Real-Time Monitoring with ITS in Work Zones / Developing Partnerships with Tech Companies

Work Zone Safety Conference

Springfield, VA

September 20, 2016

Overview of Presentation

1) Overview of Work Zone ITS
2) Why do we use ITS in the Work Zone?
3) Application of SWZ Technologies
   a) Explanation of systems
   b) Selling Use of Work Zone ITS
4) Steps of Work Flow Process
5) Use of the Real-Time Data
6) Next steps to improve data dissemination
7) Future with Connected Vehicles

What is Work Zone ITS?

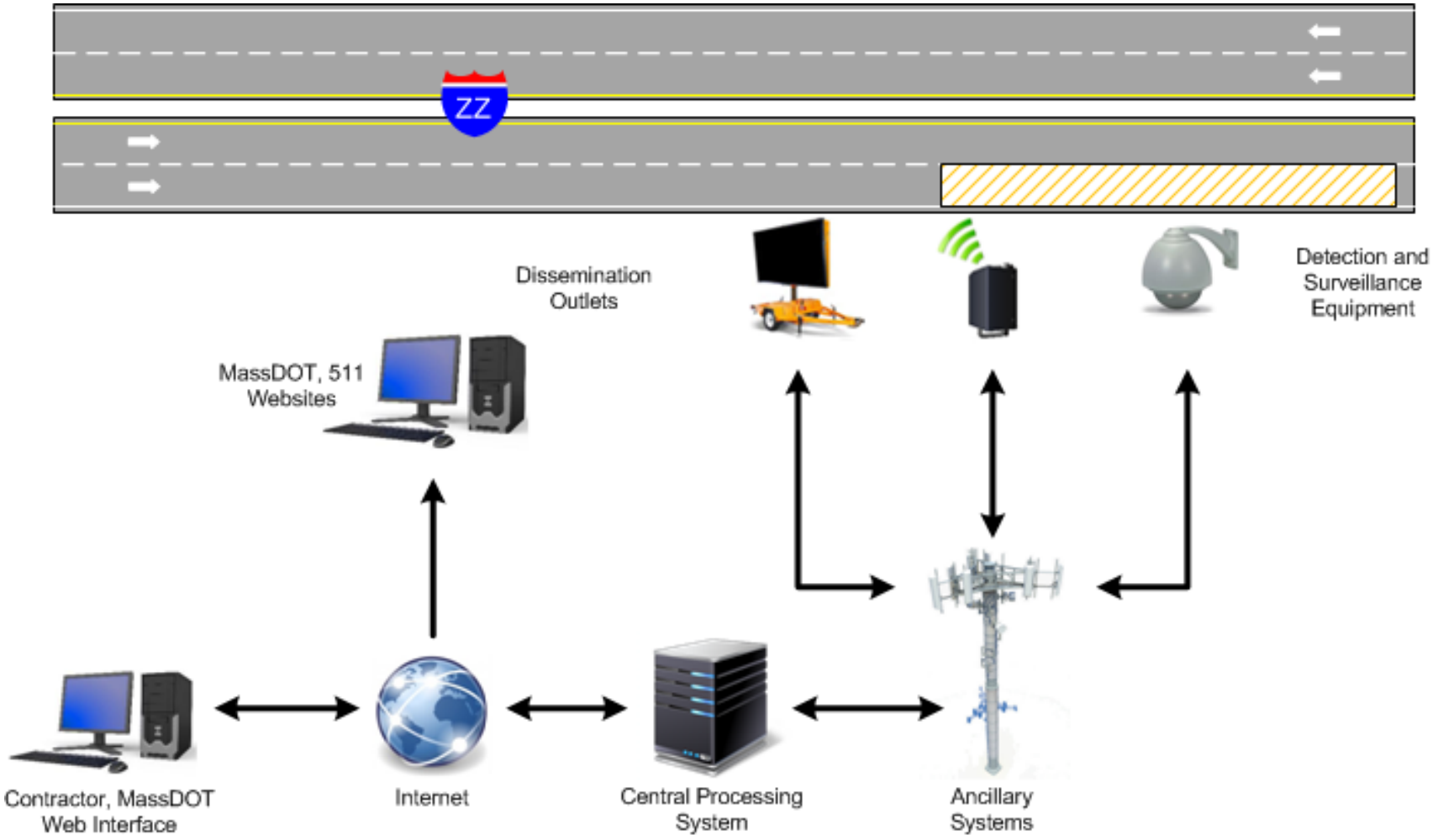
- Portable combinations of ITS equipment designed for flexible deployment in work zone environments and used to monitor and report out on traffic operations (***Smart Work Zones***)

- SWZs typically consist of four components:
  - Detection and surveillance equipment
  - Central processing systems
  - Dissemination outlets (message boards, website)
  - Ancillary systems (power and communications)

Characteristics of Smart Work Zones

- **Real-Time**: The system obtains and analyzes traffic flow data in real-time in order to provide updated information to motorists on a frequent basis
- **Portable**: The equipment is portable which allows for it to be deployed along the roadside as needed and can be adjusted as the construction project advances
- **Automated**: The system operates in an automated manner to collect data and disseminate information with minimal interaction by human operators
- **Reliable**: The system must provide accurate and reliable information to avoid misinforming motorists in work zones

Smart Work Zone Design



Smart Work Zone ITS Equipment

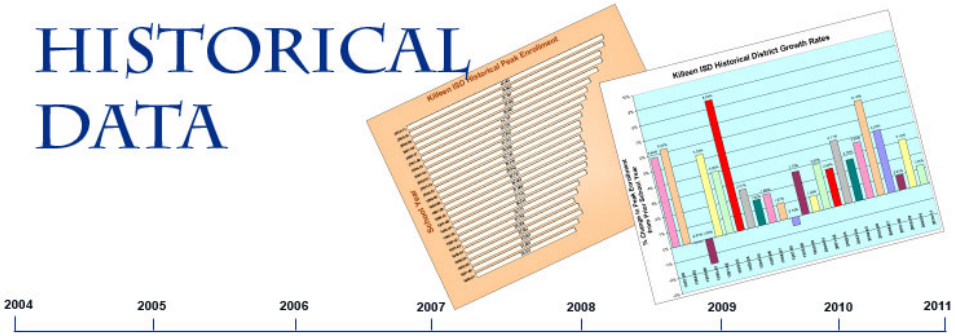
- Portable Changeable Message Signs (PCMS)
- Portable Camera Trailers

- SWZ Operating System
- Speed Feedback Boards
- Radar/Doppler Sensors
- Bluetooth Sensors
- Probe Data

Why are we using SWZ's?

