TRAFFIC INCIDENT MANAGEMENT RESOURCE MANAGEMENT

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract
The necessity of a multi-disciplinary approach – involving law enforcement, fire and rescue, transportation, towing and recovery, and others – has been well-recognized and integrated into incident management operations. This same multi-disciplinary approach has not been as widely extended to the area of resource management. Under a multidisciplinary approach, efficient and effective TIM resource management relies upon the utilization of: (1) appropriate personnel who are best qualified (i.e., capable but not over-qualified) for the various tasks; (2) appropriate equipment by function (i.e., use of the least costly equipment capable of performing the function); and (3) appropriate technology capable of supporting various on-site resource tasks, as well as a reduction in overall resources required through reduced redundancy across disciplines. To demonstrate the potential for enhanced TIM resource management efficiency and effectiveness, this Primer considered various hypothetical examples for select TIM functions including motorist assistance, dispatch and response, scene protection, temporary traffic control, detour management, firefighting, minor spill mitigation and cleanup, crash investigation, victim relocation, and vehicle or debris removal. Results from an *Incident Scenario Survey* were used to confirm potential resource management improvements in practice and estimate order of magnitude cost savings.

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U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE.
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Dear Transportation Professionals & Traffic Incident Management (TIM) Partners:

As part of the mission of the Federal Highway Administration (FHWA) to "***Keep America Moving,***" we need to safeguard the motoring public and those responding to traffic incidents. Safe, quick clearance of highway incidents—a foundation of both mature and developing TIM programs—depends on strong, coordinated multi-agency operations that are supported by integrated communications.

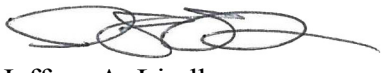
With more vehicles on the Nation's highways, traffic incidents become increasingly life threatening for those involved, including responders dispatched to help. According to the National Traffic Incident Management Coalition (NTIMC), "struck-by" secondary incidents are on the rise. In conjunction with the NTIMC partner organizations in the public safety and transportation arenas, FHWA promotes policies that enhance responder safety (such as driver removal and move-over laws); encourages the use of new technologies and gear to protect responders during roadside operations; and promotes improved safety procedures and safety training of traffic incident responders. In the coming year, FHWA will be launching a new campaign, similar to the highly successful "***Click It or Ticket*"** campaign, to increase driver awareness of their roles and duties in safely addressing traffic incidents or public safety responses on the roads.

As a part of this campaign and in support of TIM practitioners, FHWA is pleased to introduce a new set of primers, collectively known as the "***Safe, Quick Clearance Primer Series.***" This series includes five primers that address various issues associated with roadside clearance operations and provide basic building blocks on:

- ***Information Sharing for Traffic Incident Management***
- ***Traffic Incident Management in Construction and Maintenance Work Zones***
- ***Traffic Incident Management in Hazardous Materials Spills in Incident Clearance***
- ***Traffic Incident Management Resource Management***, and
- ***Traffic Control Concepts for Incident Clearance***

We encourage comments and contributions to these primers and other FHWA Traffic Incident Management documents. Please feel free to contact our Emergency Transportation Operations Team at ETO@dot.gov with suggestions for future revisions.

Sincerely,



Jeffrey A. Lindley
Associate Administrator for Operations

MOVING THE AMERICAN ECONOMY

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1.0 INTRODUCTION

Traffic incident management (TIM) requires a coordinated, multi-disciplinary approach to safely and quickly clear a highway incident. The necessity of a multi-disciplinary approach—involving law enforcement, fire and rescue, transportation, towing and recovery, and others—has been well-recognized and integrated into TIM operations. Established multi-disciplinary operational training efforts attempt to minimize any inefficiencies or ineffectiveness in response actions by any one agency that may extend the necessary duration of the incident and/or compromise the safety of field personnel or the motoring public. The economic effects of this multi-disciplinary operational approach are most often tied to a reduction in overall incident duration and reported in monetary terms as a reduction in motorist delay, fuel consumption, harmful emissions, and/or secondary incidents involving either other motorists or response personnel.

This same multi-disciplinary approach has not been as widely extended to the area of resource management (i.e., the strategic use of personnel, equipment, technologies, and supplies or materials). To optimize incident management efficiency and effectiveness from a resource management point of view, personnel and equipment should be best matched to tasks based on their respective level of training and/or capabilities. For example, a higher level of efficiency and equal or higher effectiveness may be obtained by using a transportation vehicle equipped with an arrow board and additional traffic control devices to protect the scene rather than law enforcement or fire and rescue vehicles. As a second example, use of responsive traffic signal control plans and/or transportation personnel to manage traffic at and around an incident scene would relieve law enforcement personnel from this duty and allow them to perform other tasks for which they are trained (i.e., crash investigation).

Through a multi-disciplinary, holistic approach that considers the most efficient and effective use of resources across all responding agencies in combination, economic savings are anticipated and attributable to the:

1. Utilization of personnel who are best qualified (i.e., capable, but not over-qualified) for the various tasks (this, in turn, allows alternately skilled personnel to focus on other incident management functions),

2. Utilization of appropriate equipment by function (i.e., use of the least costly equipment capable of performing the function),

3. Utilization of appropriate technology capable of supporting various on-site resource tasks, and

4. Reduction in overall resources required through reduced redundancy across disciplines.

Purpose of This Document

The purpose of this guidebook is to:

1. Identify and explore opportunities for improvement in resource management by considering the most efficient and effective use of resources across all responding agencies in combination and

2. Describe potential cost-sharing strategies that would allow these efficiencies to be realized.

This document focuses primarily on potential resource management improvements for public agencies (i.e., law enforcement, fire and rescue, emergency medical services, and transportation); private industry participants, such as towing and recovery or the media, were not considered.

Target Audience

The target audience for this guidebook includes state and local political officials, public agency management or administrative personnel, and public agency operations personnel:

- *State and Local Political Officials* – In an abbreviated form, state and local political officials will benefit from this information by identifying, promoting, and demonstrating efficient and effective resource management among government agencies within their jurisdictions.

- *Public Agency Management/Administrative Personnel* – Public agency management and administrative personnel will benefit from this information by identifying, promoting, and demonstrating efficient and effective resource management within their respective agencies.

- *Public Agency Operations Personnel* – Public agency operations personnel, responsible for affecting efficient and effective resource management on a per-incident basis, will benefit from this information through specific examples of resource management efficiencies and through a broader, multidisciplinary resource management perspective.

Structure of this Guidebook

This guidebook is one in an Information Series on Traffic Incident Management Safe, Quick Clearance. This guidebook focuses on Traffic Incident Management Resource Management. Other guidebooks available in this information series deal with the following topics:

- Traffic Control Concepts for Incident Clearance,

- Hazardous Materials Spills in Incident Clearance,

- Traffic Incident Management in Construction and Maintenance Work Zones, and

- Information Sharing for Traffic Incident Management.

Each is intended to provide sufficiently detailed and complementary information to support improvements in unique aspects of safe and quick incident clearance. This document focuses on *Traffic Incident Management Resource Management* and is intended to identify opportunities for improvement in resource management by considering the most efficient and effective use of resources across all responding agencies in combination and describe potential cost-sharing strategies that would allow these efficiencies to be realized.

Following this introductory information, this document provides a:

1. Review of the multidisciplinary approach as applied in TIM operations;
2. Description of the multidisciplinary approach as applied and/or envisioned for TIM resource management;
3. Description of common TIM resources, functions, and costs;
4. Discussion of potential TIM resource management efficiency improvements and associated cost savings; and
5. Description of companion cost-sharing strategies.


FIRE-RESCUE

2.0 THE MULTIDISCIPLINARY APPROACH IN TIM OPERATIONS

In an effort to distinguish the multidisciplinary approach traditionally applied to traffic incident management (TIM) operations from that which is applied and/or envisioned for TIM resource management, and to demonstrate the impetus for applying this approach to TIM resource management, based on observed benefits in TIM operations, this chapter briefly overviews the:

- Respective roles of TIM participants, including potential points of conflict;
- Broad-based, alternative operational procedures under a multidisciplinary approach;
- Manifestation of this approach in practice through multidisciplinary training opportunities; and
- Reported benefits resulting from a multidisciplinary approach in TIM operations.

TIM Participants and Respective Roles

Key participants in TIM typically include:

- Law enforcement,
- Fire and rescue,
- Emergency medical services,
- Transportation, and
- Towing and recovery.

The operational roles and responsibilities for each of these TIM participants are described as follows.

Law Enforcement

Law enforcement agencies exist at the state, county, and local levels with widely varying jurisdictions. Typically, state police have jurisdiction on state highways and county and municipal police have jurisdiction off the state highway system. On-scene at a traffic incident, the duties of law enforcement personnel include:

- Securing the incident scene,
- Providing emergency medical aid until help arrives,

- Safeguarding personal property,
- Conducting accident investigations,
- Serving as incident commander,
- Supervising scene clearance,
- Assisting disabled motorists, and
- Directing traffic[1]

Law enforcement agencies are first responders at traffic incident scenes, providing 24-hour emergency response. Law enforcement officers typically act alone and are trained to make unilateral decisions.[1]

Lengthy law enforcement investigation duties sometimes conflict with the objective of quickly restoring traffic flow under a multidisciplinary TIM approach. In some areas, police officers are evaluated on the basis of the completeness and accuracy of their incident investigations; insurance companies and lawyers for both the defense and prosecution in criminal cases, and for plaintiffs and defendants in civil cases, scrutinize police reports extremely carefully. Technological advances in investigation, including total station surveying equipment and electronic documentation, help police complete their investigations more quickly.[2]

Fire and Rescue

Fire and rescue services are provided by county and municipal fire departments, and by surrounding fire departments through mutual aid agreements. In most large urban areas, full-time professional personnel staff fire and rescue departments. In many suburban, and in most rural areas, volunteers primarily provide fire and rescue services. Typical roles and responsibilities assumed by fire and rescue personnel at traffic incidents include:

- Protecting the incident scene,
- Suppressing fires,
- Providing emergency medical care,
- Serving as incident commander,
- Providing initial hazardous materials (HAZMAT) response and containment,
- Rescuing crash victims from contaminated environments,
- Rescuing crash victims from wrecked vehicles,
- Arranging transportation for the injured,
- Assisting in incident clearance, and
- Providing traffic control until law enforcement or transportation agency personnel arrival.[1]

Fire and rescue agencies also operate as first responders, providing 24-hour emergency response. Unlike law enforcement—who operate individually for most duties—fire personnel may not respond individually to requests from other response agencies unless their commanding officer directs them to do so (Federal Highway Administration [FHWA] 2006). In addition, fire personnel, with the intent of protecting the incident scene, may use fire equipment which can unnecessarily block traffic lanes.

Emergency Medical Services

Emergency medical service (EMS) agencies are responsible for the triage, treatment, and transport of crash victims. In many areas, fire and rescue agencies provide emergency medical services. In some areas, other agencies or private companies provide these services to local jurisdictions under contract. EMS personnel are limited in the functions that they can perform at an incident scene by the level of training that they have received. Emergency medical technicians (EMTs) and paramedics are both trained to provide basic life support; paramedics are trained at a higher level and can perform specialized procedures, such as starting Intravenous treatments (IVs) and administering emergency medications. Typical roles and responsibilities assumed by EMS personnel at traffic incidents include:

- Providing advanced emergency medical care,
- Determining the destination and transportation requirements for the injured,
- Coordinating evacuation with fire, law, and ambulance or airlift personnel,
- Serving as incident commander for medical emergencies,
- Determining the approximate cause of injuries for the trauma center, and
- Removing medical waste from the incident scene.[1]

In some instances, EMS personnel are qualified to pronounce death, allowing them to move the decedent to a safe place out of traffic to await the coroner's arrival on the scene.

Transportation

Transportation agencies are typically responsible for restoring the flow of traffic as quickly and safely as possible following the occurrence of an incident. Typically, these agencies are involved in the development, implementation, and operation of traffic operations or management centers (TOC or TMC) as well as management of service patrols. Typical operational responsibilities assumed by transportation agencies include:

- Assisting in incident detection and verification,
- Initiating traffic management strategies on incident impacted facilities,
- Protecting the incident scene,
- Initiating emergency medical assistance until help arrives,
- Providing traffic control,
- Assisting motorist with disabled vehicles,

- Providing motorist information,
- Providing sand to absorb small fuel and anti-freeze spills,
- Providing special equipment clearing incident scenes,
- Determining incident clearance and roadway repair needs,
- Establishing and operating alternate routes,
- Coordinating clearance and repair resources,
- Serving as incident commander for clearance and repair functions, and
- Repairing transportation infrastructure.[1]

Transportation agencies are secondary responders; typically called to the incident scene by first responders, usually law enforcement. Transportation agencies are rarely connected directly to public safety emergency communications and dispatch systems and not all operate 24 hours-a-day resulting in sometimes lengthy after-hours response.

Towing and Recovery

Compared to other TIM participants, towing and recovery service providers are unique because they are not public agencies; they must remain profitable to retain a skilled work force and purchase and maintain expensive and complex equipment. Their typical responsibilities at the scene of an incident include:

- Recovering and removing vehicles from incident scene,
- Protecting victims' property and vehicles,
- Removing debris from the roadway, and
- Providing other services, such as traffic control, as directed or under contract.[1]

Towing and recovery companies are secondary responders; typically operating under a rotation or contract towing arrangement maintained by a law enforcement agency. In rotation towing, a list of pre-qualified companies, classified by capabilities and/or zones, is developed and used to dispatch towing and recovery services. If not adequately defined, rotation towing may result in lengthy response times and inappropriate equipment dispatched to the incident scene. In contract towing, companies are selected through a bidding process; qualification requirements to bid may be more rigid than requirements for placement on a rotation list. Contracts may also be awarded on a zone basis to help enable response by the closest qualified company.[1]

Commonalities

Although the roles and priorities of the various agencies that respond to incidents are largely distinct, the National Traffic Incident Management Coalition's (NTIMC) Training Task Force has identified essential TIM functions that can be commonly performed by various agency personnel in their *Multidisciplinary Core Competencies* document. For example, the NTIMC recommends that **all** responders, regardless of discipline, be trained to:

- Position vehicles to support scene safety and expeditious exit of EMS vehicles,
- Establish temporary traffic control,
- Provide basic first aid to victims until EMS arrives, and
- Assume Incident Command until replaced.

The NTIMC recommends cooperative roles for law enforcement and transportation personnel when establishing advanced traffic control and detour routes, with fire and rescue personnel providing assistance as needed. Similarly, law enforcement personnel are primarily tasked with vehicle and debris removal, but transportation and fire and rescue personnel are urged to take an assistive role. Both fire and rescue and transportation personnel are presumed qualified to competently perform functions associated with the clean-up of minor spills. These commonalities in TIM functional competencies readily support opportunities for enhanced resource management efficiency and cost effectiveness.

Multidisciplinary TIM Operations

The respective roles and responsibilities of the TIM participants are carried out through various formal and informal operational strategies or procedures. Traditional operations have been, and continue to be, supplanted by managed operations carried out under a multidisciplinary approach. The two types of operations are compared and contrasted below.

Traditional Operations

Traditional incident operations are characterized by sequential steps, largely performed independently. Law enforcement personnel may do very little, if any, investigation while fire and emergency medical personnel are on the scene. If a fatality is involved, law enforcement personnel may allow the coroner to perform their medical investigation first, and subsequently perform their own criminal investigation. Tow trucks may not be requested until well into the incident (i.e., after law enforcement performs essential duties at the scene), resulting in lost time waiting for resources to arrive. Similarly, requests for sand or road or structure damage assessments by transportation agency personnel may not occur until well after the incident has occurred.[2]

Sequential approaches to incident operations typically result from a minimal understanding of others' roles. Historically, it has been quite common for personnel in one agency to have little knowledge of the abilities, resources, and procedures of another agency. Although law enforcement, fire and rescue, emergency medical, transportation, and towing personnel are usually well trained and professional; working together is complicated by the fact that actions are governed by individual agency priorities. Fire agency personnel often close lanes in excess of the blockage to protect incident responders. Law enforcement agencies may declare a fatal incident a "crime scene" and close the freeway to protect the integrity of the investigation. Although there is validity in both of these actions, both ignore the sense of urgency to keep traffic moving for safety reasons.[2]

Multidisciplinary Operations

Multidisciplinary operations are based on an understanding of each others' roles; the more closely agencies work together, the more they discover how they can mutually and concurrently accomplish their objectives as they respond to incidents.

Multidisciplinary operations are, thus, characterized by concurrent steps. Through interagency understanding and close cooperation, incident investigation (even for fatalities) can proceed while the injured are being removed and while tow agencies are assessing how to remove a vehicle or even attaching rigging. The extent of concurrent operations must, of course, be governed by safety considerations.[2]

Unified Command (UC), a concept basic to the Incident Command System (ICS), facilitates decision making under multidisciplinary TIM operations. Under UC, a single point of contact is responsible for the overall handling of the incident; decisions regarding specific actions needed by responding agencies are made through consultation with supervisors from other responding agencies. Such "management by committee" can only be effective if there is a high degree of professional trust among the responding agencies.[2]

This professional trust also supports the sharing of equipment and personnel. For example, law enforcement and transportation agencies can share equipment and personnel when performing traffic control; law enforcement agencies may equip on-scene transportation agency personnel with hand-held radios to facilitate communications. Agencies can also share funding sources to purchase equipment to support traffic incident management; transportation agencies, for example, may purchase total station surveying equipment to speed law enforcement personnel's investigation duties and reduce overall incident duration.[2] Examples such as this directly support the premise of this investigation related to opportunities for enhanced resource management efficiency and cost effectiveness.

Multidisciplinary TIM Training

A number of awareness level and hands-on, operational level training opportunities have been developed in an effort to fully implement multidisciplinary TIM operations into practice. Examples include the following:

- National Highway Institute's (NHI) *Incident Management Course Suite*[3] provides awareness level training for personnel from law enforcement, fire and rescue, emergency communications, transportation, towing and recovery, traffic reporting media, and other agencies or companies involved in responding to unplanned traffic incidents or planning special events and comprises the following three courses that may be taken in succession or individually:
    - *Managing Traffic Incident and Roadway Emergencies* (FHWA-NHI-133048A addresses institutional and technical aspects of resolving traffic incidents and roadway emergencies safely and efficiently;
    - *Managing Travel for Planned Special Events* (FHWA-NHI-133099) guides practitioners through all phases of managing travel for planned events using a local event scenario; and
    - *Using the Incident Command System (ICS) at Highway Incidents* (FHWA-NHI-133101) presents an overview of ICS, its structure, and how it expands and

contracts to meet the demands of an incident while maintaining a manageable span of control for people managing resources on-scene.

- I-95 Corridor Coalition's *Quick Clearance Toolkit*[4] is designed for use by multiple disciplines, including law enforcement, fire and rescue, emergency communications, transportation, towing and recovery, traffic reporting media, and other agencies or companies and provides policy makers and TIM practitioners with handy and ready-to-use tools (i.e., presentations, videos, and incident management scenarios and supporting information such as sample policies, laws, memoranda of understanding [MOU], or incident management plans) to assist them in providing more effective TIM practices with a primary emphasis on quick clearance.

- *Incident Commander*,[5]sponsored by the National Institute of Justice, is a PC-based software simulation that allows players to fill the role of Incident Commander and control various agencies (i.e., law enforcement, fire and rescue, EMS, and transportation) when responding to realistic incident scenarios that incorporate time delays and resource limitations.

