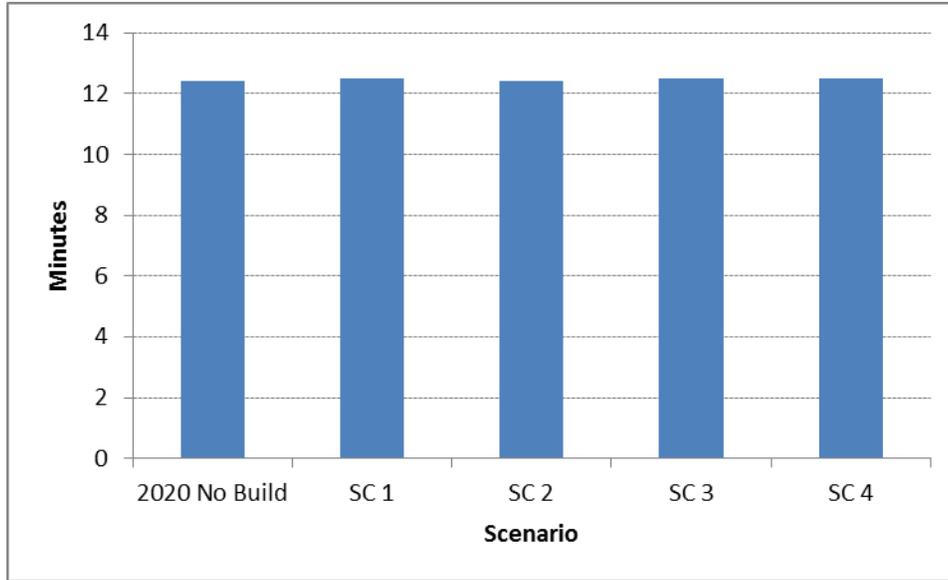


Figure 17. Northbound S. 1<sup>st</sup> Street to Lavaca Street AM Travel Time (Oltorf Street to 15<sup>th</sup> Street)

As shown in Figure 18, travel times on southbound Guadalupe Street to S. 1<sup>st</sup> Street in the PM peak period decrease significantly in the Build scenarios versus the No-Build Scenario. In this case, the improvement is partly a result of a decrease in traffic using the corridor with additional traffic traveling toward MoPac. Generally, the Build scenarios exhibit improved travel times upstream of Cesar Chavez Street with less congestion building along westbound routes to MoPac that otherwise slow southbound traffic along the corridor.

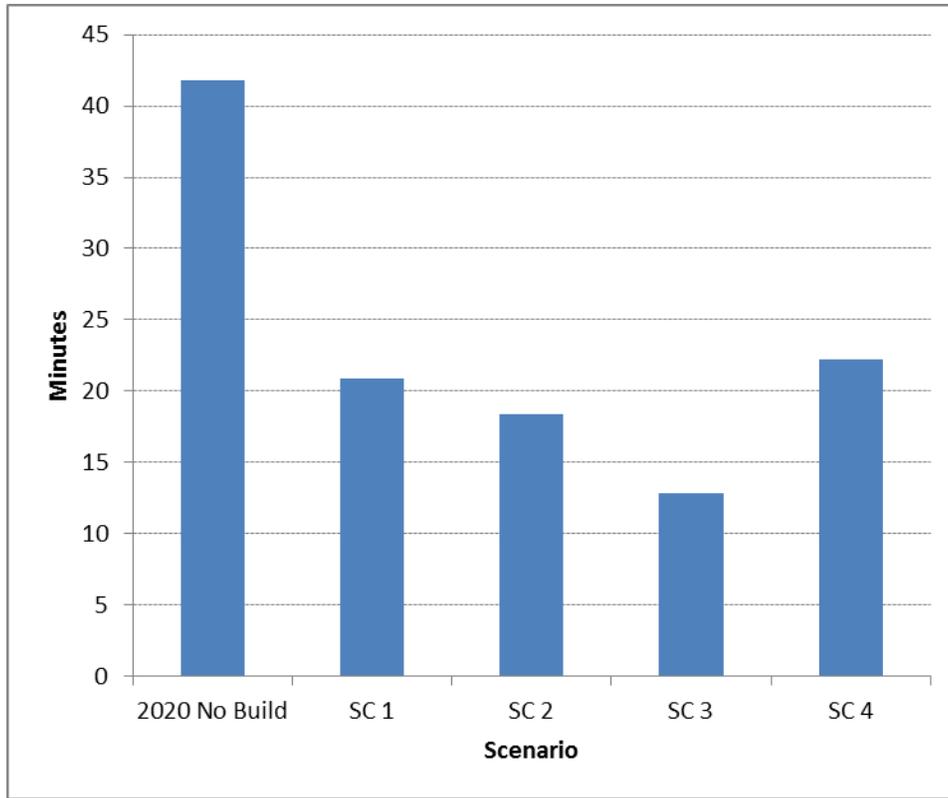


Figure 18. Southbound Guadalupe Street to S. 1<sup>st</sup> Street PM Travel Time (15<sup>th</sup> Street to Oltorf Street)

#### 4. CONCLUSIONS

Overall, the construction of MoPac South express lanes is not anticipated to negatively impact downtown Austin. Travel times in the morning peak period remain relatively constant across scenarios. This is a result of consistent travel patterns across scenarios in the morning peak period. Travel times in the afternoon peak period decrease in the Build scenarios versus the No-Build Scenario. This is a result of improved conditions at the interchange of MoPac at Lake Austin Boulevard/Cesar Chavez Street. Alleviation of congestion and improved access to MoPac in the vicinity of the interchange contributes to reduced travel times along major corridors in the study area. While not all sections improve consistently, the “Build” scenarios generally result in lower travel times in the area.

# **MoPac South: Impact on Cesar Chavez Street and the Downtown Network**

## **TECHNICAL REPORT**

**Prepared by:**

**The University of Texas at Austin  
Center for Transportation Research**

**Prepared for:**

**Central Texas Regional Mobility Authority and  
Capital Area Metropolitan Planning Organization**

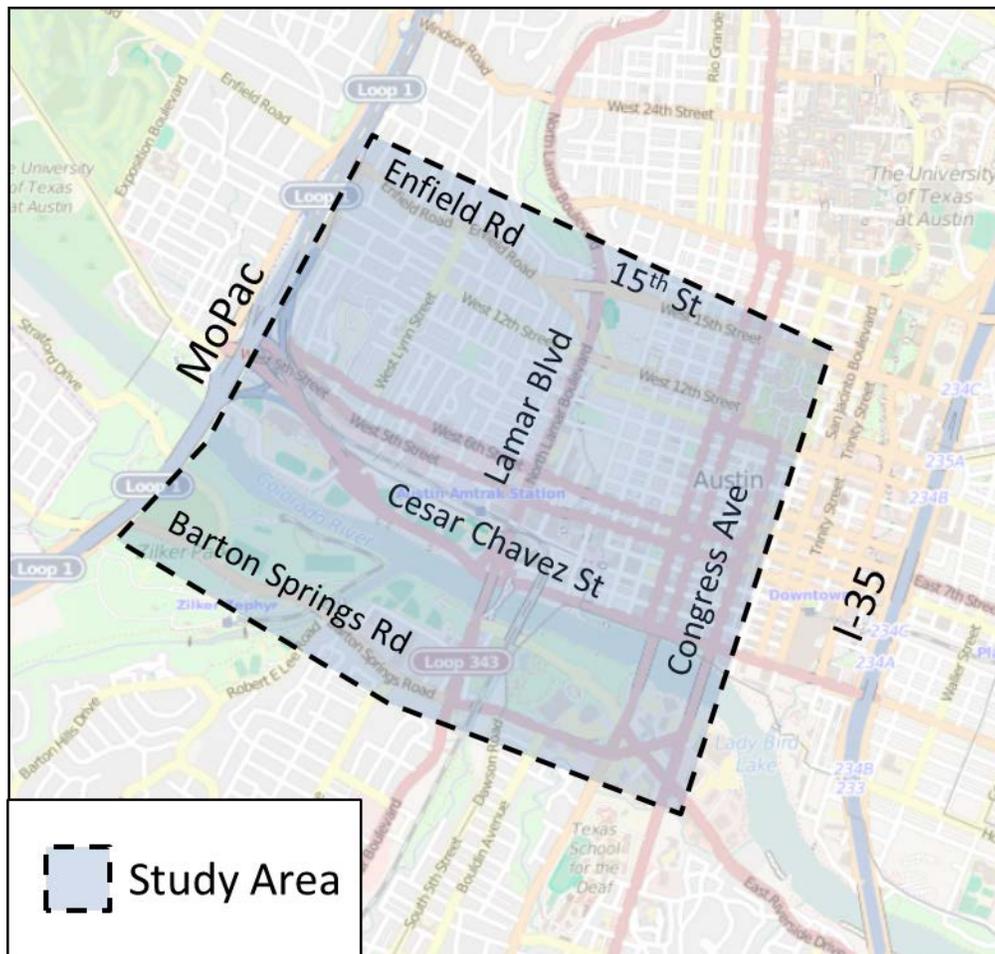
**November 2015**



**THE UNIVERSITY OF TEXAS AT AUSTIN  
CENTER FOR TRANSPORTATION RESEARCH**

## EXECUTIVE SUMMARY

The University of Texas at Austin Center for Transportation Research (CTR) was tasked with development and application of a dynamic traffic assignment (DTA) study to analyze the impact of MoPac South Express Lanes on downtown Austin. This effort was funded by the Central Texas Regional Mobility Authority and the Capital Area Metropolitan Planning Organization (CAMPO), and supplements ongoing analysis of the MoPac corridor by the project team. The area included in this study is shown in the figure.



DTA models are useful for estimating changes to area travel patterns given changes in a roadway network. The objective of this study was to analyze traffic impacts on Cesar Chavez Street and the downtown area resulting from adding express lanes to the MoPac Expressway south of Cesar Chavez Street. Further, the study assessed the impact of proposed direct-connector ramps between the MoPac South express lanes and Cesar Chavez Street. The analysis included both morning (6:00-9:00 AM) and afternoon (3:30-6:30 PM) peak period travel demand for year 2020 traffic conditions.



Five DTA models were developed representing variations of the MoPac South express lane plan:

| <u>Scenario</u> | <u>Description</u>  |
|-----------------|---|
| No-Build        | No MoPac South express lanes; MoPac North express lanes included                                    |
| 2 EL + DC       | Two express lanes in each direction with a one-lane flyover direct-connector ramp in each direction |
| 2 EL            | Two express lanes in each direction without direct-connector ramps                                  |
| 1 EL + DC       | One express lane in each direction with a one-lane flyover direct-connector ramp in each direction  |
| 1 EL            | One express lane in each direction without direct-connector ramps                                   |

Results have been compiled for all five scenarios for the AM and PM peak periods. All comparisons of results are between the Build and No-Build scenarios in year 2020. For trips beginning and ending within the designated study area, as outlined in above figure, average travel times are approximately the same for all scenarios during the AM peak. For the PM peak, average travel times are lower in all of the Build scenarios than in the No-Build Scenario within the study area. The Build scenarios facilitate better access to the corridor and reduced congestion in the vicinity of the Cesar Chavez/Lake Austin Boulevard interchange. This leads to reductions in average downtown-area travel time relative to the No-Build Scenario. Scenario “2 EL + DC” changes area travel patterns the most, and leads to some higher travel times downtown than the other build scenarios.

For the entire model area, including a section of MoPac, the Build scenarios all consistently perform better than the No-Build Scenario. Better access to the MoPac corridor coupled with improved flow along MoPac result in the lower travel times. Here, Scenario “1 EL + DC” generally performs the best. Both aggregate performance metrics and corridor-specific results were compiled.

Travel times on Cesar Chavez Street were reviewed in detail in the eastbound direction in the morning, and in the westbound direction in the afternoon between MoPac and Congress Avenue. Travel times remain relatively constant on eastbound Cesar Chavez Street in the AM peak period across scenarios. This is largely due to the fact that traffic volumes do not fluctuate substantially across scenarios. A consultant for the Mobility Authority has also determined, through detailed operational analysis, that the merge area for the direct-connector ramps with Cesar Chavez Street does not significantly disrupt flow along the roadway. Travel times on westbound Cesar Chavez Street in the PM peak period decrease in the build Scenarios relative to the No-Build Scenario. This decrease in travel time is due to less downstream congestion forming along the ramps connecting the roadway with MoPac, particularly those providing



access to southbound MoPac. Scenarios 3 and 4 attract less traffic to westbound Cesar Chavez Street and as such, result in lower travel times than Scenarios 1 and 2.

Results for 5<sup>th</sup> Street and 6<sup>th</sup> Street were also compiled between MoPac and Congress. In the morning peak period, travel times on 5<sup>th</sup> Street stay relatively constant across scenarios. Travel times on 6<sup>th</sup> Street in the PM peak period decrease in the Build scenarios relative to the No-Build Scenario. Much of this improvement occurs east of Lamar Boulevard where a change in travel pattern has a positive effect. Compared to the No-Build Scenario, the build scenarios all result in more traffic on 6<sup>th</sup> Street continuing straight through the intersection at Lamar Boulevard versus making a left turn to travel south. With improved conditions downstream at the interchange with MoPac, drivers have more incentive to use the roadway. The resulting reduction in the left-turn volume at the intersection improves conditions upstream along the roadway.

For some other roadways accessing the downtown area, including Lamar Boulevard and S. 1<sup>st</sup> Street, inbound travel times were assessed for the morning peak period and outbound travel times for the afternoon peak period. Travel times on northbound Lamar Boulevard and S. 1<sup>st</sup> Street in the morning peak period stay relatively constant across scenarios. This is largely a result of the fact that travel patterns remain consistent along these corridors across scenarios during this period.

Travel times on southbound Lamar Boulevard in the PM peak period decrease significantly in the build Scenarios versus the No-Build Scenario. This improvement is a result of a decrease in traffic using the corridor south of 6<sup>th</sup> Street as the travel pattern shifts toward more utilization of 6<sup>th</sup> Street for access to MoPac. This change is less noticeable for Scenario “1 EL”, where the least impactful change is implemented along MoPac. Travel times on southbound Guadalupe Street to S. 1<sup>st</sup> Street in the PM peak period also decrease significantly in the build Scenarios versus the No-Build Scenario. In this case, the improvement is partly a result of a decrease in traffic using the corridor with additional traffic traveling toward MoPac. Generally, the build Scenarios exhibit improved travel times upstream of Cesar Chavez Street with less congestion building along westbound routes to MoPac that otherwise slow southbound traffic along the corridor.

Overall, the construction of MoPac South express lanes is not anticipated to negatively impact downtown Austin relative to the No-Build Scenario. Travel times in the morning peak period remain relatively constant across scenarios. This is a result of consistent travel patterns across scenarios in the AM peak period. Travel times in the afternoon peak period decrease in the Build scenarios versus the No-Build Scenario. This is a result of improved conditions at the interchange of MoPac at Lake Austin Boulevard/Cesar Chavez Street. Alleviation of congestion



and improved access to MoPac in the vicinity of the interchange contributes to reduced travel times and increased throughput along major corridors in the study area. While not all sections improve consistently, the build scenarios generally result in lower travel times in the area.



## 1. INTRODUCTION

The objective of this study was to analyze traffic impacts of adding express lanes along MoPac south of Cesar Chavez Street. Further, the project involves assessing the implementation of two direct-connector ramps between the express lanes and Cesar Chavez Street. The ramps provide direct connections between the MoPac South express lanes and Cesar Chavez Street, in both directions. The analysis, covering both morning (6:00-9:00 AM) and afternoon (3:30-6:30 PM) peak periods, was completed using dynamic traffic assignment (DTA) models. These models were used to estimate changes to area travel patterns for each scenario analyzed.

This study was funded by the Central Texas Regional Mobility Authority and the Capital Area Metropolitan Planning Organization (CAMPO). This report summarizes the results observed from the DTA models and provides several recommendations based on the findings.

## 2. BACKGROUND

DTA models are designed to assign vehicles to a transportation network by adjusting route selection as simulated traffic conditions change over time. They are generally more detailed and can simulate the impact of congestion more appropriately than conventional travel demand models. Though not as refined as microsimulation models, they can be used to assess areas or regions more efficiently.

The focus of the effort discussed herein was to analyze impacts of the MoPac improvements on Cesar Chavez Street and the nearby downtown area. This includes the area from Barton Springs Road to Enfield Road/15<sup>th</sup> Street, and MoPac to Congress Avenue. Figure 1 shows the study area established for this analysis.

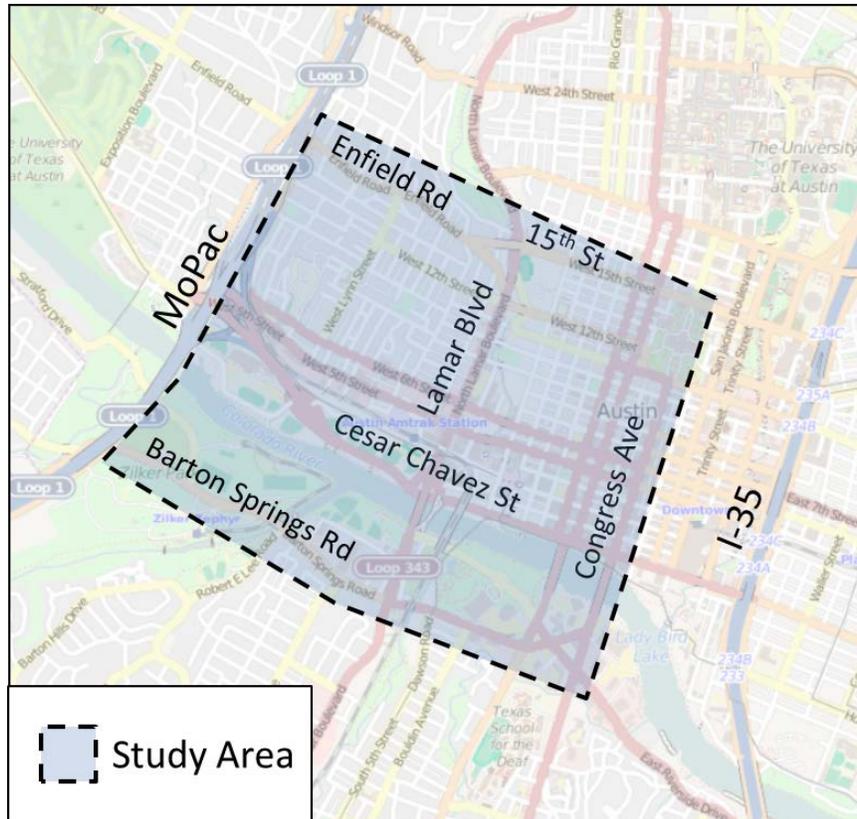


Figure 1. Project Study Area

To properly analyze the impact of the MoPac South express lanes on the study area, the limits of the DTA models extend from the area north of SH 71 (Barton Skyway) to Enfield Road/15<sup>th</sup> Street, and from MoPac to Congress Avenue. Along MoPac, the model extends just south of Loop 360 to include the ingress/egress access between the express lanes and general purpose lanes south of Cesar Chavez Street. Figure 2 shows the layout of the model used for this study. The demand for the subnetwork was extracted for each analyzed alternative from the 2020 CAMPO forecasted travel demand model with the existing plus committed network.

The CAMPO regional model used for this study covers six counties in the Austin area and establishes traffic routing throughout the region. Improvements along the MoPac corridor for each alternative were coded into the regional model to capture the full magnitude of impacts of the network changes. Therefore, route shifting that occurs beyond the DTA model boundaries, including those associated with nearby IH 35, are captured in this model and represented in the inputs used for the DTA models. Note that the IH 35 corridor modeled in the regional network does not incorporate the planned improvements as part of the Mobility 35 project since they are not expected to be complete by year 2020.

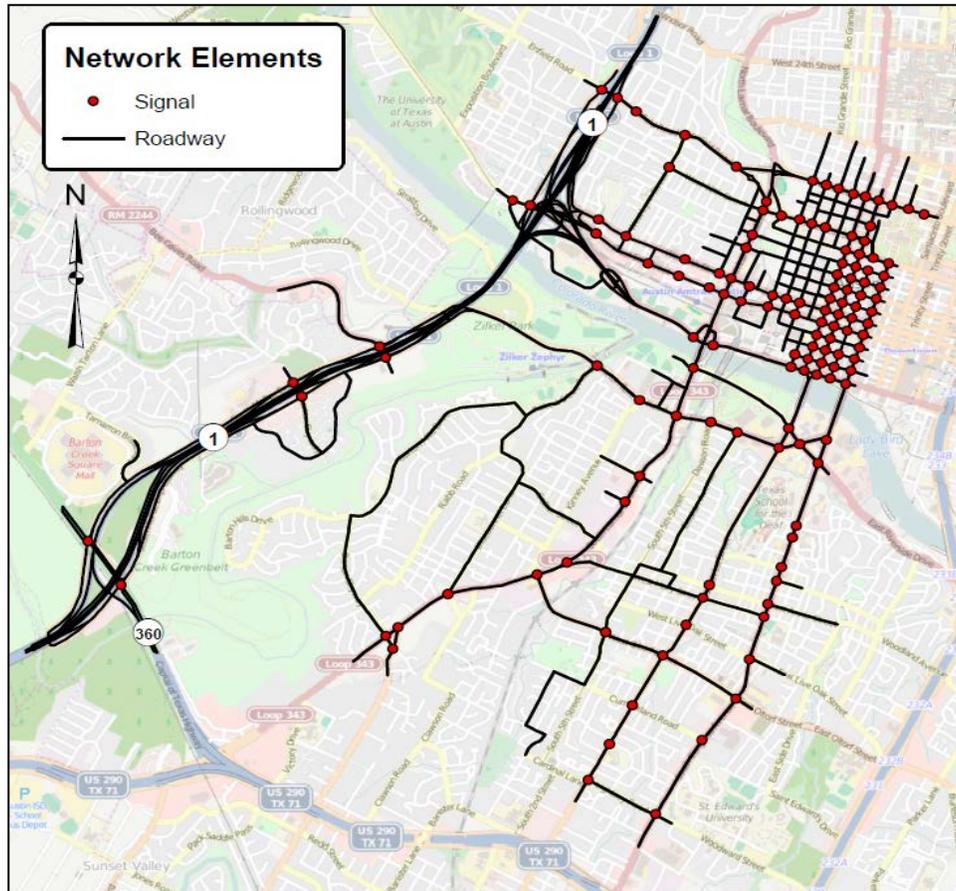


Figure 2. Layout and Extent of DTA Model

Five DTA models were developed to simulate a No-Build scenario and four build scenario models representing variations of the express lane plan. All scenarios were modeled for 2020 conditions and the demand table for each was extracted from independent runs of the CAMPO regional model with the corresponding MoPac South configuration. The scenarios with the direct-connector ramps are intended to maximize use of the facility in 2020, allowing CTR to evaluate a worst-case assessment of the impact to congestion along Cesar Chavez Street. This involved removing the toll for the direct-connector ramps in the models. The five scenarios are identified in the table below.



Table 1. DTA Model Scenarios

| Scenario  | Description   |
|-----------|---|
| No-Build  | No MoPac South express lanes; MoPac North express lanes included                                    |
| 2 EL + DC | Two express lanes in each direction with a one-lane flyover direct-connector ramp in each direction |
| 2 EL      | Two express lanes in each direction without direct-connector ramps                                  |
| 1 EL + DC | One express lane in each direction with a one-lane flyover direct-connector ramp in each direction  |
| 1 EL      | One express lane in each direction without direct-connector ramps                                   |

### 3. MODEL RESULTS

The model results have been assessed on an aggregate level, as well as with respect to Cesar Chavez Street specifically, roadways parallel to Cesar Chavez Street and other inbound roadways in the model, and downtown travel patterns. The findings are presented for both the AM and PM peak periods.

#### 3.1 AGGREGATE PERFORMANCE

For trips beginning and ending within the designated study area, as outlined in Figure 1, the average travel times are given in Table 2. For all trips within the model area, shown in Figure 2, the average travel times are provided in Table 3. Morning peak period trip travel times are shown in Figure 3 and afternoon peak period trip travel times are illustrated in Figure 4.

Table 2. Study Area Average Internal Travel Times [minutes]

| Scenario  | Time Period |         |
|-----------|-------------|---------|
|           | AM Peak     | PM Peak |
| No-Build  | 3.3         | 15.7    |
| 2 EL + DC | 3.3         | 9.5     |
| 2 EL      | 3.4         | 8.8     |
| 1 EL + DC | 3.3         | 7.4     |
| 1 EL      | 3.3         | 8.9     |

Table 3. Model Area Average Travel Times [minutes]

| Scenario  | Time Period |         |
|-----------|-------------|---------|
|           | AM Peak     | PM Peak |
| No-Build  | 11.5        | 22.8    |
| 2 EL + DC | 7.8         | 13.4    |
| 2 EL      | 9.1         | 14.6    |
| 1 EL + DC | 7.6         | 10.9    |
| 1 EL      | 8.3         | 14.0    |

In the PM peak period, travel times are lower in all of the build scenarios than in the No-Build scenario. All of the build scenarios facilitate better access to the corridor and reduced congestion in the vicinity of the Cesar Chavez/Lake Austin Boulevard interchange. This leads to reductions in average downtown-area travel time relative to the No-Build scenario. Scenario “2 EL + DC” changes area travel patterns the most, and leads to higher overall travel times downtown than the other build scenarios. The observed impact and contributing factors are discussed in more detail in the following sections.

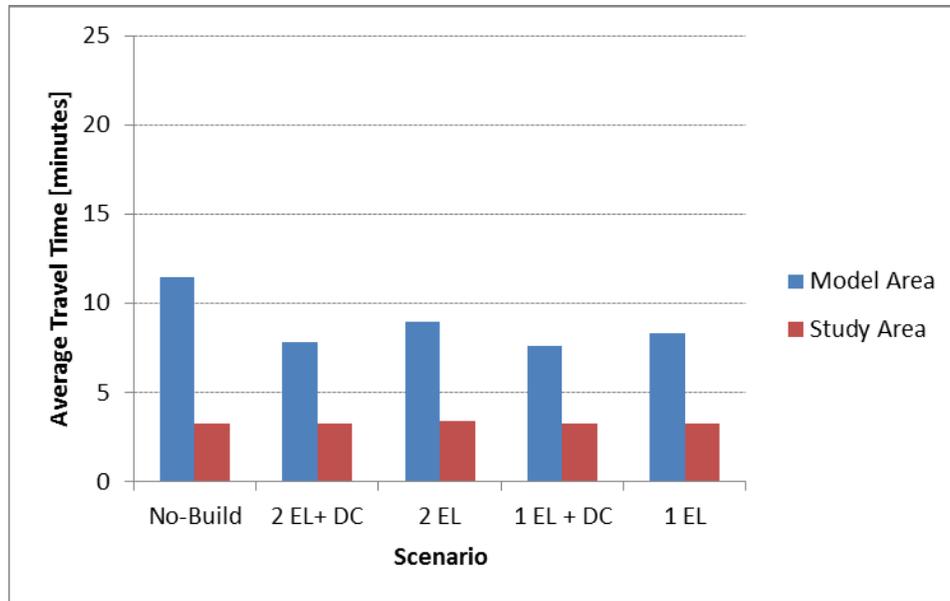


Figure 3. Average Travel Time (AM Peak Period)

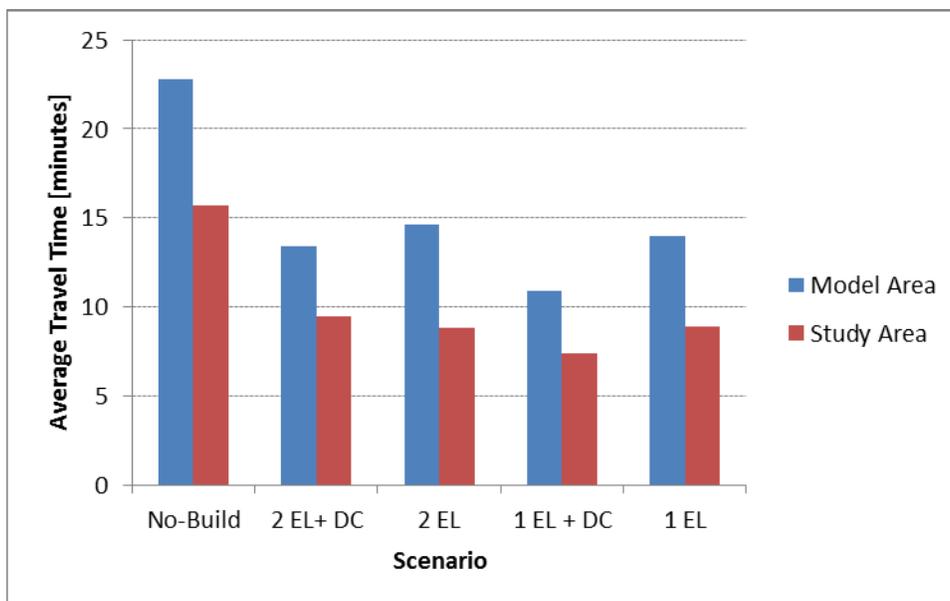


Figure 4. Average Travel Time (PM Peak Period)

For the entire model area, the build scenarios all consistently perform better than the No-Build Scenario. Better access to the MoPac corridor coupled with improved flow along MoPac result in the lower travel times. Scenario “1 EL + DC” generally performs the best where the majority of the improvements are incorporated but fewer impacts to travel patterns are experienced within the study area.

### 3.2 IMPACT TO CESAR CHAVEZ STREET

For Cesar Chavez Street, the scenarios with the direct-connector ramps influence traffic in this area. This includes an additional merge area between the northbound-to-eastbound direct-connector ramp along the corridor in the immediate vicinity of the merge point for the eastbound Reserve Road entrance ramp, as shown in Figure 5.

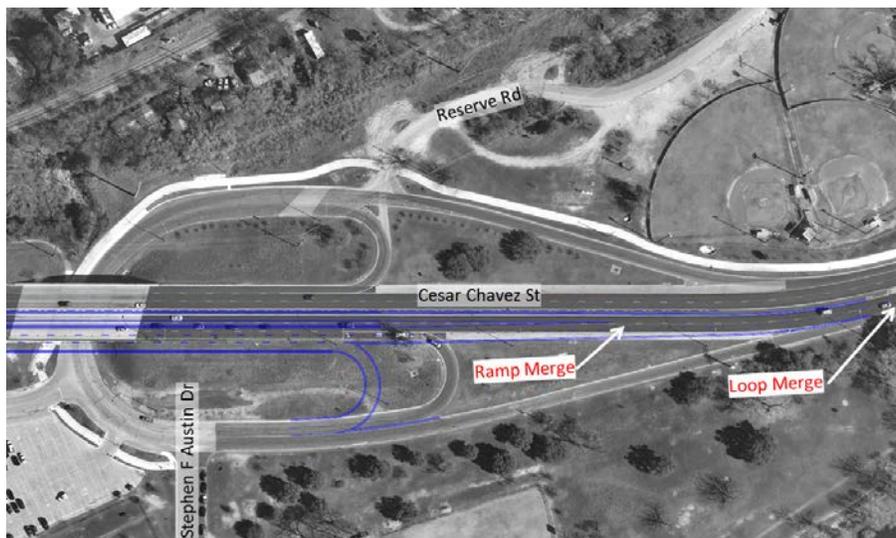


Figure 5. Merge Areas along Eastbound Cesar Chavez Street

In this section, travel times and volumes on Cesar Chavez Street are examined in the eastbound direction in the morning, and in the westbound direction in the afternoon. Figure 6 shows the limits of the corridor analyzed in the eastbound direction and Figure 7 shows the limits of the corridor analyzed in the westbound direction.



Figure 6. Travel Time Limits for Eastbound Cesar Chavez Street

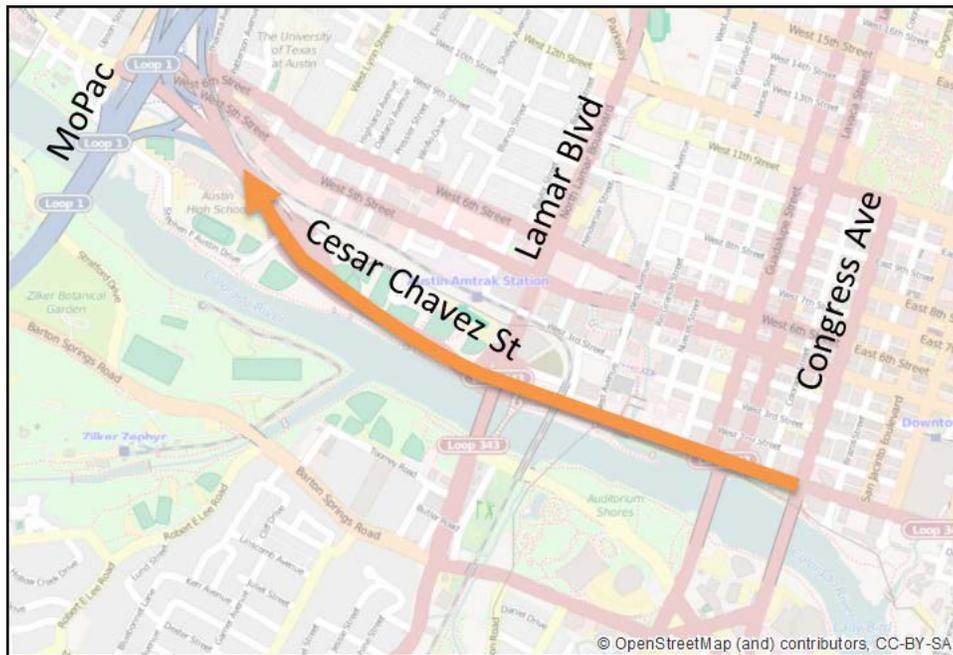


Figure 7. Travel Time Limits for Westbound Cesar Chavez Street

As shown in Figure 8, travel times remain relatively constant on eastbound Cesar Chavez Street in the AM peak period across scenarios. This is largely due to the fact that traffic volumes do not increase across scenarios. A consultant for the Mobility Authority has also determined,

through detailed operational analysis, that the merge area for the direct-connector ramps with Cesar Chavez Street does not significantly disrupt flow along the roadway.

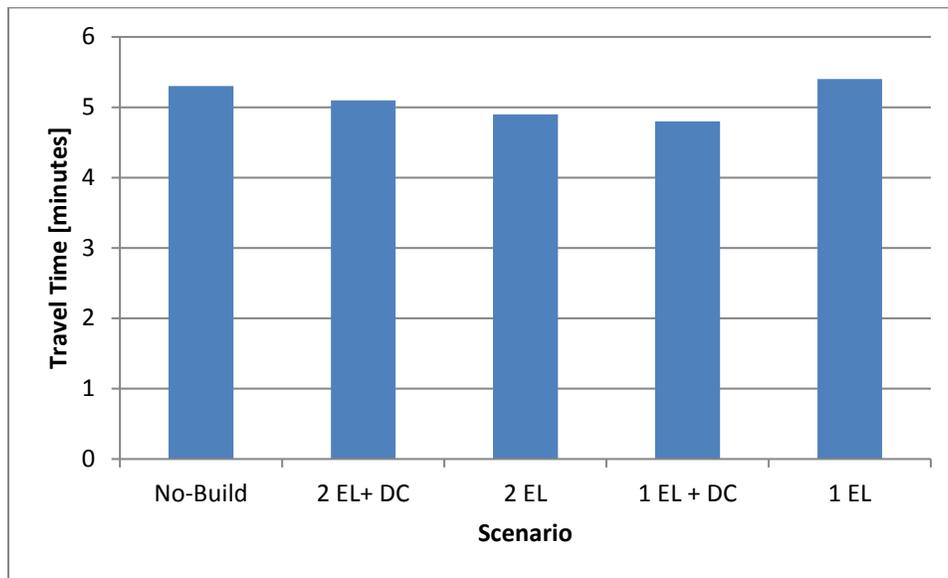


Figure 8. Eastbound Cesar Chavez Street Travel Time (AM Peak Period)

Peak direction traffic volumes along Cesar Chavez Street decrease for both peak periods west of Lamar Boulevard. This is attributable to the limited capacity downstream of the merge area with the direct-connector ramp and persistent congestion along Cesar Chavez Street across all scenarios. Some traffic diverts to 5<sup>th</sup> Street in the build scenarios further contributing to the decrease. Traffic volumes along Cesar Chavez Street and select corridors in the area were extracted from the model for the peak periods and are provided in Appendix A. Eastbound volumes along Cesar Chavez Street extracted from the model for the AM peak period are shown in Figure 9.

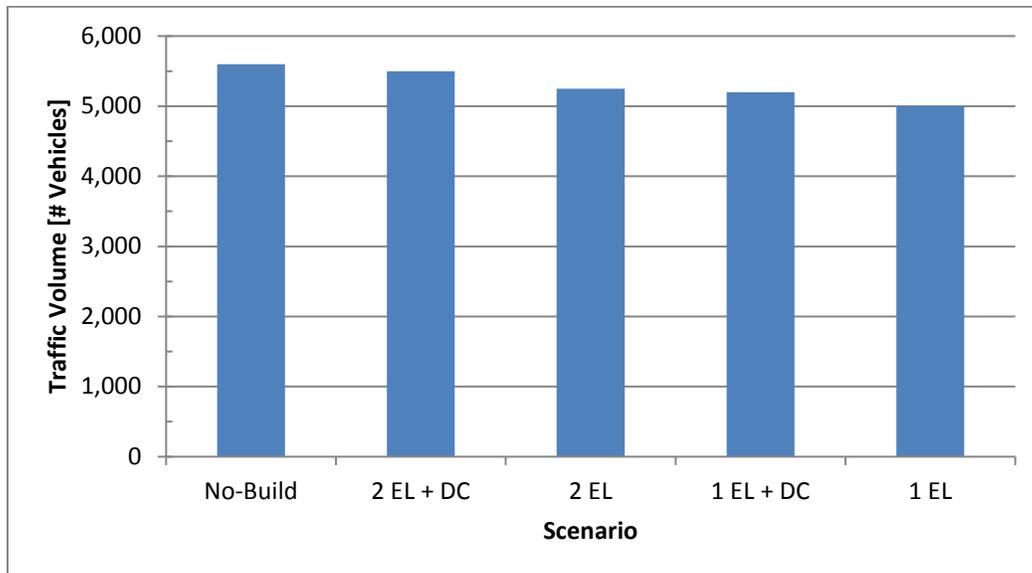


Figure 9. Eastbound Volumes along Cesar Chavez Street West of Lamar Boulevard (AM Peak Period)

In the AM peak period, the primary difference in travel pattern is in Scenario “EL 2 + DC” where traffic headed to downtown shifts to the new ramp. The number of vehicles using the inbound direct-connector ramp for the peak period (with no toll imposed on the ramp) in the model is approximately 2,300 vehicles for Scenario “EL 2 + DC” and 2,050 for Scenario “EL 1 + DC”, with only approximately 700 vehicles using the existing connection.

In the PM peak period, travel times generally decrease along westbound Cesar Chavez Street due to improved conditions downstream through the MoPac interchange and along southbound MoPac. Travel times are lower in the scenarios with one express lane than the scenarios with two express lanes in each direction. Travel patterns shift more substantially in the scenarios involving the two-lane expressway. Additional traffic accessing the corridor via northbound Lamar Boulevard resulted in congestion building upstream of the intersections and subsequently higher travel times in this section, and within the full study limits evaluated, as shown in Figure 10. Figure 7 illustrates the limits along the corridor from which the travel times were extracted. Additional travel times can be found in Appendix B.

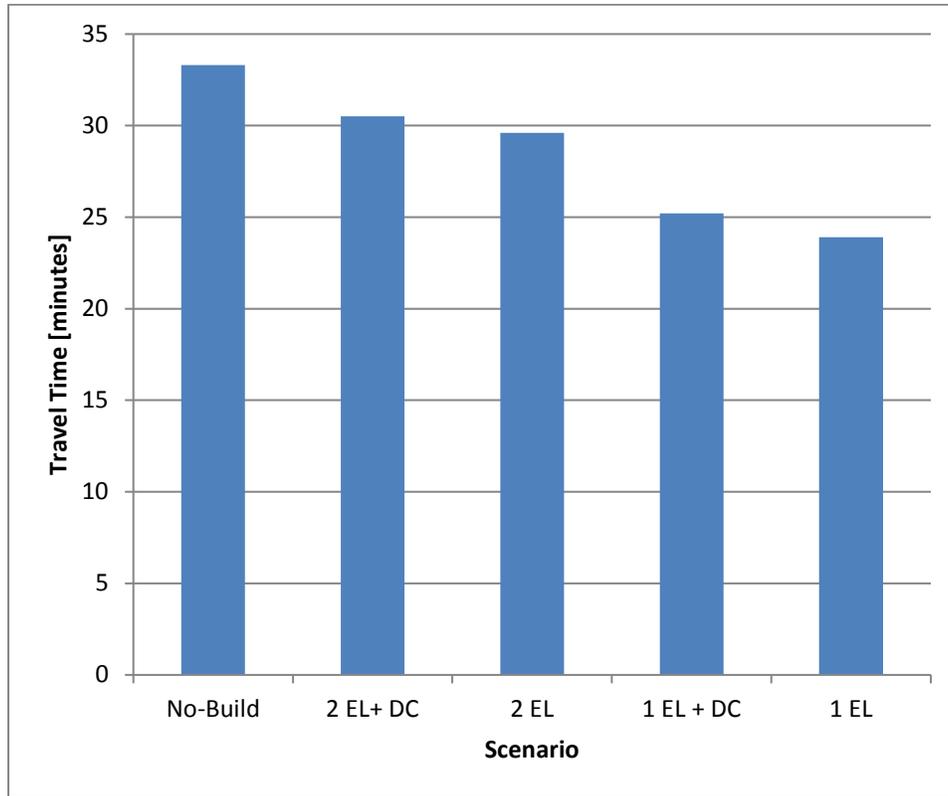


Figure 10. Westbound Cesar Chavez Street Travel Time (PM Peak Period)

This trend was also identified in the PM peak where approximately 2,850 vehicles use the outbound direct-connector ramp for Scenario “2 EL + DC” and 2,100 for Scenario “1 EL + DC” with approximately 1,000 vehicles using the existing connection. Though this shift occurs, westbound volumes along Cesar Chavez Street, west of Lamar Boulevard, remain relatively constant across scenarios. The volumes extracted from the model for the PM peak period are shown in Figure 11. Additional peak period volumes are shown in Appendix A.

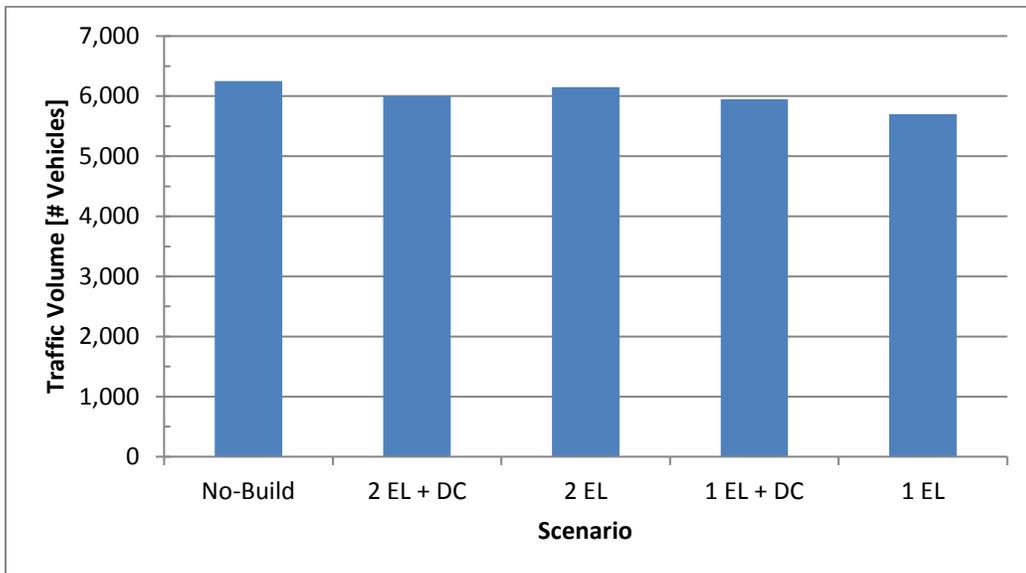


Figure 11. Westbound Volumes along Cesar Chavez Street West of Lamar Boulevard (PM Peak Period)

Additional traffic accessing Cesar Chavez Street from Lamar Boulevard is attracted to the corridor in two-lane expressway scenarios as a result of a change in congestion pattern along MoPac. Generally, travel along southbound MoPac improves in the two-lane expressway scenarios. However, two new merge conditions are created along northbound MoPac, south of Barton Skyway and near Lake Austin Boulevard. Notably, the merge area near Lake Austin Boulevard is the result of a ramp reversal with the No-Build Scenario. In the No-Build Scenario, a ramp providing access to the northbound express lane is available.

Congestion in this area in the build scenarios makes accessing northbound MoPac south of the bridge less desirable. Instead, traffic from the area just south of Lady Bird Lake tends to enter northbound MoPac via Cesar Chavez Street, accessed from northbound Lamar Boulevard, causing some additional queuing upstream. Again, while traffic volumes west of Lamar Boulevard remain fairly consistent across scenarios, the composition of this traffic changes across scenarios. This is due to improved access to northbound MoPac via the corridor with less congestion at the interchange caused by southbound traffic queuing along the ramp system. Traffic patterns for one-lane expressway scenarios do not change as much with respect to the No-Build Scenario along Cesar Chavez Street as a result of fewer downstream improvements, thus, there is not as much congestion generated along the corridor upstream of Lamar Boulevard. In all of the build scenarios, westbound traffic traveling to southbound MoPac and west on Lake Austin Boulevard shifts to 6<sup>th</sup> Street due to the improved downstream conditions through the MoPac interchange. Travel along other area corridors is discussed in more detail in the following section.



### **3.3 IMPACT TO AREA ROADWAYS**

In the AM peak period, traffic volumes and travel times remain consistent across all scenarios. Only small changes in traffic volumes occur along Enfield Road and 5<sup>th</sup> Street, east of MoPac, and S. 1<sup>st</sup> Street, at the South 1<sup>st</sup> Street Bridge, though a noticeable decrease along Congress Avenue occurs for inbound traffic in Scenario “2 EL + DC”. This corresponds with an increase along northbound Lamar Boulevard as some traffic shifts toward MoPac in this scenario. As noted above, an increase in traffic along northbound Lamar Boulevard for all of the Build scenarios is associated with an increase in traffic along westbound Cesar Chavez Street west of the intersection area to access northbound MoPac.

#### **3.3.1 IMPACT TO 6<sup>TH</sup> STREET**

In the PM peak period, more pronounced differences are found between scenarios along area roadways. Some westbound traffic (to Lake Austin Boulevard) shifts from Cesar Chavez Street and Enfield Road to 6<sup>th</sup> Street, while additional traffic destined for South Austin also uses 6<sup>th</sup> Street due to improved conditions along southbound MoPac and the interchange area along Lake Austin Boulevard in the build scenarios. Like the northbound direction, the planned configuration for the southbound direction implements a ramp reversal, changing access between the express lane and general purpose lanes for the build scenarios. Unlike the northbound direction, this reversal creates an egress point to the express lanes in the build scenarios. This change, along with the continuation of the southbound express lane, relieves congestion along the corridor in the southbound direction.

Additionally, southbound flow from westbound Cesar Chavez Street shifts to the direct-connector ramp that merges with the express lane farther to the south, further mitigating congestion in the area for scenarios with direct-connector ramps. These improvements result in attracting flow to 6<sup>th</sup> Street to access southbound MoPac. Though traffic increases along 6<sup>th</sup> Street, travel times decreased due to the improved flow along southbound MoPac with the shift in Cesar Chavez Street traffic to the southbound direct-connector ramp. Figure 12 illustrates the limits along the corridor from which the travel times were extracted. These travel times are shown in Figure 13. Additional travel times can be found in Appendix B.



Figure 12. Travel Time Limits for 6<sup>th</sup> Street

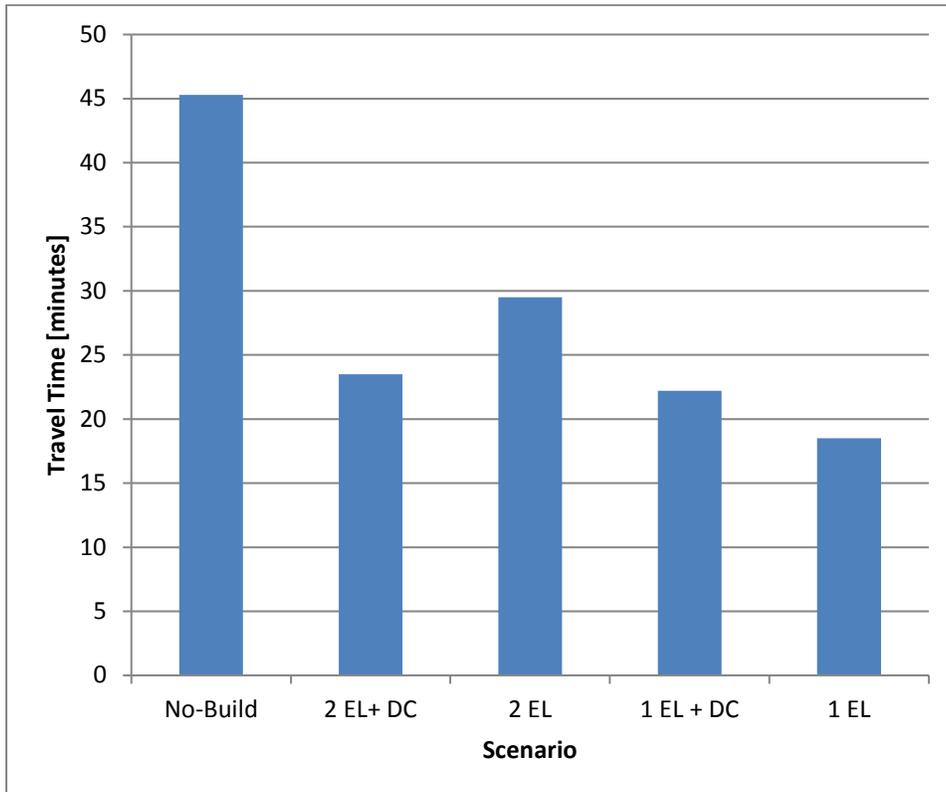


Figure 13. Westbound 6<sup>th</sup> Street Travel Time (PM Peak Period)

As shown in Figure 13, travel times on 6<sup>th</sup> Street in the PM peak period decrease in the build scenarios relative to the No-Build Scenario. Much of this improvement occurs east of Lamar Boulevard where a change in travel pattern has a positive effect. Compared to the No-Build Scenario, the build scenarios all result in more traffic on 6<sup>th</sup> Street continuing straight through the intersection at Lamar Boulevard versus making a left turn to travel south. With improved conditions downstream at the interchange with MoPac, drivers have more incentive to use the roadway. The resulting reduction in the left-turn volume at the intersection improves conditions upstream along the roadway.

### 3.3.2 IMPACT TO 5<sup>TH</sup> STREET

In this section, travel times on 5<sup>th</sup> Street, which is one-way in the eastbound direction, are examined for the morning peak period. Figure 14 shows the limits of the corridor analyzed.



Figure 14. Travel Time Limits for 5<sup>th</sup> Street

As shown in Figure 15, travel times on 5<sup>th</sup> Street in the AM peak period stay relatively constant across scenarios. Since there is available capacity along the corridor, and intersection control constrains flow, the changes in travel patterns do not lead to noticeable changes in travel time.

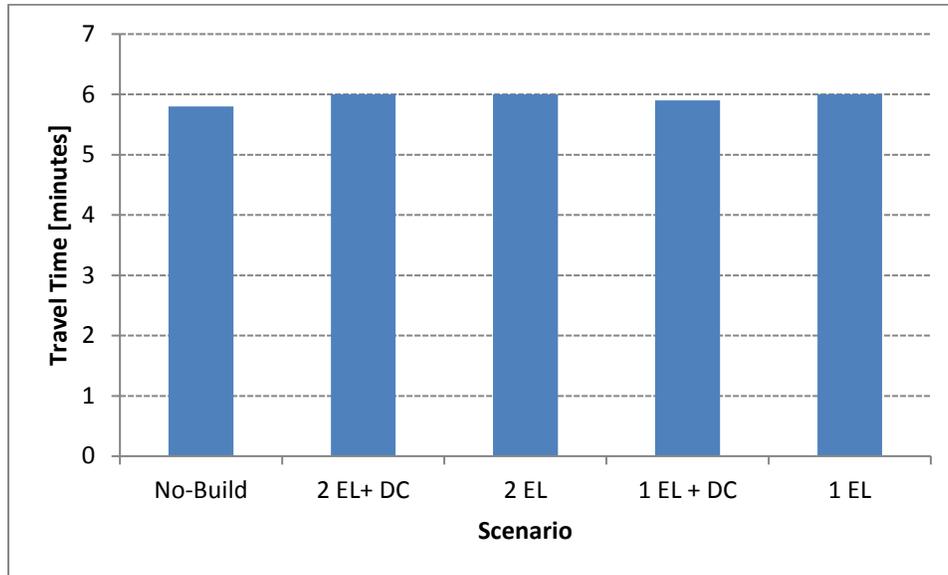


Figure 15. Eastbound 5<sup>th</sup> Street Travel Time (AM Peak Period)

### 3.3.3 IMPACT TO LAMAR BOULEVARD

In this section, travel times on Lamar Boulevard are examined in the northbound direction in the morning peak period and the southbound direction in the afternoon peak period. Figure 16 shows the limits of the corridor analyzed.

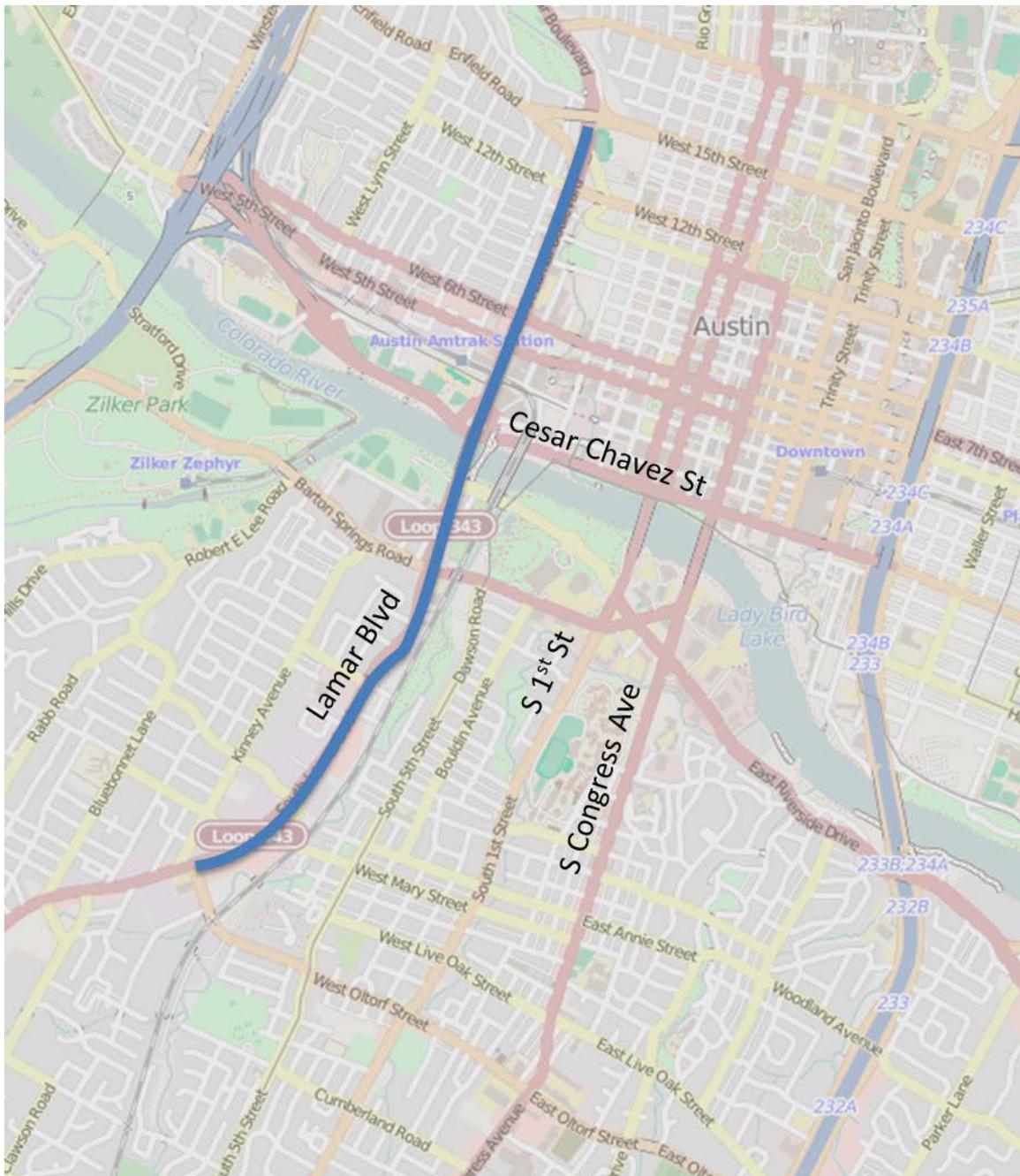


Figure 16. Travel Time Limits for Lamar Boulevard

As shown in Figure 17, travel times on northbound Lamar Boulevard in the AM peak period stay relatively constant across scenarios. This is largely a result of the fact that travel patterns remain consistent along this corridor across scenarios in the AM peak period.

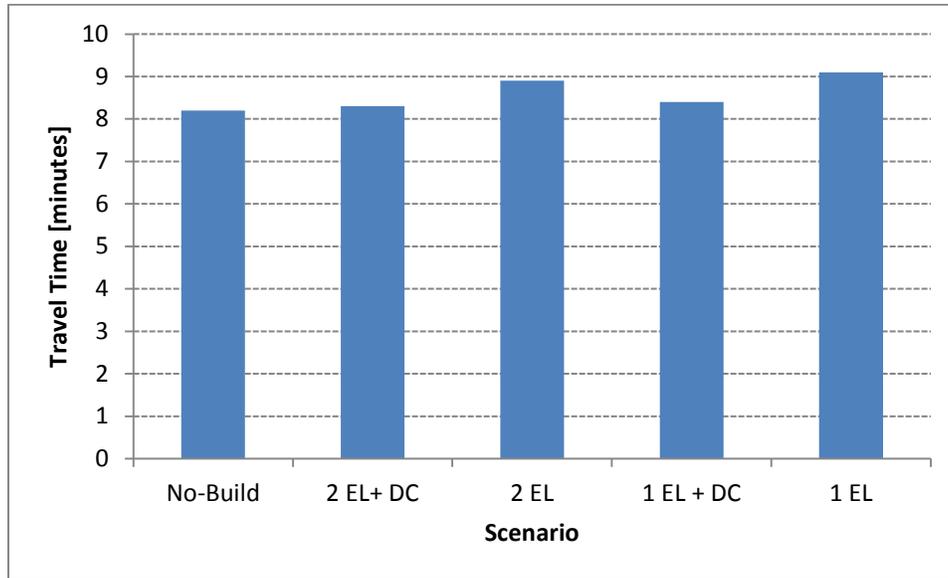


Figure 17. Northbound Lamar Boulevard Travel Time (AM Peak Period)

As shown in Figure 18, travel times on southbound Lamar Boulevard in the PM peak period decrease significantly in the build Scenarios versus the No-Build Scenario. This improvement is a result of a decrease in traffic using the corridor south of 6<sup>th</sup> Street as the travel pattern shifts toward more utilization of 6<sup>th</sup> Street for access to MoPac. This change is less noticeable for Scenario 4, where the least impactful change is implemented along MoPac.

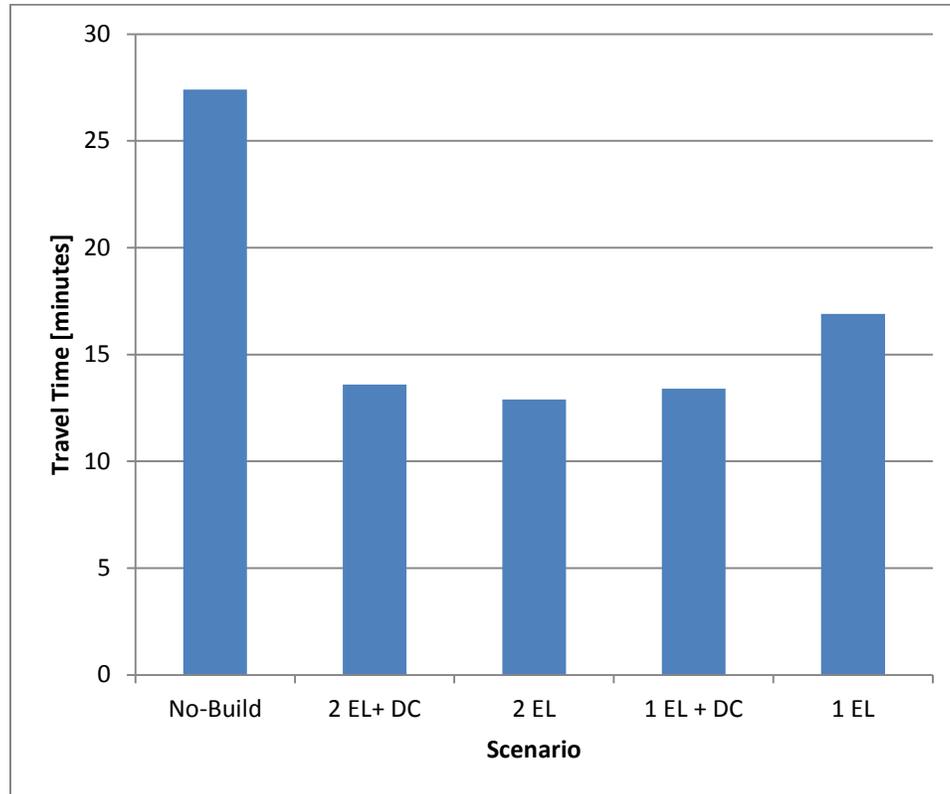


Figure 18. Southbound Lamar Boulevard Travel Time (PM Peak Period)

### 3.3.4 IMPACT TO S. 1<sup>ST</sup> STREET AND GUADALUPE/LAVACA STREETS

In this section, travel times on S. 1<sup>st</sup> Street to Lavaca Street in the northbound direction in the morning peak period, and Guadalupe Street to S. 1<sup>st</sup> Street in the southbound direction in the afternoon peak period are examined. Figure 19 shows the limits of the corridor analyzed.

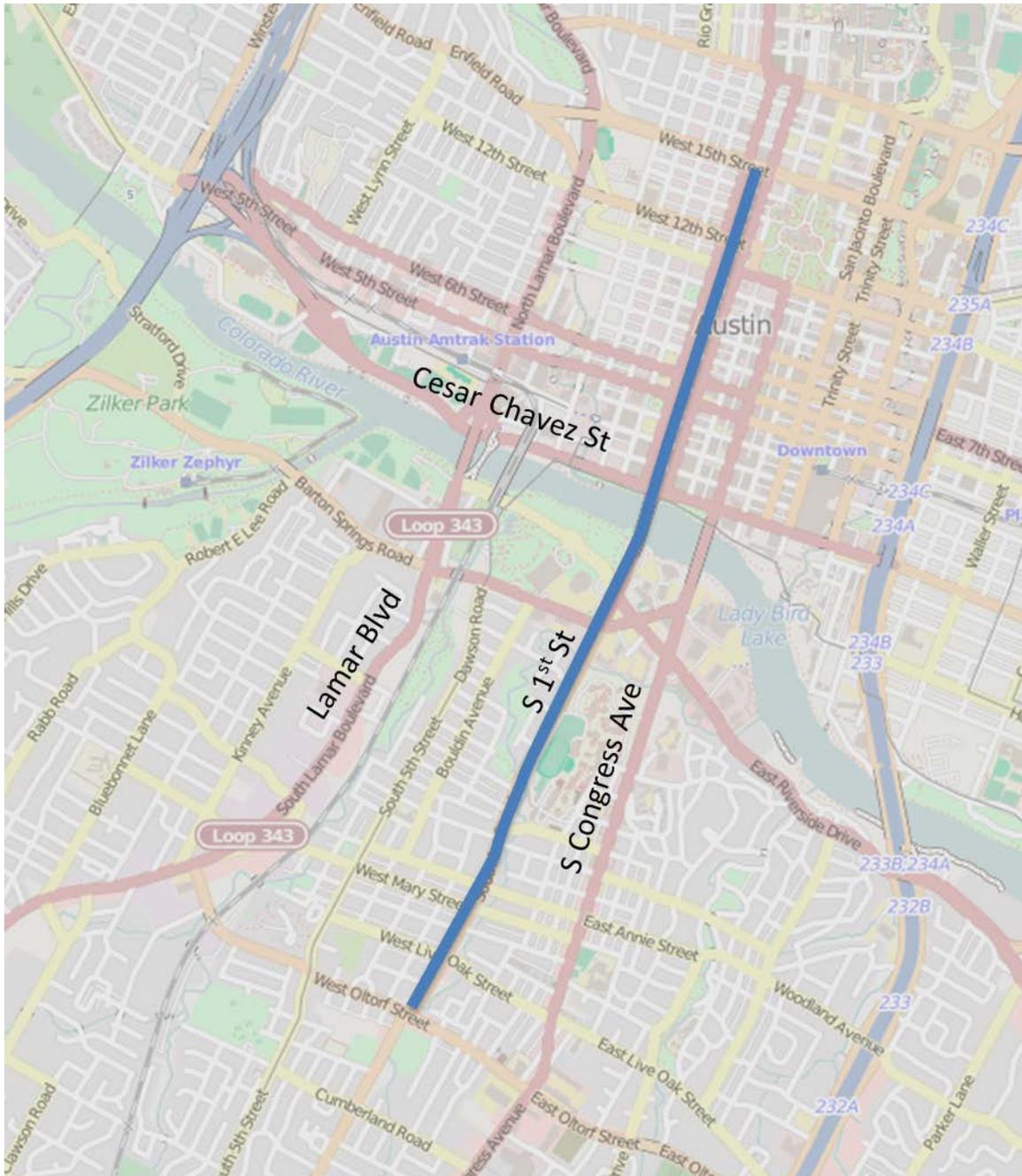


Figure 19. Travel Time Limits for S. 1<sup>st</sup> Street

As shown in Figure 20, travel times on northbound S. 1<sup>st</sup> Street to Lavaca Street in the AM peak period stay relatively constant across scenarios. Similar to northbound Lamar Boulevard, this result is largely due to travel patterns remaining consistent along this corridor across scenarios in the AM peak period.

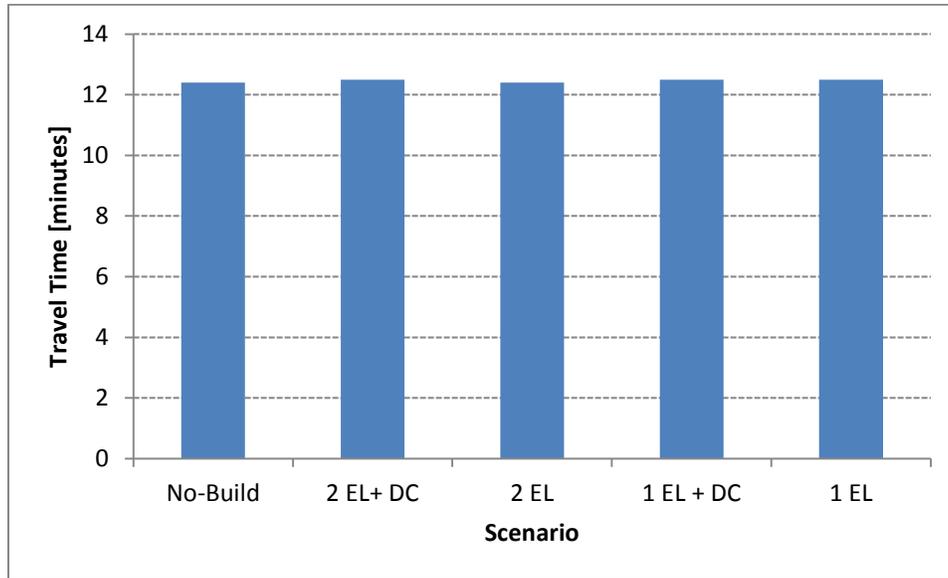


Figure 20. Northbound S. 1<sup>st</sup> Street to Lavaca Street Travel Time (AM Peak Period)

As shown in Figure 21, travel times on southbound Guadalupe Street to S. 1<sup>st</sup> Street in the PM peak period decrease significantly in the build Scenarios versus the No-Build Scenario. In this case, the improvement is partly a result of a decrease in traffic using the corridor with additional traffic traveling toward MoPac. Generally, the build scenarios exhibit improved travel times upstream of Cesar Chavez Street with less congestion building along westbound routes to MoPac that otherwise slow southbound traffic along the corridor.

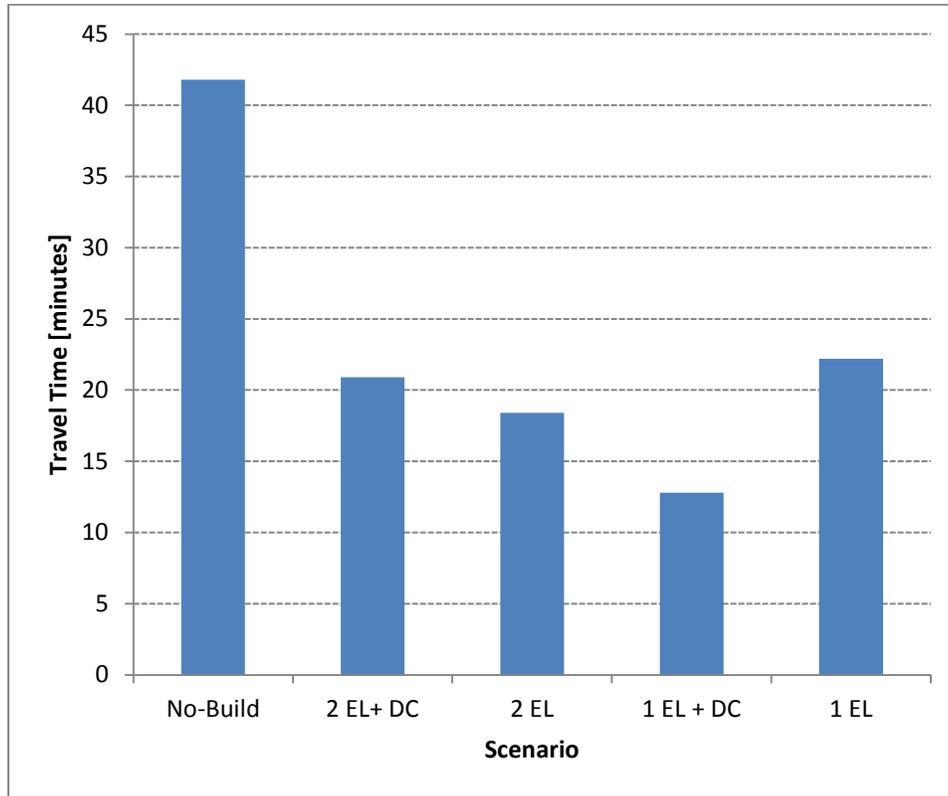


Figure 21. Southbound Guadalupe Street to S. 1<sup>st</sup> Street Travel Time (PM Peak Period)

### 3.4 IMPACT TO DOWNTOWN AREA TRAVEL PATTERNS

In the AM peak period, the general travel patterns remained consistent across scenarios. This included both travel to the downtown area, as well as within this portion of the network. An analysis of roadway congestion and signal delay throughout the downtown network revealed small differences across the scenarios. This is depicted in the figures below using the following color scale



Figure 22. Color Scale for Figures 23-26

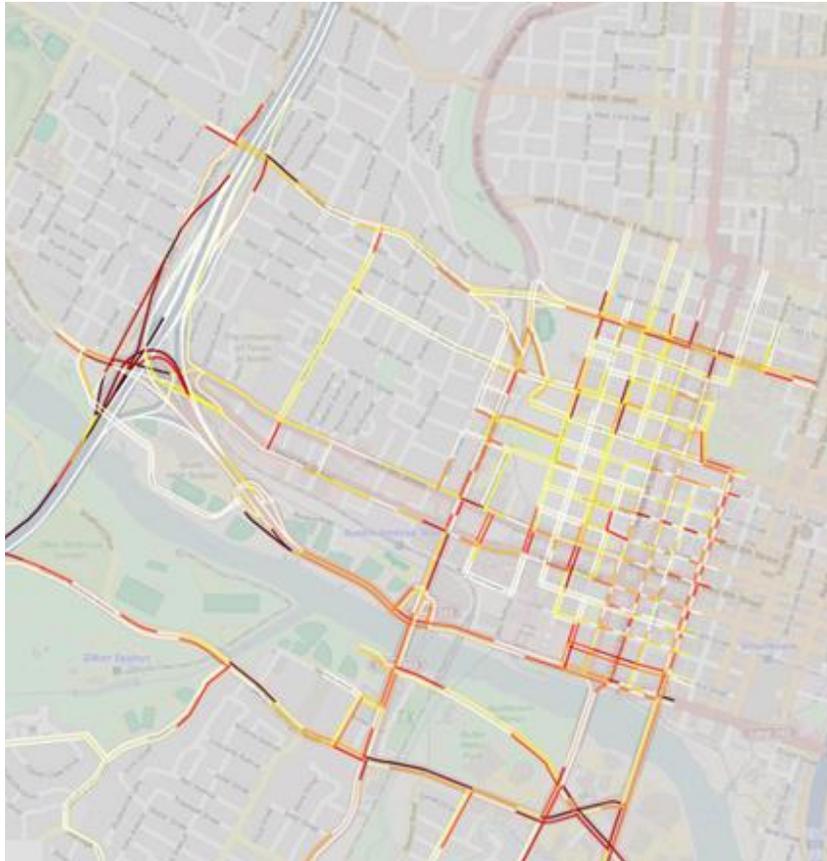


Figure 23. Congestion on Area Roadways in the No-Build Scenario (AM Peak Period)

Figure 23 illustrates some congestion forming in the downtown area during the AM peak period for the No-Build Scenario. Much of the congestion is located south of the river or along MoPac and the ramps connecting MoPac to the east/west corridors in the area. (The section of northbound MoPac shown is free-flowing because there is a bottleneck just south of Barton Springs Road that is released at this point.) For the build scenarios illustrated in Figure 24, some changes in the congestion patterns are depicted. Congestion remains visible south of the river and within the downtown grid, but is alleviated in part along MoPac and the connecting ramps. Congestion forms along the direct-connector ramp from northbound MoPac to eastbound Cesar Chavez Street. This is a result of the ramp’s merge area, which is located near the merge point for the eastbound Reserve Road entrance ramp (shown in Figure 5 on page 11).

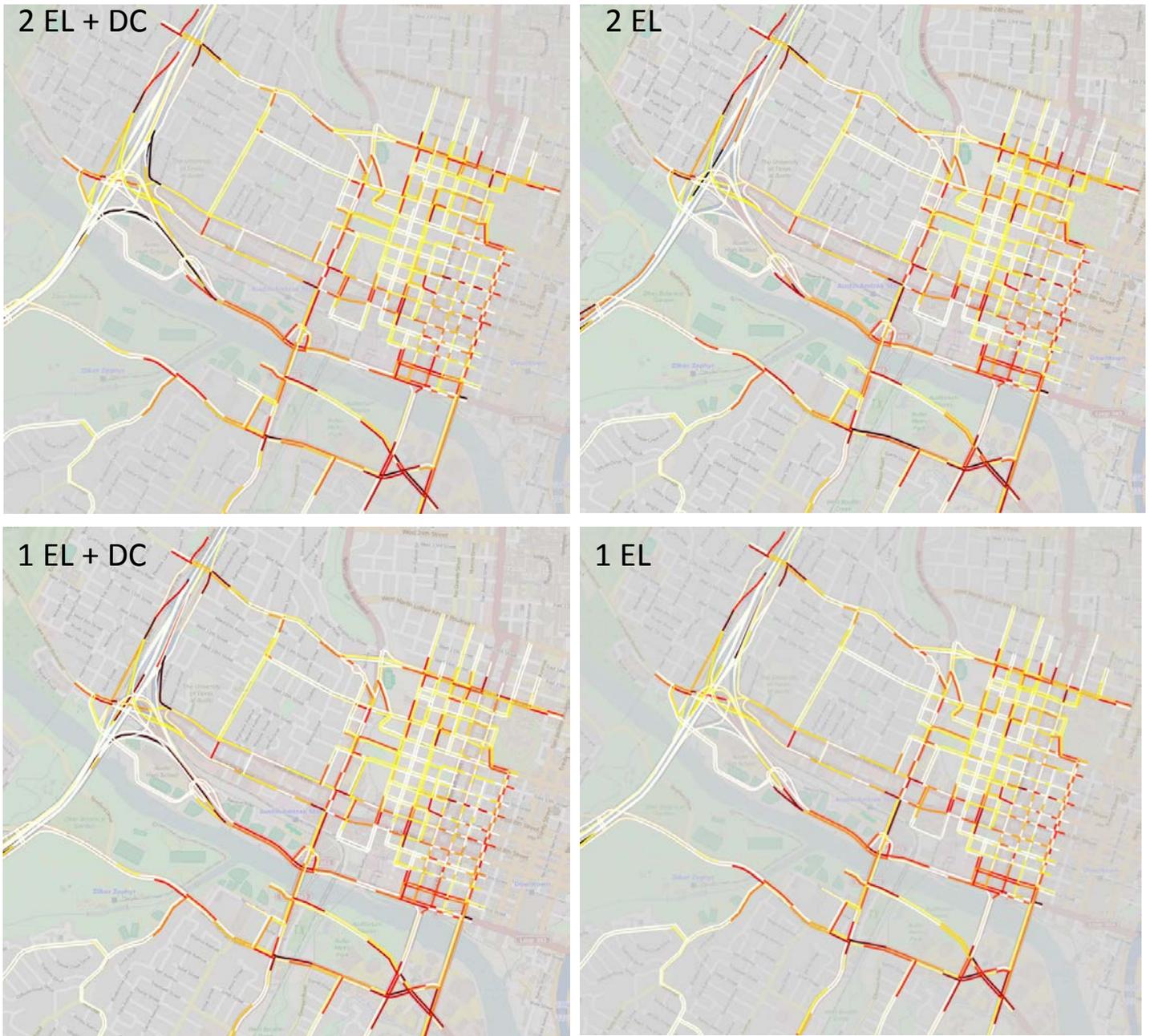


Figure 24. Congestion on Area Roadways in the Build Scenarios (AM Peak Period)

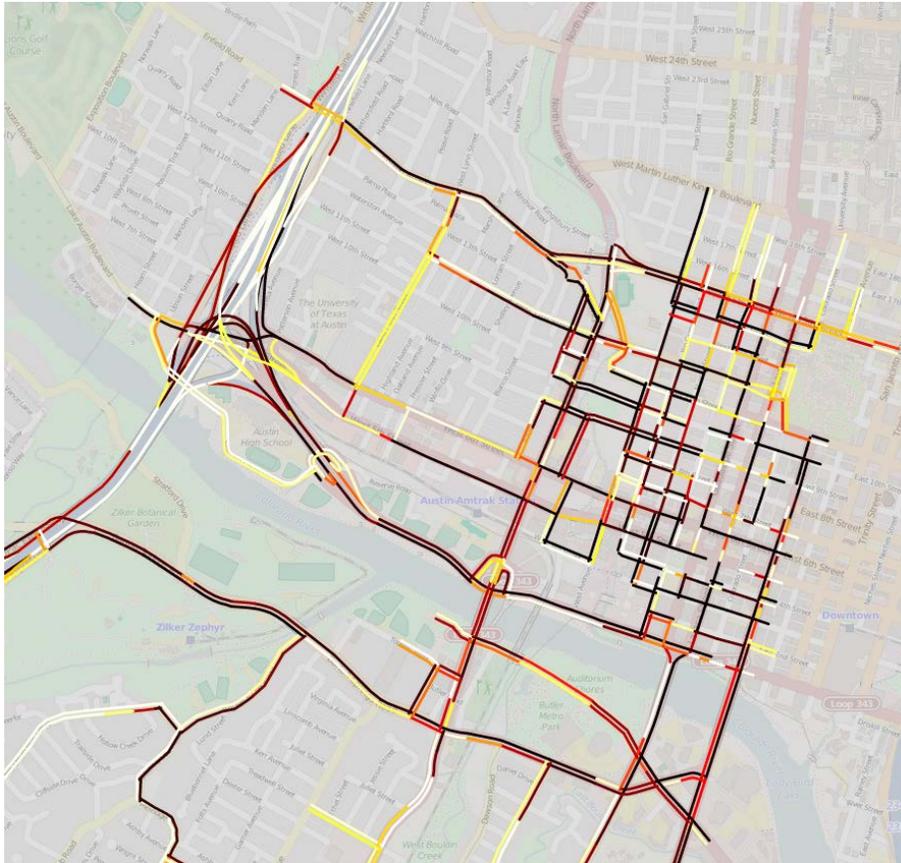


Figure 25. Congestion on Area Roadways in the No-Build Scenario (PM Peak Period)

For the PM peak period, Figure 25 illustrates heavy congestion throughout the study area in the No-Build Scenario. Congestion also persists on the ramp connections with MoPac, in particular those through the Lake Austin Boulevard/Cesar Chavez Street interchange. For the Build scenarios illustrated in Figure 26, congestion largely persists in the downtown area. Significant alleviation of congestion is shown through the aforementioned interchange, as well as along Barton Springs Road west of Lamar Boulevard. The figures clearly demonstrate better traffic flow in these areas as a result of the Build scenario improvements to MoPac.

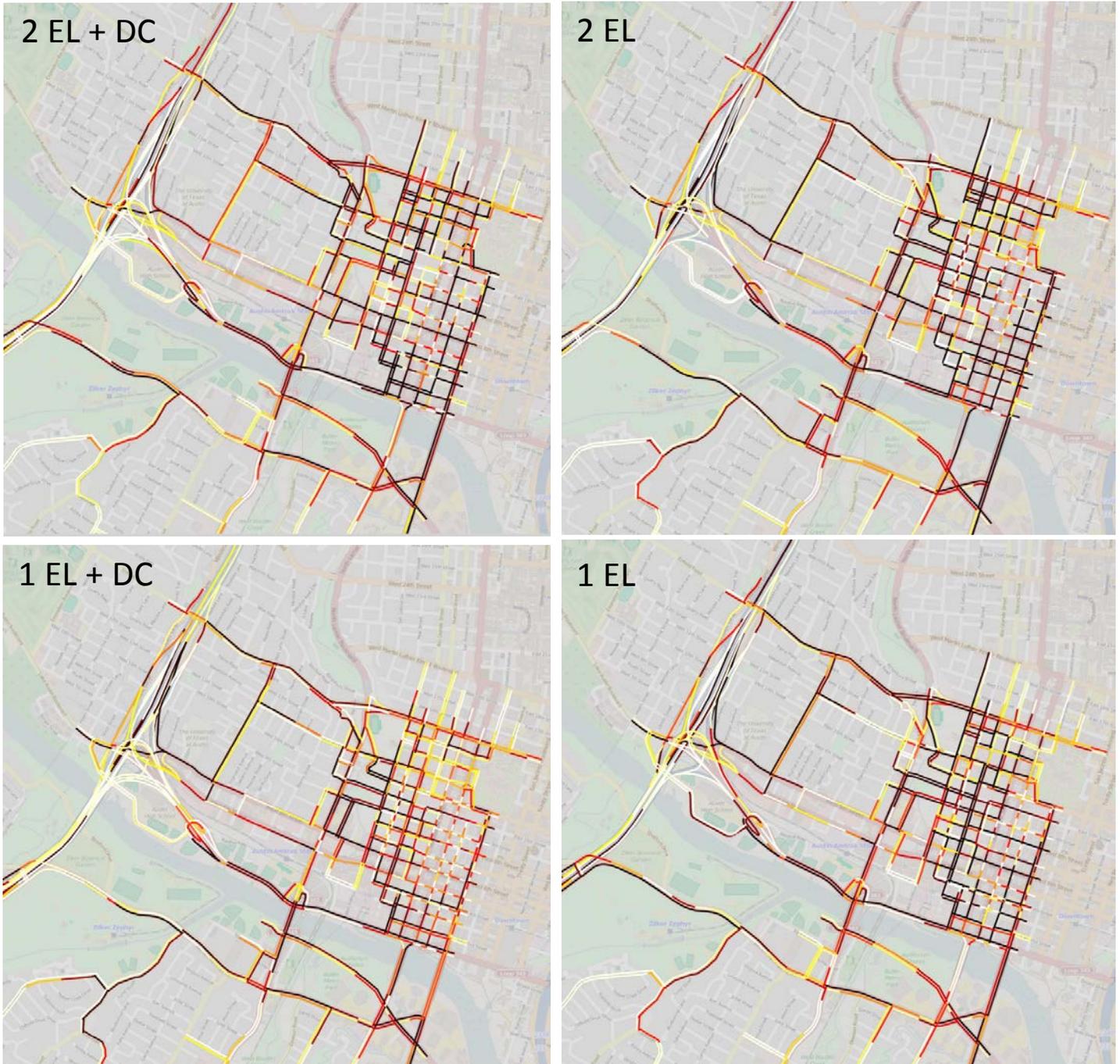


Figure 26. Congestion on Area Roadways in the Build Scenarios (PM Peak Period)

## 4. CONCLUSIONS

Overall, the construction of MoPac South express lanes is not anticipated to negatively impact downtown Austin. Travel times and volumes in the morning peak period remain relatively constant across scenarios. This is a result of relatively consistent travel patterns across scenarios for those conditions, though some changes affecting 5<sup>th</sup> Street and Enfield Road were found. The model results demonstrated a number of more substantial differences between scenarios for the afternoon peak period.

Travel times in the afternoon peak period decrease in the Build scenarios versus the No-Build Scenario. This is a result of improved conditions at the interchange of MoPac at Lake Austin Boulevard/Cesar Chavez Street. Alleviation of congestion and improved access to MoPac in the vicinity of the interchange contributes to reduced travel times along major corridors in the study area. While not all sections improve consistently, the Build scenarios generally result in lower travel times in the area.

With the improved operations at the interchange, an increase in volume was found along 6<sup>th</sup> Street, particularly for traffic heading west along Lak Austin Blvd or south along MoPac. With downstream conditions improving for westbound Cesar Chavez Street, along with access to MoPac, additional northbound MoPac traffic was found to use this corridor west of Lamar Boulevard (compared to the No-Build Scenario). This was especially evident with Scenarios 1 and 3, where changes in travel patterns in this area caused some congestion to form elsewhere.

For both the morning and afternoon peak periods, average travel times throughout the model area and the study area were found to improve in the Build Scenarios when compared to the No-Build Scenario. This was more evident for the afternoon peak. Additionally, inbound throughput during the morning peak period and outbound throughput during the afternoon peak period were found to increase. Again, this was largely attributable to improved conditions at the interchange of MoPac at Lake Austin Boulevard/Cesar Chavez Street, as well as better flow along south MoPac with the added capacity.



## **APPENDIX A**

### **ROADWAY VOLUMES**



Table A.1. AM Peak Period Traffic Volumes

| Roadway Location                      | Scenario |           |       |           |       |
|---------------------------------------|----------|-----------|-------|-----------|-------|
|                                       | No-Build | 2 EL + DC | 2 EL  | 1 EL + DC | 1 EL  |
| EB Cesar Chavez St W of Lamar Blvd    | 5,600    | 5,500     | 5,250 | 5,200     | 5,000 |
| WB Cesar Chavez St W of Lamar Blvd    | 3,100    | 3,650     | 3,350 | 3,750     | 3,600 |
| 5th St E of MoPac                     | 4,650    | 4,900     | 4,900 | 5,100     | 4,700 |
| 6th St E of MoPac                     | 1,950    | 2,150     | 2,100 | 2,150     | 2,450 |
| EB Enfield Rd E of MoPac              | 4,200    | 4,100     | 4,200 | 4,150     | 4,250 |
| WB Enfield Rd E of MoPac              | 1,900    | 1,800     | 1,800 | 1,850     | 1,700 |
| EB Barton Springs Rd W of Lamar Blvd  | 3,150    | 2,850     | 3,400 | 2,900     | 3,650 |
| WB Barton Springs Rd W of Lamar Blvd  | 3,150    | 2,200     | 2,550 | 2,000     | 2,200 |
| NB Lamar Blvd Bridge                  | 4,950    | 5,650     | 5,300 | 5,600     | 5,800 |
| SB Lamar Blvd Bridge                  | 2,650    | 2,250     | 2,350 | 2,500     | 2,250 |
| NB 1st St Bridge                      | 2,380    | 2,550     | 2,400 | 2,600     | 2,500 |
| SB 1st St Bridge                      | 3,200    | 3,300     | 2,850 | 3,100     | 2,800 |
| NB Congress Ave Bridge                | 7,050    | 6,550     | 6,950 | 6,750     | 7,050 |
| SB Congress Ave Bridge                | 4,450    | 4,150     | 4,750 | 4,200     | 4,750 |
| SB MoPac Express Lanes at Barton Skwy | -        | 1,800     | 1,300 | 1,650     | 1,250 |
| NB MoPac Express Lanes at Barton Skwy | -        | 4,500     | 2,800 | 4,150     | 2,600 |
| SB MoPac Express Lanes at Lake Austin | -        | 1,350     | 1,300 | 1,250     | 1,250 |
| NB MoPac Express Lanes at Lake Austin | -        | 2,200     | 2,800 | 2,100     | 2,600 |
| SB Express Direct-connector Ramp      | -        | 450       | -     | 400       | -     |
| NB Express Direct-connector Ramp      | -        | 2,300     | -     | 2,050     | -     |



Table A.2. PM Peak Period Traffic Volumes

| Roadway Location                      | Scenario |           |       |           |       |
|---------------------------------------|----------|-----------|-------|-----------|-------|
|                                       | No-Build | 2 EL + DC | 2 EL  | 1 EL + DC | 1 EL  |
| EB Cesar Chavez W of Lamar Blvd       | 5,350    | 4,600     | 5,050 | 4,900     | 4,750 |
| WB Cesar Chavez W of Lamar Blvd       | 6,250    | 6,000     | 6,150 | 5,950     | 5,750 |
| 5th St E of MoPac                     | 4,650    | 5,050     | 5,100 | 5,600     | 4,700 |
| 6th St E of MoPac                     | 2,800    | 4,650     | 4,200 | 4,500     | 4,350 |
| EB Enfield Rd E of MoPac              | 3,700    | 3,800     | 3,900 | 3,800     | 3,900 |
| WB Enfield Rd E of MoPac              | 5,500    | 5,250     | 5,650 | 5,300     | 5,550 |
| EB Barton Springs Rd W of Lamar Blvd  | 2,000    | 2,050     | 1,900 | 1,800     | 1,850 |
| WB Barton Springs Rd W of Lamar Blvd  | 5,500    | 4,700     | 4,800 | 4,700     | 4,950 |
| NB Lamar Bridge                       | 5,000    | 5,500     | 5,800 | 5,700     | 5,400 |
| SB Lamar Bridge                       | 8,150    | 7,000     | 7,100 | 7,150     | 7,100 |
| NB 1st St Bridge                      | 2,450    | 2,750     | 2,700 | 2,350     | 2,700 |
| SB 1st St Bridge                      | 4,700    | 4,450     | 4,450 | 5,050     | 4,750 |
| NB Congress Bridge                    | 7,500    | 6,950     | 6,950 | 6,900     | 6,950 |
| SB Congress Bridge                    | 9,050    | 9,400     | 9,800 | 9,100     | 9,200 |
| SB MoPac Express Lanes at Barton Skwy | -        | 7,600     | 4,800 | 6,350     | 4,950 |
| NB MoPac Express Lanes at Barton Skwy | -        | 6,300     | 5,200 | 6,000     | 5,950 |
| SB MoPac Express Lanes at Lake Austin | -        | 4,750     | 4,800 | 4,200     | 4,950 |
| NB MoPac Express Lanes at Lake Austin | -        | 5,100     | 5,200 | 4,700     | 5,950 |
| SB Express Direct-connector Ramp      | -        | 2,850     | -     | 2,100     | -     |
| NB Express Direct-connector Ramp      | -        | 1,200     | -     | 1,300     | -     |



## **APPENDIX B**

### **CORRIDOR TRAVEL TIMES**

*Note: The information provided in this appendix supplements information presented earlier in the report with more disaggregate travel time results along key corridors in the study area.*



Figure B.1. Travel Time Limits for Eastbound Cesar Chavez Street

Table B.1. Eastbound Travel Time along Cesar Chavez Street (AM Peak Period)

| Travel Time in Minutes |                           |                            |       |
|------------------------|---------------------------|----------------------------|-------|
| Scenario               | Mopac Merge to Lamar Blvd | Lamar Blvd to Congress Ave | Total |
| No-Build               | 2.5                       | 2.9                        | 5.3   |
| 2 EL + DC              | 2.1                       | 2.9                        | 5.1   |
| 2 EL                   | 2.0                       | 2.9                        | 4.9   |
| 1 EL + DC              | 1.9                       | 2.9                        | 4.8   |
| 1 EL                   | 2.6                       | 2.9                        | 5.4   |

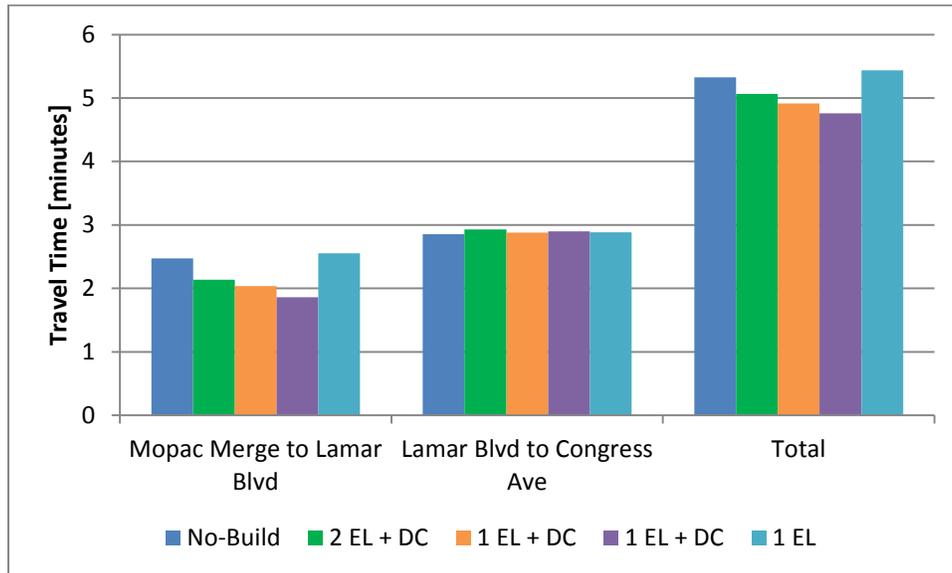


Figure B.2. Eastbound Cesar Chavez Street Travel Time (AM Peak Period)



Figure B.3. Travel Time Limits for 5<sup>th</sup> Street



Table B.2. Travel Time along 5<sup>th</sup> Street (AM Peak Period)

| Travel Time in Minutes |                           |                            |       |
|------------------------|---------------------------|----------------------------|-------|
| Scenario               | Mopac Merge to Lamar Blvd | Lamar Blvd to Congress Ave | Total |
| No-Build               | 2.4                       | 3.5                        | 5.8   |
| 2 EL + DC              | 2.6                       | 3.4                        | 6.0   |
| 2 EL                   | 2.5                       | 3.5                        | 6.0   |
| 1 EL + DC              | 2.5                       | 3.4                        | 5.9   |
| 1 EL                   | 2.6                       | 3.4                        | 6.0   |

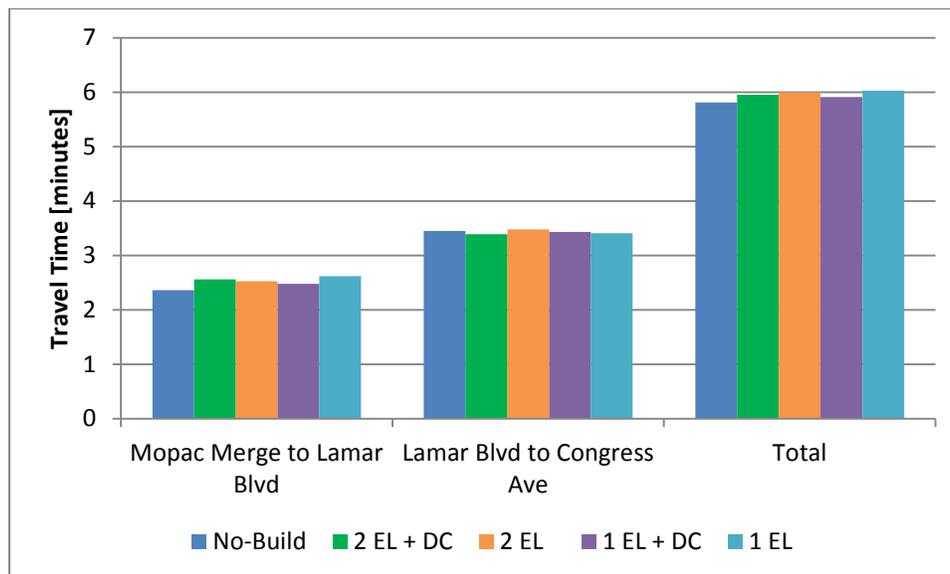


Figure B.4. 5<sup>th</sup> Street Travel Time (AM Peak Period)

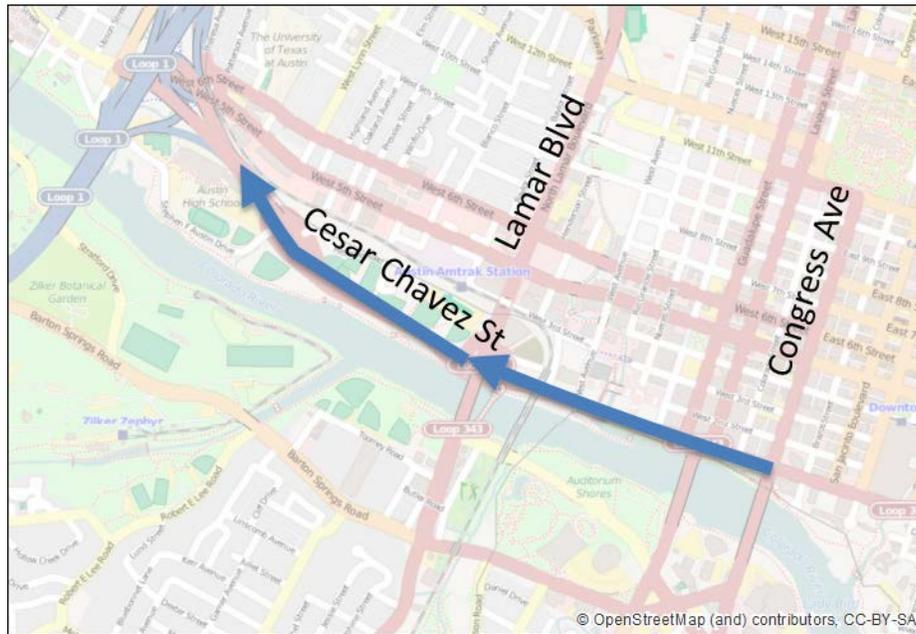


Figure B.5. Travel Time Limits for Westbound Cesar Chavez Street

Table B.3. Westbound Travel Time along Cesar Chavez Street (PM Peak Period)

| Travel Time in Minutes |                            |                             |       |
|------------------------|----------------------------|-----------------------------|-------|
| Scenario               | Congress Ave to Lamar Blvd | Lamar Blvd to Mopac Diverge | Total |
| No-Build               | 26.5                       | 6.8                         | 33.3  |
| 2 EL + DC              | 25.3                       | 5.2                         | 30.5  |
| 2 EL                   | 24.5                       | 5.1                         | 29.6  |
| 1 EL + DC              | 20.1                       | 5.1                         | 25.2  |
| 1 EL                   | 19.4                       | 4.5                         | 23.9  |

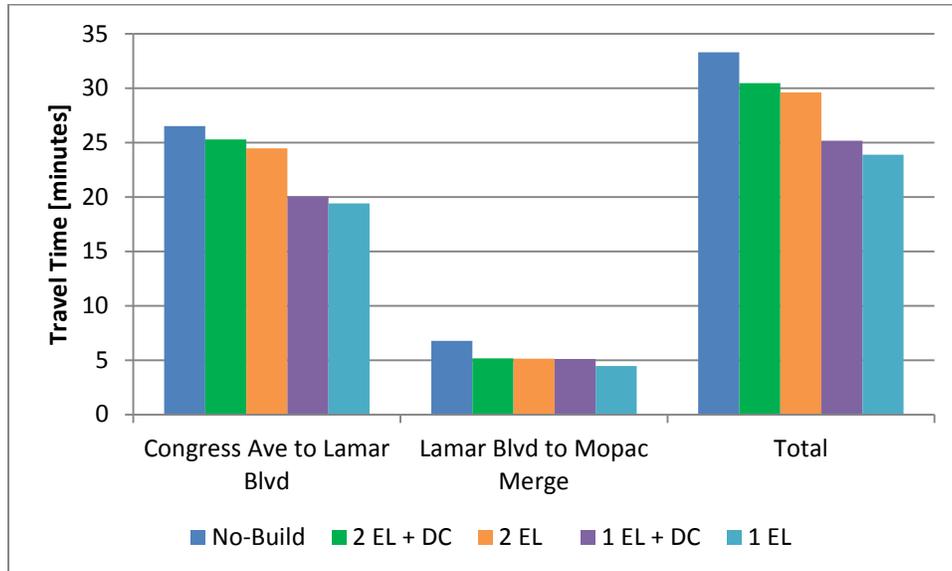


Figure B.6. Westbound Cesar Chavez Street Travel Time (PM Peak Period)

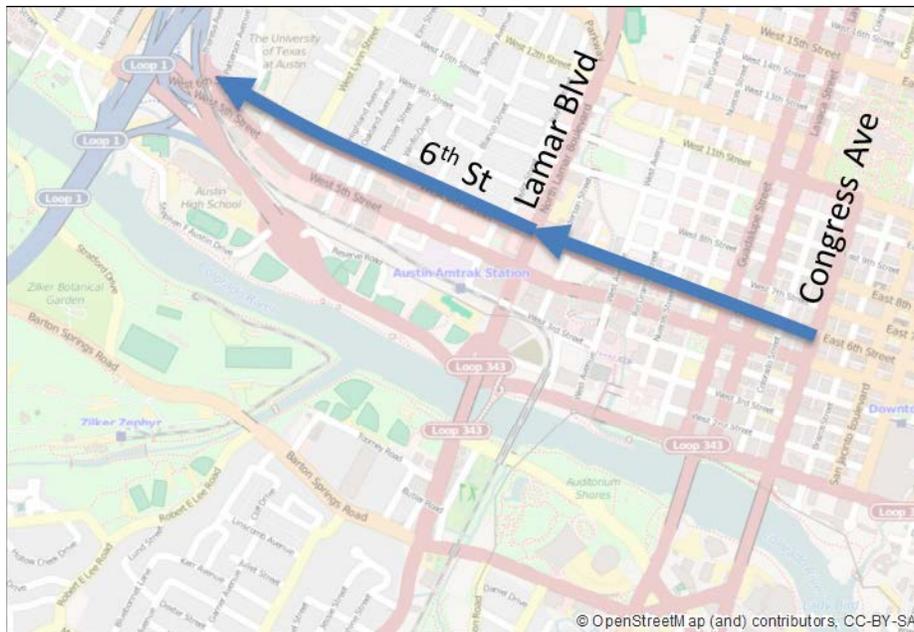


Figure B.7. Travel Time Limits for 6<sup>th</sup> Street



Table B.4. Travel Time along 6<sup>th</sup> Street (PM Peak Period)

| Travel Time in Minutes |                            |                             |       |
|------------------------|----------------------------|-----------------------------|-------|
| Scenario               | Congress Ave to Lamar Blvd | Lamar Blvd to Mopac Diverge | Total |
| No-Build               | 41.7                       | 3.6                         | 45.3  |
| 2 EL + DC              | 20.1                       | 3.4                         | 23.5  |
| 2 EL                   | 20.4                       | 9.1                         | 29.5  |
| 1 EL + DC              | 17.8                       | 4.4                         | 22.2  |
| 1 EL                   | 14.0                       | 4.5                         | 18.5  |

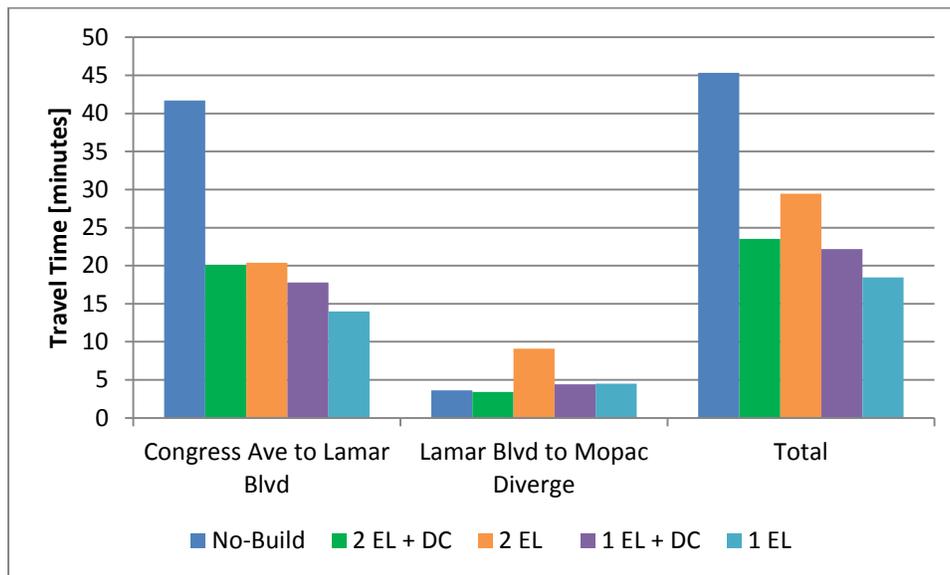


Figure B.8. 6<sup>th</sup> Street Travel Time (PM Peak Period)



## Multimodal Traffic Study of the Guadalupe Corridor

### Technical Report

Prepared for: CAMPO and City of Austin

Prepared by: Center for Transportation Research, The University of Texas at Austin

Date: November 6, 2015

This technical report describes the scenarios analyzed, an overview with the methodology used, along with a summary of preliminary results for the dynamic traffic modeling study of the Guadalupe Street corridor. Current year a.m. and p.m. peak period dynamic traffic assignment and transit models were created for the baseline scenario, along with scenarios assessing changes to transit and auto routing through the corridor and the West Campus area. All scenarios have been modeled using 2015 year traffic demand. The preliminary results, including auto and transit performance metrics, are presented and discussed herein.

## Description of Scenarios

### Scenario 0: Baseline

This scenario uses the current year conditions and provides a baseline for evaluating other scenarios in terms of effectiveness. Results were calibrated with field data and performance measures are calculated for evaluation purposes. Figure 1 shows the network configuration in the corridor.

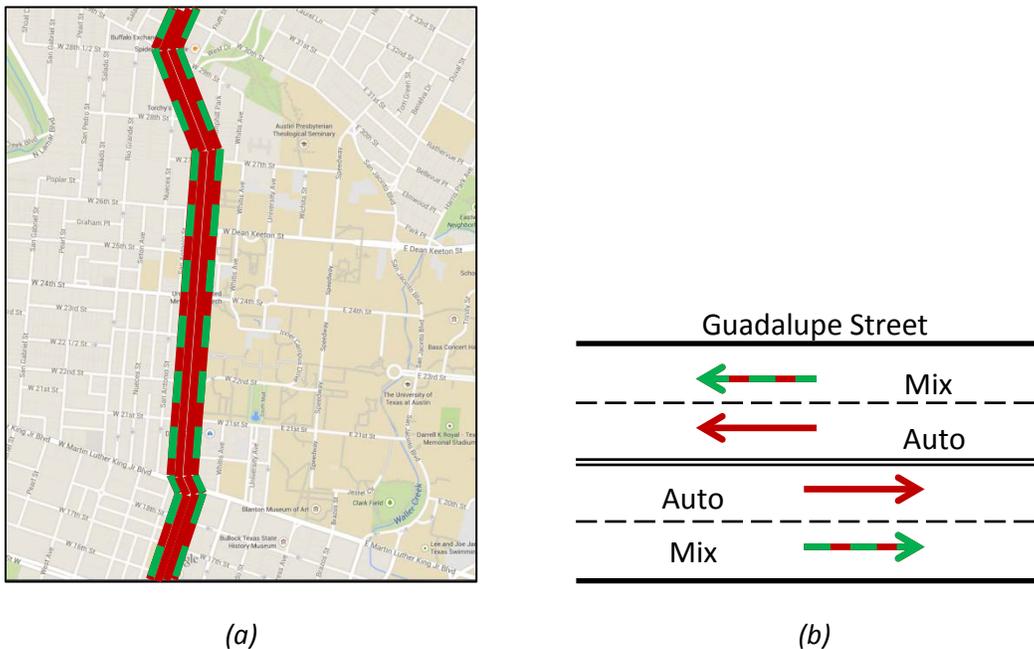


Figure 1: Baseline Configuration (Scenario 0)

### Scenario 1: Transit Priority Lane on Guadalupe Street

This scenario models the transit routes in an exclusive lane along Guadalupe Street between MLK Boulevard and 29<sup>th</sup> Street. It assumes that the right lane of Guadalupe Street is dedicated to transit routes and other through traffic can use the left lane only. However, cars may turn right at intersections using the right lane. To improve traffic flow for cars, left-turns at 21<sup>st</sup> Street in the southbound direction are prohibited. Figure 2 shows this scenario configuration.

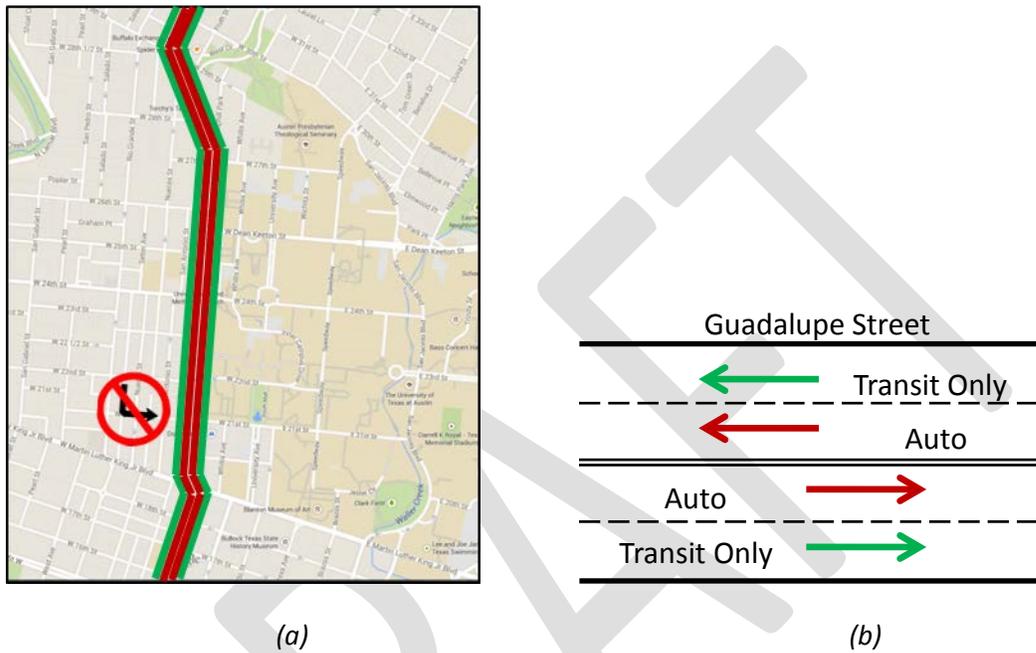


Figure 2: Transit Priority Configuration (Scenario 1)

Note: Bus traffic shifts to Nueces St for the southbound route 642, to allow buses to bypass the prohibited left turn at 21<sup>st</sup> Street.

### Scenario 2: Transit Rerouting to West Campus Streets

In Scenario 2, all buses are rerouted from Guadalupe Street to San Antonio Street for the northbound direction and Nueces Street for the southbound direction. No other changes are assumed for the network, including signals and stop signs. The northbound bus routes use San Antonio Street to 26<sup>th</sup> Street and then east to Guadalupe Street to use the existing signal at the intersection there.

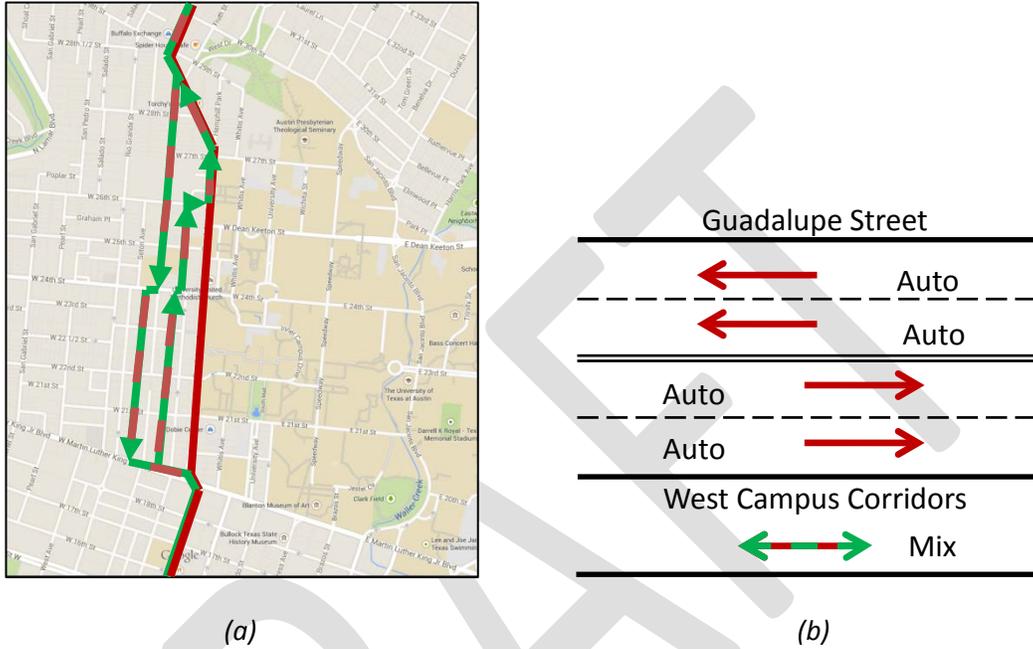


Figure 3: Rerouted Transit Configuration (Scenario 2)

### Scenario 3: Southbound Transit Rerouting, Northbound Transit Priority Lane

In Scenario 3, Nueces and San Antonio are converted to bidirectional roadways. Southbound buses are rerouted from Guadalupe to Nueces and San Antonio St, whereas northbound buses use a transit priority lane from MLK Blvd to Dean Keeton St. There are additional signals at the intersections of Nueces and Guadalupe, Nueces and 26<sup>th</sup>, San Antonio and 22<sup>nd</sup>, and San Antonio and Guadalupe. There is an added contraflow transit lane on northbound Lavaca St, that takes buses west on 18<sup>th</sup> St and north on Guadalupe St. Finally, southbound buses are rerouted to San Antonio St south of MLK Blvd to link back up with Guadalupe St at 18<sup>th</sup>.

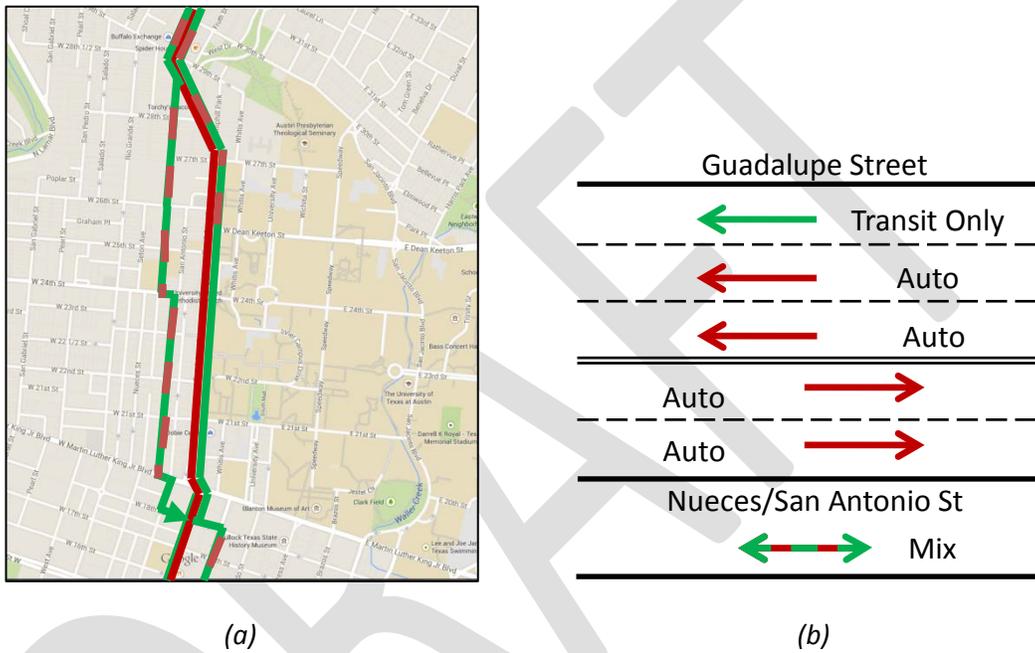


Figure 4: Hybrid Configuration (Scenario 3)

## Methodology Overview

The Center for Transportation Research (CTR) used dynamic traffic assignment (DTA) and transit assignment to model each of the scenarios described in the previous section. For the purpose of this study, the roadway network modeled area consisted of the area bordered by:

- Interstate Highway 35 on the east,
- 38<sup>th</sup> Street on the north,
- Cesar Chavez Street on the south, and
- Lamar Boulevard on the west.

The objective of the study was to predict route changes and travel time gain/loss by passenger cars, as well as improvements in bus operations and its effect on passengers' route choice. The DTA model simulated cars and buses in a mixed traffic condition to incorporate the effect of each mode on the other. A schedule-based transit assignment model was used in integration with the DTA model to determine how transit users choose their paths and stops according to each scenario.

## Results

The following questions are answered in this report.

- How does travel time change for auto drivers on the Guadalupe corridor between W. Martin Luther King Jr. Boulevard and 29<sup>th</sup> Street?
- How does travel time change for auto drivers traveling between the south end of downtown (South 1<sup>st</sup> Street bridge) and 38<sup>th</sup> Street?
- How is transit travel time impacted between Martin Luther King Jr. Boulevard and 29<sup>th</sup> Street?
- How is transit ridership impacted?
- How does transit travel time change for passengers traveling to and from university-area destinations along Guadalupe Street?
- How does walk access to transit change?
- What is the impact on parallel roadways?

