**MAG NON-RECURRING CONGESTION STUDY**

**MAG Contract No. 418 Project No. PL10-1**
**Technical Memorandum No. 5 – Development of an Implementation Plan**

## INTRODUCTION

The Lee Engineering/TTI team is conducting a study on non-recurring congestion (NRC) for the Maricopa Association of Governments (MAG). This technical memorandum is the fifth in a series to document the effort on the study. This technical memorandum summarizes the work completed for Task 5 of the study which offers a shortlist of countermeasures that could be implemented regionally over a period of five-years by interested MAG member agencies. Estimated resources required by potential participating agencies are identified for each countermeasure including Estimated Initial Capital Costs, Estimated Annual Operating Costs, and agency staff requirements in Full Time Equivalents (Estimated FTEs).

## SHORTLIST OF COUNTERMEASURES

### Freeway NRC Countermeasures

The following groups of Freeway NRC Countermeasures were presented in Tech Memo #4 (in order of generally increasing estimated implementation costs/complexity) for further consideration, and may become the impetus for this study's pilot project framework development:

1. Improved real-time travel information dissemination;
2. Installation and monitoring of vehicle sensors and its resulting data;
3. Enhanced ramp metering system;
4. Use of dynamic lane merge control within construction zones and at other lane drop locations; and
5. Implementation of Active Traffic Management strategies (e.g., dynamic lane assignment and/or variable speed limits) at appropriate locations.

The countermeasures/concepts shown above were discussed further to spur the following modified (or different) NRC countermeasure ideas that are specific to the MAG Region. Accompanying the introduction of the various NRC countermeasures below, the following descriptive elements are presented for each: local and/or national experience, potential facility application in the MAG Region, how the countermeasure affects or counteracts NRC, any additional elements to promote a successful (or comprehensive) deployment, and cost estimates (capital, operating, staff). The countermeasures are presented in no particular order in order to aid further discussion of their merits as a potential pilot project in the MAG Region.

**NRC Countermeasure Category No. 1: Improved real-time travel information dissemination**

The ability to provide timely and accurate real-time traffic information and advisories to travelers that might be impacted by NRC and is an important traffic management tool. The AZ511.gov website is devoted to Arizona's portion of the national 511 travel information system. Current information on traffic conditions is available there, and a subset of the information is also accessible by dialing 5-1-1 from any landline or mobile phone from anywhere in Arizona. The system provides information for all ADOT roadways, some special event travel and parking information, travel times on seven freeway corridors in the Phoenix area, transfers incoming phone inquiries on transit to RPTA. Freeway condition information for the Phoenix metropolitan area is also accessible via cellular phones at the mobile 511 website – www.az511.com/pda.

In addition to the AZ511.gov website, there are a number of other websites such as Google Maps, NAVTEQ (www.traffic.com) and Mapquest that also provide accurate real-time traffic information. Some of the private sector websites provide additional services. For example, NAVTEQ provides SMS text alerts if a user's travel or commute route is seriously impacted by incidents, beyond a certain Jam Factor threshold that is defined in the user's profile.

Suggested countermeasures:

C1 - Improve the availability of real-time travel information by improving data availability to private sector travel information application developers

C2 - Provide real-time information on parallel arterials and transit routes

Other suggested initiatives/projects:

- An evaluation of the entire AZ511 website from an end user viewpoint – this may provide some insights on how to refine the website and focus on a few areas.

C1 - Countermeasure Elements:

- Custom data feeds (RSS, XML) for any private developers who want to access FMS traffic data
- Enhanced functionality from existing FMS traffic cameras such as more frequent snapshot updates, video, or simulated motion through consecutive snapshots (if identified in the user survey as a desired application)

C2 – Countermeasure Elements:

- Travel time information on parallel arterials and transit
- Route planning utility that allows users to access information on their personalized route only (this is already available at NAVTEQ and might not be a function that the public sector needs to develop or support)

How these countermeasures reduce NRC:

C1 – This countermeasure would increased availability of real-time information, allowing road users to make more informed choices which could reduce the impact of NRC

C2 - Enhancement of the system to provide information pertaining to arterial roadways, especially those regularly utilized in conjunction to (or as an alternative to) the freeway system, will provide additional information for travelers to consider when determining their travel route, mode, or time. This could result in shifting of traffic demand to routes and modes that have unused capacity -- this requires a real-time information on arterials and transit which is currently unavailable

Implementation Costs:

