Testing and Evaluation of Preliminary Design Guidelines for Disseminating Road Weather Advisory & Control Information

Final Report

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June 2012
FHWA-JPO-12-073

U.S. Department of Transportation
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16. Abstract
The tremendous growth in the amount of available weather and road condition information—including devices that gather weather information, models and forecasting tools for predicting weather conditions, and electronic devices used by travelers—has led the Federal Highway Administration (FHWA) to develop effective and specific guidelines for communicating road weather information in a way that is consistent with what travelers need, want, and will use when making travel decisions.

This project, Testing and Evaluation of Preliminary Design Guidelines for Disseminating Road Weather Advisory & Control Information, builds upon the earlier Human Factors Analysis of Road Weather Advisory and Control Information project which was initiated to assist transportation officials in communicating both pre-trip and en-route road weather information effectively, consistently, and timely to meet the needs of travelers for different weather conditions and travel scenarios. This earlier project resulted in preliminary guidelines.

For the current effort, these preliminary guidelines were disseminated to a broad group of transportation and road weather officials for review and use. These reviewers included staff from private agencies and State Department of Transportation (DOT) staff working at Traffic Management Centers (TMCs). Evaluation of the guidelines followed through end user surveys, on-site interviews and discussions, and application of the preliminary guidelines to assess their suitability and effectiveness for traffic operations. Valuable feedback provided by these end users was used to modify the preliminary guidelines and develop the revised guidelines. This report documents the work of the completed project. The revised guidelines are available as Report No. FHWA-JPO-12-046.

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We would also like to acknowledge and thank all the representatives of the State Departments of Transportation (DOTs) and Transportation Management Centers (TMCs)who collaborated in support of the development and refinement of the Guidelines and generously gave of their time and expertise in reviewing the draft Guidelines, providing their constructive feedback, and meeting with members of the Guidelines team. While many individuals deserve recognition, we want to particularly acknowledge a few individuals and their organizations for helping organize their colleagues in the review and feedback process. We want to thank John Nelson and Joe Tucker of Colorado DOT; Rob Helt and Steve Tobias of the Colorado Springs TMC; Jason Sims and Nancy Powell of Kansas City SCOUT; Dave Rossbach and Theodore Valmas of Maryland CHART; Mark Leth and Ron Vessey of Washington State DOT and the WSDOT Supervisors from the six regional TMCs in Washington State; Vince Garcia and Kevin Cox of Wyoming Statewide TMC; Leon Osborne and his team at Meridian Environmental Technology, Inc.; and Peter Davies and Kristin Virshbo and their team at Castle Rock Corp. We have done our best to incorporate all the very helpful comments and suggestions for revising and improving the Guidelines received from all of these individuals.

In addition, the authors thank Dan Shamo of the URS Corporation for his assistance and feedback during this project.

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Acronyms and Abbreviations

ATMS..... Advanced Traffic Management System
CARS ..... Condition Acquisition and Reporting System
CDOT ..... Colorado Department of Transportation
CHART ..... Coordinated Highway Action Response Team
CO ..... Colorado
CSP ..... Colorado State Patrol
CSTMC ..... Colorado Springs Traffic Management Center
CVO..... Commercial Vehicle Operations
DMS ..... Dynamic Message Sign
DOT ..... Department of Transportation
EOC..... Emergency Operations Center
FCC ..... Federal Communications Commission
FHWA..... Federal Highway Administration
HAR..... Highway Advisory Radio
IT ..... Information Technology
ITS..... Intelligent Transportation System
KC ..... Kansas City
KDOT ..... Kansas Department of Transportation
MD..... Maryland
MoDOT..... Missouri Department of Transportation
ms ..... Millisecond
MUTCD ..... Manual on Uniform Traffic Control Devices
NDDOT ..... North Dakota Department of Transportation
NIMS ..... National Incident Management System
NMDOT ..... New Mexico Department of Transportation
NYSDOT ..... New York State Department of Transportation
PCMS..... Portable Changeable Message Signs
PED ..... Personal Electronic Device
PENNDOT ..... Pennsylvania Department of Transportation
PLA..... Problem, Location, Action
POC..... Point-of-Contact
RITIS ..... Regional Integrated Transportation Information System
RTMC ..... Regional Traffic Management Center

RWIS ..... Road Weather Information System
RWMP ..... Road Weather Management Program
SMS ..... Short Message Service
SOC ..... Statewide Operations Center
SOP ..... Standard Operating Procedure
TMC ..... Traffic Management Center
TMDD ..... Transportation Management Data Dictionary
TTS ..... Text to Speech
VMS ..... Variable Message Sign
WRTM ..... Weather Responsive Traffic Management
WSDOT ..... Washington State Department of Transportation
WTA ..... Winter Travel Advisory
Wx ..... Weather
WYDOT ..... Wyoming Department of Transportation

Chapter 1 Introduction

Background

The last decade has seen tremendous growth in the amount of available weather and road condition information, as well as the methods by which this information can be disseminated to travelers. This growth includes devices that gather weather information, models and forecasting tools for predicting weather conditions, and electronic devices used by travelers (National Research Council, 2004). However, simply transmitting this growing flood of data to travelers is not a viable strategy for helping them make effective use of this information. Rather, important consideration should be given to the content, format, and timing of available road weather information and making sure that it is consistent with what travelers need, want, and will use when making travel decisions.

Recognizing the need for effective and consistent procedures for communicating road weather information, the Federal Highway Administration (FHWA) began an effort in 2008 to help transportation professionals provide road weather messages to the traveling public that better support their information needs, travel decisions, and driving behaviors. The *Human Factors Analysis of Road Weather Advisory and Control Information* project was initiated to assist transportation officials in communicating both pre-trip and en-route road weather information effectively, consistently, and timely to meet the needs of travelers for different weather conditions and travel scenarios. The primary output of this effort was a preliminary guidelines report (Richard et al., 2010). The guidelines covered topics such as the content and wording of messages, message presentation and layout, and communication of information about urgency or certainty of road weather condition. They focused on three different message types of: (1) short text/visual messages, (2) open format text/visual messages, and (3) auditory messages.

In 2010, the FHWA sponsored a follow-up project to evaluate and update the preliminary guidelines using feedback from transportation practitioners. Specifically, the *Testing and Evaluation of Preliminary Design Guidelines for Disseminating Road Weather Advisory & Control Information* project included end user surveys, on-site interviews and discussions, and application of the preliminary guidelines to assess their suitability and effectiveness for traffic operations. The end users included staff from private agencies and State Departments of Transportation (DOTs) staff working at Traffic Management Centers (TMCs). The methods and findings from the evaluations are summarized in the project report (Cluett et al., 2012). Valuable feedback provided by these end users was used to modify the preliminary guidelines and develop the revised guidelines, submitted separately. This two-phased effort is summarized in Figure 1 below.

Importantly, the guidelines generated in this effort are intended to augment—not replace—the guidance provided in the *Manual on Uniform Traffic Devices* (MUTCD) and other guidance documents relevant to the presentation of traveler information such as the *Changeable Message Sign Operation and Messaging Handbook* (Dudek, 2004). The guidelines reflect best practices and principles for presenting road weather messages and are intended to be used as a day-to-day resource and to support operator training.

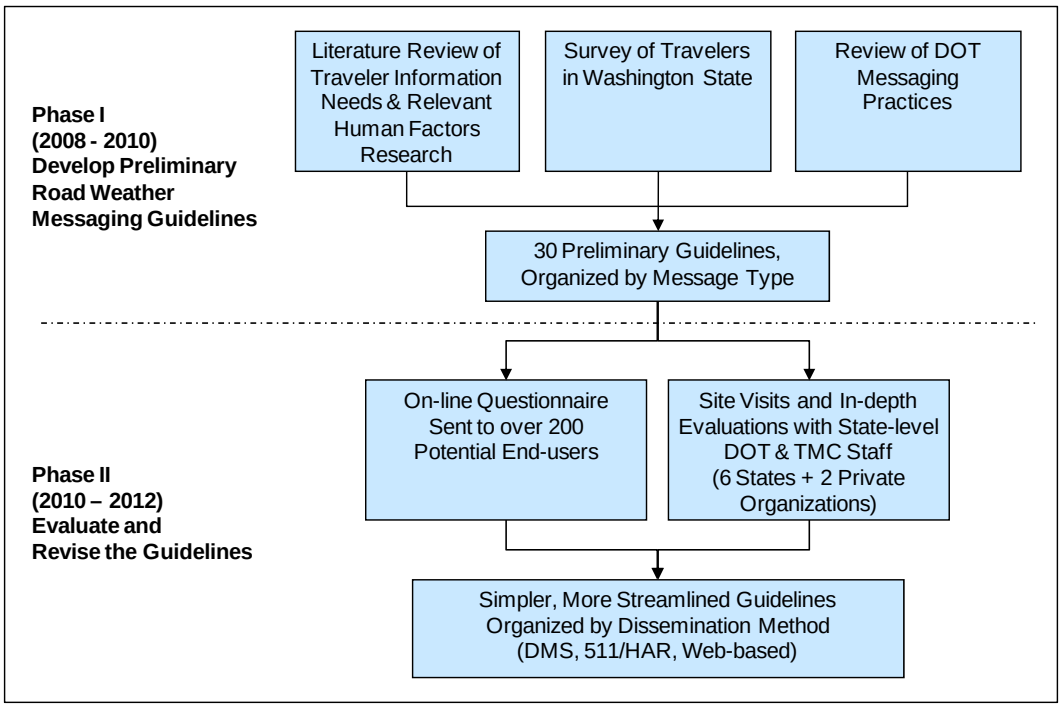


Figure 1. Overview of the two projects that led to the Guidelines for Disseminating Road Weather Advisory and Control Information.

Objectives

The main objectives of this project were: 1) to develop and implement a testing and evaluation plan to evaluate the preliminary design guidelines and 2) to update the preliminary guidelines based on the feedback and suggestions received from users. The project consisted of the following tasks:

- Task 1: Project management
- Task 2: Prepare the preliminary guide for testing and evaluation
- Task 3: Develop testing and evaluation plan
- Task 4: Implement the plan and analyze the results
- Task 5: Update the guidelines
- Task 6: Prepare final report and develop promotional flyer, paper and presentation material

Overview of this Report

This final report constitutes Task 6 of the project. It is composed of the following three main sections and their associated appendices:

- Chapter 2 summarizes the evaluation of the preliminary guidelines.
- Chapter 3 describes the guideline revisions from this project.
- Chapter 4 presents our conclusions and recommendations for next steps for continuing to improve the dissemination of road weather messages to the traveling public.

Chapter 2 Test and Evaluation of the Preliminary Guidelines

Evaluation Methods

Overview

This section describes the methods used to obtain feedback on the preliminary guidelines developed in Phase I of this project (Campbell, Richard, & Lichty, 2011). Figure 2 shows the three component methods that were used in an effort to gather information that was used to develop revisions to the preliminary guidelines document.

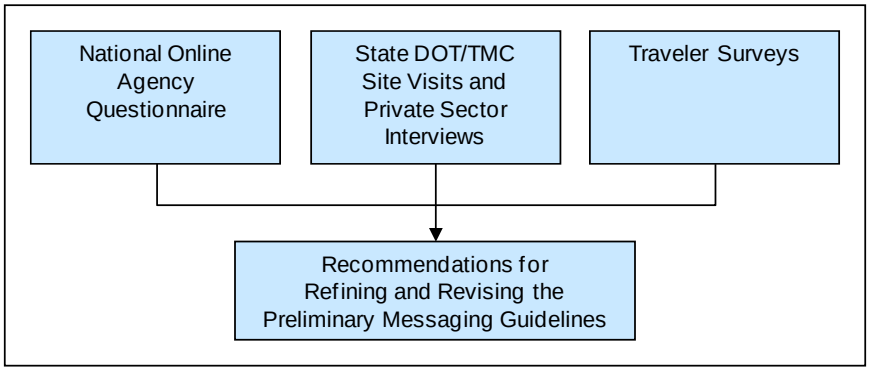


Figure 2. Evaluation components.

Three concurrent approaches were used to obtain user feedback—a national user questionnaire, site visits and telephone interviews with selected DOT and TMC personnel and other key stakeholders, and surveys with travelers, as follows:

- An online questionnaire was developed and email notifications were sent to approximately 200 potential users of the guidelines across the country (see Appendices A and B). Although responses were received from 59 individuals, only 21 completed the guideline-related questions.
- A few of the more progressive state DOTs and TMCs were identified, and site visits were conducted with those that agreed to participate in the evaluation. During these site visits detailed discussions addressed the messaging guidelines, their current road weather messaging practices, and their suggestions for improving the utility of the guidelines.
- Two private sector weather services providers were asked to review the guidelines and offer their perspective and suggestions for improvements.
- Each site DOT or TMC that was visited was asked if they could support a survey of their travelers in order to obtain direct feedback on new or revised road weather messaging that the DOT or TMC had decided to implement based on the guidelines.

On-line Questionnaire with State and Agency Officials

A web-based questionnaire was developed that included questions on a number of high-level, high-priority topics relevant to the evaluation objectives. To facilitate participation in the web-based questionnaire by state and road weather-related agencies, a request-to-participate was developed and sent by e-mail to a number of key points-of contact (POCs) associated with the following organizations:

- I-95 Corridor Coalition
- FHWA's TMC Pooled Fund Study
- I-80 Winter Operations Coalition
- Aurora Program

The e-mail included a project description and the preliminary guidelines, along with the details of the request and a link to the web-based questionnaire. This-e-mail request is provided in Appendix A, and the questions are contained in Appendix B.

Also, direct requests for participation (the letter provided in Appendix A plus the preliminary guidelines) were sent to members of the 511 Coalition and participants at the Weather Responsive Traffic Management (WRTM) conference held on October 6-7, 2011 in Portland Oregon. Overall, requests to complete the web-based questionnaire were sent by e-mail, either directly or through key POCs, to approximately 200 individuals; it is likely that some individuals received requests through multiple affiliations.

Site Visits with State DOTs and TMCs

Data were also obtained from users of the guidelines through site visits and phone interviews. Table 1 shows the criteria that were used in identifying state DOTs or TMCs that were appropriate for visiting. The approach included the following components:

- Evaluation approach.
- Selection criteria for participation in the assessment.
- Recruitment approach.
- Approach for obtaining feedback from participants.
- Approach to collecting feedback from travelers.

Table 1. Selection strategy for identifying sites to visit for the evaluation.

Criterion	Anticipated Variation
Regional Variation	North, East, South, West, NW, SW, NE, SE, N Central, S Central.
Operational Network Coverage	Regional or statewide. Freeway, arterial or both. Urban or rural.
Weather that may Affect Transportation System	Snow, ice, freezing rain, heavy rain, flooding, hurricanes, blowing dust/sand, blizzards.
Traveler Information Dissemination Methods for Weather	Group A: Dynamic Message Sign (DMS), Text, Personal Electronic Device (PED). Group B: Website, Kiosks. Group C: Highway Advisory Radio (HAR), 511. Are all 3 groups represented?
Types of Messages During Weather Events	Diversion, closures, cautions, speed control.
Who is Responsible for Deciding on and Posting Messages?	State DOTs, TMC operators, Information Technology (IT) divisions, Other agencies.
Approach to Crafting and/or Selecting Messages	Fixed, Free-form, Mixed.
Willingness to Improve Messaging, Participate in Assessment, and Gather User Data	Agree or not to participate. Agency gathers user data through surveys or focus groups (yes/no).

Preparations for the Site Visits

Nine sites/agencies were contacted by the evaluation team, and they agreed to further discussions regarding engagement in the evaluation and a possible site visit or follow-up contacts. Contacts were identified for each agency and each was provided with a copy of the preliminary messaging guidelines, along with a set of questions to help guide their review of the guidelines. Table 2 provides the list of agencies initially contacted, as well as our key points-of-contact.

Table 2. Sites/agencies that participated in the guidelines evaluation.

