BOSTON REGION METROPOLITAN PLANNING ORGANIZATION
Frank DePaola, Acting MassDOT Secretary and CEO and MPO Chairman
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE: **January 8, 2015**
TO: **Boston Region MPO**
FROM: **Kathy Jacob, Maureen Kelly—MPO Staff**
RE: **Roadway Network Inventory for Emergency Needs: A Pilot Study**

1 INTRODUCTION

This memorandum provides a summary of the Roadway Network Inventory for Emergency Needs pilot study. Here, we discuss the project in context of the MPO's all-hazards planning work, progress made to date, work that remains to be done, and the challenges going forward.

This project was included in the federal fiscal year (FFY) 2013 Unified Planning Work Program (UPWP) to build upon work that was conducted under the Emergency Evacuation and Hazard Mitigation Mapping project in the FFYs 2010 and 2011 UPWPs.

The products of this project were to be 1) a new geographic information systems (GIS) data layer depicting traffic signals in the urban core area, and 2) an inventory of signals and bridges on Boston evacuation routes and select routes in municipalities adjacent to Boston. Staff made progress on both projects; and the traffic-signal database maintained by the MPO staff, which is the foundation of the new GIS layer, was enhanced. More work remains to be done, however, to produce the final products.

2 BACKGROUND

Through the FFYs 2010 and 2011 UPWPs, the Boston Region MPO funded development of an all-hazards planning application, a GIS-based website tool that displays the transportation network in the Boston region. This tool contains data about the emergency routing network and transportation infrastructure, and the natural hazards to which the region may be vulnerable.

The natural-hazards data layers in the application depict flood zones, hurricane surge zones, areas that may be affected by sea-level rise, and land with liquefiable soils that may be vulnerable to damage during an earthquake. Other data layers show the location of transportation projects proposed for funding through the Transportation Improvement Program (TIP), evacuation routes, and critical infrastructure such as police and fire stations, hospitals, and shelters.

3 PILOT PROJECT GOALS

The primary goal of the Roadway Network Inventory for Emergency Needs pilot project was to produce a new GIS data layer for the all-hazards planning application. This would depict the location of traffic signals and allow a user to query information about the signal equipment at those locations. As the geographic focus for this project, staff selected the City of Boston and municipalities immediately adjacent to it: Brookline, Cambridge, Chelsea, Dedham, Everett, Milton, Newton, Quincy, Revere, and Somerville.

The signal-data layer would be used to identify signalized intersections that lie within natural-hazards zones. Signals in flood or hurricane surge zones might be good candidates for climate-change adaptation options, such as elevating signal controllers that house electrical equipment, or taking other measures to ensure that those intersections can return to normal operation after a storm. The signal layer also was intended to provide information about the functionality of signals, which may be helpful for emergency planning. This might include, for example: whether signals are coordinated along a corridor; the timing can be changed from a remote location; the signals operate in isolation or require manual re-timings at individual intersection locations; or if emergency pre-emption exists.

A secondary goal of the project was to produce an inventory of signals and bridges (from the databases used to create the GIS layers) that are located along designated Boston evacuation routes, and on those roadways in adjacent municipalities that are direct extensions of the Boston evacuation routes. Although there are any number of pathways that evacuating drivers could use in the absence of controls steering traffic in a particular direction, only select routes were addressed in this project.

The signal inventory would provide the same data as in the GIS layers, but in spreadsheet form, with the data arranged by evacuation route. The spreadsheet would tally bridges that are weight restricted, functionally obsolete, or structurally deficient, as well as the capabilities of signals along each particular evacuation route. The spreadsheet could identify evacuation routes that have significant infrastructure needs related to emergency management; and MPO staff could use it to evaluate proposed projects along those routes.

4 ALL-SIGNALS DATABASE

4.1 Data Gathered

The MPO’s data resources staff has compiled signal data from multiple sources to create an all-signals database, which is the foundation for the new GIS signal data layer. Data for state-owned traffic signals came from MassDOT databases

compiled in 1986, 2000, and 2012. The more current data includes information about signals formerly owned by the Metropolitan District Commission. (Now, those signals are owned by MassDOT, the Department of Conservation and Recreation, and municipalities).

To supplement the data provided by MassDOT, staff requested municipalities in the project area to provide the following information on all of the signals they own (or for those on main arterials, if complete information was not already available):

- Signal location
- Model and type of signal-controller equipment
- Presence of traffic-monitoring equipment
- Presence of back-up power sources
- Emergency vehicle pre-emption capabilities
- Coordination with other signals
- Ability for remote control from a traffic operations or control center

Seven of the eleven municipalities in the study area submitted data, which staff incorporated into the all-signals database. The amount of data varied, as some municipalities were able to share more data than others. Two municipalities reported that they do not maintain an inventory of signal data.

