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**Performance Evaluation for City of Austin
Transportation Management Center Expansion**

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Executive Summary

The City of Austin Transportation Management Center (TMC) opened in 2001. Since then the TMC has been monitoring traffic patterns, deploying resources to address equipment issues, implementing signal timing adjustments, and aiding in special event management with the ultimate goal of improving traffic operations in Austin. In April 2016, the City expanded operations of the TMC by contracting with consulting firm Kimley-Horn and Associates. The objectives of the expansion are to increase staff coverage and flexibility, increase the hours of center operation, improve operational efficiency, help manage incidents and events, and ultimately improve transportation system performance.

This report was commissioned to assess the impacts of the TMC expansion to provide guidance to the City as to whether the cost of the consultant contract is yielding the desired benefits. To this end, the report focuses on quantifying the benefits and costs accrued from the expansion from April to December 2016. The report contains a brief overview of the motivation for the expansion effort, details on staffing changes, the performance measurement methodology, and then assessments of benefits and costs.

The addition of consultant staff has enabled the City to expand the hours of TMC operation during weekdays, to include an additional 30 minutes in the morning (6:00 am–6:30 am) and an additional 90 minutes in the evening (6:30 pm–8:00 pm), as well as providing coverage on Saturdays (nine hours) and Sundays (eight hours). Beyond expanding the daily hours of operation, additional staff resources have been included during the weekday peak periods. An on-call manager has also been added for special events. With the TMC expansion, the number of person-hours spent monitoring traffic is increased by nearly 100 percent each week.

This report focuses only on TMC expansion operation strategies that are currently quantitatively measured, and does not capture all possible types of activities and savings, including emissions and cost of safety, thus providing a conservative estimate of benefits. Measured benefits include response to lane-blocking incidents and additional signal retiming enabled by the expansion of hours and staff. This analysis calculated a benefit-cost ratio of 3.7. That is, benefits to the public exceed three times the taxpayer dollars that are invested into TMC expanded operations.

TMC Expansion Activities, April–December 2016	
Activity	Benefit to Public
Lane-blocking response	\$337,478
Expansion of the annual signal retiming program	\$1,467,893
Special-case retiming	\$2,721,760
Total benefit	\$4,527,131
Final Benefit-Cost Analysis	
TMC expansion cost	\$1,237,330
Benefit-Cost Ratio¹	3.7

¹ This number only includes benefits that were quantifiable given current information. For this reason, we believe our analysis gives a conservative estimate of the benefits achieved.

Introduction

The City of Austin Transportation Management Center (TMC) opened in 2001 on Toomey Road. Since then the TMC has been monitoring traffic patterns, deploying resources to address equipment issues, implementing signal timing adjustments, and aiding in special event management with the ultimate goal of improving traffic operations in Austin. A summary of the assets monitored by the TMC can be found in Appendix A. In March 2015, the City released a Traffic Congestion Action Plan, which identified the need for activating the traffic management center to expand hours and staffing. In April 2016, the City expanded operations of the TMC by hiring a consultant firm after a competitive process. The objectives of the expansion are to increase staff coverage and flexibility, increase the hours of center operation, improve operational efficiency, help manage incidents and events, and ultimately improve transportation system performance.

This report was commissioned to assess the impacts of the TMC expansion during its first nine months. The goal of the report is to provide guidance to the City as to whether the cost of the consultant contract is yielding the desired benefits. To this end, the report focuses on quantifying the benefits and costs accrued from the expansion from April to December 2016. The report will begin with an overview of the motivation for the expansion effort, review staffing changes, and then provide assessments of benefits and costs. It is important to consider that this report focuses only on TMC operation strategies that are quantitatively measurable given current capabilities, and that this analysis does not account for all possible types of activities and savings, including those pertaining to emissions and safety.

This report is to be the first of many that will document the evolution of the TMC and provide insight on its ongoing performance. A subsequent report for 2017 will broaden the focus to all of TMC operations rather than solely addressing the initial expansion efforts.

Expanding the Transportation Management Center

The population in the Austin area is growing at a fast rate. Since 2010, it has grown approximately 14 percent, resulting in a similar increase in vehicle miles traveled in Travis County (1). Even larger increases have been reported for surrounding counties as the population has surged in area suburbs (1). This growth in demand has stressed the transportation system in Austin as many suburban residents commute into and around Austin. The area has been consistently rated as having some of the worst traffic congestion in the nation. The Texas A&M Transportation Institute recently scored several Austin-area highways as some of the most congested in the state, with fourteen segments in their Top 100 Most Congested Roadways in Texas (2).

According to a City of Austin Transportation Effectiveness Audit (1), the impact of area growth and congestion on the transportation network has not gone unnoticed by residents. In fact, growth has coincided with a significant decrease in user perception of system performance. Citizen satisfaction with traffic flow in Austin dropped from 27 percent to 17 percent in between 2010 and 2015 (3). Area growth has caused travel demand to far outpace increases in supply, as providing additional capacity is challenging given limited availability of land for new roadways and limited funding.

To address the City's congestion challenges, staff developed a Traffic Congestion Action Plan (4) that outlines short-, mid-, and long-term actions. One of the first actions in the plan is to apply extended hours and staffing to the Traffic Management Center. This served as the primary motivation for bringing on the consulting team to expand the TMC.

