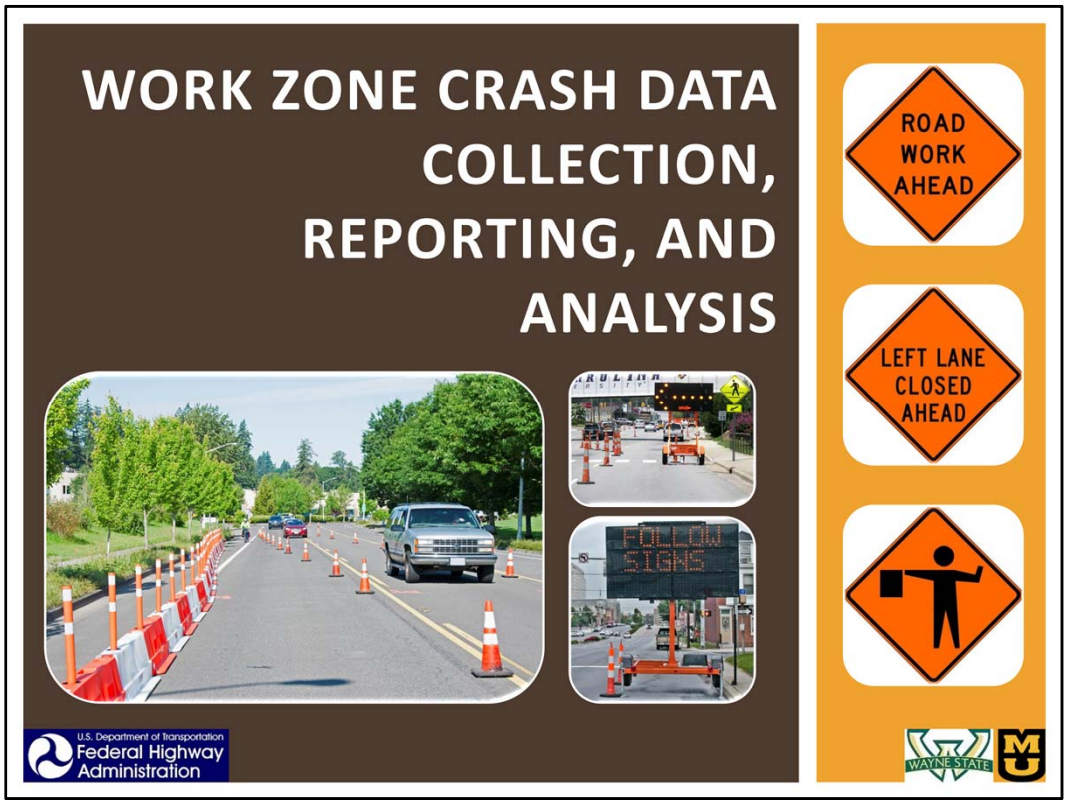
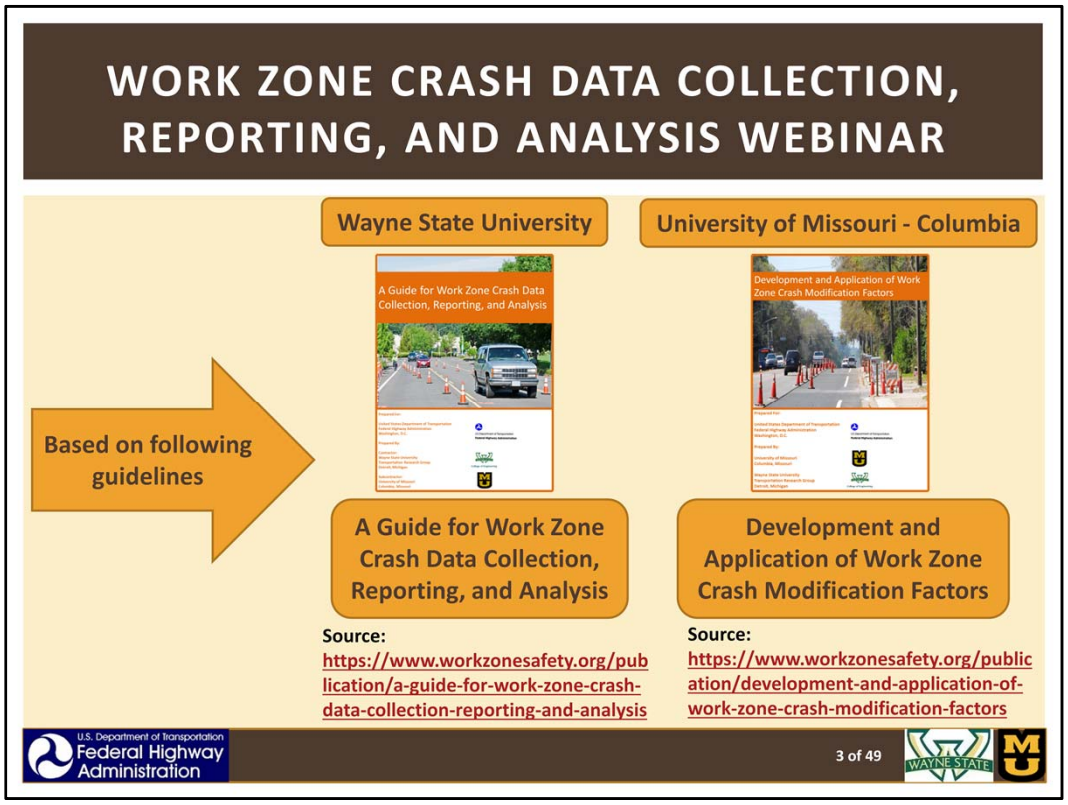


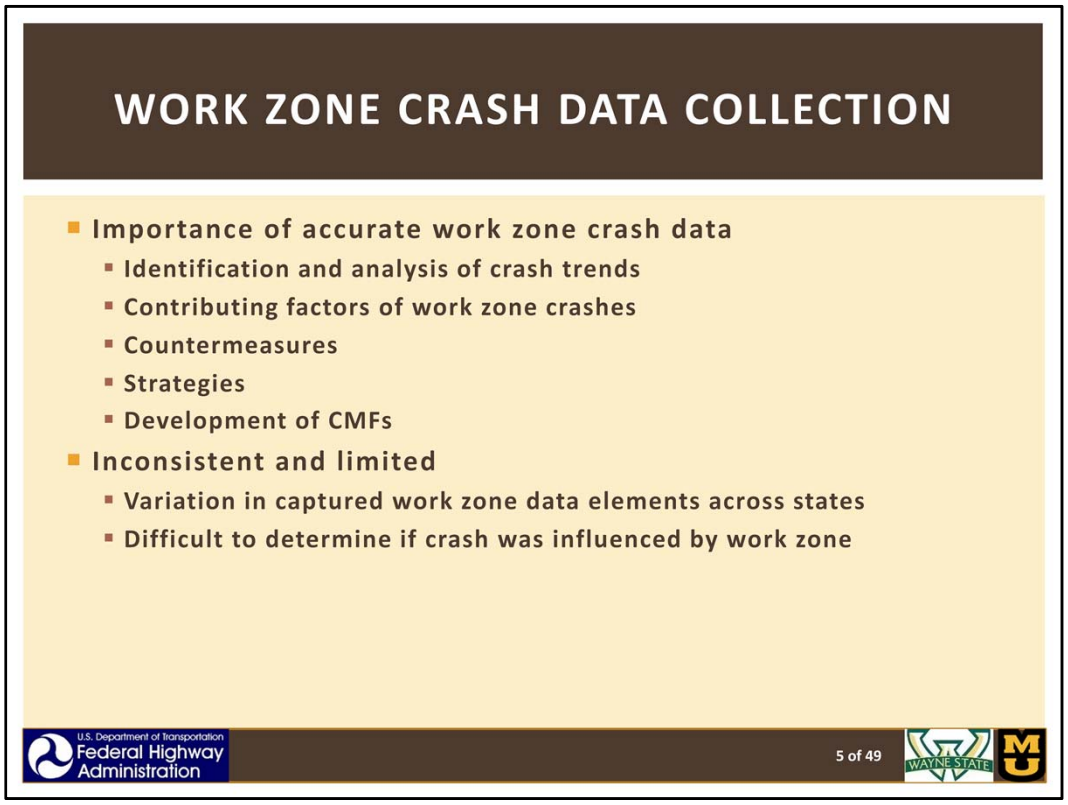
- Introduction
- Recording of webinar is available on National Work Zone Safety Information Clearinghouse (workzonesafety.org)

- Webinar developed by Wayne State University Transportation Research Group along with the University of Missouri – Columbia
    - Through 2013 FHWA Work Zone Safety Grant
- Introduction of team as applicable
    - Tapan Datta, Ph.D., P.E.
        - Professor at Wayne State University
        - Principal Investigator (P.I.)
        - Overseer of 2013 FHWA Work Zone Safety Grant
    - Nick Nicita, P.E.
        - Research Associate at Wayne State University
    - Tim Gates, Ph.D., P.E., P.T.O.E.
        - Associate Professor at Michigan State University
    - Praveen Edara, Ph.D., P.E., P.T.O.E.
        - Professor at University of Missouri – Columbia
    - Henry Brown, P.E.
        - Research Engineer at University of Missouri – Columbia



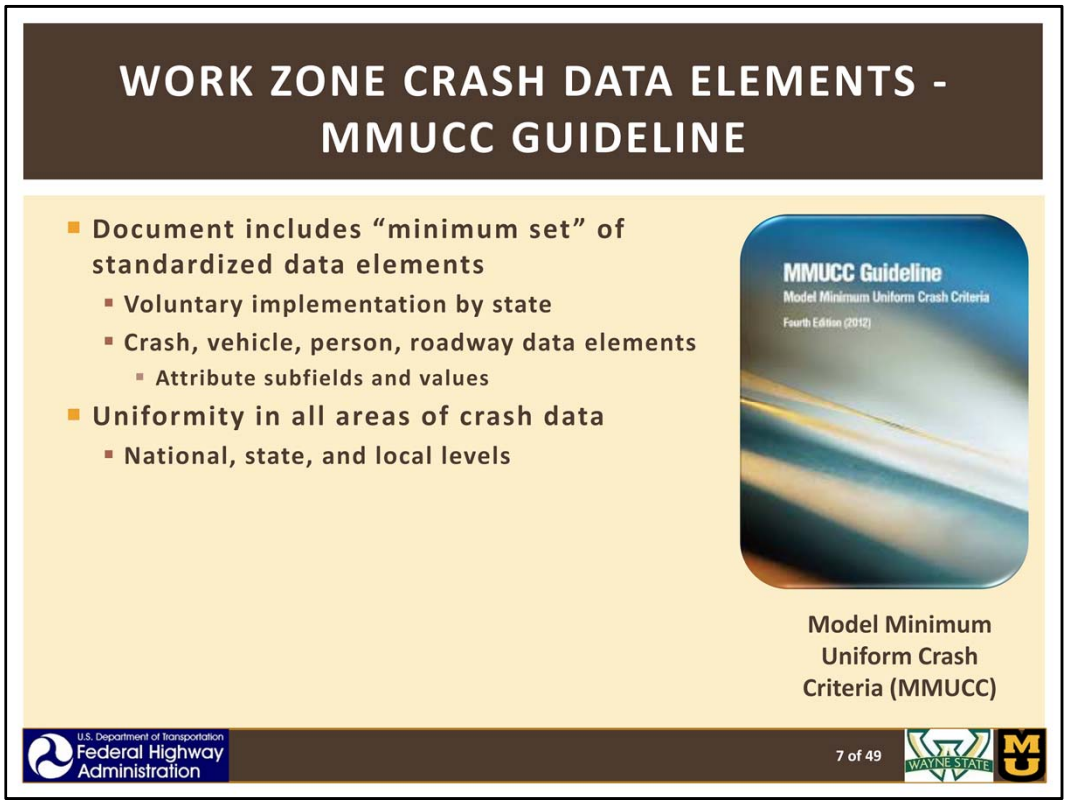
- Webinar based on two guideline documents
  - "A Guide for Work Zone Crash Data Collection, Reporting, and Analysis"
    - Prepared by Wayne State University
    - Importance of collecting work zone crash and location characteristics
    - Work zone attributes that should be included as minimum on all crash report forms
  - "Development and Application of Work Zone Crash Modification Factors"
    - Prepared by University of Missouri - Columbia
    - Use and development of Crash Modification Factors
    - Helps work zone practitioners to determine expected changes in crash experience due to the implementation of work zone traffic control

- Webinar covers a wide breadth of work zone crash data, including
  - Importance of accurate work zone crash data
    - Model Minimum Uniform Crash Criteria (MMUCC) Guideline work zone crash data elements
  - Justify need for including certain work zone attributes
  - Identification of best practices among states
  - Different agency processes of reporting crash data
  - Overcome challenges of implementing uniform work zone crash data elements
  - University of Missouri will be covering the use of crash data for analytical purposes, including CMF and SPF development
  - Various temporary traffic control strategies and countermeasures to gain interest and support from stakeholders or policy makers to include all necessary work zone attributes on next update of state's crash report form
  - Available online tools used to analyze work zone crash data

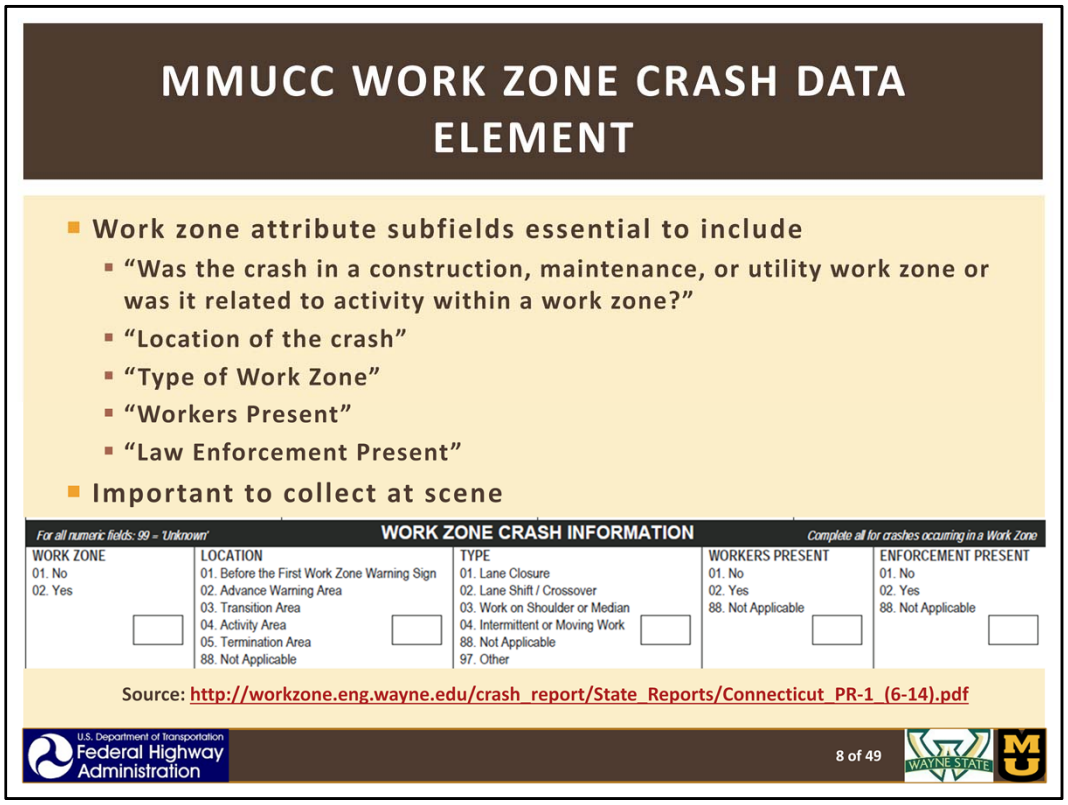


- Important to collect accurate work zone crash data
    - Analyze crash trends
        - Where did the crash occur in the work zone?
    - Determine contributing factors
    - Develop countermeasures, strategies, and crash modification factors to reduce work zone crashes and mitigate work zone safety problems
- However work zone crash data suffers from inconsistencies and limitations
    - Variation in work zone data elements generally captured by state department of transportation and other agencies
    - Difficult to determine if crash was influenced by work zone when occurring before first warning sign
        - For example: State may not be able to identify upstream rear-end crash before work zone due to queuing