- As part of FHWA's "*Work Zone Safety and Mobility*" Rule DOTs are required to gather work zone traffic operations and safety data to **monitor performance**
- SWZs are a tool that can be used as part of the Traffic Management Plan to provide **real-time feedback** to the DOT and the road user
- Involves the **dynamic management** of work zone traffic impacts to improve motorist and worker safety and mitigate work zone-related congestion

How does Work Zone ITS Help?



Versus

Opportunity

Credibility

Benefits of Real-Time Data

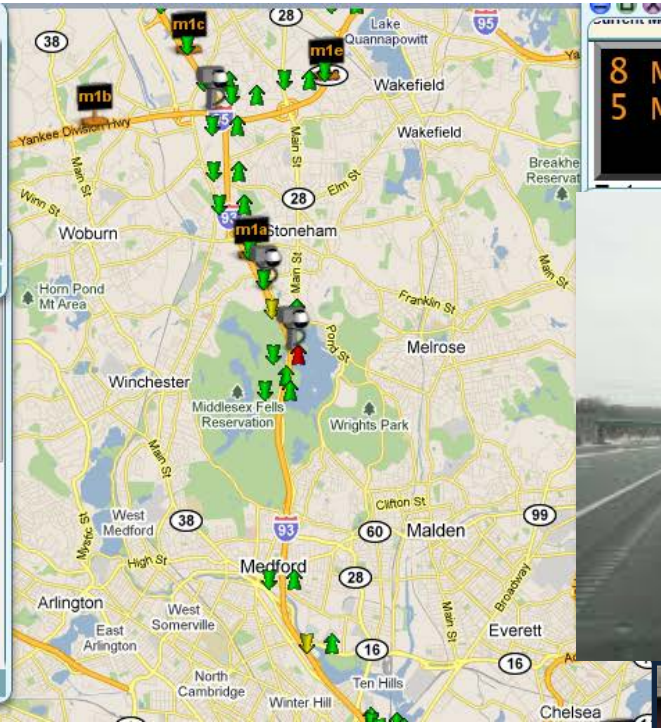
- Ability to better inform motorists of traffic conditions and reduce their frustrations
- Encourage alternate route selection through informed travel time decisions
- Reduce lane-drop congestion to promote free flowing traffic merges
- Detect and clear incidents more quickly which helps to prevent/reduce secondary incidents
- Address speed limits to help make work zones safer for highway workers and motorists

Applications of SWZ Technology

- Dynamic Travel Time Systems
- Work Zone Delay Systems
- Back-of-Queue/Speed Reduction Warning Systems
- Dynamic Lane Merge Systems
  - Early Merge
  - Late Merge

- Variable Speed Limit Technologies
- Automated Work Zone Speed Enforcement

Dynamic Travel Time Systems



Tip: When providing travel time point-to-point, use current time to show last update

Work Zone Delay Systems

In some cases, you cannot provide travel times between point-to-point locations, but you can offer the motorists details on the travel time through the work zone to provide them an opportunity to seek an alternate route

Tip: Requires less detection equipment which brings cost of system down – but still provides Real-Time information

Variable Speed Limit Systems

<u>Issue</u>: many states struggle with how to get motorists to reduce speeds through the work zone

- Need statutory authority to reduce limits
- Need to define time to when workers are present requiring reduction

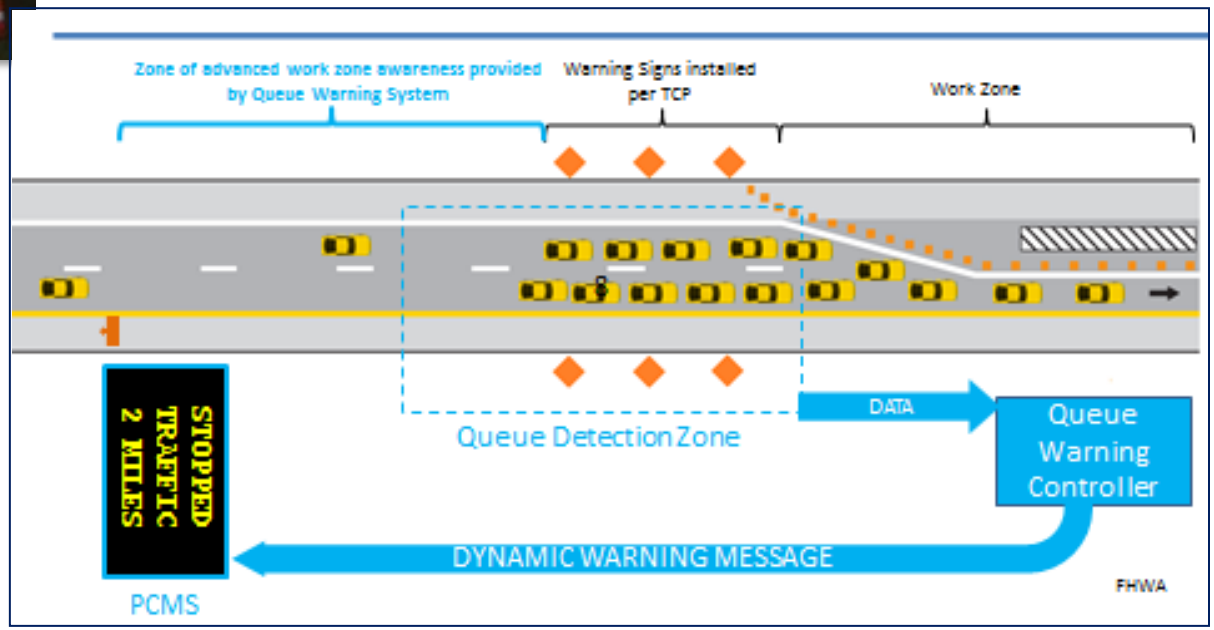
<u>Solution</u>: Variable Speed Limit systems can be deployed to allow DOTs to dynamically reduce speed during active construction

Tip: When using VSL system, it is helpful to use beacons to signify there is active work

Back of Queue Warning System

- Used to alert motorists of slow or stopped traffic before they reach the back of queue
- Helps to prevent rear-end crashes before they happen

Tip: When using BOQ systems, it is recommended that you estimate the potential queue to determine sensor equipment needs