A goal of TMC operation and capability expansion is to help address these issues. Through this, the TMC is transitioning from serving a maintenance purpose (e.g., monitoring and rectifying malfunctioning field equipment) to increasingly serving an operations purpose (more fully optimizing the movement of traffic). Austin traffic is managed both proactively (in anticipation of a disruption), and also reactively (in response to a disruption), and expanding the TMC capabilities accelerates the reaction time.

Hours and Staffing

A major emphasis of the TMC expansion is to provide additional staffing and hours of operation to monitor traffic conditions. Figure 1 summarizes the staffing plan before and after TMC expansion.

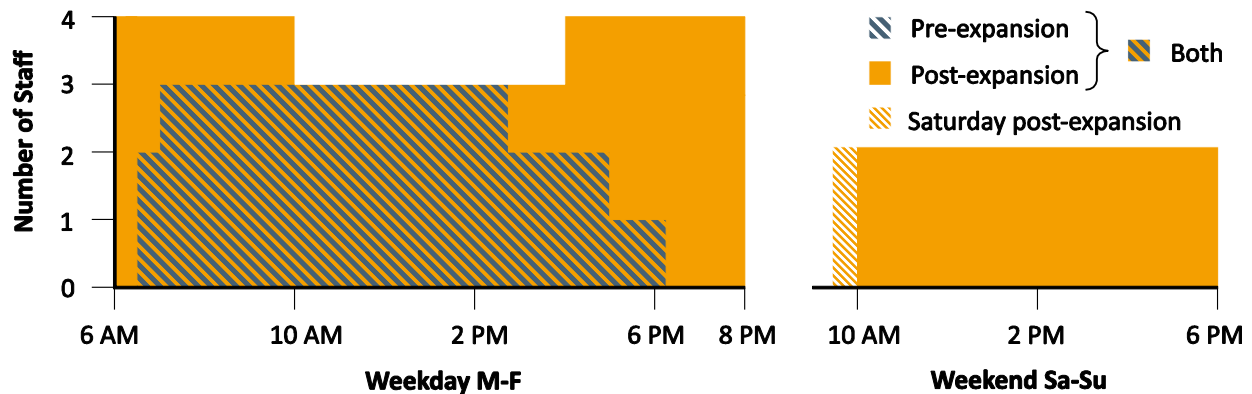


Figure 1 – TMC Staffing Changes Pre- and Post-Expansion

The addition of consultant staff has enabled the City to expand the hours of TMC operation during weekdays, including an additional 30 minutes in the morning (6:00 am–6:30 am) and an additional 90 minutes in the afternoon (6:30 pm–8:00 pm), as well as providing coverage on Saturdays for nine hours and Sundays for eight hours. Beyond expanding the daily hours of operation, additional staff resources have been included during the weekday peak periods. The number of staff for special events increased from two to three. With the TMC expansion, the total person-hours has increased by nearly 100 percent each week. This allows existing City staff more time to focus on signal retiming efforts in the office and out in the field (5). Also, the earlier TMC opening time means that field technicians are now regularly dispatched sooner for outages that had occurred during the night and early morning.

Expansion Tasks

The TMC expansion involves tasks that are undertaken by a blended city and consultant team. Most of the tasks are performed in conjunction with City of Austin staff. For the purpose of measuring effectiveness, each of the expansion tasks that follow are categorized according to these criteria:

Category	Measurability
(P)	Presently quantified in this report: A cost savings is measured and used in this report’s overall benefit-cost analysis.
(F)	Future quantifiable: Future efforts may allow this current task to be measured; however, this is not presently reflected in this report’s benefit-cost analysis.

The TMC expansion tasks include the following:

- **Traffic Signal Monitoring & Timing.** Observe and update signal operations in response to changes in traffic patterns to reduce traveler delay. This happens in three ways:
 - **Annual Signal Timing (P).** Assist in the City of Austin Annual Signal Retiming program. Provide additional expertise to allow for retiming more corridors.
 - **Incidental Traffic Signal Timing Adjustments (P).** Respond to lane-blocking or road-blocking events by temporarily retiming signals to facilitate improved traffic movement.
 - **Special-Case Retiming (P).** On a case-by-case basis, address specific non-incident bottlenecks that are not slated for the Annual Signal Retiming Program.
- **Traveler Information (F).** Update the City's strategically placed electronic signs with notifications on road closures, disruptive events, and safe driving practices to reduce congestion. Also use social media to alert travelers.
- **Incident Management (F).** Monitor and dispatch response-to-roadway incidents (such as a lane-blocking stalled vehicle) to clear incidents as soon as possible.
- **Maintenance Tracking (F).** Proactively track maintenance of infrastructure via customer service reports (CSRs) to reduce failures and repair costs. These include failed signals and detectors.
- **Performance Monitoring (F).** Track the effectiveness of traffic management to improve processes.
- **Develop Standard Operating Procedures (F).** Establish best practices for operational activities to improve effectiveness.
- **Coordination with Other Area Agencies (F).** Communicate with other agencies including the Texas Department of Transportation, the Central Texas Regional Mobility Authority, and the Austin Police Department to best leverage the capabilities and resources that each has to offer in terms of traffic management.

The cost of expanded TMC operations, including consultant costs and additional city staffing, is \$1,237,329. Further analysis is found in benefit-cost section.

