IDOT Work Zone Activity Data (WZAD)

Literature Review

Prepared for: Illinois Department of Transportation
Prepared by: University of Wisconsin-Madison and Lakeside Engineers

Date: February 11, 2026







WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Lakeside
ENGINEERS

Table of Contents

1. Introduction 1
2. Work Zone Crashes 1
3. Federal Rules and National Standards 2
3.1 Federal Rule 23 CFR Part 630 Subpart J 2
3.2 Federal Rule 23 CFR Part 630 Subpart K 3
4. National Work Zone Resources 4
4.1 FHWA Work Zone Management Program 4
4.2 National Work Zone Information Clearinghouse 5
4.3 Work Zone Data Exchange Initiative 6
5. Smart Work Zones 8
5.1 Smart Work Zone Deployment Initiative (SWZDI) 9
5.2 NCHRP Project 08-119 10
5.3 NCHRP Research Report 1142 13
6. Neighboring State WZAD Practices 15
Appendix 18

1. INTRODUCTION

Work Zone Activity Data (WZAD) are parameters that describe an active or planned work zone. Key among these data elements include type of work being performed; schedule of activities; beginning and end points of the work zone; impacts on travel lanes, exit ramps, and shoulders; and designated detour routes. Modernizing how the Illinois Department of Transportation (IDOT) collects, manages, and shares with the traveling public current, real-time WZAD is the subject of work performed under a federal Strengthening Mobility and Revolutionizing Transportation (SMART) Grant that was awarded in March 2023.

The purpose of this technical memorandum is to document the status of federal rules and national resources on highway work zone safety, the establishment of relevant WZAD national standards and on-going related implementation and adoption of those standards, and the development of the Smart Work Zone concept. In addition, noteworthy examples of WZAD management in two neighboring states will be highlighted.

2. WORK ZONE CRASHES

Work zone safety remains a key motivation for collecting and standardizing activity data. Although work zone-related crashes account for only about two percent of all traffic fatalities each year in the US, they result in about 40,000 non-fatal injuries – *see Figures 1 and 2*. There is general consensus among state DOTs and the road building industry that reducing work zone-related crashes, fatalities and injuries is a high priority traffic safety objective. However, there are challenges to assembling work zone-related incident data to help track national and state progress in that regard. For example, each state, and in some cases individual local jurisdictions, has developed their own unique traffic crash reporting system. To provide greater consistency in the definition of common data elements used in crash reporting protocols, the American National Standards Institute (ANSI) developed its Manual on Classification of Motor Vehicle Crashes, which includes definitions for "work zone" and "work zone crash" – *see the Appendix for details*.

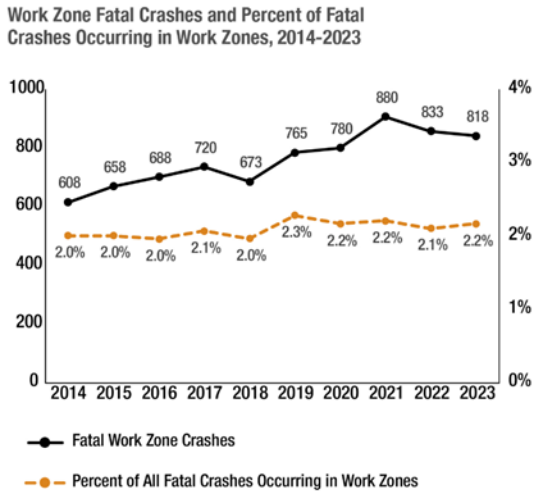


Figure 1: Work Zone Fatal Crashes, 2014 - 2023

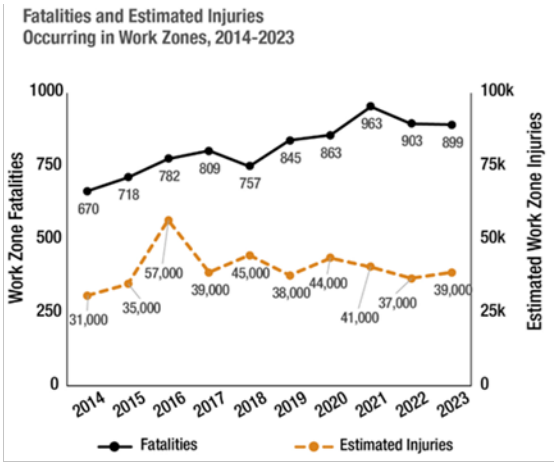


Figure 2: Work Zone Fatalities and Injuries, 2014 - 2023

The Manual on Classification of Motor Vehicle Crashes (ANSI D16) underlies the NHSTA Model Minimum Uniform Crash Criteria (MMUCC) Guideline, which serves as the basis for state agency crash data collection and management. The current version, MMUCC 6, includes additional elements for work zone

crash reporting.

3. FEDERAL RULES AND NATIONAL STANDARDS

The crash trends and data challenges presented in Section 2 underscore the need for a consistent national framework to manage safety and mobility in work zones. In response, the Federal Highway Administration (FHWA) established a series of federal rules and standards that define agency responsibilities, guide the use of traffic control devices, and promote data-driven approaches to improving work zone performance.

For as long as there have been roadways for use by the traveling public there have been highway work zones. Some are short duration (e.g. utility work zones, pothole filling), and some are longer term (e.g. pavement rehabilitation, roadway reconstruction). With the increase in vehicle miles of travel in the US since construction began of the Interstate highway system 70 years ago, it eventually became common practice for road and bridge maintenance, as well as a considerable amount of paving and reconstruction work, to be accomplished under live traffic conditions. This practice elevated concerns for better protecting construction/maintenance personnel in work zones. Eventually FHWA adopted federal rules on the subject to establish minimum requirements and guidance for state and local agencies to not only mitigate the hazards faced by workers, but also by motorists navigating through work zones.

3.1 Federal Rule 23 CFR Part 630 Subpart J

In 2004, FHWA published a new federal rule regarding work zones on any federal aid highway project. The new Work Zone Safety and Mobility Rule (23 CFR Part 630 Subpart J) replaced a legacy predecessor rule titled “Traffic Safety in Highway and Street Work Zones.” The new rule required states to develop and implement a systematic approach to manage safety and mobility in work zones. Agencies were given until the end of 2007 to come into compliance and were made subject to a 2-year compliance review cycle.

