

DEMAND

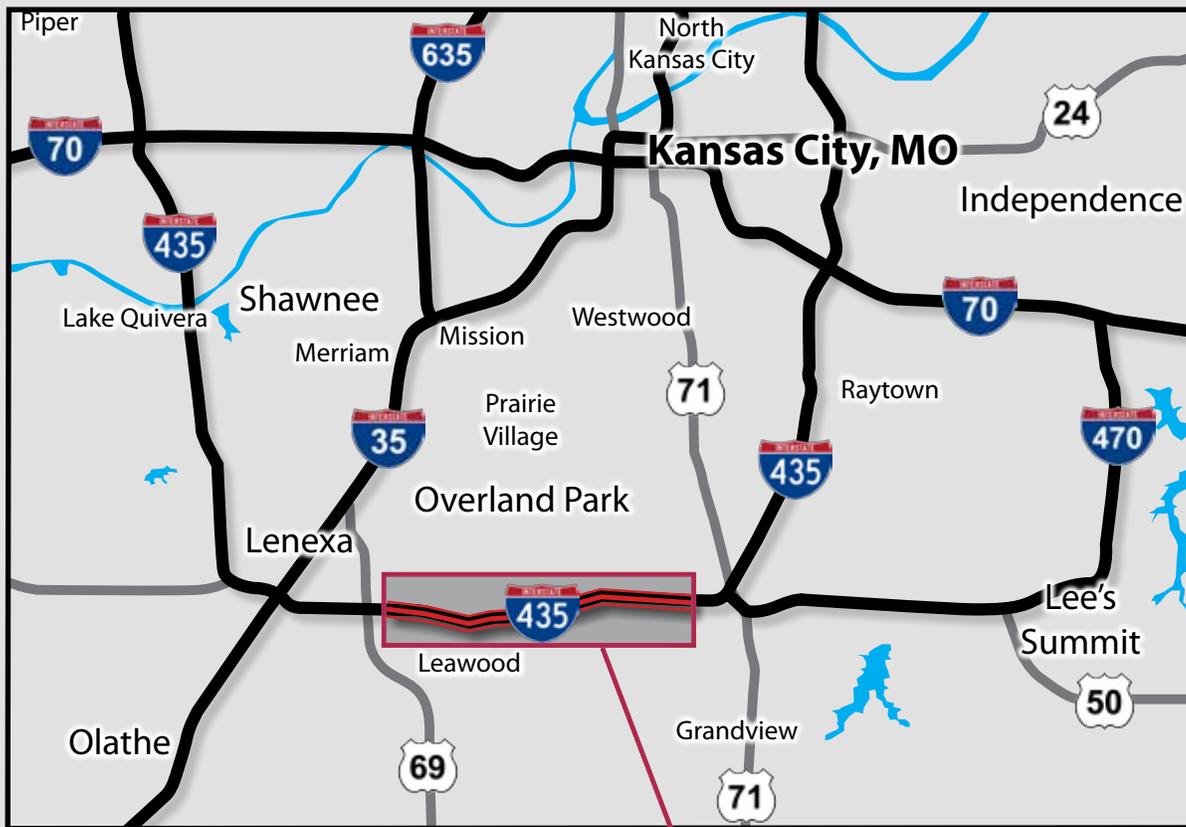
Ramp Metering

2010 evaluation report

ADVANCED **MAXIMIZING THE FLOW**

Kansas City  MoDOT + KDOT
SCOUT





RAMP METER LOCATIONS

A total of seven interchanges are metered on I-435 between Metcalf Avenue and the Three Trails Memorial Crossing (formerly the Grandview Triangle). Metered on-ramps include I-435 at:

- Metcalf Avenue (1 eastbound)
- Nall Avenue (1 eastbound and 1 westbound)
- Roe Avenue (1 eastbound and 1 westbound)
- State Line Road (2 eastbound and 1 westbound)
- Wornall Road (1 eastbound and 1 westbound)
- Holmes Road (2 eastbound and 2 westbound)
- 103rd/104th Street (1 eastbound)
- 103rd/104th Street (1 on-ramp)

Introduction

Kansas City Scout has completed an initial evaluation of the ramp meters on I-435. The meters are special traffic signals on freeway on-ramps that enhance KC Scout's existing system of cameras, pavement sensors, and electronic message signs.

