North/West Passage Pooled Fund Study

Benefit Cost Tool

Version 2 – 082212

METADATA

The following tables contain the threshold values used in the North/West Passage Benefit Cost Spreadsheet Tool. The tables include a tabular summary of the impacts of ITS devices (DMS, RWIS, CCTV) related to the configuration of devices. If based on local values or experience you have additional sources to document, please email Tina Roelofs at roelofs@acconsultants.org to cite in this document.

Dynamic Message Signs (DMS)

Use of Devices	Deployment Setting	Configuration and Use	Impacts	Source(s)
DMS: Variable Speed Limit Display	• Interstate • Rural • High wind areas	• Regulatory speeds • Minimum speed value25 mph • Speeds adjusted in increments of 5 mph • Speed limits set manually based on observation, law enforcement experience, and RWIS observations	Crashes reduced by 38%	**Wyoming DOT.** Deployment of VSL on I-90 noted a 38% reduction in crashes from 402/year in 2009 to 248/year in 2010. Success factors included enforcement and calculation approach.
DMS: Variable Speed Limit Display	Areas prone to low visibility or fog	• 7.5 miles • VMS every 0.4 to 0.5 miles and 20 visibility sensors • Speeds reduced to 37 mph to 62 mph based on visibility	Crashes reduced by 50 %	**Fog-Detection and Warning Project, Netherlands**. In 1991, a fog-detection and warning project indicated at 50% reduction in secondary accidents.

Dynamic Message Signs (DMS)				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
DMS: Variable Speed Limit Display	Areas prone to low visibility or fog	• Regulatory Speeds • Rural Autobahn 18.7 miles in length • Signs located every 0.9 to 1.2 miles • Fog, ice, wind and other detectors monitor environmental conditions • Displayed speed 37, 49 or 62 mph	Crashes reduced by 20 to 30%	**VSL on Autobahn, Germany** Crash data in Germany has shown that the use of the variable speed limit and speed warning signs has reduced the crash rate by 20 to 30%.
DMS: Variable Speed Limit Display	• Interstate • Urban • Congestion	• Advisory Speeds • Speed between 40 and 60 mph	Crashes reduced by 4.5 to 30%	**St. Louis, Missouri** A VSL system on the I-270/I-255 loop around St. Louis reduced the crash rate by 4.5 to 8 percent, due to more homogenous traffic speed in congested areas and slower traffic speed upstream.
DMS: Variable Speed Limit Display	Congestion	• Regulatory • Urban setting 14 miles • VSL spaced at 0.6 mile intervals • Loop detectors at 0.3 intervals and CCTV • Displayed speed changes from 50 mph, 60 mph and 70 mph according to detected volumes	Crashes reduced 10 to 15%	**United Kingdom** VSL system on M 25 in London. Accidents have reduced 10 to 15%.
DMS: Variable Speed Limit Display	Congestion	• Regulatory Speeds • Rural Autobahn 18.7 miles in length • Signs located every 0.9 to 1.2 miles • Displayed speed 37, 49 or 62 mph	Crashes reduced 20 to 30%	**VSL on Autobahn, Germany** crash data in Germany has shown that the use of the variable speed limit and speed warning signs has reduced the crash rate by 20 to 30%.

Dynamic Message Signs (DMS)				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
DMS: Speed Display	• Interstate • Rural • Downhill truck speed warning	• Experienced accidents involving truck rollover • Systems designed to alert truck drivers to slow down when maximum safe speeds were exceeded as they approached steep negative grade on mountain freeway	13% reduction in crashes	**Words of Warning**. System in Colorado on I-70 was evaluated and the analysis indicated the system decreased truck use of runaway ramps by 24 percent. In addition, there was a 13 percent drop in accidents involving excessive truck speeds.
DMS: Weather / Road Conditions Display	• Interstate • Urban • Linked to environmental sensor	• Pavement or precipitation sensor to detect wet highways • DMS displays warning of wet highway • System was used on temporary detour route during reconstruction of bridge on I-85 (North Carolina) • Sensors measuring traffic, visibility, roadway and weather data • Automatic traffic counters recorded vehicle counts • Camera used to verify sensor data • DMS provided information to travelers (Idaho)	39% reduction in crashes	**USDOT RITA Cost/Benefit Website: North Carolina Wet Pavement Detection System**. In North Carolina in 2003, a wet pavement detection system on I-85 yielded a 39% reduction in the annual crash rate under wet conditions.

