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16. Abstract

Much has been documented regarding traffic incident management for general purpose lanes on controlled-access highways. Incident management for general purpose lanes and that for managed lanes share many of the same goals; consequently, many of the techniques, policies, and procedures are the same for facilities of both categories. In addition to these elements, the unique features of various types of managed lanes introduce additional aspects to incident management. This report describes findings regarding incident management on managed lane facilities, based on input from a survey of managed lane operators and incident management program participants from across the nation.

Recommendations include 1) a heightened emphasis on multi-agency cooperation, especially where traffic diversion between managed lanes and general purpose lanes involves incident response teams with different agency participation, 2) adding significance to notifying the public of the end of the incident, 3) consideration for pre-positioning response vehicles on revenue-generating managed lanes, 4) multiple aspects related to response vehicle access routes, and 5) diversion plans for moving traffic between managed lanes and general purpose lanes.

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INCIDENT MANAGEMENT FOR MANAGED LANES

by

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DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation and it is not intended for construction, bidding, or permit purposes. The researcher in charge of this task of the project was Andrew J. Ballard, Texas P.E. #59027. The engineers in charge of the overall research project were Beverly Kuhn, Texas P.E. #80308 and Ginger Daniels Goodin, Texas P.E. #64560.

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CHAPTER 1. INTRODUCTION

Much has been documented regarding traffic incident management for general purpose lanes on controlled-access highways. Incident management for general purpose lanes and for managed lanes share many of the same goals; consequently, many of the techniques, policies, and procedures are the same for facilities of both categories.

In the context of this research, "managed lanes" can include any type of lane that maintains free-flow travel speeds on designated lanes or facilities by providing managed access to participating groups of vehicles. Examples could include any or various combinations of the following:

- express lanes — freeway lanes which have large spacings between access points;
- HOV lanes — high-occupancy vehicle lanes which allow only vehicles carrying a minimum specified number of occupants;
- HOT lanes — high-occupancy toll lanes which allow HOVs and vehicles for which tolls are paid;
- truck lanes — lanes which are dedicated for use by trucks only;
- truck restricted lanes — lanes in which truck use is restricted in one or more ways; and
- bus lanes — lanes which are dedicated for use by buses only;

Among the various principles for incident management for general purpose facilities, perhaps the most important is the development, and maintenance, of relationships between key individuals from each of the involved agencies. While it may not be uncommon for the heads of agencies (e.g., local and state law enforcement, local and state transportation departments, transit agency, etc.) to meet periodically during the normal course of events, this type of interaction cannot take the place of familiarity and healthy working relationships among operations staff members from these and other critical agencies.

In addition to working relationships, another characteristic of successful incident management programs is the use of various types of agreements, including mutual-aid agreements, hold-harmless agreements, wreckage clearance policies, etc.

These and various other elements of incident management programs are common to successfully minimizing non-recurring congestion due to freeway incidents in general purpose lanes. These elements are also common to incident management programs for managed lane facilities.

In addition to these incident management elements, the unique features of various types of managed lanes introduce additional aspects to incident management.

This report describes findings regarding incident management on facilities with managed lanes. The report has been prepared under one task of the multi-task TxDOT research effort 0-4160, "Operating Freeways with Managed Lanes." In this context, the term "managed lanes" encompasses a variety of facility types, including high-occupancy vehicle (HOV) lanes, high-occupancy toll (HOT) lanes, single-occupancy vehicle (SOV) express lanes, special use lanes, and truck lanes. The premise of the managed lanes concept is to increase freeway efficiency and

provide free-flow operations for certain freeway users by packaging various operational and design strategies, including time-based eligibility, vehicle type eligibility, pricing, and physical access control.

This review of incident management in managed lane facilities addresses the following questions:

- How is incident management different on facilities with and without managed lanes?
- How are managed lanes used to accommodate diverted traffic during incidents in general purpose lanes?
- What policies do incident response teams have regarding the use of managed lanes as expedient access to incident scenes?
- Who should develop managed lane diversion plans?
- What lessons can we learn from the national project experience that will assist TxDOT operating its managed lanes during incidents?

CHAPTER 2. LITERATURE REVIEW

The Federal Highway Administration's (FHWA) *Traffic Incident Management Handbook* (*1*) addresses the wide range of issues involved in incident management, including the steps of incident detection, verification, motorist communication, response, site management, traffic management, and clearance. In addition, the handbook identifies the steps in developing an incident management program, the characteristics of a successful program and the benefits that accrue to the public. While the handbook thoroughly addresses incident management for general applications, it does not address the special incident management elements associated with managed lane facilities.

A review of HOV lane and HOT lane facilities is included in a study for the Minnesota Department of Transportation (*2*). The study indicates that different managed lane operators throughout the nation have incident management plans that allow for the diversion of general purpose traffic into the managed lanes in response to an incident in the general purpose lanes. However, there is variation in the incident duration that should serve as the trigger for the diversion plan. Virginia legislators had recommended a five-minute trigger for allowing diversion into the HOV lanes in Hampton Roads, Virginia; however, after the FHWA rejected the recommendation, Virginia later settled on a 10-minute trigger. The recommendation is that the incident duration trigger be established on a case-by-case basis.

California Department of Transportation's (Caltrans) *High-Occupancy Vehicle Guidelines for Planning, Design and Operations* (*3*) acknowledges that when a managed lane is not barrier-separated from the general purpose lanes and an incident occurs in the managed lane, traffic frequently merges into the general purpose lanes. In this situation, Caltrans recommends against designating one of the general purpose lanes as a temporary HOV lane. When the incident is in the general purpose lanes, Caltrans and the California Highway Patrol (CHP) jointly determine if the general purpose traffic is allowed to divert into the HOV lanes.

On HOV lanes that are barrier-separated from the general purpose lanes, Caltrans recommends diverting managed lane traffic into the general purpose lanes when the incident blocks the managed lane. A major incident that blocks multiple general purpose lanes may shift general purpose traffic into the managed lane. Caltrans recommends caution in diverting traffic in this situation, especially if the HOV lane is reversible.

Washington State Department of Transportation (WSDOT) (*4*) reports in its review of HOV lane operating policies that the Virginia Department of Transportation estimated an average time saving of approximately four minutes per vehicle resulting from its policy of diverting general purpose traffic into the HOV lane during incidents in the general purpose lanes.

WSDOT also noted that most of the managed lane facilities where diversion policies are in place "are barrier separated or reversible, in some cases both."

Hoppers (*5*) reports on incident-induced diversion policies from six different regions of the nation and offers guidelines on the development of a diversion plan. The guidelines recognize

the importance of multi-agency cooperation, coordination with the media, public acceptance of a diversion plan, and its impact on managed lane motorists.