Site/Agency	Contacts	Schedule of Site Visits/Calls/Meetings
Kansas City (KC) Scout, MO	Nancy Powell Jason Sims	Meeting at WRTM Workshop, Portland, OR: 10/7/11. Site visit Kansas City: 11/14/11. Several follow-up calls.
Wyoming Statewide TMC (WYDOT)	Vince Garcia Kevin Cox	Initial phone call: 9/12/11. Meeting at WRTM Workshop, Portland, OR: 10/7/11. Site visit Cheyenne, WY: 11/15/11. Several follow-up calls.
Colorado Springs, CO TMC (CSTMC)	Rob Helt Steve Tobias	Initial phone call: 9/13/11. Meeting at WRTM Workshop, Portland, OR: 10/7/11. Site visit Colorado Springs, CO: 11/16/11. Several follow-up calls.
Colorado DOT, CO (CDOT)	John Nelson Joe Tucker	Initial phone call: 9/19/11. Site visit Golden, CO: 11/15/11. Several follow-up calls.
Washington State DOT (WSDOT) and six Northwest Regional TMCs	Mark Leth Chris Thomas Ron Vessey	Initial phone call: 9/15/11. Meeting at WRTM Workshop, Portland, OR: 10/7/11. Attended TMC supervisors' meeting Olympia, WA with the 6 TMC representatives: 11/17/11. Separate follow-up calls with the 6 TMC supervisors: week of Feb. 20th.
Maryland (MD) Coordinated Highway Action Response Team (CHART)	Dave Rossbach Theodore Valmas	Initial phone call: 9/19/11. Site visit Hanover, MD: 3/7/12.
Meridian Environmental Technology, Inc.	Leon Osborne Julie Theisen Mark Owens	Initial phone call: 9/15/11. Several follow-up calls. Guidelines review call: 2/16/12.
Castle Rock, Inc.	Peter Davies Karen Virshbo	Initial phone call: 9/14/11. Guidelines review call: 3/5/12.

The contacts identified in Table 2 were in several cases arrived at through an iterative referral process starting with the initial call to the agency. Kickoff calls were held with each of these contacts in September 2011, site visits were scheduled, and follow-up telephone discussions occurred after the site visits.

A kickoff phone call was held with each of the candidate sites/agencies as noted in Table 2. These calls covered the following topics:

- Whether the agency had a copy of the guidelines and determining who had reviewed them or was planning to review them.
- How each site/agency currently managed their road-weather messaging, including whether they use fixed or ad hoc messaging or a combination; what guidance sources they may use in establishing their message sets; whether they offer written message posting guidance to their operators; what technologies they use to disseminate messages to their traveling public; how they decide when to post and remove messages and where to post them; who is involved in message framing and posting decisions; and, whether any of their messaging is automated.
- Whether they archive messages and what is included in the archived information.
- Whether they were willing to use the preliminary message guidelines to make changes or adjustments to their current road-weather messages for evaluation purposes.

- Whether they survey their traveling public, or track traveler feedback on their messages that could be made available to the evaluation.

After these kickoff calls, each site/agency was provided with a set of questions to help focus their review of the message guidelines (see Appendix C).

A site visit meeting of about 3 hours each was conducted with KC Scout, WYDOT TMC, CDOT, CSTMC, and MD CHART. Meetings with the six WSDOT regional TMCs were conducted through an initial meeting with the TMC supervisors, followed by email and phone communications with the individual supervisors. Representatives of Meridian and Castle Rock were interviewed by phone. A general agenda was prepared for the in-person site visits (Appendix D), and this was fine tuned to best fit the needs of each site. A representative of the Road Weather Management Program (RWMP) joined members of the evaluation team for site visits to WYDOT TMC, CDOT, and CSTMC, and two FHWA representatives attended the meeting with CHART.

These were several objectives of these site visits:

1. To understand how the DOT/TMC currently handles their road weather messaging, including whether they use set messages in a message library and whether and how they may create ad hoc messages to fit particular circumstances.
2. To understand the different technologies they use to convey road weather messages and related information both internally to their operators and staff and externally to the traveling public.
3. To obtain general feedback on the FHWA preliminary message guidelines regarding which guidelines they find useful and what general suggestions they have for improving the guidelines document.
4. To review each individual guideline with the DOT/TMC managers and operators to obtain suggestions for modifications and improvements.
5. To determine whether the DOT/TMC would be willing to use new road weather messages, new approaches to providing those messages, or make modifications to existing messages, based on the guidelines with the particular objective of being able to test the effectiveness of the new messages during the evaluation period.
6. To implement, where feasible, a traveler survey designed to learn how the traveling public in the DOT/TMC's jurisdiction views any changes in road weather messaging based on the guidelines and to assess the perceived usefulness of those changes. An important element in these site visits was to seek opportunities to obtain feedback from travelers in these site areas who may have observed road weather messages en-route on dynamic message signs (DMSs), heard them on 511, or seen them pre-trip on their state DOT's traveler information website. An on-line survey was prepared for use by KC Scout (Appendix E), and this was shared with each of the other sites, and they were offered the opportunity to post an appropriately modified version of this survey on their respective websites.

Interviews with Private Service Providers

The two private road weather technology service providers, Meridian and Castle Rock, were asked to review the guidelines and discuss their feedback and suggestions on a phone call with the evaluation team. The following questions were prepared to guide this discussion:

- Do you think these guidelines will meet the day-to-day needs of users? How or how not?
- Comments on the presentation format? Use of graphics? Easy to understand/use?

- Is the level of detail appropriate for users? Do they need more? Less?
- Is it easy to find topics of interest? Suggestions for improvements?
- What are the strongest points in the guidelines? Weakest?
- Are there other reports, documents, etc. that should be reviewed when revising the guidelines?
- How well do these guidelines compare with other guidelines with which you are aware?
- Any additional comments/suggestions for how to improve these guidelines?

Traveler Surveys

As noted above, we asked individual agencies if and how they surveyed their traveling public—or tracked traveler feedback on their messages—so that such information could be made available to the guidelines evaluation. Our goal was to implement, where feasible, a traveler survey designed to learn how the traveling public in the DOT/TMC's jurisdiction views any changes in road weather messaging based on the guidelines, and to assess the perceived usefulness of those changes. We had hoped that we might be able to "piggyback" our evaluation questions on to any on-going activities being conducted by the agencies to obtain traveler feedback on road weather messaging.

Due in part to the timing of our activities and the relative lack of extreme weather in the winter of 2011-2012, we were only able to implement a traveler survey with KC Scout. For a time, KC Scout posted a link on their public website that directed travelers to a set of questions regarding what specific weather messages they may have recently seen, whether the message was easier to understand, the degree to which the message was useful, and how the message affected their travel behavior.

We only received a very small number of responses to the survey and, therefore, did not conduct any in-depth analyses of these data.

Evaluation Results

On-line Questionnaire with State and Agency Officials

The results for each questionnaire question are presented in the following sections. Note that the order of categories in each chart mirrors the order of response options in the questionnaire. While there were 59 total respondents, only 21 respondents answered any of the questions related to the content of the guidelines (Questions 4 to 16).

Question 1: What is your professional title?

Twenty (20) respondents working in various positions at TMCs and state DOTs provided responses to Question 1. The responses are categorized follows:

- Intelligent Transportation System (ITS) Manager (5)
- Traffic Management Center Manager (3)
- Civil Engineer (2)
- Traffic Operations Engineer
- Senior Transportation Engineer

- Assistant State Traffic Engineer
- Professional Electrical Engineer
- Supervisor
- Acting Director of the System Optimization Bureau
- Traveler Information Manager
- Policy and Business Planning Supervisor
- Weather Operations and Road Weather Information System (RWIS) Program Manager
- Maintenance Operations Section Supervisor

Question 2: Please describe your job responsibilities in 1-2 sentences.

Twenty (20) respondents provided responses to Question 2. Respondents listed a variety of job responsibilities. Some were program managers who oversaw message design and managed the ITS program or the TMC itself. Others developed the actual weather messages. Some were more involved in creating policy for the DOT or TMC. The complete list of responses is reported below:

- Head the statewide System Ops Bureau (ITS). Responsible for development and implementation of policy and procedures as well as oversight of the general direction of the ITS program throughout the state.
- Responsible for operating a large statewide ITS. Includes urban advanced traffic management system, advanced traveler information system, incident management system, hurricane evacuation systems and some rural ITS elements.
- Oversees the Central Regional Traffic Management Center (RTMC) for PENNDOT. It entails responsibility for the RTMC and traffic management. Also oversees the Signals Group in their District. This entails review and approval for traffic signals and transportation impact studies (for Highway Occupancy Permits).
- Works with Transportation Maintenance, but during the previous five years at NYSDOT, worked on 511NY and the Winter Travel Advisory (WTA).
- Assisting the ITS Division Traveler Information Section Manager with the traveler information program including the 511PA system and its associated internal policies and procedures for operations.
- Statewide ITS Program Manager, Operations IT Manager, Tri-State (ME, NH, & VT) Managing Assets for Transportation Systems Program Manager.
- Responsible for roadside devices and TOC.
- Authors the NDDOT Snow and Ice Control Plan, coordinates response to storm events and emergencies, coordinates the Emergency Relief program, and serves as project manager for the statewide Automatic Vehicle Location and Maintenance Decision Support System projects.
- Responsible for the planning, developing, deployment, maintenance and operations of all things ITS for the NMDOT.
- Provide technical support for the design and operations of ITS.

- Headquarters manager for TMC and Traveler Information for the California Department of Transportation.
- Does most everything.
- Manages devices and people to keep traffic moving.
- Provides operations support services to the Port Authority of New York and New Jersey Tunnels, Bridges, and Terminals facilities.
- Oversees operations and Dispatch in the Sacramento Regional Traffic Management Center for Caltrans.
- Manages the ITS program, incident management and Traffic Engineering. Managing the TMC in Nashville, TN.
- Supervises the daily activities of the road operations center in Elko, Nevada.
- Provides engineering oversight on the TMC including developing appropriate messages for DMS, Portable Changeable Message Sign (PCMS), HAR, and 511. 511 project manager, including other traveler information initiatives such as incident e-mail alerts and Twitter.
- 511, websites, Twitter, packaging TOC information for distribution to the traveling public.
- A meteorologist who oversees the contract with the DOT's weather forecasters, all research related to road weather, the RWIS network, and anything else related to road weather.

Question 3: How many years of experience do you have?

Twenty (20) respondents provided answers to Question 3. There was a wide range of experience levels represented, with good representation from highly experienced individuals (*Mean* = 17.6 years). The distribution of responses obtained for Question 3 is shown in Figure 3.

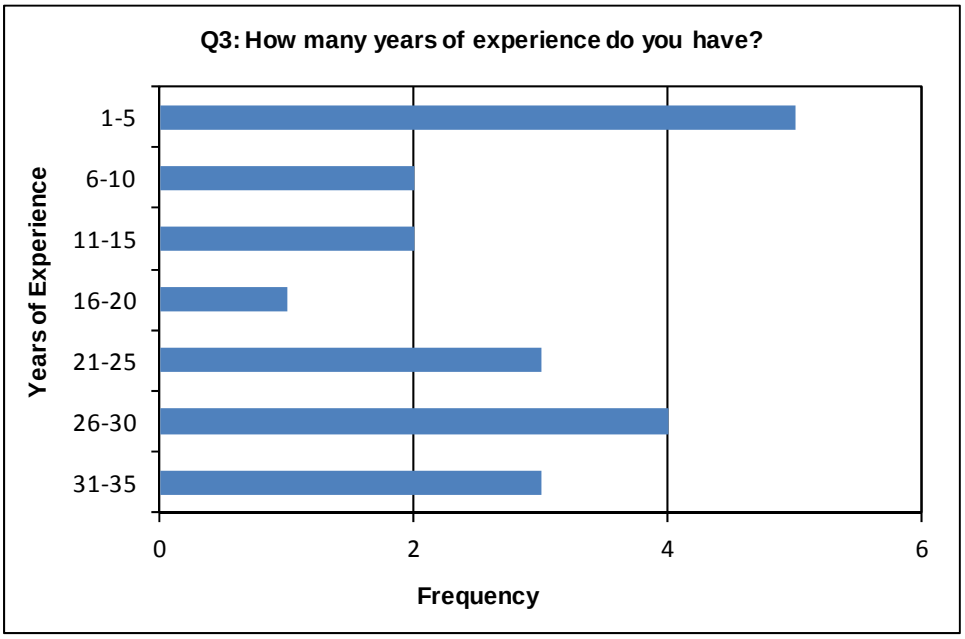


Figure 3. Responses to Question 3.

Question 4: In general, how well did the guidelines meet your day-to-day needs for this kind of information? How often would you use them?

Twenty (20) respondents answered Question 4. Seven respondents indicated that the guidelines met their day-to-day needs for this kind of information, while two respondents indicated that they did not. Seven respondents indicated that the guidelines could be useful as a reference tool (e.g. when developing operating policies on message content or refining existing policies). Two respondents indicated that their job duties do not require providing road weather information on a day-to-day basis. The remaining respondents gave a response about the guidelines in general:

- The guidelines should focus on weather-related discussions, should be specific about how messaging relates to weather, and reference information sources for standard messaging (formatting, font, length of message, etc.).
- The introduction seems lengthy and redundant in places. The discussion sections are very valuable.

Question 5: What kinds of questions were you able to address with the guidelines?

Twenty (20) respondents answered Question 5. Twelve respondents indicated that they were able to answer questions about message formatting, content, length, or structure. The remaining eight respondents indicated being able to answer questions about the following topics:

Any questions regarding operation.

- General questions that upper management may ask.
- General snow and ice removal.
- When travelers need the information (before or during their travel).
- Best and accepted practices.
- Human factors statistics.
- Working toward consistency of messages between multiple regional partners and throughout the whole state.

One respondent also indicated that there was too much information, which made it difficult to focus on weather, when the vast majority of the information covered material to which users in the Traffic Operations Centers already have access.

Question 6: How helpful are the graphics in the guidelines – how would you rate the text-to-graphics ratio in the guidelines?

Nineteen (19) respondents answered Question 6. Sixteen respondents said that the graphics were helpful and the ratio of text-to-graphics was fine; however three respondents also indicated that they would like to see more graphics used in the guidelines.

Question 7: Is the presentation format used in the guidelines easy to understand?

Twenty-one (21) respondents answered Question 7. Nine respondents (42.9%) answered "yes," that the presentation format used in the guidelines was easy to understand and seven respondents (33.3%) answered that it was "mostly" easy to understand. The distribution of responses obtained for Question 7 is

shown in Figure 4. Through additional comments, respondents suggested improving the format by grouping guidelines by dissemination method. This would allow them to avoid skipping around in the document to design a message.

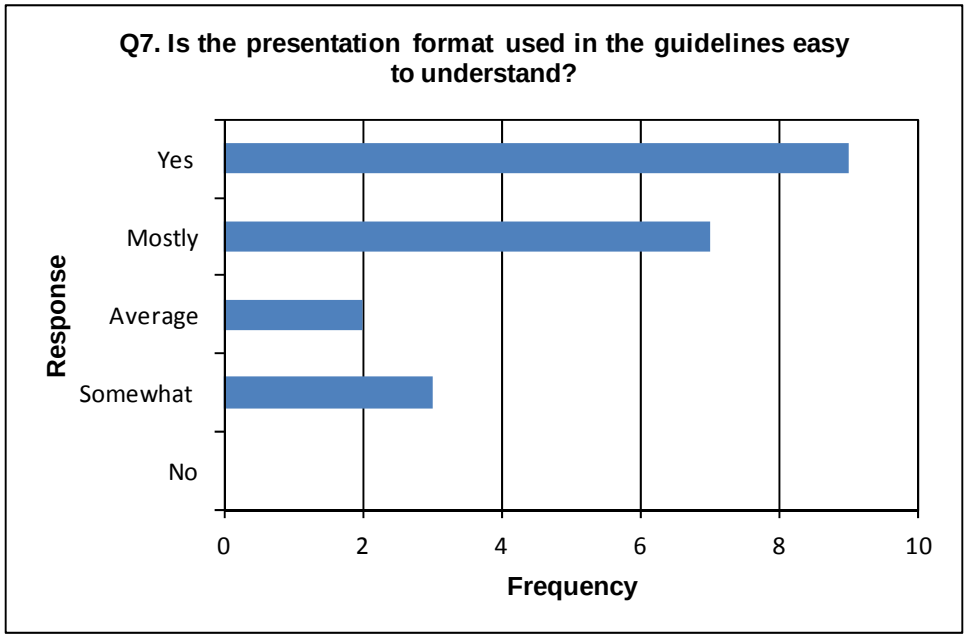


Figure 4. Responses to Question 7.

Question 8: Is the information presented in the individual guidelines easy to use?