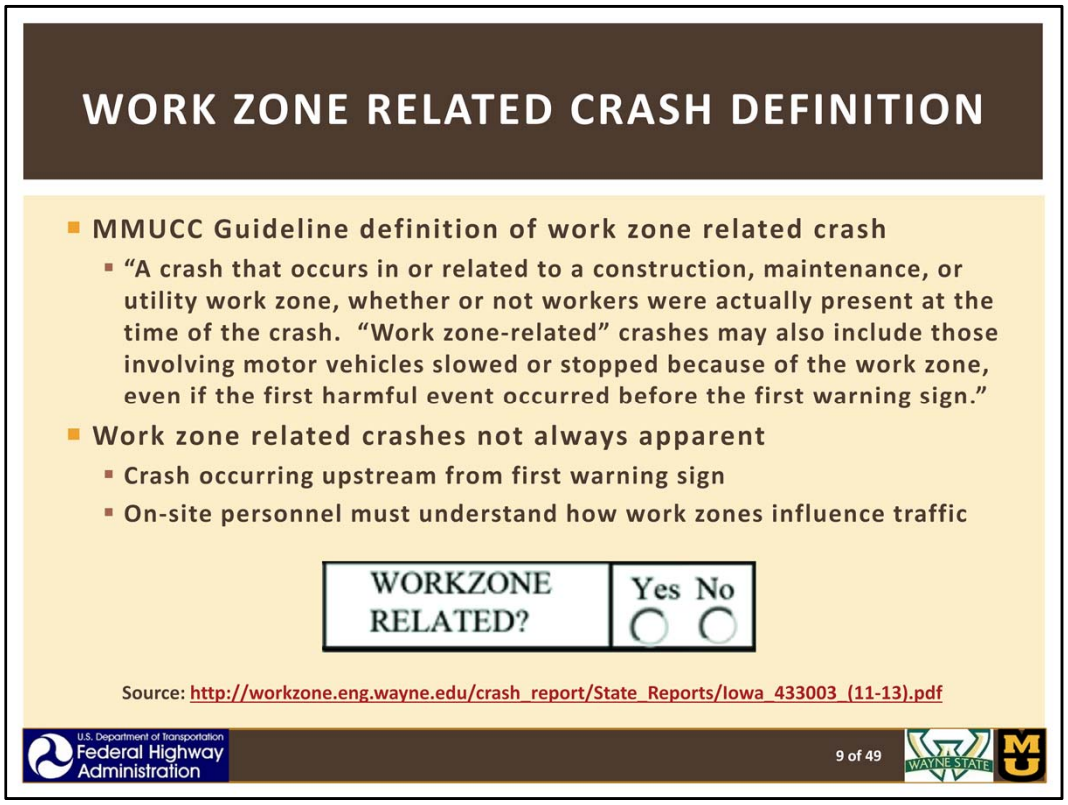
- Traffic crash data collection and reporting involves many individuals and agencies, such as departments of transportation (DOTs) or stakeholders, working together to make the system successful
    - From the call to the first responder (e.g., police, emergency medical technician, etc.), to the collection of field data, followed by completion and submission of the report, then translating the report into digital data
- Crashes involving severe injury and especially fatality require a full forensic analysis
    - Field measurements of skid marks, vehicle damage, sequence of events, photographs, and other data pertinent to the investigation



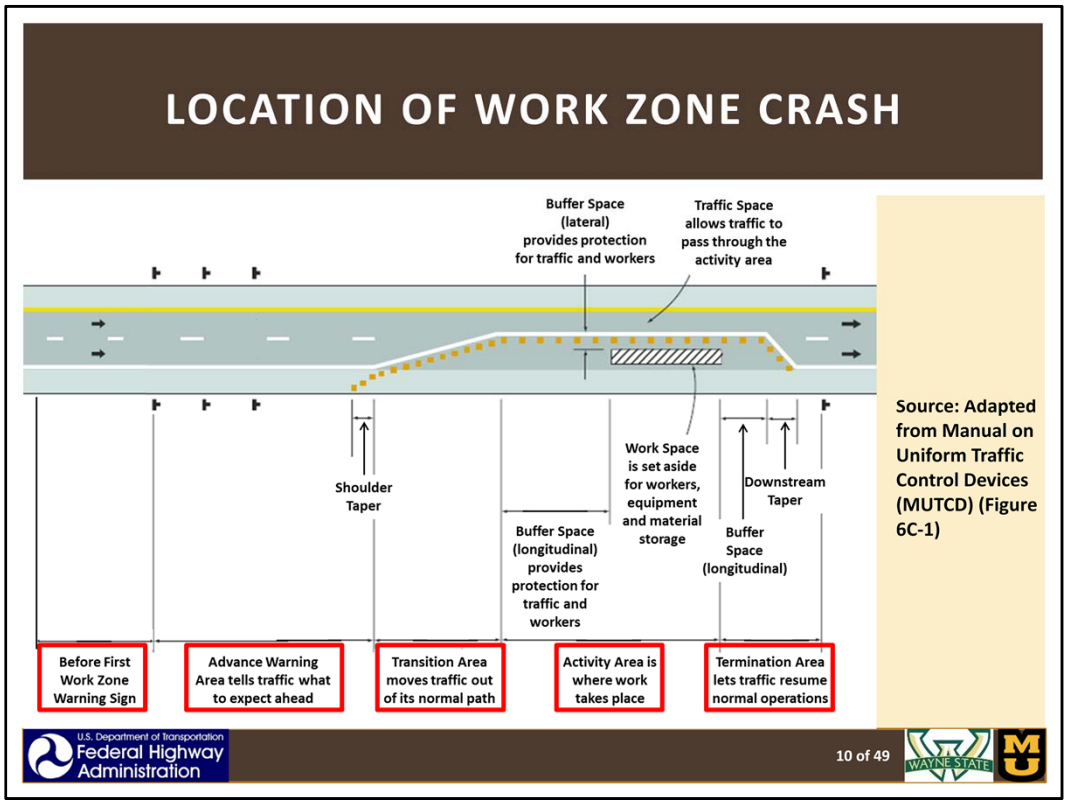
- Model Minimum Uniform Crash Criteria (MMUCC) 4th Edition Guideline document, not to be confused with the Manual on Uniform Traffic Control Devices (MUTCD), was created by the National Highway Traffic Safety Administration (NHTSA) and the Governors Highway Safety Administration (GHSA) to recommend the "minimum set" of data elements a state should include when updating their crash report form
- MMUCC guideline represents voluntary and collaborate effort to promote uniformity to help improve the sharing of data at all levels
- MMUCC guideline includes recommended crash, vehicle, person, and roadway related data elements
    - Each data element contains multiple attribute values that explain crash and other contributing factors



- MMUCC Guideline includes one work zone related crash data element that should be included on the crash report form based on data collected at the scene of the crash
    - This work zone data element included in the guideline recommends the following five attribute subfields to further clarify the work zone related crash:
        - **"Was the crash in a construction, maintenance, or utility work zone or was it related to activity within a work zone?"**
        - **"Location of the crash" with respect to the work area and traffic control**
        - **"Type of Work Zone" as it relates to the nature of the work being performed and type of closure or shift**
        - **"Workers Present"**
        - **"Law Enforcement Present"**
- Connecticut Uniform Police Crash Report Form (shown on bottom) contains all five work zone attribute subfields as recommended by MMUCC Guideline



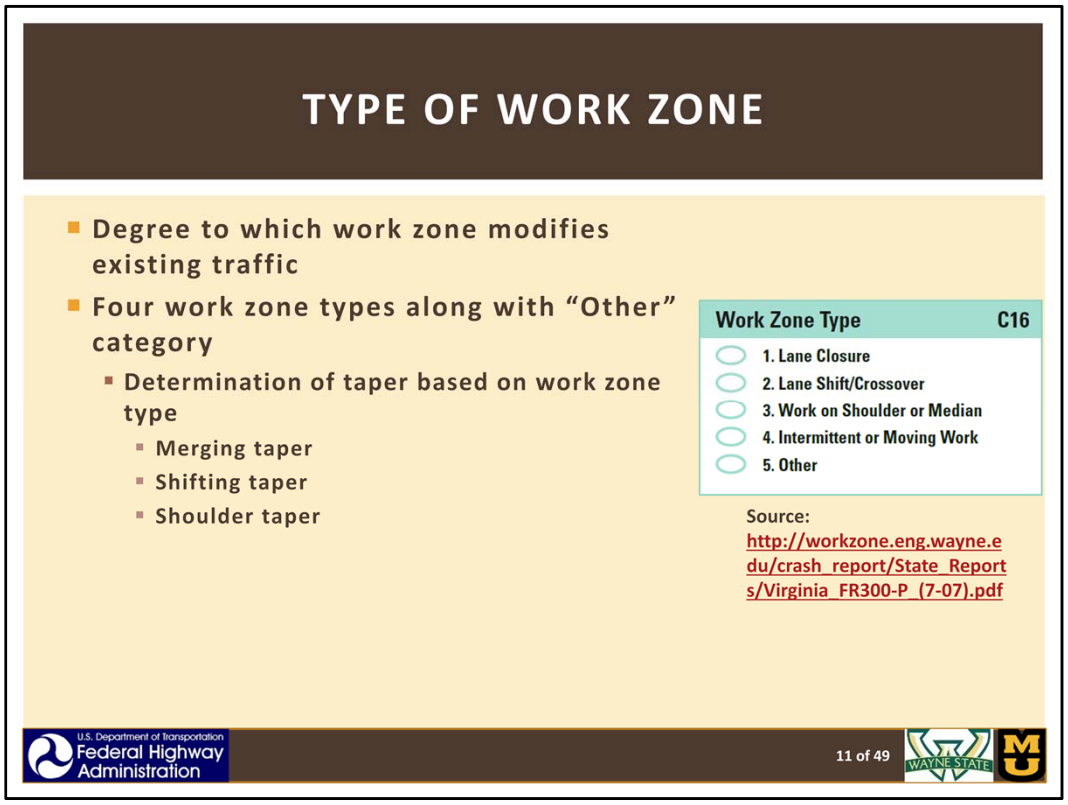
- Subfield identifies whether crash is work zone related
- MMUCC Guideline defines a work zone related crash as the following:
    - "A crash that occurs in or related to a construction, maintenance, or utility work zone, whether or not workers were actually present at the time of the crash. "Work zone-related" crashes may also include those involving motor vehicles slowed or stopped because of the work zone, even if the first harmful event occurred before the first warning sign."
- Determination of whether or not a crash is work zone related is not always obvious
    - For example: Crash occurring due to congestion from a lane closure before first warning sign
        - To make this determination, an understanding of how work zones influence traffic is one of the more important responsibilities of on-site personnel in charge of crash data collection
- Snapshot of Iowa's crash report form showing the "Work Zone Related" subfield



- Once determined that the crash is work zone related, it is important to indicate the location of the crash
- MMUCC Guideline defines location of crash into the following five areas (shown on slide)
    - Before First Work Zone Warning Sign
        - Crash occurring ahead of first advance warning sign, but location of crash is in close proximity that crash occurrence may be directly or indirectly related to work zone
        - Type of crash occurs outside boundaries of temporary traffic control zone
        - No defined distance on how close crash needs to occur in order to be deemed as work zone crash
        - Officer will typically need to make a judgement call on whether or not the crash was indirectly related to work zone
            - Identify downstream conditions associated with work zone activity
            - Base determination of work zone related crashes uniformly
        - Type of crash may happen from erratic or distracted driver behavior due to improper advance warning area setup
    - Advance Warning Area
        - Area between first advance warning sign and start of transition area
    - Transition Area

        - Roadway space that accommodates tapers
        - Area moves traffic out of normal path of travel
    - Activity Area

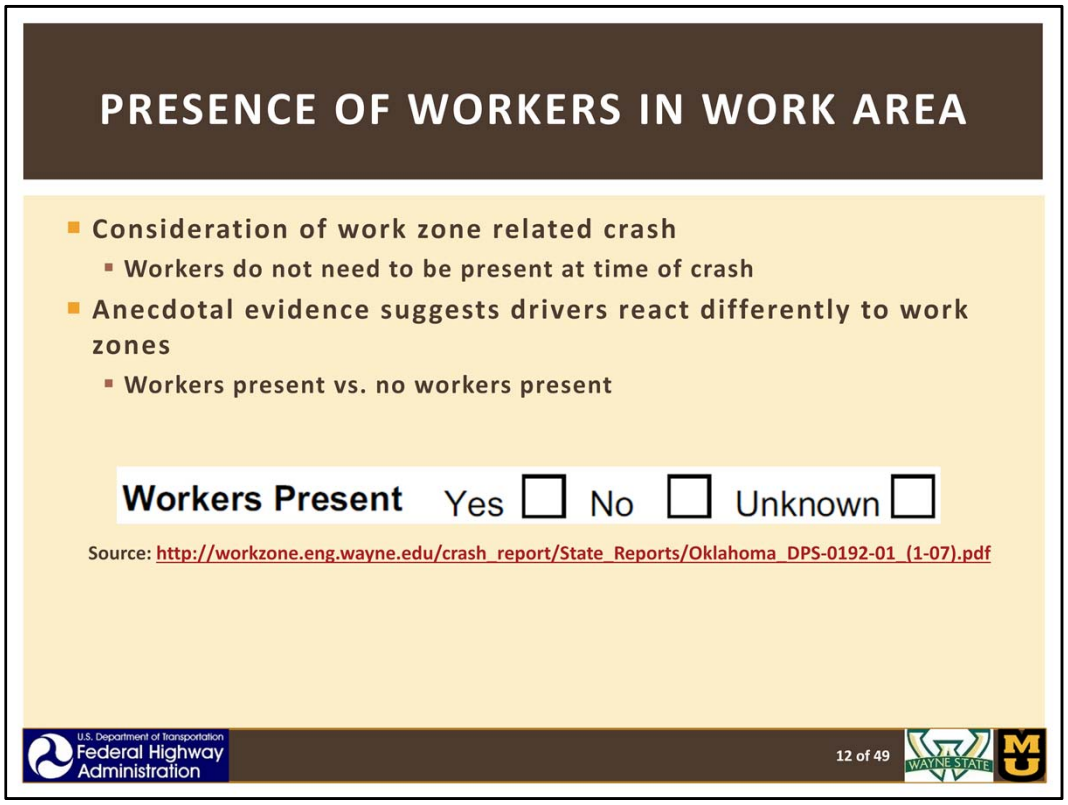
      Includes work space and longitudinal buffer
    - Termination Area
        - Includes longitudinal buffer, downstream taper, and space up to “End Road Construction” sign
- Possible crash type could include rear end crash upstream before first work zone warning sign or in advance warning area
- Another possible crash type could be sideswipe same crash in transition area



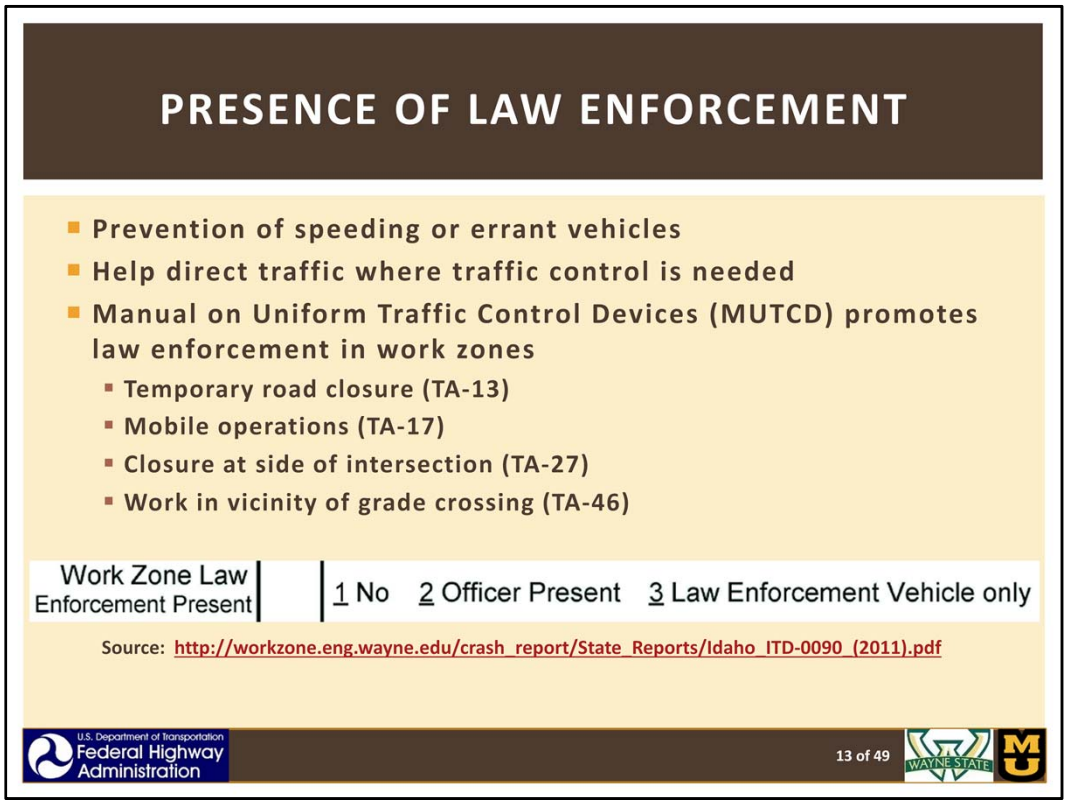
- Type of work zone refers to degree to which traffic control represents a modification to the existing traffic pattern
- MMUCC Guideline defines five work zone types
    - **Lane closure** is when the number of lanes is reduced that requires traffic to merge into an adjacent travel lane
        - Temporary traffic control devices may include a merging taper with a "Right Lane Closed Ahead" sign
    - **Lane shift/crossover** is when the lane(s) is maintained, but the alignment is modified to affect a lateral shift to avoid the need for closure of the travel lane(s)
        - Temporary traffic control devices may include a shifting taper with a "Stay in Lane" sign
    - **Work on a Shoulder or Median** occurs when the shoulder is closed to traffic to accommodate an activity area near or overlapping the roadway shoulder
        - Temporary traffic control devices may include a shoulder taper with a "Shoulder Work" sign
    - **Intermittent or moving work**, such as stripping, is when the work area is continuously or intermittently moving
        - Temporary traffic control devices may include a convoy of work vehicles, truck mounted arrow boards, portable changeable message signs, or temporary roll up signs
    - **Other** can be selected if the type of work zone does not fit any of the

categories

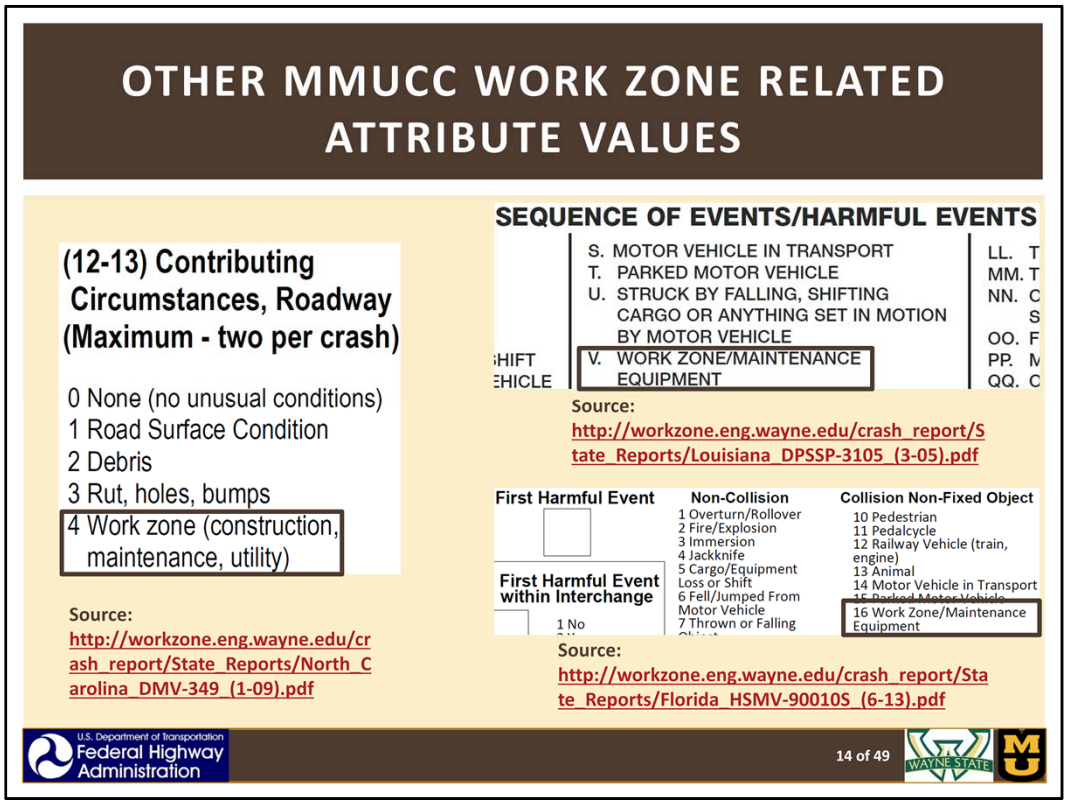
- Snapshot of Virginia's crash report form showing the "Work Zone Type" subfield