The purpose of installing ramp meters on I-435 is to:

- Decrease the number of sudden weaving and braking moments that happen as vehicles merge onto the freeway from the on-ramps.
- Reduce accidents and allow more vehicles to smoothly drive along the freeway.
- Allow more cars to use the freeway.

KC Scout began fully operating the meters during the morning and afternoon rush hours in March 2010. They are part of a KC Scout ramp meter pilot program and this initial evaluation report provides an update on how ramp meters are currently operating.



1 VEHICLE
PER GREEN
EACH LANE

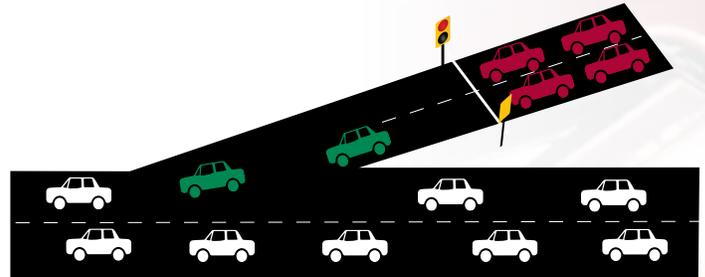
Ramp metering maximizes the flow of traffic on I-435 by making it easier for drivers to merge.



Evaluation Factors

With an evaluation team consisting of engineering and planning consultants, KC Scout evaluated the effectiveness of the I-435 ramp meters with the following factors in mind:

- Safety and Accident Reduction
- Community Feedback
- Speeds and Travel Times on the Freeway
- Compliance with the Meters
- Delay on the Ramps
- Traffic Incident Management



Ramp Meter Illustration

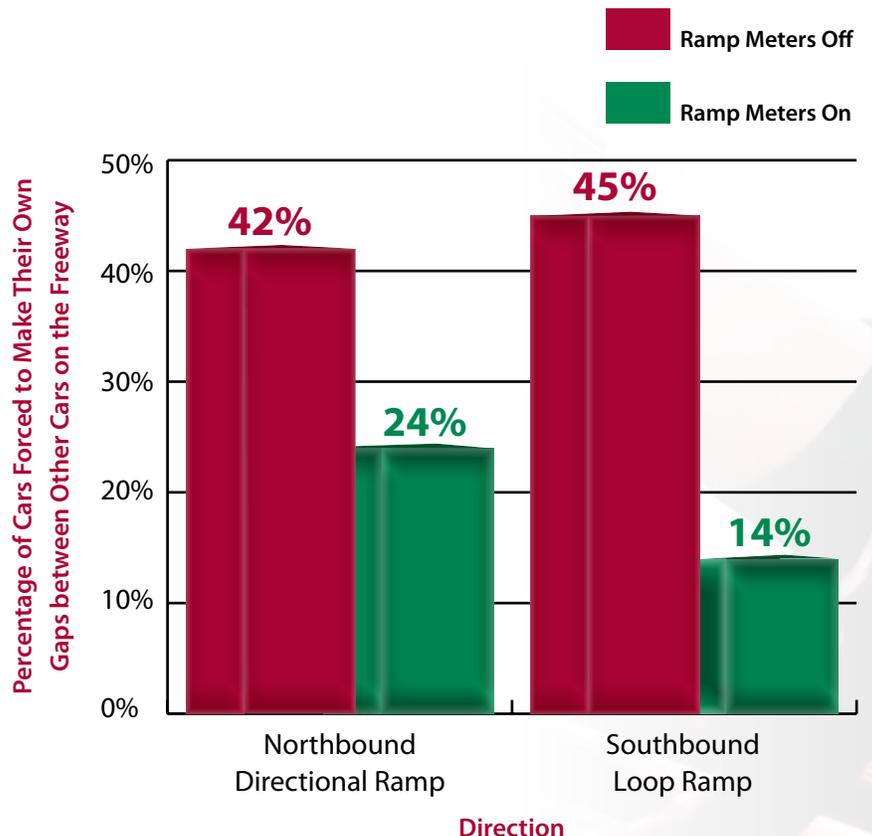
Data Collection

To gather information about the I-435 ramp meters, the evaluation team:

- Interviewed transportation professionals and law enforcement staff to better understand their experiences with the meters after turn-on.
- Observed the ramp meters in action on-site at the on-ramps and off-site via the KC Scout cameras.
- Collected traffic data for a four-month period after the meters were in operation spanning from April 2010 to July 2010.
- Compared the “after” findings to traffic conditions on I-435 between April 2009 and July 2009—before the meters were installed and turned on.