4.2 Signal GIS Data Layer

With the all-signals database as the foundation, staff created a new-signals data layer for the MPO's all-hazards planning application. A significant amount of information about the signals was included; however, the data set is not complete and uniform for the reasons cited below. Therefore, staff does not recommend making this signal layer public.

- Descriptions of signal equipment have not been standardized within the all-signals database. Those who provided data often used different nomenclature when describing equipment, particularly signal and controller types.
- Some signal records are lacking descriptions altogether or have only partial information.
- Signal data for some municipalities may not be current, although a field in the application—which shows the date data was received by MPO staff—can help to indicate if the data is up to date.

The new data layer includes, where available, the following information:

- Intersection location by street name
- Signal type
    - Fully actuated (vehicle detectors are used to activate timing phases at all approaches to the intersection)

    - Semi-actuated (a mixture of actuated and pre-timed phases, i.e., one street may have pre-timed signals, while a side street has detectors)
    - Pre-timed (fixed)
    - Pedestrian
    - Flasher
- Type of coordination
    - Centralized control (such as from a traffic-management center where signal timings can be adjusted remotely)
    - Local coordination (i.e., coordinated with other signals in the same corridor, but not controlled from a traffic-management center)
    - Time-based (set by time and only can be changed manually)
    - Isolated (no coordination with other signals and no ability for remote control)
    - Unknown (where a signal is known to exist, but the coordination type is not known)
- Emergency pre-emption (i.e., equipped with Opticom)
- Controller model and controller type
- Ownership
- Year the equipment was approved for use
- Year the MPO staff received data

5 EVACUATION-ROUTE SIGNAL AND BRIDGE INVENTORY

Staff prepared a draft inventory of the number of signals on Boston's evacuation routes and extensions into adjacent municipalities, along with a breakdown of the signals' operation and coordination types, and emergency features. This exercise was to discern whether the information in the database was sufficient enough to determine the operating characteristics of signals on these important routes. However, because of the issues discussed above—particularly the lack of data in a number of categories—the inventory is not complete enough to be used for planning purposes. Therefore, staff does not recommend making this data public.

Because of unforeseen challenges in compiling and organizing the signal data, staff could not complete the final task of inventorying bridges on evacuation routes within the project's budget. However, information on the bridges' condition is available through the existing all-hazards planning application.

6 LESSONS LEARNED

A comprehensive signal database for the region's core would be beneficial for various MPO planning activities. In addition to its uses in the all-hazards planning application, the data could be used for developing regional models to better understand why delays occur at particular intersections, and for air quality

analyses. In this pilot to ascertain the feasibility of creating such a database, staff learned that it needed to determine first whether such data was, in fact, available and next if it would be practical for staff to collect and assemble it.

In the course of the study, staff found that the amount of available data varied among municipalities. While some maintain detailed databases, others have limited data or none at all. In some cases, staff needed to request data from several departments within a municipality in order to piece together information. Often, the terminology used to describe signal functionality varied from municipality to municipality as well.

Staff explored in-house options to identify the locations of signalized intersections in municipalities that do not maintain signal databases. This was possible, to some extent, by accessing reports of accidents that occurred at signalized intersections from the Registry of Motor Vehicles' crash data system; then verifying that signals exist at those locations by checking orthophotos. Although this method provides signals' locations, and perhaps some information about the type of signal (vehicle, pedestrian, flasher, etc.), it does not yield details about the operational characteristics of those signals.

7 CHALLENGES AND RECOMMENDATIONS

Since the state ceded ownership of many signals to municipalities in the mid-1980s there has been no standard for maintaining records of those signals. Were MPO staff to conduct another signal-inventory project in the future, staff would need to develop a framework for a database that uses standard and consistent terminology across municipalities. Then, staff then would need to reach out to municipalities to request their data, follow up to clarify the terminology used, and find ways to fill in gaps where municipalities have limited or no data. (Municipalities would need to provide their information voluntarily; they are not required to provide this data to the MPO.)

While field work would be the best way to obtain complete and accurate information about signals, this method would be expensive to conduct on a regional scale. In addition, staff would need to develop a method to keep the data current. With more resources, staff also could revisit the task of creating a bridge inventory for evacuation routes, if that would be useful for planners. Going forward, staff will continue to maintain the MPO's all-hazards database, and watch for opportunities to provide input into all-hazards planning for the region.

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