- Indication of whether or not workers were present in the work zone at the time of the crash
- Workers do not need to be present in order for the crash to be considered work zone related
- Anecdotal evidence suggests drivers react differently to work zones depending upon whether or not work activities are actually taking place
- Snapshot of Oklahoma's crash report form showing the "Workers Present" subfield

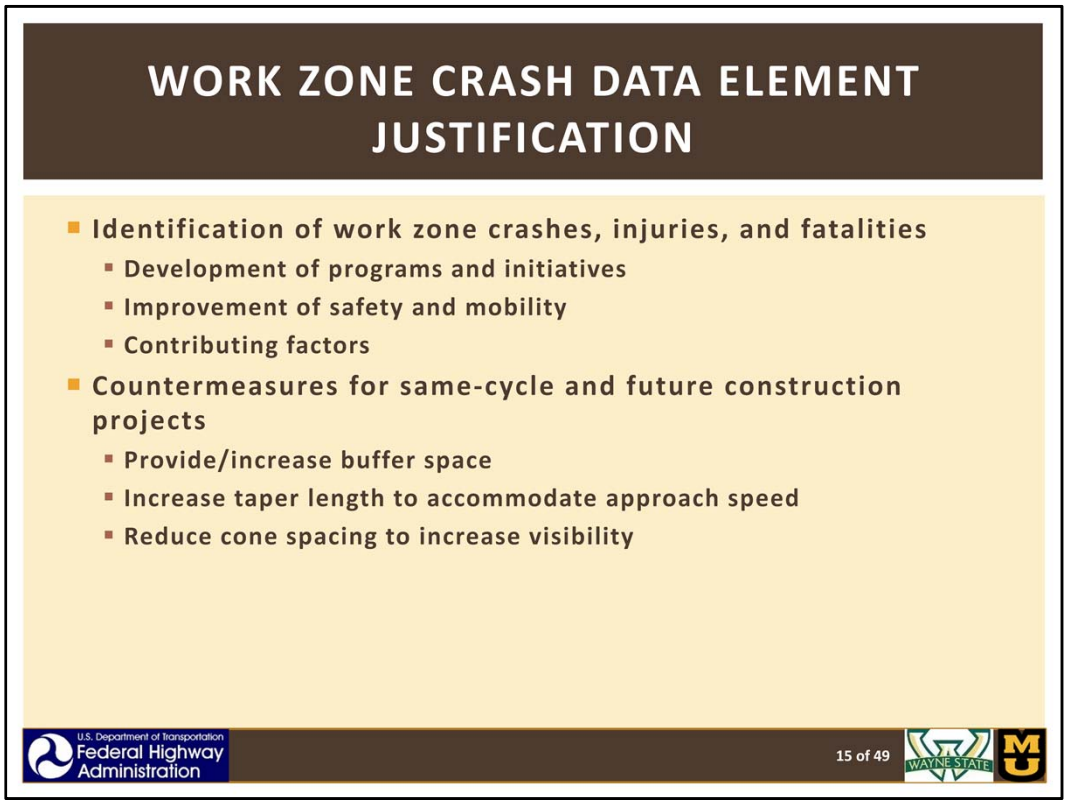


- Determination if law enforcement was present
- Presence of law enforcement in the work zone helps to prevent speeding or errant vehicles from entering the activity area
- Law enforcement may be used to help direct traffic in conditions where traffic control is needed
- Manual on Uniform Traffic Control Devices (MUTCD) includes four Typical Applications where law enforcement may be present
- Snapshot of Idaho's crash report form showing "Presence of Law Enforcement" subfield

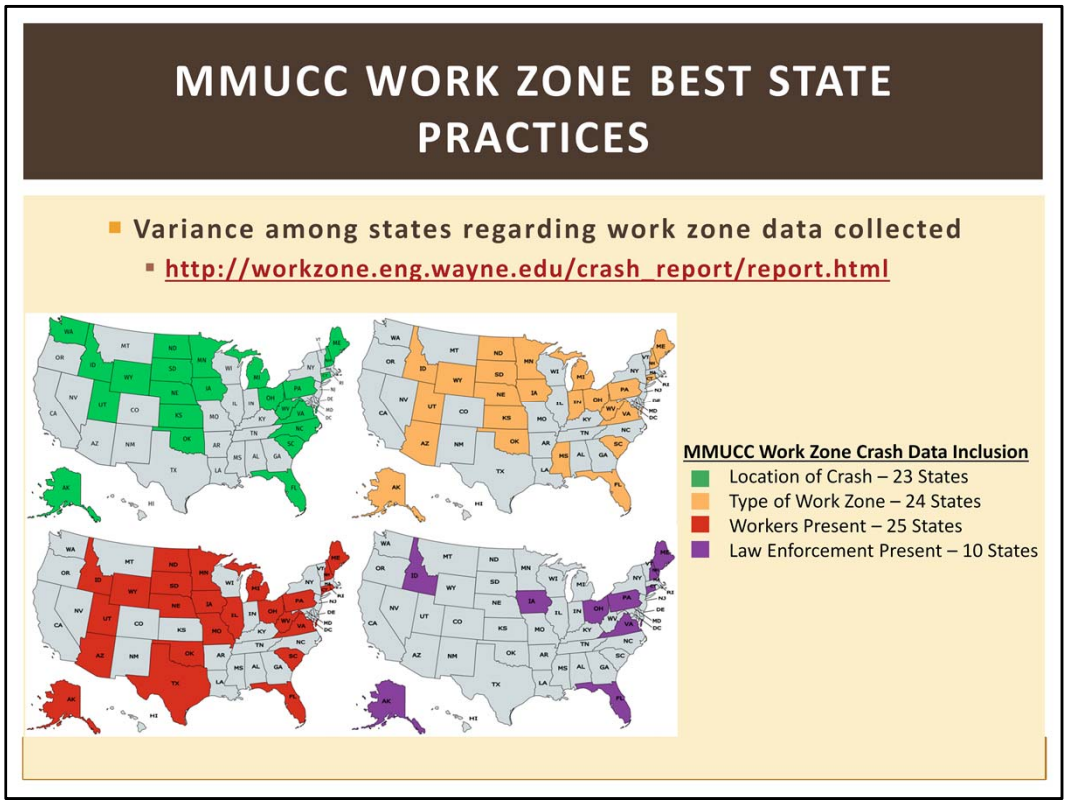


- MMUCC Guideline also includes work zone related attribute values that can be selected by an officer for other data elements if the crash is associated with a contributing road circumstance, first or most harmful event, or a sequence of events
    - Further clarify whether or not the work zone influenced the motor vehicle crash
        - The First Harmful Event
            - First injury or damage-producing event that characterizes crash type
        - Contributing Road Circumstance
            - Apparent condition of road which may have contributed to crash
        - Sequence of Events
            - Events in sequence related to motor vehicle
                - Non-collision as well as collision events
        - Most Harmful Event for this Motor Vehicle
            - Event that resulted in most severe injury
            - If no injury, greatest property damage involving motor vehicle
- North Carolina's crash report form (shown on left) shows a work zone attribute value under contributing road circumstance
- Louisiana's crash report form (shown on upper right) shows work zone / maintenance equipment under sequence of events / harmful events
- Florida's crash report form (shown on bottom right) indicates work zone /

maintenance equipment option as first harmful event

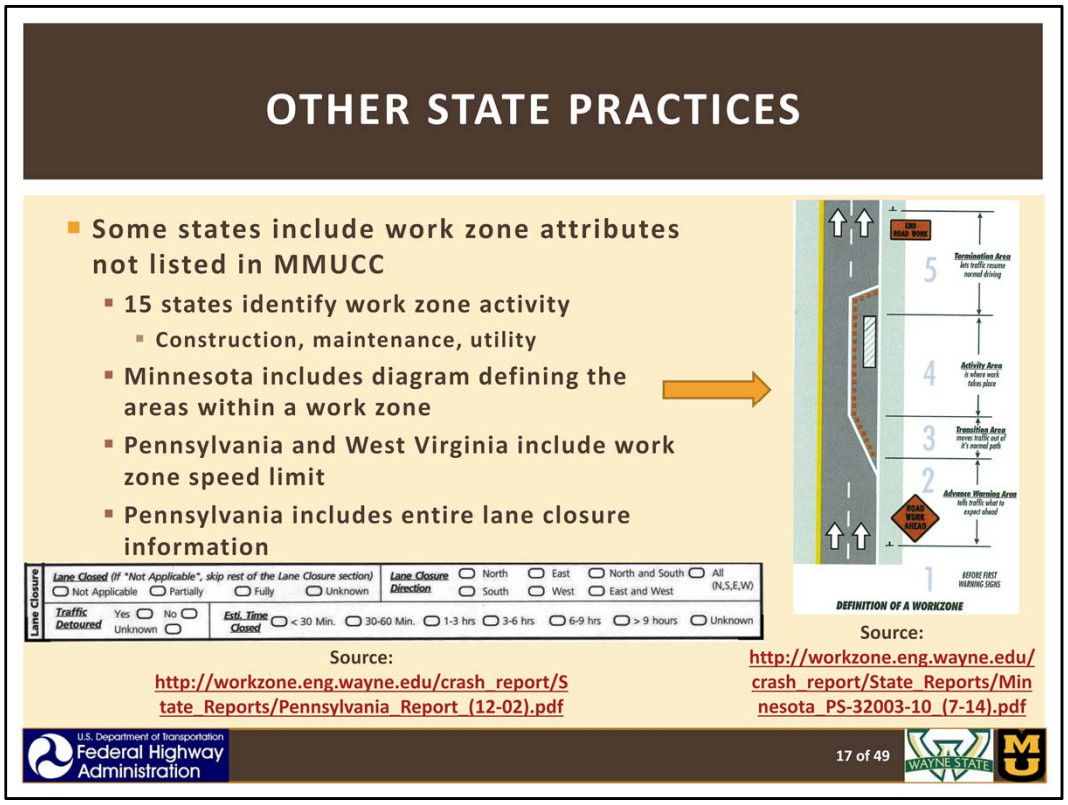


- Identifying work zone crashes, injuries, and fatalities essential to develop safety programs and initiatives
    - Targeted to improve safety and mobility in construction and maintenance work zones
- Inclusion of work zone crash data element allows for transportation practitioners to develop countermeasures for same-cycle intermediate or long term work zones
    - Alleviate issues in similar work zones
        - Increase visibility, reduce approach speed, and other measures
    - Implement additional traffic control treatments in future work zones

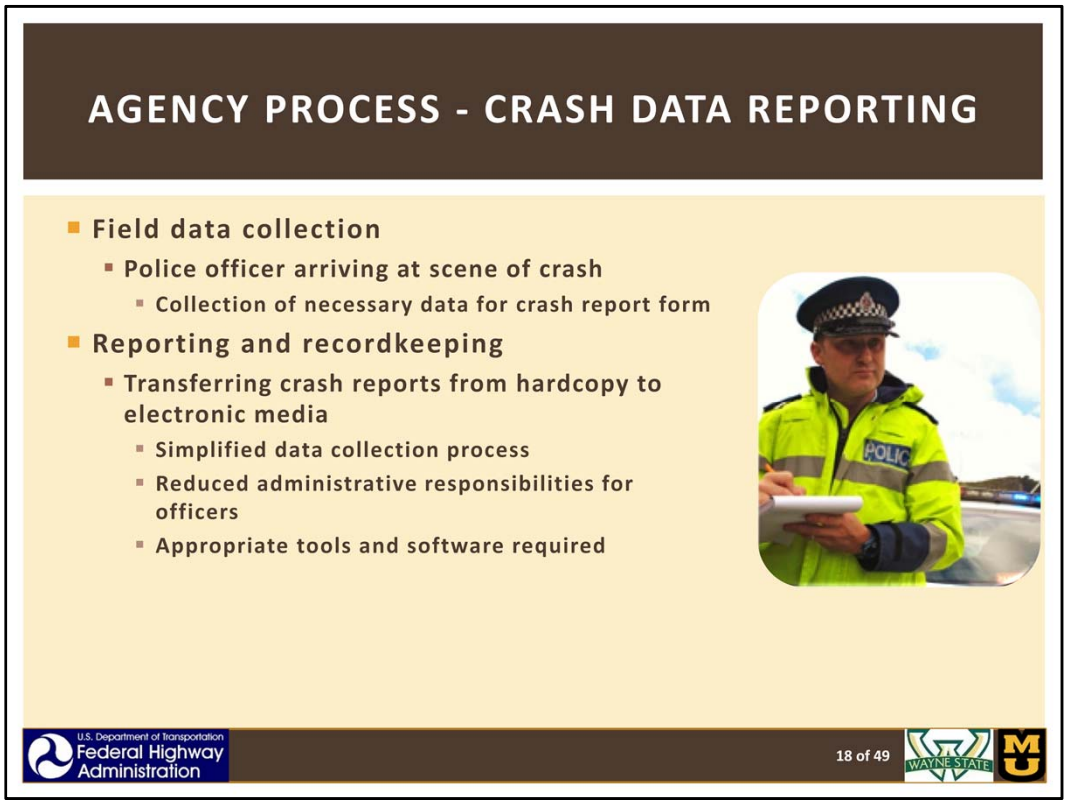


- All 50 states, as well as the District of Columbia, have their own crash report form along with supplemental reports
    - Officer has to fill out when crash occurs
- Every state crash report form, along with applicable supplemental reports, can be found at the Wayne State Crash Report link at the top
    - State crash report forms are organized in alphabetical order
        - Includes report number and last revision date
- MMUCC Guideline provides guidance on what work zone attributes can be considered as best practices and should be included on each state's crash report form
    - Wide variance among 50 states regarding the types of work zone crash data being collected, ranging from all work zone attributes down to zero, which means there is no identification the crash was in a work zone
- Map in the upper left corner shows 23 states collect the work zone location of the crash
- Map in the upper right corner shows 24 states collect the type of work zone the crash occurred
- Map in the lower left corner shows 25 states collect if there were workers present during the time of the crash
- Map in the lower right corner shows only 10 states collect if there were law enforcement present during the time of the crash
- There are 10 states that follow all work zone crash data element recommendations set forth in MMUCC