Merging Patterns

State Line Road On-ramp to Eastbound I-435



Observations and Trends

The evaluation team's findings are included in the following pages and organized by evaluation factor.

SAFETY & ACCIDENT REDUCTION

Transportation engineers, law enforcement officials, and KC Scout's traffic management center operators have observed that drivers are merging onto I-435 with safer gaps in between vehicles and fewer near miss collisions at the interchanges since the ramp meters were installed.

- KC Scout's observations are consistent with ramp meter evaluation studies in Milwaukee, Portland, Detroit, and Denver, which have shown that ramp meters can reduce crashes by 26 to 50% when metering is applied to highways throughout these metropolitan communities.
- KC Scout's ramp metering pilot program is for a single corridor. Meters have not been installed throughout Kansas City's freeway system, so accident reductions will only be quantified for the project corridor.

One month before the ramp meters were installed, KC Scout implemented its new Advanced Traffic Management Software to track in greater detail incident characteristics, such as lane blockages, locations, duration of time, and causes of accidents with greater detail and accuracy.

KC Scout will use the data from the new software plus a review of accident reports for the I-435 corridor to develop a one year summary of safety and accident information for the ramp metering pilot program. The final summary will be included with the 12-month Ramp Metering Evaluation Report.

Ramp meters improve merging at on-ramps. Merging patterns at the I-435 and State Line Road Interchange are an example.

COMMUNITY FEEDBACK

Responses from interviews with transportation professionals and law enforcement staff as well as comments from the general public related to included:

Pros and Cons of Metering:



Generally, the ramp meters are having a positive impact on merging. Gaps are easier to find and motorists are more willing to allow one or two cars to merge on to the freeway.



Ramp metering makes a lot of sense and can make the rush hour commute easier. Back-ups were an issue at Nall Avenue but KC Scout adjusted the meters to minimize them.



Drivers need more education about both merging and how to properly drive through or comply with the ramp meters.

Suggestions from the Community:

- Install meters on other Metro freeways, such as US-69 and 135th Street or extend ramp meters west along I-435 to K-10.
- Add ramp metering questions on the drivers licensing exams.
- Implement an enforcement approach that involves sending warning letters to violators rather than giving them an immediate traffic ticket for non-compliance.

SPEEDS AND TRAVEL TIMES ON THE FREEWAY

The speeds and travel times along I-435 were evaluated using a series of travel time surveys. The “before” speeds and travel times were calculated in 2007 during the ramp meter design studies. The “after” speeds and times were measured in 2010 after the ramp meters were installed and in operation for just over six months.

Survey information was collected for both the morning (6:00 a.m. to 8:00 a.m.) and afternoon (4:00 p.m. to 6:00 p.m.) rush hour periods. The evaluation team used the Floating Car Method, which involves driving the survey vehicle as the average vehicle in the traffic stream passing about as many vehicles as pass it, to gather the data.

The information from travel runs in each of the westbound and eastbound directions during the before and after periods was compiled and processed to ensure that the standard deviation of the samples were within the acceptable range of the true averages based on a five percent margin of error.

Speeds by Freeway Segment:

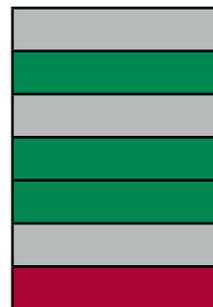
Speeds during the rush hours increased on several segments of I-435, especially between State Line and Wornall Roads irregardless of the direction or rush hour period. Some speeds decreased along the corridor, especially in the eastbound direction during the afternoon rush hour period.

