Learning Objectives

Upon completion of this class, participants will be able to:

• Recognize the main differences between Work Zone Traffic Incident Management (WZ-TIM) and TIM in ordinary situations.
• Be able to compare and contrast the WZ-TIM roles and responsibilities of first responders, transportation agency staff, and the contractor.
• Be able to describe several strategies for improving work zone incident prevention and response.
• Be familiar with the advantages and disadvantages of contractor involvement in work zone incident management.
Participant Profiles

• What type of organization do you work for?
• Which best describes your role in the organization?

Guidebook Under Development


• Discusses incident management coordination, planning, and response in work zones.
• Incorporates principles from the *Toward Zero Deaths* national strategy on highway safety.
• Incorporates *Safe System* approach to highway safety management.
Effective Response to WZ Incidents

Dealing with a crash or other traffic incident occurring in a work zone requires the combined skills of many people/disciplines.

Case Study: Yahara River Bridge Re-Decking
Madison, Wisconsin
June 2013
**Case Study: Yahara River Bridge Re-Decking**

Madison, Wisconsin – June 2013

- Urban freeway with 123,000 vehicles/day
- Causeway over river and wetlands
- Unusual split configuration

**Case Study: Complex Urban Work Zone**
Lane 1 is Closed by Service Patrol and Local LE
Towing and Recovery

All Lanes Open
Background

- 2004: Federal Work Zone Safety & Mobility Rule established to help manage traffic and safety issues on federally-funded highway projects.
- 2007: Deadline for state Departments of Transportation (DOTs) to establish a work zone planning process – producing a Transportation Management Plan (TMP).
- 2016: TMP process generally considered “best practice” for all significant projects, regardless of funding.

Why Do TMPs?

- TMP helps agency, contractor and first responders prepare for traffic issues unique to each site/project.
- TMP process has been successful in:
  - Improving travel conditions
  - Creating a better safety environment
  - Reducing complaints from the public.
Work Zone Characteristics

Competing Road Space Demands
- Lane and shoulder closures
- Narrow lanes
- Obstacles near live lanes
- Reduced visibility

Complicated Driving Environment
- Driver comprehension / distraction
- Congestion
- Regular traffic mixing with slow-moving work vehicles

Expect the Unexpected

Traffic crashes
- Within work zone
- In traffic queue leading to work zone

Worker illnesses and injuries

Construction-related mishaps, e.g.:
- Equipment tip-over
- Embankment or trench collapse
- Fire at construction site

Guide focuses mainly focusing on how these issues affect traffic management.
We’re In This Together

*All work zone partners have shared responsibility to prepare for potential work zone crashes by:*

1. Arranging the work zone to minimize the chances of a crash
2. Making efforts to ensure that crash severity and crash consequences are minimized
3. Being ready to respond quickly and efficiently if a crash occurs

How safe are we?

Photo: Todd Siegel/Wikimedia Commons
### 2016 Olympic Medal Count

<table>
<thead>
<tr>
<th>Country</th>
<th>Medals</th>
<th>Country</th>
<th>Medals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>29</td>
<td>Norway</td>
<td>4</td>
</tr>
<tr>
<td>Canada</td>
<td>22</td>
<td>Poland</td>
<td>11</td>
</tr>
<tr>
<td>France</td>
<td>42</td>
<td>South Korea</td>
<td>21</td>
</tr>
<tr>
<td>Germany</td>
<td>42</td>
<td>Spain</td>
<td>17</td>
</tr>
<tr>
<td>Italy</td>
<td>28</td>
<td>Sweden</td>
<td>11</td>
</tr>
<tr>
<td>Japan</td>
<td>41</td>
<td>Switzerland</td>
<td>7</td>
</tr>
<tr>
<td>Netherlands</td>
<td>19</td>
<td>United Kingdom</td>
<td>67</td>
</tr>
<tr>
<td>New Zealand</td>
<td>18</td>
<td>United States</td>
<td>121</td>
</tr>
</tbody>
</table>

Source: NBC

![We're the best!]

