Downtown Traffic Management System Enhancements

Concept of Operations

December 2018

State Proj. No. 164-030-012

City Proj. No. T-1371

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1. Introduction

The City of Saint Paul is seeking to improve traffic operations in the downtown Saint Paul area. The management of traffic in this area involves transportation agencies at the city, county and state levels, as well as local law enforcement and businesses that generate traffic for large events. Upgrades to the traffic management system include optimized signal operations and communications capabilities, managing traffic incidents, providing event traffic management, and upgrading the existing traffic management center. Improving these areas are critical to maintaining a modern transportation system. These improvements would be achieved with the installation of new traffic signal controllers, fiber optic communications, Dynamic Message Signs (DMS), and traffic management center upgrades.

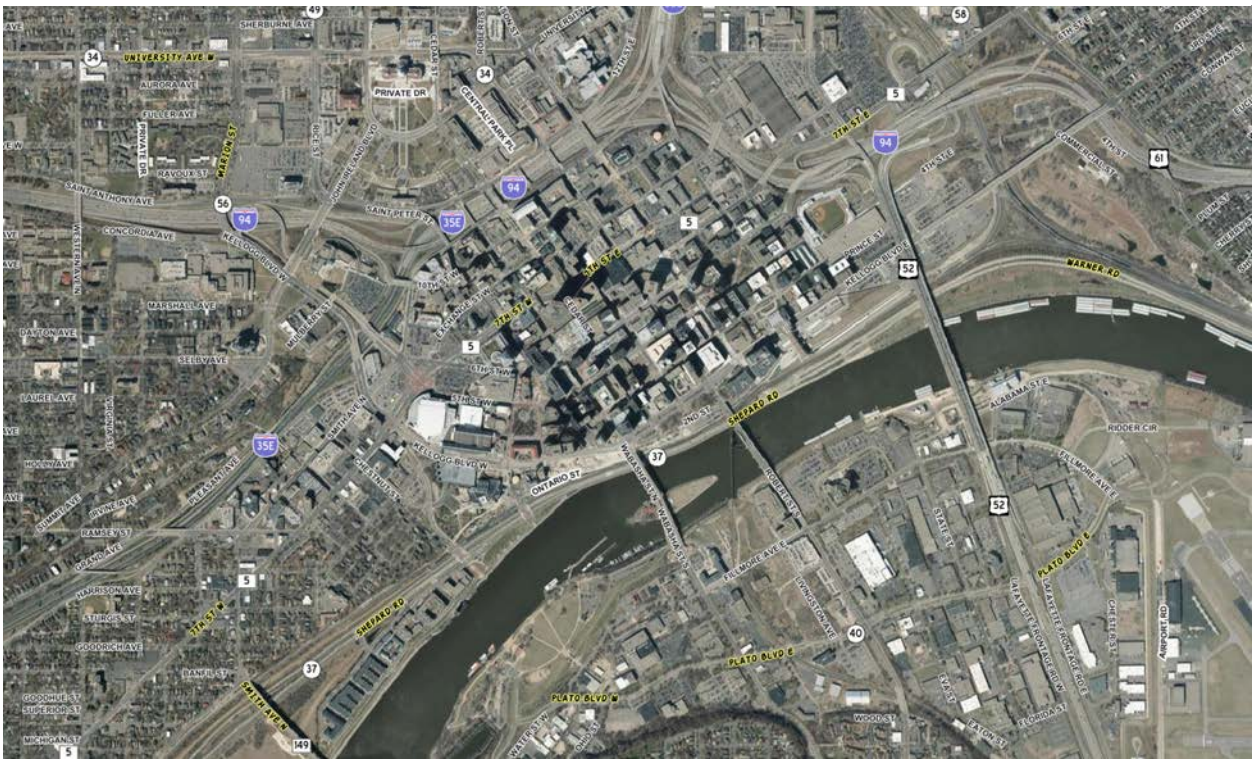
This document presents a Concept of Operations for the City of St. Paul's Downtown Traffic Management System (TMS) Enhancement Project. It describes the current system, identifies stakeholders, defines needs, presents an operational concept, proposes system components and describes scenarios for how the system will operate. One of the fundamental objectives of a Concept of Operations is to identify needs in terms that all project stakeholders can understand. The needs expressed in this Concept of Operations were identified by St. Paul Public Works, key stakeholders and documents relevant to the project. This Concept of Operations also provides a foundation for more detailed analyses that will lead into System Requirements and eventually Design.