Assessment of Benefits

The benefits assessment in this report focuses only on activities with quantifiable benefits that can be attributed to the TMC expansion. Activities that are not yet underway (e.g., enabling quicker response to fix broken detectors) and activities with benefits that are difficult to quantify (e.g., sending messages to the traveling public) are excluded from the analysis. In future reports, additional benefits will be quantified. For this report, limiting the number of areas quantified should yield a conservative estimate of benefits. The areas of focus are responses to lane-blocking and signal retiming. First, the performance measurement methodology is described, and then results for each focus area are presented.

Performance Measurement Methodology

The TMC expansion led to a renewed focus on performance measurement, and the method for logging incidents was revamped. To document issues identified through monitoring the performance of the transportation system or received via Customer Service Requests (CSR), TMC staff created a spreadsheet log. Recorded issues include the following:

- Signals in flash mode (e.g. changing to all-way flashing red)
- Signals with malfunctioning detectors

- Lane blockages near signal locations
- Other signal retiming needs
- DMS and social media messages posted to the public

An online form and data tracking reporting capability that addresses the need to more flexibly record greater detail on disruptions, including documenting the duration of incidents or response times for addressing signal issues (particularly if faulty equipment is detected) and adding the locations of events, is currently being created. The reporting tools enable TMC staff to use a series of data fields and drop-down menus to document each incident involving staff response. The electronic form can then be submitted to an associated database that organizes and stores user entries for future retrieval and analysis. A sample of the status report form is provided in Figure 2.

The screenshot displays the 'TMC Issues Device Status Report' interface. On the left, a sidebar lists several issues, with 'SIGNAL ON FLASH 227' selected. The main form area shows details for this issue: Location 'E 15TH ST / N IH 35 SVRD SB', Signal ID '227', Issue Type 'SIGNAL ON FLASH', and Status 'RESOLVED'. It also includes fields for 'Date Received' (12/13/2016 2:42:00 PM) and 'Date Resolved' (12/13/2016 3:18:37 PM). A 'Signal Lookup' button is visible. Below the main form is a 'TMC Issue Log' table with columns for Details, Location, Issue, and Status. The log shows four entries, all with 'RESOLVED' status.

Details	Location	Issue	Status
	7TH / CONGRESS	SIGNAL ON FLASH	RESOLVED
	STECK / SHOAL CREEK	SIGNAL ON FLASH	RESOLVED
	BURNET / WATERFORD CENTRE	SIGNAL ON FLASH	RESOLVED
	GRACY FARMS / MOPAC EXPY	SIGNAL ON FLASH	RESOLVED

Figure 2 – TMC Device Status Report Online Form

The benefits captured in this report are obtained from data recorded in the log, as well as data obtained through simulation modeling in cases where field data was not available. Simulation and operational models were created using PTV’s VISSIM and Trafficware’s SimTraffic. More details are described below in the assessment of benefits.

Lane-Blocking Responses

When a traffic lane is blocked due to a stalled vehicle or crash, and the incident is within view of a CCTV camera, the TMC monitors the incident and informs responders. When a signal near a traffic-blocking incident or event is retimed, the goal is to best facilitate the movement of traffic that is diverting from the affected area. Often, this new traffic pattern is very different than the expected daily traffic movements that are measured in routine annual signal timing efforts. For example, demand for a left turn may increase significantly on a busy arterial whose normal through-movement is blocked because of a street fair, major traffic accident, or a fallen tree. Adjustments to signal timing can result in notably shorter queues, which have the added benefits of reduced emissions, fewer lane blockages caused by too many vehicles waiting to make a left turn, and fewer opportunities for secondary collisions. TMC expansion has enabled more incidents to be managed during off-peak times, and improves the availability of traffic engineers to address urgent efforts in retiming signals.

An analysis was conducted to estimate off-peak benefits during the April to December 2016 analysis period. Field data and engineer logs were used as inputs. Half of the intersections were classified as involving two busy streets (“Major-Major”), and the other half was classified as having minor side streets (“Major-Minor”). In quantifying the value of travel time, an average value of \$22.32/hour was used, which comes from the TxDOT 2016 Road User Costs (6). The results of this analysis are as follows:

Off-Peak Signal Retiming for Lane-Blocking Incidents, April–December 2016		
	Major-Major	Major-Minor
Number of intersections	18	18
Delay savings	8,640 hours	6,480 hours
Cost savings	\$192,845	\$144,633
Total cost savings	\$337,478	

Expansion of the Annual Signal Retiming Program

With the TMC expansion, City traffic engineers now have more time to work on improving signal timings for short-term fixes as well as fixing longer-term problems. The consulting staff has provided additional expertise to tackle these issues. The FY16 Annual Signal Retiming Program addressed 231 signals within Austin city limits. With the expansion, sixty hours per week has been redirected, allowing engineers to retime twice as many signals as was done previously. Of the 173 retimed signals within the April-December analysis period, 87 of these are attributed to TMC expansion. By analyzing the signal retiming work that traffic engineers performed within the analysis period and isolating the work that would otherwise not have been possible to perform, an estimate of the resulting time savings can be quantified.

The audit report noted that state-of-the-practice guidance recommends all signals be retimed annually and that the City of Austin maintains a goal of retiming signals every 3.3 years (1). However, based on collected data for FYs 2013–2015, the City could only re-time all signals once every 6.2 years. With the expanded staffing of the TMC, it is estimated that the City is now retiming signals at a rate of once every three years. This is the result of enabling City staff to address signal issues rather than day-to-day operations of the TMC, as well as to achieve more efficiency in coordination of resources with consultant staff.