Incident diversion is thoroughly addressed in National Cooperative Highway Research Program (NCHRP) Synthesis 279*, Roadway Incident Diversion Practices* (*6*). It presents the processes, hindrances, and technological tools that are associated with diversion plans. However, the context of the report is not specifically for facilities with managed lanes. The report does acknowledge that agencies with toll lanes and/or HOV lanes do lift user eligibility criteria when deploying the incident management program's diversion plan.

The FHWA's *A Guide for HOT Lane Development* (*7*) specifies two major reasons why incident management is critical for HOT lanes:

1. because motorists pay a fee to use this type of managed lane, it is critical that incidents be cleared as soon as possible so that the duration of the incident is minimized and the fee-paying motorists/customers can more quickly return to receiving value for which they paid; and

2. since HOT lanes are typically barrier-separated, an incident can often completely block traffic, thereby creating heightened anxieties among motorists who have come to a standstill.

For these reasons, the Guide strongly recommends that HOT lanes be equipped with incident detection and surveillance equipment and that the facility be monitored at all times. Additionally, its recommendation explicitly calls for this equipment to be monitored by "observant staff."

Other recommendations include appropriate training for all staff involved in HOT lane incident response, including drills and training exercises. In addition, the Guide reports that "tow trucks and other rescue vehicles are typically brought in from the opposite direction of traffic if the lanes are completely blocked."

The Guide also adds recommendations for incident management in the HOT lane when there is construction at or near the incident scene:

- implement 24-hour service patrols in the construction zone;

- create temporary collision investigation/enforcement sites within the construction zone;

- establish the construction zone as an immediate tow area;

- develop agreements with construction companies to use their heavy equipment to assist in clearance of debris from truck accidents;

- identify landing locations for medical response helicopters near the construction zone;

- offer presentations to key stakeholders such as the trucking industry, major employers, and automobile clubs before construction starts; and

- install surveillance throughout the construction area to detect an incident and monitor traffic flows.

The San Diego Association of Governments (SANDAG) (*8*) reports, in its traffic operations plan for the Interstate 15 Managed Lanes Value Pricing Project, that the traffic detection, surveillance and communications components that were originally intended for traffic management and toll collection can be integrated into the facility's incident management system. For example, the dynamic message signs (DMS) that were intended for communications regarding electronic tolls can also display incident related messages to motorists. The SANDAG report also notes that the DMSs can be used in communicating messages regarding diversion of traffic between the HOT lanes and the general purpose lanes.

Benefits of incident management-related design elements in the SANDAG report are as follows:

- Numerous ingress/egress points throughout the roadway will facilitate the diversion of traffic between the managed lanes and the general purpose lanes.

- These access points will also enhance incident response vehicles' ability to quickly arrive and depart from an incident scene.

- The number of DMSs required for tolling would be increased to meet the needs of both the tolling and incident management goals.

- The closed-circuit television (CCTV) cameras that are required for electronic tolling purposes are also useful for incident detection and verification.

Challenges of the incident management program for Interstate 15 in San Diego include the following:

- Where the HOT or toll lane is a single-lane configuration, an incident could completely block the lane and the shoulders thereby creating a standstill in the managed lane. A blockage of this type may require pre-positioned service support vehicles to expedite the management of the incident and the clearance of the blockage.

- To facilitate mobility during an incident in a barrier-separated managed lane, additional width for shoulders is desirable; however, available right-of-way and cost can limit shoulder width.

CHAPTER 3. RESEARCH APPROACH

To identify incident management features that are particularly applicable to managed lane facilities, a technical advisory committee was formed. This group provided guidance in the development of an incident management survey that was distributed to an on-line national audience. The link to the survey was distributed to approximately 5100 subscribers of the *Transportation Communications Newsletter* and Texas Transportation Institute's on-line *Managed Lanes Newsletter*. In addition, the survey was also distributed to approximately 300 persons throughout the nation who are experienced with freeway incident management. Many of these individuals serve on incident management committees and task forces in numerous locales and with multiple professional associations. This group includes representatives from state and local departments of transportation, state and local law enforcement, fire and emergency medical services departments, transit agencies, towing firms, and other entities involved in incident management.

The survey was structured such that the respondent could provide input for each type of managed lane, including express lanes, high-occupancy vehicle lanes, toll lanes, high-occupancy toll lanes, truck lanes, truck-restricted lanes, transit lanes, and other. The survey included the following sections:

I. General Information on Managed Lanes Facilities
II. Incident Management for Managed Lanes
III. Emergency Vehicle Use of Managed Lanes for Incidents in General Purpose Lanes
IV. General Purpose Incident Diversion into Managed Lanes
V. Questions for Agencies without Plans for Diverting General Purpose (GP) Traffic into Managed Lanes during GP Incidents
VI. Final Comments

Based on an individual's response to specific questions, the survey deliberately skipped selected survey sections and took the respondent to the next applicable section, e.g., Sections IV and V were mutually exclusive such that no respondent was posed questions from both of these sections.

The receipt of the survey results was followed by some limited telephone interviews from selected incident response team members for clarification of their responses to survey questions which required narratives.

From these findings, various recommendations were developed and are described in a subsequent section of this report.

CHAPTER 4. SURVEY FINDINGS

From the General Information Section of the survey, the 82 survey respondents provided information for multiple types of managed lane facilities, as listed in Table 1.

Table 1. Managed Lane Types.

Managed Lane Facility Type	Quantity Represented in Survey
HOV Lanes	58
Express Lanes	28
Truck-restricted Lanes	23
Toll Lanes	21
HOT Lanes	18
Truck Lanes	14
Transit Lanes	12
Other Lanes	9

To gain an understanding of the types of interaction that are possible between the managed lanes and any adjacent general purpose lanes, it was necessary to identify the types of barriers, or lack thereof, between these lanes. For each type of managed lane, most respondents provided no response to the question of how the general purpose lanes are kept separate from the managed lanes. For those individuals that did respond, a physical barrier, e.g., a concrete traffic barrier, was more common than all the other choices combined, as summarized in Table 2.

Table 2. Methods of Separating Managed Lane from General Purpose Lanes.

Managed Lane Type	Barrier	Lane Markings	Lane Markings/ Posts	Buffer	Other
HOV Lanes	11	14	2	2	3
Express Lanes	13	0	2	0	0
Toll Lanes	10	0	0	0	0
HOT Lanes	13	0	0	0	0
Truck Lanes	4	2	0	0	1
Truck-restricted Lanes	3	4	0	0	4
Transit Lanes	1	2	2	0	0

Twenty-seven managed lane facilities were represented in responses to the question regarding the time of day when the incident management program was applicable. A majority, 21 (78 percent), reported that their incident management program is operational 24 hours per day, seven days per week. The remaining six managed lane facilities operate their incident management program during the peak hours or during the extended workday (e.g., Monday through Friday, 6 a.m. through 11 p.m.).

