DUKE STREET TRAFFIC CONGESTION MITIGATION PROJECT

City of Alexandria

Duke Street Corridor

- Duke Street corridor runs in east-west direction. The project bounds Roberts Lane/Dove Street to S. Walker Street about 3.5 miles, 19 signalized intersections and a posted speed limit of 35 mph.
- The existing traffic signal timing along Duke Street is achieved through fixed coordination timing plans on a time of day schedule.
- The level of recurring congestion can change from day to day based on residual impacts of incidents and on nearby roadways congestions such as the I-495.

Need

- The ability to implement Traffic signal control system to adjust to fluctuations in daily traffic to enable and advance the traffic operations, improve progression and reduce delays and fuel consumption.
- An Adaptive or a Responsive System to support the 19 existing Signalized intersections within the project limits.
- Expandable. To include all intersections along Duke St. At the present there is a new signalized intersection within the project limits that is under construction.

Purpose

- Implementing Traffic Responsive Signal Controls with optimized coordination timing plans for the signalized intersections along Duke St.
- Installing improved vehicle detection.
- Installing accessible pedestrian signals.

- (City staff looked into and planned for an Adaptive Systems but decided that it was not feasible at that time)

Tasks

- Existing conditions data collection and analysis.
- Linking and intersection geometry information, measured travel time between intersections and queue lengths.
- Locate Key locations for system detector installations.
- Determine the optimum placement of accessible pedestrian buttons.

Tasks (Continued)

- Developing multiple optimized traffic signal coordination timing plans.
- Modeling and simulation of the optimized timing plans.
- Implementing and testing traffic responsive signal control.
- Eagle/Siemens Training.

Traffic Responsive System

- Develop and fine tune traffic responsive thresholds that enable the City's Central Traffic Control System to change timing plans as critical conditions are detected.
- Thresholds will be based on a combination of roadway volume, occupancy, queue length and speed.
- System Detectors at the key locations will measure the occupancy to determine the suitable timing plan with the desirable Cycle Length.
- Other local intersection detectors to be used for the phase shifting as detected for the side street traffic and the main line left turning movements.

8 System Detector Locations

- Duke and W. Taylor Run
- Duke and Roth
- Duke and Wheeler
- Duke and S. Gordon
- Duke and S. Ingram
- Duke and N. Pickett
- Duke and N. Paxton
- Duke and N. Ripley

(About 40% of the intersections were determined to be equipped with Systems Detectors)

Other Detections/Systems

- Duke and S. Walker (Queue Detectors)
- Duke and N. Quaker (Queue Detectors)
- For all left turns from the main street and the side street traffic there are the local detection devices. (A mixture of the Sensys and conventional loops devices).

(Only about 1% of the intersections were determined to be equipped with Queue Detectors).

Communications

- Traffic records development such as volume and speed to be communicated through the City's Central Traffic Control System to return the appropriate commands.
- City therefore considered the integrity of the communications a priority for the success of the project.

- (City staff looked into and planned for an Adaptive Systems but decided that it was not feasible at that time)

Communications (Continued)

- The need for faster communications was recognized.
  - Existing 1200 baud FSK serial communications was inadequate for project requirements.
  - Ethernet is most widely accepted alternative.
- Most cost effective solution was to use DSL over the existing twisted copper.
  - To replace copper with fiber was too costly.
  - Existing copper infrastructure in good condition.
- Existing cable splices were reconfigured to remove bridge taps.
- Product qualification testing.

Communications (Continued)

- Rugged Com RS930L was selected.
  - 25 Mbps Symmetrical Bandwidth at 2300 feet.
  - 50 μs latency port to port.
  - Checked references .
  - Lowest unit cost.
- Modification to the controller cabinet
  - Re-terminated comm. cable to 66 punch block.
  - Installed new ground rods.
  - Installed separate PC642-008LC surge suppressors designed for higher speed Ethernet circuits.
  - The M40 controllers were replaced with M50s to provide Ethernet capability for the controller.

Procedure

- Staff envisions several series of traffic responsive plans to accommodate different times of day.
- For example: During the morning peak there will be a series plans with inbound offsets, similar side street phase lengths and varying cycle lengths. Early in the morning when traffic is light, the plan would have a low cycle length and inbound offsets. As traffic increases, a second plan with a slightly higher Cycle Length and similar offsets would be implemented.

Procedure (Continued)

- As traffic increases further, the Cycle Length would continue to increase. Later in the morning when the traffic starts decreasing the Cycle Length would also decrease while maintaining inbound offsets.
- Finally the plan would transition from inbound to balanced progression. At this point the primary change will be to the offsets as the Cycle Length will already be correct for the amount of traffic on the roadway.

Challenges

- Getting the system to implement the correct plan at the proper time.
- If parameters are set too fine, the system will forever be changing plans and the signals will rarely be synchronized due to the transitioning between plans.
- If parameters are set too coarse, the system will be unresponsive and implements the new timing plan too late.

Expectations

- This project hopes to solve this problem by having a series of close timing plans where the main change between plans is about a 10 seconds cycle length change.
- Having a series of closely spaced timing plans will eliminate the transition period when changing between plans.

Challenges (Continued)

- Appropriate and continual maintenance of the detection devices.
- Have a reliable communications media.
- Citizens Complaints when the new system is implemented.
- Controller when in transition takes about 2 to 3 Cycles to get back in step.

(Fire and Emergency Vehicle Signal Preemption at 2 locations, Duke and S. Quaker and at Duke and N. Paxton)

Benefits

- Advance the traffic operations, improve progression and reduce delays and fuel consumption.
- Improved Controller devices (M50s) and Vehicle Detection devices at the study area intersections.
- Upgraded communications media and grounding integrity at the study area intersections.
- ACTRA System will be upgraded to TACTICS.
- Intersections in the study area changed to a standard and matching Nema phasing.
- Additional Pedestrian Access with accessible pedestrian buttons will be introduced.
- Pedestrian Timing will be reviewed to replicate the amended MUTCD guidelines.

Analysis

- A before and after travel runs study.
- Changes in the traffic flow efficiency.
- MOE comparisons.
- Benefits and cost savings analysis.

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Questions