Speeds by Freeway Segment

Eastbound Freeway Segment

Metcalfe Avenue on-ramp to Nall/Roe Avenue off-ramp
Nall/Roe Avenue Interchange
Nall/Roe Avenue on-ramp to State Line Road off-ramp
State Line Road Interchange
State Line Road on-ramp to Wornall Road off-ramp
Wornall Road Interchange
Wornall Road on-ramp to Holmes Road off-ramp

Morning Rush Hour



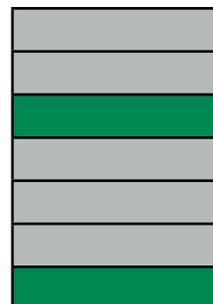
Afternoon Rush Hour



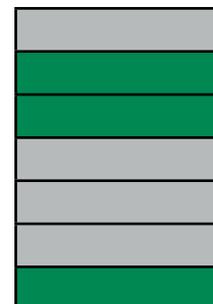
Westbound Freeway Segment

Holmes Road on-ramp to Wornall Road off-ramp
Wornall Road Interchange
Wornall Road on-ramp to State Line Road off-ramp
State Line Road Interchange
State Line Road on-ramp to Nall/Roe Avenue off-ramp
Nall/Roe Avenue Interchange
Nall/Roe on-ramp to Metcalfe Avenue off-ramp

Morning Rush Hour



Afternoon Rush Hour



Travel Times by Freeway Segment:

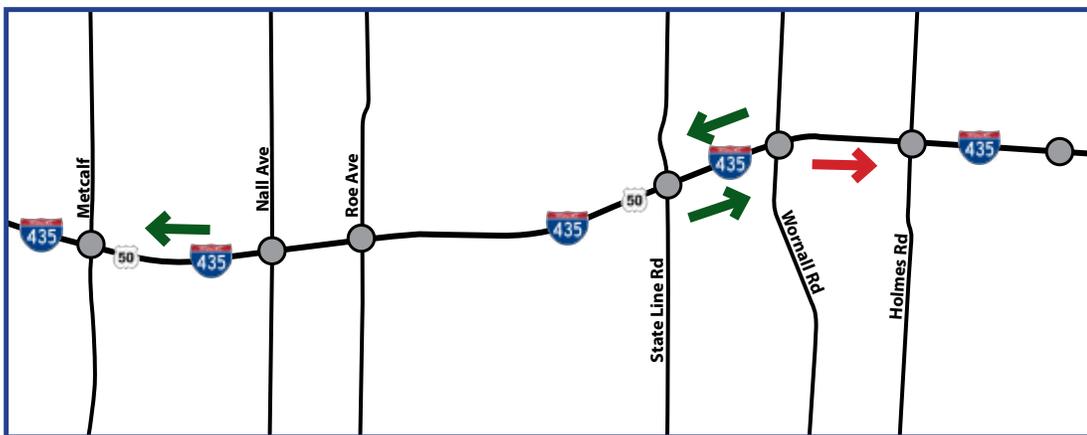
Travel times along I-435 improved when ramp metering was added to the corridor. The improvement is the result of a net overall effect of some freeway segments that experienced faster freeway speeds combined with those that did not. Segments with significant changes in travel time speeds include:

Morning Rush Hour

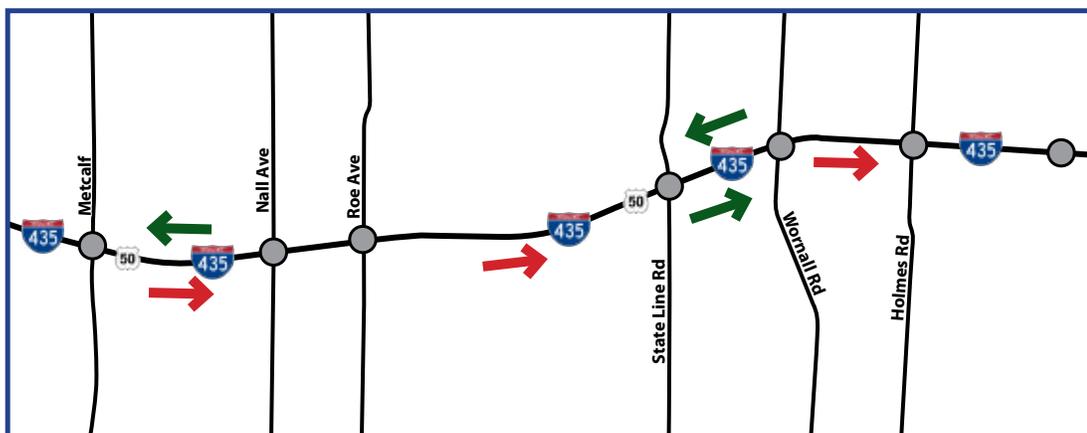
-  Westbound I-435 from the Wornall Road on-ramp to the State Line Road off-ramp and from the Nall Avenue on-ramp to the Metcalf Avenue off-ramp .
-  Eastbound I-435 from the State Line Road on-ramp to the Wornall Road off-ramp .
-  Eastbound I-435 from the Wornall Road on-ramp to the Holmes Road off-ramp