CCTV cameras are the most common tool used for detecting incidents in managed lanes. Of the 20 facilities represented where cameras are used in incident management, 15 use them in active monitoring of the facility for incidents and only three use them only for verification of the existence of incidents.

This and other incident detection technologies are used to differing degrees by various managed lane facilities as indicated in Table 3.

Table 3. Managed Lane Facilities Using Incident Detection Technologies.

Detection Technology	Quantity
CCTV	20
Courtesy Patrol	20
Mobile Call-in Number	14
Automated Vehicle Identification	6
Inductive Loops	5
Commercial Traffic Information Service	5
Aerial Surveillance	1

During an incident, congestion adversely affects the mobility of incident response teams as well as the motoring public. Where there are shoulders, response teams can more readily bypass congestion to access the scene. Where the incident scene is on one side of a barrier, it may be more expedient for response vehicles to access the scene from the lanes on the other side of the barrier, where the traffic may be moving more rapidly. Where an incident completely blocks a managed lane that is separated from general purpose lanes by a physical barrier, there may be a possibility for incident response team members to access the scene by traveling in a contraflow direction within the barrier-separated managed lane.

In light of these possibilities, the survey included questions regarding agency policies on access paths for incident response teams. Selected agencies indicated the number of facilities that have policies regarding response vehicle access routes to incident scenes where the incident is in the managed lanes (Table 4) or in the general purpose lanes (Table 5). For most incident management programs for managed lanes, there is no policy regarding the route taken to access an incident. Of those agencies that do have a policy regarding access to an incident in the managed lanes, there are three HOV facilities where the managed lanes are designated as the primary path to the incident scene.

Table 4. Number of Facilities with Policy on Accessing Incident in Managed Lanes.

Managed Lane Type	Use General Purpose Lanes to Access Site		Use Managed Lanes to Access Site		No Policy
	Only	Primary	Only	Primary	
HOV Lanes	1	0	0	3	6
Express Lanes	0	0	0	1	5
Toll Lanes	0	0	1	1	0
HOT Lanes	2	0	0	1	0
Truck Lanes	0	0	0	0	2
Truck-restricted Lanes	0	0	0	0	1
Transit Lanes	0	0	0	0	1

Table 5. Number of Facilities with Policy on Accessing Incident in General Purpose Lanes.

Managed Lane Type	Use General Purpose Lanes to Access Site		Use Managed Lanes to Access Site		No Policy
	Only	Primary	Only	Primary	
HOV Lanes	2	2	0	0	11
Express Lanes	0	1	0	0	8
Toll Lanes	0	1	0	1	3
HOT Lanes	2	0	0	1	0
Truck Lanes	0	0	0	0	4
Truck-restricted Lanes	1	0	0	0	4
Transit Lanes	0	0	0	0	2

When there is an incident in the managed lane, it can become necessary to divert traffic to the general purpose lanes. For managed lane facilities that are barrier-separated and when the incident creates a complete blockage of flow within the managed lane, traffic comes to a standstill. When traffic needs to divert, communicating with motorists is critical. This communication must extend to motorists in the managed lane upstream of the incident and to motorists in the general purpose lanes upstream of managed lane entrances. In addition, motorists who are not yet on the road but are planning imminent trips in this corridor need this information so they can account for the incident in their trip planning. Of the 23 managed lane facilities represented in responses to the question regarding communications, most facilities use most of the tools identified in Table 6.

Table 6. Communications Tools Used in Diverting Managed Lane Traffic into General Purpose Lanes.

Communication Tool	Quantity
Fixed Dynamic Message Signs	22
Media Traffic Reports	21
On-Scene Police	20
Radio	19
Website	18
Portable Dynamic Message Signs	15

DIVERSION BETWEEN GENERAL PURPOSE LANES AND MANAGED LANES

When an incident in the general purpose lanes produces significant congestion, or is anticipated to do so, a potential capacity enhancement tool is the temporary use of the managed lane for general purpose traffic that is not otherwise using the managed lanes. Of the 13 managed lanes represented among the respondents to the questions in the survey regarding diversion, Table 7 summarizes the findings. Incident response teams for most (eight) of the 13 managed lane facilities reported that their diversion plan had been reviewed after its initial implementation. Few of these diversion plans incorporate interagency agreements, yet the diversion plans for 11 of the 13 managed lane facilities are satisfactory to their operating agencies.

Respondents representing nine of these 11 managed lane facilities indicated that they discontinue the diversion of general purpose traffic into the managed lanes when the incident is cleared and/or the queue from the incident dissipates. Only two (one HOV and one HOT lane facility) replied that they will also discontinue the diversion when operations in the managed lanes deteriorate.

Table 7. Diversion Plan Summary.

Managed Lane Type	Managed Lane Facilities Reporting Use of Diversion Plans	Managed Lane Facilities Reviewing Diversion Plans after Implementation	Managed Lane Facilities with Interagency Agreements on Diversion Plans	Agencies Satisfied with Diversion Plan
HOV Lanes	5	4	1	5
Express Lanes	4	2	0	3
Toll Lanes	1	1	1	0
HOT Lanes	3	1	2	3

Thirteen managed lane facilities developed their diversion plans by varying degrees of involvement from incident response team agencies. As shown in Table 8, most diversion plans were developed with the involvement of the state department of transportation and the state police. Less than half of the 13 facilities' diversion plans were developed with the input of the hazardous materials team, emergency medical services agency, local government traffic engineers, or towing firms.

Table 8. Agencies Involved in Diversion Plan Development.

Agency Type	Involved in Diversion Plan Development
State Dept. of Transportation	11
State Law Enforcement	11
Transit Authority	9
Incident Response Team	8
Fire Department	8
HazMat Team	6
Freeway Service Patrols	6
Emergency Medical Services	5
City Traffic Engineering	5
Towing Companies	4

When a managed lane operating agency determines, on the basis of an incident, that some general purpose traffic should be allowed to use the managed lanes, this conclusion introduces an issue of criteria. If the managed lanes operate with specific user eligibility criteria, then the decision to divert general purpose traffic into the managed lanes may mean relaxing or modifying those criteria. Survey respondents, representing 11 managed lane facilities, reported implementing some or all of the changes to eligibility criteria that are found in Table 9.

Table 9. Eligibility Changes in Diversion Plan.

Managed Lane Type	Managed Lane Facilities Responding	Toll Requirement Eliminated	Vehicle Occupancy Requirement Eliminated	Vehicle Type Requirement Eliminated
HOV Lanes	5	1	3	2
Express Lanes	2	0	1	0
Toll Lanes	1	1	0	0
HOT Lanes	3	3	3	2

The very nature of a diversion plan mixes motorists that are normally not eligible for the use of managed lanes with those motorists who are. It is important to ensure that the diversion plan is not implemented so readily that a very minor incident in the general purpose lanes triggers the diversion. To do otherwise can undermine the credibility of the managed lane operating agency in the view of the motoring public. To assess the hesitation or eagerness to deploy its diversion of general purpose traffic into the managed lanes, a survey question inquired as to the minimum expected duration of an incident before the diversion plan would be implemented. Table 10 reflects the findings.