1.1 Current Environment

The current environment for managing traffic in the project area provides context for understanding the needs and conceptual operation of an updated TMS. St. Paul is the capital city of Minnesota, with a population of approximately 309,000. The downtown boundaries are University Avenue to the north, US 52 to the east, Kellogg Boulevard to the west, and the Mississippi River to the South. There are four principal arterial routes leading into St. Paul, which include Interstate 94, Interstate 35E, US 52, and Shepard Road. Within downtown St. Paul are several major routes including Jackson St, Robert St, Wabasha St, 5th St, 6th St, 7th St, and Kellogg Boulevard.

The area impacted by this project is illustrated in Figure 1. The downtown area is home to numerous of businesses, residents, and several large event venues including the Xcel Energy Center, Saint Paul RiverCentre, Roy Wilkins auditorium, and CHS Field.

Figure 1 Downtown St Paul Traffic Signal Enhancement Project Limits



Xcel Energy Center is a multi-purpose arena, home of the Minnesota Wild Hockey team, concerts, and other events. The seating capacity of the arena is 20,554.

Saint Paul RiverCentre has a seating capacity of 18,065 people. It hosts a variety of special events from home and landscape shows to the Fishing & Winter Sports show.

CHS Field is home to the Saint Paul Saints professional baseball team. The average attendance of the 2015 Saint Paul Saints season was 8,091 per game. [1] CHS Field also hosts other large events such as amateur league baseball games, festivals, and concerts. This venue can accommodate up to 12,000 guests for festivals and concerts.

Roy Wilkins auditorium is a multi-purpose arena located adjacent to the Xcel Energy Center and the RiverCentre. It is host to the Minnesota RollerGirls roller derby league, concerts, and other events. The venue has a capacity of 5,000 people.

There are several other notable event venues located in the downtown area including the Science Museum of Minnesota and the Ordway Center for the Performing Arts. The Science Museum of Minnesota is a nonprofit museum focused on technology, history, science and math. It is located across the street from the RiverCentre and hosts the omnitheater as well as private events. The Science Museum served 801,030 people during the 2016-2017 fiscal year, as noted in the 2016-2017 annual report. [2] The Ordway Center for the Performing Arts is host to a variety of performing art shows from musicals and orchestras to cultural performances. The center has a capacity of 2,206 people.

With a relatively small footprint, numerous venues, and the high capacity of events, the downtown area can become highly congested once events are finished and event-goers are trying to reach the highway system. Events today at these venues are typically managed by each venue's operational staff. For large scale events, St. Paul Police are hired to help manage event traffic. There are currently no dynamic message signs (DMS) deployed in the downtown area to help mitigate congestion or provide wayfinding to or from events.

Since 2010, St. Paul has had an overall increase of 24,000 residents to its city. The City has also had substantial changes to its downtown region including the recent addition of CHS Field, a street level Light Rail Transit (LRT) route, and several roadway realignments. Plus, high frequency transit routes are planned for several routes in the downtown area. With these significant changes as well as evolving traffic patterns, signals that were once optimized are no longer adjusted for current trends. The City has not optimized its downtown traffic signal timing plans in over 15 years. This plays a role in the current daily congestion in downtown St. Paul during peak periods.

The City currently utilizes legacy 170 traffic signal controllers at most of its traffic signals and Econolite's Centracs traffic signal management software from a traffic management center (TMC) to manage those signals. The legacy 170 controllers offer limited or no functionality for Bus Rapid Transit (BRT) and LRT operations or Signal Performance Measures (SPM). Many of these traffic controllers are not connected to the City's fiber optic network but instead use copper interconnect. St. Paul currently does not have

[1] American Association Baseball http://www.americanassociationbaseball.com/american-association-releases-2016-schedule/ , accessed November 06, 2018.

[2] Science Museum of Minnesota 2016-2017 Annual Report https://www.smm.org/sites/default/files/public/attachments/2017annualreport_1.pdf, accessed November 27, 2018.

redundancy built in to the copper interconnect system, so if one cabinet loses its connection, all subsequent cabinets lose connectivity as well.

At certain times of the year flooding can create issues for traffic accessing the downtown area. Shepard Road makes up the southern boundary of the downtown area and runs along the Mississippi River. This road is subjected to the occasional flooding and becomes impassable during these times. The current strategy to reroute traffic involves setting up temporary static signage at the closure.