- Currently under development by the Center for Advanced Transportation Technology (CATT) Lab, in partnership with the I-95 Corridor Coalition and Forterra Systems Inc., the *Virtual Incident Management Training*[6] program is designed to educate and validate incident management techniques and quick clearance practices and promote communications, coordination, and cooperation using practical, interactive incident scenarios for up to 500 responders representing law enforcement, fire and rescue, emergency communications, transportation, towing and recovery, traffic reporting media, and other agencies or companies simultaneously at a variety of locations across the I-95 Corridor.

In addition to these more established multidisciplinary training examples, a number of jurisdictions facilitate training in multidisciplinary TIM operations through table-top incident scenario exercises or full-scale mock incidents.

The commonality in each case is the focus on multidisciplinary participation in the training at both the awareness and hands-on, operational levels. The NTIMC's *Multidisciplinary Core Competencies* document[7], mentioned previously, supports these and other multidisciplinary training efforts by providing a common framework and list of core competencies that all TIM responders need to work together efficiently and effectively at traffic incident scenes. Continued awareness and cooperation among TIM responders at the operational level will facilitate the transfer of the multidisciplinary approach to TIM resource management. As TIM responders become more aware of each other's capabilities, resources, and priorities, opportunities for enhanced resource management efficiency and cost effectiveness can be more readily identified.

Resulting Benefits

Demonstrating the impetus for applying a similar approach to TIM resource management, the multidisciplinary approach in TIM operations has resulted in substantial and wide-ranging benefits.

The benefits of multidisciplinary TIM operations are most often tied to a reduction in overall incident duration and reported in monetary terms as a reduction in motorist delay, fuel consumption, harmful emissions, and/or secondary incidents involving either other motorists or response personnel. To demonstrate the magnitude of benefits realized, Atlanta, Georgia reported a reduction in:

- Average incident durations from 67 to 21 minutes;
- Vehicle-hours of delay of 7.25 million over one year with an annual cost savings of $152,053,180 (2003 dollars);
- Gasoline and diesel consumption of 5.17 million gallons and 1.66 million gallons, respectively, with a related annual cost savings of $10,365,969 (2003 dollars);
- Harmful emissions of 2,457 tons, 186 tons, and 186 tons of CO, HC, and NOx, respectively, with related annual cost savings of $1,247,985, $15,626,587, and $3,368,436 (2003 dollars); and
- Secondary crashes of 69 percent (from 676 to 210 in one year) and a related annual cost savings of $1,611,054 (2003 dollars).[8]

Similar benefits were reported previously in Maryland. In 2002, Maryland reported a reduction in:

- Average incident duration of 28.6 percent;
- vehicle-hours of delay of approximately 30 million;
- Fuel consumption of approximately 5 million gallons of fuel; and
- Secondary crashes by 377 incidents.[9]

The magnitude of these benefits, in economic terms, is high. Delay, fuel consumption, and harmful emission impacts are derived from per vehicle estimates of occupancy, wages, fuel efficiency, and emissions output applied to overall traffic volume estimates. In urban areas and along high-traffic routes, a sizeable volume of traffic may be impacted by a single incident. Extrapolated for the period of one year, the economic impacts of reducing incident duration by just a few minutes become significant.

The application of the multidisciplinary approach to TIM resource management may also contribute to these same areas of benefit by enhancing the overall efficiency and effectiveness of TIM operations. Instead, however, this document focuses on the more tangible benefits attributable to the most efficient and effective use of resources across all responding agencies in combination and incurred directly by public agencies. Economic savings are anticipated attributable to:

1. The utilization of personnel who are best qualified (i.e., capable but not over-qualified) for the various tasks (this, in turn, allows alternately skilled personnel to focus on other incident management functions),

2. The utilization of appropriate technology capable of supporting various on-site resource tasks,

3. The utilization of appropriate equipment by function (i.e., use of the least costly equipment capable of performing the function), and

4. A reduction in the overall resources required through reduced redundancy across disciplines.

3.0 THE MULTIDISCIPLINARY APPROACH IN TIM RESOURCE MANAGEMENT

Under a multidisciplinary approach, efficient and effective traffic incident management (TIM) resource management relies upon the utilization of appropriate:

- Personnel who are best qualified (i.e., capable but not over-qualified) for the various tasks. This, in turn, allows alternately skilled personnel to focus on other incident management functions. For example, the use of transportation personnel to manage traffic at and around the incident scene would relieve law enforcement personnel from this duty and allow them to perform other tasks for which they are trained (i.e., crash investigation).

- Equipment by function (i.e., use of the least costly equipment capable of performing the function). For example, a higher level of efficiency and equal or higher effectiveness may be obtained by using a transportation vehicle equipped with an arrow board and additional traffic control devices to protect the scene rather than law enforcement or fire and rescue vehicles.

- Technology capable of supporting various on-site resource tasks. For example, use of responsive traffic signal control plans to manage traffic at and around the incident scene would relieve law enforcement personnel from this duty and allow them to perform other tasks for which they are trained (i.e., crash investigation).

In addition, TIM resource management efficiency and effectiveness relies upon a reduction in overall resources required through reduced redundancy across disciplines.

This chapter describes a general framework for implementing a multidisciplinary TIM resource management approach into practice and provides various functional examples of opportunities for enhancing TIM resource management efficiency and effectiveness throughout the TIM process. In each case, resulting cost savings and efficiencies are dependent upon the ability to mobilize alternative personnel, equipment, and technology resources in a timely fashion.

Implementation Framework

Multidisciplinary TIM resource management, as with multidisciplinary TIM operations, is based on an understanding among responders of each others' roles, responsibilities, and capabilities. The more closely agencies work together, the more they discover how they can mutually accomplish their objectives as they respond to incidents and concurrently enhance the efficient and effective use of resources utilized at the incident scene.

At the most basic level, public agency operations personnel can begin to affect efficient and effective resource management on a per-incident basis. Where formal multidisciplinary TIM operation plans exist, existing policies and procedures can be reviewed with enhanced TIM

resource management in mind. For example, multidisciplinary responders may consider whether:

- Personnel who are best qualified (i.e., capable but not over-qualified) for the various tasks are currently utilized in those roles;
- The least costly equipment capable of performing the function is currently utilized;
- The use of technology is fully exploited to support various on-site tasks; and
- Any unnecessary duplication in resources is occurring.

If resource-related inefficiencies are identified in current TIM operations, appropriate revisions to formal multidisciplinary TIM operation plans, based on enhanced TIM resource management, will facilitate direct implementation into practice.

If these revisions to operations entail extensive policy or procedural changes or involve the sharing or exchange of various equipment or technologies, formal multidisciplinary agreements (i.e., Memoranda of Understanding or Agreement) may be required to facilitate implementation. These actions may require higher-level management and administrative support from multiple public agencies, particularly if funding is requested for additional equipment or technologies. Public agency management and administrative personnel serve to benefit by identifying, promoting, and demonstrating efficient and effective resource management within their respective agencies and among government agencies within their jurisdictions.

Similar to the Unified Command concept in TIM operations—where a single point of contact is responsible for the overall handling of the incident and decisions regarding specific actions by responding agencies are made through consultation with supervisors from other responding agencies—a similar structure may be required to facilitate decision making among public agencies under a multidisciplinary TIM resource management approach. Metropolitan planning organizations (MPOs) may provide a unique opportunity to support a broader multi-disciplinary approach to TIM beyond the current focus on operations through their distinctive role in facilitating regional planning and programming decisions, providing a forum for cooperative decision-making, working towards regional consensus, developing regional and institutional agreements, serving as a repository for comprehensive data, etc. Nearly 400 MPOs currently exist in the United States (U.S.); concentrated in urban areas with populations greater than 50,000. In recent years, MPOs have been encouraged to assume a greater and more consistent role in a broader range of activities, including resource management and TIM; and have noted that more effort needs to be made to support emergency response/management agencies in helping them achieve their goals.

Functional Examples

With little practical evidence of enhanced TIM resource management efficiency and effectiveness, various hypothetical examples are provided below to demonstrate the potential for improvements in TIM resource management through the use of appropriate personnel, equipment, and technology for select functions performed during the traffic incident

management process. Functions or tasks that are believed to benefit most from enhanced TIM resource management include the following:

- Motorist assistance,
- Dispatch and response,
- Scene protection,
- Temporary traffic control,
- Detour management,
- Firefighting,
- Minor spill mitigation and cleanup,
- Crash investigation,
- Victim relocation, and
- Vehicle or debris removal.

Three decision factors support the inclusion of these TIM functions:

1. Commonalities in responder competencies, identified by the National Traffic Incident Management Coalition (NTIMC) and observed in practice, suggest that responders from multiple disciplines be trained, to some extent, to perform a particular function;
2. Practice suggests that more than one type of equipment is interchangeably used for a particular function, and/or
3. Technology has been developed specifically to perform a particular function currently supported by other resources.

Specific opportunities to "exchange" higher cost personnel or equipment for lower cost, equally effective resources or technology are described for select functional areas below and summarized in Table 1. This list is not fully comprehensive; public agencies are encouraged to be creative when considering additional opportunities for enhancing TIM resource management.

Table 1. Appropriate Personnel, Equipment, and Technology for Select Functions

Functions	Personnel	Equipment	Technology
Motorist Assistance	• Transportation (dedicated)	• Transportation vehicle (dedicated)	
Dispatch and Response			• Closed-circuit television • Automatic vehicle location/ geographic information systems • Traffic signal priority systems

Functions	Personnel	Equipment	Technology
Scene Protection		• Transportation vehicle/arrow board • Traffic control devices	• Portable intrusion alarm systems
Temporary Traffic Control	• Transportation	• Transportation vehicle/arrow board • Traffic control devices • Variable message signs	
Detour Management	• Transportation	• Transportation vehicle/arrow board • Traffic control devices • Variable message signs	• Responsive traffic signal control systems
Firefighting	• Fire and Rescue (major) • Law Enforcement/ Transportation (minor)		
Minor Spill Mitigation and Cleanup	• Transportation	• Plugs/plug materials • Containment devices • Absorbent materials	
Crash Investigation	• Law Enforcement		• Total station surveying equipment • Photogrammetry
Victim Relocation	• Transportation (with Law Enforcement/Medical Examiner consent)		
Vehicle or Debris Removal	• Transportation	• Transportation vehicle/push bumper • Front end loader • Dump truck • Sweeper	

Motorist Assistance

Motorist assistance (i.e., replacing a flat tire, performing minor mechanical repairs, providing water or gasoline) is most often provided by law enforcement or transportation agencies through routine or specially established roving patrols.

Utilization of Appropriate Personnel

Motorist assistance tasks typically rank low in priority for law enforcement personnel given the breadth of their duties related to enforcing and investigating criminal activity. Similarly, these tasks may rank low in priority with transportation personnel who are not tasked exclusively with performing these functions (i.e., if they are also tasked with performing broader maintenance-related activities). Personnel who are dedicated to providing motorist assistance (i.e., as a service or courtesy patrol) may provide these services most effectively. Law enforcement personnel, who receive specialized training in criminal law, investigatory procedures, and the use of firearms, may be underutilized in this capacity. Transportation personnel, whose nature and extent of training most closely aligns with the required motorist assistance functions, may provide these services most efficiently.

Utilization of Appropriate Equipment

Use of standard law enforcement vehicles (i.e., police cruisers) to provide motorist assistance may underutilize specialized vehicle features designed to support criminal enforcement,

pursuit, transport, documentation, etc. Conversely, storage capacity limitations may restrict the extent motorists assistance services are provided (i.e., provision of gas or water, mechanical repair, etc.). Transportation vehicles that are not exclusively dedicated to providing motorist assistance services are similarly challenged (i.e., over-equipped to respond to broader maintenance-related tasks, but under-equipped to respond to motorist assistance needs), but provide several advantages over the use of standard law enforcement vehicles. The cost of a fully-equipped transportation maintenance vehicle is typically less than that of a fully-equipped law enforcement cruiser. In addition, these vehicles typically provide additional storage capacity to allow for greater responsiveness to motorist assistance needs.

Transportation or law enforcement agencies that provide dedicated motorist assistance (i.e., as a service or courtesy patrol) may opt to invest in and operate appropriately sized and equipped vehicles designed specifically to support motorist assistance. This strategy would enhance the effectiveness of motorist assistance and may reduce overall pubic agency equipment costs.

Dispatch and Response

The dispatch of appropriate resources to the scene and the expediency with which those resources reach the scene are dependent upon a number of factors including the amount and accuracy of information relayed to responders regarding the incident circumstances, the location and availability of response resources, and the level of traffic congestion and availability of alternative access routes. The dispatch of inappropriate resources to the scene or any delays encountered in getting those resources to the scene extends the overall duration of the incident and results in subsequent inefficiencies in the use of public agency resources.

Utilization of Appropriate Technology

A number of technologies have been developed and are currently utilized to ensure appropriate dispatch and expedient response of resources to the incident scene. Closed-circuit television systems, typically installed and maintained by transportation agencies, can support broader dispatch activities for multiple responders if the images are made available through common traffic management centers or through less formal image exchange arrangements. Access to images of the incident prior to arriving on-scene supports both the dispatch of appropriate equipment (i.e., heavy-duty wrecker) and quicker dispatch of resources (i.e., instant tow dispatch). Use of automatic vehicle location and geographic information system technologies can identify and mobilize resources that are closest in proximity to the incident scene, reducing overall travel times. Traffic signal priority systems can reduce delay for emergency vehicles along signalized arterials en route to the incident scene.

Scene Protection

Prior to establishing or as an ongoing supplement to on-scene traffic control, incident responders will commonly use their response vehicles upstream of the incident to protect the scene from approaching traffic.

Utilization of Appropriate Equipment

Fire and rescue vehicles are commonly used to protect the incident scene because of their large size and conspicuity. However, a significant cost may be incurred if these specially designed and equipped vehicles are struck by an approaching vehicle.

Law enforcement vehicles, equipped with light bars, are also used to protect the scene. Use of law enforcement vehicles—if observed early—may illicit a greater cooperation from approaching motorists (i.e., reduction in speed, earlier lane change/merge activity, etc.) if they suspect the potential for a citation, but because of their smaller size, these vehicles incur a greater amount of damage if impacted by an approaching vehicle.

A higher level of efficiency and equal or higher effectiveness may be achieved by using a transportation vehicle, equipped with an arrow board, to protect the scene. The use of an arrow board not only provides conspicuity but also actionable direction for approaching motorists (i.e., merge left). Transportation vehicles are also often equipped with additional traffic control devices (i.e., cones, portable signs) that can be used concurrently to warn and guide approaching motorists, reducing the likelihood of an unintended collision with the response vehicles.

Utilization of Appropriate Technology

Portable intrusion alarm systems provide a technology-based alternative to the use of response vehicles for scene protection. Consisting of a sensing mechanism (based on infrared, microwave, or pneumatic tube technology) that forms a partial perimeter around the incident scene and an audible alarm that warns incident responders if an approaching vehicle inappropriately enters the scene, intrusion alarm systems provide effective scene protection at a significantly reduced cost (i.e., less than $4,000 per unit) when compared to the cost of fire and rescue, law enforcement, or transportation response vehicles.

Temporary Traffic Control

The *Manual on Uniform Traffic Control Devices* (2003)[10] defines appropriate standards and guidelines for the control (i.e., traffic diversions, tapered lane closures, and upstream warning devices to alert approaching traffic of the end of a queue) of traffic for major, intermediate, and minor incidents (Chapter 6I). Temporary traffic control serves to move motorists safely and expeditiously past or around the incident, to reduce the likelihood of secondary traffic crashes, and to preclude unnecessary use of the surrounding local road system. Within 15 minutes of arrival, responders should establish appropriate temporary traffic controls based on estimates of the magnitude and expected time duration of the incident and the expected vehicle queue length.

Utilization of Appropriate Personnel

Although all responders, regardless of discipline, are trained to provide temporary traffic control, the extent of training received differs significantly. For example, law enforcement personnel may receive a minimum of 480 hours of academy training focused on offensive and defensive tactics, criminal investigation, use of firearms, etc. Traffic control and direction procedures typically account for only two hours in the overall curriculum. Fire and rescue personnel receive a similar level of traffic control training. By comparison, transportation personnel typically receive a minimum of 16 hours of traffic control training, allowing them to perform these functions most effectively and efficiently.

Utilization of Appropriate Equipment

Transportation agencies provide a second distinct advantage in the provision of temporary traffic control. Both law enforcement and fire and rescue vehicles suffer from storage capacity constraints. Law enforcement vehicles (i.e., cruisers) are relatively small in size and designed for passenger rather than equipment transport. Fire and rescue vehicles are larger, but

provide little excess storage capacity once fully equipped with hoses, pumping systems, ladders, axes, ventilators, etc. to support their unique functions.

Comparatively, transportation vehicles are designed and equipped to directly perform traffic control functions in support of routine maintenance activities, construction activities, or incidents. Transportation vehicles are typically equipped with an arrow board and traffic control devices (i.e., cones, portable signs, etc.). Transportation personnel also have direct access to additional traffic control devices not immediately carried on the vehicle. Separate trailers carrying additional cones, barrels, static signs, or portable variable or dynamic message signs can be requested and appropriately deployed at the incident scene. Improvement in the effectiveness and efficiency of temporary traffic control functions, as performed by transportation agencies, is highly dependent on the ability to mobilize transportation personnel and equipment quickly.

Detour Management

When an incident blocks one or more lanes of travel, motorists at or approaching the incident scene either voluntarily detour or are directed to alternate routes by incident responders. Alternate routes are commonly lower level, parallel roadways (i.e., signalized arterials, collectors, etc.) that are not designed to carry the same volume of traffic as the affected roadway. As such, traffic flow along the detour must be actively managed to prevent excessive delay and/or secondary incidents.

Utilization of Appropriate Personnel

Responsibility for establishing and maintaining detour routes typically rests cooperatively with law enforcement and transportation agencies. Transportation personnel typically receive a minimum of 16 hours of traffic control training, which includes proper procedures for establishing detour routes. Law enforcement personnel receive significantly less training in traffic control procedures. To maintain traffic flow along the alternate route, law enforcement or personnel may provide positive traffic control using officers staged at key locations (i.e., intersections) and/or may access fixed, alternate signal timing plans (i.e., to allow increased “green time” in the parallel direction) for isolated signalized intersections along the route.

Utilization of Appropriate Equipment

Transportation vehicles are typically equipped with an arrow board and traffic control devices (i.e., cones, portable signs, etc.). Transportation personnel also have direct access to additional traffic control devices not immediately carried on the vehicle. Separate trailers carrying additional cones, barrels, static signs, or portable variable or dynamic message signs can be requested and appropriately deployed at the incident scene. Use of properly deployed traffic control devices, including static and variable or dynamic message signing, can release law enforcement personnel tasked with providing advance warning and reducing approach speeds, closing critical access points or on-ramps, etc.

Utilization of Appropriate Technology

To maintain traffic flow along the alternate route, law enforcement or personnel may provide positive traffic control using officers staged at key locations (i.e., intersections) and/or may access fixed, alternate signal timing plans (i.e., to allow increased “green time” in the parallel direction) for isolated signalized intersections along the route. Depending on the level of instrumentation along alternate routes, transportation personnel may be able to access more sophisticated traffic signal control systems that are responsive to real-time traffic demand, improving overall traffic flow on the roadway network. Use of responsive traffic signal control

systems can release law enforcement personnel tasked with performing positive traffic control or signal timing plan adjustments for isolated signalized intersections along the detour route.