C1 – Additional Equipment Needed for Enhanced Data Sharing – computer servers and telecommunications

| | |
|---|---|
| Cost of infrastructure and equipment | $500,000 |
| Annual Operating Cost | $50,000 (10% of capital cost) |
| Staff required -- estimated FTEs | 0.5 |
| Responsible agency | ADOT |

C2 – Provide real-time information on parallel arterials and transit routes

| | |
|---|---|
| Cost to instrument one arterial mile | $25,000 |
| Cost to acquire real-time transit information | $0 |
| Annual operating cost | $5,000 |
| Staff required -- estimated FTEs | 1 |
| Responsible agency - arterials | Local agency |
| Responsible agency - transit | RPTA/City of Phoenix |

**NRC Countermeasure Category No. 2: Expand Coverage for Real Time Traffic Monitoring**

The foundation for this NRC countermeasure concept is that real-time knowledge of ~~space-mean speed~~ on a freeway operating speeds and travel times can provide better information for interpretation by, and/or dissemination to, the road users. The urban freeway systems is currently equipped with the Freeway Management System (FMS) detectors, located at one-mile spacing, that provide real time traffic data for about 120 miles. This coverage should be expanded to cover all heavily traveled freeway corridors. This could be achieved by advancing FMS projects that would provide additional coverage. Another viable option that is currently being studied by MAG, is the feasibility of purchasing real-time traffic flow data from the private sector. The ~~space-mean~~ speed data captured in real-time could be used to estimate and distribute actual travel times immediately, as currently performed by the FMS. This information could also be used to calculate traffic density for the freeway, and/or for travel time reliability determination. This information, filtered as appropriate, could be broadcast to DMS, local media, phone applications, possibly aid in establishing a predictive model of traffic conditions, and could become a management tool for ADOT.

The private sector data is starting to show value in real-time applications on high demand facilities that have significant traffic volumes can produce reasonable representation of real-time conditions. MAG has determined that the private sector traffic speed data for the region is sufficiently accurate for travel demand model calibration purposes and is currently in the process to purchase archived data for 2010 from two vendors. Previous concerns about the accuracy of probe based data have gone away due to large sample sizes of probe vehicles available in most large metropolitan regions areas such as the MAG region.

Suggested Countermeasures:

C1 – Expand coverage of the FMS functions on the freeway system

C2 – Real-time speed monitoring on major arterials

C1 – Countermeasure Elements:

- Broadcasts more specific travel time information (i.e., specific segment) on DMS
- Display travel time information on a greater number of DMS
- Extend the time periods that travel time information is displayed on DMS
- Monitor travel time reliability to determine propensity for NRC events

C2 – Countermeasure Elements:

- Develop color coded arterial speed map to disseminate to AZ511 and private sector travel information application developers
- Use travel time data to develop a travel time prediction model based on historical trends by day and time coupled with trending at current time; ~~provide that predicted MOE (density) on DMS~~
- Monitor travel time reliability to determine propensity for NRC events

How these countermeasures reduce NRC:

C1 – This countermeasure expands the current FMS practice and disseminates precise real-time travel time information to freeway users during their journey allowing them to make educated decisions about their travel route in order to avoid NRC.

C2 – Enhancing collection of travel time and speed information on arterial roadways, especially those regularly utilized in conjunction to (or as an alternative to) the freeway system, will provide additional information for travelers to consider when determining their travel route, mode, or time.

Implementation Costs:

*C1 – Additional Staff Hours Needed to Determine Specific Travel Time, Post Travel Time Information, and Monitor DMS – currently identified as basic FMS functions*

| | |
|---|---|
| Responsible agency | ADOT |

*C2 – Collect real-time travel time and speed information on parallel arterials*

| | |
|---|---|
| Cost to instrument one arterial mile | $5,000 |
| Annual operating cost | $5,000 |
| Staff required – estimated FTEs | 0.25 |
| Responsible agency | Local agency |

**NRC Countermeasure Category No. 3: Improve Regional Integration**

Travelers in the MAG region use roadways of multiple jurisdictions for nearly every trip they make. Open communication and sharing of resources between jurisdictions can improve traffic management following a NRC event. In addition, there is a national cultural shift and setting of priorities due to mobility demand unable to be met by building new roads. Municipalities and government agencies in the MAG region could be more strategic in how existing resources are used and how they invest in future infrastructure to preserve existing roadway capacity through better operations. Arizona has been identified by FHWA as an Opportunity State to target efforts in advancing operations. There are several improvements recommended in the Arizona Operations Action Plan that relate to Non-Recurring Congestion. A few are highlighted below:

- Travel Time
- Develop Regional Performance Measures
- Develop policies to allow alternate route information

- Develop relationships/IGAs to allow joint operations
- Advance signal coordination between jurisdictions
- Shared utilization of cameras, signals, DMS, etc.
- Establish incident management coalition (already in effect)
- Improved communications during traffic incidents (subscribe to private sector data feed at TMC level)

It must be noted that there are no new or additional federal or state funds available for states identified as Opportunity States. Any planned improvements to regional integration would have to be carried out with existing resources.