Subpart J incorporated by reference the standards/guidance for the design, application, installation, and maintenance of traffic control devices used for highway construction, maintenance operations, and utility work that were articulated in Part 6 (“Temporary Traffic Control”) of the Manual on Uniform Traffic Control Devices (MUTCD). The purpose of the new rule was to augment MUTCD Part 6 provisions by requiring states to take policy, process, and procedural actions that would help further mitigate and manage the safety and mobility impacts of work zones. To this end, key elements of Subpart J included:

- Agency must establish a work zone safety and mobility policy.
- Agency must develop and implement relevant processes and procedures that address:
    - Work zone impact assessment/management
    - Training of personnel
    - Use of safety and operational data
    - Process reviews
- Agency must implement project-level procedures to address work zone impacts, including:
    - Identification of “significant projects” (those likely to have higher level of disruption due to work zone impacts)
    - Development of Transportation Management Plans (TMPs) to mitigate/manage WZ impacts
    - Including pay item provisions for implementing the TMP in the PS&E

- Assigning a "responsible person" to implement/monitor TMP elements at the project-level

Several new, innovative concepts embodied in Subpart J were designed to help state/local agencies become more effective in reducing the safety and mobility impacts of work zones. Agencies were expected to proactively assess/plan for work zone impacts and to look beyond the immediate work zone location. They were to consider the surrounding highway corridor and transportation network, as well as anticipate how potentially affected residents, businesses, commuters, and other interested stakeholders might be impacted by disruptions arising from the presence, nature, and duration of the work zone. Alternative solutions to reduce/manage expected impacts could then be considered. The rule stressed it would be critical to begin these efforts early in program delivery so that such concerns could be addressed in work zone budgeting, scheduling, and design.

The Work Zone Safety and Mobility Rule was updated in 2024. Key elements of the Subpart J update included:

- Agency must incorporate relevant performance measures in their work zone policy and conduct annual monitoring.
- The reporting cycle for compliance reviews was increased from 2 years to 5 years (as required by the Bipartisan Infrastructure Law [BIL] enacted in 2021), and the process reviews were redesigned to be programmatic reviews.
- The term "significant projects" was clarified, as were TMP criteria for Interstate and non-Interstate projects (also per the BIL).

Agencies have until the end of 2026 to come into compliance with the requirement to develop work zone safety and mobility performance measures. However, due to the extension of the reporting cycle to 5 years, the next FHWA work zone programmatic reviews will be late 2030.

3.2 Federal Rule 23 CFR Part 630 Subpart K

In 2007, FHWA published a new federal rule regarding traffic control devices used in work zones on any federal aid highway project. The new Temporary Traffic Control Devices Rule (23 CFR Part 630 Subpart K) supplemented Subpart J by placing added emphasis on safety measures in work zones that could decrease the likelihood of fatalities and injuries to both workers and roadway users. It established minimum requirements and related guidance for:

- Positive protection devices between the workspace and motorized traffic
- Installation/maintenance of temporary traffic control devices
- Exposure control measures to ensure safe entry/exit of work vehicles and equipment
- Use of uniformed law enforcement during construction, maintenance, and utility operations
- Contract pay items to ensure funding was available for traffic control features/operations

The Temporary Traffic Control Devices Rule was also updated in 2024. In the intervening years since Subpart K was first published, new work zone concepts and technologies (e.g. Smart Work Zones [SWZ], automated flagger assistance) had been developed to help further mitigate the safety and mobility impacts of work zones and therefore deserved to be included as options within the Rule. In addition, advanced technologies to support Connected/Autonomous Vehicle (CAV) travel in/around work zones had been developed/deployed. There was also concern there had been uneven adoption across the states of the Subpart K requirement to perform an engineering study on which to base decisions

regarding the need for longitudinal traffic barriers and other positive protection devices, so there was a need to strengthen language regarding what constituted an "engineering study." Agencies will have until the end of 2025 to update/establish relevant work zone policy, process and guidance, and until the end of 2026 to implement them. Key elements of the Subpart K update included:

- Required that agency work zone policy, procedure and guidance, including use of positive protection devices, be based on an engineering study.
- Provided the characteristics of a suitable engineering study and examples of the types of engineering decision-making tools that can be used in the study.
- Required that positive protection devices be used in work zones with high operating speeds where workers had no means of escape from motorized traffic intruding into the workspace, unless an engineering study determined they were not necessary.

4. NATIONAL WORK ZONE RESOURCES

The federal rules described in Section 3 provide the regulatory backbone for how work zones are designed and operated. Building on that framework, FHWA and others have taken the lead on developing work zone management programs and a work zone information clearinghouse for state DOT's and local agencies. The following section highlights key FHWA resources and partnerships that promote consistency, innovation, and information-sharing in work zone management and data collection.

4.1 FHWA Work Zone Management Program

Within the FHWA Office of Operations at the USDOT headquarters in Washington, D.C. several program areas provide guidance and compile resources for Reducing Non-recurring Congestion. One of these is the FHWA Work Zone Management Program, whose mission is "*To mitigate the safety and mobility impacts of work zones*." This team oversees FHWA's efforts to compile information and maintain awareness of trends and best practices in work zones. A well-organized, nearly 300-page Work Zone Noteworthy Practices Guidebook groups over 170 best practices into 11 major categories – *see Appendix*. However, the most recent edition of the Guidebook dates from 2013, with an addendum released in 2017 that added over 20 additional best practice examples. Given the dynamic, accelerating nature of innovation in work zone-relevant technology and practice the Guidebook and its 2017 Addendum is arguably already out of date.

FHWA Work Zone Management Program staff also produce a series of Work Zone Mobility and Safety Fact Sheets. These are brief profiles of activities being used at the state or local level to improve mobility and safety in work zones, highlighting lessons-learned and new products or strategies. States are encouraged to self-submit "success stories" in their work zone management efforts for inclusion in these Fact Sheet profiles. However, currently there are only 19 innovative work zone initiatives highlighted in this series, the latest of which dates from 2013.

Despite the lack of recent updates/additions to the Work Zone Management Program's Guidebook and Fact Sheets series, FHWA staff have compiled an impressive number of case studies and research work products across a wide spectrum of work zone mobility and safety topic areas. Included among these are items relevant to work zone data collection and usage itemized on the Program's webpage titled "Performance Measurement Examples." Most data collection/usage case studies or synthesis of practice examples in this webpage address program or process-level work zone performance evaluation metrics (e.g. changes in crash frequency/severity, motorist/worker casualties) after completion of work, rather than the collection and relay of real-time data pertinent to motorists operating in/near active work

zones.

The Work Zone Management Program's "Publications and Studies" webpage includes links to over 200 work zone-related publications developed by FHWA and the National Cooperative Highway Research Program (NCHRP) or by outside parties with FHWA Work Zone Safety Grant funding. These items address a host of work zone-related sub-topics, including:

- Best Practices
- Construction Strategies
- Contracting Strategies
- Incident Management
- ITS and Technology
- Project Coordination
- Worker Safety
- Regulation and Policy
- Research and Training
- Work Zone and Traffic Analysis
- Work Zone Management Capability
- Work Zone Safety and Mobility Rule
- Work Zone Traffic Management
- Public Information and Outreach
- Performance Measures

4.2 National Work Zone Information Clearinghouse

The concept of a national clearinghouse for information about highway work zones was developed at a 1994 workshop co-sponsored by the American Association of State Highway and Transportation Officials (AASHTO) and the American Road and Transportation Builders Association (ARTBA). The following year Section 358(b) of the National Highway System Designation Act directed USDOT to create the National Work Zone Safety Information Clearinghouse as one of several initiatives by which to fulfill a directive embodied in the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 to establish a work zone safety program. With funding from FHWA, in 1998 the Clearinghouse began business operations as a joint venture with ARTBA and the Texas Transportation Institute at Texas A&M University. Two years later the Clearinghouse became a private sector entity operated by the ARTBA Transportation Development Foundation. FHWA funding to help support the Clearinghouse resumed in 2005.