### **How does travel time change for auto drivers on the Guadalupe corridor between W. Martin Luther King Jr. Boulevard and 29<sup>th</sup> Street?**

Table 1 shows the range of travel times in minutes for vehicles traveling along the Drag corridor across each scenario. If transit is given priority on Guadalupe Street and the auto capacity decreases by one lane in each direction, the southbound direction of travel is adversely impacted for autos. In the northbound direction, the volume of auto traffic can be handled by one lane, and the decrease in weaving leads to some improvement. However, traffic volumes are higher in the southbound direction and require two lanes to operate smoothly in each peak period.

*Table 1 – Range of Peak Hour Auto Vehicle Travel Times (minutes) on Guadalupe Street between W. Martin Luther King, Jr. Boulevard and 29<sup>th</sup> Street.*

|    |            | Baseline | Transit Priority | Rerouted Transit | Hybrid |
|----|------------|----------|------------------|------------------|--------|
| AM | Northbound | 3 to 9   | 2 to 5           | 3 to 5           | 2 to 4 |
|    | Southbound | 3 to 6   | 6 to 9           | 3 to 4           | 3 to 4 |
| PM | Northbound | 4 to 9   | 4 to 5           | 3 to 4           | 3 to 4 |
|    | Southbound | 4 to 5   | 5 to 8           | 4 to 5           | 4 to 5 |

When transit is rerouted to West Campus, auto travel times improve on the corridor, as expected. In the hybrid scenario (northbound transit priority on Guadalupe Street, maintaining two auto lanes in each direction, rerouting southbound transit to West Campus), auto travel times improve as well, similar to the previous scenario.

An interesting finding is that the variability in travel time decreases as the separation between autos and transit is greater. In the Baseline Scenario, the range of travel times during the peak periods span several minutes. This decreases somewhat when transit is given priority, and even more when transit is re-routed. It is well-known that when a facility is operating at or above capacity, the reliability of the travel time decreases, which is what we observe here.

### **How does travel time change for auto drivers traveling between the south end of downtown (South 1<sup>st</sup> Street bridge) and 38<sup>th</sup> Street?**

In the morning peak, we expect relatively small changes in travel time. When buses have priority lanes on Guadalupe Street, average auto travel time increases by one minute in the northbound direction and three minutes in the southbound direction. When transit is rerouted through West Campus, and in the hybrid scenario (which maintains two auto lanes in each direction on Guadalupe Street), travel time improves in each direction by about one minute.

### **How is transit travel time impacted between Martin Luther King Jr. Boulevard and 29<sup>th</sup> Street?**

Table 2 shows the travel time of buses in the corridor, between Martin Luther King Boulevard and 29<sup>th</sup> Street in both a.m. and p.m. peak periods. Transit travel times are the lowest when transit is given priority on Guadalupe Street, and the highest when transit is re-routed to West Campus. The hybrid scenario transit travel times are higher than the rerouting scenario in the southbound direction due to additional signal delay that is assumed.

Table 2 – Range of Peak Hour Transit Travel Time (in minutes) between W. Martin Luther King, Jr. Boulevard and 29<sup>th</sup> Street.

|    |            | Baseline | Transit Priority | Rerouted Transit | Hybrid  |
|----|------------|----------|------------------|------------------|---------|
| AM | Northbound | 4 to 9   | 3 to 7           | 7 to 12          | 3 to 8  |
|    | Southbound | 4 to 8   | 3 to 8           | 4 to 7           | 7 to 10 |
| PM | Northbound | 5 to 10  | 3 to 9           | 7 to 11          | 4 to 9  |
|    | Southbound | 3 to 10  | 3 to 8           | 5 to 11          | 6 to 13 |

### How is transit ridership impacted?

Allowing transit to have priority, or travel on a street with lower congestion than Guadalupe Street, improves service and has the potential to attract more riders. The MetroRapid buses see the greatest benefit, and may attract some riders away from local bus service as the difference in service increases. This study did not look at how many travelers would switch from auto to transit or transit to auto, but instead focused on changes in service and how transit riders would select their routes differently. Two key conclusions are 1) fewer passengers use the southbound transit routes to access The University of Texas when the routes are shifted to West Campus, and 2) more passengers use the routes that have a priority lane.

### How does transit travel time change for passengers traveling to and from university-area destinations along Guadalupe Street?

Figure 5 shows the average travel time by transit to or from the UT area along Guadalupe Street. The average travel time of a passenger remains approximately the same when transit is re-routed through West Campus, and sees a very small decrease (less than one minute) when transit is given priority on Guadalupe Street and in the hybrid scenario. These trends are the same in the morning and afternoon peak periods.

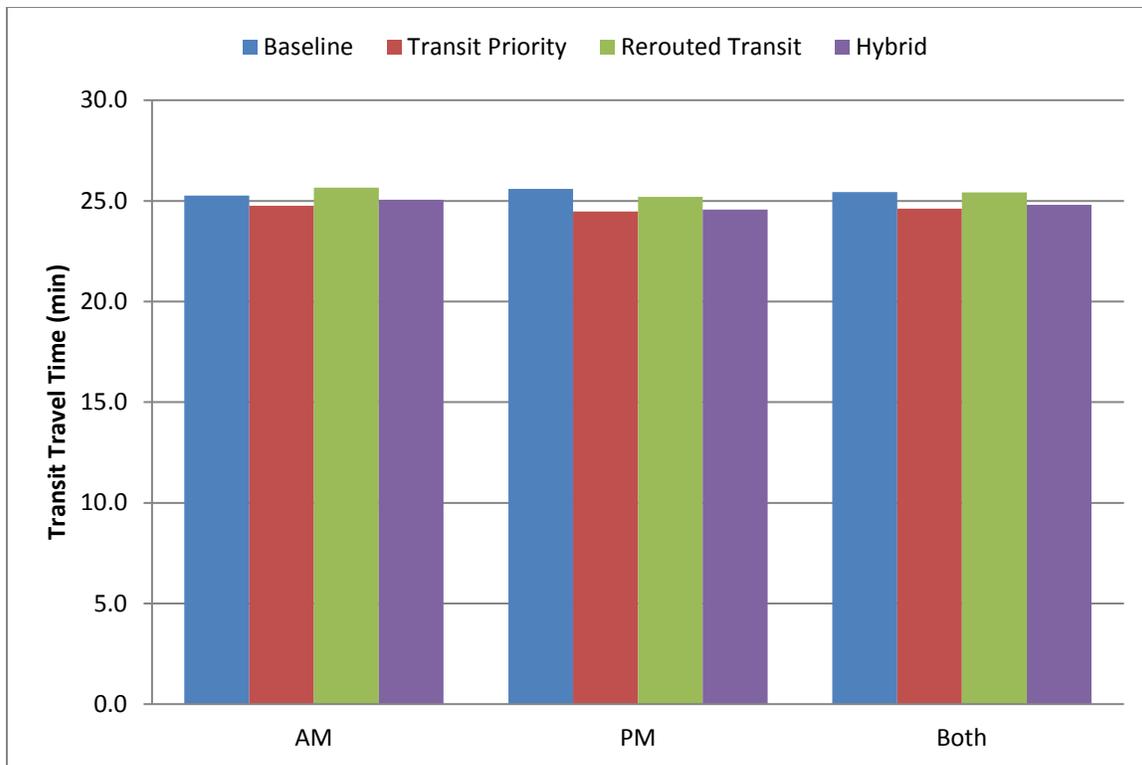


Figure 5 – Average In-Vehicle Travel Time of Transit Trips that Start or End along the Drag Corridor

### How does walk access to transit change?

While this study did not look at changes to walking time to transit, due to the more aggregate nature of the model used, it did look at changes to the number of transit users crossing Guadalupe Street between W. Martin Luther King Jr. Boulevard and 29th Street. Figure 6 shows the number of transit users that cross Guadalupe Street at the Drag corridor to access their origin or destination zones. The number of crossings increased slightly in the transit priority scenario, which is the result of more passengers taking the routes on the Drag. The number of crossings decreased in the rerouting scenario due to the fact that passengers destined to West Campus do not need to cross Guadalupe Street any more. The greatest decrease is observed in the hybrid scenario, which is the result of fewer passengers using southbound transit routes specifically to access UT campus to the east of the drag. In other words, although there is an increase in the ridership of the northbound routes, fewer people use the southbound transit to access UT zones in the hybrid scenario.

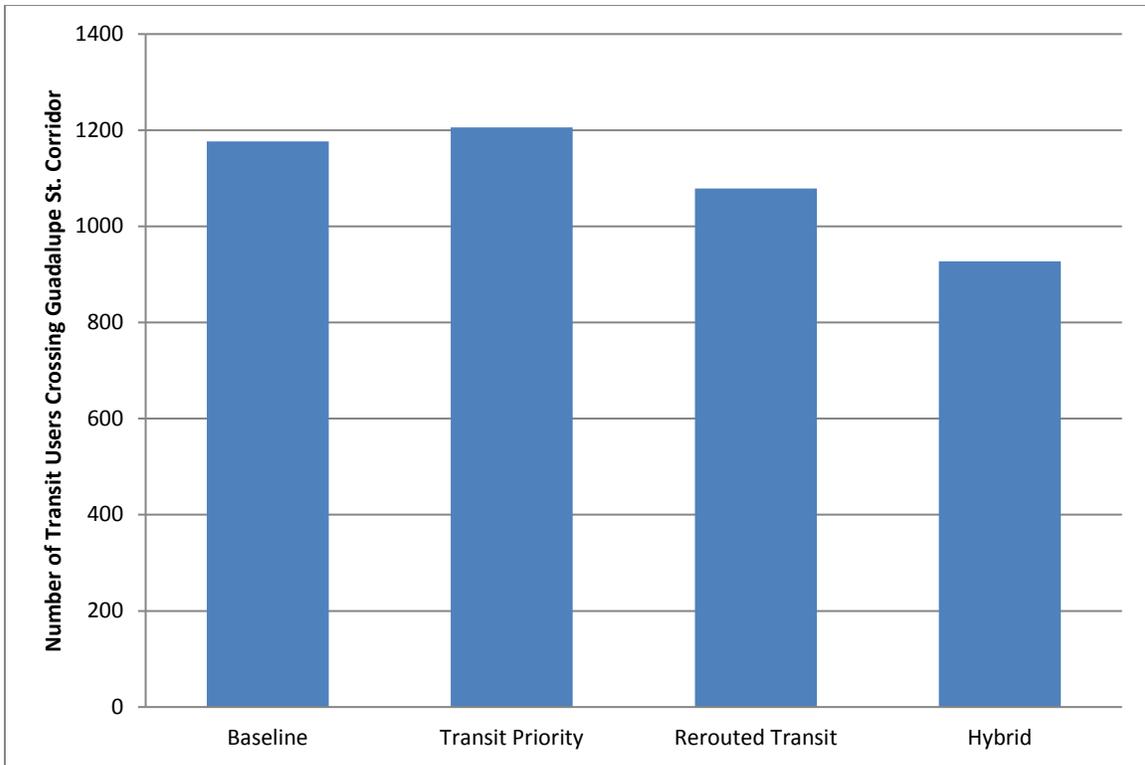


Figure 6 - Number of Transit Users Crossing Guadalupe Street between W. Martin Luther King Jr. Boulevard and 29th Street

### What is the impact on parallel roadways?

If transit is given priority on Guadalupe Street, we expect an additional 100 vehicles going northbound, and an additional 200 vehicles going southbound through West Campus in the morning peak hour. The other scenarios do not show a significant change in traffic on parallel facilities in the morning. In the afternoon peak hour, if transit is given priority, we expect a shift of  $\pm 100$ -200 northbound vehicles from Guadalupe Street to I-35. In the afternoon peak hour in the southbound direction, we expect some relief (approximately 200 vehicles) to Lamar Boulevard in scenarios where there is increased auto capacity on Guadalupe Street (hybrid scenario and rerouted transit scenario).

**AUSTIN AVENUE BRIDGE IMPROVEMENTS:  
Using Dynamic Traffic Assignment Modeling to  
Analyze the Traffic Impact of Modifications to the  
Austin Avenue Corridor**

**DRAFT TECHNICAL REPORT**

**Prepared by:**

**The University of Texas at Austin  
Center for Transportation Research**

**Prepared for:**

**CAMPO and the City of Georgetown, Texas**

**September 2015**



**THE UNIVERSITY OF TEXAS AT AUSTIN  
CENTER FOR TRANSPORTATION RESEARCH**



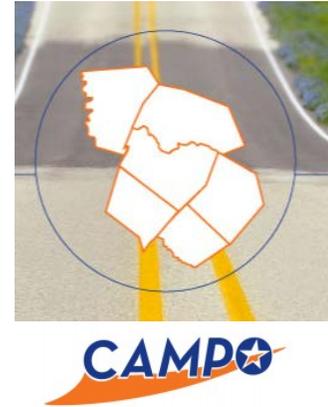
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## EXECUTIVE SUMMARY

The Capital Area Metropolitan Planning Organization (CAMPO) funds the development of a dynamic traffic assignment (DTA) model for the metropolitan planning region, with The University of Texas at Austin's Center for Transportation Research (CTR) tasked with the development and application of the DTA model. Part of the funding provided by CAMPO enables CTR to apply the DTA model to analyze various locations in the region. CAMPO's support of its member agencies enabled this project to be completed for the City of Georgetown.



The DTA model constructed for this study covers the Georgetown city limits and surrounding areas. The transportation network used in the DTA model comes from a larger network developed by Kimley-Horn and Associates.

The objective of this study was to answer the following questions regarding the Austin Avenue bridge re-construction:

- What is the morning (AM) and afternoon (PM) peak period traffic impact of implementing a traffic control plan (TCP), which closes one lane in each direction on both Austin Avenue bridges, to complete reconstruction in 2016 or in 2035?
- What is the AM and PM peak period traffic impact of providing a left-turn lane on the Austin Avenue bridges (for a total of five lanes) versus only providing four lanes in 2035?

The DTA model estimated changes to area travel patterns for base year (2016) conditions, short and long range forecast year (2016 and 2035) closures, and for the two potential lane configurations (2035), assessing both AM and PM peak periods for a total of ten DTA models:

- 1) **2016 Base** model (AM and PM peak) – current Austin Ave configuration
- 2) **2016 TCP** model (AM and PM peak) – one lane closed (each direction) along Austin Ave
- 3) **2035 4-Lane** model (AM and PM peak) – planned 4-lane Austin Ave configuration, **with** bond projects
- 4) **2035 5-Lane** model (AM and PM peak) – planned 4-lane with left-turn lanes Austin Ave configuration, **with** bond projects
- 5) **2035 TCP** model (AM and PM peak) – one lane closed (each direction) along Austin Ave, **with** bond projects

Table 1 presents the pairs of scenarios compared for results analysis.



**Table 1. Scenario Comparisons**

| Scenario Comparison   | AM  | PM  |
|---|---|---|
| 2016 Existing Conditions<br>Vs.<br>2016 Lane Closures (TCP)     | 2016 AM Base<br>compared to<br>2016 AM TCP      | 2016 PM Base<br>compared to<br>2016 PM TCP      |
| 2016 Lane Closures (TCP)<br>Vs.<br>2035-Lane Closures (TCP)     | 2016 AM TCP<br>compared to<br>2035 AM TCP       | 2016 PM TCP<br>compared to<br>2035 PM TCP       |
| Final 4-Lane Configuration<br>Vs.<br>Final 5-Lane Configuration | 2035 AM 4-Lane<br>compared to<br>2035 AM 5-Lane | 2035 PM 4-Lane<br>compared to<br>2035 PM 5-Lane |

Below is a summary of key results.

**2016 AM Base vs 2016 AM TCP**

- Reducing the number of lanes on the bridges during the reconstruction phase results in less traffic from incoming streets (Austin Avenue and Williams Drive) compared to the base scenario.
- There is a significantly higher drop in southbound traffic than northbound traffic on the Austin Avenue bridges.

**2016 PM Base vs 2016 PM TCP**

- The PM peak period traffic along the Austin Avenue bridges is not significantly affected by the reconstruction phase.
- There is a slight drop in southbound traffic and a slight rise in northbound traffic. PM traffic is much lower than AM traffic due to vehicle preference for I-35.

**2016 AM Lane Closures (TCP) vs 2035 AM Lane Closures (TCP)**

- There is less southbound traffic along the Austin Avenue bridges in 2035 than in 2016. This indicates that even with increased demand on the network in 2035, commuters spread out, using some of the new roads available.
- The northbound traffic almost doubles in 2035 from 2016. This corresponds with the increase in demand in 2035 and indicates that northbound traffic does not diversify along new paths as much as southbound traffic.
- There is more southbound traffic approaching from N. Austin Avenue in 2035 than in 2016 with a decrease in traffic approaching from Williams Drive in 2035 from 2016.



- 2016 trips have lower travel times, overall, than 2035 trips. Throughout the network, commuters using the bridges will experience less delay if construction is completed in 2016 rather than 2035.

#### 2016 PM Lane Closures (TCP) vs 2035 PM Lane Closures (TCP)

- Southbound traffic remains the same in both years, whereas northbound traffic doubles.
- The overall reach time is similar in the PM peak hours for 2016 and 2035. However, commuters traveling to the southeast and northwest experience lower travel times in 2035 than 2016. This appears to be a result of the improvements in the South East Inner Loop area.

#### 2035 AM 4-Lane Configuration vs 2035 AM 5-Lane Configuration

- The results are very similar. There is slightly higher traffic volume on I-35 in the 5-lane configuration than the 4-lane configuration.
- Twice as many vehicles travel along San Gabriel Village Boulevard to the west in the 5-lane scenarios as the addition of the left-turn lane makes it easier for vehicles to turn onto the road.
- There is slightly more reach in the 5-lane scenario, where vehicles can travel farther west in the same time as the 4-lane scenario. Otherwise, the reach time does not change much.

#### 2035 PM 4-Lane Configuration vs 2035 PM 5-Lane Configuration

- Traffic volumes and travel times on Austin Avenue are lower in the 4-Lane scenario compared to the 5-Lane scenario.
- Overall, in the study area, trip travel times are lower in the 5-lane scenario than the 4-lane scenario.



## 1. INTRODUCTION

The City of Georgetown plans to rehabilitate the two Austin Avenue bridges that cross the San Gabriel River north of downtown Georgetown. Rehabilitation may be performed in the near-term (2016) and long-term (2035) or in the near-term only. This process will involve closing one lane of Austin Avenue in each direction of travel through the area (Figure 1). The City of Georgetown is also considering upgrading the roadway from a standard four-lane facility (Figure 2) to a four-lane facility with a left-turn lane (for a total of five lanes) (Figure 3).

The objectives of this study are to determine how traffic reroutes in response to closing one lane in each direction during the reconstruction of the bridges, as part of a traffic control plan (TCP), and the traffic impact of providing the cross-section with left-turn lanes. The study used dynamic traffic assignment (DTA) models to estimate path-changing behavior in response to the network modifications.

The Capital Area Metropolitan Planning Organization (CAMPO) funded this study through an existing contract that provides transportation network modeling services to member agencies. This report summarizes the results observed from the DTA models.

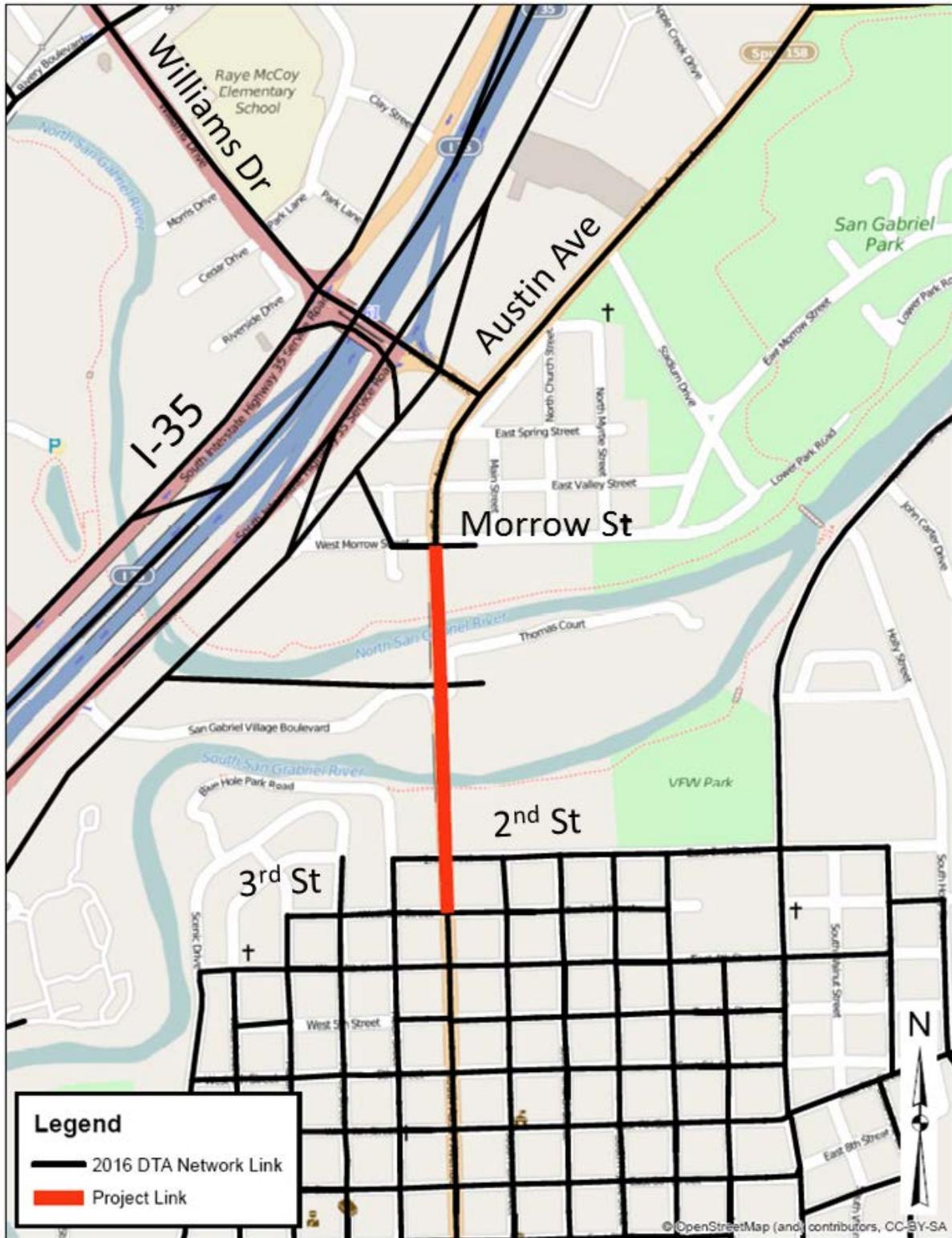
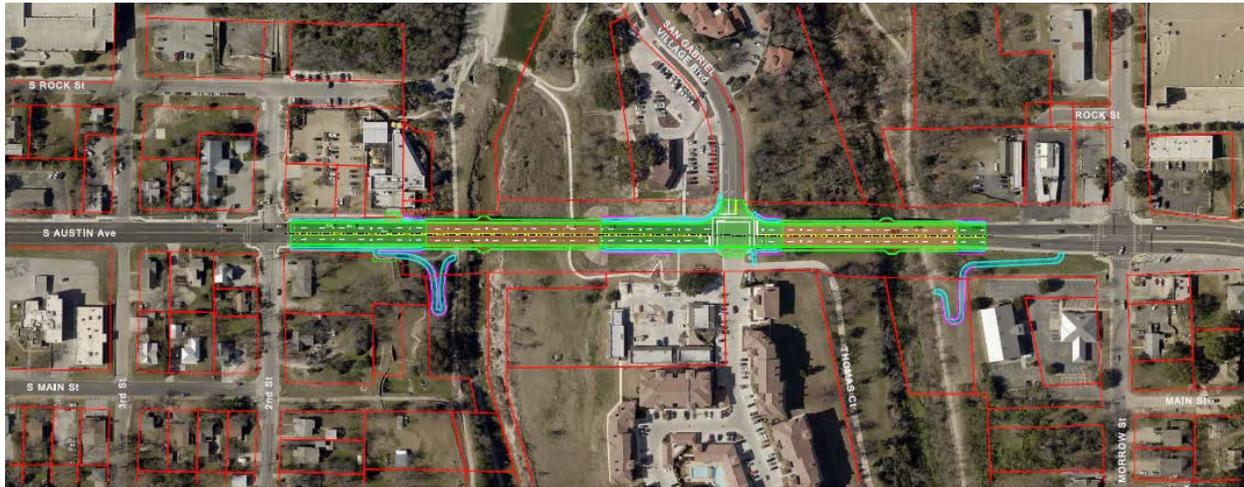
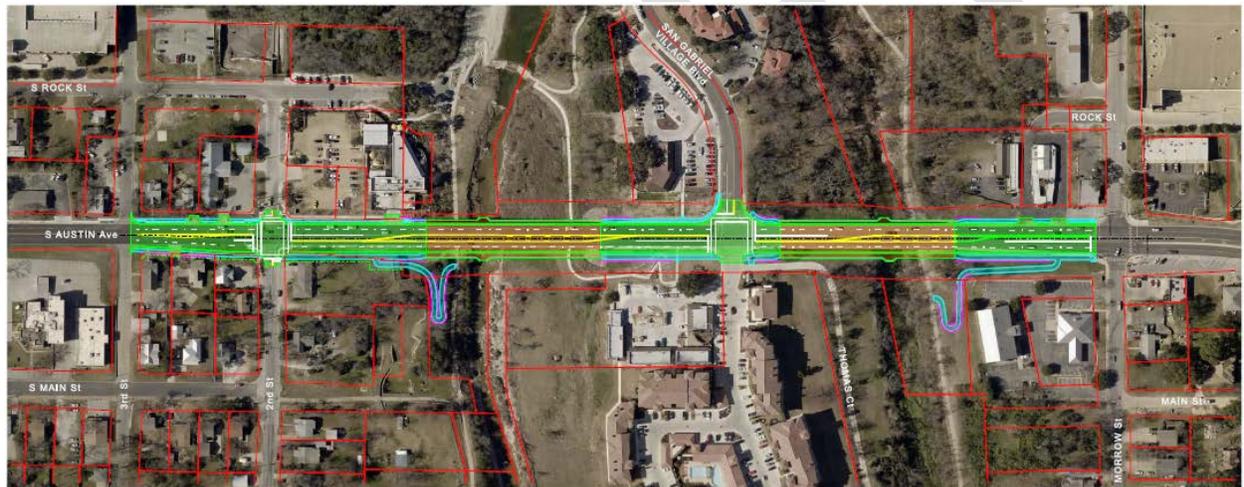


Figure 1. Location of Austin Avenue Bridges



**Figure 2. Austin Avenue Bridge 4-Lane Design  
(Source: Aguirre & Fields Engineers and Planners)**



**Figure 3. Austin Avenue Bridge 5-Lane Design  
(Source: Aguirre & Fields Engineers and Planners)**



The DTA model estimated changes to area travel patterns for base year (2016) conditions, short and long range forecast year (2016 and 2035) closures, and for the two potential lane configurations (2035), assessing both AM and PM peak periods for a total of ten DTA models:

- 1) **2016 Base** model (AM and PM peak) – current Austin Ave configuration
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- 5) **2035 TCP** model (AM and PM peak) – one lane closed (each direction) along Austin Ave, *with* bond projects

Table 2 presents the pairs of scenarios compared for results analysis.

**Table 2. DTA Model Scenario Comparisons**

| Scenario Pairs to Compare                                       | AM  | PM  |
|---|---|---|
| 2016 Existing Conditions<br>Vs.<br>2016 Lane Closures (TCP)     | 2016 AM Base<br>compared to<br>2016 AM TCP      | 2016 PM Base<br>compared to<br>2016 PM TCP      |
| 2016 Lane Closures (TCP)<br>Vs.<br>2035-Lane Closures (TCP)     | 2016 AM TCP<br>compared to<br>2035 AM TCP       | 2016 PM TCP<br>compared to<br>2035 PM TCP       |
| Final 4-Lane Configuration<br>Vs.<br>Final 5-Lane Configuration | 2035 AM 4-Lane<br>compared to<br>2035 AM 5-Lane | 2035 PM 4-Lane<br>compared to<br>2035 PM 5-Lane |

## 2. MODEL DEVELOPMENT

### 2.1 DTA Model Overview

DTA can reveal changes to travel patterns resulting from closing lanes for the reconstruction of the two Austin Avenue bridges in 2016 or 2035, and the final build-out of the four and five lane bridge alternatives in 2035. The traffic assignment process involves assigning vehicles between their origin and destination to paths with the shortest travel times (determined by simulating the movement of vehicles through the network on their assigned paths). The model evaluates possible paths and assigns vehicles to the paths across the network to achieve the lowest travel time for each individual vehicle modeled while considering the travel times of all other vehicles in the network.

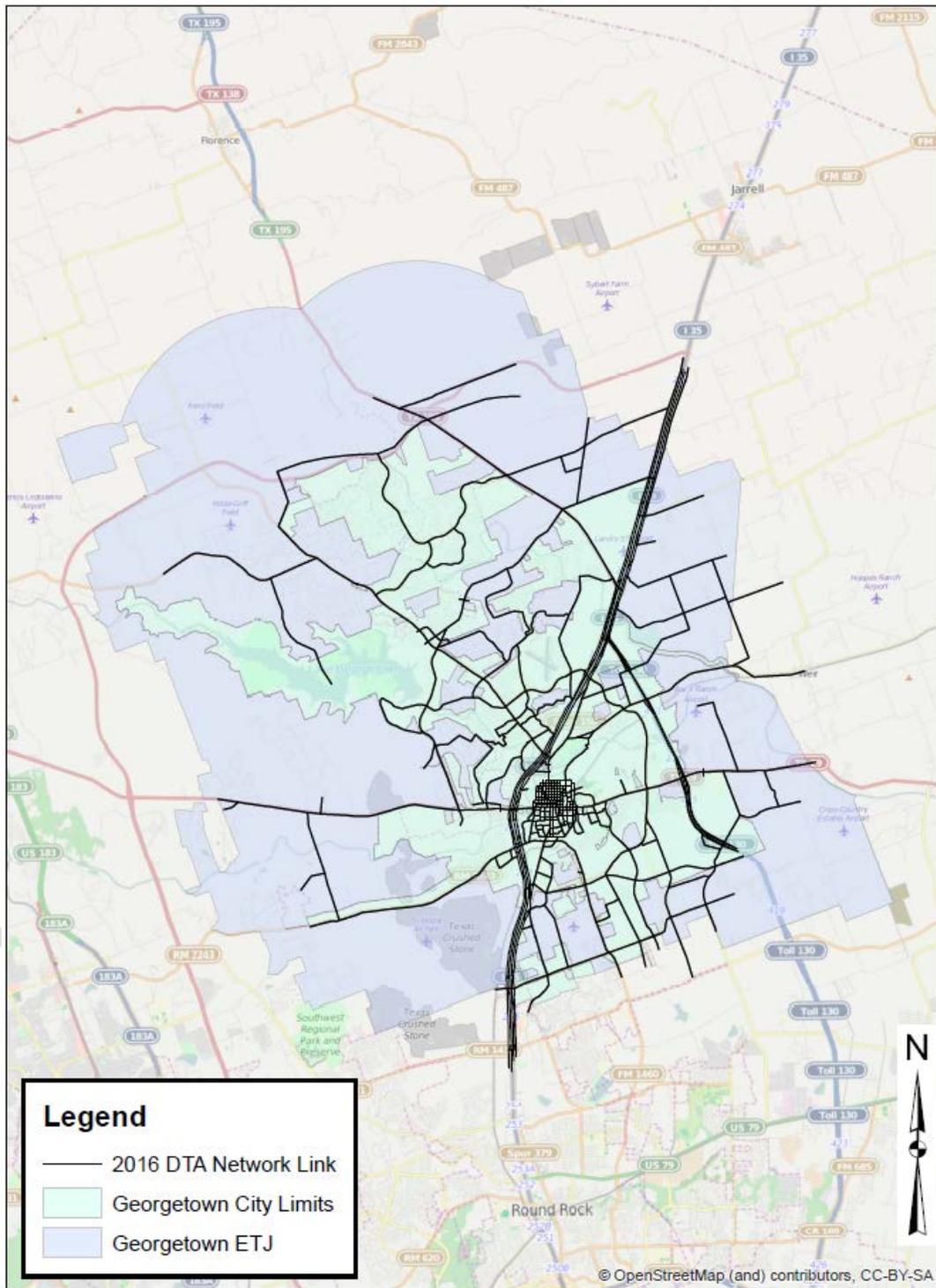


The DTA model updates the assignment of vehicles to paths iteratively as traffic conditions change due to prior assignment patterns. The model allows for congestion to form and affect travel times and thus, generally makes the model more realistic for evaluating traffic impacts during peak periods. This is particularly useful for assessing conditions related to network modifications, such as a change to roadway capacity, which is common for traffic control plan (TCP) scenarios. The DTA model, unlike a traffic microsimulation model, can model the changes in paths and travel times for a larger network; microsimulation is more suitable for using path assignments as an input to find travel times in a smaller network area or along a corridor. The closure of lanes and the possible addition of a left-turn lane on the Austin Avenue bridges lend itself to DTA, where there is concern about traffic rerouting along roadways throughout the downtown area and along adjacent north-south corridors.

## 2.2 Network

The DTA model used for this analysis is comprised of a subnetwork extracted from a regional travel demand model provided by Kimley-Horn and Associates (KHA). To establish appropriate models for 2016 and 2035 conditions, a number of changes were made to the KHA network.

The first DTA model developed used a KHA 2030 network model as the foundation to create the 2035 model used for this analysis. Changes to the KHA network model included deletion, addition, and revision of links and their attributes based on the latest transportation and construction plans and proposed bond projects. For a list of considered bond projects, please see Appendix A. Since DTA can explicitly model the impacts of traffic signals, those were added to the model too. The 2016 network was built from a copy of the 2035 network using updates to the links to more accurately represent base-year conditions with near-term improvements. The subnetwork is located within the City of Georgetown's city and ETJ limits (Figure 4 and Figure 5). These limits extend beyond the area of concern for the project evaluation while encompassing several major path alternatives and travel productions within the region.



**Figure 4. 2016 DTA Network**

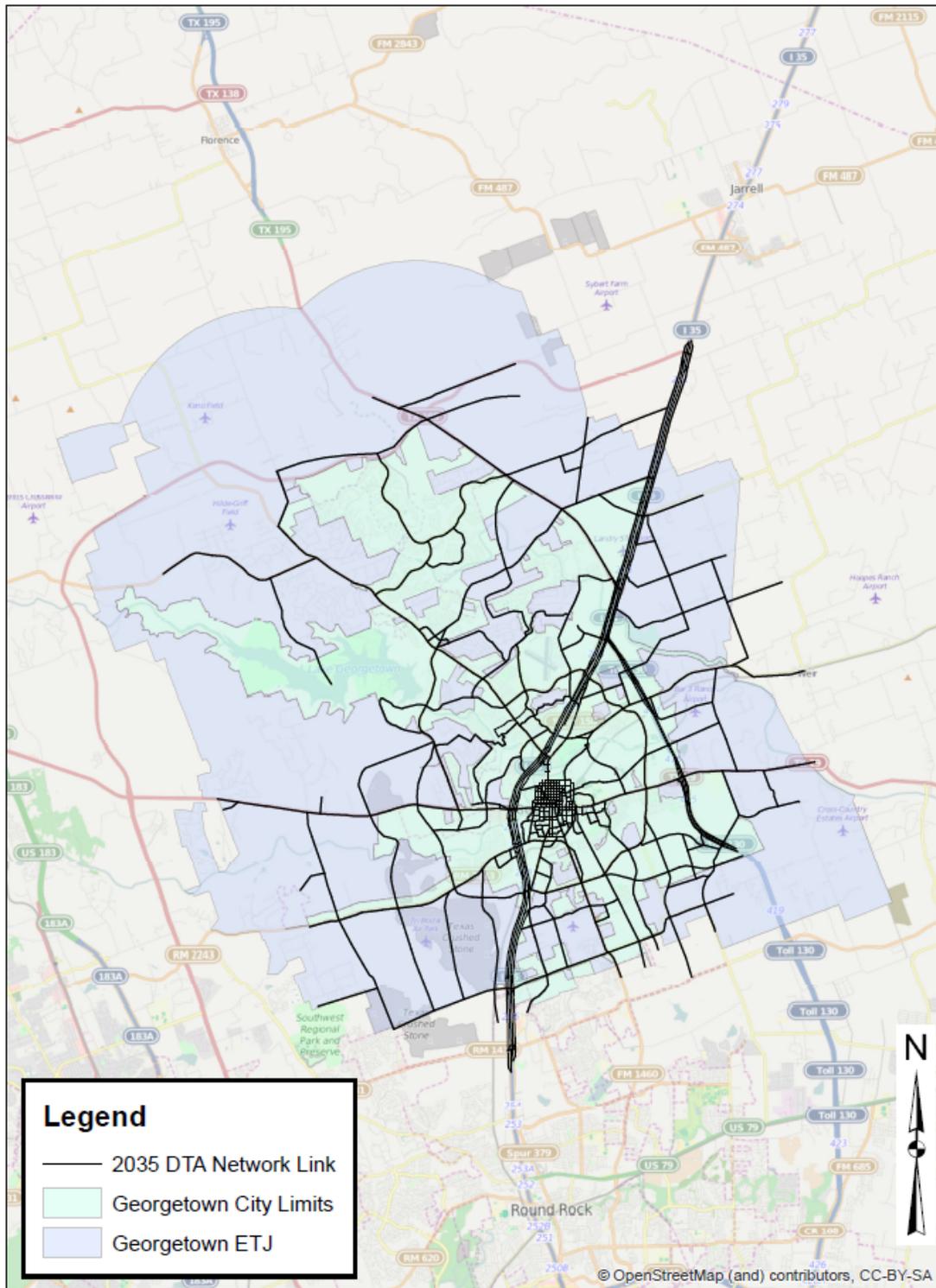


Figure 5. 2035 DTA Network



### 2.2.1 Traffic Signals

The CTR team used traffic signal plans obtained from TxDOT and the City of Georgetown, and used estimated timings from a network model prepared for Williamson County when traffic signal plans were not available from the aforementioned sources. When applicable, the AM and PM networks included the AM and PM signal plans. The 2035 network also used the current available traffic signal plans.

For some signalized intersections, signal timing plans could not be obtained or accounted for, especially for the future 2035 scenario. In those cases, CTR used the signal optimization tool within the DTA modeling software to develop estimated signal timings. Though not intended for actual implementation in the field due to the coarse (less detailed) consideration of movements in the traffic assignment model compared to a microsimulation or signal optimization software program, the optimized signal plans provide a way to estimate the delays and capacity restrictions of signalized intersections.

### 2.2.2 Roadway Capacity

Roadway capacities are assigned uniformly based on roadway functional classifications (e.g., freeway, arterial, and collector) and area type (e.g., urban or rural areas). The assigned capacities in the KHA network were kept but adjusted as needed according to updated information regarding functional classification from the City of Georgetown.

### 2.3 Travel Demand

Estimates of travel demand for the 2016 and 2035 networks came from interpolating for 2016 and extrapolating for 2035 using the 2010 and 2030 KHA 24-hour demand estimates. Since the KHA model used a 24-hour time period, a method to estimate the AM and PM peak period relied on using the CAMPO 2005 base model to find the percentage of 24-hour demand for the region occurring during the AM and PM peak periods. Those resulting time-of-day factors applied to the KHA interpolated and extrapolated demand estimates created the subsequent AM and PM peak period tables for 2016 and 2035, respectively (Table 3 shows the peak and total demand estimates). Those peak period demand tables were then included in a model run of the full KHA regional model for each time period and year to extract the demand for the subnetwork used in this study.



**Table 3. AM, PM, and Total Demand Estimates for Georgetown Subnetwork**

| Year | AM        | PM        | Total (24 hour) |
|------|-----------|-----------|-----------------|
| 2010 | 1,297,935 | 1,382,772 | 5,411,440       |
| 2016 | 1,633,971 | 1,746,049 | N/A             |
| 2035 | 2,494,580 | 2,677,664 | 10,553,208      |

### 3. MODEL RESULTS

#### 3.1 DTA Model Results

This section summarizes the DTA modeling results for the six scenario comparisons described in Section 1.0 Introduction. The results analysis includes looking at travel times along Austin Avenue for the scenarios, as well as changes to routing and travel patterns. This section explains the three frequent types of analyses:

- Selected path analysis
- Routing analysis
- Isochrones

An online software tool developed by CTR and the Texas Advanced Computing Center, hereby referred to as Viztool, was used to create the maps presented in this section.

##### 3.1.1 Selected Link Path Analysis

Viztool is used by CTR offers an option to select a particular link to visually see the paths used by vehicles in the network that use the selected link in their path, and also how many vehicles travel on each link on those paths. That information provides a useful visual of the volume and direction of traffic using the Austin Avenue bridges. This analysis sums the vehicle count and path information over a three-hour “peak” period.

To read the maps for selected path analysis, there is a color gradient bar accompanying each map. The values on either side of the bar are the upper and lower bounds for the color gradient. Since most of the analysis is a comparison of two scenarios, each scale will have different upper and lower bounds. The bounds are adjusted to whichever scenario has the lowest lower bound and highest upper bound. For example, Figure 6 shows two gradient scales with the same lower and upper bounds. The number in the parentheses next to the upper bounds is the original upper bound. The first map represented by the first gradient bar had at

most 2,378 vehicles on one of its links, but the second map had 4,062 vehicles. For a fair visual comparison between scenarios, the bounds must be equivalent.



**Figure 6. Example of Color Gradients for Vehicle Counts**

### 3.1.2 Routing Analysis

The routing analysis finds the top origins and destinations by number of vehicles on paths or by fraction of demand that use the bridges in the base year scenarios. In most cases, the origin-destination (OD) pairs with at least 100 vehicles are chosen when selecting by number of vehicles (and at least a quarter of demand). A query is then done in Viztool to create a map that shows the paths taken between the selected origins and destinations. The paths shown may or may not include the bridge link. The query in Viztool is repeated for other scenarios and the resulting maps are compared to identify shifts in the paths taken by vehicles between those selected origins and destinations. This process identifies network-wide changes in travel patterns for OD pairs of interest.

### 3.1.3 Isochrone (Time Contour) Maps

An isochrone map connects points that have the same value of time. The use of isochrones in transportation analysis allows one to estimate how far someone can drive from a single point to areas around it. The provided isochrone images depict accessibility from a specific area using travel time contours. These travel time contour maps show accessibility from Austin Avenue at the north end of downtown in the vicinity of the bridges.

The contours represent travel times, over a three-hour “peak” period, as follows:

- Blue – 2-minute travel time
- Cyan – 4-minute travel time
- Green – 6-minute travel time
- Orange – 8-minute travel time
- Red – 10-minute travel time

### 3.1.4 Traffic Counts

Traffic counts provided by the City of Georgetown for Austin Avenue (Table 4) provide a reference point for determining if the 2016 model results fall within an acceptable range for the modeling. The vehicle count data was provided for inside and outside lanes, so the sum of those provides the total traffic count for each direction. The traffic counts are for 24-hour and three-day counts, but since the modeling is done for the peak periods, only a fraction of the



vehicle count should be compared to the model traffic volumes. Without having peak period counts, Table 4 provides possible minimum and maximum estimates of peak period traffic based on work with other studies that indicate peak period traffic can be anywhere between 5% to 20% of 24-hour traffic.

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**Table 4. Austin Avenue Traffic Count Data**

| Count Date | Location                   |                 | Daily # of Vehicles | Lower Bound on Peak Period Estimate of # of Vehicles | Upper Bound on Peak Period Estimate of # of Vehicles |
|------------|----------------------------|-----------------|---------------------|--|--|
| 2013-11-08 | Austin Ave @ 2nd Street    |                 |                     |  |  |
|            | 3 Day Count                | NB              | 11,267              | 563  | 2253   |
|            | Sonics                     | SB              | 14,044              | 702  | 2809   |
| 2014-07-10 | North Austin Avenue Bridge |                 |                     |  |  |
|            | 24 Hour Count              | NB Inside Lane  | 4,073               | 204  | 815  |
|            | Plates                     | NB Outside Lane | 1,990               | 100  | 398  |
|            |                            | SB Inside Lane  | 3,433               | 172  | 687  |
|            |                            | SB Outside Lane | 3,354               | 168  | 671  |
| 2014-07-10 | South Austin Avenue Bridge |                 |                     |  |  |
|            | 24 Hour Count              | NB Inside Lane  | 2,210               | 111  | 442  |
|            | Plates                     | NB Outside Lane | 4,331               | 217  | 866  |
|            |                            | SB Inside Lane  | 3,665               | 183  | 733  |
|            |                            | SB Outside Lane | 3,543               | 177  | 709  |
| 2014-12-02 | Austin Ave @ 5th Street    |                 |                     |  |  |
|            | 3 Day Count                | NB Inside Lane  | 12,423              | 621  | 2485   |
|            | Plates                     | NB Outside Lane | 9,052               | 453  | 1810   |
|            |                            | SB Inside Lane  | 12,316              | 616  | 2463   |
|            |                            | SB Outside Lane | 3,690               | 185  | 738  |
| 2014-12-02 | 5th Street @ Austin Ave    |                 |                     |  |  |
|            | 3 Day Count                | EB Monument     | 236                 | 12   | 47   |
|            | Plates                     | EB 5th          | 1,246               | 62   | 249  |
|            |                            | WB 5th          | 792                 | 40   | 158  |
|            |                            | WB Monument     | 1,218               | 61   | 244  |
| 2014-12-17 | Austin Ave @ 5th Street    |                 |                     |  |  |
|            | 24 Hour Count              | NB Inside Lane  | 3,937               | 197  | 787  |
|            | Plates                     | NB Outside Lane | 2,963               | 148  | 593  |
|            |                            | SB Inside Lane  | 3,961               | 198  | 792  |
|            |                            | SB Outside Lane | 3,833               | 192  | 767  |

The following sections contain figures and summaries depicting the model results and relevant comparisons of scenario conditions.



### 3.1.5 Comparison of 2016 AM Base Scenario vs. 2016 AM TCP Scenario

#### *Selected Link Path Analysis*

The traffic control plan (TCP) scenario has fewer vehicles using the Austin Avenue bridges (specifically for this analysis, the northernmost bridge). For the southbound direction during the AM peak period, the TCP scenario has 2,222 vehicles and the base case has 3,805 vehicles (Table 5).

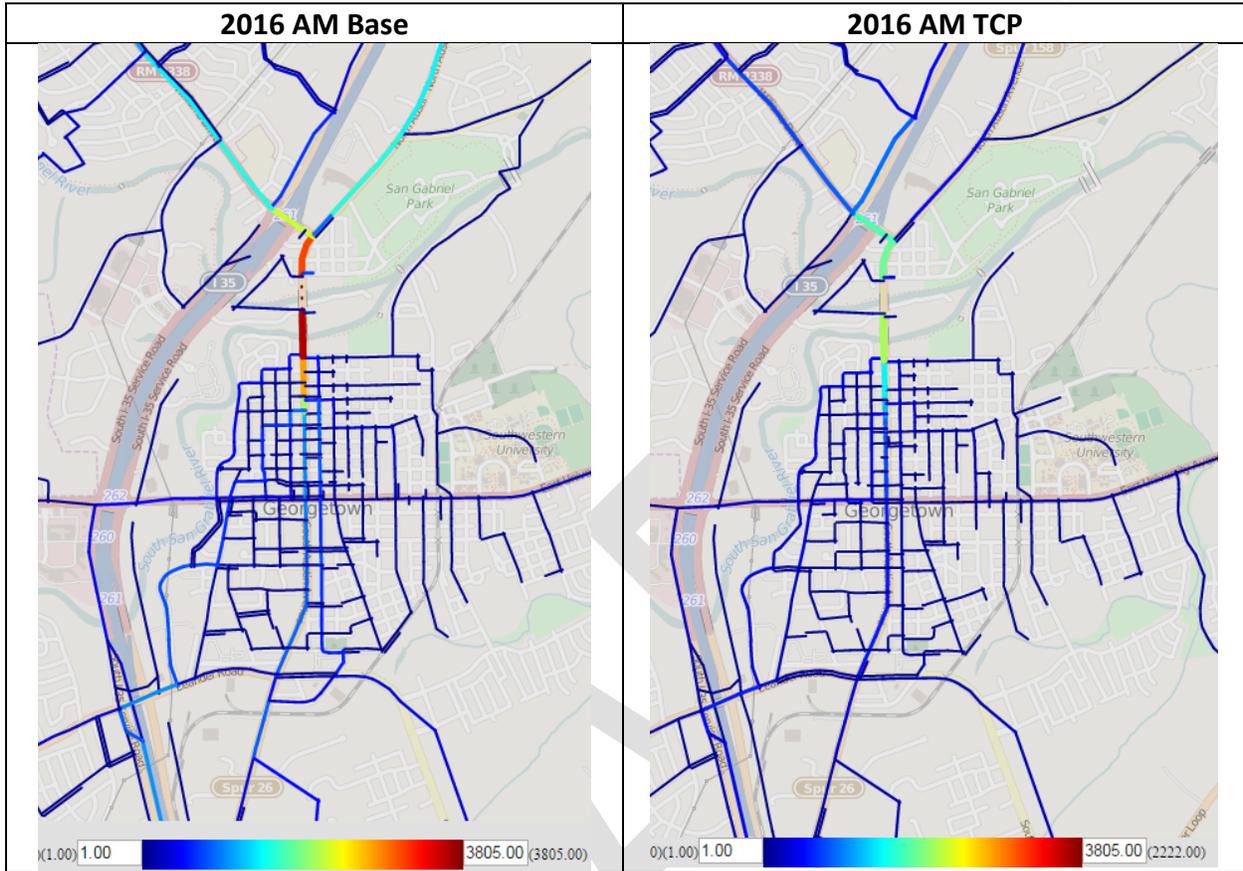
For the northbound direction, the TCP scenario has 881 vehicles and the base case has 982 vehicles (Table 6). This reduction in vehicles on the bridge link when the TCP is in place occurs for two reasons:

- The reduction in lanes to one lane each direction cannot handle the same amount of traffic as having two lanes.
- Drivers find other paths in response to knowing the Austin Avenue bridges are reduced to one lane in each direction.

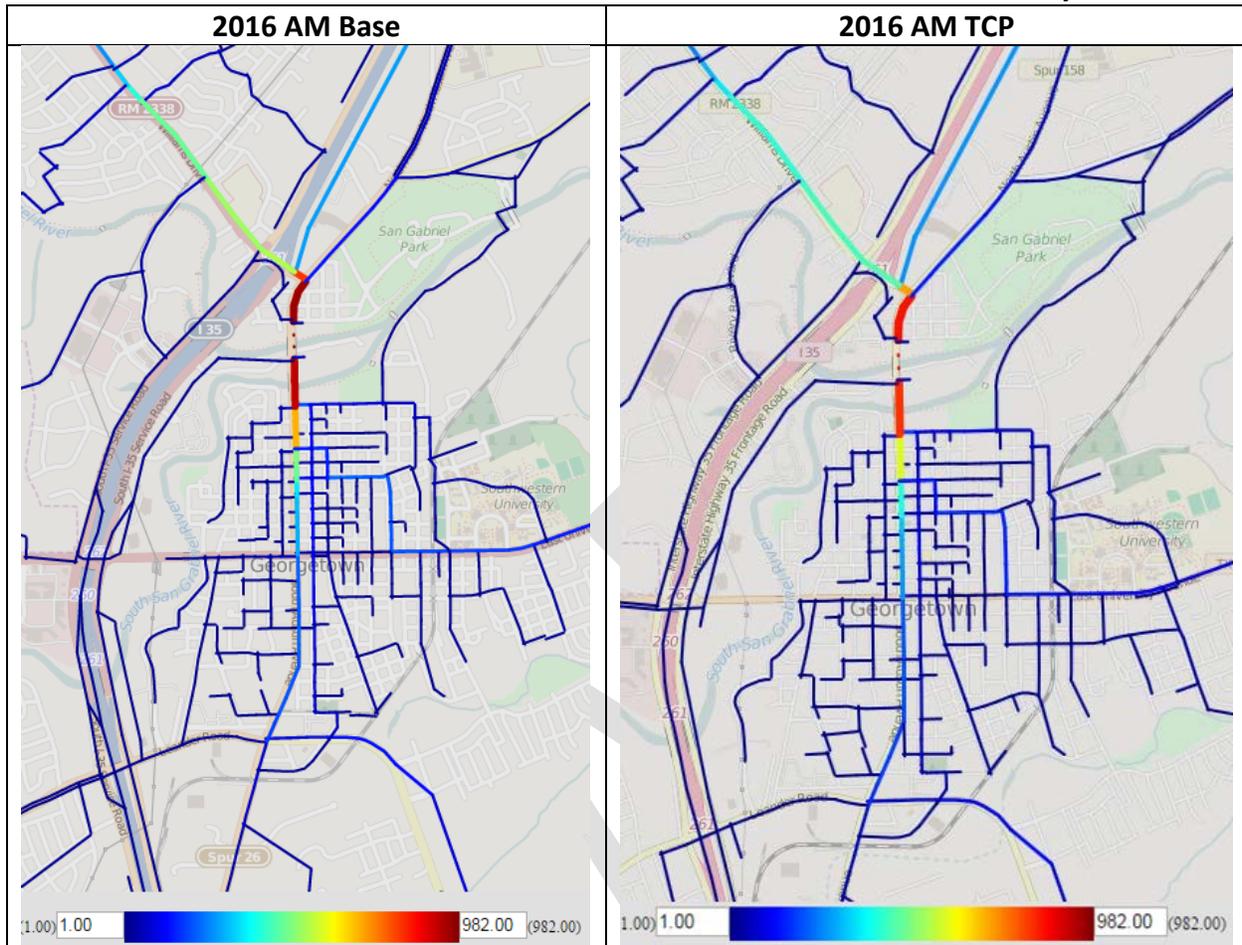
Reducing the number of lanes on the bridges during the reconstruction phase results in less traffic from incoming streets (Austin Avenue and Williams Drive) compared to the base scenario. Intuitively, the model indicates that Austin Avenue is a less attractive alternative during reconstruction when the lanes are closed. Since demand is the same for both scenarios, those vehicles not traveling on the Austin Avenue bridges in the TCP scenario have rerouted to other paths in the network that do not use the Austin Avenue bridges.



**Table 5. 2016 AM Base and 2016 AM TCP Southbound Link Path Analysis**



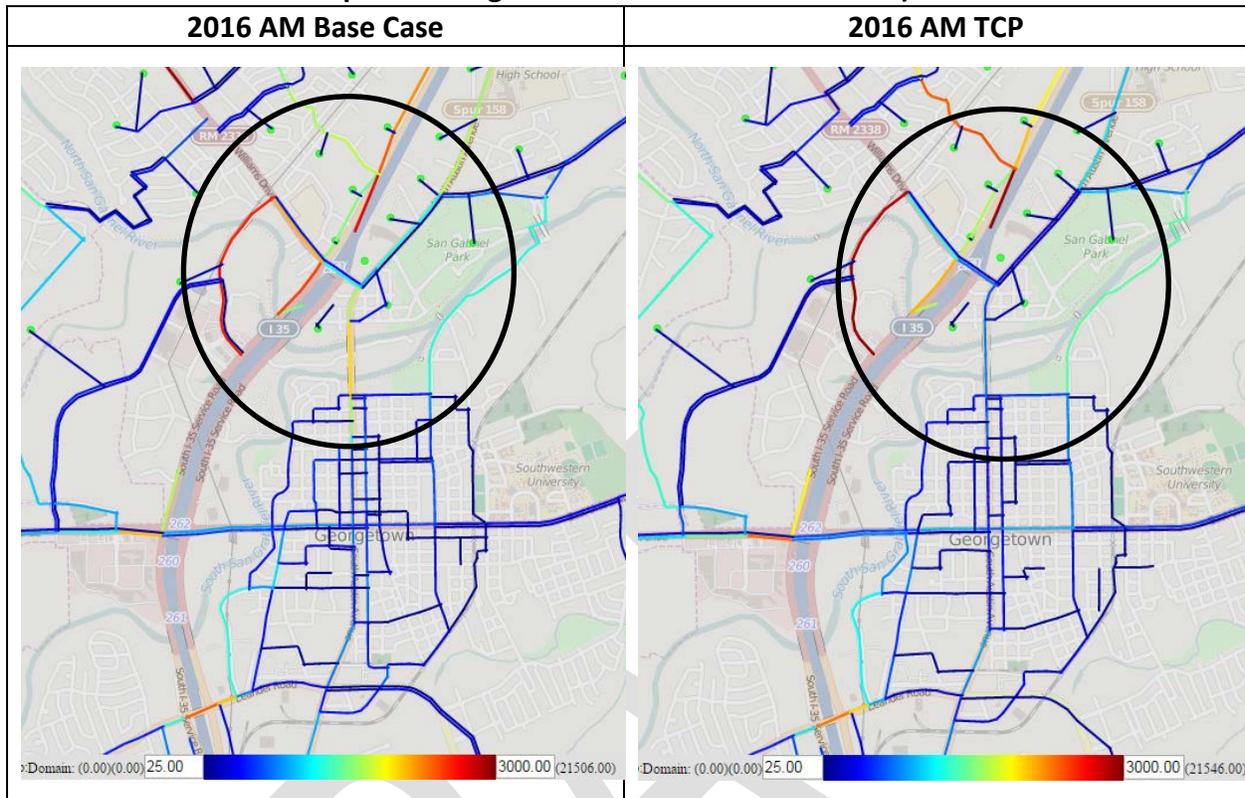
**Table 6. 2016 AM Base and 2016 AM TCP Northbound Link Path Analysis**



**Routing Analysis**

Table 7 shows a small change in routes used and number of vehicles on these routes between the base and TCP scenarios (for OD pairs that have a demand of at least 100 vehicles). Actually, Table 7 appears to show a slight decrease in traffic volume along the bridge and roads just north of the bridge in the TCP scenario with a shift in volume west of I-35. The southbound I-35 frontage road at University Avenue shows increased traffic in the TCP scenario. This suggests that some commuters take the I-35 frontage road route instead of the bridge.

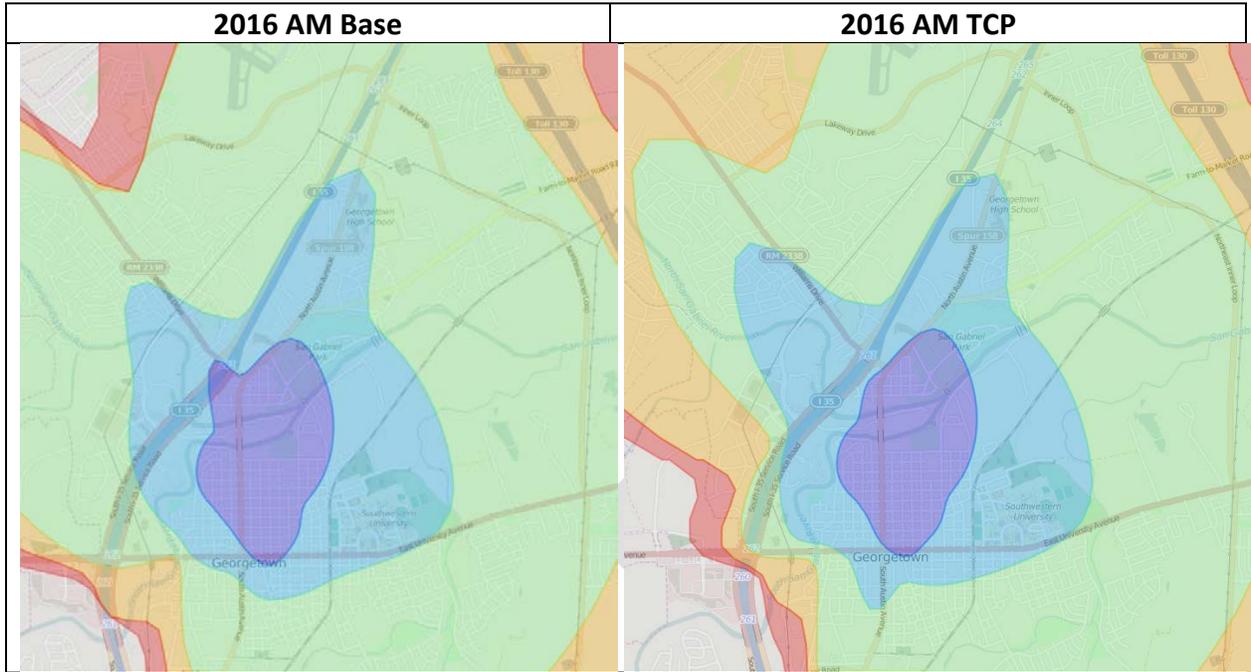
**Table 7. Southbound Direction Regional Flow Pattern (for origins and destinations with OD pairs having 100 vehicles or more demand)**



***Isochrone***

Table 8 compares isochrone images for trips from the Austin Avenue area (at the north end of downtown in the vicinity of the bridges) for 2016 AM and AM TCP conditions. Both scenarios show similar contour patterns, which corresponds with average travel time data presented later in Table (in Section 3.1.11). The average travel time on Austin Avenue in the northbound direction is approximately the same, and in the southbound direction the average travel time increases in the 2016 AM TCP scenario by approximately one minute.

**Table 8. 2016 AM Travel Time Contours**



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### 3.1.6 Compare 2016 PM Base Scenario vs. 2016 PM TCP Scenario

#### Select Link Path Analysis

In the 2016 PM scenarios there is a slight decrease in the number of vehicles (890 to 840) in the southbound direction from the base case to the TCP scenario. The northbound direction experiences a slight increase in vehicles (950 to 980), but a difference in 50 or 30 vehicles is insignificant. This indicates that closing lanes will have negligible effect on the number of commuters using the bridge in either direction.

It is important to point out the rather large difference in the vehicle volumes between the AM and PM peak southbound traffic (Table 9). The difference is consistent for peak volume traffic; southbound traffic is going towards big trip attractors such as downtown Georgetown, Round Rock, and Austin.

**Table 9. Comparison of 2016 Base and TCP Traffic Volumes**

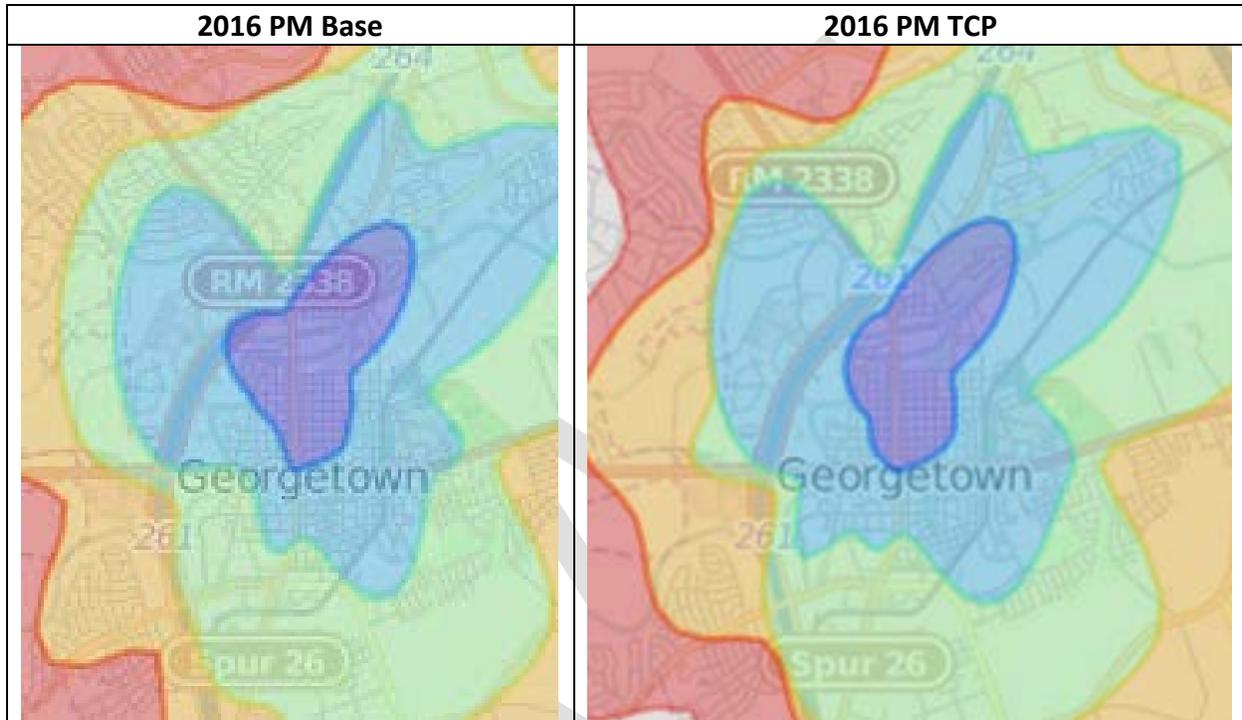
|           | AM Peak Southbound | AM Peak Northbound | PM Peak Southbound | PM Peak Northbound |
|-----------|--------------------|--------------------|--------------------|--------------------|
| 2016 Base | 3805               | 982                | 889                | 953                |
| 2016 TCP  | 2222               | 881                | 836                | 978                |

Northbound traffic volumes, on the other hand, are similar between AM and PM. In both AM and PM alternate routes, such as I-35 and Inner Loop Drive, are more attractive heading north than Austin Avenue. The traffic volumes suggest that commuters heading south towards downtown Georgetown, Round Rock, and Austin have the largest impact on the network.

***Isochrone***

Table 10 indicates that the base scenario has noticeably better reach times to the west portion of the subnetwork (as was the case for the 2016 AM base too) and to the south. Indeed, corridor travel times along Austin Avenue are slightly lower for the base scenario (as shown in Table 27).

**Table 10. 2016 PM Travel Time Contours**



**3.1.7 Compare 2016 AM TCP Scenario vs. 2035 AM TCP Scenario**

***Select Link Path Analysis***

This analysis shows which option (of closing a lane in each direction in either 2016 or 2035) results in more vehicles using the Austin Avenue bridges. Interestingly, the number of vehicles using the bridges in the 2035 AM TCP scenario for the southbound direction (1,924) is *lower* than the 2016 AM TCP scenario (2,222) (Table 11). That is a promising finding since it would be expected that because of higher forecasted demand in 2035, the traffic on the bridges in 2035 would also increase. But fewer vehicles in 2035 indicates use of alternative paths, of which there are more of in 2035 because of new roadways, roadway extensions, and roadways with capacities increased (e.g., additional lanes) compared to 2016.

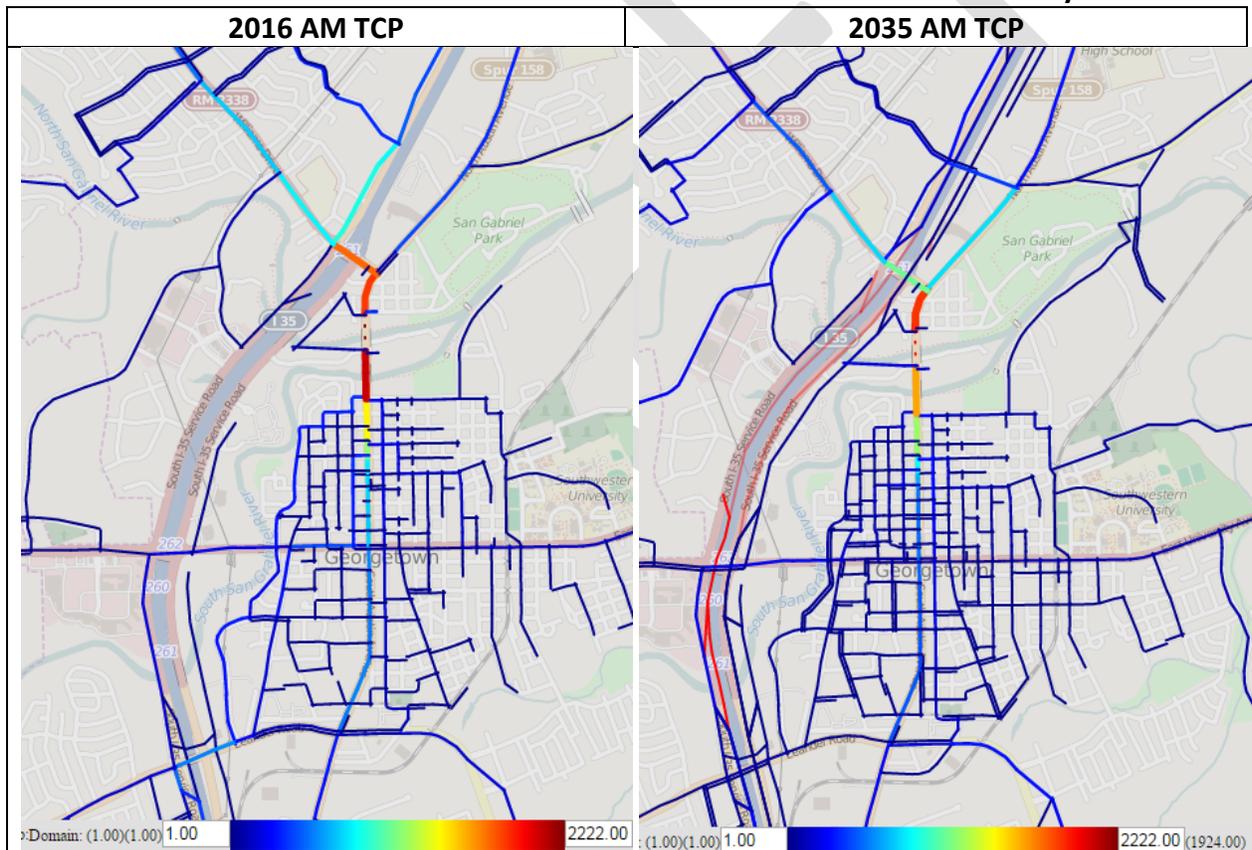
Looking at the results for the northbound approach, Table 12 shows that the northbound traffic peak period volume in the 2016 AM TCP scenario is about half (881) that of the 2035 AM TCP

scenario (1,623). Those results are quite different from the southbound direction, but what would be expected considering the higher forecasted network demand in 2035.

The 2016 and 2035 scenarios also differ in regards to the paths assigned to vehicles to reach the Austin Avenue bridges (in this case from the north going southbound) (Table 11). Southbound traffic using the bridge shifts from originating predominantly along Williams Drive (in the 2016 AM TCP scenario) to predominantly originating from Austin Avenue to the north (in the 2035 AM TCP scenario).

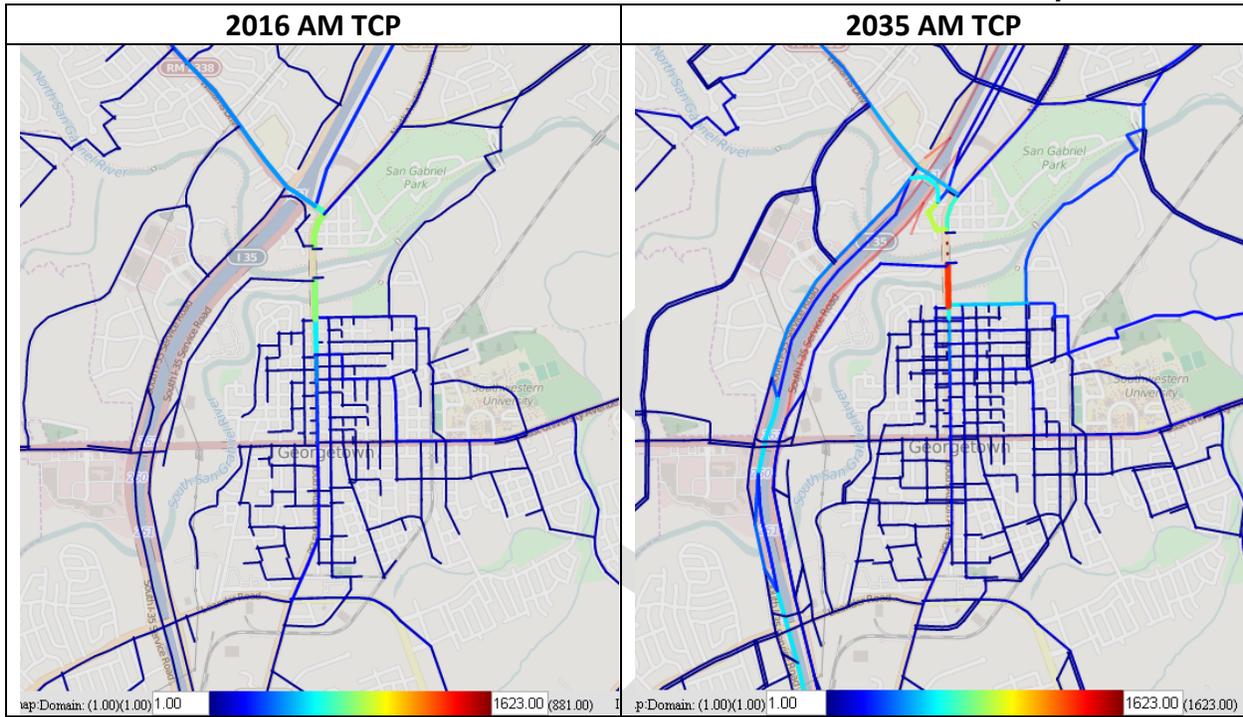
Because fewer vehicles take Williams Drive in 2035, there appears to be less dependency on Austin Avenue for vehicles traveling from the northwest (west of I-35). This is mostly due to increased capacity along I-35 in the 2035 model and additional north-south connections to the west (e.g., Southwest Inner Loop).

**Table 11. 2016 AM TCP and 2035 AM TCP Southbound Link Path Analysis**



Looking just at the traffic volume changes on roadway segments is not enough though. A comparison of the isochrone maps in the next section (Table 13) shows that there are travel time consequences for waiting until 2035 to implement the TCP on Austin Avenue.

**Table 8. 2016 AM TCP and 2035 AM TCP Northbound Link Path Analysis**



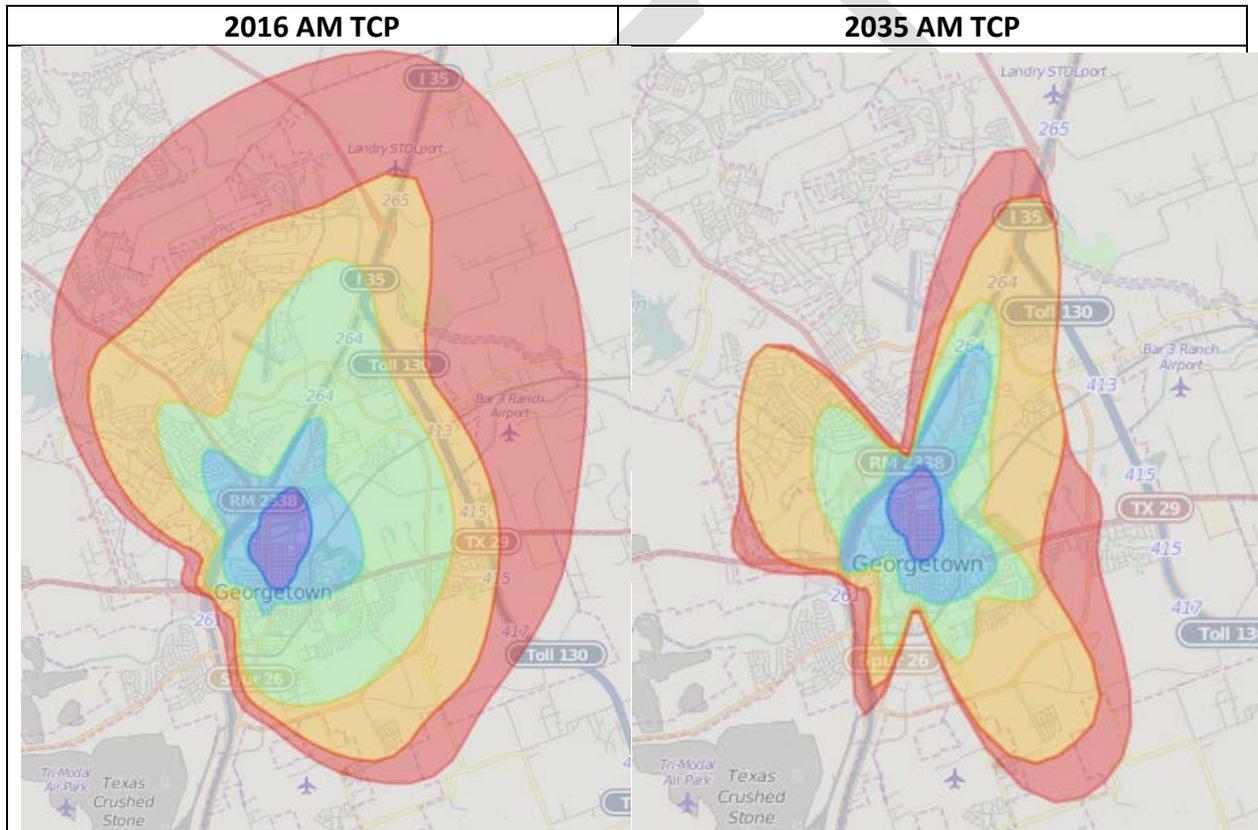
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***Isochrone***

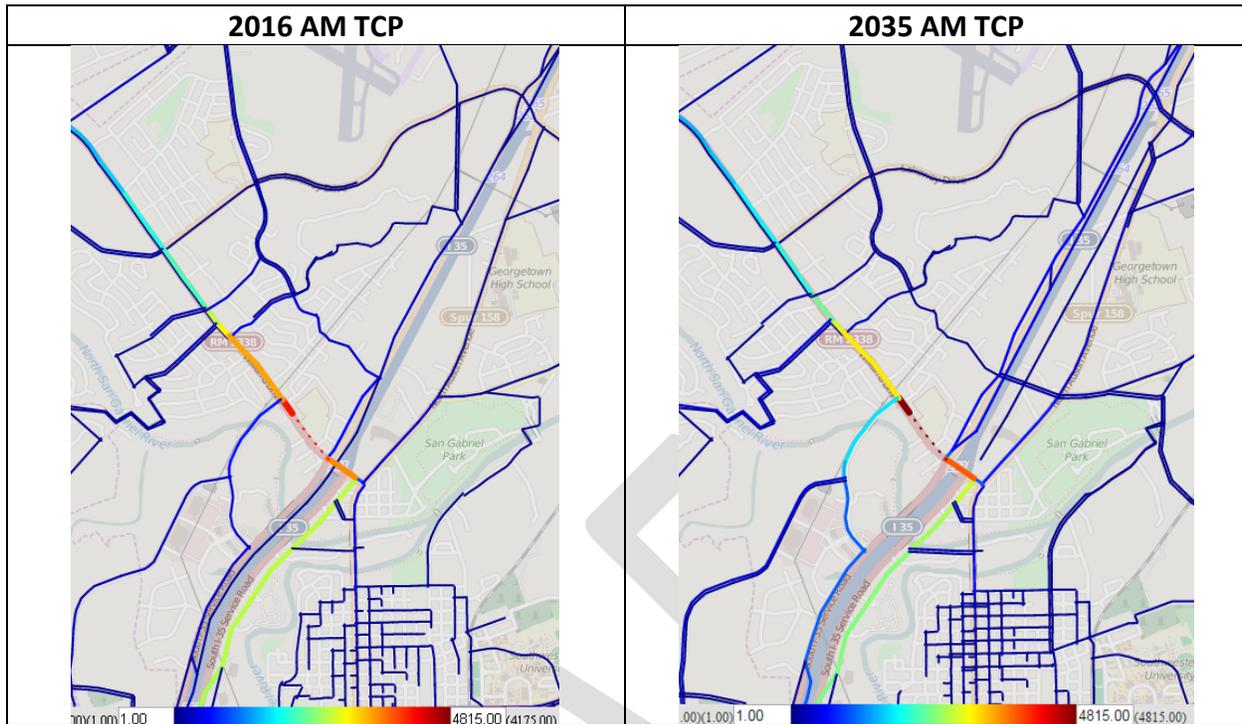
The 2016 AM TCP scenario, with significantly less network demand, overall has a better reach time than 2035 AM TCP (for most areas of Georgetown). The exception is in the southeast, most likely due to the changes expected to be completed in that area for 2035, such as the conversion of Southeast Inner Loop to a highway with frontage roads, which would allow for better travel times in the southeast direction.

The 2035 TCP scenario reach time is restricted especially in the northwest area of the subnetwork due to more traffic demand throughout the network, such as along Williams Drive where peak period traffic increases from 4,175 in 2016 to 4,815 in 2035 (Table 14).

**Table 9. 2016 AM TCP and 2035 AM TCP Travel Time Contours**



**Table 10. 2016 AM TCP and 2035 AM TCP Williams Drive Traffic Volume**



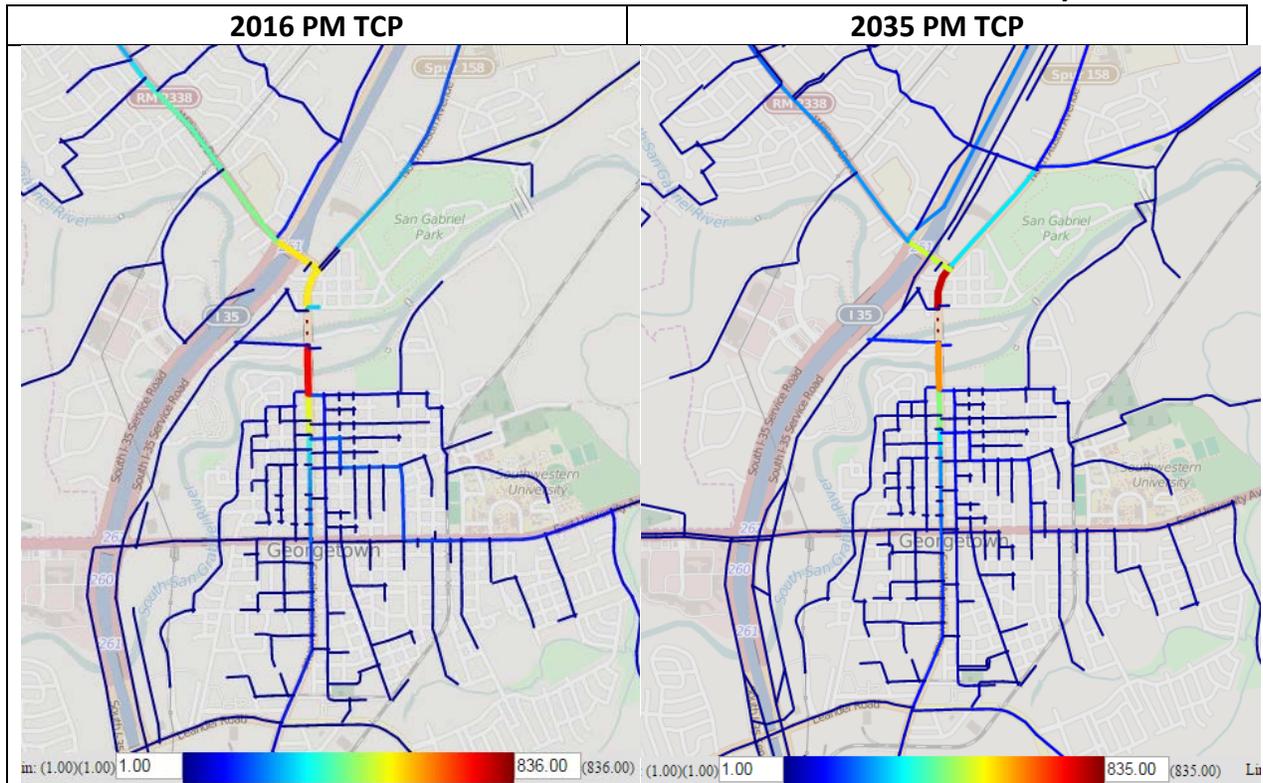
### 3.1.8 Compare 2016 PM TCP Scenario vs. 2035 PM TCP Scenario

#### *Select Link Path Analysis*

The amount of traffic traveling southbound on the northernmost Austin Avenue bridge is about the same with 835 and 836 vehicles for 2016 and 2035 PM TCP, respectively (Table 15). As with the TCP in the AM peak period, for the southbound bridge approach, more traffic volume exists on Williams Drive in 2016 compared to 2035. As mentioned before, that may be due to additional roadway options (such as Southwest Loop) west of Georgetown that help alleviate traffic demand on Williams Drive.



**Table 11. 2016 PM TCP and 2035 PM TCP Southbound Link Path Analysis**



Also, like the AM 2016 and 2035 TCP scenarios for the northbound bridge approach, Table 16 shows a higher traffic volume of 1,472 in 2035 compared to 978 in 2016. Contributing to this significant difference in traffic volume is the forecasted amount of demand in 2035 and, since the traffic on northbound I-35 in the PM in 2035 (25,791 vehicles) is heavier than in 2016 (16,642 vehicles), more traffic may have shifted from I-35 to Austin Avenue.

**Table 16. 2016 PM TCP and 2035 PM TCP Northbound Link Path Analysis**

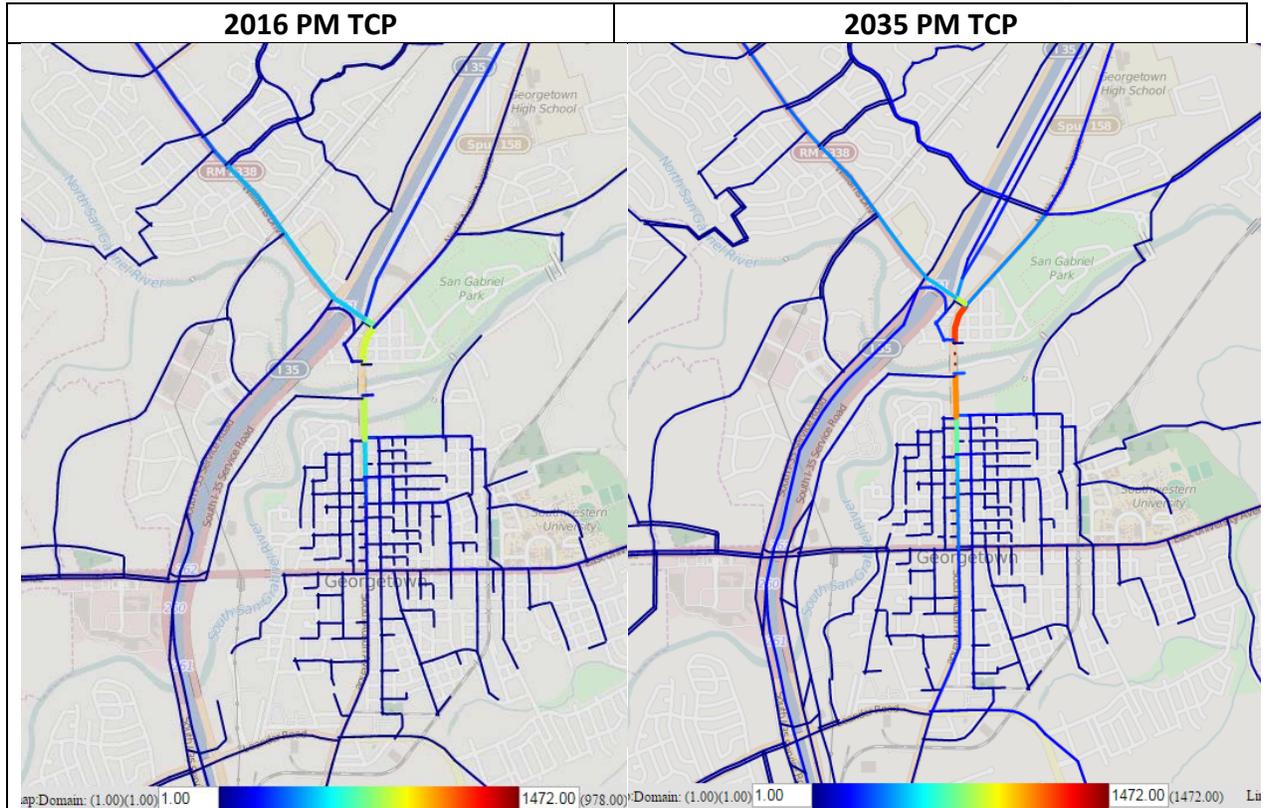
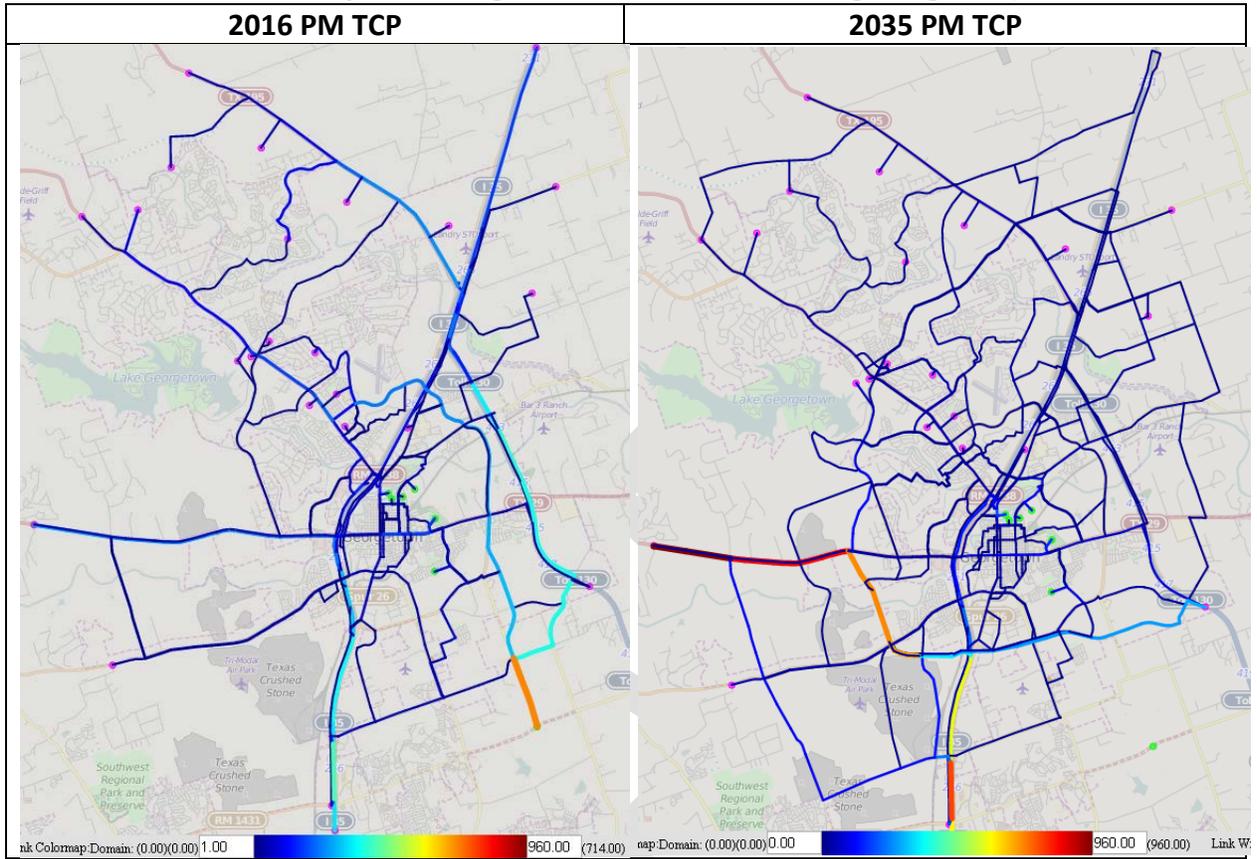


Table 17 shows, for origins (green) and destinations (purple) with at least 25% of their vehicle demand using the northernmost Austin Avenue bridge in the 2016 base scenario, that in 2035 PM the highest traffic volume (red links) occurs on SH 29 to the west due to high destination demand. Few vehicles from the selected origins to the selected destination use Austin Avenue in either scenario.

**Table 17. Northbound Bridge Approach Regional Flow Pattern (for origins and destinations with OD pairs having at least 25% demand using bridge link)**

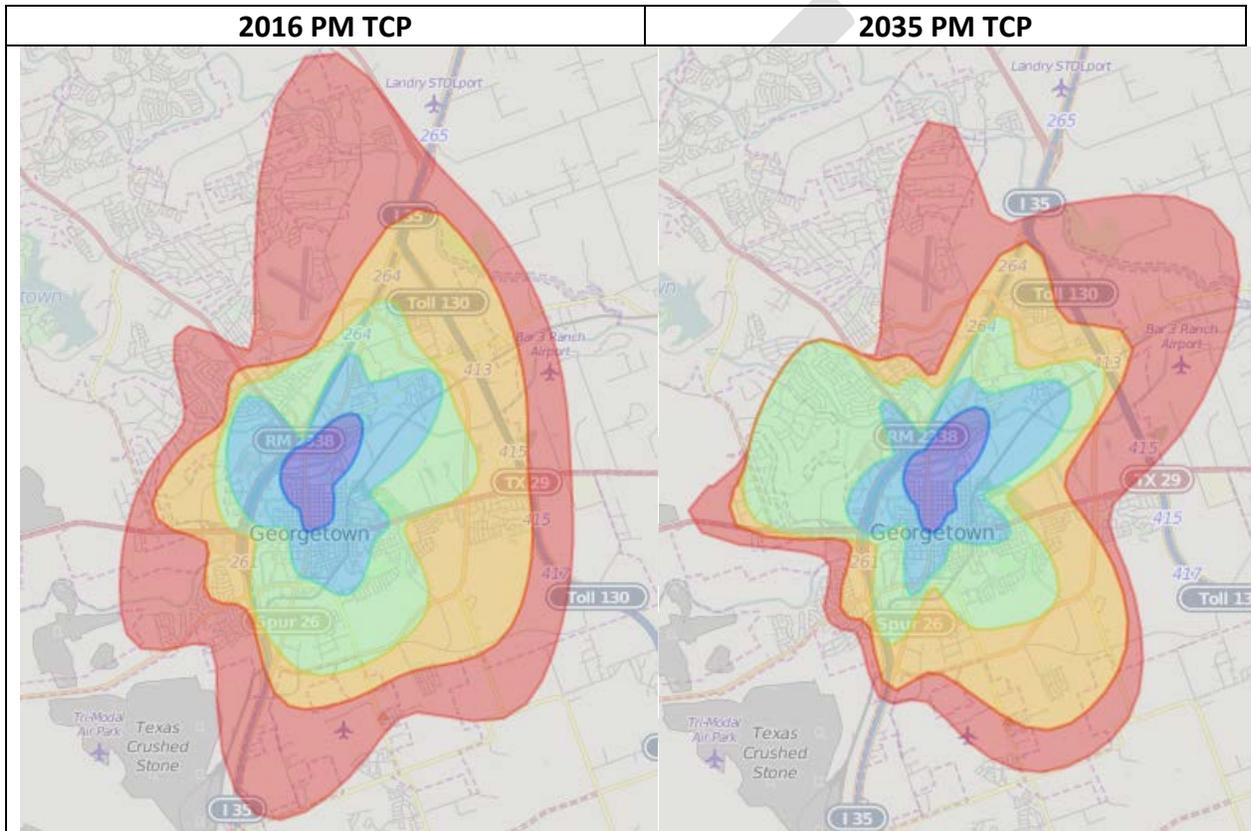


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***Isochrone***

A contraction of reach time occurs in the north/northwest and south direction with the implementation of the TCP in the year 2035 compared to 2016 (Table 18). However, again in the southeast area where the planned improvements for 2035 noticeably improve travel time in that area (such as the Southeast Inner Loop), the 2035 PM TCP scenario has better reach time, even with more demand to handle than 2016.

**Table 18. 2016 PM TCP and 2035 PM TCP Travel Time Contours**

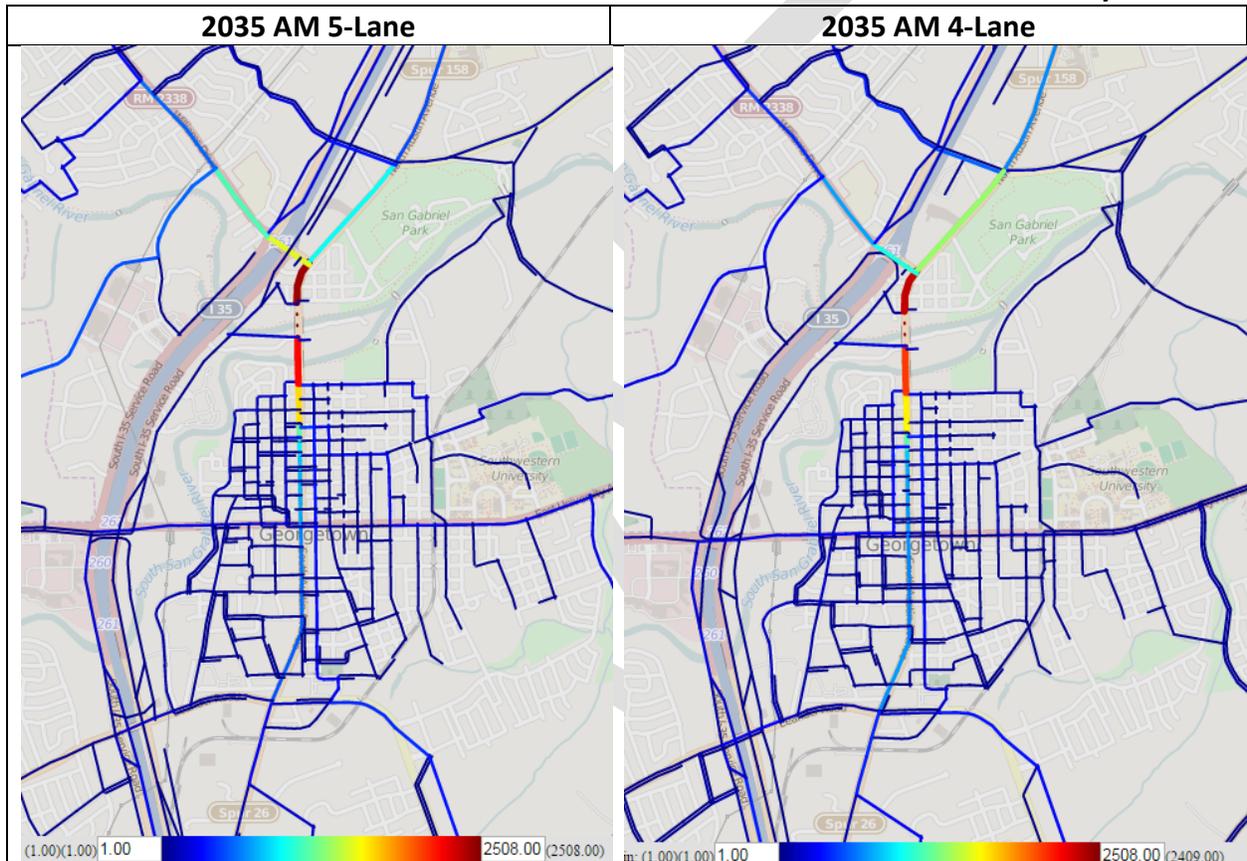


### 3.1.9 Compare 2035 AM 5-Lane Scenario vs. 2035 AM 4-Lane Scenario

#### Select Link Path Analysis

Interestingly, the link path analysis (Table 19) shows about the same total peak period traffic (2,508 and 2,409, respectively) for the five-lane and four-lane configurations for the Austin Avenue bridges. The provision of a left turn lane is a minor modification for this large scale of a model; therefore, the results often reveal only subtle differences, as is the case here.

**Table 19. 2035 AM 5-Lane and 2035 AM 4-Lane Southbound Link Path Analysis**



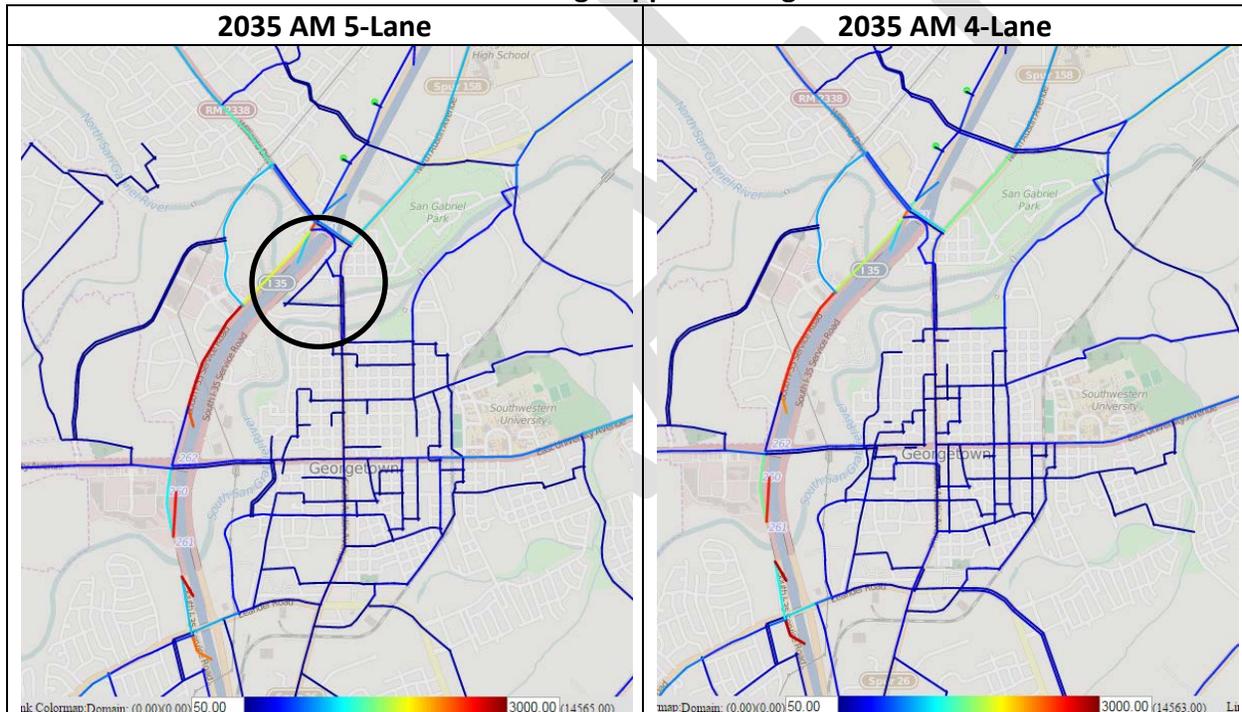
#### Routing Analysis

As with the select link analysis, the 2035 AM 5-Lane and 2035 AM 4-Lane scenarios share very similar results, although the color scale indicates a slightly higher traffic volume on I-35 frontage road in 5-Lane rather than in 4-Lane (Table 20), which is unexpected since vehicles may use I-35 as an alternate path to an Austin Avenue without a left turning lane. That finding applies specifically to the top origins and destinations selected, but a check of the traffic volume on the I-35 on-ramp link closest to Austin Avenue and Williams Drive, where those taking I-35 instead of Austin Avenue may enter the highway, shows that there is slightly more

on-ramp traffic in the 5-Lane scenario (4,926) than in 4-Lane scenario (4,561). The increase in traffic volume along the I-35 southbound frontage road seems to result from the extra traffic coming from the left-turn lane. There is a direct connect turnaround from the northbound frontage road to the southbound frontage road. It appears that the addition of the turn lane gave more vehicles access to the direct connect which is obviously faster than crossing the bridge and waiting at the lights.

Overall, aside from I-35, there is not much difference detected between the 5-Lane and 4-Lane scenarios in the routing analysis except twice as many vehicles travel on San Gabriel Village Boulevard to the west in between the bridges (for the selected OD pairs) (Table 20). The addition of the left turn lane in the 5-Lane model helps facilitate the left turn on to the street; that vehicle movement would be more difficult in the 4-Lane scenario.

**Table 20. Southbound Bridge Approach Regional Flow Pattern**

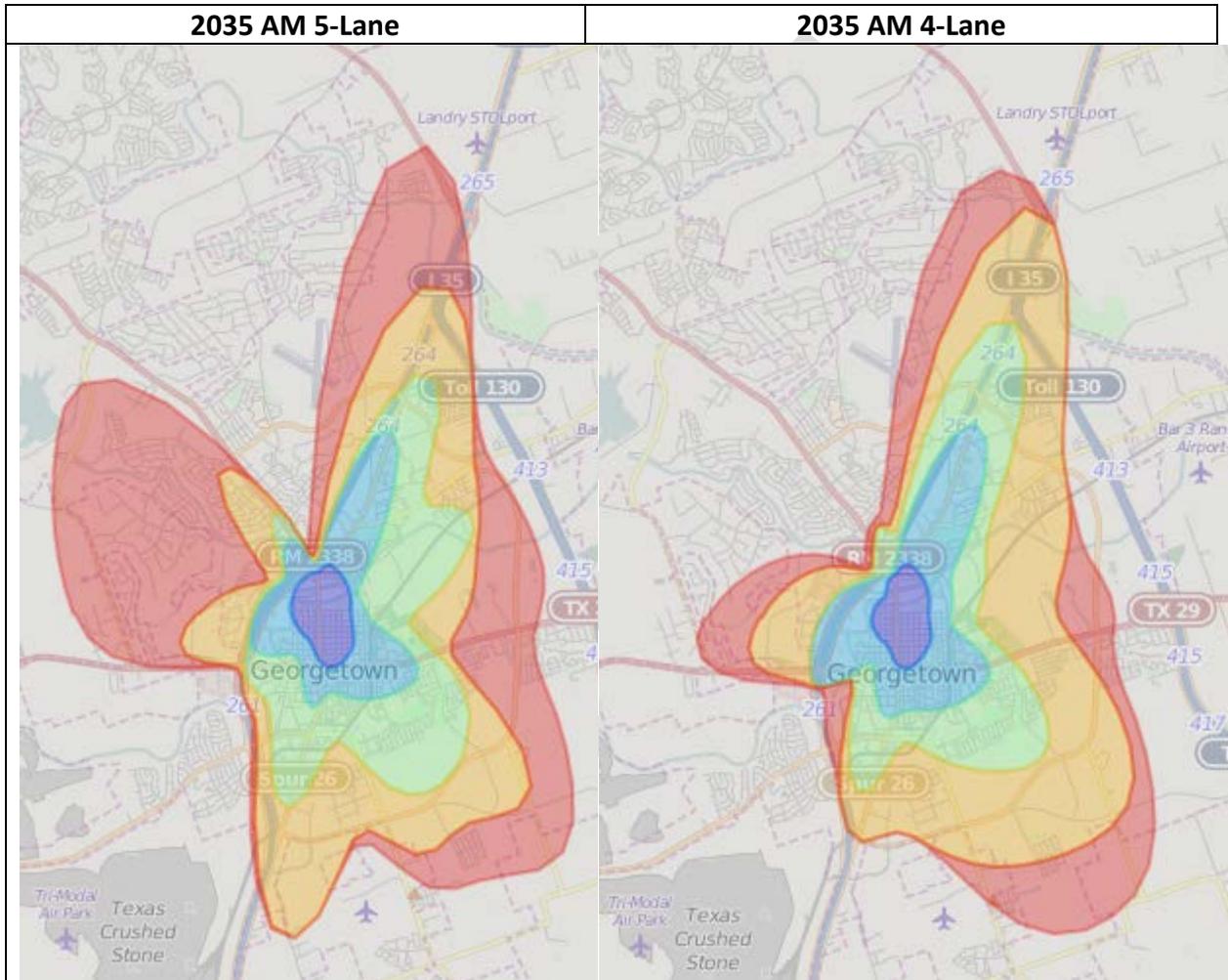


### *Isochrone*

The isochrones in Table 21 shows the 5-Lane scenario providing much better reach time notably for the west portion of the network, though the 4-Lane 2035 AM scenario shows better reach time to the east. Again, in the 5-Lane scenario, this is probably a result of commuters able to access the direct connect across I-35 rather than wait at the lights. With the only difference between the two networks being the number of lanes on the Austin Avenue bridge segments,

the differences in travel time contours may be due more to the travel time data particular to the origins in downtown Georgetown selected for this analysis, rather than to an overall impact on the network. However, the reach is contracted slightly along the north and south ends in the 4-Lane scenario in the central area (purple and blue contours) as would be expected (and confirmed by looking at Austin Avenue corridor travel times in Section 3.1.7).

**Table 21. 2035 AM 5-Lane and 2035 AM 4-Lane Travel Time Contours**

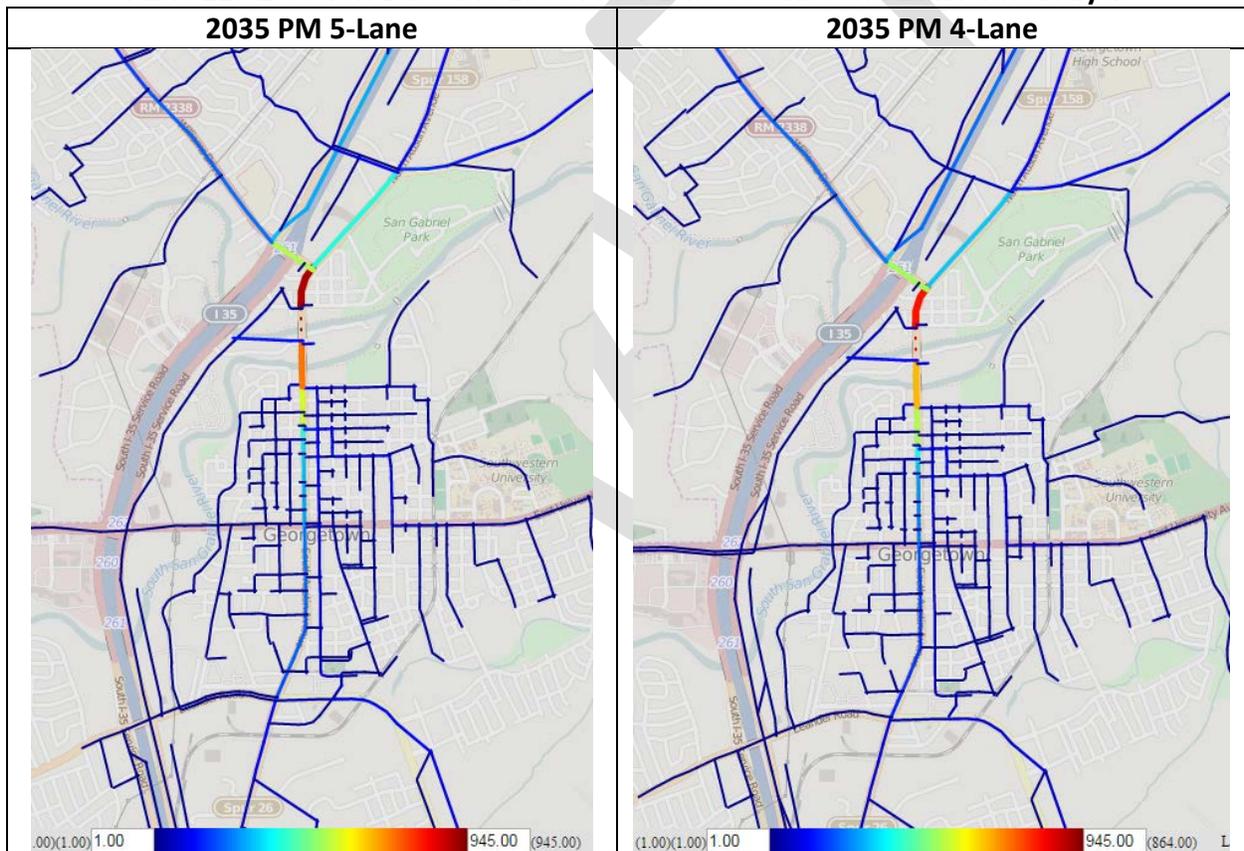


### 3.1.10 Compare 2035 PM 5-Lane Scenario vs. 2035 PM 4-Lane Scenario

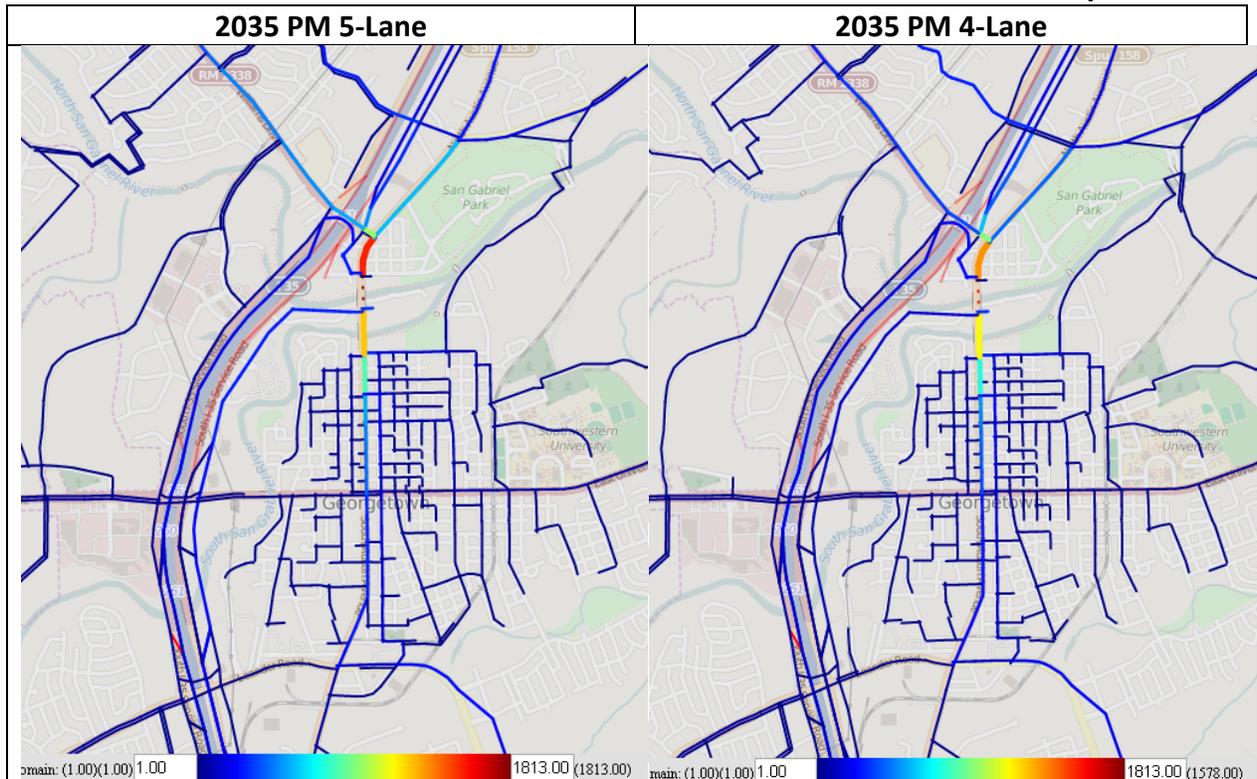
#### Select Link Path Analysis

In 2035 in the PM, the maximum amount of traffic traveling southbound on the northernmost Austin Avenue bridge (red links) in the 4-Lane scenario is slightly less (864) than the 5-Lane scenario (945) (Table 22). The 4-Lane scenario also has less traffic volume (1,578) compared to the 5-lane scenario (1,813) for the northbound approach to the northernmost Austin Avenue bridge (Table 23). This is the same pattern seen with the 2035 TCP scenario compared with the 2035 5-lane scenario. Reducing the capacity of the roadway, by either taking away left turn lanes or closing a travel through lane, results in a decrease in the number of vehicles choosing a path that uses the bridges.

**Table 12. 2035 PM Base and 2035 PM 4-Lane Southbound Link Path Analysis**



**Table 23. 2035 PM Base and 2035 PM 4-Lane Northbound Link Path Analysis**



**Routing Analysis**

As with the AM period, for the origins and destinations with demand of at least 100 that have some vehicles taking paths using the bridges in the base scenario, the 5-Lane and 4-Lane scenarios have similar maps of paths and almost the same maximum traffic (8,346 vs. 8,339) (Table 24). However, the minimum traffic volume value in the table shows that for the selected OD pairs, there are fewer vehicles using Austin Avenue bridges (only 1 vehicle in the 4-Lane scenario and 23 in the 5-Lane scenario) than compared to the 2035 AM peak period scenarios (which have at least 50 vehicles using Austin Avenue bridges).

At least for the selected OD pairs, the inclusion of a left turn line on the Austin Avenue segment does not appear to have much impact on the network.