Firefighting

A motor vehicle contains flammable liquids (i.e., gasoline, oil), solid combustibles (i.e., upholstery), and multiple potential sources of ignition (i.e., electrical short circuits, fuel leakages onto hot exhaust systems). Roughly two-thirds of highway vehicle fires are caused by some form of mechanical or electrical failure; with electrical wire, cable insulation, flammable or combustible liquid or gas as the first item ignited.[11]

Utilization of Appropriate Personnel

Fire and rescue personnel are most highly trained in firefighting capabilities. Through classroom instruction and practical training, the recruits study firefighting and suppression techniques for a variety of fire types, including flammable liquid and cargo tank fires, and are trained in vehicle extrication and rescue, hazardous materials control, and emergency medical procedures, including first aid and cardiopulmonary resuscitation (CPR). Both law enforcement and transportation personnel are commonly equipped with fire extinguishers to manage small-scale fires. If the fire can be fully mitigated through transportation or law enforcement personnel response—whoever is first to arrive on-scene—the cost of mobilizing fire and rescue personnel and equipment could be saved.

Minor Spill Mitigation and Cleanup

Minor spills from motor vehicles are generally petroleum products, and most commonly are crank-case engine oil, gasoline, or diesel fuel, but may also include coolants and transmission, brake, hydraulic, or other fluids. These may originate from the engine, drive train, fuel tanks, wheel assemblies, compressors, air handlers, or any component of the vehicle, including tractor and trailer as applicable. With respect to TIM operations, spilled motor vehicle fluids intrinsic to the operation of the vehicle are distinguished from hazardous cargo or hazardous substance spills. Typically, absorbed vehicle fluids rarely fail Toxicity Characteristic Leaching Procedures (TCLP) and thus are usually not hazardous wastes.[12]

Utilization of Appropriate Personnel

Fire and rescue and transportation personnel—as well as private towing and recovery, contractor, and responsible party personnel—are trained for mitigation and cleanup of small spills (i.e., lubricants, fuels). Responders should have *Right-to-Know* information (*Code of Federal Regulations, Title 29: Labor § 1910.1200 Hazard Communication*)[13] for handling these motor vehicle fluids and have completed at least the **Awareness** level of hazardous material training.

Considering public agency personnel only, transportation personnel may be mobilized more efficiently for such a cleanup if fire and rescue personnel are not otherwise required to be on the scene. If both are required to be on the scene, the performance of spill mitigation and cleanup tasks by transportation personnel would release fire and rescue personnel to focus on other tasks for which they are uniquely trained, such as vehicle extrication.

Utilization of Appropriate Equipment

Properly equipped responders, regardless of discipline, can take prompt action to stop the spill at its source; contain and limit the size of the spill; limit the damage to the pavement

surface; and prevent any flammable material from catching fire, reducing the overall duration of the incident.

Premixed high-absorption polymer/bentonite materials (e.g., Plug N' Dike™), that adhere to any wet, dry, or uneven surface, are most commonly used by fire and rescue and transportation agencies to plug a motor vehicle fluid leak at its source. Pre-cut wooden plugs can also be used to mitigate the impacts of a spill. Pails, buckets, kiddy pools, as well as hand transfer pumps, can be used to contain and limit the amount of motor vehicle fluids reaching the roadway. Booms, socks, topsoil, or other material can be used to contain any on-road spilled material through diking or berming. To clean-up motor vehicle fluids that reach the roadway, absorbent materials such as granular absorbents or vermiculite, floor sweep, peat moss, pads and booms, clay, or topsoil can be used. In limited situations, sand can also be used, but generally provides better adhesion (i.e., increased friction) than absorption. If immediately available, a light dusting of Portland Cement Concrete provides an alternate method for addressing the thin film that may remain after absorbents are used.[12]

If larger quantities of containment or cleanup materials (i.e., topsoil, peat moss, clay) are required, transportation agencies are better equipped to respond efficiently and effectively.

Crash Investigation

Law enforcement agencies are typically responsible for crash investigation, documenting all pertinent physical evidence and details at the incident scene. Traditional methods for capturing this information include the triangulation method and the coordinate or base tape method. The triangulation method relies on two stationary points. For each object to be documented, two measurements are required: the distance from the object to the first and second reference points, respectively. Either a measuring tape or wheel is used to collect the measurements. The coordinate or base tape method relies on a base or reference tape that is laid through or adjacent to the incident scene and a reference point along this tape. For each object to be documented, three measurements are noted: the distance along the base tape measured from the reference point, the distance perpendicular from the base tape (measures with a second measuring tape or wheel, and the direction of the object from the base tape. Traditional crash investigation methods require substantial time and manpower to properly investigate serious vehicular crashes and document on-scene data.

Utilization of Appropriate Technology

Various types of technology have been demonstrated to dramatically reduce incident duration while increasing the quality and quantity of measurements captured.

Total Station Surveying Equipment (TSSE) uses an infrared electronic distance meter combined with a rod-mounted prism to automatically measure horizontal distance to an object; a theodolite to measure horizontal angle; and an internal level to measure vertical rise. These measurements can be obtained simultaneously and recorded automatically. Early demonstration studies of TSSE indicated:

- a decrease in the crash investigation time of 33 percent, a twofold increase in the number of measurements obtained, and a decrease in law enforcement manpower required of 50 percent[14] and

- a decrease in the crash investigation time of 54 percent, a decrease in average incident clearance time of 51 minutes, and a 70 percent increase in the number of measurements obtained per hour.[15]

Photogrammetry, the technique of measuring objects from photographs or digital images, provides an alternative to TSSE for crash investigation and reconstruction by law enforcement agencies. Close range photogrammetry involves three steps: taking photographs, measuring the photographs, and processing the measurements to produce an accurate diagram. First, photographs are taken of the incident scene with key and relevant objects designated with evidence markers. In order to obtain a three-dimensional representation of the scene, these markers must be included in at least three different photographs taken at wide angles. One scale measurement must also be taken at the scene; normally, an object of known scale is simply placed in the scene. In the office, the pictures are imported into specialized software that develops measurements, scale diagrams, and computer-generated pictures.[16]

Photogrammetry equipment has a lower capital cost than that of TSSE, resulting in either a reduction in agency cost or the ability to procure additional units for the same cost. A photogrammetry package, including a quality camera, evidence markers, analysis software, and a drawing program, can cost $3,000 to $4,000. TSSE, including the instrument and field equipment and drawing package, can easily cost upward of $8,600 to $10,000.[16] Having more crash investigation units available would reduce the response time to the scene of an incident, further reducing the resulting delay.

Victim Relocation

Traffic incidents involving fatalities—requiring law enforcement investigation and additional response by the county medical examiner—often result in extended lane or roadway closures. When responding to fatality traffic incidents, it is important to balance the need for thorough investigations into the cause of death, with the need to minimize responder exposure to danger, minimize risk of secondary incidents involving the motoring public, respect the dignity and privacy of the decedent and the decedent's family, and restore the flow of traffic.

Legislation in several states allows and encourages relocation of the victim out of the roadway following the arrival of the medical examiner on-scene to prevent further harm to the victim or survivors of the incident, incident responders, and/or the motoring public. In some states, such as Tennessee and Texas, the victim is allowed to be relocated by law enforcement personnel prior to the arrival of the medical examiner on the scene with emergency medical services personnel able to provide certification of death on-site.

The extent of victim relocation varies; some programs encourage relocation to the morgue or other off-site location while some encourage relocation just off the roadway.

Utilization of Appropriate Personnel

For victim relocation just off the roadway, transportation personnel—acting only under express mutual consent from law enforcement and medical examiner agencies—may provide the greatest efficiency. If the victim is still inside of the vehicle, transportation personnel can push or tow the vehicle and victim out of the travel lane or off of the shoulder to a nearby location that is safer and less visible to passing motorists. If the victim is no longer in the vehicle, transportation personnel can remove the deceased to a location well off of the

shoulder. The use of transportation personnel for on-site victim relocation affords law enforcement personnel the opportunity to begin the crash investigation process, for which they are uniquely trained. For victim relocation to an off-site location some distance from the incident scene, the use of private transport and/or towing and recovery contractors may be required. Longer transport distances may require accompanying law enforcement personnel to preserve the chain of evidence.

Vehicle and Debris Removal

Incident-involved vehicles range in size from motorcycles to multi-trailer trucks. Although larger, heavier vehicles, and/or vehicles that have become entangled with the roadway infrastructure, require specialty response equipment to clear, most vehicles can be expeditiously moved from the travel lane or off of the shoulder using push bumper equipped response vehicles or standard tow vehicles.

The resultant debris left in the roadway following an incident is similarly variable, ranging from minor involved vehicle appurtenances to entire truckloads of bulk materials (i.e., sand, gravel, etc.) or perishable and non-perishable cargo (i.e., livestock, produce, electronics, etc.).

Utilization of Appropriate Personnel

Vehicle and debris removal is most often the responsibility of law enforcement or transportation personnel, either directly using their own personnel and equipment or through the dispatch of private towing and recovery personnel. Personnel from both law enforcement and transportation agencies are trained and experienced in the safe use of push bumpers and/or towing packages to quickly clear vehicles from the roadway and are trained to be cautious when working in moving-traffic environments to provide debris cleanup. Use of transportation personnel for vehicle and debris removal would release law enforcement personnel to focus on other tasks for which they are uniquely trained, such as crash investigation for the current incident, or would allow them to return into service more quickly to perform duties elsewhere.

Utilization of Appropriate Equipment

Typically, law enforcement and transportation agencies utilize vehicles equipped with push bumpers or limited tow capabilities intended to support the quick clearance of vehicles from the roadway. Law enforcement vehicles (i.e., cruisers) equipped with push bumpers may be more likely to incur damage than transportation vehicles (i.e., medium or heavy duty pickup trucks) when removing involved vehicles from the roadway because of size and design differences. For debris removal, particularly following cargo spills, transportation agencies are uniquely equipped with front end loaders, dump trucks, sweepers, etc., to efficiently and effectively remove large quantities of debris from the roadway.


KEEP
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4.0 COMMON TIM RESOURCES, FUNCTIONS, AND COSTS

To transition from these hypothetical examples of potential traffic incident management (TIM) resource management improvements (achieved through the use of appropriate personnel, equipment, and technology) to practical, measurable evidence of cost savings, a clear understanding of the common TIM resources, and their respective functions and costs, is required.

Information regarding common TIM resources, functions, and costs was gathered in two distinct stages. First, a comprehensive list (i.e., inventory) of common TIM personnel, equipment/technology, and supplies/materials resources and their functions was assimilated based on information:

1. Contained in existing incident and emergency management databases,
2. Published in formal TIM documents, and
3. Provided by the National Incident Management System (NIMS), Federal Emergency Management Agency (FEMA), and others.

Second, estimated costs for select TIM personnel, equipment/technology, and supplies/materials resources were gathered as part of a broader *Incident Scenario Survey* (described in more detail in *Chapter 5. Potential Efficiency Improvements and Associated Cost Savings*). Cost information was limited to those TIM resources utilized in response to an intermediate level incident occurring on a limited-access, high-speed roadway; involving three vehicles blocking two lanes; with a minor gasoline leak and entrapped driver. Various law enforcement, fire and rescue, emergency medical services, and transportation personnel from eight different highly developed and developing TIM program jurisdictions provided the cost information.

Personnel

Personnel resources generally comprise operations and supervisory personnel, with various noted specializations. Table 2 summarizes common TIM personnel resources, their functions, and select costs.

Table 2. Common TIM Personnel Resources, Costs, and Functions

Personnel	Estimated Cost		Scene Protection	Traffic Control	Medical Care	Firefighting/Extrication	Response Mobilization	Fuel Leak Mitigation	Crash Investigation	VMS/HAR Messages	Traffic Signal Control	Public/Media Information	Vehicle Removal	Cleanup	Documentation
	Range	**Mean**													
Law Enforcement															
Trooper/Officer	$20.00-35.00	$26.75	F	F	L	L	F		F	L	L	L	F	F	F
Sergeant	$25.00-30.00	$27.50													
Lieutenant	$27.00-32.50	$29.75													
Captain/Commander															
Chief/Major															
Fire and Rescue															
Driver/Engineer	$27.50	$27.50	F	L	L	F		F						L	F
Firefighter	$26.00-36.81	$31.69													
Lieutenant	$31.00-43.57	$37.14													
Captain	$35.00-50.00	$42.87													
Battalion Chief	$42.00	$42.00													
Deputy Chief															
Assistance Chief															
Chief															
Emergency Medical															
Certified First Responder			L		F										F
EMT-Basic	$30.00	$30.00													
EMT-Intermediate															
EMT-Paramedic	$35.00-45.00	$39.63													
Critical Care Paramedic															
Lieutenant	$45.00	$45.00													
Captain	$53.54	$53.54													
Transportation															
Equipment Operator			F	F	L	L	L	L		F	F	F	F	F	F
Worker/Technician															
Lead Worker/Technician	$18.00	$18.00													
Maintenance Supervisor	$17.58-25.50	$21.54													
Service Patrol Operator	$20.00-29.00	$24.50													
Traffic Management Center (TMC) Operator	$30.00	$30.00													
Traffic Signal Operator															
Engineer															

L = Limited capacity, support role F = Full capacity, lead role

Resources by Agency

Public safety agencies—including law enforcement, fire and rescue, and emergency medical services—provide a structured rank of personnel ranging from the operations to supervisory levels with generally increasing monetary compensation increments. This structured rank suggests a breadth in training and capabilities across all personnel levels (i.e., supervisory rank personnel are trained in and capable of performing operational level duties). Transportation personnel ranks are less evident; with several observed specialized positions (i.e., traffic signal operator, TMC operator) whose personnel may or may not be able to perform duties outside of their area of expertise.

Monetary compensation is generally higher for law enforcement, fire and rescue, and emergency medical services personnel. Based on the information received from the *Incident Scenario Survey*, law enforcement operations personnel earn from $26.75 per hour at the trooper/officer level to $27.50 per hour at the sergeant level, on average. Fire and rescue operations personnel earn from $27.50 per hour at the driver/engineer level to $31.69 per hour at the firefighter level, on average. Emergency medical services (EMS) operations personnel earn from $30.00 per hour at the emergency medical technician (EMT)-basic level to $39.63 per hour at the EMT-paramedic level, on average. Supervisory positions in each of these agencies have higher monetary compensations; up to $29.75 per hour for a law enforcement lieutenant, up to $42.00 per hour for a fire and rescue battalion chief, and up to $53.54 per hour for an EMS captain, on average. Transportation operations personnel that respond on-scene typically earn from $18.00 per hour at the lead worker/technician level to $24.50 per hour at the service patrol operator level, on average. Specialized transportation operations personnel were reported to earn higher monetary compensations; up to $30.00 per hour for a TMC operator.

Law enforcement and transportation personnel have the greatest breadth of duties across common TIM functional areas. Law enforcement personnel often lead efforts to protect the scene, close lanes and provide temporary traffic control, mobilize additional response (i.e., towing and recovery), investigate the crash, remove the vehicle and clean up any remaining debris, and document the incident. Law enforcement personnel are also capable of providing initial medical care to injured persons, putting out small fires, modifying vicinity traffic signal timings to better accommodate rerouted traffic, and providing traveler information via messages posted on variable message signs (VMS) or through media contacts. Transportation personnel have a similar breadth in duties, acting in the same or different capacities as law enforcement (i.e., leading the effort or providing a support role). Fire and rescue and EMS personnel are more focused in the duties that they perform. Fire and rescue personnel often lead efforts to protect the scene, fight fires and extricate entrapped victims, and respond to hazardous and non-hazardous material spills while EMS personnel focus almost exclusively on providing medical care to injured persons.

Resources by Function

As noted previously, commonalities in responder competencies, identified by the National Traffic Incident Management Coalition and observed in practice, suggests that responders from multiple disciplines are trained, to some extent, to perform a particular function. Table 2 summarizes this phenomenon. With the exception of crash investigation, each of the common TIM functional areas can be performed by personnel from multiple agencies, with varying degrees of efficiency and effectiveness. Personnel from each agency are capable of providing scene protection, initial medical care, and documentation. With the exception of EMS personnel, personnel from each agency are capable of providing temporary traffic

control, limited firefighting, and cleanup. Transportation and law enforcement personnel are each capable of mobilizing extra response, providing traveler information via VMS or through media contacts, modifying traffic signal timings, and removing the vehicle from the roadway. Fire and rescue and transportation personnel are each capable of mitigating minor vehicle fluid leaks.

Equipment and Technology

Equipment and technology resources generally comprise vehicles, appurtenances, and stand-alone devices that support TIM functions. Table 3 summarizes common TIM equipment and technology resources, their functions, and select costs.

Table 3. Common TIM Equipment and Technology Resources, Costs, and Functions

Equipment/Technology	Estimated Cost		Service Life		Scene Protection	Traffic Control	Medical Care	Firefighting/Extrication	Response Mobilization	Fuel Leak Mitigation	Crash Investigation	VMS/HAR Messages	Traffic Signal Control	Public/Media Information	Vehicle Removal	Cleanup	Documentation
	Range	Mean	Range	Mean													
Law Enforcement																	
Motorcycle	$25,000	$25,000	4	4		X											
Cruiser with Light Bar/Push Bumper	$30-48,000	$41,400	3-7	4.2	X	X									X		
Light-Duty Pickup/SUV					X	X									X		
Portable Laser Warning System					X												
Physical Incident Screen						X											
VMS/HAR					X	X						X					
Traffic Cones/Signs	$100	$100	20	20	X	X											
Laptop Computer	$1,500	$1,500	3	3							X						X
Total Station Surveying Equipment											X						X
Perspective Grid Investigation System											X						X
Other Crash Investigation System	$3,000	$3,000	5	5							X						X
Tape Measure	$80	$80	10	10							X						X
Camera/Video	$5,000	$5,000	10	10							X						X
Broom/Blower																X	
Fire and Rescue																	
Light-Duty Pickup/SUV	$50,000	$50,000	5-8	6.5	X	X											
Truck	$400-600,000	$500,000	7-10	8.5	X	X		X									
Engine	$350-500,000	$450,000	7-20	14.5	X	X		X									
Tanker					X	X		X									
Rescue Vehicle	$350-800,000	$550,000	7-20	16.2	X	X	X	X									
HAZMAT Vehicle	$650,000	$650,000	15	15	X	X		X		X						X	
Quintuple Pumper	$650,000	$650,000	10	10	X	X		X									
EMS Kit	$10,000	$10,000	NA	NA			X										
Hydraulic Tools	$18,000	$18,000	NA	NA				X									
Hand Tools	$250	$250	NA	NA						X						X	

Equipment/Technology	Estimated Cost		Service Life		Scene Protection	Traffic Control	Medical Care	Firefighting/Extrication	Response Mobilization	Fuel Leak Mitigation	Crash Investigation	VMS/HAR Messages	Traffic Signal Control	Public/Media Information	Vehicle Removal	Cleanup	Documentation
	Range	Mean	Range	Mean													
Traffic Cones/Signs					X	X											
Emergency Medical																	
Non-transporting Vehicle	$50-75,000	$56,250	5	5	X		X										
Type I Ambulance (Pickup Chassis)	$200-300,000	$237,500	7-10	9			X										
Type II Ambulance (Vanbulance)							X										
Type III Ambulance (Van Chassis)	$140,000	$140,000	8	8			X										
Medevac							X										
Transportation																	
Pickup with Arrow Board/Push Bumper	$20-50,000	$35,240	3-10	5.2	X	X									X		
Fully-equipped Service Patrol Vehicle	$75,000	$75,000	4	4	X	X									X		
Tow Truck															X		
Backhoe/Front End Loader																X	
Dump Truck																X	
Empty Box/Livestock Trailer																X	
Empty Tanker Truck																X	
Sweeper/Blower																X	
Physical Incident Screen						X											
VMS/HAR					X	X						X		X			
Traffic Cones/Signs					X	X											
Broom/Blower																X	
Responsive Traffic Signal Systems						X							X				
TMC						X						X	X	X			X

Resources by Agency

Law enforcement vehicles used for TIM most commonly include cruisers equipped with a light bar and push bumper, although motorcycles may also be used to enhance access to the scene when traffic is queued. These vehicles generally provide scene protection and support traffic control. Accompanying equipment, carried in the cruisers or an alternate vehicle, generally supports temporary traffic control (i.e., traffic cones/signs, VMS), crash investigation and documentation (i.e., crash investigation systems, tape measure, camera/video), and removal of debris (i.e., broom/blower).

