



## WEATHER-RESPONSIVE MANAGEMENT STRATEGIES

### FACT SHEET

# Weather-Responsive Management Strategies Transportation Agency Deployment

## Background

The Weather-Responsive Management Strategies (WRMS) initiative under the Federal Highway Administration (FHWA) Every Day Counts – Round 5 (EDC-5) program promotes the use of road weather data from mobile and connected vehicle (CV) technologies to support traffic and maintenance management strategies during inclement weather. The goal is to improve safety and reliability, as well as to reduce environmental impacts on the transportation system resulting from adverse weather.

Across the Nation, WRMS can be implemented to mitigate the impact of various weather conditions. Northern States with hazardous winter weather could deploy WRMS strategies such as enhanced anti-icing and de-icing, plowing, and snow removal. Southern States with tropical weather such as hurricanes, flooding, or low visibility could deploy WRMS strategies such as enhanced motorist alerts and advisories or variable speed limits (VSLs). As part of EDC-5, more than 20 states are leveraging various communication mechanisms, sensor configurations, and software tools to generate and optimize the use of road weather data and information.

This fact sheet provides an overview of what WRMS agencies across the country are currently deploying or in the planning stages of near-term implementation.

## WRMS Deployment – What's Required?

Deployment of WRMS requires identification of the following components:

- Weather event(s)
- Communication method(s)
- WRMS need/application(s)
- Data source(s)

## Available Resources

FHWA's EDC-5 WRMS Resource Toolkit:

<https://collaboration.fhwa.dot.gov/dot/fhwa/RWMX/SiteAssets/WRMS/home.aspx>

FHWA's EDC-4 Integrating Mobile Observations (IMO) Resource Toolkit:

<https://collaboration.fhwa.dot.gov/dot/fhwa/RWMX/SiteAssets/Weather%20Savvy%20Roads.aspx>



Agencies across the country are currently utilizing WRMS or are planning to implement WRMS for a variety of **weather events**. These include:



(Source: Shutterstock)

- **Winter weather.** Conditions such as sleet, ice, frost, heavy blowing, or drifting snow reduce pavement friction and vehicle maneuverability, resulting in slower speeds, reduced roadway capacity, and increased crash risk.
- **Flooding.** Tropical storms, hurricanes, and heavy rains can result in significant flooding events leading to reduced roadway capacity and major roadway infrastructure damage.
- **Dust storms.** Dust storms are difficult to forecast and occur quickly. An immediate lack of visibility creates dangerous conditions such as increased speed variance and crash risk.
- **Wildfires.** Wildfires in the western United States often leave burned land surfaces (e.g., burn scars) that are at higher risk for debris flow, erosion, and flooding.

Diverse agency needs dictate a variety of internal and public-facing **WRMS applications**:

- Internal maintenance and traffic applications:
  - Automated processes (decision support systems [DSS] or artificial intelligence)
  - Resource management:
    - End of shift reports
    - Staffing decisions
    - Material use and management
    - Route decisions or optimization
  - Other agency information (condition or performance reports)
- Public-facing applications:
  - Roadside messaging (variable message signs [VMS]/dynamic message signs [DMS])
  - Traveler information (511/websites)
  - VSLs
  - Road/lane closures or restrictions

**Data sources** include equipment via agency fleets, private vehicles, third parties, agency operators, and road users as well as agency infrastructure.

- In-vehicle equipment:
  - Plow and material sensors
  - Friction/grip sensors
  - Atmospheric and pavement condition sensors
  - Video and camera images
  - Automatic vehicle location (AVL)/ Global Positioning System (GPS)
- Other data sources:
  - Road Weather Information Systems (RWIS)
  - National Weather Service (NWS) data
  - Road user reports
  - Operator reports
  - Contracted weather service providers
  - Third-party data

**Communicating mobile and CV technology data** to the agency's back office from the roadway may be done through a variety of technologies, including those listed below. These options are especially needed in more rural and mountainous locations where connections may be intermittent at best:

- Cellular coverage
- Dedicated short range communications (DSRC)
- Wi-Fi
- Radio

## Agency Implementations

The table on the following page provides an overview of WRMS planned and active deployments across the country. Examples are provided below:

- **Winter Weather Applications.** Agencies may use a maintenance decision support system (MDSS) that leverages available road and weather condition information to make recommendations about the location, timing, and type of de-icing material for maintenance staff to apply. Over 16 agencies currently use automated processes like MDSS to support winter maintenance and operations, allowing agencies to improve materials management and make better staffing decisions. Many agencies also use data from plow vehicles for WRMS applications on traveler information websites and mobile applications that sometimes include a weather layer with "Track A Plow" or plow images.
- **Flood Forecasting and Response System.** Delaware is actively working to better monitor and predict flooding using a robust RWIS network and a fleet of vehicles equipped with mobile environmental station sensors (ESS) and dash cams. Nine unmanned aerial systems are available to the Transportation Management Center for flood response, according to the severity of the event as defined in the event management plan.
- **Dust Detection System.** Arizona is implementing a dust detection system that includes 11 sensors on a 10-mile corridor of I-10. The system automatically activates VSLs when and where needed, as the affected area is sometimes only 2 miles long. The VSLs will lower the speed limit in 10 mile per hour (mph) increments and automatic ramp closures will occur when 35 mph speeds are reached.
- **Burn Scar Management.** California will use new RWIS, mobile RWIS, and collaboration with NWS and local agencies – including law enforcement, cities, and counties – to assemble forecast information and proactively close highways, as needed, when mudslides are predicted. Caltrans intends to expand burn scar management efforts to other predicted weather events, such as winter weather and preparing for wildfires.

The table on the next page shows agencies that have, as of late 2019, implemented or are planning to implement WRMS applications, as well as focus areas, communication methods, and supporting data sources. Agencies listed are either EDC-5 adopters or model agencies for this effort. Please reach out to FHWA for contact information for any of the agencies listed. Collectively, WRMS applications provide agencies and travelers with improved mobility and safety, as well as reduced costs resulting from staffing efficiencies and reduced material usage.

State Agencies	Weather Event Focus for WRMS				WRMS Application									Data Source								Communication Method				
					Internal Maintenance and Traffic					Public Facing				In-Vehicle Equipment				Other Sources								
	Winter Weather	Flooding	Visibility (fog, dust)	Wildfires	Automated Processes	End of Shift Reports	Staffing Decisions	Material Management	Route Decisions or Optimization	Other Agency Reports or Information	Roadside Messaging	Traveler Information	Variable Speed Limits	Road/Lane Closures or Restrictions	Plow and Material Sensors	Friction/Grip Sensors	Atmospheric/Pavement Sensors	Video and Camera Images	AVL/GPS	Fixed RWIS	Road User Reports	Operator Reports	Third Party Data	DSRC	Cellular	Wi-Fi
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- Plans for future implementation under EDC-5
  - ◐ Small-scale demonstrations or deployments already in place, with possibility for expansion under EDC-5
  - Institutionalized, statewide, and/or large-scale deployments, with possible enhancements under EDC-5
- +Use modem to switch between cellular networks where availability is limited

[www.fhwa.dot.gov](http://www.fhwa.dot.gov)

For additional information, please contact:

**David Johnson**  
David.Johnson@dot.gov  
202-366-1301

 @FederalHighwayAdmin  
 @USDOTFHWA  
 USDOTFHWA

  
U.S. Department of Transportation  
**Federal Highway Administration**