Afternoon Rush Hour

-  Westbound I-435 from the Wornall Road on-ramp to the State Line Road off-ramp and from the Nall Avenue on-ramp to the Metcalf Avenue off-ramp .
-  Eastbound I-435 from the Stat Line on-ramp to the Wornall Road off-ramp.
-  Eastbound I-435 from the Metcalf Avenue on-ramp to the Nall Avenue off-ramp, from the Roe Avenue on-ramp to the State Line Road off-ramp, and from the Wornall Road on-ramp to the Holmes Road off-ramp.



MORNING



AFTERNOON

Segment Travel Time Changes on I-435

-  Shorter Travel Times
-  Longer Travel Times

-  Shorter Travel Times
-  Longer Travel Times

COMPLIANCE WITH THE METERS

To teach Metro drivers about the new meters before they were turned on, KC Scout coordinated its *Maximizing the Flow* community outreach campaign. The effort involved:

- Discussing the ramp metering pilot program with local municipalities (Kansas City, Leawood, and Overland Park), and law enforcement agencies.
- Educating and answering questions from the general public through meetings at local schools and community centers and with an on-line public meeting at www.kcscout.net.
- Posting project information on the website.
- Blogging on the KC Scout blog site.
- Developing an informative, ramp meter video and public service announcement and sharing it with local media outlets which then covered the installation of the meters in the news.
- Providing fact sheets, handouts, and slideshows that responded to the interests of key ramp metering audiences: the general public, local public officials, technical staff and officials, and law enforcement.

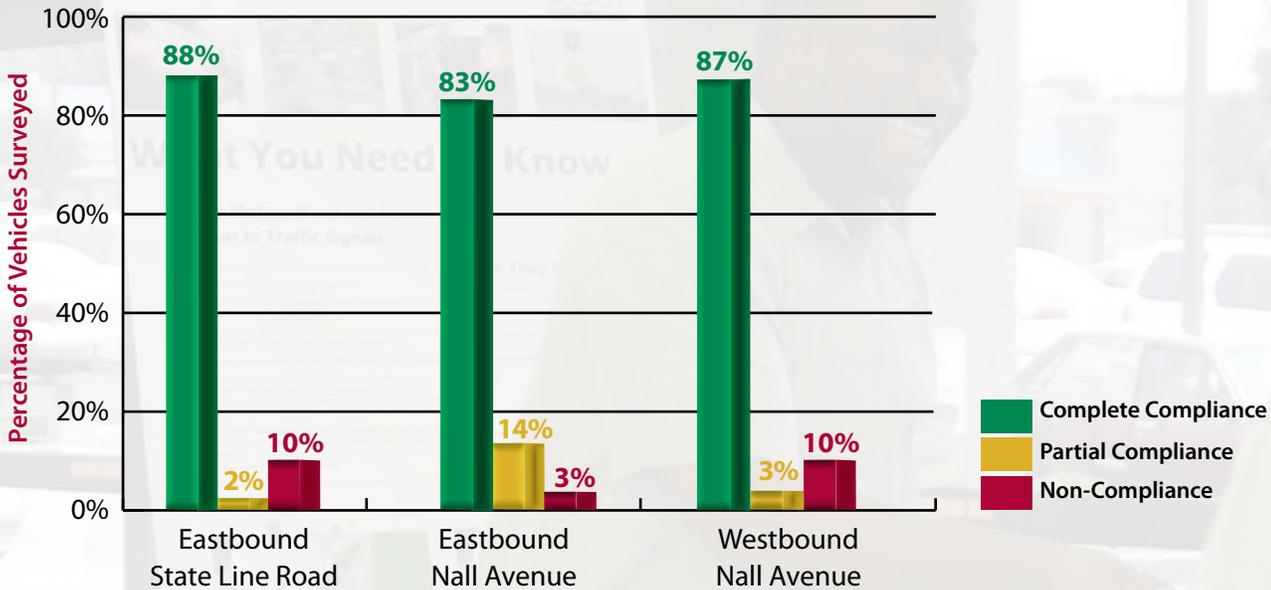
During the campaign KC Scout explained to motorists that they are complying with the ramp meters when they bring their cars to a full or rolling stop at a ramp meter signal that displays a red light. Partial compliance occurs when a driver does not pull his car close enough to the stop bar to activate the ramp meter. Partial compliance also happens when a motorist at a two-lane meter obeys the directions of the ramp meter signage for the opposite driver rather than the signage for his or her designated lane. On-site observations indicate that drivers are complying with the meters.