Fire and rescue agencies typically operate heavy-duty, specially designed vehicles (i.e., fire trucks, engines, tankers, rescue vehicles, hazardous material response vehicles, etc.) that support unique firefighting/extrication and hazardous material spill response duties. Depending on their particular function, these vehicles may be equipped with EMS kits to support advanced medical care to injured persons or hydraulic extrication tools. Most vehicles carry traffic cones/signs and hand tools (i.e., shovels, picks) to support initial traffic control and spill mitigation through diking/berming, respectively. EMS agencies also operate

specially-designed and fully-equipped vehicles (i.e., ambulances) that support initial and advanced medical care and transport for injured persons.

Transportation agencies most commonly operate commercially available medium or heavy duty pickup trucks that are retrofitted with additional features, including push bumpers and arrow boards, and equipped with traffic cones/signs and hand tools (i.e., broom, shovel) to support debris removal. If dedicated to provide motorist assistance, these vehicles may carry mechanics tools, gasoline, water, etc. Transportation agencies also have access to a variety of heavy-duty equipment used to support maintenance and construction activities, including backhoes and front end loaders, dump and tanker trucks, box trailers, sweepers, etc. This equipment can be used to support large-scale debris cleanup efforts. Off-site, responsive traffic signal systems or a TMC may support efforts to facilitate traffic flow around the incident scene.

Resources by Function

Fewer commonalities in equipment function are observed between the various TIM response agencies. Certain fire and rescue vehicles are equipped to provide advanced medical care, similar to EMS vehicles. Both law enforcement and transportation vehicles are often equipped with push bumpers for quickly removing vehicles from the travel lanes or shoulder. Additionally, law enforcement, fire and rescue, and transportation agencies commonly carry various hand tools in their vehicles to support debris removal and cleanup. The most pronounced commonality is the use of each agency's vehicles for scene protection. Varying levels of cost may be incurred if these response vehicles (used for scene protection) are struck by an approaching vehicle. In generally decreasing order, average replacement costs for: fire and rescue vehicles range from $50,000 to $650,000 (average service life of 6.5 to 16.2 years); EMS vehicles are $50,000 (average service life of 5 years); law enforcement vehicles are $41,400 (average service life of 4.2 years); and transportation vehicles range from $35,240 to $75,000 (average service life of 4 to 5.2 years).

Supplies and Materials

Expendable TIM supplies and materials resources, their functions, and select costs are summarized in Table 4.

Table 4. Common TIM Supplies and Materials Resources, Costs, and Functions

Supplies/Materials	Estimated Cost		Scene Protection	Traffic Control	Medical Care	Firefighting/ Extrication	Response Mobilization	Fuel Leak Mitigation	Crash Investigation	VMS/HAR Messages	Traffic Signal Control	Public/Media Information	Vehicle Removal	Cleanup	Documentation
	Range	Mean													
Law Enforcement															
First Aid Supplies	$8	$8			X										
Emergency Blanket					X										
Fire Extinguisher	$50	$50				X									
Flare/Fusee	$20-40	$30	X	X											
Spray Paint	$3-5	$4							X						X
Film	$6	$6							X						X
Fire and Rescue															
First Aid Supplies	$9-100	$54.50			X										
Emergency Blanket					X										
Fire Extinguisher						X									
Flare/Fusee			X	X											
Absorbent Material/Pad	$40-50	$47.50						X						X	
Plugs/Plug Material	$25-80	$52.50						X						X	
Containment Boom	$66	$66						X						X	
Emergency Medical															
First Aid Supplies	$40-250	$145			X										
Emergency Blanket					X										
Transportation															
First Aid Supplies					X										
Emergency Blanket					X										
Fire Extinguisher						X									
Flare/Fusee			X	X											
Absorbent Material/Pad	$2-20	$11						X						X	
Plugs/Plug Material								X						X	
Containment Boom								X						X	
Spray Paint															X

Resources by Agency

The expendable supplies and materials utilized by each agency mimic their TIM functional duties. Law enforcement personnel commonly carry first aid supplies to support initial medical care, fire extinguishers to support minor fire control, and flares/fusees to support temporary traffic control. Additionally, law enforcement personnel carry spray paint and film to support crash investigation and documentation. Fire and rescue personnel also carry first aid supplies, fire extinguishers, and flares/fusees, but also carry absorbent material/pad, plugs/plug material, and containment booms to support efforts to mitigate small vehicle fluid spills. Based on their singular focus on providing medical care, emergency medical services

carry a greater selection and quantity of first aid supplies. Similar to fire and rescue personnel, transportation personnel carry first aid supplies, fire extinguishers, and flares/fusees, but also carry absorbent material/pad, plugs/plug material, and containment booms to support mitigation of small vehicle fluid spills.

Resources by Function

Similar to the commonalities observed for agency personnel and equipment across various TIM functional areas, some duplication exists in the expendable supplies and materials utilized. Law enforcement, fire and rescue, and transportation personnel each carry first aid supplies to support initial medical care; fire extinguishers to support minor fire control; and flares/fusees to support temporary traffic control. Emergency medical agencies also carry first aid supplies. Fire and rescue and transportation personnel each carry absorbent material/pad, plugs/plug material, and containment booms to support efforts to mitigate small vehicle fluid spills. Law enforcement and transportation personnel each carry spray paint to support documentation efforts.

5.0 POTENTIAL EFFICIENCY IMPROVEMENTS AND ASSOCIATED COST SAVINGS

Building upon the hypothetical examples of traffic incident management (TIM) resource management efficiency improvements provided in *Chapter 3* and the TIM resource function and cost information provided in *Chapter 4*, a general estimate of efficiency improvements and associated cost savings could be derived. Lacking from this estimate, however, would be a general indication of the quantity and duration of service/use for respective TIM resources. Hence, a comparative *Incident Scenario Survey* was conducted to identify disaggregate resource utilization and costs and refine the overall estimate of associated cost savings attributable to TIM resource management efficiency improvements.

A survey instrument was developed that included a description of a common incident scenario set in each jurisdiction's locale (see Appendix A):

Figure 1. Incident Scenario Survey

DATE/TIME: *11:15 AM on Monday*

CONDITIONS: *Sunny with mild wind, 72 degrees (F)*

LOCATION: *<East/West/North/South> bound lanes of <Interstate designation>, approximately 100 yards east of the upstream <ramp designation> off-ramp*

CIRCUMSTANCES: *Vehicle #1 (small sport utility vehicle), traveling <east/west/north/south> in the leftmost lane of <Interstate designation> abruptly merged right in an attempt to access the <ramp designation> off-ramp, sideswiping Vehicle #2 (passenger car) traveling <east/west/north/south> in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards east of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.*

Survey respondents were provided a list of common resources by discipline (including personnel, equipment/technology and supplies/materials) used to manage a highway incident and were asked to explicitly list:

1. Who or what resources would be utilized at the scene (including quantity),
2. What role or function would be provided (to support later efforts to identify alternative resources that could effectively and more efficiently provide the same role and function),
3. How long the resources would be in use,
4. What was the typical monetary use rate (i.e., personnel salary, equipment rental), and
5. What are the replacement or backfill costs associated with equipment damage, supply consumption, or personnel injury (see Appendix B).

The survey was distributed to law enforcement, fire and rescue, emergency medical, and transportation personnel in 11 jurisdictions; 5 with highly developed TIM programs and 6 with developing TIM programs identified through the Federal Highway Administration's (FHWA) TIM Self-assessment Program with a focus on past operational performance. Invited and participating jurisdictions and agencies are summarized in Table 5. In all, 20 completed surveys were received: –six from law enforcement personnel, –five from fire and rescue personnel, –three from EMS personnel, and six transportation personnel. Only two jurisdictions provided complete responses from each of the four agencies—Northern Virginia and Chattanooga, Tennessee.

Table 5. Invited and Participating *Incident Scenario Survey* TIM Jurisdictions and Agencies

	LAW ENFORCEMENT	FIRE AND RESCUE	EMERGENCY MEDICAL	TRANSPORTATION
HIGHLY DEVELOPED				
Ft. Lauderdale, Florida		x		x
Baltimore, Maryland				
Minneapolis, Minnesota				x
Northern Virginia	x	x	x	x
Seattle, Washington				
DEVELOPING				
Little Rock, Arkansas	x			x
Salem, New Hampshire	x	x	x	
Albuquerque, New Mexico	x			
Oklahoma City, Oklahoma	x	x		x
Scranton, Pennsylvania				
Chattanooga, Tennessee	x	x	x	x

Results from the *Incident Scenario Survey* are detailed in Tables 6 and 7 (personnel utilization and costs), Tables 8 and 9 (equipment and technology utilization and costs), and Tables 10 and 11 (supplies and materials utilization and costs) for highly developed and developing TIM programs, respectively. The observed variability in responses within similar

groups (i.e., highly developed and developing TIM programs) and between these same groups as well as observed opportunities for improvements to TIM resource management are described below.

Perhaps one could conclude from the stakeholders that responded and the data provided that the requested information may not be readily available or tracked by all the agencies. Further investigation on availability of the necessary data as well as how to collect this information without creating an undue burden on the responding agencies may be in order since the results received support potential resource leveling.

Observed Variability in TIM Resource Utilization and Costs

At the onset of this investigation, it was assumed that the greatest efficiencies in TIM resource management would be observed in highly developed TIM programs as a result of well-established cooperative and collaborative working relationships among response agencies and well-honed incident response procedures. However, this distinction between highly developed and developing TIM programs was not observed. Instead, significant variability in the quantity and nature of TIM resources utilized in response to a common incident scenario was observed irrespective of the stage of TIM program development.

Incident Duration

As a rudimentary “control” measure, survey respondents were asked to estimate, based on their experience, how long it would take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes). Similar estimates of incident duration, combined with varying levels or types of TIM resources, suggest opportunities for resource management efficiency improvements.

Table 6. TIM Personnel Utilization and Costs – Highly Developed TIM Programs

PERSONNEL	FT. LAUDERDALE, FLORIDA			MINNEAPOLIS, MINNESOTA			NORTHERN VIRGINIA		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Law Enforcement									
Trooper/Officer (1)							$35.00	Scene protection	10
								Medical care	5
								Response mobilization	5
								Traffic control	5
								Crash investigation	35
Trooper/Officer (2)							$35.00	Traffic control	30
								Crash investigation	20
								Vehicle/debris removal	10
Fire and Rescue									
Driver/Engineer (1) Driver/Engineer (2)	$27.50	Scene protection	20						
		Firefighting/extrication	10						
		Fuel leak mitigation	10						
		Debris removal	10						
Firefighter (1) Firefighter (2) Firefighter (3)	$30.00	Medical care	20				$36.81	Scene protection	60-90
								Firefighting	30-60
								Medical care	3-13
		Firefighting/extrication	10					Fuel leak mitigation	NA
Firefighter (4) Firefighter (5) Firefighter (6)		Fuel leak mitigation	10				$36.81	Extrication	15-30
		Debris removal	10						
Firefighter (7) Firefighter (8) Firefighter (9)							$36.81	Extrication	15-30
Lieutenant (1) Lieutenant (2)	$31.00	Medical care	20				$43.57	Extrication	1-2
		Firefighting/extrication	10						
		Documentation	20						

PERSONNEL	FT. LAUDERDALE, FLORIDA			MINNEAPOLIS, MINNESOTA			NORTHERN VIRGINIA		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Captain (1)	$35.00	Scene protection	20				$48.47	Scene protection	1-2
		Firefighting/extrication	10					Documentation	NA
Captain (2)		Fuel leak mitigation	10				$48.47	Extrication	1-2
		Debris removal	10						
		Medical care	10						
		Documentation	5						
Captain (3)							$48.47	ICS/NIMS	60-90
Battalion Chief							NA	ICS/NIMS	60-90
Emergency Medical									
EMT-Paramedic (1) EMT-Paramedic (2)							$38.89	Scene protection	60-90
								Medical care	
								Documentation	
Captain							$53.54	ICS/NIMS	60-90
Transportation									
Maintenance Supervisor	$17.58	Documentation	30						
Service Patrol Operator				$20.00	Scene protection	45	$29.00	Scene protection	15
					Vehicle/debris removal	15		Traffic control	
TMC Operator							$30.00	VMS/HAR messages	10
Traffic Signal Operator							NA	Traffic signal control	10

Table 7. TIM Personnel Utilization and Costs – Developing TIM Programs

PERSONNEL	LITTLE ROCK, ARKANSAS			SALEM, NEW HAMPSHIRE			ALBUQUERQUE, NEW MEXICO		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Law Enforcement									
Trooper/Officer (1)	$25.00	Medical care	30	$27.00	Scene protection	60	$20.00	Scene protection	180
					Traffic control			Medical care	20
		Crash investigation			Crash investigation			Traffic control	180
		Documentation			Documentation			Crash investigation	60
					Public/media information			Documentation	120
Trooper/Officer (2)	$25.00	Scene protection	30				$20.00	Scene protection	180
								Medical care	20
		Traffic Control						Traffic control	180
		Documentation						Crash investigation	60
								Documentation	120
Trooper/Officer (3)							$20.00	Scene protection	180
								Medical care	20
								Traffic control	180
								Crash investigation	60
								Documentation	120
Sergeant	$30.00	Scene protection	NA				$25.00	Supervision	180
		Public/media information	10						
		Supervision	20						
Lieutenant							$27.00	Supervision	180
Fire and Rescue									
Firefighter (1) Firefighter (2)				$30.00	Scene protection	30			
					Firefighting				
					Fuel leak mitigation				
Firefighter (3) Firefighter (4)				$30.00	Extrication	30			
					Medical care				
Lieutenant				$40.00	Scene protection	30			
					Firefighting/extrication				
					Fuel leak mitigation				

PERSONNEL	LITTLE ROCK, ARKANSAS			SALEM, NEW HAMPSHIRE			ALBUQUERQUE, NEW MEXICO		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Captain				$50.00	ICS/NIMS	30			
Emergency Medical									
EMT-Basic (1) EMT-Basic (2)				$30.00	Medical care	60			
EMT-Paramedic				$35.00	Medical care	30			
Lieutenant				$45.00	Medical care	60			
Transportation									
	No on-scene transportation response								

PERSONNEL	OKLAHOMA CITY, OKLAHOMA			CHATTANOOGA, TENNESSEE		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Law Enforcement						
Trooper/Officer (1)	$29.70	Scene protection	60	$32.00	Response mobilization	5
		Traffic control	10		Crash investigation	15
		Crash investigation	45		Documentation	10
Trooper/Officer (2)	$29.70	Scene protection	60			
		Traffic control	30			
		Vehicle/debris removal	10			
Lieutenant	$32.50	Scene protection	60			
		Traffic control	20			
		Documentation	20			
Fire and Rescue						
Firefighter (1)	$26.00	Medical care	20	$30.00	Medical care	15
Firefighter (2)				$34.00	Medical care	15
Firefighter (3)		Extrication	15	$35.00	Scene protection	15
Firefighter (4)		Fuel leak mitigation	10			
Firefighter (5)						
Firefighter (6)						
Lieutenant (1)	$34.00	Firefighting/extrication	45			
Lieutenant (2)						

PERSONNEL	OKLAHOMA CITY, OKLAHOMA			CHATTANOOGA, TENNESSEE		
	Cost ($/hr)	Tasks/ Function	Time (min)	Cost ($/hr)	Tasks/ Function	Time (min)
Lieutenant (3)		Documentation	45			
Lieutenant (4)						
Lieutenant (5)						
Captain (1)	$38.00	Scene protection	45	$52.00	Medical care	15
					Documentation	10
Captain (2)		Supervision	45			
Captain (3)						
Battalion Chief	$42.00	ICS/NIMS	45			
		Documentation	45			
Emergency Medical						
EMT-Paramedic (1)				$45.00	Medical care	10
EMT-Paramedic (2)						
Transportation						
Lead Worker/Technician	$18.00	Scene protection	60			
Maintenance Supervisor	$25.50	Supervision	60			
Service Patrol Operator (1)				NA	Scene protection	30
					Traffic control	
					VMS/HAR messages	
Service Patrol Operator (2)				NA	Traffic control Vehicle/debris removal	30

Table 8. TIM Equipment and Technology Utilization and Costs – Highly Developed TIM Programs

EQUIPMENT/ TECHNOLOGY	FT. LAUDERDALE, FLORIDA				MINNEAPOLIS, MINNESOTA				NORTHERN VIRGINIA			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Law Enforcement												
Cruiser with Light Bar/Push Bumper (1)									$36,000	3	Scene protection	10
											Medical care	5
											Traffic control	45
Cruiser with Light Bar/Push Bumper (2)									$36,000	3	Traffic control	30
											Crash investigation	20
											Vehicle/debris removal	10
Tape Measure									NA	NA	Crash investigation	20
Fire and Rescue												
Truck									$400,000-$600,000	7-10	Scene protection	<60
											Medical care	
											Extrication	
Engine (1)	NA	NA	Scene protection	40					$350,000	7-10	Scene protection	<60
			Firefighting/extrication	10							Firefighting	
			Fuel Leak Mitigation	10							Medical care	
			Debris removal	10							Fuel leak mitigation	
Engine (2)			Documentation	5								
Rescue Vehicle (1)	NA	NA	Medical care	20					$400,000-$600,000	7-10	Extrication	<60
			Extrication	10								
Rescue Vehicle (2)			Documentation	20								
Hydraulic Tools	NA	NA	Extrication	10								
Traffic Cones/Signs	NA	NA	Scene protection	10								
			Traffic control									
Emergency Medical												
Non-transporting Vehicle									$50,000-$75,000	NA	ICS/NIMS	60-90
											Scene protection	
Type I Ambulance (Pickup Chassis)									$250,000-$300,000	7-10	Medical care	60-90
											Transport	
											Documentation	