### Fatal Roadway Crashes per 100,000 People

<table>
<thead>
<tr>
<th>Country</th>
<th>Rate</th>
<th>Country</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>6.1</td>
<td>Norway</td>
<td>4.3</td>
</tr>
<tr>
<td>Canada</td>
<td>6.8</td>
<td>Poland</td>
<td>11.8</td>
</tr>
<tr>
<td>France</td>
<td>6.4</td>
<td>South Korea</td>
<td>14.1</td>
</tr>
<tr>
<td>Germany</td>
<td>4.7</td>
<td>Spain</td>
<td>5.4</td>
</tr>
<tr>
<td>Italy</td>
<td>7.2</td>
<td>Sweden</td>
<td>3.0</td>
</tr>
<tr>
<td>Japan</td>
<td>5.2</td>
<td>Switzerland</td>
<td>4.3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3.9</td>
<td>United Kingdom</td>
<td>3.7</td>
</tr>
<tr>
<td>New Zealand</td>
<td>9.1</td>
<td>United States</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Source: World Health Organization

![Most of our peers are doing much better than us.]

Most of our peers are doing much better than us.
US Highway Safety: 2015 Preliminary Results

Roadways in general:
- 32,166 crashes killed 35,092 people
- 2.3 million injuries (2014)

Work Zones specifically:
- 642 crashes killed 700 people
- Every US state had at least one fatal crash in a work zone
- 62 fatal work zone crashes involved a child 12 or under

Source: NHTSA

First Responder Safety

- More on-duty police officers killed in traffic crashes than by bullets.
- More firefighters killed by motor vehicles than by fires and explosions.
- Tow truck operators and EMS personnel also at high risk of being struck by traffic.

Source: Bureau of Labor Statistics
What goes wrong?

1. **Lack of Communication** among work zone actors

2. **Lack of Planning and Coordination** of traffic control responsibilities

3. **Inadequate Training** of first responders in traffic control procedures within highway work zones

An ounce of prevention...

- Incident Prevention
- Incident Response
- Post-Incident Follow-Up
Unique WZ Challenges

Work Zone Traffic Incident Management (WZ-TIM) differs from TIM on ordinary roadways in several ways:

- **Difficult access** to work zone incidents
- **Limited space**: lane restrictions
- **Traffic congestion**: back-ups / queues
- **Many organizations** to coordinate:
  - First responders (police, fire, EMS, towing)
  - Agency traffic operations center
  - Contractor personnel
  - Agency construction management personnel

Incident Prevention:
What Can Engineers and Contractors Do?

**Pre-Construction**
- **Prepare** for handling work zone incidents
  - Physical Accommodations
  - Inter-Agency Coordination
  - Contractual Provisions
- **Engage** first responders in Transportation Management Plan (TMP) development and incident management planning.

**During Construction**
- **Keep responders informed** about lane/ramp closures and “back door” ways to access the work zone.
- **Say something** if you observe a problem.
  - Situations that encourage illegal/risky road user behavior.
  - Missing traffic control devices.
  - Improper work practices.
- **Set a positive example** by complying with work zone traffic laws, on- and off-duty.
Making the Work Zone a “Safe System”

- Safe System is a new way of thinking about the interaction of roads, road user behavior, vehicles, and speeds
- Protecting human health is the core of the Safe System approach
- Humans have very limited ability to absorb the forces of blunt trauma that occur during a crash
- Rather than try to eliminate all crashes (which is not realistic), focus on preventing crashes that result in death or serious injury

Safe System Approach

- Traffic crashes usually involve a chain of events: Mistakes – Mishaps – Behaviors
- The goal: Break the chain before a mistake turns into a serious incident, or at least reduce the severity of the outcome
Elements of a Safe System

If one element of the system fails, other elements help minimize the consequences of failure.

Human Interaction with the Roadway
Safe System Strategies

- Make the WZ environment as “forgiving” as possible to errors or misjudgments made by workers, first responders, drivers, or others
- If a crash does occur, emergency response personnel—and people already on scene—need to respond quickly and correctly
- Assure victims receive appropriate treatment as promptly as possible

Getting to the Incident Site

Potential Solution Examples
- Gates in temporary barriers
- Gated “back-door” access to work sites
- Temporary access from overpasses or sideroads
- Emergency response vehicles suitable for off-road driving
Emergency Access Identification

**Motivation for the Change**
- Freeway-to-freeway interchange reconstruction in Wisconsin
- Multiple access points
- Worker medical emergency
- Treatment delayed because EMS arrived at wrong vertical level

**What Was Done**
- Support fire and EMS response by developing system for identifying work area access points
- Unique identifier for each access
- Distinct from exit numbers and mile markers
- Also simplifies construction deliveries

Emergency Management Accommodation Examples

- Emergency parking pullouts (safe space when there is no shoulder)
- Changeable signs (hinged or electronic)
- Traffic control storage caches (traffic cones, drums, signs, etc.)
- Triage areas and landing zones (especially remote/rugged sites)
Tactical Pre-Planning