This benefit analysis is based upon before-and-after measurements of retimed signal performance. The data is collected from probe vehicles that measure travel time during the AM peak, the PM peak, and off-peak hours. On average, each driver using any of the affected corridors experienced travel times that were forty-four seconds shorter than before retiming. These drivers also stopped on average 50 percent less. Given the traffic volumes that use these corridors, and using a value of time as defined earlier, a monetary value can be determined from the travel time reductions.

Annual Signal Retiming Savings Attributed to TMC Expansion	
Retimed signals	87
Total delay savings	65,765 hours
Total cost savings	\$1,467,893

Special-Case Signal Retiming

Occasionally, signals are retimed on a special-case basis depending upon the severity of an observed daily recurring bottleneck. Such efforts are performed external to the Annual Signal Retiming Program. The most prominent example of a special-case signal retiming effort made possible through TMC expansion involves a pair of signalized intersections on N. Lamar Boulevard at 5th and 6th Streets. Both 5th and 6th Streets are major one-way thoroughfares, serving downtown to the east, and Texas Loop 1 expressway access to the west. Meanwhile, N. and S. Lamar Boulevard is a major north-south corridor, where the bridge south of the intersections is a popular access point to South Austin.

For years, traffic in the area chronically exceeded capacity for reasons that varied depending upon time of day. One problem was that the heavy amount of left-turn traffic around lunchtime from both directions of N. Lamar Boulevard led to queues that extended beyond the left-turn bays, thus blocking through traffic. In addition, despite the City's "Don't Block the Box" campaign, stopped traffic in intersections blocked east-west traffic on 5th and 6th Streets.

In a special effort during July 2016 that included monitoring of the intersection pair at the TMC and modeling in SimTraffic, traffic engineers devised a unique timing scheme that leveraged some of the techniques seen at the diamond intersections that commonly exist around Texas freeways and service roads. The goal of the scheme was to eliminate spillover from the left-turn bays on N. Lamar Boulevard, and therefore reduce the possibility of intersections and through traffic being blocked.

The simulation models were used to estimate the benefits of the change, and visual inspection of the intersection was used to verify results. Although travelers may still experience a variety of delays, the average delay among all lunchtime travelers was reduced by 40 percent, enabling a 16 percent increase in the number of vehicles that can enter the intersections. With the assumed value of time as described earlier, the following benefit was found:

Lamar Blvd. at 5th and 6th Streets: Special Case Retiming Benefits, July–December 2016	
Average lunchtime delay savings	95 sec/vehicle
Delay savings over July-Dec.	121,943 hrs
Total cost savings	\$2,721,760

This in-depth retiming effort was performed as part of the TMC expansion. Although such a scheme would have eventually been implemented within a year or two as part of the annual signal retiming program, the effort yielded a sizeable benefit to Austin travelers at an earlier time.

Benefit-Cost Analysis of TMC Expansion

The cost of consultant services to expand the TMC from April to December 2016 is \$1,067,329. This includes providing additional staff to manage and operate the TMC and providing support for the advanced traffic management software that is used to monitor traffic cameras and provide automated alerts when incidents occur. The additional cost of City of Austin personnel to support the expansion is \$170,000. Therefore, the total cost for TMC expansion is \$1,237,329.

When communicating the benefits provided to the public, it is common for public service organizations and projects to present estimates of benefit and operating costs into a cost-benefit analysis (7). In such

an analysis, evidence shows whether the benefits (B) outweigh the costs (C) of the project or service (in which the B/C ratio is greater than 1), or whether the project or service is inefficient (in which the B/C ratio is less than 1). The set of quantitative analyses above are incorporated into a benefit-cost analysis.

The analyses that are considered here include benefits of TMC lane-blocking responses, additional routine signal retiming that was enabled by the expansion, and signal retiming to alleviate major bottlenecks. All benefits and costs are estimated over the April to December 2016 analysis period.

TMC Expansion Activities, April–December 2016	
Activity	Benefit to Public
Lane-blocking response	\$337,478
Expansion of the annual signal retiming program	\$1,467,893
Special-case retiming	\$2,721,760
Total benefit	\$4,527,131
Final Benefit-Cost Analysis	
TMC expansion cost	\$1,237,329
Benefit-Cost Ratio²	3.7

The result is that the value provided to the public for TMC expansion exceeds three times the taxpayer dollars that fund it. As mentioned earlier, it is important to acknowledge that this benefit-cost analysis is only possible on TMC operation strategies that are quantitatively measurable under its current capabilities, and that all possible types of activities and savings are not accounted for, including emissions and cost of safety. The results should therefore be seen as a minimum estimation of benefit, not a portrayal of total impact, and as such should not be a stand-alone factor in decision-making processes such as budget forecasting. Rather, the quantified benefit should be complemented with other inputs for a more complete analysis. Further research efforts will improve the level of comprehensiveness in TMC activity measurements.

Conclusions

Since 2001, the City of Austin Transportation Management Center has been dedicated to improving traffic flow throughout the City. The TMC offers capabilities for quick response to signal outages, incident monitoring via cameras, active traffic signal timing adjustments, and traffic management during special events. Austin citizens are informed of travel conditions via messages posted to dynamic message signs and social media. The TMC staff assists in clearing incidents, and also promptly dispatches field technicians to repair broken signals.