Twenty (20) respondents answered Question 8. Twelve respondents (60%) answered "yes," that the information presented in the individual guidelines was easy to use, five respondents (25%) answered that it was "mostly" easy to use, and three respondents (15%) answered that it was "somewhat" easy to use. The distribution of responses obtained for Question 8 is shown in Figure 5.

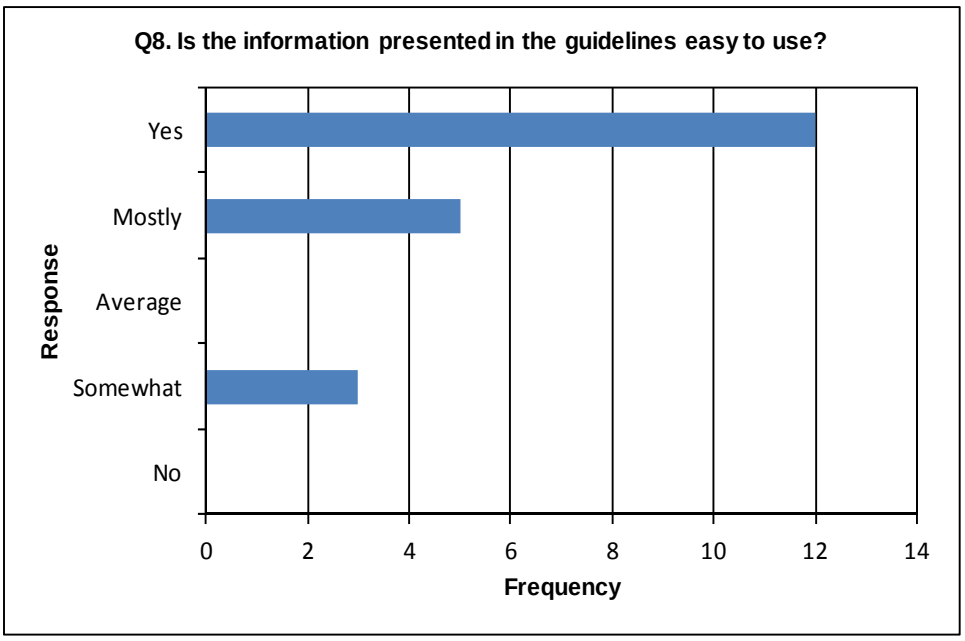


Figure 5. Responses to Question 8.

Question 9: Do individual guidelines contain an appropriate level of detail? Do they need more or less detail?

Twenty (20) respondents answered Question 9. Eighteen respondents felt there was an appropriate level-of-detail, but five respondents also indicated that sometimes they felt overwhelmed by the amount of information. These individuals suggested presenting the information in a simpler format. Suggestions to achieve this included:

- Packaging guidelines by dissemination method into multiple standalone documents.
- Moving some of the information currently included in the discussion sections to tutorials.
- Including an Executive Summary so users could avoid reading all of the details.

Question 10: Is it easy to find individual topics of interest in the guidelines?

Twenty-one (21) respondents answered Question 10. Seven respondents (33.3%) answered that it was easy to find the individual topics of interest in the guidelines, while nine respondents (42.9%) answered that it was "mostly" easy to find topics. The distribution of responses obtained for Question 10 is shown in Figure 6. Through additional comments, respondents suggested the following ways to make the guidelines easier to navigate:

- Increasing the prominence of the Guideline Look-Up Table.
- Grouping similar topics together.
- Providing a numbered index.

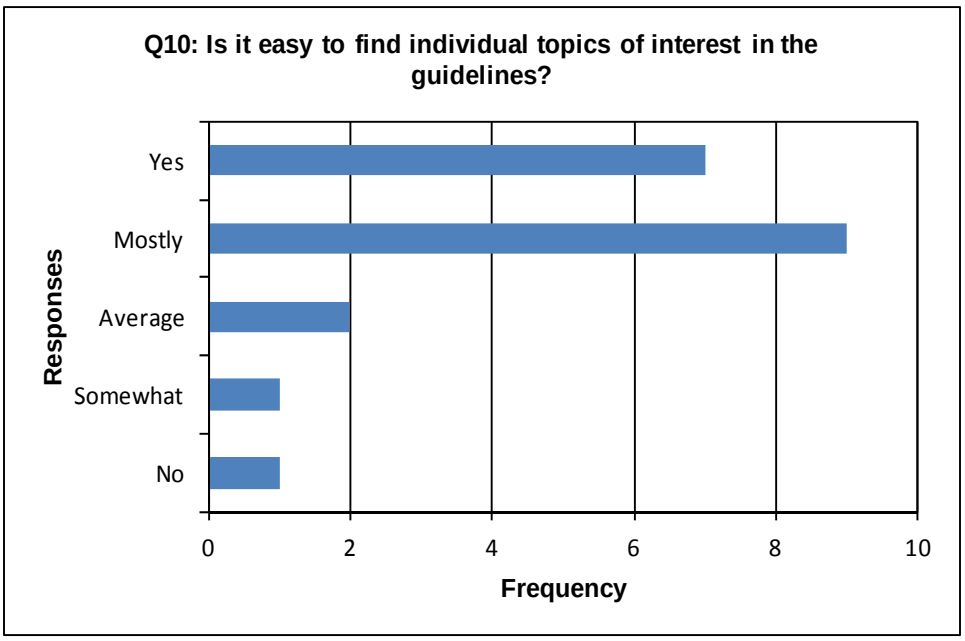


Figure 6. Responses to Question 10.

Question 11: If you could change one thing about the guidelines, what would it be?

Fifteen (15) respondents answered Question 11. Respondents suggested a variety of things that could be changed; however, each suggestion fit into one of three categories: changes to guideline content, changes to guideline organization, or changes to guideline format. The categorized suggestions are listed below:

- Changes to guideline content: make the title more representative of the content (2), condense content, expand by developing scenarios and information on special event management or incidents, eliminate probabilities in weather messages (Guideline 30), remove basic information, adopt National Standards.
- Changes to guideline organization: group guidelines by dissemination method, move information currently in discussion sections to tutorials.
- Changes to guideline format: increase the size of pictures and graphics, present in a simpler format.

Two respondents indicated that no changes should be made to the guidelines.

Question 12: Overall, is the information presented in the individual guidelines useful and valuable to you?

Twenty (20) respondents answered Question 12. Fourteen respondents (70%) stated that the information presented in the individual guidelines was useful/valuable or "mostly" useful/valuable. The other six respondents (30%) answered that the information was "average" or "somewhat" useful/valuable. The distribution of responses obtained for Question 12 is shown in Figure 7. Through additional comments, respondents said the guidelines were specifically helpful for developing new messages, editing message protocols and training new employees.

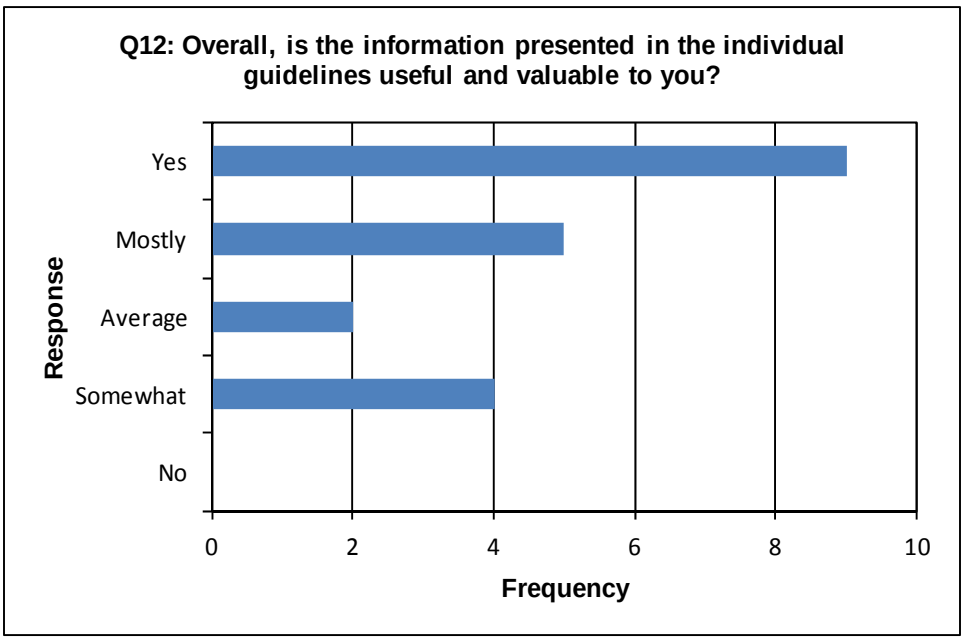


Figure 7. Responses to Question 12.

Question 13: What guidelines or topics in the guidelines document are most useful to you?

Eighteen (18) respondents answered Question 13. Seven respondents indicated that the most useful guidelines or topics in the guidelines were those about general messaging, such as, message length, message content, message structure, and message wording. The remaining eleven respondents indicated other useful guidelines, topics, or sections included in the following:

- Dissemination Methods: DMS, HAR, 511, website, PED.
- Specific Guidelines/Sections: Guideline 17, Guideline 30, Chapter 3: Tutorials.
- Before and after message examples, or identifying acceptable and unacceptable elements.
- The Weather Event and Impact on Travelers table within the Tutorials chapter.

Question 14: What guidelines or topics in the guidelines document are least useful to you?

Fourteen (14) respondents answered Question 14. Eleven respondents specified guidelines, topics, or dissemination methods that were not useful for them. Three respondents were not able to identify any guidelines that were not useful to them. Below are the individual topics or guidelines that were found to be least useful.

- Dissemination Methods: DMS, HAR, PED, 511, and kiosks.
- Specific Guidelines: Guideline 15, Guideline 22, and Guideline 30.
- Basic information on message formatting, fonts, colors, and icons.
- Weather impacts to transit.

Question 15: Can you suggest any other reports, documents, etc., that we should review when we revise the guidelines?

Ten (10) respondents answered Question 15. Five of the respondents indicated that there were not any additional materials that should be reviewed during the revision of the guidelines. The remaining respondents suggested reviewing information regarding:

- The use of symbology on DMS.
- Data from all states to create a best practices standard.
- Non-U.S. research related to the guidelines.
- How the message sets compare to the Transportation Management Data Dictionary (TMDD).

One respondent also noted that the guidelines should be revised as the capabilities of the available technologies change.

Question 16: Please provide us with any additional questions, comments, or suggestions, which relate to specific sections or elements of the guidelines.

Five (5) respondents answered Question 16, with three respondents providing a detailed answer. Those respondents suggested providing examples from other states to allow for comparison of message content and organization between states, discussing Federal Communications Commission (FCC) restrictions and requirements for HAR messages, and providing a standardized approach for structuring travel information messages.

On-line Questionnaire Summary and Observations

The 21 respondents to the on-line questionnaire reflected a wide range of job positions and responsibilities at TMCs and DOTs. It was clear from the responses to the questionnaire however, that the respondents were representative end users of the guidelines, in terms of their reported day-to-day activities and overall levels of experience.

Their reaction to the preliminary guidelines were generally very positive, in terms of overall usefulness, ease of use, level of details, content, and value. Many of the suggestions provided by the respondents for improving or refining the guidelines mirrored those provided by the in-depth evaluations (discussed below). Since the in-depth evaluations involved much more exposure to the guidelines and actual use of the guidelines, we have given the results of the site visit portion of our evaluation somewhat greater weight.

Site Visits with State DOTs and TMCs

The evaluation team made arrangements to visit the six state transportation agencies (DOTs and TMCs) that had agreed to support the evaluation of the road weather messaging guidelines (see Table 2). The team also set up conference calls with other key participants, including two private sector traveler and road weather information service providers. Initially the objective included gathering a baseline understanding of how these agencies currently conduct their road weather messaging, including the following kinds of information:

- How the agency communicates road weather information to their traveling public, including the systems and technologies that support their communications.

- How the agency decides when, where and how to post road weather messages.
- Whether the agency uses established fixed message sets and/or used ad hoc messages that their operators create for particular events and circumstances when they occur.
- Whether the agency would be willing to make changes to any of their messages or messaging procedures based on the guidelines.
- Whether the agency currently surveys their traveling public to obtain feedback on their communications and advisory messages, and whether they would be willing to specifically survey their traveling public to obtain reactions to any changes in road weather messaging based on the guidelines.

Where they were available at these sites, message sets regarding weather that each agency is currently using were obtained. Also, any written policies or guidance used by the agency to support their current messaging practices were also collected.

Agency site visits were conducted as planned in the fall of 2011. Where possible, baseline information was collected during the planning calls with each of these agencies, and additional baseline information was supplemented during the site visits.

Kansas City Scout TMC

Several telephone interviews were held with KC Scout in August and September 2011 to discuss their current road weather messaging and plans for the winter of 2011-2012. KC Scout began developing their own winter weather messaging sets beginning in the spring of 2011, based on the preliminary guidelines that were released at that time. Scout is a bi-state TMC representing Missouri and Kansas DOTs in providing traffic management for the metropolitan Kansas City area. They also implement unique Missouri DOT (MoDOT) and Kansas DOT (KDOT) messaging plans along the I-70 corridor between Colorado and St. Louis. MoDOT and KDOT met in mid-September 2011 to finalize decisions regarding severe weather message sets, and the guidelines were used in support of that decision process. KDOT operates a 511 phone service but MoDOT does not offer 511 and instead relies upon 24/7/365 live-operator customer service to answer caller's questions (1-888-ASK-MODOT). They are seeking a license to operate a HAR system. The guidelines' recommendations were forwarded by KC Scout to MoDOT's corporate website department that develops a travel map for the state. Scout looks to this website to extract information on state road closures due to weather. KDOT's website information is particularly wordy. KC Scout believes that these three systems can benefit from handling information and messaging consistently based on following the guidelines, and the guidelines can serve as a justification for making needed changes.

KC Scout stores their standard preset weather messages in libraries. Scout auto-posts recommended messages for DMS on their Advanced Traffic Management System (ATMS), and TMC operators can accept or modify these messages. KDOT and MoDOT manually select and post their road weather messages. KDOT's messages are sent to legal for review before they are accepted into a message library, due to liability concerns. They also do ad hoc messaging. They plan to use the guidelines to update their message libraries, and are reviewing snow messages used in prior years for possible inclusion into the message library. They will use the guidelines to help with this review, along with legal and operational reviews. At KC Scout road weather messaging is integrated in the ATMS with other event and traffic information, and the system will provide a recommended message plan. The TMC operator can simply accept the recommended message or change the message as they see fit, though KC Scout wants to minimize operator discretion.

Scout has a comprehensive message archiving capability. They are prepared to request public traveler feedback on messaging through their website and/or local media. When initially establishing their road weather message sets, they relied on a consultant's review of the literature and the MUTCD. At that time, weather was not a significant component, since weather wasn't considered as an "incident." The attitude was that weather is beyond their control and forecasts are highly inaccurate. Since then, attitudes have shifted dramatically, and weather information is regarded as central.

It was agreed with KC Scout that the testing and evaluation of the guidelines would primarily focus on the use of the guidelines in crafting their DMS road weather messages. Scout has used the preliminary guidelines and developed new messaging for weather-related conditions on their DMS signs. These messages will be used for the first time during the winter of 2011-2012. Table 3 lists the messages that were developed by Scout and approved for use:

Table 3. KC Scout winter road weather DMS messages.

GIVE SNOW PLOWS ROOM TO WORK USE CAUTION	BLOWING SNOW REDUCED VISBILITY TRAVEL NOT ADVISED	REDUCED VISIBILITY USE HEADLIGHTS USE CAUTION
SNOW PLOWING IN EFFECT EXPECT DELAYS	SEVERE THUNDERSTORM WARNING TUNE TO LOCAL MEDIA	WATER OVER ROADWAY [LANE SPECIFIED]
HIGH WIND ADVISORY USE CAUTION	FOG CONDITIONS REDUCED VISIBILITY USE CAUTION	DO NOT USE CRUISE CONTROL DURING [RAIN/SNOW/ICE]
EXTREME WEATHER USE CAUTION ON BRIDGES AND RAMPS	EXTREME WEATHER CONDITIONS TRAVEL NOT ADVISED	MAJOR WINTER STORM EXPECT DELAYS LIMIT TRAVEL

As a result of the site visit discussions, KC Scout is considering a few other changes to the above messages. These include:

- Creating a new message for black ice.
- Creating a message for tornado warnings.
- Including fog extent (miles) in the message relating to fog.
- Changing the cruise control message to match MoDOT's messages.