EQUIPMENT/ TECHNOLOGY	FT. LAUDERDALE, FLORIDA				MINNEAPOLIS, MINNESOTA				NORTHERN VIRGINIA			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Transportation												
Pickup with Arrow Board/Push Bumper	$21,200	10	Documentation	30	$50,000	3	Scene protection	45	$40,000	3	Scene protection	10
											Traffic control	40
VMS/HAR					NA	NA	VMS/HAR messages	NA				
Traffic Cones/Signs									NA	NA	Traffic control	40
Broom					NA	NA	Debris removal	NA				
TMC					NA	NA	NA	NA				

Table 9. TIM Equipment and Technology Utilization and Costs – Developing TIM Programs

EQUIPMENT/ TECHNOLOGY	LITTLE ROCK, ARKANSAS				SALEM, NEW HAMPSHIRE				ALBUQUERQUE, NEW MEXICO			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Law Enforcement												
Motorcycle (1)									$25,000	4	Scene protection	180
Motorcycle (2)											Traffic control	
Cruiser with Light Bar/Push Bumper (1)	$45,000	4	Scene protection	10	NA	NA	Scene protection	60	$30,000	7	Scene protection	180
			Traffic control				Traffic control					
			Vehicle/debris removal									
Cruiser with Light Bar/Push Bumper (2)											Traffic Control	
Cruiser with Light Bar/Push Bumper (3)												
Laptop Computer	$1,500	3	Crash investigation	30								
Other Crash Investigation System									$3,000	5	Crash investigation	30
Traffic Cones/Signs									NA	NA	Scene protection	180
Fire and Rescue												
Light-Duty Pickup/SUV					$50,000	5	ICS/NIMS	30				
Engine					$500,000	20	Scene protection	30				
							Firefighting					
							Fuel leak mitigation					
Rescue Vehicle					$350,000	20	Extrication	30				
							Medical care					

EQUIPMENT/ TECHNOLOGY	LITTLE ROCK, ARKANSAS				SALEM, NEW HAMPSHIRE				ALBUQUERQUE, NEW MEXICO			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Emergency Medical												
Non-transporting Vehicle					$50,000	5	Medical care	30				
Type I Ambulance (Pickup Chassis)					$200,000	10	Medical care	60				
							Transport					
Transportation												
	No on-scene transportation response											

EQUIPMENT/ TECHNOLOGY	OKLAHOMA CITY, OKLAHOMA				CHATTANOOGA, TENNESSEE			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Law Enforcement								
Cruiser with Light Bar/Push Bumper	$48,000	3	Scene protection	60	$48,000	4	Scene protection	30
			Traffic control	60				
Traffic Cones/Signs	$100	20	Scene protection	60				
			Traffic control	60				
Tape Measure	$80	10	Crash investigation	10				
Camera/Video	$5,000	10	Documentation	45				
Fire and Rescue								
Light-Duty Pickup/SUV	$50,000	8	ICS/NIMS	45				
Engine	$500,000	15	Scene protection	40				
			Medical care	25				
Rescue Vehicle	$800,000	20	Scene protection	15				
			Extrication	45				
HAZMAT Vehicle	$650,000	15	Fuel leak mitigation	20				
Quintuple Pumper					$650,000	10	Scene protection	15
EMS Kit	$10,000	NA	Medical care	NA				
Hydraulic Tools	$18,000	NA	Extrication	45				
Hand Tools	$250	NA	Fuel leak mitigation	NA				

EQUIPMENT/ TECHNOLOGY	OKLAHOMA CITY, OKLAHOMA				CHATTANOOGA, TENNESSEE			
	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)	Cost ($)	Life (yrs)	Tasks/ Function	Time (min)
Emergency Medical								
Type III Ambulance (Van Chassis)					$140,000	8	Medical care	10
Transportation								
Pickup with Arrow Board/Push Bumper (1)	$20,000	6	Scene protection	60	$45,000	4	Traffic control Vehicle/debris removal	30
Pickup with Arrow Board/Push Bumper (2)			Traffic control					
Fully-equipped Service Patrol Vehicle					$75,000	4	Scene protection Traffic control VMS/HAR messages	30
TMC					NA	NA	Public/media information	45

Table 10. TIM Supplies and Materials Utilization and Costs – Highly Developed TIM Programs

SUPPLIES/MATERIALS	FT. LAUDERDALE, FLORIDA			MINNEAPOLIS, MINNESOTA			NORTHERN VIRGINIA		
	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function
Law Enforcement									
First Aid Supplies							4	$2.00	Medical care
Spray Paint							NA	$3.00	Crash investigation
Film							NA	$6.00	Crash investigation
Fire and Rescue									
First Aid Supplies	1	NA	Medical care				NA	NA	Medical care
Emergency Blanket	1	NA	Medical care						
Flare/Fusee							5-7	NA	Scene protection
Absorbent Material/Pad	2-4	NA	Fuel leak mitigation				2	$20.00-$25.00	Fuel leak mitigation
Plugs/Plug Material	1	NA	Fuel leak mitigation						
Emergency Medical									
First Aid Supplies							NA	NA	Medical care
Transportation									
Absorbent Material/Pad				1	$2.00	Fuel leak mitigation	5	NA	Fuel leak mitigation

Table 11. TIM Supplies and Materials Utilization and Costs – Developing TIM Programs

SUPPLIES/MATERIALS	LITTLE ROCK, ARKANSAS			SALEM, NEW HAMPSHIRE			ALBUQUERQUE, NEW MEXICO		
	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function
Law Enforcement									
Fire Extinguisher	NA	NA	Firefighting						
Flare/Fusee				1	$20.00	Traffic control			
Fire and Rescue									
First Aid Supplies				NA	$100.00	Medical care			
Absorbent Material/Pad				NA	$50.00	Fuel leak mitigation			
Plugs/Plug Material				NA	$25.00	Fuel leak mitigation			
Emergency Medical									
First Aid Supplies				NA	$250.00	Medical care			

SUPPLIES/MATERIALS	LITTLE ROCK, ARKANSAS			SALEM, NEW HAMPSHIRE			ALBUQUERQUE, NEW MEXICO		
	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function
Transportation									
	No on-scene transportation response								

SUPPLIES/MATERIALS	OKLAHOMA CITY, OKLAHOMA			CHATTANOOGA, TENNESSEE		
	Quantity (units)	Cost ($/unit)	Tasks/ Function	Quantity (units)	Cost ($/unit)	Tasks/ Function
Law Enforcement						
Fire Extinguisher	2	$25.00	Firefighting			
Flare/Fusee	20	$2.00	Traffic control			
Spray Paint	1	$5.00	Crash investigation			
Fire and Rescue						
First Aid Supplies				2	$4.50	Medical care
Plugs/Plug Material	1	$80.00	Fuel leak mitigation			
Containment Boom	1	$66.00	Fuel leak mitigation			
Emergency Medical						
First Aid Supplies				8	$5.00	Medical care
Transportation						
Absorbent Material/Pad	2	$10.00	Fuel leak mitigation	1	$8.00	Fuel leak mitigation

Incident duration estimates from highly developed TIM programs ranged from 45 to 90 minutes, with an average reported duration of 64 minutes (see Table 12). Comparatively, incident duration estimates from developing TIM programs ranged from 40 to 180 minutes, with an average reported duration of 66 minutes (see Table 13). The excessive 180 minute incident duration was reportedly attributable to a gasoline leak; involved vehicles could be moved from the travel lane within 40 minutes. Transportation personnel from two jurisdictions estimated the incident duration to be between 90 and 120 minutes. With some consistency, however, 12 of the 15 (80 percent) jurisdictions (with highly developed and developing TIM programs) responding to this question estimated the incident duration to be between 40 and 60 minutes.

Table 12. Estimated Incident Duration – Highly Developed TIM Programs

	FT. LAUDERDALE, FLORIDA	MINNEAPOLIS, MINNESOTA	NORTHERN VIRGINIA
Law Enforcement			60 minutes
Fire and Rescue	NA		NA
Emergency Medical			NA
Transportation	90 minutes	45 minutes	60 minutes

Table 13. Estimated Incident Duration – Developing TIM Programs

	LITTLE ROCK, ARKANSAS	SALEM, NEW	ALBUQUERQUE,	OKLAHOMA CITY,	CHATTANOOGA, TENNESSEE
Law Enforcement	60 minutes	60 minutes	40-180 minutes	NA	40 minutes
Fire and Rescue		45 minutes		45 minutes	40 minutes
Emergency Medical		NA			40-60 minutes
Transportation	90-120 minutes			60 minutes	40 minutes

Personnel

Significant variability in the number of personnel responding from each public agency was observed (see Tables 14 and 15). The most significant variability was observed for fire and rescue personnel. Highly developed TIM programs reported sending between 12 and 14 fire personnel to the incident scene, commonly with three firefighters and one supervisory captain or lieutenant per vehicle. Developing programs reported sending as few as four fire and rescue personnel; three firefighters and a supervisory captain. Law enforcement agencies demonstrated similar variability. Developing TIM programs reported sending as few as a single trooper/officer to the scene and as many as three troopers/officers and a supervisory captain and lieutenant. Response by EMS and transportation agencies was more consistent, ranging from two to four EMS personnel and zero to three transportation personnel for both highly developed and developing TIM programs.

Considering the two jurisdictions that provided survey responses from each agency (i.e., law enforcement, fire and rescue, emergency medical services, and transportation), Northern Virginia (highly developed TIM program) would involve a total of 22 personnel in the response to this incident while Chattanooga, Tennessee would involve a total of nine personnel. Despite the difference in reported response levels, Northern Virginia and Chattanooga, Tennessee estimated incident durations of 60 minutes and 40 to 60 minutes, respectively.

Table 14. Number of Reported Response Personnel – Highly Developed TIM Programs

	FT. LAUDERDALE, FLORIDA	MINNEAPOLIS, MINNESOTA	NORTHERN VIRGINIA
Law Enforcement			2
Fire and Rescue	12		14
Emergency Medical			3
Transportation	1	1	3
Total			22

Table 15. Number of Reported Response Personnel – Developing TIM Programs

	LITTLE ROCK, ARKANSAS	SALEM, NEW HAMPSHIRE	ALBUQUERQUE, NEW MEXICO	OKLAHOMA CITY, OKLAHOMA	CHATTANOOGA, TENNESSEE
Law Enforcement	3	1	5	3	1
Fire and Rescue		6		15	4
Emergency Medical		4			2
Transportation	0			2	2
Total					9

The reported tasks and functions performed by each of these personnel are relatively consistent between TIM programs and are consistent with expectations, demonstrating commonalities and overlap in the duties performed by select agency personnel (i.e., law enforcement and transportation personnel both report performing traffic control).

Equipment and Technology

Considering equipment and technology utilized for incident response, the number of response vehicles is closely related to the number of personnel responding from each public agency (see Tables 15 and 16). The most significant variability was again observed for fire and rescue and law enforcement personnel. Developing TIM programs commonly reported sending a single police cruiser to the scene; however, one jurisdiction reported sending up to three police cruiser and two motorcycles to the scene. Fire and rescue agencies from both highly developed and developing TIM programs reported sending three or four total vehicles to the scene, although Chattanooga, Tennessee reported sending only a single, specialized quintuple combination pumper to the scene. Response by EMS and transportation agencies was more consistent, ranging from one to two EMS vehicles and zero to two transportation vehicles for both highly developed and developing TIM programs.

Considering the two jurisdictions that provided survey responses from each agency, Northern Virginia reported dispatching a total of eight vehicles to this incident while Chattanooga, Tennessee reported dispatching a total of five vehicles. Again, both Northern Virginia and Chattanooga, Tennessee estimated comparable incident durations.

Reported use of other equipment and technology was varied. Four of the six responding law enforcement agencies reported using conventional equipment (i.e., tape measure, camera/video) to support crash investigation; only Albuquerque, New Mexico reported using a technology- based crash investigation system (given the intermediate nature of this incident and the absence of fatalities or serious injuries, the limited reported use of technology-based

crash investigation systems is not surprising). Only two law enforcement agencies reported using traffic cones/signs to support temporary traffic control efforts and no law enforcement agencies reported using brooms/blowers for debris removal. Similarly, two of five responding fire and rescue agencies reported using traffic cones/signs to support temporary traffic control efforts and a single fire and rescue agency reported using hand tools (i.e., shovel, pick) for spill containment. Surprisingly, only one (out of six) transportation agency reported using traffic cones/signs and variable message signs (VMS) for temporary traffic control, although it should be noted that Oklahoma City, Oklahoma reported using private contracted traffic control services that provide pickups with arrow boards, VMS, and traffic cones/signs when dispatched to an incident scene. Two of six responding transportation agencies reported utilizing a TMC as part of their incident response.

Table 16. Number of Reported Response Vehicles – Highly Developed TIM Programs

	FT. LAUDERDALE, FLORIDA	MINNEAPOLIS, MINNESOTA	NORTHERN VIRGINIA
Law Enforcement			2
Fire and Rescue	4		3
Emergency Medical			2
Transportation	1	1	1
Total			8

Table 17. Number of Reported Response Vehicles – Developing TIM Programs

	LITTLE ROCK, ARKANSAS	SALEM, NEW HAMPSHIRE	ALBUQUERQUE, NEW MEXICO	OKLAHOMA CITY, OKLAHOMA	CHATTANOOGA, TENNESSEE
Law Enforcement	1	1	5	1	1
Fire and Rescue		3		4	1
Emergency Medical		2			1
Transportation	0			2	2
Total					5

Again, the reported tasks and functions supported by the various equipment and technologies are relatively consistent between TIM programs and are consistent with expectations, demonstrating commonalities and overlap in the duties supported by select vehicles and/or equipment (i.e., law enforcement, fire and rescue, and transportation vehicles were each reported to support scene protection efforts).

Supplies and Materials

Similar to observations regarding personnel and equipment/ technology, the expendable supplies and materials reportedly utilized by each response agency demonstrate commonalities and overlap. Law enforcement (one of six), fire and rescue (four of five), and EMS (three of three) survey respondents reported carrying first aid supplies to support initial medical care. Law enforcement (two of six) and fire and rescue (one of five) survey respondents reported carrying flares/fusees to support temporary traffic control. Fire and rescue (three of five) and transportation (four of six) survey respondents reported carrying absorbent material/pads to support efforts to mitigate small vehicle fluid spills.

Observed TIM Resource Management Efficiency Improvements and Associated Cost Savings

The variability in reported TIM resource utilization, combined with generally similar estimates of incident duration, suggest opportunities for resource management efficiency improvements. Revisiting the various hypothetical examples of potential improvements in TIM resource management provided in *Chapter 3*, results from the *Incident Scenario Survey* are used here to confirm and quantify these resource management improvements as reported in practice.

Functions or tasks that relate to the common incident scenario provided to survey respondents include the following:

- Scene protection,
- Temporary traffic control,
- Firefighting/extrication,
- Minor spill mitigation and cleanup,
- Crash investigation, and
- Vehicle or debris removal.

For each of these functions or tasks, the traditional resource-cost method—which multiplies the number of resources by the unit cost (actual or estimated)—was used to estimate costs associated with personnel, equipment/technology, and supplies/materials where sufficient data supports this type of analysis. Unit costs were derived from the information provided by each of the individual responding jurisdictions and averaged to control for regional differences. Estimated personnel costs reflect the actual in-service time performing the various functions or tasks. In several instances, an aggregate service time was provided for the performance of multiple functions or tasks (i.e., 30 minutes to provide scene protection, traffic control, and vehicle/debris removal) challenging the utility of this data. Estimated equipment/technology costs reflect the total monetary exposure to damage (i.e., the quantity and value of equipment /technology on-scene), but does not attempt to incorporate the in-service time for the various individual resources. Estimated supplies/materials costs reflect the total cost of expendable resources utilized in support of the various functions or tasks. These costs were considered per agency or discipline and by jurisdiction, considering jurisdictions with highly developed and developing TIM programs separately.

The limited completeness, consistency, and level of detail of the resource utilization and cost information received in the *Incident Scenario Survey* challenged the certainty with which personnel, equipment/technology, and supplies/materials costs could be estimated. Hence, the estimates presented here should be considered to be of a general order of magnitude of potential per incident costs savings; care should be taken in extrapolating these estimates beyond their respective levels of certainty.

Scene Protection

For highly developed and developing TIM programs, Tables 18 and 19 summarize the estimated TIM resource costs for scene protection, respectively.

Table 18. Estimated TIM Resource Costs for Scene Protection – Highly Developed TIM Programs

SCENE PROTECTION	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	**($/hr)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**
Law Enforcement							
Trooper/Officer (1)	$26.75					10	$4.46
Subtotal						10	$4.46
Fire and Rescue							
Driver/Engineer (1)	$27.50	20	$9.17				
Driver/Engineer (2)	$27.50	20	$9.17				
Firefighter (1)	$31.69					60-90	$31.69-47.54
Firefighter (2)	$31.69					60-90	$31.69-47.54
Firefighter (3)	$31.69					60-90	$31.69-47.54
Captain (1)	$42.87	20	$14.29			1-2	$0.71-1.43
Captain (2)	$42.87	20	$14.29				
Subtotal		80	$46.92			181-272	$95.78-144.05
Emergency Medical							
EMT-Paramedic (1)	$39.63					<60-90	<$39.63-59.45
EMT-Paramedic (2)	$39.63					<60-90	<$39.63-59.45
Captain	$53.54					<60-90	<$53.54-80.31
Subtotal				<180-270	<$132.80-199.21		
Transportation							
Service Patrol Operator (1)	$24.50			45	$18.37	15	$6.12
Subtotal		-	-	45	$18.37	15	$6.12
PERSONNEL TOTAL						**<205-297**	**<$239.16-353.84**
EQUIPMENT/TECHNOLOGY	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**
Law Enforcement							
Cruiser/Light Bar/Push Bumper (1)	$41,400					10	$41,400
Subtotal						10	$41,400
Fire and Rescue							
Engine (1)	$450,000	40	$450,000			<60	$450,000
Engine (2)	$450,000	40	$450,000				
Subtotal		80	$900,000			<60	$450,000
Emergency Medical							
Non-transporting Vehicle	$56,250					<60-90	$56,250
Subtotal							
Transportation							
Pickup/Arrow Board/Push Bumper (1)	$35,240			45	$35,240	10	$35,240
Subtotal		-	-	45	$35,240	10	$35,240
EQUIPMENT/TECHNOLOGY TOTAL						**<140-170**	**$1,032,890**

< indicates that the service time was reported in aggregate for multiple functions

Table 19. Estimated TIM Resource Costs for Scene Protection – Developing TIM Programs

SCENE PROTECTION	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	**($/hr)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**
Law Enforcement											
Trooper/Officer (1)	$26.75	<30	<$13.38	<60	<$26.75	180	$80.25	60	$26.75		
Trooper/Officer (2)	$26.75					180	$80.25	60	$26.75		
Trooper/Officer (3)	$26.75					180	$80.25				
Lieutenant	$29.75							60	$29.75		
Subtotal		<30	<$13.38	<60	<$26.75	540	$240.75	180	$83.25	-	-
Fire and Rescue											
Firefighter (1)	$31.69			<30	<$15.85					15	$7.92
Firefighter (2)	$31.69			<30	<$15.85						
Lieutenant (1)	$37.14			<30	<$18.57						
Captain (1)	$42.87							45	$32.15		
Subtotal				<90	$50.27			45	$32.15	15	$7.92
Transportation											
Lead Worker/Technician	$18.00							60	$18.00		
Service Patrol Operator (1)	$24.50									<30	<$12.25
Subtotal		-	-					60	$18.00	<30	<$12.25
PERSONNEL TOTAL										**<45**	**$20.17**
EQUIPMENT/TECHNOLOGY	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**	**(min)**	**($)**
Law Enforcement											
Motorcycle (1)	$25,000					<180	$25,000				
Motorcycle (2)	$25,000					<180	$25,000				
Cruiser/Light Bar/Push Bumper (1)	$41,400	<10	$41,400	<60	$41,400	<180	$41,400	60	$41,400	30	$41,400
Cruiser/Light Bar/Push Bumper (2)	$41,400					<180	$41,400				
Cruiser/Light Bar/Push Bumper (3)	$41,400					<180	$41,400				
Traffic Cones/Signs	$100					<180	$100	60	$100		
Subtotal		<10	$41,400	<60	$41,400	1,080	$174,300	120	$41,500	30	$41,400
Fire and Rescue											
Engine (1)	$450,000			<30	$450,000			40	$450,000		
Rescue Vehicle (1)	$550,000							15	$550,000		

SCENE PROTECTION	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
Quintuple Pumper	$650,000									15	$650,000
Subtotal				<30	$450,000			55	$1,000,000	15	$650,000
Transportation											
Pickup/Arrow Board/Push Bumper (1)	$35,240							<60	$35,240		
Pickup/Arrow Board/Push Bumper (2)	$35,240							<60	$35,240		
Fully-equipped Service Patrol Vehicle	$75,000									<30	$75,000
Subtotal		-	-					<120	$70,480	<30	$75,000
EQUIPMENT/TECHNOLOGY TOTAL										**<75**	**$766,400**

< indicates that the service time was reported in aggregate for multiple functions

Utilization of Appropriate Equipment

As reported by survey respondents, one or two fire and rescue vehicles are commonly used to protect the incident scene, valued at from $450,000 to $650,000 for a single vehicle and from $900,000 to $1,000,000 for two vehicles. The duration of time that these vehicles were used in this capacity ranged from 15 to 80 minutes. Similarly, one to five law enforcement vehicles were reportedly used for scene protection, valued at $41,400 for a single cruiser to $174,200 for three cruisers and two motorcycles.