- Most appear to be aware of the flashing yellow lights that indicate that a ramp is metered, changes in signal colors, and signage explaining where to stop and how to proceed. Some drivers seem to miss or disregard the same information.
- Interviewees said that compliance appeared to be an issue at three ramps in particular: Eastbound State Line Road, Eastbound Nall Avenue, and Westbound Nall Avenue. The evaluation team surveyed the ramps and found that over 80% of motorists complied with them.
- Non-compliance is synonymous with a motorist's complete disregard for a ramp meter that shows a red light.



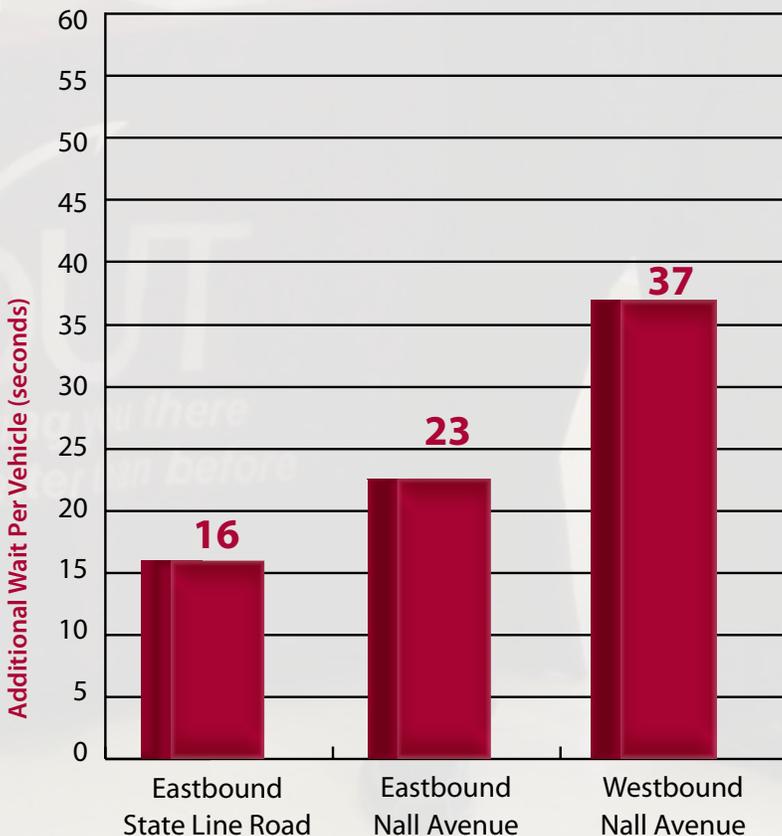
MAXIMIZING THE FLOW

Ramp Meter Compliance (2010)



The campaign informed and educated motorists about ramp meters, specifically describing the benefits, how the meters work, and how to drive through them.

Ramps with Perceived Delays after Ramp Meters Were Installed (2010)



DELAY ON THE RAMPS

Ramp meter compliance can impact the amount of delay drivers experience on the ramps. The evaluation team measured the delay on the ramps that interviewees believed had compliance issues. The data collected shows that Kansas City motorists experienced less than one minute of additional wait time per vehicle on the ramps after the ramp meters were installed. The added time is less than the minute wait KC Scout promised when it began educating the public about the meters.

TRAFFIC INCIDENT MANAGEMENT

Traffic incidents are lane blockages involving many factors such as, single or multiple cars, car fires, debris, or stalled cars in travel lanes. For every minute a freeway lane is blocked during the rush hour, a minimum 10-minute backup will result after the incident is cleared. As a result, it is critical that KC Scout monitor and track incident times and implement measures that will improve incident clearance times.