Table 24. Southbound Bridge Approach Regional Flow Pattern – 2035 PM Peak

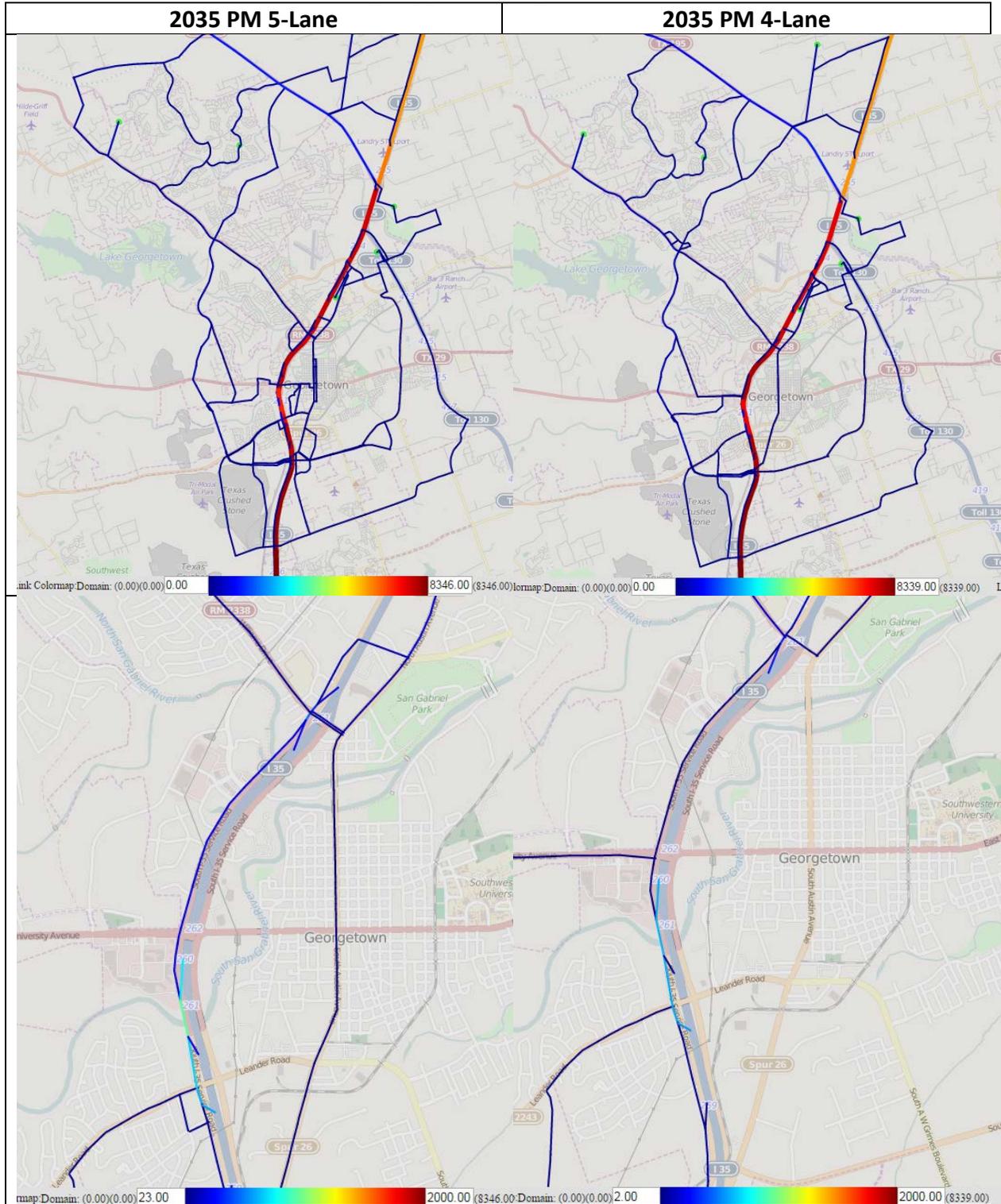


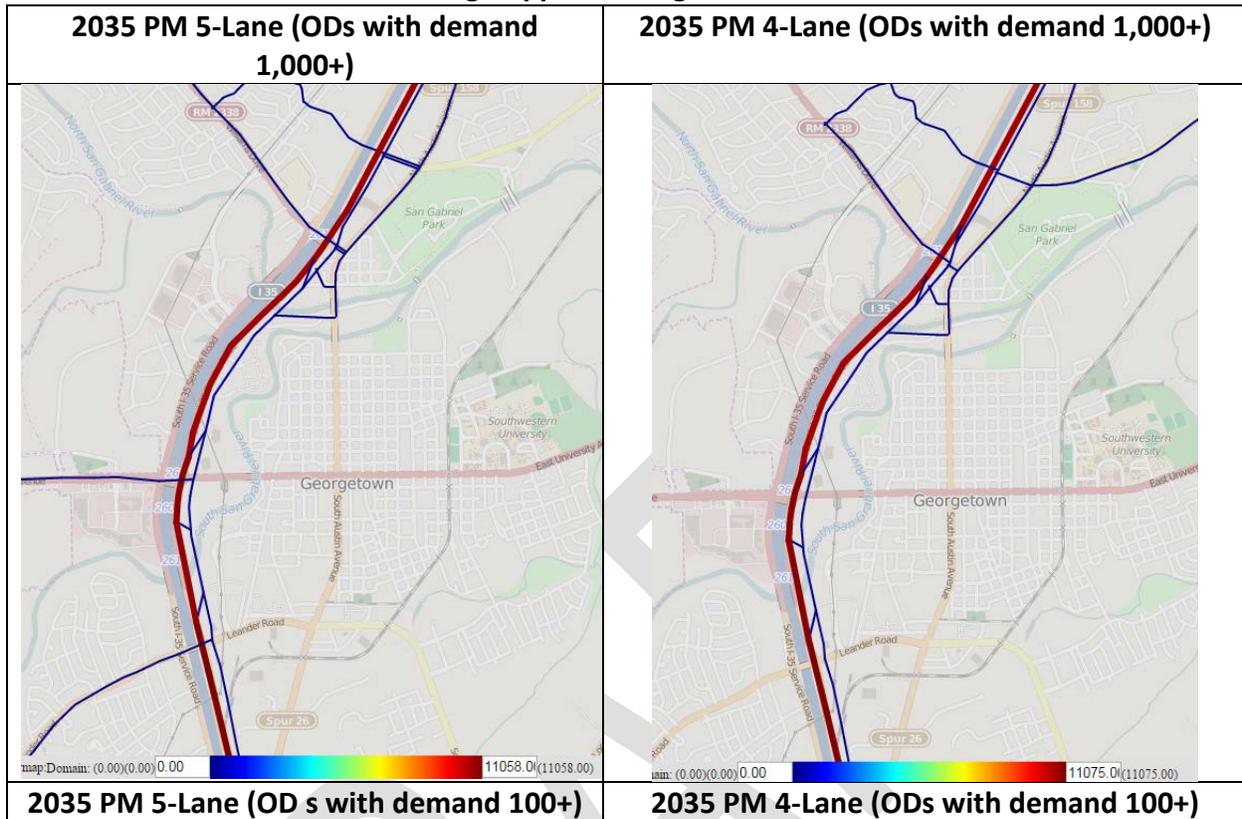


Table 25 shows that for the vehicles coming from and to the very high demand OD pairs (those with demand 1,000 or greater), the vehicle paths do not use the northbound northernmost Austin Avenue bridges in either the 5-Lane or 4-Lane scenario. The scenarios also appear similar when considering origins and destinations with demand of 100 or more. For those, the number of vehicles using the Austin Avenue bridges is about the same (57 for 5-Lane and 62 for 4-Lane). Again, it appears that the inclusion of a left turn line on the Austin Avenue segment does not appear to have much impact on the network.

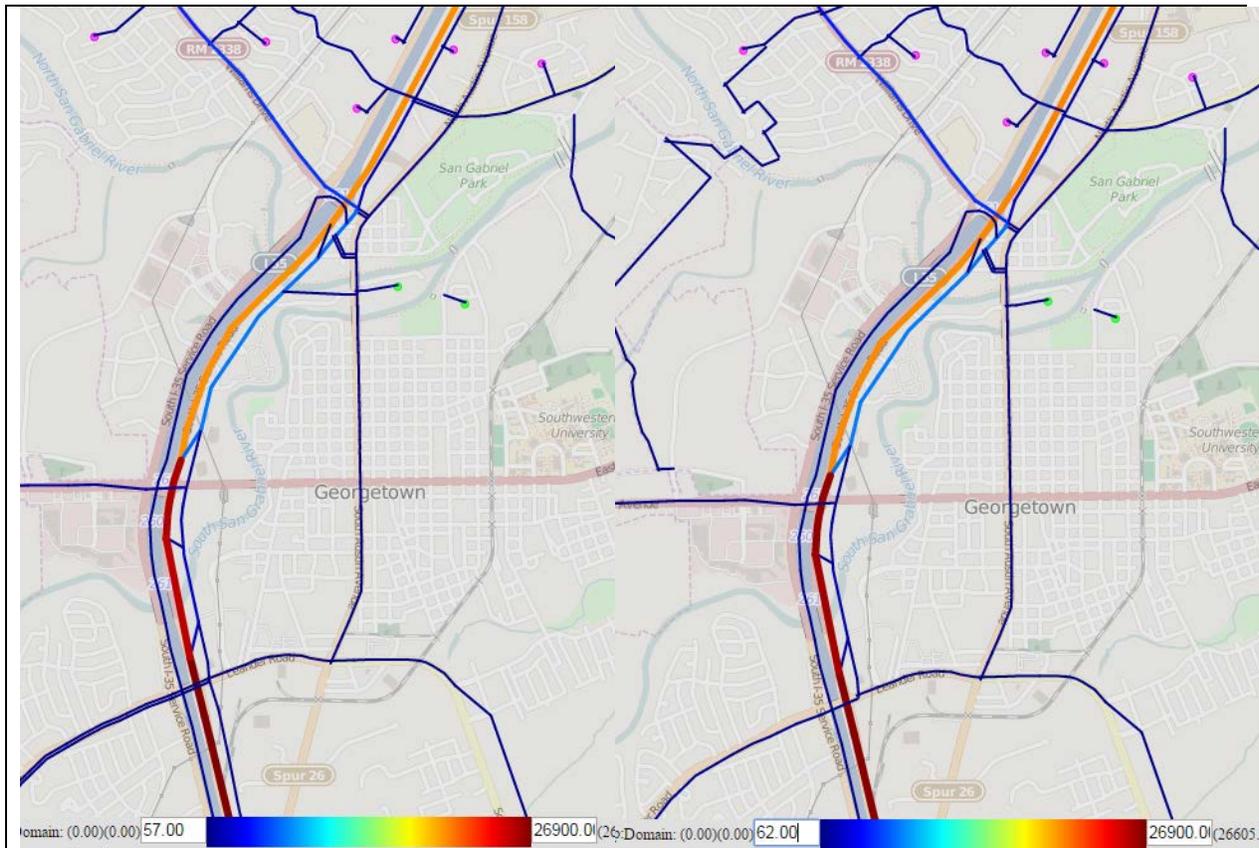
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**Table 25. Northbound Bridge Approach Regional Flow Pattern – 2035 PM Peak**



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### *Isochrone*

The reach from points near the Austin Avenue bridges at the north end of downtown to all the destinations appears slightly better in the 4-Lane scenario than the 5-Lane scenario in the west, northeast, and southeast directions during the 2035 PM peak period (Table 26). This result may be explained by reviewing the estimated travel times and volumes on Austin Avenue (see Tables 29 and 30). For the PM peak period:

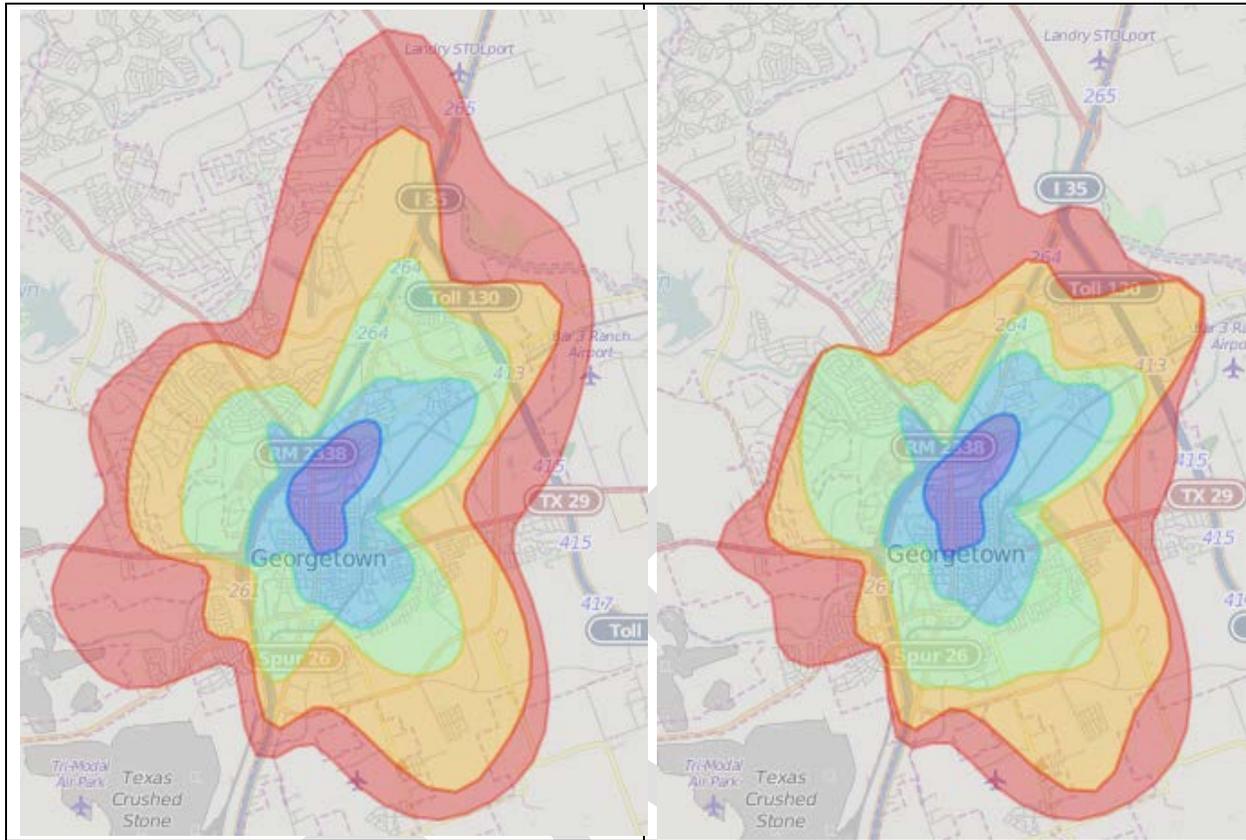
- Traffic volumes on Austin Avenue are less in the 4-Lane scenario compared to the 5-Lane scenario.
- Travel times on Austin Avenue are slightly less in the 4-Lane scenario.

That would explain seeing the larger purple, blue, and green contours in the 4-Lane scenario.

The vehicles that do not take the Austin Avenue bridges in the 4-Lane scenario (that would in the 5-Lane scenario) are using alternative paths. Their alternative paths may be negatively affecting travel times on those paths such that the reach time contracts in the other directions.

**Table 26. 2035 PM 5-Lane and 2035 PM 4-Lane Travel Time Contours**

| 2035 PM 5-Lane | 2035 PM 4-Lane |
|----------------|----------------|
|----------------|----------------|



### 3.1.11 Travel Time and Volume Data

This section identifies the average travel time and volumes along the Austin Avenue corridor during the AM and PM peak periods obtained from the DTA models. Table 27 shows a comparison of northbound and southbound travel times along Austin Avenue between Madison Oaks Avenue and FM 971.

**Table 27. Estimated Travel Time (Minutes) for Austin Avenue – 2016 Conditions**

| Direction             | Morning Peak |        | Afternoon Peak |        |
|-----------------------|--------------|--------|----------------|--------|
|                       | AM           | AM TCP | PM             | PM TCP |
| Northbound Austin Ave | 6.8          | 6.8    | 6.9            | 7.0    |
| Southbound Austin Ave | 10.1         | 11.9   | 7.3            | 7.5    |

The travel time values indicate that the closure of a lane along Austin Avenue does not result in a large increase in the corridor travel time with the exception of the southbound direction in the AM peak period due to relatively lower traffic volumes in the model, influenced in part due to vehicles changing paths. Lower volumes indicate that traffic is not congested in the model in this section in the off-peak directions, and as a result, the travel times between scenarios are



similar. Table 28 shows the traffic volume taken from the 2016 DTA models at the two San Gabriel River bridge locations.

**Table 28. Estimated Volumes (Peak Hour) for Austin Avenue – 2016 Conditions**

| Direction                             | Morning Peak |        | Afternoon Peak |        |
|---------------------------------------|--------------|--------|----------------|--------|
|                                       | AM           | AM TCP | PM             | PM TCP |
| Northbound Austin Ave at North Bridge | 318          | 293    | 319            | 347    |
| Northbound Austin Ave at South Bridge | 331          | 300    | 279            | 304    |
| Southbound Austin Ave at North Bridge | 1,358        | 797    | 334            | 269    |
| Southbound Austin Ave at South Bridge | 1,459        | 959    | 393            | 322    |

Like the travel times, the volumes at the north and south bridges are not very different between the scenarios except for the southbound direction during the AM peak period. As discussed earlier, uncongested conditions due to lower traffic volumes result in relatively small differences between scenarios. It appears that the longer travel time for the southbound direction during the AM peak results in fewer vehicles using the corridor. It appears that the longer travel time results in fewer vehicles using the corridor. This is substantiated by the select path analysis that showed a total reduction in vehicles on Austin Avenue bridges in the 2016 TCP AM and PM scenarios.

For 2035, three different scenarios were evaluated for the AM and PM peak periods, Austin Avenue 5-lane section, Austin Avenue 4-lane section, and the Austin Avenue TCP (1-lane) section. Table 29 shows a comparison of northbound and southbound travel times along Austin Avenue for each scenario.

**Table 29. Estimated Travel Time (Minutes) for Austin Avenue – 2035 Conditions**

| Direction                | Morning Peak |      |        | Afternoon Peak |      |        |
|--------------------------|--------------|------|--------|----------------|------|--------|
|                          | AM 5         | AM 4 | AM TCP | PM 5           | PM 4 | PM TCP |
| Northbound Austin Avenue | 7.2          | 7.2  | 14.5   | 7.2            | 7.2  | 7.2    |
| Southbound Austin Avenue | 8.3          | 9.5  | 17.7   | 8.0            | 7.8  | 8.0    |

The travel time values indicate the following:

- The closure of a lane along Austin Avenue does not result in a large increase in the corridor travel time during the PM peak, but does result in a noticeably higher travel time for the AM peak in both directions.



- Provision of left turn lanes appears to result in little change for the corridor in the model, with the exception of the southbound direction during the AM peak, which consistently had the highest traffic volume within each scenario.
- There are noticeable increases in travel time for the AM peak in 2035 compared to 2016 conditions, particularly in the southbound direction.
- It should be noted that during the AM peak, the travel times were taken for the first two hours of simulation for the model. Beyond the first two hours, congestion along SH 29 creates gridlock conditions at Austin Avenue, causing corridor travel times to increase dramatically and skew the results.
- The PM peak period reveals a consistent travel time for the corridor.

Table 30 shows the traffic volume taken from the 2035 DTA models at the two San Gabriel River bridge locations. The model volumes at the north and south bridges for the AM peak period show little difference between the scenarios with and without left-turn lanes, though volumes are generally lower for the TCP scenario. Since the travel times were approximately equal or higher for the 4-lane configuration and the TCP scenario, this is indicative of congestion on nearby north-south corridors, notably I-35, and the inability for vehicles to adjust their paths to avoid congestion on Austin Avenue.

For the PM peak, the 5-lane roadway configuration has consistently higher volumes than both the other scenarios. Overall, the 2035 volumes along the corridor are much higher than 2016, with the exception of the southbound direction during the AM peak. These patterns are illustrated and discussed in more detail in Sections 3.1.1 through 3.1.6. Congestion along I-35 and SH 29 in the area during this period noticeably influences the use of Austin Avenue. Gridlock conditions along SH 29 during the AM peak period result in vehicles re-routing away from Austin Avenue in the 2035 scenario models. Thus the southbound volume is lower in the model for 2035 than 2016 even with more network demand.

**Table 30. Estimated Volumes (Peak Hour) for Austin Avenue – 2035 Conditions**

| Direction                             | Morning Peak |      |        | Afternoon Peak |      |        |
|---------------------------------------|--------------|------|--------|----------------|------|--------|
|                                       | AM 5         | AM 4 | AM TCP | PM 5           | PM 4 | PM TCP |
| Northbound Austin Ave at North Bridge | 700          | 630  | 581    | 636            | 507  | 604    |
| Northbound Austin Ave at South Bridge | 868          | 887  | 757    | 469            | 421  | 434    |
| Southbound Austin Ave at North Bridge | 841          | 863  | 796    | 319            | 290  | 288    |
| Southbound Austin Ave at South Bridge | 950          | 984  | 918    | 377            | 348  | 340    |



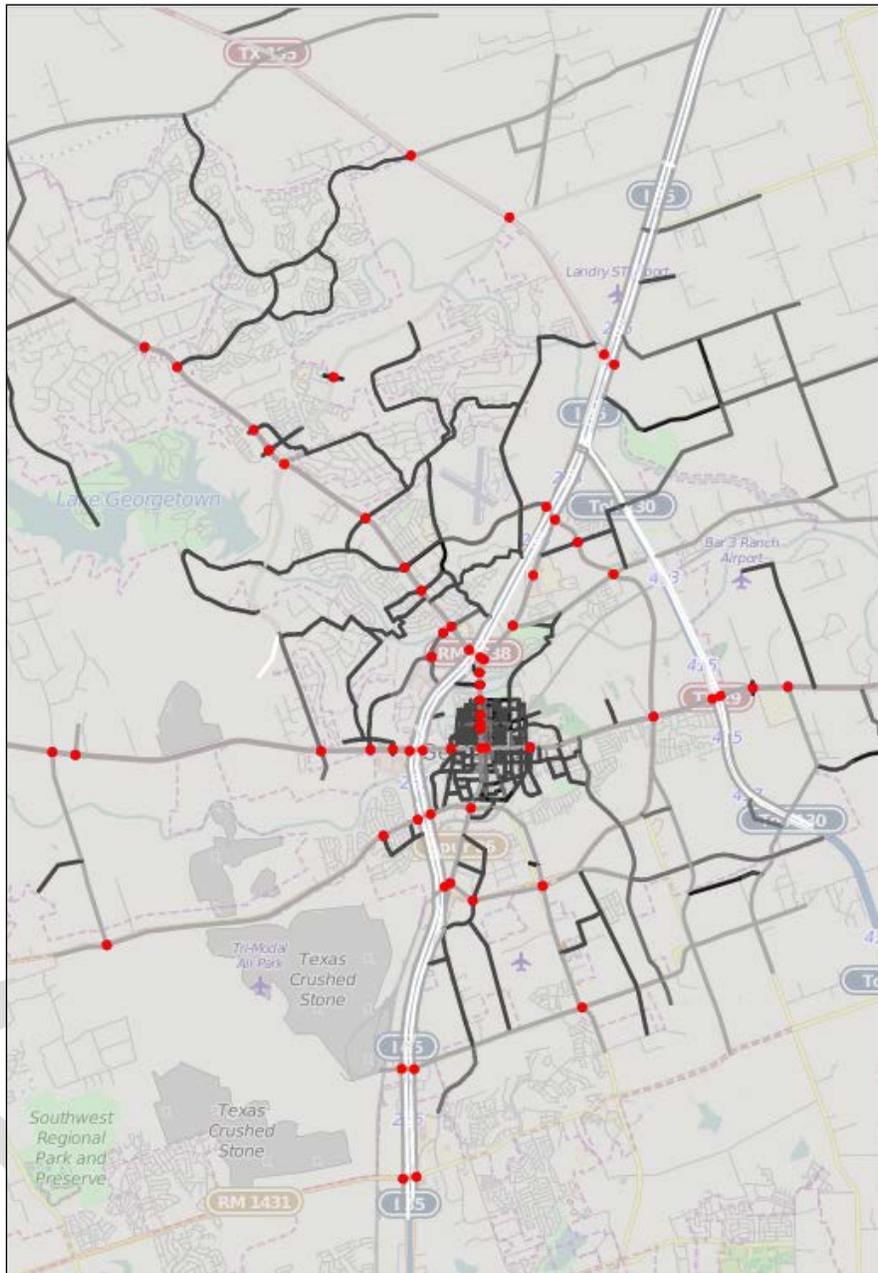
### 3.1.12 Signalized Intersections

The DTA program can estimate the signal delay at signalized intersections, and the Viztool can render visual representations of the results. This analysis was done for four scenarios:

- 2016 AM non-TCP
- 2016 PM non-TCP
- 2035 AM non-TCP
- 2035 PM non-TCP

Signals in the DTA model approximate delay according to the signal timing plans. However, the resolution of DTA is too coarse to recommend particular signal timing plans for implementation. Nonetheless, the Viztool can be used to estimate delays in the model attributable to input traffic signal control for determining the relative performance of each signalized intersection in the network. Signal timing plans throughout the modeled area were obtained from area agencies to include in the model. However, these timing plans do not necessarily represent the optimized plan for each intersection for 2016 or 2035 conditions. While these provide estimates for controlling movements at the intersections, they are effectively approximations of appropriate control at these locations.

Figure 7 shows the location of the signals in the 2016 network. Additional signals were added as deemed plausible because of new roadway segments in the 2035 network per planned improvements. This brought the number of signalized intersections up from 61 to 75.



**Figure 7. Traffic Signals in 2016 Georgetown Subnetwork**

***Network-Wide Signal Analysis***

These conclusions are drawn from a broad scope analysis. Specific intersections and corridors in are addressed through more in-depth analysis discussed in subsequent sections. The following are main conclusions resulting from the analysis of the performance of the intersections in the model runs:

- Delays in the AM scenarios are much higher than in PM scenarios.

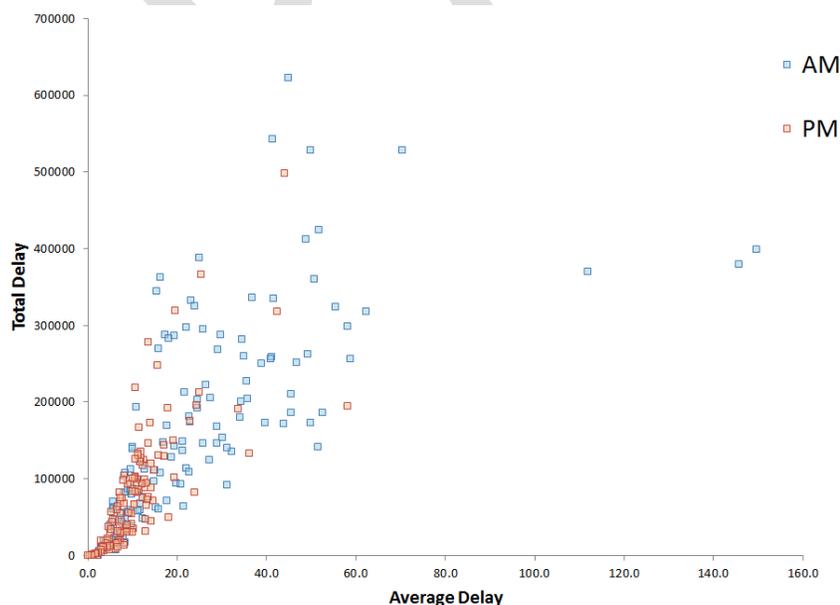
- As expected, delays worsen from 2016 to 2035.
- The 2016 PM model represents the only scenario to show no long delays (>55 seconds).

Table 31 shows the maximum, minimum, average, and standard deviation in intersection signal delay (per vehicle) for the four scenarios.

**Table 13. Network-wide Aggregate Performance**

| Year                     | 2016 AM | 2035 AM | 2016 PM | 2035 PM |
|--------------------------|---------|---------|---------|---------|
| Maximum (sec)            | 111.9   | 149.8   | 36.3    | 58.1    |
| Minimum (sec)            | 0       | 0.1     | 0       | 0       |
| Average (sec)            | 18.5    | 28.2    | 9.3     | 11.3    |
| Standard Deviation (sec) | 18.3    | 25.9    | 6.6     | 9.6     |

Network-wide, there seems to be noticeably less delay in the PM peak scenarios. The higher delay values seen for the AM peak period reflect the significant number of high delay intersections in both 2016 and 2035 AM. Figure 8 shows the difference between AM and PM in terms of delay. The x-axis represents the *Average Delay (per vehicle)* and the y-axis is the *Total Delay*. The *Average Delay* is calculated as the average amount of delay, in seconds, a car spends at an intersection. The *Total Delay* is the cumulative sum of all delay experienced at an intersection in seconds. The spread and range of data for the AM peak demonstrates that many of the signals are functioning worse in the AM peak when compared to the PM peak for both modeled years.



**Figure 8. Delay Distribution AM vs PM**

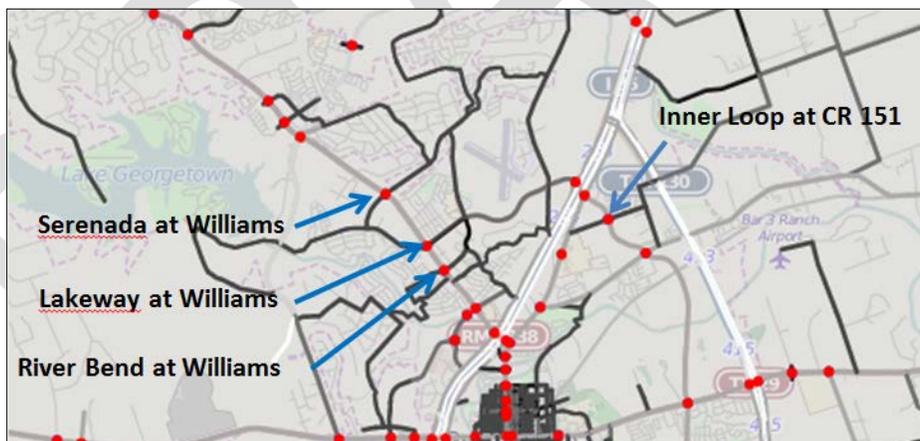
### Intersections of Interest

The City of Georgetown staff provided a list of intersections for review in the model based on reported performance. The DTA analysis includes an assessment of signalized intersection delay but not un-signalized intersection delay. Therefore, only four of the intersections of interest are part of the detailed intersection delay analysis. Figure 9 shows the location of these four intersections. Table 32 lists the intersections of interest (TWSC: two-way stop control; AWSC: all-way stop control).

**Table 32. Intersections of Interest**

| Street 1               | Street 2               | Actual Control |
|------------------------|------------------------|----------------|
| Southwestern Blvd      | Inner Loop             | TWSC           |
| Inner Loop             | CR 151 (Stadium Drive) | Signal         |
| CR 151 (Stadium Drive) | Austin Avenue          | TWSC           |
| Shell Road             | Shell Spur Road        | TWSC*          |
| Lakeway Drive          | Northwest Blvd         | AWSC           |
| Lakeway Road           | Airport Road           | AWSC           |
| River Bend             | Williams Drive         | Signal*        |
| Lakeway Drive          | Williams Drive         | Signal*        |
| Serenada Drive         | Williams Drive         | Signal*        |

\*Those intersections identified for special consideration by City staff



**Figure 9. Signalized Intersections of Interest**

Table 33 shows the average delay experienced at each intersection and how the intersections rank in terms of worst average vehicle delay. (e.g., Williams @ Lakeway ranks 9th in 2016 AM, which means this intersection has the ninth worst delay out of 61 intersections). Again, the 2035 model has 75 intersections.

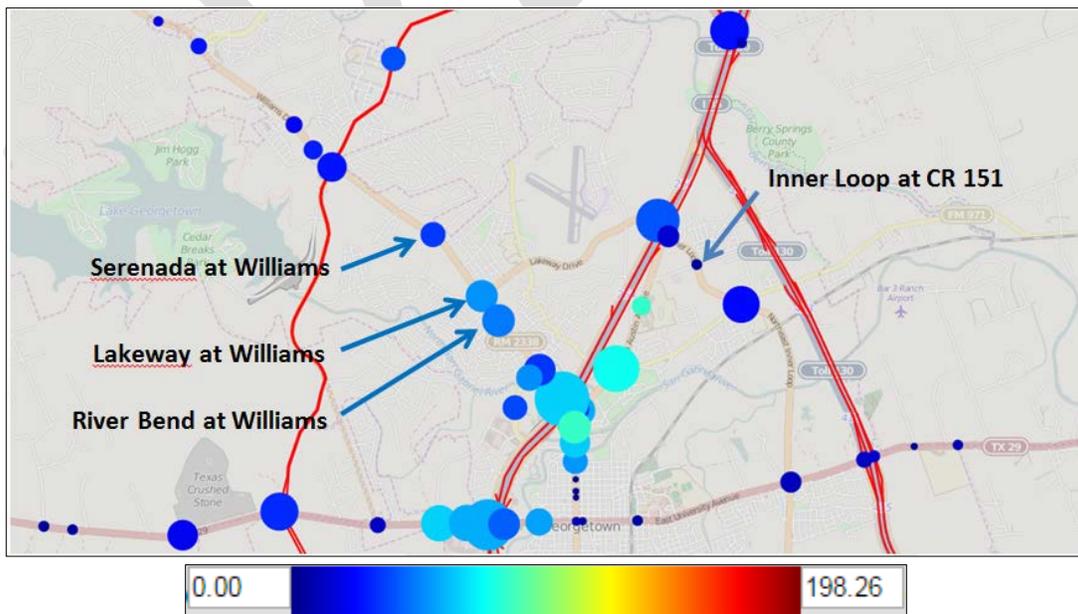
**Table 33. Intersections of Interest**

| Name/Year             | 2016 AM |      | 2035 AM |      | 2016 PM |      | 2035 PM |      |
|-----------------------|---------|------|---------|------|---------|------|---------|------|
| Williams @ Lakeway    | 34.3s   | 9th  | 35.0s   | 23rd | 19.2s   | 5th  | 24.3s   | 7th  |
| Williams @ River Bend | 21.3s   | 20th | 34.6s   | 24th | 14.3s   | 12th | 12.2s   | 20th |
| Williams @ Serenada   | 3.6s    | 55th | 24.6s   | 33rd | 2.9s    | 54th | 15.9s   | 9th  |
| Inner Loop @ CR 151   | 6.1s    | 49th | 5.7s    | 70th | 4.1s    | 48th | 5.5s    | 58th |

The average delays were determined by looking at a 4-hour time period. None of these intersections appear to contribute as significantly to overall system performance as other intersections in the network. However when broken down into 1-hour segments there are a noticeable peaks in delay.

- Williams @ Lakeway showed average delays over **50 seconds** during three analyzed 1-hour time periods. Once in 2016 AM and twice in 2035 AM.
- Williams @ River Bend showed average delays over **50 seconds** once in 2016 AM.
- Williams @ Serenada showed average delays over **60 seconds** once in 2035 AM.

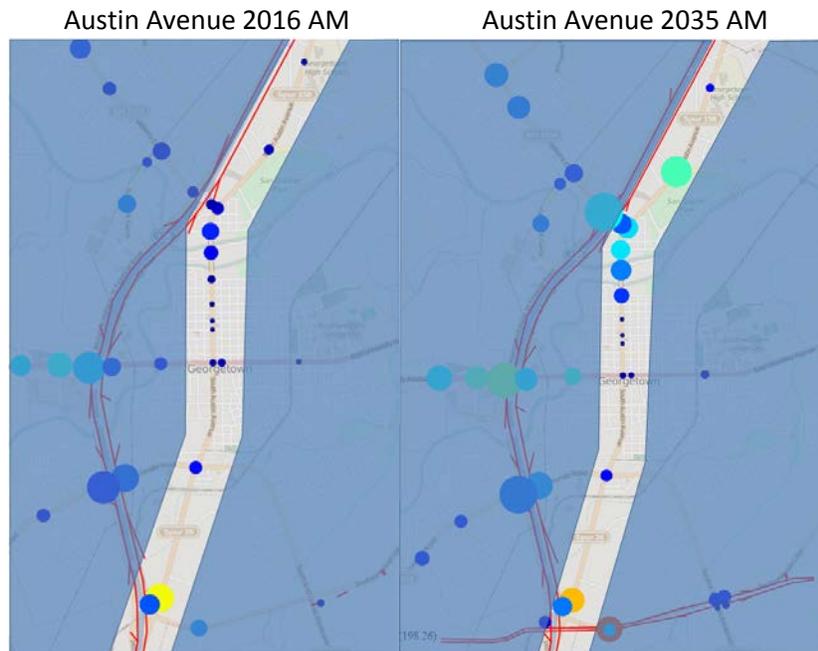
Figure 10 shows an output of Viztool, which clearly shows that these four intersections are not as heavily delayed as others. In the figure, the size of the circle represents *Total Delay* whereas the color represents *Average Delay*. Larger circles represent higher total delays at the intersection. The color ranges from dark blue to green to red, where red represents the worst delay experienced in the network.



**Figure 10. Significance of Intersections of Interest**

### Corridors of Interest

The City of Georgetown was also interested in the Williams Drive and Austin Avenue corridors. Most of the delay in both of the corridors occurred near their intersection east of I-35. Figures 11 and 12 show the distribution of delay along Austin Avenue, and Figures 13 and 14 show the delay along Williams Drive.



**Figure 11. Austin Avenue Corridor**

| 2016 AM                                 |         |          |          |          |          | 2035 AM                                 |         |          |          |          |          |
|---|---------|----------|----------|----------|----------|---|---------|----------|----------|----------|----------|
| Intersection Name                       | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour | Intersection Name                       | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour |
| Austin Ave. @ SE Inner Loop             | 1       | 81.9     | 121.7    | 115.4    | 139.7    | Austin Ave. @ SE Inner Loop             | 1       | 161.8    | 137.0    | 139.5    | 162.4    |
| Austin Ave. @ Leander Rd.               | 15      | 9.7      | 25.6     | 59.4     | 46.7     | Austin Ave. @ West Morrow St.           | 5       | 18.9     | 69.5     | 84.5     | 78.4     |
| Austin Ave. @ San Gabriel Village Blvd. | 19      | 22.3     | 22.0     | 22.3     | 21.5     | Austin Ave. @ San Gabriel Village Blvd. | 13      | 20.7     | 49.5     | 64.7     | 65.3     |
| Austin Ave. @ West Morrow St.           | 21      | 8.5      | 6.9      | 84.6     | 28.3     | Austin Ave. @ FtM Rd. 971               | 17      | 19.2     | 88.2     | 76.1     | 23.4     |
| Austin Ave. @ W University Ave.         | 22      | 15.1     | 30.5     | 14.0     | 5.4      | Austin Ave. @ Williams Dr.              | 20      | 19.9     | 67.9     | 58.4     | 33.3     |
| Austin Ave. @ Williams Dr.              | 29      | 11.1     | 14.5     | 11.3     | 9.7      | Austin Ave. @ Leander Rd.               | 25      | 9.2      | 24.3     | 62.1     | 88.9     |
| Austin Ave. @ FtM Rd. 971               | 32      | 11.8     | 11.9     | 11.1     | 4.2      | Austin Ave. @ W 2nd St.                 | 29      | 7.0      | 34.3     | 53.6     | 31.5     |
| Austin Ave. @ NE Inner Loop             | 42      | 8.5      | 8.1      | 8.0      | 6.0      | Austin Ave. @ Georgetown HS             | 40      | 5.7      | 24.3     | 84.2     | 2.9      |
| Austin Ave. @ W 2nd St.                 | 51      | 4.4      | 6.0      | 6.4      | 1.6      | Austin Ave. @ NE Inner Loop             | 56      | 9.6      | 9.2      | 15.8     | 4.4      |
| Austin Ave. @ Georgetown HS             | 53      | 4.9      | 5.2      | 5.1      | 3.5      | Austin Ave. @ W University Ave.         | 60      | 8.3      | 8.5      | 10.3     | 8.9      |
| Austin Ave. @ W 5th S.                  | 56      | 4.2      | 3.1      | 2.4      | 2.9      | Austin Ave. @ W 7th St.                 | 71      | 2.8      | 3.0      | 3.9      | 2.5      |
| Austin Ave. @ W 7th St.                 | 57      | 2.9      | 2.8      | 2.9      | 3.5      | Austin Ave. @ W 5th S.                  | 72      | 3.1      | 2.1      | 1.7      | 3.3      |
| Austin Ave. @ W 8th St.                 | 58      | 2.8      | 2.1      | 1.7      | 4.0      | Austin Ave. @ W 8th St.                 | 73      | 3.2      | 2.2      | 1.9      | 1.4      |

**Figure 12. Austin Avenue Corridor Delay Distribution**



In Figure 12, the first and sixth hours of the simulation are not included in the delay analysis since the network is loading and unloading during these periods. The second through fifth hour of simulation provide a more accurate model of traffic delay representative of the peak period. Figure 12 is a ranking based on average delay from the second through fifth hour. SE Inner Loop clearly experiences the highest average delay along the Austin Avenue corridor. However, the majority of delay is concentrated around the Austin Avenue @ Williams Drive intersection. There is almost no delay at the 5<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> Street intersections, and the discrepancy between those three locations and the intersections near Williams Drive gets larger in 2035.

One interesting case is Georgetown HS during the 4<sup>th</sup> hour of simulation in 2035. The overall delay is rather low, but there is a spike in the 4<sup>th</sup> hour with delay = 84.2 seconds. On the other hand, the delay in 2016 does not get higher than 6 seconds. The two intersections with the largest increase in delay are Austin Avenue @ 2<sup>nd</sup> Street and Austin Avenue @ Georgetown HS. The intersection with the largest decrease in delay is Austin Avenue @ W University Avenue. If you look at the rankings in Figure 12, remembering that there are 61 intersections in 2016 and 75 in 2035, the ranking of the Austin Avenue corridor in the scope of the network almost stays the same. Although individual intersections along Austin Avenue got worse or better, as a corridor, its delay grew evenly with the network's delay.



**Figure 13. Williams Drive Corridor Delay**

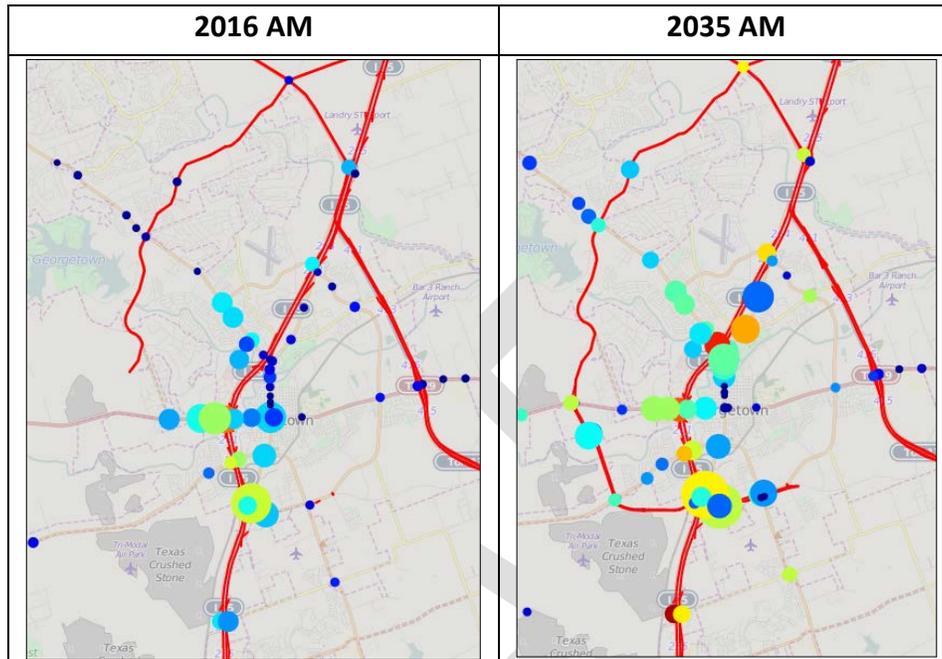
| 2016 AM                       |         |          |          |          |          | 2035 AM                       |         |          |          |          |          |
|-------------------------------|---------|----------|----------|----------|----------|-------------------------------|---------|----------|----------|----------|----------|
| Intersection Name             | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour | Intersection Name             | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour |
| Williams Dr. @ Lakeway Dr.    | 9       | 25.2     | 33.4     | 49.2     | 59.9     | Williams Dr. @ I-35 SB FR     | 10      | 25.9     | 74.1     | 65.3     | 54.5     |
| Williams Dr. @ Rivery Blvd.   | 20      | 13.5     | 17.4     | 50.0     | 17.9     | Williams Dr. @ Jim Hogg Rd.   | 16      | 29.9     | 76.3     | 20.2     | 48.8     |
| Williams Dr. @ River Bend Dr. | 23      | 12.3     | 17.3     | 31.7     | 11.2     | Williams Dr. @ N Austin Ave.  | 20      | 19.9     | 67.9     | 58.4     | 33.3     |
| Williams Dr. @ I-35 SB FR     | 29      | 11.1     | 14.5     | 11.3     | 9.7      | Williams Dr. @ Del Webb Blvd. | 21      | 25.0     | 64.2     | 27.2     | 33.5     |
| Williams Dr. @ N Austin Ave.  | 36      | 10.8     | 9.1      | 8.2      | 0.8      | Williams Dr. @ Lakeway Dr.    | 23      | 19.8     | 50.1     | 53.3     | 32.7     |
| Williams Dr. @ D B Wood Rd.   | 37      | 10.4     | 8.7      | 8.5      | 13.6     | Williams Dr. @ River Bend Dr. | 24      | 19.4     | 45.7     | 48.6     | 42.1     |
| Williams Dr. @ I-35 NB FR     | 38      | 9.6      | 9.3      | 7.8      | 0.1      | Williams Dr. @ Rivery Blvd.   | 28      | 29.7     | 30.5     | 34.7     | 22.2     |
| Williams Dr. @ Del Webb Blvd. | 45      | 7.5      | 9.1      | 6.2      | 2.0      | Williams Dr. @ I-35 NB FR     | 30      | 18.4     | 41.3     | 33.7     | 19.4     |
| Williams Dr. @ Woodlake Dr.   | 46      | 7.3      | 7.1      | 7.3      | 0.8      | Williams Dr. @ Serenada Dr.   | 33      | 7.9      | 60.9     | 35.5     | 11.8     |
| Williams Dr. @ Wildwood Dr.   | 48      | 7.2      | 5.6      | 5.3      | 1.6      | Williams Dr. @ Wildwood Dr.   | 34      | 19.4     | 46.1     | 29.4     | 13.1     |
| Williams Dr. @ Serenada Dr.   | 55      | 4.0      | 3.4      | 3.2      | 0.0      | Williams Dr. @ D B Wood Rd.   | 36      | 15.4     | 46.5     | 27.7     | 13.1     |
| Williams Dr. @ Jim Hogg Rd.   | 59      | 1.7      | 1.8      | 1.5      | 0.0      | Williams Dr. @ Woodlake Dr.   | 39      | 16.0     | 32.3     | 22.6     | 19.0     |

**Figure 14. Williams Drive - Corridor Delay Distribution**

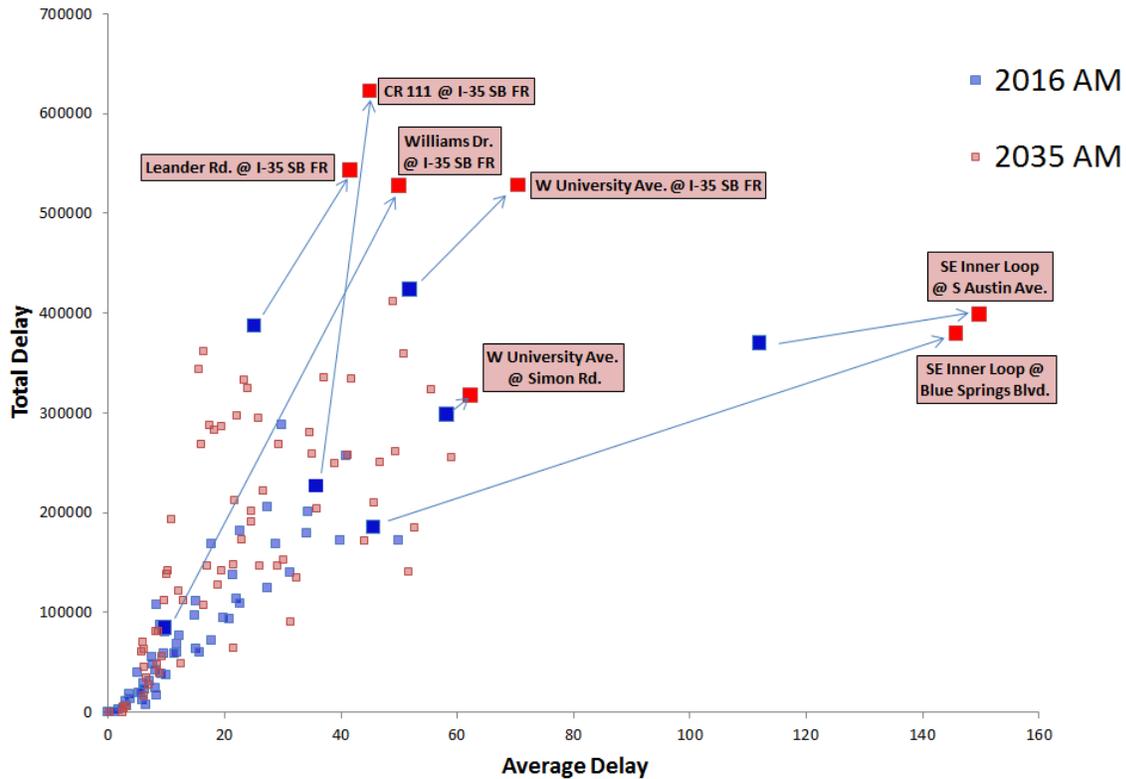
Figures 13 and 14 show a large increase in delay along the entire length of Williams Drive. The only intersections that show little change in delay are Lakeway Drive, River Bend Drive, and Rivery Boulevard. While they are ranked as the worst intersections along Williams Drive in 2016 with delays above 30 seconds at certain times, they get surpassed in 2035 by the intersections at the southernmost and northernmost ends of the corridor. Also, the overall rankings from 2016 to 2035 get worse. Most of the intersections in 2016 perform well with low delay, whereas in 2035 the entire corridor has higher delay and performs worse in the scope of the Georgetown network.

**2016 AM vs. 2035 AM**

Figures 15, 16, and 17 visually summarize the signal performance for the AM peak. Figure 15 shows the signal delays during the peak of the simulation. Figure 16 shows the spread of delay and isolates the intersections with the worst delay from 2016 to 2035.



**Figure 15. Average and Total Delay for the AM Scenarios**



**Figure 16. Spread of Delay and Important Intersections**

The *Total Delay* and *Average Delay* in Figure 16 are calculated for a four-hour simulation period.

- *Total Delay*: Each vehicle experiences some amount of delay as it goes through an intersection. The total delay is the sum of all the delays experienced at the intersection over a given period.
- *Average Delay*: The total delay divided by the number of vehicles that passed through an intersection.

Several conclusions can be drawn from Figure 16.

- Intersections creating bottleneck conditions can be easily identified.
- High total delay and low average delay imply highly used, uncongested intersections.
- High average delay and low Total delay imply few vehicles, yet highly congested intersections.
- The general trend in delay shift can be seen from 2016 to 2035.
- Several of the selected intersections experience large increases in delay from 2016 to 2035.
  - Southeast Inner Loop Drive @ Blue Springs Boulevard



- CR 111 @ I-35 Southbound Frontage Road
- Williams Drive @ I-35 Southbound Frontage Road

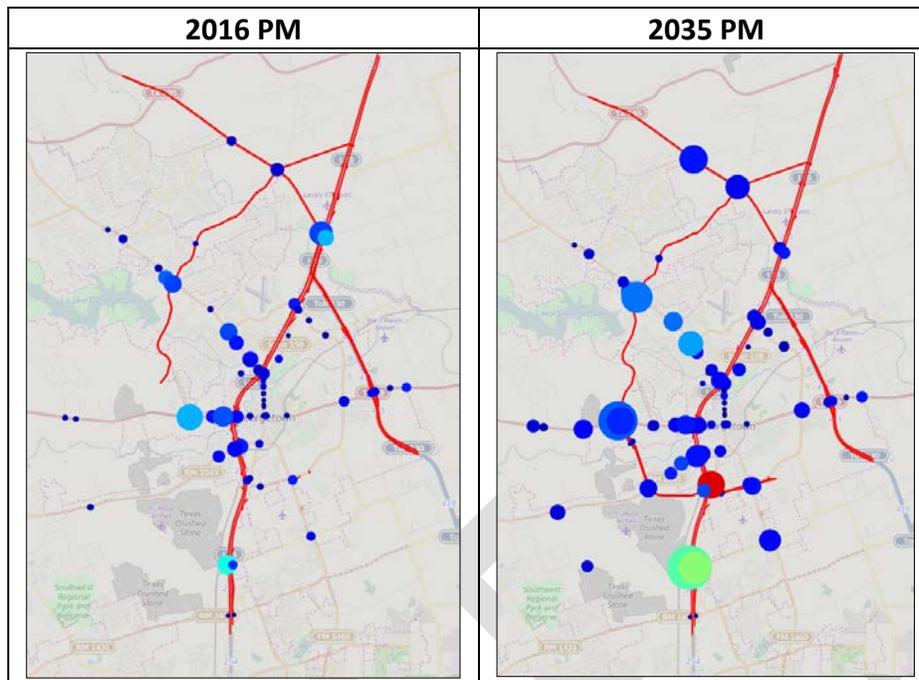
Figure 17 specifically focuses on average delay, ranking intersections by highest average delay. The figure shows some consistency in the rankings between the two model years. The SE Inner Loop Drive at Austin Avenue intersection consistently ranks the highest in terms of delay. A number of intersections along SE Inner Loop and University Avenue also show up in both lists.

| 2016 AM                             |         |          |          |          |          | 2035 AM                             |         |          |          |          |          |
|-------------------------------------|---------|----------|----------|----------|----------|-------------------------------------|---------|----------|----------|----------|----------|
| Intersection Name                   | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour | Intersection Name                   | Ranking | 2nd Hour | 3rd Hour | 4th Hour | 5th Hour |
| SE Inner Loop @ S Austin Ave.       | 1       | 81.9     | 121.7    | 115.4    | 139.7    | SE Inner Loop @ S Austin Ave.       | 1       | 161.8    | 137.0    | 139.5    | 162.4    |
| W University Ave. @ Simon Rd.       | 2       | 25.2     | 79.7     | 89.0     | 93.0     | SE Inner Loop @ Blue Springs Blvd.  | 2       | 136.6    | 159.7    | 133.3    | 157.5    |
| W University Ave. @ I-35 SB FR      | 3       | 17.2     | 63.7     | 70.9     | 79.4     | W University Ave. @ I-35 SB FR      | 3       | 58.7     | 97.6     | 58.6     | 78.5     |
| CR 111 @ I-35 NB FR                 | 4       | 49.3     | 42.4     | 49.7     | 64.2     | W University Ave. @ Simon Rd.       | 4       | 37.8     | 91.5     | 58.6     | 85.7     |
| SE Inner Loop @ Blue Springs Blvd.  | 5       | 23.8     | 51.9     | 68.6     | 59.1     | West Morrow St. @ N Austin Ave.     | 5       | 18.9     | 69.5     | 84.5     | 78.4     |
| SE Inner Loop @ I-35 NB FR          | 6       | 36.6     | 40.6     | 41.5     | 46.0     | W University Rd. @ Wolf Ranch Pkwy. | 6       | 36.4     | 70.6     | 65.4     | 63.9     |
| W University Rd. @ Wolf Ranch Pkwy. | 7       | 13.3     | 68.5     | 75.8     | 44.3     | W University Rd. @ Wolf Ranch Pkwy. | 7       | 10.9     | 103.6    | 71.8     | 58.4     |
| CR 111 @ I-35 SB FR                 | 8       | 34.0     | 33.8     | 35.9     | 39.2     | CR 111 @ I-35 SB FR                 | 8       | 25.9     | 62.1     | 61.4     | 109.2    |
| Williams Dr. @ Lakeway Dr.          | 9       | 25.2     | 33.4     | 49.2     | 59.9     | Leander Rd. @ I-35 NB FR (sort of)  | 9       | 53.0     | 54.1     | 45.7     | 50.1     |
| W University Ave. @ D B Wood Rd.    | 10      | 24.6     | 37.6     | 50.0     | 46.8     | Williams Dr. @ I-35 SB FR           | 10      | 25.9     | 74.1     | 65.3     | 54.5     |

**Figure 17. Intersections with Highest Average Delay**

**2016 PM vs. 2035 PM**

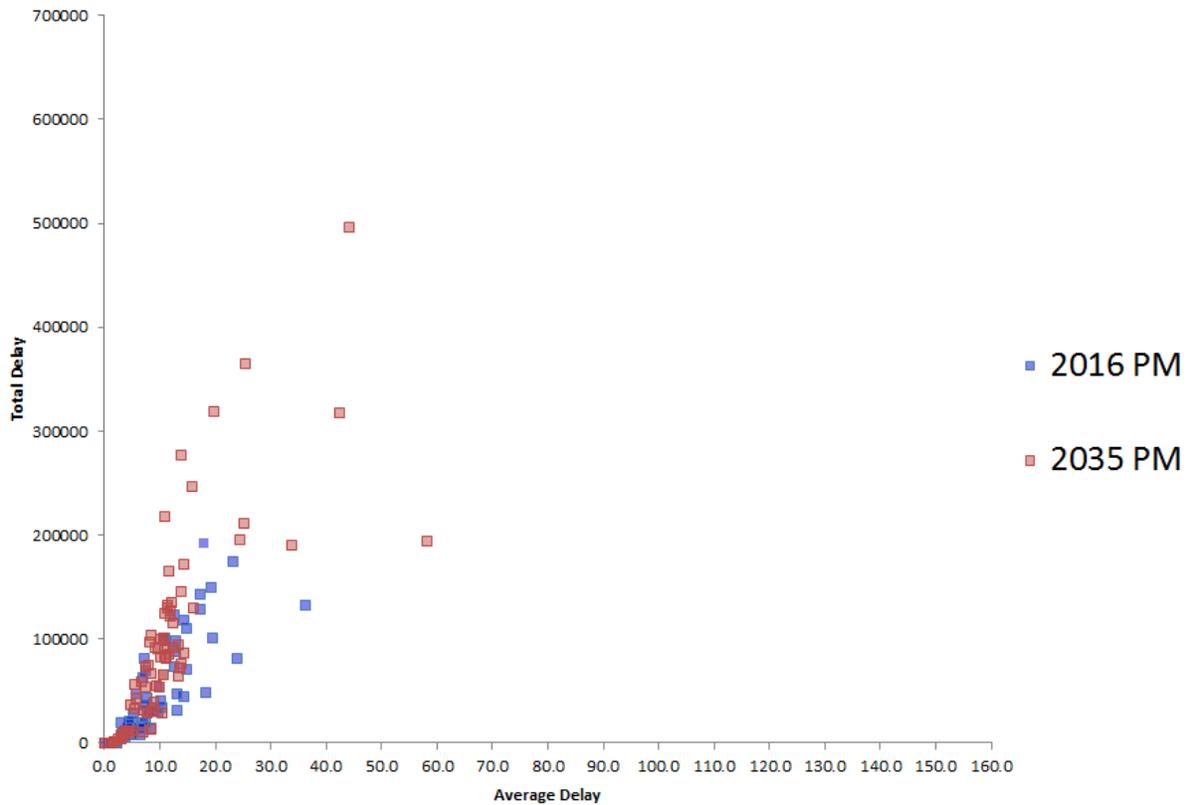
As in, the AM scenarios, Figures 18 and 19 visually summarize signal performance for the PM peak. The color and size of the circles cannot be compared with the AM scenarios. The scale was adjusted for the PM so it would be easier to see the variation in delay.



**Figure 18. Average and Total Delay for PM Scenarios**

There are four important conclusions from Figure 18.

- There are three significant increases in delay in the southern portion of the PM network.
  - I-35 SB FR @ Westinghouse Road
  - I-3 NB FR @ Westinghouse Road
  - S. Austin Avenue @ SE Inner Loop
- With the introduced intersections along West University Boulevard, TX 29, the delay at TX 29 @ DB Wood Road shifted to the intersections to its west.
- Delay along Austin Avenue does not change, whereas delay along Williams Drive increases.
- TX 195 @ I-35 Northbound Frontage Road at the northern tip of the network shifts its delay to the intersections farther north-west along TX 195 from 2016 to 2035.



**Figure 19. Spread of Delay and Important Intersections**

Although the changes in delay shown in Figure 18 are useful, when the actual delay in the PM scenarios is compared to the delay in the AM scenarios, the network does not look bad. There is only one intersection estimated to experience an average delay greater than 50 seconds in the model over the four-hour simulation period.

#### 4. SUMMARY OF FINDINGS

The following summarizes the findings and conclusions from the model results:

For the TCP scenarios:

- The TCP scenario results in fewer vehicles on the bridge links during the 2016 AM and PM peak periods (except for the northbound bridge approach in the PM).
- Interestingly, for the southbound Austin Avenue bridge approach in the AM, the 2035 AM TCP has lower traffic volume than the 2016 AM TCP. This suggests more use of alternative paths in 2035 to avoid Austin Avenue during the lane closures, most notably on the west side of I-35.



- Closing the bridge in either 2016 or 2035 would not change the traffic volume substantially, if looking just at the traffic volume impact; however, some path changes in travel patterns during the AM peak are discernable. Additionally, a review of the isochrone maps shows that there are travel time consequences for waiting until 2035.
- Where vehicles travel (i.e., the paths taken) in response to the TCP will depend upon the year of TCP implementation since the 2035 network offers additional path alternatives.
- Improvements in the southeast portion of the network, including those to Inner Loop Drive into a highway with frontage roads in 2035, improve the reach travel time in the 2035 scenarios compared to the 2016 scenarios, including the 2035 TCP scenarios.
- More traffic routes to I-35 in response to closure of Austin Avenue bridge lanes.
- In 2035, the proportion of southbound traffic in the morning using Austin Avenue is less than in 2016 (considering I-35 main lanes and frontage roads, Northeast Inner Loop Drive, and Austin Avenue). Due to the incorporated improvements to I-35 and Northeast Inner Loop, rerouting southbound traffic during the 2035 AM peak period primarily uses these roadways.
- Some increase in travel time was found for the scenario without left-turn lanes (4-Lanes) along Austin Avenue in the vicinity of the bridges during 2035 conditions.
- Substantial congestion appears to build along SH 29 in the model for 2035 conditions, particularly during the AM peak, and influences traffic along Austin Avenue.

For the TCP scenarios:

- DTA model results detect very few significant differences between the 4 and 5-Lane 2035 scenarios

## 5. RECOMMENDATIONS

Based on observations from the model results and subsequent conclusions, as well as a review of the project, the following are recommended:

- The model indicates a preference for using San Gabriel Parkway and Morrow Street for access to the northbound frontage road (and ultimately N/S I-35). These roadways become even more attractive with growth in the area (2035 conditions). Accommodation of traffic from the north along Austin Avenue influences northbound left turns along the corridor and should be considered with improvements to Austin Avenue. Consideration should be made for treatment of these connections with future development.
- Reducing Austin Avenue to one lane will require careful consideration of turning movements that could block through traffic. Special provision should be made to



accommodate turning movements at intersections within the construction limits (this need can be verified with turning movement counts at the intersections prior to implementation of a traffic control plan) to reduce delays and impacts to area traffic. These impacts are not readily assessed using a DTA model.

- Consideration should be made of the impact of construction along I-35 as part of the Mobility 35 project which may influence traffic along Austin Avenue.
- Provision of left-turn lanes along Austin Avenue will accommodate through traffic along the corridor and consideration should be made for this result, particularly during construction along I-35. This should be considered in deciding on a cross-section through this area.
- Turning movement counts should be collected at San Gabriel Boulevard and 2<sup>nd</sup> Avenue to further assess left-turn movements and verify the need for left-turn bays at these intersections.

DRAFT



**APPENDIX A**

DRAFT



**Table A.1. Area Bond Program, February 2015**

| No. | Roadway Project   | Functional Classification | Target Completion Year |
|-----|---|---------------------------|------------------------|
| 1   | Austin Avenue Bridges                                   | Minor Arterial            | 2018                   |
| 2   | Northwest Blvd Bridge - Fontana Dr To Austin Ave        | Major Arterial            | 2019                   |
| 3   | Rivery Blvd Extension - Williams Dr To Northwest Blvd   | Collector                 | 2019                   |
| 4   | IH 35 NB Frontage Road - Williams Dr To Lakeway Bridge  | Frontage                  | 2020                   |
| 5   | Southwest Bypass - Wolf Ranch Pkwy To Leander Rd        | Freeway                   | 2022                   |
| 6   | Wolf Ranch Pkwy - DB Wood Dr To Southwest Bypass        | Minor Arterial            | 2023                   |
| 7   | Intersection/Capital Pool                               | -                         |                        |
| 8   | Leander Rd Bridge @ IH 35                               | -                         | 2020                   |
| 9   | Sidewalk, Safety and ADA Accessibility Pool             | -                         |                        |
| 10  | Leander Rd (RM 2243) - W of SW Bypass to River Ridge Dr | Major Arterial            | 2023                   |
| 11  | DB Wood Dr - SH 29 To Oak Ridge Dr                      | Minor Arterial            | 2024                   |
| 12  | Williams Dr - Rivery Blvd. to Frontage Rd               | Major Arterial            | 2024                   |
| 13  | IH 35 SB Frontage Rd - Williams Dr To Rivery Blvd       | Frontage                  | 2029                   |
| 14  | NE Inner Loop - Stadium Dr To FM 971                    | Major Arterial            | 2021                   |
| 15  | SE Inner Loop - Southwestern Blvd To IH 35              | Freeway                   | 2025                   |
| 16  | Stadium Dr (CR 151) - Austin Ave To NE Inner Loop       | Minor Arterial            | 2025                   |
| 17  | SE Inner Loop - SH 29 To Southwestern Blvd              | Minor Arterial            | 2021                   |
| 18  | Southwestern Blvd - Raintree Dr To SE Inner Loop        | Collector                 | 2026                   |
| 19  | Southwest Bypass- Wolf Ranch Pkwy To SH29               | Freeway                   | 2026                   |
| 20  | Shell Rd - Williams Dr to Shell Spur Rd                 | Major Arterial            | 2031                   |
| 21  | SH 29 (Haven Lane to SH130)                             | Major Arterial            | 2026                   |
| 22  | DB Wood Dr - Oak Ridge Dr To Lake Overlook Dr.          | Major Arterial            | 2035                   |



## Task 5.1 Summary of workshops, including documentation of feedback received

For CTR's contract with CAMPO, Task 5 includes outreach and training, workshops, documentation, and quarterly updates. Task 5.1 deliverables include summary of workshops, as well as documentation of feedback received.

One of the primary tasks for CTR this past fiscal year was to deploy the DTA modeling tool through a series of trainings. CTR and CAMPO's shared goal is to train practitioners to use the tool, so that others eventually run the model on their own to address their needs. This fiscal year, we held a total of four workshops related to DTA deployment. DTA 1.0 was an introductory training workshop, which summarized the elements of DTA, the visualization tool used to understand results, and provided an overview of how the tool can be used to study a variety of scenarios. DTA 2.0 was a much more detailed workshop given to CAMPO modeling staff. This training was technical in nature, and walked through the entire process for coding, running, and visualizing results from a DTA model.

The workshops featured an interactive training approach using presentation materials, demonstrations, exercises, and surveys led by CTR staff. Attendees were asked prior to the first DTA 1.0 workshops (in January) to utilize laptops in order to participate in workshop activities, including interactive surveys and software exercises. CTR staff members helped participants during portions of the workshops where attendees were asked to complete these interactive elements. Interactive surveys presented periodically through the presentation were intended to elicit feedback regarding attendee subject-matter knowledge and perceived value of the tools presented. Feedback was used to help shape the proceedings such that the presenters could cater to the needs of the group, as well as refine subsequent training.

Workshop exercises were formulated to introduce material to the participants in an interactive and engaging way. Participants were encouraged to apply the skills learned during the presentation portion and increase their knowledge of typical applications of the software tools, including the dynamic traffic assignment software, interactive visualization tool, and additional tools designed to help users review model results. The DTA 2.0 material was designed to build on the materials and exercises introduced in DTA 1.0, advancing the capabilities of those in attendance.

At the conclusion of each workshop, attendees were asked to fill out a brief survey indicating their interest in further training, perceived benefit of the presented tools and desire to use them, and general evaluation of the workshop format and content. The feedback following each workshop was over-





# CAMPO-CTR Dynamic Traffic Assignment Interlocal Agreement

## FY16 Deliverables Submittal

whelmingly positive, with participants expressing enthusiasm about future training opportunities and the value of using the tools in their respective agency or jurisdiction to evaluate the impact of transportation improvement projects in the region. It is intended that training opportunities continue to be offered in the future.

The first DTA training sessions were held in January, 2016. There was such high demand for the training that two sessions were held, on concurrent mornings (1/27 and 1/28) in the large conference room at CTR. In order to notify member agencies of training opportunities, CTR utilized its partnership with CAMPO to distribute training announcements and invitations.

The first of two sessions had twelve attendees representing the following agencies: CAMPO, City of Austin, City of Hutto, City of San Marcos, and Williamson County. The second session also had twelve attendees representing the following agencies: CAMPO, City of Austin, City of Hutto, City of Bastrop, City of Cedar Park, Travis County, CAPCOG, and CapMetro.

DTA 2.0 was held on April 19, 2016, in a full day session at CTR. Three attendees from CAMPO attended the training to obtain great insight into the DTA tool applications.

Another half-day DTA 1.0 training session was held on June 7, 2016, this time at the newly opened Texas Advanced Computing Center (TACC). Representatives from six agencies, including CTRMA, Travis County, HNTB Corporation, and CapMetro, were in attendance.

### Enclosed

- Invitations to DTA 1.0 and 2.0 training sessions
- Feedback from DTA 1.0 and 2.0 training sessions
- Sign-in sheets from DTA 1.0 and 2.0 training sessions
- Announcement of NMC/CAMPO seminar



## Brandy Savarese

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**From:** Avila, Sabas <SAvila@sanmarcostx.gov>  
**Sent:** Monday, January 25, 2016 3:27 PM  
**To:** Westerfield Ross, Heidi R  
**Cc:** Duthie, Jennifer C  
**Subject:** FW: DTA 1.0 Workshop 1/28/15

Sorry for the late response. I hope that you can accommodate one more participant. My information is as follows:

**Name:** Sabas Avila, P.E.

**Position:** Assistant Director of Public Services - Transportation

**Agency:** City of San Marcos

**Reason for attending training:** CAMPO TAC rep for the City

Sabas J. Avila, P.E., CFM  
Assistant Director of Public Services  
Transportation Division

City of San Marcos  
630 E. Hopkins  
San Marcos, Texas 78666  
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**From:** Zamorano, Art [mailto:Art.Zamorano@campotexas.org]

**Sent:** Friday, January 08, 2016 1:24 PM

**To:** CAMPO-OTC; Adler, Steve; City of Cedar Park (Mayor Powell); Commissioner Alfredo Muñoz; Commissioner Brigid Shea; Commissioner Clara Beckett; Commissioner Cynthia Long; Commissioner Gerald Daugherty; Commissioner Will Conley; Council Member Craig Morgan; Council Member Joe Bain (Travis Co. Rep.); Gallo, Sheri; Garza, Delia; Judge James Oakley; Judge Sarah Eckhardt; Kitchen, Ann; Mayor Dale Ross; Guerrero, Daniel; Mayor Dave DeOme (City of Lakeway); Mayor Jeff Coleman; Terry McCoy (TxDOT DE); Terry Mitchell (Capital Metro Rep.); Writ Baese (City of Round Rock); Brake, Alison; Anna Bowlin (Travis County); Barbara Rush (for Comm. Shea); Bob (for Gerald Daugherty) Moore (bob.moore@co.travis.tx.us); Bonnie Parks (City of Round Rock); Cannon, Tina; Caren Lee (For Round Rock); Carolyn Dill (for Comm. Beckett); Charlie Watts (Travis County); Chase, Suzie; Christy Willhite; Cindy Mueller (TxDOT); City of Cedar Park (Planning); Cortez, John Michael; Craig, Ken; Darwin Marchell (Cedar Park); Dave Marsh - CARTS; Diana Vargas (TxDOT); Pettijohn, Jamie; Jennifer Anderson (for Will Conley); Jessica Brettle (for Mayor Garver); Joe Hon (for Judge Eckhardt); John Dean (City of Round Rock); Foreman, John; Karen Thompson (for Mayor Pro-Tem Gonzales); Kathryn Cromwell (Williamson County); Kathy Pierce (for Comm. Long); Kitten, Cole; Kristian Caballero (for Comm. Shea); Lara Wilson (for Comm. Beckett); Moyer, Laurie; Lorena Echeverria de Misi (TxDOT Austin District); Lyle Nelson (CARTS); Madison Gessner (for Comm. Daugherty); Mandy Moriel (for Comm. Long); Marie Cavanagh (for Comm. Cyrier); Marisabel Ramthun (TxDOT); Maya Reisman (for Judge Eckhardt); 'Melissa Velasquez'; Morgan Cotten (Travis Co.); Nicely, Katherine; Penny Ewell (for Cedar Park); Peter Einhorn (for Judge Eckhardt); Spillar, Rob; Sam Roberts (Cedar Park); Schleen Walker (Travis Co.); Smith, Taylor; Steve Manilla (Travis County); Tara Ambrose (City of Round Rock); 'Terrie Wilhelm' (Terrie.Wilhelm@txdot.gov); Tiemann, Donna; Tim Juarez (TxDOT - TPP); Hernandez, Amanda; Amy

Miller (City of Elgin); Andrews, Pharr; Barrera, Nadia; Beaudet, Annick; Bob Daigh (Williamson County); Bob van til - (City of Taylor); Bollich, Eric; Bonnie Lister (TxDOT); Brian LaBorde (City of Buda); Buetow, Cari; Cassandra Lee (City of Round Rock); Cathy Stephens (Travis County); Chance Sparks (City of Buda); Chessie Zimmerman (ChessieZimmerman@lakeway-tx.gov); Dan Gibson (City of Lockhart); Darwin Marchell (City of Cedar Park); Debbie Guerra (City of Kyle); Derr, Gordon; Dierenfield, Laura; Ed Polasek (City of Georgetown); Erika Ragsdale (City of Hutto); Gary Hudder (ghudder@roundrocktexas.gov); Greg Haley (for Burnet Co.); Helen Ramirez (City of Hutto); Jen Duthie (UT/CTR); Jerry Borcharding - Hays County; Jill Strube (City of Smithville); Joe Clemens (CapMetro); Joe England - Williamson County; John Elsdon (City of Taylor); Justin Word (jword@mobilityauthority.com); Ken May (CAPCOG); Leon Barba (City of Kyle); Mary Anne Griss (TxDOT); Lewis, Matthew; Melissa McCollum (City of Bastrop); Michael Aulick (for Hays County); Michael Gonzalez (City of Elgin); Miller, Liane; Morgan Cotten (Travis County); Nathaniel Waggoner (City of Georgetown); Patricia Davis (City of Pflugerville); Paul Duncan (City of Lakeway); Rachel Clampffer (LSRD); Raymond Sanchez (TxDOT); Ross Milloy (Lone Star Rail); Avila, Sabas; Sara Garza (TxDOT); Scheleen Walker (Travis County); Sean Beal (CTRMA); Terri Crauford (City of Leander); Terron Evertson (Williamson County); Todd Hemingson (CapMetro); Tom Word (City of Pflugerville); Tom Yantis (City of Leander); Trey Fletcher (City of Pflugerville); Vance Rodgers (City of Lockhart); Wesley Brandon (City of Bastrop); Wesley Burford (wburford@ctrma.org); Wilkes, Nathan

**Subject:** DTA 1.0 Workshop 1/28/15

This email is a follow-up to my December 17 email regarding the DTA 1.0 Workshop. CAMPO has been working with UT's Center for Transportation Research (CTR) since 2011 on a new modeling tool for the Central Texas region. This Dynamic Traffic Assignment (DTA) tool enables us to better understand traffic patterns related to congestion. During this fiscal year CTR will deploy the DTA tool and teach us to use it. There will be multiple choices of introductory workshops and trainings between now and August, in which I hope you (or your designated representative), will choose to participate. The initial beta training (DTA 1.0), will take place **January 28 from 8:30-12:30** at CTR's offices. In this session, practitioners will be exposed to the following:

1. Overview of Dynamic Traffic Assignment (DTA) modeling;
2. Overview of the DTA model built for this region;
3. Introduction to viewing results using the VizTool;
4. Training on how to create and review model results within the VizTool.

CTR has already registered 14 people for the training. I encourage you to direct this email to the appropriate person in your office, or your consultant, so that they can register for the training.

To register, please email Heidi Ross ([heidewross@austin.utexas.edu](mailto:heidewross@austin.utexas.edu)) at CTR with the following information before 1/11/2016:

Name

Position

Agency

Reason for attending training

Thank you,

\*\*\*\*\*

Heidi W. Ross, P.E., PTOE  
Network Modeling Center  
Center for Transportation Research  
The University of Texas at Austin  
512-934-1400  
[heidiwross@austin.utexas.edu](mailto:heidiwross@austin.utexas.edu)

## Brandy Savarese

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**From:** Zamorano, Art <Art.Zamorano@campotexas.org>  
**Sent:** Tuesday, May 17, 2016 2:17 PM  
**To:** nvargas@ctrma.org; Westerfield Ross, Heidi R  
**Cc:** Tindall, Phillip  
**Subject:** FW: DTA 1.0 Training Opportunity

**Importance:** High

Natasha,

Per request of Heidi, here is the original request sent out last week.

Heidi – I did have a question from Bob Daigh last week asking for specific time. I emailed Brandy and I'm not sure if she responded or not.

**Art Zamorano**, Administrative Specialist

**CAPITAL AREA METROPOLITAN PLANNING ORGANIZATION**

512 974 2275 | art.zamorano@campotexas.org  
P.O. Box 1088 | Austin, TX 78767

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**From:** Zamorano, Art

**Sent:** Friday, May 13, 2016 3:13 PM

**To:** 'Amanda Hernandez (City of San Marcos)' <ahernandez2@sanmarcostx.gov>; 'Amy Miller (City of Elgin)' <amiller@ci.elgin.tx.us>; Andrews, Pharr <Pharr.Andrews@austintexas.gov>; 'Anna Bowlin (Travis County)' <anna.bowlin@co.travis.tx.us>; Barrera, Nadia <Nadia.Barrera@austintexas.gov>; Beaudet, Annick <Annick.Beaudet@austintexas.gov>; 'Bob Daigh (Williamson County)' <bdaigh@wilco.org>; 'Bob van til - (City of Taylor)' <bob.vantil@ci.taylor.tx.us>; Bollich, Eric <Eric.Bollich@austintexas.gov>; 'Bonnie Lister (TxDOT)' <bonnie.lister@txdot.gov>; 'Bonnie Parks (City of Round Rock)' <bparks@roundrocktexas.gov>; 'Brian LaBorde (City of Buda)' <blaborde@ci.buda.tx.us>; Buetow, Cari <Cari.Buetow@austintexas.gov>; 'Caren Lee (For Round Rock)' <clee@roundrocktexas.gov>; 'Carolyn Dill (For Bastrop Co.)' <carolyn.dill@co.bastrop.tx.us>; 'Cassandra Lee (City of Round Rock)' <cassandraleee@roundrocktexas.gov>; 'Cathy Stephens (Travis County)' <cathy.stephens@traviscountytexas.gov>; 'Chance Sparks (City of Buda)' <csparks@ci.buda.tx.us>; 'Charlie Watts(Travis County)' <charlie.watts@co.travis.tx.us>; 'Chessie Zimmerman (ChessieZimmerman@lakeway-tx.gov)' <ChessieZimmerman@lakeway-tx.gov>; 'Chris Anderson (CAPCOG)' <canderson@capcog.org>; 'Chris Schreck (CAPCOG)' <cschreck@capcog.org>; 'Dan Gibson (City of Lockhart)' <dgibson@lockhart-tx.org>; 'Darwin Marchell (City of Cedar Park)' <Darwin.Marchell@cedarparktx.us>; 'Dave Marsh(CARTS)' <dave@ridecarts.com>; 'Debbie Guerra (City of Kyle)' <dguerra@cityofkyle.com>; 'Deborah Melba (CTRMA)' <dmelba@mobilityauthority.com>; Derr, Gordon <Gordon.Derr@austintexas.gov>; 'Diana Vargas (TxDOT)' <diana.vargas@txdot.gov>; Dierenfield, Laura <Laura.Dierenfield@austintexas.gov>; 'Ed Polasek (City of Georgetown)' <ed.polasek@georgetown.org>; 'Erika Ragsdale (City of Hutto)' <erika.ragsdale@huttotx.gov>; 'Gary Hudder (ghudder@roundrocktexas.gov)' <ghudder@roundrocktexas.gov>; 'Gerald Pohlmeier (City of Round Rock)' <gpohlmeier@roundrocktexas.gov>; 'Greg Haley (for Burnet Co.)' <gregh@kcengineering.com>; 'Helen Ramirez (City of Hutto)' <helen.ramirez@huttotx.gov>; 'Jen Duthie (UT/CTR)' <jduthie@mail.utexas.edu>; 'Jerry Borcharding - Hays County' <jerry@co.hays.tx.us>; 'Jill Strube (City of Smithville)' <jstrube@ci.smithville.tx.us>; 'Joe Clemens (CapMetro)' <joe.clemens@capmetro.org>; 'Joe England - Williamson County' <jengland@wilco.org>; 'John Elsdon (City of Taylor)' <john.elsdon@ci.taylor.tx.us>; 'Justin Word (jword@mobilityauthority.com)' <jword@mobilityauthority.com>; 'kathryn Cromwell (Williamson Co)' <krcromwell@wilco.org>; Kitten, Cole <Cole.Kitten@austintexas.gov>; 'Laurie Moyer (Imoyer@sanmarcostx.gov)' <Imoyer@sanmarcostx.gov>; 'Leon Barba (City of Kyle)' <cityengineer@cityofkyle.com>; 'Lyle Nelson (CARTS)' <Lyle@RideCARTS.com>; 'Marisabel Ramthun (TxDOT)' <marisabel.ramthun@txdot.gov>; 'Mary Anne Griss (TxDOT)'

<Maryanne.Griss@txdot.gov>; 'Matt Lewis (City of San Marcos)' <mlewis@sanmarcostx.gov>; 'Melissa McCollum (City of Bastrop)' <mmccollum@cityofbastrop.org>; 'Michael Aulick (for Hays County)' <michael.aulick@gmail.com>; 'Michael Gonzalez (City of Elgin)' <mgonzalez@ci.elgin.tx.us>; Miller, Liane <Liane.Miller@austintexas.gov>; 'Morgan Cotten (Travis County)' <morgan.cotten@co.travis.tx.us>; 'Nathaniel Waggoner (City of Georgetown)' <nathaniel.waggoner@georgetown.org>; 'Patricia Davis (City of Pflugerville)' <patriciad@cityofpflugerville.com>; 'Patrick Collins (Bastrop Co.)' <patrick.collins@co.bastrop.tx.us>; 'Paul Duncan (City of Lakeway)' <paulduncan@lakeway-tx.gov>; 'Peter Einhorn (for Judge Eckhardt)' <peter.einhorn@co.travis.tx.us>; 'Rachel Clampffer (LSRD)' <rclampffer@lonestarrail.com>; 'Raymond Sanchez (TxDOT)' <raymond.sanchez@txdot.gov>; 'Ross Milloy (Lone Star Rail)' <remnyt@aol.com>; 'Sabas Avila (City of San Marcos)' <savila@sanmarcostx.gov>; 'Sara Garza (TxDOT)' <sara.garza@txdot.gov>; 'Scheleen Walker (Travis County)' <scheleen.walker@traviscountytexas.gov>; 'Steven Manilla (Travis County)' <Steven.Manilla@co.travis.tx.us>; 'Terri Crauford (City of Leander)' <tcrauford@leandertx.gov>; 'Terron Evertson (Williamson County)' <tevertson@wilco.org>; 'Tim Juarez (TxDOT - TPP)' <tim.juarez@txdot.gov>; 'Todd Hemingson (CapMetro)' <Todd.Hemingson@capmetro.org>; 'Tom Gdala (City of Cedar Park)' <Tom.Gdala@cedarparktx.us>; 'Tom Word (City of Pflugerville)' <tomw@cityofpflugerville.com>; 'Tom Yantis (City of Leander)' <tyantis@leandertx.gov>; 'Trey Fletcher (City of Pflugerville)' <TREYF@pflugervilletx.gov>; 'Vance Rodgers (City of Lockhart)' <vroddgers@lockhart-tx.org>; 'Wesley Brandon (City of Bastrop)' <wbrandon@cityofbastrop.org>; Wilkes, Nathan <Nathan.Wilkes@austintexas.gov>  
**Cc:** CAMPO-OTC <CAMPO-OTC@austintexas.gov>  
**Subject:** DTA 1.0 Training Opportunity  
**Importance:** High

CAMPO has been working with UT's Center for Transportation Research (CTR) since 2011 on a new modeling tool for the Central Texas region. This Dynamic Traffic Assignment (DTA) tool enables us to better understand traffic patterns related to congestion. During this fiscal year CTR is deploying the DTA tool and teaching us to use it. The first DTA 1.0 training was held in January, and was very well received. Another DTA 1.0 training is scheduled for **June 7** at UT's Pickle Research Center. The content of the four hour DTA 1.0 training will be similar to that of the January session. In this session, practitioners will be exposed to the following:

1. Overview of Dynamic Traffic Assignment (DTA) modeling;
2. Overview of the DTA model built for this region;
3. Introduction to viewing results using the VizTool;
4. Training on how to create and review model results within the VizTool.

I encourage you to direct this email to the appropriate person in your office, or your consultant, so that they can register for the training.

To register, please email Brandy Savarese ([bsavarese@utexas.edu](mailto:bsavarese@utexas.edu)) at CTR with the following information before 5/25/2016:

Name  
Position  
Agency  
Reason for attending training

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Heidi W. Ross, P.E., PTOE  
Network Modeling Center  
Center for Transportation Research  
The University of Texas at Austin  
512-934-1400  
[heidwross@austin.utexas.edu](mailto:heidwross@austin.utexas.edu)

## Brandy Savarese

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**From:** Westerfield Ross, Heidi R <heidiwross@austin.utexas.edu>  
**Sent:** Monday, February 08, 2016 6:14 PM  
**To:** Westerfield Ross, Heidi R  
**Cc:** Duthie, Jennifer C; Johnson, Ashby (Ashby.Johnson@campotexas.org); Tindall, Phillip (Phillip.Tindall@campotexas.org)  
**Subject:** DTA 1.0 Workshop follow-up

Workshop Attendees:

Thanks again for attending the DTA 1.0 workshop last month. We appreciate the feedback you provided to us, and encourage you to send us additional feedback if you have any.

Here are a few items to note:

1. There is a timeline for future trainings located on the DTA Deployment webpage: <http://ctr.utexas.edu/dta/>.
2. On this webpage, you'll find an email address for sending questions/comments about using DTA. Please feel free to send us questions about use of the tool, or about DTA in general.
3. The DTA 1.0 Workshop Materials webpage can be used as an ongoing reference. It can be accessed through the previously listed website link, or directly using this link: <http://ctr.utexas.edu/dta/dta-1-0/>.
4. On this page, you'll find access to the workshop materials.

We will be scheduling DTA 2.0 trainings in the near future.

Thanks again for your attendance last week.

- Heidi Ross

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Heidi W. Ross, P.E., PTOE  
Strategic Planning Manager  
Network Modeling Center  
Center for Transportation Research  
The University of Texas at Austin  
512.934.1400  
[heidiwross@austin.utexas.edu](mailto:heidiwross@austin.utexas.edu)  
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## Brandy Savarese

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**From:** Westerfield Ross, Heidi R <heidewross@austin.utexas.edu>  
**Sent:** Tuesday, March 01, 2016 5:39 PM  
**To:** michael.dutton@campotexas.org; kelly.porter@campotexas.org; Xu, Lei (Lei.Xu@campotexas.org); Anteneh.Yohannes@campotexas.org; daniel.yang@campotexas.org  
**Cc:** Johnson, Ashby (Ashby.Johnson@campotexas.org); Tindall, Phillip (Phillip.Tindall@campotexas.org); Jennifer Duthie; Brandy Savarese  
**Subject:** DTA 2.0 training date - April 7

Hi, everyone.

One comment we received multiple times from the DTA 1.0 training, is that people are ready for the next one. So, we are working to schedule DTA 2.0.

DTA 2.0 is a more technical training, and is therefore limited to a class size of 5 people. The first training will be for you – CAMPO staff. Therefore, please respond with your availability to take the training on April 7. The exact hours of the training aren't yet set. For now, we ask that you set aside 8:30AM - 4PM.

If April 7 doesn't work, please provide alternate days between April 7-15.

Thanks,

Heidi

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Heidi W. Ross, P.E., PTOE  
Strategic Planning Manager  
Network Modeling Center  
Center for Transportation Research  
The University of Texas at Austin  
512.934.1400  
[heidewross@austin.utexas.edu](mailto:heidewross@austin.utexas.edu)  
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## Brandy Savarese

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**From:** Brandy Savarese <bsavarese@utexas.edu>  
**Sent:** Tuesday, April 12, 2016 3:37 PM  
**To:** bsavarese@utexas.edu  
**Subject:** DTA Training 2.0

Hello everyone,

We're looking forward to seeing you at CTR for Dynamic Traffic Assignment (DTA) Deployment 2.0 on April 19.

As we prepare for the training, we'd like to remind you that you will need to bring your UT EID and password to the training. If you do not have a UT EID and password, please visit [this website](#) no later than Friday, 4/15, to ensure an EID is created before the training.

You will need EIDs and passwords to access the training materials on the laptops we will provide for you. Please try to arrive at [our building](#) at 8:30 so that we can get you set up with a laptop.

We will be catering lunch--please let me know if you have any dietary restrictions.

If you need parking, please park in the parking deck attached to our building (access off 17th Street) so that we can validate your parking. (We cannot validate your parking if you park in the deck south of our building.)

Please let me know if you have any questions, or if your availability to attend changes.

Thank you!

BLS

Brandy Savarese

The University of Texas at Austin | Center for Transportation Research | [ctr.utexas.edu/nmc](http://ctr.utexas.edu/nmc)



## Brandy Savarese

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**From:** Westerfield Ross, Heidi R <heidiwross@austin.utexas.edu>  
**Sent:** Thursday, May 05, 2016 3:53 PM  
**To:** Westerfield Ross, Heidi R  
**Cc:** Duthie, Jennifer C; Tindall, Phillip; Johnson, Ashby (Ashby.Johnson@campotexas.org)  
**Subject:** DTA 2.0 Workshop Follow-Up

Workshop Attendees:

Thanks again for attending the DTA 2.0 workshop last month. We appreciate the feedback you provided to us, and encourage you to send us additional feedback if you have any.

Here are a few items to note:

1. There is a timeline for future trainings located on the DTA Deployment webpage: <http://ctr.utexas.edu/dta/>.
2. On this webpage, you'll find an email address for sending questions/comments about using DTA. Please feel free to send us questions about use of the tool, or about DTA in general.
3. The DTA 2.0 Workshop Materials webpage can be used as an ongoing reference. It can be accessed through the previously listed website link, or directly using this link: <http://ctr.utexas.edu/nmc/dta/dta-2-0-workshop-materials/>
4. On this page, you'll find access to the workshop materials.

The next DTA 1.0 Training has been scheduled for June 7th. We'll be sending an announcement out soon.

Thanks again for your attendance.

- Heidi Ross

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Heidi W. Ross, P.E., PTOE  
Network Modeling Center  
Center for Transportation Research  
The University of Texas at Austin  
512-934-1400  
[heidiwross@austin.utexas.edu](mailto:heidiwross@austin.utexas.edu)

DTA 1.0 Training  
Follow-up survey  
January 27, 2016



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Yes, very well coordinated"**
2. What more would you like to learn about DTA?  
**"How the regional TDM is uploaded into the DTA system"**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"Yes, and they are."**
4. Are you interested in attending the DTA 2.0 training?  
**"Yes"**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"increase the number of server locations to meet the size of the training class"**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Fair enough "**
2. What more would you like to learn about DTA?  
**"Little more information on how to measure TT using simulator"**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"Yes"**
4. Are you interested in attending the DTA 2.0 training?  
**"Absolutely! I would like to know more about the technical explanation of (more on transit side) DTA."**
5. What more would you like to learn about the Network Modeling Center at CTR?  
**"na"**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"Good Presentation."**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Yes."**
2. What more would you like to learn about DTA?  
**"At least 2-day training course."**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"Yes. "**
4. Are you interested in attending the DTA 2.0 training?  
**"Yes, obviously. "**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"We should have longer training sessions. "**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

**"Yes."**

2. What more would you like to learn about DTA?

**"How to import existing network files from GIS."**

3. After attending today, do you think your colleagues should attend this training? If so, who?

**"Yes, CAMPO TAC members."**

4. Are you interested in attending the DTA 2.0 training?

**"Yes."**

6. Please provide any additional feedback that will help us improve our training for future audiences.

**"I thought the training was good. Training 2.0 should include building a network from an existing GIS network."**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

**"Yes, good training. "**

2. What more would you like to learn about DTA?

**"How do we upload our local data to run models and simulations in our jurisdictions?"**

3. After attending today, do you think your colleagues should attend this training? If so, who?

**"Pretty excited about the representation from my colleagues, did not expect this many to show up."**

4. Are you interested in attending the DTA 2.0 training?

**"Yes"**

5. What more would you like to learn about the Network Modeling Center at CTR?

**"content at this time"**

6. Please provide any additional feedback that will help us improve our training for future audiences.

**"Some technical difficulties, but that stuff happens, hard to predict. "**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

**"Yes. Just a quick overview."**

2. What more would you like to learn about DTA?

**"How to get network set up like the example San Angelo."**

3. After attending today, do you think your colleagues should attend this training? If so, who?

**"Yes, the other engineer and our consultants"**

4. Are you interested in attending the DTA 2.0 training?

**"Yes"**

5. What more would you like to learn about the Network Modeling Center at CTR?

**"How to use in our city"**

6. Please provide any additional feedback that will help us improve our training for future audiences.

**"be able to do the hands on exercise."**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

**"Yes, very much so. "**

2. What more would you like to learn about DTA?

***"More about the requirements for new projects. I'd also like more of an opportunity to experiment with the product."***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"Perhaps. I could see this tool being used by staff-level employees to support projects. I think a presentation for the senior officials would be helpful, but not a full training session."***

4. Are you interested in attending the DTA 2.0 training?

***"Yes."***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"As much as I can about the modelling work that CTR is developing."***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"Due to the system requirements and data limitations, I think smaller class sizes would be preferred."***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"It did! As a non-transportation focused planner, I had limited knowledge going into today. So this provided a good introduction for me regarding DTA and the software."***

2. What more would you like to learn about DTA?

***"I would be interested in learning more particulars regarding the specific data that goes into DTA, especially existing and future land use."***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"Definitely."***

4. Are you interested in attending the DTA 2.0 training?

***"Yes."***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Definitely surpassed expectations - was expecting to see a tool for viewing modeling results, am excited to see how interactive and customizable this tool is"***

2. What more would you like to learn about DTA?

***"Would like to see how the remaining features worked - I'd like to be able to use a specific example from our county and visualize it in the tool"***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"I think this training is best for GIS-oriented people in our office, but I'd love to be able to show less technical demos of this tool to my supervisors to see how they foresee its use in Wilco"***

4. Are you interested in attending the DTA 2.0 training?

***"definitely!"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"I'd like to learn more about the data warehouse"***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"I really enjoyed this training - I think this tool has a lot of cool uses for local governments. I'd like to be able to meet in smaller groups (maybe 5 or so people) to be able to get a more in-depth look at how this could be used"***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Yes. I would like to see a Manual/Help material to learn the interface"**
2. What more would you like to learn about DTA?  
**"How to build the network"**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"Yes. This tool can be used to simulate a network before making changes."**
4. Are you interested in attending the DTA 2.0 training?  
**"Yes"**
5. What more would you like to learn about the Network Modeling Center at CTR?  
**"Data management"**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"NA"**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Yes, the training today basically met my expectation."**
2. What more would you like to learn about DTA?  
**"How the network, input files, model parameters, etc, got initiated and setup."**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"Yes, I would recommend all CAMPO modeling team members to attend this training."**
4. Are you interested in attending the DTA 2.0 training?  
**"Yes, it would be interesting."**
5. What more would you like to learn about the Network Modeling Center at CTR?  
**"Maybe a detailed case study workshop?"**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"During the training today, there were a few technical difficulties due to the server or the software being used by more than 10 people at the same time. Was there any way to improve the stability and reliability of DTA Vista model tool?"**



1. Did the training meet your expectations for today? If not, what were you expecting to learn?  
**"Yes it is a good basic introduction. "**
2. What more would you like to learn about DTA?  
**"More advanced training about using the tool."**
3. After attending today, do you think your colleagues should attend this training? If so, who?  
**"N/A"**
4. Are you interested in attending the DTA 2.0 training?  
**"Yes"**
5. What more would you like to learn about the Network Modeling Center at CTR?  
**"Current projects CTR is working on."**
6. Please provide any additional feedback that will help us improve our training for future audiences.  
**"Need to make the tool more user friendly. Need a stand alone version so consulting engineer can run models on their own server."**

DTA 1.0 Training

Follow-up survey

January 28, 2016



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"yes, it met my expectations. I expected to learn how the system works and what it's capabilities are."***

2. What more would you like to learn about DTA?

***"I'd like to be able to add new roadways to a system and then run iterations for route assignment"***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"I believe Scheleen Walker and Charlie Watts from our Long Range Planning would benefit from this."***

4. Are you interested in attending the DTA 2.0 training?

***"yest"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"ability to generate reports"***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Yes. I would love to see how cities have used the information from the tool"***

2. What more would you like to learn about DTA?

***"How DTA can be used for future scenarios (long-range) with changes in mode split"***

4. Are you interested in attending the DTA 2.0 training?

***"Yes"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"How we could work with NMC on our current planning effort"***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"I believe you said there will be smaller groups for the next training, but having a laptop for everyone would be helpful."***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Yes the training met my expectations and I was pleased with the way it was presented in an engaging format"***

2. What more would you like to learn about DTA?

***"I would like to learn more about the different functions that DTA has and see possible ways it can be utilized. Learning about the transit tool would also be nice"***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"I think my colleagues that handle planning for projects and modeling scenarios should attend this training."***

4. Are you interested in attending the DTA 2.0 training?

***"I am interested in attending the next training"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"What data that NMC has available and what data it would like to have"***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"I thought the training was well done and would not change much about the training format. Being able to interact with the system was extremely helpful so making sure that's possible would be best."***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Yes, it's a good one."***

2. What more would you like to learn about DTA?

***"Remote access to play with various scenarios "***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"Yes, it'd open their eyes to see opportunities in applying DTA for daily operations"***

4. Are you interested in attending the DTA 2.0 training?

***"For sure"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"Manipulate O-D tables"***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"A good job!"***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"yes "***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"Unknown"***

4. Are you interested in attending the DTA 2.0 training?

***"yes"***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Yes"***

2. What more would you like to learn about DTA?

***"More detailed instruction."***

4. Are you interested in attending the DTA 2.0 training?

***"Yes."***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"Yes, I'm interested in getting the more detailed training, but this was a great primer."***

2. What more would you like to learn about DTA?

***"How it could be a long term planning tool beyond closures and other short term scenarios. Also, different mode shift scenarios."***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"Yes, we could probably have 2 or 3 other employees in my group learn this."***

4. Are you interested in attending the DTA 2.0 training?

***"Yes."***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"Great job guys!"***



1. Did the training meet your expectations for today? If not, what were you expecting to learn?

***"yes"***

2. What more would you like to learn about DTA?

***"more detail regarding DTA"***

3. After attending today, do you think your colleagues should attend this training? If so, who?

***"no"***

4. Are you interested in attending the DTA 2.0 training?

***"yes"***

5. What more would you like to learn about the Network Modeling Center at CTR?

***"data availability and coordination, assistance with analyses"***

6. Please provide any additional feedback that will help us improve our training for future audiences.

***"very informative! looking forward to next training."***

**DTA 2.0 Training Survey Responses**

|                     | <b>Which aspects of the training you would like to learn more about?</b>  | <b>Are there any parts of the training you would remove?</b> | <b>Can you suggest any improvements to the training?</b> | <b>What do you like about the visualization tool? Also, how could it be improved?</b> | <b>Would you like to participate in further DTA training about:</b> |
|---------------------|---|--|--|---|---|
| <b>Respondent 1</b> | Preparing DTA model data, Quality Control of Inputs, Model Results Analysis, Scenario Comparisons with the Visualization Tool | Keep all   | The TA's (assistants) were helpful                       |   | Transit modeling, Subnetwork analysis                               |
| <b>Respondent 2</b> | Quality Control of Inputs, Validation of Outputs  |  |  |   | Transit modeling, Subnetwork analysis, Model Calibration            |
| <b>Respondent 3</b> | Quality Control of Inputs, Running a model, may some more frequent errors   | none   | It is good.  |   | Transit modeling, Subnetwork analysis                               |

## **Survey responses, DTA 1.0 June 7, 2016**

### **Did the training meet your expectations for today? If not, what were you expecting to learn?**

1. Yes.
2. Yes.
3. Yes.
4. Yes. Good introduction to what it is and how it works.

### **What more would you like to learn about DTA?**

1. Would be interesting to see comparisons to real world results after modeling.
2. I would like to learn more about the modeling decisions that were made. How are lights handled? Are vehicles discretized or a continuous flow? If continuous how do you handle transit vehicles?"
3. more real world applications, need to play with it more to get familiar first though

### **After attending today, do you think your colleagues should attend this training? If so, who?**

1. I can't think of anyone who needs to attend.
2. yes, traffic engineering section

### **Are you interested in attending additional DTA training?**

1. "I think the understanding provided today is sufficient for what we need to know, which is the capability of the system. The details of advanced training would be used by our consultants.
2. Yes!
3. Yes.

### **What more would you like to learn about the Network Modeling Center at CTR?**

1. Possibly
2. what other services are available to jurisdictions
3. What other resources are available to agencies.

### **Please provide any additional feedback that will help us improve our training for future audiences.**

1. Great training actually. Setup and functions were good.
2. The presentation was great!



## Sign-In Sheet

DTA 1.0 Workshop  
January 27, 2016

| Check | First    | Last        | Position   | Organization       | Email                           | Phone        |
|-------|----------|-------------|--|--------------------|---------------------------------|--------------|
| ✓     | Michael  | Dutton      | ?  | CAMPO              | Michael.dutton@campotexas.org   |              |
| ✓     | Lei      | Xu          | Senior Planner   | CAMPO              | Lei.Xu@campotexas.org           |              |
| ✓     | Anteneh  | Yohannes    | Planner II   | CAMPO              | Anteneh.Yohannes@campotexas.org |              |
| ✓     | Upal     | Barua       | Senior Engineer  | City of Austin     | upal.barua@austintexas.gov      | 512-974-7110 |
|       | Tina     | Cannon      | Policy Aide, CM Gallo<br>District 10                   | City of Austin     | tina.Cannon@austintexas.gov     | 512-978-2110 |
| ✓     | Emily    | Truman      | City Engineer  | City of Hutto      | Emily.Truman@HuttoTX.gov        | 512-759-4024 |
| ✓     | Sabas    | Avila       | Asst. Dir. Public Services,<br>Transportation Division | City of San Marcos | SAvila@sanmarcostx.gov          | 512-393-8018 |
| ✓     | Brandon  | Melland     | Senior Planner, Planning<br>and Development Services   | City of San Marcos | BMelland@sanmarcostx.gov        | 512-393-8238 |
| ✓     | Will     | Parrish     | Planning Technician                                    | City of San Marcos | wparrish@sanmarcostx.gov        | 512-805-2658 |
| ✓     | Rohit    | Vij         | Sr. Engineer, Engineering<br>and Capital Improvements  | City of San Marcos | rvij@sanmarcostx.gov            | 512-393-8133 |
| ✓     | Ning     | Zou         | Transp. Engineering Mgr.                               | City of San Marcos | nzou@sanmarcostx.gov            |              |
| ✓     | Katheryn | Cromwell    | Planner  | Wilco              | kcromwell@wilco.org             | 512-943-3375 |
| ✓     | Nathan   | Jones-Meyer | Planner  | Wilco              | sjones@wilco.org                |              |
|       |          |             |  |                    |                                 |              |
|       |          |             |  |                    |                                 |              |



## Sign-In Sheet

DTA 1.0 Workshop  
January 28, 2016

| Check | First   | Last      | Position  | Employer                       | Email                               | Phone        |
|-------|---------|-----------|---|--------------------------------|-------------------------------------|--------------|
| ✓     | Kelly   | Porter    | Senior Planner                                      | CAMPO                          | Kelly.Porter@campotexas.org         |              |
| ✓     | Jacob   | Calhoun   | Transportation Planner,<br>Project Controls         | Cap Metro                      | Jacob.Calhoun@capmetro.org          | 512-369-6501 |
| ✓     | Chris   | Anderson  | Senior Planner                                      | CAPCOG                         | canderson@capcog.org                | 512-916-6012 |
| ✓     | Stephen | Hanuscin  | Senior Engineer, Traffic<br>Signals & Street Lights | Cedar Park                     | stephen.hanuscin@cedarparktexas.gov | 512-401-5565 |
| ✓     | Eric    | Bollich   | Managing Engineer                                   | City of Austin                 | Eric.Bollich@austintexas.gov        |              |
| ✓     | Liane   | Miller    | Senior Planner                                      | City of Austin                 | liane.miller@austintexas.gov        | 512-974-7922 |
| ✓     | Mike    | Schofield | Traffic Engineer                                    | City of Austin                 | Mike.Schofield@austintexas.gov      | 512-974-7834 |
|       | Nadia   | Barrera   | Urban Trails Program Mgr.                           | City of Austin Public<br>Works | Nadia.Barrera@austintexas.gov       | 512-974-7142 |
| ✓     | Wesley  | Brandon   | City Engineer                                       | City of Bastrop                | wbrandon@cityofbastrop.org          | 512-332-8846 |
| ✓     | Thomas  | Gdala     | Senior Engineering Assoc.                           | City of Cedar Park             | Tom.Gdala@cedarparktexas.gov        | 512-401-5064 |
| ✓     | Candace | Douglas   | Associate Engineer                                  | City of Hutto                  | Candace.Douglas@HuttoTX.gov         | 512-759-4024 |
|       | Helen   | Ramirez   | Director of Development<br>Services                 | City of Hutto                  | Helen.Ramirez@HuttoTX.gov           | 512-759-4024 |
| ✓     | David   | Greear    | Engineering Division Mgr.                           | Travis County                  | David.Greear@traviscountytexas.gov  |              |
|       | Karen   | Lorenzini | I-35/Mobility35 Program<br>Manager                  | TxDOT Austin<br>District       | karen.lorenzini@txdot.gov           | 512-832-7369 |
|       | Tim     | Juarez    | MPO Coordinator<br>DTA Program Manager              | TxDOT                          | Tim.Juarez@txdot.gov                |              |
| ✓     | Daniel  | Yang      | Program Manager                                     | CAMPO                          | Daniel.Yang@campotexas.org          |              |



## Sign-In Sheet

DTA 2.0 Workshop  
April 19, 2016

| Check-In | First   | Last   | Position   | Organization       | Email                         | Phone        |
|----------|---------|--------|--|--------------------|-------------------------------|--------------|
| X        | Michael | Dutton | Planner  | CAMPO              | Michael.dutton@campotexas.org | 512.232.8336 |
| X        | Lei     | Xu     | Senior Planner                                     | CAMPO              | Lei.Xu@campotexas.org         | 512.232.8342 |
| X        | Daniel  | Yang   | GIS & Modeling Program Manager                     | CAMPO              | Daniel.Yang@campotexas.org    | 512-232-8393 |
|          | Kelly   | Porter | Senior Planner                                     | CAMPO              | kelly.porter@campotexas.org   | 512.974.2084 |
|          | Rohit   | Vij    | Sr. Engineer, Engineering and Capital Improvements | City of San Marcos | rvij@sanmarcostx.gov          | 512-393-8133 |



Seminar for NMC and CAMPO modeling staff

Who: Robert Lehr (NMC staff)

When: 9/18/15, 12:15pm

Where: UTA 4.302

Title: "Bluetooth in the City: Analyzing Austin Traffic"

Abstract: The appeal of Bluetooth in transportation research is its low cost and high volume of data. Bluetooth detectors spread throughout Austin offered an opportunity to gather individual and mass travel time and origin-destination information with a granularity not offered by current methods. We will explain how Bluetooth works, its benefits and drawbacks, and what we gleaned from Austin's network of Bluetooth detectors.



## FY16 Deliverables Submittal

### Task 5.2 Summary of feedback given at quarterly updates to CAMPO's TAC and/or TPB meetings

An important element of CTR's contract with CAMPO includes accountability for the work that we are completing as part of our contract. To ensure that we are effectively communicating with CAMPO leadership as well as the Technical Advisory Committee (TAC) and Transportation Policy Board (TPB), our scope of work includes providing periodic updates. The list of enclosures includes board and committee presentations made throughout the fiscal year. Through this accountability process, CTR obtained feedback and worked together with CAMPO to better meet the region's needs.

#### Enclosed

- October 2015 TAC Meeting Memo and Presentation
- January 2016 TAC Meeting Presentation
- February 2016 TAC Meeting Presentation
- March 2016 TAC Meeting Presentation
- March 2016 TPB Meeting Memo
- April 2016 TPB Meeting Memo and Presentation





Date: October 21, 2015  
Continued From:  
Action: N/A  
Requested:

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To: Technical Advisory Committee  
From: Jen Duthie, Ph.D., UT - Austin  
Agenda Item: 9  
Subject: Quarterly Update on CTR's DTA Deployment

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**RECOMMENDATION**

None.

**PURPOSE AND EXECUTIVE SUMMARY**

The purpose of this agenda item is to provide the TAC with a quarterly report on the deployment of the Dynamic Traffic Assignment (DTA) by the Center for Transportation Research (CTR) under the current interlocal agreement in the CAMPO region.

**FINANCIAL IMPACT**

No financial impact to CAMPO.

**BACKGROUND AND DISCUSSION**

CAMPO and CTR entered into an interlocal agreement in December 2014 for the fiscal year of 2015 for supporting the research and deployment of DTA in the CAMPO area.

**SUPPORTING DOCUMENTS**

None

# Update on Work for CAMPO:

## General Assistance, Dynamic Traffic Assignment, & Data Warehouse

Presentation to TAC  
October 28, 2015

Jen Duthie, Ph.D.



# General Assistance

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- Plan for 2015 base year travel demand model
  - RFP
  - QAQC
  - Tools and methods



# DTA Model Applications

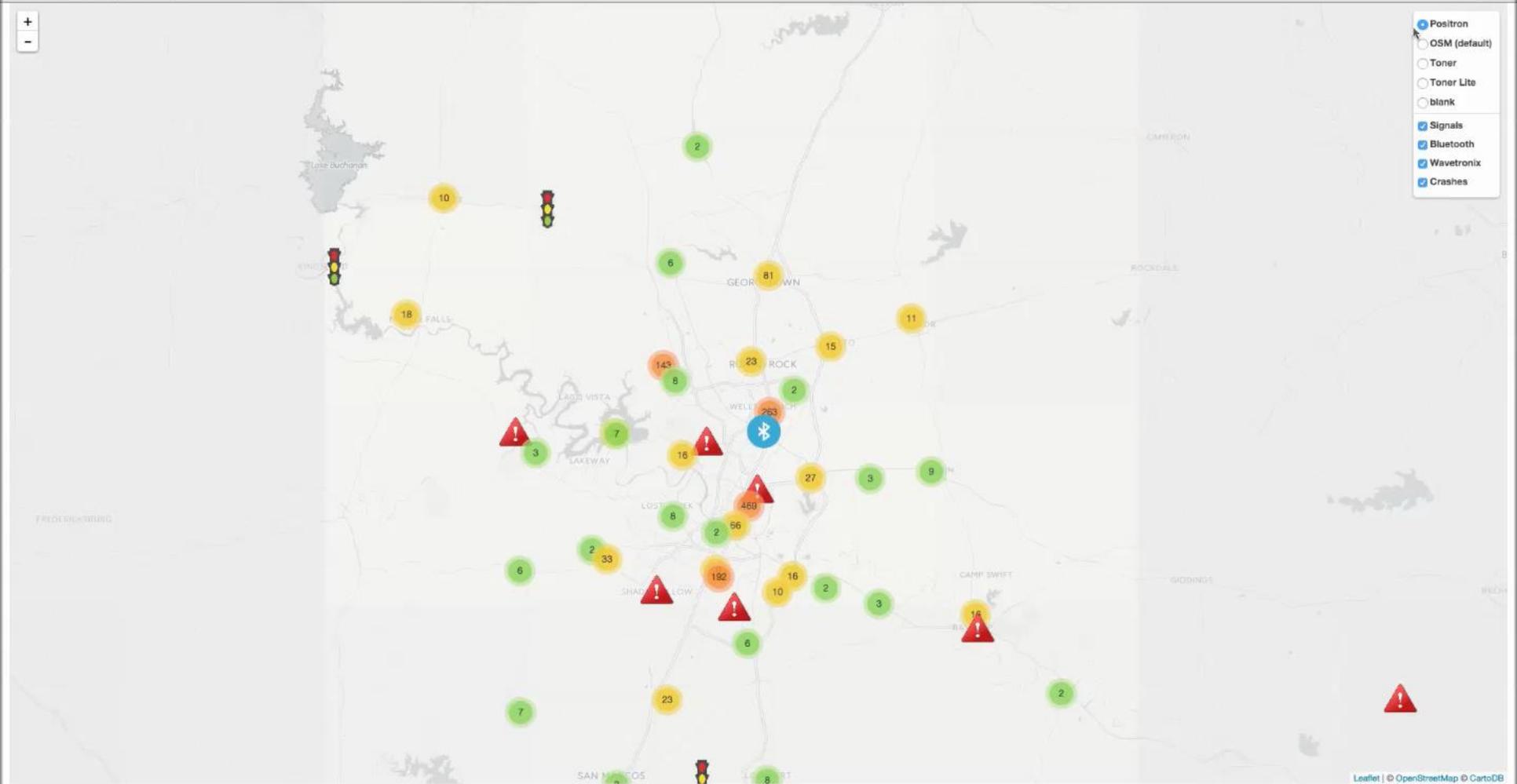
- Austin Avenue Reconstruction for City of Georgetown
  - Report sent to Georgetown staff for review
- SH 71 Overpass Construction for City of Bastrop
  - Complete; planning follow-up
- Guadalupe Corridor Improvements for City of Austin
  - Report sent to team for review
- MoPac South for Central Texas Mobility Authority
  - Report on impacts to downtown sent to team for review
  - Open houses 11/5 and 11/10
  - <http://www.mopacsouth.com/voh/impacts.php>



# Data Discovery Environment

- [Prototype](#)
  - Sharing at NACTO session tomorrow 10:15 a.m.
- Active in region's Integrated Corridor Management conversations





# Data Discovery Enviroment

# QUESTIONS?



Center for Transportation Research  
The University of Texas at Austin  
Email: [jduthie@mail.utexas.edu](mailto:jduthie@mail.utexas.edu)





# Dynamic Traffic Assignment Training 1.0

January, 2016



## Workshop Feedback

"I thought the training was well done and I wouldn't change much about the format. Being able to interact with the system was extremely helpful."

"I think my colleagues who handle planning . . . and modeling scenarios should attend this training" . . .  
"it'd open their eyes to opportunities in applying DTA in daily operations."