Chattanooga, Tennessee provides an example of a more appropriate use of equipment for scene protection, relying upon a single law enforcement cruiser and a fully equipment transportation service patrol vehicle to provide scene protection each for a duration of 30 minutes or less. A single fire and rescue vehicle was also reportedly used for scene protection, but for a limited duration of 15 minutes. The monetary value of this equipment totals $766,400. Comparatively, the monetary value of equipment exposed to potential damage in Northern Virginia totals $1,111,980 ($345,580 higher).

Additional savings attributable to fewer and lower wage personnel assigned to scene protection duties can be realized. Personnel costs resulting from scene protection functions in Chattanooga, Tennessee totals $20.17. Comparatively, personnel costs for scene protection in Northern Virginia totals $133.40 ($113.23 higher). This cost difference may appear minor, but when multiplied by the total number of incidents occurring on an annual basis, personnel savings may become significant.

Utilization of Appropriate Technology

Portable intrusion alarm systems provide a technology-based alternative to the use of response vehicles for scene protection at a significantly reduced cost (i.e., less than $4,000 per unit). None of the survey respondents indicated the use of such a system to provide effective scene protection. With the monetary value of equipment used for scene protection and exposed to potential damage approaching or exceeding $1,000,000, the costs savings through the use of this technology could be significant.

Reduced Redundancy

Each of the responding disciplines—law enforcement, fire and rescue, emergency medical, and transportation—reported a role in scene protection to varying degrees. One to three law enforcement personnel are reportedly tasked with scene protection at a cost ranging from $4.46 to $240.75 (a difference of $236.29), depending on the service duration. Similarly, one to four fire and rescue personnel are reportedly tasked with scene protection at a cost ranging from $7.92 to $144.05 (a difference of $136.13), again depending on the service duration. In a single reporting jurisdiction, up to three EMS personnel are also reportedly tasked with scene protection at a cost of up to $199.21. Assuming that the minimum staffing reported is sufficient (and all additional staffing is redundant), a personnel cost savings of $571.63 per incident could be realized.

A similar reduction in redundancy can be realized when considering equipment and technology. One to five law enforcement vehicles are reportedly utilized for scene protection at a cost ranging from $41,400 to $174,200 (a difference of $132,800). Similarly, one to two fire and rescue vehicles are reportedly utilized for scene protection at a cost ranging from $450,000 to $1,000,000 (a difference of $550,000). In a single reporting jurisdiction, one EMS vehicle was also reportedly utilized for scene protection at a cost of $56,250. Assuming that

the minimum reported equipment is sufficient (and all additional equipment is redundant), the monetary value of equipment exposed to potential damage could be reduced by $739,050 per incident.

Temporary Traffic Control

For highly developed and developing TIM programs, Tables 20 and 21 summarize the estimated TIM resource costs for temporary traffic control, respectively.

Utilization of Appropriate Personnel

As reported by survey respondents, one to three law enforcement personnel are commonly tasked with temporary traffic control at the scene, most often ranging in cost from $13.38 for a single trooper/officer providing traffic control for less than 30 minutes to $27.76 for three troopers/officers providing traffic control for 10, 20, and 30 minutes respectively (one jurisdiction reported using three troopers/officers for a duration of 180 minutes). Reported with more consistency, up to two transportation personnel are commonly tasked with temporary traffic control at the scene, at a cost of up to $24.50 per incident. In four of the six reporting law enforcement agency jurisdictions, transportation agencies had no role in supporting traffic control. Conversely, in one of the six reporting transportation agency jurisdictions, the law enforcement agency had no role in supporting traffic control. Cost savings, resulting from the greater utilization of transportation personnel rather than law enforcement personnel to provide temporary traffic control, are difficult to estimate because of the varying quality and extent of traffic control services provided. Using monetary compensation as the basis, a 60 minute traffic control service duration for law enforcement and transportation personnel would average $26.75 and $24.50 ($2.25 lower) per person per incident, respectively.

Utilization of Appropriate Equipment

One to five law enforcement vehicles are reportedly used for traffic control, valued at $41,400 for a single cruiser to $174,200 for three cruisers and two motorcycles. The duration of time that these vehicles are used in this capacity ranged from less than 10 to 60 minutes. One to two transportation vehicles are reportedly used for traffic control, valued at $35,240 for a pickup equipped with an arrow board to $110,240 for a pickup equipped with an arrow board and a fully-equipped service patrol vehicle. The duration of time that these vehicles are used in this capacity ranged from less than 30 to 60 minutes. Note that the value of transportation vehicles is generally lower than that of law enforcement vehicles.

Chattanooga, Tennessee provides an example of appropriate use of equipment for temporary traffic control, relying upon a pickup equipped with an arrow board and a fully-equipped service patrol vehicle provided by the transportation agency (law enforcement in this jurisdiction reportedly had no or only a minor role in traffic control). The monetary value of this equipment totals $110,240. Comparatively, the monetary value of equipment exposed to potential damage in Northern Virginia totals $118,040 ($7,800 higher). Although this cost difference is minor, the distinct advantages that transportation vehicles offer in the provision of temporary traffic control should not be overlooked. Transportation vehicles are typically equipped with an arrow board and traffic control devices (i.e., cones, portable signs, etc.). Transportation personnel also have direct access to additional traffic control devices not immediately carried on the vehicle.

Table 20. Estimated TIM Resource Costs for Traffic Control – Highly Developed TIM Programs

TRAFFIC CONTROL	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Trooper/Officer (1)	$26.75					5	$2.23
Trooper/Officer (2)	$26.75					30	$13.38
Subtotal						35	$15.61
Transportation							
Service Patrol Operator (1)	$24.50					<15	<$6.13
Subtotal		-	-	-	-	<15	<$6.13
PERSONNEL TOTAL						**<50**	**$21.74**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Cruiser/Light Bar/Push Bumper (1)	$41,400					45	$41,400
Cruiser/Light Bar/Push Bumper (2)	$41,400					30	$41,400
Subtotal						75	$82,800
Transportation							
Pickup/Arrow Board/Push Bumper (1)	$35,240					40	$35,240
Subtotal		-	-	-	-	40	$35,240
EQUIPMENT/TECHNOLOGY TOTAL						**115**	**$118,040**

< indicates that the service time was reported in aggregate for multiple functions

Table 21. Estimated TIM Resource Costs for Traffic Control – Developing TIM Programs

TRAFFIC CONTROL	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Trooper/Officer (1)	$26.75	<30	<$13.38	<60	<$26.75	180	$80.25	10	$4.46		
Trooper/Officer (2)	$26.75					180	$80.25	30	$13.38		
Trooper/Officer (3)	$26.75					180	$80.25				
Lieutenant	$29.75							20	$9.92		
Subtotal		<30	<$13.38	<60	<$26.75	540	$240.75	60	$27.76	-	-
Transportation											
Service Patrol Operator (1)	$24.50									<30	<$12.25
Service Patrol Operator (2)	$24.50									<30	<$12.25
Subtotal		-	-					-	-	<60	<$24.50
PERSONNEL TOTAL										**<60**	**<$24.50**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Motorcycle (1)	$25,000					<180	$25,000				
Motorcycle (2)	$25,000					<180	$25,000				
Cruiser/Light Bar/Push Bumper (1)	$41,400	<10	$41,400	<60	$41,400	<180	$41,400	60	$41,400		
Cruiser/Light Bar/Push Bumper (2)	$41,400					<180	$41,400				
Cruiser/Light Bar/Push Bumper (3)	$41,400					<180	$41,400				
Traffic Cones/Signs	$100							60	$100		
Subtotal		<10	$41,400	<60	$41,400	<900	$174,200	120	$41,500	-	-
Transportation											
Pickup/Arrow Board/Push Bumper (1)	$35,240							<60	$35,240	<30	$35,240
Pickup/Arrow Board/Push Bumper (2)	$35,240							<60	$35,240		
Fully-equipped Service Patrol Vehicle	$75,000									<30	$75,000
Subtotal		-	-					<120	$70,480	<60	$110,240

TRAFFIC CONTROL	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
EQUIPMENT/TECHNOLOGY TOTAL										**<60**	**$110,240**
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Flare/Fusee	$30			NA	$30			NA	$30		
Subtotal		-	-	NA	$30	-	-	NA	$30	-	-
SUPPLIES/MATERIALS TOTAL										**-**	**-**

< indicates that the service time was reported in aggregate for multiple functions

Separate trailers carrying additional cones, barrels, static signs, or portable variable or dynamic message signs can be requested and appropriately deployed at the incident scene.

Reduced Redundancy

With respect to temporary traffic control, less redundancy in personnel or equipment/technology was generally observed. In some instances, the reported staffing and equipment/technology resources appeared, in fact, to be insufficient to ensure adequate traffic control. In at least one of the reporting jurisdictions, a single law enforcement trooper/officer with a cruiser comprised the traffic control resources. More commonly, a total of two to three law enforcement and/or transportation personnel in an equal or lesser number of vehicles were assigned to traffic control functions.

One possible reduction in redundancy relates to the equipment/technology resources dedicated to traffic control in Albuquerque, New Mexico. Five law enforcement vehicles (two motorcycles and three cruisers) are reportedly utilized for temporary traffic control at a cost of $174,200. Assuming a more appropriate set of resources, that may include a single law enforcement cruiser and two transportation pickups equipped with arrow boards, the monetary value of equipment exposed to potential damage could be reduced to $111,880 (a difference of $62,320).

Firefighting/Extrication

For highly developed and developing TIM programs, Tables 22 and 23 summarize the estimated TIM resource costs for firefighting/extrication, respectively.

Utilization of Appropriate Personnel

As reported by survey respondents, fire and rescue personnel were exclusively responsible for firefighting and extrication functions in the common incident scenario. Both law enforcement and transportation personnel are commonly equipped with fire extinguishers to manage small-scale fires (although only two of the six responding law enforcement agencies and none of the responding transportation agencies indicated carrying a fire extinguisher), but none indicated a role in firefighting for this scenario. If the fire can be fully mitigated through transportation or law enforcement personnel response—whoever is first to arrive on-scene—the cost of mobilizing fire and rescue personnel and equipment, ranging from $67.52 to $192.84 in personnel costs per incident and $550,000 to $2,018,000 in the monetary value of equipment exposed to potential damage, could be saved.

Reduced Redundancy

Fire and rescue response, for the purpose of firefighting and extrication, ranged from five to 12 personnel at a total cost of $67.52 to $192.84 (a difference of $125.32), depending on service duration; and one to four vehicles valued at $550,000 for a single vehicles to a total of $2,000,000 for four vehicles (a difference of $1,450,000). Assuming that the minimum staffing reported is sufficient (and all additional staffing is redundant) and that the minimum reported equipment is sufficient (and all additional equipment is redundant), a personnel cost savings of $125.32 per incident could be realized and the monetary value of equipment exposed to potential damage could be reduced by $1,450,000 per incident.

Table 22. Estimated TIM Resource Costs for Firefighting/Extrication – Highly Developed TIM Programs

FIREFIGHTING/ EXTRICATION	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue							
Driver/Engineer (1)	$27.50	10	$4.58				
Driver/Engineer (2)	$27.50	10	$4.58				
Firefighter (1)	$31.69	10	$5.28			30-60	$15.85-31.69
Firefighter (2)	$31.69	10	$5.28			30-60	$15.85-31.69
Firefighter (3)	$31.69	10	$5.28			30-60	$15.85-31.69
Firefighter (4)	$31.69	10	$5.28			15-30	$7.92-15.85
Firefighter (5)	$31.69	10	$5.28			15-30	$7.92-15.85
Firefighter (6)	$31.69	10	$5.28			15-30	$7.92-15.85
Firefighter (7)	$31.69					15-30	$7.92-15.85
Firefighter (8)	$31.69					15-30	$7.92-15.85
Firefighter (9)	$31.69					15-30	$7.92-15.85
Lieutenant (1)	$37.14	10	$6.19			1-2	$0.62-1.24
Lieutenant (2)	$37.14	10	$6.19				
Captain (1)	$42.87	10	$7.15			1-2	$0.71-1.43
Captain (2)	$42.87	10	$7.15				
Subtotal		120	$67.52			182-364	$96.40-192.84
PERSONNEL TOTAL						**182-364**	**$96.40-192.84**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue							
Truck	$500,000					<60	$500,000
Engine (1)	$450,000	10	$450,000			<60	$450,000
Engine (2)	$450,000	10	$450,000				
Rescue Vehicle (1)	$550,000	10	$550,000			<60	$550,000
Rescue Vehicle (2)	$550,000	10	$550,000				
Hydraulic Tools	$18,000	10	$18,000				
Subtotal		50	$2,018,000			<180	$1,500,000
EQUIPMENT/TECHNOLOGY TOTAL						**<180**	**$1,500,000**

< indicates that the service time was reported in aggregate for multiple functions

Table 23. Estimated TIM Resource Costs for Firefighting/Extrication – Developing TIM Programs

FIREFIGHTING/ EXTRICATION	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue											
Driver/Engineer (1)	$27.50							15	$6.88		
Driver/Engineer (2)	$27.50							15	$6.88		
Firefighter (1)	$31.69			<30	<$15.85			15	$7.92		
Firefighter (2)	$31.69			<30	<$15.85			15	$7.92		
Firefighter (3)	$31.69			<30	<$15.85			15	$7.92		
Firefighter (4)	$31.69			<30	<$15.85			15	$7.92		
Lieutenant (1)	$37.14			<30	<$18.57			45	$27.86		
Lieutenant (2)	$37.14							45	$27.86		
Lieutenant (3)	$37.14							45	$27.86		
Lieutenant (4)	$37.14							45	$27.86		
Lieutenant (5)	$37.14							45	$27.86		
Subtotal				<150	$81.57			315	$184.74	-	-
PERSONNEL TOTAL										-	-
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue											
Engine (1)	$450,000			<30	$450,000						
Rescue Vehicle (1)	$550,000			<30	$550,000			45	$550,000		
Hydraulic Tools	$18,000							45	$18,000		
Subtotal				<60	$1,000,000			90	$568,000	-	-
EQUIPMENT/TECHNOLOGY TOTAL										-	-
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Fire Extinguisher	$50	NA	$50					NA	$50		
Subtotal		NA	$50	-	-	-	-	NA	$50	-	-
SUPPLIES/MATERIALS TOTAL										-	-

< indicates that the service time was reported in aggregate for multiple functions

Minor Spill Mitigation and Cleanup

For highly developed and developing TIM programs, Tables 24 and 25 summarize the estimated TIM resource costs for minor spill mitigation and cleanup, respectively.

Utilization of Appropriate Personnel

As reported by survey respondents, fire and rescue personnel are exclusively responsible for minor spill mitigation and cleanup functions in the common incident scenario. Transportation personnel are commonly equipped with plugs/plug materials, containment booms, and absorbent materials/pads to stop, contain, and clean up minor vehicle fluid spills (four of the six responding transportation agencies indicated carrying these supplies/materials), but none indicated a role in spill mitigation for this scenario. If the spill can be fully mitigated through transportation agency response, the cost of mobilizing fire and rescue personnel—ranging from $31.68 to $55.14 in personnel costs per incident—could be saved.

Utilization of Appropriate Equipment

Properly equipped responders, regardless of discipline, can take prompt action to stop the spill at its source, to contain and limit the size of the spill, to limit the damage to the pavement surface, and to prevent any flammable material from catching fire reducing the overall duration of the incident. Three of the five responding fire and rescue agencies reported carrying plugs/plug materials to stop the spill and absorbent materials/pads to clean-up motor vehicle fluids that reach the roadway. Four of the six responding transportation agencies also indicated carrying these supplies and materials. If the spill can be fully mitigated through transportation personnel response, the cost of mobilizing fire and rescue equipment—ranging from $450,000 to $900,000 in the monetary value of equipment exposed to potential damage—could be saved. Comparably, the monetary value of a transportation vehicle ranges from $35,240 to $75,000 (a difference of between $375,000 and $864,760).

Reduced Redundancy

Fire and rescue response, for the purpose of minor spill mitigation and cleanup, ranged from three to ten personnel at a total cost of $31.68 to $55.14 (a difference of $23.46), depending on service duration; and one to two vehicles valued at $450,000 for a single vehicle to a total of $900,000 for two vehicles (a difference of $450,000). Assuming that the minimum staffing reported is sufficient (and all additional staffing is redundant) and that the minimum reported equipment is sufficient (and all additional equipment is redundant), a personnel cost savings of $23.46 per incident could be realized and the monetary value of equipment exposed to potential damage could be reduced by $450,000 per incident.