Table 10. Minimum Expected Incident Duration prior to Deploying Diversion Plan.

Managed Lane Type	Managed Lane Facilities Responding	10 minutes	15 minutes	30 minutes	55 minutes
HOV Lanes	4	1	1	1	1
Express Lanes	1	0	1	0	0
Toll Lanes	1	1	0	0	0
HOT Lanes	3	0	0	2	1

Another measure that relates the magnitude of the incident to the decision to deploy a diversion plan is in the number of blocked lanes. Although few survey recipients responded, they were asked to identify the number of lanes that must be blocked in order to trigger the diversion plan. As indicated in Table 11, six respondents said there is no minimum number of lanes that must be blocked to initiate the diversion plan. Among those individuals that did indicate a minimum number of blocked lanes, the most common response was "2 of 3 lanes" must be blocked. One respondent said the diversion plan is used when both of two lanes are blocked.

Table 11. Number of Blocked Lanes Required to Deploy Diversion Plan.

Quantity of Respondents	No. of Blocked Lanes		No. of Total Lanes
6	0	of	0
2	1	of	2
1	2	of	2
1	1	of	3
3	2	of	3

Survey recipients were asked about the use of managed lanes to provide unimpeded access for emergency responders and other incident management personnel in the event of a homeland security emergency, natural disaster, or other major emergency. Approximately three-fourths of

the responses were negative, as shown in Table 12. Some agencies reported current use of managed lanes for emergency services during natural disasters, e.g., hurricane evacuation plans. Others indicated that there would be significant difficulty in rapidly and dynamically implementing the concept in an emergency.

Table 12. Use of Managed Lanes during Homeland Security and Natural Disaster Emergencies.

	Yes	No	Maybe
Currently have plans to use managed lanes for unimpeded access for emergency services?	9	28	-
Should managed lanes be considered for such purposes?	4	30	3

CHAPTER 5. RECOMMENDATIONS

In addition to the survey questions and answers reflected in the previous section, several respondents shared additional comments. As a result, several survey recipients were contacted for follow-up telephone interviews. The survey responses and subsequent interviews result in several recommendations.

MULTI-AGENCY COOPERATION

As indicated in a previous section of this report, good incident management practices for non-managed lane facilities include cooperation among the various agencies involved in all aspects of incident management. Among these participants are state departments of transportation, state and/or local law enforcement departments, local transportation departments, transit authority, fire departments, emergency medical services departments, medical examiner's office, towing contractors, etc. Incident management, as applied to managed lanes, requires as much or more cooperation as that for non-managed lane facilities.

Where the make-up of the incident response team for the managed lanes is different from that of the nearby general purpose lanes, the potential for poor incident management is heightened. As an example, where an incident on, or immediately upstream of, the ramp to the managed lanes is within the purview of an incident response team that does not have jurisdiction over the managed lanes themselves, the operational efficiency of the managed lanes can suffer, yet the incident response team that is handling the incident may have no accountability to the agency operating the managed lanes. This scenario has financial implications for managed lanes where revenues are generated, e.g., HOT and toll lanes.

Conversely, where an incident in the managed lanes impedes access to the general purpose lanes or frontage road, and the incident response teams differ for the two types of lanes, there is potential for the operations of the general purpose lanes to suffer by the actions of a team that has no accountability for traffic operations in those lanes.

Where one law enforcement agency has responsibility for traffic laws and incident management, yet another law enforcement agency has responsibility for managed lane eligibility violations, there is potential for inefficiency and poor incident management when an incident occurs in the presence of the wrong law enforcement staff.

Ideally, the incident response team roles (e.g., police, fire, emergency medical services, traffic operations, etc.) for the managed lanes team are filled by the same agencies as those for the general purpose lanes; although because different agencies can have different goals, this is not always the case. In these circumstances, the negative potentials within these scenarios can be mitigated through multi-agency cooperation that includes mutual aid agreements, hold-harmless agreements, quick clearance policies, abandoned vehicle policies, post-incident briefings, shared information, etc.

PUBLIC NOTIFICATION OF AN INCIDENT

Various traffic incident management programs use differing arrays of technologies to notify motorists of an incident. To communicate with motorists who are moments away from the incident, these technologies include fixed and portable dynamic message signing at upstream location(s) and on-site incident response personnel. In addition to these motorists, it is important to notify others who may be miles away, and perhaps not yet in a vehicle, of the presence of the incident so that they can plan alternate routes or even alternate departure times. For these motorists, additional notification technologies include AM/FM radio and television traffic reports as well as website reports.

Sometimes public notification of the clearance of the incident does not happen as rapidly as the notification of the onset of the incident. This delay or omission is likely due to a presumption that the clearance notification is less critical. However, the likelihood that a motorist will choose to use the managed lanes can be significantly reduced as the website and media report that the managed lanes are congested due to an incident in those lanes. Continued reporting of this message *after* the incident has been cleared reduces the usage of the managed lanes. In cases where the managed lanes are toll or HOT lanes, the erroneous continuation of an incident report, after it has cleared, can unnecessarily create adverse impacts on revenues. This result is in addition to the congestion implications of managed lane-eligible motorists electing to forego the managed lane option and choosing to join the congested general purpose lanes.

Therefore, it is recommended that communications to the public regarding the clearance of an incident in the managed lanes be delivered quickly, just as with messages regarding the beginning of the incident. As with incident management for non-managed lanes, incident management for managed lanes should include coordinating statements to the media through a designated incident response team member, e.g., state department of transportation public information officer. In addition, this designated public information officer should provide regular briefings to other incident response team agencies.

PRE-POSITIONED RESPONSE VEHICLES

Many incident response teams on non-managed lane facilities use contracted towing companies to clear wreckage from the scene where involved vehicles have become inoperable. The expense of pre-positioning tow trucks at strategically selected locations throughout the corridor is deemed prohibitive.

However, this expense may be worth considering for managed lane facilities that generate revenue. Depending on the specific financial details of a managed lane facility, it may be that the cost of pre-positioning tow trucks, or other response vehicles, is offset by the more rapid response to an incident. If the incident is cleared more quickly and the incident-induced congestion is thereby minimized, then potential toll-paying motorists may choose to use the HOT or toll lane more often. The consideration of deploying pre-positioned tow trucks is an issue of travel time reliability and the resultant beneficial impact on toll revenues.

CREATION OF A SAFE WORK AREA

When incident response teams arrive at a scene where a one-lane incident is sufficiently severe, it may require that a second lane be closed to create a safe work area in which the team can maneuver. Where this situation occurs on a facility that includes a non-barrier-separated managed lane, e.g., a concurrent flow HOV lane, and the one-lane incident occurs in the general purpose lane immediately adjacent to the managed lane, a question arises regarding which lane should serve as the second closed lane for the incident response team.