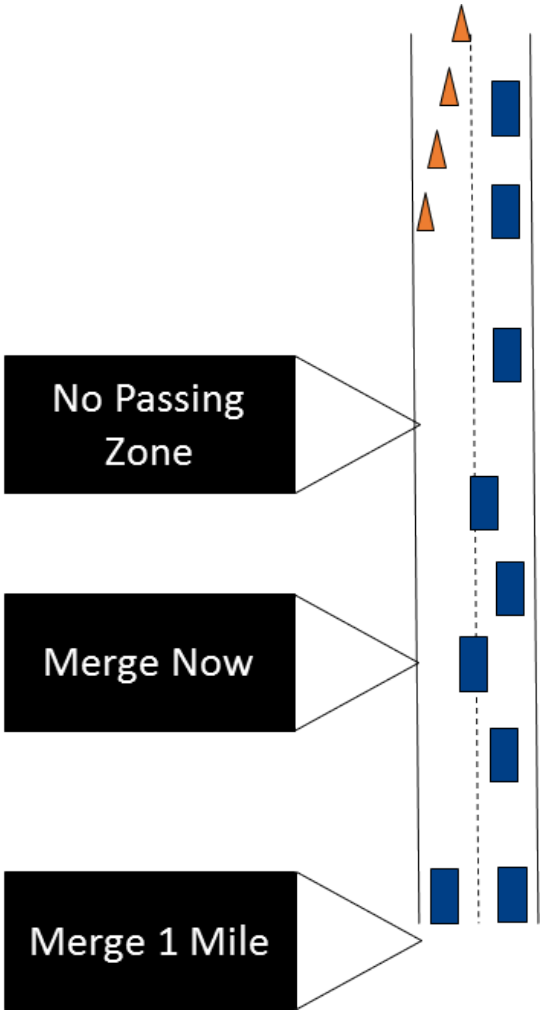


Speed Reduction Warning System

- Utilizes similar algorithms as a Back-of-Queue system to alert motorists of travel speed reductions due to the presence of slow moving traffic ahead
- Helps to prevent unsafe lane changes or side-swipe/rear-end crashes

Tip: Speed Reduction System is better suited when volumes are lower and reduced speeds are likely

Dynamic Merge System: Early Merge

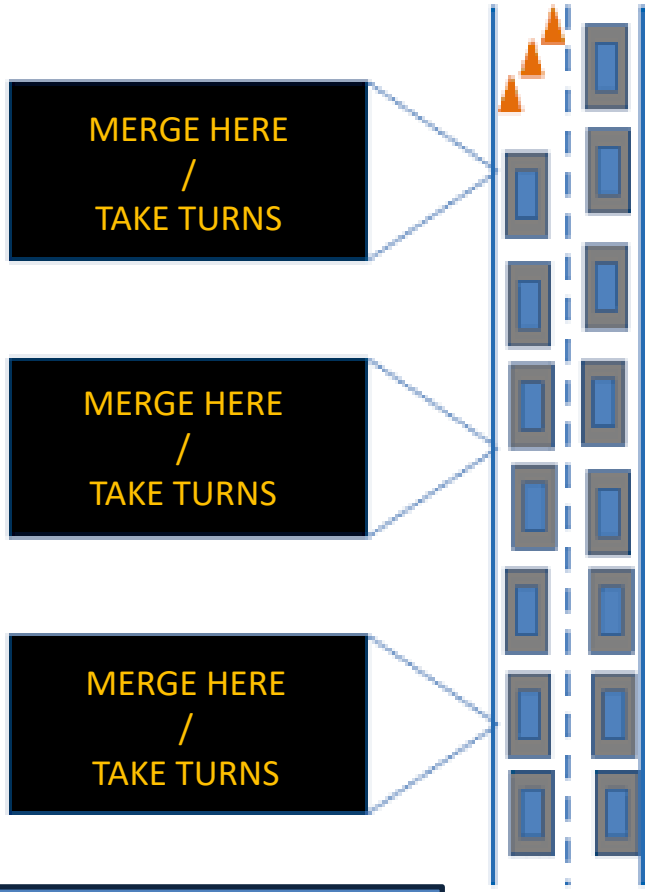


- Effective for longer passing zones and lower traffic volumes
- The early merge is intended to encourage aggressive drivers to merge into the open lane sooner than they would with traditional static lane closures

Tip: Works well for light, free-flowing traffic

Dynamic Merge System: Late Merge

- Effective for higher volumes of traffic where the demand exceeds the capacity of the open lane and there is the potential for extensive queuing
- Encourages all drivers to remain in their lanes until they reach the defined merge point



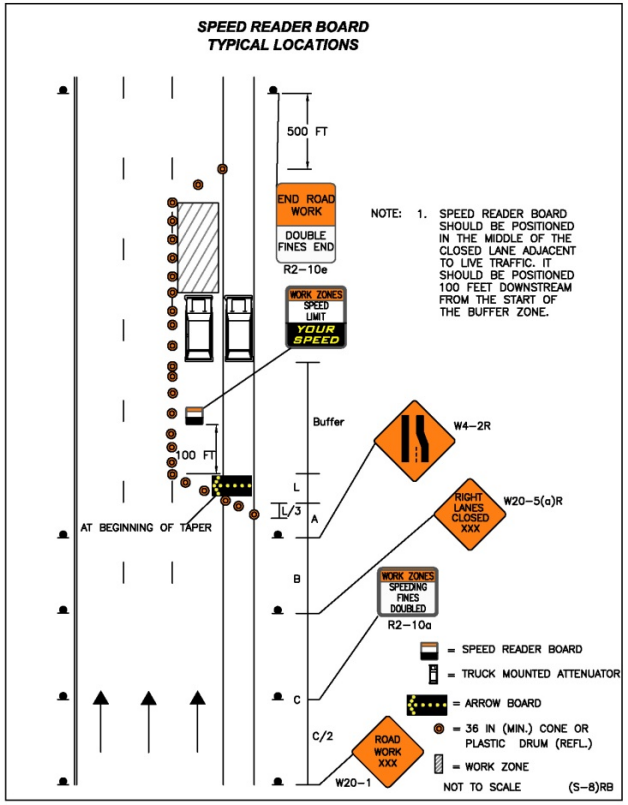
Tip: Works well for heavy, stop & go or slow moving traffic

Automated Enforcement

- Excessive speed, speed variability and driver distraction are major issues for work zone safety
- Use of law enforcement is one of the effective means at increasing speed limit compliance

Tip: Automated Enforcement helps to deter speeding when workers are present but also mitigate the lack of available details

Speed Feedback Signs



STATIONARY OPERATIONS

Tip: Flashers used only if workers present

How to sell Smart Work Zones

SWZs provide **Real-Time Traffic Management** and video coverage of the work area/key traffic decision points

Mobility Applications: capability to ensure an efficient flow of traffic through the work zone, minimizing the congestion through traffic diversion and providing travel/delay times