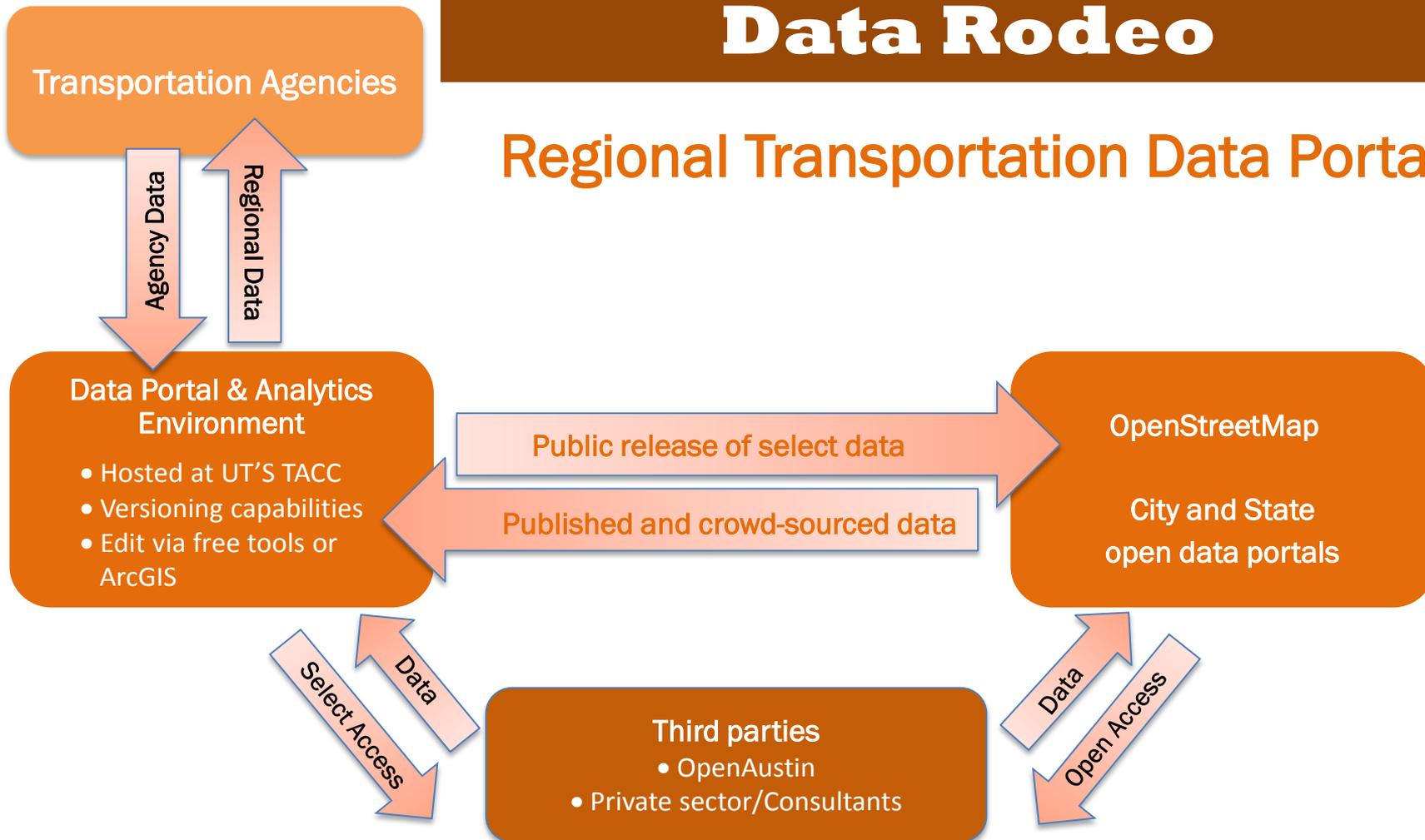
## Workshop Highlights

- collaborative learning environment
- hands-on access to DTA resources
- "engaging presentation"



# Central Texas Data Rodeo

## Regional Transportation Data Portal





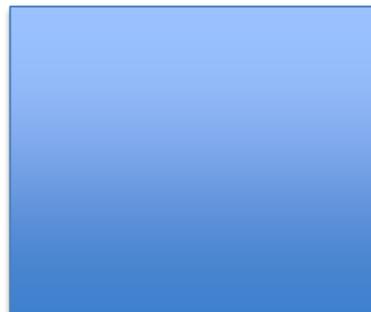
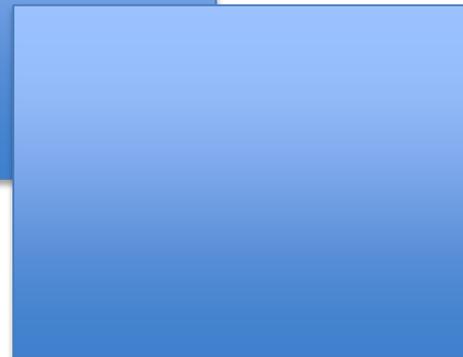
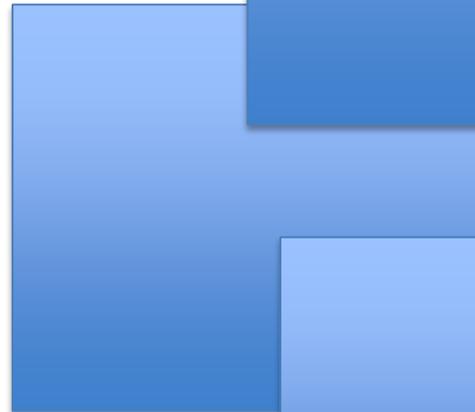
# Dynamic Traffic Assignment 1.0 Deployment January 2016

*“... As a non-transportation focused planner, I had limited knowledge going into today. So this provided a good introduction for me regarding DTA and the software.”*

*“I really enjoyed this training - I think this tool has a lot of cool uses for local governments.”*

*“Definitely surpassed expectations - was expecting to see a tool for viewing modeling results, am excited to see how interactive and customizable this tool is.”*

*“I am interested in attending the next training.”*



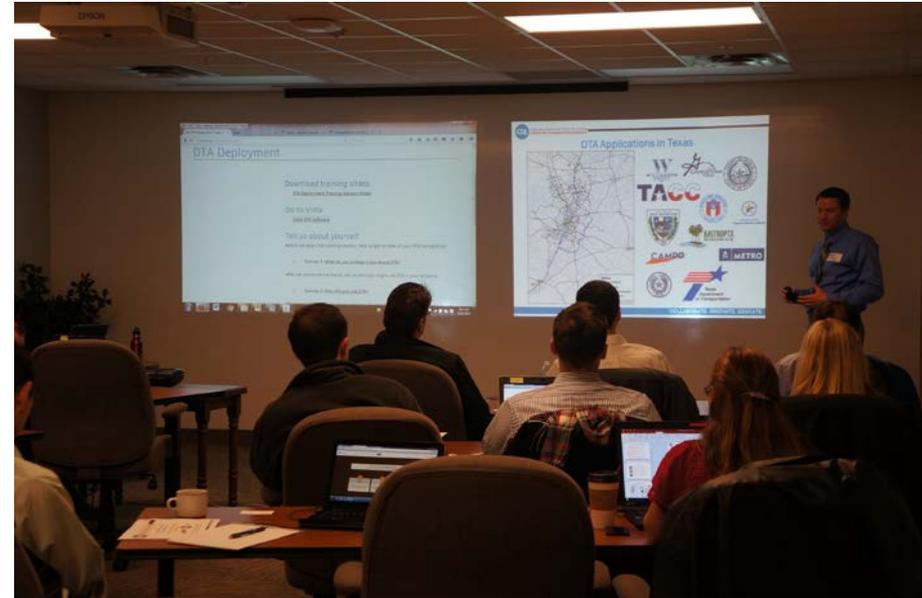
<http://ctr.utexas.edu/dta/>

# Update

- Interlocal Agreement with CoA ATD
- Regional transportation data portal

# Interlocal Agreement with CoA ATD

- 5 years
- Max \$2.5mil
- Leverage expertise at CTR and throughout UT



# Interlocal Agreement with CoA ATD

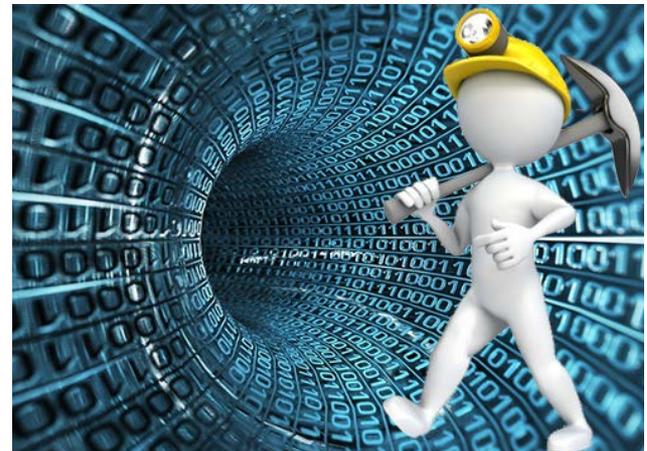
## Potential Work Tasks

- Smart City Challenge Grant
  - Assist with grant preparation
- TMC Expansion
  - Evaluate performance
  - Pilot new sources of data and technologies
- Adaptive Signal Control Performance
  - Evaluate City pilots
  - Recommend improvements

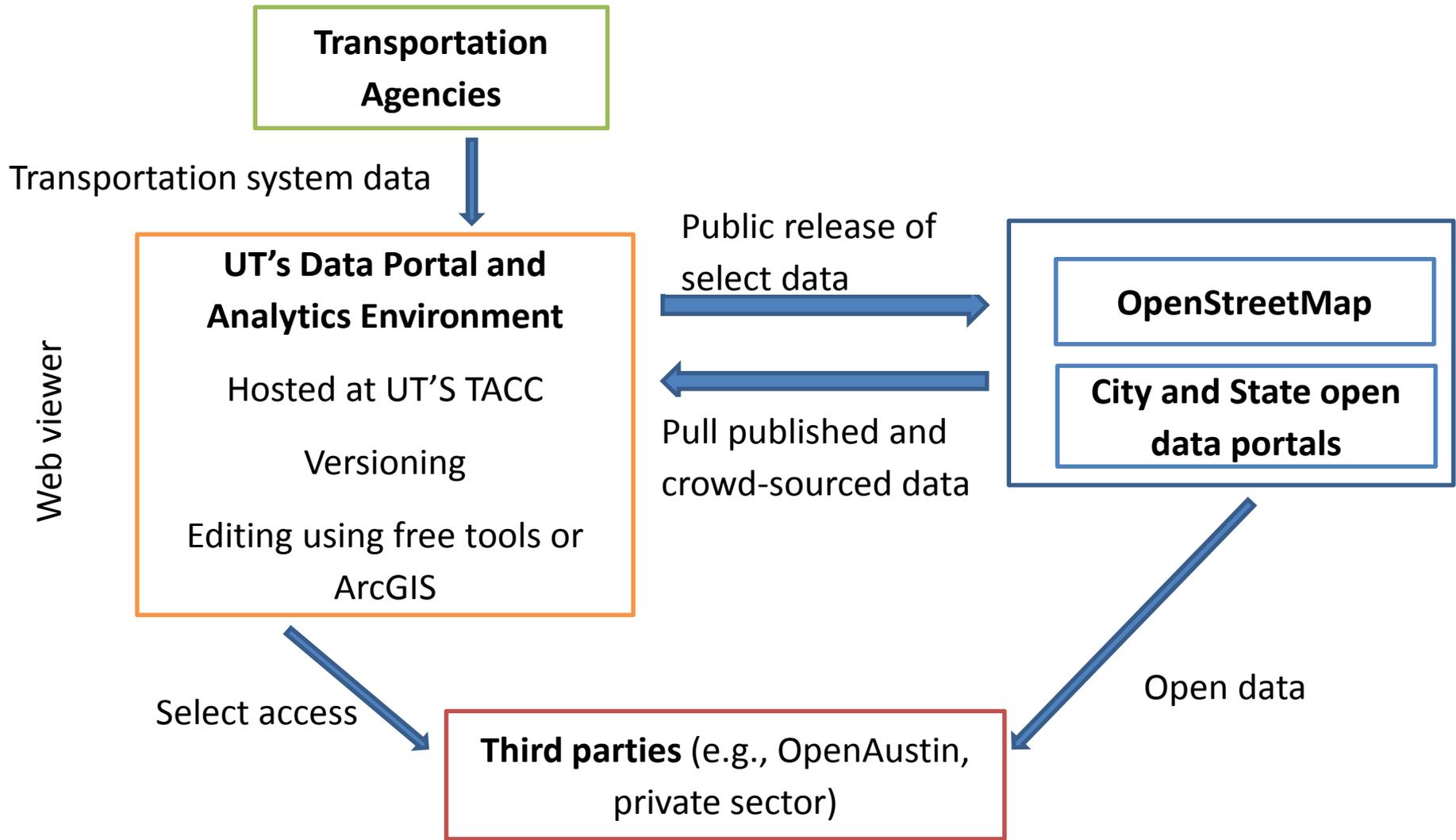


# Interlocal Agreement with CoA ATD

- ROW Fee Assessment
  - Evaluate current fee capture methods in Austin and nationwide
  - Recommend method that captures all costs and minimizes community impact
- Open Data and Analytics
  - Facilitate opening real-time data streams
  - Develop tools to merge data streams and maximize value



# Regional Transportation Data Portal





Date: March 16, 2016  
Continued From:  
Action: N/A  
Requested:

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To: Transportation Policy Board  
From: Jen Duthie, Ph.D., UT - Austin  
Agenda Item: 11  
Subject: Quarterly Update on CTR's DTA Deployment

---

**RECOMMENDATION**

For informational purposes only.

**PURPOSE AND EXECUTIVE SUMMARY**

The purpose of this agenda item is to provide the TPB with a quarterly report by the Center for Transportation Research (CTR) on contract activities under the current interlocal agreement in the CAMPO region. CTR will update TAC on deployment of the Dynamic Traffic Assignment (DTA) model, development of the Regional Data Warehouse, and other contract-related activities.

**FINANCIAL IMPACT**

No financial impact to CAMPO.

**BACKGROUND AND DISCUSSION**

CAMPO and CTR entered into an interlocal agreement in December 2014 for the fiscal year of 2015 for supporting the research and deployment of DTA in the CAMPO area.

**SUPPORTING DOCUMENTS**

None



Date: March 25, 2016  
Continued From:  
Action: N/A  
Requested:

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To: Transportation Policy Board  
From: Jen Duthie, Ph.D., UT - Austin  
Agenda Item: 11  
Subject: Quarterly Update on CTR's DTA Deployment

---

**RECOMMENDATION**

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**BACKGROUND AND DISCUSSION**

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**SUPPORTING DOCUMENTS**

None



# Dynamic Traffic Assignment Training 1.0

January, 2016



## Workshop Feedback

"I thought the training was well done and I wouldn't change much about the format. Being able to interact with the system was extremely helpful."

"I think my colleagues who handle planning . . . and modeling scenarios should attend this training" . . . "it'd open their eyes to opportunities in applying DTA in daily operations."

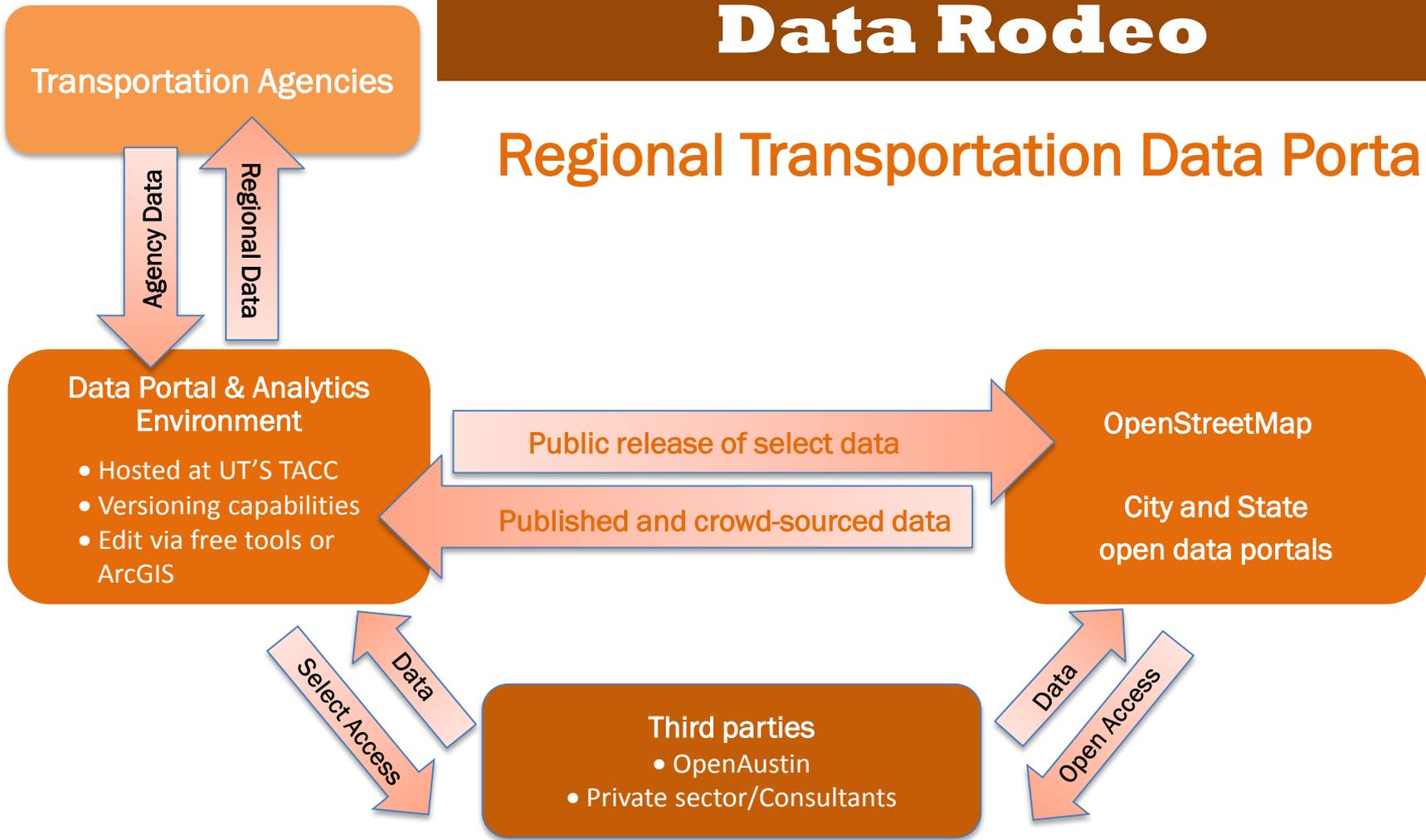
## Workshop Highlights

- collaborative learning environment
- hands-on access to DTA resources
- "engaging presentation"



# Central Texas Data Rodeo

## Regional Transportation Data Portal





## FY16 Deliverables Submittal

### Task 5.3 DTA Training Materials and Documentation

For CTR's contract with CAMPO, Task 5 includes outreach and training, workshops, documentation, and quarterly updates. Task 5.3 deliverables include DTA training/presentation materials and the documentation developed to enhance the trainings and provide post-training support for users.

We utilized customized websites for each training session, to provide easy, centralized access to training materials. The DTA 1.0 training portal is permanently located at <http://ctr.utexas.edu/nmc/dta/dta-1-0/>. The DTA 2.0 web portal is permanently located at <http://ctr.utexas.edu/nmc/dta/dta-2-0-workshop-materials/>.

#### Enclosed

- DTA 1.0 Deployment materials and documentation. (The June presentation differs slightly from the January presentation due to improvements made as a result of feedback from the January session.)
- DTA 2.0 Deployment materials and documentation. (The presentation is followed by a collection of "cheat sheets" and reference documents that will provide post-training support for users.)





THE UNIVERSITY OF TEXAS AT AUSTIN  
**CENTER FOR TRANSPORTATION RESEARCH**

**Dynamic Traffic Assignment  
Deployment Training 1.0  
January 27 and 28, 2016**

**UT Center for Transportation Research**  
**In collaboration with**



To access training resources, please visit  
[ctr.utexas.edu/nmc/dta-deployment/](http://ctr.utexas.edu/nmc/dta-deployment/)

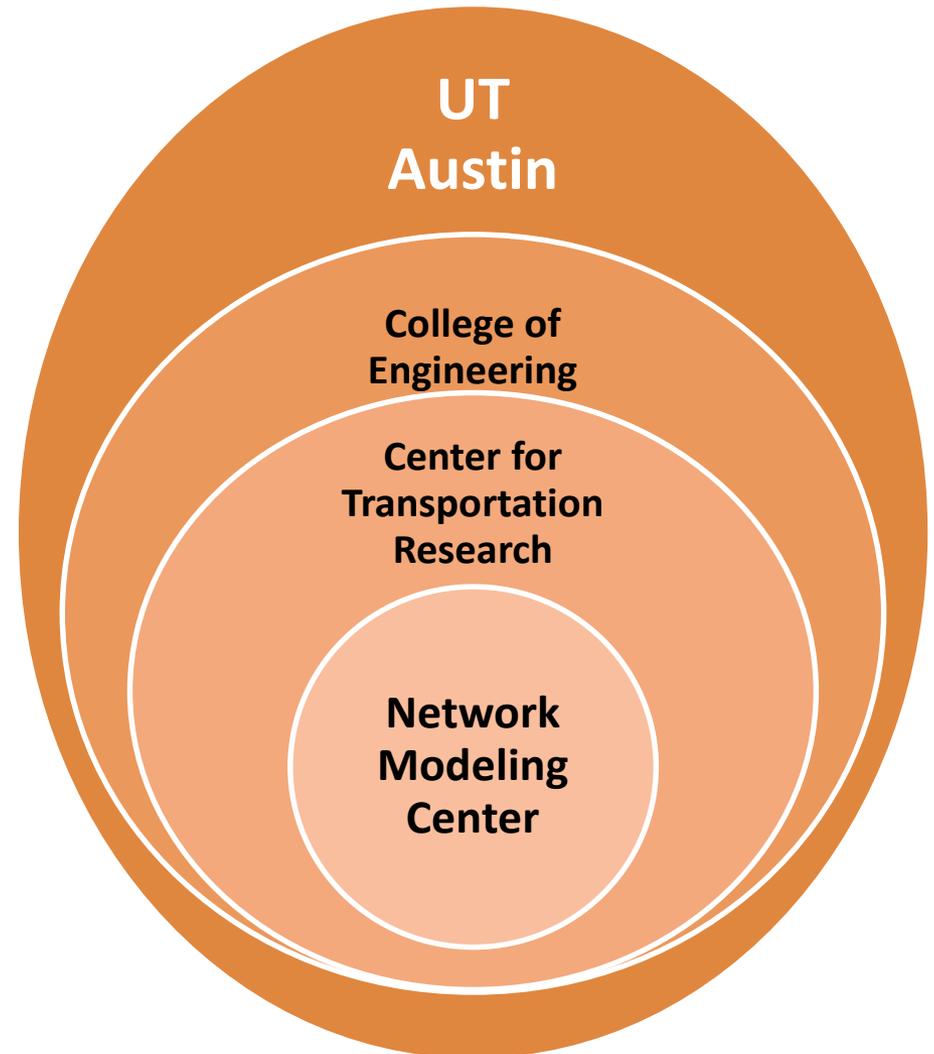
## Tentative Schedule

| 8:30  | Set-up and introductions                     |
|-------|--|
| 9:00  | What is DTA and why use it?                  |
| 9:50  | Break  |
| 10:00 | How to build and run a DTA model             |
| 11:00 | Break  |
| 11:10 | DIY: Web-based analysis of DTA model results |
| 12:00 | What's next?                                 |

# Center for Transportation Research (CTR)

CTR is one of the leading university-based transportation research centers in the world.

We have been working with CAMPO to apply a Dynamic Traffic Assignment (DTA) tool to the region and we are now ready to teach users how to maximize its benefits.



## Today's goals

Understand Dynamic  
Traffic Assignment (DTA)

Learn how to create and  
view DTA model results





# What Do You Already Know About DTA?

## What is Dynamic Traffic Assignment (DTA)?

- DTA is a planning tool used to compare possible future year scenarios.
- DTA models “strategic” driving behavior, or how drivers choose their routes at a typical time based on least-cost path selection.

## What makes DTA different from other models?

- DTA considers the evolution of traffic conditions at small time intervals (seconds).
- DTA captures changes in traffic conditions every 100 to 500 feet.

## What kinds of resources does DTA use?

- Because DTA model results are very fine-grained, models require significant computational and data resources.

## How would you use DTA in your jurisdiction?

- DTA analyzes region-wide changes to traffic patterns and illustrates the resulting traffic conditions.

Please access the survey at

<http://ctr.utexas.edu/nmc/dta-deployment/>

## Model Types

### Macro

- CAMPO Travel Demand Model
- Less detailed, regional study

### Meso

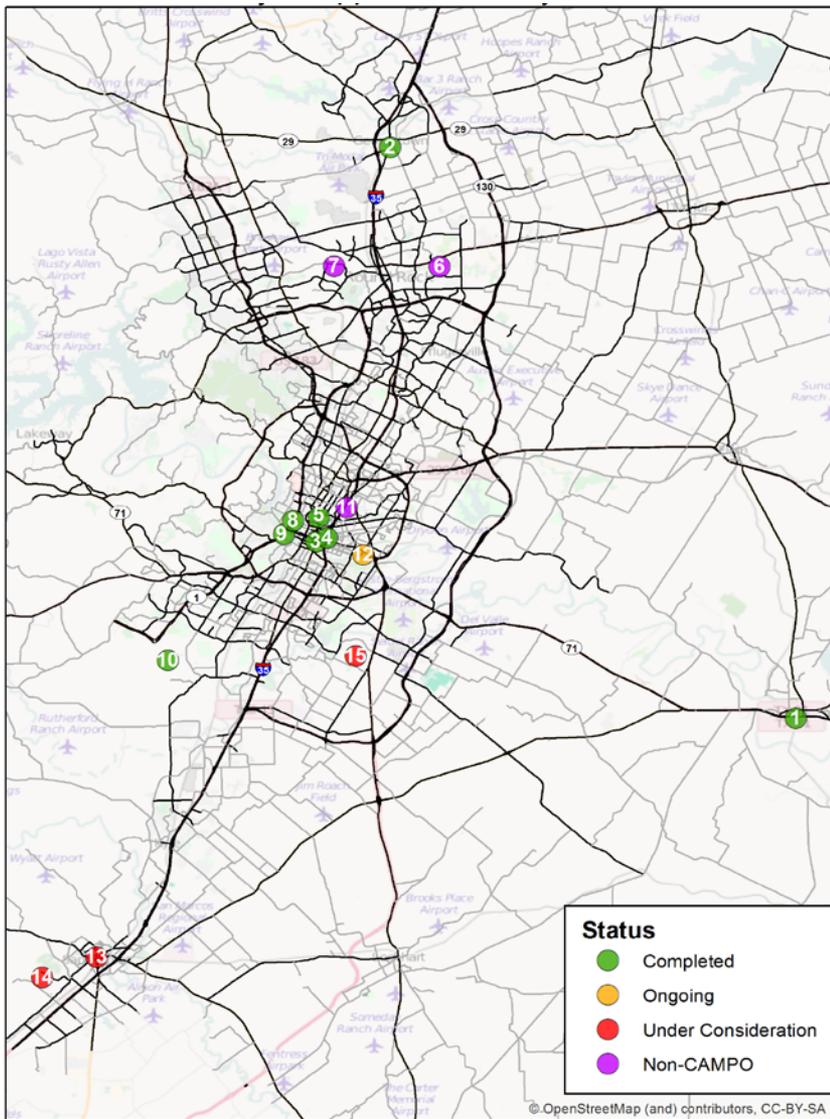
- **CTR Dynamic Traffic Assignment (DTA)**
- **More detailed, sub-area study**

### Micro

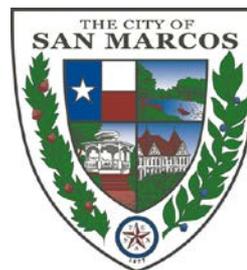
- Consultant microsimulation models
- Most detailed, corridor study



# DTA Applications in Texas



CENTRAL TEXAS  
Regional Mobility Authority



**BASTROPTX**  
Heart of the Lost Pines / Est. 1832



# 7th Street and 8th Street Conversions

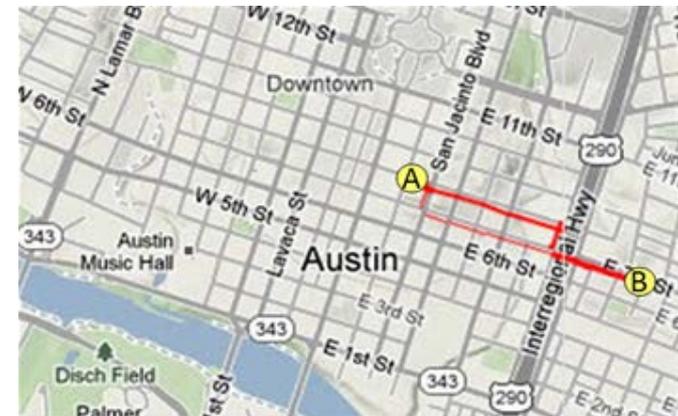
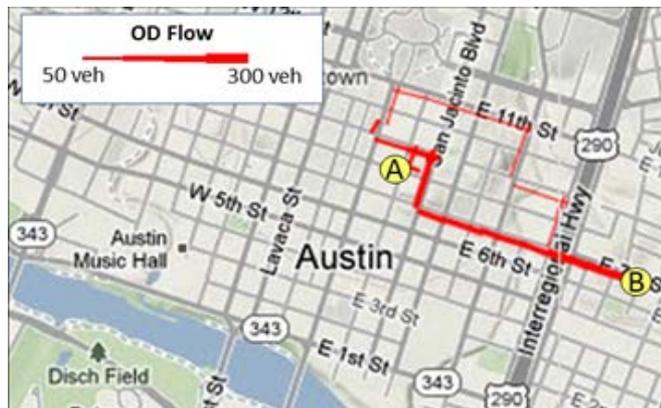
## Path Analysis

ONE-WAY

TWO-WAY



7:00 AM to 9:00 AM



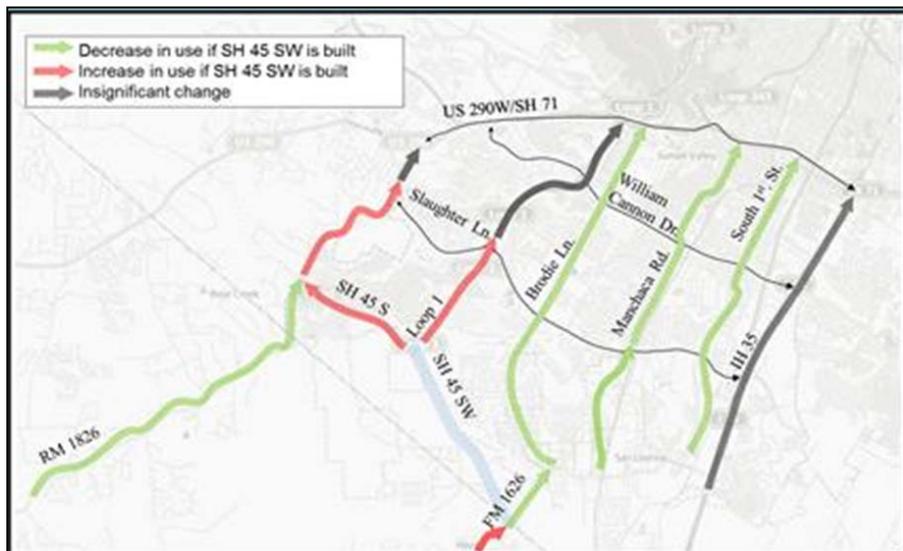
4:00 PM to 6:00 PM



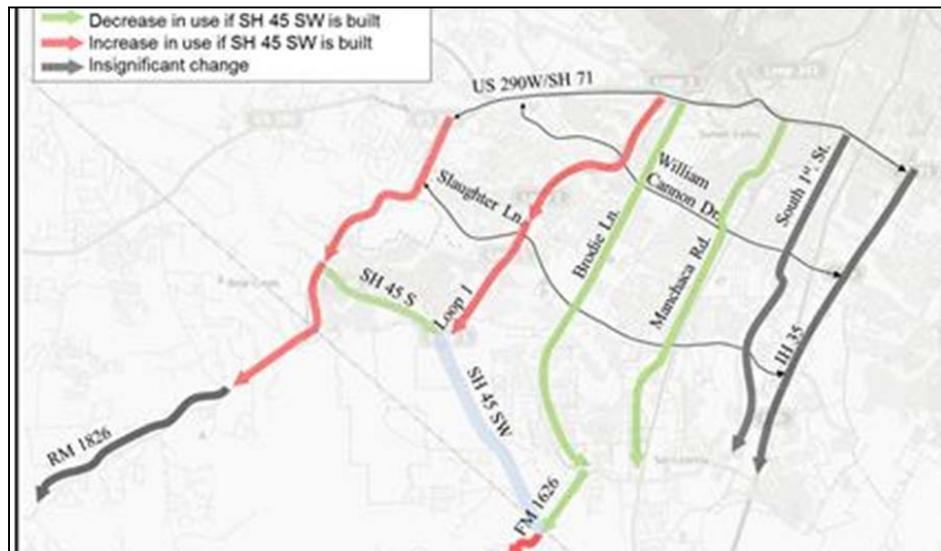
# State Highway 45 Southwest



## Analysis of Major Corridors



**2025 AM Peak Conditions  
Northbound**



**2025 PM Peak Conditions  
Southbound**

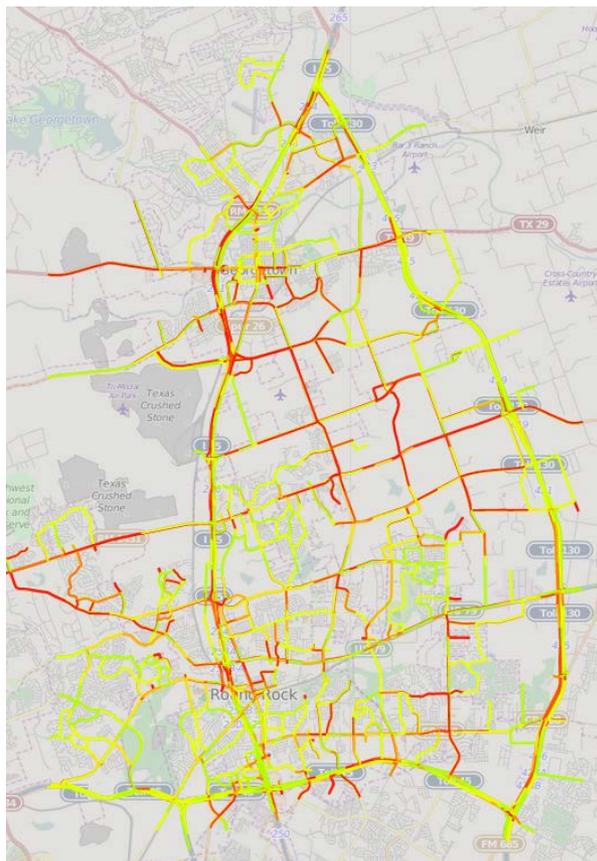


# Williamson County

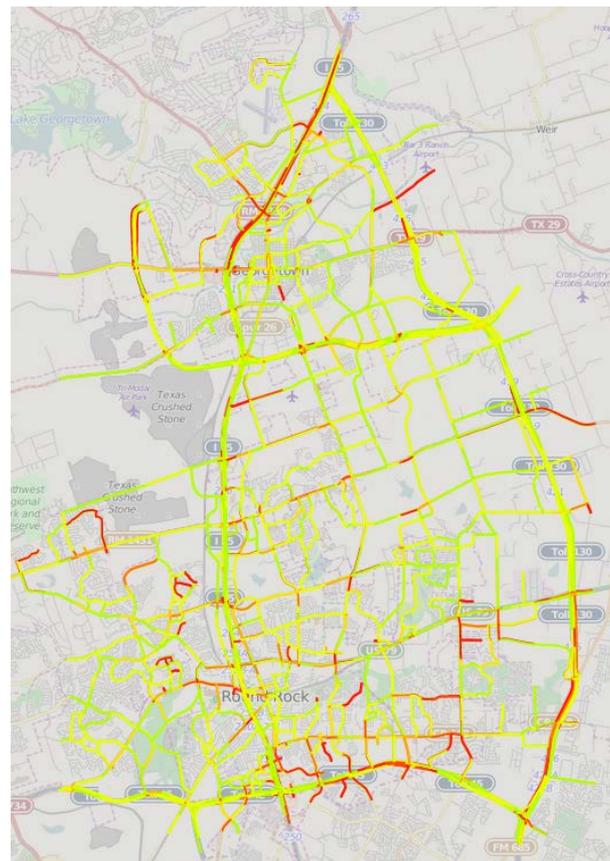


Average speed compared to speed limit

Slow Fast



2035  
Alternative A



2035  
Alternative B

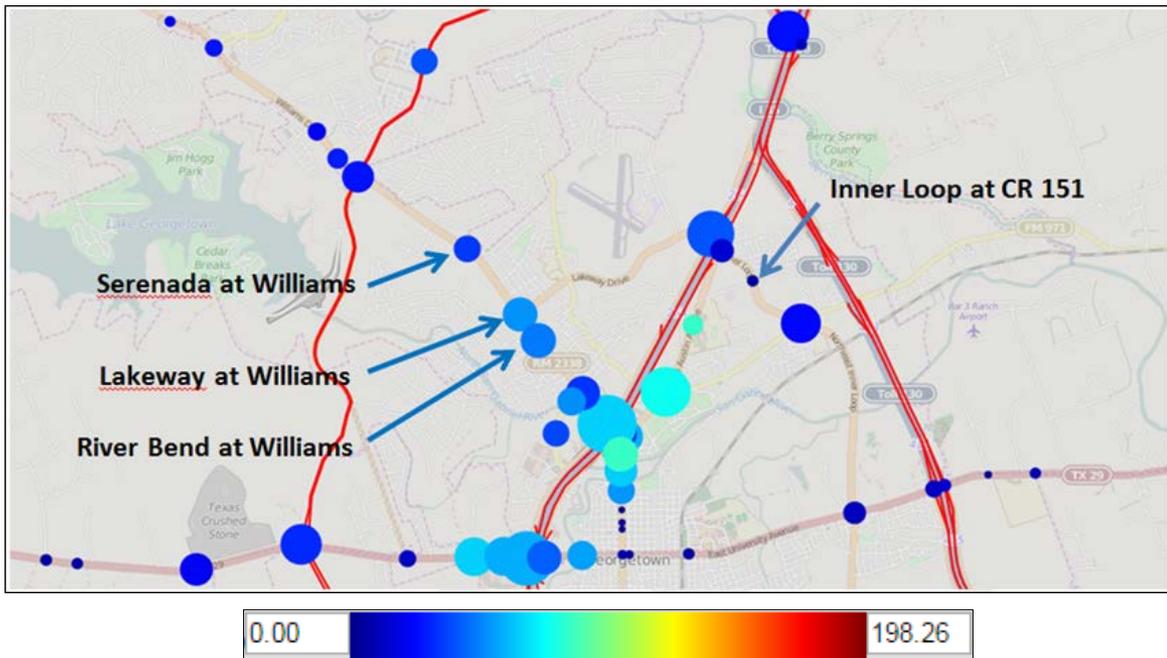
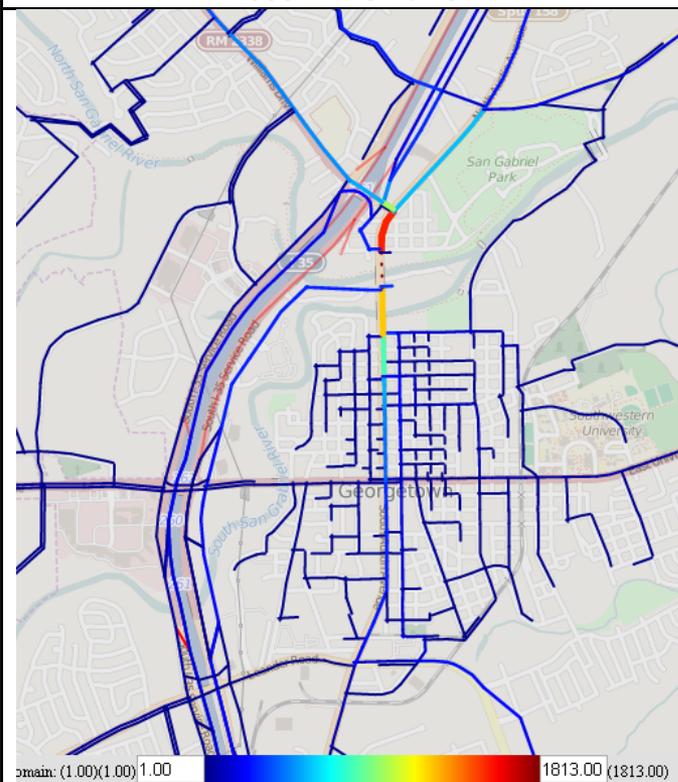


# Austin Avenue



## Signalized Intersections of Interest

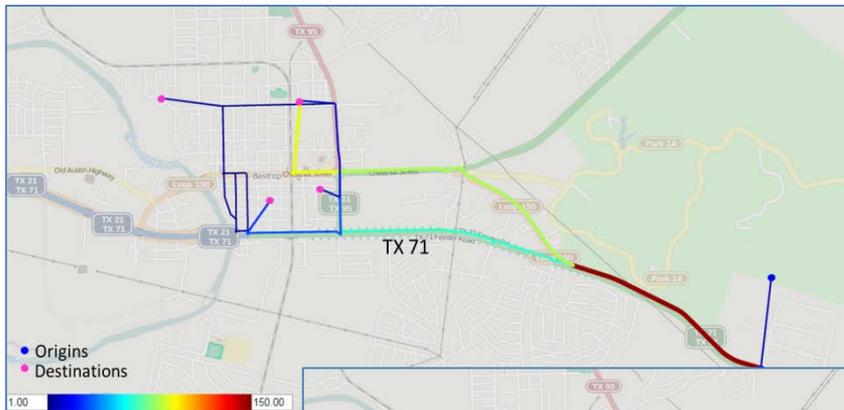
2035 PM 5-Lane



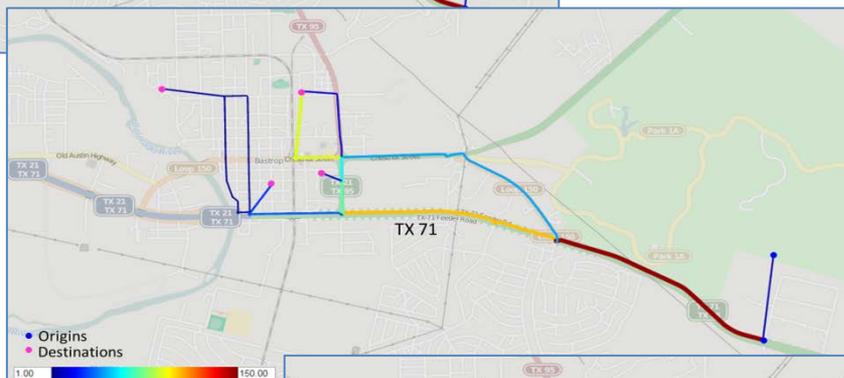
2035 Northbound Traffic Flow  
PM Peak

# SH 71 Interchanges

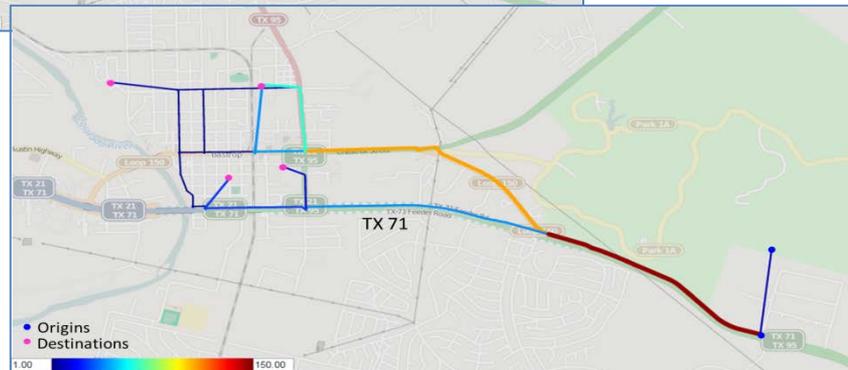
Existing



Construction of Loop 150 Interchange

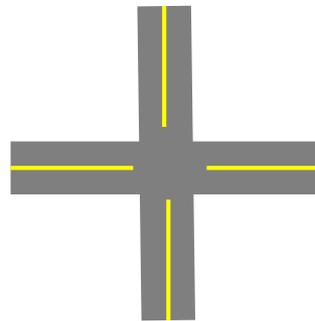


Construction of SH 95 Interchange

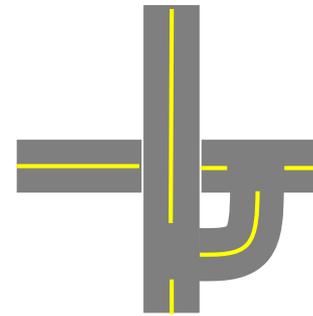


# A typical DTA application

What are the impacts of two different intersection designs?



AT GRADE



OVERPASS

## Process

- Collect data
- Build and review model inputs (GIS tools)
- Test and calibrate the model
- Run and validate the model
- Analyze results

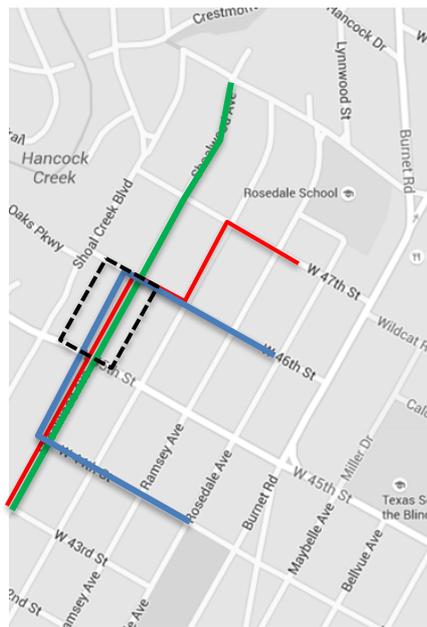
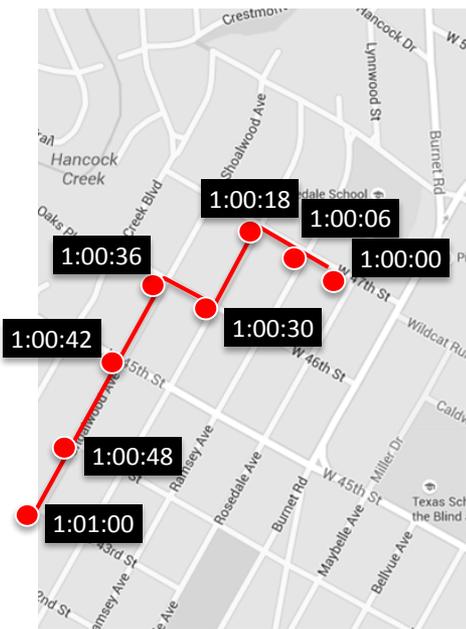
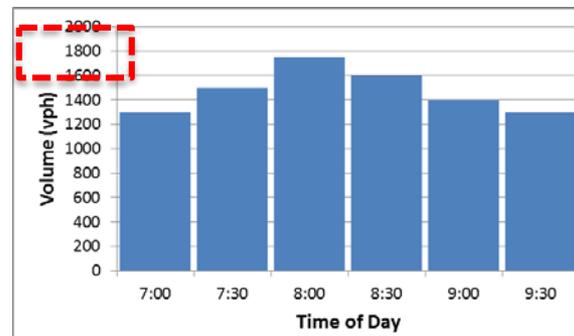
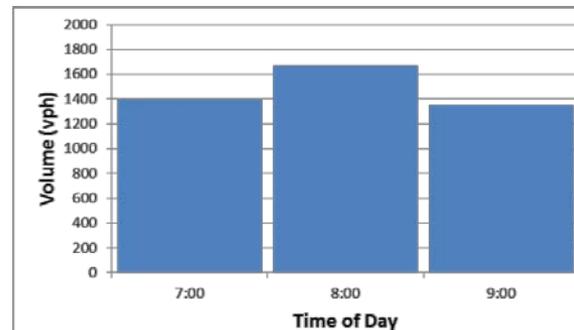
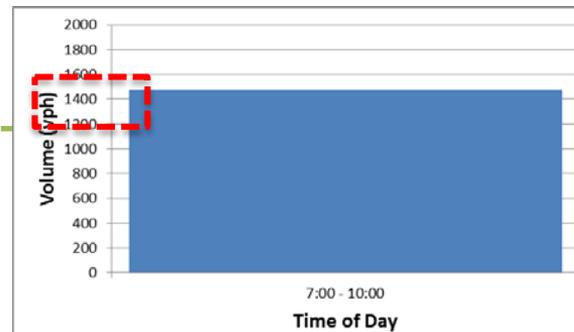
# DTA Model Results

## Raw Results

- Individual vehicles trajectories

## Aggregation for analysis

- Space
- Time



## DTA Results Analysis

System-level and average performance

Detailed analysis to interpret system-level trends

- Intersections, corridors, roadway segments
- Origins and destinations

## System-Level Analysis

Total system travel time

Average travel time

Network-wide vehicle volumes

- Time-dependent
- Difference across scenarios

Delay at signalized intersections

## Detailed Metrics

### Select link analysis

- Identify the paths of all vehicles using a particular roadway segment (link)

### Origin-Destination path analysis

- Identify all used paths connecting selected origins and destinations

### Reach time

- Identify how far vehicles can travel from selected origins within pre-specified time intervals

## How will you use DTA?

1. Name a current or prospective project in your jurisdiction where rerouting is an issue.
2. Name a current or prospective project where traffic impacts will differ by time of day.
3. Name other projects where DTA can be helpful to your jurisdiction.

Please access the survey at  
[ctr.utexas.edu/nmc/dta-deployment/](https://ctr.utexas.edu/nmc/dta-deployment/)



## Ten-Minute Break



# Fundamental DTA Concepts

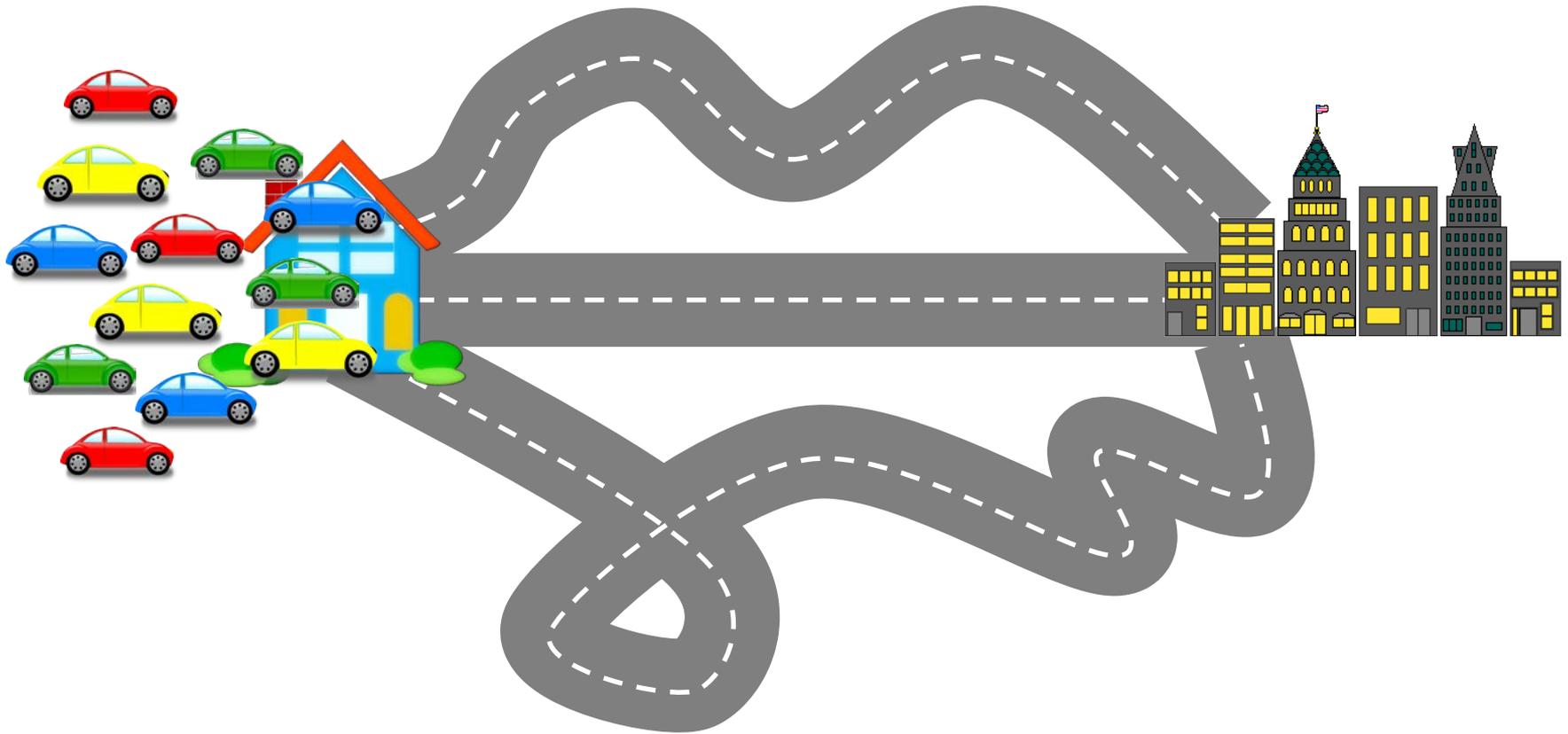
## Goal

- Given: Travel demand and transportation network
- Find: Paths that travelers take to go from origins to destinations throughout the network.
  - Traffic patterns and system performance emerge from these paths

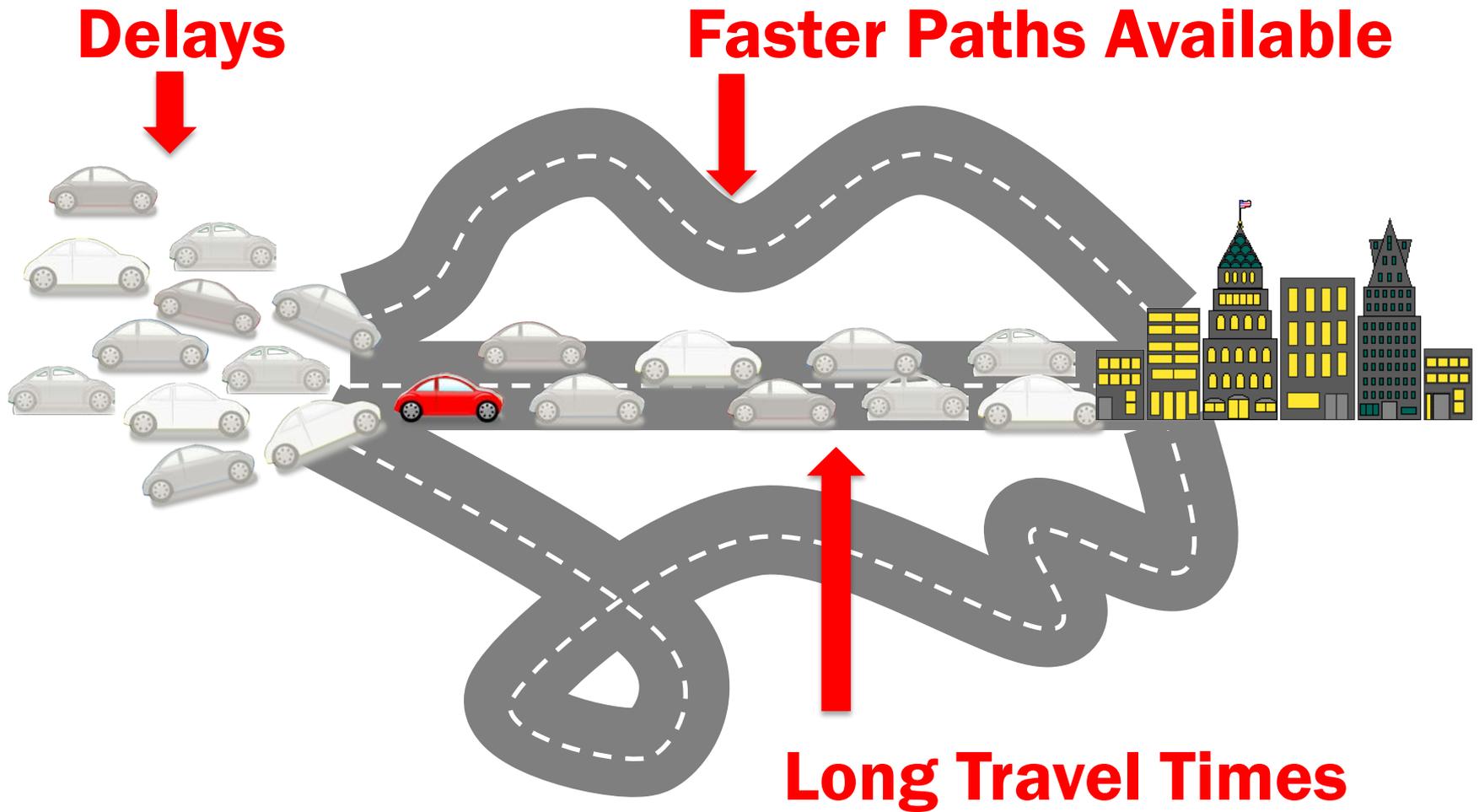
## Assumptions

- Selfish behavior of drivers
- Equilibrium of usage

# Equilibrium

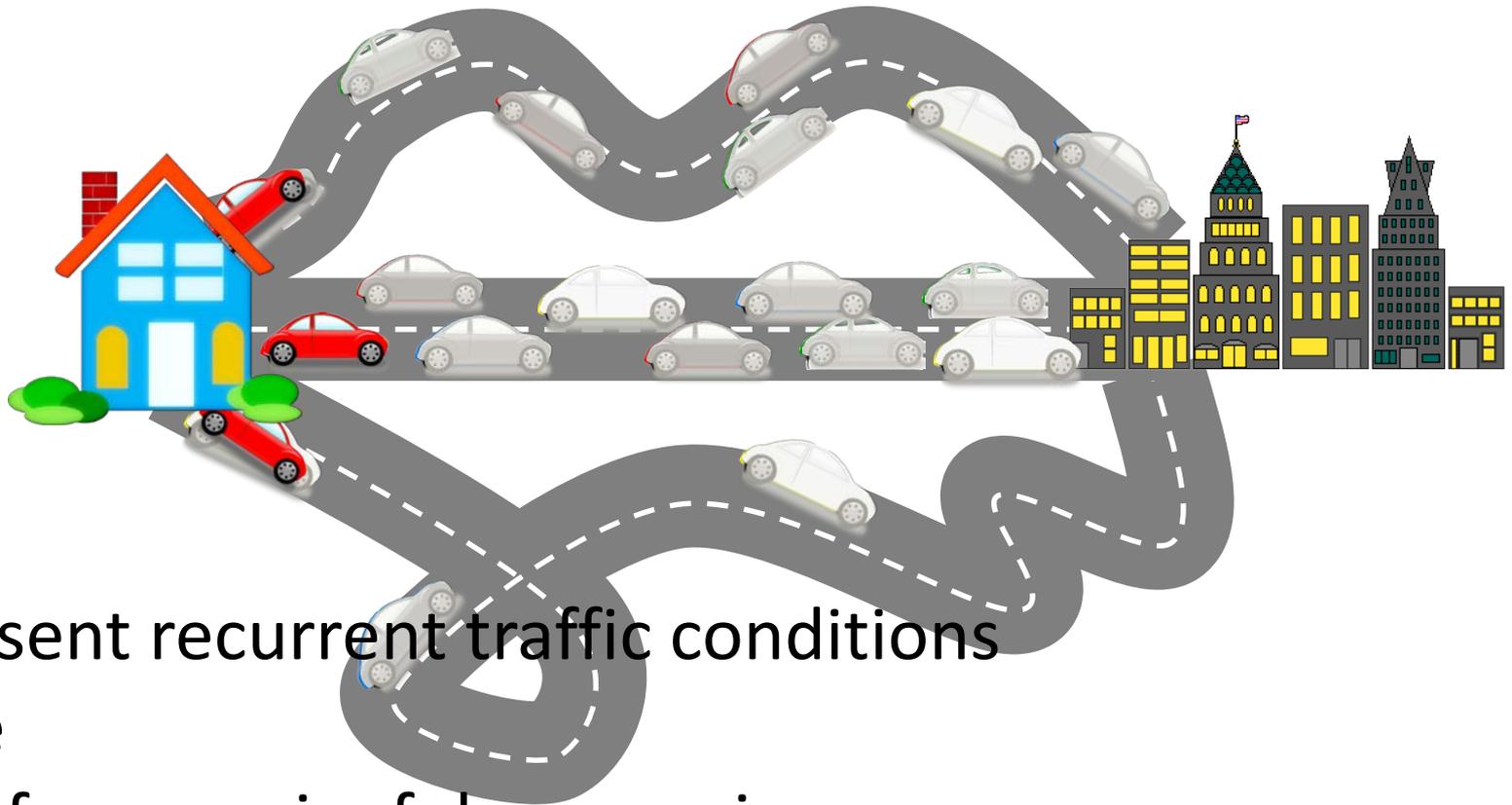


# Non-Equilibrium Solution



## Equilibrium Solution

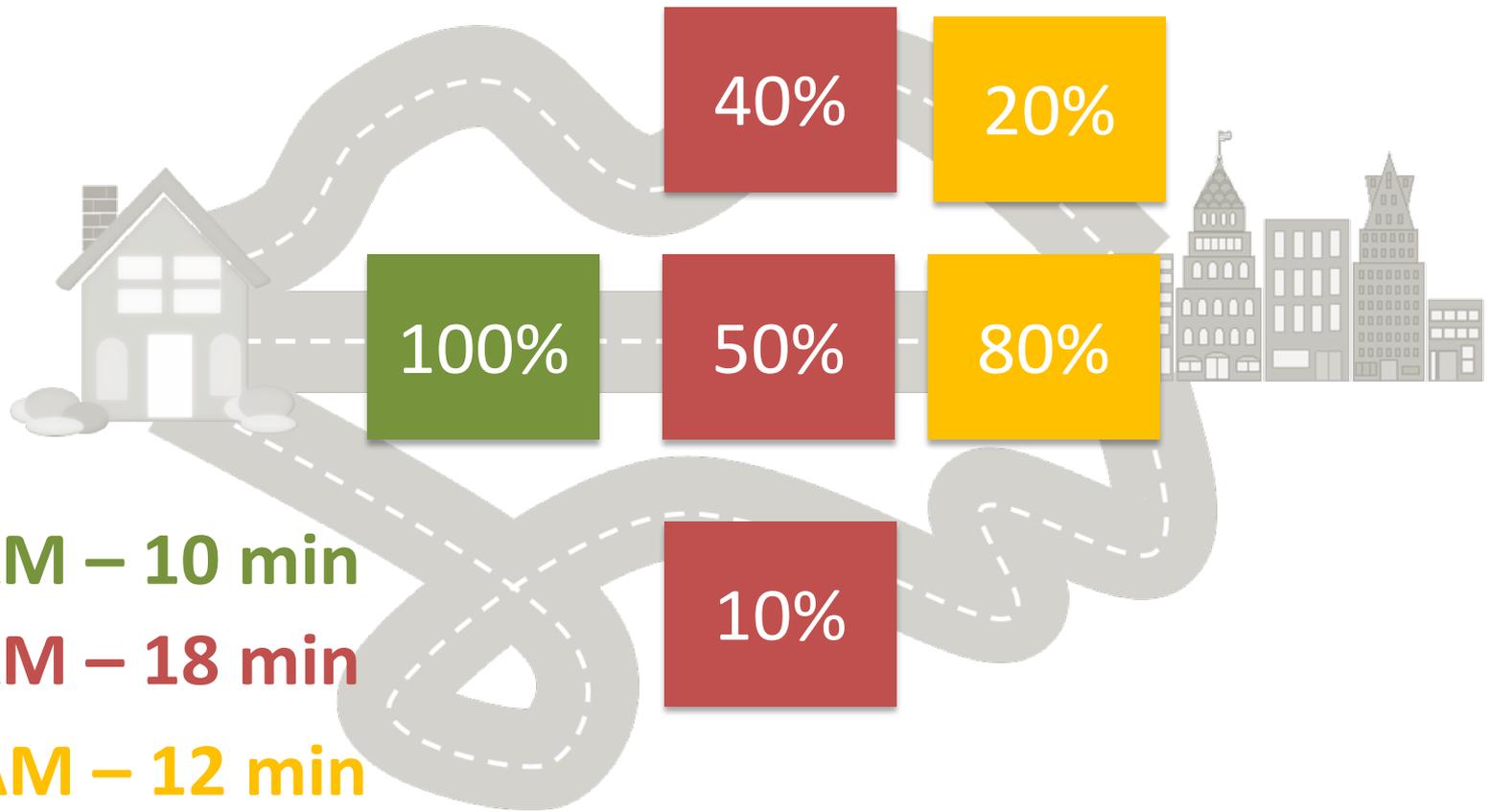
**All used paths have equal and minimum travel time**



- Represent recurrent traffic conditions
- Stable
- Allow for meaningful comparisons

# Dynamic Traffic Equilibrium

## Different Equilibrium Strategy per Time Period



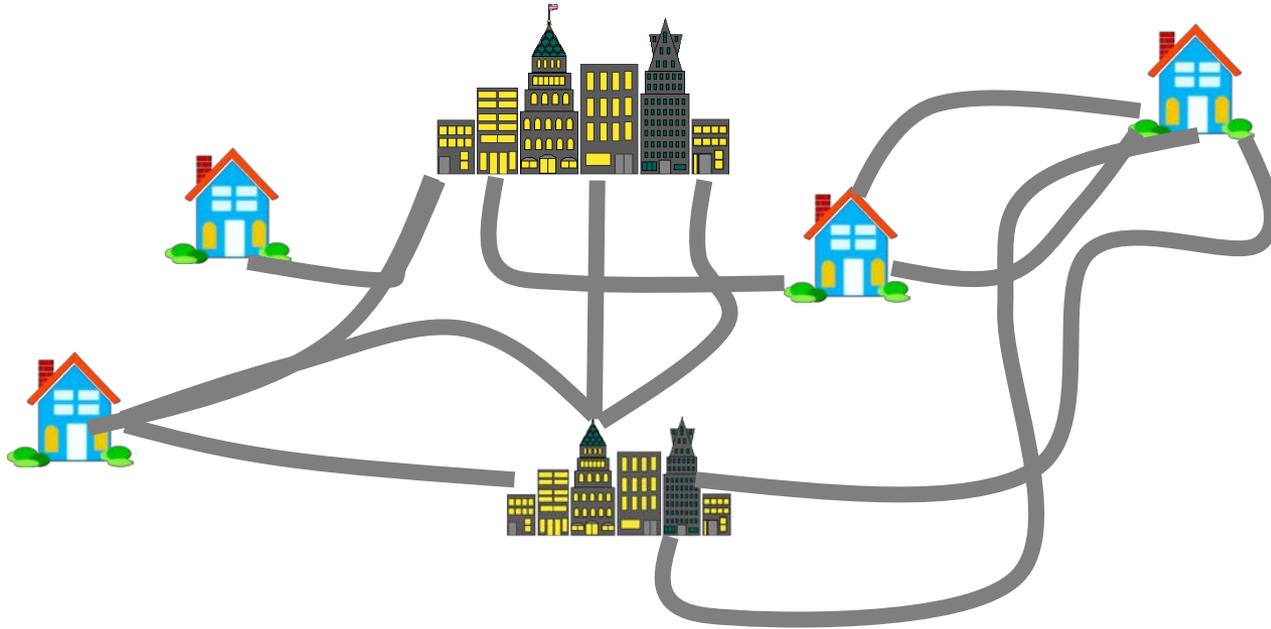
6:00AM – 10 min

8:00AM – 18 min

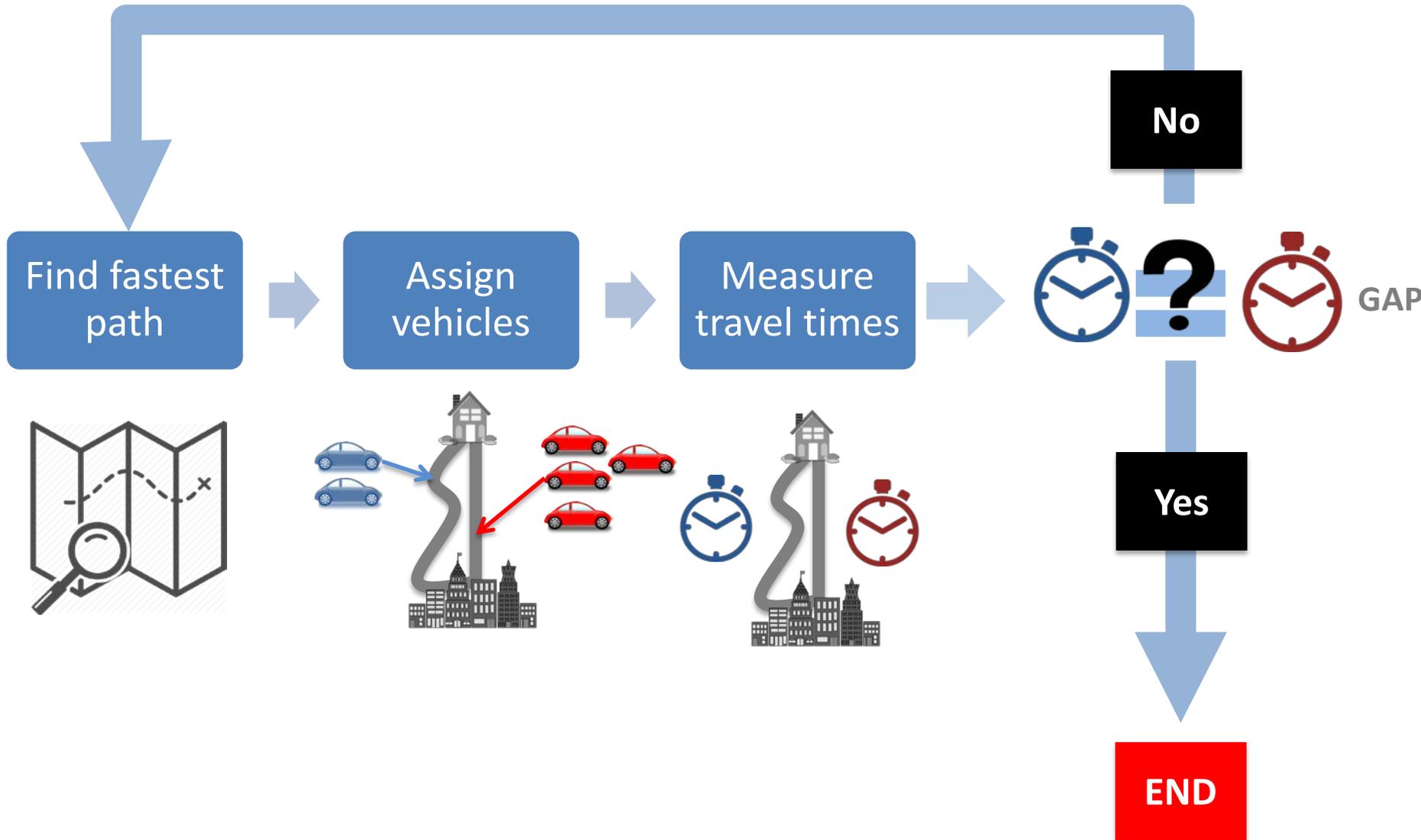
10:00AM – 12 min

# Methodology

Finding an Equilibrium Solution in a real network is a complex and iterative process



# DTA Iterations



## Model Area Boundaries

Include most of the expected changes in  
drivers' route choice

Typically a sub-area within the region

- Reduce runtime
- Improve convergence for better comparisons

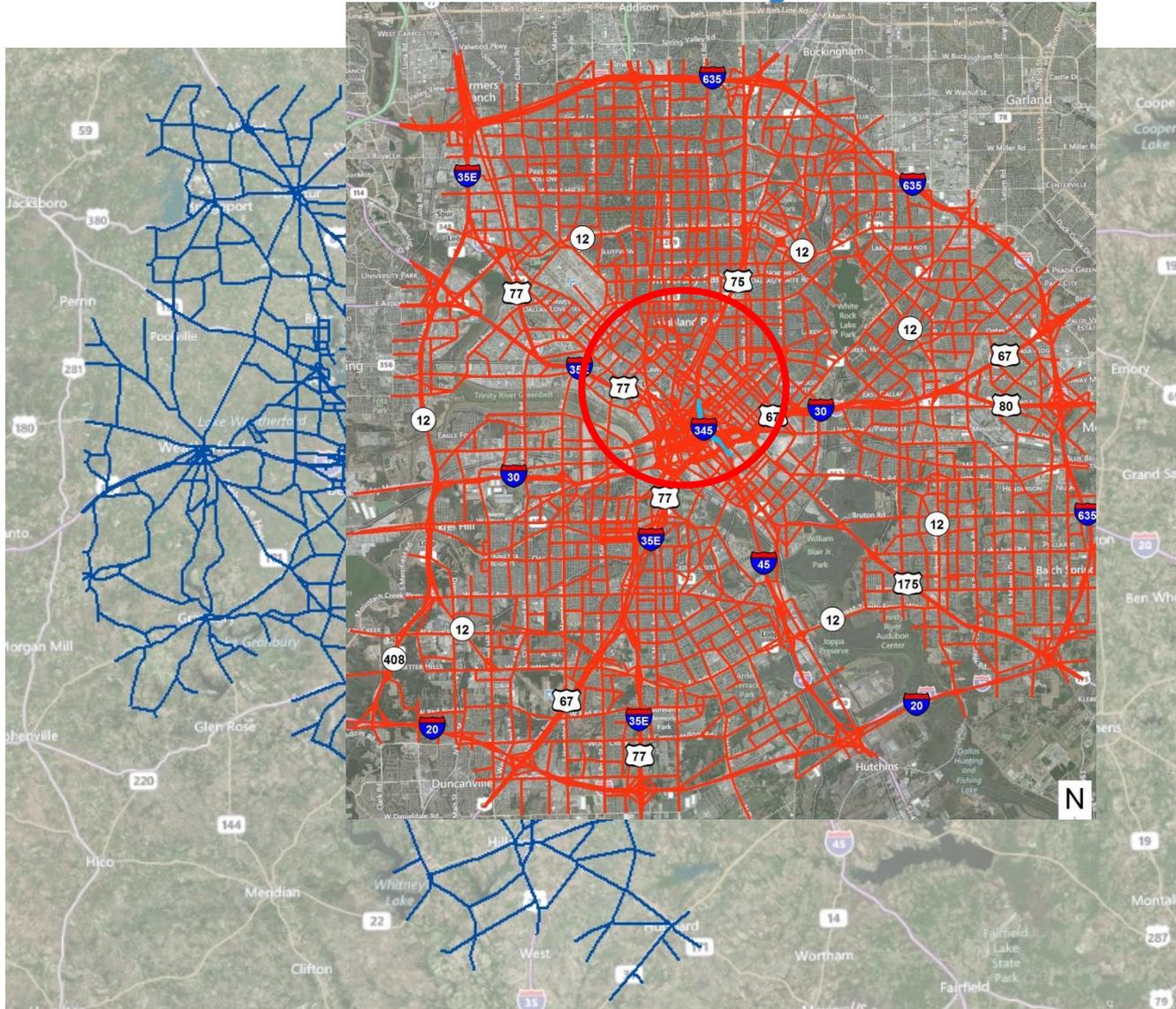
Sub-area demand

- From a regional DTA model
- From a regional static model

Boundary Conditions



# Subnetwork Analysis



# Data Used in DTA Models

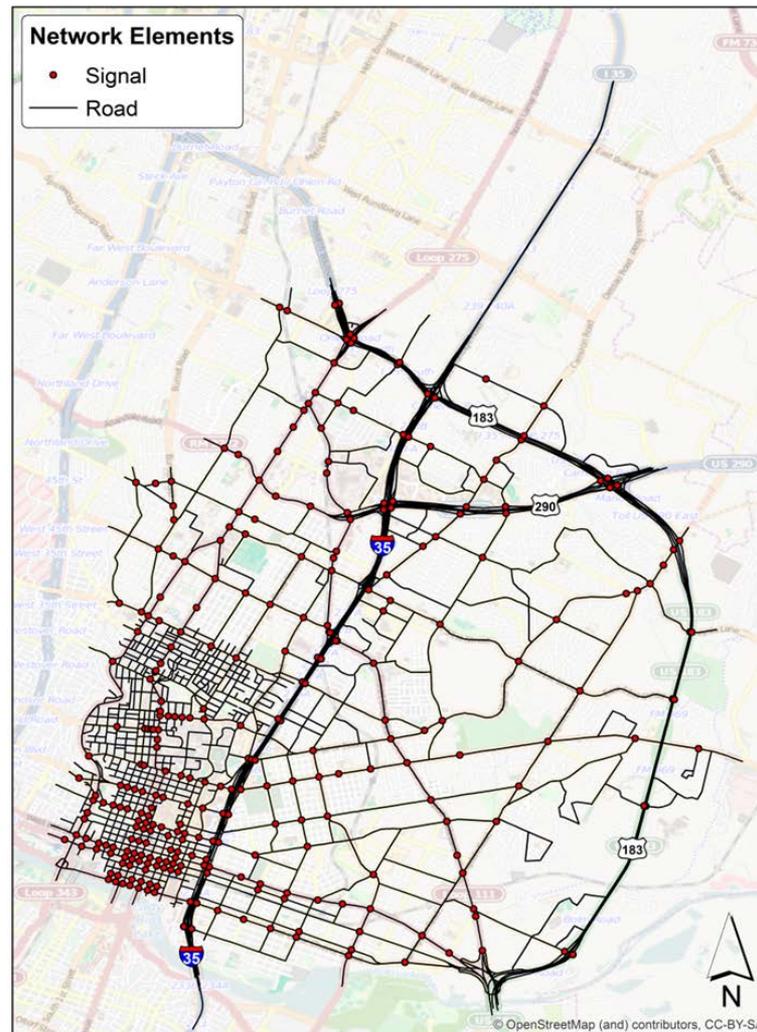
## Input Data

- Network
- Travel demand (vehicle trips)
- Traffic control
- Transit network and schedule

## Validation Data

- Traffic counts
- Corridor travel times (including Bluetooth data)

| linkid | from_sec | to_sec | count | sourceid |
|--------|----------|--------|-------|----------|
| 9615   | 0        | 900    | 16    | 1        |
| 9615   | 900      | 1800   | 29    | 1        |
| 9615   | 1800     | 2700   | 46    | 1        |
| 9615   | 2700     | 3600   | 43    | 1        |
| 9615   | 3600     | 4500   | 37    | 1        |
| 9615   | 4500     | 5400   | 54    | 1        |
| 9615   | 5400     | 6300   | 74    | 1        |
| 9615   | 6300     | 7200   | 87    | 1        |
| 9615   | 7200     | 8100   | 84    | 1        |
| 9615   | 8100     | 9000   | 57    | 1        |
| 9615   | 9000     | 9900   | 59    | 1        |
| 9615   | 9900     | 10800  | 32    | 1        |
| 9914   | 0        | 900    | 29    | 1        |
| 9914   | 900      | 1800   | 29    | 1        |
| 9914   | 1800     | 2700   | 53    | 1        |
| 9914   | 2700     | 3600   | 90    | 1        |
| 9914   | 3600     | 4500   | 81    | 1        |





# Data Sources



**METRO**  
PLAN, PURCHASE, RIDE  
Get The CapMetro App and GO!

Plan Your Trip | Schedules & Maps | Rider's Guide | About Us | Business | Public Involvement | Plans & Progress

MetroBus | MetroRapid | MetroRail | UT Shuttles | Park & Ride | Schedule Book | Service Area | ADA Corridors | System Map (PDF)

Select a Route ▶

**1 South Congress/Metric, Northbound, Weekday**

Weekday | Saturday | Sunday

| Northbound |       |       |       |       |       |       |       |       |       |       | Southbound |       |       |       |        |        |        |        |        |        |        |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|
| 1          | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 1          | 2     | 3     | 4     | 5      | 6      | 7      | 8      | 9      | 10     | 11     |
| 4:44a      | 4:56a | 5:04a | 5:21a | 5:32a | 5:37a | 5:45a | 5:54a | 6:06a | 6:14a | 6:22a | 6:22a      | 6:30a | 6:38a | 6:55a | 7:06a  | 7:11a  | 7:19a  | 7:28a  | 7:40a  | 7:48a  | 7:56a  |
| 5:10a      | 5:22a | 5:30a | 5:47a | 5:58a | 6:03a | 6:11a | 6:20a | 6:32a | 6:40a | 6:48a | 6:48a      | 6:56a | 7:04a | 7:21a | 7:32a  | 7:37a  | 7:45a  | 7:54a  | 8:06a  | 8:14a  | 8:22a  |
| 5:28a      | 5:44a | 5:54a | 6:11a | 6:24a | 6:29a | 6:37a | 6:46a | 6:58a | 7:06a | 7:14a | 7:14a      | 7:22a | 7:30a | 7:47a | 7:58a  | 8:03a  | 8:11a  | 8:20a  | 8:32a  | 8:40a  | 8:48a  |
| 5:54a      | 6:10a | 6:20a | 6:37a | 6:50a | 6:55a | 7:03a | 7:12a | 7:24a | 7:32a | 7:40a | 7:40a      | 7:48a | 7:56a | 8:13a | 8:24a  | 8:29a  | 8:37a  | 8:46a  | 8:58a  | 9:06a  | 9:14a  |
| 6:20a      | 6:36a | 6:46a | 7:03a | 7:16a | 7:21a | 7:29a | 7:38a | 7:50a | 7:58a | 8:06a | 8:06a      | 8:14a | 8:22a | 8:39a | 8:50a  | 8:55a  | 9:03a  | 9:12a  | 9:24a  | 9:32a  | 9:40a  |
| 6:40a      | 6:56a | 7:06a | 7:23a | 7:41a | 7:47a | 7:55a | 8:04a | 8:16a | 8:24a | 8:32a | 8:32a      | 8:40a | 8:48a | 9:05a | 9:16a  | 9:21a  | 9:29a  | 9:38a  | 9:50a  | 9:58a  | 10:06a |
| 7:06a      | 7:22a | 7:34a | 7:54a | 8:07a | 8:13a | 8:21a | 8:30a | 8:42a | 8:50a | 8:58a | 8:58a      | 9:06a | 9:14a | 9:31a | 9:42a  | 9:47a  | 9:55a  | 10:04a | 10:16a | 10:24a | 10:32a |
| 7:32a      | 7:48a | 8:00a | 8:20a | 8:33a | 8:39a | 8:47a | 8:56a | 9:08a | 9:16a | 9:24a | 9:24a      | 9:32a | 9:40a | 9:57a | 10:08a | 10:13a | 10:21a | 10:30a | 10:42a | 10:50a | 10:58a |

## Travel Demand Data

- MPO

## Network Data

- MPO + refinement (GIS maps)

## Validation Data

- Project specific

## Transit Network Data

- Transit agency (GTFS format)

|                    | Loop 150 Southbound |             |             |          |             |
|--------------------|---------------------|-------------|-------------|----------|-------------|
| Start Time         | Left                | Thru        | Right       | Peds     | App. Total  |
| 07:00              | 7                   | 8           | 22          | 0        | 37          |
| 07:15              | 8                   | 22          | 42          | 0        | 72          |
| 07:30              | 6                   | 19          | 58          | 0        | 83          |
| 07:45              | 16                  | 30          | 42          | 0        | 88          |
| <b>Total</b>       | <b>37</b>           | <b>79</b>   | <b>164</b>  | <b>0</b> | <b>280</b>  |
| 08:00              | 13                  | 20          | 50          | 0        | 83          |
| 08:15              | 26                  | 44          | 35          | 0        | 105         |
| 08:30              | 11                  | 21          | 46          | 0        | 78          |
| 08:45              | 18                  | 31          | 36          | 0        | 85          |
| <b>Total</b>       | <b>68</b>           | <b>116</b>  | <b>167</b>  | <b>0</b> | <b>351</b>  |
| <b>Grand Total</b> | <b>105</b>          | <b>195</b>  | <b>331</b>  | <b>0</b> | <b>631</b>  |
| <b>Apprch %</b>    | <b>16.6</b>         | <b>30.9</b> | <b>52.5</b> | <b>0</b> |             |
| <b>Total %</b>     | <b>4.1</b>          | <b>7.6</b>  | <b>12.9</b> | <b>0</b> | <b>24.5</b> |

|  | Loop 150 Southbound |             |             |             |             |
|--|---------------------|-------------|-------------|-------------|-------------|
| Start Time   | Left                | Thru        | Right       | Peds        | App. Total  |
| Peak Hour Analysis From 07:00 to 08:45 - Peak 1 of 1 |                     |             |             |             |             |
| Peak Hour for Entire Intersection Begins at 07:30    |                     |             |             |             |             |
| 07:30  | 6                   | 19          | 58          | 0           | 83          |
| 07:45  | 16                  | 30          | 42          | 0           | 88          |
| 08:00  | 13                  | 20          | 50          | 0           | 83          |
| 08:15  | 26                  | 44          | 35          | 0           | 105         |
| <b>Total Volume</b>                                  | <b>61</b>           | <b>113</b>  | <b>185</b>  | <b>0</b>    | <b>359</b>  |
| <b>% App. Total</b>                                  | <b>17</b>           | <b>31.5</b> | <b>51.5</b> | <b>0</b>    |             |
| <b>PHF</b>   | <b>.587</b>         | <b>.642</b> | <b>.797</b> | <b>.000</b> | <b>.855</b> |

# Accessing the Model

Web-based environment with project specific login to access model, data, and results

- Upload data
- Access GIS editor
- Run model
- Analyze results

Software/data live in powerful servers

Data stored in databases

The screenshot shows a web browser window titled 'downtown\_pm\_base\_project'. The main content area displays 'public.linkdetails' with a table of data. Navigation controls include 'First', 'Previous', 'Next', and 'Last', along with 'Download' and 'Upload' buttons. The table lists link details with columns for id, type, source, destination, length, speed, capacity, and lanes. A map view at the bottom shows a street network with nodes labeled 13065, 13068, 13067, and 13155. A 'Phase 3' dialog box is open, showing a 'Green' light indicator set to 12.

| id   | type | source | destination | length  | speed    | capacity | lanes |
|------|------|--------|-------------|---------|----------|----------|-------|
| 893  | 1    | 3686   | 3687        | 393.883 | 0.583333 | 1500.0   | 3     |
| 894  | 1    | 3684   | 3688        | 737.731 | 0.583333 | 1600.0   | 2     |
| 1471 | 1    | 4040   | 13109       | 634.476 | 0.75     | 1700.0   | 3     |
| 1474 | 1    | 4045   | 4046        | 1641.69 | 0.666667 | 1400.0   | 1     |
| 1480 | 1    | 4054   | 4055        | 3777.27 | 0.583333 | 1300.0   | 1     |

```
select * from nodes where type=100
```

Query:





# Log in to VISTA



Welcome to VISTA. Documentation is available [online](#).

## Login

---

Please provide your username and password to log in.

**Username:**

**Password:**

Login

## Recover

---

Have you forgotten your username or password? Enter your email address below and click the button to have your username and a new password emailed to you.

**Email:**

Recover

# Typical Model Run

Specify desired number of iterations

In each iteration

- Find paths
- Assign vehicles to paths
- Confirm they all have the same travel time, or “GAP”

Iterations repeated until “GAP” is acceptable

Process takes from 15 minutes to 48 hours depending network

## DUE - New

Set the options below for this task. Fields in **bold** are required. Default values have been provided.

**Network:** 2020\_region\_am

The module will be run on this network.

### Options

Run to total iteration # 20

Prevent gap increase

Seed random number generator

Partial Demand Loading iterations 5

Warm start iteration (0 for none) 0

Route report CSV

Nonexiting incr. thresh. (0: off) 0

DUE new to 20 iterations with 5 partial demand loading iterations

Notes:

You may enter any notes you wish you to make about this run. These notes will be visible in the network history.

Start

## Tasks

Task 10993

76 %



50: Simulating.

DUE - Continue running on 2015\_region\_pm.

Started at 22:45 Tuesday.



# Ten-Minute Break



# Practice Exercises

## Practice Exercise 1

- Use GIS editor to model a roadway closure
- Run traffic simulator (vehicles will NOT change paths in response to the closure)
- Visualize results in GIS editor

## Practice Exercise 2

- Use interactive visualization tools to compare two scenarios for which we have computed an equilibrium solution

# Practice Exercise 1

Use “practice\_simulation” network

Create a delay by changing a traffic signal or creating a closure

Run the simulator to estimate the impacts

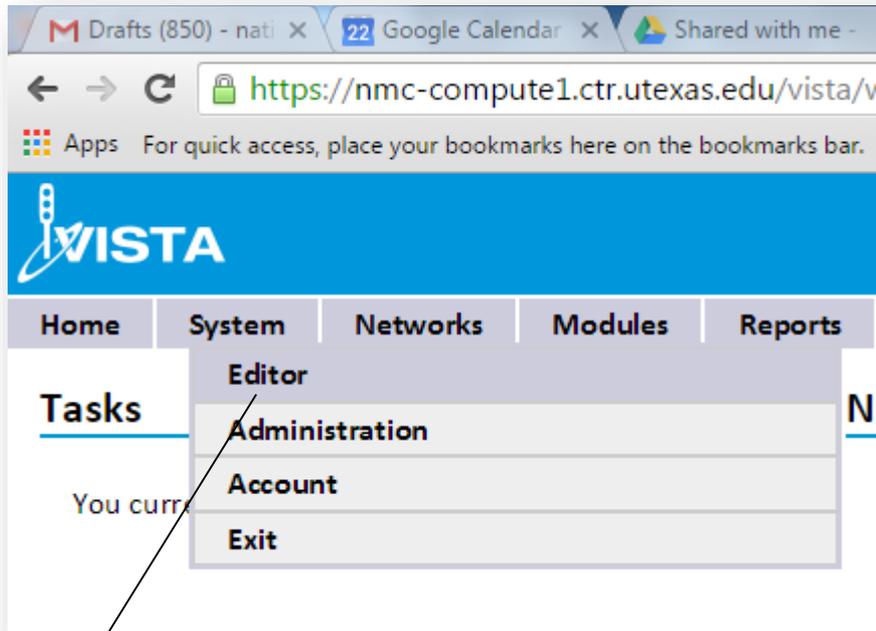
Import results

Visualize results in the GIS editor

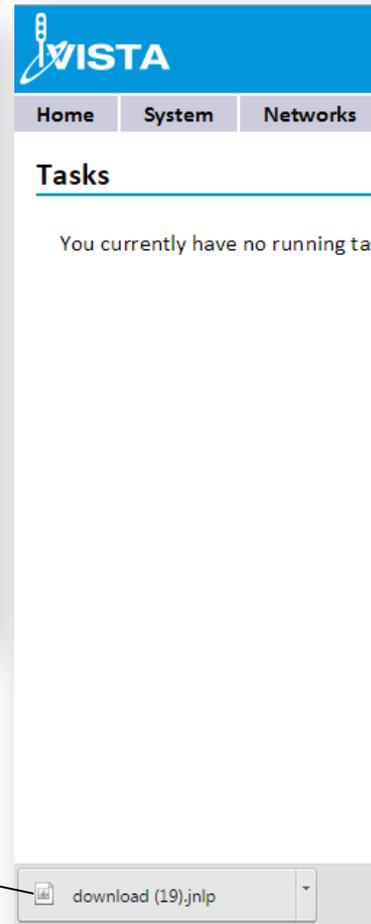
- How far is congestion propagating?
- How long does it last?

➤ **REMEMBER:** If we only run simulation, travelers don't change routes, and impacts are exaggerated.

# Accessing the GIS Editor

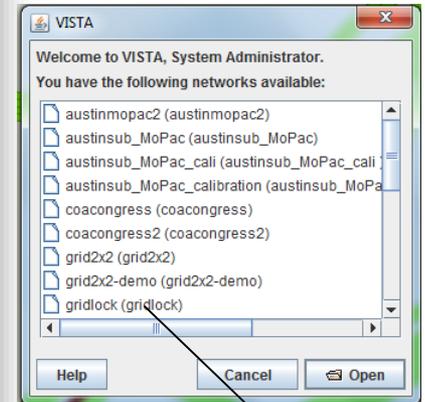


1) Download Launcher



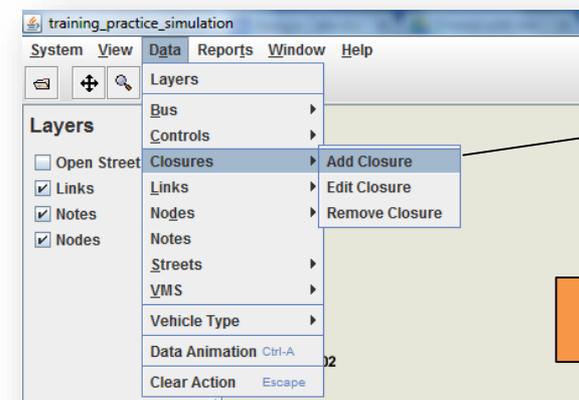
2) Open Download

3) Login with same credentials



4) Select Network

# Creating a road closure

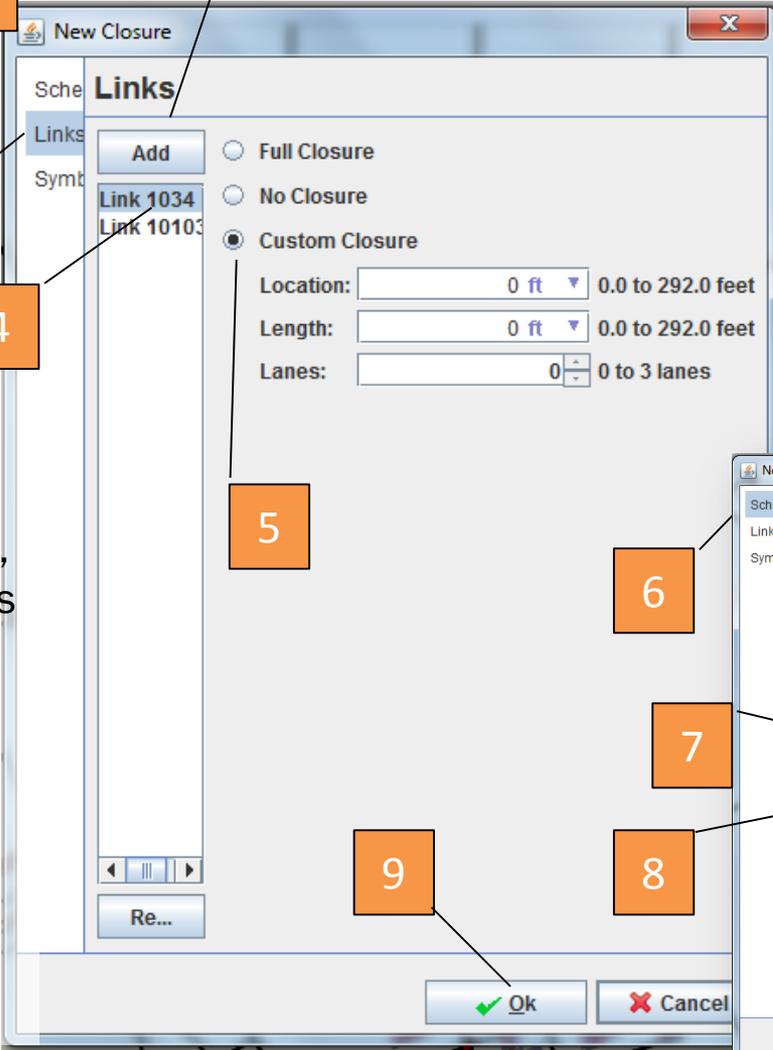


1

3

2

4



5

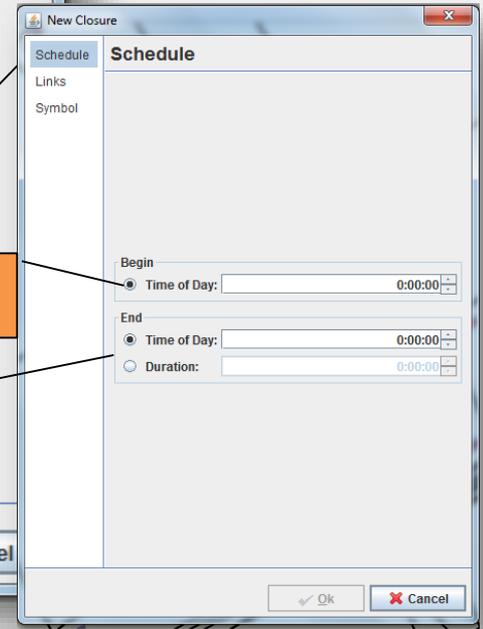
6

7

8

9

**Closure details**  
 Link ID 1993  
 Start 0:0:0  
 Location "0"  
 Length 1300 feet  
 Duration 2 hours  
 Closed 1 lane



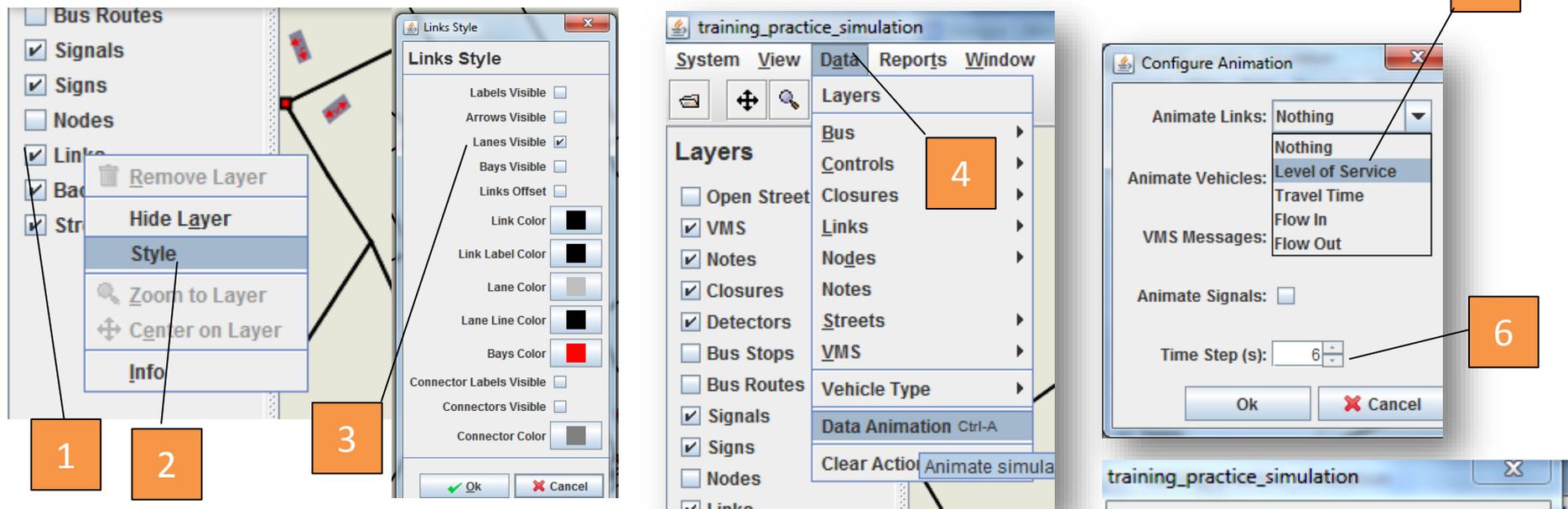
1. Enter "Closure" menu
2. Enter "Link Selection" menu
3. Click on "Add" to select links from the map
4. Once the links appear in the box, highlight one or more (two values will appear for two-way streets)
5. Select "Custom Closure" and specify desired values
6. Enter the "Schedule" menu
7. Select start time (in hh:mm:ss from beginning of simulation)
8. Select end time or duration
9. Click "OK"

# Running Simulation and Importing Results

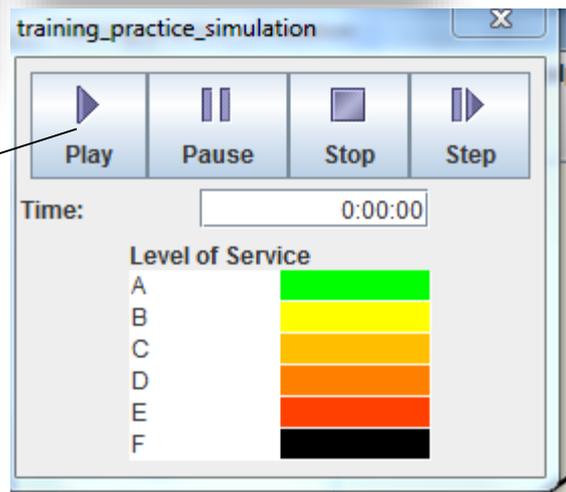
The screenshot shows the VISTA web application interface. On the left, the 'Tasks' menu is open, with the 'Simulate' option highlighted. A red box labeled '1' points to the 'Simulate' menu item. On the right, the 'Simulate' configuration page is shown. A red box labeled '2' points to the 'Network' dropdown menu, which is set to 'V4\_Austin2010'. A red box labeled '3' points to the 'Start' button. A red box labeled '4' points to the 'Import Results' option in the 'Tasks' menu.

1. Enter "Simulate" menu
2. Select "Network" from drop-down menu
3. Click on "Start"
4. Once done, enter the "Import Results" menu and repeat steps 2 & 3

# Visualizing congestion in the Editor



1. Right click on “Links” to display menu
2. Select “Style”
3. Check the “Lanes visible” box to visualize directional traffic
4. Enter the “Data” menu and select “Data Animation”
5. Select what to animate: “Travel Time” or “Level of Service” are appropriate to visualize congestion. Click “OK”
6. Select a time step. Three minutes (180 seconds) is small enough to see congestion
7. The animation bar may take a few seconds to appear. Press “Play” to visualize.



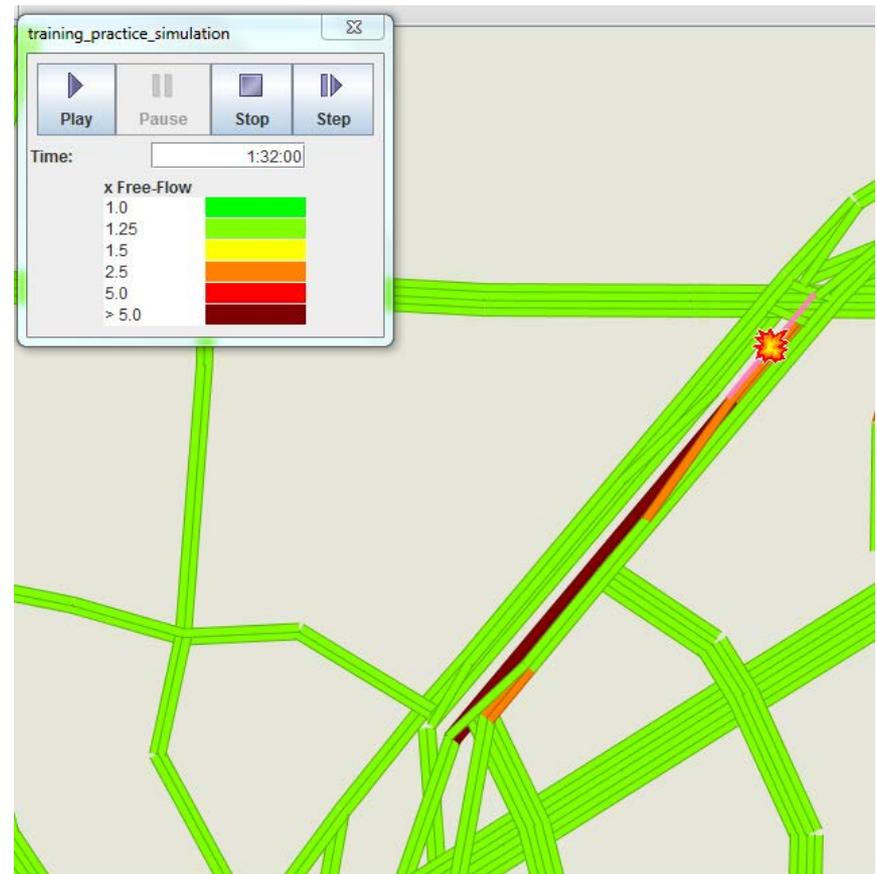
# Our Case Study

## Closure details

- Created a closure on link 1993
- Start 0:0:0
- Location “0”
- Length 1300 feet
- Duration 2 hours
- Closed 1 lane

Observed backups on main lanes, entry ramp, and briefly on frontage road

Backups start around 50 minutes into the simulation and dissipate around 1:50



# Short-term versus Long-term Impacts

training\_practice\_simulation

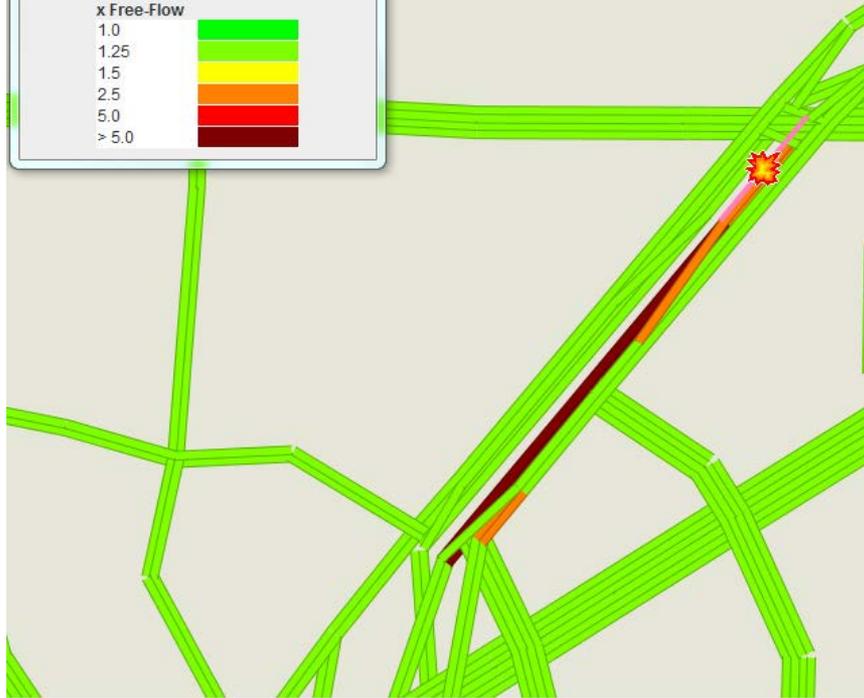
Play Pause Stop Step

Time: 1:32:00

x Free-Flow

|       |             |
|-------|-------------|
| 1.0   | Green       |
| 1.25  | Light Green |
| 1.5   | Yellow      |
| 2.5   | Orange      |
| 5.0   | Red         |
| > 5.0 | Dark Red    |

Simulation Only



training\_scenario\_1

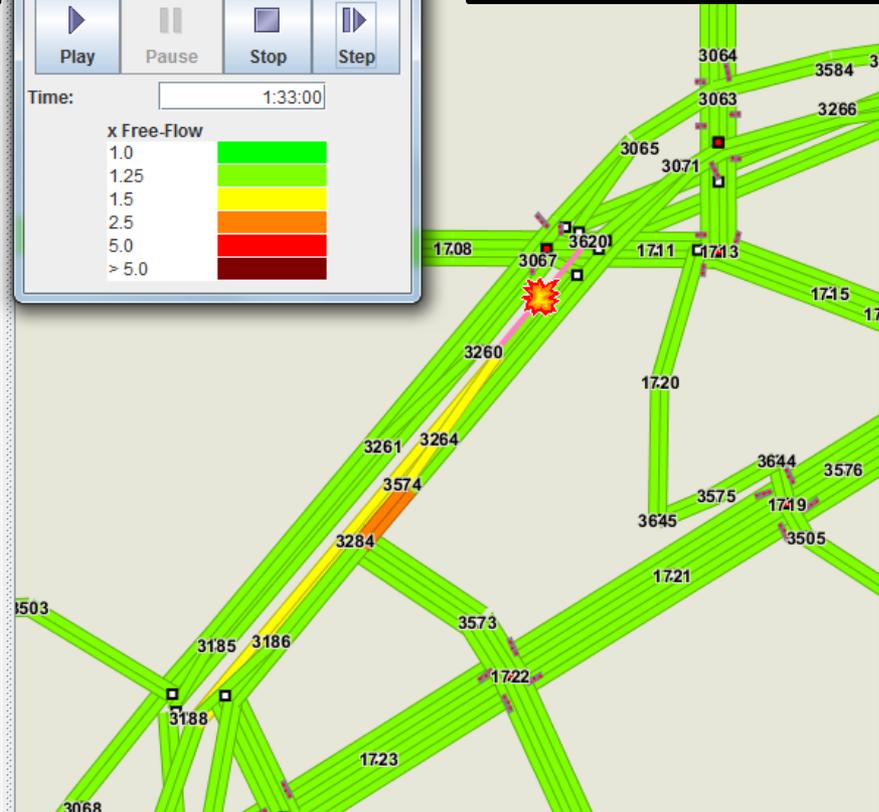
Play Pause Stop Step

Time: 1:33:00

x Free-Flow

|       |             |
|-------|-------------|
| 1.0   | Green       |
| 1.25  | Light Green |
| 1.5   | Yellow      |
| 2.5   | Orange      |
| 5.0   | Red         |
| > 5.0 | Dark Red    |

New DTA



If we run DTA on the same network with the closure in place, the new solution shows less congestion than the simulation-only case because drivers are able to change their paths.



## Practice Exercise 2

### Use your “base\_case”, “scenario\_1” and “scenario\_2” networks

- Base case: Original network
- Scenario 1: Network with closure analyzed in Exercise 1 (DTA)
- Scenario 2: Network with major reduction in capacity (DTA-Next Slide)

### Use web-based chart tool to compare average performance metrics

- Total system travel time
- Average travel time

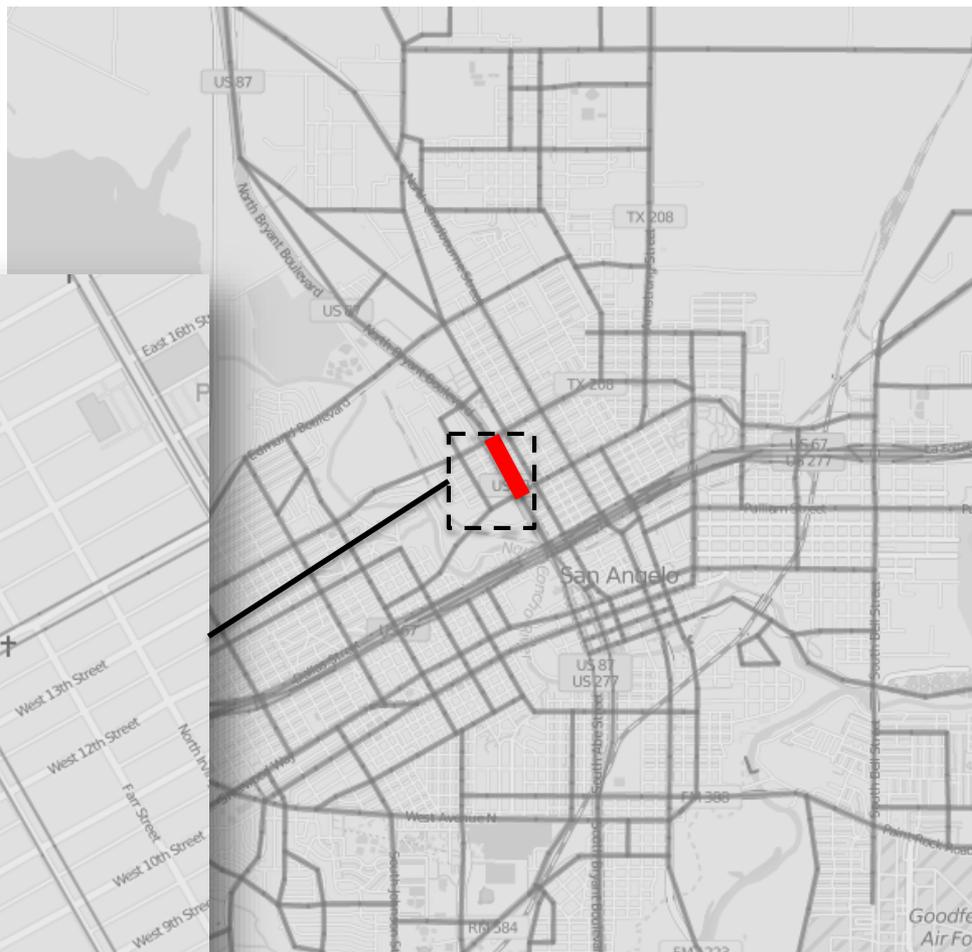
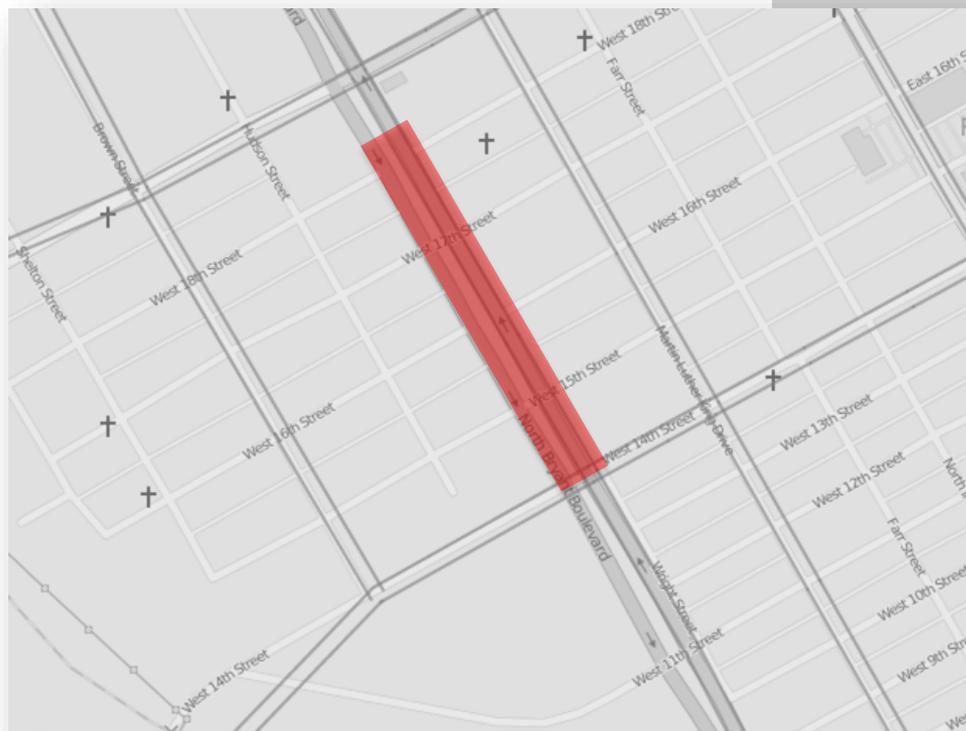
### Export results to Interactive Visualization tool

### Analyze detailed metrics

- How has the traffic flow pattern changed?
- Who was using the affected link before?
- How have major origins/destination paths changed?

# Scenario 2

**Full closure for construction work (northbound direction)**



# Visualize average performance metrics

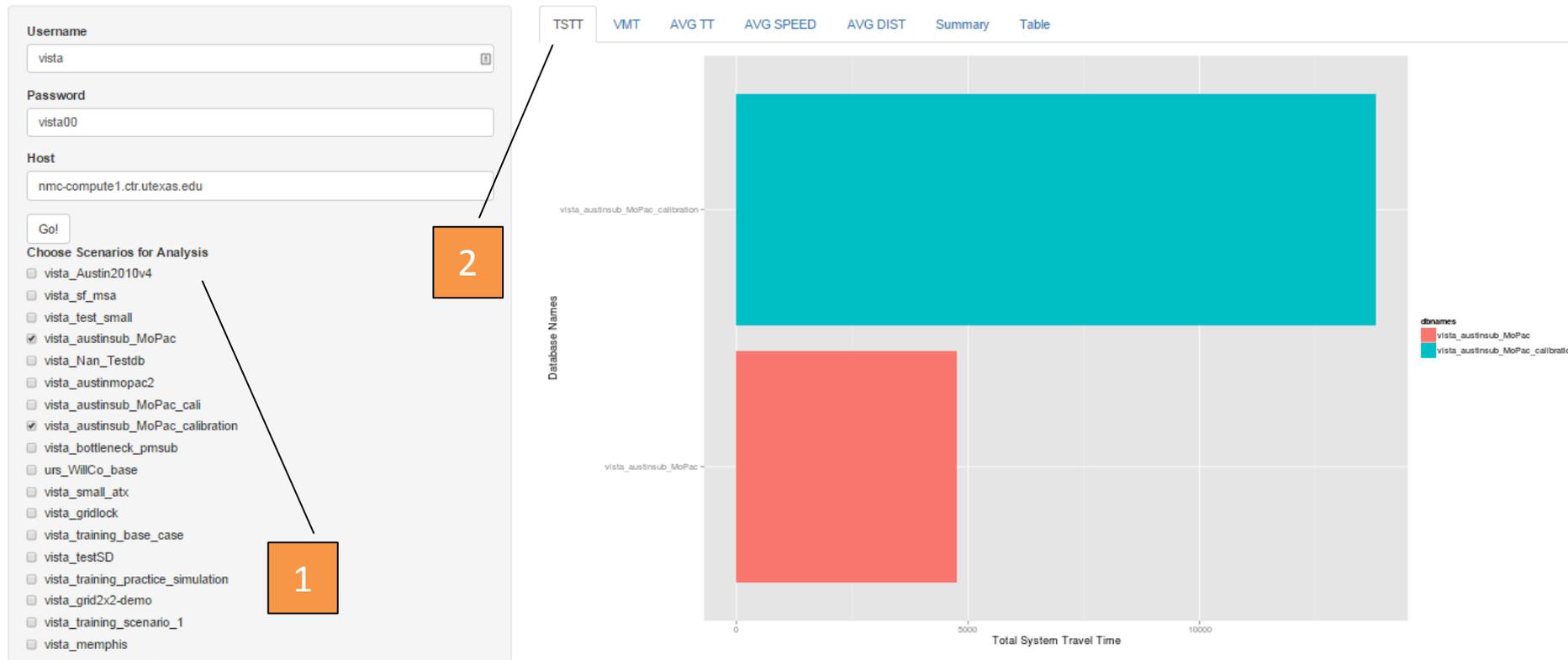
## Vista Scenario Comparison

A screenshot of a web form titled "Vista Scenario Comparison". The form has three input fields: "Username" with the value "myuser", "Password" with the value "mypasswd", and "Host" with the value "nmc-compute1.ctr.utexas.edu". Below the fields is a "Go!" button. Three orange boxes with numbers 1, 2, and 3 are connected to the form by lines. Box 1 points to the title, box 2 points to the Host field, and box 3 points to the Go! button.

1. Import results into the VISTA GUI (same as Exercise 1)
2. Login with your credentials into the prototype tool (see above)
3. Change the host to **nmc-compute1.ctr.utexas.edu**

Access this tool by clicking  
**Interactive Chart Tool**  
in your DTA Deployment Resources

# Prototype tool for high-level analysis



1. Check all networks to compare and select the performance metric to be displayed.

- TSTT: total system travel time
- VMT: Vehicles miles traveled
- AVGT: Average travel time
- AVG SPEED: Average speed
- AVG DIST: Average distance traveled

2. Results are displayed as horizontal bars. It may take a few seconds for the plot to appear.

# Our Analysis: Average Metrics



**Very small changes in most average performance metrics**

# Interactive web-based results analysis

Click **Interactive Map Tool** in your **DTA Deployment Resources**

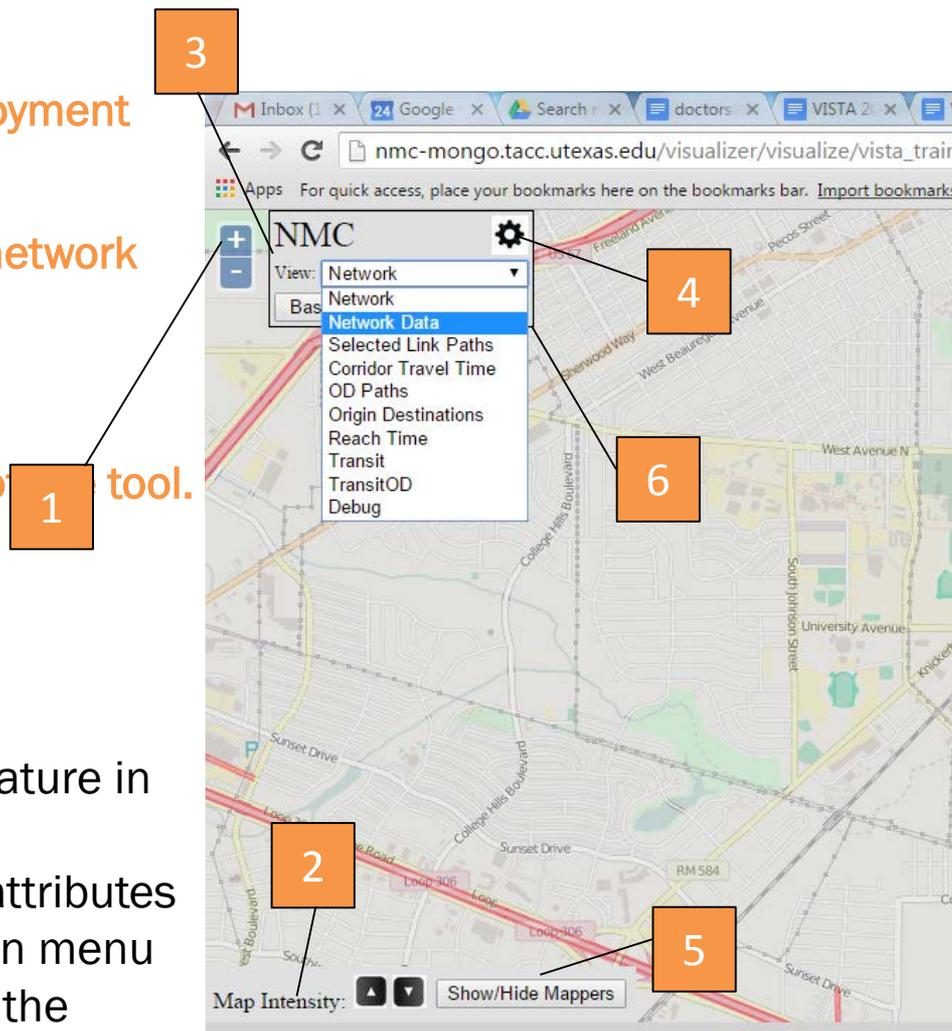
Login with your credentials and select the network you wish to analyze

Initially only major roadways are displayed

We'll have a training workshop on the use of this tool.