If the managed lane is closed (see Figure 1) to create the safe work area, then the managed lane traffic must merge to the right, into the general purpose lanes. This channelization temporarily eliminates the benefits of the managed lane, and it may involve the merging of traffic from a lane operating at higher speeds into lanes operating at lower speeds. The result offers the possibility of secondary collisions.

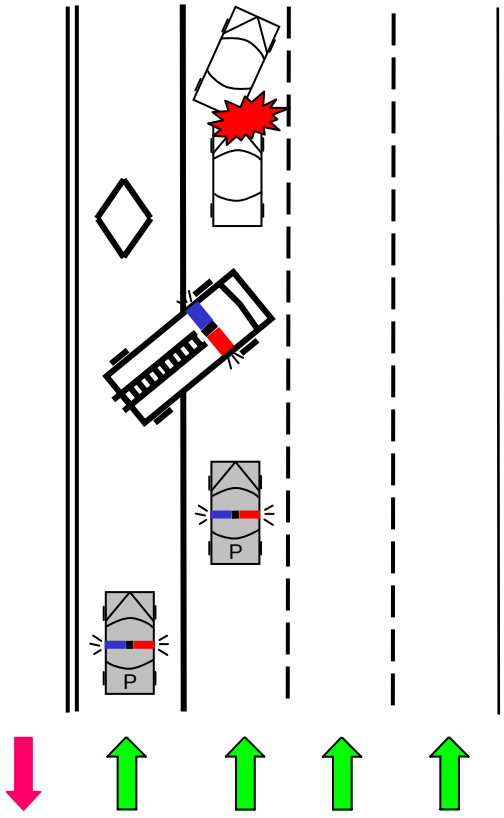

Figure 1. "Safe Work Area" Blocking Managed Lane.

The alternative is to keep the managed lane open and close the lane to the right of the incident lane, as illustrated in Figure 2. This channelization results in the "safe area" being a temporary

island with moving traffic on both the right and left sides of the incident scene. Incident response teams report that the island concept should be avoided, for the safety of everyone involved at the scene.

Both of these scenarios have shortcomings. This issue may be one for which additional research may be beneficial.

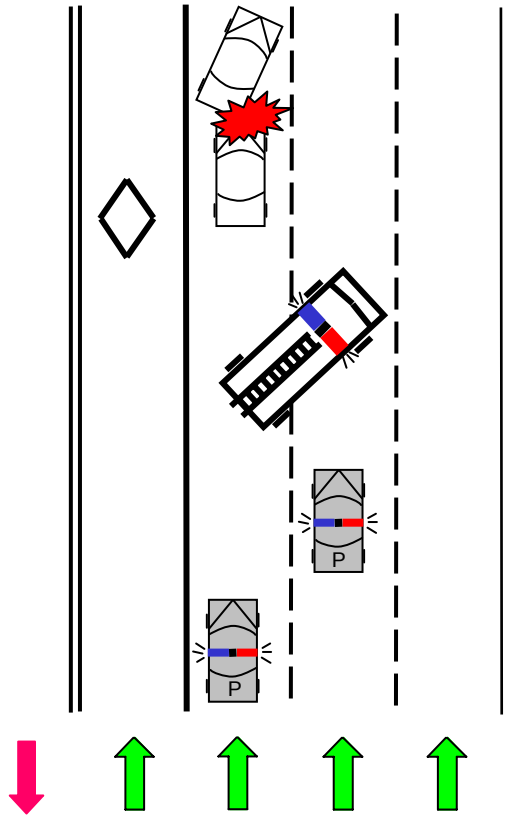

Figure 2. "Safe Work Area" as an Island.

RESPONSE VEHICLE ACCESS

Where managed lanes are separated from general purpose lanes by a barrier, access to an incident, when congestion levels are high and speeds are slow, can be achieved via traveling on the shoulders. Where the best route to an incident scene is via the lanes on the opposite side of the barrier from the incident, emergency response vehicles can benefit by the use of emergency access points in the barrier.

Discussions with incident response team personnel argue against directing response vehicles to travel in a contraflow direction in a managed lane even when it is one-lane, barrier-separated, and the lane is completely blocked. Opposition to response vehicle contraflow is based on the high cost (head-on secondary collision) of making an error in reporting that the lane downstream

of the incident is clear for a "wrong way" approach. The time required to achieve a sufficient level of certainty may be too great for the contraflow approach to be worthwhile as a time saver. Consequently, unless the managed lane downstream of the complete blockage is absolutely devoid of other moving vehicles it is recommended that incident response vehicles access the incident scene without traveling in a contraflow direction. The exception to this recommendation is the completely blocked, one-lane, barrier-separated facility that has excellent coverage by CCTV cameras and is actively monitored by traffic management center personnel. In this case, emergency vehicle contraflow access to an incident scene may be accomplished with a sufficient level of safety to the responders.

DIVERSION INTO MANAGED LANES

The first recommendation regarding the diversion plan is that it be developed by all the relevant parties, including all the agencies on the incident response team. Typically this team should include the state department of transportation, state law enforcement, transit authority, incident response team, fire department, hazardous materials team, freeway service patrols, emergency medical services, local government traffic engineering, towing companies, medical examiner, the designated agency's public information office, etc.

The diversion plan should provide for the elimination, or curtailment, of the usual managed lane user eligibility criteria during incidents in the general purpose lanes. These eligibility criteria include vehicle type restrictions, occupancy restrictions, and toll payments.

It is recommended that the diversion plan be deployed if an incident has blocked, or will block, traffic for a specified duration, e.g., 10, 15, or 30 minutes. One managed lane facility operator reported that since they introduced a 10-minute minimum threshold, the managed lane users have issued fewer complaints regarding sharing the lane with general purpose traffic. Agencies report that once the general purpose traffic is allowed to divert into the managed lanes, it is very difficult to "turn it off." Consequently, the specific threshold should be selected based on facility experience. It may be necessary to select the minimum duration such that the frequency of diversion plan deployment is not so often as to motivate managed lane motorists away from regularly using it.

Where the managed lane's physical features and communications infrastructure can support it, it is recommended that the diversion of general purpose traffic into the managed lane cease prior to its reaching an unacceptable congestion level.