In addition to the DMS information, Scout planned to improve their Twitter feed for weather-related messaging.

The test approach in Scout included tracking the message usage and obtaining feedback on effectiveness—where possible—from users. Scout's system archives messages posted for each event and is well-suited to tracking usage of DMS messages. Scout shared their archived data of message use during each event in the upcoming winter (December – February), as well as for the same time period in the prior winter for comparison.

Scout also posted a survey on their website to collect qualitative user perception data during the winter months (see Appendix E). Due to an unusually mild winter, however, few winter weather messages were posted and the online survey generated no usable responses.

Wyoming Statewide TMC

In discussions during the summer of 2011, the TMC personnel in Cheyenne agreed to participate in the evaluation of the preliminary messaging guidelines. The TMC indicated that message scripts have been in place there for about 18 months, for 511 and 511 notify (push text messaging), DMS, HAR, and their web site. They anticipated using the messaging guidelines to support making periodic adjustments. Both the TMC and the University of Wyoming conduct periodic public traveler surveys. Most of their messaging is automated, but they also make ad hoc adjustments to standard messages to fit special situations. Shift supervisors are authorized to do ad hoc messaging. The TMC planned to start archiving messages beginning October 2011. They said they also are interested in Commercial Vehicle Operator (CVO) messaging.

WYDOT reviewed the guidelines in detail and identified the following changes that they would consider making this winter for DMS.

- Follow the design guideline to have a 300 ms gap between message phases.
- Review phase cycle times to account for having one phase go longer than the second based on the number of information units, traffic speeds, and visibility.

In addition, WYDOT identified the following changes that they plan to implement for their website:

- Changing the district-level web pages from a text-oriented to more column-based approach with route-icons as is illustrated in the guidelines.
- Providing a time stamp for the statewide map. It was noted that some elements within a statewide map area are likely to have independent updates and timestamps.
- Changing the "square" hazard icon to a triangle.

WYDOT reported making several changes in their messaging as of January 2012, based on the messaging guidelines. They indicated that they refer to the guidelines weekly in addressing message issues. They have revamped their text-based traveler information communications based on the guidelines, and they report that the guidelines have given them an easier way to focus their efforts. More recently they have embarked on a substantial rebuild of their traveler information website, transitioning from a text-oriented mode to a graphics-oriented mode. In carrying out this redevelopment effort, they have followed Guideline #24 on communicating open format table information.

They made four changes in messaging since the site visit of November 2011. The first three are outlined in Table 4 below, with new messaging illustrated in Figure 8 and a customized web-based data entry form illustrated in Figure 9. Additional website modifications are illustrated in Figure 10 and Figure 11, showing the approach before the update and then after the update. WYDOT planned to release the new web design by the end of March 2012, then seek comments through a user survey, and complete final revisions by late August 2012.

Table 4. Messaging changes by WYDOT based on selected guidelines.

Source: Personal communication with Chris Cluett and WYDOT, dated January 26, 2012

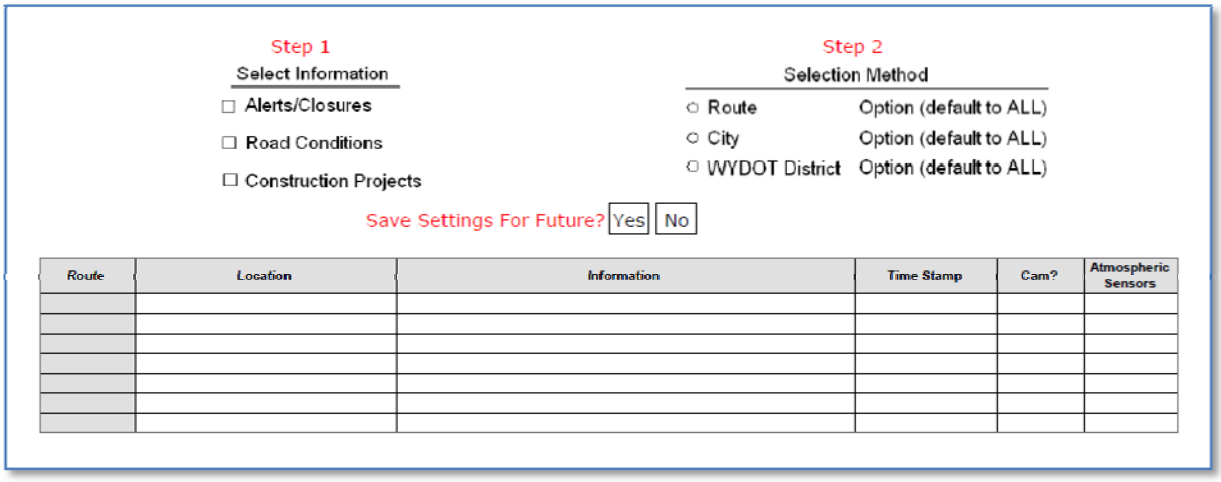
FHWA Message Guidelines			
Date	Guideline	Implementation	Implemented By:
11/16/2011	GUIDELINE 11. DYNAMIC CHARACTERISTICS –	Inserted a 300 ms blank screen between	Kevin Cox
12/8/2011	GUIDELINE 23. ACCOMMODATING OTHER WEB-BASED DISSEMINATION METHODS – SHORT	Developed and deployed Google-TV based information system for trip generating	Suzie Roseberry
1/11/2012	GUIDELINE 15. USE OF VISUAL ICONS – SHORT TEXT/VISUAL & OPEN-FORMAT	Changed map symbols to be triangular	David Rush

The second item shown in Table 4, based on guideline #23, is reflected in new electronic signage in the University of Wyoming's sports arena to provide road-weather travel information to people when leaving the arena to travel home (see Figure 8 images below).

Source: Personal communication with Chris Cluett and WYDOT, dated January 26, 2012

Figure 8. Images of WYDOT's new sports arena message signs.

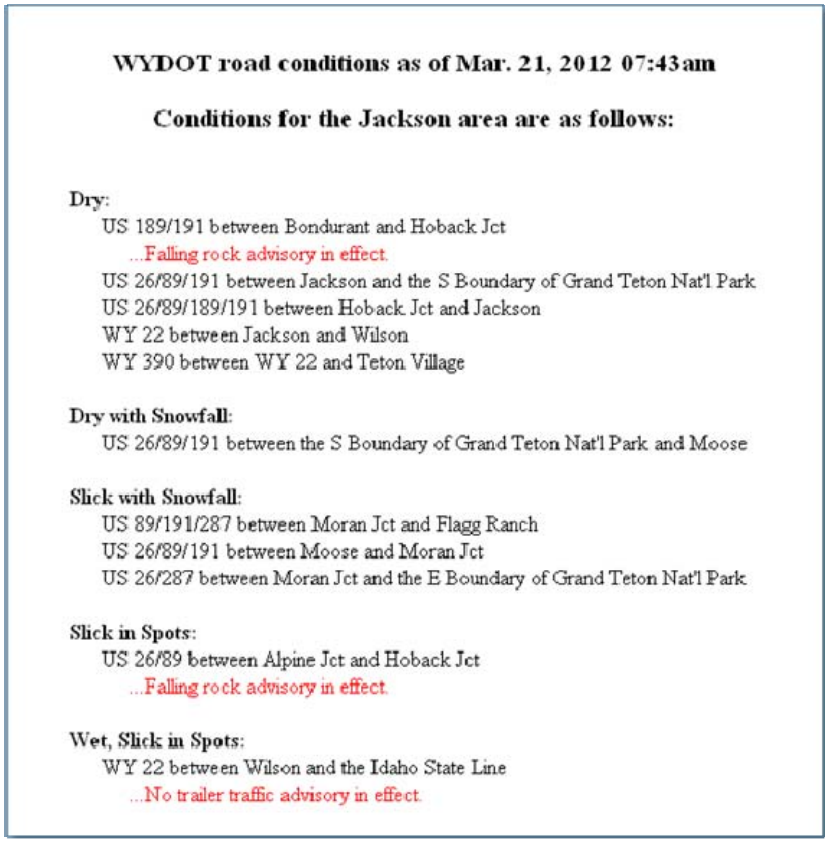
WYDOT's most recent use of the guidelines is to offer travelers a web-based method to customize road-weather information. This combines several different current web approaches into a single method that is in compliance with the guidelines.



Source: Personal communication with Chris Cluett and WYDOT, dated January 26, 2012

Figure 9. Draft of WYDOT data entry format for web users to customize road weather information.

Figure 10 shows an example of how road condition information has been communicated to the traveling public to date, and Figure 11 shows the same information content presented on their website after the rebuild.



WYDOT road conditions as of Mar. 21, 2012 07:43 am

Conditions for the Jackson area are as follows:

Dry:
US 189/191 between Bondurant and Hoback Jct
...Falling rock advisory in effect.
US 26/89/191 between Jackson and the S Boundary of Grand Teton Nat'l Park
US 26/89/189/191 between Hoback Jct and Jackson
WY 22 between Jackson and Wilson
WY 390 between WY 22 and Teton Village

Dry with Snowfall:
US 26/89/191 between the S Boundary of Grand Teton Nat'l Park and Moose

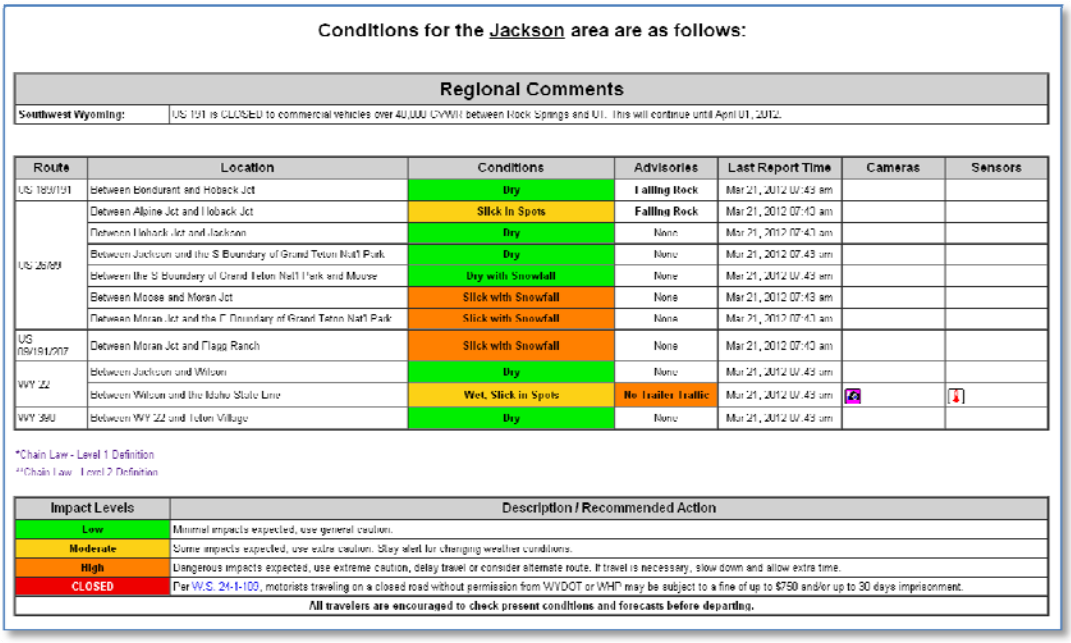
Slick with Snowfall:
US 89/191/287 between Moran Jct and Flagg Ranch
US 26/89/191 between Moose and Moran Jct
US 26/287 between Moran Jct and the E Boundary of Grand Teton Nat'l Park

Slick in Spots:
US 26/89 between Alpine Jct and Hoback Jct
...Falling rock advisory in effect.

Wet, Slick in Spots:
WY 22 between Wilson and the Idaho State Line
...No trailer traffic advisory in effect.

Source: Personal communication with Chris Cluett and WYDOT, dated March 21, 2012

Figure 10. Example of WYDOT road condition information dissemination before the website rebuild.



Conditions for the Jackson area are as follows:

Regional Comments	
Southwest Wyoming:	US 191 is CLOSED to commercial vehicles over 40,000 GVWR between Rock Springs and UT. This will continue until April 01, 2012.

Route	Location	Conditions	Advisories	Last Report Time	Cameras	Sensors
US 189/191	Between Bondurant and Hoback Jct	Dry	Falling Rock	Mar 21, 2012 07:43 am		
US 26/89	Between Alpine Jct and Hoback Jct	Slick in Spots	Falling Rock	Mar 21, 2012 07:40 am		
	Between Hoback Jct and Jackson	Dry	None	Mar 21, 2012 07:40 am		
	Between Jackson and the S Boundary of Grand Teton Nat'l Park	Dry	None	Mar 21, 2012 07:43 am		
	Between the S Boundary of Grand Teton Nat'l Park and Moose	Dry with Snowfall	None	Mar 21, 2012 07:43 am		
	Between Moose and Moran Jct	Slick with Snowfall	None	Mar 21, 2012 07:43 am		
	Between Moran Jct and the E Boundary of Grand Teton Nat'l Park	Slick with Snowfall	None	Mar 21, 2012 07:40 am		
US 89/191/287	Between Moran Jct and Flagg Ranch	Slick with Snowfall	None	Mar 21, 2012 07:40 am		
WY 22	Between Jackson and Wilson	Dry	None	Mar 21, 2012 07:40 am		
	Between Wilson and the Idaho State Line	Wet, Slick in Spots	No Trailer Traffic	Mar 21, 2012 07:43 am		
WY 390	Between WY 22 and Teton Village	Dry	None	Mar 21, 2012 07:43 am		

*Chain Law - Level 1 Definition
**Chain Law - Level 2 Definition

Impact Levels	Description / Recommended Action
Low	Minimal impacts expected, use general caution.
Moderate	Some impacts expected, use extra caution. Stay alert for changing weather conditions.
High	Dangerous impacts expected, use extreme caution, delay travel or consider alternate route. If travel is necessary, slow down and allow extra time.
CLOSED	Per W.S. 24-1-100, motorists traveling on a closed road without permission from WYDOT or WHP may be subject to a fine of up to $750 and/or up to 30 days imprisonment.
All travelers are encouraged to check present conditions and forecasts before departing.	

Source: Personal communication with Chris Cluett and WYDOT, dated March 21, 2012

Figure 11. Example of WYDOT road condition information dissemination after the website rebuild.

Colorado DOT Statewide TMC

The evaluation team visited the CDOT TMC in Golden, CO on November 15, 2011. CDOT has been developing their own message library for their Variable Message Signs (VMSs), along with internal guidance for using those messages. The 14 TMC operators in CDOT's facility in Golden sometimes refer to their message library as a source of guidance to help craft free form (ad hoc) messages to fit the particular conditions with which they are faced in deciding what to post on their VMSs, website and 511 systems. Management encourages their operators to consider message wording taking account of the perspective of the traveler and what would be most appropriate for the traveler under particular circumstances, including road weather conditions. They have some road weather messages in their library of messages, but most of the time the experienced operators know what message to post, or in unusual circumstances they craft ad hoc messages. The operators observe radar images and roadside cameras, and in the winter they communicate regularly with their plow truck drivers regarding current road weather conditions to help them decide on the most appropriate messaging.

When there are no incidents or weather events, the operators may post public service information on their message signs. This typically includes information for truckers, and they use their VMSs to let travelers know about the 511 system. During the winter, CDOT used to post general messages, such as "winter driving conditions," but more recently they have tried to provide more specific information about the particular conditions.

The CDOT TMC supervisors reviewed the preliminary guidelines and determined that their current procedures and internal guidelines are mostly consistent with the preliminary guidelines document for DMSs. They thought the best way they could take advantage of the preliminary guidelines is to incorporate the information, where they thought appropriate, into their TMC operator training manuals. Historically, the more experienced TMC shift operators have guided the newer operators in how to frame messages, but now they are aiming to offer internal guidelines and consistent training for their operators based on those guidelines.

Since the site visit in November 2011, CDOT TMC updated their internal guidelines and submitted the document for review by the directors. Most of the updated changes in the current draft guidelines were initiated due to changes in technology or changes in their incident management plans. They are awaiting feedback from the directors' review before publishing a final draft. They have sought to incorporate a few adjustments based on the preliminary guidelines, but for the most part they believe their guidelines are consistent with the preliminary guidelines. They intend to refer to the federal guidelines, especially as they emerge in more final form, as they further refine their own operator training.