The mission of the Clearinghouse is to provide the transportation construction industry and the general public with "*comprehensive information to improve motorist, worker and pedestrian safety in roadway work zones*." To that end the Clearinghouse compiles national and state work zone traffic crash data, as well as data on worker fatalities/injuries at highway construction sites. The organization also provides links to numerous work zone-relevant training resources and to state-specific work zone laws, technical standards, and approved work zone device product lists. The Clearinghouse stages an annual National Work Zone Management Conference and coordinates an annual Work Zone Awareness Week to promote public awareness of the subject area. Its robust, informative website highlights six topics of special interest, including:

- Commercial Motor Vehicle Safety
- Smart Work Zones
- Transportation Management Plans
- Accommodating Pedestrians
- Worker Safety and Welfare
- Project Coordination in Work Zones

The Clearinghouse webpage for Smart Work Zones provides links to a variety of related webinars, fact sheets, case studies, guidance documents, evaluation studies, and design and operating procedure standards/guidelines, as well as a half dozen examples of bid specifications and deployment plan. In addition, numerous links to the same types of resources (webinars, fact sheets, case studies, and so on) are provided for the following subtopics:

- Real Time Traveler Information
- Queue Warning
- Dynamic Lane Merge
- Incident Management
- Variable Speed Limit
- Speed Safety Cameras
- Entering/Exiting Vehicle Notification
- Performance Measurement
- Connected Vehicles (CV) and Autonomous Vehicles (AV) Operations in Work Zones

4.3 Work Zone Data Exchange Initiative

In the late 1990's new technology was introduced by US automakers to connect vehicle operators with emergency call centers if involved in an incident. Quite rapidly this in-vehicle communications technology proliferated for uses beyond emergency reporting (e.g. route selection/navigation, traffic congestion alerts, stolen vehicle assistance, vehicle diagnostics) in parallel with dramatic advancements in the capabilities and coverage areas of digital communication networks. This prompted researchers to explore new applications to allow the conveyance of useful roadway condition information to drivers to make informed decisions. Some of this CV research focused on ways to support and improve safety in the dynamic conditions of highway work zones. However, by the late 2010's it was recognized there was no industrywide consistency in the interpretation and use of existing technical standards or related data security requirements. Nor was there consensus on how WZAD that was capable of being exchanged between roadside devices and in-vehicle devices should or could be used.

These inconsistencies hindered national interoperability and reduced the efficacy of CV-enabled devices being deployed in work zones. To address this issue the Work Zone Data Exchange Initiative (WZDI) was launched in 2020 to establish a consensus work zone data-sharing technical specification under the co-leadership of FHWA and the Intelligent Transportation Systems Joint Programs Office (ITS JPO). The WZDI work products were developed by a Working Group that reported to the Federal Geographic Data Committee's Transportation Subcommittee. The goal of the WZDI effort was to provide a standard vocabulary and formatting for collecting and publishing real-time data for highway work zones in the form of a Work Zone Data Exchange (WZDx), as shown in Figure 3.

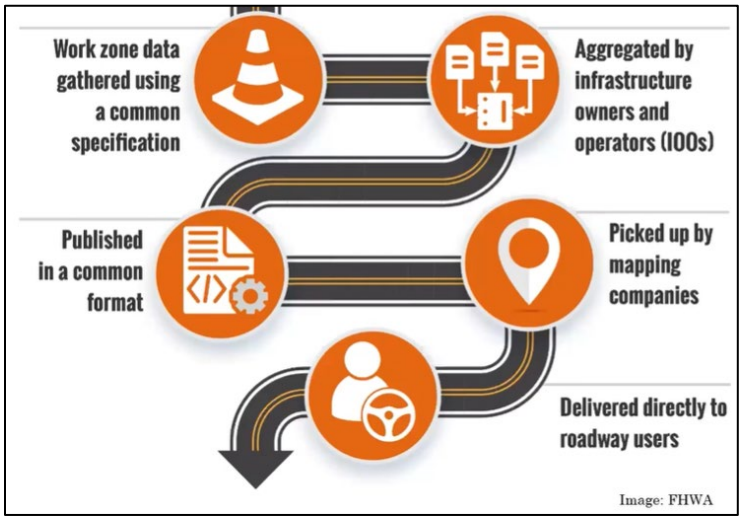


Figure 3: Work Zone Data Exchange

The belief was that when WZDx guidance on the deployment, operation and maintenance of CV-enabled devices and related WZDx technical specifications were adopted and implemented by an infrastructure owner/operator (IOO) the results would be improved/safer navigation through (or around) work zones by all motorists, including early adopters of next-generation connected autonomous/semi-autonomous vehicles. This would be accomplished by making accurate, timely work

zone status data widely available to the traveling public using consistent language and formatting structure.

Two key work products were developed by the Working Group and made publicly available:

- **WZDI Framework** – Articulated a conceptual architecture for WZAD systems to collect, store, disseminate, manage, maintain, and archive data related to work zone activities.

- **WZDI Data Dictionary** – Descriptions of work zone activities and metrics to enable IOO's and third-party service providers to describe and communicate WZAD to internal and external end users in a timely and seamless manner.

Table 1 summarizes the high-level framework of the two categories of WZDx data feeds: Work Zone feeds, and Field Device feeds.

Table 1: WZDx Data Feed Framework

	Description	Producer	Consumer	Uses	Content
Work Zone Feed	High-level event information on roadways in/near work zones that impact characteristics of the roadway that deviate from normal conditions (e.g. fewer lanes, absence of median, reduced lane width, road/lane/ ramp closures)	Agency managing the roadway and road work	Traveling public via third parties (e.g. mapping/navigation services, OEM/ after-market infotainment systems, TMS fleet management services, traffic management/511 centers); CAV users	Safer navigation/ improved route planning; better driver awareness of work zone schedule and detour routes; user-friendly map display of work zone location	Work zone events (e.g. begin/end dates and times, start/end points and cross streets, traffic lanes impacted, length, type of work, worker presence, road restrictions); detour route events, if any (e.g. begin/end dates and times; start/end points; length)
Device Feed	Information about devices deployed in/near work zones (e.g. location, status, live data)	Work zone device manufacturer or vendor	Agency managing roadways and related work permits; agency issuing OS/OW trip permits. Third parties (noted above) and CAVs may also have uses for field device information	Simplified technical design process to interface with equipment manufacturers; dynamically generate accurate information; reduce effort for device makers to conform to varying agency-specified technical requirements	Device type (i.e. arrow board, camera, DMS, flashing beacon, hybrid sign, location marker, traffic sensor, traffic signal); device location; coordinates of device boundary box range

In 2021 FHWA awarded 13 WZDx demonstration grants to various transportation agencies around the US. In early 2022 the North Carolina DOT became the first agency to deploy and activate a WZDx-compliant work zone activity data-sharing system. Since that time additional WZDx funding has been awarded by USDOT (mostly via the SMART Grant program), and to date 31 other jurisdictions in the US and Canada have developed WZDx-compliant work zone data feeds. All but one of these entities (Michigan DOT) have continued to maintain their WZAD feed systems, including one (Colorado DOT) that very recently upgraded to the latest WZDx version format. Data update frequency rates are set at the discretion of the agency and currently range from one minute (the most common) to 168 minutes.