St. Paul's current downtown environment shows a need for a more robust TMS to better maintain the current and future technologies on the road. The proposed upgrades to the TMS will further help to relieve congestion for daily peak periods and events, provide alternate wayfinding during emergencies and other incidents, provide advanced signal timing features, and allow for more reliable and capable communications back to the TMC.

1.2 Stakeholders

There are several stakeholders with traffic management needs around the project area. There are travelers accessing the area on local roadways that are under the jurisdiction of transportation agencies at the city, county, and state levels. There are businesses and regional event venues that can generate high volumes of traffic at times. Following is a list of the primary stakeholders who will most directly benefit from the planned enhancements to the City's TMS. Each stakeholder is defined for consistent references and according to how they will interact with the system.

- **Travelers:** People driving throughout the downtown area or visiting the event venues within the project area. All the other stakeholders are ultimately trying to provide safe, efficient transportation to and from the event venues for these people. There are also commuters who travel through the area and the traffic management system enhancements are envisioned to serve them with general wayfinding, emergency alerts, or during incidents.
- **Event venues**: Staff responsible for the operation and administration of the major event venues in the area.
- **City of St. Paul/St. Paul Public Works:** Staff responsible for the safety and efficiency of the roads. This group is expected to install, maintain and be the primary user of the TMS.
- **City of St. Paul Emergency Services (Police):** The TMS will be used to assist police with traffic management for events.
- **MnDOT**: Minnesota Department of Transportation staff at the Regional Transportation Management Center (RTMC) and in Traffic Engineering responsible for the safety and efficiency of the state highway. This group is expected to be a secondary user of the TMS. Anticipated coordination for backups onto the freeway or major highway diversions.
- **Ramsey County:** Ramsey County has jurisdiction over several roads in the project area. It is anticipated the County will be a secondary user of the system for coordination as needed and provide any permits and agreements required to construct and maintain TMS devices installed on County routes as needed. Ramsey County is also partially funding the TMS.
- **Metro Transit:** Metro Transit operates the LRT and will operate future streetcar and bus lines in the project area. It is anticipated that they will be a secondary user of the system or coordination as needed.

The challenges and corresponding needs presented in the next section were identified from the perspective of these stakeholders.

2. Needs

This section presents a series of needs that have been identified for the enhancements to the City's TMS. Needs were identified through discussions with stakeholders and review of key documents. The needs are presented in Table 1 first by describing a challenge (column 1) facing one or more of the stakeholders who will be involved in the TMS. Based on each challenge, one or more needs (column 2) are described next. The needs are numbered for identification and traceability purposes.

Table 1 Needs for St Paul Signal Enhancements

Challenge	Need

Challenge	Need
A. Event congestion or incidents that require traffic management may occur at any time of the day or on any day of the week.	1. The City needs a central software system that can manage the DMS.
	2. City staff and authorized users need the ability to monitor and make modifications to the TMS components (signals, DMS) via a mobile device 24/7/365.
B. Travelers may be unaware or leery of alternate routes for accessing the major venues, particularly if they are relying on navigation systems for guidance.	3. Travelers need directional signing that is credible and assertive to guide them to alternate access points.
C. Flooding of Shepard Road and other low-lying access routes into downtown St. Paul causes road closures lasting up to a month.	4. Travelers need alternate route information to avoid closed roads due to flooding.
D. Travelers may not know the nearest parking facility for their event.	5. Travelers need wayfinding to public parking facilities during event times.
E. The current downtown traffic signals have not been retimed in over 15 years but has had substantial changes to the downtown area which has changed traffic patterns significantly.	6. The City needs an update to its traffic signal optimization throughout the downtown area to keep up with the significant changes in the area.
F. Event venues currently use St. Paul Police to direct traffic when events let out. Police are posted at the same key congestion points for most large events.	7. The City needs a permanent solution that allows them to efficiently manage traffic during events and incidents to augment police operations.
G. Travelers may be unaware of current snow emergency status, amber alerts, other temporary restrictions or general alerts.	8. Travelers need general information about snow emergencies, temporary restrictions, or other alerts when necessary.
H. Parts of Kellogg Boulevard are closed post-event west of the RiverCentre parking lot. Event traffic from RiverCentre parking lot forced to travel eastbound on Kellogg Boulevard when leaving.	9. The City needs a permanent solution that allows them to dynamically manage egress event traffic and guide traffic to alternate routes.
I. Entering event traffic building up on main entry routes when there are other access routes available.	10. The City needs a permanent solution that can dynamically direct traffic to the alternate routes.
J. Current copper communications system has no redundancy, limited data transfer rates, and lack of remote monitoring of devices connected to the system.	11. The City needs a reliable communications system that allows for redundancy in case of failure, ability to transfer large amounts of data, and the capability to remotely monitor devices on the network (i.e. signal systems, DMS, PTZ cameras).
K. Legacy 170 controllers are an old technology with limited functions. It does not allow for BRT, LRT operations, dynamic signal timing or signal performance measures.	12. The City needs modern signal controllers that can accommodate modern traffic signal operations with BRT, LRT, and future CAV technologies.
	13. The City needs modern signal controllers that allow for collecting signal performance