Some basics

1. Zoom in/out
2. Dim background map
3. Main menu
4. Hide/show options of selected feature in main menu (when available)
5. Hide/show color map and other attributes of the feature selected in the main menu
6. Select "Network Data" to explore the network properties

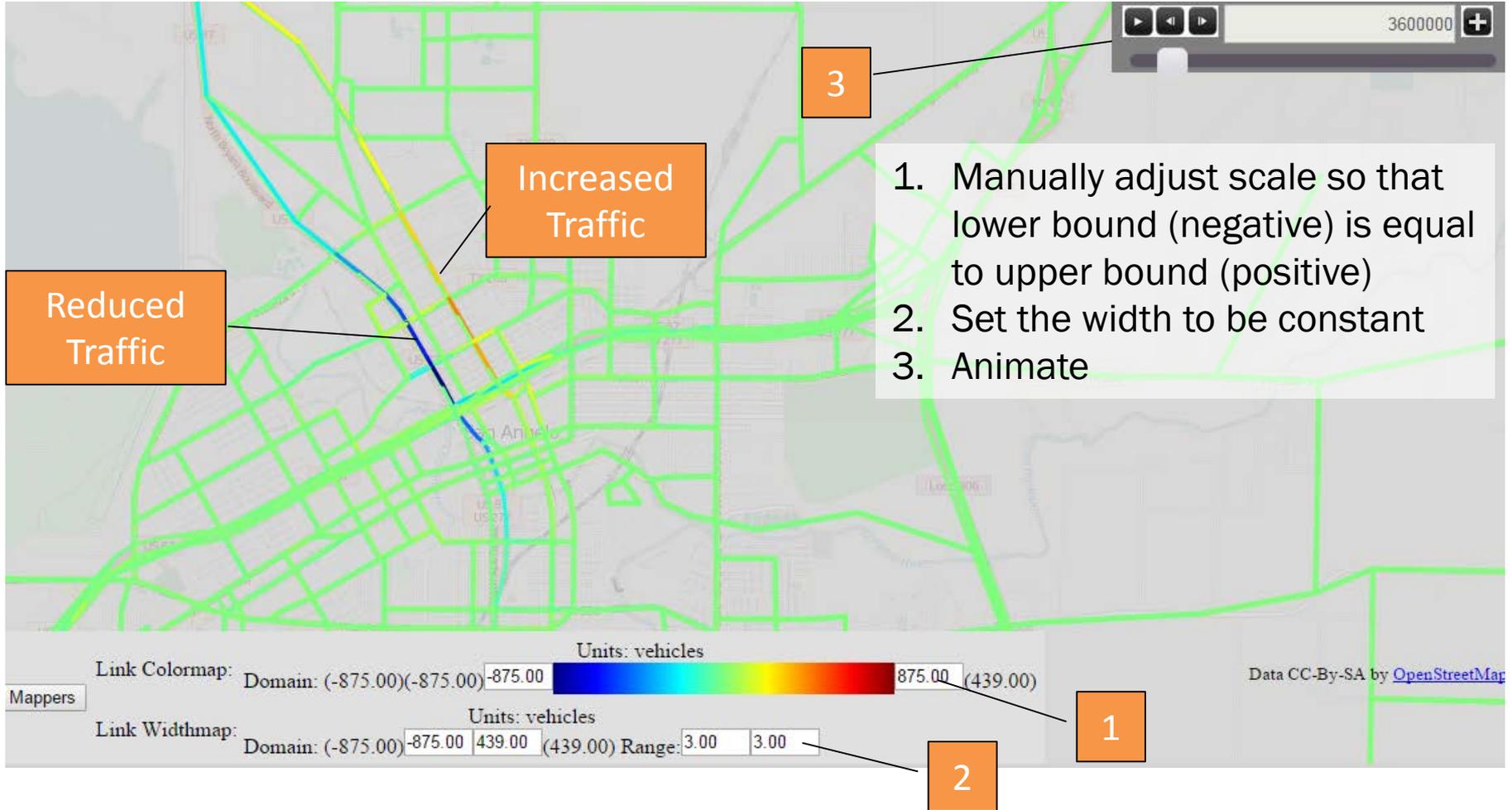


# Comparing link-flows

The screenshot shows the NMC web application interface. The main menu is visible on the left, and the 'Link Dataset' dialog is open in the foreground. The dialog has three tabs: 'Raw', 'Predefined', and 'Custom'. The 'Predefined' tab is selected, showing a list of metrics and aggregation options. The 'Name' field is set to 'test\_diff', and the 'Network' dropdown is set to 'vista\_training\_'. The 'Aggregation' dropdown is set to '60'. The 'Compare with' checkbox is checked, and the 'Compare with' dropdown is set to 'vista\_training\_'. The 'Load' button is at the bottom right of the dialog.

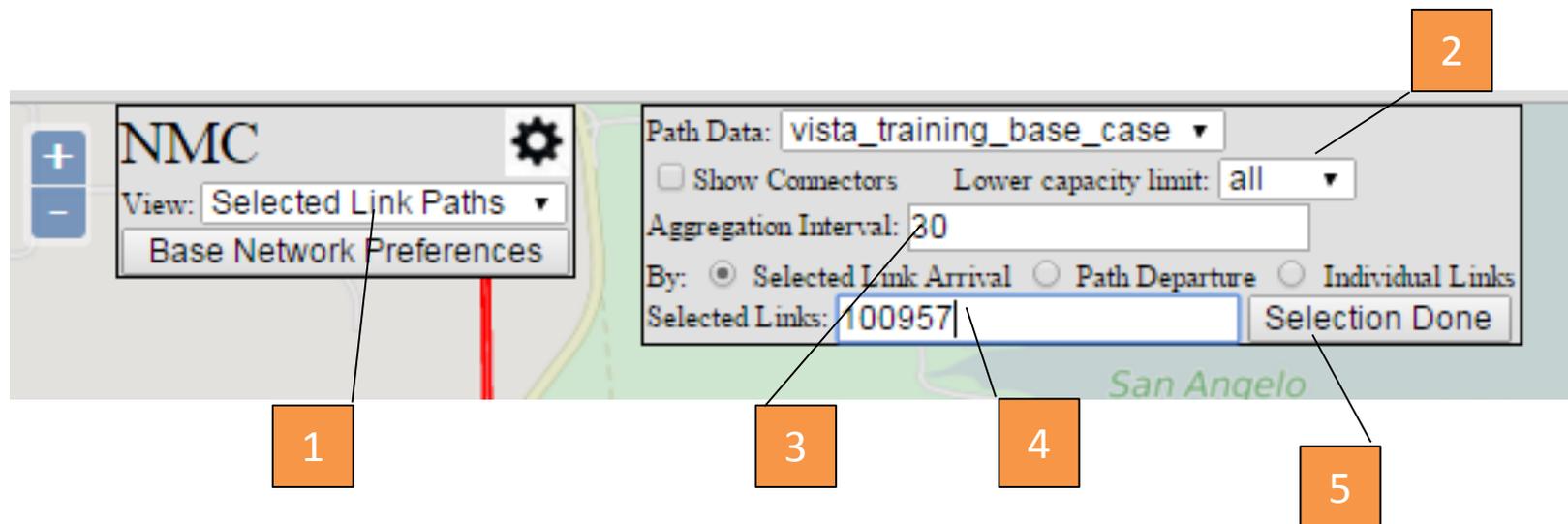
1. Select "Network Data" from main menu
2. Click on "+" sign next to "Links"
3. Select "Predefined" tab
4. Choose a name for the comparison
5. Choose "Volume"
6. Choose a time-step (minutes)
7. Check "Compare with" box
8. Select the network to compare
9. Click "Load"

# Our Analysis



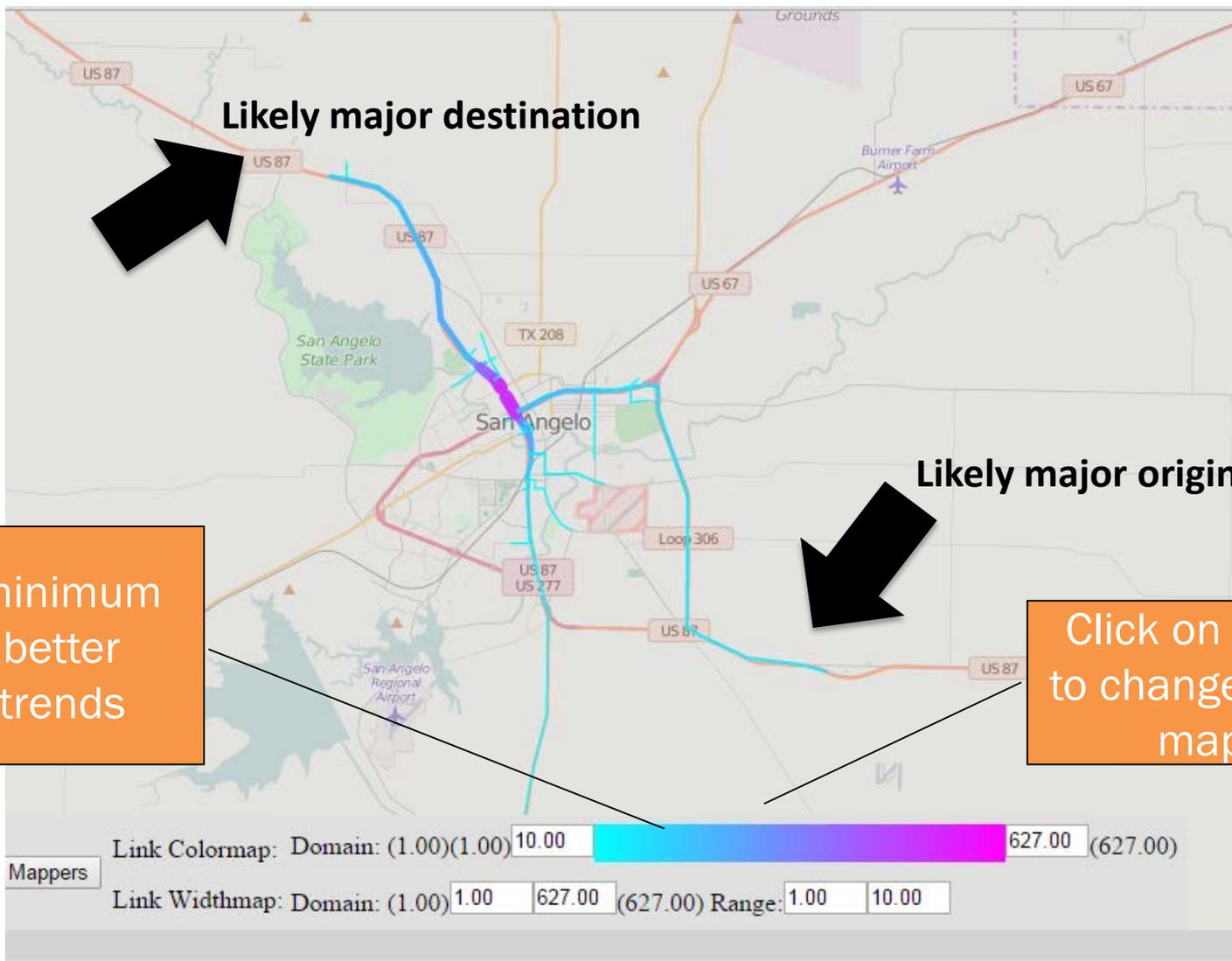
We compared Scenario 2 (top) to Base Case (bottom) every hour

# Identifying Roadway Users in Base Case

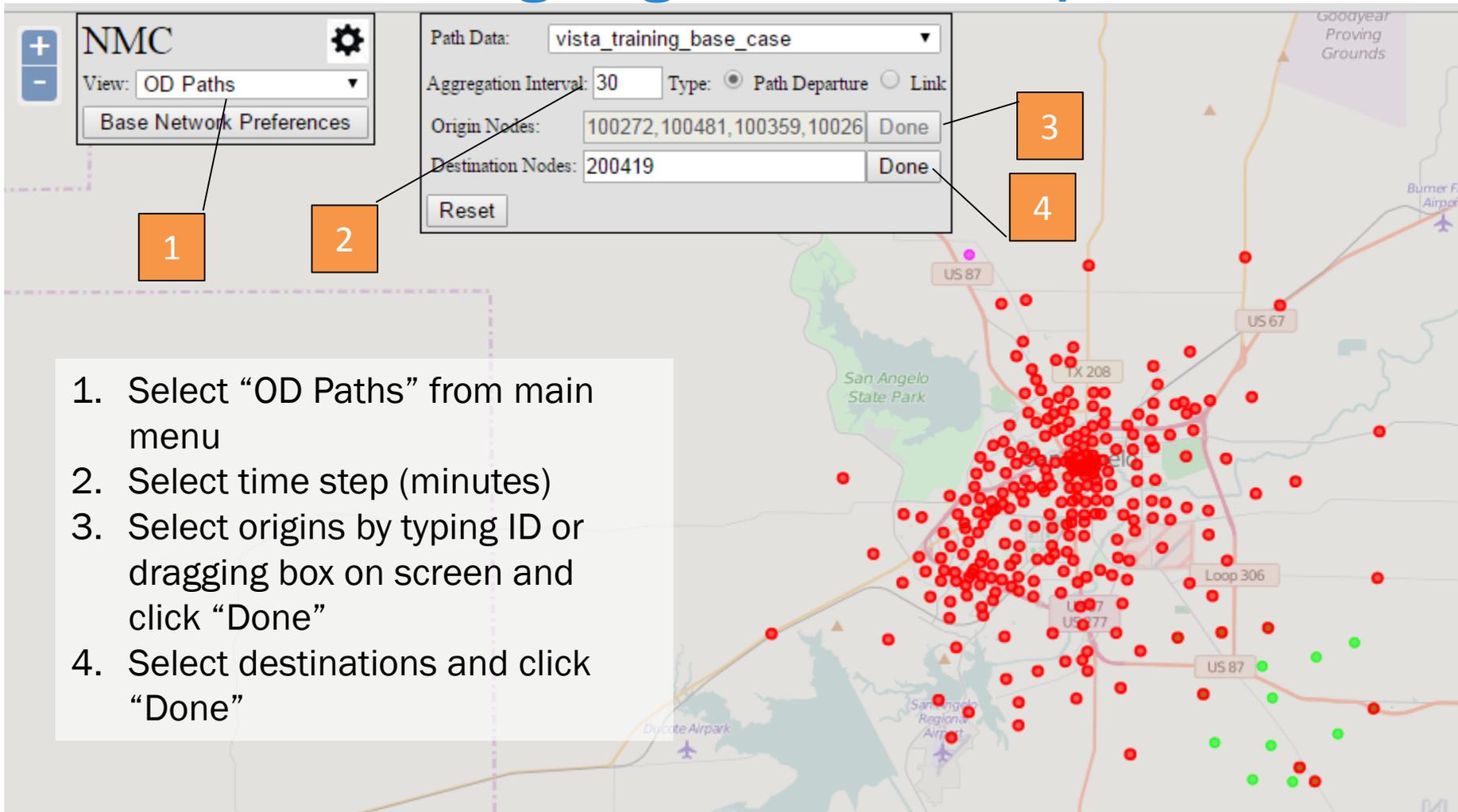


1. Select “Selected Link Paths” in main menu
2. Choose “All” in Lower capacity limit field
3. Select a time interval (in minutes)
4. Select a link by clicking on the map or typing a known ID
5. Click on “Selection Done”

# Analyzing Your Results

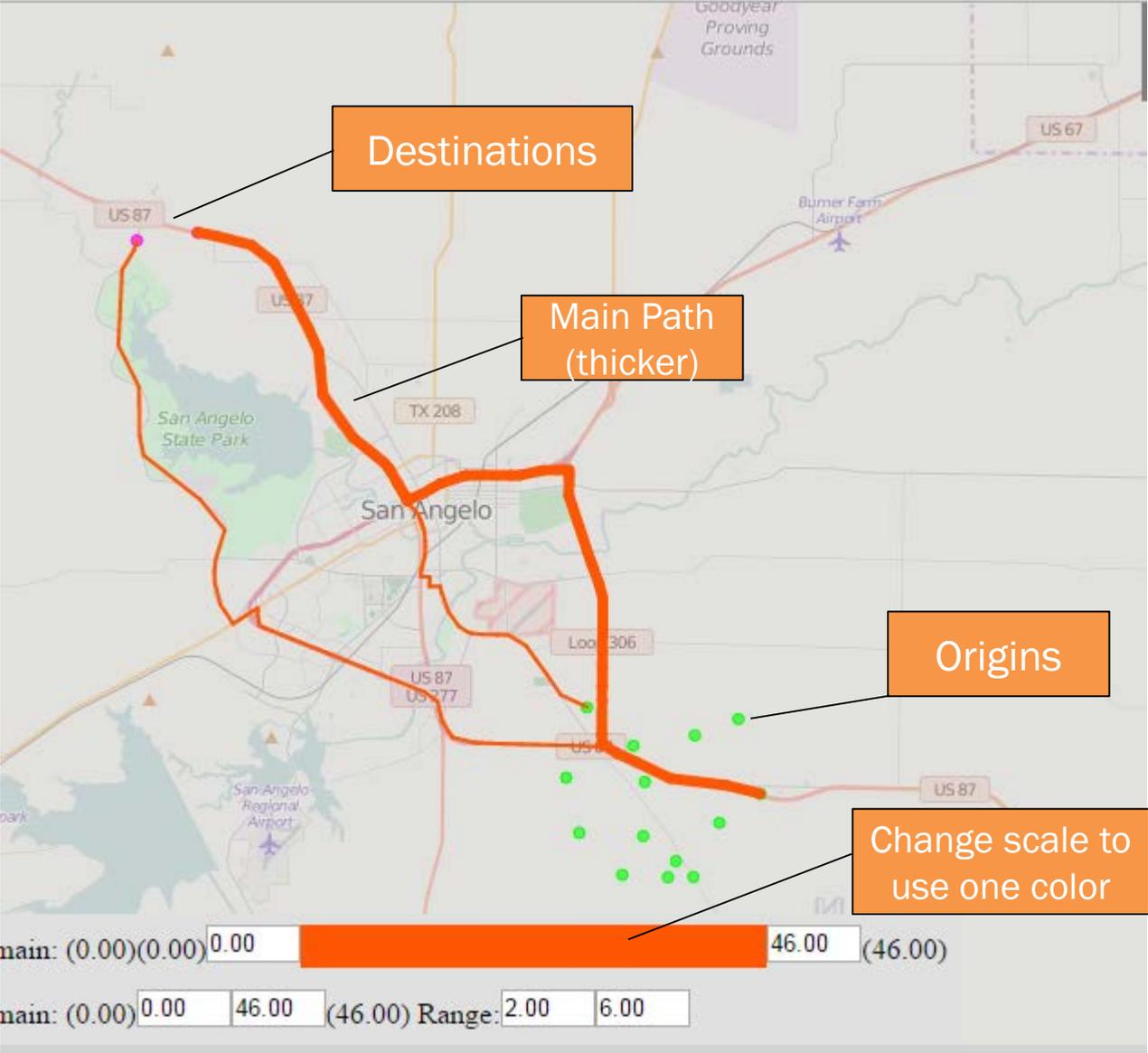


# Visualizing origin-destination paths

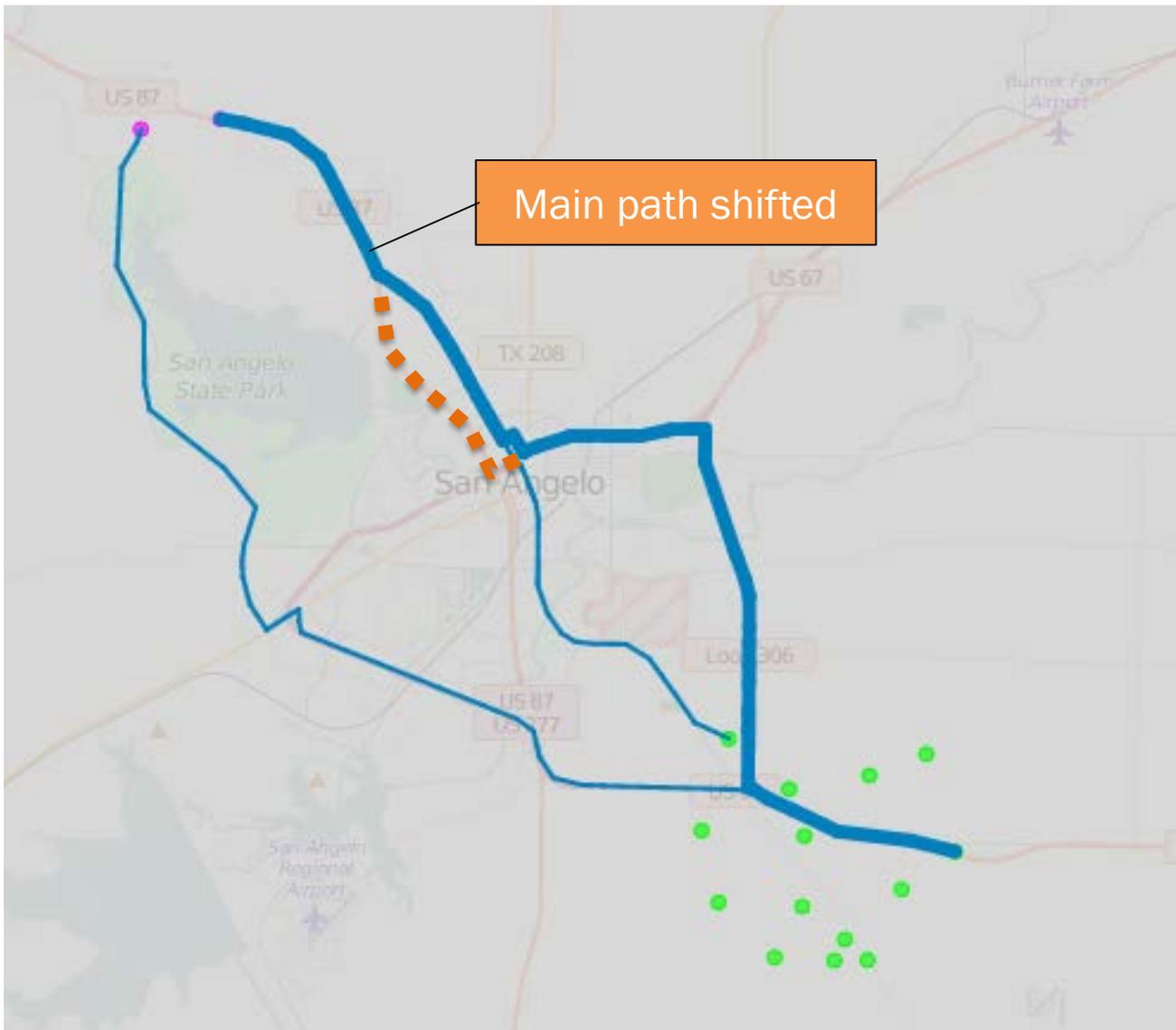


1. Select "OD Paths" from main menu
2. Select time step (minutes)
3. Select origins by typing ID or dragging box on screen and click "Done"
4. Select destinations and click "Done"

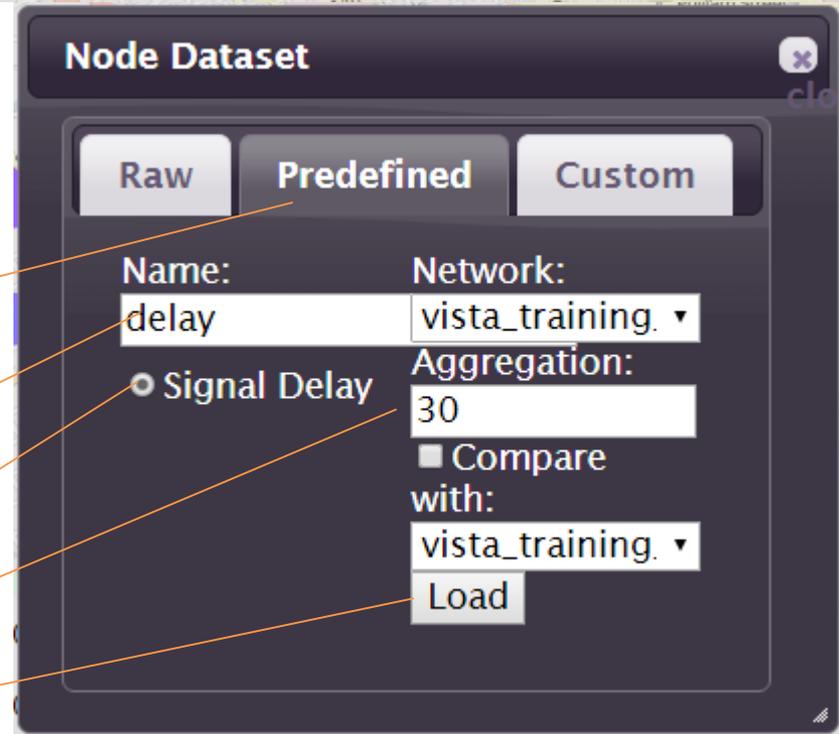
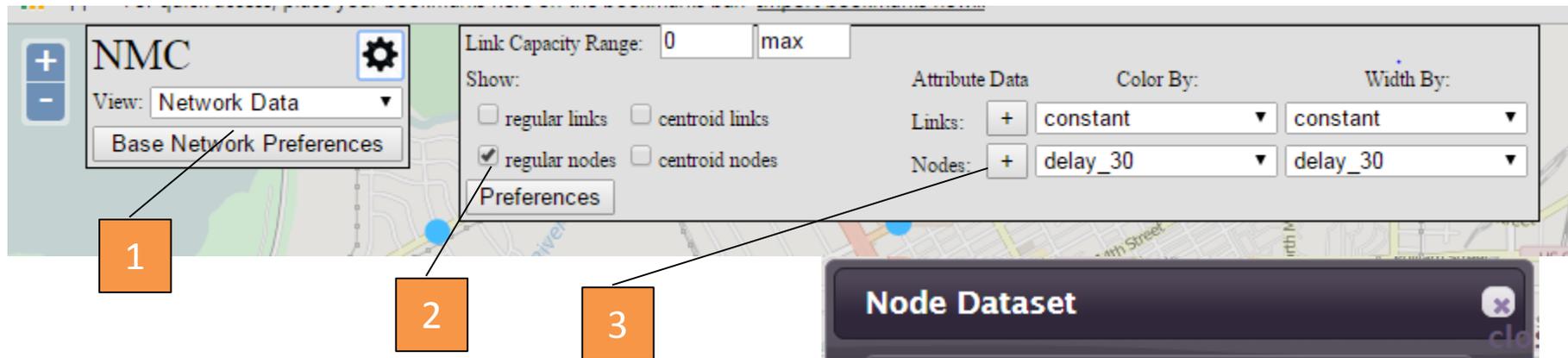
# Base Case



# Scenario 2



# Visualizing Signal Delay



1. Select “Network Data” from main menu
2. Check the “regular nodes” box and uncheck “regular links”
3. Click on “+” sign next to “Nodes”
4. Select “Predefined” tab
5. Choose “Signal Delay”
6. Choose a name for the signal delay
7. Choose a time-step (minutes)
8. Click “Load”

- 4
- 5
- 6
- 7
- 8

# Visualizing Reach Time

The screenshot shows the NMC software interface. The top panel is titled 'NMC' and has a 'View: Reach Time' dropdown menu. Below it is a 'Base Network Preferences' button. To the right, there are several input fields: 'Dataset: vista\_training\_scenario\_2', 'Interval: 30', 'Filter: Bartlett', and '30'. Below these are 'Origin Nodes:' (empty), 'Departure Clip: ', and 'Eliminate Passed: '. Further down are 'Contour Levels: 3,6,9,12,15' and 'Artery: 0'. A 'Done' button is at the bottom left of this panel. Orange boxes with numbers 1 through 5 point to these various settings. The bottom panel shows 'Dataset: vista\_training\_base\_case', 'Contours: 3,6,9,12,15', 'Show Contours: ', 'Links: ', 'Locations: ', 'Origins: ', 'Contour Fill Opacity: 0.3', and a 'Reset' button. An orange box with the number 6 points to the 'Origins' checkbox. The map on the right shows San Angelo, Texas, with several concentric contour plots in purple, blue, green, and yellow. The city center is marked with red dots and labeled 'San Angelo'. Major roads like US 87, US 67, and Loop 306 are visible. Other landmarks include San Angelo State Park and San Angelo Regional Airport.

1. Select "Reach Time" from main menu
2. Select time-step for animation
3. Select origins by typing IDs or clicking on the map
4. Define the time thresholds used to create the plot (a different color will be used to identify the area that can be covered from the selected origins at each of these thresholds)
5. Click "Done"
6. Check the "Origin" box to visualize the selected origins along with the contour plots



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**CENTER FOR TRANSPORTATION RESEARCH**

Please take our survey on today's training,  
located in the DTA Deployment Resources at  
<http://ctr.utexas.edu/nmc/dta-deployment/>

## What's Next?

### Future DTA Deployment Trainings

| DTA 1.0 | DTA 2.0 | DTA 2.1   | Webinar      |
|---------|---------|-----------|--------------|
| May     | April   | July      | As requested |
| August  | August  | September |              |

Questions?

Thank You!



## Sign-In Sheet

DTA 1.0 Workshop  
January 27, 2016

| Check | First    | Last        | Position   | Organization       | Email                           | Phone        |
|-------|----------|-------------|--|--------------------|---------------------------------|--------------|
| ✓     | Michael  | Dutton      | ?  | CAMPO              | Michael.dutton@campotexas.org   |              |
| ✓     | Lei      | Xu          | Senior Planner   | CAMPO              | Lei.Xu@campotexas.org           |              |
| ✓     | Anteneh  | Yohannes    | Planner II   | CAMPO              | Anteneh.Yohannes@campotexas.org |              |
| ✓     | Upal     | Barua       | Senior Engineer  | City of Austin     | upal.barua@austintexas.gov      | 512-974-7110 |
|       | Tina     | Cannon      | Policy Aide, CM Gallo<br>District 10                   | City of Austin     | tina.Cannon@austintexas.gov     | 512-978-2110 |
| ✓     | Emily    | Truman      | City Engineer  | City of Hutto      | Emily.Truman@HuttoTX.gov        | 512-759-4024 |
| ✓     | Sabas    | Avila       | Asst. Dir. Public Services,<br>Transportation Division | City of San Marcos | SAvila@sanmarcostx.gov          | 512-393-8018 |
| ✓     | Brandon  | Melland     | Senior Planner, Planning<br>and Development Services   | City of San Marcos | BMelland@sanmarcostx.gov        | 512-393-8238 |
| ✓     | Will     | Parrish     | Planning Technician                                    | City of San Marcos | wparrish@sanmarcostx.gov        | 512-805-2658 |
| ✓     | Rohit    | Vij         | Sr. Engineer, Engineering<br>and Capital Improvements  | City of San Marcos | rvij@sanmarcostx.gov            | 512-393-8133 |
| ✓     | Ning     | Zou         | Transp. Engineering Mgr.                               | City of San Marcos | nzou@sanmarcostx.gov            |              |
| ✓     | Katheryn | Cromwell    | Planner  | Wilco              | kcromwell@wilco.org             | 512-943-3375 |
| ✓     | Nathan   | Jones-Meyer | Planner  | Wilco              | sjones@wilco.org                |              |
|       |          |             |  |                    |                                 |              |
|       |          |             |  |                    |                                 |              |



## Sign-In Sheet

DTA 1.0 Workshop  
January 28, 2016

| Check | First   | Last      | Position  | Employer                       | Email                               | Phone        |
|-------|---------|-----------|---|--------------------------------|-------------------------------------|--------------|
| ✓     | Kelly   | Porter    | Senior Planner                                      | CAMPO                          | Kelly.Porter@campotexas.org         |              |
| ✓     | Jacob   | Calhoun   | Transportation Planner,<br>Project Controls         | Cap Metro                      | Jacob.Calhoun@capmetro.org          | 512-369-6501 |
| ✓     | Chris   | Anderson  | Senior Planner                                      | CAPCOG                         | canderson@capcog.org                | 512-916-6012 |
| ✓     | Stephen | Hanuscin  | Senior Engineer, Traffic<br>Signals & Street Lights | Cedar Park                     | stephen.hanuscin@cedarparktexas.gov | 512-401-5565 |
| ✓     | Eric    | Bollich   | Managing Engineer                                   | City of Austin                 | Eric.Bollich@austintexas.gov        |              |
| ✓     | Liane   | Miller    | Senior Planner                                      | City of Austin                 | liane.miller@austintexas.gov        | 512-974-7922 |
| ✓     | Mike    | Schofield | Traffic Engineer                                    | City of Austin                 | Mike.Schofield@austintexas.gov      | 512-974-7834 |
|       | Nadia   | Barrera   | Urban Trails Program Mgr.                           | City of Austin Public<br>Works | Nadia.Barrera@austintexas.gov       | 512-974-7142 |
| ✓     | Wesley  | Brandon   | City Engineer                                       | City of Bastrop                | wbrandon@cityofbastrop.org          | 512-332-8846 |
| ✓     | Thomas  | Gdala     | Senior Engineering Assoc.                           | City of Cedar Park             | Tom.Gdala@cedarparktexas.gov        | 512-401-5064 |
| ✓     | Candace | Douglas   | Associate Engineer                                  | City of Hutto                  | Candace.Douglas@HuttoTX.gov         | 512-759-4024 |
|       | Helen   | Ramirez   | Director of Development<br>Services                 | City of Hutto                  | Helen.Ramirez@HuttoTX.gov           | 512-759-4024 |
| ✓     | David   | Greear    | Engineering Division Mgr.                           | Travis County                  | David.Greear@traviscountytexas.gov  |              |
|       | Karen   | Lorenzini | I-35/Mobility35 Program<br>Manager                  | TxDOT Austin<br>District       | karen.lorenzini@txdot.gov           | 512-832-7369 |
|       | Tim     | Juarez    | MPO Coordinator<br>DTA Program Manager              | TxDOT                          | Tim.Juarez@txdot.gov                |              |
| ✓     | Daniel  | Yang      | Program Manager                                     | CAMPO                          | Daniel.Yang@campotexas.org          |              |



THE UNIVERSITY OF TEXAS AT AUSTIN  
**CENTER FOR TRANSPORTATION RESEARCH**

## Dynamic Traffic Assignment Deployment Training 2.0

**UT Center for Transportation Research**  
In collaboration with



To access training resources, please visit  
[ctr.utexas.edu/nmc/dta/dta-2-0-workshop-materials/](http://ctr.utexas.edu/nmc/dta/dta-2-0-workshop-materials/)



# Today's Schedule

| 8:30  | Set-up and Introductions                |
|-------|---|
| 8:45  | Training Overview                       |
| 9:15  | Module 1: Prepare DTA Model Data        |
| 10:30 | Break                                   |
| 10:40 | Module 2: Quality Control of Inputs     |
| 11:15 | Module 3: Run a DTA model               |
| 12:00 | Lunch                                   |
| 12:30 | Module 4: DTA Model Results Analysis    |
| 1:00  | Module 5: Validate Model Results        |
| 1:45  | Module 6: Analyze and Compare Scenarios |
| 3:00  | Wrap-Up                                 |

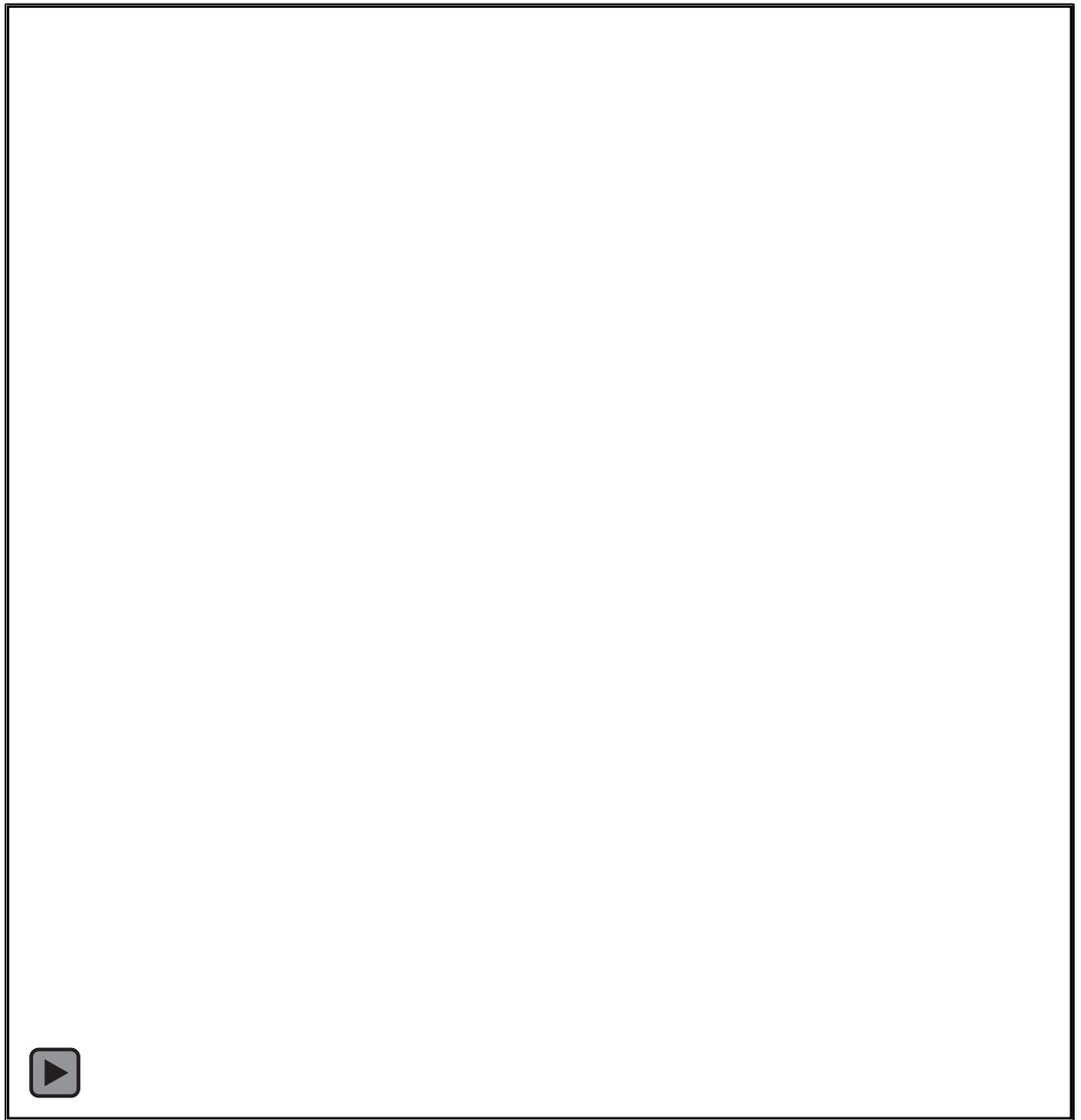


# Today's goals

## Dynamic Traffic Assignment (DTA) characteristics and uses

### DTA Modules

- Prepare data
- Run the model
- Validate model results
- Compare scenarios



# What do you recall from DTA 1.0?

## What is Dynamic Traffic Assignment (DTA)?

- DTA is a planning tool used to compare possible future year scenarios.
- DTA models “strategic” driving behavior, or how drivers choose their routes at a typical time based on least-cost path selection.

## What is different about DTA?

- DTA considers the evolution of traffic conditions at small time intervals (seconds).
- DTA allows for different traveler strategic behavior depending on departure time.
- DTA captures changes in traffic conditions every 100 to 500 feet.

## What types of data do we use in DTA?

- Model inputs: Transportation network, traffic control and travel demand data.
- Model validation/calibration: time-dependent traffic counts/travel times.

## What are some of the tools used at CTR for DTA modeling?

- The DTA software VISTA is used at CTR (equilibrium and convergence).
- The VISTA Editor tool can be used to edit networks and animate results.
- A sophisticated web-based visualization tool and supplemental applications have been developed to review results.

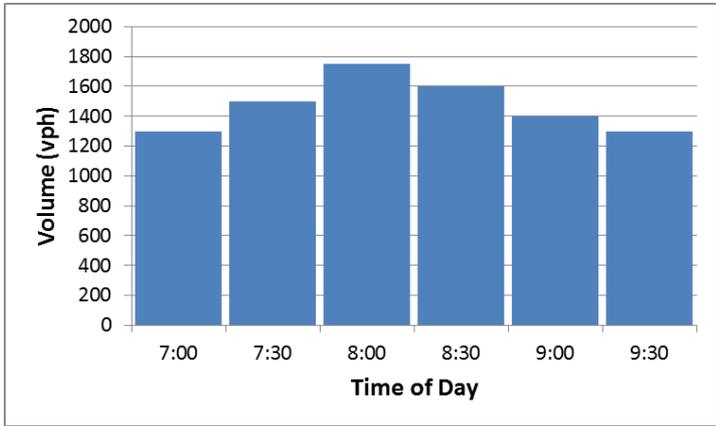
# What is “dynamic” about DTA?

DTA uses input and generates output that will vary over time

| Start Time         | Loop 150 Southbound |            |            |          |            |
|--------------------|---------------------|------------|------------|----------|------------|
|                    | Left                | Thru       | Right      | Peds     | App. Total |
| 07:00              | 7                   | 8          | 22         | 0        | 37         |
| 07:15              | 8                   | 22         | 42         | 0        | 72         |
| 07:30              | 6                   | 19         | 58         | 0        | 83         |
| 07:45              | 16                  | 30         | 42         | 0        | 88         |
| <b>Total</b>       | <b>37</b>           | <b>79</b>  | <b>164</b> | <b>0</b> | <b>280</b> |
| 08:00              | 13                  | 20         | 50         | 0        | 83         |
| 08:15              | 26                  | 44         | 35         | 0        | 105        |
| 08:30              | 11                  | 21         | 46         | 0        | 78         |
| 08:45              | 18                  | 31         | 36         | 0        | 85         |
| <b>Total</b>       | <b>68</b>           | <b>116</b> | <b>167</b> | <b>0</b> | <b>351</b> |
| <b>Grand Total</b> | <b>105</b>          | <b>195</b> | <b>331</b> | <b>0</b> | <b>631</b> |
| Approch %          | 16.6                | 30.9       | 52.5       | 0        |            |
| Total %            | 4.1                 | 7.6        | 12.9       | 0        | 24.5       |

- ### Dynamic Inputs
- Travel demand
  - Signal timing plans
  - Tolls
  - Closures

- ### Dynamic Outputs
- OD route selection strategies and corresponding
  - Link volumes
  - Link travel times



DTA is different than multiple/discrete static models

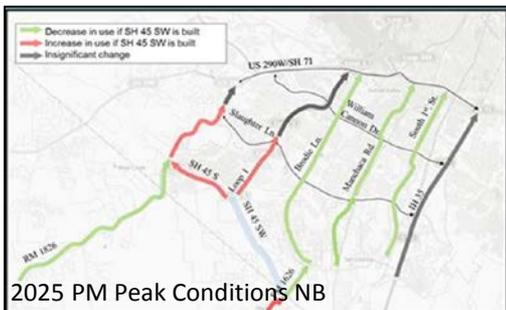
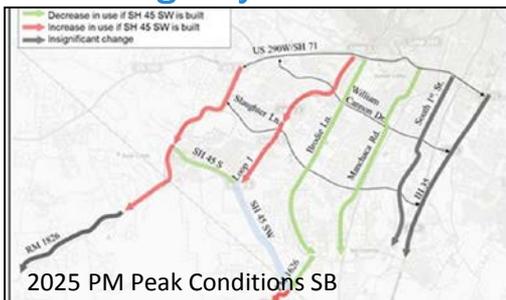
# DTA Applications

Analyze time-dependent changes in traffic patterns within peak period/short duration

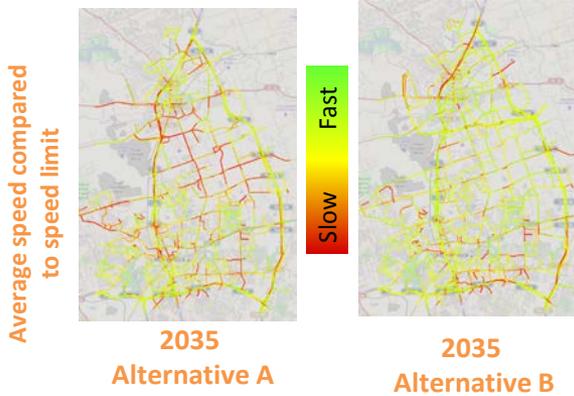
Visualize impact of projects on medium/large regions

Compare results across scenarios

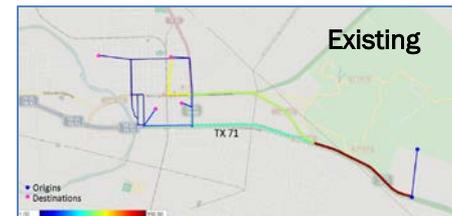
## State Highway 45 Southwest



## Williamson County



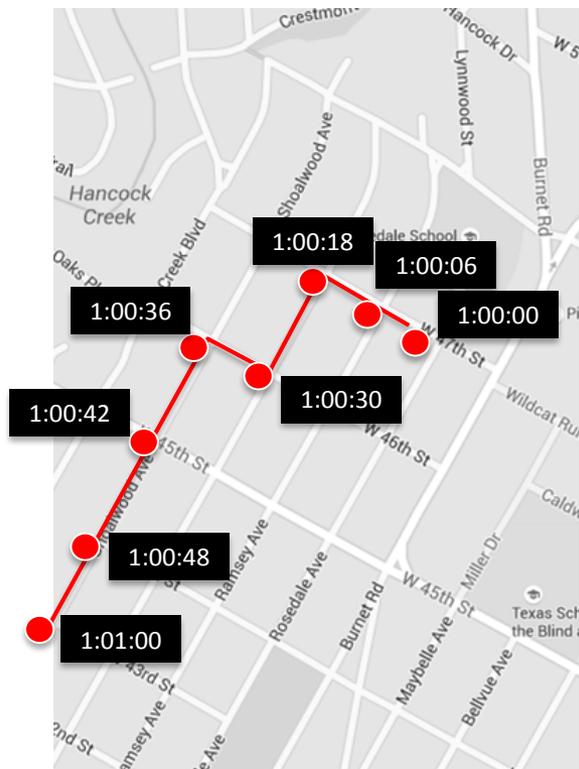
## SH 71 Interchanges



# DTA Model Results

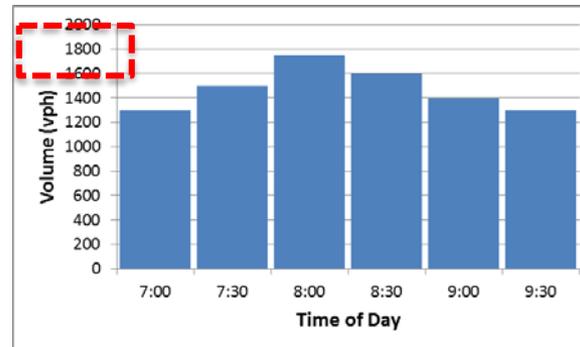
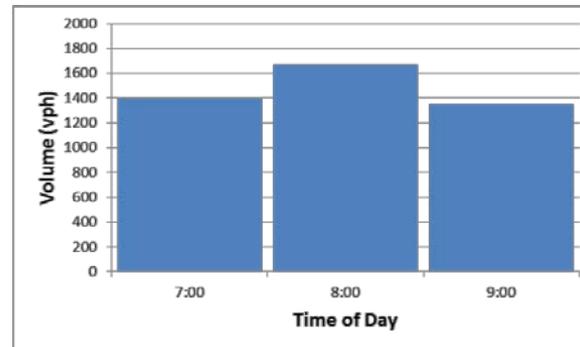
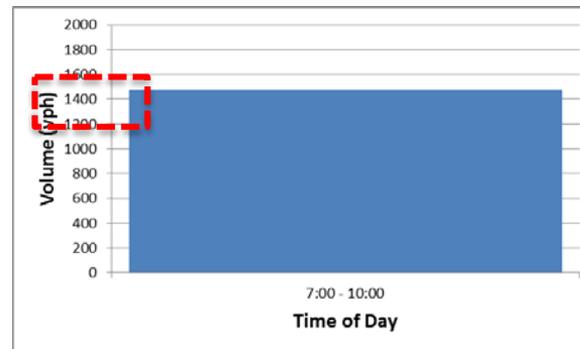
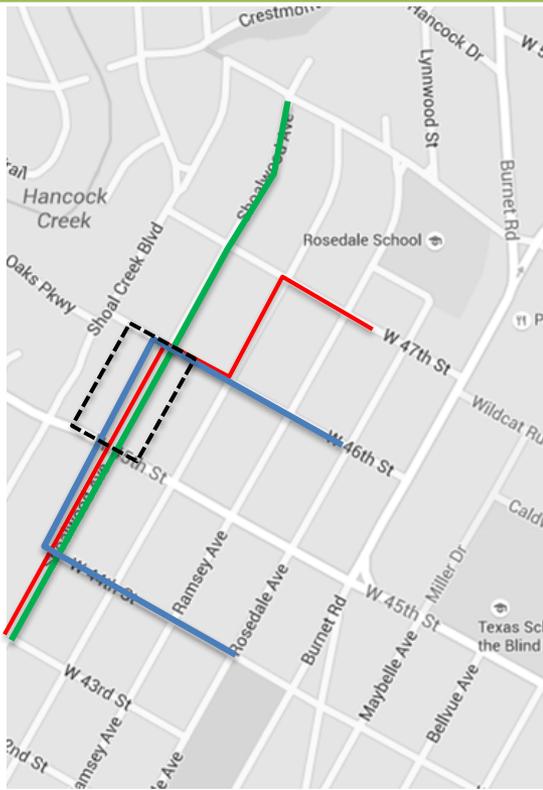
## Raw Results

- Individual vehicles trajectories



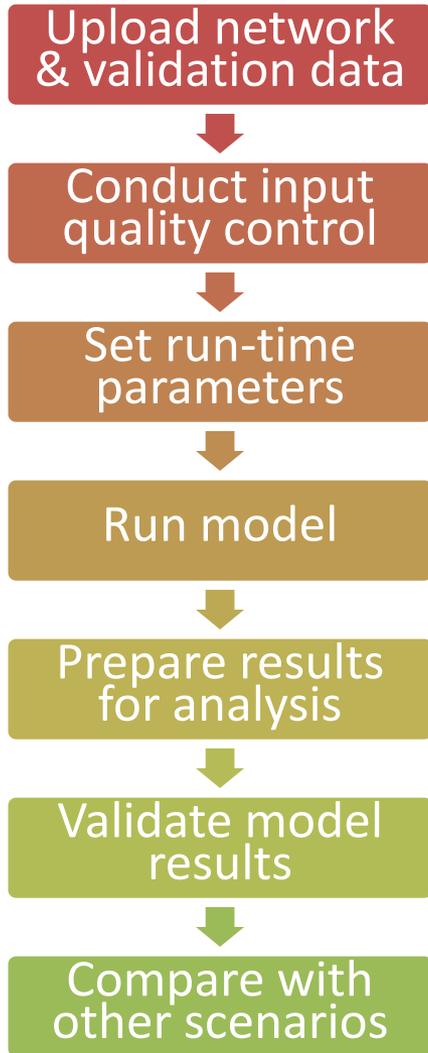
## Aggregation for Analysis

- Space
- Time

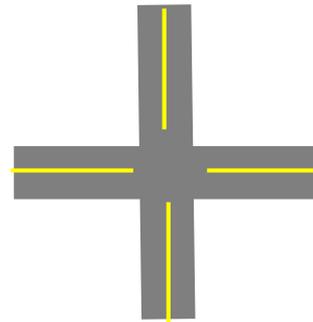


# TODAY: Workflow for a DTA application

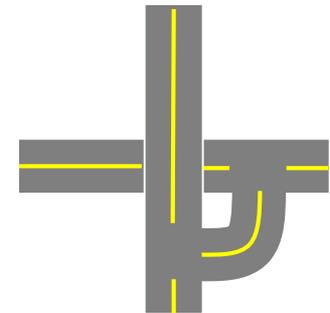
DTA At-A-Glance 1



What are the impacts of different intersection designs?



AT GRADE



OVERPASS



# Getting Ready: Accessing Modeling Tools

Cheat Sheet 1

Your credentials

UT EID

Project login

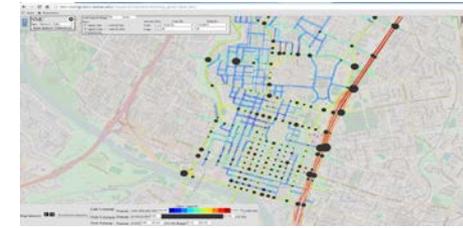
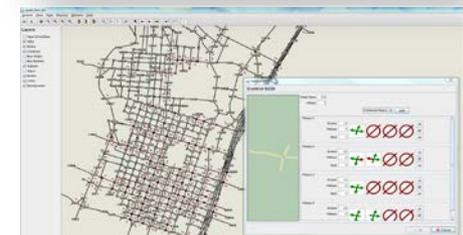
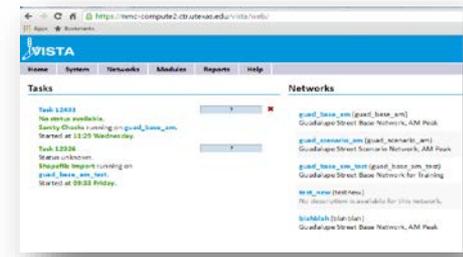
Access to software tools

VISTA web portal

VISTA GIS Editor

Viztool

Interactive Reports

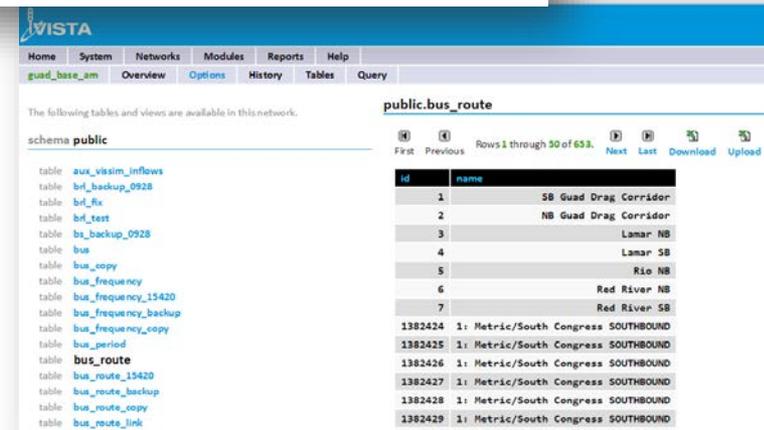
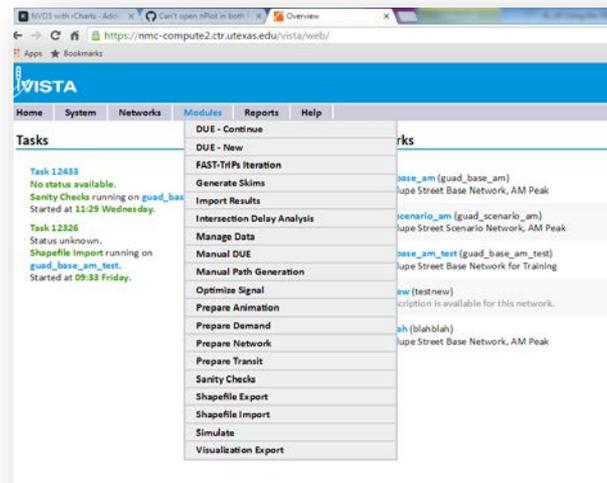


# The VISTA web portal

Web-based environment with project specific login to access model, data, and results

- Upload data
- Access GIS editor
- Run model
- Analyze results
- Generate Interactive reports

Model processes completed using Vista software module



# The VISTA GIS Editor

Cheat Sheet 3

Access the VISTA GIS Editor

Download small file into your computer and launch (no installation needed)

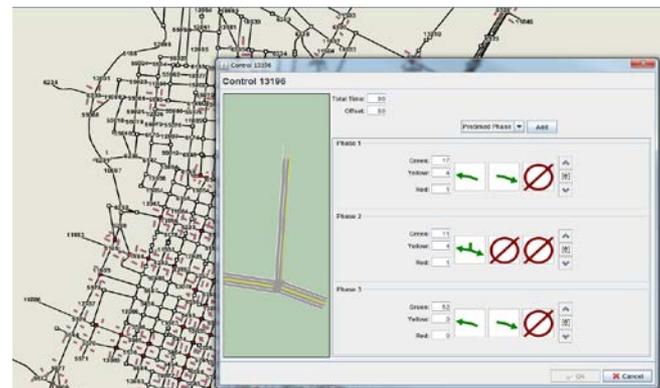
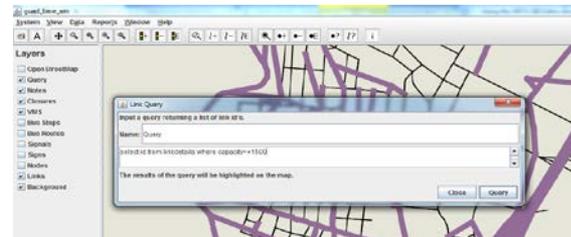
Edit network elements

Animate model results

Query links and nodes

Fix network errors

Add traffic control



Java application that allows changes to data in the VISTA database using a GIS interface

# The Viztool

## Cheat Sheet 4

### Access the Viztool

General use tips

Detailed feature use

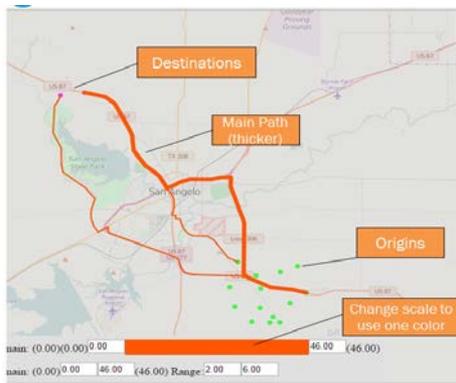
Visualize link & node data

OD paths

Select link paths

Intersection delay

Contour plots



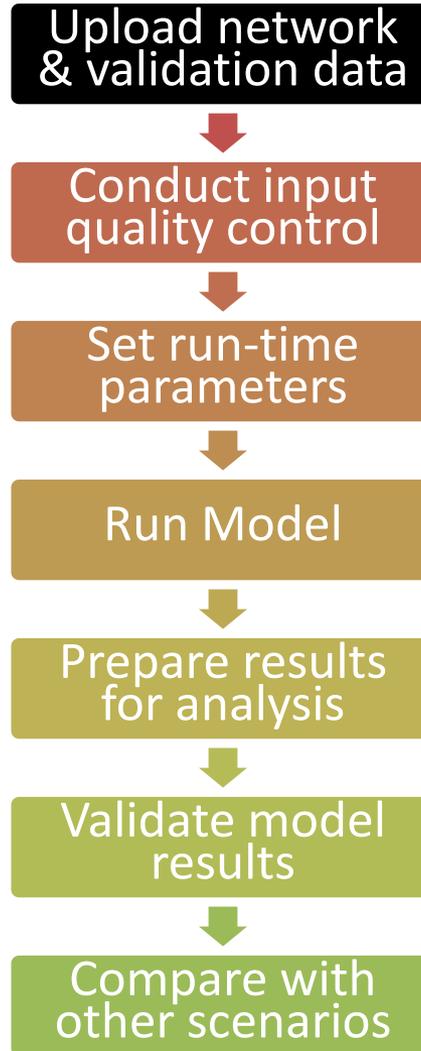
A screenshot of the NMC software interface. The 'Base Network Preferences' window is open, showing settings for 'Reach Time', 'Origin Node', 'Origin Level', 'Interval', 'Filter', 'Departure Clip', and 'Elasticity Period'. Numbered callouts 1 through 6 point to specific UI elements: 1 points to the 'Reach Time' dropdown, 2 points to the 'Interval' dropdown, 3 points to the 'Origin Node' input field, 4 points to the 'Origin Level' input field, 5 points to the 'Done' button, and 6 points to the 'Origin' checkbox. Below the screenshot is a list of instructions.

1. Select "Reach Time" from main menu
2. Select time-step for animation
3. Select origins by typing IDs or clicking on the map
4. Define the time thresholds used to create the plot (a different color will be used to identify the area that can be covered from the selected origins at each of these thresholds)
5. Click "Done"
6. Check the "Origin" box to visualize the selected origins along with the contour plots

Web-based application that allows for interactive analysis and animation of model results



# Module 1: Prepare DTA Model Data



# Module 1: Prepare Model Data

## Overview of process

Discussion of model data types and sources

Exercises

- Importing roadway network data
- Importing travel demand data
- Creating traffic control data
- Adding calibration data
- Reviewing transit data
- Reviewing toll data

# Summary of Input Data

What types of input data are used in DTA models?

DTA At-A-Glance 2



Roadway Network Data



Demand Data

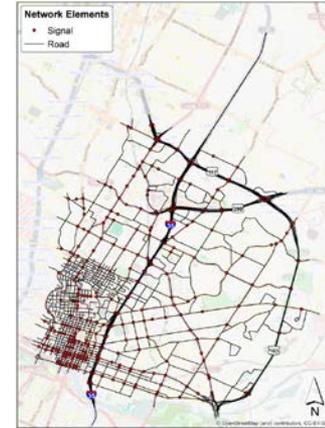
Traffic Control Data

Calibration Data



Transit Data

Toll Data





# Roadway Network Data

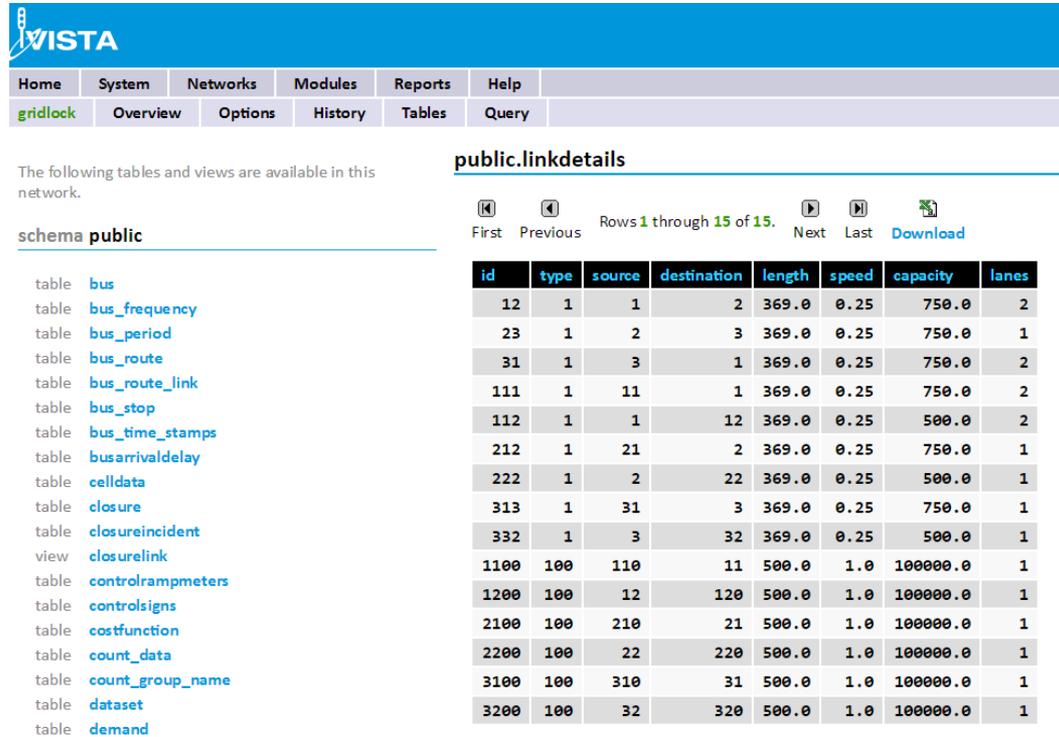
# Roadway Network Data Characteristics

## Links

- Origin/destination node
- Speed in miles per minute
- Capacity in vphpl
- Lanes
- Length in feet
- Type (regular/centroid connector)
- Geometry

## Nodes

- Coordinates
- Type (regular/centroid)



**WISTA**

Home System Networks Modules Reports Help

gridlock Overview Options History Tables Query

The following tables and views are available in this network.

schema public

- table bus
- table bus\_frequency
- table bus\_period
- table bus\_route
- table bus\_route\_link
- table bus\_stop
- table bus\_time\_stamps
- table busarrivaldelay
- table celldata
- table closure
- table closureincident
- view closurelink
- table controlrampmeters
- table controlsigns
- table costfunction
- table count\_data
- table count\_group\_name
- table dataset
- table demand

**public.linkdetails**

First Previous Rows 1 through 15 of 15. Next Last Download

| id   | type | source | destination | length | speed | capacity | lanes |
|------|------|--------|-------------|--------|-------|----------|-------|
| 12   | 1    | 1      | 2           | 369.0  | 0.25  | 750.0    | 2     |
| 23   | 1    | 2      | 3           | 369.0  | 0.25  | 750.0    | 1     |
| 31   | 1    | 3      | 1           | 369.0  | 0.25  | 750.0    | 2     |
| 111  | 1    | 11     | 1           | 369.0  | 0.25  | 750.0    | 2     |
| 112  | 1    | 1      | 12          | 369.0  | 0.25  | 500.0    | 2     |
| 212  | 1    | 21     | 2           | 369.0  | 0.25  | 750.0    | 1     |
| 222  | 1    | 2      | 22          | 369.0  | 0.25  | 500.0    | 1     |
| 313  | 1    | 31     | 3           | 369.0  | 0.25  | 750.0    | 1     |
| 332  | 1    | 3      | 32          | 369.0  | 0.25  | 500.0    | 1     |
| 1100 | 100  | 110    | 11          | 500.0  | 1.0   | 100000.0 | 1     |
| 1200 | 100  | 12     | 120         | 500.0  | 1.0   | 100000.0 | 1     |
| 2100 | 100  | 210    | 21          | 500.0  | 1.0   | 100000.0 | 1     |
| 2200 | 100  | 22     | 220         | 500.0  | 1.0   | 100000.0 | 1     |
| 3100 | 100  | 310    | 31          | 500.0  | 1.0   | 100000.0 | 1     |
| 3200 | 100  | 32     | 320         | 500.0  | 1.0   | 100000.0 | 1     |

### Important to remember:

- 2-way street requires two links
- Centroids: one for origin, one for destination
- Boundary congestion

# Roadway Network Data Tables

## Required Tables

- Links (geometry)
- Linkdetails (attributes)
- Nodes

## Additional and optional tables

- Link bays (linkbays)
- Link prohibitions (prhb\_links)

public.links

First Previous Rows 1 through 15 of 15.

| id   | points            |
|------|-------------------|
| 12   | [(10,10),(15,17)] |
| 23   | [(15,17),(20,10)] |
| 31   | [(20,10),(10,10)] |
| 111  | [(5,3),(10,10)]   |
| 112  | [(10,10),(0,10)]  |
| 212  | [(10,23),(15,17)] |
| 222  | [(15,17),(20,23)] |
| 313  | [(30,10),(20,10)] |
| 332  | [(20,10),(25,3)]  |
| 1100 | [(0,-4),(5,3)]    |
| 1200 | [(0,10),(-10,10)] |
| 2100 | [(5,29),(10,23)]  |
| 2200 | [(20,23),(25,29)] |
| 3100 | [(40,10),(30,10)] |
| 3200 | [(25,3),(30,-4)]  |

public.nodes

First Previous Rows 1 through 15 of 15.

| id  | type | x     | y    |
|-----|------|-------|------|
| 1   | 1    | 10.0  | 10.0 |
| 2   | 1    | 15.0  | 17.0 |
| 3   | 1    | 20.0  | 10.0 |
| 11  | 1    | 5.0   | 3.0  |
| 12  | 1    | 0.0   | 10.0 |
| 21  | 1    | 10.0  | 23.0 |
| 22  | 1    | 20.0  | 23.0 |
| 31  | 1    | 30.0  | 10.0 |
| 32  | 1    | 25.0  | 3.0  |
| 110 | 100  | 0.0   | -4.0 |
| 120 | 100  | -10.0 | 10.0 |
| 210 | 100  | 5.0   | 29.0 |
| 220 | 100  | 25.0  | 29.0 |
| 310 | 100  | 40.0  | 10.0 |
| 320 | 100  | 30.0  | -4.0 |

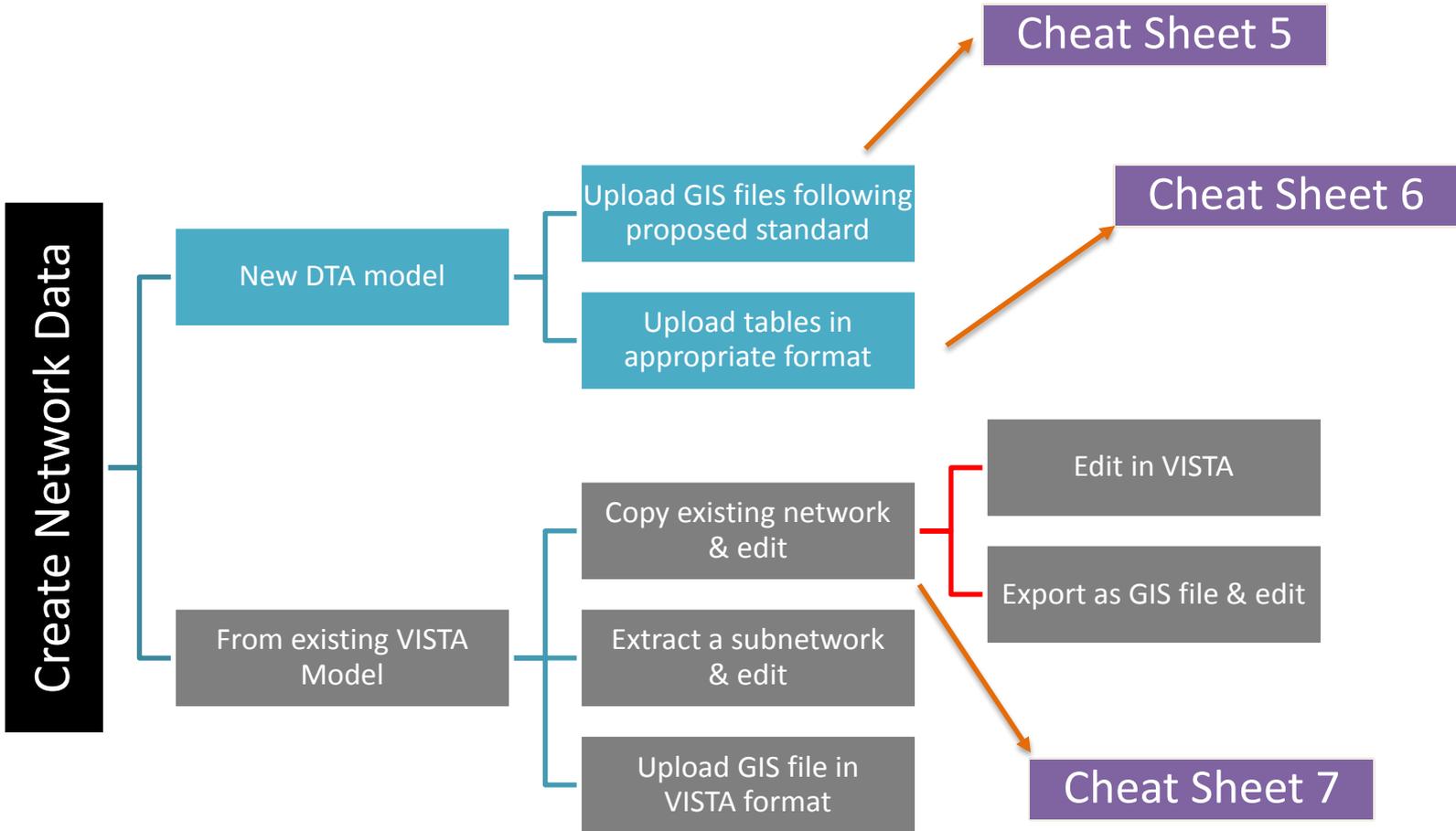
public.linkbays

First Previous Rows 1 through 1 of 1.

| id | isleft | isturn | lanes | length |
|----|--------|--------|-------|--------|
| 25 | f      | t      | 1     | 300.0  |

# Create Network Data

DTA At-A-Glance 3

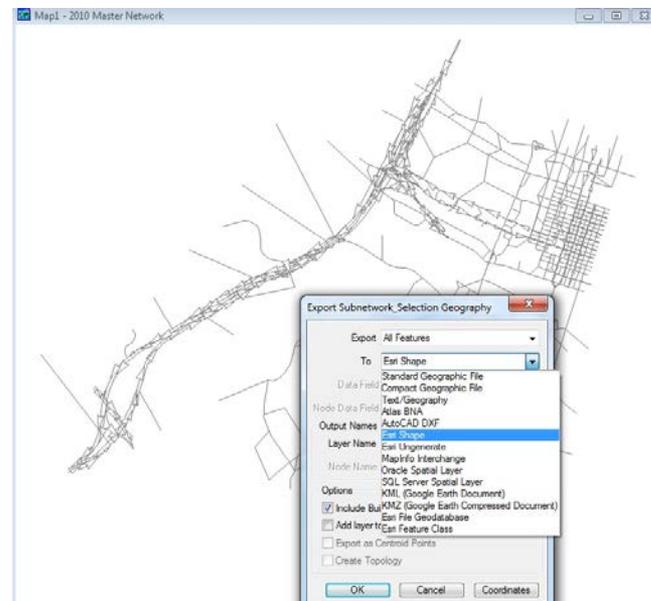


# Create Network Data

Exercise 1.1

## Import shapefiles (CAMPO format)

1. Utilizes shapefiles exported from TransCAD (need files to contain specific fields)
2. Use “Shapefile Import” module in VISTA
3. Review network in Editor

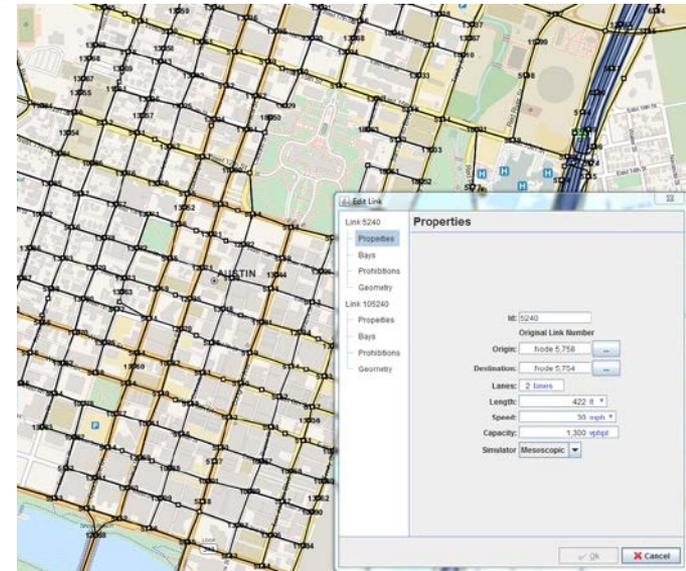


# Create Network Data

## Import shapefiles (VISTA Format)

1. Utilizes shapefiles exported from VISTA or ArcGIS (need files to contain specific fields)
2. Use “Shapefile Import” module in VISTA with different inputs than Exercise 1.1
3. Review network in VISTA Editor

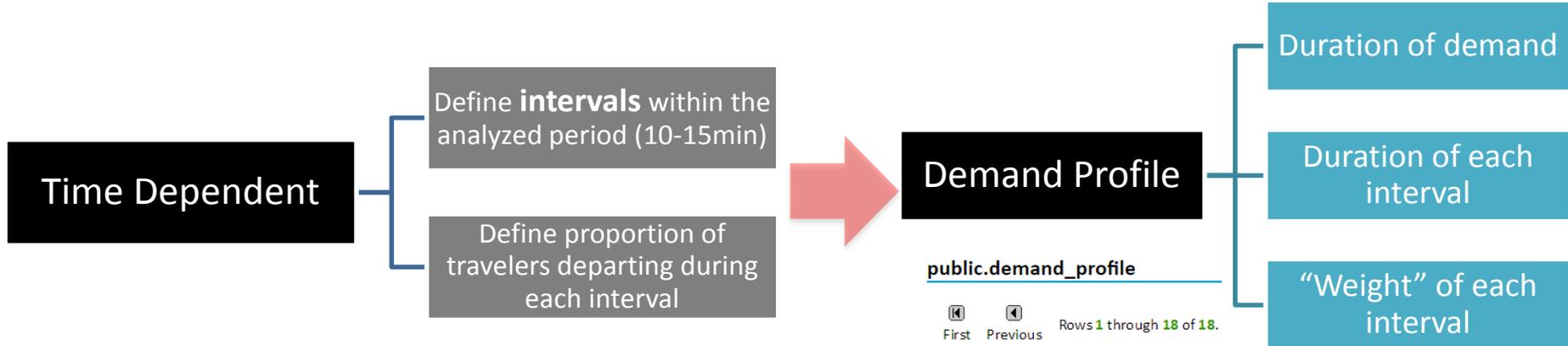
### Exercise 1.2





# Demand Data

# Demand Data Characteristics



public.demand\_profile

First Previous Rows 1 through 18 of 18.

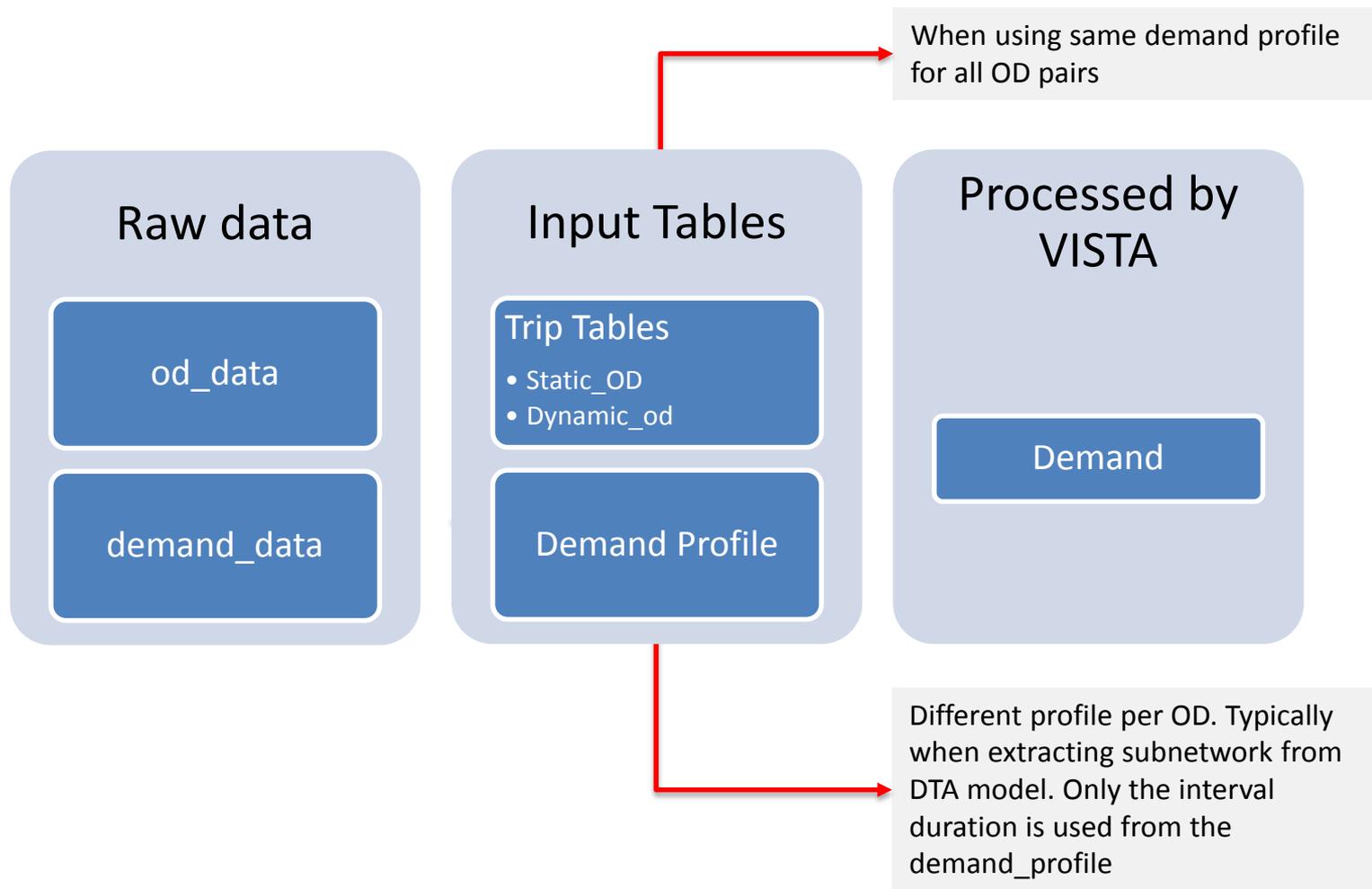
| id | weight | starttime | duration |
|----|--------|-----------|----------|
| 0  | 1.0    | 0         | 600      |
| 1  | 1.0    | 600       | 600      |
| 2  | 1.0    | 1200      | 600      |
| 3  | 1.0    | 1800      | 600      |
| 4  | 1.0    | 2400      | 600      |
| 5  | 1.0    | 3000      | 600      |
| 6  | 1.0    | 3600      | 600      |
| 7  | 1.0    | 4200      | 600      |
| 8  | 1.0    | 4800      | 600      |
| 9  | 1.0    | 5400      | 600      |

Module "Prepare Demand"

Combines total OD demand information with demand profile

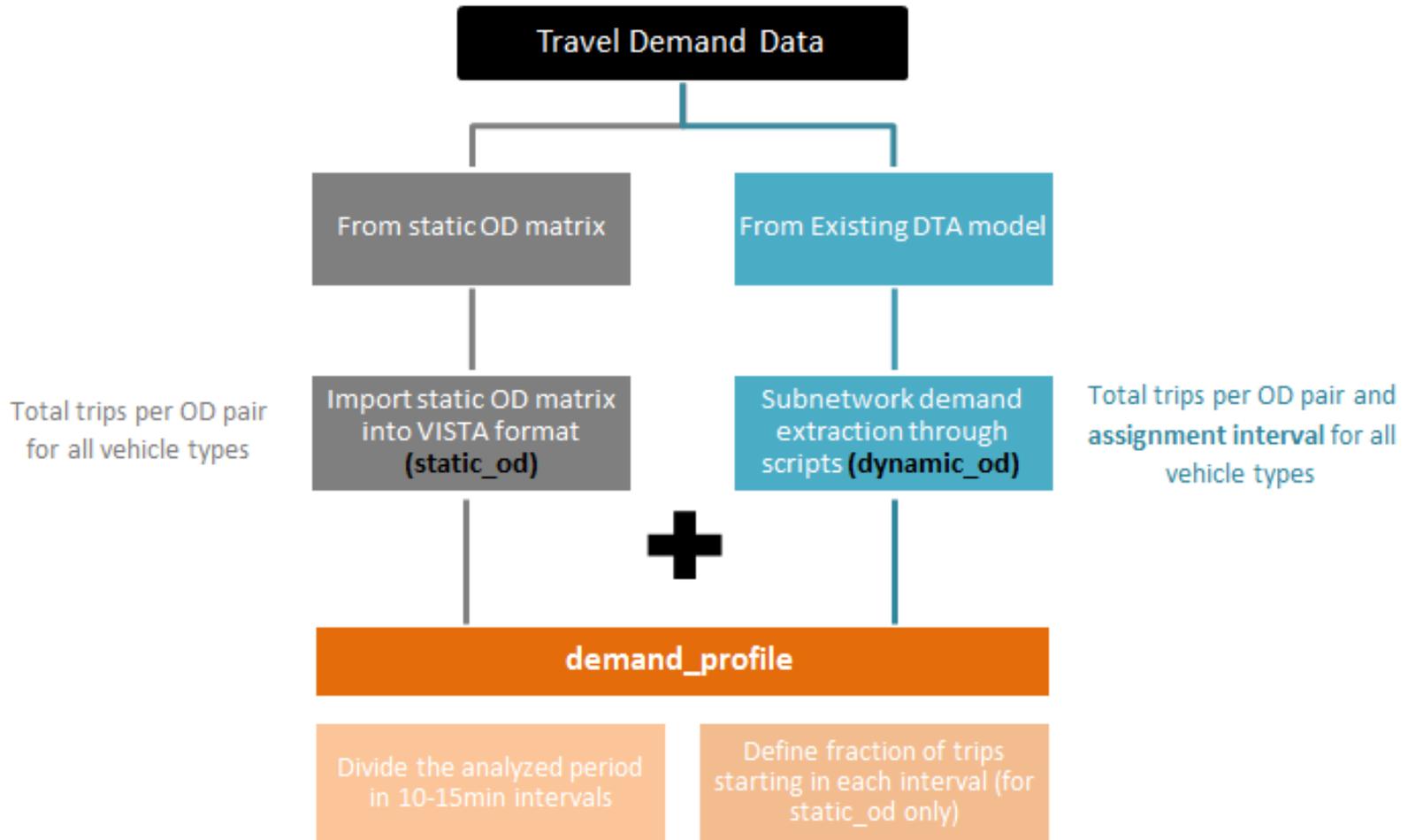
Produces "demand" table used by VISTA

# Demand Data Tables



# Create Demand Data

DTA At-A-Glance 4



# Create Demand Data

## Exercise 1.3

### Import and Prepare Demand Data

1. Upload source data for travel demand and temporal distribution
2. Use database function in the Web Portal to create VISTA input tables and add boundary centroids
3. Use VISTA Prepare Demand module

See Cheat Sheet 8



# Traffic Control

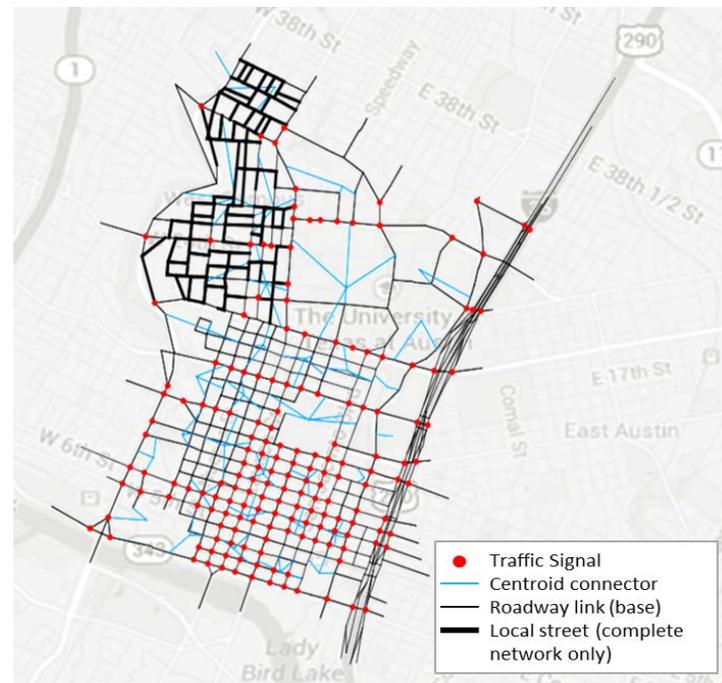
# Traffic Control Data Characteristics

## Traffic signals

- Location
- Timing plans/optimization
- Modeling: right-of-way allocation

## Stop signs

- Location
- Identifying stop-controlled approaches
- Modeling: approximate speed/capacity impacts



# Traffic Control Tables

## Traffic Signals

- Signals table
- Phases table

## Stop/Yield Control

- Controlsigns table
- Potential modifications to linkdetails (link attributes) table



# Create Traffic Control

## Overview

- Obtain field data, including signal timing plans as appropriate
- Enter control information into model
- Run additional queries/optimize as needed

## Exercise 1.4

### Create and Edit Traffic Control

1. Insert traffic signal control
2. Insert STOP sign control
3. Use instructions to complete exercise



# Validation Data



# Validation Data Characteristics

Cheat Sheet 9

| Types   | Characteristics  | Processing  | Use  |
|---|--|---|--|
| <ul style="list-style-type: none"><li>• Link counts from fixed sensors</li><li>• Corridor travel times from probe vehicles</li><li>• Turning movements at intersections</li></ul> | <ul style="list-style-type: none"><li>• Time-dependent</li><li>• Directional</li></ul> | <ul style="list-style-type: none"><li>• Obtain field data, including source and collection time</li><li>• Map data to network elements</li><li>• Reformat data for input into model</li><li>• Upload data into VISTA via web portal</li></ul> | <ul style="list-style-type: none"><li>• Link counts: compare field data to model estimates on appropriate links</li><li>• Corridor travel time: simulate “probe vehicles” along corridors and compare their travel time to field data.</li></ul> |

# Validation Data Tables

## Link Count

Link\_group

Link\_volume\_data

## Corridor Travel Time

Ttime\_group

Ttime\_data

Tables to define corridors in the model

## Upcoming improvements

Tools to facilitate the mapping of corridors to model link IDs (when data is collected using GPS).  
Alternative methodology which does not require simulation of probe vehicles.



## Add Validation Data

### Overview

- Obtain field data, including source and collected data
- Reformat data for input into model
- Upload data into VISTA via web portal
- If using corridor travel times: model corridors for the simulation of probe vehicles

### Exercise 1.5

## Upload and View Calibration Data

1. Upload count data
2. Use instructions to complete exercise
3. Visualize data locations in VISTA Editor



# Transit Data

# Transit Data Characteristics

- Departure times for buses are fixed within the schedule
- Requires route, stops, and schedule information
- Schedules can vary by time of day/peak period
- Importing data from General Transit Feed Specification (GTFS) generates one “route” per bus, based on map-matching algorithm
- VISTA “Prepare Transit” module generates vehicles for model
- Can be validated using AVL data





# Transit Data

## Tables

### Input Tables

Bus\_route

Bus\_route\_link table

Bus\_stop table

Bus\_frequency table (regular headways)

Bus\_period table (time period over which buses run)

### Processed by VISTA

Bus

# Add Transit Data

## Overview

- Import from GTFS with map-matcher, or
- Add manually (using agency information)

## Exercise 1.6

### Review Transit Input Data

1. Run query to see how many buses in model during peak period
2. Visualize bus routes in VISTA Editor



# Toll data

# Toll Data

## Characteristics

- Link based, time dependent, and vehicle-type dependent
- Modeled using generalized costs (value of time)
- Cost units \$/sec
  - Ensure consistency across tables in database



# Toll Data

## Tables

- Link toll
  - Identify tolled links and corresponding toll per time period and vehicle class. Only one fare per time period and toll type is allowed.
- Toll type
  - Define types in order to specify different toll fares per vehicle type.
- Cost function
  - Specify the impact of tolls on routing decisions assuming a money value of time.
- Vehicle class
  - Identify an appropriate toll type per vehicle



# Add Toll Data

## Overview of Process

### Overview

Data sources and manipulation

- CAMPO network
- Cross check toll authority info
- Data must be translated into links so that VISTA can utilize it

Review cost function

### Exercise 1.7

#### Review Toll Input Data

1. Run query to see how many links have a toll assigned
2. Visualize toll route in VISTA Editor

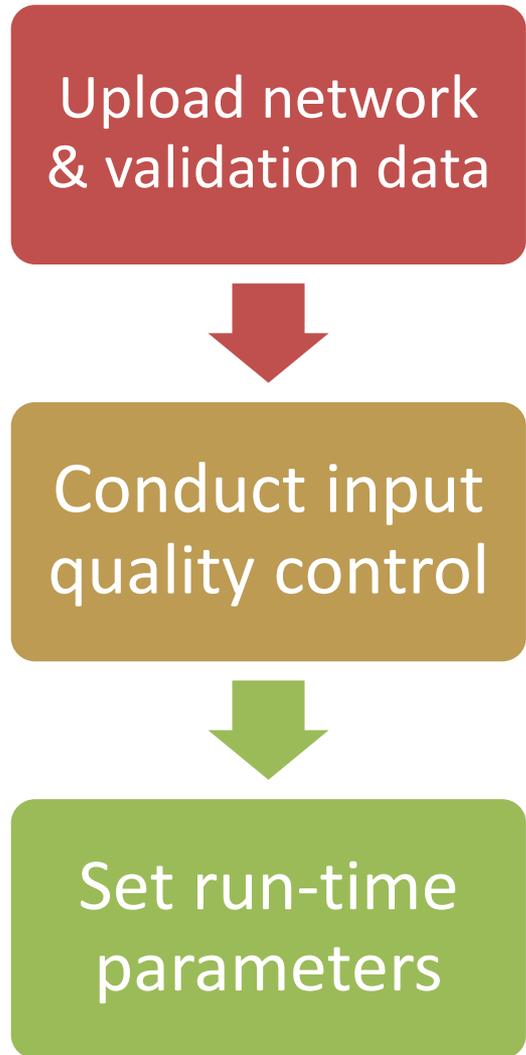


# Ten-Minute Break





## Module 2: Quality Control of Inputs



# Module 2: Quality Control of Inputs

## Overview

### Quality Control of Inputs

- Use Sanity Check module
- Use visualization tool to review network data

### DTA Model Run

- General concepts
- Review of Equilibrium
- Overview of built-in iterative methodology for DTA
- Typical model run
- More about simulation and path search

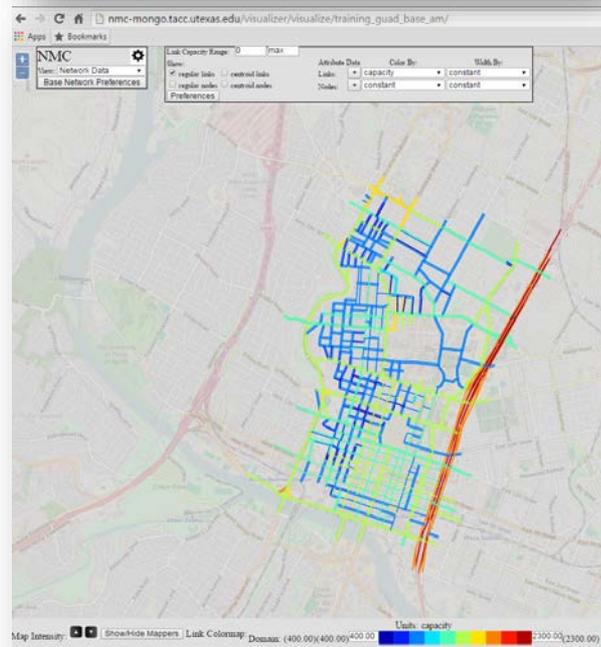
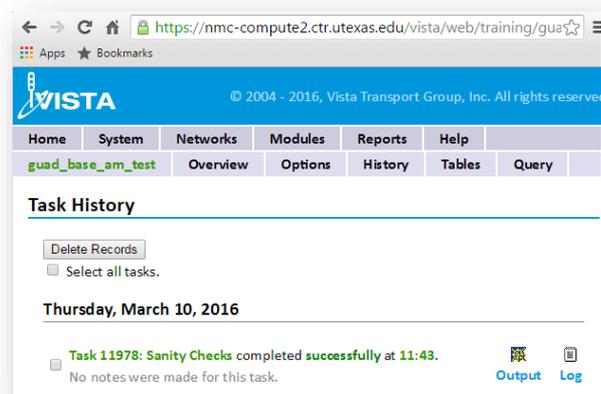
# Quality Control of Inputs

## Run sanity check module

- Identify missing or inconsistent data
- Identify input values that are outside expected ranges

## Visual inspection in the visualization tool

- Identify potential network coding errors, such as discontinuities in the values of link attributes (e.g. number of lanes)

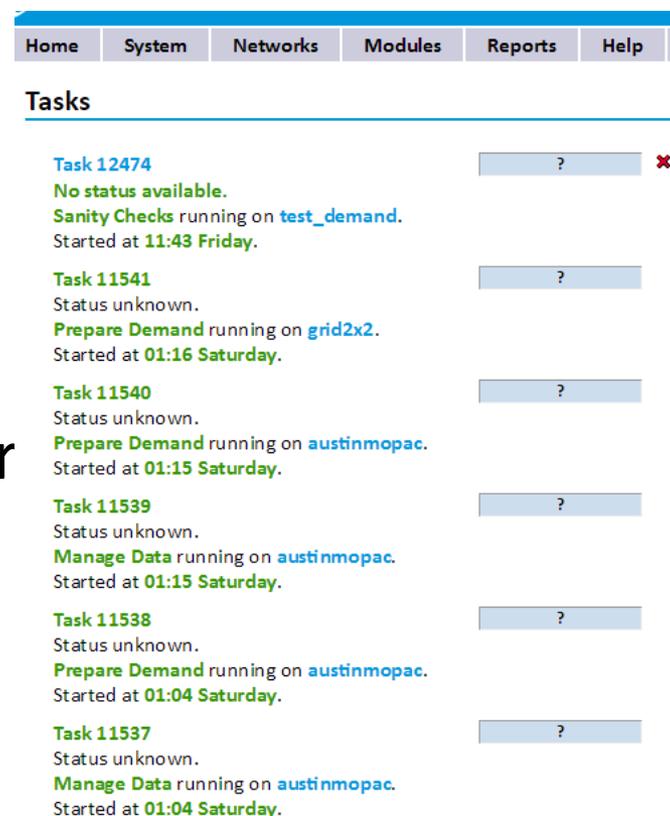


# Quality Control of Inputs: Sanity Check Module

## Exercise 2.1

### Use the VISTA Sanity Check Module

1. Run the module
2. Review log file
3. Review HTML output file
4. Review .csv output file
5. Correct errors in VISTA Editor



The screenshot shows a web interface with a navigation bar containing 'Home', 'System', 'Networks', 'Modules', 'Reports', and 'Help'. Below the navigation bar is a section titled 'Tasks' which lists several tasks with their status and start times. Each task entry includes a task ID, a status message, and a start time. The tasks listed are:

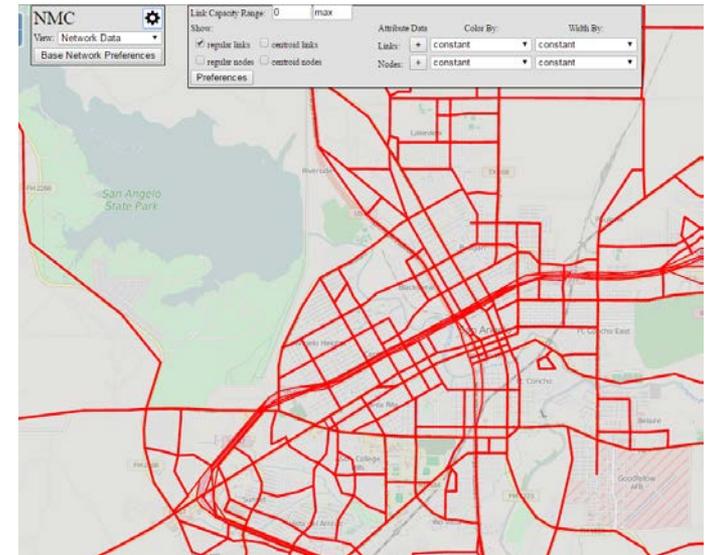
| Task ID    | Status   | Start Time                 |
|------------|--|----------------------------|
| Task 12474 | No status available. Sanity Checks running on test_demand. | Started at 11:43 Friday.   |
| Task 11541 | Status unknown. Prepare Demand running on grid2x2.         | Started at 01:16 Saturday. |
| Task 11540 | Status unknown. Prepare Demand running on austinmopac.     | Started at 01:15 Saturday. |
| Task 11539 | Status unknown. Manage Data running on austinmopac.        | Started at 01:15 Saturday. |
| Task 11538 | Status unknown. Prepare Demand running on austinmopac.     | Started at 01:04 Saturday. |
| Task 11537 | Status unknown. Manage Data running on austinmopac.        | Started at 01:04 Saturday. |

# Quality Control of Inputs Viztool

## Exercise 2.2

### Use the Visualization Tool (Viztool) to Check Model Inputs

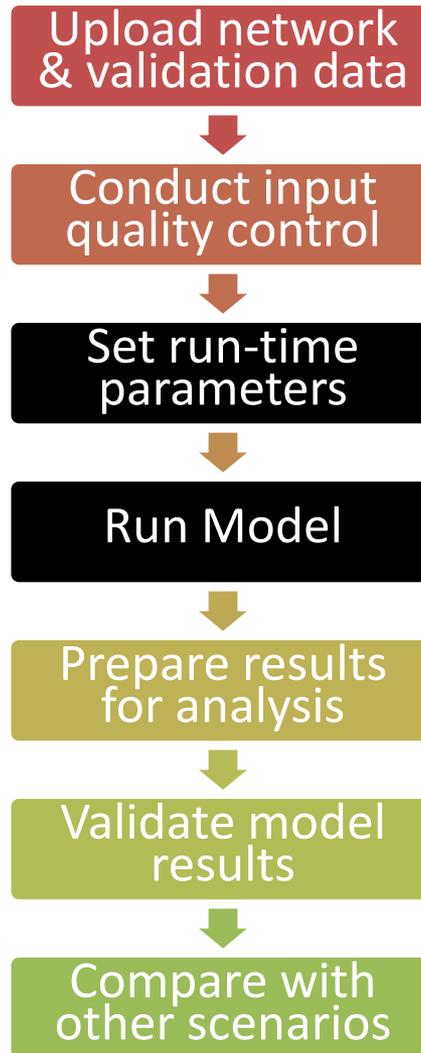
1. Export data to the Viztool using the VISTA module
2. Use Network Data visualization capabilities
3. Look at the network data and identify potential errors



See Cheat Sheet 4

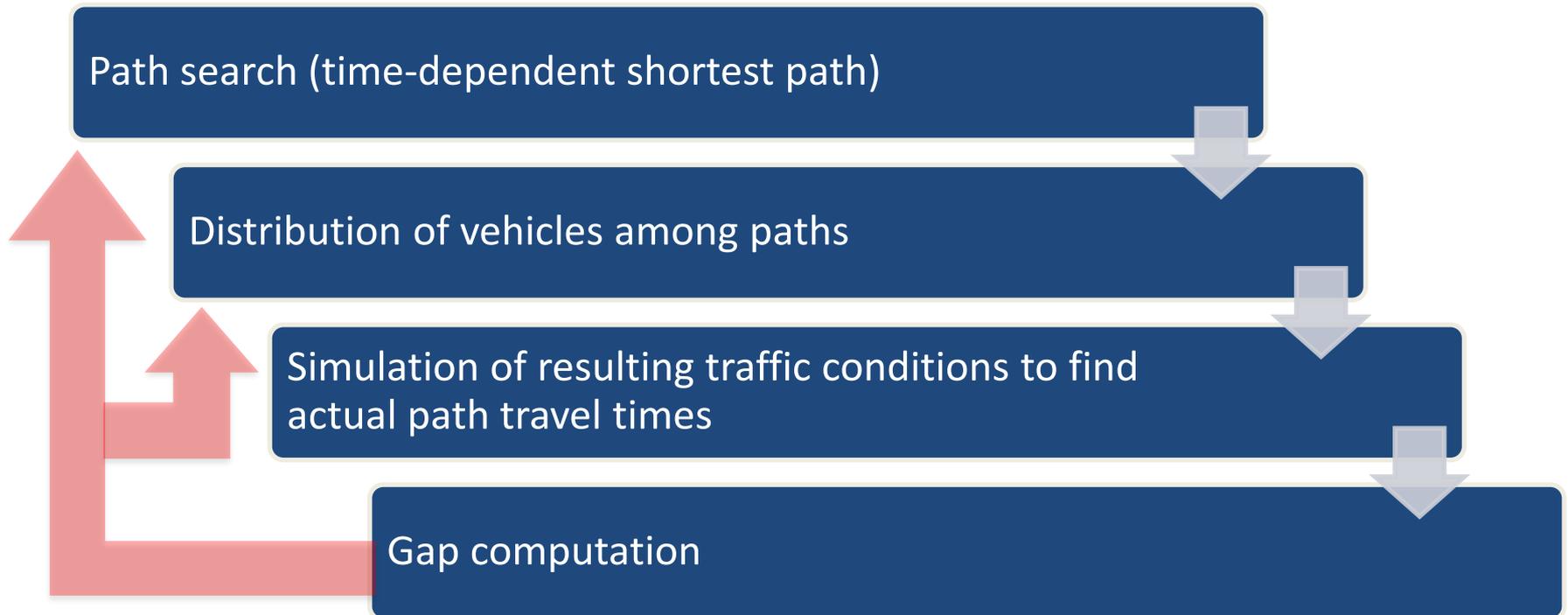


# Module 3: DTA Model Run



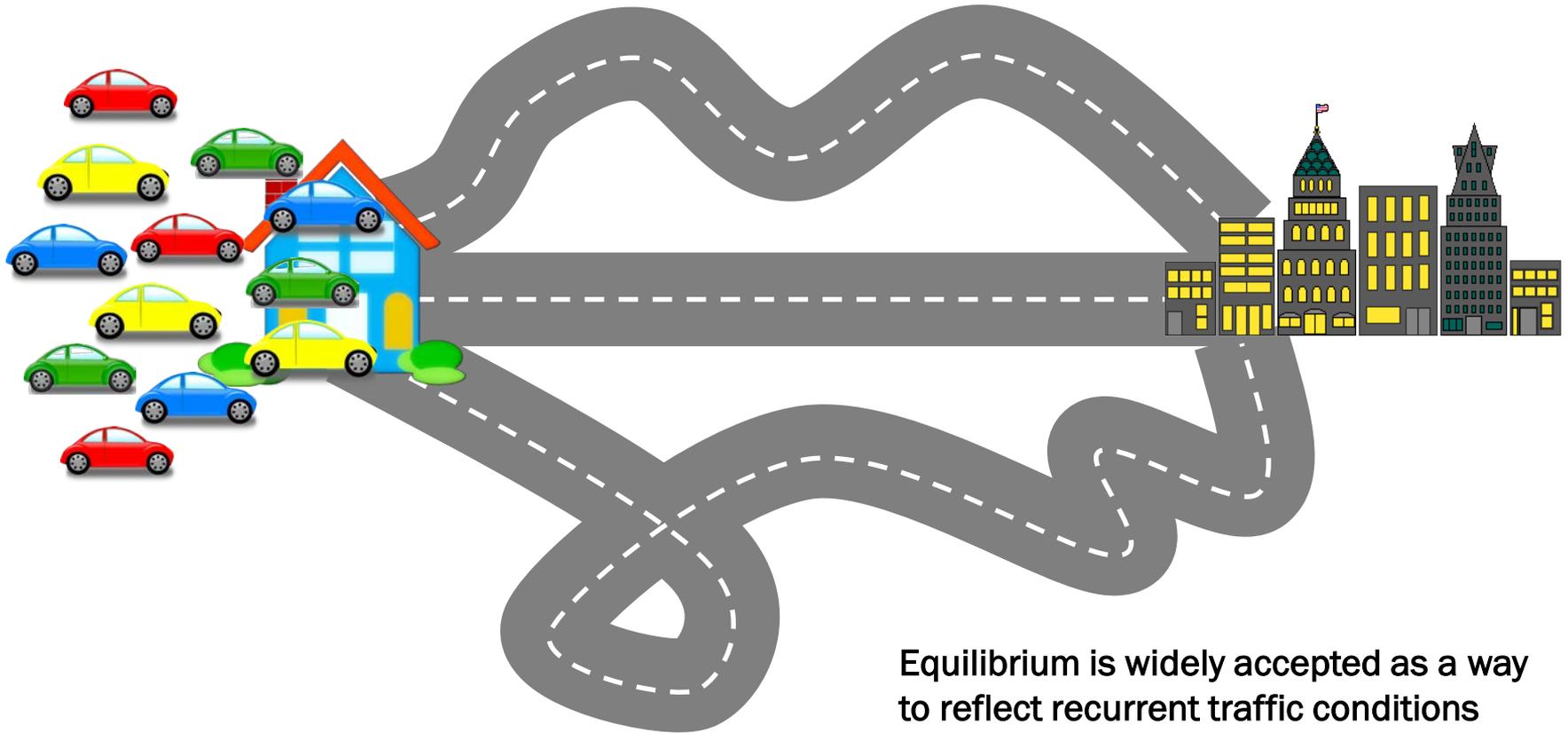
# Run the Model: Find Equilibrium Solution

Equilibrium is attained by repeating a series of steps  
(also called an iterative process)



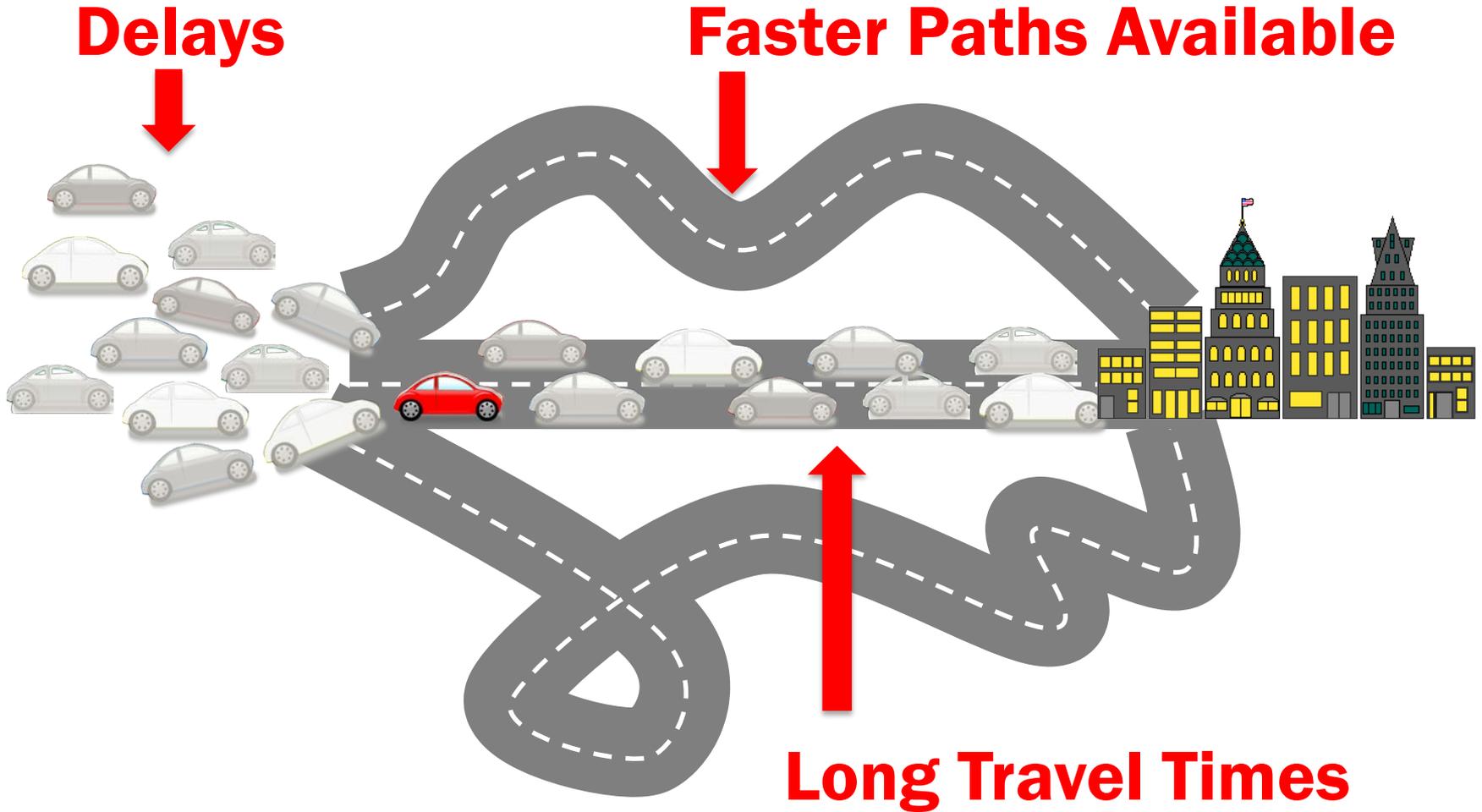
# Equilibrium

Running DTA means finding Dynamic Traffic Equilibrium for a given travel demand & traffic network



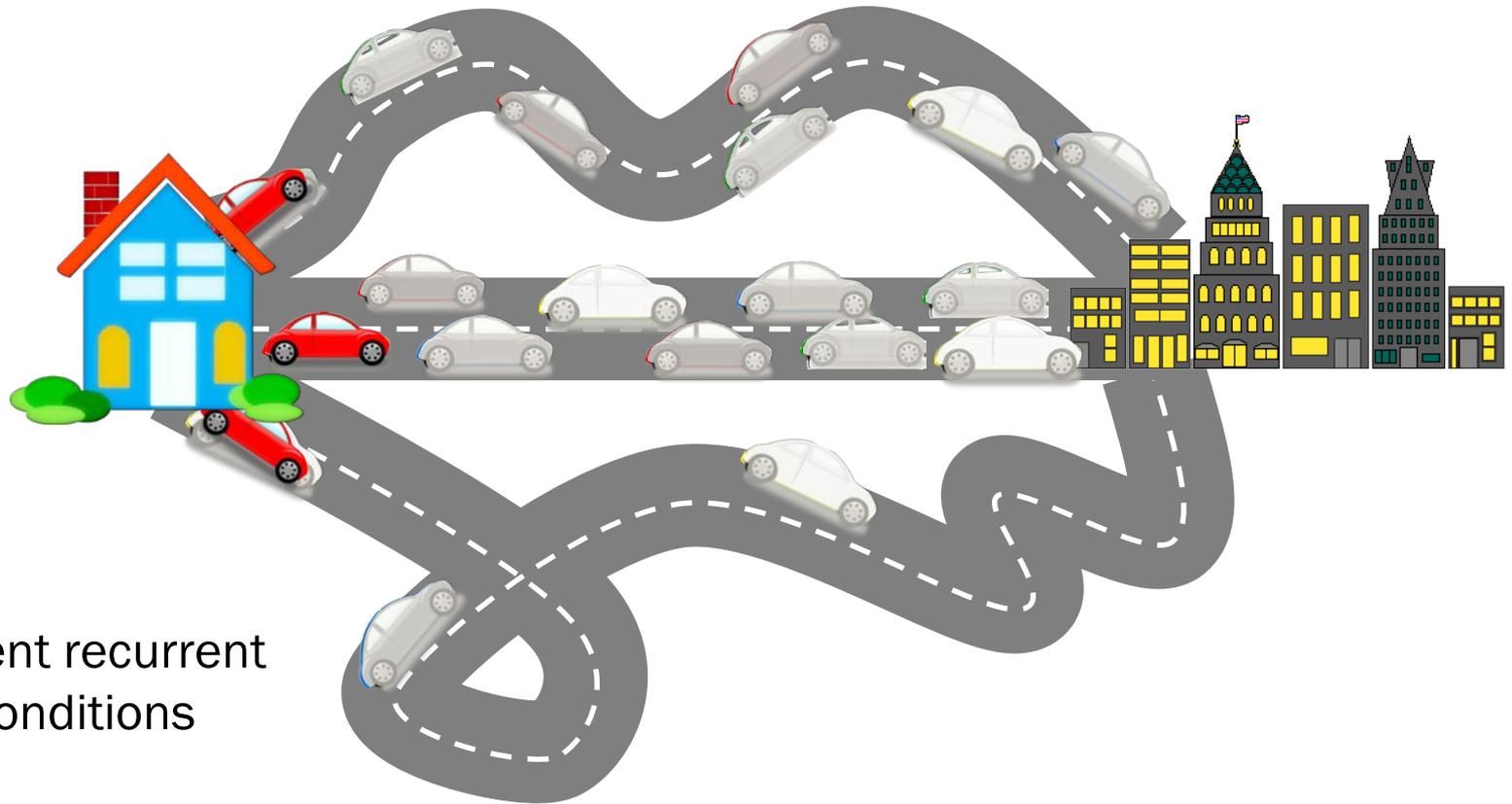
Equilibrium is widely accepted as a way to reflect recurrent traffic conditions

# Non-Equilibrium Solution



# Equilibrium Solution

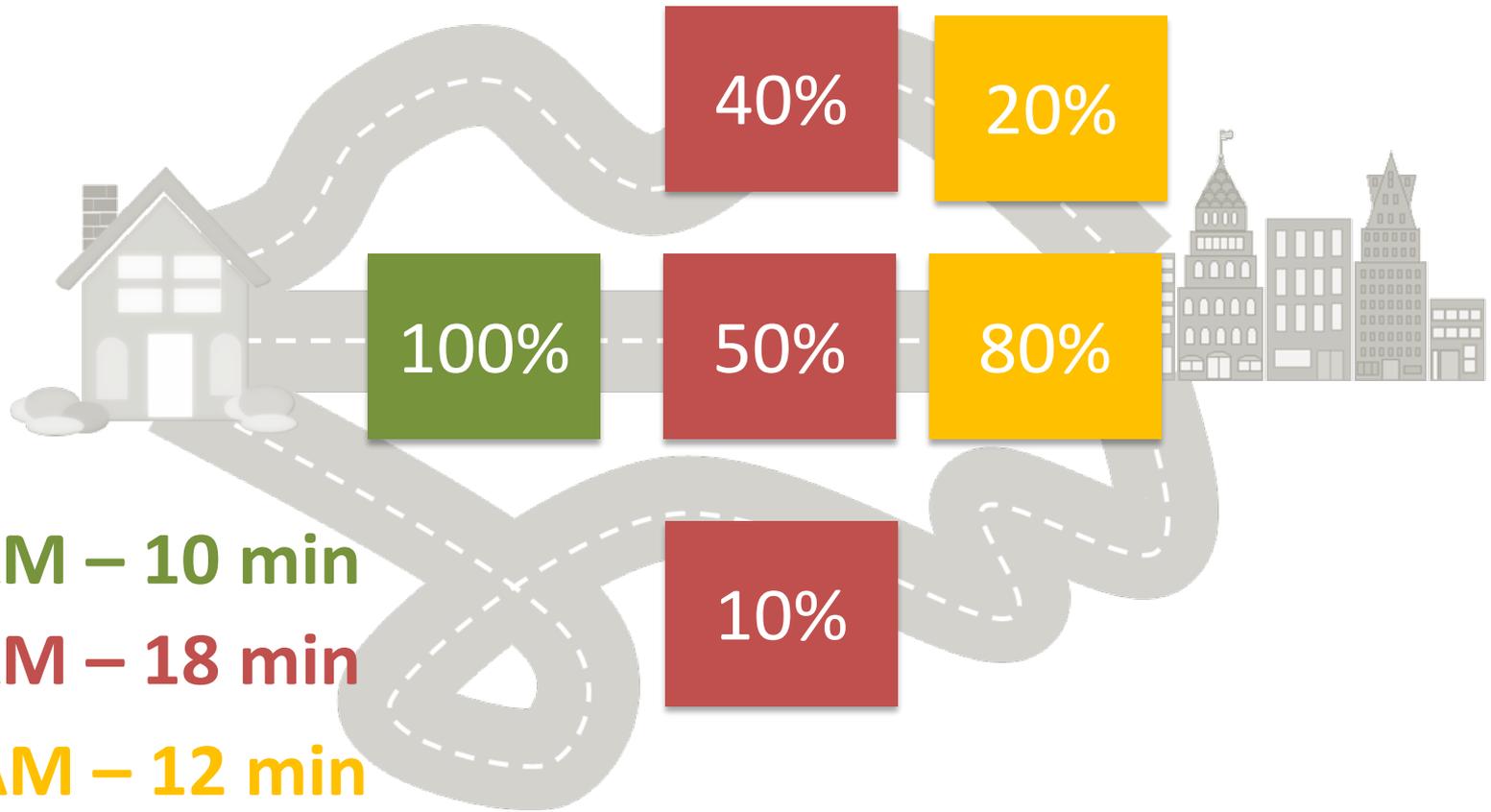
All used paths have equal and minimum travel time



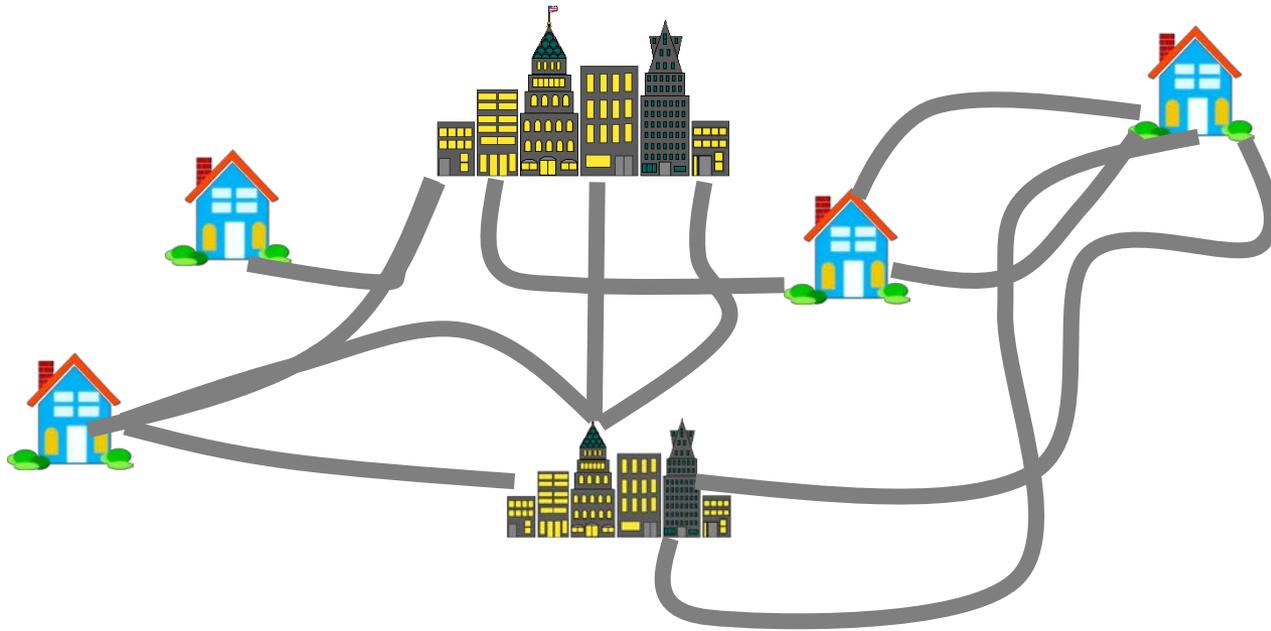
- Represent recurrent traffic conditions
- Stable
- Allow for meaningful comparisons

# Dynamic Traffic Equilibrium

## Different Equilibrium Strategy per Time Period

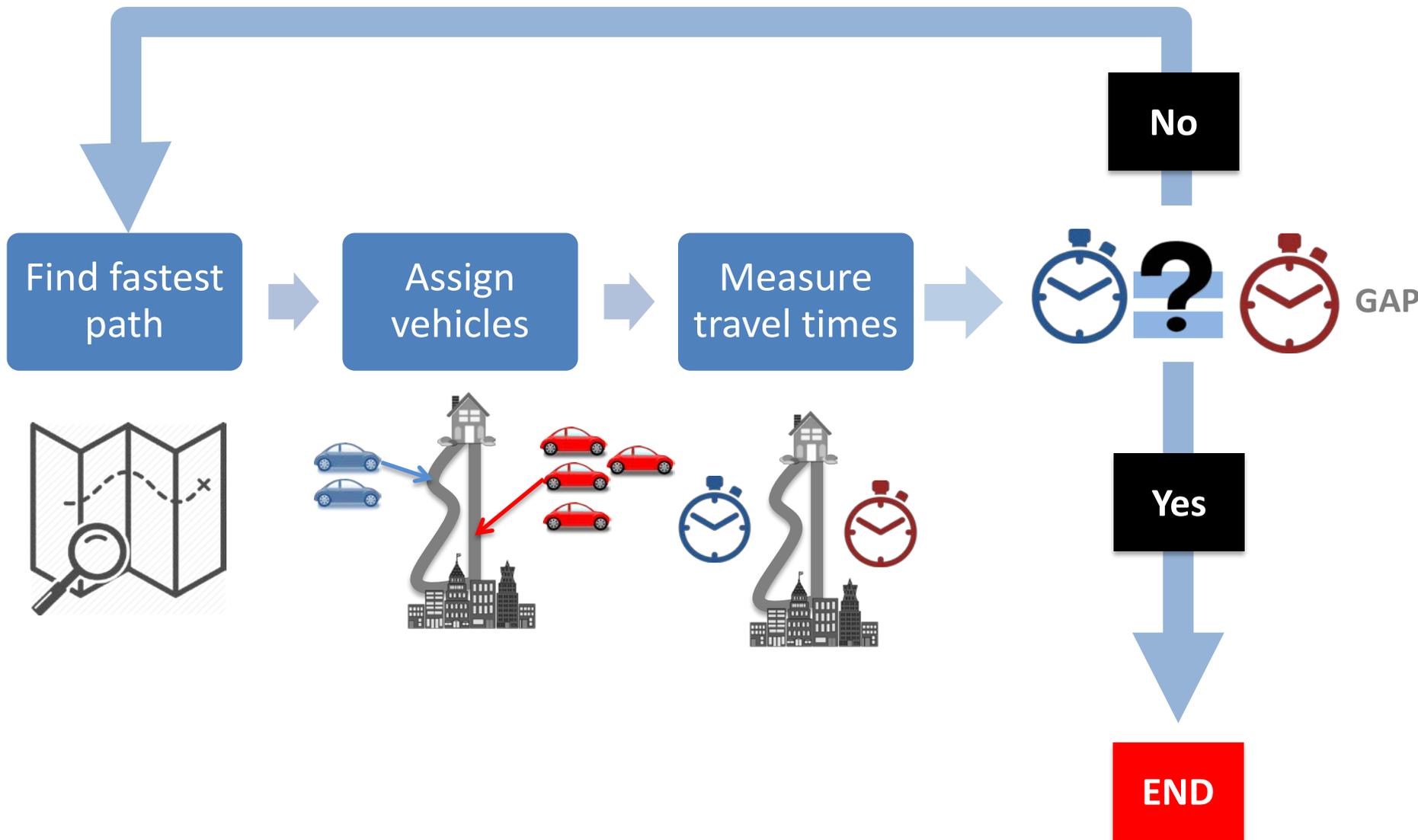


# Methodology



Finding an Equilibrium Solution in a real network  
is a complex and iterative process

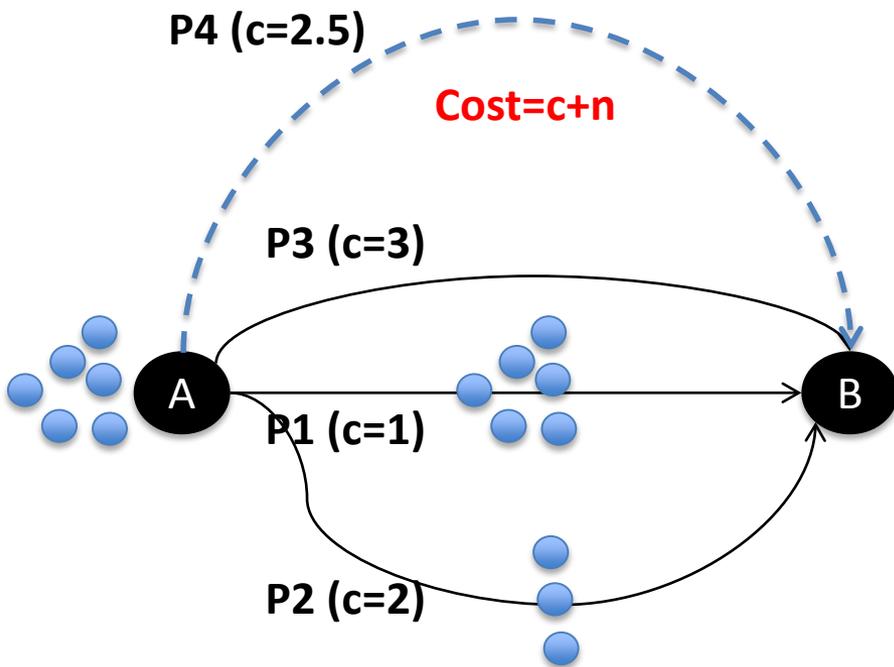
# DTA Iterations



# MSA: An Iterative Process

## Method of Successive Averages

- Proved to find an equilibrium solution in Static Traffic Assignment



| Iter . # | Path Cost                                 | Assign Veh. | New Cost                                  | Rel. Gap   |
|----------|---|-------------|---|--|
| 1        | <b>P1:1</b><br>P2:2<br>P3:3               | 6<br>0<br>0 | <b>P:7</b><br>P2:2<br>P3:3                | 0  |
| 2        | <b>P1:7</b><br><b>P2:2</b><br>P3:3        | 3<br>3<br>0 | <b>P1:6</b><br><b>P2:5</b><br>P3:3        | $\frac{3 \times (6 - 5)}{3 \times 6 + 3 \times 5}$     |
| 3        | <b>P1:6</b><br><b>P2:5</b><br><b>P3:3</b> | 2<br>2<br>2 | <b>P1:3</b><br><b>P2:4</b><br><b>P3:5</b> | $\frac{2 \times 1 + 2 \times 2}{2 \times (3 + 4 + 5)}$ |

True Gap?