City of Colorado Springs TMC (CSTMC)

The evaluation team visited the CSTMC in Colorado Springs, CO on November 16, 2011. CSTMC and CDOT jointly post road weather messages which are mostly pulled from a library of fixed message sets. CSTMC also creates and posts local ad hoc weather messages based on their camera images and local patrol observations. They have the highest concentration of DMSs in the country on their city arterials. CDOT has the authority to override the CSTMC in posting statewide messages on their city DMSs, and actually half or more of all messages posted on the CSTMC message boards are posted by CDOT. All the CSTMC messages are manually posted, and CSTMC is eager for clearer messaging guidance. CSTMC hasn't conducted traveler surveys in the past but would be willing to solicit traveler feedback on posted road weather messages.

CSTMC tries to be as consistent as possible with CDOT in the posting of traveler information on their DMSs, though they would like to have more autonomy in determining when, where and what to post on their city's DMSs.

Most of the traveler information that the CSTMC provides on 511 and web pages is routed through the CDOT's Statewide TMC. CDOT is also active in posting DMS messages on interstates that run through the Colorado Springs area, and they are responsible for posting messages in the evening and nighttime hours on the CSTMC signs. CDOT is CSTMC's primary source for road weather information, and although CSTMC is aware of current and forecast weather conditions in their area, they experience considerable local variability which makes it difficult to anticipate which road segments will be impacted and how severe the effects are likely to be. They rely to a considerable degree on the state patrol, as well as CDOT, to request message updates, but there are inevitable inefficiencies in the systems communications that lead to messages not being posted when CSTMC feels they should be or messages left on well after the time when they should have been removed (a problem with the nighttime posting of messages by CDOT when CSTMC operators are not in the TMC).

CSTMC discussed during the site visit their plans to implement a number of changes or adjustments to their current road weather messaging as follows:

- *Guideline 02 Message Content – Auditory.* While this guideline pertains to auditory messages, CSTMC has discussed the use of "Major Delay" to indicate a delay of at least 20 minutes. In the future VMS and Twitter messages originated by the CSTMC will conform to using "Major Delay" when it is obvious the delay will be at least 20 minutes or more.
- *Guideline 03 Message Content for Diversion Directions – Auditory.* The CSTMC does not provide auditory recordings for 511; however, they do provide diversion directions using Twitter messages and also when contacting CDOT for use on statewide 511 messages. In the future when composing Twitter messages and when providing information to CDOT for 511, CSTMC will consider the words and phrases appropriate for both familiar drivers and unfamiliar drivers.
- *Guideline 11 Dynamic Characteristics – Short Text/Visual.* The recommendation to use a 300 ms blank screen between message phases 1 and 2 is excellent to help improve message readability. Currently CSTMC has zero time between each phase. CSTMC intends to change the default time between each message phase from zero to 300 ms.
- *Guideline 13 Use of Visual Icons – Short Text/ Visual and Open Format.* The CSTMC is just starting the use of color VMSs. This guideline will help the CSTMC in developing borders, backgrounds, elements, symbols and text labels that conform to the listed guidelines.
- *Guideline 22 Traffic Camera Displays – Open Format.* The CSTMC has over 60 cameras on the http://www.springsgov.com/Trafficeng/ website. The map and a number of cameras are being updated in the next few months. For the new webpage the design guidelines will be utilized to make sure a timestamp is provided, a time is provided on the frequency of the updates, and the direction of travel is listed.
- *Guideline 25 Communicating Timeframe – Short Text/Visual & Open Format.* The CSTMC has utilized both days of the week and calendar dates on VMSs to provide warnings for upcoming road work. This guideline will help provide consistency regarding when to use either days of the week or calendar dates for both VMSs messages and for Twitter messages.

- *Guideline 27 Communicating Geographic Extent – Short Text /Visual.* The CSTMC has always attempted to utilize the best description of incidents based on interchange name, mileage and exit number. CSTMC will review the content commonly used on each VMS, based on the distance between the VMS and incident location, to provide both familiar as well as unfamiliar drivers the best possible description to help them determine the location, based on the design guidelines.
- *Guideline30 Communicating Degree of Certainty – Short Text/Visual, Open Format & Auditory.* The design guidelines recommend that road weather information be at least 70% accurate. This guideline will be utilized in two ways at the CSTMC. The first will be in the deployment of new color VMSs on arterial streets in the Colorado Springs area with a test of displaying road weather messages when there is a prediction of changing road weather conditions and when there is at least a 70% chance of occurrence of the condition.

CSTMC shared the road weather messages that were posted on their I-25 DMSs during the winter seasons of 2010-2011 and 2011-2012. Both of these winters were more mild than normal. The messages are shown in Table 5 and Table 6. CSTMC is hopeful that the new messaging guidelines can be helpful in resolving some of the issues, not only with regard to message content, but also the timing of message posting and removal.

Table 5. CSTMC road weather messages posted on I-25, Nov. 2010 to Mar. 2011.

Date	Time	Duration	Message	Requesting Agency
11/15/10	8:50 AM	2 HRS	WINTER CONDITIONS MONUMENT HILL	CSTMC
11/29/10	12 AM	7 HRS	ROAD ICY SLOWER SPEED ADVISED	CSP
12/20/10	10:55 AM	2 HRS	HIGH WIND WARNING	CSP
12/30/10	1:40 PM	20 HRS	ROAD ICY SLOWER SPEED ADVISED	CDOT
12/30/10	2 PM	4 HRS	WINTER DRIVING CONDITIONS LIMITED VISIBILITY	CDOT
1/11/11	12 PM	3 HRS	PLOWING AHEAD WATCH FOR CREWS	CDOT
1/24/11	6:45 AM	3 HRS	ICY CONDITIONS DRIVE WITH CAUTION	CSP
1/24/11	9:20 AM	2 HRS	ICY CONDITIONS DRIVE WITH CAUTION	CSP
1/31/11	10:15 AM	6 HRS	ICY CONDITIONS DRIVE WITH CAUTION	CDOT
2/8/11	2:30 PM	3.5 HRS	ICY CONDITIONS SLOWER SPEEDS ADVISED	CDOT
2/25/11	8 AM	3.5 HRS	ROAD ICY SLOWER SPEED ADVISED	CDOT
3/7/11	6:50 AM	3 HRS	ICY ROAD 6 MILES AHEAD	CSP

CSTMC – Colorado Springs Traffic Management Center
CDOT – Colorado Department of Transportations
CSP – Colorado State Patrol

Table 6. CSTMC road weather messages posted on I-25, Nov. 2011 to Mar. 2012

Date	Time	Duration	Message	Requesting Agency
12/1/11	6:50 AM	2 HRS	BRIDGES MAY BE ICY SLOWER SPEED ADVISED	CDOT
12/19/11	1:15 PM	30 MIN	SNOW REMOVAL IN PROGRESS EXPECT SLOWING AHEAD	CDOT
12/21/11	9 AM	2 HRS	ROAD ICY SLOWER SPEED ADVISED	CSP
12/29/11	10 AM	15 MIN	SNOW REMOVAL IN PROGRESS EXPECT SLOWING AHEAD	CDOT
1/17/12	8:50 AM	2 HRS	BRIDGES MAY BE ICY SLOWER SPEED ADVISED	CDOT
2/2/12	4 PM	12 HRS	BRIDGES MAY BE ICY SLOWER SPEED ADVISED	CDOT
2/7/12	4:50 PM	4 HRS	BRIDGES MAY BE ICY SLOWER SPEED ADVISED	CDOT
2/20/12	8:15 AM	2 HRS	ICY ROADS AND BRIDGES AHEAD SLOWER SPEED ADVISED	CDOT

CSTMC – Colorado Springs Traffic Management Center
CDOT – Colorado Department of Transportations

At the time of the site visit, CSTMC was in the process of acquiring new full-color matrix signs to be installed on key arterials throughout the city, and this offered a unique test environment to assess the use of color and icons for weather-related messaging on these signs. The CSTMC planned to install 37 of these signs and develop their own messages and visual icons to be displayed on them. The TMC planned to craft road weather messages based on the preliminary guidelines, including consideration of colors and use of icons. These messages would be posted on the arterial streets to provide improved traveler information to drivers. The first of these signs was anticipated to be deployed in mid-January 2012.

Discussions with CSTMC personnel in late January 2012 revealed that their contractor had fallen behind on their installation schedule for installing the new DMSs. In addition, FHWA had provided guidance that indicated no untested and unapproved graphic images could be used on any DMSs for testing purposes on public roadways. As a result, CSTMC experienced significant delays, and plans to post and evaluate DMS messages on these new signs, with changes from their normal winter weather messaging based on the preliminary guidelines, could not be carried out. Further compromising the evaluation plans was the fact that the winter weather patterns for the 2011-2012 winter were unusually mild, with few significant road weather events during this period.

Maryland CHART TMC

The CHART is a joint effort of the Maryland Department of Transportation, Maryland Transportation Authority and the Maryland State Police, in cooperation with other federal, state and local agencies. The Statewide Operations Center (SOC) is the hub of CHART, and through the command and control center, operators monitor, control and respond to conditions on all state highways in Maryland. In phone conversations prior to the site visit, CHART operators confirmed that they:

- Use both fixed message libraries as well as free form (ad-hoc) messaging based on the situation and the event. Messages are automated and archived in the system.

- Use a canned message list that consists of safety and special events messages. They have no canned messages for 511, as they are auto generated from the CHART system through the Regional Integrated Transportation Information System (RITIS).
- Are willing to review the guidelines and make changes to the message sets. The operations staff is involved in the review of the guidelines, and they said they were open to trying out new messages this winter.

On March 7, 2012, Battelle and FHWA representatives visited CHART to review the preliminary guidelines. CHART was represented by their operations lead and operations supervisor. CHART reviewed the guidelines in detail and provided the following overall comments in addition to guideline-specific comments:

- Overall, weather information is still provided based on ad-hoc messaging so it was noted that consistency between operators (and even other neighboring states) is a real need. They view the guidelines as a great start but were inclined to suggest a need for federal standards.
- Most of the guidelines are currently followed by CHART, especially for DMS in terms of length and content. However, CHART rarely uses two phase messages.
- CHART indicated a need for guidelines on text-to-speech approaches as many of their guidelines for 511 are automatically generated.
- They noted that they don't distinguish between familiar and unfamiliar drivers in their messages.
- They also noted that these guidelines are not just for TMCs but also for Emergency Operations Centers (EOCs). In many cases, when weather events escalate, the EOCs start formulating messages, especially paragraphs/open-text format releases to media, etc.
- They suggested coordinating with the National Incident Management System (NIMS) messaging guidelines.

As a result of these discussions, CHART said that they feel very comfortable about their DMS messaging. CHART pointed out the value of the guidelines for new and inexperienced operators. They noted that they will use the final guidelines as a part of their training for new employees.

Washington State DOT (WSDOT) and Six WA State Regional TMCs

Background. Members of the guidelines evaluation team attended a meeting of the state's regional TMC supervisors, WSDOT IT representatives, and headquarters traffic and operations managers on November 17, 2011. This group meets periodically throughout the year in Olympia, WA, and the evaluation team was afforded time on the agenda to introduce the road weather messaging guidelines evaluation and obtain agreement from the supervisors to participate in individual follow-up phone calls to discuss how each regional TMC has used the guidelines and their suggestions for improvements. These calls with WSDOT's TMC supervisors included discussion of the effectiveness of the guidelines for operator training, any changes in messaging that these TMCs may decide to make based on the guidelines, and any additional feedback on the individual guidelines.

At the Olympia meeting the supervisors noted that some of the regional TMCs are more involved in road weather messaging than others. For example, the South Central Yakima TMC is responsible for messaging on I-90 over Snoqualmie Pass and the North Central Wenatchee TMC handles messaging on SR2 over Stevens Pass. The Spokane TMC also has a mountain pass (Sherman Pass) and winter weather events in their jurisdiction. The Seattle TMC (Dayton) is mostly concerned with winds and waves that affect travel across the Lake Washington bridges (SR520 and I-90), and they are considering integrating

weather messaging into their ATMS. WSDOT doesn't have many VMSs in the more rural parts of the state, nor are there many alternative routes in rural areas that can be used in adverse weather conditions. As a general matter, WSDOT is concerned about liability risks in what they convey to the traveling public regarding weather. For example, they will not say there may be ice on the road ahead. A message about snow and ice on the road can be posted only if the condition has been verified and state crews are out doing something about it. They are more likely to say "winter conditions, use caution" than offer more detail that may raise liability concerns.

WSDOT has draft policy guidelines for VMS use *(Statewide VMS Use Policy, July 2011)*, but that document is limited with regard to weather messaging.[1] They also have a library of messages, including weather. Each regional TMC has its own Standard Operating Procedures (SOPs) for messaging protocol, they have autonomy to adjust their weather messages (as long as they are consistent with the state's VMS policy), and the TMC engineer may determine ad hoc weather messaging as needed, but mainly only for significant weather events. WSDOT TMCs place winter weather messages on VMSs, DMSs, 511, web, HAR. Web messaging is done out of the Olympia office. All messaging is archived (content, timing, operator, etc.). Based on feedback received from travelers, the public is generally pleased with WSDOT's messaging.

TMC operators are trained to develop ad hoc messages that incorporate three basic elements: what the problem is, where the problem is, and what to do about it. WSDOT always uses three lines of text to do this. If the VMS only supports two lines, the second line will rotate between the middle and last line of the message.

For training new operators in messaging, WSDOT uses their statewide VMS policy, and one of the TMC supervisors said he also uses a Virginia Transportation Research Council study (Miller, Smith, Newman & Demetsky, 1995) about human factors issues in the effective use of VMS. SOPs address number of phases, font sizes, and the like. New operators are taken on the road with experienced operators so they can observe messaging from a traveler's perspective.

Feedback on Guidelines. A few of the supervisors have already used or plan to use the guidelines to support operator training, along with the other materials they have been using. For those supervisors who don't do much weather messaging, the guidelines go into much more detail than they require. Some said they keep the guidelines with their operations manual and use the guidelines document for backup. The experienced supervisors feel they have a well-established approach and style for messaging, and they don't use the guidelines much. They are more often going to use existing messages from their library than create an ad hoc message.

All VMS and HAR messaging fall first under the auspices of the state traffic engineer, and then the regional traffic engineer. They are the people who would need to approve the guidelines for regional TMC use in Washington State. Even though the TMCs are regionalized, they all operate as one DOT.

One of the supervisors found the guidelines useful but too academic in presentation, and he suggested they be rewritten in plain "everyday" language. He found the guidelines to be more advanced and detailed than an operator could use. He shared the preliminary guidelines document with his operators, but they had difficulty reading and getting through it. He thought it could be useful for operator training if it were

[1] Excerpt from WSDOT's VMS Use Policy: "Weather related hazards shall only be displayed if there is a need to inform motorists of an unexpected condition. VMSs will not generally be used to display road conditions due to apparent weather (e.g. icy roads during freezing winter weather). An exception may be to alert motorists to hazardous weather-related roadway conditions IF identifying a specific location, and using a specific sign (e.g. using the SR-3 N. sign with the following message "Ice on Roadway, 3 miles ahead at Sherman Hill" or the SR-16 VMS for "Severe side winds at Narrows Bridge") and the information is received and verified from reliable sources."

simplified and focused on core issues, placed references and supporting text in appendices, had more white space, and used more summary bullets to make points succinctly.

In summary, WSDOT TMCs find the guidelines to be in line with their current policy but more detailed than they need. For them to more actively use the guidelines to make any adjustments to their road weather messaging, they would have to be first reviewed and approved by WSDOT and most likely used as a source reference to modify their current VMS policy.

Site Visit Summary and Observations

The agencies that were visited said the messaging guidelines are useful in helping them improve how they frame and communicate road weather information. They are also seen as being helpful in meeting a need to achieve greater consistency across jurisdictions in messaging for travelers, across all the dissemination methods. They offered the following general observations:

- The guidelines offer a useful tool for training operators, both experienced and new personnel.
- The format of the individual guidelines was viewed as extremely useful, with the discussions providing helpful information to the agencies, although too detailed for real-time use by operators.
- They do not expect the guidelines document to sit on an operator's desk as a reference document. Rather, they want operators to learn and internalize the principles incorporated in the guidelines and use them when considering their messaging decisions.
- These State DOTs and TMCs want to understand how motorists are responding to the messages; namely, there is a desire to have better data on driver behavior changes based on messaging. Demographics are important in this regard, as older drivers respond differently than younger drivers for example. Commercial drivers can be expected to use and respond to messaging differently from other travelers.