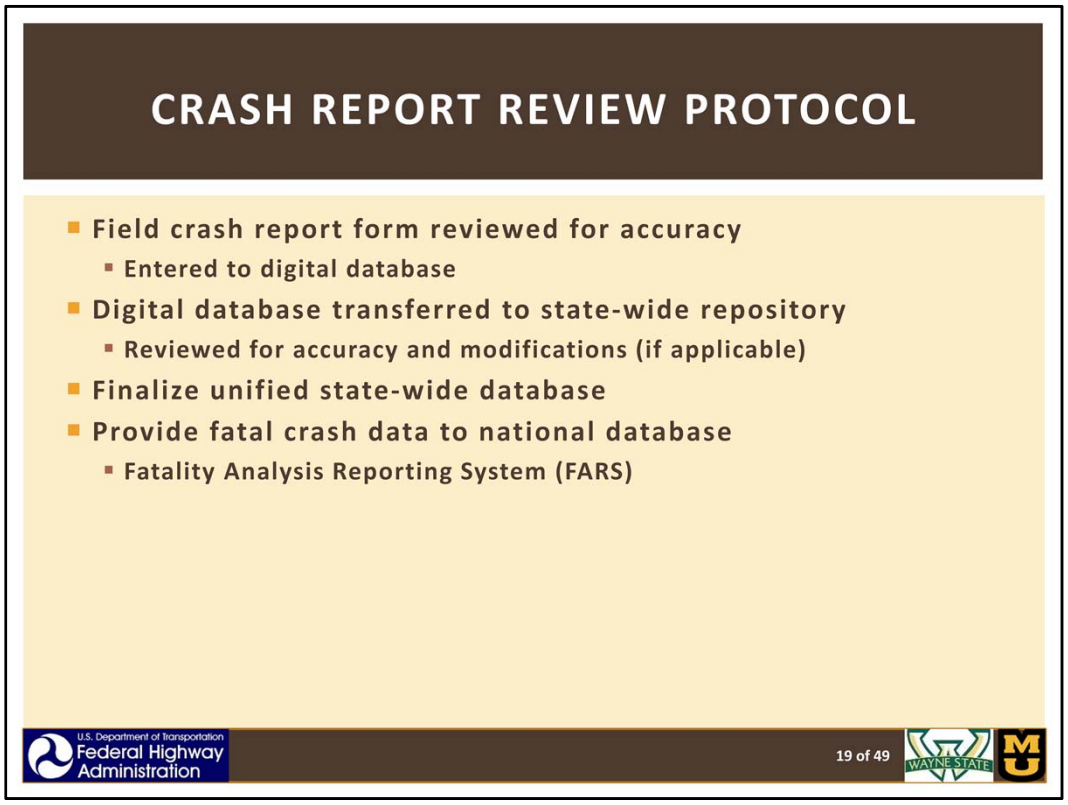
- Alaska, Connecticut, Florida, Idaho, Iowa, Maine, New Hampshire, Ohio, Pennsylvania, and Virginia
- These states are generally considered leaders in capturing the entire work zone related crash data element with all associated attribute subfields and values



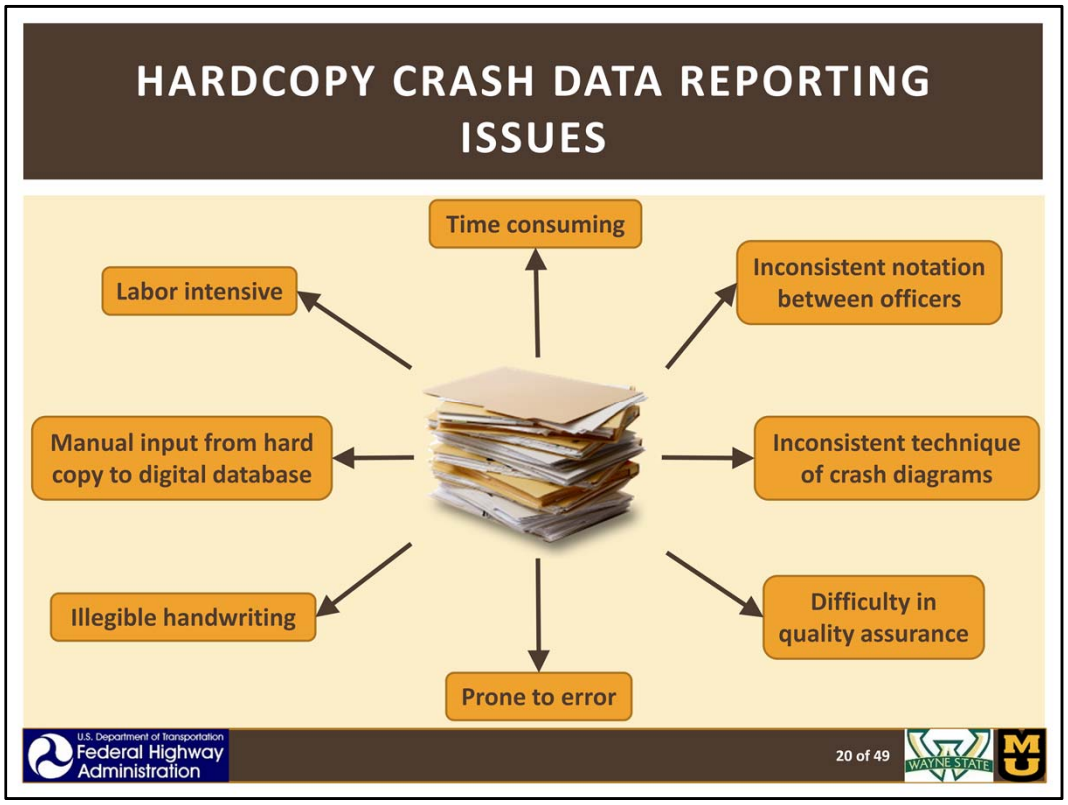
- Some states include work zone attributes not listed in MMUCC
- 15 states include the work zone related attribute subfield, “Work Zone Activity,” or something similar
    - Distinguishes whether crash occurred during construction, maintenance, or utility activity
- Minnesota includes a diagram (shown on right) defining the different areas within a work zone to assist the officer in identifying the location of the crash
    - Before First Warning Signs > Advance Warning Area > Transition Area > Activity Area > Termination Area
- Pennsylvania and West Virginia include a work zone speed limit category
- Pennsylvania includes additional lane closure information (shown on bottom)
    - Lane Closed
        - Not Applicable, Partially, Fully, Unknown
    - Lane Closure Direction
        - North, South, East, West, North and South, East and West, All (N, S, E, W)
    - Traffic Detoured
        - Yes, No, Unknown
    - Estimated time Closed
        - < 30 Min, 30 – 60 Min, 1 – 3 Hrs, 3 – 6 Hrs, 6 – 9 Hrs, > 9 Hours, Unknown



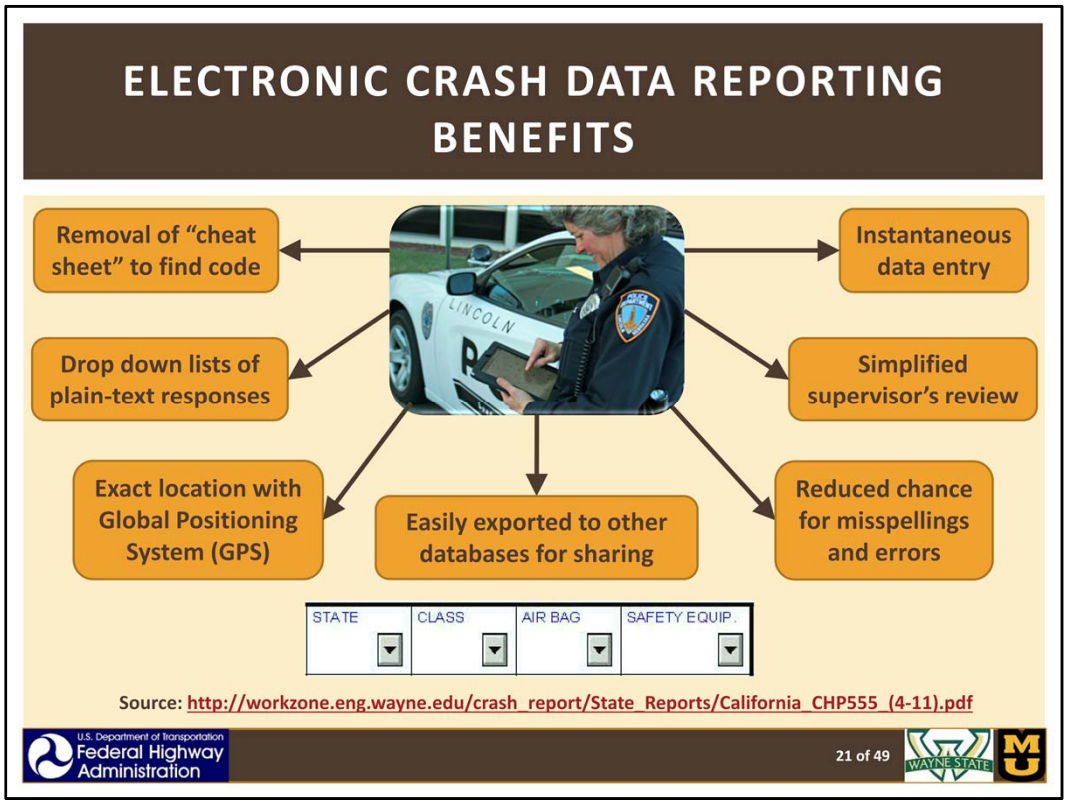
- Crash data collection is a field activity performed by the police officer arriving at the scene of the traffic crash
- Officer can belong to a local city/township, county sheriff, or state police department
- Police officers in the field are trained to collect the necessary data for the uniform crash report form
- Many states are transferring crash reports from hard copy to electronic
    - Simplifies the data collection process
    - Reduces administrative responsibilities related to filing the crash report in the office
    - Requires appropriate hardware and software



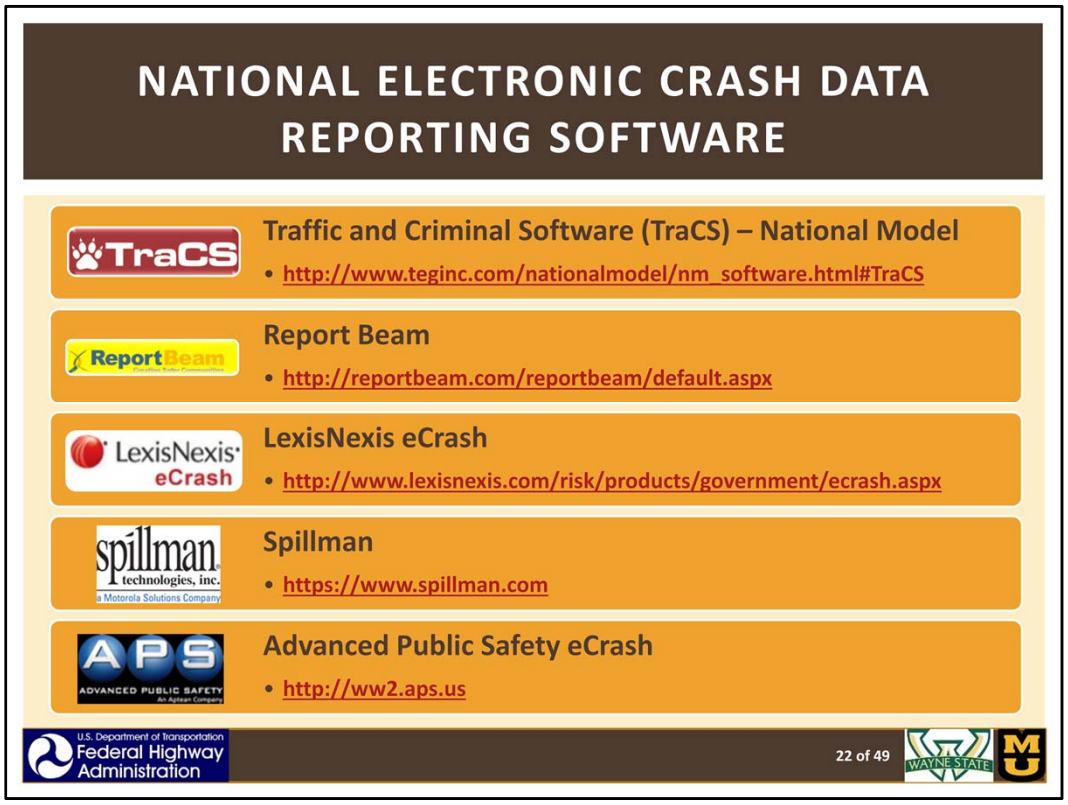
- All states have a report review protocol for all types of crashes that the supervising officer must follow before reporting data at respective state's data repository
- In some instances, field hard copy crash report forms are reviewed by a supervisor for accuracy and then entered to form a digital database
- Digital database is transferred to statewide repository and further reviewed manually for accuracy
    - Any modifications required are completed before finalizing a unified statewide database
- If crash is fatal, final step in reporting process is to provide information to the Fatality Analysis Reporting System (FARS) database



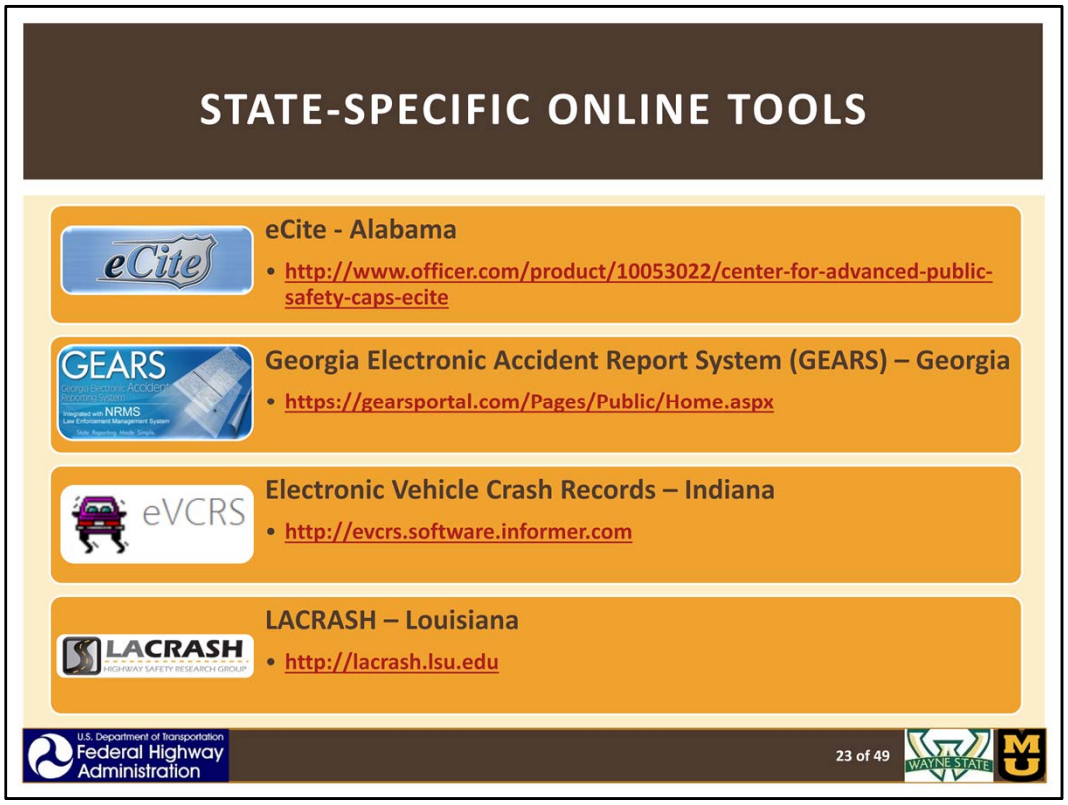
- The quality assurance when using hard copy crash data collection is both time consuming and labor intensive due to:
    - Transitioning and archiving manual data entry from a hard copy to a digital database
    - Trying to interpret illegible handwriting with notetaking in the field
    - Trying to verify inconsistent notation and technique between officers in preparation of crash diagrams
    - Correcting errors, such as duplicate crash report numbers, incomplete data fields, or incorrect data element codes



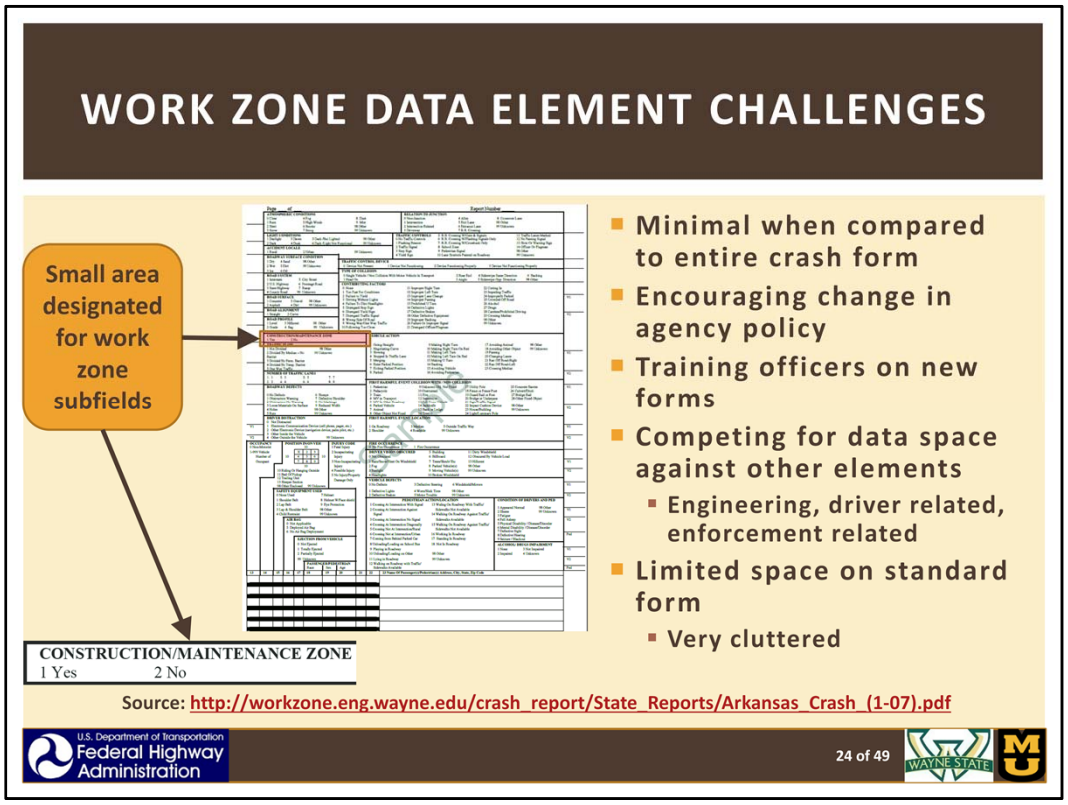
- The quality assurance when using electronic crash data collection software is simplified and more reliable due to:
  - Misspellings and coding errors associated with data elements are reduced by drop down lists of plain-text responses
  - A supervisor's review can be expedited since submission of the electronic form is instantaneous using web-based deployment
  - Time for data entry is minimized with auto-filling text since an officer no longer needs to "cheat sheet" to find the correct code associated with various data elements
  - The location of a crash can now be exact using Global Positioning System (GPS) units rather than approximating the distance to the nearest intersection
  - Data can easily be exported to other databases to share with state and federal agencies
- California's electronic traffic collision report (shown at bottom) presents data elements in the form of drop down lists