See the Appendix for a more complete summary of the current WZDx Feed Registry and for an abbreviated description of the contents of the WZDx specification.

State DOT's with currently active WZDx-compliant work zone activity data systems are shown in Figure 4. Not shown are the nine local/regional entities that have also deployed WZDx-compliant WZAD systems, which include:

- ✓ National Park Service
- ✓ Metropolitan Transportation Commission of San Francisco
- ✓ Maricopa County DOT (Arizona)
- ✓ Pennsylvania Turnpike Commission
- ✓ New Jersey Institute of Technology
- ✓ City of Austin (Texas)
- ✓ Illinois Tollway
- ✓ Quebec City, Quebec, Canada
- ✓ St. Charles County (Missouri)

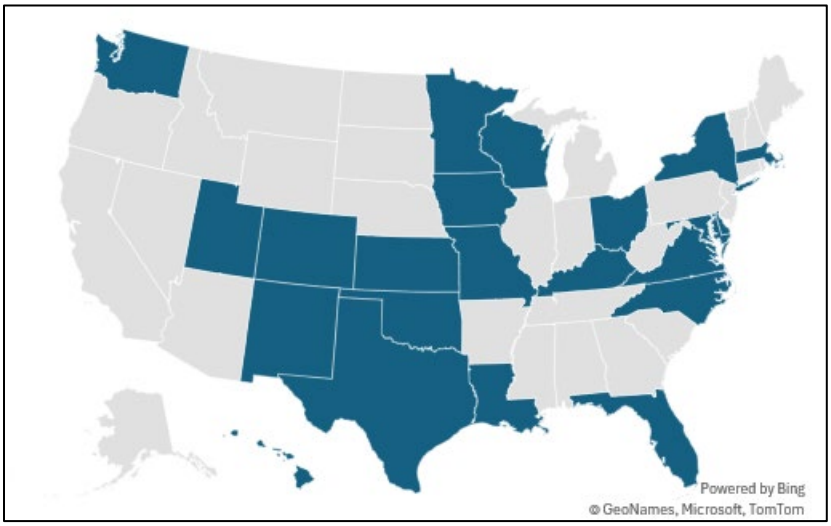


Figure 4: States with WZDx-compliant Systems (September 2025)

In early 2023 the WZDx protocol began the formal process of transitioning to become a Standard under the governance of the Institute of Transportation Engineers (ITE). This USDOT-funded transition process was titled "Connected Work Zones Implementation Guidance Standardization" (CWZ Standard). A Connected Work Zone Standard Committee within ITE provided oversight of the transition process. In February 2025 the 187-page CWZ Implementation Guide and Standard (Version 01.00) was published. This new CWZ Standard not only standardized WZDx specifications, but it also harmonized various related existing work zone-related standards. Establishment of a presumably more static set of technical specifications is expected to encourage adoption by more transportation agencies across the US. The CWZ Standard has been jointly endorsed by ITE, AASHTO, National Electrical Manufacturers Association (NEMA), and Society of Automotive Engineers International (SAE). Although "CWZ" is now the accepted term of reference for the Standard, the original term WZDx is still in common use by device manufacturers/vendors and jurisdictions with deployed WZDx-compliant systems, as well as many published reference materials.

5. SMART WORK ZONES

While Section 4 focused on the programs and standards that enable consistent data collection and

exchange, this section shifts to the practical application of those principles in the field. The Smart Work Zone concept demonstrates how agencies can leverage technology and real-time data to transform traditional work zone management into an integrated, adaptive system.

Simply put, a "Smart Work Zone" is one that uses ITS technology to continuously monitor traffic conditions, process the data for analysis, and then provide the results in real time. The first phase is data collection, which can involve a variety of devices (e.g. non-intrusive sensors, cameras, probe vehicles) to monitor travel speeds and detect traffic backups (queues) or other disruptions to normal conditions. The data analysis phase is performed off-site at a central system or cloud-based platform. The results are then automatically transmitted to devices, such as signs or in-vehicle systems, that inform motorists of the status of travel conditions in/near the work zone, such as lane closures, increased travel times, and traffic crashes.

5.1 Smart Work Zone Deployment Initiative (SWZDI)

The Midwest Smart Work Zone Deployment Initiative began under the auspices of the USDOT Transportation Pooled Fund Program in 1999. Initially four states (Iowa, Kansas, Missouri, Nebraska) opted to pool a portion of their USDOT transportation research funding for the effort. Their shared purpose was to investigate better ways to control traffic approaching and moving through work zones by supporting research and outreach activities focused on innovative ways to improve safety and mobility in work zones. Wisconsin joined the effort in 2001. The name of the venture was shortened to the Smart Work Zone Deployment Initiative (SWZDI). Since 2020, seven other states (Illinois, Michigan, Texas, Minnesota, Alaska, Georgia, Pennsylvania) have joined the consortium. The Iowa DOT serves as the lead state agency, and the Center for Transportation Research (CTRE), an element of the Institute for Transportation (InTrans) at Iowa State University, administers the project. Oversight of the consortium is provided by a Board of Directors, which includes representatives from the sponsoring state DOTs and non-voting FHWA personnel.

Since its founding in 1999, SWZDI has solicited ideas for proposed research studies related to Smart Work Zones from its Board of Directors, vendors of work zone-related products and technologies, and researchers interested in the field. Every year the Board reviews the submitted topics or products and then distributes requests-for-proposal (RFPs) to potentially interested academic researchers in the pooled fund member states. Proposals and work plans submitted in response to the RFPs are vetted by the Board for prioritization and selection in the next funding cycle, based on expected benefits and available funding. Over 120 SWZDI-sponsored work products have been produced in the organization's 25 years of operation, and five studies are currently in progress.