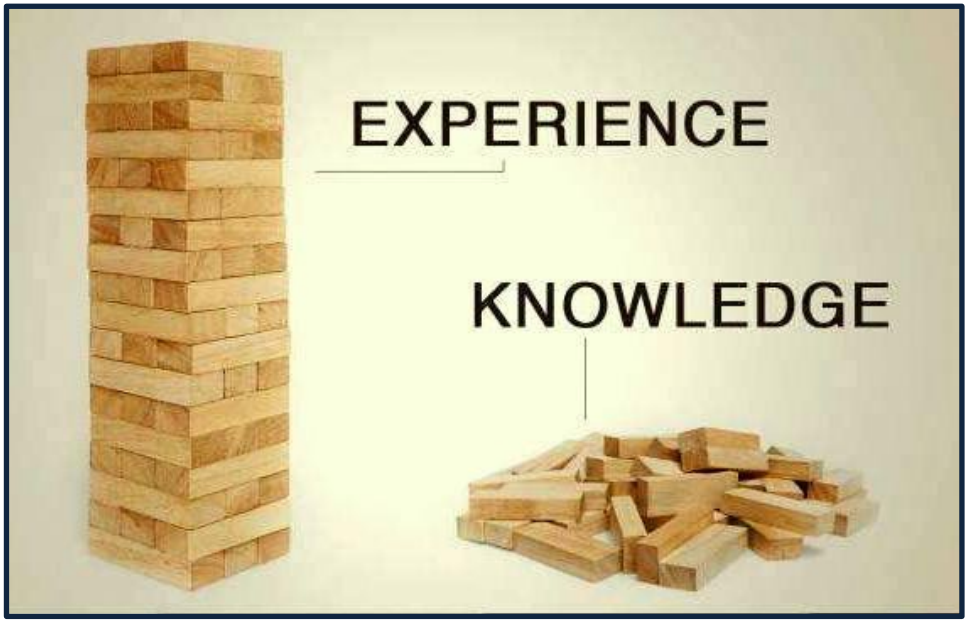
Safety: capability to minimize the number and severity of traffic-related incidents, injuries and fatalities, and asset damage in the work zone

Planning and Monitoring: capability to collect work zone data in order to develop performance reports, allocate enforcement patrols, refine guidance for allowable working hours, and evaluate throughput capacity

So who has experience with SWZs?

Have not yet tried a SWZ system

Some past experience / not currently using SWZ technology

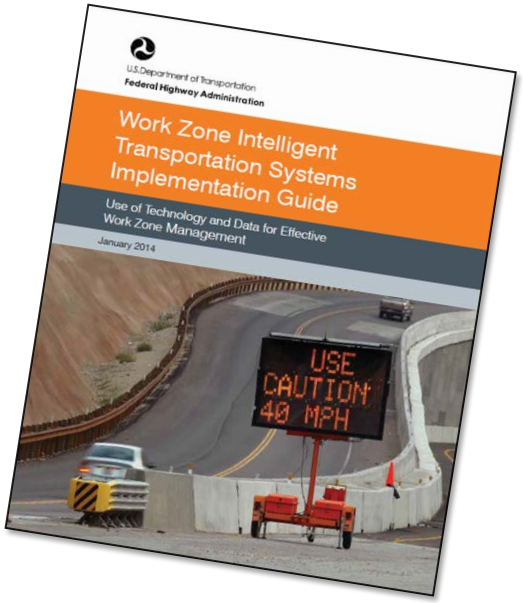


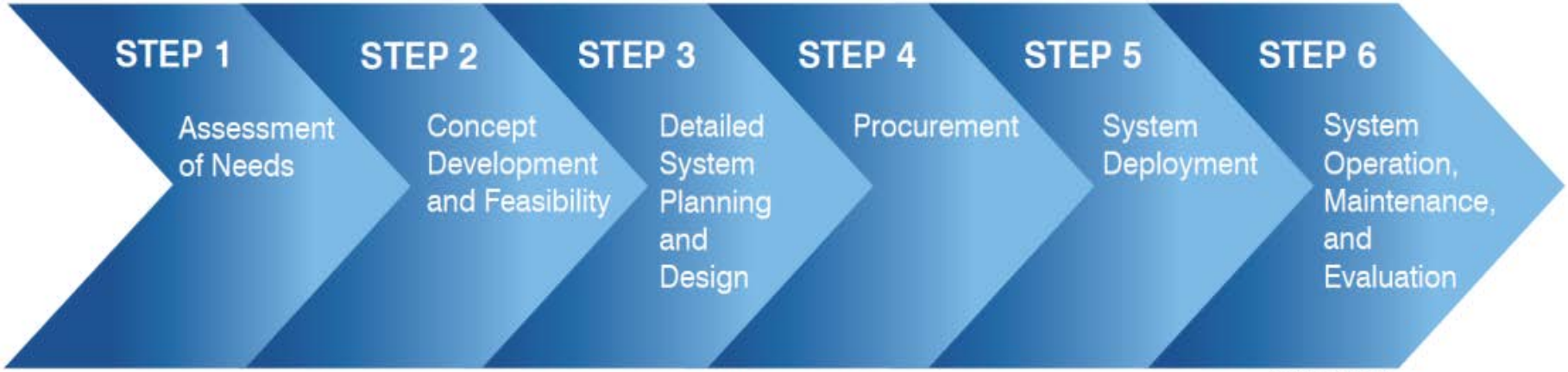
Tried SWZ system but had bad experience

Actively using SWZ systems and successful

FHWA's Work Flow Process

FHWA *Work Zone Intelligent Transportation Systems Implementation Guide*: Six-Step Process





Source: Battelle

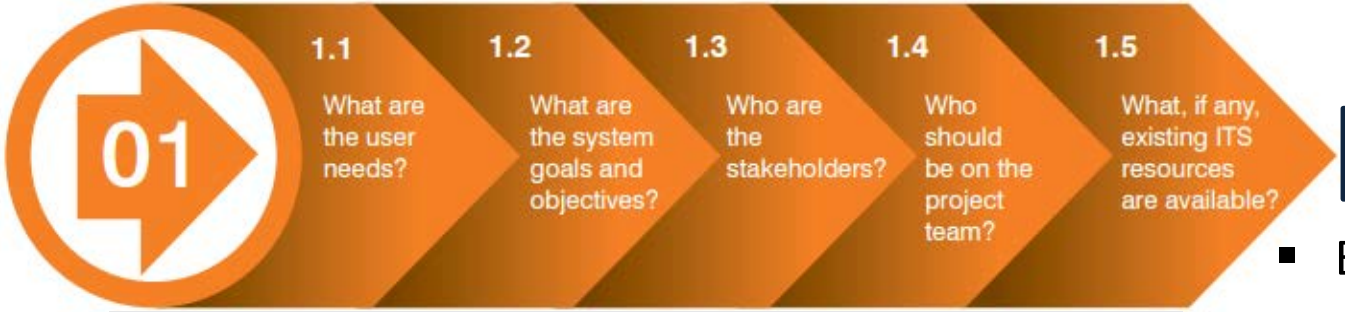
Figure 4. Overview of the implementation process.