• Pre-planning incident response tactics helps avoid secondary incidents.
  - For example, a plan can be established to close upstream ramps to limit incoming traffic volume.
• Up-front consideration should be given for how tactics will change depending on traffic conditions

Matching Response to Site Conditions

• Pre-determine:
  - Who has authority to decide when to divert traffic to alternate routes
  - Who is authorized to discontinue use of alternative routes when the situation improves
  - What criteria will be used to make these decisions
• If the work site is complicated, it may be necessary to prepare step-by-step deployment instructions in advance
• Utilize pre-incident exercises
Matching Response to Site Conditions

• Scene access is an important consideration for incident planning and response management
• Pre-planned detours or alternate routes can be helpful in managing incidents
• Develop effective, dynamic media/social media strategies
• Determine how motor carrier traffic (trucks) will be managed during an incident

Pre-Project Agenda

• **Determine** jurisdictions/agencies affected by the project
• **Identify** access locations and plan alternate routes
• **Evaluate** impacts on existing incident response methods and equipment
• **Confirm** physical accommodations for incident management
Coordination Agenda

- **Discuss and agree** on project expectations and objectives
- **Clarify** incident management roles and responsibilities of agencies, construction managers, contractors, and subcontractors
- **Review/update** communication protocols, coordination procedures, inter-agency memos, mutual aid agreements, contracts, etc.

Coordination Tasks

- **Prepare** contact lists (including contractor Point of Contact) for routine updates and emergencies
- **Distribute** anticipated project timeline
- **Agree** to periodic evaluations of work zone effectiveness
- **Conduct** training/tabletop exercises to practice and clarify incident management procedures
A pound of cure...

Incident Prevention | Incident Response | Post-Incident Follow-Up

Crash or Other Incident Occurs

Call 911 to report incident
Activate signs and messages to warn approaching drivers of incident
Assess situation and request additional resources as necessary
Check on victims and give first aid if feasible
Provide temporary traffic control devices
Protect victim(s) and provide advanced medical care

Move uninjured workers and equipment (except traffic control) to safe locations
Assist in securing and protecting incident scene
Protect back of traffic queue if required
Secure and protect the incident scene
Provide additional temp traffic control

Give first aid to victims
Manage traffic and bystanders
Provide temporary traffic control devices
Assist in securing and protecting incident scene
Suppress fires

Assess situation and request additional resources as necessary
Assist in securing and protecting incident scene
Protect back of traffic queue if required
Secure and protect the incident scene
Provide additional temp traffic control

Extricate trapped victims
Provide emergency medical care
Assess injuries and provide advanced medical care
Assess hazardous materials

Transport victims to hospital
Examine deceased victims and pronounce death
Contain and stabilize hazardous materials
Coordinate hazmat cleanup with natural resources dept.

Supervise scene clearance
Remove vehicles that are blocking traffic lanes
Remove medical waste
Clean up hazardous materials

Remove debris from pavement
Restore temporary work zone traffic control
Issue citations

Collect evidence
Assist people with disabled vehicles
Remove medical waste
Remove damaged vehicles

Resume typical work zone traffic operations
Resume typical work zone traveler information
Resume typical construction operations

Contractor | Highway Agency | Police | Fire Dept | EMS | Coroner/ Med Exmnr | Towing Services | Hazmat Specialist

Note: Roles and responsibilities shown in this chart are generalized, and could vary based on State and local laws, agreements, and contracts.
Incident Response:
Roles for First Responders

- Secure and protect the scene
- Aid crash victims
- Coordinate the response
- Protect the back-of-queue to prevent secondary collisions
- Manage traffic and re-route if necessary
- Ask for contractor equipment and manpower if it will help expedite response and recovery
- Investigate the incident, gather evidence, and issue citations as appropriate

Incident Response:
Roles for Contractors

- Report the incident by calling 911
- Move construction personnel and equipment out of the way
- Give First Aid to crash victims until help arrives (if qualified)
- Assist with the response if requested:
  - Traffic control equipment
  - Back-of-queue protection
  - Lifting equipment
  - Containment of fuel spills
Case Study: Truck Rollover
West Des Moines, Iowa – September 2014

Facts & Circumstances

- Rural freeway with 25,800 veh/day
- Northbound semi struck, penetrated concrete barrier
- Two SB passenger cars struck the semi
- All lanes blocked
- Diesel spill
- Traffic re-routed to arterials
- Extended closure due to delayed arrival of HazMat contractor
Traffic Control

- FHWA’s *Manual on Uniform Traffic Control Devices* (MUTCD) establishes national standards for traffic control devices, such as signs, lights and traffic cones.
- Chapter 6 of the MUTCD includes recommended layouts for work zone traffic control and incident management.
- Can be downloaded free of charge at http://mutcd.fhwa.dot.gov.
- Printed copies available from online booksellers.