The most recent SWZDI work product (released August 2025) was the Work Zone Performance Metrics Analytical Tool (WZPERFOMAT). It was designed to serve as a user-friendly, data-driven analytical tool that translates the wide array of work zone activity data being collected by SWZ protocols into easy-to-understand performance indicators and metrics. WZPERFOMAT is a web-based application that calculates work zone safety and mobility performance metrics and then merges those results with geolocation data for the work zone to produce a visual display of the information. User agencies can display results for many work zones across their road network or for individual projects to assess work zone conditions. The results can also be downloaded for project-specific documentation purposes and for future review of the agency's work zone management program. The intended value-added of WZPERFOMAT is to enable user agencies to not only better understand how well their work zones are performing day-to-day and to identify locations in need of improvement, but also to enable them to better communicate the results with all internal and external stakeholders and to meet FHWA work

zone program reporting standards.

5.2 NCHRP Project 08-119

The Transportation Research Board (TRB) is part of the National Academies of Sciences, Engineering and Medicine and for over 100 years has assembled experts, practitioners and researchers across a range of disciplines to find solutions to complex existing and emerging transportation challenges. One of TRB's research initiatives is the National Cooperative Highway Research Program (NCHRP), which since the early 1960's has coordinated a program of cooperative research on topics deemed to be of the highest priority based on input from state DOTs, committees of AASHTO, and FHWA. In 2019 the NCHRP initiated Project 08-119: Data Integration, Sharing, and Management for Transportation Planning and Traffic Operations. The stated objective of the project was "*to develop tools, methods, and guidance for improving data integration, sharing, and management practices to enable transportation agencies, in collaboration with private-sector and public-sector stakeholders, to make better planning and operations decisions*." An expected secondary benefit for successful completion of the project was "*increased uniformity of data across states and improved consistency of practice*."

The 26-page Phase I Executive Summary Report of NCHRP Project 08-119 was published in 2021. Researchers had gathered input from a wide range of sources, developed a representative sample of transportation planning/operations data use cases, assessed challenges and needs related to the topic area, developed an initial data catalog, and identified potential products that could be developed in later phases of the research. The project team identified 10 use cases on which to focus their efforts:

- Integrating Work Zone Event Data with other data sources
- Transportation Incident Management (TIM) performance measures
- Managing "Big Data" from emerging technologies
- Next generation Integrated Corridor Management (ICM)
- Using data for effective operations and enforcement of private shared mobility services
- Improving transportation planning with emerging data
- Freight data for planning and operations
- Integrating Intelligent Transportation System (ITS) transit data for planning and operations
- Modernization of Active Transportation and Demand Management (ATDM) approaches
- Preparing agencies for "Smart Cities"

The project team traced the development of the Work Zone Data Exchange by FHWA. The project team determined that while there was consensus that having standard definitions to communicate WZAD was essential to enable agencies to be more data-driven in their operations/maintenance activities, as of early 2021 relatively few agencies had chosen to implement the WZDx specifications. They identified many challenges agencies face in integrating work zone data with other data feeds, including:

- Work zone data collection is often performed only as needed, which requires multiple interfaces and significant processing (and the commitment of IT support services) to standardize.
- Work zone data are seldom collected in a systematic manner, absent in-house consensus on what information to collect and what tangible operational benefits would result.
- Work zone data elements often reside in data "siloes" (e.g. project plans, computer aided dispatch databases) or in contract administration software; also, work zone-related functions are often spread across different business units within an agency (e.g. construction, maintenance, permitting), which tend to operate as separate, unrelated activity centers and do not integrate their data in a single database.

- Work zone data maintenance requires not only advance planning, but also the commitment of resources to proactively maintain/update work zone data summaries throughout the construction season.
- Some agencies are unable to create/maintain additional data beyond what they already produce for work zones, so the WZDx specifications include optional data fields; this means any data set purporting to conform to the specification might not include all the expected data fields.
- Agencies may lack the ability to verify if/when a work zone-related lane closure becomes active.
- Some agencies already publish their WZAD in a different format, such as the 511 system, which uses the Traffic Management Data Dictionary (TMDD) standards developed/maintained jointly by AASHTO and ITE since the 2000's to support center-to-center communications in regional/statewide traffic management systems.
- Work zones are dynamic by nature (e.g. the location/schedule of a work zone might be initiated in rapid response to an unexpected situation, with virtually no advance notice).
- Complex work zones can require multiple lane closure configurations/schedules, which makes it problematic to obtain accurate information in real time.

The project team identified three existing products with potential for helping agencies better understand the WZDx specifications and taking steps to adopt a standardized WZAD framework, including:

- WZDx GitHub website – Provides a high-level overview of WZDx standards, as well as illustrating how WZDx data tables interrelate and required/optional fields, and detailed descriptions of each data table, field, and enumeration.
- Framework for Standardizing and Communicating Work Zone Event Data – An FHWA-developed conceptual architecture for a WZAD warehouse and for work zone data systems to collect, store, use, and communicate WZAD; also includes an intro-level implementation guide for agency adoption of the WZDx specifications
- Deploying and Integrating Smart Devices to Improve Work Zone Data for WZDx – A presentation by a CTRE research team at the 2021 TRB Annual Meeting that summarized Iowa DOT efforts to obtain work zone data from field-deployed smart arrow boards to improve the location and temporal accuracy of work zone information as part of the agency's WZDx data feed.

Subsequent to their Phase I efforts, the project team developed five case studies of real-world transportation agency projects that used smart work zone technology to provide data for their WZDx feeds. Each case study identified how the agency implemented the smart work zone devices; types of data collected; data integration, management, and application; and key lessons learned. A final report on the five case studies is contained in NCHRP Research Report 1121: Data Integration, Sharing, and Management for Transportation Planning and Traffic Operations. In summary, these case studies included:

- **Minnesota Department of Transportation (MnDOT)** – Enhanced its Condition Acquisition and Reporting System (CARS) to include a WZDx-compliant data feed, automatically-generated work zone reports, and the ability of field workers to "check-in" at agency work zones to populate the (optional) Worker Presence field in the WZDx feed.
- **Regional Transportation Commission of Southern Nevada (RTC)** – A multi-faceted initiative that included: automated machine vision to recognize/geolocate work zones and related equipment; a work zone ITS specification for Smart Work Zone devices and related processes/procedures; a vendor cloud and alert system in which smart devices provided location information for construction, responder, and construction vehicles, as well as for work zone equipment and

workers; and a smart phone app to enable workers and inspectors to photograph/geolocate/connect work zones to project permit data.

- **Kentucky Transportation Cabinet (KYTC)** – Implemented an analytics system using "Big Data", including the input of data from Smart Work Zone devices to monitor travel speeds and crashes in work zones and a WZDx-compliant feed.
- **Iowa Department of Transportation (Iowa DOT)** – Used smart arrow boards to automate geo-locating the starting points of active work zones on all state/Interstate highways that featured lane closures; integrated that data with data from the agency's work zone planning system to generate a data feed for third-party use; and integrated the work zone data with the agency's Advanced Traffic Management System (ATMS).
- **Massachusetts Department of Transportation (DOT)** – Implemented an application to pull data from Smart Work Zone sensors/equipment; developed an open, Massachusetts-specific Application Programming Interface (API), the foundation of which was to be used for a national standard element of the WZDx specifications for collecting information from smart work zone devices.