Table 24. Estimated TIM Resource Costs for Minor Spill Mitigation – Highly Developed TIM Programs

MINOR SPILL MITIGATION	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue							
Driver/Engineer (1)	$27.50	10	$4.58				
Driver/Engineer (2)	$27.50	10	$4.58				
Firefighter (1)	$31.69	10	$5.28				
Firefighter (2)	$31.69	10	$5.28				
Firefighter (3)	$31.69	10	$5.28				

MINOR SPILL MITIGATION	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
Firefighter (4)	$31.69	10	$5.28				
Firefighter (5)	$31.69	10	$5.28				
Firefighter (6)	$31.69	10	$5.28				
Captain (1)	$42.87	10	$7.15				
Captain (2)	$42.87	10	$7.15				
Subtotal		1,000	$55.14			-	-
PERSONNEL TOTAL						**-**	**-**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue							
Engine (1)	$450,000	10	$450,000			<60	$450,000
Engine (2)	$450,000	10	$450,000				
Subtotal		20	$900,000			<60	$450,000
EQUIPMENT/TECHNOLOGY TOTAL						**<60**	**$450,000**
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue							
Absorbent Material/Pad	$47.50	NA	$47.50			NA	$47.50
Plugs/Plug Material	$52.50	NA	$52.50				
Subtotal		NA	$100			NA	$47.50
Transportation							
Absorbent Material/Pad	$11			NA	$11	NA	$11
Subtotal		-	-	NA	$11	NA	$11
SUPPLIES/MATERIALS TOTAL						**NA**	**$58.50**

< indicates that the service time was reported in aggregate for multiple functions

Table 25. Estimated TIM Resource Costs for Minor Spill Mitigation – Developing TIM Programs

MINOR SPILL MITIGATION	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue											
Firefighter (1)	$31.69			<30	<$15.85			10	$5.28		
Firefighter (2)	$31.69			<30	<$15.85			10	$5.28		
Firefighter (3)	$31.69							10	$5.28		
Firefighter (4)	$31.69							10	$5.28		
Firefighter (5)	$31.69							10	$5.28		
Firefighter (6)	$31.69							10	$5.28		
Lieutenant (1)	$37.14			<30	<$18.57						
Subtotal				<90	$50.27			60	$31.68	-	-
PERSONNEL TOTAL										**-**	**-**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue											
Engine (1)	$450,000			<30	$450,000						
HAZMAT Vehicle	$650,000							20	$650,000		
Hand Tools	$250							NA	$250		
Subtotal				<30	$450,000			20	$650,250	-	-
EQUIPMENT/TECHNOLOGY TOTAL										**-**	**-**
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Fire and Rescue											
Absorbent Material/Pad	$47.50			NA	$47.50						
Plugs/Plug Material	$52.50			NA	$52.50						
Subtotal				NA	$100			-	-	-	-
Transportation											
Absorbent Material/Pad	$11							NA	$11	NA	$11
Subtotal		-	-					NA	$11	NA	$11
SUPPLIES/MATERIALS TOTAL										**NA**	**$11**

< indicates that the service time was reported in aggregate for multiple functions

Crash Investigation

For highly developed and developing TIM programs, Tables 26 and 27 summarize the estimated TIM resource costs for crash investigation, respectively.

Utilization of Appropriate Technology

Various types of technology have been demonstrated to dramatically reduce incident duration while increasing the quality and quantity of measurements captured. Only a single jurisdiction reported using technology-based crash investigation systems to support crash investigation duties (given the intermediate nature of this incident and the absence of fatalities or serious injuries, the limited reported use of technology-base crash investigation systems is not surprising). Counterintuitive to the purported benefits of crash investigation systems, this same jurisdiction reported the highest utilization of law enforcement personnel (three troopers/officers) and the longest duration of investigation (60 minutes) at a cost of $80.25 per incident. The crash investigation system (respondents did not specify the type) was estimated to cost $3,000.

Reduced Redundancy

Law enforcement personnel were exclusively reported to perform crash investigation duties. As reported by survey respondents, one to three troopers/officers were tasked with performing crash investigation duties at a total cost of $6.69 to $80.25 (a difference of $73.56), depending on service duration, ranging from 15 to 60 minutes. Assuming that the minimum staffing reported is sufficient (and all additional staffing is redundant), a personnel cost savings of $73.56 per incident could be realized. Again, this cost difference may appear minor, but when multiplied by the total number of incidents occurring on an annual basis, personnel saving may become significant.

Table 26. Estimated TIM Resource Costs for Crash Investigation – Highly Developed TIM Programs

CRASH INVESTIGATION	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINIA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Trooper/Officer (1)	$26.75					35	$15.60
Trooper/Officer (2)	$26.75					20	$8.92
Subtotal						55	$24.52
PERSONNEL TOTAL						**55**	**$24.52**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Cruiser/Light Bar/Push Bumper (1)	$41,400					20	$41,400
Tape Measure	$80					20	$80
Subtotal						40	$41,480
EQUIPMENT/TECHNOLOGY TOTAL						**40**	**$41,480**
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Spray Paint	$4					NA	$4
Film	$6					NA	$6
Subtotal						NA	$10
SUPPLIES/MATERIALS TOTAL						**NA**	**$10**

< indicates that the service time was reported in aggregate for multiple functions

Table 27. Estimated TIM Resource Costs for Crash Investigation – Developing TIM Programs

CRASH INVESTIGATION	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Trooper/Officer (1)	$26.75	<30	<$13.38	<60	<$26.75	60	$26.75	45	$20.06	15	$6.69
Trooper/Officer (2)	$26.75					60	$26.75				
Trooper/Officer (3)	$26.75					60	$26.75				
Subtotal		<30	<$13.38	<60	<$26.75	180	$80.25	45	$20.06	15	$6.69
PERSONNEL TOTAL										**15**	**$6.69**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Laptop Computer	$1,500	30	$1,500								
Other Crash Investigation System	$3,000					30	$3,000				
Tape Measure	$80							10	$80		
Subtotal		30	$1,500	-	-	30	$3,000	10	$80	-	-
EQUIPMENT/TECHNOLOGY TOTAL										**-**	**-**
SUPPLIES/MATERIALS	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Spray Paint	$4							NA	$4		
Subtotal		-	-	-	-	-	-	NA	$4	-	-
SUPPLIES/MATERIALS TOTAL										**-**	**-**

< indicates that the service time was reported in aggregate for multiple functions

Vehicle and Debris Removal

For highly developed and developing TIM programs, Tables 28 and 29 summarize the estimated TIM resource costs for vehicle and debris removal, respectively.

Utilization of Appropriate Personnel

Consistent with expectations, survey respondents confirmed that vehicle and debris removal is most often the responsibility of law enforcement or transportation personnel, either directly using their own personnel and equipment or through the dispatch of private towing and recovery personnel (one jurisdiction reported utilizing fire and rescue personnel and equipment for vehicle/debris removal, but this likely relates to specialized cleanup tasks associated with the minor fuel leak and not the broader function of vehicle and debris removal). Vehicle/debris removal duties are reportedly performed by a single law enforcement trooper/officer for a duration of 10 minutes at a cost of $4.46 per incident or a single transportation service patrol operator for a duration of 30 minutes at a cost of $12.25 per incident. With no intuitive explanation for the difference in in-service durations, cost estimates may better be compared using monetary compensation as the basis. A 30-minute vehicle/debris removal effort for law enforcement and transportation personnel would average $13.38 and $12.25 ($1.13 lower) per incident, respectively. While this cost difference is minor, use of transportation personnel for vehicle and debris removal would additionally release law enforcement personnel to focus on other tasks for which they are uniquely trained, such as crash investigation for the current incident, or would allow them to return into service more quickly to perform duties elsewhere.

Utilization of Appropriate Equipment

A single law enforcement or transportation vehicle was reportedly utilized to support vehicle/debris removal activities for the common incident scenario: a law enforcement cruiser with a push bumper valued at $41,400 and a transportation pickup with a push bumper valued at $35,240 (a difference of $6,160). In addition to the higher monetary value of equipment exposed to potential damage, law enforcement vehicles (i.e., cruisers) equipped with push bumpers may be more likely to incur damage than transportation vehicles (i.e., medium or heavy duty pickup trucks) when removing involved vehicles from the roadway because of size and design differences.

Reduced Redundancy

In the four jurisdictions that included survey responses from both law enforcement and transportation agencies, three of the jurisdictions reported using a single law enforcement trooper/officer for vehicle/debris removal; while the fourth jurisdiction reported using a single transportation service patrol officer to provide vehicle/debris removal. No redundancy in reported law enforcement/transportation personnel or equipment/technology was observed in the survey responses.

Table 28. Estimated TIM Resource Costs for Vehicle/Debris Removal – Highly Developed TIM Programs

VEHICLE/DEBRIS REMOVAL	Estimated Mean Cost	FT. LAUDERDALE, FLORIDA		MINNEAPOLIS, MINNESOTA		NORTHERN VIRGINA	
		Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Trooper/Officer (1)	$26.75					10	$4.46
Subtotal						10	$4.46
Fire and Rescue							
Driver/Engineer (1)	$27.50	10	$4.58				
Driver/Engineer (2)	$27.50	10	$4.58				
Firefighter (1)	$31.69	10	$5.28				
Firefighter (2)	$31.69	10	$5.28				
Firefighter (3)	$31.69	10	$5.28				
Firefighter (4)	$31.69	10	$5.28				
Firefighter (5)	$31.69	10	$5.28				
Firefighter (6)	$31.69	10	$5.28				
Captain (1)	$42.87	10	$7.15				
Captain (2)	$42.87	10	$7.15				
Subtotal		1,000	$55.14			-	-
Transportation							
Service Patrol Operator (1)	$24.50			15	$6.13		
Subtotal		-	-	15	$6.13	-	-
PERSONNEL TOTAL						**10**	**$4.46**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement							
Cruiser/Light Bar/Push Bumper (1)	$41,400					10	$41,400
Subtotal						10	$41,400
Fire and Rescue							
Engine (1)	$450,000	10	$450,000				
Engine (2)	$450,000	10	$450,000				
Subtotal		20	$900,000			-	-
EQUIPMENT/TECHNOLOGY TOTAL						**10**	**$41,400**

< indicates that the service time was reported in aggregate for multiple functions

Table 29. Estimated TIM Resource Costs for Vehicle/Debris Removal – Developing TIM Programs

VEHICLE/DEBRIS REMOVAL	Estimated Mean Cost	LITTLE ROCK, ARKANSAS		SALEM, NEW HAMPSHIRE		ALBUQUERQUE, NEW MEXICO		OKLAHOMA CITY, OKLAHOMA		CHATTANOOGA, TENNESSEE	
		Time	Cost	Time	Cost	Time	Cost	Time	Cost	Time	Cost
PERSONNEL	($/hr)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Trooper/Officer (1)	$26.75							10	$4.46		
Subtotal		-	-	-	-	-	-	10	$4.46	-	-
Transportation											
Service Patrol Operator (1)	$24.50	-	-					-	-	<30	<$12.25
Subtotal		-	-					-	-	<30	<$12.25
PERSONNEL TOTAL										**<30**	**<$12.25**
EQUIPMENT/TECHNOLOGY	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)	(min)	($)
Law Enforcement											
Cruiser/Light Bar/Push Bumper (1)	$41,400	<10	$41,400								
Subtotal		<10	$41,400	-	-	-	-	-	-	-	-
Transportation											
Pickup/Arrow Board/Push Bumper (1)	$35,240									<30	$35,240
Subtotal		-	-					-	-	<30	$35,240
EQUIPMENT/TECHNOLOGY TOTAL										**<30**	**$35,240**

< indicates that the service time was reported in aggregate for multiple functions


ONLY

6.0 COMPANION COST-SHARE STRATEGIES

With an anticipated overall cost savings per incident (attributable to the hypothetical and observed examples of potential improvements in traffic incident management [TIM] resource management), but potential cost increases and decreases for individual disciplines or agencies, a multi-disciplinary, holistic approach to resource management may require various companion cost-sharing strategies to support implementation and widespread acceptance.

Historically, multi-disciplinary and multi-jurisdictional mutual aid agreements that support the sharing of personnel and equipment resources between agencies and/or jurisdictions at no cost to the recipient (i.e., each jurisdiction or agency is responsible for its own costs incurred in the performance of duties, and does not receive reimbursement from any other jurisdiction), at like-kind or negotiated costs to the recipient, or through third party reimbursement were first introduced in response to larger-scale emergencies, but have migrated into TIM practice to largely support expeditious operational response at jurisdictional boundaries.

Likely following the same evolutionary implementation, multi-disciplinary cost-share agreements have proven effective in establishing the financial responsibility for resources used in response to larger-scale emergencies, but are, at present, less commonly used in TIM. Known examples of cost-share agreements in TIM include the operation, maintenance, management, and sometimes development of joint traffic management centers (TMC) and the performance of TIM services provided by one agency, but procured by a second distinct agency.

Several joint TMCs exist in urban areas across the nation, most often occupied by law enforcement and transportation agencies. Some include a broader set of agencies representing fire and rescue, emergency medical, transit and others. Each of these agencies, co-located at the TMC, often enter into a cost-share agreement to support ongoing facility operation, maintenance, and management and, in some cases, may agree to share facility development costs. As an early example, the California Department of Transportation (Caltrans) and the California Highway Patrol (CHP) signed a Memorandum of Understanding (MOU) to support the development and operation of a joint TMC. Similarly, the Florida Department of Transportation (FDOT) and the Florida Highway Patrol (FHP) have a MOU that encourages TMC co-location with the intent of enhancing cost-effective statewide operations. Partnering agencies need to secure funding commitments to support their share of recurring operations and maintenance expenses as well as initial design and construction costs.

A second example of a type of cost-share agreement in TIM relates to the performance of TIM services provided by one agency, but procured by a second distinct agency. As part of a pilot project, the FDOT procured the services of the FHP to quickly clear incidents along a 53-mile stretch of urban interstate and improve the overall operation of the facility. Similar arrangements may result when a particular agency is constrained in providing these services in-house due to personnel caps (i.e., limits on the number of full-time employees), but has the fiscal means to procure these services from another public agency or private contractor.

The remainder of this chapter considers the various levels and applicability of cost-sharing strategies as they relate to a multi-disciplinary, holistic approach to TIM resource management.

Cost-sharing Levels

In general, three levels of multi-disciplinary, multi-jurisdictional cost-sharing have been defined, ranging from less formal to more formal:[17]

In-kind	**Individuals commit to periodic meetings to address issues of regional significance.** **Agencies assign staff members and other resources (i.e., equipment, facilities) to support collaboration efforts on an ongoing basis.**
Pooled Resources	**Jurisdictions and public and private organizations pool funds, personnel, equipment, and other resources to sustain collaboration.** **Agencies and jurisdictions commit resources to be used in regional operating activities (i.e., mutual aid agreements)**
Funded Entity	**Jurisdictions and public and private organizations allocate funds to support a regional entity responsible for regional collaboration.** **Entities are formed and funded to own and operate resources (i.e., maintenance vehicles, emergency response equipment) on behalf of multiple jurisdictions.**

At the most basic level (i.e., in-kind cost-sharing), public agency operations personnel can begin to affect efficient and effective resource management by assigning existing personnel and resources to certain TIM functions and tasks for which they are appropriately trained and designed, respectively. An example includes the consistent use of existing transportation personnel to provide temporary traffic control at the scene of an incident, releasing law enforcement personnel to perform other duties for which they are uniquely trained. In-kind contributions can generally be administered by a single agency on behalf of all participants. As a next step in cost-sharing evolution, law enforcement, fire and rescue, and emergency medical agencies and/or private towing and recovery industries—who value the scene protection provided through adequate traffic control—may opt to pool funds to support and ensure rapid and consistent dispatch and response of transportation personnel and equipment to the scene. Ultimately, metropolitan planning organizations (MPO) may support a broader multi-disciplinary approach to TIM through their distinctive role in facilitating regional planning and programming decisions, providing a forum for cooperative decision-making, working towards regional consensus, developing regional and institutional agreements, serving as a repository for comprehensive data, etc.

Costs Shared and Borne by Each Agency

Based on cost-sharing guidance for large-scale emergencies,[18] the types of TIM costs that can be shared include the following:

- Personnel costs associated with assigned incident response personnel;
- Equipment costs associated with response equipment used to support the incident;

- Incident cache costs associated with refurbishing, replacing, or restocking supplies and materials; and

- Transportation costs associated with movement of resources to and from an incident.

Under a cost-share agreement, personnel generally receive wages, salaries, and any and all other compensation (i.e., contributions for insurance and retirement) for mobilization, hours worked, and demobilization and have all the duties, responsibilities, immunities, rights, interests, and privileges related to their usual employment regardless of the funding source. The costs of operating equipment under a cost-share agreement generally include fuels, other consumable supplies, and maintenance, service, and repairs necessary to keep the equipment in a state of operational readiness.

The types of TIM costs that should be borne by each agency include the following:[18]

- Accountable and/or sensitive property, as defined by each agency, that is purchased by the agency and becomes property of that agency;

- Administrative overhead costs that include normal operating expenses (i.e., basic utility costs, buildings and facilities rent, administrative support, and personnel);

- Claims or extraordinary settlement costs;

- Additional costs over and above base salary of "backfilling" agency personnel to meet agency-specific staffing requirements; and

- Waste, fraud, and abuse costs.

Eligible costs can be shared proportionately based on the level of resources or responsibility at the incident scene, or through a more direct means of measured incident response and reimbursement.

This Primer directly supports the identification of candidate costs to be shared through the identification of potential TIM resource management improvements related to the:

1. Utilization of personnel who are best qualified (i.e., capable but not over-qualified) for the various tasks,

2. Utilization of appropriate equipment by function (i.e., use of the least costly equipment capable of performing the function),

3. Utilization of appropriate technology capable of supporting various on-site resource tasks, and

4. Reduction in overall resources required through reduced redundancy across disciplines.

A change in perspective regarding TIM resource management from the traditional, intra-agency approach to a multi-disciplinary, holistic approach—combined with supporting implementation strategies (i.e., cost-share agreements)—will help to ensure that the tangible benefits attributable to the most efficient and effective use of TIM resources will be realized across all responding public agencies combined.

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APPENDIX A. INCIDENT SCENARIOS

Ft. Lauderdale, Florida

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

Surveys can be returned via fax (512-467-8971), email (j-carson@tamu.edu) or mail (Texas Transportation Institute, Texas A&M University System, 1106 Clayton Lane, Suite 300E, Austin, TX 78723), attention Jodi L. Carson. If you have specific questions as you complete the worksheets, please contact Jodi L. Carson at j-carson@tamu.edu or (512) 467-0946. We'd appreciate your response no later than **Monday, June 2, 2008**. Thank you in advance for your participation.

INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Eastbound lanes of Interstate 595, approximately 100 yards east of the upstream N. Federal Highway (1) off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling east in the leftmost lane of Interstate 595 abruptly merged right in an attempt to access the N. Federal Highway (1) off-ramp, sideswiping Vehicle #2 (passenger car) traveling east in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards east of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Baltimore, Maryland

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

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For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

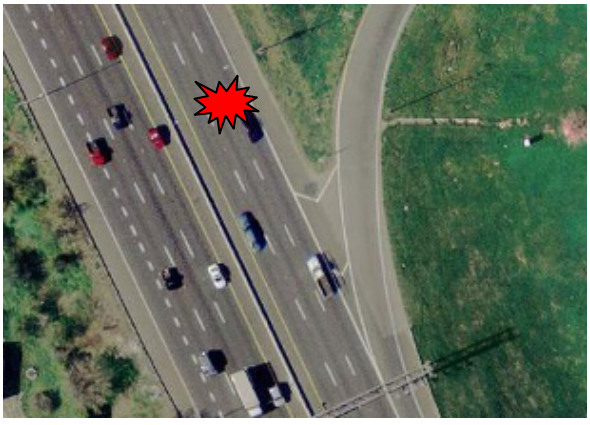
DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Northbound lanes of Interstate 695 north of the Baltimore Washington Parkway (295), approximately 100 yards north of the upstream Fairview Avenue off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling north in the leftmost lane of Interstate 695 abruptly merged right in an attempt to access the Fairview Avenue off-ramp, sideswiping Vehicle #2 (passenger car) traveling north in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards north of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____



Minneapolis, Minnesota

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

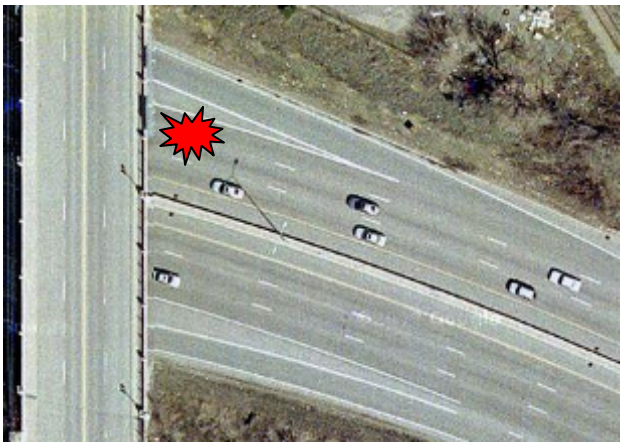
DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Westbound lanes of Interstate 94, approximately 100 yards west of the upstream Huron Boulevard SE off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling west in the leftmost lane of Interstate 94 abruptly merged right in an attempt to access the Huron Boulevard SE off-ramp, sideswiping Vehicle #2 (passenger car) traveling west in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards west of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____



Northern Virginia

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Eastbound lanes of Interstate 66, approximately 100 yards east of the upstream N. Westmoreland Street off-ramp in Falls Church

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling east in the leftmost lane of Interstate 66 abruptly merged right in an attempt to access the N. Westmoreland Street off-ramp, sideswiping Vehicle #2 (passenger car) traveling east in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards east of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Seattle, Washington

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

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For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Northbound lanes of Interstate 5, approximately 100 yards north of the upstream Interstate 90 West off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling north in the leftmost lane of Interstate 5 abruptly merged right in an attempt to access the Interstate 90 West off-ramp, sideswiping Vehicle #2 (passenger car) traveling north in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards north of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Westbound lanes of Interstate 630, approximately 100 yards west of the upstream S. Chester Street off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling west in the leftmost lane of Interstate 630 abruptly merged right in an attempt to access the S. Chester Street off-ramp, sideswiping Vehicle #2 (passenger car) traveling west in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards west of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Northbound lanes of Interstate 93, approximately 100 yards north of the upstream Rockingham Park Boulevard off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling north in the leftmost lane of Interstate 93 abruptly merged right in an attempt to access the Rockingham Park Boulevard off-ramp, sideswiping Vehicle #2 (passenger car) traveling north in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards north of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Albuquerque, New Mexico

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Northbound lanes of Interstate 25, approximately 100 yards north of the upstream Pan American East Freeway NE/Frontage Road N. off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling north in the leftmost lane of Interstate 25 abruptly merged right in an attempt to access the Pan American East Freeway NE/Frontage Road N. off-ramp, sideswiping Vehicle #2 (passenger car) traveling north in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards north of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Oklahoma City, Oklahoma

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

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INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Southbound lanes of Interstate 235, approximately 100 yards south of the upstream Interstate 40 West off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling south in the leftmost lane of Interstate 235 abruptly merged right in an attempt to access the Interstate 40 West off-ramp, sideswiping Vehicle #2 (passenger car) traveling south in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards south of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Scranton, Pennsylvania

TRAFFIC INCIDENT MANAGEMENT (TIM)
RESOURCE UTILIZATION SURVEY

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

Surveys can be returned via fax (512-467-8971), email (j-carson@tamu.edu) or mail (Texas Transportation Institute, Texas A&M University System, 1106 Clayton Lane, Suite 300E, Austin, TX 78723), attention Jodi L. Carson. If you have specific questions as you complete the worksheets, please contact Jodi L. Carson at j-carson@tamu.edu or (512) 467-0946. We'd appreciate your response no later than **Monday, June 2, 2008**. Thank you in advance for your participation.

INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Westbound/northbound lanes of Interstate 84/380, approximately 100 yards west/north of the upstream Tigue Street off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling west/north in the leftmost lane of Interstate 84/380 abruptly merged right in an attempt to access the Tigue Street off-ramp, sideswiping Vehicle #2 (passenger car) traveling west/north in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards west/north of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____

Chattanooga, Tennessee

The Federal Highway Administration (FHWA) is sponsoring an investigation to determine the nature and extent of public agency resources utilized when responding to a typical incident scenario (described below). Public agency response may include law enforcement, fire and rescue, emergency medical services, and transportation.

For each type of public agency, a series of three worksheets are provided that request resource utilization information for: (1) personnel, (2) equipment and technology, and (3) supplies and materials utilized at the scene of the incident described below. Please complete the three attached worksheets for your respective public agency detailing the resources and associated costs for incident response. Assume that you have access to sufficient personnel, equipment, supplies, and materials and that these resources are not otherwise engaged. Technology resources should reflect existing capabilities (i.e., only list the use of variable message signs or total station surveying equipment if you have them presently available to you).

Surveys can be returned via fax (512-467-8971), email (j-carson@tamu.edu) or mail (Texas Transportation Institute, Texas A&M University System, 1106 Clayton Lane, Suite 300E, Austin, TX 78723), attention Jodi L. Carson. If you have specific questions as you complete the worksheets, please contact Jodi L. Carson at j-carson@tamu.edu or (512) 467-0946. We'd appreciate your response no later than **Monday, May 19, 2008**. Thank you in advance for your participation.

INCIDENT SCENARIO: LANE-BLOCKING, INJURY CRASH

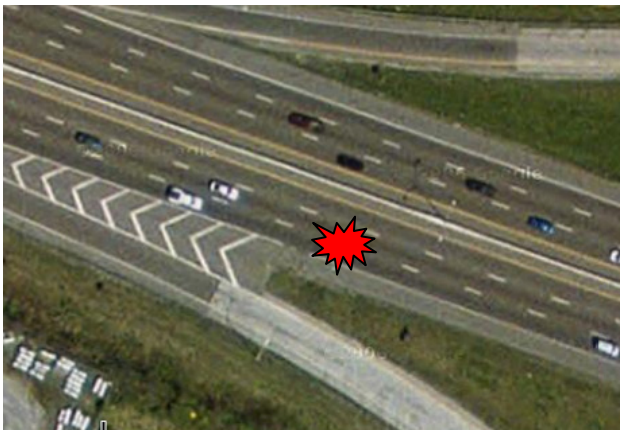
DATE/TIME: 11:15 AM on Monday

CONDITIONS: Sunny with mild wind, 72 degrees (F)

LOCATION: Eastbound lanes of Interstate 24, approximately 100 yards east of the upstream 4th Avenue off-ramp

CIRCUMSTANCES: Vehicle #1 (small sport utility vehicle), traveling east in the leftmost lane of Interstate 24 abruptly merged right in an attempt to access the 4th Avenue off-ramp, sideswiping Vehicle #2 (passenger car) traveling east in the center lane. Upon impact, Vehicle #2 braked abruptly, spun and was hit at a high rate of speed by Vehicle #3 (small pickup truck). The three involved vehicles are blocking the two rightmost travel lanes of the highway approximately 100 yards east of the upstream off-ramp. Vehicle #2 has a minor gasoline leak and the driver is trapped with minor injuries. Vehicle #1 and Vehicle #3 sustained minor damage but are drivable. The drivers of Vehicle #1 and Vehicle #3 are uninjured. Traffic is light and moving past the incident at approximately 10 MPH. A backup is slowly building behind the blockage. Traffic volumes are expected to increase between noon and 1:00 PM. Law enforcement is first to arrive at the scene, followed by fire and rescue and EMS and later, transportation.

In your experience, how long would it take to clear this incident (i.e., from the time of occurrence to the time all lanes are reopened and normal traffic flow resumes)? _____



APPENDIX B. RESOURCE UTILIZATION AND COST SURVEY

LAW ENFORCEMENT PERSONNEL

	RANK/TITLE	HOURLY RATE	TASKS/FUNCTION	SERVICE TIME	BACKFILL COSTS
	List the rank or title of each individual from your agency who would respond to the incident scene.	List the corresponding hourly rate of each individual. An average hourly rate by rank or title is acceptable.	List the general tasks or functions that each individual will perform at the incident scene. Each individual may perform multiple and progressive tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each individual spends performing each task or function.	Estimate any costs associated with "backfilling" (i.e., paying replacement personnel to perform duties that would have otherwise been provided by the individual at the incident scene).
	• Trooper/Officer • Sergeant • Lieutenant • Captain/Commander • Chief/Major	($ per hour)	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)
	Example *Sergeant*	*$35 per hour*	*scene protection* *medical care* *extra response mobilization (towing, transportation)* *traffic control* *crash investigation* *documentation*	*10 minutes* *10 minutes* *5 minutes* *30 minutes* *30 minutes* *10 minutes*	*no backfill required*
1					
2					
3					
4					
5					

LAW ENFORCEMENT
EQUIPMENT/TECHNOLOGY

	EQUIPMENT/TECHNOLOGY	TASKS/FUNCTION	SERVICE TIME	HOURLY/RENTAL RATE	REPLACEMENT COSTS
	List the equipment or technology from your agency that would be used at the scene of this incident. Example items are listed below; include additional equipment or technology as necessary.	List the general tasks or functions that each piece of equipment or technology would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each item would be in use for each task or function.	List the hourly use or rental cost rates associated with each item used.	Estimate the replacement costs and expected life associated with each item used.
	• motorcycle • cruiser with light bar/push bumper • light-duty pickup/sport utility vehicle • portable laser warning system • traffic cones, signs, barricades • physical incident screen • variable message sign/highway advisory radio (VMS/HAR) • tape measure • cameras/video equipment • total station surveying equipment • perspective grid investigation system • broom/blower	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)	($ and years)
	Example *cruiser with light bar/push bumper*	*scene protection* *lane closures/traffic control* *vehicle removal*	*10 minutes* *20 minutes* *10 minutes*	*$20 per hour*	*$45,000* *5-year life*
1					
2					
3					
4					
5					

LAW ENFORCEMENT
SUPPLIES AND MATERIALS

	SUPPLIES AND MATERIALS	TASKS/FUNCTION	QUANTITY USED	REPLACEMENT COSTS
	List the supplies and materials from your agency that would be used at the scene of this incident. Example items are listed below; include additional supplies and materials as necessary.	List the general tasks or functions that each of the supplies and materials would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the quantity of supplies and materials used for each task or function.	List per unit costs to replenish expended supplies and materials.
	• first aid supplies • emergency blanket • fire extinguisher • flare/fusee • absorbent material/pad • plug and dike • containment boom • spray paint	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(units)	($/unit)
	Example *flares/fusees*	*lane closures/traffic control*	*5 units*	*$2.00 per unit*
1				
2				
3				
4				
5				

FIRE AND RESCUE PERSONNEL

	RANK/TITLE	HOURLY RATE	TASKS/FUNCTION	SERVICE TIME	BACKFILL COSTS
	List the rank or title of each individual from your agency who would respond to the incident scene.	List the corresponding hourly rate of each individual. An average hourly rate by rank or title is acceptable.	List the general tasks or functions that each individual will perform at the incident scene. Each individual may perform multiple and progressive tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each individual spends performing each task or function.	Estimate any costs associated with "backfilling" (i.e., paying replacement personnel to perform duties that would have otherwise been provided by the individual at the incident scene).
	• Lieutenant • Captain • Battalion Chief • Deputy Chief • Assistance Chief • Chief	($ per hour)	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)
	Example *Lieutenant*	*$35 per hour*	*scene protection* *firefighting/extrication* *fuel leak mitigation* *documentation*	*10 minutes* *30 minutes* *10 minutes* *10 minutes*	*no backfill required*
1					
2					
3					
4					
5					

FIRE AND RESCUE
EQUIPMENT/TECHNOLOGY

	EQUIPMENT/TECHNOLOGY	TASKS/FUNCTION	SERVICE TIME	HOURLY/RENTAL RATE	REPLACEMENT COSTS
	List the equipment or technology from your agency that would be used at the scene of this incident. Example items are listed below; include additional equipment or technology as necessary.	List the general tasks or functions that each piece of equipment or technology would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each item would be in use for each task or function.	List the hourly use or rental cost rates associated with each item used.	Estimate the replacement costs and expected life associated with each item used.
	• light-duty pickup/sport utility vehicle • engine • tanker • heavy/technical rescue vehicle • hazardous materials vehicle • traffic cones, signs, barricades	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)	($ and years)
	Example *engine*	*scene protection* *extrication*	*40 minutes* *30 minutes*	*$80 per hour*	*$450,000* *15-year life*
1					
2					
3					
4					
5					

FIRE AND RESCUE
SUPPLIES AND MATERIALS

	SUPPLIES AND MATERIALS	TASKS/FUNCTION	QUANTITY USED	REPLACEMENT COSTS
	List the supplies and materials from your agency that would be used at the scene of this incident. Example items are listed below; include additional supplies and materials as necessary.	List the general tasks or functions that each of the supplies and materials would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the quantity of supplies and materials used for each task or function.	List per unit costs to replenish expended supplies and materials.
	• first aid supplies • emergency blanket • fire extinguisher • flare/fusee • absorbent material/pad • plug and dike • containment boom	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(units)	($/unit)
	Example *absorbent material/pad*	*fuel leak mitigation*	*1 unit*	*$3.00 per unit*
1				
2				
3				
4				
5				

EMERGENCY MEDICAL SERVICES
PERSONNEL

	RANK/TITLE	HOURLY RATE	TASKS/FUNCTION	SERVICE TIME	BACKFILL COSTS
	List the rank or title of each individual from your agency who would respond to the incident scene.	List the corresponding hourly rate of each individual. An average hourly rate by rank or title is acceptable.	List the general tasks or functions that each individual will perform at the incident scene. Each individual may perform multiple and progressive tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each individual spends performing each task or function.	Estimate any costs associated with "backfilling" (i.e., paying replacement personnel to perform duties that would have otherwise been provided by the individual at the incident scene).
	• Certified First Responder • EMT-Basic • EMT-Intermediate • EMT-Paramedic • Critical Care Paramedic	($ per hour)	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)
	Example *EMT-Basic*	*$35 per hour*	*medical care*	*10 minutes*	*no backfill required*
1					
2					
3					
4					
5					

EMERGENCY MEDICAL SERVICES
EQUIPMENT/TECHNOLOGY

	EQUIPMENT/TECHNOLOGY	TASKS/FUNCTION	SERVICE TIME	HOURLY/RENTAL RATE	REPLACEMENT COSTS
	List the equipment or technology from your agency that would be used at the scene of this incident. Example items are listed below; include additional equipment or technology as necessary.	List the general tasks or functions that each piece of equipment or technology would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each item would be in use for each task or function.	List the hourly use or rental cost rates associated with each item used.	Estimate the replacement costs and expected life associated with each item used.
	• Non-transporting vehicle • Type I ambulance (pickup chassis) • Type II ambulance (vanbulance) • Type III ambulance (van chassis) • MedEvac	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)	($ and years)
	Example *Type III ambulance*	*medical care*	*10 minutes*	*$67 per hour*	*$130,000* *10-year life*
1					
2					
3					
4					
5					

EMERGENCY MEDICAL SERVICES
SUPPLIES AND MATERIALS

	SUPPLIES AND MATERIALS	TASKS/FUNCTION	QUANTITY USED	REPLACEMENT COSTS
	List the supplies and materials from your agency that would be used at the scene of this incident. Example items are listed below; include additional supplies and materials as necessary.	List the general tasks or functions that each of the supplies and materials would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the quantity of supplies and materials used for each task or function.	List per unit costs to replenish expended supplies and materials.
	• first aid supplies • emergency blanket	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(units)	($/unit)
	Example *emergency blanket*	*medical care*	*1 unit*	*$4.00 per unit*
1				
2				
3				
4				
5				

TRANSPORTATION
PERSONNEL

	RANK/TITLE	HOURLY RATE	TASKS/FUNCTION	SERVICE TIME	BACKFILL COSTS
	List the rank or title of each individual from your agency who would respond to the incident scene.	List the corresponding hourly rate of each individual. An average hourly rate by rank or title is acceptable.	List the general tasks or functions that each individual will perform at the incident scene. Each individual may perform multiple and progressive tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each individual spends performing each task or function.	Estimate any costs associated with "backfilling" (i.e., paying replacement personnel to perform duties that would have otherwise been provided by the individual at the incident scene).
	• equipment operator • worker/technician • lead worker/technician • supervisor • engineer	($ per hour)	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)
	Example *lead worker/technician*	*$20 per hour*	*scene protection* *lane closure/traffic control* *VMS/HAR messages*	*30 minutes* *30 minutes* *10 minutes*	*no backfill required*
1					
2					
3					
4					
5					

TRANSPORTATION
EQUIPMENT/TECHNOLOGY

	EQUIPMENT/TECHNOLOGY	TASKS/FUNCTION	SERVICE TIME	HOURLY/RENTAL RATE	REPLACEMENT COSTS
	List the equipment or technology from your agency that would be used at the scene of this incident. Example items are listed below; include additional equipment or technology as necessary.	List the general tasks or functions that each piece of equipment or technology would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the amount of time each item would be in use for each task or function.	List the hourly use or rental cost rates associated with each item used.	Estimate the replacement costs and expected life associated with each item used.
	• light-duty pickup with push bumper and arrow board • traffic cones, signs, barricades • physical incident screen • variable message sign/highway advisory radio (VMS/HAR) • responsive traffic signal systems • traffic management center • tow truck • backhoe/front end loader • dump truck • empty box/livestock trailer • empty tanker truck • sweeper/blower	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(minutes)	($ per hour)	($ and years)
	Example *light-duty pickup with push bumper and arrow board*	*scene protection* *lane closures/traffic control*	*30 minutes* *30 minutes*	*$20 per hour*	*$45,000* *5-year life*
1					
2					
3					
4					
5					

TRANSPORTATION
SUPPLIES AND MATERIALS

	SUPPLIES AND MATERIALS	TASKS/FUNCTION	QUANTITY USED	REPLACEMENT COSTS
	List the supplies and materials from your agency that would be used at the scene of this incident. Example items are listed below; include additional supplies and materials as necessary.	List the general tasks or functions that each of the supplies and materials would support at the incident scene. Each item may support multiple tasks. Example tasks or functions are listed below; include additional tasks or functions as necessary.	Estimate the quantity of supplies and materials used for each task or function.	List per unit costs to replenish expended supplies and materials.
	• first aid supplies • emergency blanket • fire extinguisher • flare/fusee • absorbent material/pad • plug and dike • containment boom • spray paint	• scene protection • lane closure/traffic control • medical care • firefighting/extrication • extra response mobilization • fuel leak mitigation • crash investigation • VMS/HAR messages • traffic signal control • public/media information • vehicle removal • cleanup • documentation	(units)	($/unit)
	Example *flares/fusees*	*lane closures/traffic control*	*5 units*	*$2.00 per unit*
1				
2				
3				
4				
5				

U.S. Department of Transportation
Federal Highway Administration

FHWA Office of Operations, HOTO
1200 New Jersey Avenue, SE
Washington, DC 20590

http://ops.fhwa.dot.gov

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