Work Zone Traffic Control Equipment

- Signs
- Portable Changeable Message Signs (PCMS)
- Barricades
- Cones
- Drums
- Vertical Panels
- Flexible tubular markers
- Arrow panels
- Concrete barriers
- Lighting
- Striping/skip lines
- Attenuators
MUTCD Signage Colors

Orange: Construction

Fluorescent Pink: Incident Management

Using Contractor’s Traffic Control Devices

• Sometimes, drums and other devices already on site are repositioned to expedite incident traffic management.
• Coordinate with responders to assure that traffic is not directed into impassable areas.
• When incident is cleared, discuss whether traffic control should be put back in its previous location.

Photo: Andrew Bossi/WikiMedia Commons
Apparel

- High-visibility garments help assure that first responders are seen by drivers.
- Apparel must meet standards set by the American National Standards Institute (ANSI).
- Many states require the use of both vests and high-visibility pants at night.
- ANSI standards allow the use of both orange and yellow-green.
Secondary Crashes

• “Secondary crash” is a second (or subsequent) crash that occurs at the incident scene or in a traffic queue resulting from the original incident.
• About 18% of freeway fatalities are the result of secondary crashes.
• Most common scenario: traffic is backed up and a fast-moving vehicle strikes a slowed or stopped vehicle at the back of the queue.
• Less likely to occur if warning is provided about ¼ mile in advance of the slowed traffic.
## Back-of-Queue Protection Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll-Up Fabric Signs</td>
<td>• Pro: Easy to set up and remove</td>
<td>• Con: Small, may need to reposition as queue changes</td>
</tr>
<tr>
<td>Hinged Fixed Signs</td>
<td>• Pro: Bigger and more conspicuous than portable signs</td>
<td>• Con: Queues move, signs don’t</td>
</tr>
<tr>
<td>Electronic Signs</td>
<td>• Pro: Large, conspicuous, can change the message</td>
<td>• Con: Queues move, signs don’t. Expensive. Not crash-tested.</td>
</tr>
<tr>
<td>Law Enforcement Vehicle</td>
<td>• Pro: Can move as queue grows/shrinks</td>
<td>• Con: Officer not available for other duties</td>
</tr>
<tr>
<td>Contractor-Supplied Vehicle</td>
<td>• Pro: Can move as queue grows/shrinks</td>
<td>• Con: Requires special contractual provisions, response time possibly slower than law enforcement</td>
</tr>
</tbody>
</table>

## Floodlighting

- Human eyes cannot adjust to bright and dim light at the same time.
- Lighting experts call the excessive contrast “glare.”
- Drivers can be temporarily blinded by glare from floodlights.
- Older drivers are the most affected.
- Aim work lights (and emergency vehicle headlights) away from traffic.
Emergency & Work Vehicle Lighting

- Lights needed while emergency vehicles travel to incident site.
- Multiple lights, colors and flash patterns can dazzle and distract drivers when several contractor and first responder vehicles assemble in the same area.
- Glare from flashing lights can temporarily blind older drivers, especially at night.
- MUTCD recommends reducing flashing lights on emergency vehicles to the essential few after arrival at the scene (Section 61.05).
Incident Command Principles

- Establish command/unified command
- Chain of command
- Management by objective
- Safety is paramount
- Common terminology

Incident Complexity Levels

Traffic incident and response levels can be organized into three categories, based on expected duration and complexity:

- **Minor** – Expected duration *less than 30 minutes*
- **Intermediate** – Expected duration *30 minutes to two hours*
- **Major** – Expected duration *more than two hours*
Incident Command System (ICS)

- A systematic tool for command, control and coordination of emergency response.
- Efficiently use personnel, facilities, equipment and communications by integration within a common organizational structure.
- Applied from the time an incident occurs until the need for management and operations no longer exists.
- Should be used for every traffic incident in a work zone, regardless of complexity or duration.

ICS Principles

Who’s In Charge?
- Top-down hierarchy
- First to arrive establishes initial command and control.
- Command is handed over to the agency most deeply involved in response and recovery.
- As the response progresses, the leader will change.