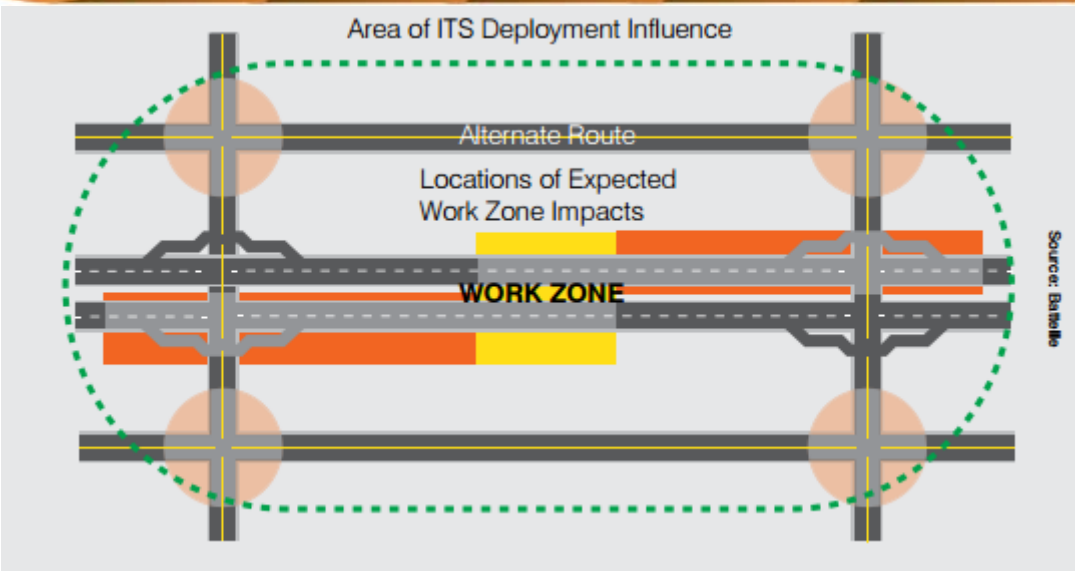
MassDOT's SWZ 7-Step Process

Separate out the Operation and Maintenance of the SWZ System from the Evaluation of the data collected

- Step 1 • Assessment of SWZ Needs
- Step 2 • Planning SWZ Applications
- Step 3 • Layout and Design SWZ
- Step 4 • Define SWZ Specifications
- Step 5 • Deploy, Calibrate and Test SWZ
- Step 6 • Operate and Maintain SWZ
- Step 7 • Evaluate SWZ Data

Step 1: Assessment of Need





***Key Points*:**

- Evaluate need as part of the Transportation Management Plan (TMP) development
- Ensure that you have an end goal in mind
- Establish realistic project expectations
- Engage stakeholders early in the process

Step 2: Planning WZ Applications

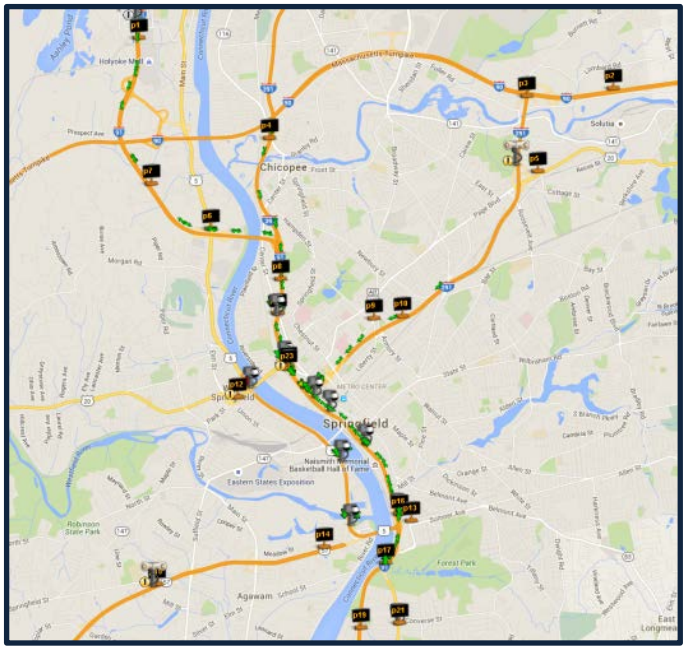
***Key Points*:**

- Investigate the possible SWZ technology applications available to mitigate the conditions of your project
- Identify any jurisdictional or institutional challenges that might limit the use of a SWZ and engage appropriate stakeholders
- Engage the vendors - they have the experience and legitimately want to help you develop the concept of operations and succeed
- Successful implementations helps drive the desire for continued use of ITS technology in the work zone

Source: Battelle

Step 3: Layout and Design SWZ

- Layout Guidelines – Identify the following key locations:
  - Start and end points
  - Merge points for lane drop(s)
  - Approaches to project site
  - Upstream decision points
  - Stable points upstream and downstream of the bottleneck
- Locate required detection and surveillance equipment
- Add PCMS to disseminate messages at key locations