Challenge	Need
	measurement data.
L. Signal Performance Measurement data comes in as a massive data collection, with no easy way to analyze or report the data automatically. This data can be used for optimization of signals.	14. The City needs a SPM software that can analyze and report the collected data in a readable format.
M. During events, signalized intersections may become overloaded and not optimized for the current traffic flow.	15. The City needs real-time signal operation capability from a remote facility in order to monitor, review, and optimize timing plans during events.
N. Trains using the rail line running parallel to Shepard Road may impact the access to alternate routes.	16. Travelers need to know in real-time when train traffic impacts on Shepard Road may make it an undesirable route.

These needs are further referenced in the next two sections as they are used to describe the operational concept and the proposed system components. The need identification number will allow each subsequent reference to be traced back to the original needs and corresponding challenges. The needs will also serve as the basis for developing system requirements for the enhancements to the City's TMS.

3. Operational Concept

This section describes the operational concept from each stakeholder's perspective and in terms of how the enhancements to the City's TMS will address their needs. The operational concept is intended to help each stakeholder see how their needs have been interpreted and how the system is expected to address their needs. It is presented in a sequential manner from each stakeholder's perspective, and the original needs and corresponding challenges identified in the previous section are noted in parentheses following each description. Each piece of the description is also numbered for reference purposes. Following the description of the operational concept, this section also includes an overview of the anticipated roles and responsibilities that will be associated with operating and maintaining the TMS.

3.1 Travelers

Travelers represent the largest group of stakeholders who will interact with the TMS. They have the most fundamental needs associated with navigating roadways within the project area during daily trips, events, incidents and flooding. They are the group for whom the enhancements to the City's TMS is being developed so that their travel is safer and more efficient.

3.1.1 **When entering the area for an event** at Xcel Energy Center, RiverCentre, or CHS Field, travelers will **see static and dynamic signs** guiding them toward the safest, most efficient access to parking for the event venue. Alternate routes may be used based on congestion. (Need 5)

3.1.2 **When entering or driving through the area during an incident**, travelers will be **informed by dynamic signs** of congestion, closures and appropriate alternate routes. (Needs 3, 4, 7, 8, 10, 16)

3.1.3 **When leaving the area from an event** at Xcel Energy Center or RiverCentre, travelers will **see static and dynamic signs** guiding them toward the safest, most efficient access to the major highways through local roads. (Need 9)

3.1.4 **When entering the downtown area from Shepard Road during flooding**, travelers will be **directed by dynamic signs** to take alternate routes based on the flood status of Shepard Road. (Need 4)

3.2 Event Venues

Xcel Energy Center, Saint Paul RiverCentre, and CHS Field have staff responsible for operation and administration of events hosted by their venue. They are concerned with travelers having a positive experience when arriving for, attending, and leaving an event.

3.2.1 **Prior to a large event**, the hosting event venue will provide information about the event to St. Paul Public Works to **prepare for traffic management and notify others** of potential impacts. (Needs 3, 5, 7, 9, 10)

3.2.2 Event venues will **coordinate, as needed, with St. Paul Public Works and Police Department** during events to ensure that travelers are directed to the safest, most efficient routes for accessing and leaving their venues. (Needs 3, 5, 7, 8, 9, 10)

3.3 City of St. Paul

The City of St. Paul Public Works staff are responsible for the safety and efficiency of city streets within the project area. As such, they are expected to be a primary user of the TMS.