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APPENDIX

On-Line Survey:

http://managed-lanes.tamu.edu/incident/survey

Texas Transportation Institute

MANAGED LANES

The Texas Transportation Institute is assisting the Texas Department of Transportation and the Federal Highway Administration with a multiyear project that evaluates various aspects of the broad topic of managed lanes on freeways. These can include any type of lane that maintains free-flow travel speeds on designated lanes or facilities by providing managed access to participating groups of vehicles. Examples could include any or various combinations of Express lanes, HOV lanes, HOT lanes, truck lanes, truck restricted lanes, bus lanes, etc. The objectives of this project are to investigate the complex and interrelated issues surrounding the safe and efficient operation of managed lanes using various operating strategies and to develop a managed lanes manual to help TxDOT make informed planning, design, and operational decisions when considering these facilities for its jurisdiction. Additional information is available at http://managed-lanes.tamu.edu. Your assistance is desired in identifying issues, challenges, and solutions related to INCIDENT MANAGEMENT ***in and around*** managed lanes. Your help is appreciated. *(If you need to backup to a previous page, please exit and re-enter the site. DO NOT use the BACK button.)*

Depending on your roadway system, this survey can take 10 to 20 minutes to complete.

Take Survey

Texas Transportation Institute

MANAGED LANES

Depending on your roadway system, this survey can take 10 to 20 minutes to complete.

Please check all the types of Managed Lanes with which your agency is involved:

- ☐ Express Lanes
- ☐ High Occupancy Vehicle (HOV) Lane
- ☐ Toll Lanes
- ☐ High Occupancy Toll (HOT) Lanes
- ☐ Truck Lanes
- ☐ Truck Restricted Lanes
- ☐ Transit Lanes
- ☐ Other:

Start Survey | No Thanks

SECTION I. GENERAL INFORMATION ON MANAGED LANES (ML) FACILITIES

1.) For each Managed Lane (ML) type, specify how General Purpose (GP) lanes are kept separate from the ML.

ML Type	Separation Method				
	Barrier	Buffer	Lane Markings Only	Lane Markings and Vertical Posts/Panels	Other (specify)
Express	◉	○	○	○	○
HOV	◉	○	○	○	○
Toll	◉	○	○	○	○
HOT	◉	○	○	○	○
Truck	◉	○	○	○	○
Truck Restricted	◉	○	○	○	○
Transit	◉	○	○	○	○

2.) For each Managed Lane (ML) type, specify those vehicles authorized to use the lane (check all that apply).

ML Type	Authorized Vehicles											
	ALL	Single Occupant Passenger	Two Person Carpool	3+ Carpool	18-Wheeler	Commercial Panel Truck	Bus	Van pool	Motorcycle	Low-Emissions	Fuel-Efficient	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3.) For each Managed Lane (ML) type, specify if there exists an INCIDENT MANAGEMENT program that is implemented in response to incidents (e.g., major accident, roadway construction or maintenance, roadway closure, special event, hazardous material spill, weather event such as flooding, snowstorm, or hurricane evacuation, etc.) on the ML.

ML Type			
	No	Yes, and I can send a copy of the documentation	Yes, but I cannot send a copy of the documentation
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

Continue

SECTION II. INCIDENT MANAGEMENT FOR MANAGED LANES (ML)

This section deals only with incidents in the managed lanes (ML).
Subsequent sections will address incidents in the general purpose (GP) lanes.

4.) For each ML type, specify those types of incidents addressed by the INCIDENT MANAGEMENT program (check all that apply).

ML Type	Addressed Incidents							
	ALL	Traffic Accident	Special Events	Freeway Construction	Stalled Vehicles	Debris/Spills	Inclement Weather	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

5.) For each ML type, specify when the INCIDENT MANAGEMENT program is applicable?

ML Type	Applicable Time Period		
	24/7	Peak Hours	Other (specify)
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

6.) For each ML type, specify technologies used in incident detection (check all that apply).

ML Type	Incident Detection Technology									
	ALL	Inductive Loop Detectors	CCTV	AVI	VIVDS	Mobile call-in Number	Courtesy Patrol	Commercial Traffic Info. Services	Aerial Surveillance	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

7.) For each ML where CCTV is used in incident detection, specify how operators **primarily** use the cameras.

ML Type	Primary Camera Usage			
	Not Used	Active Monitoring of Incidents	Only Verification of Incidents	Other (specify)
Express	◉	○	○	○
HOV	◉	○	○	○
Toll	◉	○	○	○
HOT	◉	○	○	○
Truck	◉	○	○	○
Truck Restricted	◉	○	○	○
Transit	◉	○	○	○

8.) For each ML type, specify if the INCIDENT MANAGEMENT program is part of a larger program that includes the General Purpose Lanes.

ML Type	Exclusive or part of a Larger IM Program	
	It is exclusively for the ML	It is part of a larger program that includes GP Lanes
Express	◉	○
HOV	◉	○
Toll	◉	○
HOT	◉	○
Truck	◉	○
Truck Restricted	◉	○
Transit	◉	○

9.) For each ML type, if the larger INCIDENT MANAGEMENT program was modified to allow for ML incidents, please explain how.

ML Type	Modifications to Include Managed Lane
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

10.) For each ML type, specify agencies/groups which are involved in the INCIDENT MANAGEMENT program (check all that apply)

ML Type	Involved Agencies												
	ALL	Fire Dept.	EMS	Hazmat Team	Tow Trucks	County Sheriff/Police	State Police	Incident Response Team	Transit Authority	City Traffic Engineering	State DOT	Freeway Service Patrol	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11.) For each ML type, is there an interagency agreement that defines each agency's role in INCIDENT MANAGEMENT?

ML Type	No	Yes, and I can send a copy of the documentation	Yes, but I cannot send a copy of the documentation
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

12.) For each ML type, which of the following best describes policy regarding the designated access path for emergency service vehicles to take in responding **to incidents in the ML Lanes**?

ML Type	Designated Access Path Policy					
	a) No Policy	b) ML are primary path, GP Lanes are secondary	c) GP Lanes are primary path, ML are secondary	d) ML are the only designated path	e) GP Lanes are the only designated path	f) Other (specify)
Express	◉	○	○	○	○	○
HOV	◉	○	○	○	○	○
Toll	◉	○	○	○	○	○
HOT	◉	○	○	○	○	○
Truck	◉	○	○	○	○	○
Truck Restricted	◉	○	○	○	○	○

13.) For each ML where you answered the previous question with a, b, or c, how often are the general purpose (GP) lanes used for accessing a ML incident?

ML Type	Estimate	Actual, if known
Express	Within 0 percent of the time.	Within 0 percent of the time.
HOV	Within 0 percent of the time.	Within 0 percent of the time.
Toll	Within 0 percent of the time.	Within 0 percent of the time.
HOT	Within 0 percent of the time.	Within 0 percent of the time.
Truck	Within 0 percent of the time.	Within 0 percent of the time.
Truck Restricted	Within 0 percent of the time.	Within 0 percent of the time.
Transit	Within 0 percent of the time.	Within 0 percent of the time.

14.) For each Managed Lane (ML) during an incident, what actions, *concerning upstream ML access,* are taken to divert ML traffic into the GP lanes (check all that apply)?