Dynamic Message Signs (DMS)				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
DMS: Weather / Road Conditions Display	• Non-interstate highway • Linked to environmental sensor	• Pavement ice detector detects presence of ice • DMS displays warning message about ice	3-17% reduction in crashes	**Road Weather Management Performance Metrics: Implementation and Assessment**. Road Weather Information System = 3-17% Reduction in Crashes.
		• Divided roadway section typically has speed limits of 75 MPH in summer and 50-62 MPH in winter based on road/weather conditions and ESS data. • Recommended speed limits are based on pavement condition, precipitation, visibility and wind. • When speed limits are reduced, VMS display the reason for reduced speeds using one of three symbols indicating "slippery road surface," "hazardous conditions ahead," or "road construction ahead" • If speed limits are not reduced, VMS display only air and pavement temperatures. (Finland)	8-25% reduction in crashes (Finland)	**Weather Controlled Road and Investment Calculations**. Average yearly accident rate was projected to decrease by eight to 25 percent. This impact on safety is due to lower average speeds when accident risk is greatest (i.e., when poor road conditions exist). It is anticipated that annual costs will likely decrease nearly $234,500 (1.5 million Finnish marks).
DMS: Weather / Road Conditions (Manual Observations)	Rural areas prone to winter weather	• Manual observations of weather conditions (DOT personnel, weather spotters, CCTV monitoring) • Manual creation of weather messages on DMS as reported	2.8% reduction in crashes	**Road Weather Management Performance Metrics: Implementation and Assessment**. Conditions on DMS = 2.8% Reduction in Crashes.

Dynamic Message Signs (DMS)				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
DMS: Low Visibility/Fog Warning to Drivers	• Interstate • Rural • Areas prone to fog or low visibility	• RWIS or other sensors to detect low visibility • DMS automatically displays warning message about low visibility or traffic conditions • Tied to VSL and HAR systems • Advisory messages (e.g. SLOW TRAFFIC AHEAD, DENSE FOG AHEAD) are displayed according to speed, visibility and wind parameters (California)	70-100% reduction in crashes	**Road Weather Management Performance Metrics: Implementation and Assessment.** Fog Warning Systems = 70-100% Reduction in Crashes. **Best Practices for Road Weather Management, Version 2.0 – California Motorist Warning System.** System improved highway safety by significantly reducing the frequency of low-visibility crashes. Nineteen fog-related crashes occurred in the four-year period before the system was deployed in I-5 in San Joaquin County, California. Since the system was activated in November 1996, there have been no fog-related crashes. **Adverse Visibility Information System Evaluation (ADVISE): Interstate 215 Fog Warning System Final Report.** Reduced the average standard deviation of speed between vehicles by 22 percent in I-215 near Salt Lake City, Utah. Prior to the deployment, the standard deviation was 9.5 mi/h. After the system was deployed and ADVISE messages were provided, the standard deviation decreased to 7.4 mi/h.

Dynamic Message Signs (DMS)				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
DMS: Travel Time Display	• Interstate • Urban • Temporary work zone setting informing travelers of delays in the work zone	• Automated travel time estimation; updated every 10 minutes • Automated DMS control • DMS displayed 1 of 6 messages depending on congestion level • Detours recommended when travel times exceeded 50 minutes (Devore, California)	Delay reduced by 50%	**Automated Work Zone Information System (AWIS) on Urban Freeway Rehabilitation: California Implementation**. Rapid Rehab project on I-15 in Devore, CA, deployed AWIS to display travel times and manage congestion.
		• Microscopic simulation approach was used to evaluate the effects of an Automated Workzone Information System (AWIS) deployed near Los Angeles, California on Interstate 5 between Magic Mountain Parkway and Rye Canyon Road • Included vehicle detectors and three portable Dynamic Message Signs (DMS) • During construction, AWIS was deployed to manage traffic on the interstate, which has four lanes in each directions separated by a median. One southbound lane and one northbound lane adjacent the median were closed. • A parallel arterial route with one lane in each direction was recommended to motorists as an alternative when the freeway was congested. (Los Angeles, California)		**Evaluation of Traffic Delay Reduction from Automatic Workzone Information Systems Using Micro-simulation**. After AWIS deployment on I-5 near Los Angeles, California, average freeway delay was reduced by 46 percent and total freeway delay decreased by 41 percent. The average freeway travel time fell by 38 percent (from 22 minutes to 14 minutes). While freeway delay decreased, arterial delay increased significantly. Average arterial delay increased by 191 percent and total arterial delay rose by 293 percent. Average arterial travel time increased by 22 percent. However, average arterial travel time (11.1 minutes) was nearly 18 percent lower than average freeway travel time (13.5 minutes), indicating that freeway motorists benefited by taking the alternate route.