3.3.1 **When travelers enter the area for an event**, St. Paul Public Works may **observe traffic flows** around the event venue and direct traffic in real time to alternative routes during times of heavy congestion. (Needs 1, 2, 7, 10, 11)

3.3.2 **When a large event causes congestion**, **activate special event signal timing plans** for inbound/outbound traffic. (Needs 6, 11, 12, 13, 14, 15)

3.3.3 St. Paul Public Works will **provide Time of Day (TOD) wayfinding signing on local roads** to support the direction of travelers when entering or leaving the area for an event or incident. (Needs 1, 2, 3, 7, 9, 10, 11)

3.3.4 St. Paul Public Works will **maintain the TMS** so that it is available for monitoring and dynamically directing traffic during events and incidents **as needed 24/7/365**. (Needs 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16)

3.3.5 During business hours, St. Paul Public Works will manage the signal timing along local roads by **activating operational plans in the TMS** based on traffic when travelers are entering or leaving the area on a daily basis, for an event, or during incidents and flooding. (Needs 6, 11, 12, 13, 14, 15)

3.3.6 During business hours, **as travelers enter or leave the area on a daily basis, for an event, or during incidents and flooding**, St. Paul Public Works will **dynamically direct traffic to alternate routes** by activating operational plans in the TMS. (Needs 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 16)

3.3.7 During business hours, St. Paul Public Works will **monitor traffic and train movements** along Shepard Road to know when Shepard Road is not a favorable route. (Needs 11, 16)

3.4 City of St. Paul Emergency Services (Police)

The St. Paul Police Department is actively involved in traffic management for the large events hosted by Xcel Energy Center, RiverCentre, and CHS Field. They provide staff and coordinate with the event venue to help manage traffic and pedestrians exiting the venue.

3.4.1 Whenever a major event or incident occurs that causes major congestion on the roadways, St. Paul Police will activate/coordinate with St. Paul Public Works the relevant dynamic message signs to alert drivers of the congestion and/or direct traffic to alternate routes. (Needs 1, 2, 3, 7, 9, 10)

3.5 MNDOT

St. Paul Public Works staff will coordinate with MNDOT RTMC staff for any situation that may require the use of MNDOT dynamic message signs along the freeway in the vicinity.

3.5.1 When a large event occurs that is expected to impact the major freeway system adjacent to the downtown area, St. Paul Public Works staff will coordinate with MNDOT to activate the appropriate dynamic message signs along the freeway. (Needs 3, 10)

3.5.2 When the freeway system is diverted to local roads, MNDOT will coordinate with St. Paul Public Works to activate dynamic message signs to route traffic through the detoured routes. (Need 10)

3.6 Ramsey County

Ramsey County has jurisdiction over several roads in the project area. It is anticipated the County will be a secondary user of the system for coordination as needed and provide any permits and agreements required to construct and maintain TMS devices installed on County routes as needed. Ramsey County is also partially funding the TMS.

3.7 Metro Transit

Metro Transit operates the LRT and will operate future streetcar and bus lines in the project area. It is anticipated Metro Transit will not be direct users of the TMS, but they will benefit from improved traffic signal timing and controllers that will allow for improved transit signal operations for future streetcar and bus lines routes.

3.7.1 Metro Transit is planning high frequency transit routes for the downtown area and will be requesting the St. Paul Public Works staff to look at transit signal operations along these routes. (Need 12)

3.7.2 Metro Transit operates numerous of bus routes throughout the downtown area and they rely on efficient traffic signal operations to help keep buses on schedule. (Needs 6, 13)

3.8 Operational Roles and Responsibilities

Based on the operational concept, this section summarizes the potential roles and responsibilities for the stakeholders who will operate or contribute to the operation of the TMS. The roles and responsibilities described in Table 2 are intended to maintain consistency and familiarity among the stakeholders who will ultimately make the TMS operate effectively and efficiently. As operational plans

are more formally developed for the TMS, these roles and responsibilities will be discussed again and may be further modified. The roles and responsibilities presented here should be viewed as a starting point for that discussion.

Table 2 Potential Roles and Responsibilities

Stakeholder	Role / Responsibility
St. Paul Public Works	Coordinate with event venues, St. Paul Police Department and MnDOT to review and select appropriate operational plans for events. (3.3.1, 3.3.2, 3.3.3, 3.3.5, 3.3.6)
	Based on traffic conditions, activate operational plans for signals and DMS. (3.3.1, 3.3.2, 3.3.3, 3.3.5, 3.3.6)
	Notify and coordinate activation of operation plans with St. Paul Police Department and MnDOT. (3.3.1, 3.3.2, 3.3.3, 3.3.5, 3.3.6)
	Maintain TMS components to ensure 24/7/365 availability. * (3.3.4)
	Monitor roadway conditions to determine if travelers need to be alerted of roadway closures, incidents, or other information that may impact the use of the roadways in the downtown area. (3.3.3, 3.3.6, 3.3.7)
	Periodically review operational plans and current traffic for performance impacts that may require changes in operational parameters. (3.3.5)
St. Paul Police Department	During events and incidents, coordinate with St. Paul Public Works to activate an operation plan as needed to alert traffic of the incident and/or provide alternate routes. (3.4.1)
	Coordinate with event venues, St. Paul Public Works and MnDOT to review and select operational plans appropriate for events. (3.4.1)
MnDOT	Coordinate with St. Paul Public Works for any operation plans that impact MnDOT roads during large events. (3.5.1)
	Coordinate with St. Paul Public Works when traffic on the freeway system is expected to be diverted to local roads. (3.5.2)
Event Venues	Notify St. Paul Public Works of upcoming event schedules. (3.2.1)
	Coordinate with St. Paul Public Works and Police Departments during events as needed. (3.2.2)