In April 2016, work began to expand TMC operations to cover more hours during the work week, as well as weekends. The intent of the expansion was to offer prompt response time to incidents and signal outages, translating to improved traffic flow and reduced travel delay. Also, extra staffing was added to the TMC so that traffic engineers who formerly staffed the TMC could instead focus more on retiming signals. This report used collected data and traffic modeling to analyze the impact of TMC operation and

² This number only includes benefits that were quantifiable given current information. For this reason, we believe our analysis gives a conservative estimate of the benefits achieved.

expansion on signal outage scenarios, lane blockages, and signal retiming. By focusing on these three areas where quantitative analysis was possible, a benefit-cost ratio of 3.7 was estimated. That is, benefits to the public exceed three times the taxpayer dollars that are invested into TMC expanded operations.

References

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- (3) ETC Institute City of Austin Community Surveys 2010-2015, February 2016.
- (4) City of Austin, Austin Traffic Congestion Action Plan, March 27, 2015. Accessed Jan. 2017 at http://austintexas.gov/sites/default/files/files/CongestionActionPlan_3.27.15_FINAL.pdf
- (5) Kimley-Horn, TMC Staffing: A Summary of Quantifiable Value to Signal Engineers, December 2016.
- (6) TxDOT, Road User Costs, 2016. Accessed Dec. 2016 at <http://www.txdot.gov/inside-txdot/division/construction/road-user-costs.html>
- (7) FHWA, Operations Benefit/Cost Analysis Desk Reference, May 2012, accessed Dec. 2016 at <http://ops.fhwa.dot.gov/publications/fhwahop12028/index.htm>

Appendix A: Background on TMC-Monitored Assets

The TMC procures and utilizes a variety of assets to help efforts in managing traffic within the City:

- **Central software.** To help monitor the status of deployed equipment and implement real-time adjustments to signal timing plans, the City operates a transportation management software tool called the Kimley-Horn Integrated Transportation System (KITS). See Figure A1. The City is currently undergoing an effort to connect more components, including detectors, to this system.

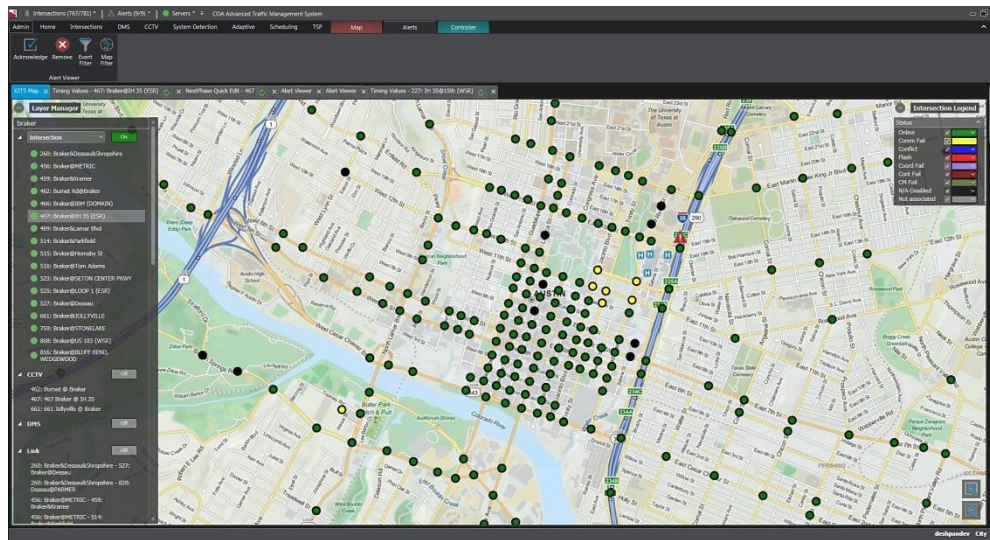
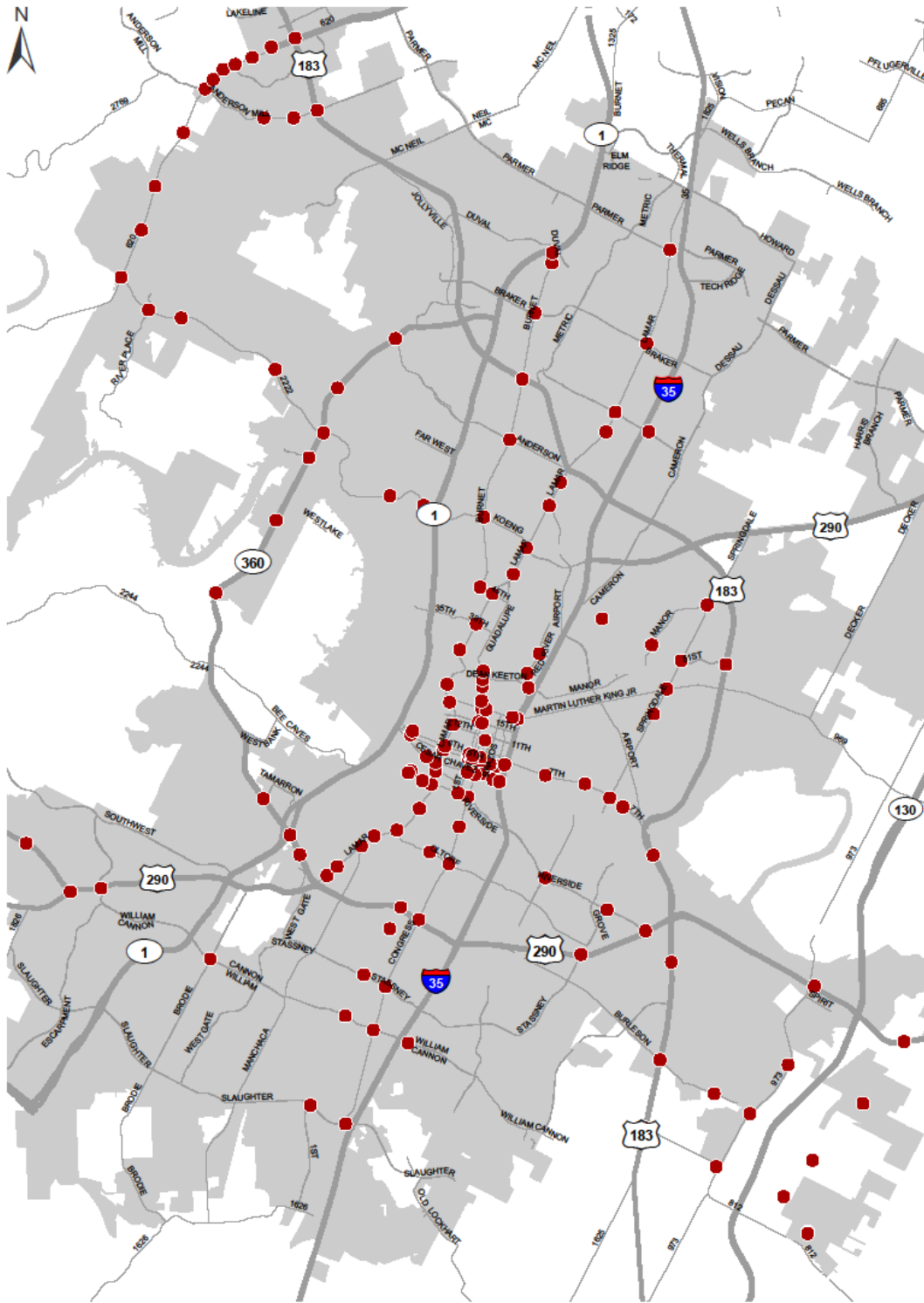