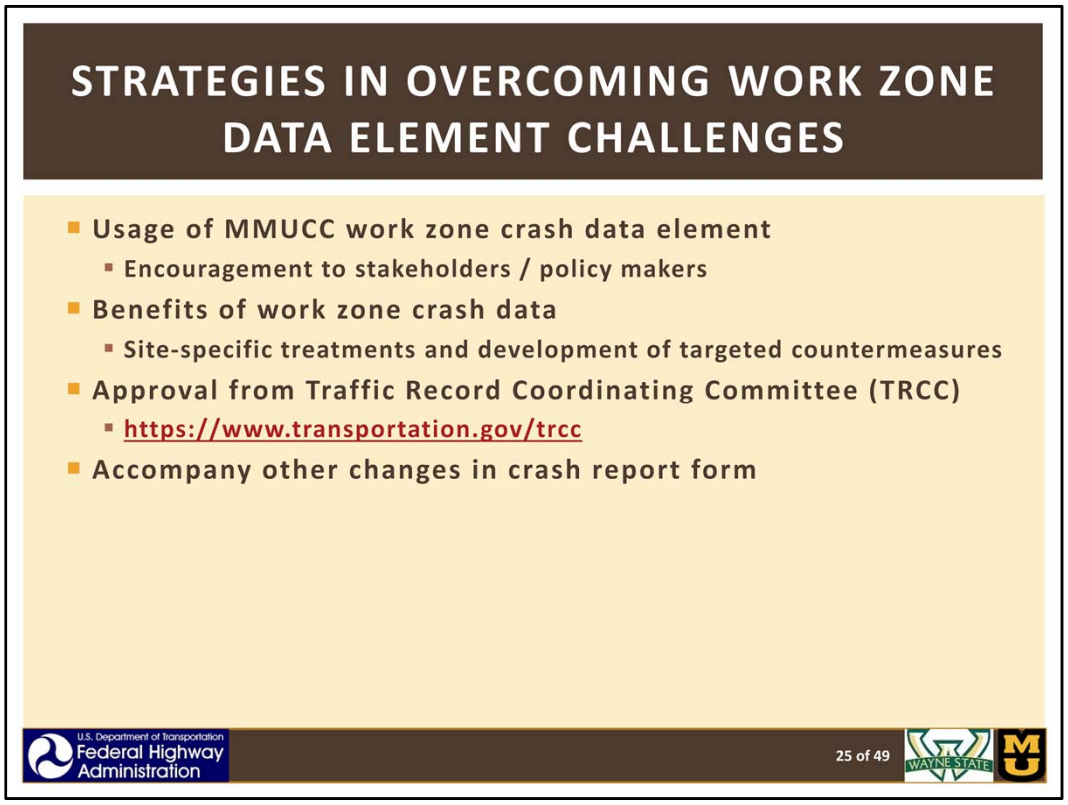
- Many states are transitioning to electronic traffic crash reporting for all types of crashes
    - Help simplify the data collection process
    - Reduce administrative responsibilities
- Various online tools and software are available for states to perform electronic traffic crash reporting
    - TraCS (national model), Report Beam, LexisNexis, Spillman, and Advanced Public Safety



- Some states use state-specific online tools and software (developed in-house or with a vendor) for all types of crashes
    - Alabama uses eCite
    - Georgia uses Georgia Electronic Accident Report System (GEARS)
    - Indiana uses Electronic Vehicle Crash Records (eVCRS)
    - Louisiana uses LACRASH



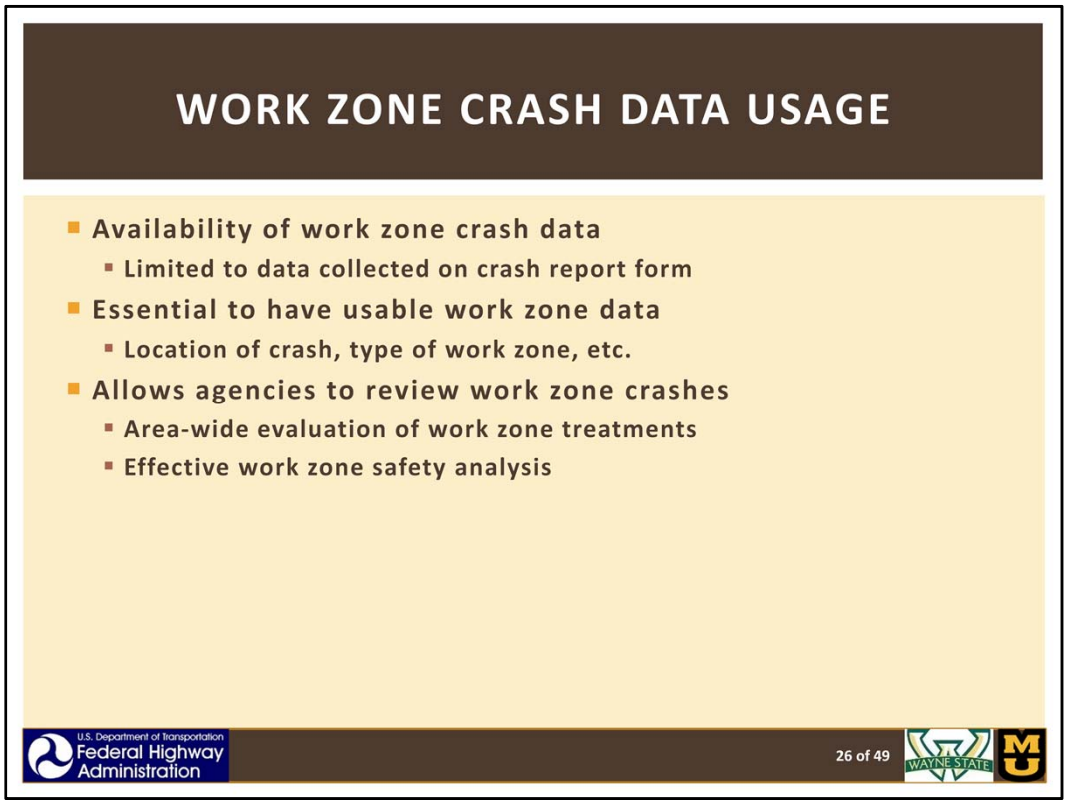
- Including uniform work zone related crash data elements on crash report form brings challenges
    - Work zone data elements are minimal when compared to the entire crash data collection form
    - Difficult to encourage agencies to change their policies
    - Time consuming to train officers on how to use a new form
    - Work zone data elements compete for limited data space with a variety of interests
        - Engineering, driver related, enforcement related
        - Some crash report forms may not even have space necessary to include recommended MMUCC work zone attributes
- Arkansas's Motor Vehicle Crash Report (shown above), contains only a small area designated for work zone subfields (highlighted in "red")



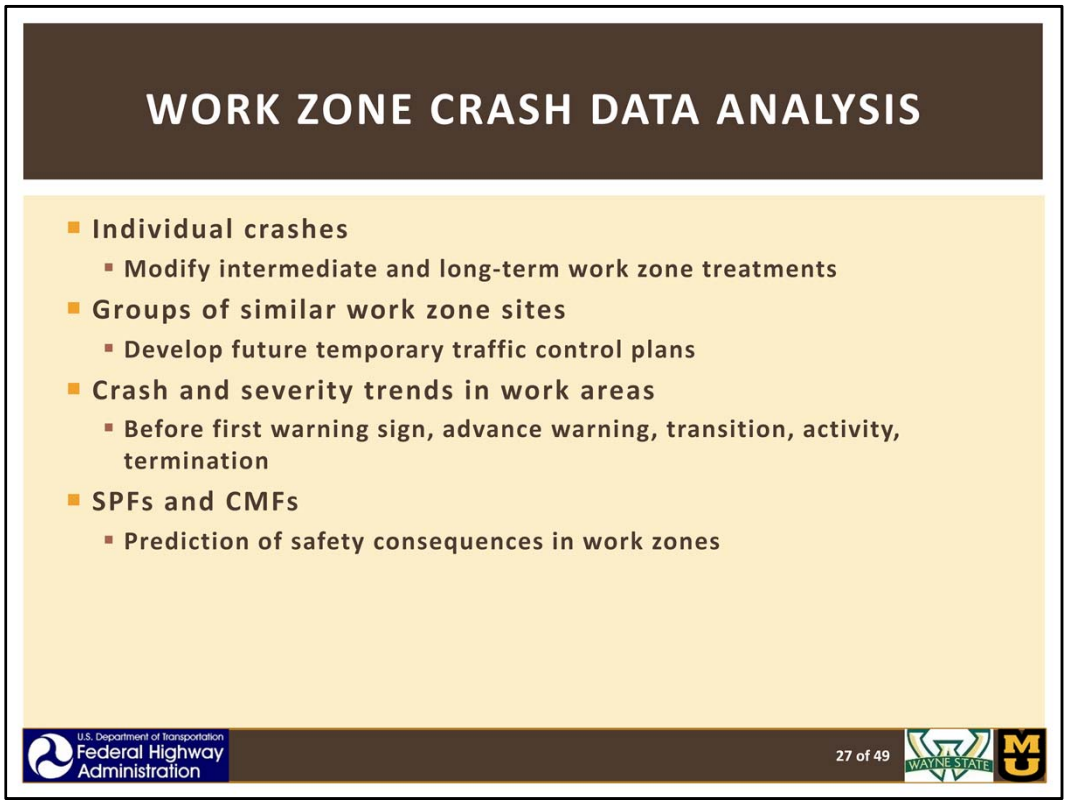
- Transportation practitioners may experience challenges when trying to convince policy makers to include the work zone data element
- Guidance available to overcome challenges
    - Review MMUCC Guideline and encourage stakeholders / policy makers to use the work zone related crash data element with corresponding attribute subfields and values
    - Prepare concise documents articulating short term and long term benefits of work zone crash data
        - Location, characteristics, and type of crashes in work zones
            - May allow for applying treatments to alleviate occurrence of similar crashes at the site
        - Analysis of crashes considering several similar site and traffic scenarios might allow for the development of targeted countermeasures
            - Used as part of a future Temporary Traffic Control Plan (TTCP) development
    - Present proposal to state's crash report task force / user group
        - Often referred to as Traffic Record Coordinating Committee (TRCC)
            - Groups include local and state enforcement officials, engineers, trainers, and administrators
        - Changing the crash report form requires understanding and approval of all stakeholders
        - Consideration of the impact on current software and grass-root

training

- Making changes to include or modify work zone related attributes can also accompany other changes in the crash report form

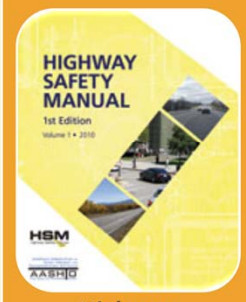


- Availability of work zone crash data is only as good as what is being collected on the state crash report form
- It is essential to have usable work zone data, such as location of crash and type of work zone
- Work zone crash data allows agencies to review the number of work zone crashes and perform an effective safety analysis



- Access to work zone crash data and analysis tools is important in assisting work zone traffic control professionals
- Analysis of work zone crash data consists of many components
    - Site specific analysis of individual crashes which may lead to modifying work zone traffic control treatments at site to help alleviate recurrence of same crashes at same site (intermediate and long term work zones)
    - Analyze groups of similar work zone sites
        - Develop future temporary traffic control plans for such situations
    - Determine crash and severity trends in different work area locations
    - Develop safety performance functions and crash modification factors for highway work zones
        - Application in prediction of safety consequences in work zones
            - Such data will help improve crash prediction and analysis of future projects
            - Develop optimal work zone traffic control strategies and an implementation plan

SPF AND CMF OVERVIEW



Highway Safety Manual (HSM)

$$N_{predicted} = N_{SPF} * CMF_1 * CMF_2 \ldots * C$$

(AASHTO, 2014)

Where:

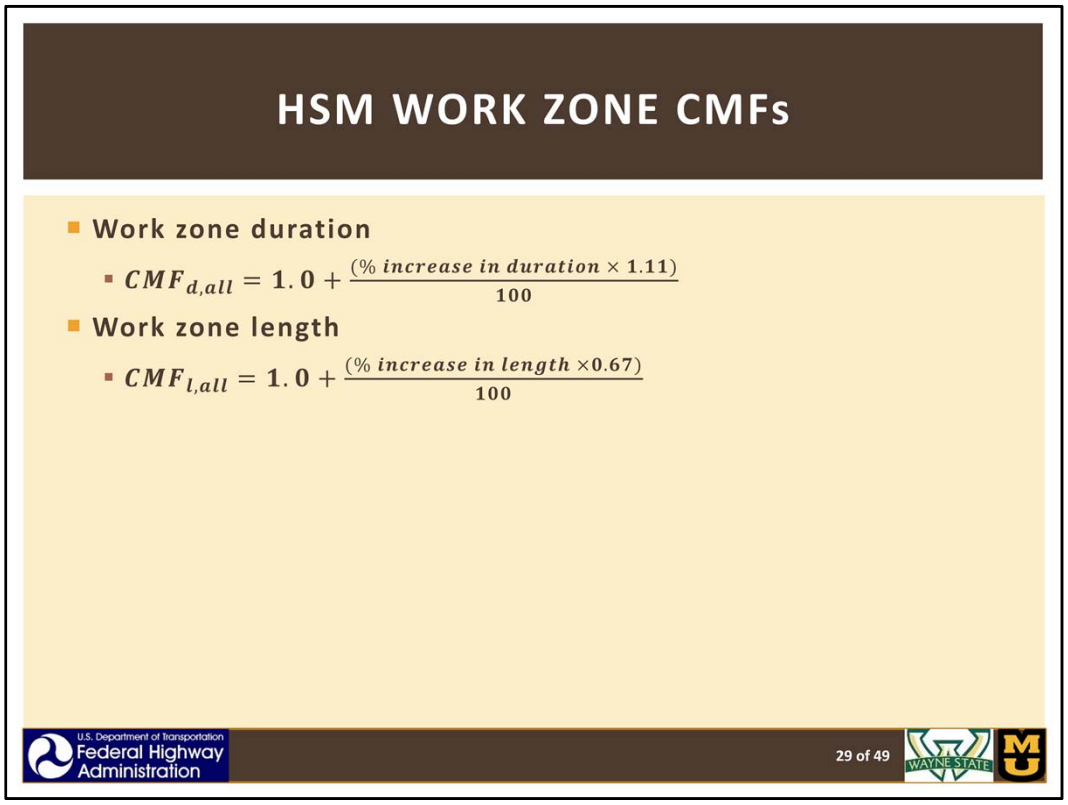
$N_{predicted}$ = predicted crash frequency

N_{SPF} = predicted crashed frequency (base conditions)

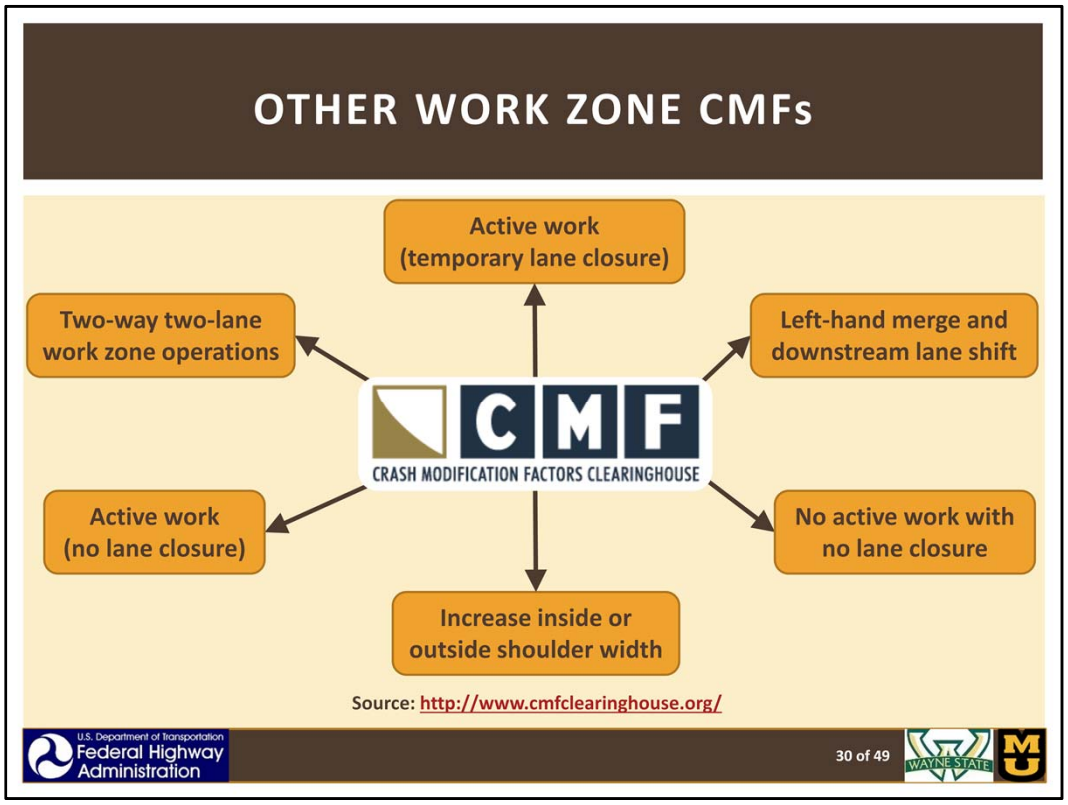
CMF_i = Crash Modification Factor (adjustment from base condition)

