MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

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To: Ald. Chantia Lewis

From: Kathleen Brengosz, Fiscal Planning Specialist, x3926

Date: July 12, 2019

Subject: Traffic Signal Coordination

In response to your request for information regarding how traffic signal coordination affects driver compliance, the Legislative Reference Bureau is providing the following information.

The City maintains approximately 780 traffic signals. Their purpose is to facilitate the safe movement of vehicles and pedestrians through intersections. This is done by using phases (typically red, yellow and green) to assign the right of way alternately to conflicting flows of traffic. The total time required for a signal to sequence through all of the phases is called the cycle. The majority of City-operated traffic signals have a cycle between 60 and 90 seconds.

The timing of a traffic signal refers to the portion of time given to each phase. There is no standard timing for traffic signals. The length of each phase is determined by the classification of the roadways, traffic volume, the configuration of the intersection, and other safety considerations. When properly timed, traffic signals may increase the traffic-handling capacity in an intersection, improving efficiency and safety for vehicular and pedestrian traffic.

Traffic signal coordination refers to the relationship between traffic signal operation at adjacent intersections. Offset is the time from a reference point (such as the start of a green phase) at one intersection to the same reference point at another intersection. The offset is used to allow vehicles moving at the proper speed to advance from intersection to intersection without stopping. A well-coordinated signal system maximizes progressive movement through the system.

There are many factors which limit traffic signal coordination. Most constraints fall into 3 general categories: institutional constraints, physical constraints and temporal or time constraints. Institutional constraints pertain to the allocation of resources, jurisdictional relationships and political climate. Physical constraints are barriers to efficiency such as close signal-spacing, irregular intersection geometry, inadequate turn lanes, and mid-block access points. Temporal constraints are associated with competing simultaneous demands, such as conflicting movements, fluctuating demand patterns, and differences in clearance times. Traffic signal prioritization and preemption for emergency vehicles, mass transit and railroad operations are also temporal constraints.

The City's current traffic signal system allows for coordination. In establishing signal timing, consideration has been given to maximizing traffic flows, especially during the morning and afternoon peak demand periods. The Department of Public Works has begun

installing newer technology which enables more sophisticated coordination and allows greater responsiveness to changes in traffic patterns and roadway conditions. The Department uses a variety of strategies to upgrade intersections. Some traffic signals are included in paving projects. Others are completed as stand-alone projects. When equipment is damaged in the field, the Department attempts to incorporate an equipment upgrade into the repair. The Department has applied for and received several federal grants to help offset costs. Approximately 200 intersections have been upgraded so far. It is anticipated that 500 intersections will be completed by 2022. The average cost per intersection is $20,000.

If traffic signal equipment supports coordination, signals can be retimed to maximize efficiency. Retiming signals is a complex and extended procedure. An initial survey is required to identify system information and collect field observations of current traffic conditions. The initial study should include traffic and pedestrian volume, vehicle classifications, and counts of turning and through movements. Collision records need to be reviewed. After collected data are processed, analyzed and calibrated, the model is adjusted to determine optimum signal timing. The new timing is implemented at the affected intersections. The new timing is evaluated and final adjustments are made. Travel time and delay studies must be conducted to document improvements in traffic flow.

Ideally, retiming should be done every 3 to 5 years or more frequently if traffic conditions change. In practice, many jurisdictions postpone or disregard signal retiming due to financial or staffing constraints. Although the cost of signal timing projects can vary widely, a 2004 article in the Institute of Transportation Engineers Journal estimated that the cost of retiming an intersection was between $2,500 and $3,500. When updated by the Consumer Price Index to 2019, the estimated cost for each intersection is between $3,400 and $4,700.

Most of the literature regarding traffic signal coordination examines the economic and environmental impact of improved coordination. Generally, improved signal coordination reduces traffic delays, which reduces fuel costs. Less fuel consumption results in fewer emissions and improved air quality. Although it is widely accepted in the traffic engineering field that motorist frustration can be reduced by providing coordinated flow through traffic signals, no studies which examined the relationship between uncoordinated signals and driver compliance were found.

A 2018 article in the Journal of Transportation Research explored the ways that traffic signal coordination could create or limit speeding opportunities on bidirectional urban arterials. The author found that it may be possible to limit speeding opportunities with little or no increase in vehicular delay. It is important to note that the author defined “opportunity” in relation to the spacing and speed of other vehicles on the road. The article did not consider drivers’ deliberate disregard of traffic signals. The article is attached to this memo.

If you would like further information, please do not hesitate to contact me.

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Attachment