# Non-exiting Vehicles & Partial Demand Loading

## MSA behaves well in DTA, however:

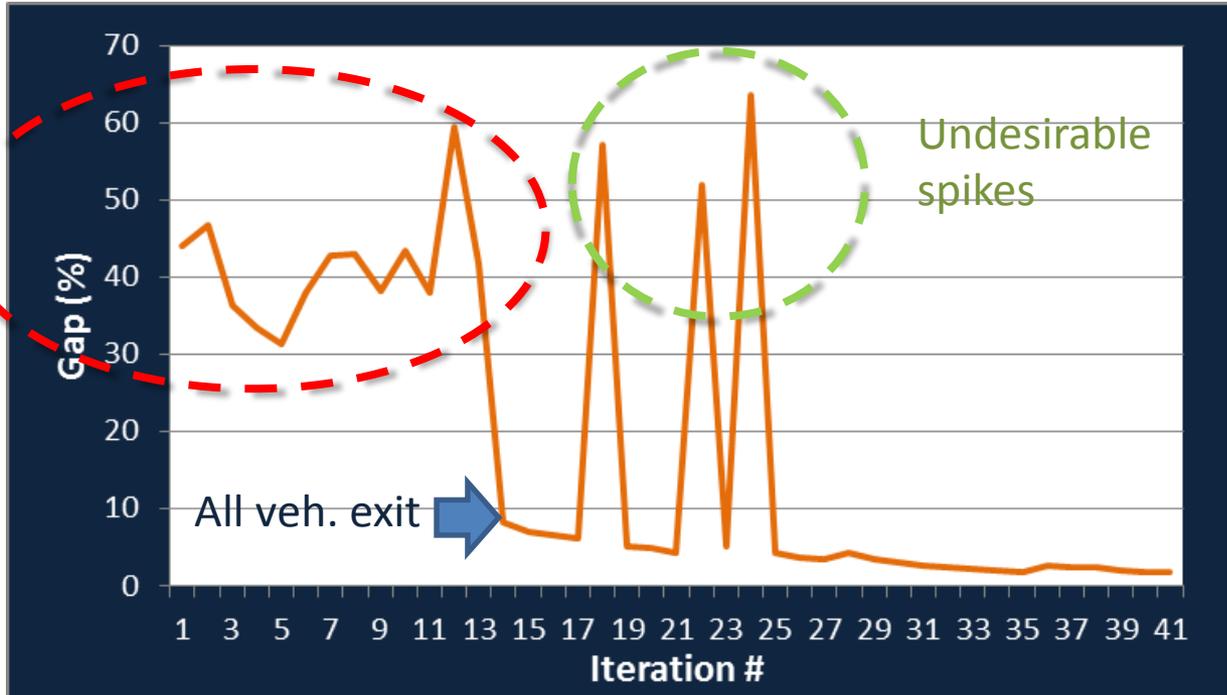
- Congestion may be excessive at initial iterations
- Gap may peak at later iterations
- Slow convergence

Partial Demand Loading

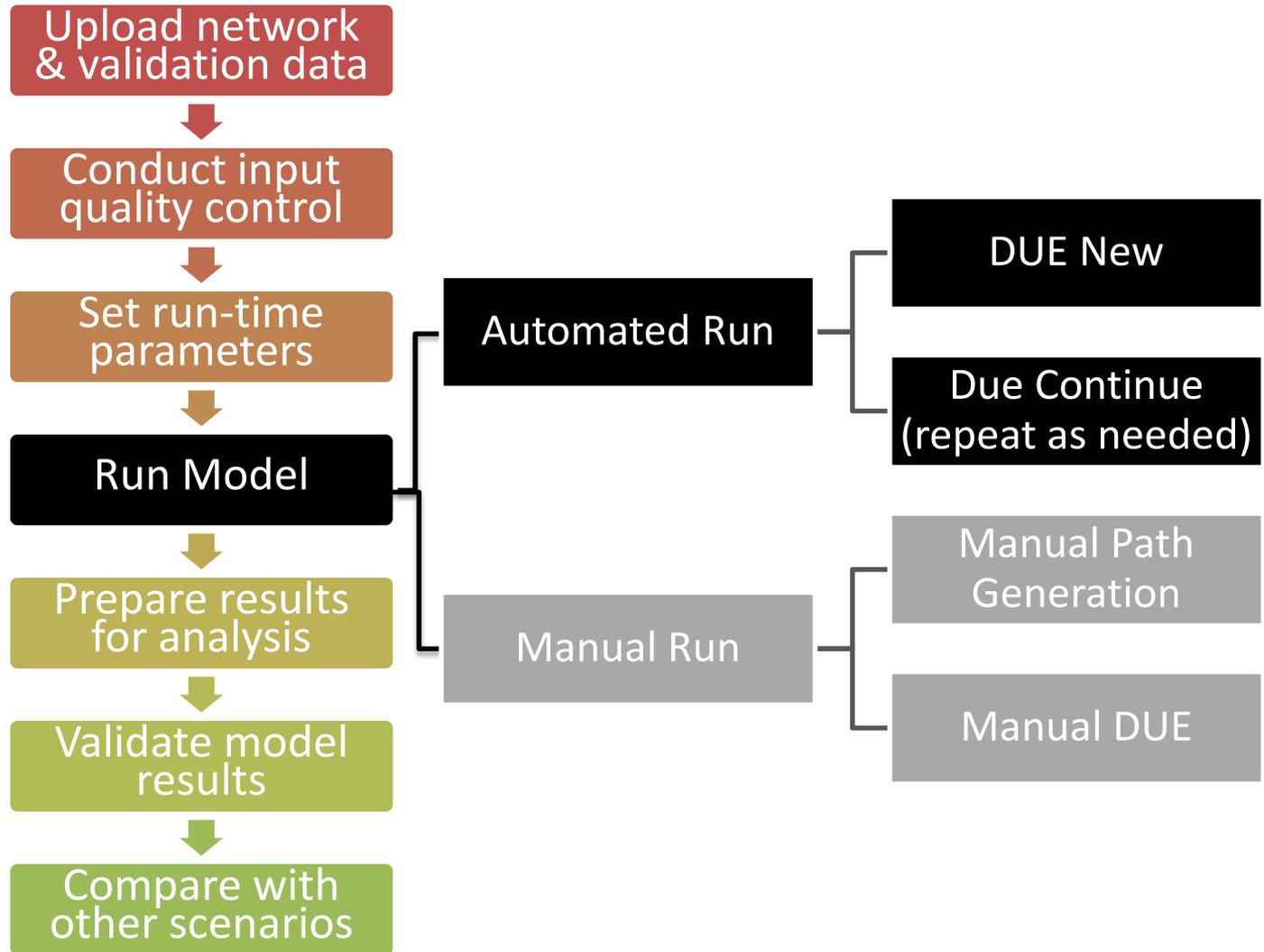
Options to prevent Gap increase

Manual assignment/Advanced method

Normal ups and downs



# DTA Model Run



# Built-in Procedures for DTA

## Simulation

- Estimate time-dependent traffic conditions for a given assignment of vehicles to paths

## Path Generation

- Find a time-dependent shortest path for each origin-destination pair and assignment period
- Shift a pre-defined fraction of OD demand to the new shortest path

## Manual DUE

- Balance vehicles among existing paths by testing several values of LAMBDA and choosing the one that reduces the gap the most.
- LAMBDA is the fraction of vehicles shifted to the current shortest path

## DUE New/DUE Continue

- Run iterative process (MSA) starting from scratch or continuing from previous iteration

## Typical Model Run

### DUE New + DUE Continue

- Process takes between 15 minutes and 48 hours depending on the input data
- DUE Continue is necessary when the gap value remains high after running DUE New

### Start by adjusting run-time parameters

- “Options” Tab in web interface



# Run-time Parameters

Cheat Sheet 10

## Assignment & Routing

- For advanced users performing manual runs

## Outputs

- For debugging and research, uncheck all boxes to avoid slow downs

## Simulation

- Duration (secs)
- Mesoscopic Step
- Mesoscopic Delta

# DUE New

1. Specify number of iterations
2. Gap increase: it will revert iterations in which the gap increases. Not recommended in the initial run
3. Seeding random numbers: guarantee identical results if the run is repeated
4. Partial demand loading: avoid over-congested conditions in the initial iterations. Recommended 3-7.
5. Warm start iterations: used if results from previous model runs are available (networks must be identical).
6. Report: for debugging and research. Do NOT use unless required (large outputs slow down process)
7. Non-exiting threshold: reverts an iteration if the number of non-exiting vehicles increases. Not recommended in the initial run.

### DUE - New

Set the options below for this task. Fields in **bold** are required. Default values have been provided.

**Network:**  ▼  
The module will be run on this network.

**Options**

Run to total iteration #

Prevent gap increase

Seed random number generator

Partial Demand Loading iterations

Warm start iteration (0 for none)

Route report CSV

Nonexiting incr. thresh. (0: off)

DUE new to 20 iterations with 5 partial demand loading iterations

**Notes:**  
You may enter any notes you wish you to make about this run. These notes will be visible in the network history.

# DUE Continue

1. Specify TOTAL number of iterations (including previous runs)
2. Equilibrate: continue path search (if checked) or use exiting paths only
3. Gap increase (As above)
4. Route report (As before)
5. Non-exiting (As before)

### DUE - Continue

Set the options below for this task. Fields in **bold** are required. Default values have been set.

**Network:**  ▼  
The module will be run on this network.

#### Options

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| Run to total iteration #          | <input type="text" value="5"/>      |
| Equilibrate                       | <input type="checkbox"/>            |
| Prevent gap increase              | <input type="checkbox"/>            |
| Seed random number generator      | <input checked="" type="checkbox"/> |
| Route report CSV                  | <input type="checkbox"/>            |
| Nonexiting incr. thresh. (0: off) | <input type="text" value="0"/>      |

Notes:

# Run a Model in Vista

## Exercise 3.1

### Run a model in VISTA

1. Copy the network `guad_base_am`
2. Create a new scenario model by editing the network
3. Set runtime model parameters
4. Start the model run with the VISTA DUE - New module

See Cheat Sheet 7

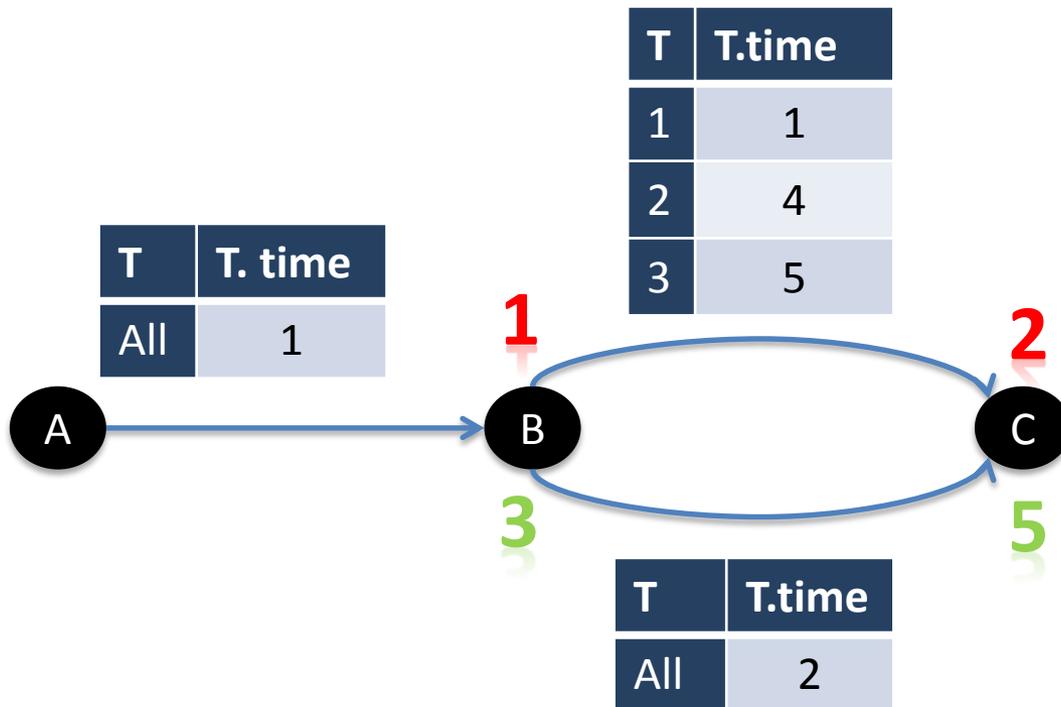
# Path Search Algorithm

## Time-dependent shortest path

- Time-dependent link cost
- Travel time depends on arrival time -> may select different paths at different times

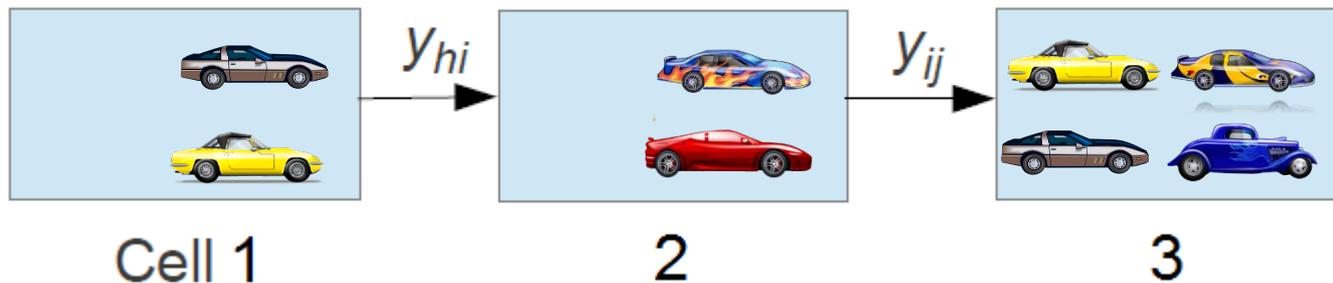


2



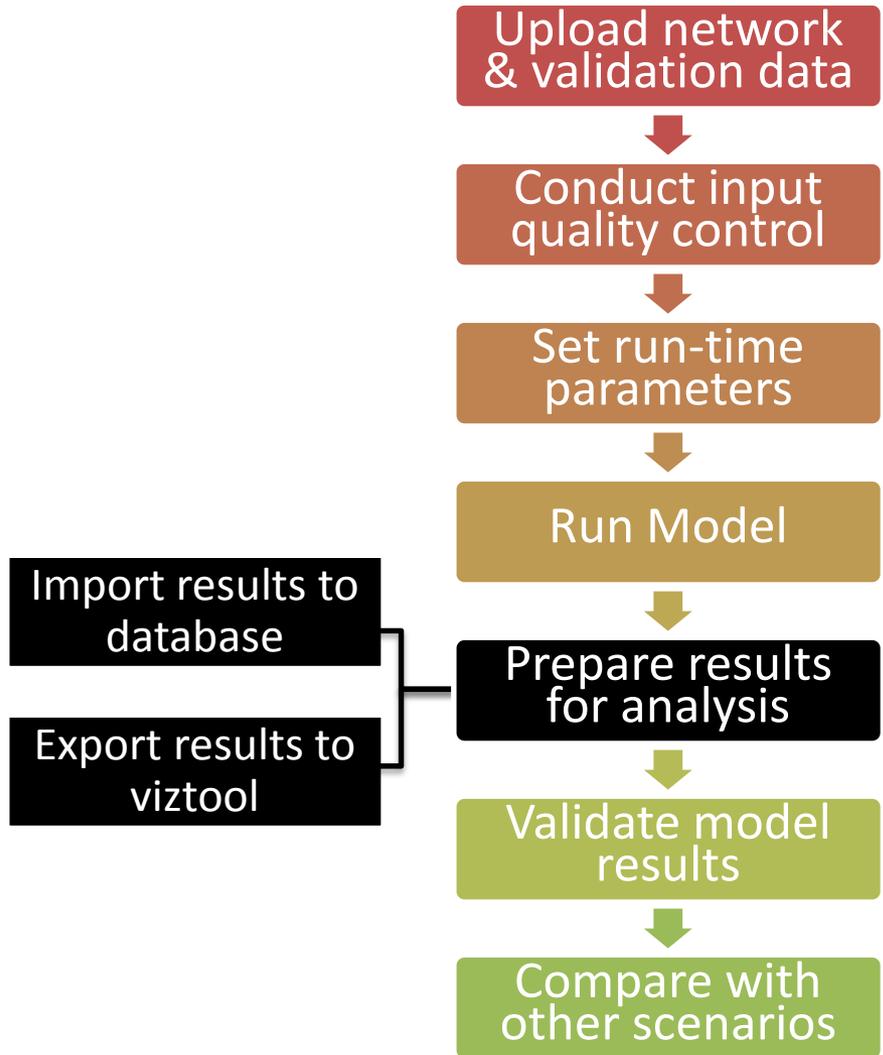
## More About Simulation

- A primary component of DTA is a flow model
- VISTA implements the cell-transmission model
- The cell-transmission model is based on concepts related to water flow
- Involves dividing links into equal-length cells





# Module 4: DTA Model Results Analysis



# Module 4: DTA Model Results Analysis

## Overview

- Overview of DTA model results
- Results Analysis Workflow
- DTA results in database
- Types of results analysis
  - model validation
  - scenario analysis

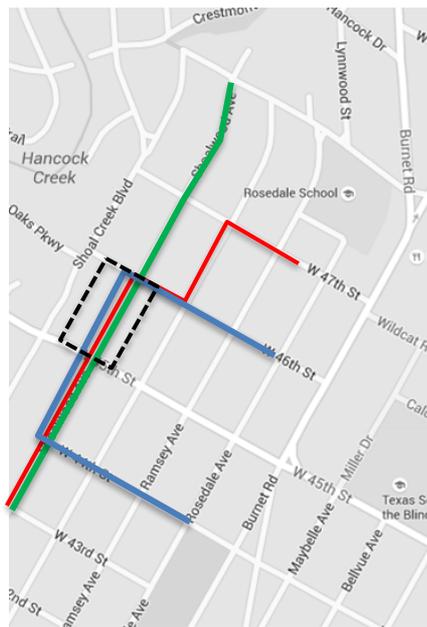
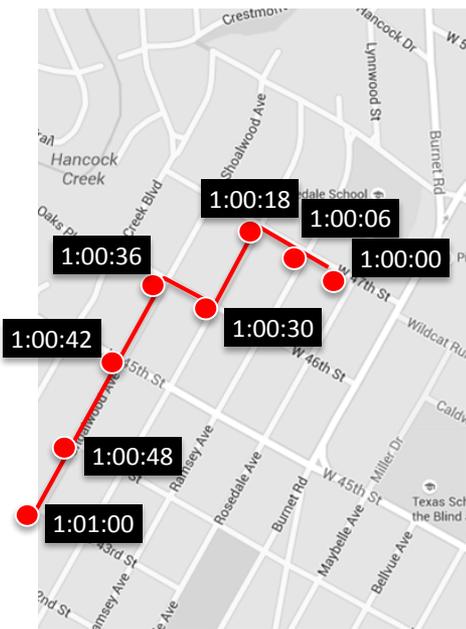
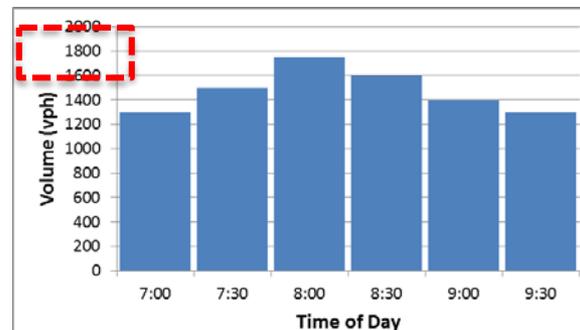
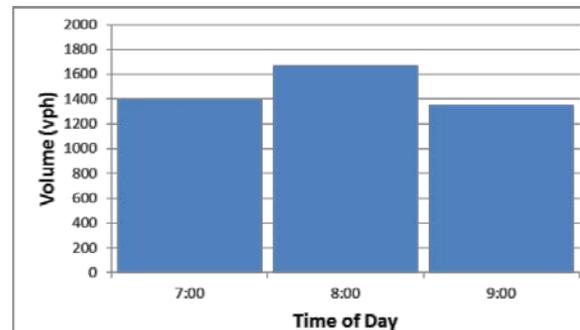
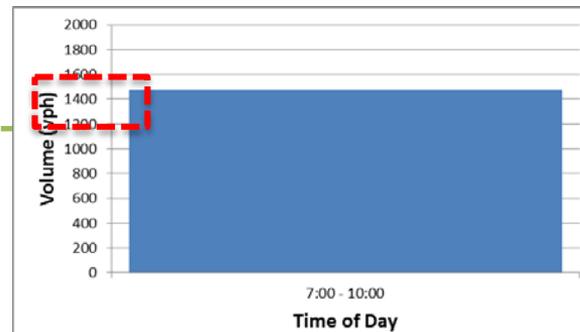
# DTA Model Results

## Raw Results

- Individual vehicles trajectories

## Aggregation for analysis

- Space
- Time



# Results Analysis Workflow

## Model produces multiple files

- All files live in network-specific folders in the same server where the model runs

## Files are imported into database tables for analysis using queries and charts

- Module “Import Results”

## Files are exported to a different database for analysis in Viztool

- Module “Visualization Export”

# Model Output Files

- Text files
    - sim.vat (trajectories)
    - Vehicle.xx (assignment)
  - Binary Files
    - Paths
- Link travel times & flows
  - Movement travel times and flows

**Sim.vat**

```

2 18163 1.000 3.00
2 126178 1.00 306178 3.00
1 50779 7.000 9.000
2 126178 7.00 306178 9.00
1 52147 11.000 12.000
2 126178 11.00 306178 12.00
1 106273 14.000 15.000
2 406178 14.00 226178 15.00
2 16273 1.000 18.000
3 125573 1.00 117735 9.00 304900 18.00
1 39547 12.000 21.000
3 125573 12.00 117735 12.00 304900 21.00
1 52237 20.000 21.000
2 126178 20.00 306178 21.00
1 52273 21.000 21.000
2 126178 21.00 306178 21.00
1 39583 18.000 24.000
3 125573 18.00 117735 18.00 304900 24.00
1 50887 23.000 24.000
2 126178 23.00 306178 24.00
1 120655 20.000 27.000
3 204900 20.00 17735 21.00 225573 27.00
1 120763 24.000 30.000
          
```

**Vehicle.xx**

```

1990 1 5711
3142 1 5435 4561
4006 1 5745 93979
4330 1 5915 9647
1000 1 5000 25515
          317628
          120232
          12893
          32050
          21924
          163437
          3567
          177494
          6685
          3242
          3242
          3242
          3242
          3242
          3242
          3242
          
```

- Can be converted to .csv
- One row per simulation step
- One column per link/movement

# Results in Database Tables

## Vehicle Path

- One row per path
- Column with sequence of links

## Vehicle Path Time

- One row per vehicle
- Column with sequence of arrival times to each link on path
- Additional columns with path IDs, simulation departure time and arrival time

# Types of Results Analysis

## Model Validation

- For present-year models: compare model results to field data to detect errors

## Scenario analysis and comparison

- Detailed analysis of model results to describe/explain current or future year scenarios

## Before any analysis

- Check output of last run
  - Are all vehicles exiting? Is the gap acceptable?
- Check high-level output analyses
  - Are average travel times reasonable? (Query or Report?)

# Results Analysis Tools

DTA At-A-Glance 5



**Reports**



**GIS Editor**



**Visualization tool**



**Database queries**

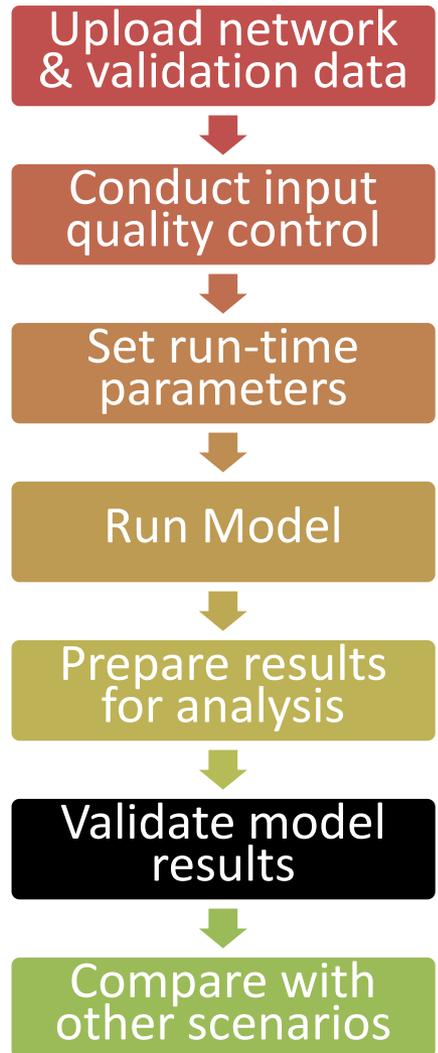


**Direct analysis of output files**





# Module 5: Validate Model Results



## Module 5: Validate Model Results

### Overview

- Validation of model results
- Typical causes of differences between model and data
- Validation tools
  - Interactive reports
  - Queries

# Validate Model Results

Goal: Compare model outputs to field data

- Usually done for present-year models (or near future)

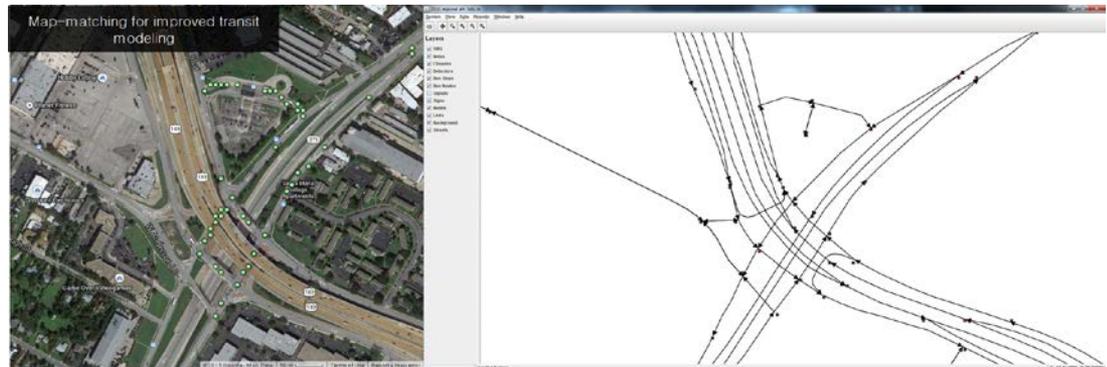
Typical field data

- Corridor Travel Times (Ttime\_data,ttime\_group)
- Link Counts (link\_volume\_data,link\_group)
- Turning movement data (used less frequently)

# Considerations

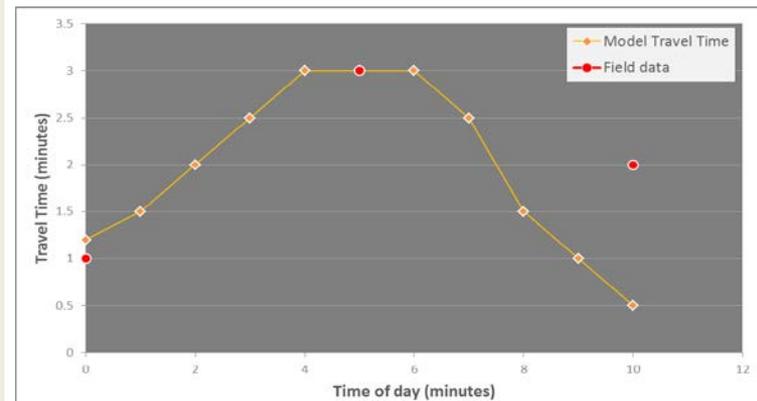
## Data processing

- Requires mapping of data to network elements & data aggregation. Manual processing may be tedious, working on automated procedures.



## Deciding what to compare

- Select **temporal aggregation** to compare model results to field data
  - Options: Entire simulation period, hourly results, or smaller intervals
  - Model results may be noisy at time intervals of less than 15 minutes
- **Comparing only averages may be misleading**
  - Field and model data may vary within the selected period
  - Visualization can support the selection of appropriate intervals and metrics





# Typical Causes of Differences Between Model and Field Data

Cheat Sheet 9

Error in network model inputs

Placement of centroid connectors

Congestion

Travel demand matrix

Error in data

# Validation Reports

Interactive reports will be generated using a Module in the Web Portal

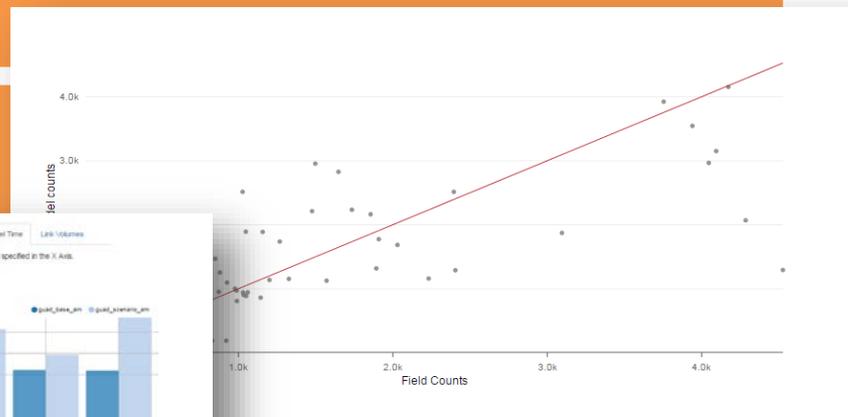
Validation reports will be HTML files that can be opened by any browser.

- Data stored in your computer and is static (a snapshot of the database)

Reports include maps/charts for quick analysis and tables that users can copy and paste for custom analysis

Validation reports

- Link counts
- Corridor travel times

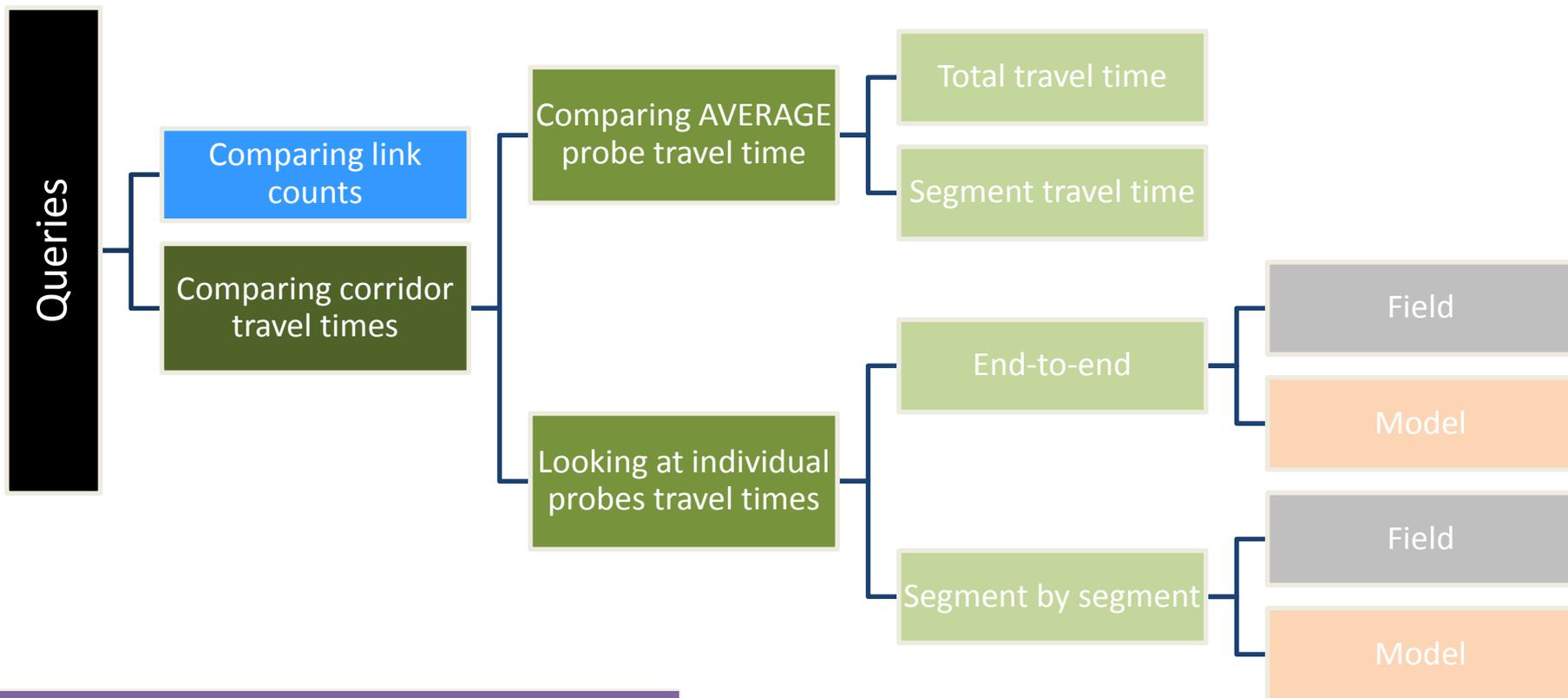


# Validate model results using reports and database queries

## Exercise 5.1

1. Open HTML reports and assess model performance
2. Try database queries from the web portal

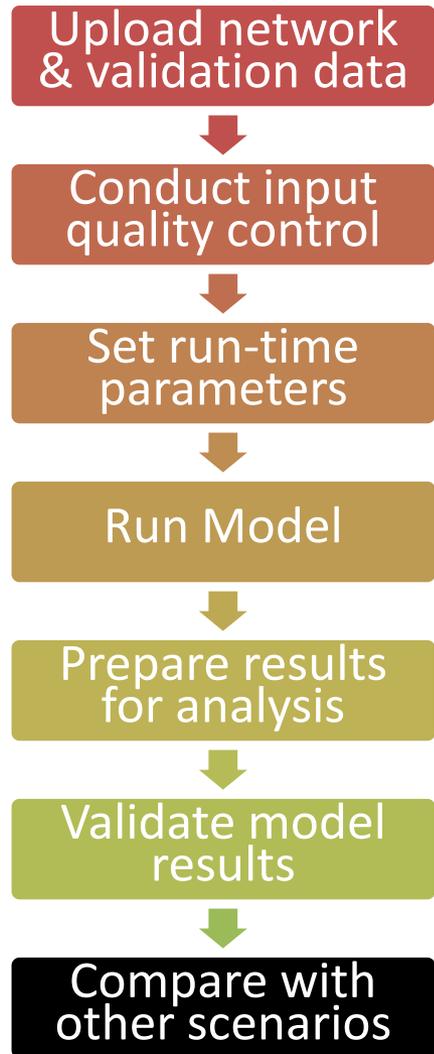
# VISTA Queries



See Cheat Sheet 11



# Module 6: Analyze and Compare Scenarios



# Module 6: Analyze and Compare Scenarios

## Overview

- Typical steps in model result analysis
- High-level results analyses and scenario comparisons
- Detailed results analyses and comparisons

## DTA Results Analysis

### System-level and average performance

- Important to understand model performance beyond the area where large impacts are expected

### Detailed analysis to interpret system-level trends

- Typically focused on areas where changes are expected
- Intersections, corridors, roadway segments
- Origins and destinations

# System-Level Analysis

## Reports

- Summary of aggregate performance metrics
- Travel times from/to TAZs & differences (if more than two scenarios are compared, difference is with respect to the first scenario)
- Frequency distribution of travel time, distance and speeds in all scenarios
- Corridor travel times for pre-programmed corridors (bus\_route\_link, bus\_route, bus\_frequency, bus\_period)
- Link volumes for pre-programmed links (links\_for\_analysis, link\_group)

## Network-wide vehicle volumes

- **GIS Editor**
  - Quick approach, less flexibility for visuals
- **Visualization Tool**
  - More flexible visuals
  - Can visualize differences across scenarios

## Delay at signalized intersections

- **Visualization tool**

# Detailed Metrics in Viztool

## Select link analysis

- Identify the paths of all vehicles using a particular roadway segment (link)

## Origin-Destination path analysis

- Identify all used paths connecting selected origins and destinations

## Reach time

- Identify how far vehicles can travel from selected origins within pre-specified time intervals

# Compare Scenarios

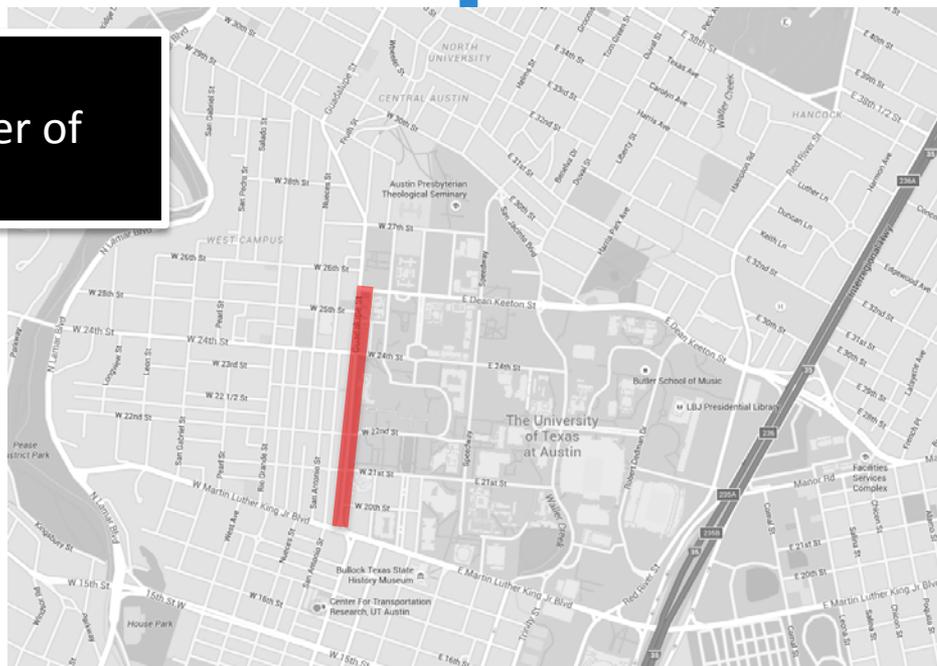
## Exercise 6.1

1. Discussion of scenario modeled in network “guad\_scenario\_am”
2. Open HTML reports for high-level scenario comparison
3. Use visualization tool for network-level comparisons
4. Use visualization tool for detailed results analysis
5. Analyze your own scenario

# Scenario Description

## Scenario

Reduction in the number of lanes on Guadalupe St.



What questions would YOU like to answer with DTA?

What happens with travel times and flows on Guadalupe?

What are the most affected corridors

Which travelers are affected the most

Any signal seems to be a problem?

Impacts constant over time?

What's the system-level impact?

# High-level Analysis

## Any significant difference in the summary statistics?

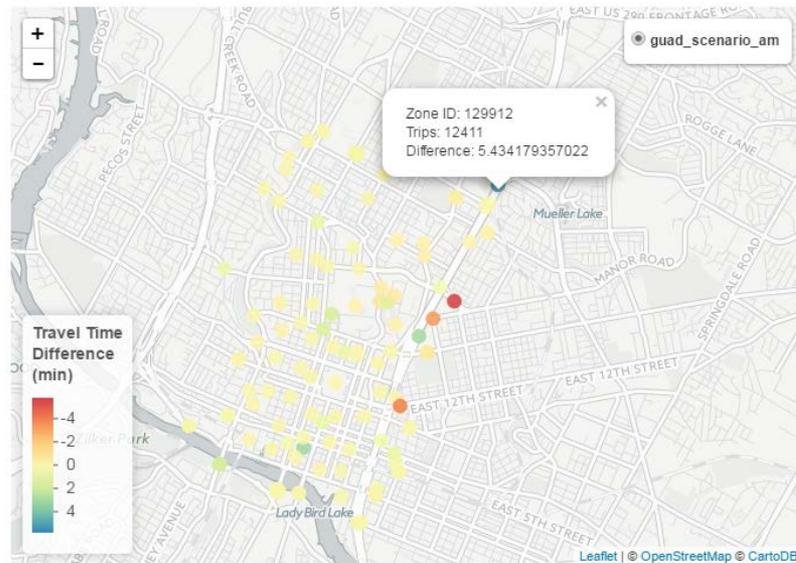
- Higher total system travel time in the scenario, along with lower vehicle-miles-traveled. Why?
  - Possibly vehicles are forced to take shorter, more congested paths

| scenario         | type | title | count  | zero_length | tstt  | vmt    | ttime_m | speed_mph | distance_m |
|------------------|------|-------|--------|-------------|-------|--------|---------|-----------|------------|
| guad_base_am     | 1    | Car   | 174825 | 2761        | 58595 | 254675 | 20      | 13.2      | 1.5        |
| guad_scenario_am | 1    | Car   | 174825 | 2761        | 59123 | 253614 | 20      | 13.2      | 1.5        |

Showing 1 to 2 of 10 entries

## Travel time differences

- Small changes, in general
- There are “winners” and “losers”
- Notice large change for node 129912

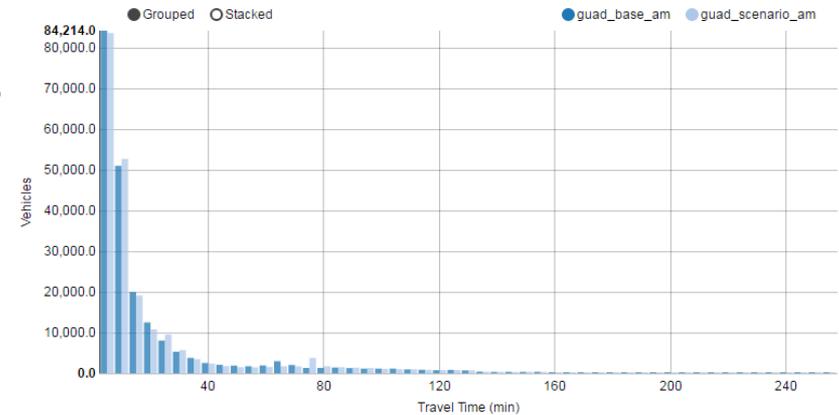


# High-level Analysis

Travel Time

## Frequency distributions

- A few less trips with travel times <5 minutes in the scenario.
- Similar pattern if we look at speeds

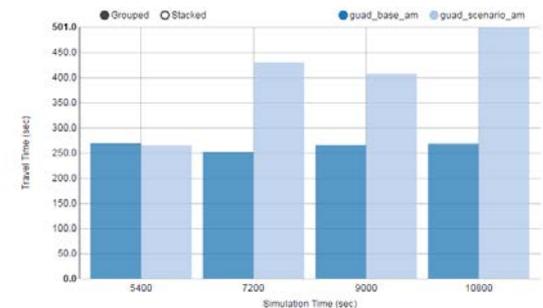


## Corridor travel time

- Guadalupe (both directions): Increase of travel time, mostly after the first time interval
- Lamar NB: DECREASE of travel time in the initial intervals, compensated by an increase during the last interval
- Red River SB: DECREASE in travel time. Identify link where differences are most noticeable for further analysis.

Average travel time data table view.

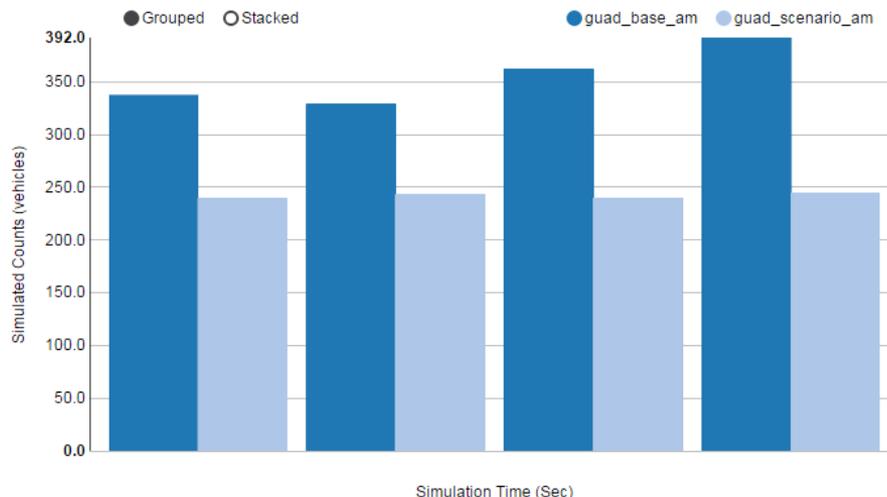
| name                         |
|------------------------------|
| SB Guad Drag Corridor        |
| <b>NB Guad Drag Corridor</b> |
| Lamar NB                     |
| Lamar SB                     |
| Rio NB                       |
| Red River NB                 |
| Red River SB                 |
| 1_Metric/South Congress S    |
| 1_Metric/South Congress N    |
| 10_South 1st/Red River SO *  |



# High-level Analysis

## Link Volume

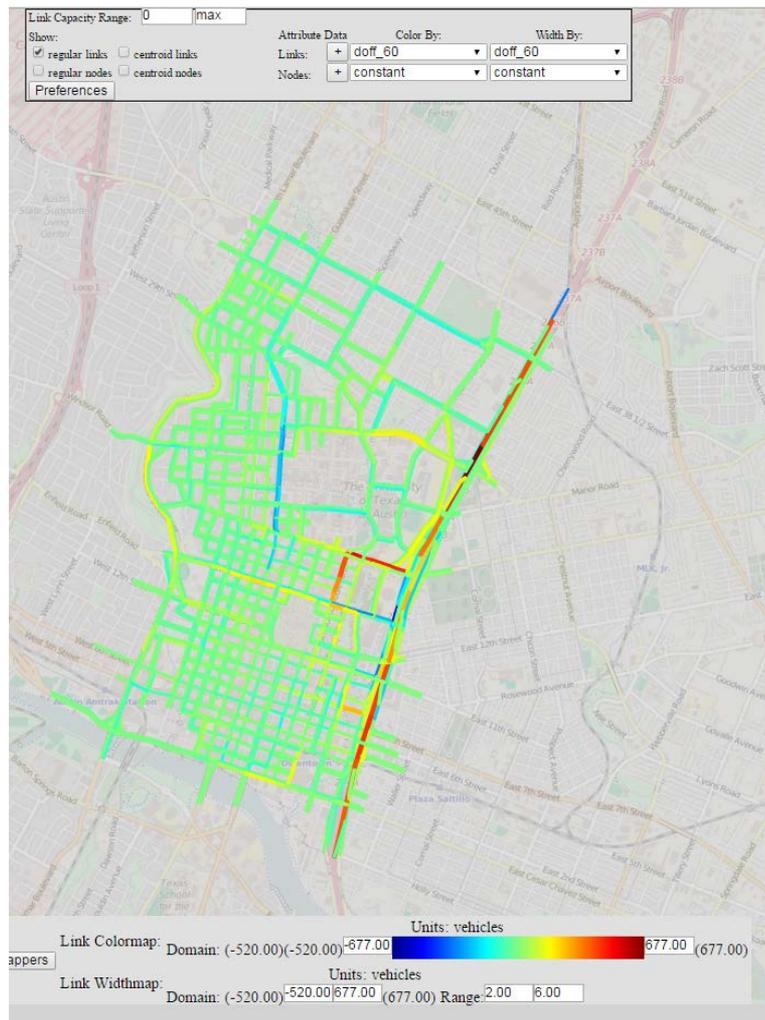
- Guadalupe: decrease in volume in both directions
- Lamar NB: minor changes, possible because the corridor is congested under current conditions
- Lamar SB: volume increase
- Rio Grande/Nueces: volume increase
- Red river NB: volume increase
- Red river SB: change in congestion pattern



# Results: Network-level

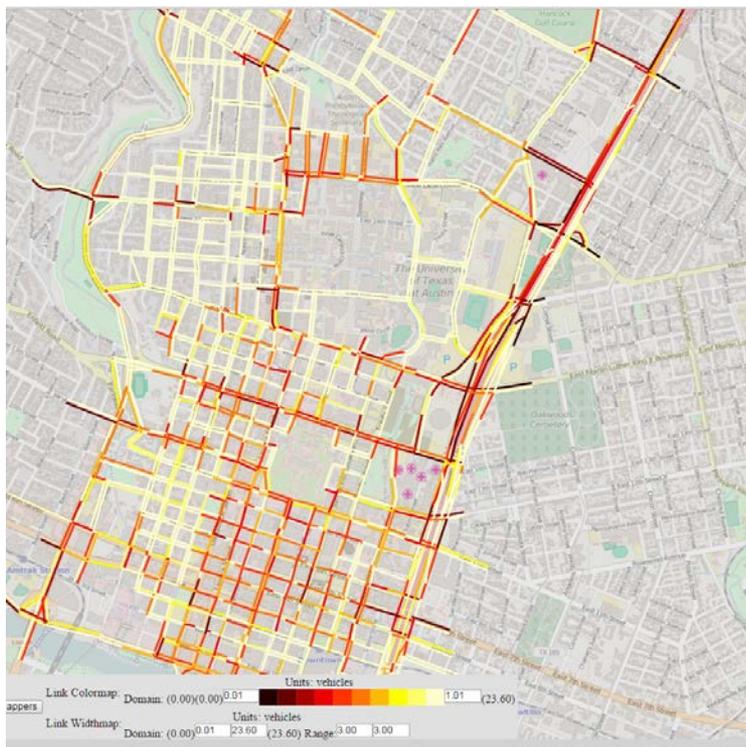
## Link volume difference

- Decrease in Guadalupe
- Increase in Lamar NB
- Impacts on MLK @ IH35
  - May be convergence

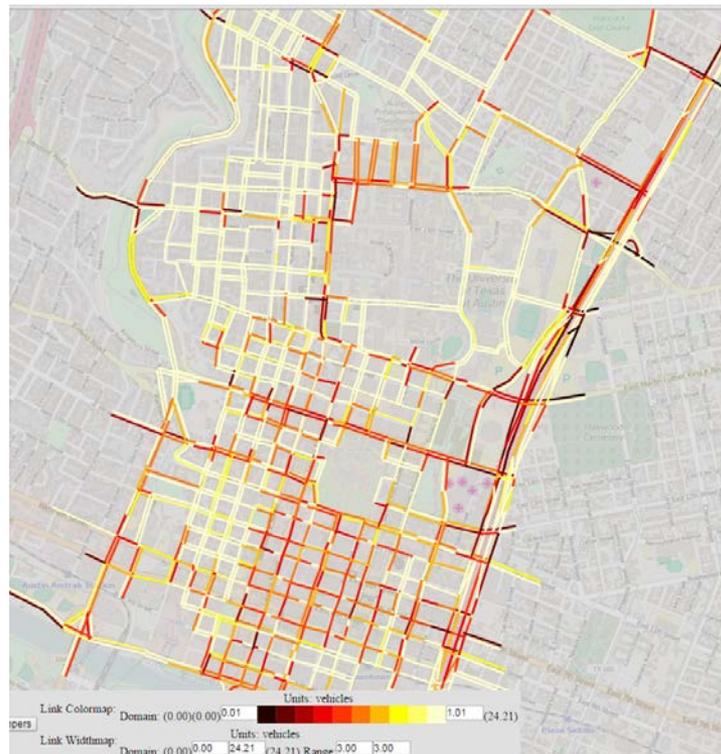


# Results: Network-level

## Link travel time (side-to-side)



Base

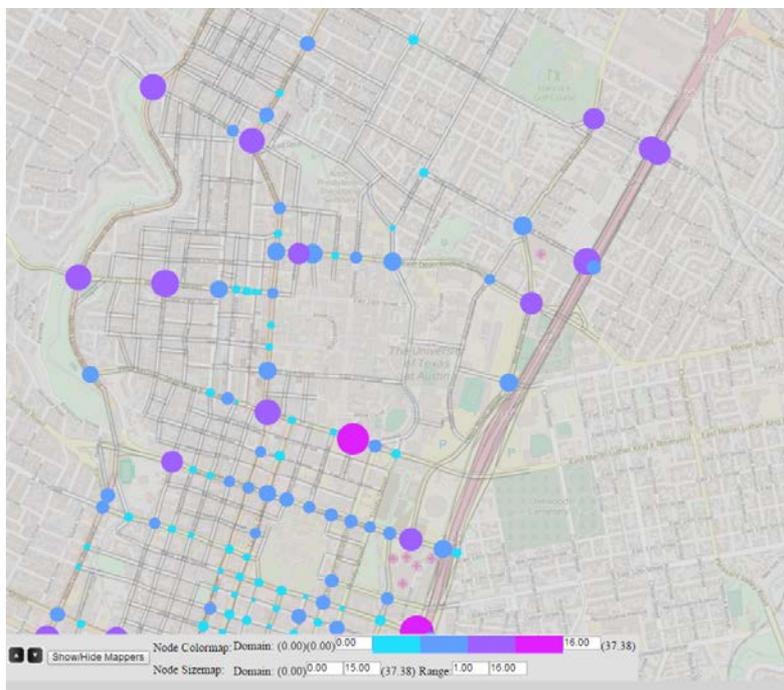


Scenario

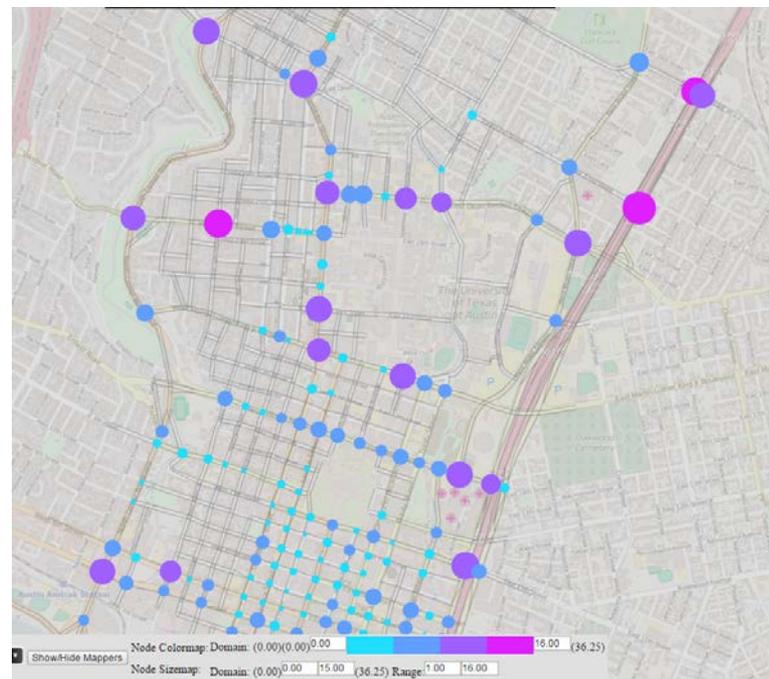
# Results: Network-level

## Intersection delay (side to side)

- Average delay per vehicle, in seconds (for interval starting at 10800, when visualizing delay every 30 minutes)
- Maximum delay reduced to 15 seconds to enhance visualization
- We could also use total delay (sum across all vehicles) to define circle size
  - This would allow us to assess reduction in volume across scenarios



Base

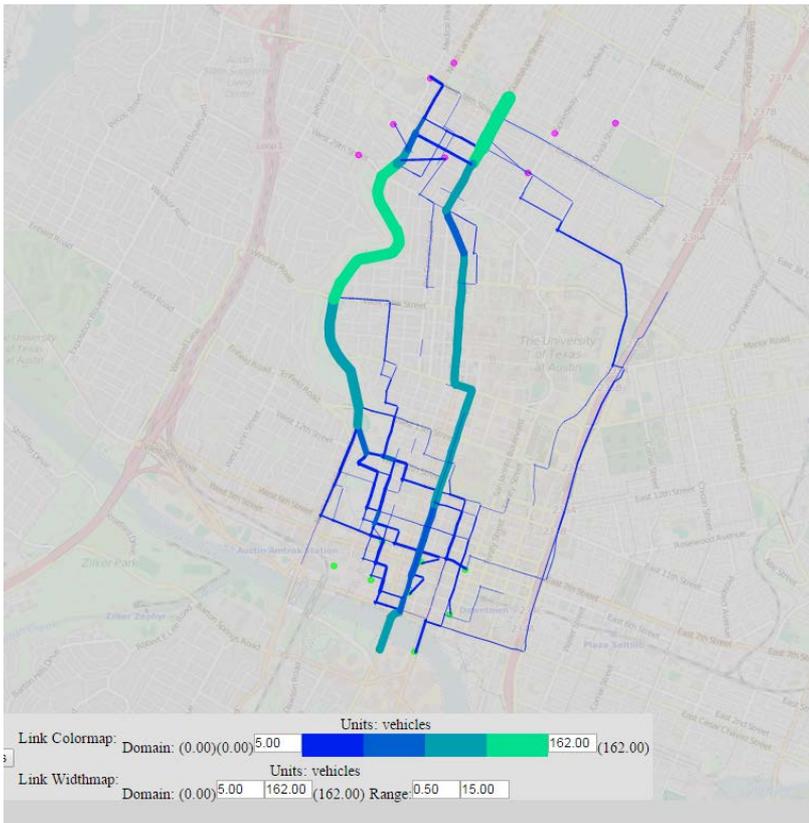


Scenario

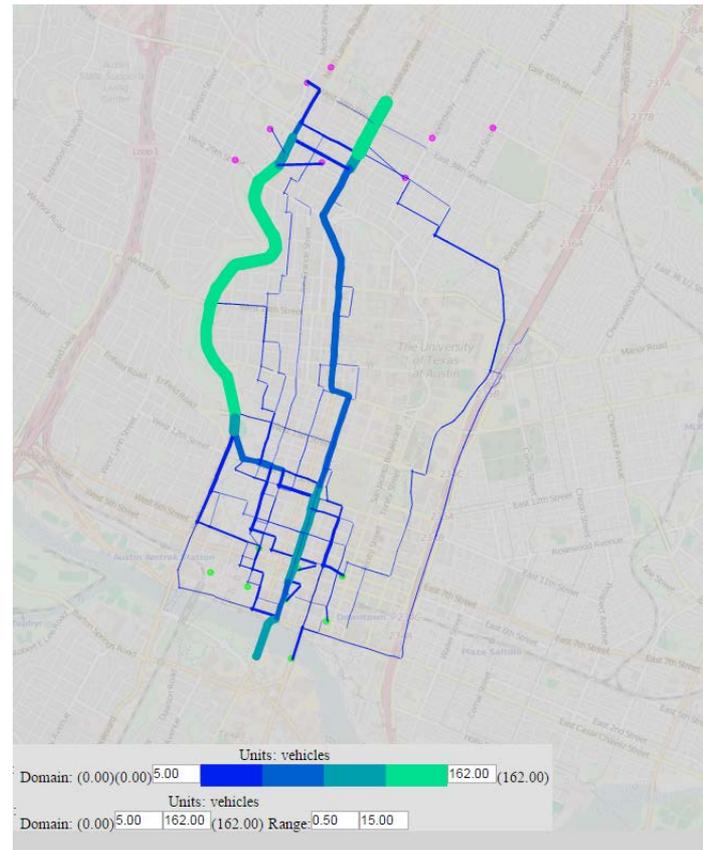


# OD paths

Notice larger use of Lamar in scenario, as well as smaller streets in West Campus and Red River

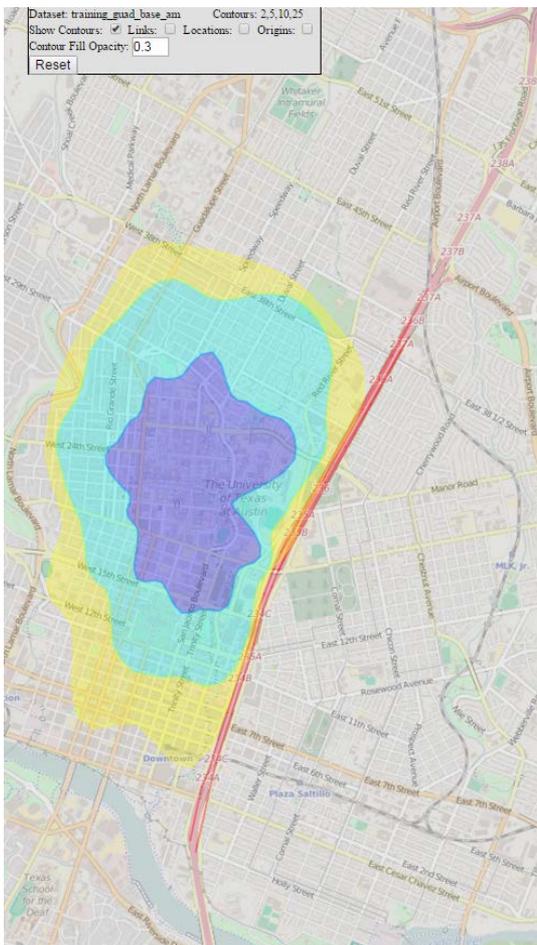


Base

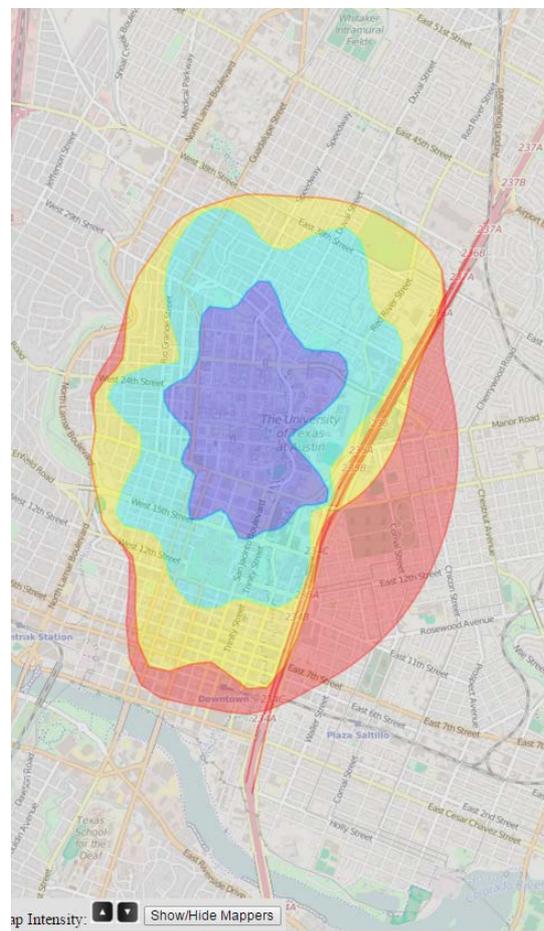


Scenario

# Reach time from the UT campus area



Base



Scenario



# VISTA Database

## Input Tables

### User defined

- Links\_for\_analysis
- Link group
- Bus data for probe vehicles

### Generated when we import results

- Vehicle\_path
- Vehicle\_path\_time

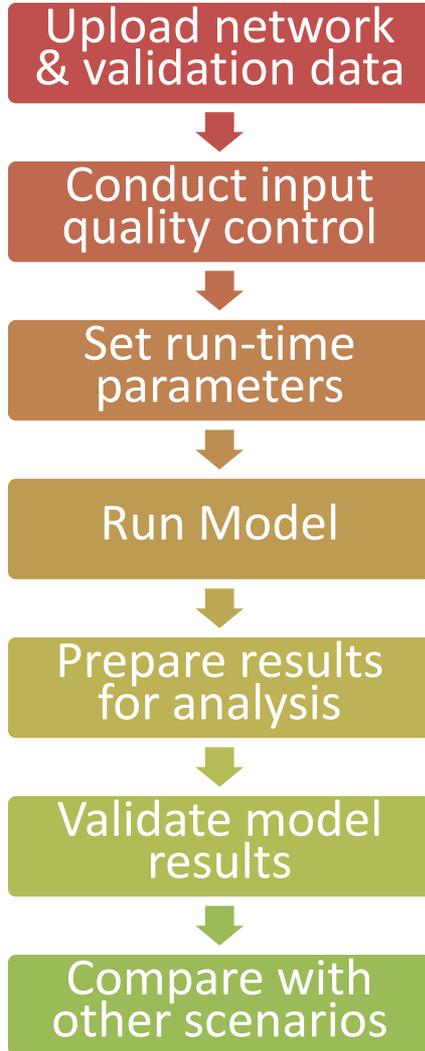
## Queries

**Link volumes for selected time intervals**

**Corridor travel time for selected time intervals**

- End-to-end
- Link- by link

## DTA 2.0 Summary



- Complete workflow of a typical DTA application
- Training material
  - Presentation
  - Cheat Sheets
  - Practical Exercises
  - Files
    - Data
    - Examples
    - Interactive reports

# Feedback

Please take our [survey](#)!

([https://docs.google.com/forms/d/16r1pCJ4abLYoCMJnqOz2VLtrxrws\\_mP-AcJO3utqYQg/viewform](https://docs.google.com/forms/d/16r1pCJ4abLYoCMJnqOz2VLtrxrws_mP-AcJO3utqYQg/viewform))

# What's Next?

## Training

- Transit modeling
  - Dynamic Transit Assignment & integration with DTA
  - Results analysis and visualization
- Advanced model use
  - Subnetwork creation
  - Modeling tips (stop signs, link bays, blocking turning movements)
  - Manual model run
  - Calibration tips
  - High Performance Computing

## Data Rodeo

- COA wavetronix and bluetooth data

## DTA 2.0 Training Materials

| DTA At-a-Glance | Number | Name                   | Corresponding Slide |
|-----------------|--------|------------------------|---------------------|
|                 | 1      | Typical DTA Workflow   | 8                   |
|                 | 2      | DTA Model Data         | 15                  |
|                 | 3      | Create Network Data    | 19                  |
|                 | 4      | Create Demand Data     | 25                  |
|                 | 5      | Results Analysis Tools | 75                  |

| Cheat Sheets | Number                   | Name  | Corresponding Slide |
|--------------|--------------------------|---|---------------------|
|              | 1                        | Access Modeling Tools   | 9                   |
|              | 2                        | Use the Vista Web Portal  | 10                  |
|              | 3                        | The Vista GIS Editor  | 11                  |
|              | 4                        | The Viztool   | 12                  |
|              | 5                        | Create Network Data   | 19                  |
|              | 5a                       | Create a Shapefile for Import Directly from TransCAD                  | –                   |
|              | 5b                       | Create a Shapefile for Import Directly from ArcGIS (non-VISTA format) | –                   |
|              | 6                        | Upload Data Tables  | 19                  |
|              | 7                        | Copy a Network  | 19                  |
|              | 8                        | Import Travel Demand Data   | 26                  |
|              | 9                        | Validate Model Results  | 32                  |
| 10           | Run a DTA Model in VISTA | 62  |                     |
| 11           | Run VISTA Queries        | 83  |                     |



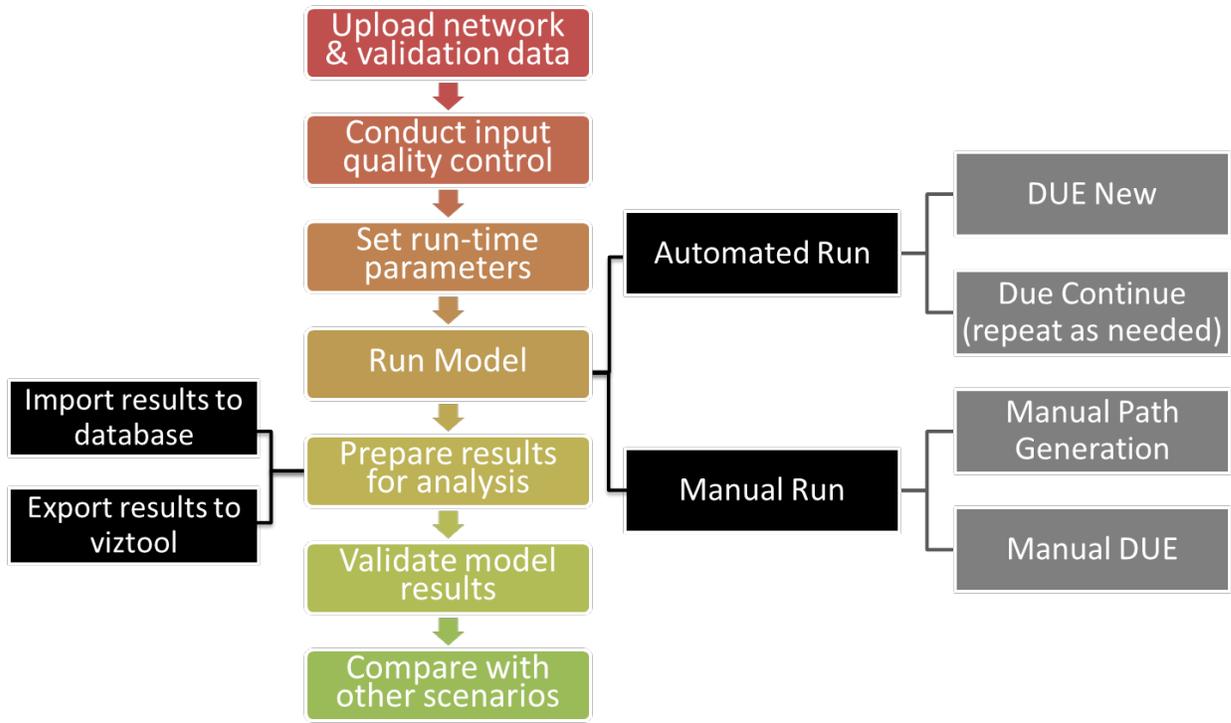
# DTA 2.0 Training Materials

|                  | Number   | Name                                  | Corresponding Slide |
|------------------|--|---------------------------------------|---------------------|
| <b>Exercises</b> | <b>Module 1: Prepare DTA Model Data</b>                    |                                       |                     |
|                  | 1.1  | Import Shapefiles (CAMPO Format)      | 20                  |
|                  | 1.2  | Import Shapefiles (Vista Format)      | 21                  |
|                  | 1.3  | Import and Prepare Demand Data        | 26                  |
|                  | 1.4  | Create and Edit Traffic Control Data  | 30                  |
|                  | 1.5  | Upload and View Calibration Data      | 34                  |
|                  | 1.6  | Review Transit Input Data             | 38                  |
|                  | 1.7  | Review Toll Input Data                | 42                  |
|                  | <b>Module 2: Quality Control of Inputs</b>                 |                                       |                     |
|                  | 2.1  | Use the Vista Sanity Check Module     | 47                  |
|                  | 2.2  | Use the VizTool to Check Model Inputs | 48                  |
|                  | <b>Module 3: DTA Model Run</b>                             |                                       |                     |
|                  | 3.1  | Run a Model in Vista                  | 65                  |
|                  | <b>Module 4: DTA Model Results Analysis (No Exercises)</b> |                                       |                     |
|                  | <b>Module 5: Validate Model Results</b>                    |                                       |                     |
|                  | 5.1  | Validate Model Results                | 82                  |
|                  | <b>Module 6: Analyze and Compare Scenarios</b>             |                                       |                     |
|                  | 6.1  | Compare Scenarios                     | 89                  |



# DTA At-A-Glance 1

## DTA Model Workflow



## DTA At-A-Glance 2 DTA Model Data

### Roadway Network Data

- Roadway links and nodes & relevant attributes
- Centroids/centroid connectors

MPO  
Open source data  
Google Maps

### Demand Data

- Trips among TAZs by vehicle type
- Boundary demand
- Demand profile

MPO  
Traffic counts  
Previous model

### Traffic Control Data

- Location of traffic signals (and stop signs if available)
- Signal timing plans

Transportation  
agencies  
Open source data  
Google Maps

### Calibration Data

- Traffic counts
- Corridor travel times
- Boundary conditions

Project-specific  
Open data

### Transit Data

- Bus routes & stops
- Schedules and dwelltimes

Transit agencies (GTFS  
files)

### Toll Data

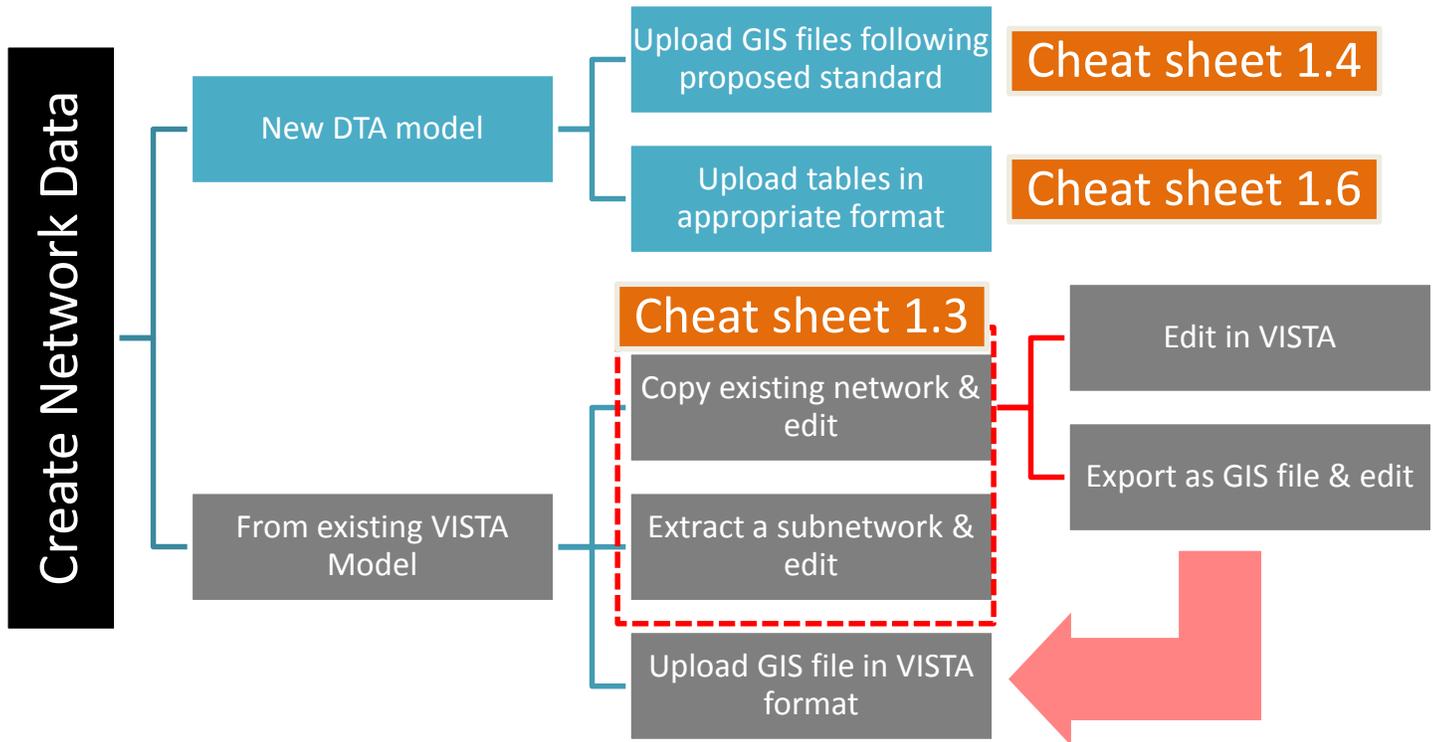
- Toll locations and rates

MPO  
Tolling agency



# DTA At-A-Glance 3 Creating Network Data

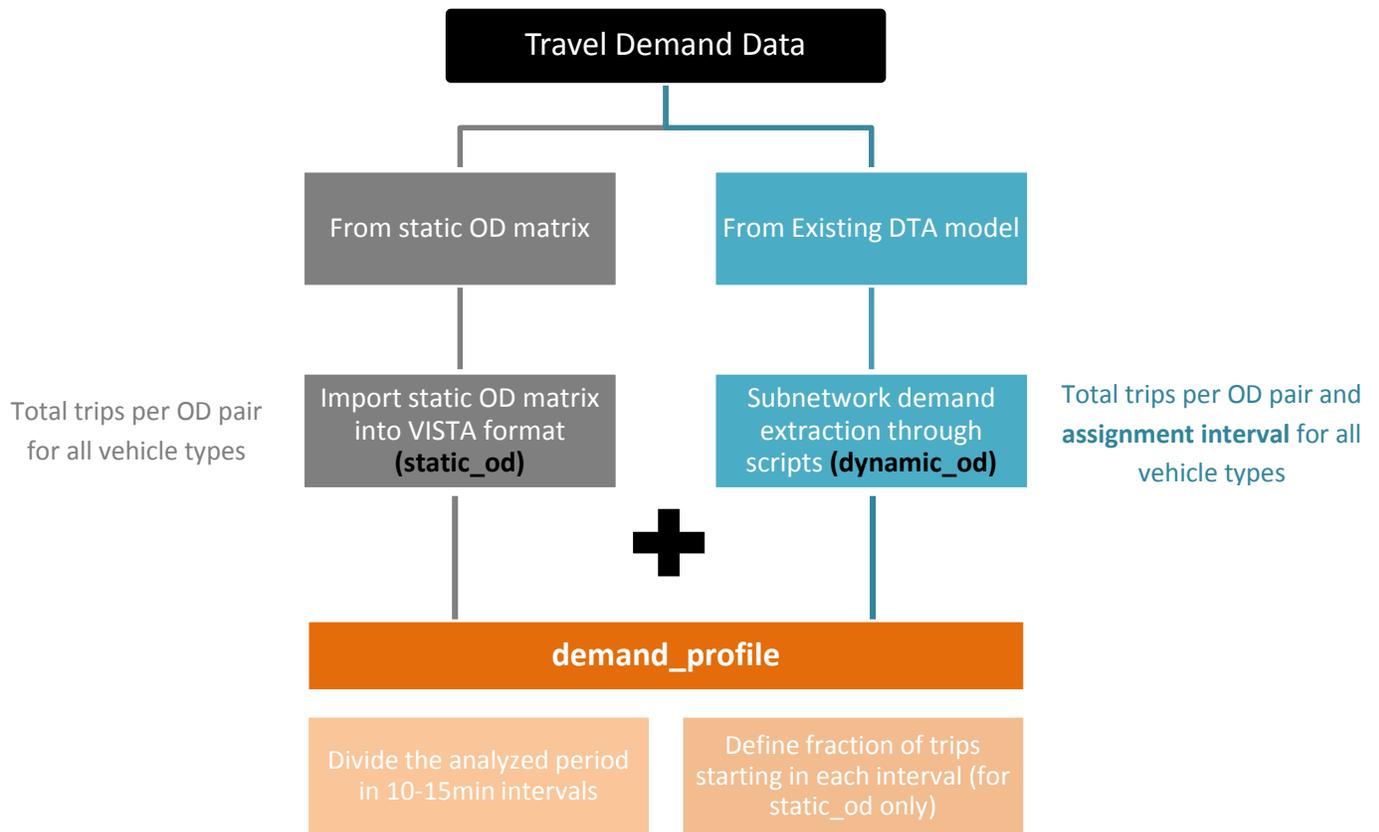
## Approaches to create network data



# DTA At-A-Glance 4

## Creating Travel Demand Data

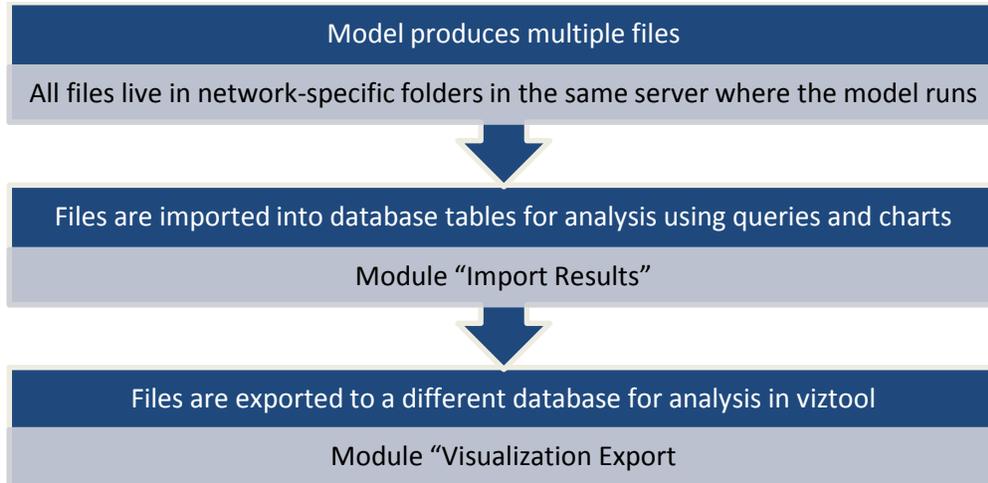
### Approaches to create travel demand data



# DTA At-A-Glance 5

## Results Analysis

### Workflow

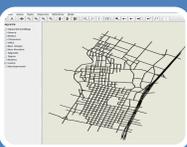


### Tools



#### Reports

- Pre-programmed queries and charts for typical summaries analyses



#### GIS Editor

- Quick visualization and animation of link-based congestion (map based)



#### Visualization tool

- Web-based, interactive graphical user interface
- Detailed map-based results analyses and animations at different time steps



#### Database queries

- Flexible analysis of model inputs and results
- Use of SQL in GUI or connecting to the Postgres database



#### Direct analysis of output files

- Advanced users, usually requires programming



# Cheat Sheet 1

## Access VISTA Model and Web-Based Analysis Tools

### Your Credentials

#### UT EID and password

- Obtain these directly from UT:  
[https://idmanager.its.utexas.edu/eid\\_self\\_help](https://idmanager.its.utexas.edu/eid_self_help)
- Used to grant you access to computational resources (servers)



#### Project specific username/password

- Obtained from a VISTA administrator
- Required to login into various web-based tools used for DTA modeling

#### VISTA web portal



Welcome to VISTA. Documentation is available [online](#).

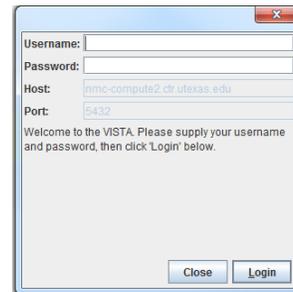
#### Login

Please provide your username and password to log in.

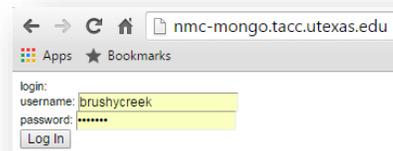
Username:

Password:

#### VISTA GIS Editor



#### Viztool



# Cheat Sheet 1

## Access VISTA Model and Web-Based Analysis Tools

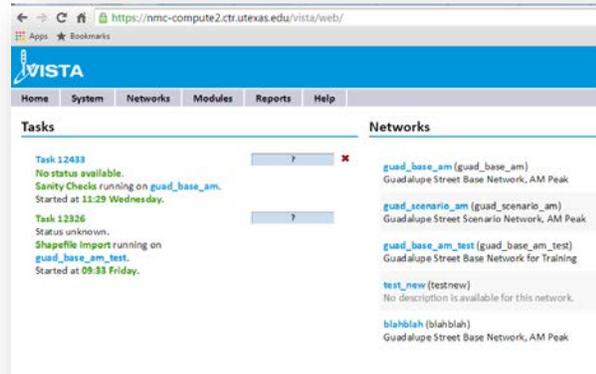
### Vista Web Portal

#### Access

- Link available on training pages.
- Web address of appropriate server:
  - <https://nmc-compute1.ctr.utexas.edu/vista>
  - <https://nmc-compute2.ctr.utexas.edu/vista>

#### Required credentials

- UT EID
- Project-specific login



#### Use

- Create scenarios
- Upload input data and validation data
- Edit data in the database
- Quality control of model inputs
- Run DTA modeling tools
- Analyze results using database queries
- Export results to Viztool
- Import results into database
- Launch the VISTA GIS editor for easier network data manipulation
- Generate interactive reports (Upcoming)
- Record workflow and intermediate results/outputs

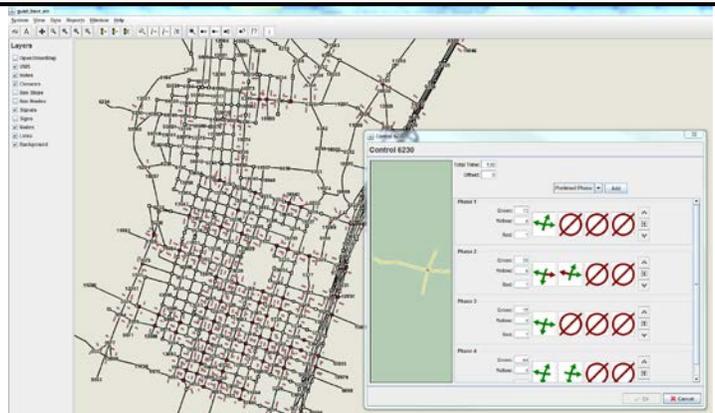
### VISTA GIS Editor

#### Access

- Launch from Vista web portal
- Required credentials

#### Required credentials

- UT EID
- Project-specific login



#### Use

- Map-based visualization of network and traffic control
- Manual edition of link/node attributes
- Manual addition/edition of traffic controls (traffic signals/stop signs)
- Manual edition of transit routes
- Simple analysis of model inputs and results using database queries
- Animation of limited link-based results (LOS, flow)



# Cheat Sheet 1

## Access VISTA Model and Web-Based Analysis Tools

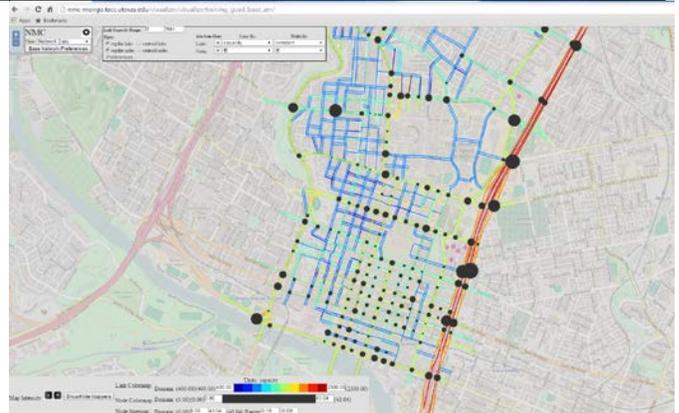
### Viztool

#### Access

- Launch from Vista web portal
- Web address: nmc-mongo.tac.utexas.edu

#### Required credentials

- Project-specific login



#### Use

- Detailed analysis of time-dependent model results using pre-programmed features
  - Link volume difference
  - Select link analysis
  - Origin-destination paths
  - Travel time contour plots
  - Link travel time/congestion
  - Intersection delay
- Map-based visualization of network inputs and results
- Quality control of model inputs
- Advanced: manipulation and analysis of custom time-dependent node/link data sets

### Interactive Reports

#### Access

- Launch from Vista web portal

#### Required credentials

- None once it's generated and downloaded to local computer



#### Use

- Perform high-level scenario comparisons and assessment of model consistency with field data using automatically generated charts, maps and tables.
- Reports reflect results from a specific run and do NOT communicate with the database once generated.
- Interactivity facilitates the analysis of fine-grained data stored in a single file.

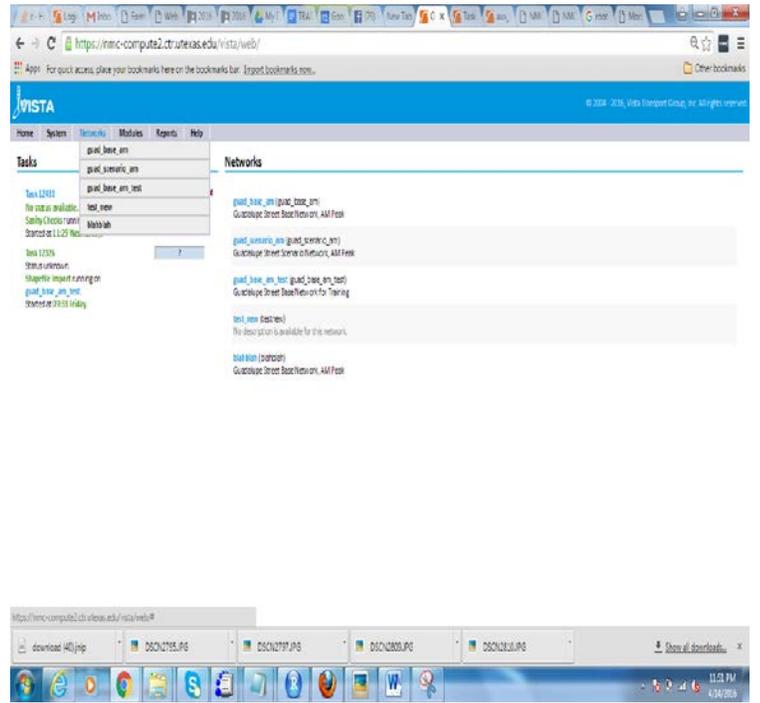


# Cheat Sheet 2

## The VISTA Web Portal

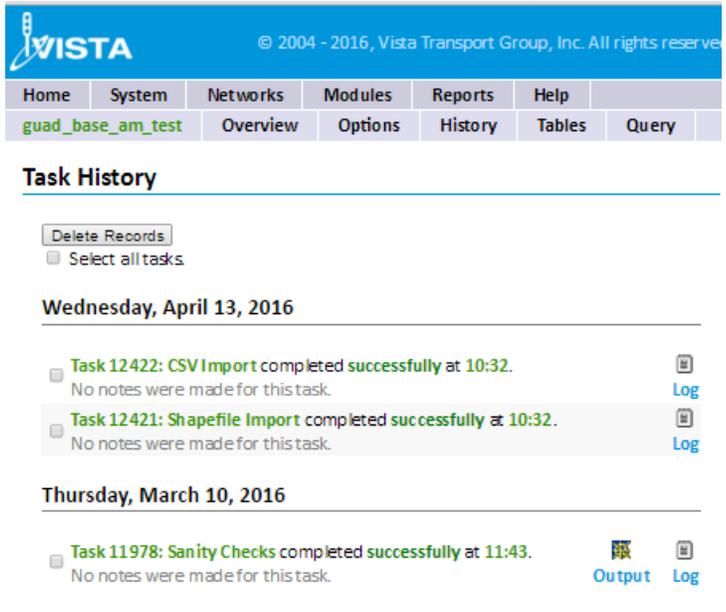
### Your credentials: UT EID and password

- The home tab has a list of all running processes and all networks created within a particular project
- To visualize the data corresponding to a specific network
  - Click on the blue text in a running process
  - Click on the network name in the list displayed in the "Home" tab
  - Select the network name from the drop-down menu "Network" in the top bar



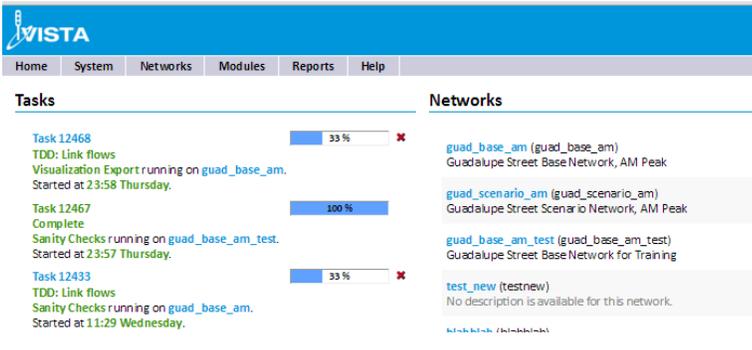
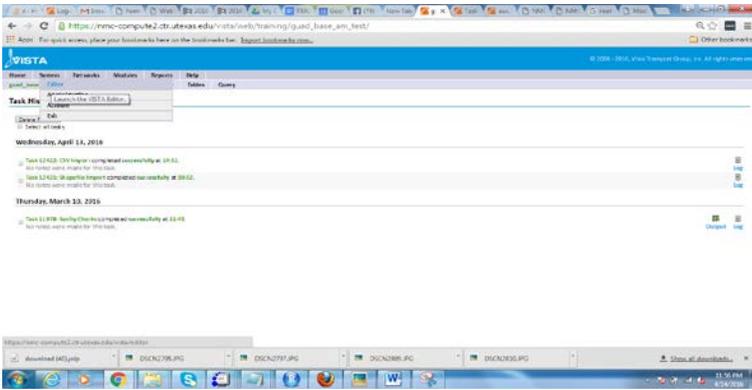
### Network Data

- Once a network is selected, a second set of tabs specific to the network becomes available
  - Overview: summary of network characteristics
  - Options: runtime options
  - History: contains a list of all processes run in the network and corresponding outputs when applicable
  - Tables: database tables containing data used in model runs
  - Query: interface to enter queries in SQL language for data and results analysis



# Cheat Sheet 2

## The VISTA Web Portal

|  |  |
|--|--|
| <p><b>Processes</b></p> <ul style="list-style-type: none"> <li>The tabs “Modules” and “Reports” contain processes that can be run on any network             <ul style="list-style-type: none"> <li>The progress bar is updated when the page is refreshed</li> <li>The red cross to the right of the progress bar indicates a running process and can be used to cancel it</li> </ul> </li> </ul> |  <p>The screenshot shows the VISTA web portal interface. At the top, there is a navigation bar with tabs for Home, System, Networks, Modules, Reports, and Help. Below this, there are two main sections: 'Tasks' and 'Networks'. The 'Tasks' section displays three tasks with their progress bars: Task 12468 (33% complete, with a red cross indicating it is running), Task 12467 (100% complete), and Task 12433 (33% complete, with a red cross). The 'Networks' section lists several networks, including 'guad_base_am', 'guad_scenario_am', 'guad_base_am_test', and 'test_new', each with a brief description.</p> |
| <p><b>System</b></p> <ul style="list-style-type: none"> <li>The tab “System” can be used to :             <ul style="list-style-type: none"> <li>Create blank networks</li> <li>Copy existing networks</li> <li>Download the editor</li> </ul> </li> </ul>   |  <p>The screenshot shows the VISTA web portal interface with the 'System' tab selected. The page displays a 'Task History' section with a table of tasks. The table has columns for 'Task ID', 'Task Name', 'Status', and 'Date'. Below the table, there are several task entries with their respective dates and descriptions. The bottom of the screenshot shows a Windows taskbar with several application icons and the system clock.</p>   |

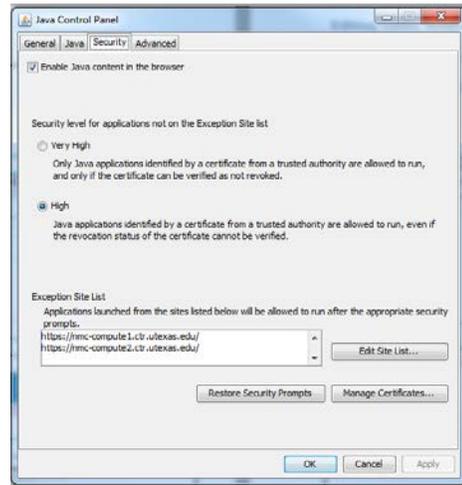


# Cheat Sheet 3

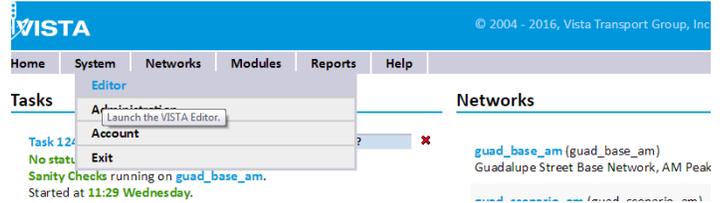
## The VISTA GIS Editor

### Launching the Editor

1. Prepare your computer:
  - a. Make sure Java is installed  
<https://java.com/en/download/>
  - b. Make sure the Java configuration allows running content from compute servers by adding the two following web addresses to the "Security" tab  
<https://nmc-compute1.ctr.utexas.edu>  
<https://nmc-compute2.ctr.utexas.edu>



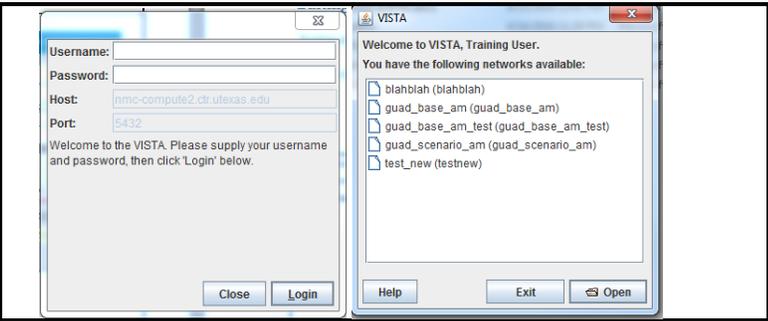
2. Access the VISTA web portal and navigate to System->Editor
  - a. This will **download a file to your computer**
3. Double click on the file to launch the VISTA GIS editor.
  - a. If prompted provide your UTEID and password
  - b. If prompted, check on the box "I accept the risk and want to run this application"



# Cheat Sheet 3

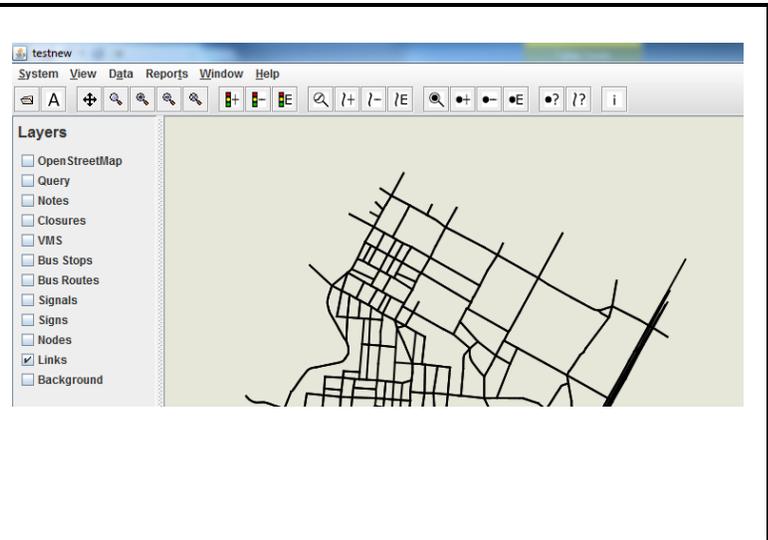
## The VISTA GIS Editor

1. Enter project-specific login
2. Select desired network.
3. Once a network is opened, other networks may be accessed by using the File->Open menu

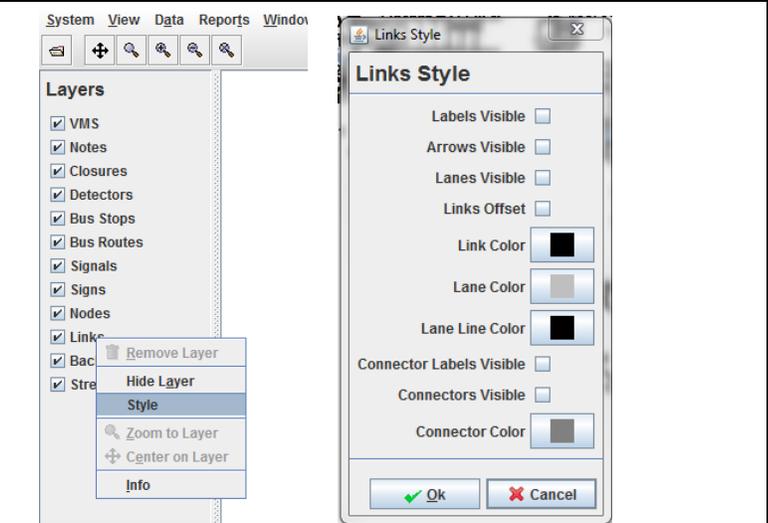


### Adjusting the visualization

1. Select the layers to be displayed from the left side list of check boxes. Typically only links need to be checked to understand the network layout.
2. The OpenStreetMap layer inserts a map background.
3. Pan and zoom tools are available among the icons on the top tool bar
4. To access the attributes of links, nodes and traffic control start the “edit” mode for the desired layer (see below)
  - a. The information icon in the toolbar may be used to visualize link attributes



5. Visualization options for each layer may be accessed by right-clicking on top of the layer name
  - a. For nodes these may be used to **visualize centroids.**
  - b. For links, these include options to **visualize centroid connectors and lanes.**



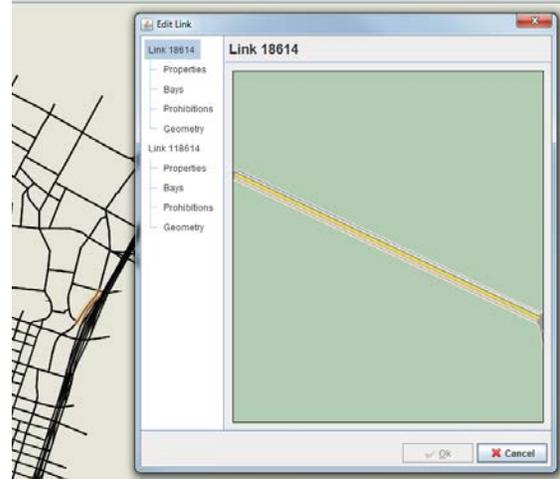
# Cheat Sheet 3

## The VISTA GIS Editor

### Editing Network Elements

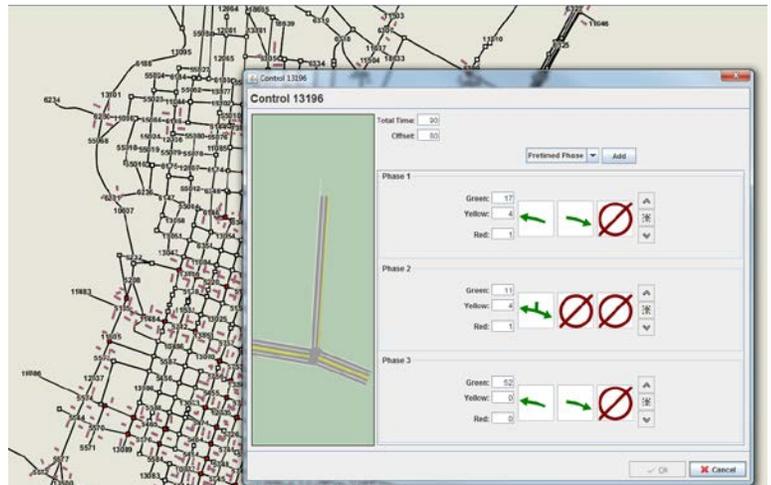
#### 1. Editing links & nodes

- a. Start link editing mode by going to data->Link->Edit Link or click on the appropriate icon in the toolbar.
- b. Click on any link to visualize and edit its properties
- c. In two-way streets, two sets of link properties will be available. Switch between them by clicking on the Link ID in the left list.
- d. There are also icons/menu items to delete existing links and to add links between existing nodes
- e. Similar features available for nodes



#### 2. Editing traffic signals

- a. Start link editing mode by going to data->Control->Edit Link or click on the appropriate icon in the toolbar.
- b. Click on an existing signal to edit the timing plan
  - i. Each "Phase" box contains windows to select the movements allowed during that phase
  - ii. Click on each window to see a list of movements from all candidate approaches
  - iii. Once an approach is selected, you can click on individual arrows to disallow a specific movement
  - iv. Add green, yellow and ALL Red time for each phase.
  - v. Adjust the offset (under the total time window)
- c. There are also icons/menu items to delete existing signals and to add signals to existing nodes

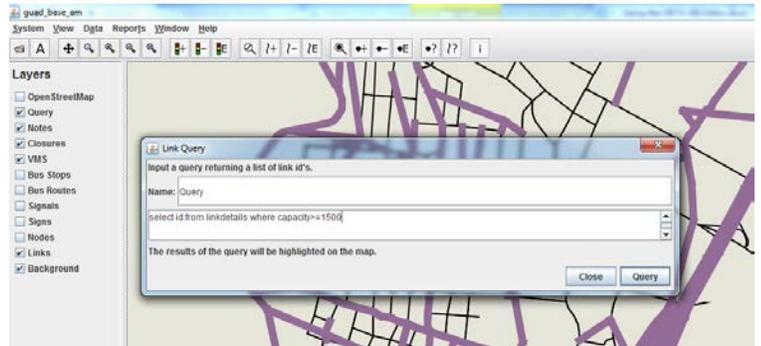


# Cheat Sheet 3

## The VISTA GIS Editor

### Querying Links and Nodes

1. Access the query window using the icon in the toolbar or through Reports->QueryLinks.
2. Type a name for the layer that will be generated when running the query
3. Type a query to identify a subset of link/node IDs based on information in the data table.
  - a. The query must return a list of integer values.
  - b. If more than one column is returned, the first one will be used for highlighting the network elements
  - c. All nodes/links with IDs matching the query return will be highlighted.
4. Change the style of the new layer as desired (see above)



### Animating model results

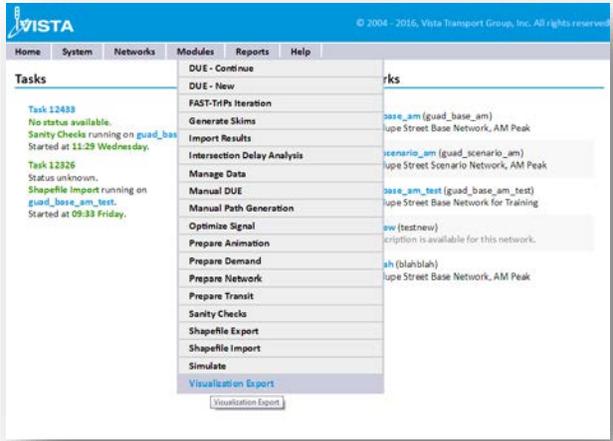
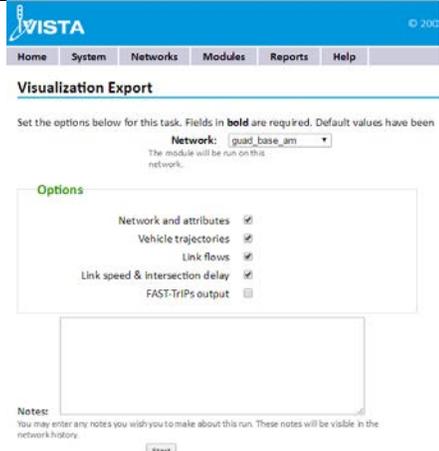
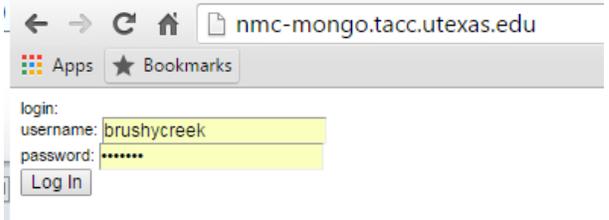
## Visualizing congestion in the Editor

1. Right click on "Links" to display menu
2. Select "Style"
3. Check the "Lanes visible" box to visualize directional traffic
4. Enter the "Data" menu and select "Data Animation"
5. Select what to animate: "Travel Time" or "Level of Service" are appropriate to visualize congestion. Click "OK"
6. Select a time step. Three minutes (180 seconds) is small enough to see congestion
7. The animation bar may take a few seconds to appear. Press "Play" to visualize.

# Cheat Sheet 4

## The Viztool

### Accessing the Viztool

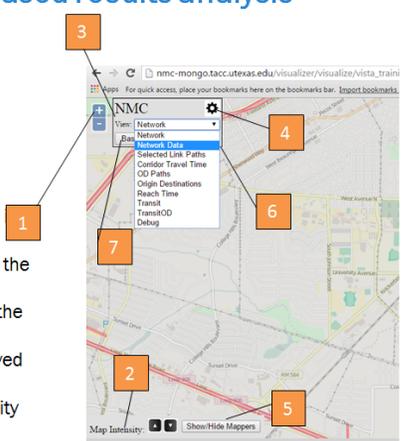
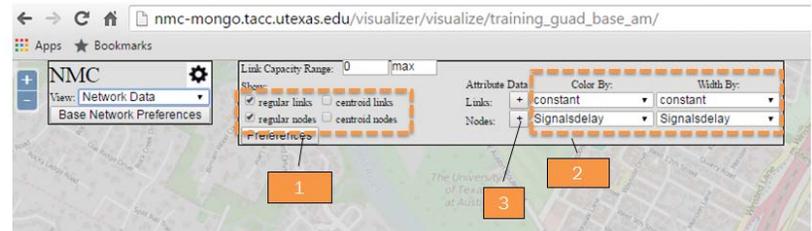
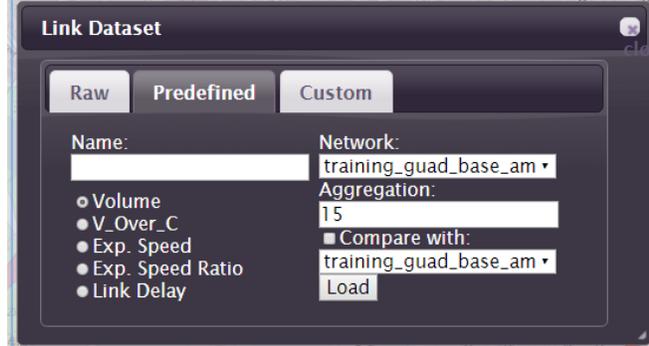
|   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Export results to Viztool             <ol style="list-style-type: none"> <li>a. Each time results are updated they must be exported to the Viztool through the VISTA web portal</li> <li>b. Login into the VISTA web portal and navigate to Modules-&gt;Viztool Export</li> </ol> </li> </ol>   |  <p>The screenshot shows the VISTA web portal interface. The 'Modules' menu is open, and 'Visualization Export' is highlighted at the bottom. Other visible options include 'DUE - Continue', 'DUE - New', 'FAST-Trip Iteration', 'Generate Skims', 'Import Results', 'Intersection Delay Analysis', 'Manage Data', 'Manual DUE', 'Manual Path Generation', 'Optimize Signal', 'Prepare Animation', 'Prepare Demand', 'Prepare Network', 'Prepare Transit', 'Sanity Checks', 'Shapefile Expert', 'Shapefile Import', and 'Simulate'.</p> |
| <ol style="list-style-type: none"> <li>2. Select the correct network</li> <li>3. Set options as desired, based on available data/results             <ol style="list-style-type: none"> <li>a. Network Data: appropriate if you have set your links/linkdetails/nodes tables</li> <li>b. Vehicle trajectories, Link flows and intersection delay are only available if the model has been run</li> <li>c. Fasttrip outputs are available only when a dynamic traffic assignment model has been run</li> </ol> </li> </ol> |  <p>The screenshot shows the 'Visualization Export' configuration page in the VISTA web portal. The 'Network' dropdown is set to 'quad_base_am'. Under the 'Options' section, the following items are checked: 'Network and attributes', 'Vehicle trajectories', 'Link flows', and 'Link speed &amp; Intersection delay'. 'FAST-Trip's output' is unchecked. There is a 'Notes' field at the bottom for additional information.</p>   |
| <ol style="list-style-type: none"> <li>1. Access the Viztool             <ol style="list-style-type: none"> <li>a. Point your browser to the Viztool website from the NMC website</li> <li>b. Access website directly at nmc-mongo.tacc.utexas.edu</li> </ol> </li> <li>2. Enter your project specific credentials</li> <li>3. You will see a list off all networks that have been exported to the the Viztool from the VISTA web portal</li> </ol>   |  <p>The screenshot shows a web browser login page for 'nmc-mongo.tacc.utexas.edu'. The browser address bar shows the URL. Below the address bar, there are fields for 'login: username:' (containing 'brushycreek') and 'password:' (containing '*****'). A 'Log In' button is visible at the bottom.</p>  |



# Cheat Sheet 4

## The Viztool

### General Use

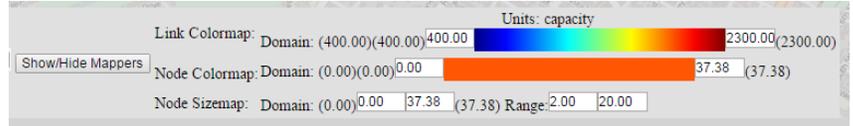
|  |   |
|--|---|
| <p>4. Basics</p>   | <p style="text-align: center;"><b>Interactive web-based results analysis</b></p> <ol style="list-style-type: none"> <li>Zoom in/out</li> <li>Dim background map</li> <li>Main menu</li> <li>Hide/show options of selected feature in main menu (when available)</li> <li>Hide/show color map and other attributes of the feature selected the main menu</li> <li>Select "Network Data" to explore the network properties</li> <li>Base Network Properties: select the network elements (and corresponding style) to be displayed when no other feature is in use.             <ol style="list-style-type: none"> <li>Initially only links with capacity higher than 2000vph are shown.</li> </ol> </li> </ol>  |
| <p>5. Network Data</p> <ol style="list-style-type: none"> <li>Select elements to be shown</li> <li>Select pre-computed dataset to specify element color/size.</li> <li>Pre-computed datasets include all link attributes</li> </ol>  |    |
| <p>4. Adding pre-computed datasets</p> <ol style="list-style-type: none"> <li>Raw datasets are very fine-grained VISTA outputs. They can be manipulated in the "custom" tab using a special language.</li> <li>Pre-defined datasets summarize the information in the raw data files for typical analyses. See link volume comparison for an example</li> </ol> |   |

# Cheat Sheet 4

## The Viztool

### Adjusting visualization

5. Mappers depend on the type of visualization.
  - a. Color scales can be changed by clicking on the scale. "Quantize" allows to select how many color bins to display
  - b. All the white boxes defining the domain of the visualized attribute may be edited. Press enter after making changes.