C = Calibration Factor

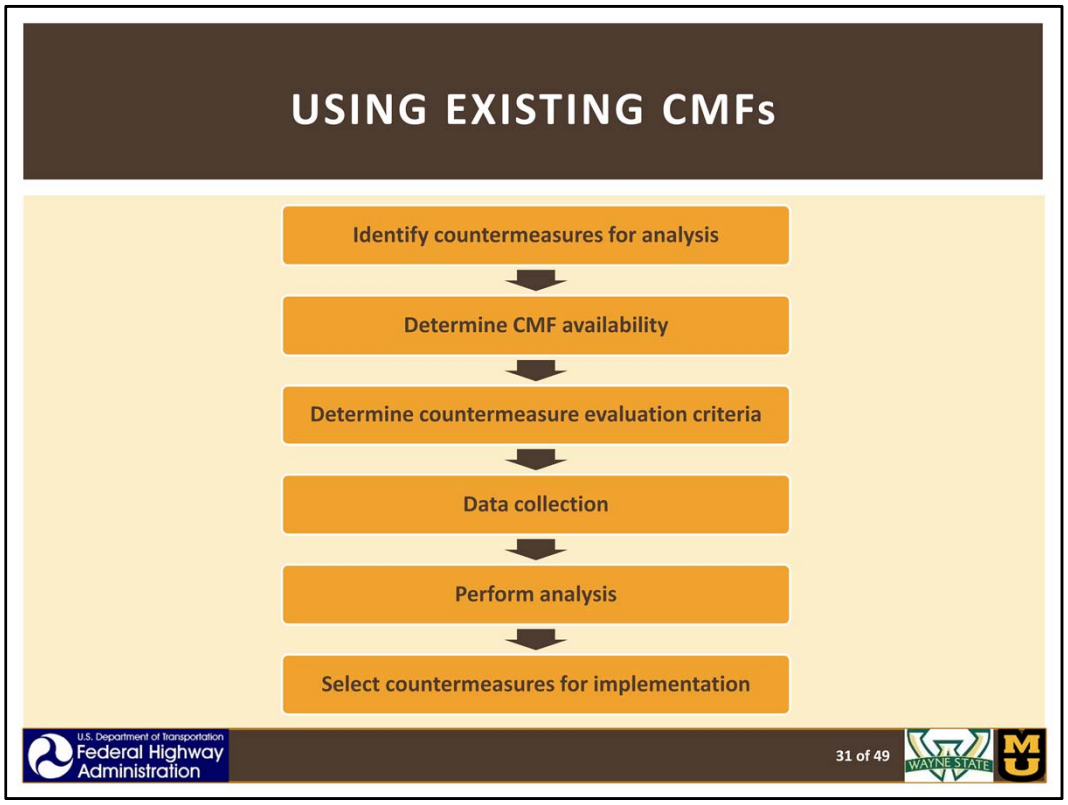
- General HSM methodology-predicted crash frequency based on SPF, CMF, Calibration Factor
- SPF (Safety Performance Function) – predicts crashes for a given set of base conditions based on exposure variables such as segment length and AADT
- CMF (Crash Modification Factor) – adjusts predicted crash frequency to account for conditions that are different from base conditions such as different work zone duration and length. CMFs can be used to evaluate effectiveness of countermeasures.
- Calibration factor – used to adjust predicted crash frequencies for local conditions such as driver behavior, crash reporting thresholds, climate, etc. Calibration process is recommended by HSM to account for these local conditions.



- HSM has limited information on work zone CMFs
- HSM CMFs for work zone length and duration
- Based on data from 36 high impact freeway work zones in California
- These are actually CMF functions – CMF value depends on the independent variable
- Increase in work zone duration or length leads to increased number of crashes



- Other work zone CMFs on CMF clearinghouse
- CMF clearinghouse – online repository of CMFs that have been developed. It is supported by FHWA.
- CMF clearinghouse includes information on the CMF such as applicability and a rating
- CMF clearinghouse contains thousands of CMFs, but only a very limited number of work zone CMFs as shown on this slide.
- CMF clearinghouse contains other resources such as guide and tips for developing effective CMFs



- Figure shows general procedure for evaluating effectiveness of work zone countermeasures using existing CMFs
- Which countermeasures are being evaluated?
- Is there an existing CMF available for the countermeasure?
- How will the countermeasure be evaluated (e.g. benefit cost ratio)?
- Collect data appropriate for the CMF
- Use CMF to predict countermeasure effectiveness and determine if countermeasure should be implemented

EXISTING CMF EXAMPLE

- Step 1: Identify countermeasures for analysis
  - Increase outside shoulder width by 1 ft
- Step 2: Determine CMF availability
  - CMF = 0.948 (CMF Clearinghouse)
- Step 3: Determine countermeasure evaluation criteria
  - Implement if B/C > 1.25
- Step 4: Data collection
  - Improvement cost = $3,000 / mile
  - Project length = 2 miles
  - Expected number of crashes = 8
  - Crash cost = $20,000

Source: http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/chapter13_01.htm

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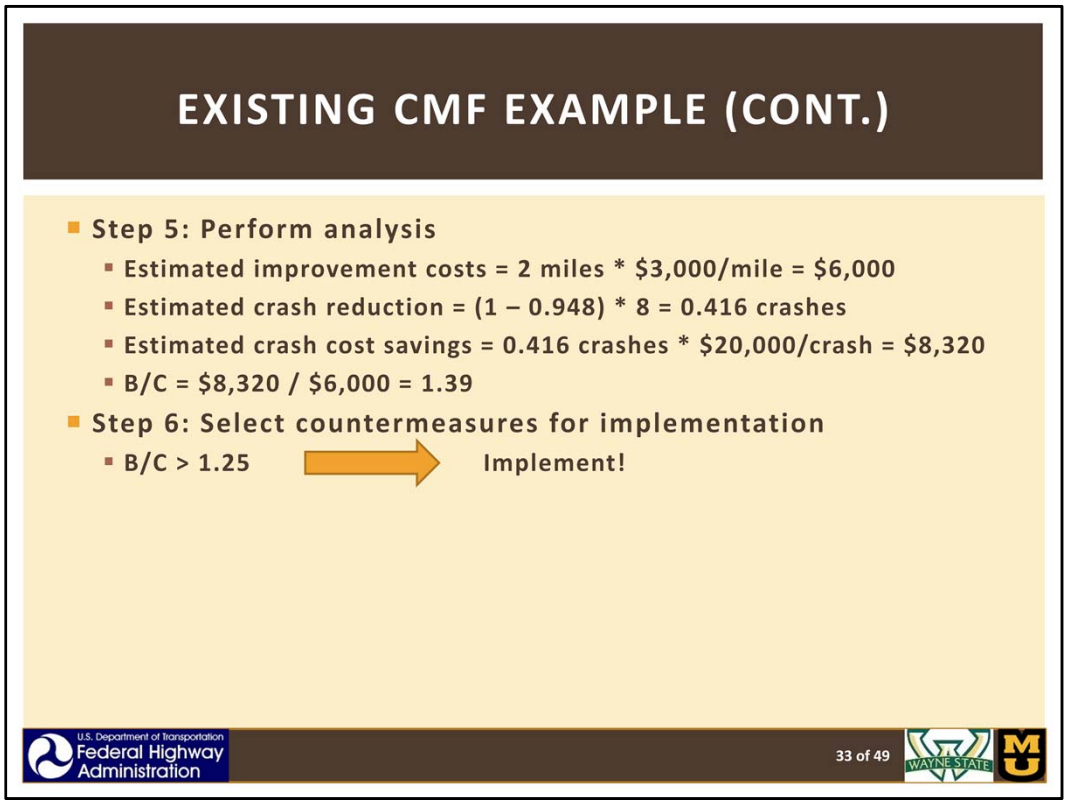
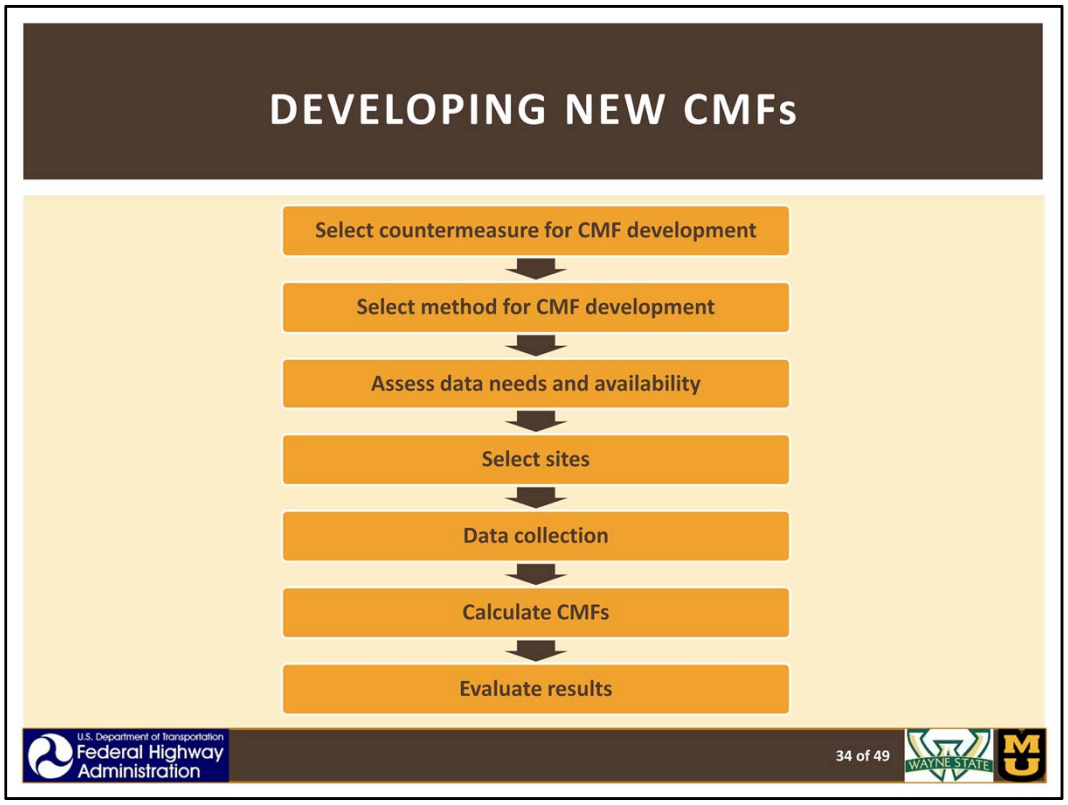
WAYNE STATE

- Example of using an existing CMF to evaluate effectiveness of work zone countermeasure
- Work zone countermeasure – increase in outside shoulder width by 1 ft throughout the work zone
- We would expect this countermeasure to reduce crashes, but by how much?
- A CMF for this countermeasure is available in the CMF clearinghouse (5.2 percent crash reduction, star quality = 3 out of 5)
- In this example, agency will implement countermeasure if benefit cost ratio is greater than 1
- Collect data on project information and crashes

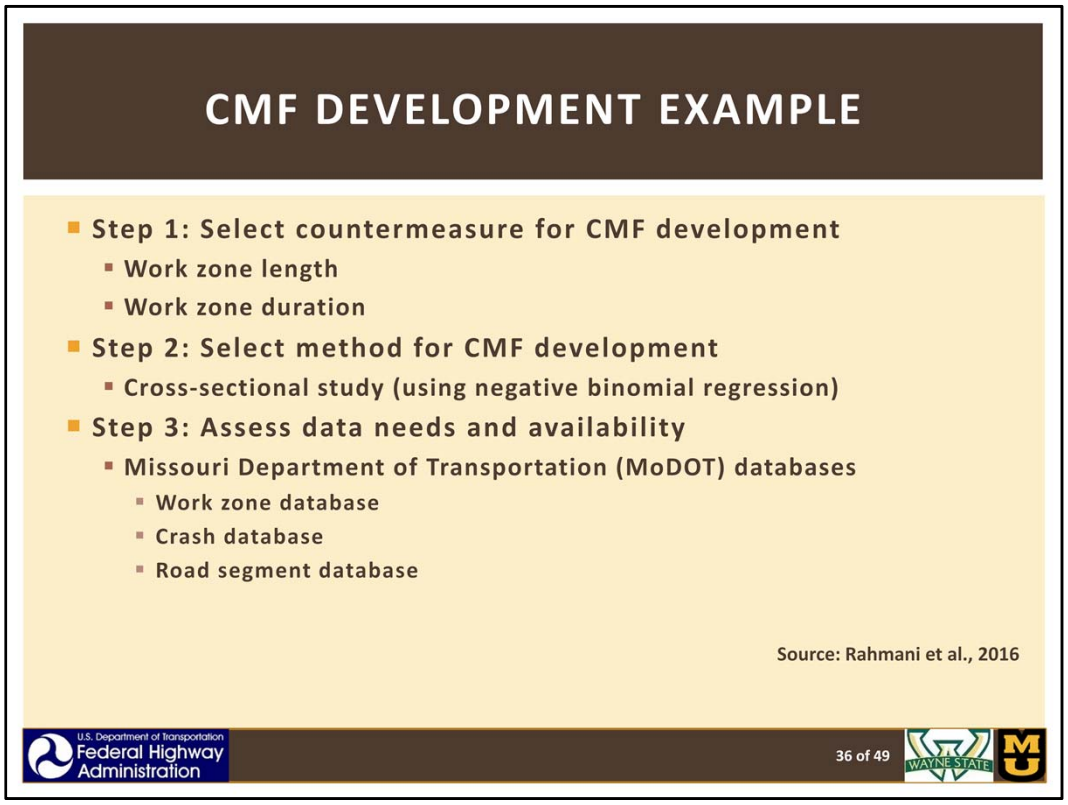


- Estimated benefit is savings in crash costs (calculated from CMF, anticipated number of crashes for base condition, monetary value assigned to crash)
- Improvement cost is $6k
- Benefit cost ratio is greater than 1.25, so agency decides to implement countermeasure
- Assuming site conditions are suitable for widening work zone outside shoulder by 1 ft

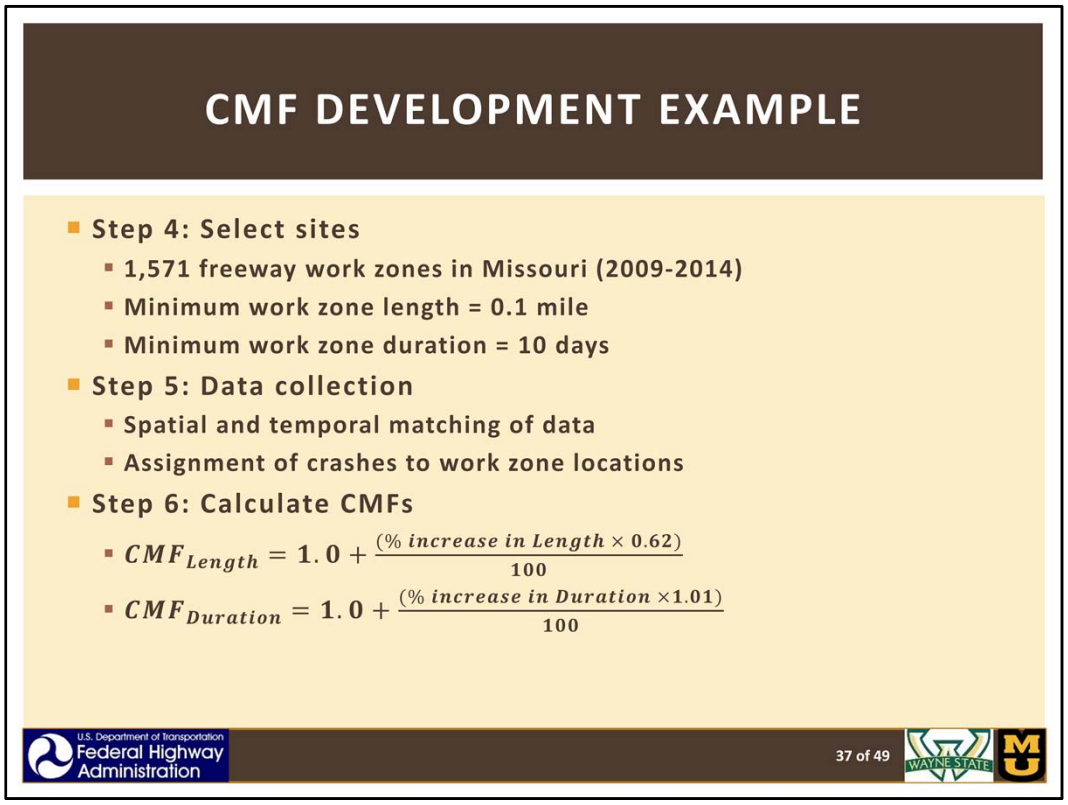


- Availability of existing work zone CMFs is very limited
- May be necessary to develop a CMF for a particular countermeasure being evaluated
- Figure shows general process for developing a new CMF
- What countermeasure is being studied? What method will be used (discussed on next slide)?
- What data is needed for the analysis and is this data available?
- Many challenges in working with data for work zone CMFs (Accuracy of work zone presence and schedule, inconsistency between crash database and crash report description, difficulty in determining the spatial influence of work zones for assigning work zone-related crashes, and lack of actual traffic volumes).
- Site selection - balance statistical needs with level of effort required.
- Work zone safety analysis often involves fusing multiple sources of data (e.g. geometric data, traffic data, work zone data, crash data). May need to do temporal and spatial matching to link work zones with crashes.
- Calculation method depends on CMF development being used.
- Make sure to evaluate CMF value for reasonableness. CMF less than one reduces crash frequency. CMF greater than one increases crash frequency. Develop guidelines for conditions under which CMF you developed is applicable (e.g. variable ranges).
- Finally, CMF is ready to use!