Most of the DOTs/TMCs have developed their own internal messaging protocols and guidelines for operators. They were very interested in reviewing these preliminary guidelines for ideas about how they could improve their own procedures. In some cases they were willing to make changes in their protocol immediately, and in other cases they said the guidelines document, when finalized, would need to be reviewed and approved for use in their DOT before any changes in current procedures could be made. They offered additional thoughts on the context and constraints for following the messaging guidelines:

- Operators don't want to post messages that state the obvious. They want to be providing motorists with new, useful road weather information that they don't already know about.
- There is a question regarding how to prioritize the posting of road weather messages with other important messages, such as amber alerts and chain control messages for example. DOTs generally have their own procedures for determining such priorities.
- It is important to be sure that there is consistency in messaging across the different dissemination tools, such as 511, DMSs and websites.
- Making changes to how road weather messages are imbedded in systems and conveyed to travelers can be time-consuming, given the institutional issues surrounding any decisions to make changes in web sites, 511 or the other dissemination media. Part of the problem is that many of these legacy systems were designed for traffic operations and not for managing road weather information.

- State DOTs and TMCs face a dilemma when considering making changes based on the guidelines, especially to web sites and especially when the proposed changes are significant. Travelers and other users have become comfortable with the current interface and content and are likely to resist changes, even if those changes represent improvements. There is a need to consider strategies such as making changes in a beta version that runs in parallel for a while, or introducing changes gradually to allow for user acceptance to take hold. Being open to user feedback is another way to soften the impacts of changes in messaging. Adding a tutorial focused on strategies for introducing such process and content changes would be helpful.
- Some state DOTs and TMCs may find themselves under political pressure to provide the public with messages that seem to the DOTs and TMCs to be inappropriate, unnecessary or even counterproductive. They would appreciate the guidelines specifying certain kinds of messaging that should not be done.
- TMC operators are seeking ways to overcome institutional barriers and improve internal communications between traffic operations, road maintenance, weather information providers, IT departments, and communications departments in an effort to better coordinate the provision of road weather information to travelers.
- The provision of traveler information raises liability issues for state DOTs and TMCs. For example, if road weather information is available but not provided to the public, the agency may be liable, and if information is provided one time, or in one place, or under one condition but not provided later under similar circumstances, that too can create liability. Also, if notice of an icy road condition, for example, is communicated to the public and maintenance has not been able to treat the road at the indicated location, resulting in an accident, that creates a liability.

Interviews with Private Service Providers

In addition to the state DOT site visits, the evaluation team interviewed representatives of two prominent road weather information service providers from the private sector. These included Meridian Environmental Technology, Inc. and Castle Rock Associates. These two organizations develop road weather information content for State DOTs and have interacted with the transportation and meteorological communities for many years. Each has developed tools to assist state DOTs to effectively deploy 511 systems, advanced traveler information websites, and decision support tools that aid operational decision making during weather events.

Meridian Environmental Technology, Inc. Meridian[2] was founded in 1996 in North Dakota with the mission of becoming the premier leader in developing, distributing, and managing atmospheric and earth sciences information and technology. Meridian converts raw weather and geographic data into information to deliver customized route-specific surface weather and road condition reports statewide across eight states. They provide road weather decision support tools to state DOTs.

Meridian agreed, in mid-September 2011, to review the guidelines and provide feedback based on their extensive experience to support the evaluation. During that initial discussion the evaluators shared a set of questions to help guide Meridian's review of the guidelines document. Those questions are listed in the Methods section of this report. Meridian has supported the development and deployment of a national 511 weather and traffic information program and is therefore uniquely qualified to assess the preliminary guidelines. Three principals at Meridian participated in a phone discussion with the evaluation team five months after that initial call in mid-February 2012.

[2] http://www.meridian-enviro.com/pages.pl?pg=about

At the time the guidelines were being developed and released in preliminary form in the spring of 2011, Meridian had an opportunity to review early drafts and provide their input at that time as well, so they embarked on this phase of the evaluation with a good understanding of the document. General comments and suggestions are noted below, including some comments offered in the spring of 2011, and more guideline-specific suggestions are aggregated with others' comments where each guideline is discussed in more detail.

- Many of the guidelines imply too much wordiness, especially for audio messages for broadcast over a 511 phone system. Travelers calling in to 511 want to get their information quickly and get off. Along with traveler needs, it is important to also consider the limitations and costs of these systems and keep messaging as efficient as possible.
- The resource documents cited in the preliminary guidelines appear dated, based on studies conducted two or more decades ago. Since then technology has rapidly evolved with sophisticated systems, and the guidelines need to be updated to account for current technologies and systems, such as the connected vehicle program, the availability of mobile phone apps, in-vehicle display systems, and social media that are shaping information dissemination. An example of a document that should be included in the references is a study[3] of the use of colors and icons by Ed Boselly for the Aurora Project, an international partnership of public road agencies working together to perform joint research activities in the area of road weather information.
- Defining specific scenarios for guidelines is problematic. Individual travelers have very different travel and commute patterns. You can close an interstate or freeway due to adverse weather, but not a state route. 511 phone information cannot be expected to detail every turn. Travelers don't want to take the time to listen to that, nor can they be expected to remember all the details. They expect detour signage, and a message that offers viable alternative routes. Directing travelers to take a particular route raises liability issues that state DOTs tend to avoid.
- Message content should focus on "what" and "where," without trying to explain all the detail on the nature of the problem or the steps to be taken.
- Web pages present major difficulties regarding guidance on icons and colors. No two states share a common sense of how to do this, and each state has its own preferences. Guidelines in this area are particularly challenging. At this time standards don't exist that would force states to use a predictable, consistent approach, though this would be desirable. With regard to the use of colors, consider the needs of persons who are color blind or deficient; if colors were removed, the message should still properly be communicated.
- Because the general public has difficulty understanding and interpreting the meaning of probabilistic weather forecasts, Meridian recommends avoiding using terminology in messages such as "a 95% chance of rain." If no rain occurs, the public's reaction is that this was a bad forecast. They tend to confuse confidence in the forecast with the likelihood that the event will occur. It is preferred to use terms such as "slight chance," "likely," or "none."
- The guidelines should emphasize the term "road weather information" rather than "weather information." Road weather information explicitly seeks to link atmospheric weather occurring close to the surface with conditions drivers face on the surface of the pavement, such as icy, slippery, and the like.

[3] http://www.aurora-program.org/knowledgebase/Road%20Weather.Aurora-Project-1997-05-Standardized-Weather-and-Road-Condition-Information.ashx.

- Providing messaging guidance regarding "accuracy" must account for distinctions between a scientific definition of what constitutes an accurate forecast, versus how a traveler perceives the accuracy of the information provided, along with the dimensions of timeliness and location specificity. Presenting forecast probabilities in percentage terms is closely related to the issue of accuracy. A goal of road weather messaging is to cause travelers to make appropriate behavior changes, and if travelers lose trust in the messages due to perceived inaccuracy, those changes are less likely to occur.

Castle Rock Associates. Castle Rock[4] was established in 1984 and consults on advanced technology deployment in ITS. Castle Rock works with a dozen state DOTs, providing web based and 511 traveler and road weather information through the Condition Acquisition and Reporting System (CARS).

Principals at Castle Rock agreed to review the preliminary guidelines and provide their comments, drawing on their extensive experience with framing messaging for the traveling public. For example, they have worked for several decades with the European Union and automobile firms developing and refining spoken audio traveler information messaging. Their general comments follow:

- The guidelines are way overly detailed. For example, travelers don't want or need detailed information on turn by turn detours. It is especially difficult to communicate specific location information that all travelers can understand. The language suggested comes across as "DOT speak" and academic rather than in simple, easy to understand form. Instead of trying to provide all the possible details, offer the user a link to more information if they should want that.
- As a general observation, the guidelines don't seem to be directed to the realities of road weather conditions; rather, it appears they are more like guidelines that would be prepared to speak to a traffic incident or event. Weather often impacts broad parts of a region, limiting, for example, opportunities for detours.
- For road weather information on web sites, colored lines on maps work reasonably well. They offer a good statewide overview, and the user can zoom in for more detail.
- Providing forecasted information presents challenges and is difficult to do. A snapshot in space and time can work well, along with links to a web site where more detail on future conditions can be provided. On 511 the message can convey briefly that a National Weather Service weather warning will apply to a particular segment of roadway over the next 2-3 days. Location indicators can be highways and junctions. Animations of weather forecasts look nice but are not very helpful. They raise issues about the accuracy of the information.
- Regarding ways to effectively communicate urgency or criticality associated with road weather information, Castle Rock prefers a 10-point rating to express priority of information. State DOTs often want to disseminate information on everything, but it is better to avoid the lower priority information. Different media have different practices and rules in this regard. Generally states try to tell travelers everything to cover themselves in terms of liability risks.

Recommended Modifications to the Preliminary Guidelines

The questionnaires, site visits, and interviews summarized in the previous sections provided a rich set of recommendations for potential modifications to the guidelines. Through a structured process, the evaluation walked agencies through all the individual guidelines while also assessing the overall suitability of the guidelines to the agencies' needs. The following sections bring together all the

[4] http://www.crc-corp.com/

comments across all the evaluation approaches, to analyze and summarize the high-level modifications suggested by the agencies as well as guideline-specific changes and recommendations.

High-level Changes and Modifications

The following are the broad high-level changes suggested to the guidelines based on the reviews and team discussions of the site visits, interviews and survey results.

A. Organize the guidelines by major dissemination methods. Universally, the agencies noted that the guidelines as organized require the reader to jump from one set of guidelines to another. They clearly indicated a need for a set of guidelines for each of the major dissemination media. Participants noted the need for new guidelines on emerging areas of dissemination such as various social media technologies. Currently, they feel that this guidance is focused more on the traditional approaches and should be more forward-looking. They also noted that "short text" has multiple subtle variations that need to be accounted for. For example, a text message and Twitter message might have similar character restrictions but have different audiences and interactions with the travelers. The following approaches were identified as candidates for grouping the guidelines:

- DMSs with a distinction made between full-size DMS and portable message signs.
- 511 Phone Systems with guidelines including both flood-gate/free form messages as well as Text-to-Speech messaging.
- HAR – Combining 511 and HAR was not recommended, although they are both auditory, because of different message/menu structures.
- Websites – Focusing on both mobile web and full website versions.
- Short Text Alerts – Focusing on text dissemination with a character limit.
- Email – Focusing on text dissemination without a character limit.
- Twitter – While similar to short texts, the interviewees noted that the two-way exchange between users and system operators presents unique opportunities and challenges.
- Other social media such as Facebook.

B. Increase focus on weather and road weather in the guidelines. The agencies noted that, currently, the guidelines are heavily drawn from research conducted in the incident management domain. However, there are differences between the road weather domain and the incident management domain which need be carefully considered in the guideline development. Primarily, these comments from the end-users pertained to providing diversion information but were also highlighted for other guidelines. The major differences in road weather and incidents directly affect the type of messaging. Agencies noted that for area-wide weather events such as snow storms, thunderstorms and blizzards, they would be loath to provide diversion information as they typically have little or no information about conditions on the other roads and, generally, the weather condition that is affecting the facility of interest is also affecting the alternate detour routes. Other differences include differences in temporal, spatial extents between weather information and incident information. The probabilistic nature of weather is also different from incidents. Overall, the agencies noted that the guidelines need to carefully consider and adapt the differences between incidents and road weather where the underlying research comes from the incident management arena.

C. Identify how to communicate road weather information such as roadway surface conditions more clearly in the guidelines. Agencies noted that the guidelines were lacking clear information on road weather conditions such as pavement conditions and focused more on atmospheric conditions. This

comment was particularly noted for website information where there has been an increased emphasis on sharing road surface conditions with the traveler. While some information is already included in various portions of the guidelines, they need to be highlighted more.

D. Consolidate guidelines and reduce verbosity as much as possible. While agencies generally felt the amount of detail in each guideline was appropriate and liked the format, they did note that there were a lot of guidelines to absorb. Ideally, they recommended combining and eliminating a few guidelines to end up with a shorter list of final guidelines. Overall, the agencies strongly emphasized the need to be as concise as possible. Fewer, simpler guidelines were preferred.

E. Include tutorials on how agencies can integrate these guidelines into their existing training manuals/practices. Agencies currently have a plethora of training manuals and SOPs as part of their day to day operations and operator training. Agencies clearly noted the value of these guidelines but requested a tutorial on how agencies integrate these guidelines into operations. A tutorial on this topic could include:

- How the guidelines can be used for operator training?
- How the guidelines can supplement SOPs?

F. Where human factors research in road weather is lacking, seek examples of best practices to develop guidelines. Agencies and interviewees acknowledged the inherent difficulty in developing guidelines where the requisite human factors research is not available, but they advocated using various best practices to support guideline development. While this comment has to be treated carefully, it points to a greater need to acknowledge some of the ad-hoc approaches used by agencies to solve some of the problems that the guidelines are intended to address.

G. Provide clearer titles to each guideline. Some of the agencies and interviewees suggested that the titles used for some of the guidelines seem somewhat obscure and not clearly related to the content of the guideline.

H. Consider eliminating or changing various diversion and detour specific messages. Several agencies had concerns about the provision of diversion information to travelers. They noted that diversions are typically not provided and in the rare cases that they are, they typically do not go into the level of detail identified in the guidelines.

Guideline-specific Comments and Modifications

At each of the site visits, the project team went over each preliminary guideline with the group and discussed the guideline's suitability, effectiveness and potential for implementation. Table 7 summarizes all these comments from the various site visits and interviews.

Table 7. Individual guideline modifications.

Guideline #	Comments
Guideline 01. Message Content – Short Text/Visual	• Overall – Useful and necessary guideline. • Suggest separating DMS from Short Message Services (SMS)/Twitter type messages into two guidelines. • Include in the guideline instructions regarding how to link to other sources for more information. For example – "Call 511 for more information". • "Use Caution" had mixed reactions. Some agencies were ok with it. Others indicated they do not use such messages. • There is also confusion about the word "Caution" in the guideline and the discussion. • The first guideline—Specific diversion route if available—is troublesome for road weather as typically it is hard to provide diversion routes. Might not be best as the first piece of the first guideline.
Guideline 02. Message Content – Auditory	• Overall – Useful and necessary guideline. • Delay information is typically notoriously difficult to calculate. Typically provide a surrogate "minor, major delays" rather than specific times. • HAR information needs to be specific for the location and not just say "ahead" as the guideline discussion states. • In addition to "Attention", the words "Advisory or Please be Advised" are also used. • Too complex and verbose. Can be simplified. For example: o Getting a driver's attention is redundant even in a HAR. First guideline can be eliminated. • "Provide one good reason." Guideline is another that is hard to do for road weather. • Last guideline block is too incident focused. Should be reworded.
Guideline 03. Message Content for Diversion Directions – Auditory	• Overall – Not often used or provided at this level. • Most of the agencies noted that diversion information would typically state "follow posted detours". • However, they might use this guideline for long-term disruptions or closures. • Typically, this guideline is not very applicable for road weather type situations unless it is a very major event. In many cases, interstates are often the best road to travel.
Guideline 04. Message Length – Short Text/Visual	• Overall – Useful and necessary guideline. • Concern that this guideline is too broad. The number of words per phase needs to be a function of travel speed and visibility and not just based on the number of words displayed. Suggest a look-up table. • Change the word "per message" to "per phase" in the design guideline. • Suggest breaking out the SMS/Twitter section as a separate guideline with an example.
Guideline 05. Message Length – Auditory	• Overall – Useful and necessary guideline. • In cases where live recording is used, message length typically varies by operator. • Prefer concise messages.
Guideline 06. Message Structure – Auditory	• Overall – Useful and necessary guideline. • Suggest adding – "Voice inflexions are very important. The use of uptones/downtones is strongly recommended." Avoid monotones. • Several of the agencies use "Text to Speech" (TTS) systems for 511. The guideline should elaborate on such systems.