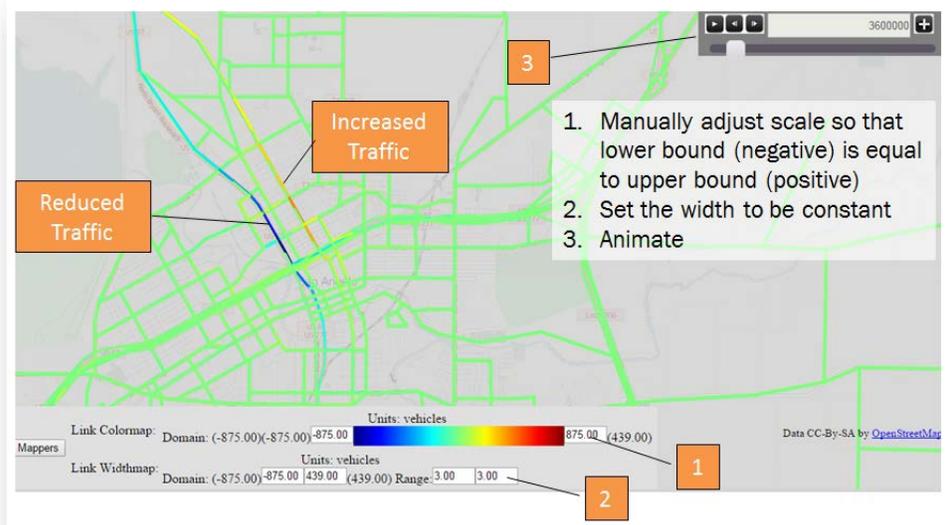
### Visualizing link data sets: comparing link flows across scenarios

#### 1. Process

1. Select "Network Data" from main menu
2. Click on "+" sign next to "Links"
3. Select "Predefined" tab
4. Choose a name for the comparison
5. Choose "Volume"
6. Choose a time-step (minutes)
7. Check "Compare with" box
8. Select the network to compare
9. Click "Load"

## Cheat Sheet 4 The Viztool

### 2. Results



### Select Link Analysis

### 3. Process

Select Link Analysis

NMC

View: Selected Link Paths

Base Network Preferences

Path Data: vista\_training\_base\_case

Show Connectors Lower capacity limit: all

Aggregation Interval: 30

By: Selected Link Arrival Path Departure Individual Links

Selected Links: 100957

Selection Done

1. Select "Selected Link Paths" in main menu

2. Choose "All" in Lower capacity limit field

3. Select a time interval (in minutes)

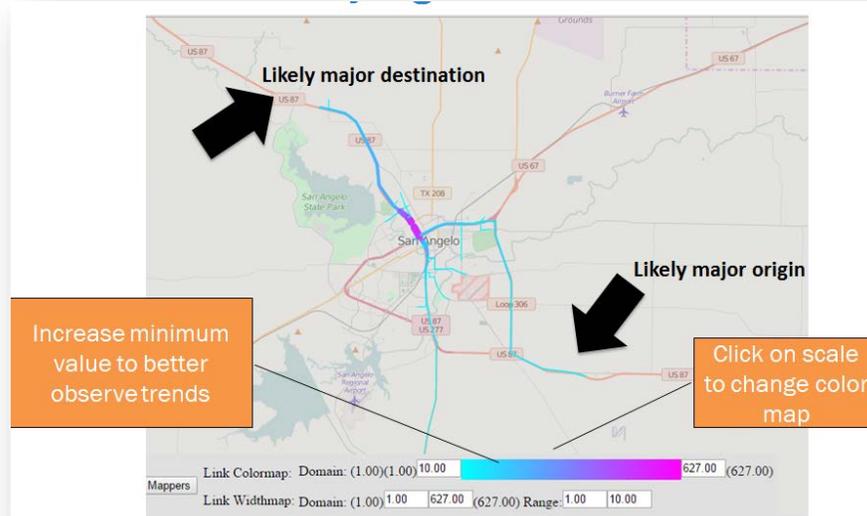
4. Select a link by clicking on the map or typing a known ID

5. Click on "Selection Done"

# Cheat Sheet 4

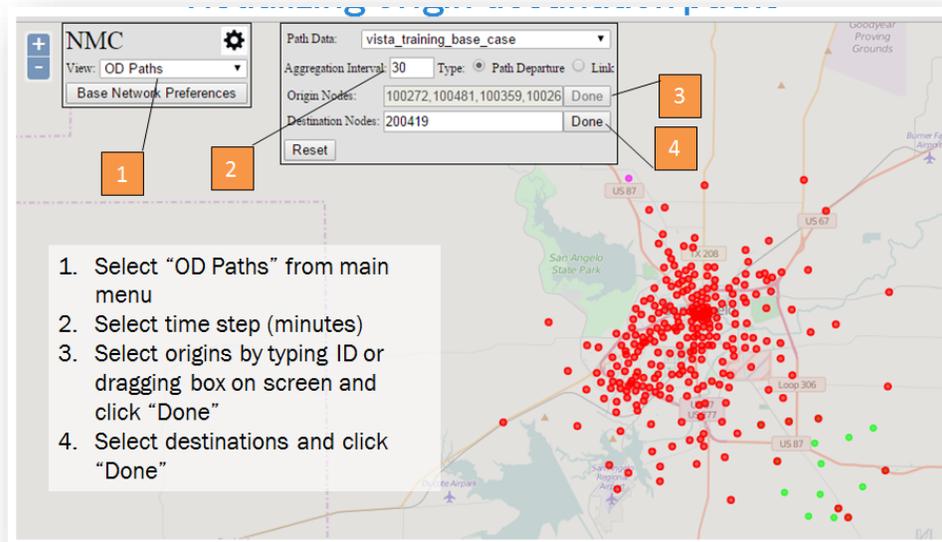
## The Viztool

### 4. Results



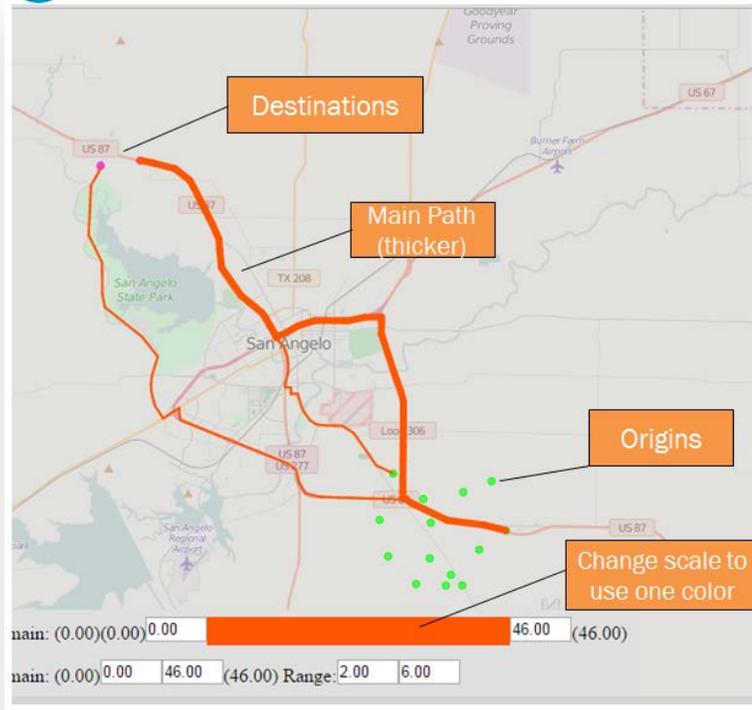
## OD Paths

### 1. Process



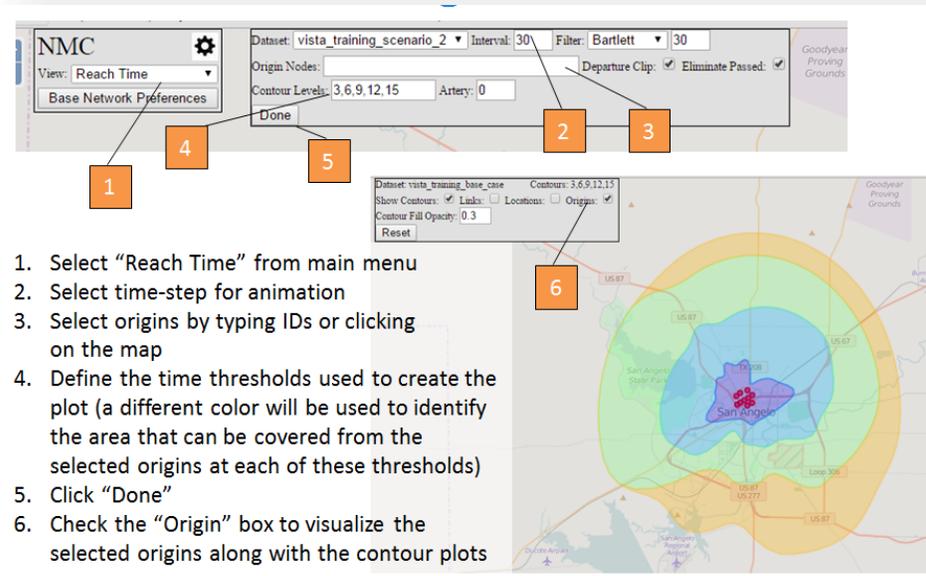
# Cheat Sheet 4 The Viztool

## 2. Results



## Reach Time

### 1. Process & Results

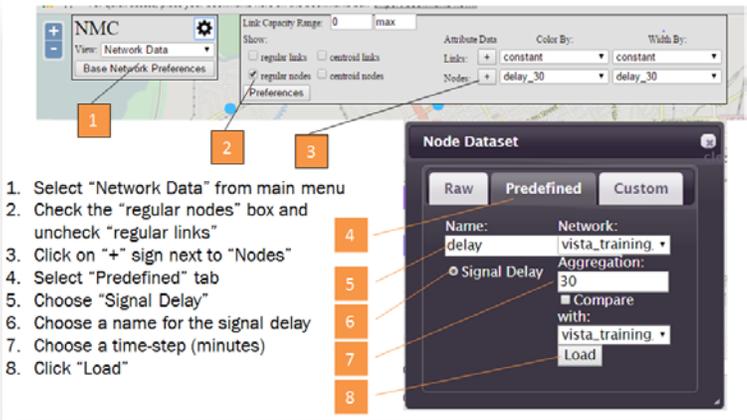
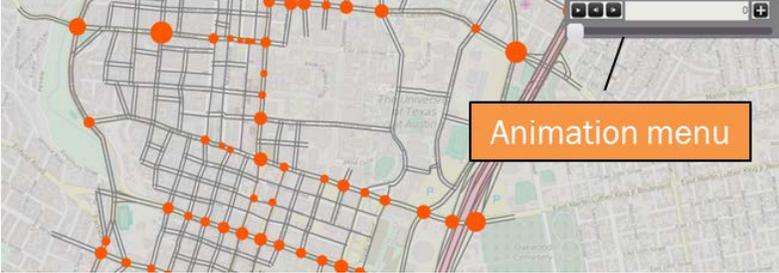


1. Select "Reach Time" from main menu
2. Select time-step for animation
3. Select origins by typing IDs or clicking on the map
4. Define the time thresholds used to create the plot (a different color will be used to identify the area that can be covered from the selected origins at each of these thresholds)
5. Click "Done"
6. Check the "Origin" box to visualize the selected origins along with the contour plots

# Cheat Sheet 4

## The Viztool

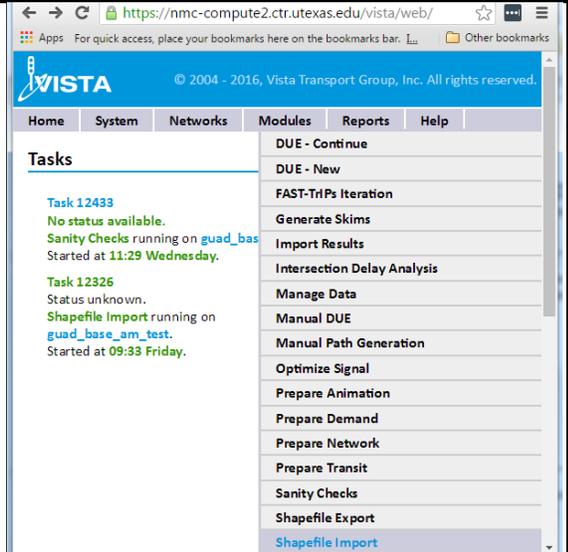
### Signal Delay

|                   |  |
|-------------------|--|
| <p>1. Process</p> |  <ol style="list-style-type: none"><li>1. Select "Network Data" from main menu</li><li>2. Check the "regular nodes" box and uncheck "regular links"</li><li>3. Click on "+" sign next to "Nodes"</li><li>4. Select "Predefined" tab</li><li>5. Choose "Signal Delay"</li><li>6. Choose a name for the signal delay</li><li>7. Choose a time-step (minutes)</li><li>8. Click "Load"</li></ol> |
| <p>2. Results</p> |  <p>Animation menu</p>  |

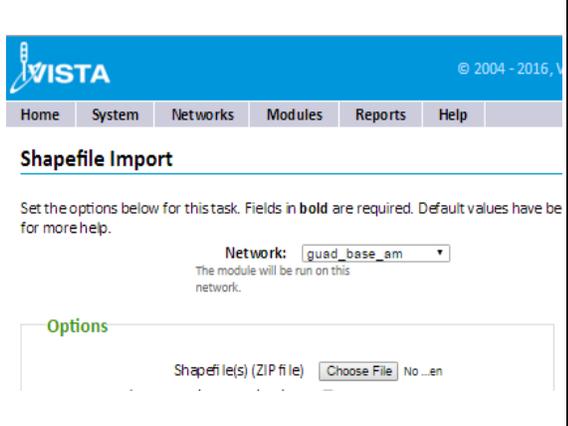
# Cheat Sheet 5

## Create Network Data

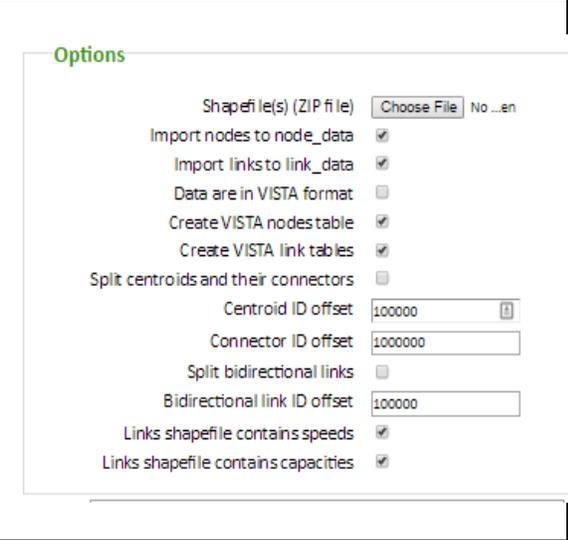
1. Access VISTA web portal and login to project from which data will be copied
2. Navigate to Modules->Import Shapefiles



3. Select the VISTA model to which the data will be uploaded
4. Select the data to be uploaded (see formats below) for the appropriate location in your computer
  - i. A single .zip file can be uploaded per network
  - ii. Separate files are required for links and nodes. Respective names **MUST** include the word link/node.
  - iii. Three files with the same name and the following extensions must be provided per data type (link/node): shp, shx, dbf
  - iv. In shapefiles generated by TransCAD the extension is often in **capital letters. Manually modify it.**



5. Adjust options as desired
  - a. If importing network **in VISTA format**
    - i. Check "Data are in VISTA format"
    - ii. Check "Links shapefile contains speeds"
    - iii. Check "Links shapefile contains capacities"
  - b. If importing from **other formats**
    - i. Check "Import nodes to node\_data" if node data is available
    - ii. Check "Import links to link\_data" if link data is available
    - iii. If you wish to **automatically generate VISTA** tables
      1. Check "Create VISTA nodes table" and/or "Create VISTA link tables"
      2. See required format and options below



# Cheat Sheet 5

## Create Network Data

### Format requirement for automated generation of network tables

Refer to Cheat Sheets 5a and 5b for additional information on how to format data in TransCAD/ArcGIS to prepare for VISTA import.

#### Link Data

1. "ID" (integer): Link ID
2. "from\_node" to indicate node id at beginning of link
3. "to\_node" to indicate node id at end of link
4. "Dir" : as typically defined in TRansCAD. Dir=1 denotes a link that allows flow in the direction specified by "from\_node" and "to\_node", while Dir=-1 indicated a link which allows flow in the opposite direction. Dir=0 is used for links that allow bidirectional flow.
5. "Type" to indicate link type (1 for regular links, 100 for centroid connectors)
6. "FC" to indicate functional class
7. "AT" to indicate area type
8. "Lanes\_AB" to indicate lanes in direction drawn
9. "Lanes\_BA" to indicate lanes in opposite direction
10. "Cap\_AB" to indicate capacity in direction drawn. Capacity is required in vehicles per hour for all lanes. **It may be necessary to divide the values typically used in TransCAD by the duration of the modeled period (e.g. 3hours for the morning peak period)**
11. "Cap\_BA" to indicate capacity in opposite drawn. Capacity is required in vehicles per hour for all lanes. **It may be necessary to divide the values typically used in TransCAD by the duration of the modeled period (e.g. 3hours for the morning peak period)**
12. "Speed\_AB" to indicate speed in direction drawn. Speed is expected in miles per hour.
13. "Speed\_BA" to indicate speed in opposite drawn. Speed is expected in miles per hour.

#### Node Data

1. ID: Integer
2. Type: 1 for regular nodes and 100 for centroid connectors
3. X: longitude, in decimal degrees
4. Y: latitude, in decimal degrees

### Options for automated generation of input tables

1. **Split centroids and their connectors:** If the original data contains a single centroid per TAZ, a transformation is needed to generate one origin centroid and one destination centroid per TAZ. Unidirectional centroid connectors must be created from each origin centroid to one or more regular nodes, and to each destination centroid from one or more regular nodes.
  - a. **Centroid ID offset:** value added to the TAZ ID to generate the ID of the corresponding origin centroid (The offset will be multiplied by 2 for destination centroid IDs). Use a number larger than all existing node IDs. Using multiples of 10 facilitates identifying original TAZ ID when needed.



## Cheat Sheet 5

### Create Network Data

- b. **Connector ID offset:** value added to the TAZ ID to generate the ID of the corresponding origin centroid (The offset will be multiplied by 2 for destination centroid IDs). Use a number larger than all existing node IDs. Using multiples of 10 facilitates identifying original TAZ ID when needed.
  2. **Split bidirectional links:** If the original data uses a single link to represent two way streets, a transformation is needed to create two separate links in VISTA, one for each direction.
    - a. **Bidirectional ID offset:** value added to the original link ID to generate the ID of the link in the reverse direction (if Dir=1 or Dir=0, the original ID will be used for the link that runs in the direction defined by the “from\_node” and “to\_node” fields). Use a number larger than all existing link IDs. Using multiples of 10 facilitates identifying original Link ID when needed.
  3. **Link file contains speeds/Link file contains capacity:** check when link capacity/speed values are not available, or when it is desirable to replace the values contained in the data based on link functional classification and area type. The latter is often done to ensure that the selected values are not affected by adjustments made during the calibration of static traffic assignment models. If this option is checked, the table **capacity\_lookup** must be populated with values appropriate for the FC/AT defined for the network.



# Cheat Sheet 5a

## Create a Shapefile for Import Directly from TransCAD

1. Make a selection of links (including connectors) in TransCAD and export the selection to a standard geographic file and add the layer to the map.
  - a. This should create a node and link layer to manipulate
2. Open a Dataview portal for the new node layer
  - a. The layer should already have the ID field which will be used for the VISTA node id
  - b. Create a formula field called “type” for node type and enter the following formula:
    - i. if Centroid=1 then 100 else 1
    - ii. This will populate the necessary “type” field for import to VISTA
3. Export the node layer as an Esri Shapefile
4. Open a Dataview portal for the new link layer
  - a. The layer should already have the ID field which will be used for the VISTA link id
  - b. Create a formula field to populate from and to nodes
    - i. Adding node fields can be selected in the dialogue box and the “ID” field used to generate these values
    - ii. A subsequent formula field should then be created called “from\_node” using the newly created “From ID” field
    - iii. Another formula field should be created called “to\_node” using the newly created “To ID” field
  - c. The layer should already have the “Dir” field which will be used for creating directional links in VISTA
  - d. Create a formula field called “lanes\_AB” for lanes in the AB direction consistent with the model year intended:
    - i. Use the “ABLNY” field where YY represents the year intended
  - e. Create a formula field called “lanes\_BA” for lanes in the BA direction consistent with the model year intended:
    - i. Use the “BALNY” field where YY represents the year intended
  - f. Create a formula field called “cap\_AB” for link capacity in the AB direction consistent with the model year intended (DO NOT NEED, can use VISTA lookup table – this may require correcting for low/zero values):
    - i. Use the field for the AB capacity for the period and year intended
    - ii. Since the CAMPO capacity is currently coded for the entire analysis period and VISTA uses an hourly value, it is important to use the formula to divide by the analysis period duration in hours (e.g., 3 for the peak)
  - g. Create a formula field called “cap\_BA” for link capacity in the BA direction consistent with the model year intended (DO NOT NEED, can use VISTA lookup table – this may require correcting for low/zero values):
    - i. Use the field for the BA capacity for the period and year intended
    - ii. Since the CAMPO capacity is currently coded for the entire analysis period and VISTA uses an hourly value, it is important to use the formula to divide by the analysis period duration in hours (e.g., 3 for the peak)



## Cheat Sheet 5a

# Create a Shapefile for Import Directly from TransCAD

- h. Create a formula field called “speed\_AB” for link speed in the AB direction consistent with the model year intended (DO NOT NEED, can use VISTA lookup table – this may require correcting for low/zero values):
    - i. Use the field for the AB/link speed for the year intended
  - i. Create a formula field called “speed\_BA” for link speed in the BA direction consistent with the model year intended (DO NOT NEED, can use VISTA lookup table – this may require correcting for low/zero values):
    - i. Use the field for the BA/link speed for the year intended
  - j. The layer should already have the “Length” field which will be used for the VISTA length
  - k. Create a formula field called “type” for link type and enter the following formula:
    - i. if SEGMENT = "CC" then 100 else 1
    - ii. This will populate the necessary “type” field for import to VISTA
  - l. Create a formula field called “FC” for functional class consistent with the model year intended:
    - i. Use the “FCYY” field where YY represents the year intended
    - ii. This is used for the lookup table to establish speed and capacity if no data exists or it is not intended for use from the CAMPO model
    - iii. Check for missing values and update as appropriate
  - m. Create a formula field called “AT” for area type consistent with the model year intended:
    - i. Use the “ATYY” field where YY represents the year intended
    - ii. This is used for the lookup table to establish speed and capacity if no data exists or it is not intended for use from the CAMPO model
    - iii. Check for missing values and update as appropriate
5. Verify that direction (Dir) and lane designation (AB, BA) fields are consistent. If a link has a direction indication and zero lanes in an associated field, it will fail the import when capacity is checked as defined in the shapefile (directional capacity values are divided by the directional # lanes in the import process; zero lanes results in an invalid mathematical solution). If capacity is unchecked, resultant link will have a capacity value assigned, but will still have zero lanes and result in a VISTA sanity check error.
6. With the Dataview portal open for the links, drop all fields that are not needed for export leaving only the following (too many active fields causes some to be dropped at export which may leave out the newly created formula fields):
- a. ID
  - b. from\_node
  - c. to\_node
  - d. Dir
  - e. Lanes\_AB
  - f. Lanes\_BA
  - g. Capacity\_AB



## Cheat Sheet 5a

### Create a Shapefile for Import Directly from TransCAD

- h. Capacity\_BA
  - i. Speed\_AB
  - j. Speed\_BA
  - k. Length
  - l. Type
  - m. FC
  - n. AT
7. Export the link layer as an Esri Shapefile
  8. Zip the link and node files together (shp, shx, and dbf files for each) – make sure that the file naming convention has consistent casing and the file extension is not in all caps for any of the required file types (TransCAD may export with names/extensions for the dbf file in all caps).



# Cheat Sheet 5b

## Create a Shapefile for Import Directly from ArcGIS (non-VISTA format)

1. If not already working with a subnetwork, make a selection of network elements in ArcGIS to cover intended area of study.
  - a. Select the links (including connectors – make sure these link types are distinguishable by a unique attribute value) within the limits intended and export as a separate subnetwork links file and add the layer to the map.
  - b. Select the nodes (including centroids – make sure these nodes are distinguishable by a unique attribute value) within the limits intended. Make sure that both nodes that serve as endpoints to included links are included in the selection (the network boundary should be represented by nodes). Export the selection as a separate subnetwork nodes file and add the layer to the map.
2. Create new fields in the node shapefile.
  - a. If one does not already exist, create a new field in the node shapefile with name “ID” (integer). Use “Field Calculator” to calculate ID = “currentIDfield”.
  - b. Create a new field in the node shapefile with name “Type” (integer). Use “Field Calculator” to calculate: Type = 100 where “CENTNODE = 1” (“CENTNODE” is indicator field for centroid - use a selection by attributes to establish which values to apply the calculation. Reverse the selection and calculate Type = 1 for non “CENTNODE” links (i.e., where “CENTNODE = 0”).
3. Create new fields in the link shapefile for the following:
  - a. “from\_node” to indicate node id at beginning of link
    - i. Use “Field Calculator” to calculate from\_node = FROM\_ID (from node field added to link file in TransCAD)
  - b. “to\_node” to indicate node id at end of link
    - i. Use “Field Calculator” to calculate to\_node = TO\_ID (to node field added to link file in TransCAD)
  - c. “Type” to indicate link type
    - i. Use “Field Calculator” to calculate Type = 100 where “SEGMENT = CC” (Use selection by attributes to establish which values to apply the calculation)
    - ii. Reverse selection and calculate Type = 1 for non “CC” links.
  - d. “FC” to indicate functional class
    - i. Use “Field Calculator” to calculate FC = FCYY where YY represents respective model year. Used to establish estimated capacity and speed if missing.
  - e. “AT” to indicate area type
    - i. Use “Field Calculator” to calculate AT = ATYY where YY represents respective model year. Used to establish estimated capacity and speed if missing.
  - f. “Lanes\_AB” to indicate lanes in direction drawn



## Cheat Sheet 5b

### Create a Shapefile for Import Directly from ArcGIS (non-VISTA format)

- i. Use “Field Calculator” to calculate lanes\_AB = ABLNYY where YY represents respective model year.
  - g. “Lanes\_BA” to indicate lanes in opposite direction
    - i. Use “Field Calculator” to calculate lanes\_BA = BALNYY where YY represents respective model year.
  - h. “Cap\_AB” to indicate capacity in direction drawn
    - i. Use “Field Calculator” to calculate value based on corresponding field, if available and intended for use. FC and AT combination can be used to establish estimated capacity if missing.
  - i. “Cap\_BA” to indicate capacity in opposite drawn
    - i. Use “Field Calculator” to calculate value based on corresponding field, if available and intended for use. FC and AT combination can be used to establish estimated capacity if missing.
  - j. “Speed\_AB” to indicate speed in direction drawn
    - i. Use “Field Calculator” to calculate value based on corresponding field, if available and intended for use. FC and AT combination can be used to establish estimated speed if missing.
  - k. “Speed\_BA” to indicate speed in opposite drawn
    - i. Use “Field Calculator” to calculate value based on corresponding field, if available and intended for use. FC and AT combination can be used to establish estimated speed if missing.
4. Save the shapefile
5. Be sure that the link and node files (shp, shx, dbf) contain connectors and centroids, respectively
6. Zip the link and node files together (shp, shx, and dbf files for each) – make sure that the file naming convention has consistent casing and naming convention with “link” and “node” in respective filenames



# Cheat Sheet 6

## Upload a Data Table

1. Access VISTA web portal and navigate to the network to which data will be uploaded
2. In the "Tables" Tab, select the table to be uploaded from the list on the left
3. Click on the "Upload" button

The following tables and views are available in this network.

schema public

- table boundary\_nodes
- table bus
- table bus\_frequency
- table bus\_period
- table bus\_route
- table bus\_route\_link
- table bus\_stop
- table bus\_time\_stamps
- table busarrivdelay
- table capacity\_lookup
- table celldata

public.capacity\_lookup

| fc | at | speed | lanes | capacity |
|----|----|-------|-------|----------|
| 0  | 1  | 60    | 1     | 100000   |
| 0  | 2  | 60    | 1     | 100000   |
| 0  | 3  | 60    | 1     | 100000   |
| 0  | 4  | 60    | 1     | 100000   |
| 0  | 5  | 60    | 1     | 100000   |
| 1  | 1  | 70    | 1     | 2300     |
| 1  | 2  | 70    | 1     | 2300     |

4. Click on "Choose File" and select the appropriate .csv file in your computer
  - a. The file must contain headers
  - b. The headers in the file must match the headers in database table
  - c. There may be additional data before the headers, which will be ignored.
5. Click on "upload"

Upload to table 'capacity\_lookup': Step 1

Please browse for the CSV file you wish to upload, and then click the "Upload" button.

Options

CSV file:  No file chosen

6. Examine the data sample to confirm that the correct file has been selected
7. Enter the line number corresponding to the row with column headers
8. Check box if existing data in the selected VISTA database table must be erased. If unchecked, new data will be ADDED to the table.
9. Click on "Start"

Upload to table 'capacity\_lookup': Step 2

```

1:      User,training
2:      Network,guad_scenario_am
3:      Table,public.capacity_lookup
4:      Tue Apr 12 15:40:24 2016
5:
6:      "fc","at","speed","lanes","capacity",
7:      "0","1","60","1","100000",
8:      "0","2","60","1","100000",
9:      "0","3","60","1","100000",
10:     "0","4","60","1","100000",
11:     "0","5","60","1","100000",
      ...
  
```

In the current CSV importer, the first line imported must be a comma-separated

Options

Table name: capacity\_lookup

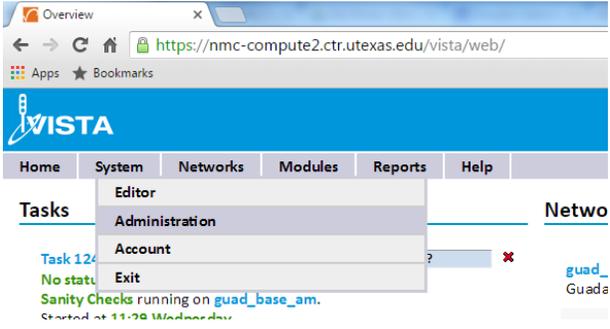
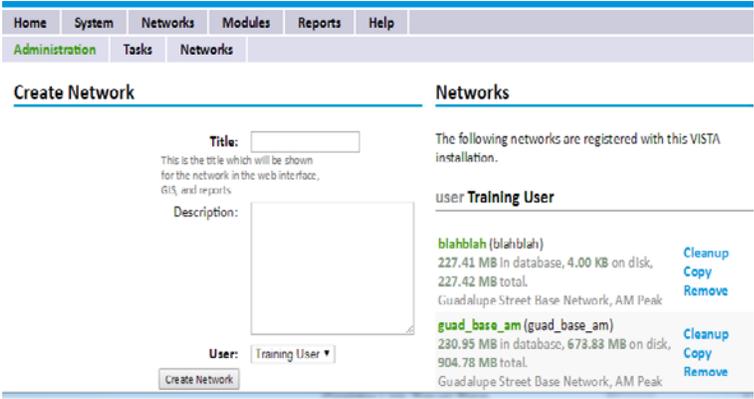
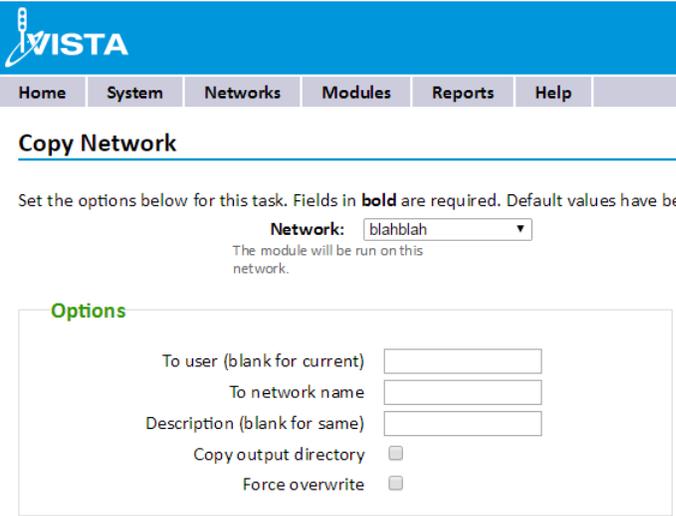
Start at line number:

Clear table first:

Notes: You may enter any notes you wish you to make about this run. These notes will be visible in the network history.

# Cheat Sheet 7

## Copy a Network

|   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Access VISTA web portal and login to project from which data will be copied</li> <li>2. Navigate to System -&gt; Administration</li> </ol>  |  <p>The screenshot shows a web browser window with the URL <a href="https://nmc-compute2.ctr.utexas.edu/vista/web/">https://nmc-compute2.ctr.utexas.edu/vista/web/</a>. The VISTA logo is at the top left. A navigation menu includes Home, System, Networks, Modules, Reports, and Help. A dropdown menu is open under 'System', showing options: Editor, Administration, Account, and Exit. A status message at the bottom reads: 'Sanity Checks running on guad_base_am. Started at 11:28 Wednesday'.</p>  |
| <ol style="list-style-type: none"> <li>3. Select the Networks Tab</li> <li>4. Click on the "copy" option for the desired network</li> </ol>   |  <p>The screenshot shows the 'Create Network' form on the left and a list of existing networks on the right. The 'Create Network' form has fields for 'Title' (with a note: 'This is the title which will be shown for the network in the web interface, GIS, and reports'), 'Description', and 'User' (set to 'Training User'). A 'Create Network' button is at the bottom. The 'Networks' section lists two networks: 'blahblah (blahblah)' and 'guad_base_am (guad_base_am)'. Each network entry includes size information and 'Cleanup', 'Copy', and 'Remove' links.</p> |
| <ol style="list-style-type: none"> <li>5. Adjust options as desired             <ol style="list-style-type: none"> <li>i. Destination username (if network will be used in a different project)</li> <li>ii. New network name</li> <li>iii. Click to copy results (warmstart/network refinement)</li> <li>iv. Replace existing database if name exists</li> </ol> </li> </ol> |  <p>The screenshot shows the 'Copy Network' page. It has a 'Network:' dropdown menu set to 'blahblah' with a note: 'The module will be run on this network.' Below is an 'Options' section with four input fields: 'To user (blank for current)', 'To network name', 'Description (blank for same)', and 'Copy output directory' (with a checkbox). There is also a 'Force overwrite' checkbox.</p>   |



# Cheat Sheet 8

## Import Travel Demand Data

- Navigate to desired network and upload table “od\_data”
- Format:
  - One row per origin/destination pair
  - Columns:
    - i. Origin ID
    - ii. Destination ID
    - iii. Demand in four categories:
      - iv. SOV
      - v. HOV2
      - vi. HOV3
      - vii. Trucks
      - viii. External
    - All passenger car types are added together as vehicles type 1 when the VISTA travel demand is generated
    - Origin/Dest ID must be TAZ IDs consistent with those used when uploading the network or VISTA centroid IDs created using the same convention used when creating the network data.

| origin | dest | sovr      | hov2     | hov3     | auto_ext | truck    |
|--------|------|-----------|----------|----------|----------|----------|
| 344    | 345  | 7.395988  | 2.434228 | 0.628663 | 3.4272   | 1.071    |
| 344    | 347  | 1.344435  | 0.445956 | 0.104963 | 0.2142   | 0.1071   |
| 344    | 348  | 0.584976  | 0.166497 | 0.042993 | 0.218618 | 0.187387 |
| 344    | 356  | 5.131109  | 1.94562  | 0.415739 | 1.4994   | 0.5355   |
| 344    | 358  | 3.966153  | 1.471484 | 0.314171 | 0.9639   | 0.5355   |
| 344    | 359  | 3.448399  | 1.115527 | 0.273762 | 1.2852   | 0.6426   |
| 344    | 360  | 6.095775  | 1.942564 | 0.485795 | 2.4633   | 0.9639   |
| 344    | 361  | 13.477625 | 3.949652 | 0.956709 | 0.6426   | 0.6426   |
| 344    | 362  | 14.82028  | 5.114009 | 1.189574 | 0.8568   | 1.1781   |

- Run query to create static OD table (refer to Cheat Sheet 11 – Running Database Queries)
- Run query to create border centroids (refer to Cheat Sheet 11 – Running Database Queries) (only if the original query returns a table with a list of missing origins/destinations)

**Query**

You may execute queries and commands on your network database using this form. Be careful! Any operations done using this form cannot be undone.

3,

**Query:**  
This can be any SQL query or statement. Be careful! Any changes you make to the database cannot be undone.

Notes:

Execute

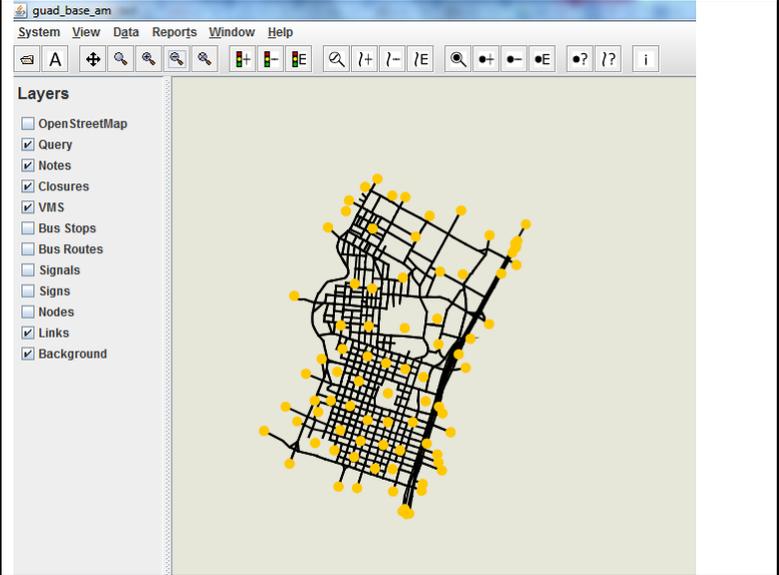


# Cheat Sheet 8

## Import Travel Demand Data

- Verify that static OD table has been created by looking at it in the web portal
- Verify that there are centroid nodes at all entry points
  - Run the following node query in the VISTA GIS editor (refer to Cheat Sheet 3 – Using the VISTA GIS Editor)

“select id from nodes where type=100”



# Cheat Sheet 9

## Model Results Validation

### Creating Validation Data

#### Link counts

|                       |   |
|-----------------------|---|
| Map                   | <ul style="list-style-type: none"> <li>Map traffic counts to model Link IDs (manual)</li> </ul>   |
| Define time intervals | <ul style="list-style-type: none"> <li>For each available count, identify start and end time of the corresponding data collection period (in seconds from beginning of simulation)</li> <li>Aggregate data as desired (manual)</li> </ul>   |
| Group                 | <ul style="list-style-type: none"> <li>Create groups based on data source, collection date, project characteristics, etc.</li> <li>Data for all links in a group must have same number and duration of intervals</li> <li>At least one group must be specified</li> <li>Table <b>count_group</b></li> </ul> |
| Create                | <ul style="list-style-type: none"> <li>Populate table <b>link_volume_data</b></li> </ul>  |

#### Corridor Travel Times from Probe vehicles

|                       |  |
|-----------------------|--|
| Map                   | <ul style="list-style-type: none"> <li>Map corridors to sequence of links using tables               <ul style="list-style-type: none"> <li>bus_route: define one per corridor</li> <li>bus_route_link: one sequence of links required for each routes.</li> <li>bus_period: define the period within the model during which probes will be simulated (start and end defined in seconds from the beginning of the model). Typically consistent with the period during which field data was collected.</li> <li>bus_frequency: define how often probe vehicles should be simulated within the defined period. Smaller frequencies will produce a better representation of average travel times, but values lower than 300 seconds (5 minutes) may alter corridor travel time significantly. One row per route.</li> </ul> </li> </ul>   |
| Define time intervals | <ul style="list-style-type: none"> <li>For each available probe identify start time and arrival time to one or more intersections along the corridor(manual)</li> </ul>  |
| Group                 | <ul style="list-style-type: none"> <li>Create groups based on data source, collection date, project characteristics, etc.</li> <li>At least one group must be specified</li> <li>Table <b>ttime_group</b></li> </ul>   |
| Create                | <ul style="list-style-type: none"> <li>Populate table <b>ttime_data</b> <ul style="list-style-type: none"> <li>Include data for one or more probe vehicles per defined corridor. Use field “<b>vehid</b>” to identify probes.</li> <li>For each probe enter information for AT LEAST the <b>first and last links</b> along the corridor.               <ul style="list-style-type: none"> <li><b>Link_atime</b> : arrival time to the link. For the first link, this is consistent with the departure time of the probe vehicle.</li> <li><b>Link_dtime</b> : departure time from the link. For the last link, this is consistent with the arrival time of the probe to its destination.</li> <li>If arrival time data is NOT available for the last link on the corridor set it equal to the last available link_atime.</li> </ul> </li> <li>If arrival time data <b>to intermediate intersections</b> along the corridor is available for one or more points               <ul style="list-style-type: none"> <li>Set <math>link\_dtime(i)=link\_atime(i+1)</math>, where i and i+1 are two successive links in the corridor.</li> </ul> </li> </ul> </li> </ul> |



# Cheat Sheet 9

## Model Results Validation

### Typical causes of differences between model results and field data

| Cause                            | Explanation  | Find/Fix  |
|----------------------------------|--|---|
| Error in network attributes      | User error when defining network attributes may create unrealistic congestion or provide excessive capacity, distorting traffic patterns   | Double check signal timing plans, capacities, speed limits & number of lanes in locations of concern.   |
| Placement of centroid connectors | Centroid connectors define traffic entry/exit points and their location may distort traffic counts and/or increase/decrease congestion.  | Assess whether centroid connectors in the area of concern may be affecting traffic patterns significantly, and considering new placement or changes to the traffic network that may mitigate their impact.  |
| Congestion                       | Overly congested networks may exhibit lower counts during a specific time period (but adequate values over the entire simulation). DTA models may create more congestion due to capacity constraints and explicit modeling of traffic signals. | <p>Identify and fix possible causes of artificial congestion</p> <ul style="list-style-type: none"> <li>Errors in signal timing plans or network attributes</li> <li>Errors in travel demand</li> <li>Position of centroid connectors</li> </ul> <p>Assess whether overall network capacity is adequately represented</p> |
| Travel demand matrix             | The temporal or spatial distribution of travel demand may not be correct   | <p>Use traffic counts or other data sources to adjust demand profile</p> <p>Use data to adjust OD matrix.</p> <ul style="list-style-type: none"> <li>The process is complex, and it is not easy to project changes into future year networks.</li> </ul>  |
| Error in data                    | Often, data samples are small and they may not represent typical traffic conditions. There may be also human errors during data processing   | <ul style="list-style-type: none"> <li>Identify and fix processing errors.</li> <li>Use data from alternative sources to double-check the validation data in problematic areas (google maps, traffic sensors)</li> </ul>  |



# Cheat Sheet 10

## Run a DTA Model in VISTA

### DUE New

#### Set run-time options

1. Login to the VISTA web portal and navigate to the desired network
2. In the "Options" tab adjust the Simulation parameters (all other values are automatically adjusted)
  - a. Duration: Length of simulation period. Should be at least 2 hours longer than demand profile.
  - b. Mesoscopic step: 3 or 6 seconds. Run module "Prepare Network" after making a change. Smaller values lead to more precise simulation but longer run times
  - a. Mesoscopic Delta: Related to the speed at which congestion is propagated through the network. Recommended value is 0.5, other values may be adopted if justified by data/research.

The screenshot shows the VISTA web portal interface. The top navigation bar includes Home, System, Networks, Modules, Reports, and Help. Below this, a breadcrumb trail shows 'guad\_base\_am' > Overview > Options > History > Tables > Query. The main content area is titled 'Assignment' and contains several input fields with descriptive text:

- Direction Cutoff**: Input field with value '1'. Description: Force the direction choice to include only the this fraction of the total gap, starting with trips having the most gap. This value must be between 0 and 1.
- Lambda Maximum**: Input field with value '0.000000000000000000'. Description: The maximum lambda value to use in dynamic user equilibrium assignment iterations.
- Minimum Gap**: Input field with value '0.05'. Description: Stop the assignment search when the gap is at or below this fraction of total travel time. This value must be between 0 and 1.

Below the 'Assignment' section is the 'Simulation' section with the following fields:

- Duration**: Input field with value '30600'. Description: The length of the simulation period, in seconds.
- Mesoscopic Step**: Input field with value '3'. Description: The default time step to be used in mesoscopic simulation, in seconds.
- Mesoscopic Delta**: Input field with value '0.5'. Description: The backwards propagation factor to use in cell transmission.

#### Run DUE-New

1. Go to Module->DUE New
2. Confirm that the selected network is correct
3. Options:
  - c. Total Iterations: Recommended to start with 20
  - d. Prevent gap increase: not recommended
  - e. Seed Random number: recommended for reproducibility of results
  - f. Partial demand loading: recommended values 3-7
  - g. Warm-start: use if an existing set of results can be used to reduce computational effort. Results MUST be totally consistent with latest network data.
  - h. Route report: Used only for software development & enhancement.
  - i. Non exiting vehicles threshold: it may be used to accelerate convergence. Recommended values depend on network characteristics. Use a large value (>30% of demand) if combined with new run.

The screenshot shows the 'DUE - New' configuration page in the VISTA web portal. The top navigation bar is the same as in the previous screenshot. The main content area is titled 'DUE - New' and contains the following elements:

- A message: "Set the options below for this task. Fields in **bold** are required. Default values have been" followed by a dropdown menu for 'Network:' with the value 'guad\_base\_am' selected. Below the dropdown is the text: "The module will be run on this network."
- An 'Options' section with several input fields and checkboxes:
  - Run to total iteration #**: Input field with value '5'.
  - Prevent gap increase**: Checkbox, currently unchecked.
  - Seed random number generator**: Checkbox, currently checked.
  - Partial Demand Loading iterations**: Input field with value '5'.
  - Warm start iteration (0 for none)**: Input field with value '0'.
  - Route report CSV**: Checkbox, currently unchecked.
  - Nonexiting incr. thresh. (0: off)**: Input field with value '0'.
- A 'Notes' section with a text area and a 'Start' button. The text area contains the message: "You may enter any notes you wish you to make about this run. These notes will be visible in the network history."



# Cheat Sheet 10

## Run a DTA Model in VISTA

### DUE Continue

#### Decide if needed

1. Analyze output of last DUE new/DUE continue run
2. Run when gap after DUE new (or last DUE Continue run) is higher/less stable than desired. Acceptable values depend on network (10% in large networks, 1-3% in small networks).
3. In some cases DUE continue is not able to improve the gap. This may reflect issues in the existing network, excessive congestion, or insufficient capacity.
  - j. Large, congested networks may require manually running other built in procedures to reduce gap.

| Iteration | Lambda  | Non-exiting | Exiting | Total travel time | Cost gap     | Cost gap per vehicle | Cost gap percentage | New paths | Total paths | Vehicles moved | Time(s)  |
|-----------|---------|-------------|---------|-------------------|--------------|----------------------|---------------------|-----------|-------------|----------------|----------|
| 1         | 1.00000 | 160653      | 56387   | 13270926.22       | 5840671.8378 | 26.910578            | 44.01103            | 75174     | 75174       | 0              | 431.5357 |
| 2         | 0.50000 | 158427      | 58613   | 15434571.09       | 7220273.4933 | 33.267018            | 46.77988            | 28348     | 103522      | 78639          | 228.6041 |
| 3         | 0.33333 | 134704      | 82336   | 10768100.69       | 3911357.1556 | 18.021365            | 36.32356            | 31572     | 135094      | 50671          | 209.5937 |
| 4         | 0.25000 | 130782      | 86258   | 9073530.31        | 3040267.6622 | 14.007868            | 33.50700            | 34638     | 169732      | 37924          | 204.1811 |
| 5         | 0.20000 | 114172      | 102868  | 8083396.27        | 2532167.2889 | 11.669588            | 31.33296            | 29490     | 199222      | 29386          | 193.3345 |
| 6         | 0.16667 | 80361       | 136679  | 5191797.19        | 1976587.5209 | 9.107020             | 38.07135            | 30464     | 229686      | 23798          | 172.2495 |
| 7         | 0.14286 | 67956       | 149084  | 3813543.82        | 1633825.4222 | 7.527762             | 42.84271            | 28977     | 258663      | 21151          | 167.4536 |
| 8         | 0.12500 | 55100       | 161940  | 2452431.93        | 1055111.8222 | 4.861370             | 43.02308            | 25588     | 284251      | 18486          | 164.1655 |
| 9         | 0.11111 | 61013       | 156027  | 3402864.64        | 1301193.2444 | 5.995177             | 38.23817            | 15613     | 299864      | 16102          | 172.4603 |
| 10        | 0.10000 | 46543       | 170497  | 2249025.42        | 976183.9644  | 4.497715             | 43.40475            | 24215     | 324079      | 13731          | 174.5979 |
| 11        | 0.09091 | 84526       | 132514  | 5179608.18        | 1965719.1822 | 9.056944             | 37.95112            | 11847     | 335926      | 12749          | 206.3033 |
| 12        | 0.08333 | 25390       | 191650  | 1199695.79        | 713075.9111  | 3.285458             | 59.43806            | 21030     | 356956      | 11514          | 180.2983 |
| 13        | 0.07692 | 38526       | 178514  | 2000003.70        | 836096.7111  | 3.852270             | 41.80476            | 8528      | 365484      | 10583          | 181.5324 |
| 14        | 0.07143 | 11992       | 215848  | 135744.13         | 11232.4756   | 0.051753             | 8.27474             | 15450     | 380934      | 9519           | 187.7821 |
| 15        | 0.06667 | 41          | 216999  | 115127.06         | 8153.6622    | 0.037568             | 7.08232             | 4240      | 385174      | 8700           | 178.9424 |
| 16        | 0.06250 | 0           | 217040  | 100353.99         | 6558.9378    | 0.030220             | 6.53580             | 6568      | 391742      | 8073           | 183.9875 |
| 17        | 0.05882 | 0           | 217040  | 95372.30          | 5851.9244    | 0.026962             | 6.13587             | 3348      | 395090      | 7395           | 179.7915 |
| 18        | 0.05556 | 21086       | 195954  | 1027843.20        | 587964.5156  | 2.709015             | 57.20372            | 4674      | 399764      | 6621           | 191.2447 |
| 19        | 0.05263 | 0           | 217040  | 90437.87          | 4637.9322    | 0.021369             | 5.12831             | 4461      | 404225      | 6516           | 188.9976 |
| 20        | 0.05000 | 0           | 217040  | 88614.39          | 4417.2258    | 0.020352             | 4.98477             | 3481      | 407706      | 6055           | 186.4673 |
| True gap  | 0.00000 | 0           | 217040  | 88614.39          | 4483.7903    | 0.020659             | 5.05989             | 3820      | 411526      | 0              | 233.4700 |

#### Options

1. Total Iterations: reflects the total number of iterations including those previously run (refer to the last number visible in the log of the last run)
2. Equilibrate: check if no more path searches are needed. Usually done when the true gap is very close to the last relative gap value in the latest run log (<0.1-0.5%).
3. Prevent gap increase: usually desirable after the first 20 iterations (if all vehicles are exiting)
4. **Other options as above**

**DUE - Continue**

Set the options below for this task. Fields in **bold** are required. Default values have been

Network: **guad\_base\_am**  
The module will be run on this network.

**Options**

Run to total iteration #

Equilibrate

Prevent gap increase

Seed random number generator

Route report CSV

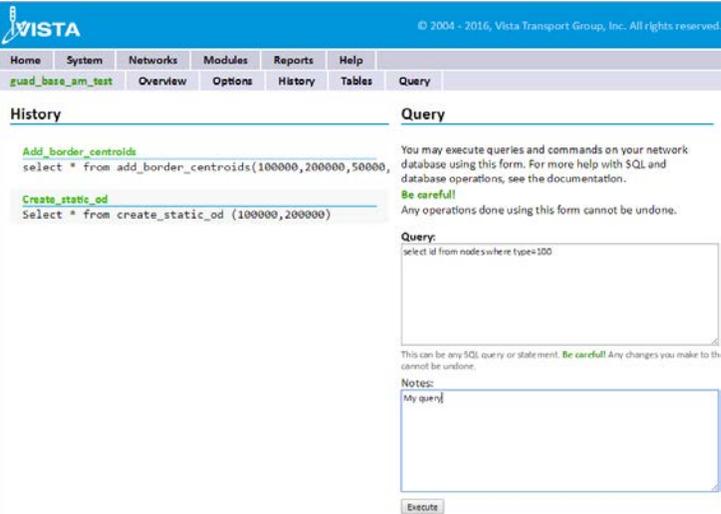
Nonexiting incr. thresh. (0: off)

Notes:  
You may enter any notes you wish you to make about this run. These notes will be visible in the network history.



# Cheat Sheet 11

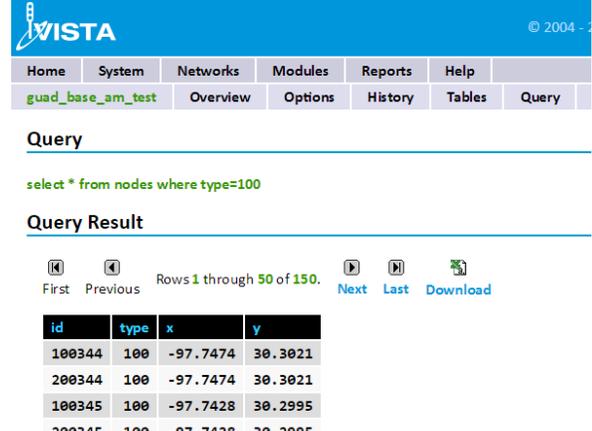
## Run VISTA Queries

|  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Access VISTA web portal and login to project from which data will be copied</li> <li>2. Navigate to desired Network and select the “Query” tab</li> </ol>  |   |
| <ol style="list-style-type: none"> <li>3. Approaches to execute a query             <ol style="list-style-type: none"> <li>a. Type a query in the Query box using SQL (see examples below).                 <ol style="list-style-type: none"> <li>i. The last 10 successfully executed queries are saved on the left.</li> </ol> </li> <li>b. If you write a name for your query in the “Notes box”, it will save the query as a “Named” query. These are not replaced by new queries. Only 10 Named queries can be stored per database. To make space for new ones, run query: “delete from userquery”</li> <li>c. Choose a named query or a previously run query from the list on the left</li> </ol> </li> </ol> |  |



# Cheat Sheet 11

## Run VISTA Queries

| <ol style="list-style-type: none"> <li>4. If the query returns data, results are displayed in a table that may be downloaded</li> <li>5. BE CAREFUL if you run queries that <b>update/delete from tables</b>, as these can NOT be UNDONE.</li> </ol> |  <p>The screenshot shows the VISTA web interface. At the top, there is a navigation menu with options: Home, System, Networks, Modules, Reports, Help. Below this, there are sub-menus: quad_base_am_test, Overview, Options, History, Tables, Query. The main content area shows a query: <code>select * from nodes where type=100</code>. Below the query, there is a 'Query Result' section with a table of results. The table has columns: id, type, x, y. The results are:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>id</th> <th>type</th> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>100344</td> <td>100</td> <td>-97.7474</td> <td>30.3021</td> </tr> <tr> <td>200344</td> <td>100</td> <td>-97.7474</td> <td>30.3021</td> </tr> <tr> <td>100345</td> <td>100</td> <td>-97.7428</td> <td>30.2995</td> </tr> <tr> <td>200345</td> <td>100</td> <td>-97.7428</td> <td>30.2995</td> </tr> </tbody> </table> | id       | type    | x | y | 100344 | 100 | -97.7474 | 30.3021 | 200344 | 100 | -97.7474 | 30.3021 | 100345 | 100 | -97.7428 | 30.2995 | 200345 | 100 | -97.7428 | 30.2995 |
|--|--|----------|---------|---|---|--------|-----|----------|---------|--------|-----|----------|---------|--------|-----|----------|---------|--------|-----|----------|---------|
| id   | type   | x        | y       |   |   |        |     |          |         |        |     |          |         |        |     |          |         |        |     |          |         |
| 100344   | 100  | -97.7474 | 30.3021 |   |   |        |     |          |         |        |     |          |         |        |     |          |         |        |     |          |         |
| 200344   | 100  | -97.7474 | 30.3021 |   |   |        |     |          |         |        |     |          |         |        |     |          |         |        |     |          |         |
| 100345   | 100  | -97.7428 | 30.2995 |   |   |        |     |          |         |        |     |          |         |        |     |          |         |        |     |          |         |
| 200345   | 100  | -97.7428 | 30.2995 |   |   |        |     |          |         |        |     |          |         |        |     |          |         |        |     |          |         |

## Sample Queries Using Custom Database Functions

### Results Validation

#### Comparing link counts

|                   |  |
|-------------------|--|
| <b>Query</b>      | <code>select * from link_count_check();</code>   |
| <b>GOAL</b>       | Compare <b>model results to count data</b> as specified in <a href="#">link_volume_data</a> table  |
| <b>Parameters</b> | None   |
| <b>Results</b>    | <p>[linkid]: link ID</p> <p>[from_sec]: start of the analysis interval</p> <p>[to_sec]: end of the analysis interval</p> <p>[field_count]: field counts for the selected period</p> <p>[model_count]: model counts for the selected period</p> <p>[error_veh]: difference between field and model counts. Negative values indicate underestimation by the model</p> <p>[error_perc]: difference between field and model counts, expressed as a percent of field counts. Negative values indicate underestimation</p> <p>[error_vph]: difference between field and model counts, expressed in vehicles per hour equivalent. Negative values indicate underestimation</p> <p>[count_groupid]: count group, as defined in table count_group</p> |

#### Comparing travel times

- The following queries compare model results (in tables [vehicle\\_path](#) and [vehicle\\_path\\_time](#)) to field data (in table [link\\_volume\\_data](#) ).
- Entries in tables [bus\\_route](#), [bus\\_route\\_link](#), [bus\\_frequency](#) and [bus\\_period](#) are required to collect data from model results.



# Cheat Sheet 11

## Run VISTA Queries

|                   |   |
|-------------------|---|
| <b>Query</b>      | <code>select * from corridor_ttime_validation(3600,7200,1800);</code>   |
| <b>GOAL</b>       | Comparison of <b>total corridor travel time</b> (average within the considered time aggregation)  |
| <b>Parameters</b> | <p><b>From time:</b> start time of the comparison, in seconds from beginning of simulation</p> <p><b>To time:</b> end time of the comparison, in seconds from beginning of simulation</p> <p><b>Aggregation:</b> time interval for the comparison. Only intervals for which there is field data available will be reported</p>  |
| <b>Results</b>    | <p>[[routeid] Route ID consistent with ttime_Data routeid and bus_route ID</p> <p>[from_sec] beginning of analysis period. The travel time of all probe vehicles departing within the analysis period will be averaged and compared to the travel time of all model probes departing during the same time frame. Corresponding standard deviations will be reported.</p> <p>[to_sec] end of analysis period</p> <p>[field_ttime_avg] average travel time of all reported probe vehicles departing during the considered period</p> <p>[field_ttime_stddev] standard deviation of probe travel time during the period</p> <p>[model_ttime_avg] average travel time of all model probes assigned during the considered period</p> <p>[model_ttime_stddev] standard deviation of model probe travel time during the period</p> <p>[ttime_error_min] difference between average travel time in the model and according to probe data. Negative values indicate underestimation by the model</p> <p>[ttime_error_perc] travel time error as above, expressed as a percent of field travel time</p> <p>[ttime_groupid] group id for analysis purposes (identifying source or other)</p> |

|                   |  |
|-------------------|--|
| <b>Query</b>      | <code>select * from validate_corridor_link_tt(7200,10800,3600);</code>   |
| <b>GOAL</b>       | Compare <b>segment travel time</b> (average within the considered time aggregation)  |
| <b>Parameters</b> | <p><b>From time:</b> start time of the comparison, in seconds from beginning of simulation</p> <p><b>To time:</b> end time of the comparison, in seconds from beginning of simulation</p> <p><b>Aggregation:</b> time interval for the comparison. Only intervals for which there is field data available will be reported</p>   |
| <b>Results</b>    | <p>routeid] route id, consistent with bus_route and ttime_data</p> <p>[ttime_groupid] ttime group id</p> <p>[from_t] start of analysis period</p> <p>[to_t] end of analysis period</p> <p>[to_link] considered link along the corridor</p> <p>[field_tt_to_link] travel time from beginning of corridor to link source. Average across all probes departing within the analysis period</p> <p>[field_link_ttime] travel time on link (from source to destination, as defined in vista). Average across all probes departing within the analysis period</p> <p>[model_tt_to_link] travel time from beginning of corridor to link source. Average across all buses departing within the analysis period</p> <p>[model_link_ttime] travel time on link (from source to destination, as defined in vista). Average across all buses departing within the analysis period</p> <p>[field_count] number of probes departing within the analysis period</p> <p>[model_count] number of buses dispatched during the analysis period</p> |



# Cheat Sheet 11

## Run VISTA Queries

|  |  |
|--|--|
|  | <p>[model_sd_tt_to_l] standard deviation of model ttime to link</p> <p>[model_sd_l_tt] standard deviation of model link travel time</p> <p>[field_sd_tt_to_l] standard deviation of field travel time to link</p> <p>[fieldl_sd_l_tt] standard deviation of field link travel time</p> |
|--|--|

|            |  |
|------------|--|
| Query      | <code>select * from get_probe_ttime();</code>  |
| GOAL       | Analyze <b>total travel time of individual vehicles (field data)</b>   |
| Parameters | None   |
| Results    | <p>[routeid] Route ID consistent with ttime_Data routeid and bus_route ID</p> <p>[vehid] Vehicle ID, consistent with ttime_data vehID</p> <p>[dtime] vehicle departure time</p> <p>[ttime] vehicle travel time</p> <p>[ttime_group_id] travel time grou, used to identify source or other grouping</p> |

|            |  |
|------------|--|
| Query      | <code>select * from get_veh_ttime();</code>  |
| GOAL       | Analyze <b>total travel time of individual vehicles (model data)</b>   |
| Parameters | None   |
| Results    | <p>[routeid] Route ID consistent with ttime_Data routeid and bus_route ID</p> <p>[vehid] Vehicle ID, consistent with ttime_data vehID</p> <p>[dtime] vehicle departure time</p> <p>[ttime] vehicle travel time</p> |

|            |  |
|------------|--|
| Query      | <code>select * from get_probe_ttime_link();</code>   |
| GOAL       | Analyze <b>segment travel time for all vehicles (field)</b>  |
| Parameters | None   |
| Results    | <p>[routeid] route id consistent with bus_Route and ttime data</p> <p>[vehid] vehicle id, consistent with ttime_data</p> <p>[dtime] vehicle departure time</p> <p>[linkid] link id</p> <p>[ttime_to_link_source] cumulative travel time to beginning of link</p> <p>[link_ttime] travel time on link</p> <p>[ttime_groupid] travel time group for analysis purpose</p> |

|            |   |
|------------|---|
| Query      | <code>select * from get_veh_ttime_data();</code>            |
| GOAL       | Analyze <b>segment travel time for all vehicles (model)</b> |
| Parameters | None  |



# Cheat Sheet 11

## Run VISTA Queries

|                |  |
|----------------|--|
| <b>Results</b> | [[routeid] route id consistent with bus_Route and ttime data<br>[vista_vehid] vehicle id, consistent with bus,demand tables<br>[dttime] vehicle departure time<br>[linkid] link id<br>[ttime_to_link_source] cumulative travel time to beginning of link<br>[link_ttime] travel time on link |
|----------------|--|

### Scenario Analysis

- The following queries summarize results for an individual scenario based on data imported to tables **vehicle\_path** and **vehicle\_path\_time**
- Entries in table **links\_for\_analysis** and **link\_group** are required to identify analyzed links
- Entries in tables **bus\_route**, **bus\_route\_link**, **bus\_frequency** and **bus\_period** are required to report corridor travel time results.

|                   |   |
|-------------------|---|
| <b>Query</b>      | <code>select * from link_flow_analysis(0,10800,900) ;</code>  |
| <b>GOAL</b>       | Analyze <b>link volumes</b> for links in table <b>links_for_analysis</b>  |
| <b>Parameters</b> | <b>From time:</b> start time of the comparison, in seconds from beginning of simulation<br><b>To time:</b> end time of the comparison, in seconds from beginning of simulation<br><b>Aggregation:</b> time interval for the comparison. Only intervals for which there is field data available will be reported |
| <b>Results</b>    | [linkid]: link ID<br>[from_sec]: start of the analysis interval<br>[to_sec]: end of the analysis interval<br>[counts]: model counts for the selected period<br>[vph]: model counts for the selected period expressed in vph<br>[link_groupid]: group id as defined in table link_group                          |

|                   |  |
|-------------------|--|
| <b>Query</b>      | <code>select * from corridor_ttime(0,7200,1800);</code>  |
| <b>GOAL</b>       | Analyze <b>total corridor travel time</b> (average within selected time interval)  |
| <b>Parameters</b> | <b>From time:</b> start time of the comparison, in seconds from beginning of simulation<br><b>To time:</b> end time of the comparison, in seconds from beginning of simulation<br><b>Aggregation:</b> time interval for the comparison. Only intervals for which there is field data available will be reported  |
| <b>Results</b>    | [routeid] Route ID consistent with ttime_Data routeid and bus_route ID<br>[from_sec] beginning of analysis period. The travel time of all probe vehicles departing within the analysis period will be averaged and compared to the travel time of all model probes departing during the same time frame. Corresponding standard deviations will be reported.<br>[to_sec] end of analysis period<br>[model_ttime_avg] average travel time of all model probes assigned during the considered period |



# Cheat Sheet 11

## Run VISTA Queries

|  |   |
|--|---|
|  | <p>[model_ttime_stddev] standard deviation of model probe travel time during the period</p> <p>[avg_speed_mph] average speed on the corridor in mph. Computed using average travel time over corridor length</p> <p>[stddev_speed_mph] standard deviation of the speed of each probe on the corridor, computed as above</p> <p>[corridor_length_mi] corridor length, computed as the summation of the length of all links in the bus_oute_link table, and used for speed computations</p> |
|--|---|

|            |  |
|------------|--|
| Query      | <code>select * from bus_link_report();</code>  |
| GOAL       | Analyze <b>link-by-link travel time for all vehicles</b> in each corridor ( as defined in <b>bus_route table</b> )   |
| Parameters | None   |
| Results    | <p>[veh_id] VISTA vehicle ID</p> <p>[route] bus route ID</p> <p>[to_link] link along the vehicle route</p> <p>[distance_ft] cumulative distance traveled from beginning of route to the END of the considered link</p> <p>[sim_departure_sec] departure time of vehicle in seconds from beginning of simulation</p> <p>[link_at_time_sec] arrival time to begginign of link in seconds from the start of the simulation</p> <p>[dwelltime_sec] irrelevant for this analysis</p> <p>[ttime_sec] cummualtive travel time from the beginning of the route to the end of the route</p> |

### Travel Demand Creation

|            |   |
|------------|---|
| Query      | <code>Select * from create_static_od (100000,200000)</code>   |
| GOAL       | Generate table static_od based on data in table <b>od_data</b>  |
| Parameters | <p><b>Origin centroid offset:</b> Value to be added to the “origin” column in table od_data to generate the “origin” column in table static_od</p> <p><b>Destination Centroid Offset:</b> Value to be added to the “dest” column in table od_data to generate the “destination” column in table static_od</p> |
| Results    | Populated static_od table   |



# Cheat Sheet 11

## Run VISTA Queries

|                   |  |
|-------------------|--|
| <b>Query</b>      | <code>select * from add_border_centroids(100000,200000,50000,1000000);</code>  |
| <b>GOAL</b>       | Insert centroids and corresponding connectors on top of regular nodes listed as trip origins/destinations in the od_data table   |
| <b>Parameters</b> | <p><b>Origin centroid offset:</b> Value to be added to the “origin” column in table od_data to generate the “origin” column in table static_od</p> <p><b>Destination Centroid Offset:</b> Value to be added to the “dest” column in table od_data to generate the “destination” column in table static_od</p> <p><b>Border Centroid Offset:</b> Value to be added ( in addition to the corresponding centroid offset) to the origin/dest column in table od_data to generate the origin/destination ID column in table static_od. The same ID will be used to denote new centroid nodes (border centroids) located at the same position as the node ID listed in the od_data table.</p> <p><b>Border Connector Offset:</b> Value to be added to the border centroid ID to generate the ID of the corresponding centroid connector.</p> |
| <b>Results</b>    | Updates/additions to tables links, linkdetails, nodes and static_od  |



## Exercise 1.1

### Import Shapefiles (CAMPO Format)

1. Login to the VISTA web portal
2. Upload capacity\_lookup table consistent with network data
  - a. Locate file “capacity\_lookup.csv”
  - b. In the VISTA web portal, select the target network and navigate to the “Tables” tab
  - c. Select table “capacity\_lookup” from the list of tables on the left of the screen
  - d. Click on “Upload”
  - e. Click on “Choose file” and select the .csv file identified in a)
  - f. Adjust options:
    - i. Start at line number 6 (which contains the appropriate headers for this table).
    - ii. It is not necessary to clear the table, as it is empty to begin with.
  - g. Click on “start” to run the module
3. Locate network shapefile and supporting files as a zipped package:  
“CAMPO\_Subnetwork\_Sample.zip”
  - a. Node and link files (shp, shx, and dbf files for each) must be zipped for import into VISTA
  - b. See cheat sheet on instructions for creating network shapefiles in TransCAD for import into VISTA
4. In the VISTA web portal, select the “Modules” tab and click on the “Shapefile Import” module
5. Make sure that the network select in the drop down menu says “guad\_base\_am\_test”
6. Click the “Browse...” button and find the location of the zip file. Select the file for import “CAMPO\_Subnetwork\_Sample.zip” and click “Open”.
7. Make sure that the options are set consistently with the following:
  - a. Check the box next to “Import nodes to node\_data”
  - b. Check the box next to “Import links to link\_data”
  - c. Leave the box unchecked next to “Data are in VISTA format”
  - d. Check the box next to “Create VISTA nodes table”
  - e. Check the box next to “Create VISTA links tables”
  - f. Check the box next to “Split centroids and their connectors”
    - i. This splits single centroids in the current CAMPO format to dual centroids consistent with VISTA format (1 origin and 1 destination per TAZ)
  - g. Change the “Centroid ID offset” to 1000000 (1 million)
    - i. This sets the offset from the CAMPO centroid ID to an offset ID in VISTA (original CAMPO ID + offset value for origin centroids; original CAMPO ID + 2 \* offset value for destination centroids)



## Exercise 1.1

### Import Shapefiles (CAMPO Format)

- h. Leave the “Connector ID offset” to the default (1000000)
    - i. This sets the offset from the CAMPO connector ID to an offset ID in VISTA (original CAMPO ID + offset value for origin/outbound connectors; original CAMPO ID + 2 \* offset value for destination/inbound connectors)
  - i. Check the box next to “Split bidirectional links”
    - i. This splits links in the current CAMPO format to directional links consistent with VISTA format
  - j. Change the “Bidirectional link ID offset” to 1000000 (1 million)
    - i. This sets the offset from the CAMPO link ID for bidirectional links with the CAMPO ID for one direction and an offset ID (original CAMPO ID + offset value) for the opposite direction consistent with VISTA format
  - k. Uncheck the box next to “Links shapefile contains speeds”
    - i. If checked, the module uses speeds entered into the shapefile database for VISTA
    - ii. If unchecked, the module uses a VISTA lookup table to convert functional class and area type values entered into the shapefile to a speed estimate (the VISTA lookup table may be manually updated by the user)
  - l. Uncheck the box next to “Links shapefile contains capacities”
    - i. If checked, the module uses capacity values entered into the shapefile database for VISTA (these values must be set to a vehicles per hour total for the individual link directions [AB and BA], not per lane)
    - ii. If unchecked, the module uses a VISTA lookup table to convert functional class and area type values entered into the shapefile to a capacity estimate in vehicles per hour per lane (the VISTA lookup table may be manually updated by the user)
8. Add notes to document the import process
  9. Click the “Start” button to run the module
  10. Confirm the module status and that it has completed in the “Tasks” list; clicking on the Task number will show the status in real-time
  11. After the module completes, the database tables for “nodes”, “links” and “linkdetails” will be populated and may be reviewed
  12. Open the VISTA Editor to view the network
    - a. In the VISTA web portal, select the “System” tab and click on “Editor”
    - b. Complete the process to run the Java application
    - c. Enter the username (e.g., training##) and password (e.g., password) for the VISTA network and click “Login”
    - d. Select the network “guad\_base\_am\_test” in the dialogue box and click “Open”



## Exercise 1.1

### Import Shapefiles (CAMPO Format)

- e. The network and related attribute layers can be viewed and filtered in the Editor window



## Exercise 1.2

### Import Shapefiles (VISTA Format)

1. Locate network shapefile and supporting files as a zipped package:  
“VISTA\_Subnetwork\_Sample.zip”
  - a. Node and link files (shp, shx, and dbf files for each) must be zipped for import into VISTA
  - b. See cheat sheet on instructions for creating network shapefiles in ArcGIS for import into VISTA
2. In the VISTA web portal, select the “Modules” tab and click on the “Shapefile Import” module
3. Make sure that the network select in the drop down menu says “guad\_base\_am\_test”
4. Click the “Browse...” button and find the location of the zip file. Select the file for import “VISTA\_Subnetwork\_Sample.zip” and click “Open”.
5. Make sure that the options are set consistently with the following:
  - a. Check the box next to “Import nodes to node\_data”
  - b. Check the box next to “Import links to link\_data”
  - c. Check the box next to “Data are in VISTA format”
  - d. Check the box next to “Create VISTA nodes table”
  - e. Check the box next to “Create VISTA links tables”
  - f. Do not check the box next to “Split centroids and their connectors”
  - g. The “Centroid ID offset” may remain its default value as it will not be used in this format
  - h. The “Connector ID offset” may remain its default value as it will not be used in this format
  - i. Do not check the box next to “Split bidirectional links”
  - j. The “Bidirectional link ID offset” may remain its default value as it will not be used in this format
  - k. Check the box next to “Links shapefile contains speeds”
  - l. Check the box next to “Links shapefile contains capacities”
6. Add notes to document the import process
7. Click the start button to run the module
8. Confirm the module status and that it has completed in the “Tasks” list; clicking on the Task number will show the status in real-time
9. After the module completes, the database tables for “nodes”, “links” and “linkdetails” will be populated and may be reviewed
10. Open the VISTA Editor to view the network
  - a. In the VISTA web portal, select the “System” tab and click on “Editor”
  - b. Complete the process to run the Java application



## Exercise 1.2

### Import Shapefiles (VISTA Format)

- c. Enter the username (e.g., training##) and password (e.g., password) for the VISTA network and click “Login”
- d. Select the network “guad\_base\_am\_test” in the dialogue box and click “Open”
- e. The network and related attribute layers can be viewed and filtered in the Editor window



## Exercise 1.3

# Import and Prepare Demand Data

### Upload Data

1. Locate origin-destination (OD) demand files: “od\_data\_raw.csv” and “od\_data\_header.csv”
  - a. The OD data tables represent demand from the CAMPO model that can be exported using TransCAD in Origin, Destination table format, not matrix (origin, destination, sov, hov2, hov3, auto\_ext, truck are the included fields)
  - b. The OD data tables typically represent only a peak period for analysis (AM or PM peak)
  - c. The tables must be in CSV format for compatibility with the upload functionality in the VISTA web portal
2. Review the format of the Excel table “od\_data\_header.csv”
  - a. The table intended for import should have a header row that matches the corresponding table header row in VISTA
3. In the VISTA web portal and navigate to the table “od\_data”
  - a. Make sure that the active network is “guad\_base\_am\_test” (this can be found in the web address at the top of the page or under the “Home” tab in the web portal); if not, click on the “Networks” tab and select the appropriate network
  - b. Click on the “Tables” tab and find the “od\_data” table in the list to the left
4. While in the “Tables” tab, click on the table “od\_data” to view the table
5. Click on the “Upload” link
6. Click the “Browse...” button and find the location of the Excel data files. Select the file for import “od\_data\_raw.csv” and click “Open”
7. Click “Upload”
8. In the “Options” dialogue, change the “Start at line number:” to 1 and click “Start”
9. The upload task should now fail – note that this underscores the need to have a matching header row in VISTA. The upload process will fail otherwise.
10. Repeat the upload process for the “od\_data” table and use the “od\_data\_header.csv” file instead.
11. Confirm the task status and that it has completed in the “Tasks” list
12. Now navigate to the “**od\_data**” table for the “guad\_base\_am\_test” network and verify that the table is now populated with demand data
13. Next, navigate to the “**demand\_profile**” table and verify that it is populated; if it is not, complete the upload process as before by finding and selecting the “demand\_profile.csv” file



## Exercise 1.3

### Import and Prepare Demand Data

#### Create Static OD table

14. The next step involves using a function in VISTA which formats the data in “od\_data” to generate “static\_od” automatically. This function will become part of the “upload demand” module in future updates
  - a. The function is run by typing a query in the box available in the “Query” tab in the VISTA web portal
  - b. Appropriate queries have been saved in network “guad\_base\_am\_test”; these are listed on the left on the screen. To use **saved queries**, click on the query title (in green). This will paste the query in the query box. You can then press “execute”.
  - c. To create the static\_od table use query “Create\_static\_od”. The parameters are
    - i. Dummy Origin ID (100000): represents the number to be added to the origin ID in the “od\_data” table to be consistent with the “nodes” table for origin centroid IDs (set up during the network shapefile import process)
    - ii. Dummy destination ID (200000): represents the number to be added to the destination ID in the “od\_data” table to be consistent with the “nodes” table for destination centroids IDs
  - d. If the “create\_static\_od” function returns a table with “missing centroids”. These are nodes listed as origins/destinations in the od\_data table which are not coded as centroids in the nodes table. When subnetworks are used, missing centroids are typically found at the boundaries of the network, given that transcad uses regular nodes as origins/destination at such locations. Missing centroids may be visualized in the editor. The function described in the next sections can be used to add the necessary centroids and centroid connectors
  - e. To visualize existing centroids in the editor run the following query in the “node query” dialog  
“select id from nodes where type=100”
  - f. To visualize missing centroids in the editor run the following query in the “node query” dialog  
“select origin from od\_data where origin+100000 not in (select id from nodes )”

#### Add Border Centroids

15. Run saved query “add\_border\_centroids” as described in step 14. The parameters for this function are



## Exercise 1.3

### Import and Prepare Demand Data

- a. Dummy Origin ID (as in 14.c.i)
  - b. Dummy destination ID (as in 14.c.ii)
  - c. Dummy border ID: the number to be added to the node ID in the od\_data table to distinguish border centroids from regular centroids.
  - d. Dummy centroid connector ID: number to be added to the node id in the OD data table to generate the corresponding centroid connector ID. . In general the value is chosen so that the centroid connector IDs are higher than the centroid connector IDs for regular centroids and any other link ID. Typical values are 100000/1000000 depending on the order of magnitude of dummyO/dummyD
16. The function “add\_border\_centroids” will automatically do the following:
- a. Create an origin and a destination centroid on top of all boundary node locations; these centroids will have a node ID = original\_ID+DummyO+DummyB, where DummyO and DummyB are user inputs
  - b. Creates centroid connectors to connect the new origin/destination centroids to the underlying regular nodes. The connectors will have a link ID = original\_ID+DummyCC+DummyB for the origin connector, and original\_ID+DummyCC\*2+DummyB for the destination connector, where DummyCC is another user input

#### **Create vehicles**

17. In the VISTA web portal, select the “Modules” tab and click on the “Prepare Demand” module to generate a dynamic demand based on the “static\_od” and “demand\_profile” tables; the “Prepare Demand” module distributes the static demand based on the entered profile
18. Make sure that the network select in the drop down menu says “guad\_base\_am\_test”
19. Make sure that the options are set consistently with the following:
  - a. Leave the “Demand Percentage” at 100
  - b. Leave the box unchecked for “Use Dynamic Trips”
20. Add notes to document the import process
21. Click the start button to run the module
22. Confirm the module status and that it has completed in the “Tasks” list; clicking on the Task number will show the status in real-time
23. After the module completes, the database table for “demand” will be populated and may be reviewed
24. Verify that the network demand matches the “static\_od” table:
  - a. Click on the “Query” tab in the VISTA web portal, entering the following query and press “Execute”:



## Exercise 1.3

### Import and Prepare Demand Data

- b. `select sum(demand) from static_od;`
  - c. Compare this total against the total number of entries in the “demand” table; this can be done by selecting the table or running the following query:
  - d. `select count(*) from demand;`
25. Open the VISTA Editor to view the network
26. Select the “Query Nodes” button, enter the following query and select “Query” to run:
- a. `Select * from nodes where type = 100;`
  - b. This query will select all centroids in the network for viewing



## Exercise 1.4

### Create and Edit Traffic Control Data

1. Locate the intersection of Guadalupe and 21<sup>st</sup> in the VISTA editor
  - a. Turn on the “Open StreetMap” layer and find the Guadalupe Street/West 21<sup>st</sup> Street intersection at node ID 6339; this can also be done by using the “Find a Node” button
2. Click on the “Edit a Control Action” button and select node 6339; click “Ok” to add control for the intersection, click on the “Signals” radio button and select “Ok” to add a signal at the node
3. Insert a reasonable signal timing plan
  - a. Timing plans in nearby signals may be used as a reference. When data is available real timing plans are used (the NMC has a web-based tool to access available timing plans)
    - i. Enter the offset time
    - ii. Add a phase by clicking the “Add” button
    - iii. Select the allowed movements
    - iv. Enter the green, yellow, and all red times for each phase
    - v. Select “Ok” to save the entered data
4. With the “Open StreetMap” layer on, find the San Antonio Street/West 21<sup>st</sup> Street intersection at node ID 55000; this can also be done by using the “Find a Node” button
5. Click on the “Edit a Control Action” button and select node 55000; click “Ok” to add control for the intersection, click on the “Signs” radio button and select “Ok” to add sign control at the node
6. In the subsequent dialogue box, click on each approach to the intersection to adjust the sign control and establish a stop sign (clicking twice) for each of the three applicable approaches; then click the “Ok” button to save the control information
7. In the VISTA web portal, the following tables can be viewed to see entered control information
  - a. signals (node ID and offset time)
  - b. phases (phase ID, node ID, phase times, and linkto/from movements)
  - c. controlsigns (node ID, sign type [1 for stop, 2 for yield], and impacted approach link ID)



## Exercise 1.5

### Upload and View Calibration Data

1. Find the files for the traffic count data: “counts.csv” and “count\_group.csv”
2. Find the original data collection files: “Guadalupe\_Intersection\_Counts.pdf” and “Travel Time Run Summary”
3. Review the format of the “counts.csv” calibration data and compare it with the “Guadalupe\_Intersection\_Counts.pdf” file
4. Upload the tables through the vista web portal
  - a. In the “Options” dialogue, change the “Start at line number:” to 1 and click “Start”
5. Next, open the VISTA Editor to view the network and review link locations for the entered count data:
  - a. Select the “Query Links” button, enter the following query and select “Query” to run:

```
select * from links where id in (select linkid from link_volume_data);
```
  - b. The following query can isolate a count group (e.g., count group 1):

```
select * from links where id in (select linkid from link_volume_data where count_groupid=1);
```



## Exercise 1.6

### Review Transit Input Data

1. Access the VISTA web portal and navigate to the “Tables” tab for the “guad\_base\_am\_test” network:
  - a. Select the “bus\_route” table and review the bus routes entered in the model database (note some are set for travel time runs and others for transit)
    - i. Route ids 1-7 are for setting probe vehicle routes to collect travel time information from the model
    - ii. The other routes represent transit routes map matched from GTFS data
  - b. Select the “bus\_route\_link” table to review the link sequences for the different routes map matched in the model database
  - c. Select the “bus\_stop” table to review the map matched bus stops in the model database
  - d. Select the “bus\_frequency” and “bus\_period” tables to review the user-defined inputs
  - e. Select the “bus” table to review the individual buses assigned in the model by route and departure time (these are established by the “Prepare Transit” module)
2. Next, open the VISTA Editor to view the network and review link sequences for the transit routes:
  - a. Uncheck all of the layers on the left-hand side except for the “Bus Stops”, “Bus Routes”, and “Links” layers for ease of viewing transit data in the network
    - i. The bus routes are outlined in grey
    - ii. The bus stops are represented by bus icons
  - b. Individual routes may also be visualized using queries and in the visualization tool
    - i. Select the “Query Links” button to review a specific bus route sequence, enter the following query and select “Query” to run:  
select \* from links where id in (select link from bus\_route\_link where route = 1395855);
    - ii. In absence of knowing a specific coded route ID, review the “bus\_route” table for a CapMetro coded route name
    - iii. Use the following query to identify a link sequence for a specific route name (e.g., 1: Metric/South Congress SOUTHBOUND):
    - iv. select \* from links where id in (select link from bus\_route\_link where bus\_route\_link.route in (select id from bus\_route where name = ‘1: Metric/South Congress SOUTHBOUND’));



## Exercise 1.7

### Review Toll Input Data

1. Access the VISTA web portal and navigate to the “Tables” tab for the “guad\_base\_am\_test” network:
  - a. Select the “costfunction” table and review the costfunction entered in the model database
    - i. A separate function exists for passenger cars and trucks
    - ii. The “timefactor” is a representation of the value of time in the model in the unit \$/sec
    - iii. The “moneyfactor” represents a coefficient multiplier for the toll cost per link in the database
    - iv. The “distancefactor” represents a coefficient multiplier for the cost (\$) per unit mile
    - v. These function coefficients can be adjusted by the user
  - b. Select the “linktoll” table to review the links with tolls established
    - i. The “tolltypeid” represents 1 for passenger cars and 2 for trucks (separate toll rates for each vehicle class)
    - ii. The start and end times are associated with the simulation time over which the toll rates are to be established (allows for time variability)
    - iii. The “tollcost” is the total toll cost for the link (not a toll rate per unit length)
2. Next, open the VISTA Editor to view the network and review links with tolls applied:
  - a. Select the “Query Links” button, enter the following query and select “Query” to run:  
select \* from links where id in (select linkid from linktoll);
  - b. This will highlight the links in the network with a toll assigned for at least one vehicle type; zoom in to reveal the IH 35 ramps with tolls assigned



## Exercise 2.1

# Use the VISTA Sanity Check Module

### Run the module

1. Access the VISTA web portal and go to the “guad\_base\_am\_test” network
2. While in the “guad\_base\_am\_test” network, select the “Modules” tab from the menu and click on the “Sanity Checks” module
3. Make sure that the network select in the drop down menu says “guad\_base\_am\_test”
4. Add notes to document the module process if desired
5. Click the “Start” button to run the module
6. Confirm the module status and that it has completed in the “Tasks” list; clicking on the Task number will show the status in real-time

### Correct Errors

7. Click on a link to the network (click on the network name in the “Tasks” window)
8. On the “Task History” page, click on the “Log” icon for the Sanity Checks task (last completed task) to open the log file
  - a. The log file opens in a separate tab and shows the summary output, including the checks run and the number of errors reported
  - b. Some errors (e.g., network connectivity related errors) will cause subsequent network runs to completely fail; therefore, it is important to run this module before running the network and correct errors reported
9. Next, return to the “Task History” page, click on the “Output” icon for the Sanity Checks task to open the output file
  - a. The output file shows a more detailed output in html format; a description of each check is presented along with important network element attributes associated with individual reported errors
  - b. This information is more useful for specifically identifying and correcting errors than what is reported in the log file (though the log provides a general idea of how many issues are present in the model)
10. The next step is to open the VISTA Editor to view the network
  - a. In the VISTA web portal, select the “System” tab and click on “Editor”
  - b. Complete the process to run the Java application
  - c. Enter the username (e.g., training##) and password (e.g., password) for the VISTA network and click “Login”
  - d. Select the network “guad\_base\_am\_test” in the dialogue box and click “Open”
  - e. The network and related attribute layers can be viewed and filtered in the Editor window



## Exercise 2.1

### Use the VISTA Sanity Check Module

11. Turn on centroids using the node layer “Style” option; do the same for connectors with the link layer
  - a. Right click on the layer to access the layer “Style” and check the box next to the appropriate visual element to turn it on
12. In the output file, look for the **“Centroid Is Source and Destination Check”**, and also the related **“Demand Destination is Link Source Check”**
  - a. With the Editor window, search for the node ID listed in the output file (200385) using the “Find a Node” button;
  - b. Another option is to search for corresponding link ID “218505”
13. Use the link editor tool to examine the connecting links (notably 218505)
  - a. Click on the “Edit a Link” button and select the adjacent links to pull up their attribute information in the Editor
14. Edit the origin to be the correct origin centroid ID; this will fix both of the reported errors
15. In the output file, look for the **“Connector Speed Check”**, and also the related **“Fast Speed Check”**
  - a. With the Editor window, search for the link ID listed in the output file (217610) using the “Find a Link” button
16. Again use the link editor tool to adjust the link speed
  - a. The adjacent links may be used for determining the appropriate speed for the link
  - b. Google Streetview or other sources may also be used to verify roadway speeds
17. In the output file, now look for the **“Invalid Move Check”**
  - a. In the Editor window, make sure the “Signals” layer is turned on by checking the adjacent checkbox
  - b. With the Editor window, search for the node ID listed in the output file (6336)
  - c. Click on the “Edit a Control Action” button and select node “6336”
  - d. With the edit control window open, fix the southbound thru movement in the phases list
18. In the output file, look for the **“Link Endpoint Check”**, and the related **“Transit Route Continuity Check”**
  - a. With the Editor window, search for the link ID listed in the output file (18613)
19. Use the link editor tool to adjust the source node to the correct node ID
20. In the output file, look for the **“Link Lanes Check”**, and the related **“Non Positive Lanes Check”**
  - a. With the Editor window, search for the link ID listed in the output file (106204)



## Exercise 2.1

### Use the VISTA Sanity Check Module

21. Again use the link editor tool to adjust the link lanes
  - a. The adjacent links may be used for determining the appropriate number of lanes for the link
  - b. Google Maps or other sources may also be used to verify the number of lanes
22. In the output file, look for the **“LinkTrueLengthCheck”**
  - a. With the Editor window, search for the link ID (type 1) listed in the output file (18612)
23. Use the link editor tool to adjust the link length
  - a. Use the length value for the link in the opposite direction to establish an appropriate length value
  - b. A script has been developed to automatically calculate link length based on link geometry and will be available as a VISTA module soon
24. In the output file, look for the **“Low Capacity Check”**
  - a. With the Editor window, search for the link ID listed in the output file (6016)
25. Use the link editor tool to adjust the link capacity
  - a. Use the capacity value for the link in the opposite direction to establish an appropriate capacity value (or an adjacent link)
26. In the output file, look for the **“Missing Movement Check”**
  - a. With the Editor window, search for the node ID listed in the output file (6335)
  - b. Click on the “Edit a Control Action” button and select node “6335”
  - c. With the edit control window open, find and open the Excel file for the traffic signal timing plan for the intersection (Guadalupe at 24<sup>th</sup>)
  - d. Find the corresponding timing plan information for the AM peak hours (6-9 AM)
  - e. Find the plan ID in the schedule portion of the spreadsheet
  - f. Enter the offset time for the associated plan ID
  - g. Add a phase by clicking the “Add” button
  - h. Enter the green, yellow, and all red times for the first phase based on the timing plan for the corresponding plan ID
  - i. In the Editor, click on the phase windows and select the corresponding movements for the first phase
  - j. Complete adding each phase with corresponding times and movements for each subsequent signal phase
  - k. Verify the “Total Time” at the top of the dialogue box (automatically summed) matches the cycle length for the timing plan
  - l. Select “Ok” to save the entered data (for more information, see instructions for Exercise 1.4: Creating/Editing Traffic Control Data)



## Exercise 2.1

### Use the VISTA Sanity Check Module

27. In the output file, look for the “**Unused Node Check**”, and the related “Tethered Node Check”
  - a. With the Editor window, search for the node ID listed in the output file (233411)
  - b. Use the “Delete a Node” button to delete node ID 233411
28. Close the Sanity Check “Output” file

#### **Use .csv Outputs to Analyze Errors**

29. While in the “guad\_base\_am\_test” network, reselect the “Modules” tab and click on the “Sanity Checks” module to rerun the validation
30. On the “Task History” page, click on the “Output” icon for the Sanity Checks task to open the output file and confirm resolution of the errors corrected
31. Find the corresponding “CSV” file for “Missing Movement Check” output
  - a. Note the information provided; node ID, link from ID, link to ID
32. Create a table in database to import the CSV file
  - a. To create a table, first click on the “Query” tab in the VISTA web portal
  - b. Then, enter the following query and press “Execute”:
  - c. create table missingmovementcheck (node\_id integer, in\_link integer, out\_link integer);
33. Click on the “Tables” tab and find the “missingmovementcheck” table just created in the list to the left
34. While in the “Tables” tab, click on the table “missingmovementcheck” to view the table (which should be blank)
35. Click on the “Upload” link
36. Click the “Browse...” button and find the location of the Excel data files. Select the file for import “missingmovementcheck.csv” and click “Open”
37. Click “Upload”
38. In the “Options” dialogue, change the “Start at line number:” to 1 and click “Start”
39. Confirm the task status and that it has completed in the “Tasks” list
40. Now navigate to the “missingmovementcheck” table for the “guad\_base\_am\_test” network and verify that the table is now populated with the error data
41. Open the Editor tool if it’s not open already
42. Select the “Query Nodes” button, enter the following query and select “Query” to run:
  - a. select \* from nodes where id in (select node\_id from missingmovementcheck);
  - b. This will highlight the nodes with missing movements to visualize the extent/location of the errors (or were identified as erroneous when the Sanity Check module was initiated)



## Exercise 2.2

### Use the Visualization Tool (Viztool) to Check Model Inputs

1. Access the VISTA web portal and go to the “guad\_base\_am\_test” network
2. While in the “guad\_base\_am\_test” network, select the “Modules” tab from the menu and click on the “Visualization Export” module
  - a. Leave only the “Network and attributes” item checked (uncheck all of the other boxes)
3. Find the link to the VizTool login on the DTA training instructions website
  - a. Click on the link “map visualizations”
4. A dialogue box will pop up: enter your EID and password
5. ON the subsequent webpage, at the prompts, enter the username (e.g., training##) and password (e.g., password) for the network (for more information, see the cheat sheet on Accessing the Visualization Tool)
6. Click on the link for the “guad\_base\_am\_test” network
7. Look at the network data in the map
8. Turn off the links in the “Base Network Preferences” to help with visibility of specific network attributes
9. Select “Network Data” from the provided dropdown menu at the top left corner of the page
10. In the corresponding dialogue box at the top of the page, select “lanes” from the dropdown menu next to “Links”
11. Find the link along Guadalupe St that violates color attribute consistency (#15778)
12. Now select “capacity” from the dropdown menu next to “Links”
13. Find the link along Guadalupe St that violates color attribute consistency (#118516)
14. Use the Editor tool to find the corresponding links for adjustment:
  - a. The “Open StreetMap” layer in the Editor is a good reference for finding the link locations
  - b. Click on the “Edit a Link” button and select the identified links to pull up their attribute information in the Editor; use the “Find a Link” button to search for the individual link IDs listed above if having trouble locating them using the map
  - c. Use the link editor tool to adjust the link lanes for link ID “15778”
    - i. The adjacent links may be used for determining the appropriate number of lanes for the link
    - ii. Google Maps or other sources may also be used to verify the number of lanes
  - d. Use the link editor tool to adjust the link capacity for link ID “118516”
    - i. Use the capacity value for the link in the opposite direction to establish an appropriate capacity value (or an adjacent link)



## Exercise 2.3

### Run a Model in Vista

#### Create your own scenario

1. Copy network “guad\_base\_am”
2. Open network in the GIS Editor and make a change to the network or traffic control

#### Prepare for running

3. In the VISTA web portal select the new network from the “Networks” dropdown menu and go to the “Options” tab.
4. Adjust the runtime parameters. Only the Simulation options need to be changed (others are adjusted automatically when running DUE New/DUE continue):

**Simulation**

**Duration**   
The length of the simulation period, in seconds.

**Mesoscopic Step**   
The default time step to be used in mesoscopic simulation, in seconds.

**Mesoscopic Delta**   
The backwards propagation factor to use in cell transmission.

#### Run the module

5. From the “Modules” drop-down menu, select “DUE-New”
6. Confirm that the network showing in the drop-down window is the one you want to run.
7. Adjust options as shown below. You can choose a different number of iterations.



## Exercise 2.3

### Run a Model in Vista

#### Options

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| Run to total iteration #          | <input type="text" value="20"/>     |
| Prevent gap increase              | <input type="checkbox"/>            |
| Seed random number generator      | <input checked="" type="checkbox"/> |
| Partial Demand Loading iterations | <input type="text" value="5"/>      |
| Warm start iteration (0 for none) | <input type="text" value="0"/>      |
| Route report CSV                  | <input type="checkbox"/>            |
| Nonexiting incr. thresh. (0: off) | <input type="text" value="0"/>      |

8. Add notes to document the module process if desired
9. Click the “Start” button to run the module
10. Confirm the module status and that it has completed in the “Tasks” list; clicking on the Task number will show the status in real-time
11. Once the run is completed, check the “History” tab for the appropriate network and look at the log.
  - a. Check the number of non-exiting vehicles
  - b. Check the gap value.
  - c. Compare True Gap to last relative gap value
12. If desired, conduct additional runs using the “DUE-Continue” module. Below is an example of typical module parameter values for a network that is close to convergence.

#### Options

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| Run to total iteration #          | <input type="text" value="30"/>     |
| Equilibriate                      | <input checked="" type="checkbox"/> |
| Prevent gap increase              | <input checked="" type="checkbox"/> |
| Seed random number generator      | <input checked="" type="checkbox"/> |
| Route report CSV                  | <input type="checkbox"/>            |
| Nonexiting incr. thresh. (0: off) | <input type="text" value="100"/>    |



# Exercise 4.1

## Validate Model Results

### Open Interactive Reports

1. Locate and open the .html files provided for the training. In the future these will be generated from the VISTA web portal.
2. Explore location and magnitude of link volume errors
  - a. Link count report: Maps and charts showing the difference between model and field data expressed in
    - i. Total number of vehicles
    - ii. Vehicles per hour equivalent
    - iii. Percent of the field counts
3. Explore corridor travel time errors and possible location of modeling issues
  - a. Corridor Travel Time report: Charts displaying
    - i. Average end-to-end travel time
    - ii. Average segment travel time (when intermediate arrival times are available in field data)
    - iii. Individual probe travel time visualization

### Explore Data Using Database Functions

4. Navigate to the “guad\_base\_am” network in the vista web portal, and click on the “Query” tab.
5. Run the pre-programmed queries. Try to change the input parameters to see their impact on the reported errors, or to restrict outputs to desired links/routes.
  - a. Link count validation:
    - i. Show only high-volume links:

```
select * from link_count_check() where field_count>1000;
```
  - b. Corridor t.time validation:
    - i. Show results for route 2, every 15 minutes, sorted by time interval.

```
select * from corridor_ttime_validation(0,10800,900) where routeid=2 order by from_sec;
```
  - c. Detailed corridor t.time validation
    - i. Show results for link 15777

```
select * from validate_corridor_link_tt(0,10800,3600) where to_link=15777;
```
  - d. Model probe t.time:
    - i. Show travel time for all probes on route 1

```
select * from get_veh_ttime() where routeid=1;
```
  - e. Field probe t.time :
    - i. Show travel time for all probes on route 1



## Exercise 4.1

### Validate Model Results

```
select * from get_probe_ttime_link() where routeid=1;
```

- f. Detailed model probe t.time
  - i. Pick two probes from previous queries and compare their link-by-link travel time. Sort by link ID to facilitate the comparison.

```
select * from get_probe_ttime_link() where routeid=1 and vehid in (1,3) order by linkid,dtime;
```

- g. Detailed field probe t.time
  - i. Get the average travel time to all links on route 1 (more advanced)  

```
select routeid,to_link,avg(link_ttime) as link_ttime from get_veh_ttime_data()  
where routeid=2 group by routeid,to_link;
```



# Exercise 5.1

## Compare Scenarios

### High-level comparison using reports

1. Locate and open the .html files provided for the training. In the future these will be generated from the VISTA web portal.
2. Explore results (refer to analysis in power point)
  - a. Summary: are there any major changes in summary statistics?
  - b. Travel Time Differences: identify origin/destination with large changes for further analysis
  - c. Frequency distributions of speed, distance and travel time: analyze if patterns look reasonable
  - d. Corridor travel time/link volumes
    - i. Are the differences what is expected based on the scenario characteristics?
    - ii. Are they the same throughout the simulation?
    - iii. Can we identify specific links to help us explain unintuitive results?

### Network-Level comparison using viztool

1. For examples of results, refer to the power point.
2. Open two instances of the viztool, one for each scenario (“guad\_base\_am” and “guad\_scenario\_am”)
3. In the “guad\_scenario\_am” network
  - a. Analyze link volume differences between models.
    - i. Are the differences intuitive?
    - ii. Are there links that we need to study in further detail?
4. In both networks
  - b. Visualize link travel times side-to-side
  - c. Visualize intersection delay side-to-side
    - i. Are the differences intuitive?
    - ii. Are there links that we need to study in further detail?

### Detailed comparison using viztool

5. Explain observed differences in travel times and volumes
  - a. Identify travelers using the Guadalupe NB corridor in the base case
    - i. Run a select link analysis (e.g. link 106991)
    - ii. Visually Identify corresponding origin/destination areas



## Exercise 5.1

### Compare Scenarios

- b. Visualize the alternative paths connecting the identified origins/destinations
  - i. Run an OD Path analysis in both networks. You can try the following origins and destinations
    - 1. 100405,125469,100406,100381,125551,100403,100380,100404,5551,100849
    - 2. 200346,231270,200345,11270,226168,231633,200344,226256,231227,232153
  - ii. Compare paths in both networks
- 6. Visualize network-level impact of the modeled scenario
  - a. Conduct a reach-time analysis in both networks and compare results
    - i. Eg. From UT Campus: 100362

#### **Analyzing your own scenario**

- 1. Verify that your network run and attained an acceptable gap (and that there are no not exiting vehicles)
- 2. Import results to database, and export to Visualization tool. Request an interactive report from the instructor
- 3. Analyze your scenarios
- 4. If needed, add links/corridors to the analysis tables
  - a. Links\_for\_analysis / link\_group
  - b. Bus tables
    - i. If new corridors are added for comparison, it is necessary to run the simulator and import results.





## Sign-In Sheet

DTA 2.0 Workshop  
April 19, 2016

| Check-In | First   | Last   | Position   | Organization       | Email                         | Phone        |
|----------|---------|--------|--|--------------------|-------------------------------|--------------|
| X        | Michael | Dutton | Planner  | CAMPO              | Michael.dutton@campotexas.org | 512.232.8336 |
| X        | Lei     | Xu     | Senior Planner                                     | CAMPO              | Lei.Xu@campotexas.org         | 512.232.8342 |
| X        | Daniel  | Yang   | GIS & Modeling Program Manager                     | CAMPO              | Daniel.Yang@campotexas.org    | 512-232-8393 |
|          | Kelly   | Porter | Senior Planner                                     | CAMPO              | kelly.porter@campotexas.org   | 512.974.2084 |
|          | Rohit   | Vij    | Sr. Engineer, Engineering and Capital Improvements | City of San Marcos | rvij@sanmarcostx.gov          | 512-393-8133 |



THE UNIVERSITY OF TEXAS AT AUSTIN  
**CENTER FOR TRANSPORTATION RESEARCH**

# Dynamic Traffic Assignment Deployment Training 1.0

June 7, 2016

UT Center for Transportation Research

In collaboration with



To access training resources, please visit  
[ctr.utexas.edu/nmc/dta/dta-1-0/](http://ctr.utexas.edu/nmc/dta/dta-1-0/)

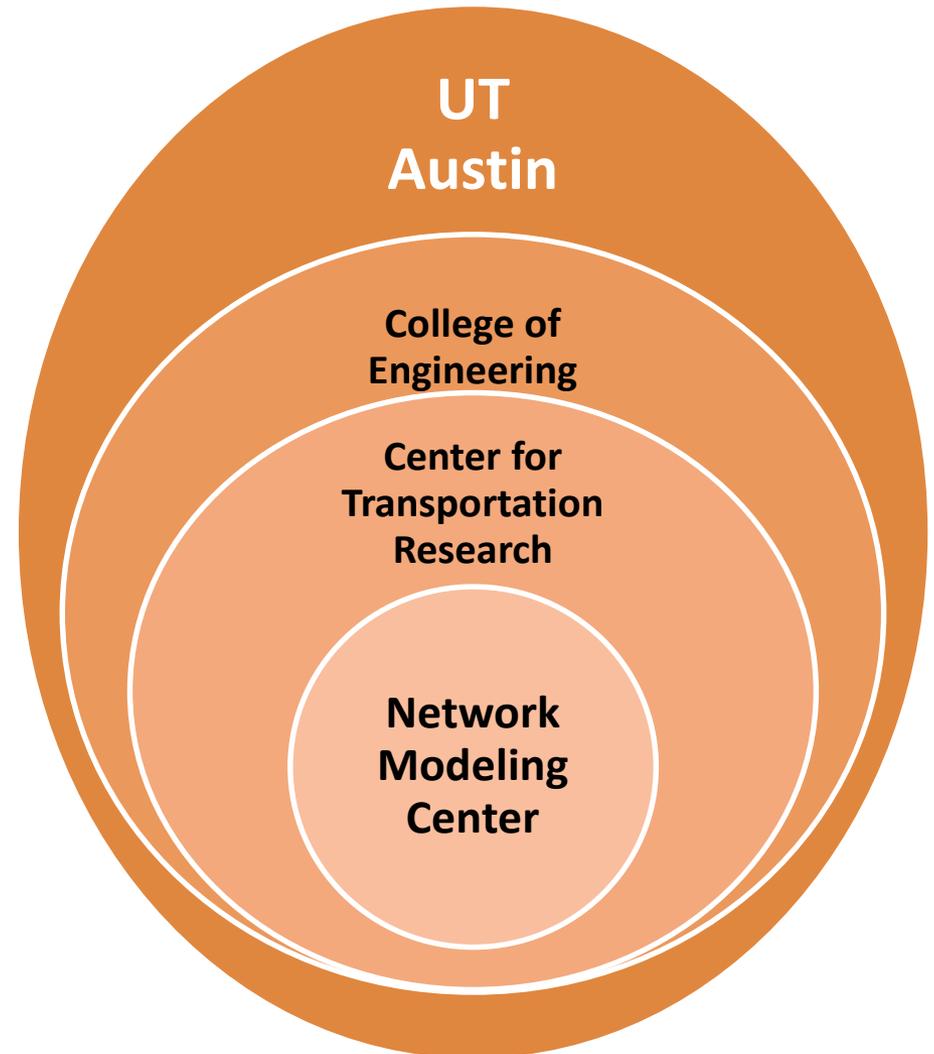
## Tentative Schedule

| 8:30  | Set-up and introductions                     |
|-------|--|
| 9:00  | What is DTA and why use it?                  |
| 9:50  | Break  |
| 10:00 | How to build and run a DTA model             |
| 11:00 | Break  |
| 11:10 | DIY: Web-based analysis of DTA model results |
| 12:20 | What's next?                                 |

# Center for Transportation Research (CTR)

CTR is one of the leading university-based transportation research centers in the world.

We have been working with CAMPO to apply a Dynamic Traffic Assignment (DTA) tool to the region and we are now ready to teach users how to maximize its benefits.



## Today's goals

Understand Dynamic  
Traffic Assignment (DTA)

Learn how to create and  
view DTA model results



# What Do You Already Know About DTA?

## What is Dynamic Traffic Assignment (DTA)?

- DTA is a planning tool used to compare possible future year scenarios.
- DTA models “strategic” driving behavior, or how drivers choose their routes at a typical time based on least-cost path selection.

## What makes DTA different from other models?

- DTA considers the evolution of traffic conditions at small time intervals (seconds).
- DTA captures changes in traffic conditions every 100 to 500 feet.

## What kinds of resources does DTA use?

- Because DTA model results are very fine-grained, models require significant computational and data resources.

## How would you use DTA in your jurisdiction?

- DTA analyzes region-wide changes to traffic patterns and illustrates the resulting traffic conditions.