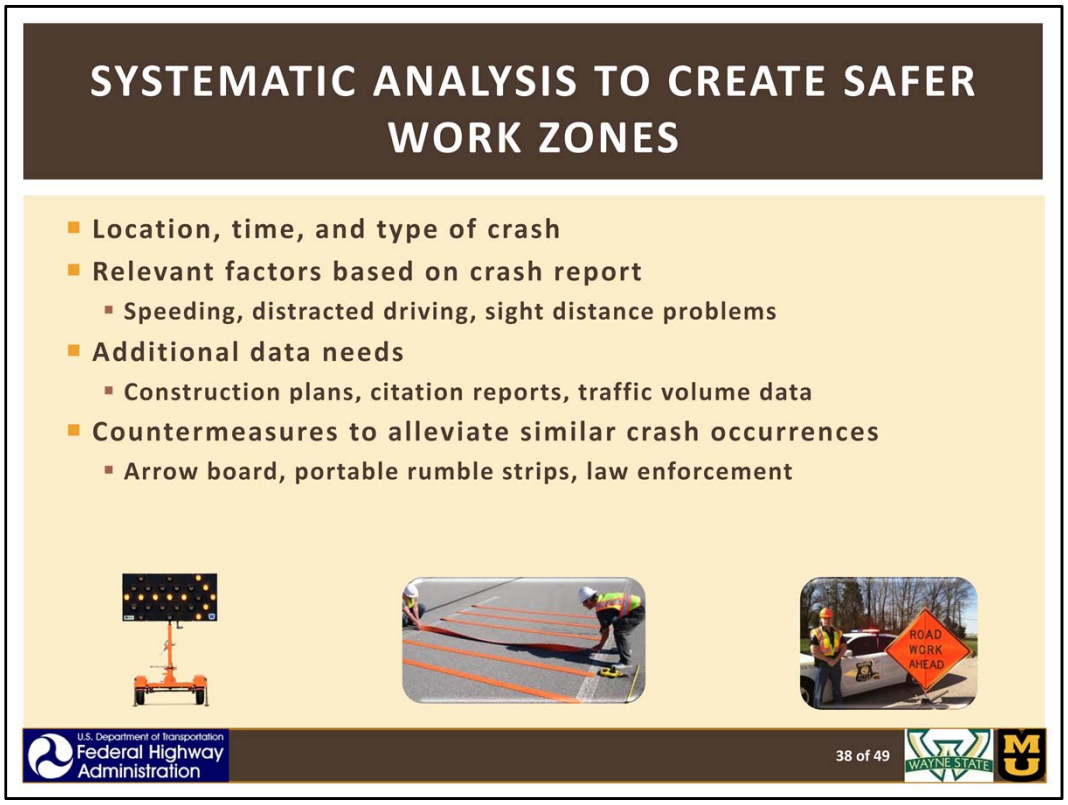
- Empirical Bayes (EB) - utilizes SPFs to estimate the average crash frequency for treated sites during the after period as though the treatment had not been applied. CMF is calculated based on the **observed crash frequencies** during the before and after periods, the **expected crash frequencies** during the before and after periods, and the variance of the expected crash period during the after period
- **Cross-sectional study** compares the crash performance at **treatment sites** with the crash performance at **control sites** (that have not received any treatment) over the same period of time. The CMF can be estimated as the ratio of the crash frequency averaged across all sites receiving treatment and the crash frequency averaged across all control site.
- Multivariate regression can also be used, and CMFs can be calculated from regression model coefficients.
- The best method for use in a given situation depends on many factors such as the availability of data during the before and after periods and the availability of control sites.



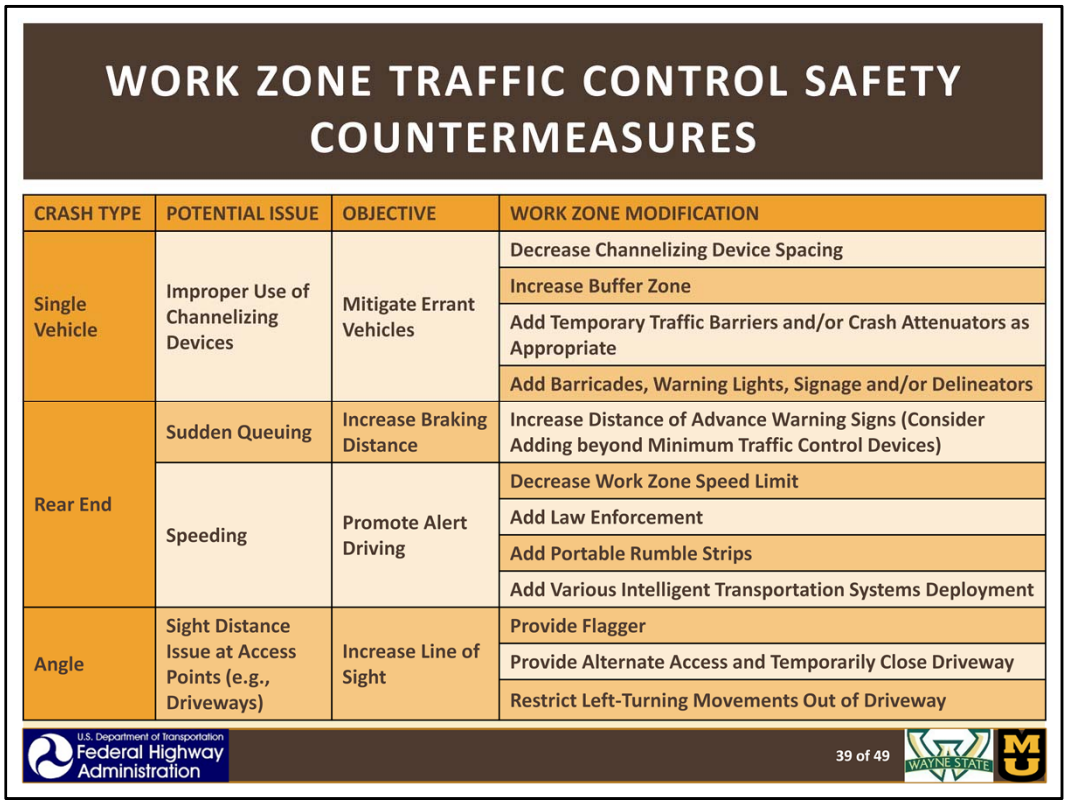
- CMF development example based on study by Rahmani et al. (2016). Study was to develop freeway work zone CMFs based on Missouri data.
- Let's examine the effect of work zone length and duration on crash frequency. Although these are not engineering countermeasures such as rumble strips or lane widening, the work zone lengths and duration can be controlled by adjusting work schedules.
- This study used a form of cross-sectional study that estimates negative binomial regression models. The CMF values for the treatment variables can then be inferred from their coefficients in the regression model.
- To perform the analysis, it was necessary to collect data from several MoDOT databases, including a work zone database, crash database, and road segment database. Information contained in the work zone database includes work zone ID, roadway segment ID, work zone start and end date, and work zone start and end location. Crash database included archived highway patrol reports. Road segment database contained AADT and other road segment data.



- Potential sites – all freeway work zones in Missouri between 2009 and 2014. Concern about too many work zones with short duration and length. Therefore, thresholds were determined for optimum minimum length (0.1 mile) and duration (10 days). Work zones not meeting these thresholds were excluded from analysis.
- Data fusion was required to link work zones and crashes. Crashes were assigned to the work zones based on spatial and temporal matching of the crash data and work zone data. Assignment of crashes to locations in the work zone (advance warning area, transition area, buffer area, work area, and termination area) was determined from variable thresholds based on the MUTCD.
- CMFs calculated from regression coefficients. These are actually CMF functions. Results show that increased work zone length and work zone duration leads to an increased in the expected number of crashes. This result seems reasonable (Step 7). Length and duration results are comparable to HSM results (1.11 – duration coefficient, 0.67 – length coefficient)



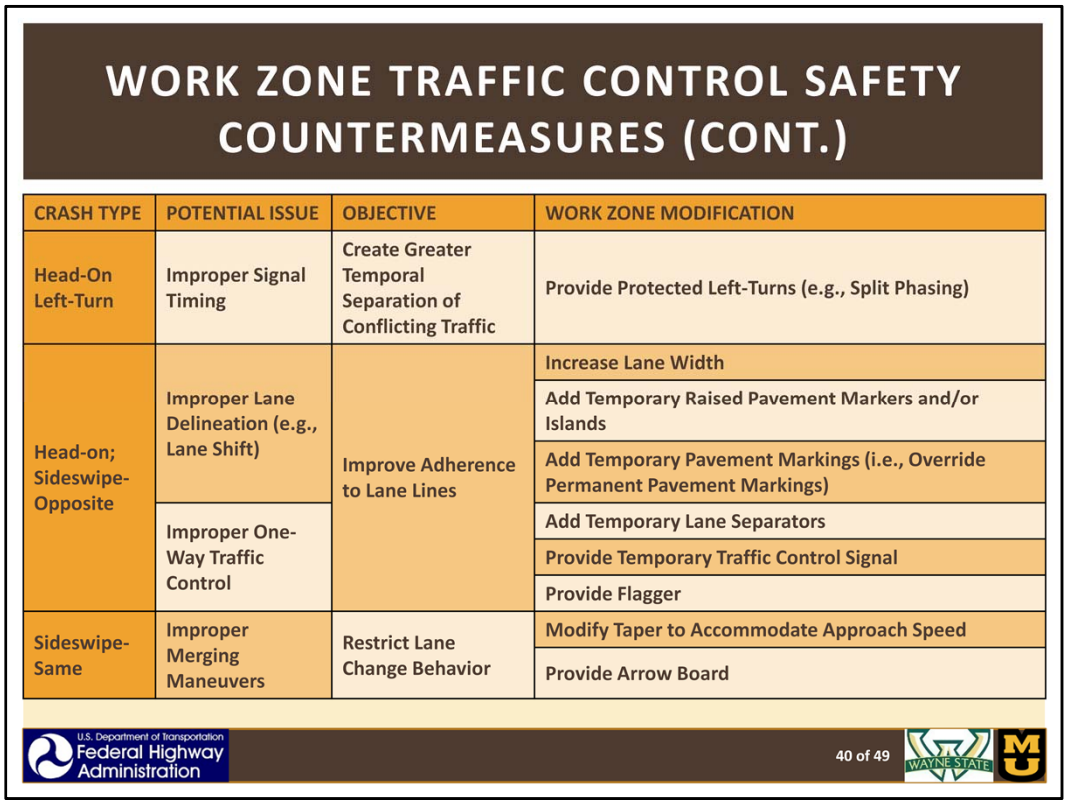
- Improvements to work zone crash data collection will provide a better long term understanding of crash causation within a work zone
- Developing countermeasures to assist with possible policies and standards in order to create safer work zones may require systematic analysis
    - Determine location of crash, time of day or night, type of crash, such as single vehicle, rear end, head on, etc., and environmental conditions
    - Determine relevant factors based on crash report
        - Speeding under current conditions, distracted driving, sight distance problems due to roadway geometry, visual clutter, information overload
    - Determine additional data needs
        - Detailed crash report, construction and maintenance plans and standards, citation reports, reviews of temporary traffic control, traffic volume data, approach speed data
    - Develop countermeasures to alleviate similar crash occurrences
        - Arrow boards or changeable message signs, portable rumble strips, added law enforcement, end-of-queue warning systems, dynamic lane merge systems



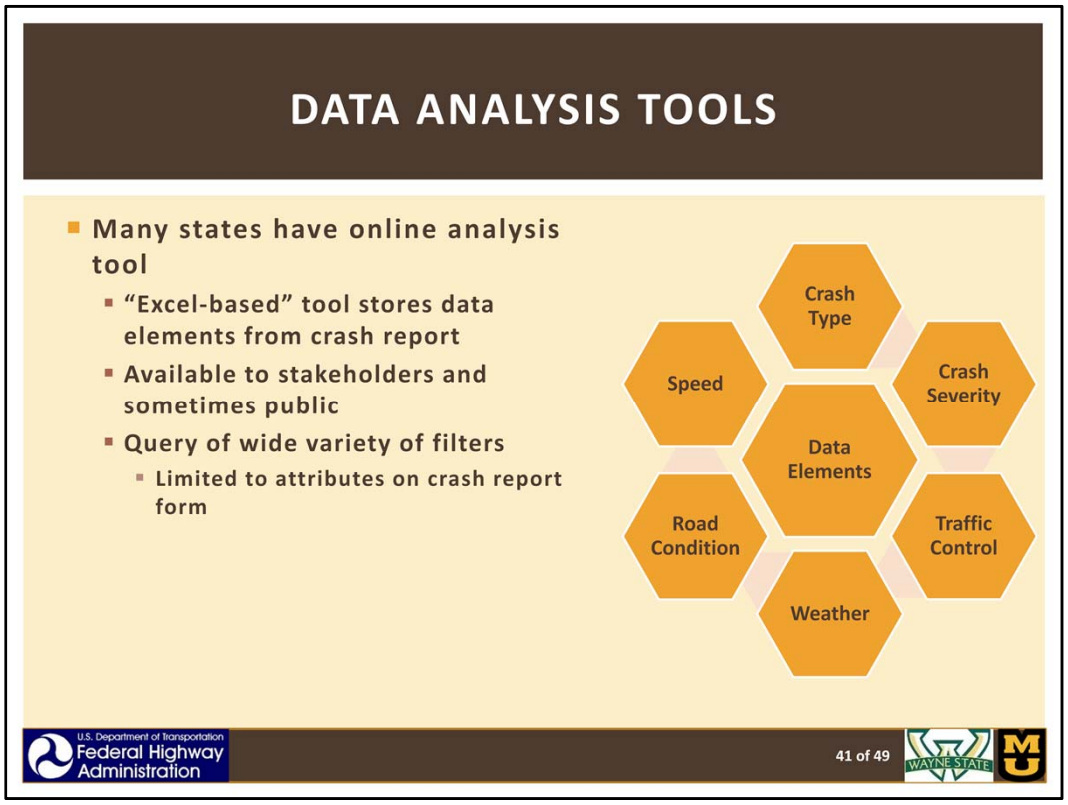
WORK ZONE TRAFFIC CONTROL SAFETY COUNTERMEASURES

CRASH TYPE	POTENTIAL ISSUE	OBJECTIVE	WORK ZONE MODIFICATION
Single Vehicle	Improper Use of Channelizing Devices	Mitigate Errant Vehicles	Decrease Channelizing Device Spacing
			Increase Buffer Zone
			Add Temporary Traffic Barriers and/or Crash Attenuators as Appropriate
			Add Barricades, Warning Lights, Signage and/or Delineators
Rear End	Sudden Queuing	Increase Braking Distance	Increase Distance of Advance Warning Signs (Consider Adding beyond Minimum Traffic Control Devices)
	Speeding	Promote Alert Driving	Decrease Work Zone Speed Limit
			Add Law Enforcement
			Add Portable Rumble Strips
			Add Various Intelligent Transportation Systems Deployment
Angle	Sight Distance Issue at Access Points (e.g., Driveways)	Increase Line of Sight	Provide Flagger
			Provide Alternate Access and Temporarily Close Driveway
			Restrict Left-Turning Movements Out of Driveway