Suggested countermeasures:
C1 – Share resources between municipalities and government agencies to facilitate traffic management
C2 – Encourage jurisdictions to input information into RADS

C1 – Countermeasure Elements:
- Share utilization of cameras, signals, and DMS between agencies
- Share Freeway Travel Times to post on Arterials
- Coordinate with already established Incident Management Coalition

C2 – Countermeasure Elements:
- Encourage jurisdictions to input workzone and incident information into RADS to facilitate regional information sharing

How these countermeasures reduce NRC:
C1 – This countermeasure would allow better management of diverting traffic in the vicinity of a NRC event.
C2 – This countermeasure would collect NRC event information such as incidents which would allow future analysis of NRC in the region as well as facilitate multi-jurisdictional preparation for road closures or reduced capacity due to workzones.

Implementation Costs:
*C1 – Time devoted to communication and information sharing*

| | |
|---|---|
| Cost of infrastructure and equipment | $0 |
| Annual Operating Cost | $0 |
| Staff required -- estimated FTEs | 0.5 ADOT, 0.25 per member agency |
| Responsible agency | ADOT, MAG Member Agencies |

*C2 – Training and time required to upload data*

| | |
|---|---|
| Cost of Training | $5,000 |
| Annual Operating Cost | $0 |
| Staff required -- estimated FTEs | 0.1 per member agency |
| Responsible agency | MAG Member Agencies |

**NRC Countermeasure Category No. 4: Implement Active Traffic Management**

"[Active Traffic Management] is the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases throughput and safety through the use of integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly and without the delay that occurs when operators must deploy operational strategies manually. This congestion management approach consists of a combination of operational strategies that, when implemented in concert, fully optimize the existing infrastructure and provide measurable benefits to the transportation network and the motoring public. These strategies include but are not limited to speed harmonization (variable speed limits), temporary shoulder use, junction control, and dynamic signing and rerouting. Managed lanes, as applied in the United States, are an obvious addition to this collection."

- FHWA's *Active Traffic Management: The Next Step in Congestion Management*

The key challenges for implementing Active Traffic Management are:

- Funds for the installation of sophisticated FMS infrastructure
- Better tools required for Active Traffic Management at the TOC
- Highly skilled technical staff for advanced traffic management

Of these, the staffing issue may be the biggest challenge due to inability to pay the requisite salaries for the required technical staff positions and inadequate position descriptions in the public sector. This issue, however, may be overcome by other models for delivery of such skilled services considered a valuable public service.

Regional funds have already been programmed in the MAG RTP for expanding the FMS infrastructure. Through careful planning, it may be possible to reprogram available FMS funds to both acquire any required tools for ATM and to incorporate ATM infrastructure within a revised FMS expansion plan.

Existing Facility Application Examples:

- Minneapolis-St. Paul, Minnesota

  Minnesota DOT, as part of their priced dynamic shoulder lane project, is now operating variable speed controls and queue warnings in a three-mile segment of I-35W as part of their Urban Partnership grant, and an extension of the system is planned. They are studying the implementation of a similar approach for portions of I-94 between Minneapolis and St. Paul. A 2010 study estimated benefit/cost ratios (for 2030 and including safety benefits) between 15:1 and 50:1 (see Tables 1 and 2 at http://www.metrocouncil.org/planning/transportation/MHSIS/AppEATMmodel.pdf).

