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MEMORANDUM

To: CMAP Freight Committee

From: CMAP Staff

Date: January 2016

Re: Freight Bottleneck Identification

Freight bottlenecks occur on highway links where traffic experiences recurring slow speeds due to an operational or network deficiency. The identification of freight bottleneck locations is a component of multiple projects in the FY2016 work plan, including the Freight Deficiency Analysis, Highway Needs Analysis, and Freight Snapshot Update. The Chicago region is a key hub for goods movement across the country. Finding cost effective solutions to move freight into, out of, and within the region is important to the success of the region's economy. The first step in finding solutions to freight bottlenecks is to identify where bottlenecks occur on our region's transportation system. Currently, CMAP does not have a process to identify freight or any other traffic related bottlenecks in the region. The goal of this project is to develop a process to identify and rank freight bottlenecks that occur on the National Highway System (NHS) in the CMAP region. Staff is interested in the committee's input and feedback on the proposed method to identify bottlenecks and the draft results.

Background

The efficient movement of people and goods on our region's roads is vital to the success of our region's economy. As a national freight hub, it is important to identify, track, and find solutions to traffic bottlenecks that adversely affect freight movement through the Chicago region. Increased costs and travel times caused by bottlenecks will continue to hamper the region unless these locations are properly identified and sound solutions are implemented to address the bottleneck.

Past work, including traffic scans and other performance metrics, revealed well known expressway bottleneck locations, but CMAP staff never dug deeper into the identification or causes of bottlenecks on the region's roadways. This project will first locate where freight bottlenecks occur in the region and then identify network deficiencies that contribute to the bottleneck. Next, a menu of possible solutions will be listed for the bottleneck. Finally, the bottleneck locations will be ranked by severity.

This analysis has multiple goals. First, the ranking of bottlenecks can provide a transparent way to help partners target funds to alleviate the worst bottlenecks in the CMAP region through capital investment or operations improvements. It may also supplement CMAP's programming work over the long term. Finally, not all bottlenecks may have proposed capital or operational improvements. The results should highlight locations that warrant more detailed study to identify the root cause of the bottleneck, preferred solution, and its estimated cost.

Bottleneck Identification

Identifying freight bottleneck locations is the first step of this project. CMAP staff proposes using the National Performance Measurement Research Data Set (NPMRDS) to first calculate the congestion measure, light congested hours, as the primary screening tool to locate freight bottlenecks in the region. Light congested hours is the average number of hours per weekday in which the speed on the highway link drops below 90 percent of the free-flow speed. Light congested hours was chosen over heavy congested hours because the former provides a more comprehensive view of network deficiencies than the latter.

NPMRDS is provided by FHWA to state DOTs and MPOs free of charge. The raw NPMRDS provides average travel time in seconds by link by direction in five-minute slices (or epochs) every day for the NHS. Data on travel time is only provided where there is vehicle data available. Vehicle travel times are reported for trucks, passenger vehicles, and all vehicles. The truck data is provided by the American Transportation Research Institute (ATRI) and includes primarily Classes 7, and 8 of the FHWA vehicle classification definition. Along with the travel time data, a link shapefile is also provided to display the data.

The first step in the screening process is to calculate the light congested hours for each link, which starts by selecting a date range and non-holiday weekdays from the data. Questionable data, including speeds below 5 mph and above 90 mph, is not used in the analysis. The data is then aggregated into 15-minute epochs, which are the simple average of the 3 epochs that make up the 15 minute interval, to help with data coverage. A free-flow speed is then calculated first breaking the day into separate time periods corresponding to the periods used in CMAP's travel demand model, calculating the median speed in each of those time periods, and finally taking the maximum of the calculated median speeds as the free-flow speed. Next, 15-minute epochs with a speed below 90 percent of the free-flow speed are flagged and summed by date. Then the average number of light congested 15-minute epochs a day is calculated and converted to hours.

To determine if the locations experiencing the most freight congestion are logical, the results were overlaid with industrial land use, intermodal facility locations, and the percent heavy truck average annual daily traffic (AADT) on a link. The results are very promising and staff recommends continuing to use the average number of light congested hours per weekday as the initial screening tool to locate freight bottlenecks.

Network Deficiency

With freight bottleneck locations identified, finding probable causes for the bottleneck is the next step in the process. Network deficiencies that could lead to bottlenecks include the following:

- Lane drops and pinch points
- Lane imbalances
- Lane use restrictions
- Geometric issues
- Interchanges (e.g., weaving movements)
- Signal operations
- Intersection and mainline capacity
- Rail crossing

The Illinois Highway Information System (IHIS), CMAP's regional travel demand model network, and the regional transportation data archive are the primary sources used to locate network deficiencies. The process of matching network deficiencies to a bottleneck involves mapping the deficiency and overlaying the congested hours graphic. It is important to note that work zones may cause short-term bottlenecks and should be masked from the analysis unless the bottleneck persists past construction.

Next Steps

So far, the draft bottleneck locations have been identified and network deficiencies have been mapped along with the bottleneck locations. The next steps will include determining if sequential links should be grouped as a single bottleneck, creating a table of causes and solutions for the top bottlenecks in the region, and developing a method to calculate the annual cost the region incurs for each bottleneck. The process will be replicated with historical and more current data to determine if locations are consistently identified as a freight bottleneck or if locations react to changing economic and travel conditions.

CMAP will also evaluate the utility of analyzing raw ATRI probe data to supplement the above analysis.

ACTION REQUESTED: Discussion