The NCHRP Project 08-119 final report has been published and in addition to documenting the five work zone case studies, it contains an appendix that assesses the relationship between WZDx feeds and similar or related data feeds, including:

- **Advanced Travel Information System (ATIS) Feeds** – Telephone- and Internet-based systems that allow motorists to make informed travel decisions by reaching 511 centers for real-time information about travel, road and weather conditions. These 511 systems use TMDD standards for center-to-center communications, which include dialogs, message sets, data frames, and data elements needed to manage the sharing of data.
- **HAAS Alert Safety Cloud©** – A proprietary digital alerting system available in many metro areas; provides real-time notifications to drivers (via their in-vehicle infotainment system using various popular navigation apps, such as Waze or Google Maps) about nearby emergency vehicles and road hazards; in 2024, the company expanded application of their service to include WZDx information in their data feed from devices that can be mounted on emergency/construction vehicles (i.e. the alert is activated when the vehicle's flashing lights and/or siren is on).
- **Real On-time Accurate Data (R.O.A.D)™ for Work Zones** – A proposed cloud-based data service for digitally-marked highway work zone events initiated in 2022 by iCones Products, LLC; the concept would consolidate all smart work zone traffic control and infrastructure devices in North America into a single database, supported by integrated "Internet of Things" (IoT) technology. The R.O.A.D. database will adhere to the data feed protocols established by the Work Zone Data Group of the Federal Geographic Data Committee and will enhance the feed through certification of traffic control components with secured, documented data transfers to establish chain of custody from the field device to the client.

  The vision of the R.O.A.D. for Work Zones data feed as a centralized, nationwide platform featuring a fully integrated, single database of all smart work zone devices has not yet been achieved. In addition, widespread industry adoption and formal integration among agencies have not been publicly documented. However, iCones Products continues to expand and market its Connected Tech™ suite of communication interface devices, which can be installed on new or existing traffic control equipment (e.g. traffic cones, channelizing barrels, barricades, arrow boards, message boards, signs, flagging batons) or construction/maintenance/ utility/emergency vehicles; a variety of data can be collected and transmitted (e.g. speed of passing vehicles,

sudden movement of equipment, geolocation of work zone devices/flaggers, arrow board direction).

5.3 NCHRP Research Report 1142

As part of NCHRP Project 10-109 "Modern Solutions to Safe and Efficient Work Zone Travel" the Virginia Polytechnic Institute and State University (Virginia Tech) was engaged to evaluate emerging innovative and adaptive technologies designed to enhance work zone safety and mobility, and to evaluate crowdsourcing applications and data analytics for dynamic work zone devices and in-vehicle notification. The Virginia Tech project team was also tasked with developing a guidance document for applying/managing these innovative work zone management technologies. Their results were published in 2025 as NCHRP Research Report 1142.

The project team identified seven work zone technology use cases and assessed the level of maturity of SWZ technologies within each area. "Maturity" was defined as readiness for scaled-up deployment. Each SWZ technology category was rated on a 4-point scale, with ranges from 0 to 3 (*where 0 = experimental concept only; 1 = basic research/controlled laboratory tested; 2 = field pilot tested; and 3 = commercially available*). Their maturity assessments for data generation and data dissemination capabilities for each SWZ technology are summarized in Table 2 below.

Table 2: SWZ Technology Data Generation/Data Dissemination Capabilities

Traveler Information Systems (Speed and Travel Time)		
	Technology	Maturity
Data Generation	Probe data	3
	Infrastructure-based sensor data	3
Data Dissemination	511/State DOT systems	3
	DMS	3
	Connected and Automated Vehicle (CAV)	1

Queue Warning Systems		
	Technology	Maturity
Data Generation	Point detectors (side-fire radar)	3
	Crowdsourced floating car data	3
	CAV data	0
Data Dissemination	Static signs with flashers	3
	DMS	3
	Smartphone applications	3
	CAVs, future WZDx	0

Work Zone Intrusion Alert Systems		
	Technology	Maturity
Data Generation	Kinematic	1
	Pneumatic	3
	CAV data	1
Data Dissemination	Auditory – worker	1
	Visual – worker	2
	Haptic – worker	3
	CAVs – vehicle	1

Work Zone Presence Systems		
	Technology	Maturity
Data Generation	Work zone presence establishing systems	1
	Crowdsourcing	3
	Emergency vehicle warning system (digital alerting)	3
Data Dissemination	Work Zone Data Exchange	2
	511/State DOT systems	3
	DMS	3
	CAV	1

Speed Harmonization Systems		
	Technology	Maturity
Data Generation	Point detectors (side-fire radar)	3
	CAV data	0
Data Dissemination	VSL signs	3
	Mobile applications/Internet sites	3
	CAV's	0

Speed Compliance Systems		
	Technology	Maturity
Data Generation/Data Dissemination	CAV	0
	Smartphone applications	3
	Advisory speed compliance	3
	Regulatory speed compliance	3

Dynamic Merge Assistance		
	Technology	Maturity
Data Generation	Smart arrow boards	3
	Point detectors	3
	CAV data	0
Data Dissemination	Sequential warning lights	3
	DMS & static signs with flashers	3
	Smartphone applications	3
	CAV display & control	0

For each of the seven use cases the project team focused on two technologies, with preference given for emerging technologies (i.e. those with a maturity rating of 0 or 1), and reviewed available research literature and early-stage testing. The team then performed a conceptual evaluation of the potential benefits and drawbacks of several promising SWZ technologies: CAV, crowdsourced data/smartphone applications, and speed safety cameras – *see Table 3 below*.

Table 3: Pros/Cons of Emerging Technologies for Smart Work Zones

	Potential Benefits/Outcomes	Potential Drawbacks/Impediments
Connected/Autonomous Vehicle *(Assuming CAVs someday attain a higher rate of market penetration)*	Improved safety	Cost
	Increased efficiency	Complexity
	Better information for drivers	Funding
	Reduced emissions	Training and staffing
	Setup accountability	Dependence on technology
		Privacy concerns
Crowd-sourced Data/ Smartphone Applications	Real-time information	Accuracy
	Large pool of data	Data integration
	Cost-effectiveness	Data management
	User-friendliness	Data costs
		Training and staffing
		Limited availability
		Privacy concerns
		Navigation routing
Speed Safety Cameras	Increased worker safety/crash reduction	Cost
	Increased law enforcement safety	Privacy concerns
	Consistent enforcement	Technical issues
	Improved compliance	Equitable enforcement
		Public/policy/political opposition

6. NEIGHBORING STATE WZAD PRACTICES

The advancements described in Section 5 have begun to take shape in state-level applications. This section highlights noteworthy WZAD practices with an initial focus on Iowa and Wisconsin. The intent is not to provide an exhaustive survey, but rather to establish a foundation that IDOT can continue to expand as technologies evolve and regional approaches mature. By documenting examples of how peer agencies are collecting, managing, and applying work zone activity data, this "living" reference will support IDOT in identifying relevant strategies, benchmarking progress and adapting practices over time.