Figure A1 – KITS software with downtown Austin detail

- **Signals.** As of September 2016, the City was operating and maintaining 998 signals and 53 pedestrian beacons.
- **Sensors and detectors.** The TMC also monitors 125 Bluetooth and WiFi sensors, recording travel time throughout the City (see Figure A2). Additionally, the City has 13 operational Wavetronix volume detectors that measure the amount of traffic on respective sections of roadways (see Figure A3). Finally, the City has inductive loop detection working on 685 signals that allow signals to be responsive to current traffic conditions.
- **Cameras.** The TMC spends a considerable amount of time monitoring CCTV cameras. Currently, the center operates 244 operational CCTV cameras. TxDOT operators at the Combined Transportation, Emergency & Communications Center (CTECC) can tap into the City's cameras to assist in freeway operations. Cameras and detector sensors are all used by TMC staff to understand and respond to changing traffic conditions without needing to physically access the respective locations. Figure A4 shows the location of proposed and operational cameras.
- **Dynamic message signs.** Lastly, the TMC maintains and operates thirteen dynamic message signs (DMS) throughout Austin, installed at permanent locations (Figure A5). Each sign has the capability of providing three-line messages with up to two phases, and are used to convey information about upcoming events, road closures, and standard safety messages to the traveling public.

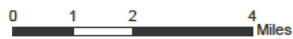
Many TMC services that use these assets are beneficial but not necessarily quantifiable at this time. Further research will be conducted to quantify more TMC services and costs of equipment. Additionally, most TMC services stand to benefit from expanded operating hours. The underlying intent and result of all TMC services that use these assets is to reduce travel time, reduce congestion, increase traffic flow, reduce emissions, and improve safety.