** Additional detail regarding the maintenance of specific TMS components is provided in the next section.*

4. System Components

Based on the operational concept and needs described in the previous sections, this section presents a list of proposed system components and an overview of the support responsibilities that may be associated with each. The components list, and subsequent maintenance responsibilities will be discussed again and may be further modified during design and procurement of the enhancements to the system. The information provided at this stage is intended as a starting point for stakeholders to discuss the scale and scope of ongoing support that will be required for the TMS.

4.1 Component List

Table 3 provides a list of potential components that could function together as parts of the TMS. Each component is listed under a primary function. A general description of the component and the potential

locations where it may be placed are also provided. Some of the components already exist within the project area and they are noted here to associate them with the new components that may be added for the enhancements to the City's TMS.

Table 3 System Components

Function	Component	Description	Potential Locations
Monitoring	Camera	Existing Pan, Tilt, Zoom (PTZ) cameras are located at various locations in the downtown area.	New PTZ cameras will be added in future projects. The location is TBD.
	Traffic Signals	Existing traffic signals used to manage traffic at intersections operated by St. Paul Public Works. Most of the signals have the legacy 170 controllers.	Most intersections in the downtown area have traffic signals. The legacy 170 controllers will be replaced with new controllers that provide more features and monitoring capabilities through the use of SPMs.
Processing	Control Software (Traffic Signals)	Existing software used to monitor, and process data gathered from traffic signals to activate signal timing plans according to predefined operational plans.	St. Paul Public Works currently operates a central control software for traffic signals. Public Works staff operates the software from the City's TMC. The software may also be accessed via the Internet by staff to monitor and adjust timing plans remotely.
	Control Software (DMS)	Software used to monitor and operate DMS devices according to predefined operational plans.	St. Paul Public Works TMC. Software may also be accessed via the Internet by other stakeholders for view purposes.
Dissemination	Dynamic Message Signs (DMS)	Signs used to convey changing information and general direction to travelers based on current status of the roadway network.	SB Kellogg Blvd at 7th St W EB Kellogg Blvd at Market St EB Kellogg Blvd at Wabasha St EB Kellogg Blvd at Minnesota St EB Kellogg Blvd at Jackson St EB Kellogg Blvd at Broadway St SB 5th St W at 7th St W NB Shepard Rd at Eagle Pkwy NB Shepard Rd South of Randolph Av SB Shepard Rd east of Sibley St
	Communications Equipment (Fiber Optic Cable and Network Switches)	Communications equipment required to operate and bring back data from field devices to the TMC (i.e. traffic signals, DMS, PTZ cameras)	Fiber optic connection made to all traffic signals and DMS located in the downtown area.

4.2 Maintenance Support and Responsibilities

Each component of the TMS will require deployment, operations and maintenance activities to support their function. The operational roles associated with the system were described in a previous section. Table 4 now describes some of the more likely activities that will be required to maintain various components of the TMS. This is not an all-inclusive list of activities as there will be additional maintenance specified by manufacturers of the specific technologies that are ultimately chosen for the TMS. It is also assumed that all of these activities will be performed by City of St. Paul Public Works; however, they may also choose to contract all or some of the activities to another party. As with the previous sections, this list is intended as an initial reference point for City of St. Paul Public Works to begin understanding the ongoing maintenance implications of the TMS.