Iowa

Iowa DOT has emerged as an early leader in the collection and management of work zone activity data through the development of its Work Zone Data Hub, a centralized database hosted by Iowa State University. The Hub aggregates lane closure data, connected device feeds, and aligns with the FHWA WZDx framework. Data are automatically pulled from the Iowa 511 system via API every five minutes, along with inputs from connected arrow boards. While the Hub currently stores data received from these devices, specific analytical outputs have not yet been developed. The primary benefit to date has been the ability to capture accurate start and end times for work zones, improving temporal accuracy across the dataset.

The Hub has been highlighted by FHWA as a national case study, underscoring Iowa DOT's role as a model for centralized work zone data management. In parallel, Iowa DOT maintains a Work Zone Reference Library to provide staff and partners with standards, guidance, and lessons learned, while public-facing traveler information continues to be shared through the Iowa 511 Travel Information Map.

Iowa DOT has also mandated that all yellow arrow boards used on its projects be connected devices

capable of transmitting location and operational data. The agency collaborated with leading sign manufacturers to ensure that any arrow board purchased by a contractor from an approved product list includes this connectivity feature. This approach minimizes administrative burden, as data distribution is handled by the manufacturer rather than by the contractor or DOT personnel. Although the Iowa DOT's current ATMS platform (Q-Free OpenTMS) can associate only one arrow board per work zone (a limitation that requires manual adjustments and is not always practical), the standardized use of connected devices provides significant benefits. Even when the DOT itself is not directly using the collected data, the manufacturers' established integrations with third-party applications such as Waze and Google Maps ensure that real-time work zone information is disseminated to the public, enhancing traveler awareness and safety.

Wisconsin

Wisconsin DOT relies on its 511 Wisconsin traveler information system and associated construction project pages to provide the public with real-time updates on lane closures, detours, and traffic conditions. At the program level, the WisDOT Work Zone Safety and Mobility Program establishes statewide guidance for reporting and sharing work zone data, supporting a consistent approach across the agency and contractors. Lane closure data is primarily captured through contractor reporting and other WisDOT processes/systems, most notably the Wisconsin Lane Closure System (WisLCS) and their ATMS, which together integrate lane closure details with statewide traveler information tools and ITS assets such as dynamic message signs, cameras, and connected devices.

Wisconsin established a WZDx data feed in 2023 as one of the thirteen state recipients of the 2021 FHWA WZDx Demonstration Grant program (WZDx Demonstration Grants - Work Zone Management - FHWA Office of Operations). WisDOT has continued to build on its connected work zone data capabilities through participation in the USDOT's SMART Grant Program. WisDOT launched a Stage 1 pilot project to evaluate local road smart work zone ITS data integration into the Wisconsin WZDx feed with three identified projects. Since completing the Stage 1 grant, WisDOT has identified a plan to incorporate all work zones through connected devices into the Wisconsin WZDx Work Zone Feed. WisDOT is pursuing a Stage 2 grant that will focus on automated work zone ITS integration to support a scalable, statewide solution. It is also in the process of updating its feed, which is currently based on the WZDx 4.2 specification, to align with the CWZ 1.0 standard.

Table 4 shows a cross-comparison of Illinois DOT with existing Iowa DOT and WisDOT work zone activity data deployments.

Table 4: Cross-Comparison of Illinois to Peer States

Category	Illinois	Iowa	Wisconsin
Population Distribution	75% of population in Chicago metro (9.4M)	24% of population in Des Moines metro (0.75M)	27% of population in Milwaukee metro (1.6M)
Lane Closure Systems	District 1 LCS	Work Zone Data Hub	WisLCS
Connected Work Zone Technology	Select deployments with ITS devices	Pilots with smart arrow boards and queue warning	Select deployments with ITS devices; corridor wide ITS deployments during construction
Traveler Information Systems	Travel Midwest and Getting Around Illinois websites	Iowa 511 Travel Map	511 Wisconsin website and mobile app

WZDx Feeds	In development	Active pilot and open data exchange feed	WZDx 4.2 feed available in the Registry / underlying work zone data source for Wisconsin 511
Traveling Work Zones	Pilot with IDOT maintenance vehicles	No	No
Innovative Approaches		Centralized WZ Data Hub with library; connected arrow board mandate	Integration of work zone info with broader statewide ITS; focus on enhancing interoperability between existing systems (WisLCS and ATMS)

Iowa and Wisconsin illustrate two complementary paths in advancing work zone activity data practices. Iowa demonstrates the benefits of investing in a centralized data hub that aligns with national standards and emphasizes open access, while Wisconsin highlights the value of incremental integration within existing statewide traveler information and safety programs. Both states show that consistent reporting, quality control, and public-facing transparency are achievable, even though their metropolitan concentrations are smaller than Illinois' and scalability considerations differ. For IDOT, these examples provide an important starting point for identifying strategies that can be adapted or scaled to Illinois' unique context. As technologies advance and neighboring states develop their approaches, this section can be expanded to serve as a living reference that tracks regional practices and informs IDOT's own roadmap for digital work zone data management.

APPENDIX

ANSI DEFINITIONS: Work Zone & Work Zone Crashes

American National Standards Institute, Manual on Classification of Motor Vehicle Accidents (8th edition, 2017)

2.5.24 WORK ZONE

A work zone is an area of a trafficway where construction, maintenance, or utility work activities are identified by warning signs/signals/indicators, including those on transport devices (e.g., signs, flashing lights, channelizing devices, barriers, pavement markings, flagmen, warning signs and arrow boards mounted on the vehicles in a mobile maintenance activity) that mark the beginning and end of a construction, maintenance, or utility work activity.

It extends from the first warning sign, signal or flashing lights to the END ROAD WORK sign or the last traffic control device pertinent for that work activity.

Work zones also include roadway sections where there is ongoing, moving (mobile) work activity such as lane line painting or roadside mowing only if the beginning of the ongoing, moving (mobile) work activity is designated by warning signs or signals.

Inclusions:
The following situations within the trafficway:

- Long-term stationary construction such as building a new bridge, adding travel lanes to the roadway, extending an existing trafficway, etc. (Construction activity/work)
- Work involving moving activities such as striping the roadway, median and roadside grass mowing/ landscaping, pothole repair, snowplowing, lane line painting, etc., where there are warning signs or signals marking the beginning of the moving work area (Mobile maintenance activity/work)
- Short-term stationary work such as repairing/ maintaining electric, gas, water lines, or traffic signals (Utility activity/work)
- Areas identified by signage as a work zone where the ongoing work activity has temporarily paused

Exclusions:

- Any private construction, maintenance, or utility work outside the trafficway
- Any area of the trafficway where there is moving maintenance activity (e.g., roadside grass mowing/landscaping, pothole repair, snowplowing, lane line painting) without warning signs or signals
- Citizen removing snow from the trafficway as a neighborly gesture
- Area identified by signage, where the activity has not begun or is complete

2.7.8 WORK ZONE CRASH

A work zone crash is a motor vehicle traffic crash in which the first harmful event occurs within the boundaries of a work zone or on an approach to or exit from a work zone, resulting from an activity, behavior, or control related to the movement of the traffic units through the work zone (See 2.5.24).