Guideline #	Comments
Guideline 07. Information Units – Short Text/Visual	• Overall – Useful and necessary guideline. • Change "Who is the Message for" to "Who is Affected". • Change the example "New York" to "All Traffic". • Agencies use the acronym PLA as their guideline – Problem, Location, Action. • Consistent with current practice. • Noted confusion in the guideline between phase, line, information units and speeds. • Several DMS signs have only 3-lines instead of four and in fact the portable ones may just have two. Unclear how guidelines address this aspect.
Guideline 08. Information Units for Diversions – Auditory	• Overall – Not often used on HAR. • Typically will say "Call 511" or "Follow Posted Signs". • Too detailed and not very relevant to road weather. • If included, need to include phraseology like "We suggest", "travelers are recommended".
Guideline 09. Message Phases/Cycles – Short Text/Visual	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated. • Most agencies try to avoid two phase messaging but have to use sometimes.
Guideline 10. Message Phases/Cycles – Auditory	• Overall – Useful and necessary guideline. • Better examples and explanation of external and internal redundancy noted. Agencies were unclear on what the differences between the two approaches were.
Guideline 11. Dynamic Characteristics – Short Text/Visual	• Overall – Useful and necessary Guideline. • Disagree with design guideline for 2 seconds per word/unit. This would imply about 8 seconds for a phase if the previous guideline of maximum of 4 units were followed (Guideline 7). Most of the agencies have a 2-3 second maximum. Some agencies are able to change the time per phase but in other cases, this might be a software limitation. • May want to spell out what an information unit is. • Some use of alternating line messages in road weather may involve directing travelers to 511 with the bottom line going from a 1-800-CALL-511 to the actual number.
Guideline 12. Abbreviations – Short Text/Visual	• Overall – Doesn't hurt/Doesn't add. • No changes identified. Guideline is good as stated. • Might be good to identify appropriate weather specific abbreviations that are listed in the MUTCD and others.
Guideline 13. Use of Fonts – Short Text/Visual & Open-format	• Overall – Useful and necessary guideline but generally part of standard practice. Critically this is not really road weather related and can be a candidate for deletion. • No changes identified. Guideline is good as stated.

Guideline #	Comments
Guideline 14. Use of Color – Short Text/Visual & Open-format	• Overall – Useful and necessary guideline. • Guideline unclear on how to structure a webpage for familiar and unfamiliar travelers. Should there even be a distinction between familiar and unfamiliar travelers? This led to a broad discussion of whether the messaging needs to be for the lowest common denominator or others. • Need to recognize the great uncertainty in road weather messaging (see Ed Boselly's report; Boselly, 2000). • Need to provide direction on how to address pavement conditions. • Need to mention the fact that the maps need to work for color-blind travelers as well.
Guideline 15. Use of Visual Icons – Short Text/Visual & Open-format	• Overall – Useful and necessary guideline. • Icons are ok but are only for atmospheric weather. • Include icons and directions on how to code pavement conditions. • The major problem that was noted is how the icons can overwhelm the page with visual clutter.
Guideline 16. Use of Icons – Auditory	• Overall – No use of such systems. • Might be a candidate for deletion.
Guideline 17. Display of Text Paragraphs – Open-format	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated. • Emphasize conciseness. • Clarify when such messages should be used. Typically, these sort of messages are sent out for larger weather events via the Emergency Operations Centers (EOCs).
Guideline 18. Display of Severe Weather Alerts – Short Text/Visual & Open Format	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated.
Guideline 19. Display of Weather Maps – Open-format (1)	• Overall – Useful and necessary guideline. • Timestamp for the entire map may be confusing as various elements are updated at various times. Plus with most new applications, the maps are recreated every time you refresh a page. • Guidelines should expand the concept of layering of information mentioned in the third bullet. Very important on how the information is structured in a map. • Agencies want radar information on their maps. • Statewide only applies to Statewide TMCs. Reword.
Guideline 20. Display of Map Information – Open-format (2)	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated. • Suggest using other examples in the discussion section.
Guideline 21. Linking to Weather Information – Open-format	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated.

Guideline #	Comments
Guideline 22. Traffic Camera Displays – Open-format	• Overall – Useful and necessary guideline. • Unsure on how and why to provide users with pause and play control for live streaming video. Suggest not including the second row in the guideline.
Guideline 23. Accommodating Other Web-based Dissemination Methods – Short Text/Visual & Open-format	• Overall – Useful and necessary guideline. • Too high-level. Can we add more specificity on what portions of the main site are most important to include in the mobile version and how? • Title of the guideline is confusing.
Guideline 24. Use of Table Information – Open-format	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated.
Guideline 25. Communicating Timeframe – Short Text/Visual & Open format	• Overall – Useful and necessary guideline but not well crafted. • As written, it is more suited for planned maintenance and construction activities. This guideline needs to be refined for road weather. Typically timing for road weather is notoriously difficult to predict. Currently, as it is written, it is not a road weather guideline. • Design guideline does not include how to show time of closures. • Delay is not often shared as it is difficult to calculate.
Guideline 26. Communicating Timeframe – Auditory	• Overall – Useful and necessary guideline. • Same comment as Guideline #25. Currently, this is not very applicable to weather/road weather. • Design guideline does not include how to show time of closures.
Guideline 27. Communicating Geographic Extent – Short Text/Visual	• Overall – Useful and necessary guideline. • Better discussion on road weather application needed.
Guideline 28. Communicating Geographic Extent – Auditory	• Overall – Useful and necessary guideline. • No changes identified. Guideline is good as stated. • Geographic references that can be understood by the traveler are key for 511.
Guideline 29. Communicating Degree of Urgency – Short Text/Visual, Open-Format & Auditory	• Overall – Useful and necessary guideline. • Inconsistency with guideline 1 on use of danger words and increasing font size. • Unclear whether the guideline should recommend a list of words or not. • This guideline needs to be clarified. Noted that this guideline is more verbose and complex than the others.

Guideline #	Comments
Guideline 30. Communicating Degree of Certainty – Short Text/Visual, Open-Format & Auditory	• Overall – Useful and necessary guideline. • No major changes identified but concerns about communicating likelihood to travelers were expressed. • Unclear on where the levels of accuracy were identified and how they should be calculated. • Might be better to create a 10 point rating for priority. • Need to better distinguish between weather and road weather.

Chapter 3 Description of the Revised Guidelines

In response to the broad and specific suggestions that were received during the end user evaluations, the following steps were taken to address each of the High Level Changes and Modifications as listed in the previous chapter. Note that the order and title of the changes listed below follow the "A, B, C…" format presented and used in the *Recommended Modifications to the Preliminary Guidelines* section above.

A. Organize the guidelines by major dissemination methods. The guidelines were restructured and organized around a few major dissemination methods. The guidelines for each method or group of methods formed a chapter in the finished document. Although it would be ideal to provide chapters for each of the methods identified by the TMCs, some of the methods have little to no available research to use to write multiple guidelines. The revised chapters include:

- Dynamic Message Signs
- Auditory Messages
- Web-based Messages

B. Increase focus on weather and road weather in the guidelines. All of the guidelines were carefully reviewed with a particular sensitivity to road weather as the central conceptual framework. Particularly, guidance derived from incident management research was reexamined to ensure that the guidance was applicable to road weather messaging.

C. Identify how to communicate road weather information such as roadway surface conditions more clearly in the guidelines. Where appropriate, the guidelines were revised to communicate road weather information in terms of the interaction between atmospheric weather and pavement conditions, with a focus on the effects on travel.

D. Consolidate guidelines and reduce verbosity as much as possible. Guidelines were edited to reduce wordiness and recognize that users of the information, particularly on 511 audio systems, desire information that is short and to the point. The guidelines were reviewed and combined, as appropriate, resulting in a smaller number of guidelines in the final document. This was implemented with an eye towards retaining the simplicity of the guideline information.

E. Include tutorials on how agencies can integrate these guidelines into their existing training manuals/practices. State DOTs pointed out the particular value offered by the guidelines for providing training, especially for new operators. However, across DOTs, there is a wide variety of training approaches and operating procedures associated with road weather messaging. Given this variability, it was not clear how the guidelines can or should be incorporated into current training procedures and SOPs at this time. In the near term, it therefore seems most appropriate to let individual DOTs/agencies determine where and how to incorporate the road weather messaging guidelines into their existing training manuals and SOPs. This may be a topic for future guideline development.

F. Where human factors research in road weather is lacking, seek examples of best practices to develop guidelines. The revised guidelines reflect current best practices where available or were derived from the site visits to supplement the lack of available human factors research on road weather.

G. Provide clearer titles to each guideline. With the new organization of the guidelines by dissemination method, both the guideline numbers and titles changed. The guideline titles were revised to communicate a specific and simple guideline focus.

H. Consider eliminating or changing various diversion and detour specific messages. Guidelines that discuss diversion and detour information were modified to reflect the current reality that few DOTs are willing to offer that information, along with concerns expressed regarding the wordiness associated with providing detailed directional information of that sort.

State DOTs and TMCs value the flexibility and discretion offered by these messaging guidelines, rather than being required to follow rigid standards for message communication. Each state has its own approach to messaging, usually involving some combination of using an approved message library and allowing experienced personnel to construct ad hoc messages under special circumstances. In this environment, having guidelines available is of great value to them. In the future, it will be important to identify effective outreach for the revised guidelines to maximize awareness and use of the document.

Each state DOT has evolved ways to provide road weather information under various different circumstances that work for them, and it is not plausible to expect that all states will adopt a common answer about how to frame and communicate road weather information to the public. Nevertheless, the preliminary messaging guidelines have been widely accepted as useful and desirable. Many good suggestions have been incorporated into the revised guidelines. These will serve as a valuable resource for state DOTs and TMCs as they continue to evolve more effective ways of communicating road weather information to their traveling public.

Outline of the Revised Guidelines and Tutorials

The end user evaluation described above provided a rich set of ideas and recommendations for revising the preliminary guidelines developed in Campbell et al. (2011). Based on these recommendations, the guidelines development team identified a number of changes that should be made to the preliminary guidelines. Table 8 below provides a general overview of the revised design guidelines and tutorials resulting from the end user evaluations conducted in this project. The final guidelines have been published by the FHWA (publication number FHWA-JPO-12-046).

Table 8. Overview of the revised guidelines.

Guideline	Content
Chapter 2. Dynamic Message Signs	
2-1. Structuring DMS Message Content	Discussion of common DMS message elements and specific content issues.
2-2. Determining DMS Message Length Limits	Information about determining the appropriate length of a DMS message by considering information units.
2-3. Dividing Information between Display Phases	Guidance on how to divide the information units in a message into phases.
2-4. Determining Phase Timing and Other Dynamic Properties	Information on the length of time to display message phases, the time between phases, and dynamic display methods.

Guideline	Content
2-5. Creating Acceptable DMS Abbreviations	Information on finding and creating abbreviations that travelers will understand.
2-6. Communicating Travel or Delay Times	Information on clear and succinct ways to describe trip impacts through travel or delay times.
2-7. Communicating Event Location	Information on communicating the location of a weather event in both urban and rural locations.
2-8. Communicating Degree of Urgency on Dynamic Message Signs	Information on communicating the priority, timing, and driving impacts of weather events using dynamic message signs.
2-9. Communicating Degree of Certainty and Enhancing Message Credibility on Dynamic Message Signs	Information on communicating the likelihood of road weather event predictions, conveying the associated impacts, and increasing traveler trust in road weather messages.
Chapter 3. Auditory Messages	
3-1. Structuring Auditory Message Content	Information on auditory message elements to include in 511 and HAR messages.
3-2. Auditory Message Length	Information on developing concise auditory messages.
3-3. Auditory Message Delivery	Guidance for operators who deliver auditory weather messages.
3-4. Communicating Travel Times and Message Timestamps	Discussion about communicating the travel time or delay length for a route and providing time-stamps to inform travelers how current the information is.
3-5. Designing Auditory Diversion Directions	Information on choosing auditory diversion message elements and determining the appropriate length for diversion directions.
3-6. Communicating Degree of Urgency in Auditory Messages	Information on communicating the priority, timing, and impacts of weather events through 511 or HAR.
3-7. Communicating Degree of Certainty and Enhancing Message Credibility for Auditory Messages	Information on communicating the likelihood of road weather event predictions, conveying the associated impacts, and increasing traveler trust in road weather messages.
Chapter 4. Web-Based Messages	
4-1. Design of Table Information	Information on the design of tables or lists used to present mostly textual road condition information.
4-2. Display of Text Paragraphs	Discussion of display characteristics of text passages to maximize readability and comprehension.
4-3. Traffic Camera Displays	Information related to the use of camera images to convey road weather information.
4-4. Designing General Map Displays	Information on map characteristics that improve usability.
4-5. Designing Weather-Specific Map Displays	Discussion of elements of map displays that are specific to the provision of road weather information.
4-6. Use of Visual Icons	Information on selecting or designing icons and their labels.
4-7. Color Selection	Guidance for selecting colors for text and maps in web-based messages.
4-8. Display of Severe Weather Alerts	Specific advice for displaying severe weather alerts which are essential for travelers to receive.
4-9. Linking to Road Weather Information	Guidance about the internal and external links on the homepage through which travelers can access the road weather information.
4-10. Website Use on Portable Electronic Devices	Information on supporting website usage by travelers who use portable electronic devices to access internet weather websites.
4-11. Communicating Degree of Urgency on Websites	Information on communicating the priority, timing, and driving impacts of weather events through websites.

Guideline	Content
4-12. Communicating Degree of Certainty and Enhancing Message Credibility on Websites	Information on communicating the likelihood of road weather event predictions, conveying the associated impacts, and increasing traveler trust in road weather messages.
Chapter 5. Tutorials	
5-1: Traveler Adjustments based on Road Weather Information	Information on the adjustments that travelers may make in response to road weather information, and potential safety implications.
5-2: When Travelers Use Road Weather Information	Information on when travelers prefer to receive road weather information relative to the start of their trip, and the suitability of using various dissemination methods at different trip stages.
5-3: How to Determine which Dissemination Methods Travelers will Use	Information on the availability of various dissemination methods at different trip stages, in addition to information about traveler awareness of and preferences for specific dissemination methods.
5-4: Safety Implications of Road Weather Information	Information on how safety/mobility impacts for weather events can affect travelers' safety, crash risk, and convenience or schedules.
5-5: Description of the Road Weather Message Design Tool	Description of the road weather message design tool, which outlines a systematic approach for developing weather messages that incorporate traveler information needs, and appropriate formats for dissemination.
5-6: Example Applications of the Road Weather Message Guidelines	Examples of how the guidelines can be used to improve existing road weather messages.
5-7: Road Weather Messaging for Personal Electronic Devices and Social Media	Guidance for disseminating road weather messages on personal electronic devices.

Chapter 4 Conclusions and Recommendations

Based on the project efforts conducted by Battelle so far, we have developed the following conclusions for this project, as well as the future recommendations listed below.

Conclusions

1. The response to the messaging guidelines from the road weather community indicates that the guidelines will be a valuable tool that provides useful information to message designers. Overall, the positive feedback obtained from the site visits and online questionnaire generally demonstrates that the road weather guidelines are a helpful and valued resource. Some TMCs had started using the preliminary guidelines to design or refine their messages even before the evaluation of the preliminary guidelines was initiated, reflecting their need for such guidance., We have since learned that state DOT traffic supervisors and operators have used the preliminary guidelines to update their current messaging and operator training materials. As discussed above, most state DOTs contacted in the evaluation preferred to use the guidelines as a training resource for new operators, or as a tool for reviewing and updating their existing messaging, rather than expecting operators to frequently access the guidelines on a day-to-day operational basis. State DOTs typically use a mix of approved fixed messages and ad hoc messaging. The refined guidelines are expected to be useful to experienced operators who are tasked with creating ad hoc messages to fit unique road weather situations. Also, the ability of the guidelines to encourage consistency among messages between operating agencies was touted by the end users as a real benefit to their messaging efforts.

2. From a methodological perspective, the surveys, site visits, and interviews used in this project were valuable approaches for obtaining feedback on the guidelines from the selected state DOTs, TMCs, and private service providers. The end user community was able and willing to provide feedback through these structured processes, and the surveys, site visits, and interviews conducted in the project provided a rich and helpful set of recommendations for modifying the preliminary guidelines developed in 2010. Critical feedback included suggestions for crafting the guidelines to be more responsive to road weather conditions and restructuring the presentation of the guidelines to be more consistent with how they were expected to be used in practice.