Table 4 Maintenance Activities for System Components

Component	Maintenance Activity
Traffic Signal Controllers	• Periodic checks of database parameters and controller settings • Maintain backups for software and databases
Control Software	• Test to check for accuracy in performing operations • Monitor performance of operational plans • Administrative adjustments to operational parameters • Maintenance of user access and authorizations • Maintenance of software and associated servers and databases
DMS	• Remove dust and dirt from exposed elements • Clean display screen • Check wiring and cable, harnesses and connectors for wear • Check mounting structures for overall stability • Testing to ensure all pixels are working and to check for accuracy and timeliness in displaying information
Network Switches	• Periodically verify network switch firmware is up to date. • Review logs for issues or trends. • Verify virus protection is up to date. • Periodically verify messaging alarms are functioning. • Maintain network switch configuration backups. • Maintain list user accounts and passwords.
Camera (To be installed in future projects)	• Lens cleaning • Check pan/tilt/zoom features • Check wiring and cable, harnesses and connectors for wear • Check monitors for burn-in or distortion • Management of recorded video

4.3 Performance Measures

Establishing performance measures is helpful for setting and managing expectations for how the TMS will operate. However, measures should be meaningful to a specific audience and should ultimately be applicable to the goal for operating the system – to balance traffic during special events to reduce congestion and safety issues. In general, performance measures should be specific, measureable, agreed-upon, realistic and time-bound. Measures can be qualitative or quantitative. Following are three measures that have been established for the TMS. The measures may also change over time as

operational experience is gained or as performance reporting requirements for transportation agencies change.

Measure	1. Traveler complaints
Target	Reduce traveler complaints regarding congestion during special events
Data	Customer comments
Data Source	
Analysis	Compare feedback from event prior to TMS operation to event after TMS operation
Reporting	Share summary during post-event debriefing

Measure	2. Event congestion
Target	Reduce congestion during special events
Data	Observations
Data Source	
Analysis	Compare feedback from event prior to TMS operation to event after TMS operation
Reporting	Share summary during post-event debriefing

Measure	3. Event-related crashes
Target	Reduce event-related crashes due to congestion during special events
Data	Crashes
Data Source	
Analysis	Compare feedback from event prior to TMS operation to event after TMS operation
Reporting	Share summary during post-event debriefing

5. Operational Scenarios

Now that the needs have been identified and an operational concept has been described, along with the potential operational and maintenance roles and responsibilities, this final section presents operational scenarios that describe how the TMS may be used in actual situations that commonly occur in the project area. Scenarios are designed to help stakeholders understand how they may interact with the TMS and with one another during the situations that will most commonly require activation of the system. The scenarios generally describe the situation and identify which components may be used. Then the scenarios describe how the system performs and who interacts with the system in response to the actions performed before, during and after an event. The scenarios use times of day as a general reference to illustrate changing conditions over the passage of time. The scenarios also describe system performance only to the extent necessary for stakeholders to understand how the TMS will operate. Following is a summary of the scenarios that are featured in greater detail later in this section.

1. **Incident/Emergency Management**. During a normal day when there are no special events taking place in the area, there are still significant morning and afternoon peak periods of commuter traffic. If an unplanned incident (e.g. crash, stalled vehicle, pavement heave, etc.) were to occur, the TMS could be used to alert travelers of lane closures, detour or alternate routes. Other incident cases include snow emergencies and amber alerts.
2. **Xcel Energy Center/RiverCentre Events**: Minnesota Wild Hockey games, concerts, and other events at the Xcel Energy Center/RiverCentre can draw large volumes of visitors. The event can

occur on any day of the week and during a wide variety of times. Operational plans for the TMS use during these events may have unique details for alternate routes.

3. **CHS Field Events**: Saint Paul Saints baseball games, concerts, and other events at CHS Field can draw large volumes of visitors. The event can occur on any day of the week and during a wide variety of times. Operational plans for the TMS use during these events may have unique details for alternate routes.
4. **Flooding:** It is common for flooding to occur along the Mississippi River, especially around Shepard Rd. When flooding occurs, Shepard Rd is closed, and traffic is detoured to alternative routes. The TMS may be activated during these times to alert travelers of the road closure and the alternative route.

5.1 Scenario 1: Incidents/Emergency Management

Incident Occurrence

5.1.1 During a Wednesday in July, there are no scheduled special events at Xcel Energy Center, RiverCentre, or CHS Field. However, at 8:15 am during the morning commute peak period, St. Paul Police are notified of a traffic incident that occurred at the intersection of EB 5th St E at N Sibley St. The incident has blocked all movement east of the intersection and is expected to take approximately 1 hour to clear.

5.1.2 St. Paul Police notify St. Paul Public Works of the incident and assist at the scene with directing traffic away from the incident.

5.1.3 St. Paul Public Works uses the TMS to monitor traffic (cameras) and activate the relevant DMS to alert travelers of the closure and alternate routes.