Supervision
- Everyone on site has one and only one supervisor.
- Every supervisor has 3 to 7 subordinates.
- Supervisors allocate work based on individual skills and abilities.
- Objectives → Strategy → Tactics → Implementation
Keeping Good Practice Going

Incident Prevention  Incident Response  Post-Incident Follow-Up

Measuring Success

Three generally accepted performance measures for gauging TIM effectiveness:

• **Roadway Clearance Time** – Interval between first awareness of an incident by a responding agency (detection, notification, or verification) and first confirmation that all lanes are available for traffic flow

• **Incident Clearance Time** – Interval between first awareness of an incident and time the last responder leaves the scene

• **Secondary Incidents** – Number of additional unplanned incidents that occur at the scene (or in the traffic queue approaching the scene) after the original incident is reported
Post-Incident Review

- Post-incident information sharing contributes to long-term improvement in roadway safety.
- Each incident is an opportunity to:
  - **Review** how effectively response was handled.
  - **Inform** roadway agency and contractor about work zone conditions that potentially contributed to the incident.
  - **Consider** what can be done to achieve higher levels of safety and efficiency in the future.
- Works best when the discussion is open and candid.

Safety Culture in Organizations

1. **Pathological:** The organization thwarts changes that improve safety, even when the need is obvious and the payoff is rapid.
2. **Reactive:** Changes accepted only in response to a significant incident/threat.
3. **Calculative:** Potential improvements considered systematically as part of cost control and risk management.
4. **Proactive:** Organization actively searches for ways to improve performance and reduce risks.
5. **Generative:** Safety is an integral part of everything the organization does.
Case Study: Emergency Response Through Work Zone

- Winnebago County, WI
- Sheriff’s deputy is responding during hours of darkness, at high speed, to an emergency call
- Enters a low traffic work zone that had been recently been altered
- Deputy's vehicle strikes a gravel pile that was blocking much of both traffic lanes
- Crash results in a fatality to the deputy
Collision Sequence

Case Study
**Lessons Learned**

- Lack of coordination between the municipality and the signing contractor
- Signing and lighting of the work zone were not in conformity with the MUTCD requirements
- Signs were not properly secured and were moved by high winds which limited their effectiveness
- Signs at the gravel pile were defective and of inferior quality
- Little coordination with law enforcement regarding work zone dynamics and changing conditions

**Lesson Learned**

- All partners participated in pre-construction meetings
- Law enforcement and towing were assigned primary responsibility for the work zone
- Changing work zone conditions were discussed with partners
- Response was coordinated between law enforcement, towing and freeway service patrol, contractors and the traffic operations center
- Back of queue warning and protection strategies were implemented
- After action reviews were conducted to discuss lessons learned
### FOR YOU TO DISCUSS

**Should contractors be involved in incident management?**

**Pro**
- Typically, the contractor is already on scene
- Some contractor personnel have experience as fire/EMS volunteers
- Contractor assets such as traffic control drums and lifting equipment might be useful for incident response

**Con**
- Contractor could get in the way of first responders
- Contractor personnel might lack relevant training
- Contractors might not understand Integrated Command
- Not a contractual bid item
Case Example: Dam Spillway Construction
Folsom, California – July 2013

- Errant truck penetrated security fence surrounding dam construction site.
- Vehicle “plunged” down 100 foot embankment.
- Employees of Granite Construction, Inc. were the first to respond and safely pulled driver from vehicle.
- Recognition award from Army Corps of Engineers.

ADDITIONAL RESOURCES
Agency Guideline Examples

• MN: Traffic Incident Management – Recommended Operational Guidelines – 2002 document by the Minnesota Incident Management Coordination Team; incorporates practices agreed upon by Minnesota DOT, Minnesota State Patrol, Minnesota Metro Fire Chiefs, and Minnesota Professional Towing Association

• WI: Emergency Traffic Control and Scene Management Guidelines – Guidelines established to provide incident responders with a uniform approach to emergency traffic control and scene management, maximize responder safety, and minimize the risk of secondary crashes

Traffic Incident Management—General Publications

• Guidebook on Incident Management Planning in Work Zones – Developed in 2005 for the Smart Work Zone Deployment Initiative; provides engineers and construction managers guidance on developing WZ incident management plans

• CO: Guidelines for Developing Traffic Incident Management Plans for Work Zones – 2008 report from Colorado DOT that discusses best practices, existing TIM programs, and considerations/key components for developing/implementing work zone TIM programs
Conclusion

*Engineers, Contractors and First Responders Need To:*

- Understand the uniformity of work zones and proper devices/layouts
- Look for and identify problems/deficiencies
- Report problems/deficiencies through appropriate channels
- Understand the minimum standards articulated in the MUTCD
- Work with one another to improve incident response continuously