Inclusions:

- Collision and non-collision crashes occurring within the signs or markings indicating a work zone
- Collision and non-collision crashes occurring on approach to, exiting from, or adjacent to work zones that are related to the work zone, regardless of distance

Exclusions:

- Crashes involving working motor vehicles that do not involve a motor vehicle in-transport
- A crash that occurs on the opposite side of a divided highway from the work zone, if the work zone is not signed on the crash side of the highway, and the crash is clearly unrelated to the work zone

WORK ZONE NOTEWORTHY PRACTICES GUIDEBOOK: Best Practice Categories

Federal Highway Administration, Work Zone Operations Best Practices Guidebook (3rd edition, 2013)



WORK ZONE DATA EXCHANGE (WZDx) FEED REGISTRY

ISSUING ORGANIZATION	FEED NAME	CURRENTLY ACTIVE	DATA FEED UPDATE FREQUENCY (hr/min/sec)	WZDx VERSION FORMAT	START DATE
North Carolina DOT	ncdot	YES	4m	3.1	2022 Jan 15
Oklahoma DOT	odot	YES	1m	4	2022 Mar 30
Colorado DOT	cdot	YES	5m	4.2	2022 May 03
Utah DOT	udot	YES	15m	4	2022 Jul 15
Iowa DOT	idot	YES	1m	4	2022 Aug 25
National Park Service	nps	YES	60m	4	2022 Sep 02
Florida DOT	fldot	YES	4m	4.2	2022 Sep 21
Minnesota DOT	mndot	YES	1m	4	2022 Oct 19
Maryland DOT	mdot	YES	1m	4.1	2022 Dec 13
Metropolitan Transportation Commission of San Francisco (California)	mtc	YES	5m	4.1	2022 Dec 13
Maricopa County DOT (Arizona)	mcdot	YES	1m	4.2	2023 Mar 16
Missouri DOT	modot	YES	3m	4.1	2023 Mar 16
Wisconsin DOT	wisdot	YES	5m	4.1	2023 Mar 16
Virginia DOT	vdot	YES	1m	4	2023 Mar 17
New Mexico DOT	nmdot	YES	72h	4.1	2023 Apr 21
Michigan DOT	michigandot	NO			2023 Apr 21
Hawaii DOT	hidot	YES	168h	4.1	2023 May 17
New York DOT	nysdot	YES	15m	4.1	2023 Aug 03
Pennsylvania Turnpike Commission	ptc	YES	1m	4.1	2023 Aug 30
Massachusetts DOT	massdot__v4_1	YES	1m	4.1	2023 Oct 09
Texas DOT	txdot_v4_2	YES	5m	4.2	2024 Jan 17
Washington State DOT	wsdot	YES	1m	4.2	2024 Feb 05
St. Charles County (Missouri)	stcharlesco_v4	YES	60m	4	2024 Feb 07
Kentucky Transportation Cabinet	kytc	YES	30m	4.1	2024 Mar 11
New Jersey Institute of Technology	njdot	YES	2m	4.1	2024 Mar 11
Kansas DOT	kansas	YES	60s	4	2024 Jul 23
City of Austin (Texas)	austin	YES	60m	4.2	2024 Nov 07
Illinois Tollway	iltollway	YES	60m	4.2	2025 Jan 27
Ohio DOT	ohio	YES	60m	4.2	2025 Feb 18
Delaware DOT	dedot	YES	10m	4.1	2025 Apr 28
Quebec City (Quebec, Canada)	quebec	YES		3.1	2025 Apr 28
Louisiana DOTD	ladotd	YES	10m	4.1	2025 Jun 19
Colorado DOT	cdot_cwz	YES	5m	CWZ 1.0	2025 Aug 08

SOURCE: https://datahub.transportation.gov/Roadways-and-Bridges/Work-Zone-Data-Exchange-WZDx-Feed-Registry/69qe-yiui/data_preview (retrieved 9/9/2025)

WORK ZONE DATA EXCHANGE (WZDx) SPECIFICATION CONTENT

Road Event Objects – Describe events occurring on roadways that impact characteristics of the roadway and involve a change from the default state.

CdsCurbZonesReference	A reference to one or more CDS curb zones that are impacted by road work.
DetourRoadEvent	A detour on a roadway.
Lane	An individual lane within a road event.
RelatedRoadEvent	Identification a road event that is related to the road event that the RelatedRoadEvent object occurs on.
Restriction	A restriction on a road event or lane, including type and value.
RoadEventCoreDetails	The core details of an event occurring on a roadway (i.e. a road event) that is shared by all types of road events.
RoadEventFeature	The GeoJSON Feature container object for a WZDx road event.
TypeOfWork	A description of the type of work being done in a road event and an indication of if that work will result in an architectural change to the roadway.
WorkerPresence	Information about the presence of workers in the road event area.
WorkZoneRoadEvent	A work zone road event including where, when, and what activities are taking place within a work zone on a roadway.

Field Device Objects – Describe deployed roadside devices.

ArrowBoard	An electronic, connected arrow board that can display an arrow pattern to direct traffic.
Camera	A camera device deployed in the field, capable of capturing still images.
DynamicMessagesSign	An electronic traffic sign deployed on the roadway, used to provide information to travelers.
FieldDeviceCoreDetails	The core details—both configuration and current state—of a field device that are shared by all types of field devices.
FieldDeviceFeature	The GeoJSON Feature container object for a deployed field device.
FlashingBeacon	Describes a flashing warning beacon used to supplement a temporary traffic control device. A flashing warning beacon is mounted on a sign or channelizing device and used to indicate a warning condition and capture driver attention.
HybridSign	A hybrid sign that contains static text (e.g. on an aluminum sign) along with a single electronic message display, used to provide information to travelers.
LocationMarker	Describes any GPS-enabled ITS device that is placed at a point on a roadway to dynamically know the location of something (often the beginning or end of a work zone).

MarkedLocation	Describes a specific location where a LocationMarker is placed, such as the start or end of a work zone road event.
TrafficSensor	A traffic sensor deployed on a roadway which captures traffic metrics (e.g. speed, volume, occupancy) over a collection interval.
TrafficSensorLaneData	Data for a single lane within a road event (e.g. WorkZoneRoadEvent) measured by a TrafficSensor deployed on the roadway.
TrafficSignal	A temporary traffic signal deployed on a roadway.