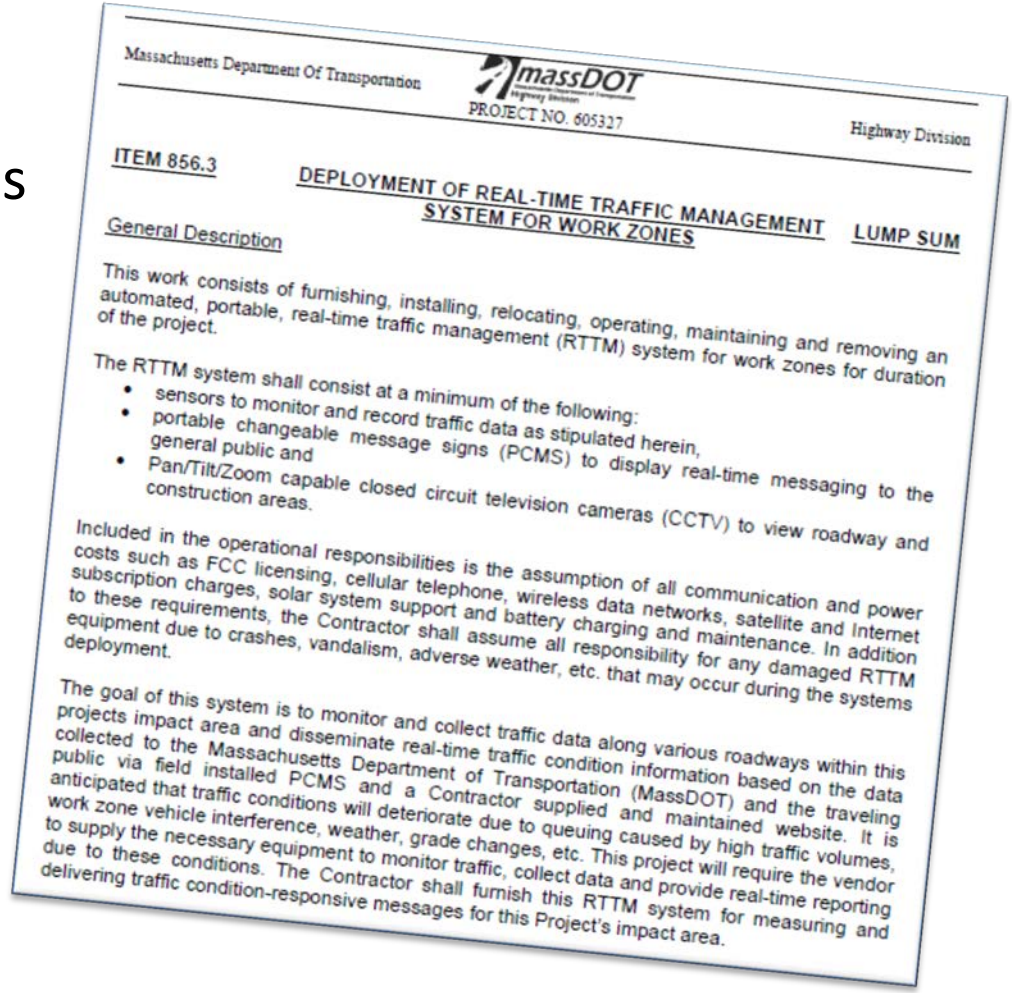


Tip: Engage SWZ Vendors

Step 4: Define SWZ Specifications

***Key Points*:**

- Include detailed descriptions of the required equipment and expected functions
- Define expectations for system operations
- Document placement, calibration and testing expectations
- Define expected performance/deliverables



Massachusetts Department Of Transportation — massDOT — Highway Division

PROJECT NO. 605327

ITEM 856.3 — **DEPLOYMENT OF REAL-TIME TRAFFIC MANAGEMENT SYSTEM FOR WORK ZONES** — **LUMP SUM**

General Description

This work consists of furnishing, installing, relocating, operating, maintaining and removing an automated, portable, real-time traffic management (RTTM) system for work zones for duration of the project.

The RTTM system shall consist at a minimum of the following:

- sensors to monitor and record traffic data as stipulated herein,
- portable changeable message signs (PCMS) to display real-time messaging to the general public and
- Pan/Tilt/Zoom capable closed circuit television cameras (CCTV) to view roadway and construction areas.

Included in the operational responsibilities is the assumption of all communication and power costs such as FCC licensing, cellular telephone, wireless data networks, satellite and Internet subscription charges, solar system support and battery charging and maintenance. In addition to these requirements, the Contractor shall assume all responsibility for any damaged RTTM equipment due to crashes, vandalism, adverse weather, etc. that may occur during the systems deployment.

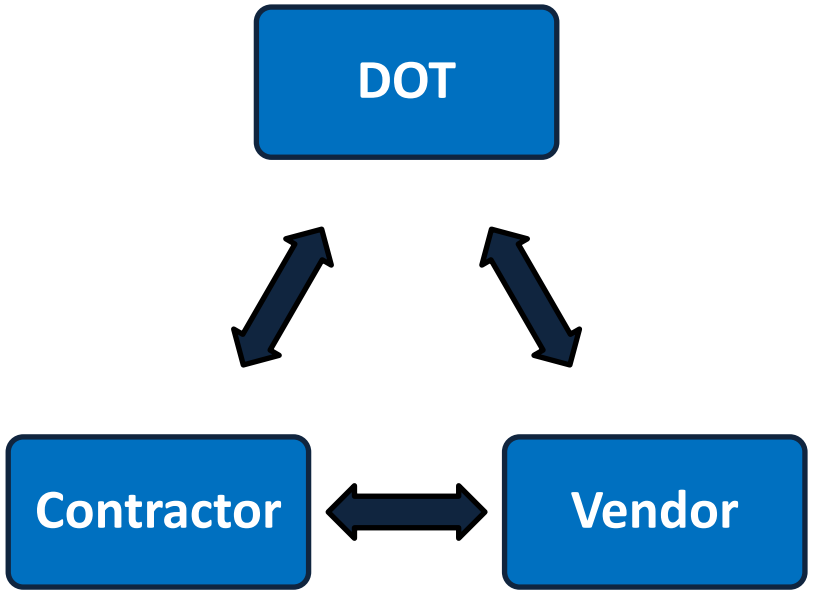
The goal of this system is to monitor and collect traffic data along various roadways within this projects impact area and disseminate real-time traffic condition information based on the data collected to the Massachusetts Department of Transportation (MassDOT) and the traveling public via field installed PCMS and a Contractor supplied and maintained website. It is anticipated that traffic conditions will deteriorate due to queuing caused by high traffic volumes, work zone vehicle interference, weather, grade changes, etc. This project will require the vendor to supply the necessary equipment to monitor traffic, collect data and provide real-time reporting due to these conditions. The Contractor shall furnish this RTTM system for measuring and delivering traffic condition-responsive messages for this Project's impact area.