ML Type	Upstream Managed Lane Access is:		
	Closed	Discouraged	Other (specify)
Express	☐	☐	☐
HOV	☐	☐	☐
Toll	☐	☐	☐
HOT	☐	☐	☐
Truck	☐	☐	☐
Truck Restricted	☐	☐	☐
Transit	☐	☐	☐

15.) For each Managed Lane (ML) during an incident, what actions, *concerning motorist notification,* are taken to divert ML traffic into the GP lanes (check all that apply)?

ML Type	Notify Motorists via:							
	ALL	Advisory Radio	On-Scene Police	Media Traffic Reports	Website	Portable DMS	Fixed DMS	Other
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

16.) For each ML type, please describe in what other ways INCIDENT MANAGEMENT in an ML differs from that in the GP lanes.

ML Type	Incident Management Differences
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

17.) For each ML type, please provide suggestions for improving INCIDENT MANAGEMENT.

ML Type	Incident Management Improvements
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

SECTION III. EMERGENCY VEHICLE USE OF MANAGED LANES (ML) FOR INCIDENTS IN GENERAL PURPOSE (GP) LANES

This section deals only with incidents in the general purpose (GP) lanes.

18.) For each ML type, which of the following best describes policy regarding the designated access path for emergency service vehicles to take in responding **to incidents in the GP Lanes**?

ML Type	Designated Access Path Policy					
	a) No Policy	b) GP Lanes are primary path; ML is the secondary path	c) ML is the primary path; GP Lanes are secondary path	d) GP Lanes are the only designated path	e) ML is the only designated path	f) Other
Express	◉	○	○	○	○	○
HOV	◉	○	○	○	○	○
Toll	◉	○	○	○	○	○
HOT	◉	○	○	○	○	○
Truck	◉	○	○	○	○	○
Truck Restricted	◉	○	○	○	○	○
Transit	◉	○	○	○	○	○

19.) For each ML type where you answered the previous question with a, b, or c, how often are ML used for accessing a GP Lane incident?

ML Type	Estimate	Actual, if known
Express	Within 0 percent of the time.	Within 0 percent of the time.
HOV	Within 0 percent of the time.	Within 0 percent of the time.
Toll	Within 0 percent of the time.	Within 0 percent of the time.
HOT	Within 0 percent of the time.	Within 0 percent of the time.
Truck	Within 0 percent of the time.	Within 0 percent of the time.
Truck Restricted	Within 0 percent of the time.	Within 0 percent of the time.
Transit	Within 0 percent of the time.	Within 0 percent of the time.

20.) For each ML type, what suggestions do you have for utilizing ML to improve INCIDENT MANAGEMENT in the GP lanes?

ML Type	ML Utilization
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

21.) For each ML type, does your agency have a plan for diverting GP traffic into the ML in the event of an incident in the GP lanes?

ML Type	Divert GP Traffic to ML?		
	No	Yes, and I can send you the documentation.	Yes, but I cannot send you any documentation.
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

22.) Does your agency have plans to use ML(s) to provide unimpeded access for emergency responders and other management personnel in the event of a homeland security emergency, natural disaster, or other major emergency?

No ◉ Yes ○

23.) If not, do you believe that ML(s) use for such purposes as above should be considered?

No ◉ Yes ○ Maybe ○

24.) What suggestions do you have for utilizing ML(s) to improve emergency management operations for such events?

Continue

SECTION IV. GENERAL PURPOSE (GP) INCIDENT DIVERSION INTO MANAGED LANES (ML)

This deals only with incidents in the general purpose (GP) lanes.

25.) For each ML, which agencies/groups were consulted when developing the GP traffic to ML diversion plan (check all that apply)?

ML Type	Consulted Agencies												
	ALL	Fire Dept	EMS	Hazmat	Tow Trucks	County Law Enforcement	State Law Enforcement	Incident Response Team	Transit Authority	City Traffic Engineering	State DOT	Freeway Service Patrol	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

26.) For each ML, has the diversion plan been reviewed after its initial implementation?

ML Type	Diversion Plan Review		
	No	Yes, but no modifications were made.	Yes, and modifications were made. (specify)
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

27.) For each ML, how often is the diversion plan updated?

ML Type	Diversion Plan Update Frequency					
	Quarterly	Semi-Annually	Annually	Bi-Annually	None	Other (specify)
Express	◉	○	○	○	○	○
HOV	◉	○	○	○	○	○
Toll	◉	○	○	○	○	○
HOT	◉	○	○	○	○	○
Truck	◉	○	○	○	○	○
Truck Restricted	◉	○	○	○	○	○
Transit	◉	○	○	○	○	○

28.) For each ML, did you encounter any resistance from within your agency in developing the diversion plan? If so, please explain.

ML Type	Internal Resistance to Diversion Plan
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

29.) For each ML, did you encounter any resistance from outside your agency in developing the diversion plan? If so, please explain.

ML Type	External Resistance to Diversion Plan
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

30.) For each ML, approximately how often has the diversion plan been implemented in the past year?

ML Type	Implementation Frequency this past Year
Express	Within 0 times.
HOV	Within 0 times.
Toll	Within 0 times.
HOT	Within 0 times.
Truck	Within 0 times.
Truck Restricted	Within 0 times.
Transit	Within 0 times.

31.) For each ML, approximately how often has the diversion plan been implemented in the past five years?

ML Type	Implementation Frequency in the past Five Years
Express	Within 0 times.
HOV	Within 0 times.
Toll	Within 0 times.
HOT	Within 0 times.
Truck	Within 0 times.
Truck Restricted	Within 0 times.
Transit	Within 0 times.

32.) For each ML, what agency(s) is responsible for Authorizing the Diversion Plan (check all that apply) ?

ML Type	Authorizing Agencies												
	ALL	Fire Dept	EMS	Hazmat	Tow Trucks	County Law Enforcement	State Law Enforcement	Incident Response Team	Transit Authority	City Traffic Engineering	State DOT	Freeway Service Patrol	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

33.) For each ML, what agency(s) is responsible for Implementing the Diversion Plan (check all that apply)?

ML Type	Implementing Agencies												
	ALL	Fire Dept	EMS	Hazmat	Tow Trucks	Local Law Enforcement	State Law Enforcement	Incident Response Team	Transit Authority	City Traffic Engineering	State DOT	Freeway Service Patrol	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

34.) For each ML, what agency(s) is responsible for Informing the Public about the Diversion Plan (check all that apply)?

ML Type	Informing Agencies												
	ALL	Fire Dept	EMS	Hazmat	Tow Trucks	County Law Enforcement	State Law Enforcement	Incident Response Team	Transit Authority	City Traffic Engineering	State DOT	Freeway Service Patrol	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

35.) For each ML, what difficulties have there been in coordinating, communicating, or cooperating with other agencies involved in implementing the diversion?

