

DATE ISSUED: November 7, 2001

REPORT NO. 01-244

ATTENTION: Honorable Mayor and City Council

SUBJECT: Traffic Signal System Timing

REFERENCE: City Manager Report No. 99-167, dated August 3, 1999.

### SUMMARY

THIS IS AN INFORMATION ITEM ONLY. NO ACTION IS REQUIRED ON THE PART OF THE COMMITTEE OR THE CITY COUNCIL.

### BACKGROUND

On September 24, 2001, the City Council approved the expenditure of a \$240,000 Congestion Mitigation and Air Quality (CMAQ) federal grant to collect traffic count data needed to retime at 320 signalized intersections citywide. Attachment 1 lists all the arterial streets to be retimed using this data. Also, included in this report is a description of how and why traffic signal coordination timing is conducted, along with a description of the benefits of traffic signal interconnection. The City of San Diego has approximately 1430 traffic signals in its jurisdiction with six full-time staff dedicated to timing traffic signals.

### DISCUSSION

#### **Traffic Signal Systems Timing**

Traffic signals may operate in one of two modes: one where the amount of green time provided for each movement is only dependant on the amount of traffic demand, and the other where signals operate in a fixed time relationship to one another. The second mode is called coordination.

Traffic signal coordination is a method of timing traffic signals to produce a smooth flow of a group of vehicles along an arterial or street network. For traffic signals to be coordinated with one another, they must be on the same cycle length, or multiples of the same cycle length. The cycle length is the amount of time it takes a signal to provide a green indication to all its movements.

The first step necessary to coordinate an arterial is to gather manual counts for each traffic signal involved. Manual count data includes the number of turning vehicles, through vehicles, and pedestrians crossing an intersection. Manual counts are typically conducted for morning, midday, and evening peak periods. These separate counts are necessary, since the traffic patterns of most intersections vary by the time of day. This data is then entered into a computer software package which ultimately recommends the cycle length, the amount of green time for each

movement of traffic, and the time the main street signals turn yellow. This information is then provided to the computer running each traffic signal. The new timing may either be entered by hand at each traffic signal, or remotely if the signal is on a central communication link. The timing is observed by traffic engineers in the field, and timing adjustments are made, as needed, to match actual conditions. Travel time studies are then conducted on the arterial to determine the success of the new timing. A properly coordinated arterial should have a lower travel time after retiming is conducted. Although traffic signal coordination may increase delay to motorists wishing to access or cross the major arterial, studies have shown that properly coordinated signals reduce overall delay, fuel consumption, air pollution, and accidents.

Not all arterials or street systems benefit by coordination, however. For example, arterials with very light main street traffic, or signals spaced more than one half mile apart, would receive little benefit from signal coordination.

Additional attachments summarize previous and planned traffic signal coordination projects. Attachment 2 is a list of arterials to be retimed with counts available or being collected, and Attachment 3 is a list of arterials retimed since 1998.

### **Selection Process**

Since 1994, the City of San Diego has been allocated over \$11 million in federal Congestion Mitigation and Air Quality (CMAQ) grant funding for traffic flow improvements. These funds come from the federal 18.4 cents per gallon gasoline tax, and are distributed on a regional basis by SANDAG. The types of projects funded are traffic signal coordination timing, traffic signal interconnect, central communication, left turn signal modification, detection improvements, and motorists information systems. All the above improvements are considered to be low cost - high benefit methods of relieving traffic congestion in urban areas.

All the jurisdictions represented in SANDAG compete for this funding based on a priority rating system. There are two levels for assigning priority points for each project, and they are as follows:

Category of project (in order of priority):

1. Retime traffic signal
2. Protected-permissive left turn signal installation
3. Traffic signal central control computer systems and communication links (interconnect)
4. Replace obsolete equipment; improvements to vehicle detection
5. Motorists information and monitoring systems

In addition, SANDAG has established the following additional factors for priority ranking:

1. Improvements to air quality
2. Arterials identified in SANDAG's Regional Arterial System
3. Regional implications/inter-jurisdictional coordination
4. Roadway traffic volumes
5. Demonstrated intelligent vehicle/highway systems, advanced traffic management systems

All jurisdictions represented in SANDAG are allowed to submit a list of project applications for each category. Each application must be accompanied by an evaluation criteria which includes factors such as air quality benefits quantified by computerized traffic modeling, analysis of service improvements to the Regional Arterial System and Congestion Management Program System, analysis of regional or inter-jurisdictional implications, and analysis of congestion improvements to high volume arterials, among other factors.

In the case of signal retiming projects, the Traffic Engineering Division analyzes all areas in the City for the above criteria, and has additional factors to consider prior to submitting applications to SANDAG. Such factors include whether there is central communication (communication to Downtown Traffic Control Center) planned or already existing at the subject location. The retiming of traffic signals is most effective when there is central communication control to the area, and the clocks and timing parameters that coordinate the timing in a system of traffic signals can be automatically adjusted and modified on a daily basis. When there is no central communication to an area, it is difficult to monitor the performance of the system and make adjustments when traffic patterns change. The clocks in signal controllers also tend to drift, thus creating a less efficient flow of traffic. In fact, it is often preferable to leave the traffic signals responding only to the conditions and sensors in their immediate vicinity, or what is commonly known as "free operation mode." Central communication is achieved by installing fiber or copper interconnect cable. Attachment 4 is a list of traffic signal interconnect systems currently in design or under construction funded by CMAQ grants. Upon completion of these projects, the arterials involved will be retimed.

Another factor that is considered is whether the subject area has been previously approved for retiming with federal, state or any other type of funding. There are other federal and state programs which have funded retiming projects in the past, and if no major changes in traffic patterns have occurred in a system since the last retiming, then staff favors other areas for the use of new funding sources.

All of the above factors are considered prior to submitting traffic signal timing applications to

SANDAG. All the projects that are submitted by the City of San Diego compete for the available funding in a priority basis with all other projects submitted in the region. Typically, approximately fifty percent of the total dollar amount submitted by the City of San Diego is approved for final funding. Attachment 5 is a list of projects in all categories that have been funded over the last 7 years as part of the CMAQ program.

Respectfully submitted,  D. Cruz Gonzalez Director, Transportation Department		Approved: George I. Loveland
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- Attachments:
1. Traffic Counts to Be Collected for 320 Signals by CMAQ Funds
  2. Traffic Signal Systems Ready to be Retimed
  3. Traffic Signal Systems Retimed Since 1998
  4. Traffic Signal Interconnect Systems in Design or Under Construction
  5. CMAQ Grant Funded Projects for the City Since for Fiscal Years 1994-2000