Proper traffic incident management is a vital factor in the battle to combat congestion, to improve public safety, and to advance the overall quality of the commute for drivers in the Kansas City Metro. Through its Traffic Incident Management Program, KC Scout coordinates the resources of a variety of partnering agencies and private sector companies to identify, respond to, and clear traffic incidents as quickly as possible while protecting the safety of on-scene responders and the traveling public.

KC Scout tracks and timestamps all incidents along the corridor using its Advanced Traffic Management System (ATMS) software. Current ATMS data indicates that the average time to clear an incident prior to ramp metering was about **22 minutes** on I-435 between Metcalf Avenue and 104th street in 2009. During the same months of 2010 the average time to clear an incident dropped to approximately **18 minutes** overall when the meters were in operation during the morning and afternoon rush hours.

Data from KC Scout's Advanced Traffic Management System software shows that on average incidents have been cleared 4 minutes quicker during rush hour periods since ramp metering has become operational.

Improved traffic incident clearance times can be attributed to several factors:

- Increased collaboration and communication on incidents due to KC Scout's Traffic Incident Management Program.
- Ramp meters helping motorists to merge more easily and move at a consistent rate on the corridor; thereby causing fewer back-ups, secondary accidents and congestion, which allows emergency personnel to arrive to the scene faster and clear incidents at a faster rate.

Emergency responders have improved response times along the corridor despite the fact that responders often must utilize the same metered ramps as commuters. The back-ups on the metered ramps have not only been minimized, but also responders have noted that the wider striped left hand ramp shoulders still allow them to bypass other stopped vehicles when emergencies necessitate their quick response



Conclusion

The goal of the I-435 ramp metering pilot program was to help decrease congestion by maximizing the flow of traffic and increasing merge safety on the freeway. The results of the current evaluation study indicate that ramp metering is benefiting traffic flow on I-435 because:

- **Drivers are more easily able to find gaps in the flow of freeway traffic** when entering from the on-ramps than they were before ramp meters were added to the route.
- **Freeway speeds have increased** within several segments of the I-435 corridor and **travel times have improved** slightly overall as well.
- **Motorists have generally accepted the meters, choosing to comply with rather than ignore them**, thereby helping to improve the safety of their commutes.
- **Motorists have also requested that meters be added to another congested portion of I-435**, such as the area between Metcalf Avenue and I-35.
- Emergency responders are able to achieve **faster incident clearance on the freeway** since the meters have been in operation.



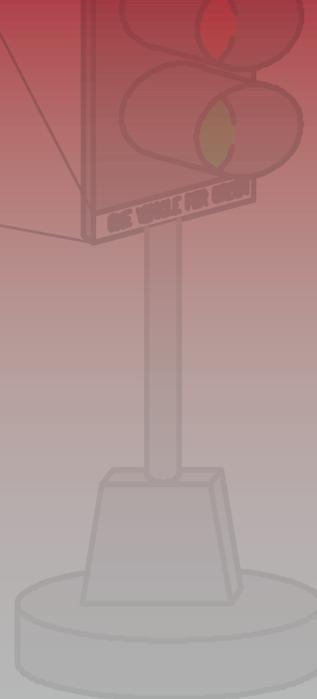
Kansas City motorists, transportation professionals, and law enforcement officials have indicated that additional driver's education is needed to improve merging skills and ramp meter compliance. In addition, transportation improvements beyond ramp metering may be needed to improve congestion issues at I-435 cross-streets.

Speeds on I-435 have been reduced along some segments, especially in the eastbound direction during the afternoon commute. Interchanges within the corridor are spaced close together and more and more vehicles are now merging onto I-435 in the eastbound direction due to interchange improvements at Antioch Road and US-69.

Ramp meters will not always be able to keep traffic flowing near the posted speed limit (65 mph), but they will be able to help make merging smoother and reduce rear-end and side-swipe accidents. Other transportation improvements beyond ramp metering may ultimately be needed to improve congestion issues along I-435.

As promised, Kansas City Metro motorists experienced less than one minute of additional wait time per vehicle on the ramps after the ramp meters were installed.

ONE VEHICLE PER GREEN



RAMP
METERED
WHEN
FLASHING

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Kansas City's Traffic Management System



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