Travel Time Sensors

Arterial Mangement Division
 Austin Transportation Department
 January 2017

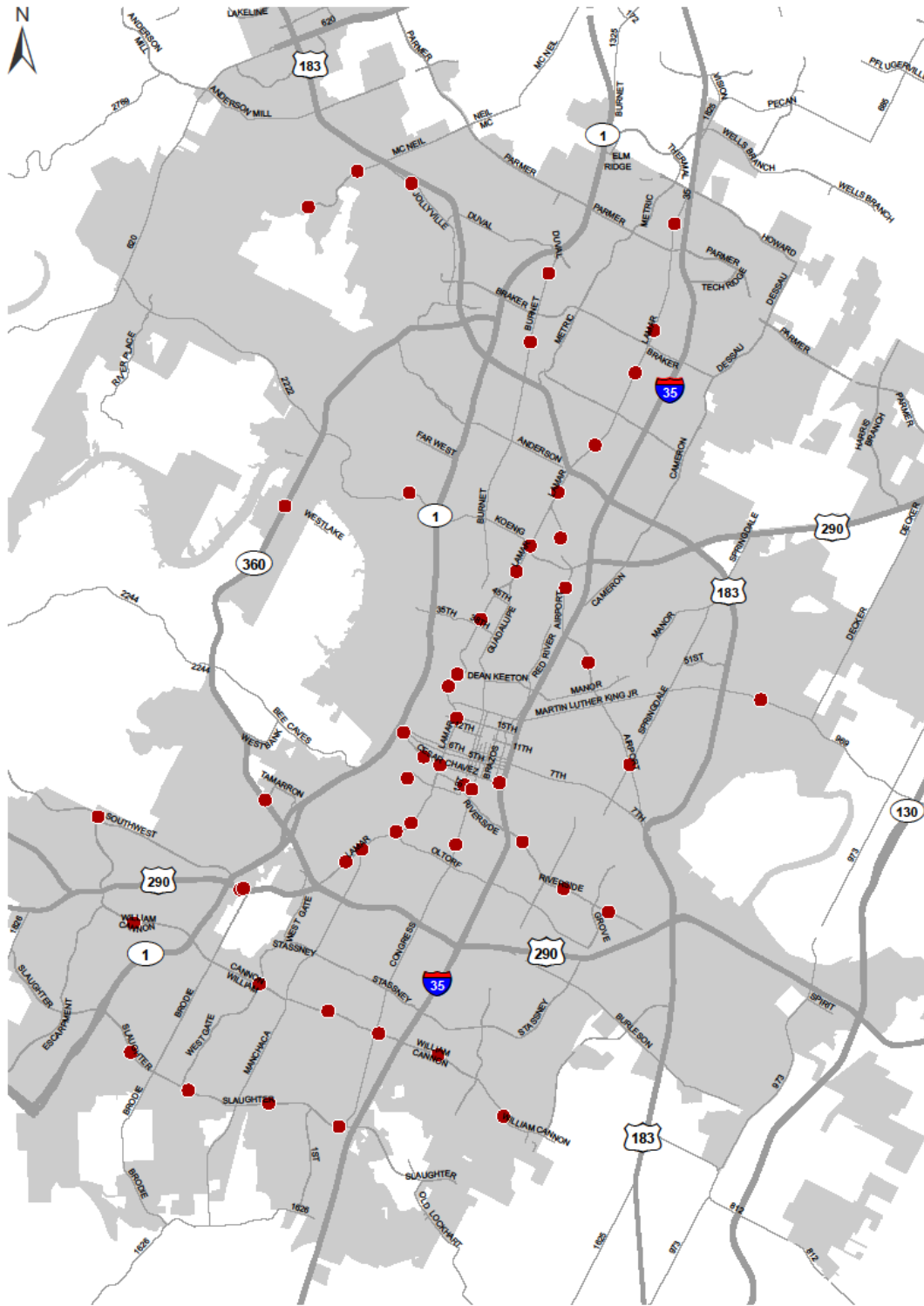
● Travel Time Sensor



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 Prepared by J. Clay on 2 FEB 2017

Figure A2 – City of Austin Travel-Time Sensors



Volume Count Stations

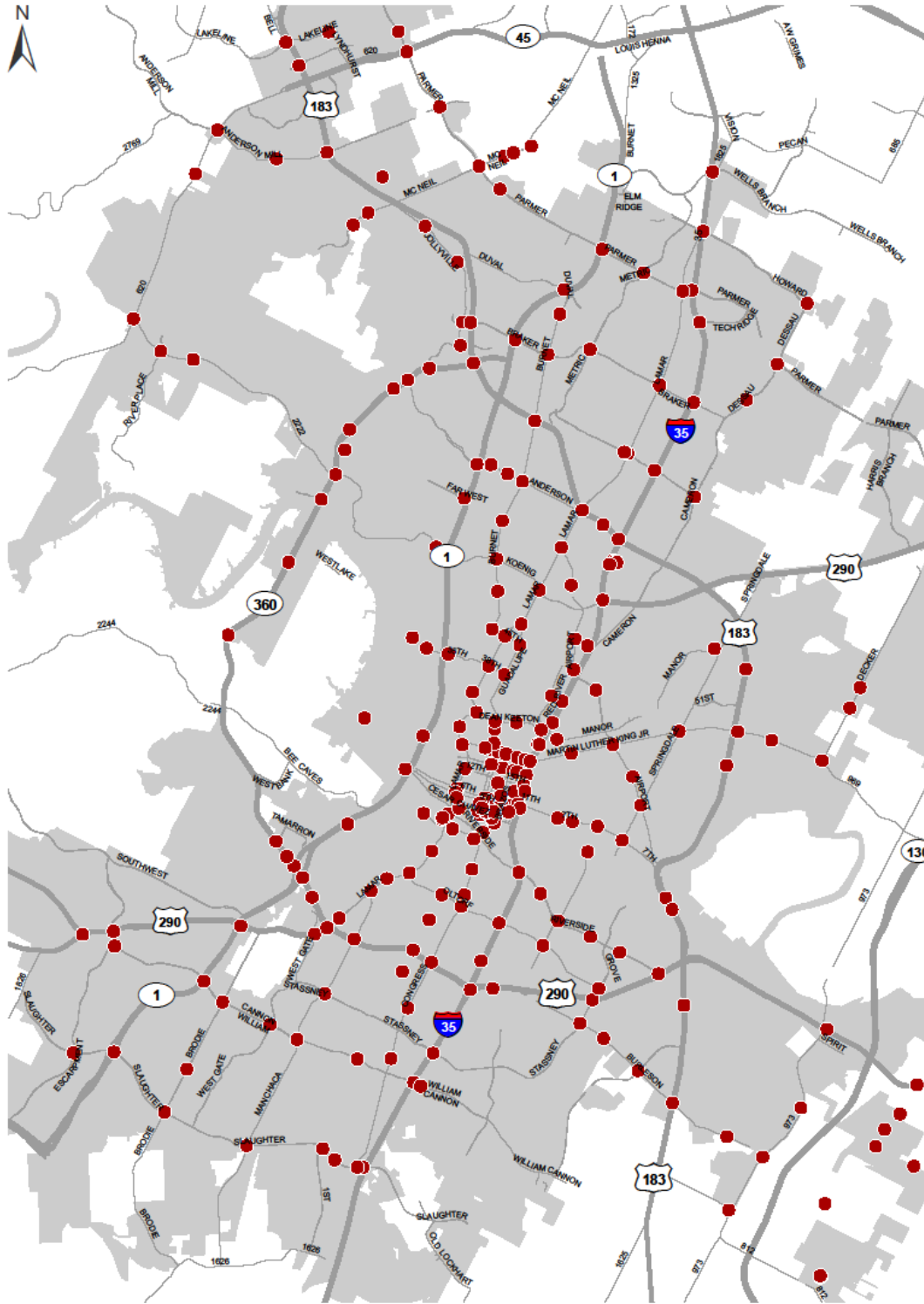
Arterial Mangement Division
 Austin Transportation Department
 January 2017