- Seattle, Washington

  Washington State DOT constructed a variable speed limit/queue warning system on approximately eight miles of I-5 as it approaches Downtown Seattle in the northbound direction. The signs post variable speed limits that help warn drivers of backups ahead and smooth out traffic as it approaches a lane blocking incident. The overhead signs can also quickly close entire lanes and provide warning information to drivers before they reach slower traffic. This advance notification has initially shown to help reduce the number of congestion-related collisions, such as rear-end collisions. The I-5 ATM project is funded as part of WSDOT's Alaskan Way Viaduct and Seawall Replacement Project at $23.8M. WSDOT is also proceeding with the design and

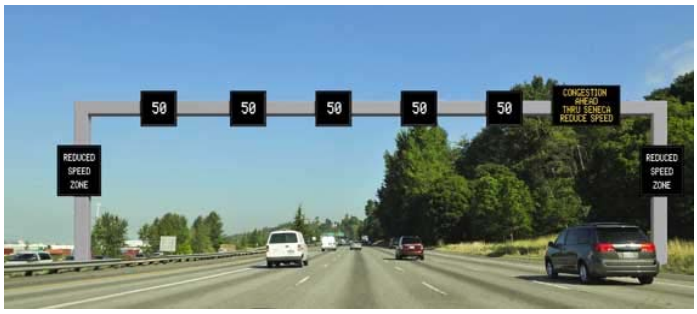
construction of a similar system on I-90 and SR 520 across Lake Washington as part of their Urban Partnership grant from USDOT.

Suggested Countermeasure:
C1 – Implement active traffic management on freeway corridors prone to NRC (e.g., approaches to I-10 Deck Park Tunnel)

C1 – Countermeasure Elements:

- Dynamic Ramp Metering (in progress by ADOT)
- Dynamic Lane Merge
- Peak Hour Shoulder Running
- Variable Speed Limits
- ¼ to ½ mile gantry structures
- Monitoring of freeway performance and Travel Time Reliability in corridors

How this countermeasure reduces NRC:
C1 – This countermeasure would actively manage traffic around blocked lanes from incidents, harmonize speed to reduce secondary incidents, and meter traffic entering the freeway based on congestion levels.




Implementation Costs:

*C1 – Installation of infrastructure, equipment, and hiring of technical staff.*
Cost of infrastructure and equipment varies:

- Data loops/stations: $25,000
- TMC Software for various traffic controls: $2.25M (e.g., speed harmonization = $1.5M)
- Gantry with foundation: $225,000
- Variable Speed Limit sign (shoulder): $15,000

Annual Operating Cost varies:

- $500 per structure (Gantry use example)
- $5,000 per DMS
- $1,000 per data station
- $3,000 per instance of VSL Sign
- Up to $40,000 per mile for fully instrumented section

| | |
|---|---|
| Staff required -- estimated FTEs | 2 to 4 |
| Responsible agency | ADOT |

**NRC Countermeasure Category No. 4: Improved Freeway Incident Response**

Quick response and clearance reduce the amount of traffic exposed to non-recurring events and congestion. Although the MAG Region is already proactive in identifying and responding to incidents via the FMS and operators at the Traffic Operations Center, ALERT Team and the Freeway Service Patrol, additional measures could be considered to enhance response times and effectiveness.

Suggested countermeasures:

C1 – Increase the number of Freeway Service Patrol vehicles available to respond to disabled vehicles and incidents.

C2 – Reduce the time incidents affect traffic; thereby, reducing NRC.

Other suggested initiatives/projects:

- Expand coverage to include frontage roads and ramp/arterial intersections

C1 – Countermeasure Elements:

- Enhance DPS's Safe Commute program to provide more officers/vehicles, or extend hours of operation, or expand the freeway coverage.

C2 – Countermeasure Elements:

- "SafeClear" Program (see inset below)

**Houston SafeClear Program**

In January 2005, the City of Houston began its SafeClear traffic incident management program. The program's primary objective is to improve public safety, i.e. a reduction of accidents, injuries and deaths on Houston freeways. A 2007 study comparing two years before/after data concluded that the program was successful by having the desired effect of reducing collisions, congestion, and crash clearance times. With the program in place there were 1300 fewer freeway crashes per year which translated into $35 million in savings per year. The program essentially divides Houston's freeways into segments with assigned private tow operators responsible for their own segments. By doing this it addresses problems associated with the 'free-for-all' that occurs as tow operators race towards disabled vehicles, thus minimizing response times and collisions (primary and secondary).

Houston's SafeClear program was modeled after a similar program in New York City. In the months leading up to formal action by the City Council creating the program, anecdotal information was collected such as Houston freeway incidents as reported by TranStar, incident management results of preventing accidents prepared by the Texas Transportation Institute at Texas A & M University. As part of a nationwide training effort, the American Traffic Safety Association reported that "Thirty percent of highway crashes are secondary crashes…and 18% of all highway deaths occur in those crashes".

Clearly, a secondary benefit of the program is improved travel times. When accidents are reduced, travel times improve. Disabled vehicles create both physical hazards and visual distractions, increasing the risks of collisions and increasing travel times.