Step 5: Deploy, Calibrate & Test SWZ

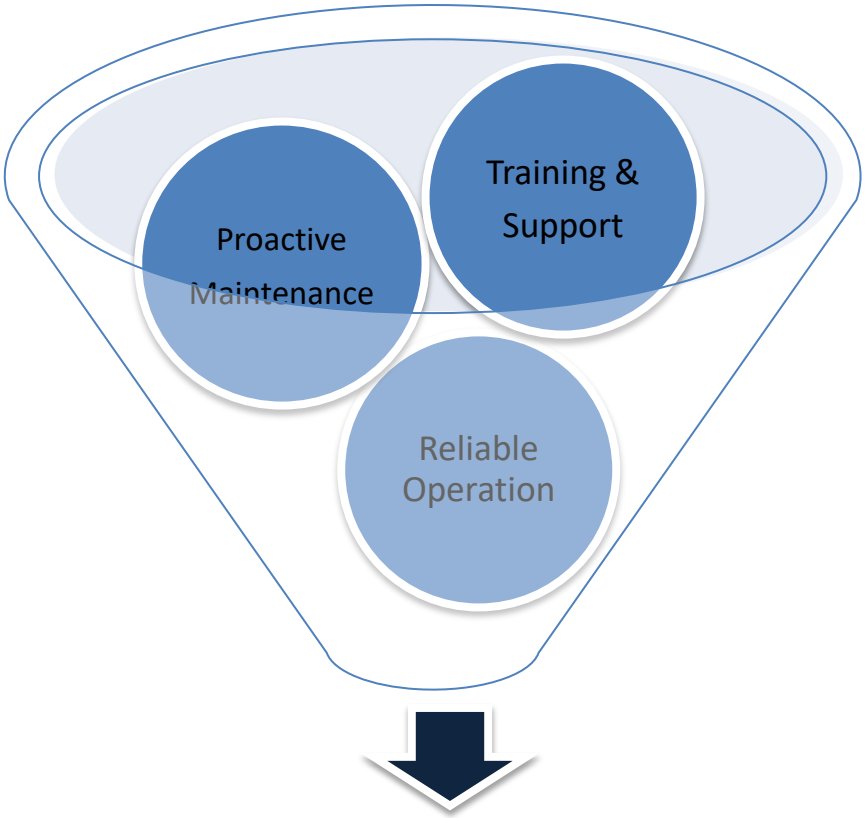
***Key Points*:**

- Safe deployment that follows the Roadside Design Guide (*clear zone*)
- Capture the GPS coordinates for equipment locations in the field for reporting
- All devices must be calibrated to field conditions
- Develop testing plan to execute the functionality of the system

Maintain Communication Flow



Step 6: Step 6: Operate & Maintain SWZ



Successful Implementation

Step 7: Evaluate SWZ Data

- On-going evaluation of operations to support construction work hours
- Ability to calculate work zone throughput capacity
- Work zone mobility performance measures
- Develop public-facing work zone dashboard
- Planning for future traffic management plans

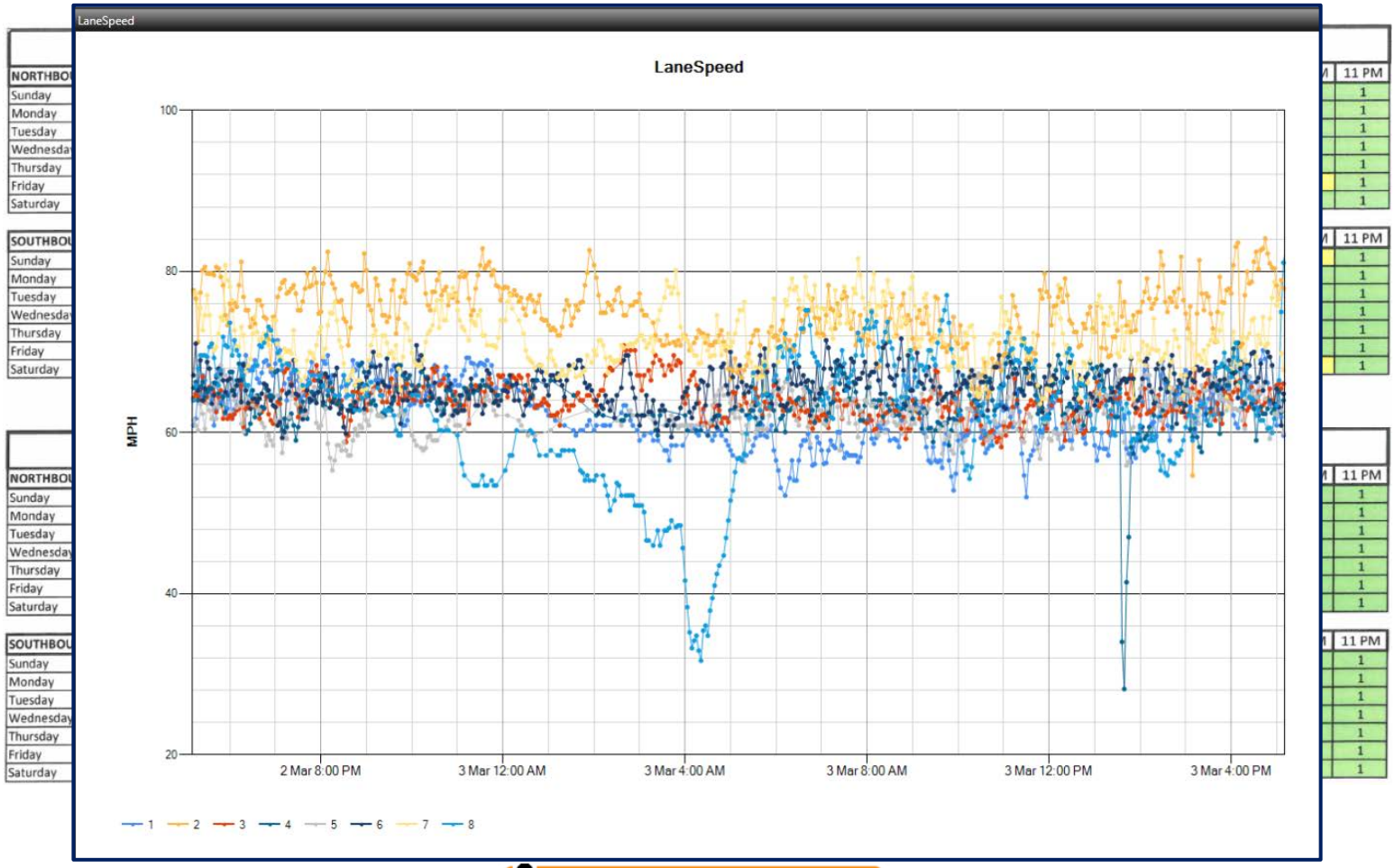
Source: clarabridge.com

***Key Points*:**

Need a wrap up evaluation that identifies and documents key findings and lessons learned. Provides a valuable learning tool for future efforts

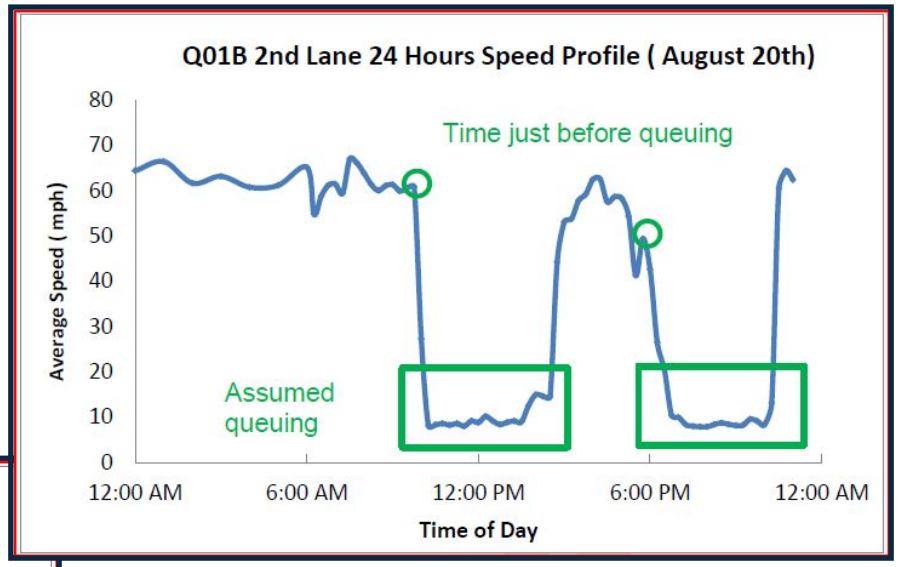
What is the data good for?