Also, given a lack of specific research focused on road weather messaging, the feedback from the evaluation of the preliminary guidelines was essential for helping refine the guidelines that were based primarily on non-road-weather traffic research to make them more appropriate for road-weather conditions. State DOT and TMC users of the guidelines found the research foundation for the preliminary guidelines to be highly credible and confirming of their existing practices.

3. Despite our earlier concerns about the lack of road-weather specific research data available to support guideline development, the use of applicable data from comparable domains has led to a successful outcome with respect to the revised guidelines. In particular, while end users recognized that much of the content of the guidelines reflected human factors design principles from more general DMS, 511, and web guidance studies, they viewed these sources as credible, authoritative, and relevant. Even in specific instances where the guidelines did not provide new information to end users, they tended to confirm

existing practices, thus providing end users with greater confidence in their procedures and approaches to road weather messaging.

Recommendations

1. Promote the revised road weather messaging guidelines through a variety of means, including the use of webinars, flyers, workshops, and presentations at appropriate venues. In general, the goal of an outreach effort for the road weather messaging guidelines should be to attract, engage, and involve end users in the on going process of using and improving the guidelines developed in this project. Given the positive feedback on the guidelines provided by end users so far, it would seem valuable to the FHWA to widely promote and disseminate the road weather messaging guidelines. It may be appropriate to develop a short training course to introduce end users to the guidelines, provide general background information on human factors as it relates to traveler information systems, and train end users on how the guidelines could be used.

2. Gather more end user feedback from state DOT/TMC staff to validate the final revised messaging guidelines, and better understand how the guidelines are being used in practice. In particular, the end users included in the current study seemed to be more focused on DMS messaging than on auditory or web-based messaging. It would be helpful to expand the end-user group to include agencies and organizations with a greater focus on auditory and web-based messaging and to then extend the current evaluation using the updated guidelines with this larger group of end users. It would be especially helpful to spend more time exploring specific ways that the TMCs are or could be using the guidelines; i.e., for training, message development (fixed and ad hoc), use of dissemination strategies, or incorporation of the guidelines into their existing procedures. It would also be helpful to see what kinds of tools or decision aids would help end-users make better use of the guidelines. For example, some of our feedback from the end user study indicated that users might like a short, highly-summarized version of the guidelines to keep handy near their desks and use as a checklist when developing road weather messages. Such a tool was outside of what could be accomplished in the current project, but could perhaps be developed in the future. It would also be useful to continue development of guidelines to reflect newer research and for emerging areas of information dissemination such as social media.

3. Obtain traveler feedback to understand how road-weather messaging affects traveler decisions and driving behavior and—ultimately—mobility and safety outcomes. During this current phase of the project, KC Scout posted a traveler survey on their website, but very few travelers took the survey (possibly due to a lack of relevant weather events). In general, we still don't know if or how the revised road weather messaging guidelines can help travelers make better and safer driving decisions.

A key concern is developing a methodology for obtaining such information from travelers in a reliable manner. One approach would be to work with TMCs to obtain lists of messages used both before and after application of the revised guidelines and to then conduct surveys and focus groups with travelers to explore the efficacy of the messaging changes. Specific questions that could be addressed include:

a. What are traveler's expectations for road weather messages?
b. When do they use specific messages?
c. Do they understand the messages?
d. How would they change their behavior if faced with a certain message?
e. What is the relative value of the before vs. after messaging approaches?

In this regard, it would probably be best to conduct the surveys/focus groups in the states/cities where the messages were created or along routes where the messages were posted so that the users would be familiar with the weather patterns, weather events, location names, and typical weather for the area (and typical

actions required or warranted when those weather events are witnessed). This future research could also be an opportunity to gather information about some additional issues that the TMCs would like guidance about.

Another approach could be to survey users who have subscribed to messaging on their phone, or those who follow the TMCs on Twitter. In the revised guidelines, we included a tutorial on using social media, but both cell phone and social media messaging guidance is very under-developed due to a lack of research and a small user group of TMCs. It would be useful to survey travelers who use those services to determine how they use them, when they use them, and what makes a good message. (Also, since social media use is increasing in general, it may be good to survey the TMCs about whether they use social media, and if so, how they create the messages.)

4. Identify and widely distribute: institutional procedures that encourage and support effective road-weather messaging strategies across the country, effective use of the revised guidelines, and effective ways to disseminate information about new messaging strategies. Throughout the site visits and discussions reported above, DOT and TMC staff mentioned a desire to know more about what the other states/agencies were doing from a procedural standpoint with respect to road weather messaging (e.g., considerations for diversion messaging, regional coordination, etc). It was clear that end users of the guidelines would benefit from having broader knowledge about best practices and lessons learned across DOTs/TMCs both inside and outside the US. It might be useful to gather a group of TMC operators for a workshop or meeting (perhaps at a conference venue) to review and discuss the best practices among TMCs and relevant issues such as: considerations for message implementation, how often they update their messaging, social media messaging, etc. It may also be possible to engage the DOT/FHWA Division Offices in working with and supporting the state DOTs and TMCs in their jurisdictions to be more effective users of the messaging guidelines, including building awareness of best practices and supporting training of operators in the application of those practices. In this regard, it would be useful to explore how road-weather messaging can be better integrated with the DOTs Connected Vehicle program, both in terms of new sources for road-weather conditions that can inform messaging decisions and in terms of the dissemination of road-weather messages through in-vehicle devices.

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Appendix A

Text of E-mail Request Sent to Key Points-of-Contact in the Road Weather Community

Dear Colleague,

The FHWA Road Weather Management Program (RWMP) recently completed a study to develop design recommendations for disseminating road weather advisory and control information to the traveling public. A flyer describing this study and where to obtain a copy of the final report is attached. The study was motivated by a recognition that weather significantly impacts traveler mobility and safety; and unless the content, format, and timing of road weather information is consistent with what travelers need, want, and will use, then such information may not be useful.

Thirty (30) detailed guidelines for road weather information were developed, reflecting relevant literature and best practices pertaining to: (1) Message content, length, and structure (2) Design of fonts, colors, icons, and alerts, (3) Display of map, weather, and traffic information, and (4) Communicating weather event timeframe, urgency, and likelihood. The preliminary guidelines are attached.

We are asking agencies and other end users to review and evaluate these preliminary guidelines, focusing on their suitability and effectiveness for traffic operations. Please distribute this email including the attached guidelines to colleagues and staff in your organization who you think could offer helpful feedback or benefit from using them. We would appreciate your comments/feedback on these guidelines by responding to the questions in the following link:

http://www.surveymonkey.com/s/X72ZSZ5

In addition to this general questionnaire, we are also interested in any questions, comments, or suggestions that relate to specific sections or elements of the guidelines. We are also planning to conduct a more in-depth evaluation of the guidelines with a small number of agencies and would be glad to discuss this type of engagement with you. This level of evaluation would include more detailed discussions of where and how you could use these guidelines, opportunities to obtain in-person feedback from you and your staff regarding the utility of the guidelines, some field testing of the guidelines themselves, and perhaps opportunities to obtain feedback on the guidelines from travelers in your area. Please let me know if you are interested in participating in this more in-depth evaluation of the attached guidelines. You can either respond to this email (campjohn@battelle.org) or call me at 206.528.3254.

Thanks for your help – I look forward to hearing from you.

Sincerely,

John L. Campbell, Ph.D.
Project Manager, Battelle

Appendix B

National Online Questionnaire
Evaluation of Guidelines for Presenting and Disseminating Road Weather Information

You have been identified as a person who is knowledgeable about framing and presenting road weather messaging to travelers in your state (or agency), and therefore would be in a position to help assess the utility of a set of guidelines for road weather advisory and control information. We appreciate your time and willingness to review and answer these evaluation questions about the Guidelines for Road Weather Advisory and Control Information (Preliminary). Your feedback will help to revise the guidelines as part of our continuing efforts to make them more relevant, valuable, and easy to use.

Thank you for your assistance.

General Information

These three (3) General Information questions are optional, but your answers will give us a better idea of the professional characteristics of individuals who answer the evaluation questions.

1. Your Professional Title:

2. Please describe your job responsibilities in 1-2 sentences:

3. Years of Experience:

Questions about the Guidelines

Your answers to the questions below will provide us with important feedback on the content, format, and organization of the preliminary guidelines. Please try to answer each question in this section. We are especially interested in any recommendations that you have for improving or revising the guidelines.

4. In general, how well do the guidelines meet your day-to-day needs for this kind of information? How often would you use them?

5. What kinds of questions are you able to address with the guidelines?

6. How helpful are the graphics in the guidelines – how would you rate the ratio of text-to-graphics in the guidelines?

7. Is the presentation format used in the guidelines easy to understand? (select your answer and add any additional thoughts below)

- ○ Yes
- ○ Mostly
- ○ Average
- ○ Somewhat
- ○ No

Additional thoughts:

8. Is the information presented in the individual guidelines easy to use? (select your answer and add any additional thoughts below)

- ○ Yes
- ○ Mostly
- ○ Average
- ○ Somewhat
- ○ No

Additional thoughts:

9. Do individual guidelines contain an appropriate level-of-detail? Do they need more or less detail?

10. Is it easy to find individual topics of interest in the guidelines? (select your answer and add any additional thoughts below)

- ○ Yes
- ○ Mostly
- ○ Average
- ○ Somewhat
- ○ No

Additional thoughts:

11. If you could change one thing about the guidelines, what would it be?

12. Overall, is the information presented in the individual guidelines useful and valuable to you? (select your answer and add any additional thoughts below)

- ○ Yes
- ○ Mostly
- ○ Average
- ○ Somewhat
- ○ No

Additional thoughts:

13. What guidelines or topics in the guidelines document are ***most*** useful to you?

14. What guidelines or topics in the guidelines document are ***least*** useful to you?

15. Can you suggest any other reports, documents, etc. that we should review when we revise the guidelines?

16. Please provide us with any additional questions, comments, or suggestions that relate to specific sections or elements of the guidelines:

Appendix C

Questions to Agencies to Help Focus Guideline Review and Feedback
Evaluation of Guidelines for Presenting and Disseminating Road Weather Messages

Your Name:

Agency Name:

Please describe your job responsibilities (brief):

Years of Experience:

---

1. In general, how well do the guidelines meet your day-to-day needs for this kind of information? How often would you use them?

2. What kinds of questions are you able to address with the guidelines?

3. How helpful are the graphics in the guidelines – how would you rate the ratio of text-to-graphics in the guidelines?

4. Is the presentation format used in the guidelines easy to understand? (underline your answer and add any additional thoughts below)

   Yes Mostly Average Somewhat No

Additional thoughts:

5. Is the information presented in the individual guidelines easy to use? (underline your answer and add any additional thoughts below)

   Yes Mostly Average Somewhat No

Additional thoughts:

6. Do individual guidelines contain an appropriate level-of-detail? Do they need more or less detail?

7. Is it easy to find individual topics of interest in the guidelines? (underline your answer and add any additional thoughts below)

Easy	Somewhat Easy	Average	Somewhat Difficult	Difficult

Additional thoughts:

8. If you could change one thing about the guidelines, what would it be?

9. Overall, is the information presented in the individual guidelines useful and valuable to you? (underline your answer and add any additional thoughts below)

Yes	Mostly	Average	Somewhat	No

Additional thoughts:

10. What guidelines or topics in the guidelines document were most useful to you?

11. What guidelines or topics in the guidelines document were least useful to you?

12. Can you suggest any other reports, documents, etc. that we should review when we revise the guidelines?

13. Please provide us with any additional questions, comments, or suggestions that relate to specific sections or elements of the guidelines.

Appendix D

Discussion of Weather Messaging Guidelines
Agenda: Approximately 3 hours

15 minutes — Introductions
Opening remarks – Roemer
Purpose/objectives – Chris/Deepak
Adjustments to agenda (as needed)

20 minutes — Review of Current Wx Messaging
- Fixed message sets & ad hoc messaging
- Review operational procedures for selecting & posting Wx messages

25 minutes — Review of Guidelines
- Overview
- Review of guidelines table
- High-level feedback from the site on their review of the guidelines document

10 minutes — Break

45 minutes — Review of Applicable Portions of the Guidelines and Changes to Site's Messaging
- Discussion of how the guidelines will be used
- Identification of planned messaging changes
- Review detailed guidelines (aspects of guidelines linked to dissemination methods)

45 minutes — Evaluation and Feedback Mechanisms for Changes
- Data archives (messaging by event)
- Operator feedback/event case studies
- Traveler survey
- Tracking the regular usage of the guide

15 minutes — Wrap-up and Next Steps
- Evaluation schedule
- Message tracking, data archiving, monitoring use of guidelines

Handouts (from the evaluation team)
- Preliminary Guidelines

Handouts (from the site)
- Existing Message Sets (where available)
- Archive of Message Use for Wx – (Last year)

Participation from the site (tailor to each site)
- TMC Manager
- Traveler Information Service (website and 511) staff person
- Operator or Operators responsible for messaging (different shifts)
- Public Information Officer
- Site meteorologist
- Others?

Appendix E

KC Scout On-line Web Survey Questions

KC Scout is offering new traveler information messages on overhead electronic message signs (Dynamic Message Signs – DMS) regarding weather events to improve travel safety and mobility. Please take a short survey to let us know what you think about road weather messages you may have seen recently. We would like your opinions any time, but particularly during/after major weather events.

1. Have you seen any messages in the past month from KC Scout on roadway message signs offering information or guidance about a weather event?

   ○Yes
   [If participants said "yes," they continued on to questions 2-7.]

   ○ No
   [If participants said "no," they saw the following text displayed on the next page:
   "Thank you for your interest in our road weather message survey. This survey asks about specific road weather messages that you saw on overhead electronic message signs. Please return to this survey once you have seen one of these messages."]

2. Please check which message or messages you saw.

Check if You Saw Message on Message Sign	Road Weather Message
☐	GIVE SNOW PLOWS ROOM TO WORK USE CAUTION
☐	SNOW PLOWING IN EFFECT EXPECT DELAYS
☐	HIGH WIND ADVISORY USE CAUTION
☐	EXTREME WEATHER USE CAUTION ON BRIDGES AND RAMPS
☐	BLOWING SNOW REDUCED VISBILITY TRAVEL NOT ADVISED

Check if You Saw Message on Message Sign	Road Weather Message
☐	SEVERE THUNDERSTORM WARNING TUNE TO LOCAL MEDIA
☐	FOG CONDITIONS REDUCED VISIBILITY TRAVEL NOT ADVISED
☐	EXTREME WEATHER CONDITIONS TRAVEL NOT ADVISED
☐	REDUCED VISIBILITY USE HEADLIGHTS USE CAUTION
☐	WATER OVER ROADWAY (LANE SPECIFIED)
☐	DO NOT USE CRUISE CONTROL DURING RAIN/SNOW/ICE
☐	MAJOR WINTER STORM EXPECT DELAYS LIMIT TRAVEL

Please answer each of the questions below with regard to the weather message that you selected above.

3. Was this message easy to understand?
   - ○ Very Understandable
   - ○ Somewhat Understandable
   - ○ No Opinion
   - ○ Not Particularly Understandable
   - ○ Not At All Understandable

   Comment:

4. Was this a useful message under the conditions you encountered?
   - ○ Very Useful
   - ○ Somewhat Useful
   - ○ No Opinion
   - ○ Not Particularly Useful
   - ○ Not At All Useful

   Comment:

5. As a result of seeing this message, did you change your travel in any way? *(Check all that apply)*
   - ☐ Took a different route
   - ☐ Shortened or ended my planned trip
   - ☐ Felt better prepared
   - ☐ Slowed down and/or drove with greater caution
   - ☐ Other travel change
   - ☐ No changes in travel

   If other effects or actions taken, please briefly describe below.

6. Could this message be improved or made more effective?
   - ○ Yes
   - ○ No. The message is fine as is.

   If yes, please briefly explain how the message could be improved.

7. Did you see any other messages that you would like to comment on?
   - ○ Yes
   - ○ No

[If participants selected "yes" for Question 7, then Questions 2-6 were repeated up to two additional times. Participants were allowed to comment on a total of up to three messages before answering Question 8.]

8. For classification purposes, please indicate your age category:
   - ○ Under 20
   - ○ 20 – 39
   - ○ 40 – 59
   - ○ 60 or over

Thank you for taking the time to respond to these questions. Your answers will be very helpful to us in improving our communications with travelers.

Please come back to this survey again when you see any of these messages during other weather events, and share your opinions with us.

U.S. Department of Transportation
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Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

FHWA-JPO-12-073

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