Road Weather Information Systems				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
RWIS: Network	Network, statewide	• Statewide RWIS network in well-maintained condition, defined as accurate sensing equipment that is constantly monitored for sensor faults and when a fault is identified it is rectified as part of a standard maintenance regime.	10% reduction in crashes statewide	**A study to determine the effects of employing a well maintained RWIS network on accident rates on major highways in the US state of Idaho.** This study looks into the effect on state wide accident rates across Idaho before and after the implementation of a well maintained RWIS network.
RWIS: Monitor Conditions to Support Anti-Icing Strategy	Locations prone to ice	• Pavement sensor • Atmospheric sensor • Anti-icing strategy tied to RWIS knowledge	Reduce weather related crashes by 83% near the RWIS Reduced labor hours by 62%	**Anti-Icing Success Fuels Expansion of the Program in Idaho.** In Idaho, RWIS tied to anti-icing strategy reduced labor hours by 62% and crashes by 83%.
RWIS: Monitor Conditions to Support Anti-Icing Strategy	Locations prone to ice	• Pavement sensor • Atmospheric sensor • Anti-icing strategy tied to RWIS knowledge	Reduce labor hours by 62% and material costs by 83%	**Idaho DOT.** With RWIS sensors in place, DOTs could eliminate 100% of trips to observe a location when treatment is not required (by observing RWIS data). Also DOTs reduce the unwarranted application of materials.
RWIS: Monitor Road Conditions to Activate Automated Deicing System	• Interstate • Urban • Locations prone to early icing	• Pavement sensor • Atmospheric sensor • Automated de-icing system tied to RWIS	Reduce weather related crashes by 68% near the RWIS	**Best Practices for Road Weather Management, Version 2.0 - Minnesota DOT Anti-Icing/Deicing System**. On I-35W over the Mississippi River in Minnesota, RWIS was tied to automated de-icing system reduced weather related crashes by 68%.

Road Weather Information Systems				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
RWIS: Monitor Conditions Remotely to Avoid DOT Trips to Site	Locations prone to snow, ice, flooding	• Pavement sensor • Atmospheric sensor	100% reduction in trips to the site to observe conditions when treatment is not needed.	**No source cited.** The opinion of NWP members is that with RWIS sensors in place, DOTs could eliminate 100% of trips to observe a location when treatment is not required. Calculation of benefits would require estimate of the number of trips to a location when treatment is not needed per year, combined with DOT personnel and vehicle costs per trip.

Closed Circuit Television Cameras				
Use of Devices	**Deployment Setting**	**Configuration and Use**	**Impacts**	**Source(s)**
CCTV: Observe Field Devices, Incidents and Conditions to Reduce DOT Trips to Site for initial confirmation	Locations with field devices (e.g. closure gates, DMS) and weather or incident history	• Cameras deployed with a view to field devices • Cameras deployed allow remote monitoring of field device status and initial confirmation of incidents and conditions	100% reduction in DOT trips to observe and make initial confirmation of field device status, conditions or incidents	**No source cited.** The opinion of NWP members is that for situations where field devices, conditions or incidents must be initially observed in rural areas, CCTV eliminates 100% of the trips to the locations. Calculation of benefits would require estimate of the number of trips to the location per year, combined with DOT personnel and vehicle costs per trip.

Impact	Societal Benefit	DOT Resource Savings	Traveler Delay Cost Savings
Reduced Crashes	Step 1: Determine total number of crashes in the project area per year Step 2: Determine percentage of crashes in each severity level (property damage, personal injury, fatal); or use national average Step 3: Multiply total crashes by percentage of each severity level to estimated the number of crashes reduced after deployment Step 4: Multiply societal cost savings per each severity level by estimate crashes reduced per year.	Step 1: Determine distance from area of influence to nearest DOT maintenance shop. Step 2: Determine typical amount of time spent on site responding to crashes in this area, and typical number of DOT employees who respond. Step 3: Add drive time and on-site time to determine total response time. Step 4: Multiply total response time by estimated hourly cost for personnel and vehicles.	Step 1: Determine estimate of percentage of crashes that close the rural highway for a period of time. Step 2. Multiply percentage by number of crashes reduced. Step 3. Determine typical duration highway is closed. <<add additional steps in here based on calculations e.g. cost per vehicle/hour. Etc..>>
Reduction in trips to the site to observe conditions or devices	N/A	Step 1: Determine distance from area of influence to nearest DOT maintenance shop. Step 2: Determine typical round trip travel time and time observing conditions/devices Step 3: Multiply total time by estimated hourly cost for personnel and vehicles.	N/A