ML Type	Interagency Collaboration Difficulties
HOV	
Express	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

36.) For each ML, is there an interagency agreement with another agency involved in authorizing and/or implementing the diversion?

ML Type	No	Yes, and I can send a copy of the documentation	Yes, but I cannot send a copy of the documentation
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

37.) For each ML, describe the sequence of events for implementing the diversion plan:

ML Type	Implementation Description
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

38.) For each ML, what changes are made during the diversion (check all that apply)?

	ML Diversion-time Changes					
ML Type	ALL	Occupancy Requirement Eliminated	Tolls Eliminated	Tolls Reduced	Vehicle Type Restriction Eliminated	Other
Express	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐

39.) For each ML, how are motorists notified of the diversion (check all that apply)?

	Notify Motorists via:							
ML Type	ALL	Advisory Radio	On-Scene Police	Media Traffic Reports	Website	Portable DMS	Fixed DMS	Other
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

40.) For each ML, how are motorists notified that the diversion has been discontinued?

ML Type	Notify Motorists via:							
	ALL	Advisory Radio	On-Scene Police	Media Traffic Reports	Website	Portable DMS	Fixed DMS	Other
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

41.) For each ML, what types of incidents has the diversion **actually** been implemented (check all that apply)?

ML Type	Handled Incidents							
	ALL	Traffic Accident	Special Events	Freeway Construction	Stalled Vehicles	Debris/Spills	Inclement Weather	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

42.) For each ML, what types of incidents **could** the diversion be implemented (check all that apply)?

ML Type	Potentially Handled Incidents							
	ALL	Traffic Accident	Special Events	Freeway Construction	Stalled Vehicles	Debris/Spills	Inclement Weather	Other (specify)
Express	☐	☐	☐	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐	☐	☐	☐

43.) For each ML, if there is a minimum expected duration of an incident before the diversion plan would be implemented, what is that minimum duration?

ML Type	Minimum Duration
Express	Within NA minutes.
HOV	Within NA minutes.
Toll	Within NA minutes.
HOT	Within NA minutes.
Truck	Within NA minutes.
Truck Restricted	Within NA minutes.
Transit	Within NA minutes.

44.) For each ML, is there a minimum number of lanes in a section with 'x' number lanes (e.g., 2 out of 3 lanes, etc.) that would have to be blocked to implement the diversion? If so, how many lanes out of how many?

ML Type	Blocked Lanes
Express	0 lanes are blocked out of 0 total lanes
HOV	0 lanes are blocked out of 0 total lanes
Toll	0 lanes are blocked out of 0 total lanes
HOT	0 lanes are blocked out of 0 total lanes
Truck	0 lanes are blocked out of 0 total lanes
Truck Restricted	0 lanes are blocked out of 0 total lanes
Transit	0 lanes are blocked out of 0 total lanes

45.) For each ML, are there time-of-day criteria for implementation (e.g., peak hours only or any time)? If so, when?

ML Type	Criteria
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

46.) For each ML, what, if any, other criteria are considered for implementation?

ML Type	Other Criteria
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

47.) For each ML, is your agency satisfied with previous implementations of the diversion?

ML Type	No	Yes
Express	◉	○
HOV	◉	○
Toll	◉	○
HOT	◉	○
Truck	◉	○
Truck Restricted	◉	○
Transit	◉	○

48.) For each ML, what, if any, problems have been encountered?

ML Type	Misc. Problems
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

49.) For each ML, what, if any, public feedback such as positive comments from GP motorists or complaints from ML motorists have you received?

ML Type	Public Feedback
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

50.) For each ML, what, if any, negative impact on ML operations was observed with the diversion in place?

ML Type	Negative Impact on Managed Lane Operations
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

51.) For each ML, describe any contingency plan to eliminate the diversion or adjust toll/occupancy/vehicle type requirements dynamically if operations in the ML deteriorate?

ML Type	Contingency
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

52.) For each ML, when is the diversion discontinued (check all that apply)?

ML Type	Discontinue Diversion when:				
	ALL	Operations on ML deteriorates	Incident is cleared	Queue from the incident dissipates	Other
Express	☐	☐	☐	☐	☐
HOV	☐	☐	☐	☐	☐
Toll	☐	☐	☐	☐	☐
HOT	☐	☐	☐	☐	☐
Truck	☐	☐	☐	☐	☐
Truck Restricted	☐	☐	☐	☐	☐
Transit	☐	☐	☐	☐	☐

53.) Has a cost effectiveness study or benefit analysis been conducted regarding the diversion of GP traffic into the ML during a GP incident?

ML Type	No	Yes, and I can send a copy of the documentation	Yes, but I cannot send a copy of the documentation
Express	◉	○	○
HOV	◉	○	○
Toll	◉	○	○
HOT	◉	○	○
Truck	◉	○	○
Truck Restricted	◉	○	○
Transit	◉	○	○

Continue to Finish

SECTION V. QUESTIONS FOR AGENCIES WITHOUT PLANS FOR DIVERTING GENERAL PURPOSE (GP) TRAFFIC INTO MANAGED LANES (ML) DURING GP INCIDENTS

54.) For each ML, is there any expectation to develop a diversion plan in the future?

ML Type	Diversion Plan In Your Future?	
	Yes	No
Express	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
HOV	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
Toll	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
HOT	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
Truck	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
Truck Restricted	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other
Transit	◉	○ No, because (check all that apply) ☐ Diversion Not Needed ☐ Avoid Negatively Impacting OPs in ML ☐ Avoid Negatively Impacting OPs in GP Lanes ☐ Avoid Loss of Toll Revenue ☐ Other

55.) If your agency were to develop a policy of diverting GP traffic into parallel ML, what criteria would be most significant in the determination to implement the diversion?

ML Type	Implementation Criteria
Express	
HOV	
Toll	
HOT	
Truck	
Truck Restricted	
Transit	

Continue to Finish

SECTION VI. FINAL COMMENTS

56.) Do you have any other comments?

57.) Please provide your contact information, so that we may reach you in the event that we need to discuss this topic further.

Name:

Address:

City: State: Zip Code:

Phone: Email:

Finish

Thank you for your contribution to the survey and toward a better understanding of managing incidents in and near managed lanes.

In this survey, you stated that you are able to provide a copy of the following documents:

- None

Please, at your earliest convenience, send any of the documentation identified above to the following address:

Andrew J. Ballard, PE, PTOE
Research Engineer
Texas Transportation Institute
NW Loop 410, Suite 460
San Antonio, TX 78213

or **FAX** 210-979-9694

If you have any questions or wish to discuss this topic further with the research team, please feel free to contact

Andrew J. Ballard (Texas Transportation Institute) at
(210) 979-9411 or by e-mail at
a-ballard@tamu.edu.

The survey results should be available in late 2004 on the project website. To access helpful links and documents and/or to find out more about this research project, you can visit the project website at:

http://managed-lanes.tamu.edu.