[Please take our survey](#)

## Model Types

### Macro

- CAMPO Travel Demand Model
- Less detailed, regional study

### Meso

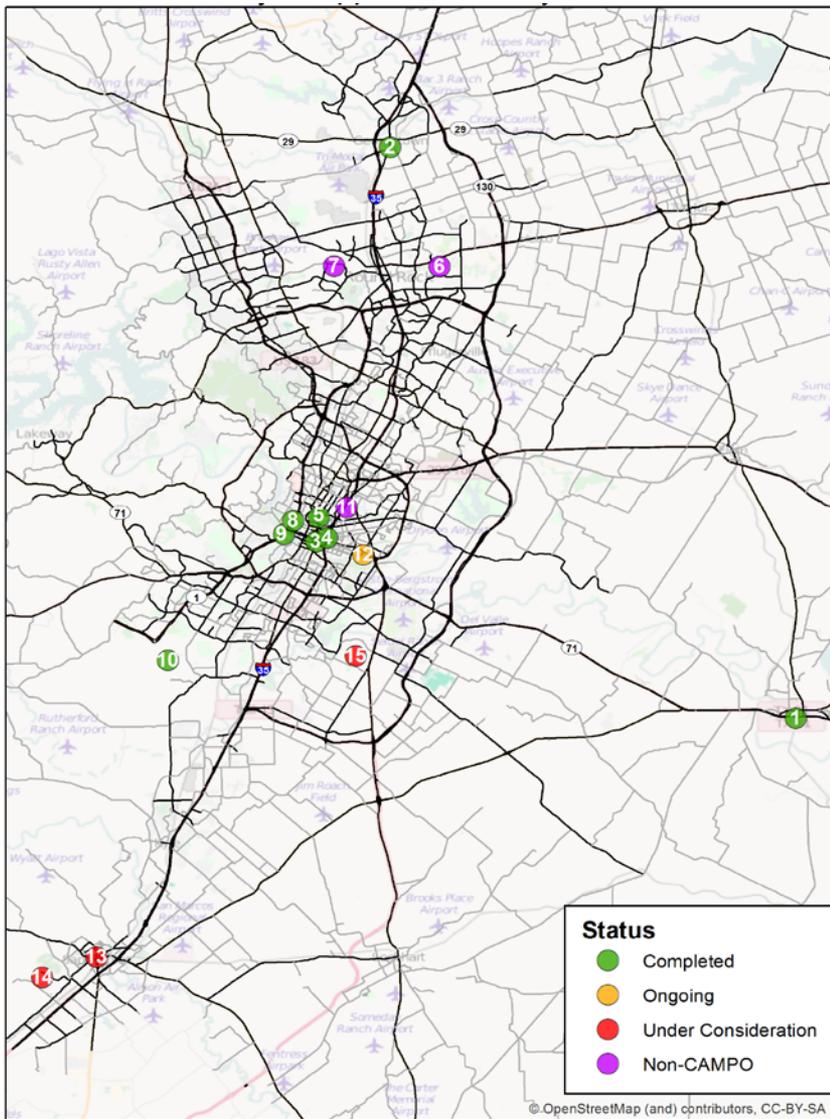
- **CTR Dynamic Traffic Assignment (DTA)**
- **More detailed, sub-area study**

### Micro

- Consultant microsimulation models
- Most detailed, corridor study



# DTA Applications in Texas



CENTRAL TEXAS  
Regional Mobility Authority



**BASTROPTX**  
Heart of the Lost Pines / Est. 1832

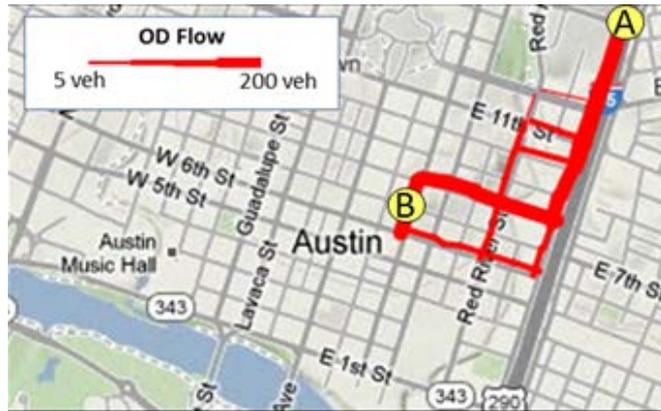


# 7th Street and 8th Street Conversions

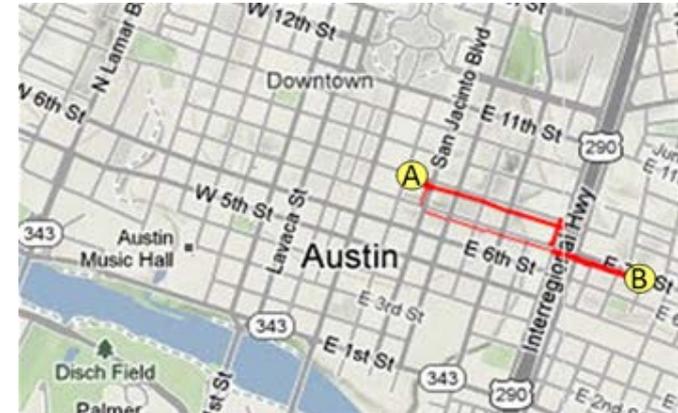
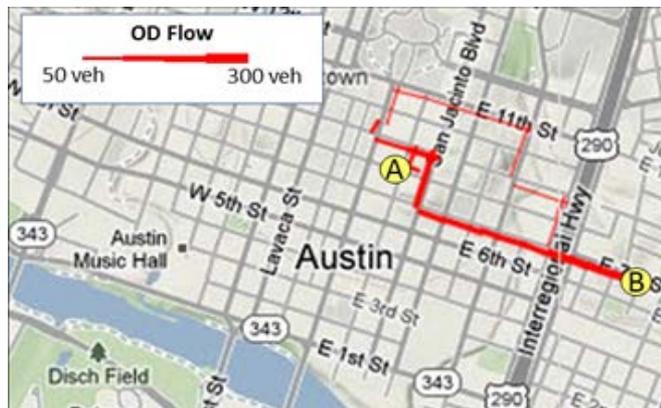
## Path Analysis

ONE-WAY

TWO-WAY



7:00 AM to 9:00 AM



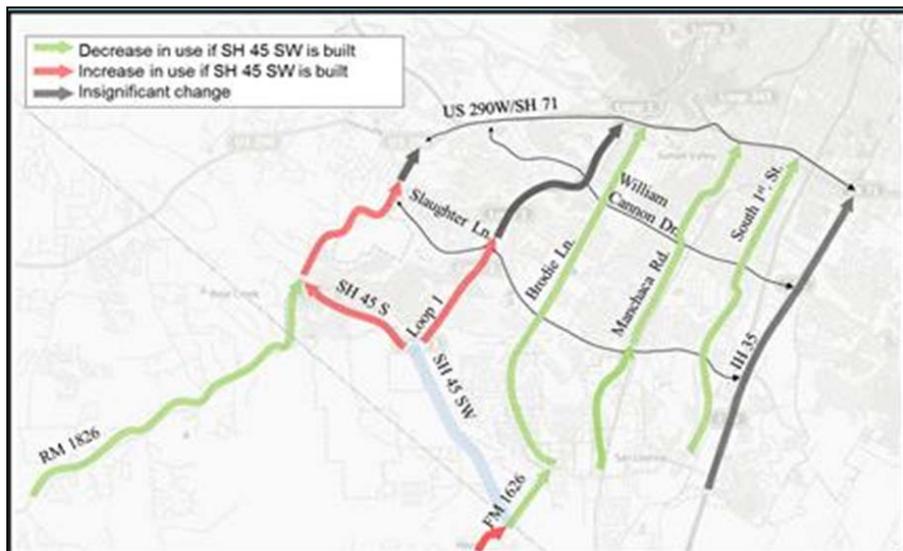
4:00 PM to 6:00 PM



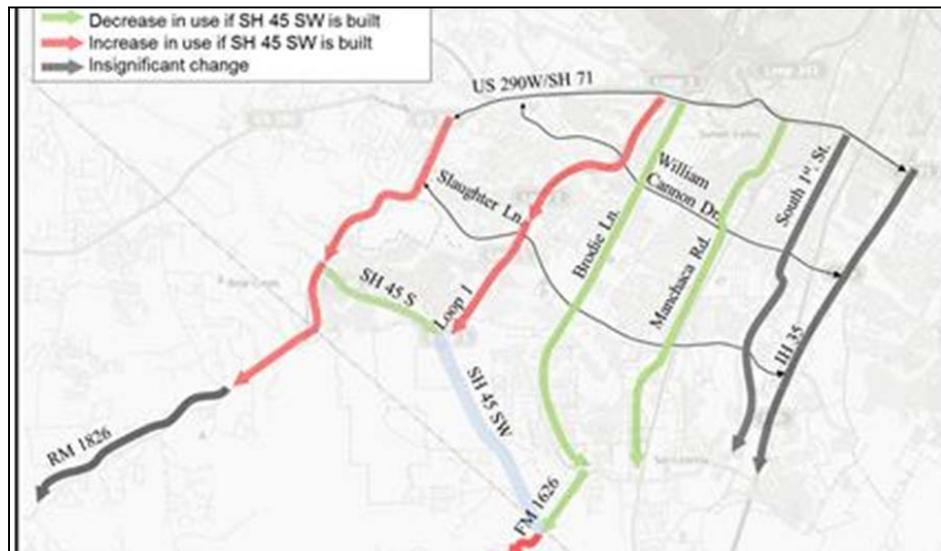
# State Highway 45 Southwest



## Analysis of Major Corridors



**2025 AM Peak Conditions  
 Northbound**



**2025 PM Peak Conditions  
 Southbound**

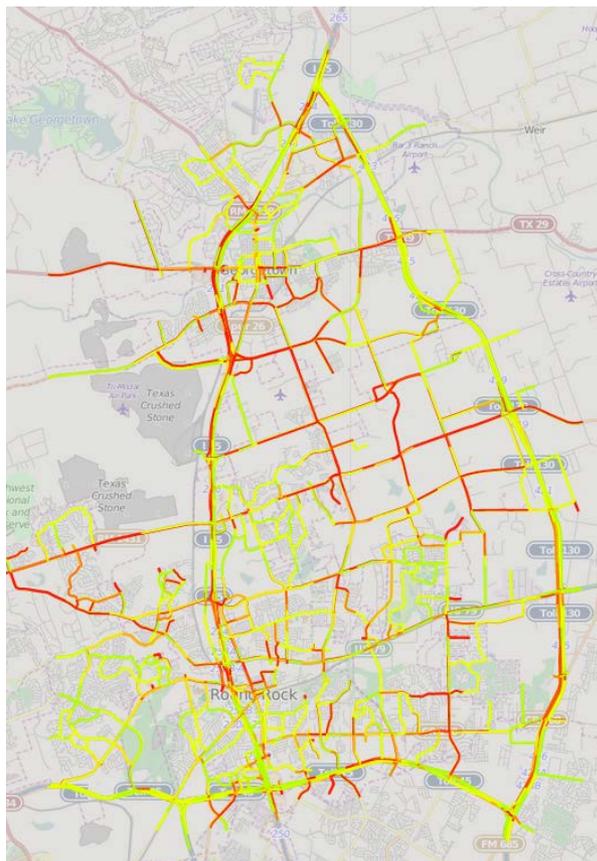


# Williamson County

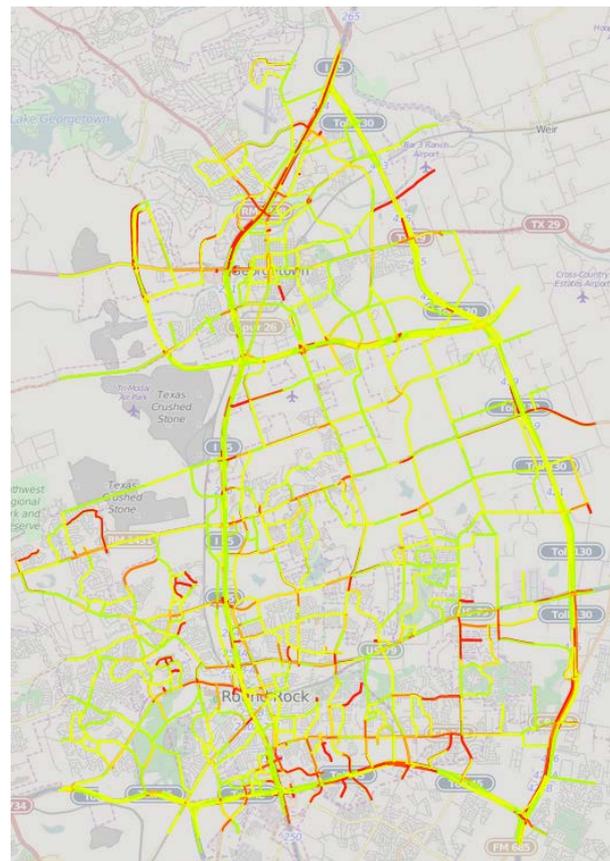


Average speed compared to speed limit

Slow Fast



2035  
Alternative A



2035  
Alternative B

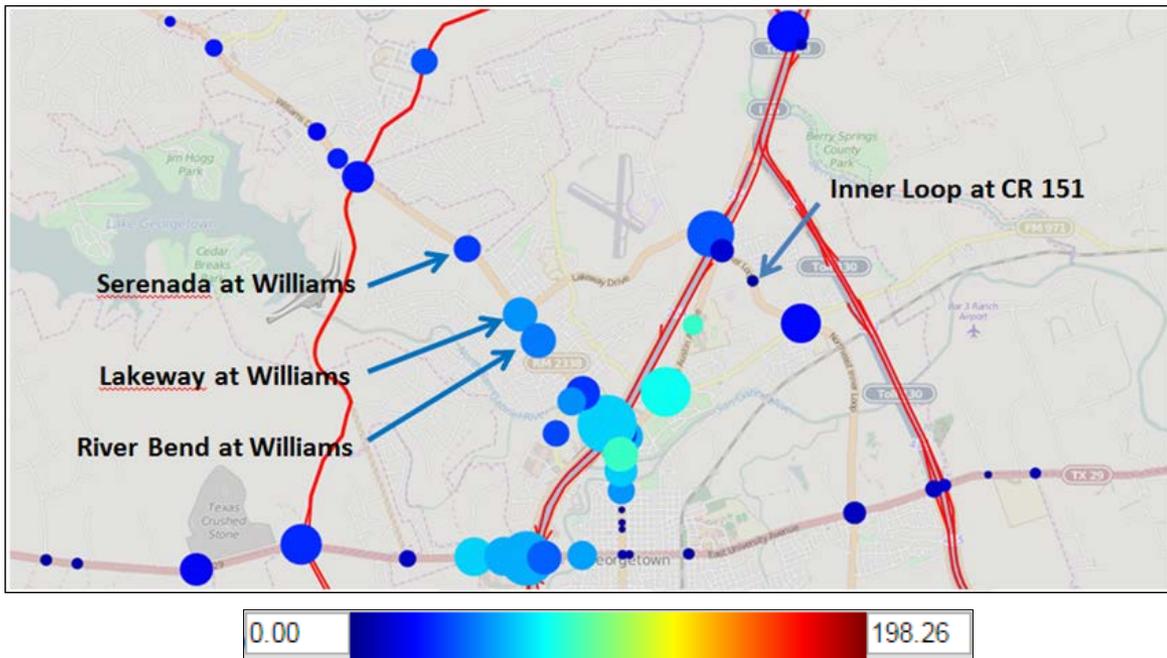
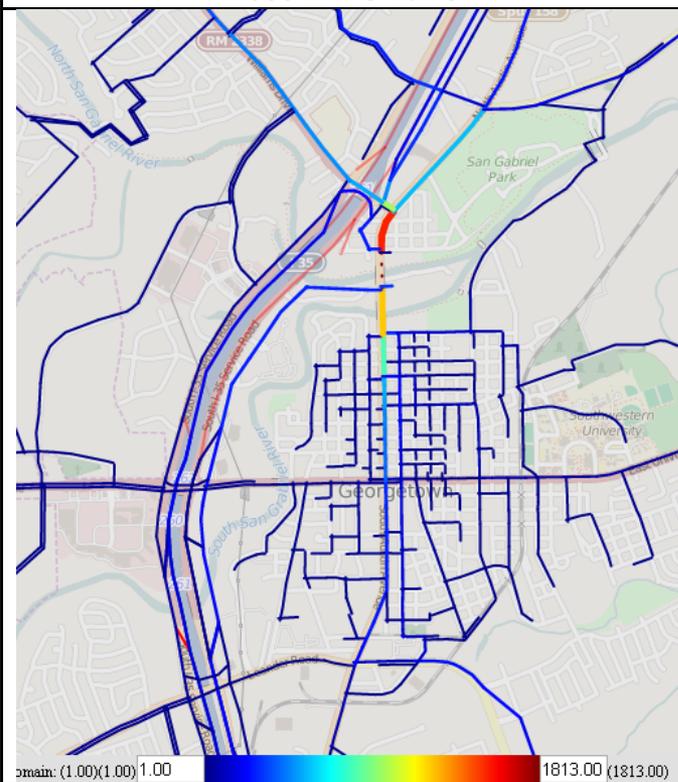


# Austin Avenue



## Signalized Intersections of Interest

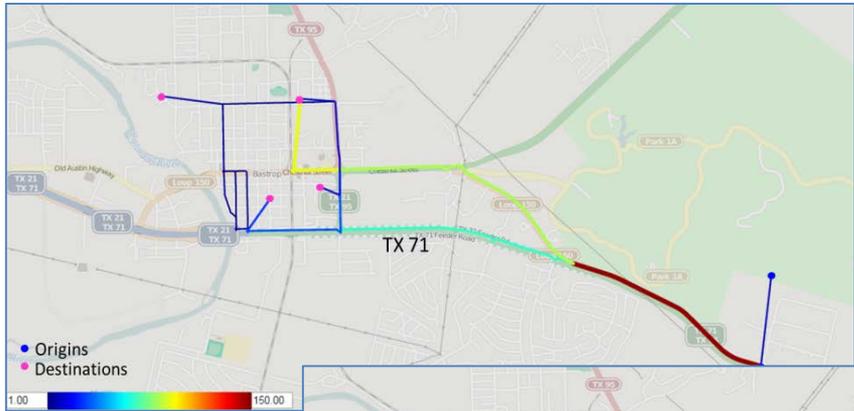
2035 PM 5-Lane



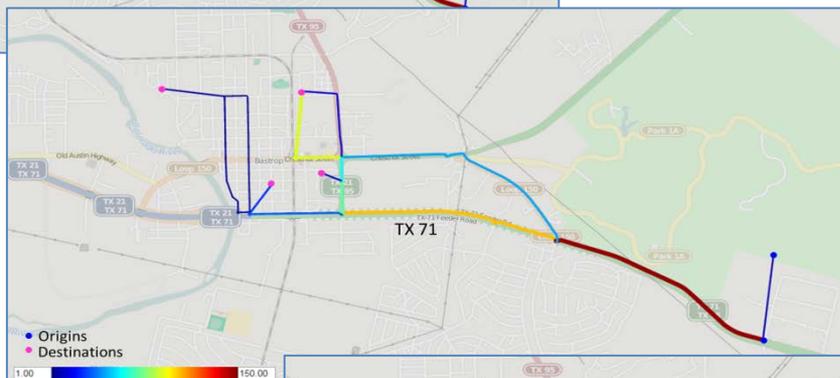
2035 Northbound Traffic Flow  
PM Peak

# SH 71 Interchanges

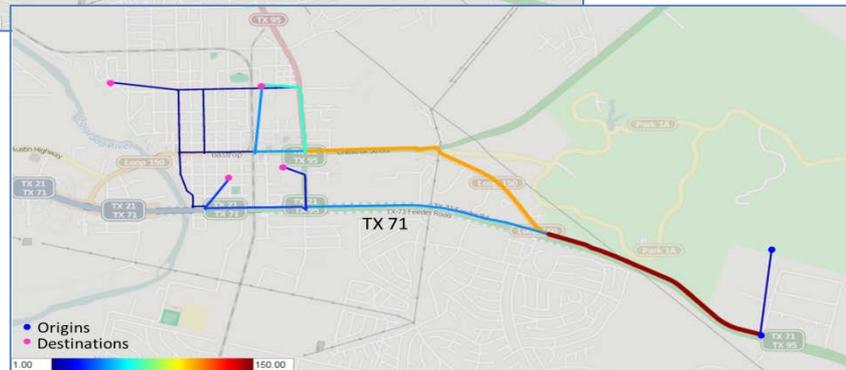
Existing



Construction of Loop 150 Interchange

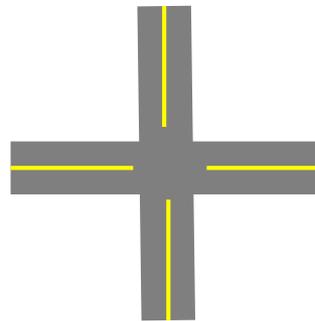


Construction of SH 95 Interchange

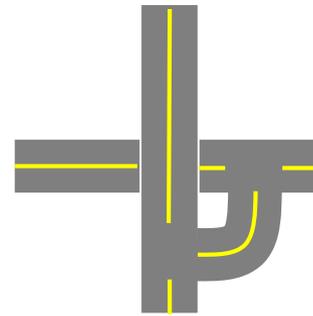


# A typical DTA application

What are the impacts of two different intersection designs?



AT GRADE



OVERPASS

## Process

- Collect data
- Build and review model inputs (GIS tools)
- Test and calibrate the model
- Run and validate the model
- Analyze results

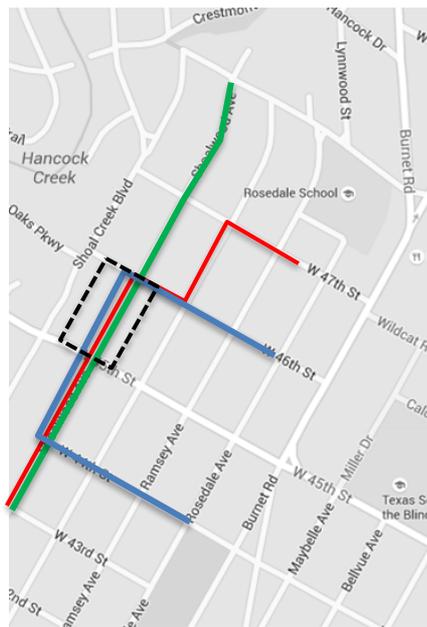
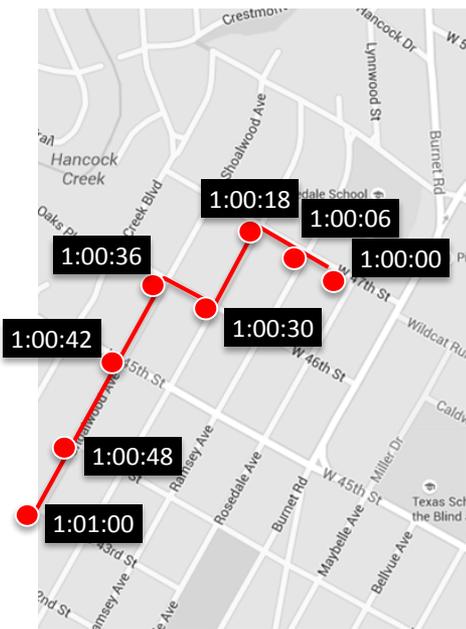
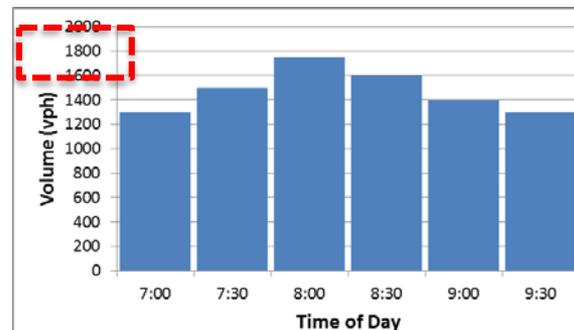
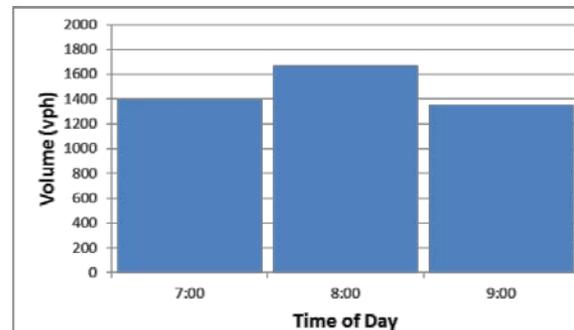
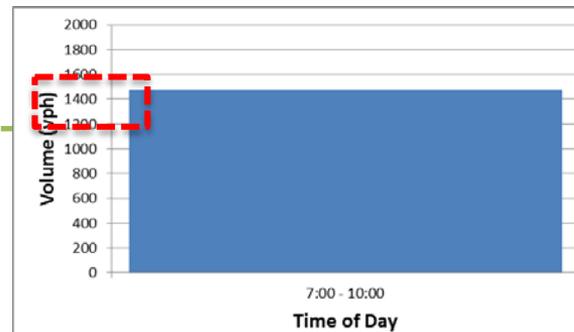
# DTA Model Results

## Raw Results

- Individual vehicles trajectories

## Aggregation for analysis

- Space
- Time



## DTA Results Analysis

System-level and average performance

Detailed analysis to interpret system-level trends

- Intersections, corridors, roadway segments
- Origins and destinations

## System-Level Analysis

Total system travel time

Average travel time

Network-wide vehicle volumes

- Time-dependent
- Difference across scenarios

Delay at signalized intersections

## Detailed Metrics

### Select link analysis

- Identify the paths of all vehicles using a particular roadway segment (link)

### Origin-Destination path analysis

- Identify all used paths connecting selected origins and destinations

### Reach time

- Identify how far vehicles can travel from selected origins within pre-specified time intervals

## How will you use DTA?

1. Name a current or prospective project in your jurisdiction where rerouting is an issue.
2. Name a current or prospective project where traffic impacts will differ by time of day.
3. Name other projects where DTA can be helpful to your jurisdiction.

[Please take our survey!](#)



## Ten-Minute Break



# Fundamental DTA Concepts

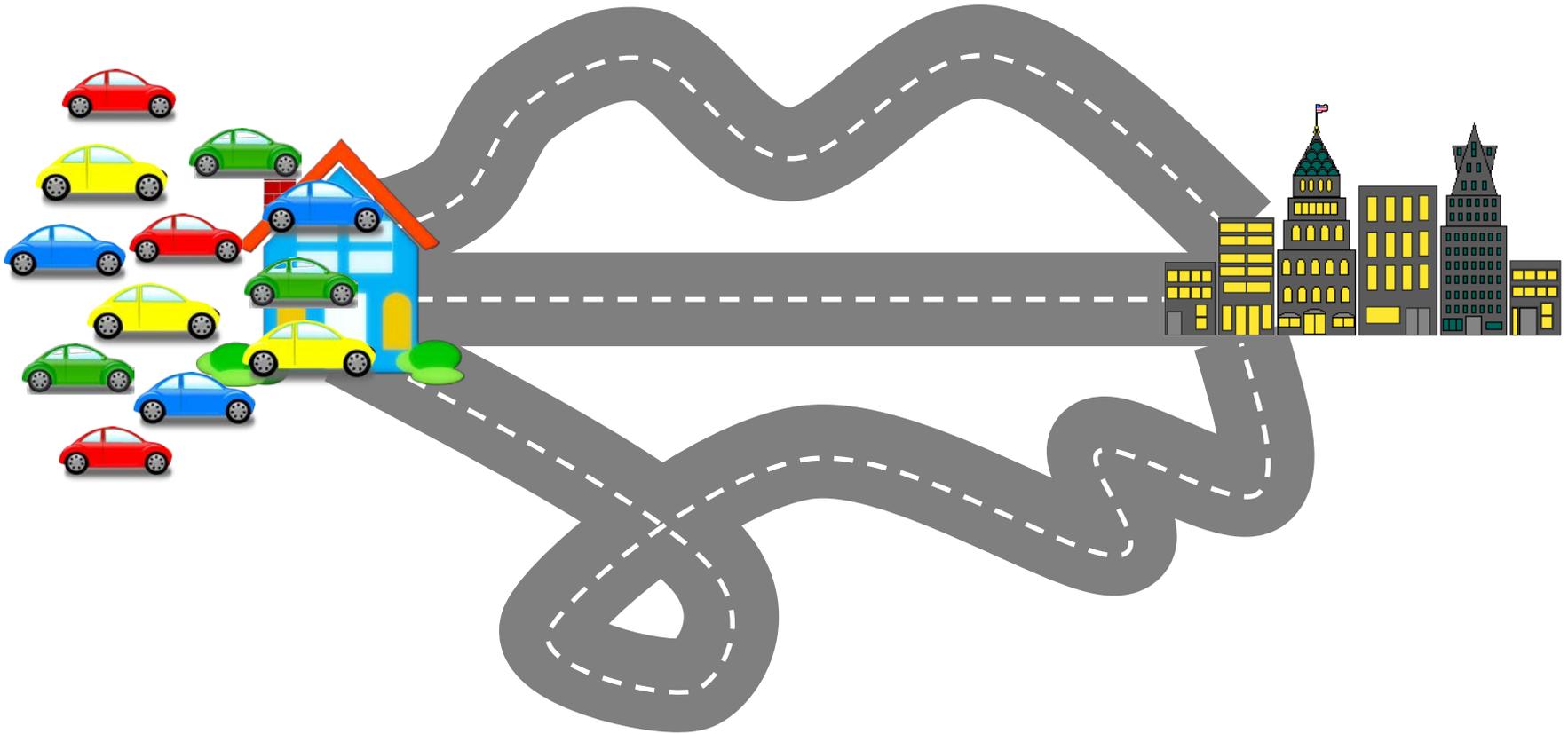
## Goal

- Given: Travel demand and transportation network
- Find: Paths that travelers take to go from origins to destinations throughout the network.
  - Traffic patterns and system performance emerge from these paths

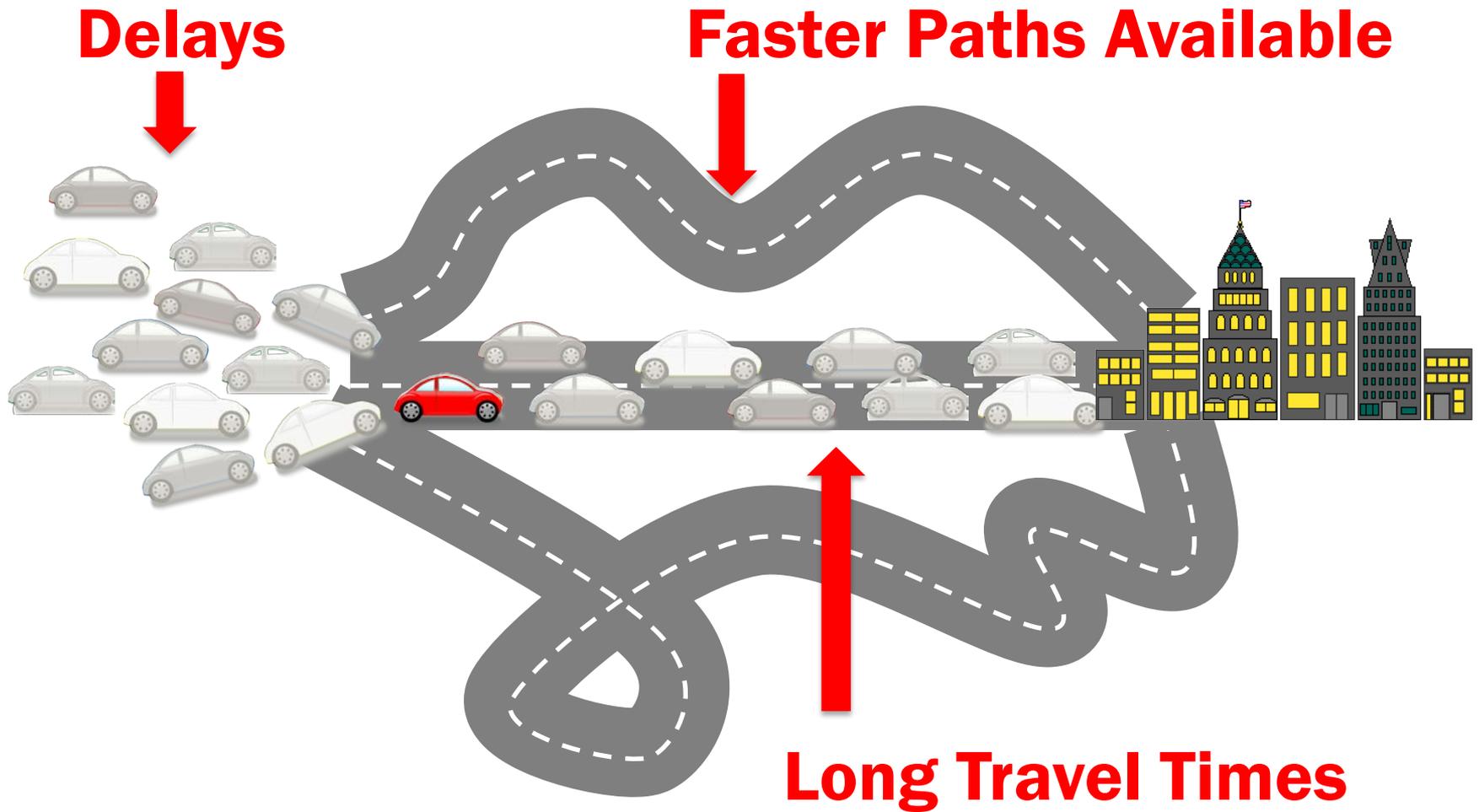
## Assumptions

- Selfish behavior of drivers
- Equilibrium of usage

# Equilibrium

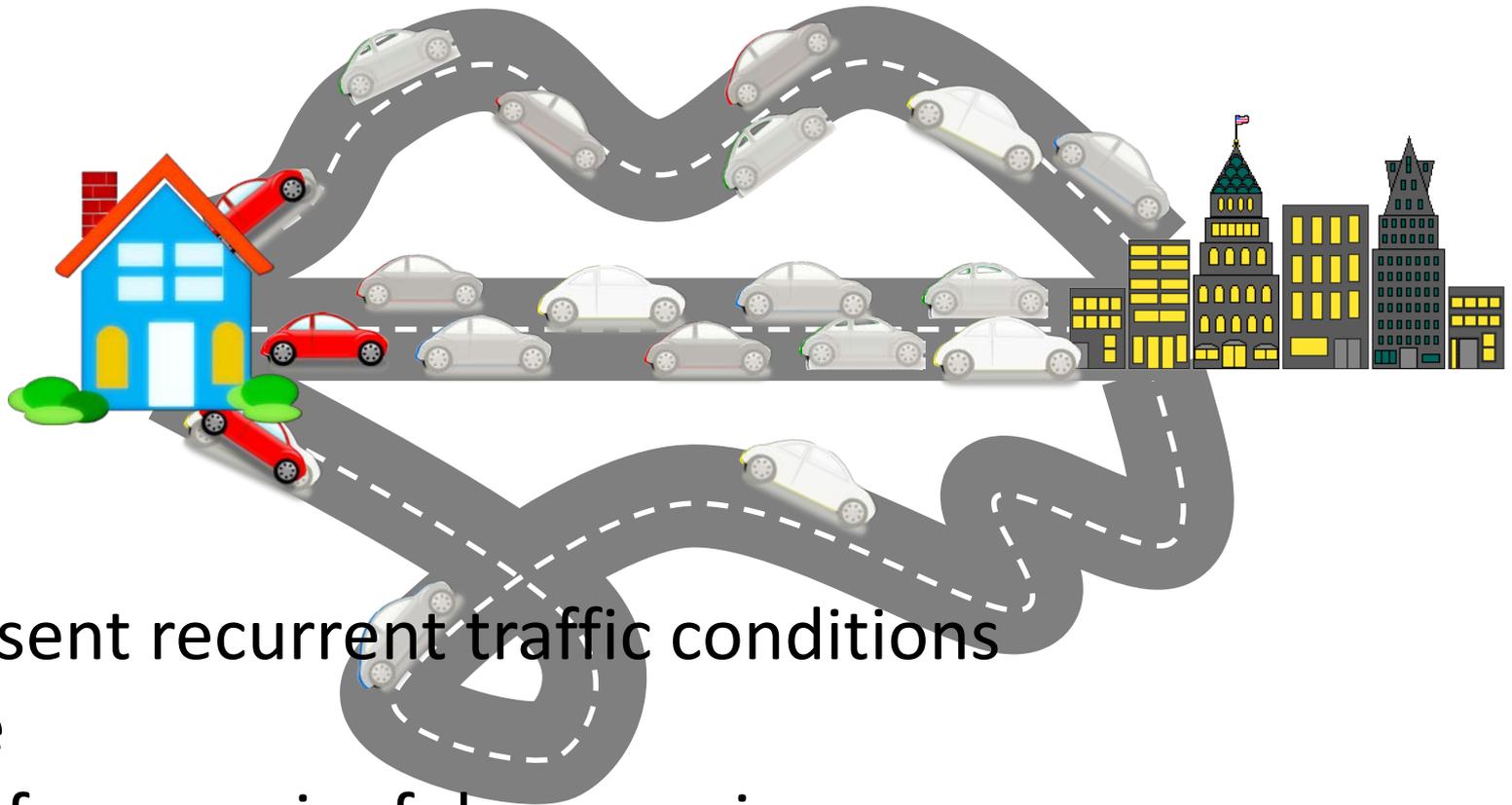


# Non-Equilibrium Solution



## Equilibrium Solution

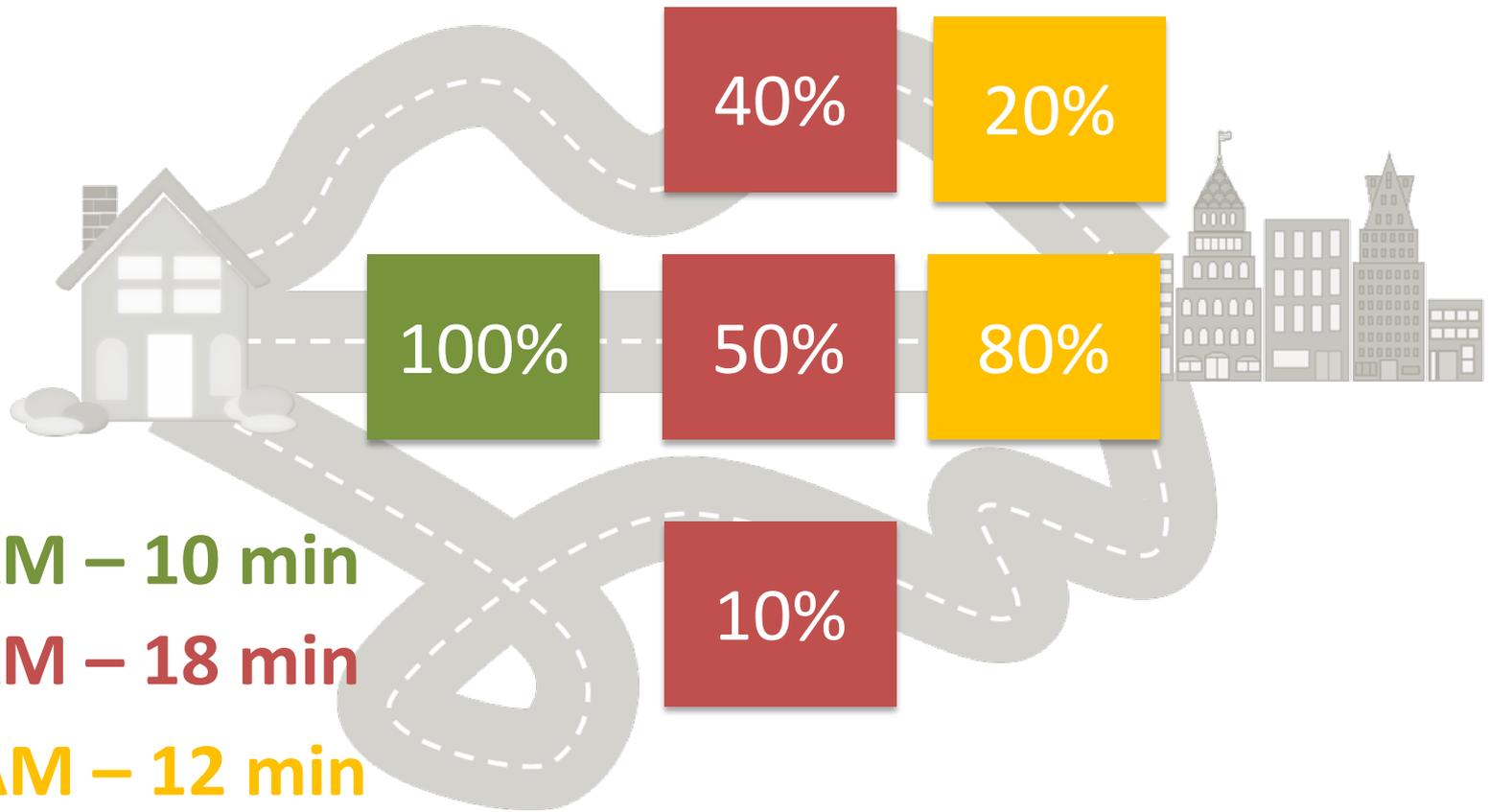
**All used paths have equal and minimum travel time**



- Represent recurrent traffic conditions
- Stable
- Allow for meaningful comparisons

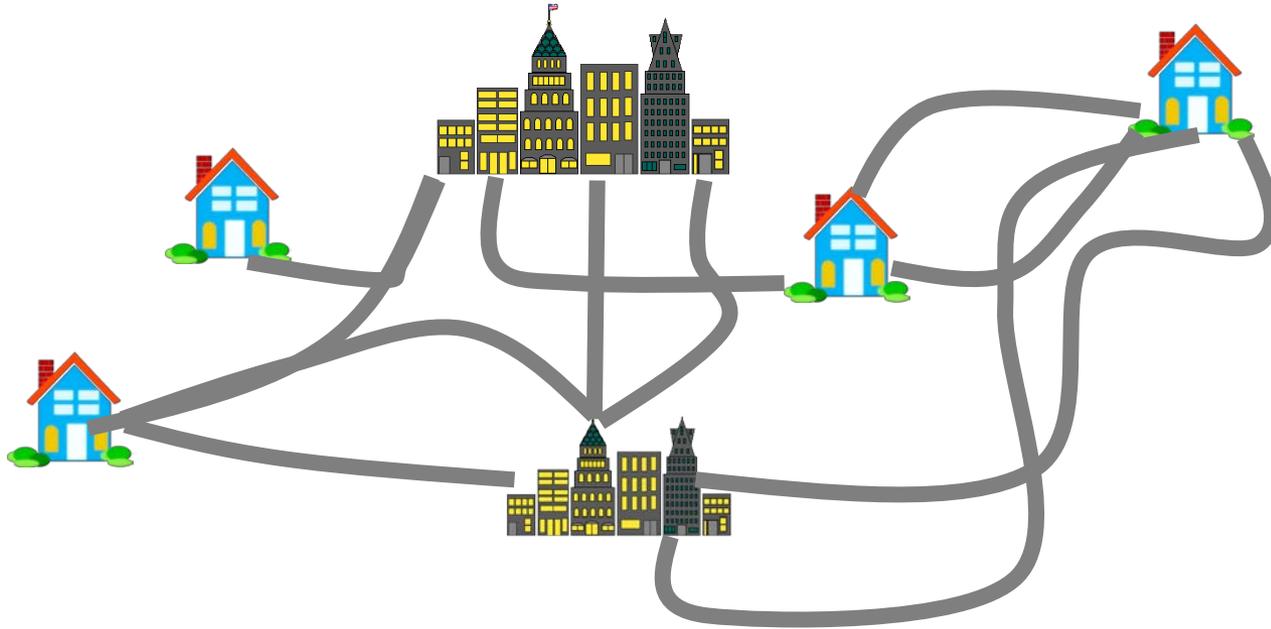
# Dynamic Traffic Equilibrium

## Different Equilibrium Strategy per Time Period

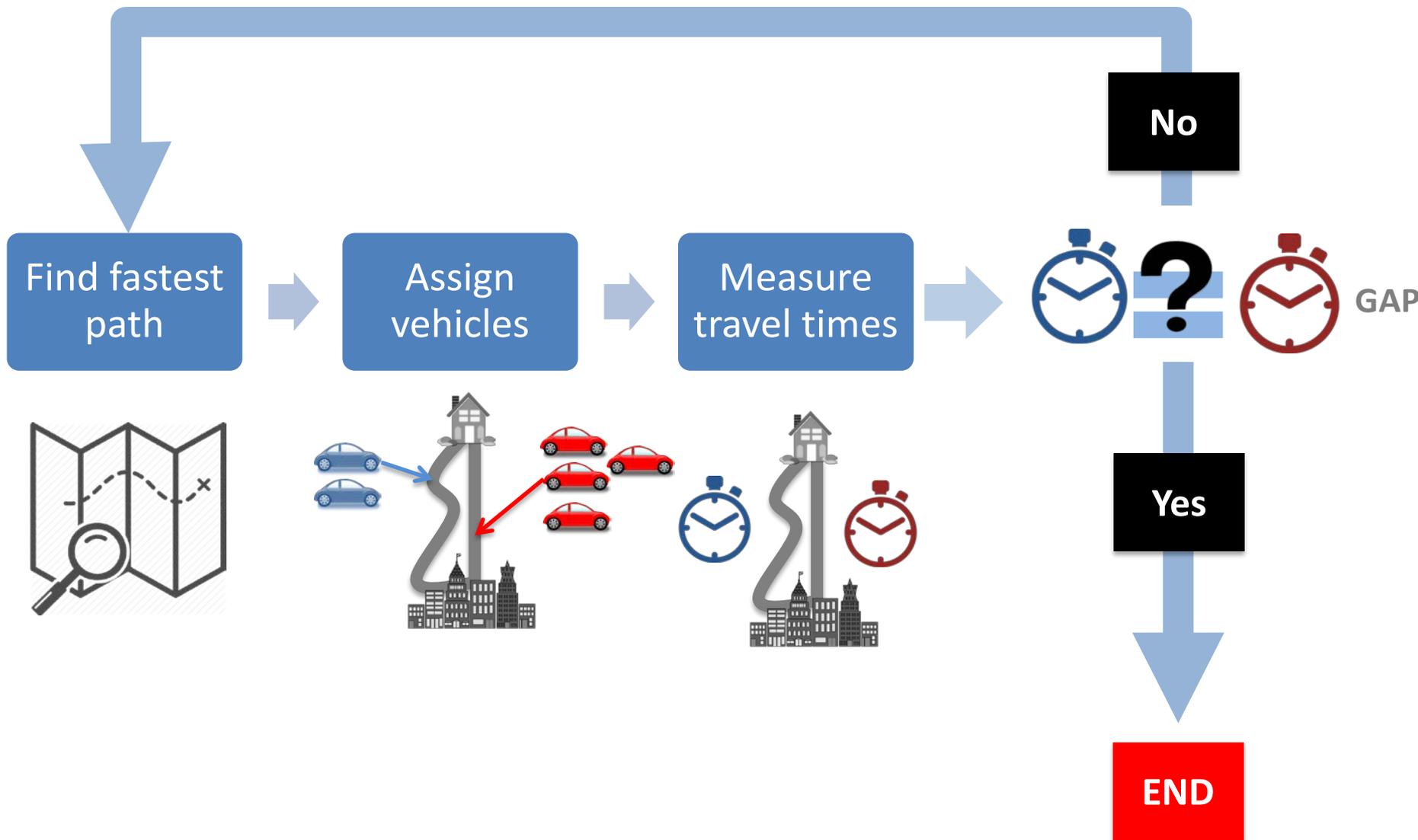


# Methodology

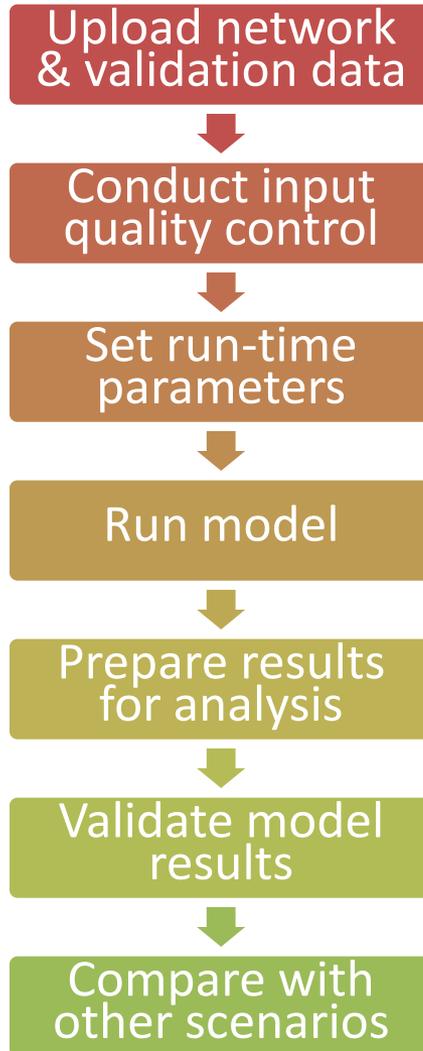
Finding an Equilibrium Solution in a real network is a complex and iterative process



# DTA Iterations



# Workflow for a DTA application



## Choosing Model Limits

Include most of the expected changes in  
drivers' route choice

Typically a sub-area within the region

- Reduce runtime
- Improve convergence for better comparisons

Sub-area demand

- From a regional DTA model
- From a regional static model

Boundary Conditions



# Data Used in DTA Models

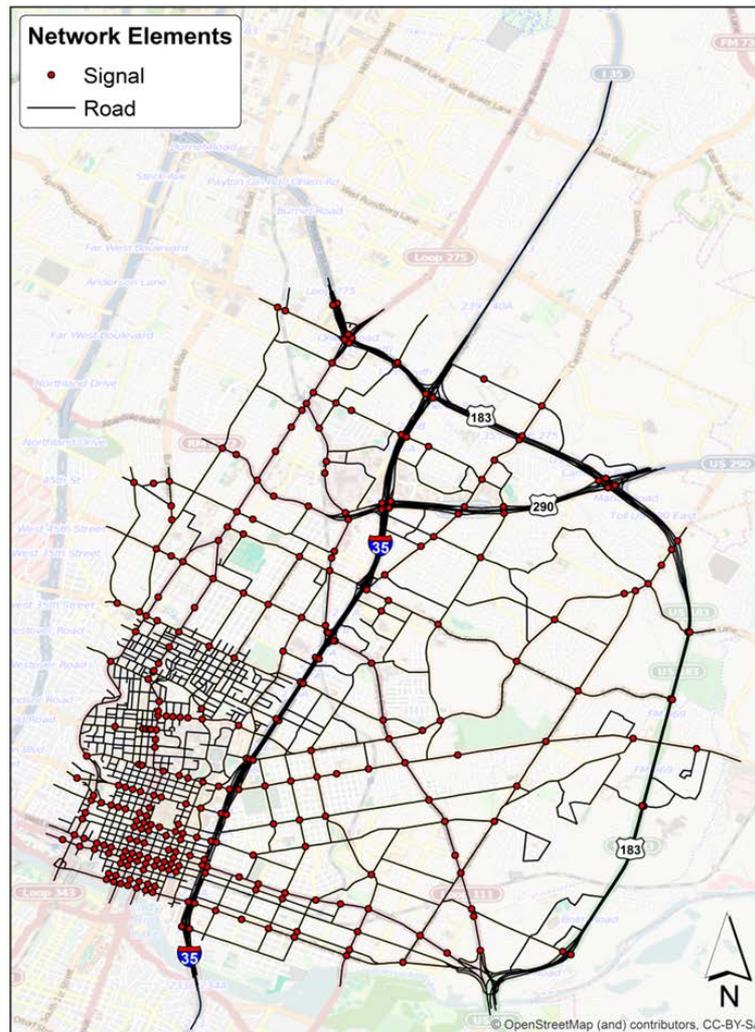
## Input Data

- Network
- Travel demand (vehicle trips)
- Traffic control
- Transit network and schedule

## Validation Data

- Traffic counts
- Corridor travel times (including Bluetooth data)

| linkid | from_sec | to_sec | count | sourceid |
|--------|----------|--------|-------|----------|
| 9615   | 0        | 900    | 16    | 1        |
| 9615   | 900      | 1800   | 29    | 1        |
| 9615   | 1800     | 2700   | 46    | 1        |
| 9615   | 2700     | 3600   | 43    | 1        |
| 9615   | 3600     | 4500   | 37    | 1        |
| 9615   | 4500     | 5400   | 54    | 1        |
| 9615   | 5400     | 6300   | 74    | 1        |
| 9615   | 6300     | 7200   | 87    | 1        |
| 9615   | 7200     | 8100   | 84    | 1        |
| 9615   | 8100     | 9000   | 57    | 1        |
| 9615   | 9000     | 9900   | 59    | 1        |
| 9615   | 9900     | 10800  | 32    | 1        |
| 9914   | 0        | 900    | 29    | 1        |
| 9914   | 900      | 1800   | 29    | 1        |
| 9914   | 1800     | 2700   | 53    | 1        |
| 9914   | 2700     | 3600   | 90    | 1        |
| 9914   | 3600     | 4500   | 81    | 1        |





# Data Sources



PLAN, PURCHASE, RIDE  
Get The CapMetro App and GO!

Plan Your Trip | Schedules & Maps | Rider's Guide | About Us | Business | Public Involvement | Plans & Progress

MetroBus | MetroRapid | MetroRail | UT Shuttles | Park & Ride | Schedule Book | Service Area | ADA Corridors | System Map (PDF)

Select a Route ▶

1 South Congress/Metric, Northbound, Weekday

Weekday | Saturday | Sunday

| Northbound |       |       |       |       |       |       |       |       |       |       | Southbound |       |       |       |        |        |        |        |        |        |        |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|
| 1          | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 1          | 2     | 3     | 4     | 5      | 6      | 7      | 8      | 9      | 10     | 11     |
| 4:44a      | 4:56a | 5:04a | 5:21a | 5:32a | 5:37a | 5:45a | 5:54a | 6:06a | 6:14a | 6:22a | 6:22a      | 6:30a | 6:38a | 6:55a | 7:06a  | 7:11a  | 7:19a  | 7:28a  | 7:40a  | 7:48a  | 7:56a  |
| 5:10a      | 5:22a | 5:30a | 5:47a | 5:58a | 6:03a | 6:11a | 6:20a | 6:32a | 6:40a | 6:48a | 6:48a      | 6:56a | 7:04a | 7:21a | 7:32a  | 7:37a  | 7:45a  | 7:54a  | 8:06a  | 8:14a  | 8:22a  |
| 5:28a      | 5:44a | 5:54a | 6:11a | 6:24a | 6:29a | 6:37a | 6:46a | 6:58a | 7:06a | 7:14a | 7:14a      | 7:22a | 7:30a | 7:47a | 7:58a  | 8:03a  | 8:11a  | 8:20a  | 8:32a  | 8:40a  | 8:48a  |
| 5:54a      | 6:10a | 6:20a | 6:37a | 6:50a | 6:55a | 7:03a | 7:12a | 7:24a | 7:32a | 7:40a | 7:40a      | 7:48a | 7:56a | 8:13a | 8:24a  | 8:29a  | 8:37a  | 8:46a  | 8:58a  | 9:06a  | 9:14a  |
| 6:20a      | 6:36a | 6:46a | 7:03a | 7:16a | 7:21a | 7:29a | 7:38a | 7:50a | 7:58a | 8:06a | 8:06a      | 8:14a | 8:22a | 8:39a | 8:50a  | 8:55a  | 9:03a  | 9:12a  | 9:24a  | 9:32a  | 9:40a  |
| 6:40a      | 6:56a | 7:06a | 7:23a | 7:41a | 7:47a | 7:55a | 8:04a | 8:16a | 8:24a | 8:32a | 8:32a      | 8:40a | 8:48a | 9:05a | 9:16a  | 9:21a  | 9:29a  | 9:38a  | 9:50a  | 9:58a  | 10:06a |
| 7:06a      | 7:22a | 7:34a | 7:54a | 8:07a | 8:13a | 8:21a | 8:30a | 8:42a | 8:50a | 8:58a | 8:58a      | 9:06a | 9:14a | 9:31a | 9:42a  | 9:47a  | 9:55a  | 10:04a | 10:16a | 10:24a | 10:32a |
| 7:32a      | 7:48a | 8:00a | 8:20a | 8:33a | 8:39a | 8:47a | 8:56a | 9:08a | 9:16a | 9:24a | 9:24a      | 9:32a | 9:40a | 9:57a | 10:08a | 10:13a | 10:21a | 10:30a | 10:42a | 10:50a | 10:58a |

## Travel Demand Data

- MPO

## Network Data

- MPO + refinement (GIS maps)

## Validation Data

- Project specific

## Transit Network Data

- Transit agency (GTFS format)

|                    | Loop 150 Southbound |             |             |          |             |
|--------------------|---------------------|-------------|-------------|----------|-------------|
| Start Time         | Left                | Thru        | Right       | Peds     | App. Total  |
| 07:00              | 7                   | 8           | 22          | 0        | 37          |
| 07:15              | 8                   | 22          | 42          | 0        | 72          |
| 07:30              | 6                   | 19          | 58          | 0        | 83          |
| 07:45              | 16                  | 30          | 42          | 0        | 88          |
| <b>Total</b>       | <b>37</b>           | <b>79</b>   | <b>164</b>  | <b>0</b> | <b>280</b>  |
| 08:00              | 13                  | 20          | 50          | 0        | 83          |
| 08:15              | 26                  | 44          | 35          | 0        | 105         |
| 08:30              | 11                  | 21          | 46          | 0        | 78          |
| 08:45              | 18                  | 31          | 36          | 0        | 85          |
| <b>Total</b>       | <b>68</b>           | <b>116</b>  | <b>167</b>  | <b>0</b> | <b>351</b>  |
| <b>Grand Total</b> | <b>105</b>          | <b>195</b>  | <b>331</b>  | <b>0</b> | <b>631</b>  |
| <b>Apprch %</b>    | <b>16.6</b>         | <b>30.9</b> | <b>52.5</b> | <b>0</b> |             |
| <b>Total %</b>     | <b>4.1</b>          | <b>7.6</b>  | <b>12.9</b> | <b>0</b> | <b>24.5</b> |

|  | Loop 150 Southbound |             |             |             |             |
|--|---------------------|-------------|-------------|-------------|-------------|
| Start Time   | Left                | Thru        | Right       | Peds        | App. Total  |
| Peak Hour Analysis From 07:00 to 08:45 - Peak 1 of 1 |                     |             |             |             |             |
| Peak Hour for Entire Intersection Begins at 07:30    |                     |             |             |             |             |
| 07:30  | 6                   | 19          | 58          | 0           | 83          |
| 07:45  | 16                  | 30          | 42          | 0           | 88          |
| 08:00  | 13                  | 20          | 50          | 0           | 83          |
| 08:15  | 26                  | 44          | 35          | 0           | 105         |
| <b>Total Volume</b>                                  | <b>61</b>           | <b>113</b>  | <b>185</b>  | <b>0</b>    | <b>359</b>  |
| <b>% App. Total</b>                                  | <b>17</b>           | <b>31.5</b> | <b>51.5</b> | <b>0</b>    |             |
| <b>PHF</b>   | <b>.587</b>         | <b>.642</b> | <b>.797</b> | <b>.000</b> | <b>.855</b> |

# Accessing the Model

Web-based environment with project specific login to access model, data, and results

- Upload data
- Access GIS editor
- Run model
- Analyze results

Software/data live in powerful servers

Data stored in databases

The screenshot shows a web browser window titled 'downtown\_pm\_base\_project'. The interface includes a menu bar (System, View, Data, Reports, Window, Help) and a toolbar with navigation icons. On the left, a 'Layers' panel lists various map elements like VMS, Notes, Closures, Detectors, Bus Stops, Bus Routes, Signals, Signs, Nodes, Links, Background, and Streets, with checkboxes for each. The main area displays a table titled 'public.linkdetails' with 50 rows of data. Below the table, a map shows a street network with several nodes highlighted in red and labeled with IDs like 13065, 13068, 13067, and 13155. A 'Phase 3' dialog box is open, showing a 'Green' phase duration of 12 seconds and 'Ok'/'Cancel' buttons.

| id   | type | source | destination | length  | speed    | capacity | lanes |
|------|------|--------|-------------|---------|----------|----------|-------|
| 893  | 1    | 3686   | 3687        | 393.883 | 0.583333 | 1500.0   | 3     |
| 894  | 1    | 3684   | 3688        | 737.731 | 0.583333 | 1600.0   | 2     |
| 1471 | 1    | 4040   | 13109       | 634.476 | 0.75     | 1700.0   | 3     |
| 1474 | 1    | 4045   | 4046        | 1641.69 | 0.666667 | 1400.0   | 1     |
| 1480 | 1    | 4054   | 4055        | 3777.27 | 0.583333 | 1300.0   | 1     |

```
select * from nodes where type=100
```

Query:



# Typical Model Run

Specify desired number of iterations

In each iteration

- Find paths
- Assign vehicles to paths
- Confirm they all have the same travel time, or “GAP”

Iterations repeated until “GAP” is acceptable

Process takes from 15 minutes to 48 hours depending network

## DUE - New

Set the options below for this task. Fields in **bold** are required. Default values have been provided.

**Network:** 2020\_region\_am

The module will be run on this network.

### Options

Run to total iteration # 20

Prevent gap increase

Seed random number generator

Partial Demand Loading iterations 5

Warm start iteration (0 for none) 0

Route report CSV

Nonexiting incr. thresh. (0: off) 0

DUE new to 20 iterations with 5 partial demand loading iterations

Notes:

You may enter any notes you wish you to make about this run. These notes will be visible in the network history.

Start

## Tasks

Task 10993

76 %



50: Simulating.

DUE - Continue running on 2015\_region\_pm.

Started at 22:45 Tuesday.

# Getting Ready: Accessing Modeling Tools

Cheat Sheet 1

Your credentials

UT EID

Project login

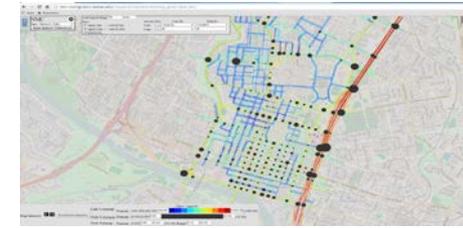
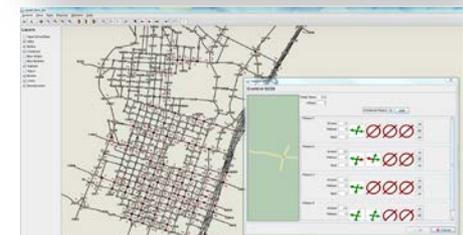
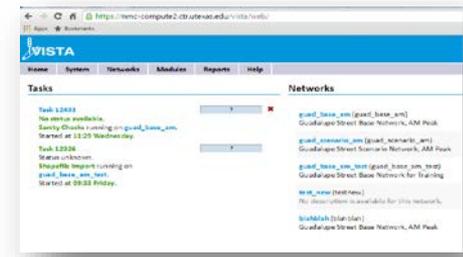
Access to software tools

VISTA web portal

VISTA GIS Editor

Viztool

Interactive Reports

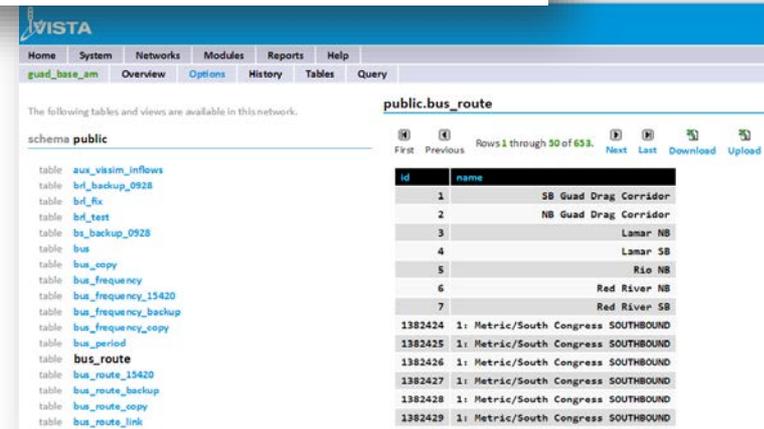
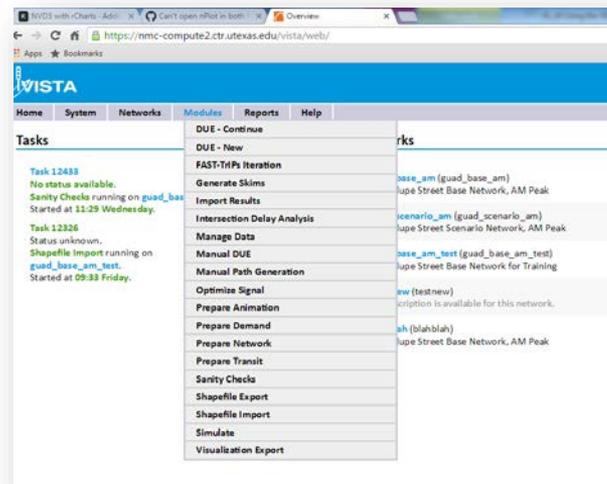


# The VISTA web portal

Web-based environment with project specific login to access model, data, and results

- Upload data
- Access GIS editor
- Run model
- Analyze results
- Generate Interactive reports

Model processes completed using Vista software module





# Log in to VISTA



Welcome to VISTA. Documentation is available [online](#).

## Login

---

Please provide your username and password to log in.

**Username:**

**Password:**

Login

## Recover

---

Have you forgotten your username or password? Enter your email address below and click the button to have your username and a new password emailed to you.

**Email:**

Recover



# Ten-Minute Break



# Practice Exercises

## Practice Exercise 1

- Use GIS editor to model a roadway closure
- Run traffic simulator (vehicles will NOT change paths in response to the closure)
- Visualize results in GIS editor

## Practice Exercise 2

- Use interactive visualization tools to compare two scenarios for which we have computed an equilibrium solution

# The VISTA GIS Editor

Cheat Sheet 3

Access the VISTA GIS Editor

Download small file into your computer and launch (no installation needed)

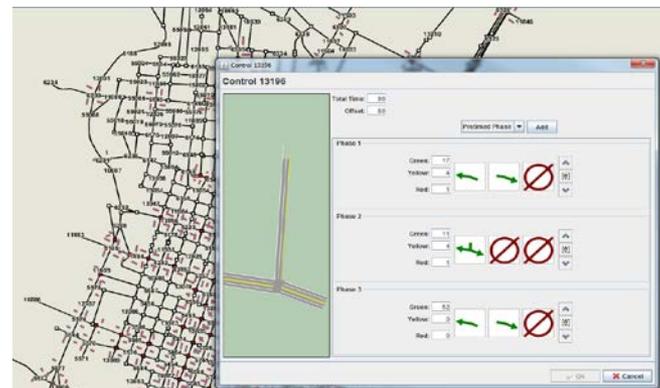
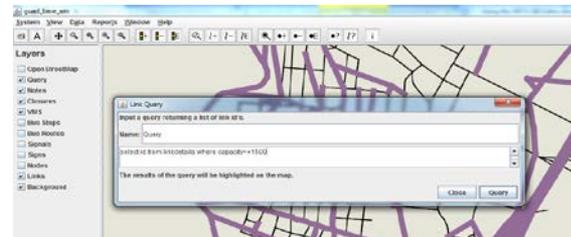
Edit network elements

Animate model results

Query links and nodes

Fix network errors

Add traffic control



Java application that allows changes to data in the VISTA database using a GIS interface

# Practice Exercise 1

Use “practice\_simulation” network

Create a delay by changing a traffic signal or creating a closure

Run the simulator to estimate the impacts

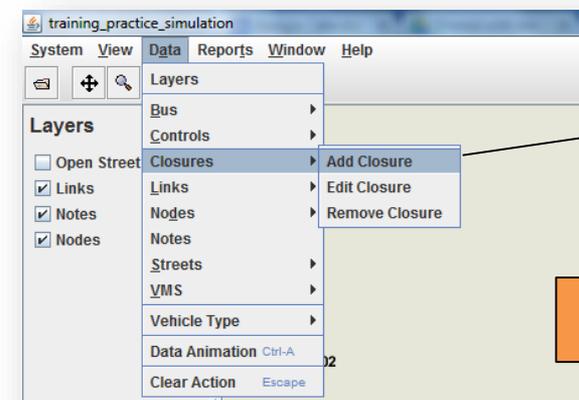
Import results

Visualize results in the GIS editor

- How far is congestion propagating?
- How long does it last?

➤ **REMEMBER:** If we only run simulation, travelers don't change routes, and impacts are exaggerated.

# Creating a road closure

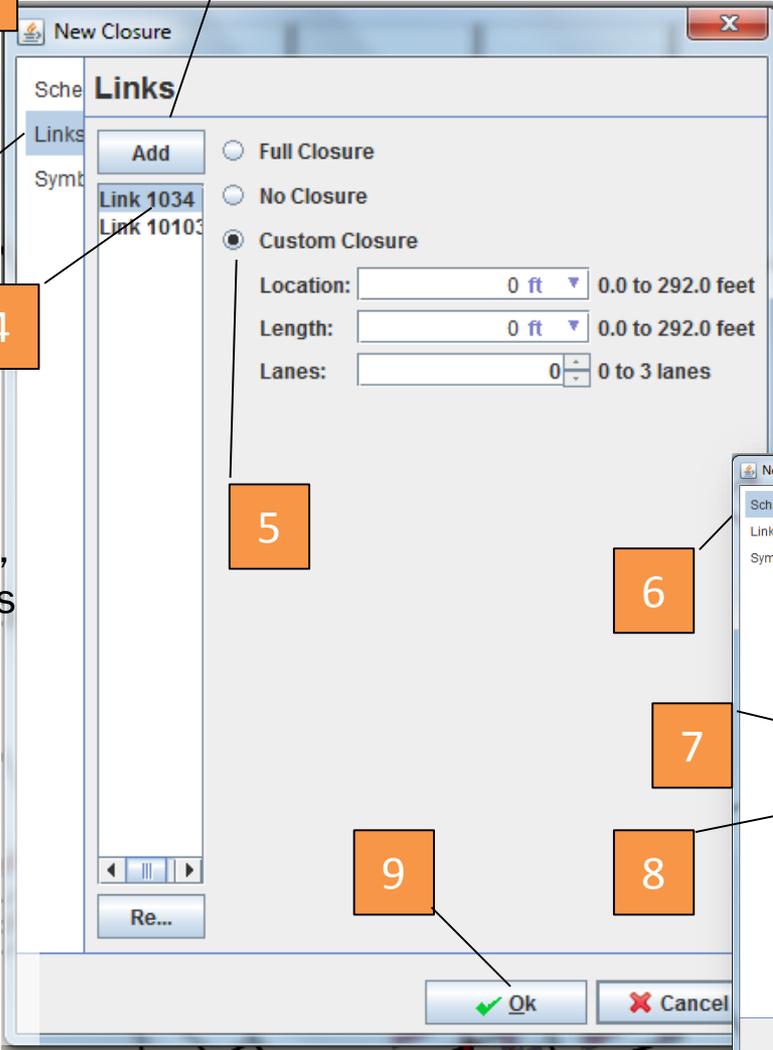


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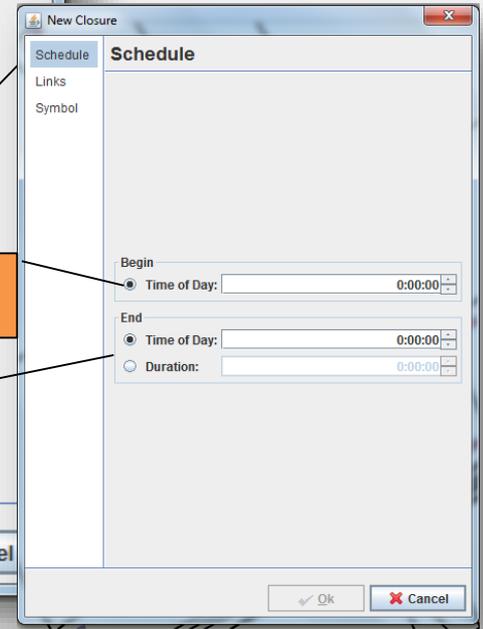
6

7

8

9

**Closure details**  
 Link ID 1993  
 Start 0:0:0  
 Location "0"  
 Length 1300 feet  
 Duration 2 hours  
 Closed 1 lane



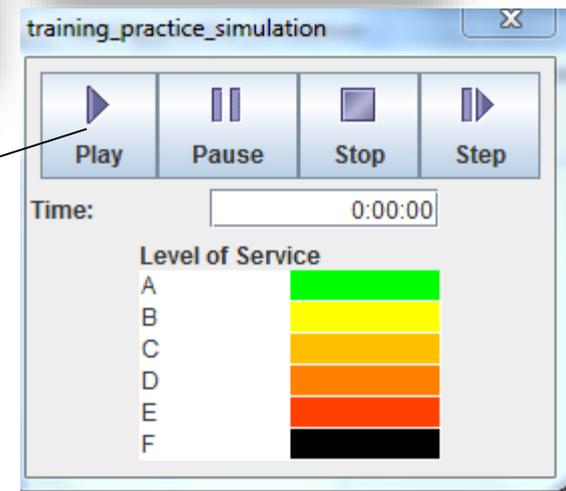
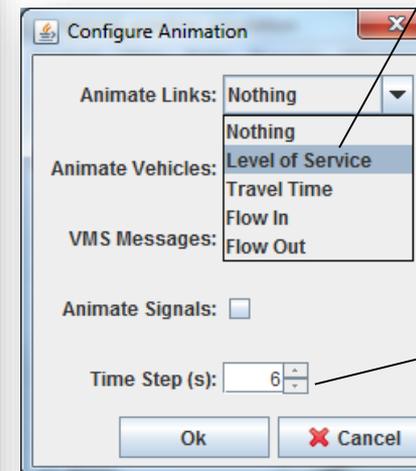
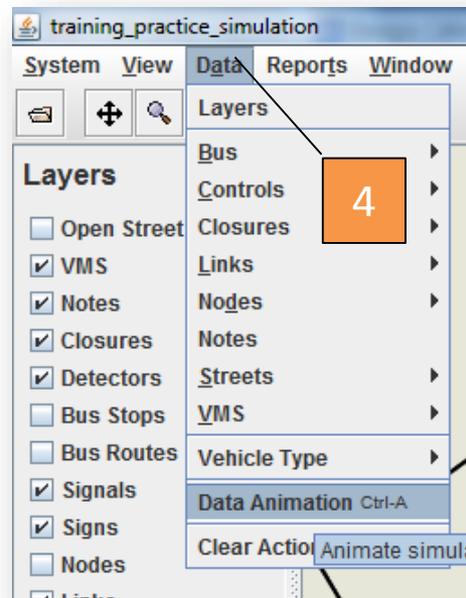
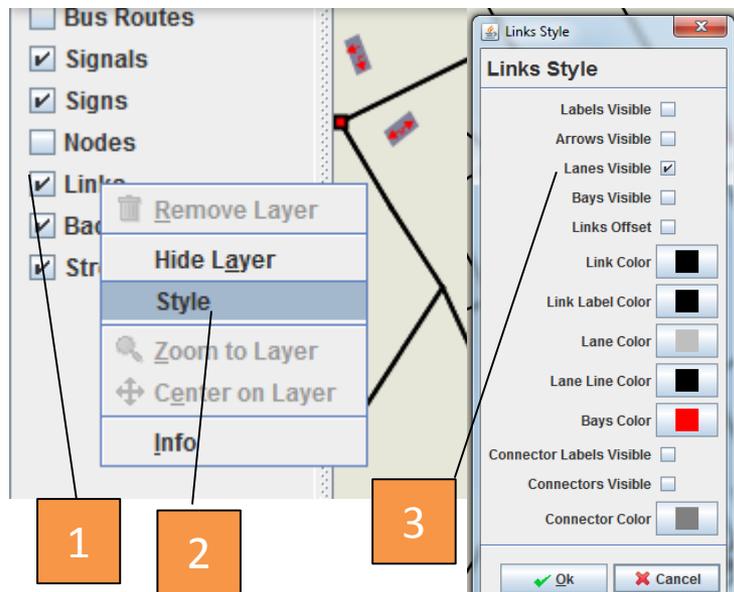
1. Enter "Closure" menu
2. Enter "Link Selection" menu
3. Click on "Add" to select links from the map
4. Once the links appear in the box, highlight one or more (two values will appear for two-way streets)
5. Select "Custom Closure" and specify desired values
6. Enter the "Schedule" menu
7. Select start time (in hh:mm:ss from beginning of simulation)
8. Select end time or duration
9. Click "OK"

# Running Simulation and Importing Results

The screenshot shows the VISTA web application interface. On the left, the 'Tasks' menu is open, with the 'Simulate' option highlighted. A red box labeled '1' points to the 'Simulate' menu item. On the right, the 'Simulate' task configuration page is shown. A red box labeled '2' points to the 'Network' dropdown menu, which is set to 'V4\_Austin2010'. A red box labeled '3' points to the 'Start' button. A red box labeled '4' points to the 'Import Results' option in the 'Tasks' menu.

1. Enter "Simulate" menu
2. Select "Network" from drop-down menu
3. Click on "Start"
4. Once done, enter the "Import Results" menu and repeat steps 2 & 3

# Visualizing congestion in the Editor



1. Right click on “Links” to display menu
2. Select “Style”
3. Check the “Lanes visible” box to visualize directional traffic
4. Enter the “Data” menu and select “Data Animation”
5. Select what to animate: “Travel Time” or “Level of Service” are appropriate to visualize congestion. Click “OK”
6. Select a time step. Three minutes (180 seconds) is small enough to see congestion
7. The animation bar may take a few seconds to appear. Press “Play” to visualize.

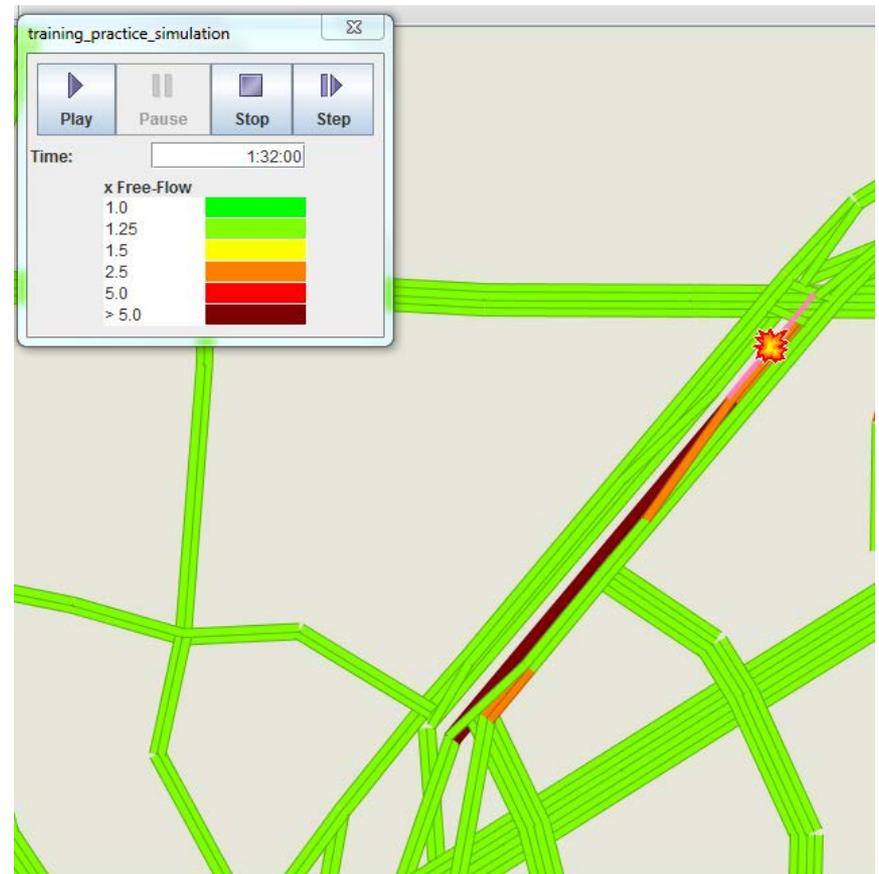
# Our Case Study

## Closure details

- Created a closure on link 1993
- Start 0:0:0
- Location "0"
- Length 1300 feet
- Duration 2 hours
- Closed 1 lane

Observed backups on main lanes, entry ramp, and briefly on frontage road

Backups start around 50 minutes into the simulation and dissipate around 1:50



# Short-term versus Long-term Impacts

training\_practice\_simulation

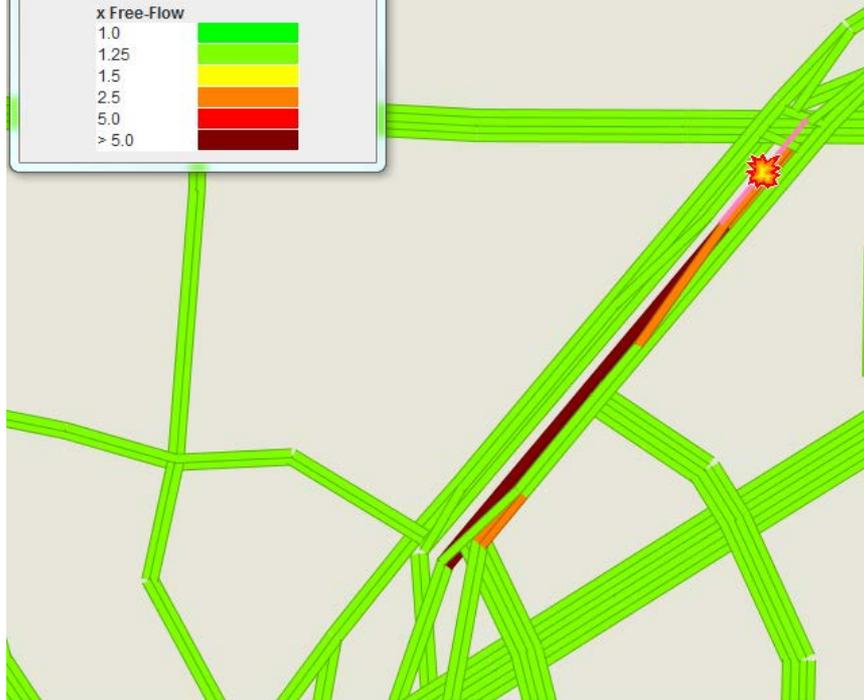
Play Pause Stop Step

Time: 1:32:00

x Free-Flow

|       |             |
|-------|-------------|
| 1.0   | Green       |
| 1.25  | Light Green |
| 1.5   | Yellow      |
| 2.5   | Orange      |
| 5.0   | Red         |
| > 5.0 | Dark Red    |

Simulation Only



training\_scenario\_1

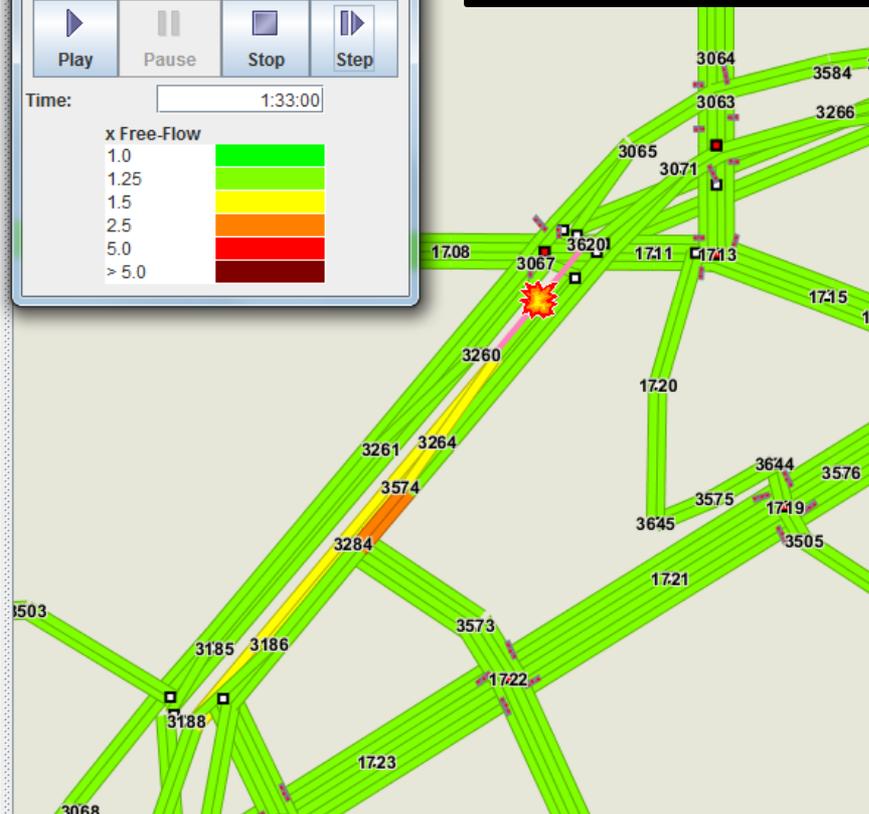
Play Pause Stop Step

Time: 1:33:00

x Free-Flow

|       |             |
|-------|-------------|
| 1.0   | Green       |
| 1.25  | Light Green |
| 1.5   | Yellow      |
| 2.5   | Orange      |
| 5.0   | Red         |
| > 5.0 | Dark Red    |

New DTA



If we run DTA on the same network with the closure in place, the new solution shows less congestion than the simulation-only case because drivers are able to change their paths.



# The Viztool

## Cheat Sheet 4

### Access the Viztool

General use tips

Detailed feature use

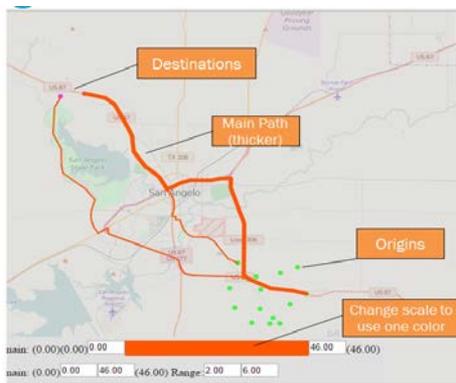
Visualize link & node data

OD paths

Select link paths

Intersection delay

Contour plots



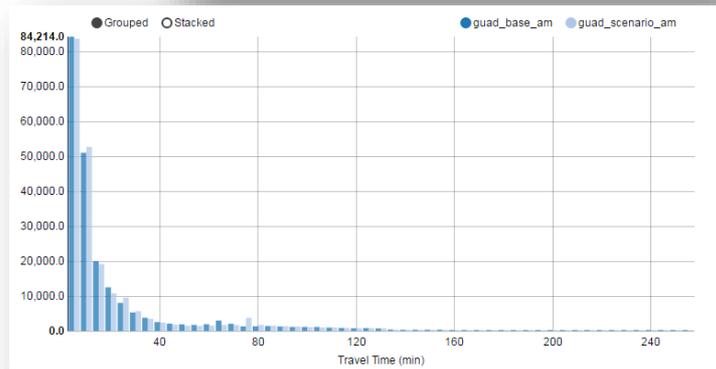
A screenshot of the NMC software interface. It shows a 'Base Network Preferences' dialog box with various settings. Numbered callouts 1 through 6 point to specific elements: 1. 'Reach Time' dropdown, 2. 'Interval' dropdown, 3. 'Origins' input field, 4. 'Done' button, 5. 'Origin' checkbox, and 6. A contour plot on a map showing different colored regions.

1. Select "Reach Time" from main menu
2. Select time-step for animation
3. Select origins by typing IDs or clicking on the map
4. Define the time thresholds used to create the plot (a different color will be used to identify the area that can be covered from the selected origins at each of these thresholds)
5. Click "Done"
6. Check the "Origin" box to visualize the selected origins along with the contour plots

Web-based application that allows for interactive analysis and animation of model results

# Interactive Reports

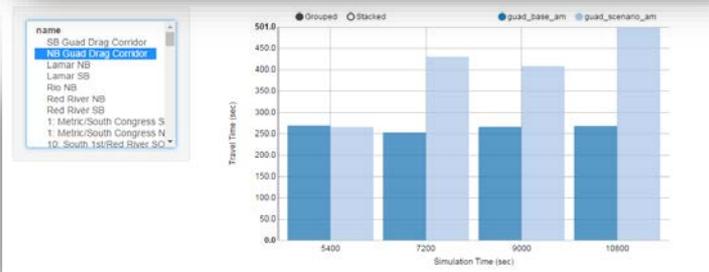
- Generated from the web interface (starting next release)
  - Self-contained .html file that allows for some interactivity
  - Data extracted from the database and saved in the file. Will NOT change if results change.
- Used for high-level scenario analysis
  - Validation of model results by comparing to field data
    - Corridor travel time
    - Link volumes
  - Comparison of aggregate statistics across scenarios



| scenario         | type | title | count  | zero_length | tsst  | vmt    | ttime_m | speed_mph | distance_m |
|------------------|------|-------|--------|-------------|-------|--------|---------|-----------|------------|
| guad_base_am     | 1    | Car   | 174825 | 2761        | 58595 | 254675 | 20      | 13.2      | 1.5        |
| guad_scenario_am | 1    | Car   | 174825 | 2761        | 59123 | 253614 | 20      | 13.2      | 1.5        |

Showing 1 to 2 of 10 entries

Previous 1 2 3 4 5 Next



## Practice Exercise 2

### Use your “base\_case”, “scenario\_1” and “scenario\_2” networks

- Base case: Original network
- Scenario 1: Network with closure analyzed in Exercise 1 (DTA)
- Scenario 2: Network with major reduction in capacity (DTA-Next Slide)

### Use web-based chart tool to compare average performance metrics

- Total system travel time
- Average travel time

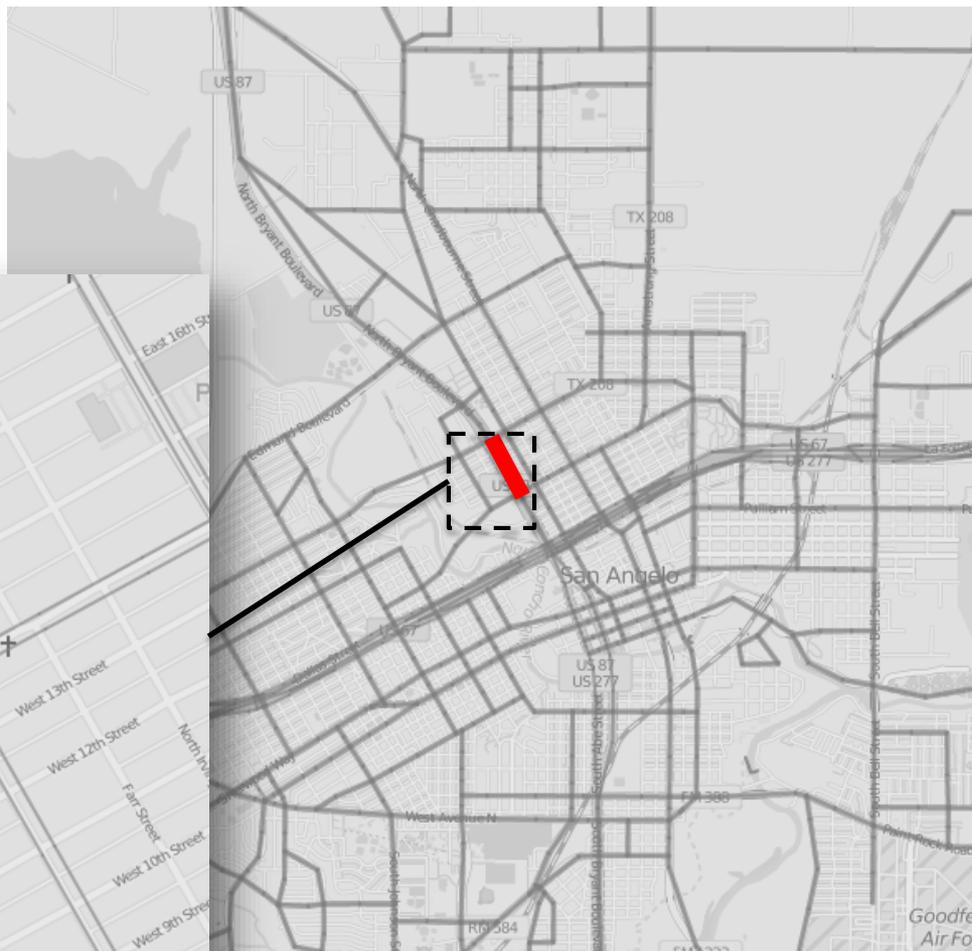
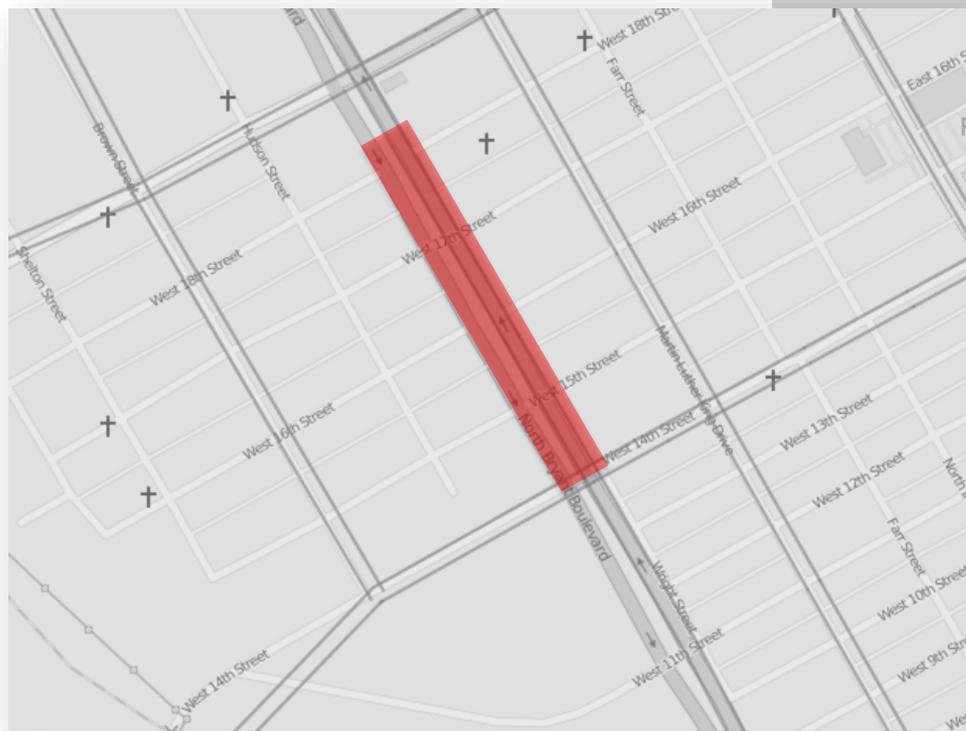
### Export results to Interactive Visualization tool

### Analyze detailed metrics

- How has the traffic flow pattern changed?
- Who was using the affected link before?
- How have major origins/destination paths changed?

# Scenario 2

**Full closure for construction work (northbound direction)**



## High-level comparison

- Use interactive report (provided in file attachment)
- Analyze major differences across scenarios

# Interactive web-based results analysis

Click **Interactive Map Tool** in your **DTA Deployment Resources**

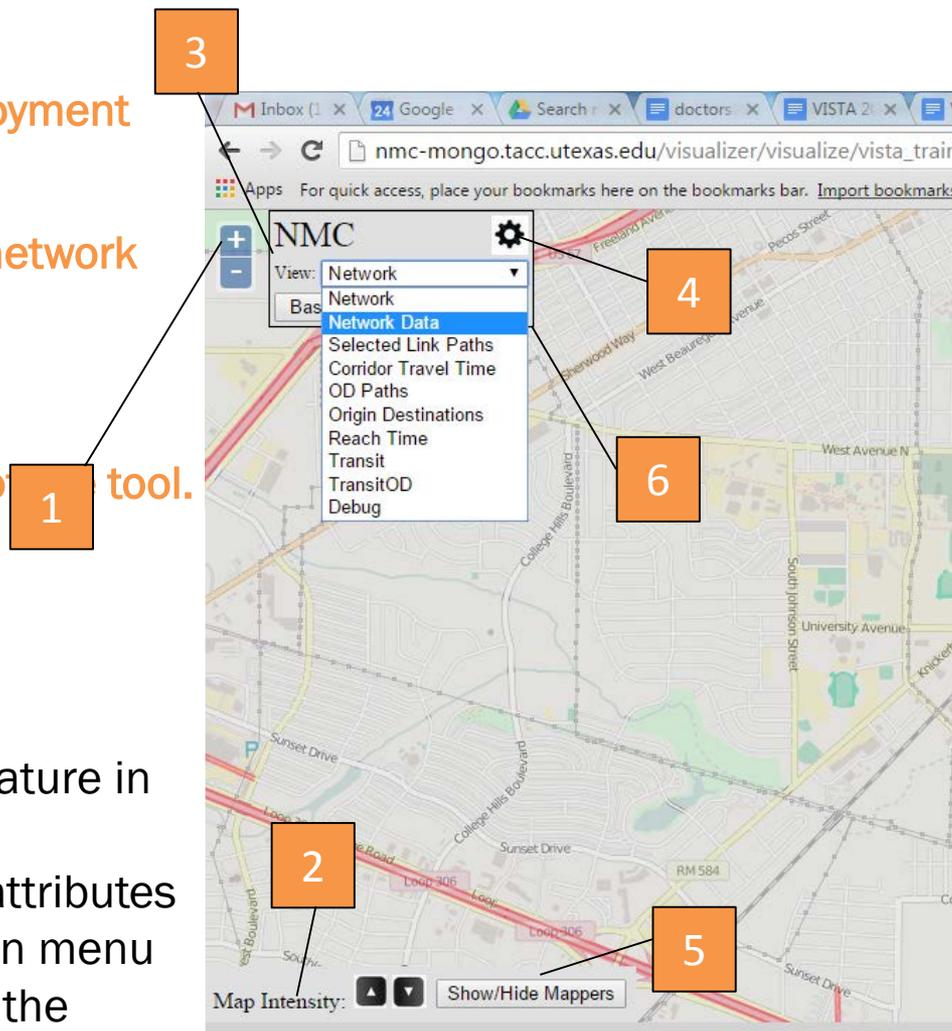
Login with your credentials and select the network you wish to analyze

Initially only major roadways are displayed

We'll have a training workshop on the use of this tool.

Some basics

1. Zoom in/out
2. Dim background map
3. Main menu
4. Hide/show options of selected feature in main menu (when available)
5. Hide/show color map and other attributes of the feature selected in the main menu
6. Select "Network Data" to explore the network properties

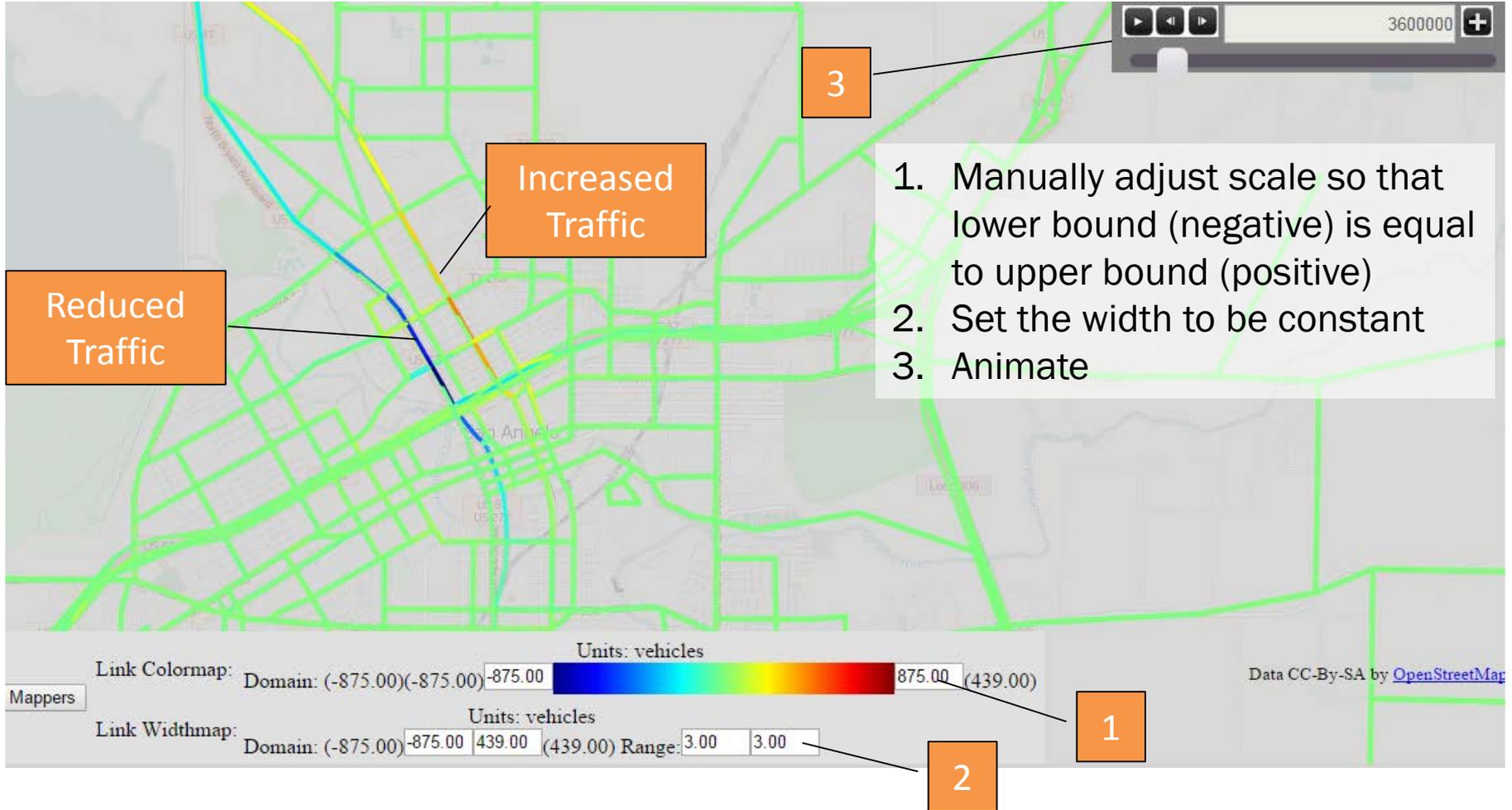


# Comparing link-flows

The screenshot shows the NMC web interface. The main menu on the left has 'Network Data' selected. The 'Link Capacity Range' is set to 0 to max. The 'Show' section has 'regular links' checked. The 'Attribute Data' section has 'Links' and 'Nodes' both set to 'constant'. The 'Link Dataset' panel is open, showing the 'Predefined' tab. The 'Name' is 'test\_diff' and the 'Network' is 'vista\_training\_'. The 'Aggregation' is '60'. The 'Compare with' checkbox is checked, and the 'Load' button is visible.

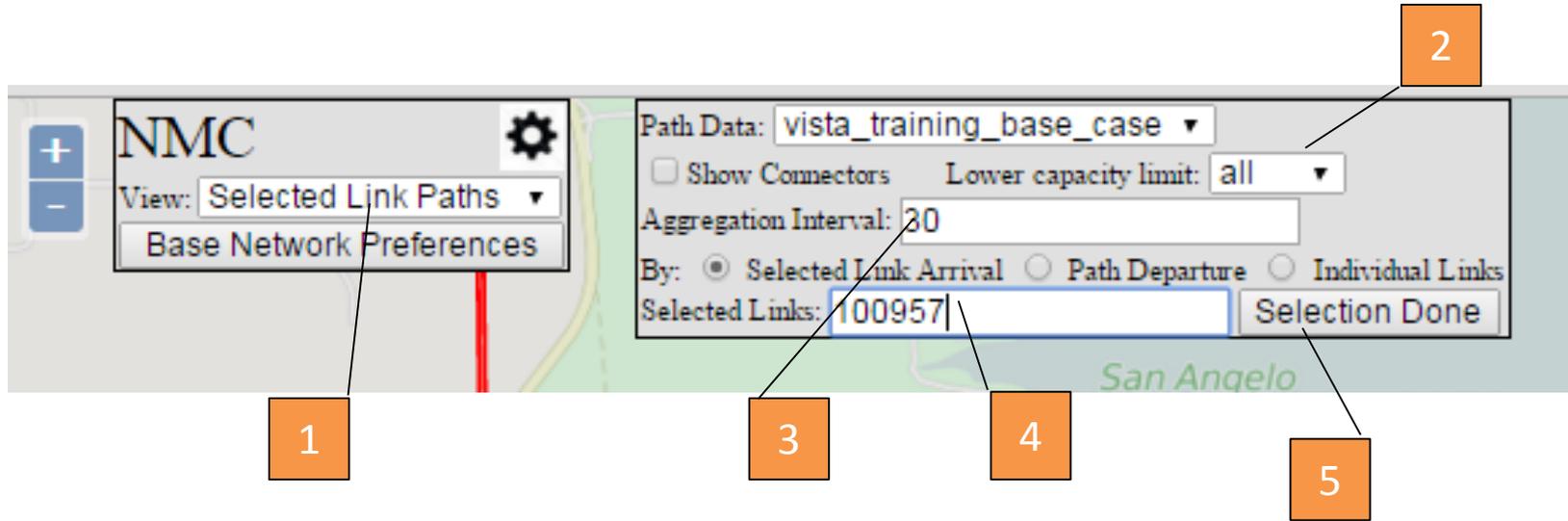
1. Select “Network Data” from main menu
2. Click on “+” sign next to “Links”
3. Select “Predefined” tab
4. Choose a name for the comparison
5. Choose “Volume”
6. Choose a time-step (minutes)
7. Check “Compare with” box
8. Select the network to compare
9. Click “Load”

# Our Analysis



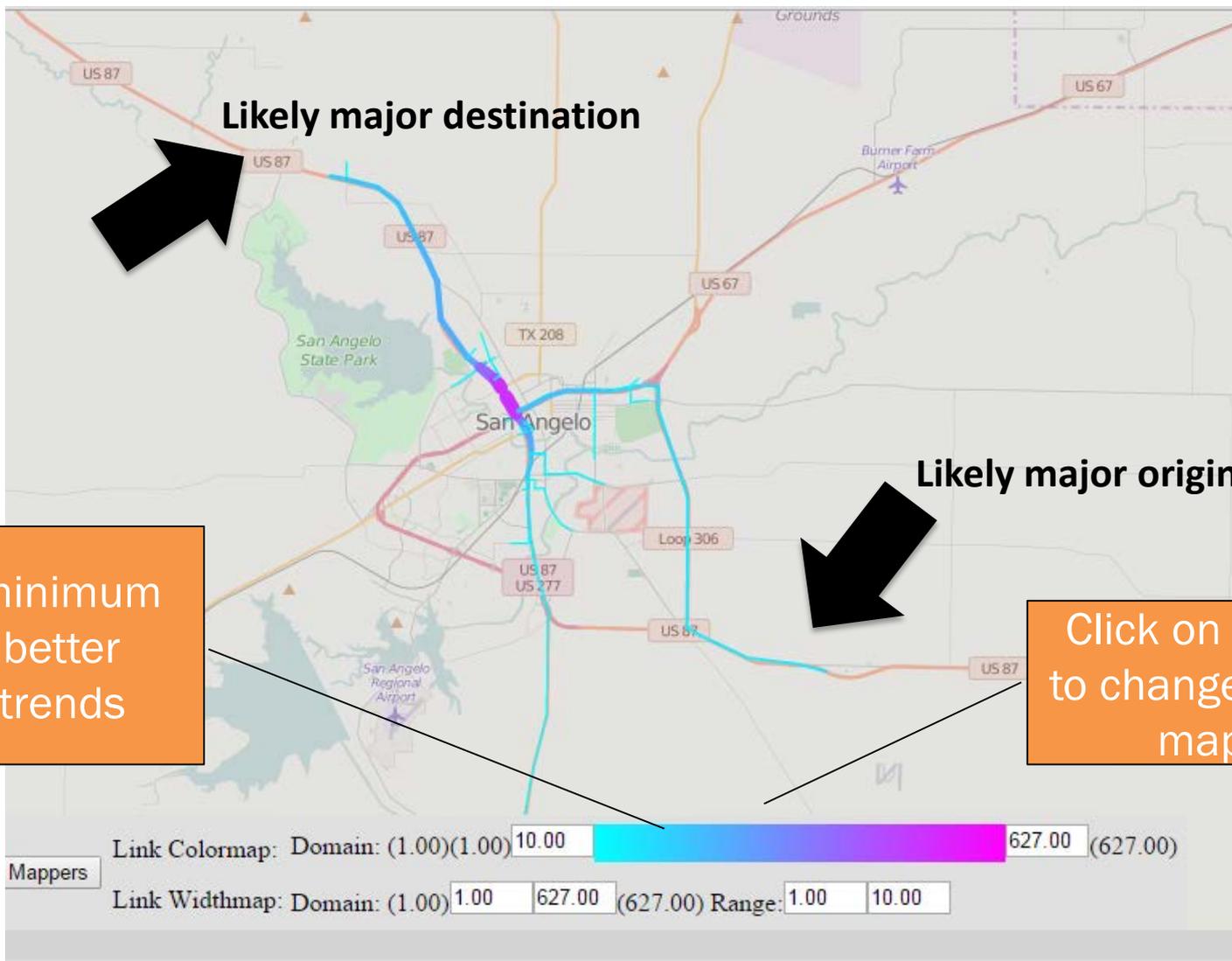
We compared Scenario 2 (top) to Base Case (bottom) every hour

# Identifying Roadway Users in Base Case

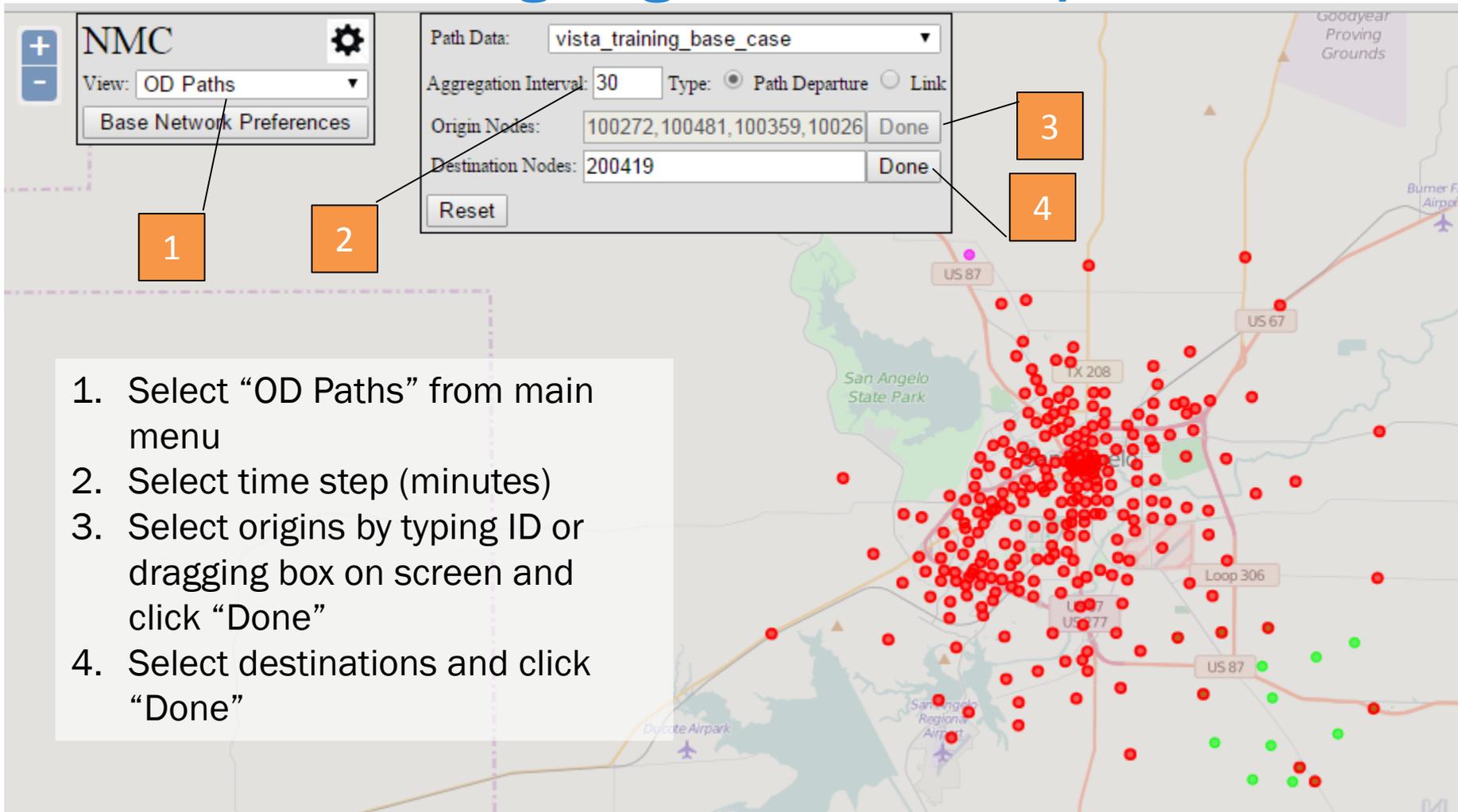


1. Select “Selected Link Paths” in main menu
2. Choose “All” in Lower capacity limit field
3. Select a time interval (in minutes)
4. Select a link by clicking on the map or typing a known ID
5. Click on “Selection Done”

# Analyzing Your Results

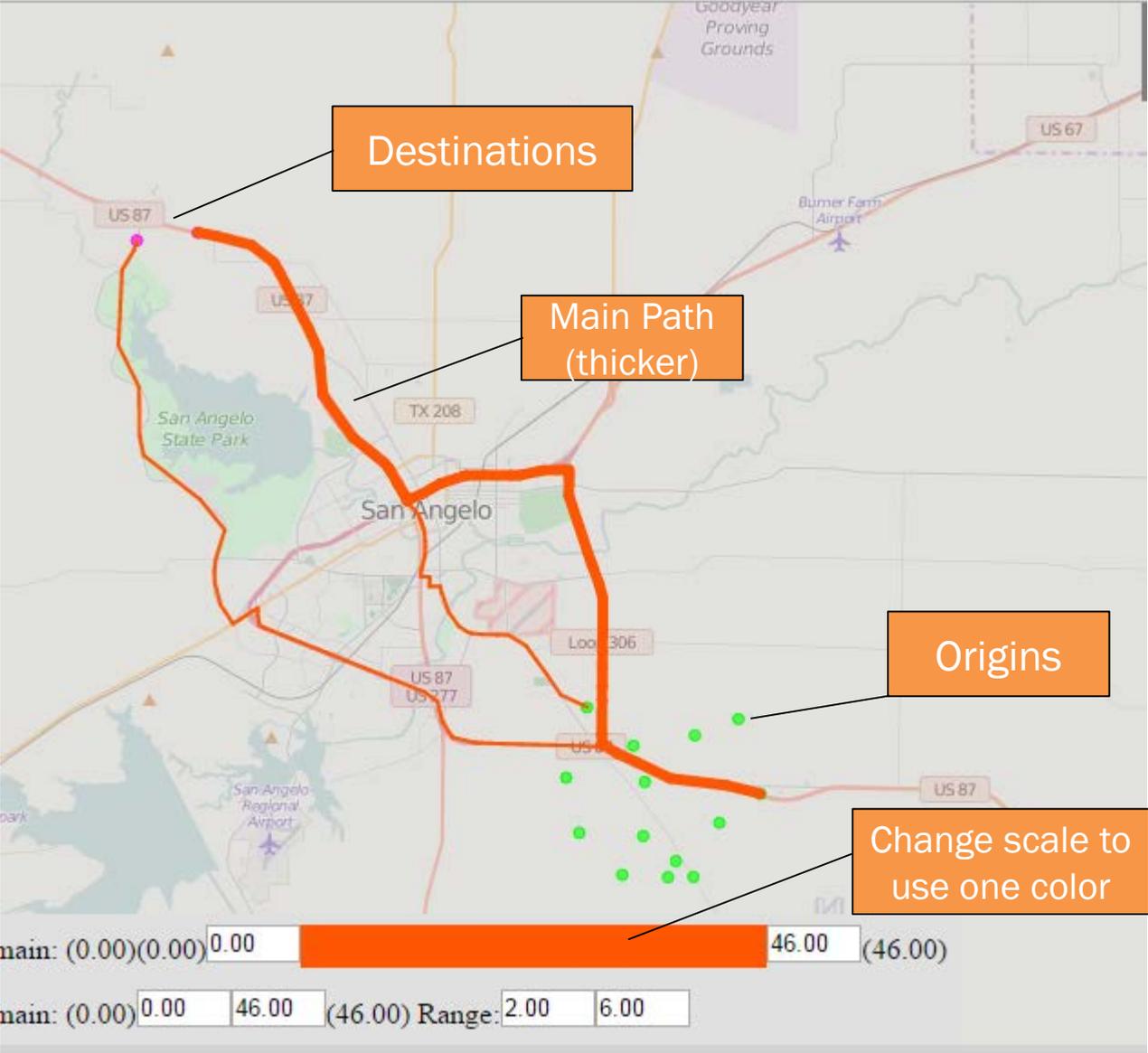


# Visualizing origin-destination paths

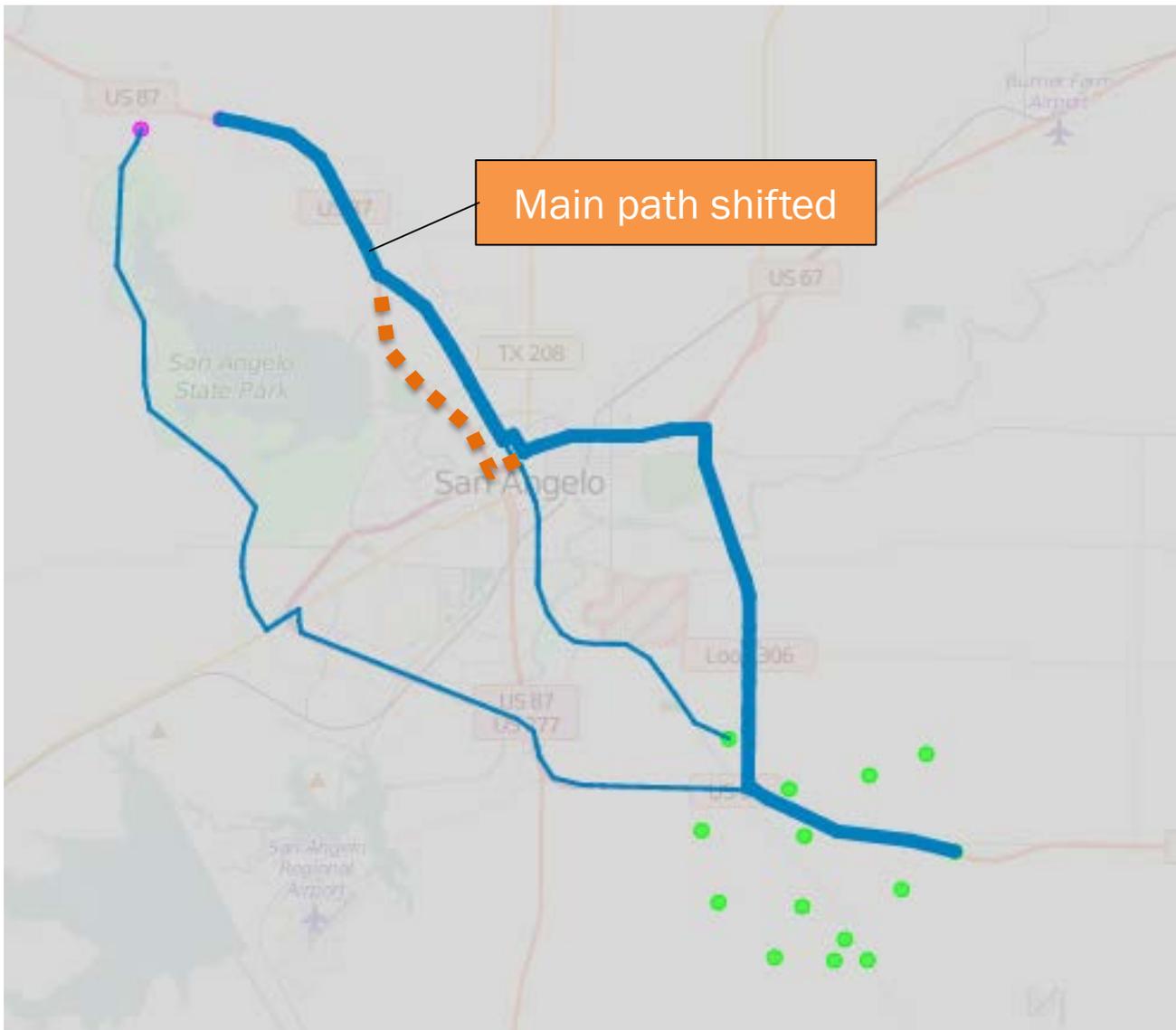


1. Select "OD Paths" from main menu
2. Select time step (minutes)
3. Select origins by typing ID or dragging box on screen and click "Done"
4. Select destinations and click "Done"

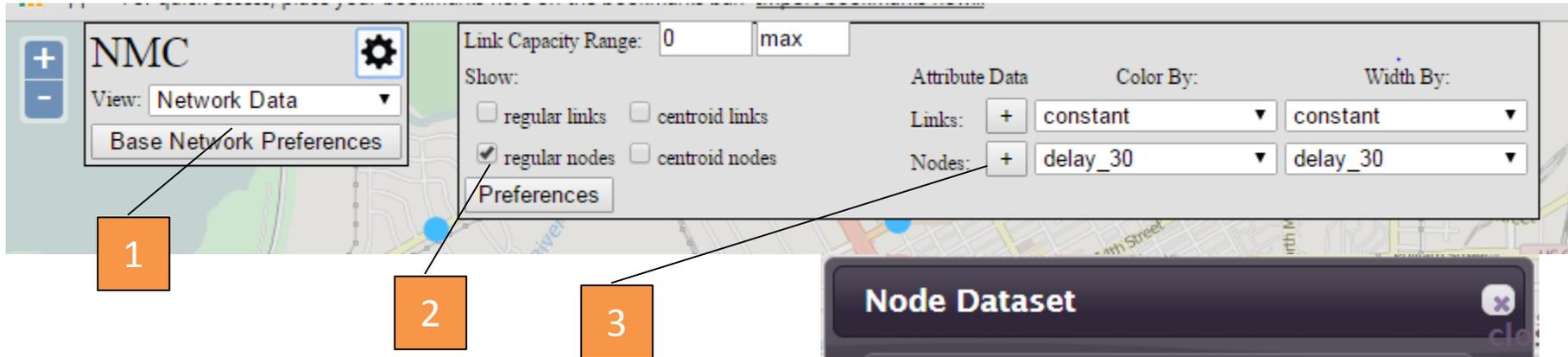
# Base Case



# Scenario 2



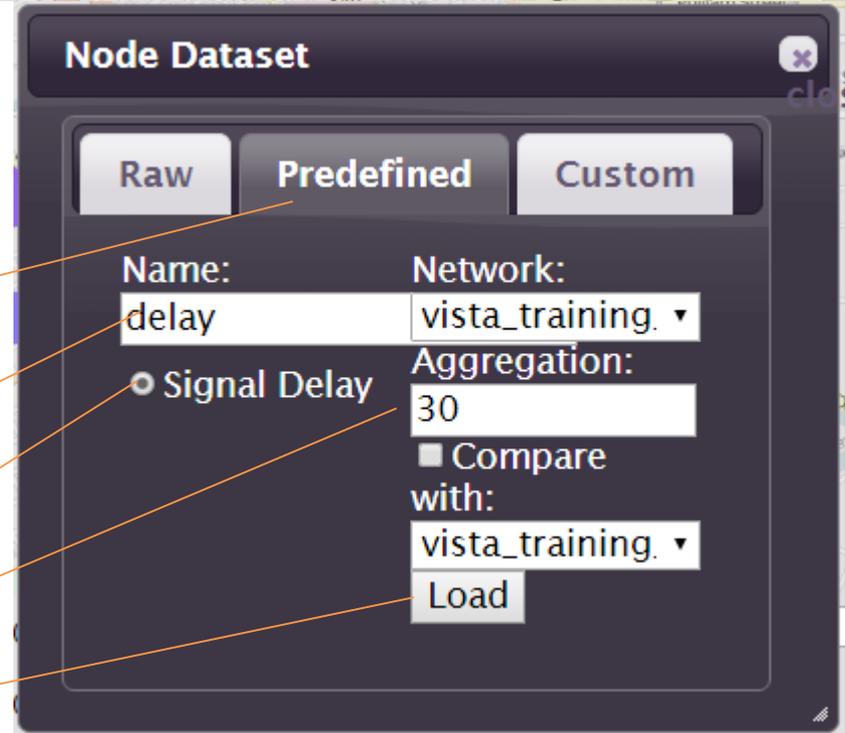
# Visualizing Signal Delay



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1. Select "Network Data" from main menu
2. Check the "regular nodes" box and uncheck "regular links"
3. Click on "+" sign next to "Nodes"
4. Select "Predefined" tab
5. Choose "Signal Delay"
6. Choose a name for the signal delay
7. Choose a time-step (minutes)
8. Click "Load"

# Visualizing Reach Time

The screenshot shows the NMC software interface. The top panel includes a 'View' dropdown set to 'Reach Time' and a 'Base Network Preferences' button. The main configuration area contains fields for 'Dataset' (vista\_training\_scenario\_2), 'Interval' (30), 'Filter' (Bartlett), and 'Origin Nodes'. It also has checkboxes for 'Departure Clip' and 'Eliminate Passed', and a 'Done' button. The 'Contour Levels' are set to 3, 6, 9, 12, 15, and 'Artery' is set to 0. A second panel shows 'Dataset' (vista\_training\_base\_case), 'Contours' (3, 6, 9, 12, 15), 'Show Contours' (checked), 'Links' (unchecked), 'Locations' (unchecked), 'Origins' (checked), and 'Contour Fill Opacity' (0.3). A 'Reset' button is also present. The map below shows San Angelo, Texas, with concentric contour plots in purple, blue, green, and yellow. Red dots represent the origin nodes. Numbered callouts 1 through 6 point to specific UI elements: 1 points to the 'View' dropdown, 2 to the 'Interval' field, 3 to the 'Origin Nodes' field, 4 to the 'Contour Levels' field, 5 to the 'Done' button, and 6 to the 'Origins' checkbox.

1. Select "Reach Time" from main menu
2. Select time-step for animation
3. Select origins by typing IDs or clicking on the map
4. Define the time thresholds used to create the plot (a different color will be used to identify the area that can be covered from the selected origins at each of these thresholds)
5. Click "Done"
6. Check the "Origin" box to visualize the selected origins along with the contour plots



THE UNIVERSITY OF TEXAS AT AUSTIN  
**CENTER FOR TRANSPORTATION RESEARCH**

Please take our survey on today's training,  
located in the [DTA Deployment Resources](#)