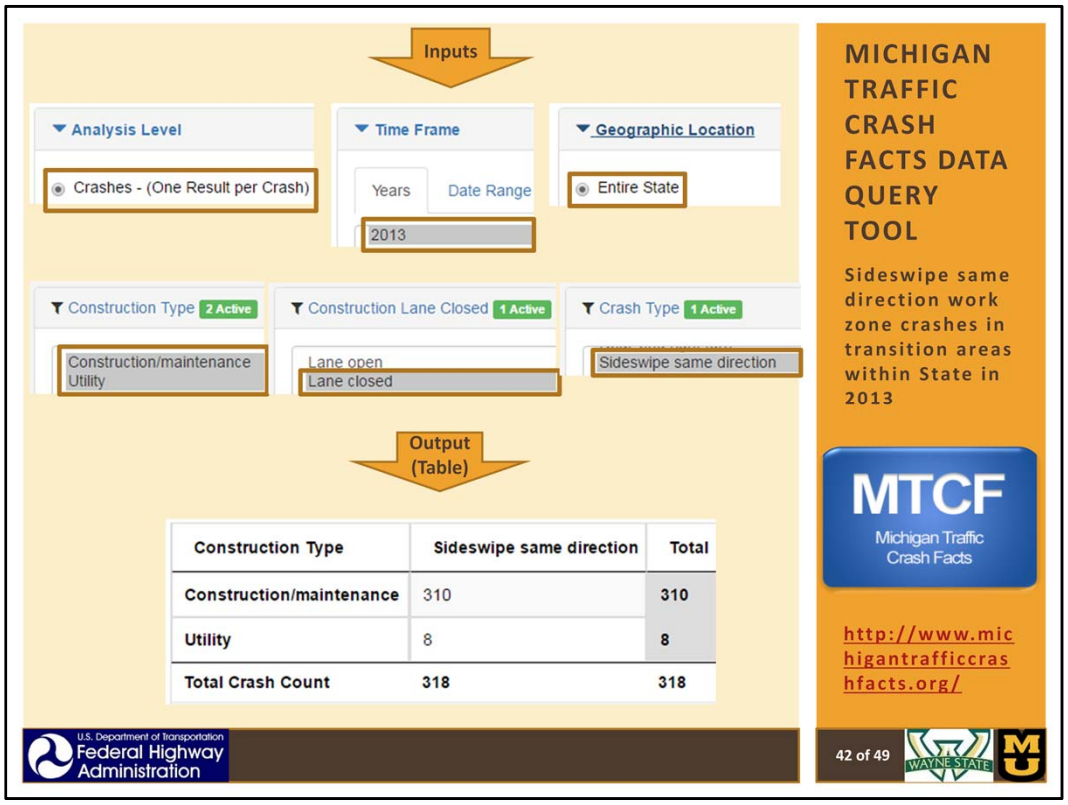
- The next two slides provide a list of work zone traffic control modifications that can be used to help alleviate specific types of crashes in work zones.
- The first step is to identify the crash type and potential issue. From there, the appropriate work zone modification can be selected.
- This can be used to modify an active work zone with a safety issue, but can also be used to alleviate issues in similar work zones, or in future work zones.
- Table shows some typical work zone crash types, such as single motor vehicle, rear end, or angle crash, along with potential issues related to work zone and possible countermeasures



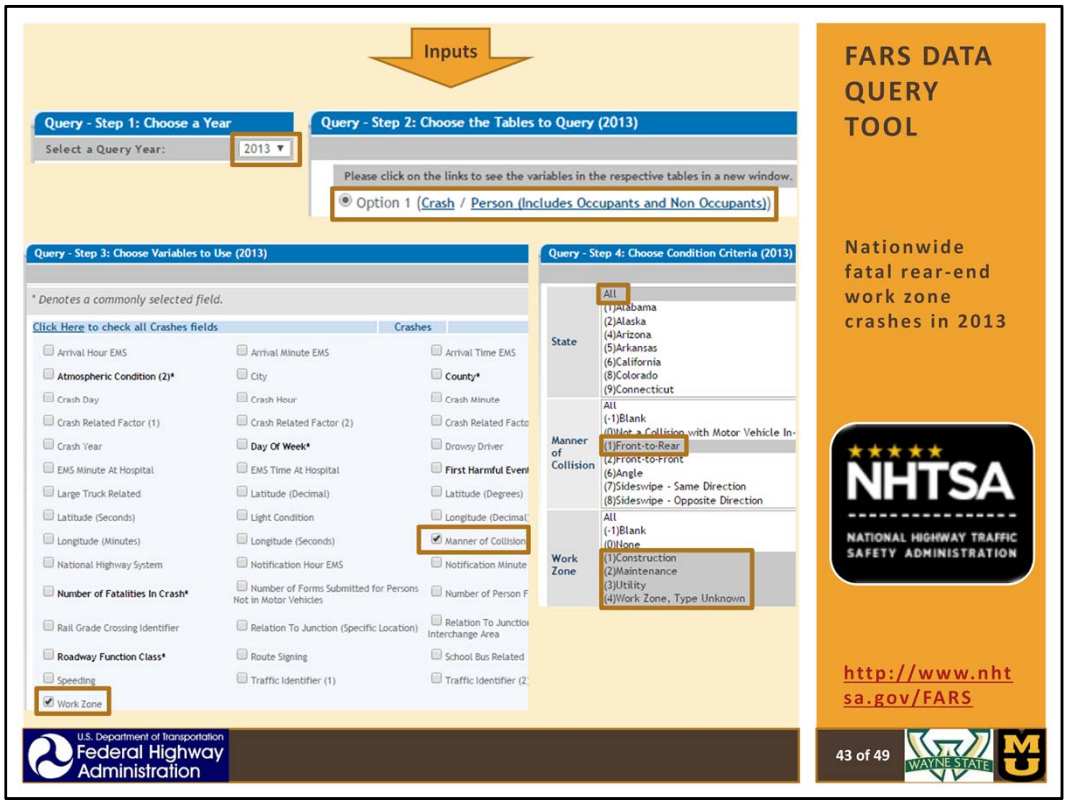
- Table shows other typical work zone crash types, such as head-on left-turn, head-on or sideswipe-opposite, and sideswipe-same along with potential issues related to work zone and possible countermeasures
- These tables are an example of what state agencies should study with regard to work zone crashes and developing similar data
    - Allow construction engineers / supervisors to identify and implement countermeasures in the field
- These tables can also be found in the Guide for Work Zone Crash Data Collection, Reporting, and Analysis



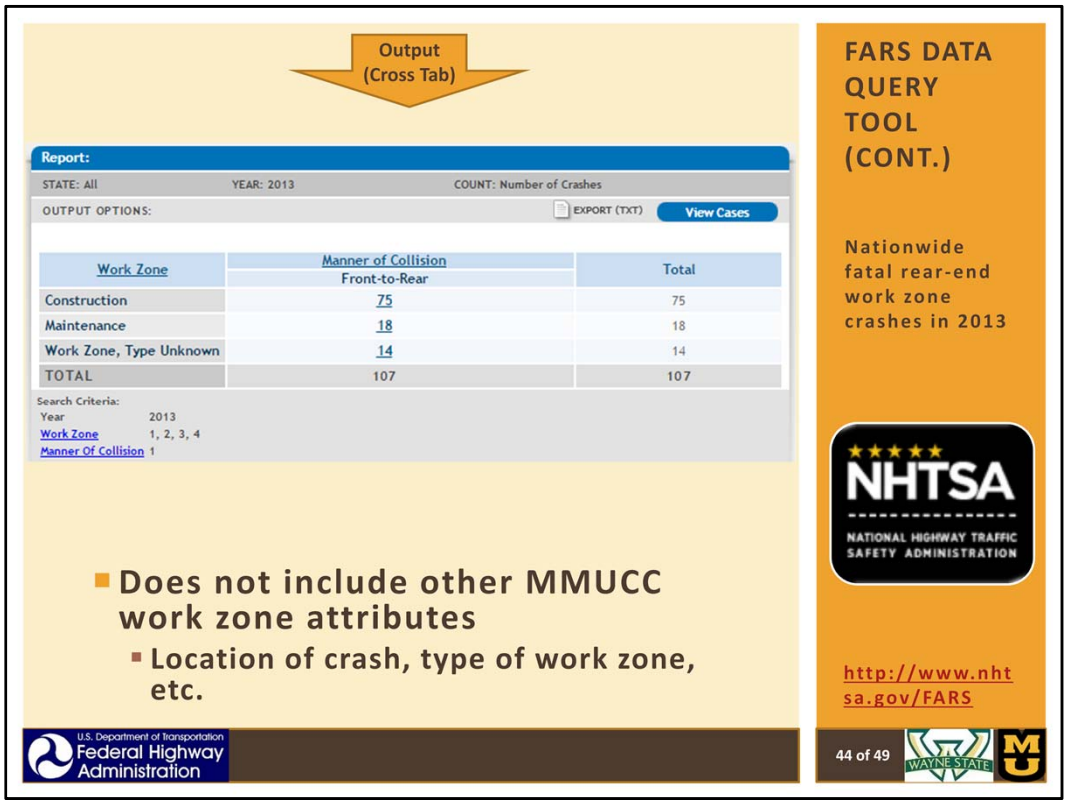
- All data elements, such as crash type, crash severity, traffic control, weather, lighting conditions, road conditions, year, area of road, time of day, speed, driver citation data, and driver distraction data can be used to analyze work zone crashes
- Many states have their own "Excel-based" or similar analytical tool available
    - Stores data collected from every crash report
    - Provides opportunity for use by stakeholders and in some cases public
- Each state's online storage tool typically contains query of a wide variety of filters
    - Used to search for crashes that meet a set of specific criteria
- Comprehensive data summaries updated annually are also made available online for users



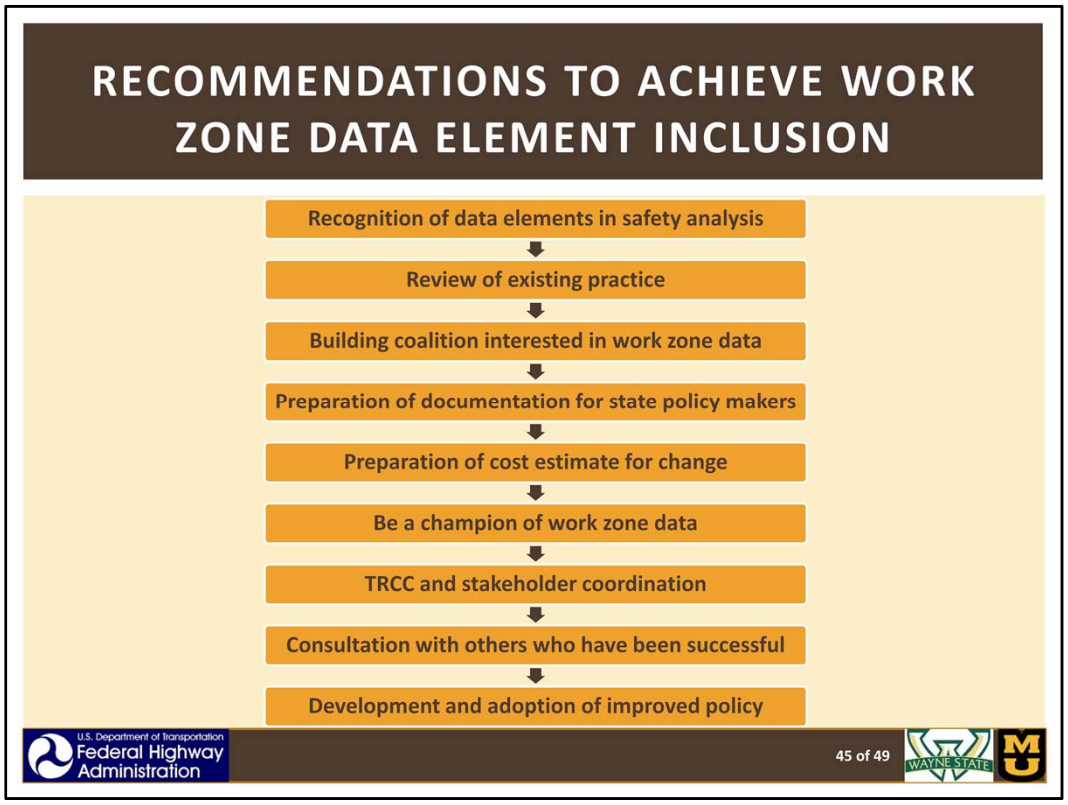
- Michigan uses an online data query tool called Michigan Traffic Crash Facts (MTCF), which is a model tool that allows users to:
    - Build their own query
    - Filter data elements identified on Michigan crash report form
    - The filterable data is however limited to what is being collected on the state crash report form though
- User can determine the overall frequency of sideswipe same direction work zone crashes related to transition areas within the state in 2013 by inputting filters (example shown above)
    - Year – 2013
    - Geographic Area – Entire State
    - Analysis Level – Crash
    - Construction Type – Construction/Maintenance; Utility
    - Crash Type – Sideswipe same direction
    - Construction Lane Closed – Lane closed
- Using this query provides an output of 318 crashes
- Results can be displayed in the form of a map, table, list, chart, calendar, or copy of actual crash report forms
- In this case, the figure shows the result in the form of a table



- NHTSA has an online data query tool called the Fatality Analysis Reporting System (FARS) Encyclopedia
    - Available to crash data users
    - Contains data on all vehicle crashes involving fatalities in United States
    - User can build their own query by selecting specific crash, occupant, vehicle, driver, and pre-crash fields to filter fatal crashes meeting selected criteria
- User can determine the overall frequency of fatal rear end work zone crashes, nationwide, for the year of 2013 (example shown above) by inputting filters
    - Step 1: Choose a Year – 2013
    - Step 2: Choose the Tables to Query – Option 1 (Crash / Person)
    - Step 3: Choose Variables – Work Zone; Matter of Collision
    - Step 4: Choose Condition Criteria
        - State – All
        - Manner of Collision – (1) Front-to-Rear
        - Work Zone – (1) Construction; (2) Maintenance; (3) Utility; (4) Work Zone, Type Unknown

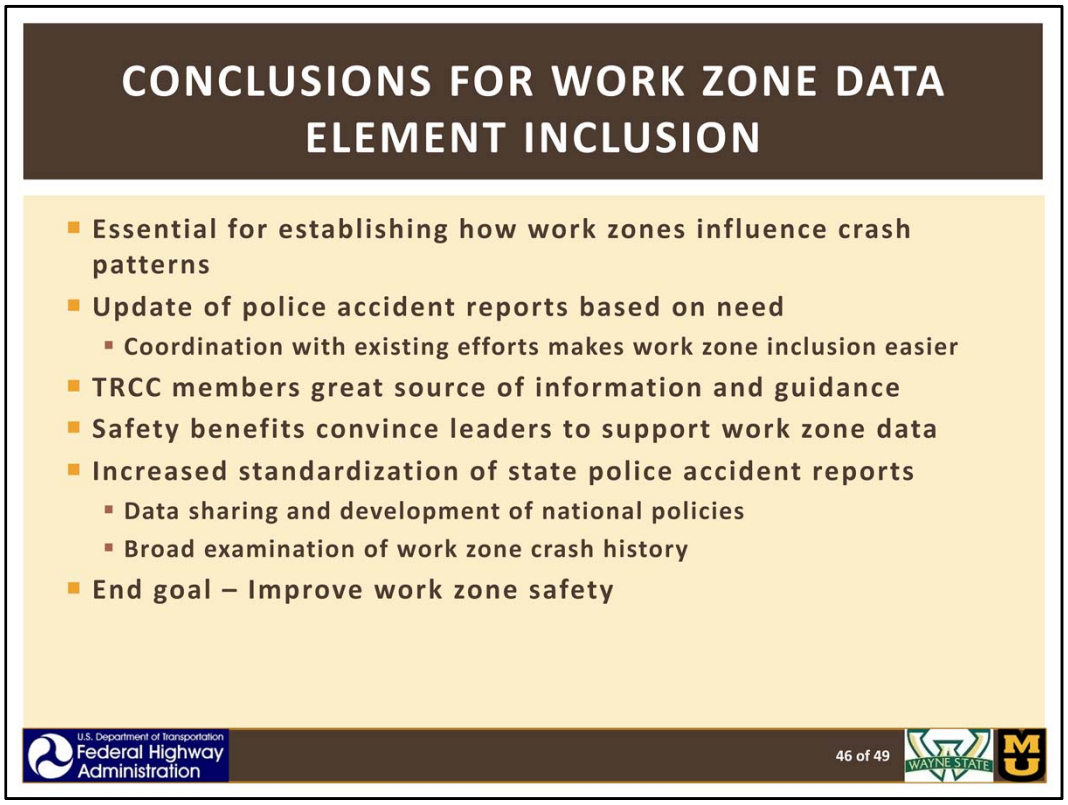


- Results can be displayed in the form of a table or case listing
- Figure shows results in the form of a table
- Other than work zone activity, FARS does not include any other work zone attribute subfields as included in the MMUCC Guideline
    - Location of crash within work zone, type of work zone, workers present, law enforcement present are not filterable items



- Recognizing that adding additional attributes to the work zone crash data element can be a challenge, a series of recommendations have been developed (based on the state-of-the-art and state-of-the-practice) to assist states in achieving inclusion of work zone data elements on the traffic crash report forms
    - Recognize use of various data elements in safety data analysis, countermeasure selection, and safety evaluation
    - Review existing state practice and compare with other best state practices
    - Build a coalition of stakeholders who are interested in the inclusion of additional work zone data elements in the state police accident report (PAR)
    - Prepare documentation for state policy makers to consider
    - Prepare cost estimate, as necessary, for such a change
        - Cost and time of training generally a major factor that often influences frequency of changes in PAR
    - Identify agency champions that have the authority to institute change in work zone crash data collection
    - Contact the Traffic Records Coordinating Committee (TRCC) and be involved with stakeholder coordination
    - Consult with Federal Highway Administration (FHWA), National Highway Traffic Safety Administration (NHTSA), and other states carrying out best practices who have already achieved the inclusion of work zone data elements in their PAR
        - Understand how long it takes

    - Understand what was done
- Develop and adopt the improved policy



- Work zone data elements, as recommended in MMUCC Guideline, are essential for identifying factors that may have caused or contributed towards a crash in or around a highway construction zone
- When states update their police accident report, much of the update is based on stakeholder needs and desires
    - Including additional work zone related data elements to other existing and ongoing police accident report updating efforts can make such data element additions easier to implement
- Traffic Records Coordinating Committee members at the state level are a great source of information and guidance to learn about the needs and desires for the upcoming police accident report
- Preparing documentation that includes potential safety benefits and development of countermeasures related to work zone crash data analysis will help assist in convincing policy makers and leaders to support initiatives to add the work zone crash data element
- Increased standardization of state police accident reports at a national level will create many benefits
    - Data sharing and development of national policies
    - Broad examination of work zone crash history
- Work zone data element inclusion will help achieve the end goal of improving work zone safety

- Additional resources that provide further information regarding work zone data element

- Answer questions submitted during presentation

- Conclusion of webinar on Work Zone Crash Data Collection, Reporting, and Analysis