As a result of concerns related to "ability to pay and owners' choice", City Council approved amendments to the freeway tow operator contracts in early 2005 to provide a free tow ($50 paid by the City) to a safe location no more than one mile from a freeway exit. There is no 'cash' incentive to clear a crash quicker; however, there is a performance requirement for tow operators to respond to calls within six minutes.

How these countermeasures reduce NRC:
C1 – This countermeasure reduces the overall time disabled vehicles or incident vehicles block travel lanes which can relieve the buildup of NRC.
C2 – This countermeasure reduces the overall time an incident remains on the freeway which can alleviate NRC quicker and prevent secondary incidents.

Implementation Costs:
*C1/C2 – Additional service patrol vehicles and operating personnel*

| | |
|---|---|
| Cost of equipment | $150,000 for 3 more service patrol vehicles |
| Annual Operating Cost | $75,000 |
| Staff required -- estimated FTEs | 3 |
| Responsible agency | ADOT and DPS |

**NRC Countermeasure Category No. 5: Dynamic Lane Control**

Dynamic lane control/merge improves traffic flow in advance of, and at, lane closures. ITS technology can be used to monitor traffic flow and, as queuing increases at approaches to lane closures, regulates the merge, requiring either early merge or late merge depending on traffic conditions. This countermeasure could be applied in conjunction with an Active Traffic Management strategy or applied as needed for long-term construction projects (or known lane-drop locations).

Source: Michigan State University

Suggested countermeasures:
C1 – Monitor traffic flow for individual lanes and provide signs to drivers regulating lane merge in advance of, and at, lane closures

Other suggested initiatives/projects:
- Apply dynamic lane control in conjunction with an active traffic management strategy

C1 – Countermeasure Elements:
- Install sensors to monitor traffic flow
- In work zones, connect or equip portable DMS with traffic condition sensors
- Install infrastructure and signing to guide drivers at merge

How this countermeasure reduces NRC:
C1 – This countermeasure would facilitate real time data collection in each lane which would be used to provide information to drivers to regulate lane merge. This would result in better/smoother control of traffic during a NRC event or as a means to mitigate a possible secondary event (e.g., crash).

Implementation Costs:
*C1 – Additional sensors, infrastructure, and signing*

| | |
|---|---|
| Cost of infrastructure and equipment | up to $1,000/day per direction (leased for construction) |
| Staff required – estimated FTEs | none (contractor) |
| Responsible agency | ADOT |

## Arterial NRC Countermeasures

The following subset of Arterial NRC Countermeasures were presented in Tech Memo #4 (in order of generally increasing estimated implementation costs/complexity) for further consideration, and may become the impetus for this study's pilot project framework development:

- Real-time traffic monitoring and control
- Improved travel information dissemination
- Use of portable DMS to disseminate immediate information concerning NRC event; and
- Adaptive signal timing to adjust traffic control to NRC events

The countermeasures/concepts shown above were discussed further to spur the following modified (or different) NRC countermeasure ideas that are specific to the MAG Region.

### NRC Countermeasure Category No. 6: Real-time Traffic Information

Real-time point-to-point travel time information would be very valuable to agency staff in actively managing traffic from the TMC. This information plus other timely traffic advisories to travelers on major arterials would help minimize NRC by redistributing traffic along less congested paths. Obtaining real-time travel times on the arterial road network in the MAG region would require extensive instrumentation for this data collection effort. An option for public agencies is to instrument selected corridors with data gathering devices such as the Anonymous Wireless Address Matching (AWAM) device. Another option would be to purchase real-time traffic speed information that is already being gathered and synthesized by a number of private sector traffic information providers. A number of national studies have verified the accuracy and reliability of the data provided by these data vendors such as INRIX, NAVTEQ and TrafficCast. The real-time point-to-point travel time estimates generated could be displayed on arterial DMS, provided to local media, broadcast via PDA website. This information could also be used to develop models and decision support systems to aid in Active Traffic Management.

Existing Facility Application Examples:

- Houston's *TranStar*
  Performed a pilot deployment of AWAM on arterial streets on the west side of the City
- Minneapolis/University of Minnesota
  Modified data feedback from signal sensors

Suggested countermeasures:

C1 – Expand coverage and distribution of real time speed and travel time data collection on arterials

C1 – Countermeasure Elements

- Instrument corridors with AWAM or purchase real-time traffic speed information from private sector
- Display travel time information on DMS
- Distribute gathered data to AZ511 or other agency websites for public access

How this countermeasure reduces NRC:

C1 – This countermeasure disseminates real-time travel time information to arterial users during their journey allowing them to make educated decisions on their travel route in order to avoid NRC.