5.1.4 At 9:15 am, the incident has cleared, and St. Paul Police notify Public Works that the road is now open.

5.1.5 St. Paul Public Works removes the posted messages from the DMS and traffic flows as normal.

Snow Emergency or other Citywide Alert

5.1.6 On a Thursday at 3pm, snow has accumulated up to 6” and the City of St. Paul has declared a snow emergency for that night beginning at 9pm.

5.1.7 St. Paul Public Works activates the operation plan for displaying snow emergency routes on all relevant DMS to alert travelers of the scheduled snow emergency.

5.1.8 Once the City has lifted the snow emergency, St. Paul Public Works removes the snow emergency messages from all DMS.

Other operation plans for general citywide alerts such as an amber alert would have similar operation plans activated when the city deems it necessary to alert travelers.

5.2 Scenario 2: Xcel Energy/RiverCentre Event

Pre-Event Activities

5.2.1 One month before the scheduled 7pm event, Xcel Energy Center or RiverCentre notifies St. Paul Public Works and Police of the event dates, times and anticipated traffic.

5.2.2 St. Paul Public Works coordinates with St. Paul Police to review operation plans for Xcel Energy/RiverCentre events to ensure accurate and up to date messages.

Day of Event Activities

5.2.3 At 5pm, St. Paul Public Police begins monitoring vehicle traffic heading towards parking at the RiverCentre Parking Ramp for an event at Xcel Energy Center/RiverCentre. Signal timing event plan for ingress traffic is enabled.

5.2.4 At 6:15pm, traffic is backing up on Kellogg Boulevard up to 7th St. St. Paul Public Works activates the Xcel Energy/RiverCentre ingress event operation plan, which will direct traffic south on 7th St, and east on Chestnut St to the second entrance to the RiverCentre Parking Ramp.

5.2.5 At 7pm, the event has begun, and traffic has reduced to normal flow. St. Paul Public Works deactivates the operation plan. The signal timing event plan for ingress traffic is disabled.

5.2.6 At 10pm, the event has ended, and traffic is trying to leave the RiverCentre Parking Ramp by using eastbound Kellogg Blvd or northbound 7th St to reach I-35E and I-94. St. Paul Public Works activities the Xcel Energy/RiverCentre egress event operation plan, which will direct traffic to near-by freeway entrances. The signal timing event plan for egress traffic is enabled.

5.2.8 Around 11pm traffic has calmed to normal levels. St. Paul Public Works removes posted messages from the DMS. The signal timing event plan for egress traffic is disabled.

Post-Event Activities

5.2.9 St. Paul Public Works fields feedback from event venue staff, and St. Paul Police on the overall operations to/from the event and adjusts to the messages or signal timing accordingly as needed.

5.3 Scenario 3: CHS Field Event

Pre-Event Activities

5.3.1 One month before the scheduled 7pm event, CHS Field event staff notifies St. Paul Public Works and Police of the event dates, times and anticipated traffic for the event.

5.3.2 St. Paul Public Works develops an operation plan to route traffic toward CHS Field.

Day of Event Activities

5.3.3 Prior to the event, St. Paul Public Works activates the event operation plan to direct people to CHS Field. Signal timing event plan for ingress traffic is enabled.

5.3.4 At 7pm, the event has begun, and traffic has reduced to normal flow. St. Paul Public Works deactivates the operation plan. The signal timing event plan for ingress traffic is disabled.

Post-Event Activities

5.3.5 St. Paul Public Works fields feedback from event venue staff and St. Paul Police on the overall operations to/from the event, and adjusts messages accordingly as needed.

5.4 Scenario 4: Flooding

Flood Event

5.4.1 After significant melting of the heavy snow pack along the Mississippi River during spring, the Mississippi River is anticipated to overflow its' banks and cause flooding. The flooding will occur on portions of the North river bank in St. Paul and onto Shepard Road.

5.4.2 St. Paul Public Works activates an advance warning operation plan for the DMS on Shepard Road. The plan will notify traffic of the upcoming road closure on Shepard Road.

5.4.3 During the closure, the plan directs all traffic approaching on Eagle Parkway or Jackson Street toward Shepard Road to turn before they reach the closed road. Additional DMS or static signing is used to detour traffic. The City continues to monitor the flooding situation and adjusts the messages as needed.

5.4.4 Flood waters have receded back down below the banks of the river. St. Paul Public Works deactivates the flood operation plan and reopens the road. Traffic can resume travel on Shepard Road.