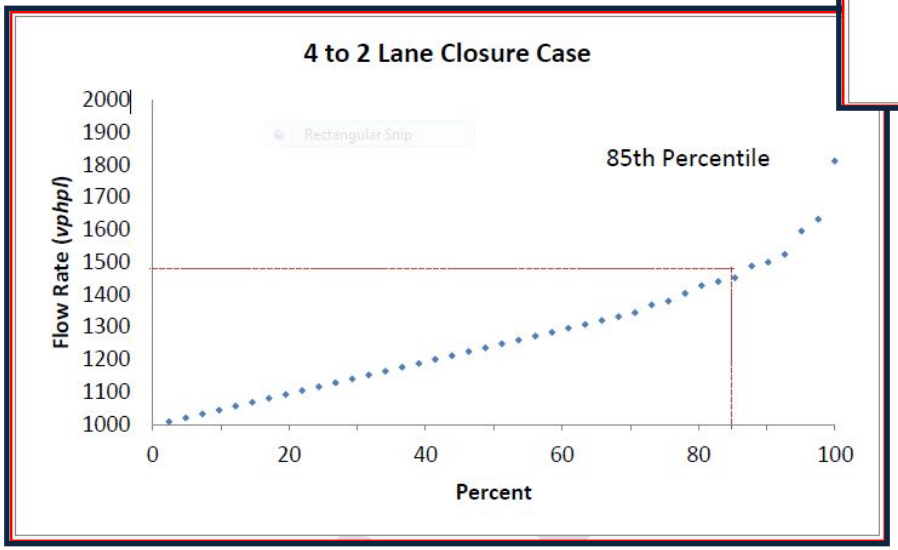
Lane Speed Graph



What is the data good for?

The measured capacity for the 4-2 lane closure is close to the MassDOT standard of 1480 vphpl used to determine WZ capacity





The 24-hour speed profile is helpful in identifying precipitous drops in speed that indicate where queuing exists at the sensor location

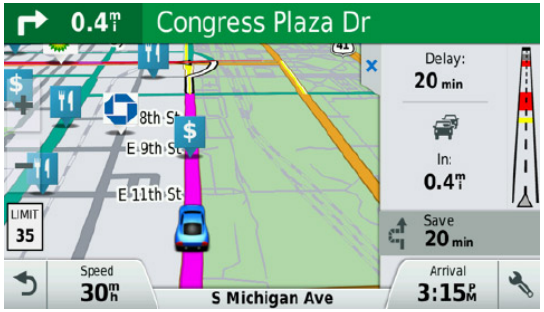
So what is next?

- Need to continue spreading the word about the benefits of using ITS in the work zone to improve safety and mobility
- Foster peer-to-peer support to help guide state and local agencies with the preparation of a SWZ project plan
- Engage the industry partners for help improving information dissemination
- Collect data during project, evaluate and report out on the benefits

Improve Information Dissemination

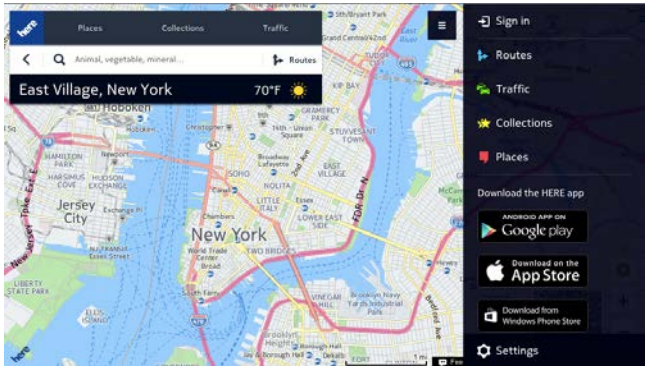
- Work with Traffic Services to ensure that real-time data collected for Smart Work Zones is getting out for the public benefit
- The “Industry” needs to start the conversation as the use of probe data alone may not produce the most accurate results
- States can help start the process by requiring that SWZ data become publically available to the providers

Who has the most accurate data?



Garmin

TomTom



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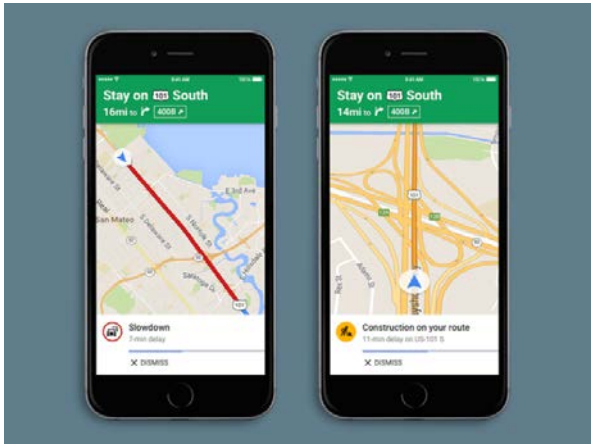


Google

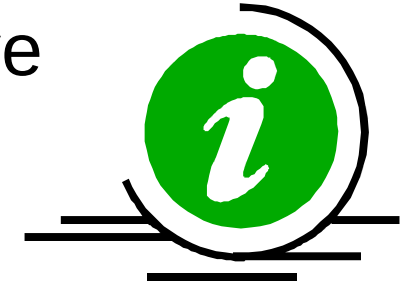
INRIX

Waze

What does the future hold?

How can Smart Work Zones be leveraged to support Connected Vehicle Technology?

- Majority of SWZ devices utilize cellular modems to send data back to the CPU
- The communication medium could be updated to DSRC or other means such that the data could be sent directly back to the vehicle
- Providing information directly to the driver inside of the vehicle should be effective for improving safety & mobility



Key Takeaways…

- Make use of ITS in work zones part of your traffic management mitigation strategies
- Start planning your Concept of Operations early in project development
- Be sure to engage stakeholders to get them invested in the project and support the scope of work
- Set realistic expectations for the system operations
- Maintain flexibility as field conditions may differ significantly from what was expected during system planning and design
- Verify the quality of the information being disseminated to the public to build credibility
- Evaluate the data results post-project and document results

Thank you!

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