Implementation Costs:

*C1 – Collect real-time travel time and speed information on arterials and disseminate information*

| | |
|---|---|
| Cost of equipment | $150,000 (25 AWAM devices @ 2 mile spacing in grid = 64 square miles) |
| Annual Operating Cost | $63,000 ($210 per month per device) |
| Staff required -- estimated FTEs | 0.25 per agency involved |
| Responsible agency | Local Agencies |

**NRC Countermeasure Category No. 7: Adaptive Traffic Signal Control**

Adaptive traffic signal control (ATSC) systems can quickly adapt the current timing plan to accommodate the diverted traffic from the nonrecurring event. Also, incidents occurring at a system intersection could be better accommodated by the ATSC as it senses the reduced demand or even the concentrated use of an approach/lane. There are a number of different types of ATSC systems, but the basic premise is that existing signal control can be made more efficient through the use of additional sensor data, the interpretation of it (by the ATSC), and the real-time modification of the basic signal control parameters (cycle lengths, offsets, phase splits, phase sequencing). Although this countermeasure is not new, its more extensive use and capabilities are on the rise. For example, ATSC could help at signalized interchanges and along signalized arterial corridors when there is a surge in demand due to a freeway incident and travelers divert to parallel arterial routes.

Suggested Countermeasure:

C1 – Implement ATSC on arterials (e.g., Bell Road corridor, Glendale sports arena area, Rural Road/ASU, extend Mesa project)

C1 – Countermeasure Elements:

- Install adequate detection required for ATSC system selected and integrate the ATSC system
- Obtain data from ATSC system, AWAM devices, or purchase private sector data to monitor travel time as a measure of effectiveness

How this countermeasure reduces NRC:

C1 – ATSC system signals would modify the basic signal control parameters in real time in response to NRC events to reduce and prevent congestion.

Implementation Costs:

*C1 – ATSC system and additional detection required*

| | |
|---|---|
| Cost of infrastructure and equipment | $800,000 ($40,000 per intersection – assume test of 20 intersections) |
| Annual Operating Cost | $100,000 ($5,000 per intersection) |
| Staff required -- estimated FTEs | none – assumed advantage is that staff monitoring and timing costs are reduced |
| Responsible agency | Local agencies |

**NRC Countermeasure Category No. 8: Improved Incident Response**

Pinpointed and quicker response to incidents on arterial roadways could be realized by integrating real-time data/information feeds and additional vehicles at strategic stationing. Public agencies are increasingly exploring the use of private sector traffic data for various types of applications. The private sector data has shown useful for planning and historical applications, but may be lacking at this time with respect to the arterial roadway network. As an alternative, AWAM devices could be deployed to establish a grid for monitoring real-time traffic conditions during the peak demand periods (when NRC would have the most impact). Expanded coverage area would necessitate additional response vehicles/staffing. This countermeasure assumes that the institutional issues related to staff from one local agency addressing traffic incident management needs in another jurisdiction, can be resolved.

Existing Facility Application Examples:

- Maricopa County REACT Program

Suggested countermeasure:

C1 – Enhance area of incident response on arterials. Establish a test section 8 miles by 8 miles (64 square miles) in contiguous jurisdictions. If private sector data are unavailable, assume 2-mile spacing of AWAM devices to provide coverage. Assume one staffed truck per 16 square-mile area (an area 4 miles on a side) results in 4 staffed trucks strategically placed.

C1 – Countermeasure Elements:

- Monitor test area to detect major incidents by acquiring private real-time data or rely on AWAM coverage
- Monitor traffic conditions on potential alternative routes
- Strategically place staffed trucks for dispatch to assess/restore traffic conditions

How this countermeasure reduces NRC:

- Quick incident response time and clearing vehicles and debris from travel lanes will reduce and prevent congestion.
- Monitoring potential alternative routes will allow traffic to be directed away from an NRC event that cannot be cleared quickly.

Implementation Costs:

*C1 – Additional service/response vehicles and associated personnel plus real-time monitoring capabilities*

| | |
|---|---|
| Cost of infrastructure and equipment | $200,000 for three new vehicles + $100,000 to $200,000 for private sector data or AWAM coverage |
| Annual Operating Cost | $100,000 to $125,000 (does not include staff cost) |
| Staff Required -- estimated FTEs | 6 to 8 (some current resource re-assignment considered) |
| Responsible agency | Local agencies |