● Volume Count Station



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Figure A3 – City of Austin Volume Count Stations



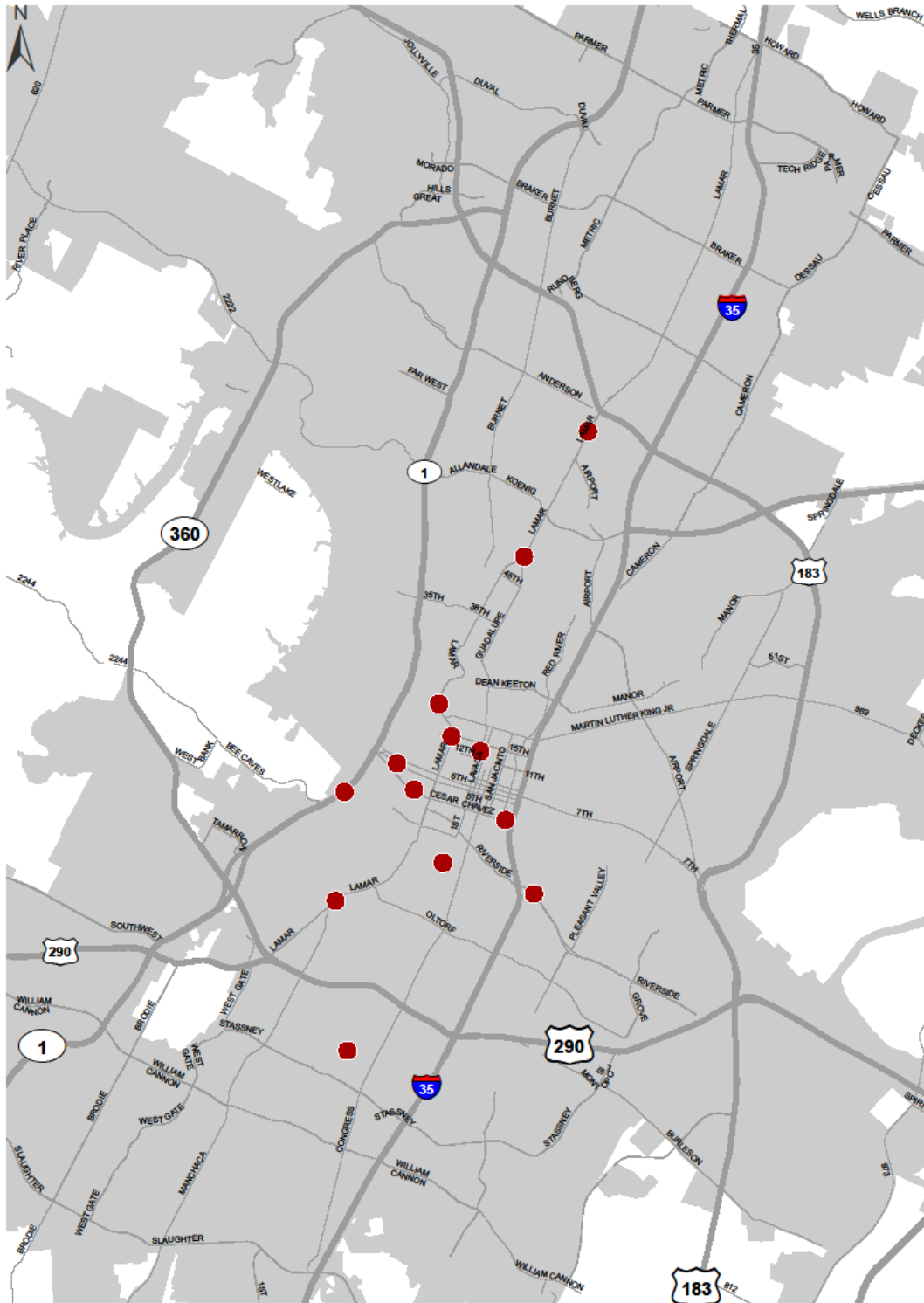
Traffic Cameras
 Arterial Mangement Division
 Austin Transportation Department
 January 2017

● Traffic Camera



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Figure A4 – City of Austin Camera Locations



Dynamic Messaging Signs

Arterial Mangement Division
 Austin Transportation Department
 January 2017

● Dynamic Messagin Sign

0 0.75 1.5 3 Miles



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Figure A5 – City of Austin Dynamic Messaging Sign Locations