AASHTO Technology Implementation Group
Nomination of Technology Ready for Implementation
2005 NOMINATIONS DUE BY FRIDAY, SEPTEMBER 9, 2005

Sponsoring DOT	1. Sponsoring DOT (State): South Dakota		
Primary Technical Contact	2. Name: David L. Huft		
	Organization: South Dakota Department of Transportation		
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Technology Description	3. Name of Technology: Maintenance Decision Support System (MDSS)		
	4. Briefly describe the technology. MDSS is an interactive management support system that combines knowledge of existing pavement conditions, of current and forecast weather conditions, of physical and chemical behavior of pavement surfaces, of past maintenance treatments, and of available winter maintenance techniques and resources to recommend the most effective, route-specific winter maintenance treatments and timing. In addition, the MDSS allows users to do "what-if" analyses to see how alternative treatments and timings might perform. MDSS also provides a complete and integrated suite of weather observations—such as air and surface temperature, wind direction and velocity, precipitation rates and amounts, visible and infrared satellite imagery, and radar—and predictions that can be used for many purposes other than winter maintenance. Users interact with the MDSS via a powerful, geographically-based graphical user interface. The MDSS supports manual input of current pavement conditions and applied maintenance treatments, as well as automated input from trucks equipped with automatic vehicle location (AVL) and sensors for pavement condition, plow position, and material application.		
	5. Briefly describe the history of its development. MDSS began in 2000 as a cooperative initiative between the Federal Highway Administration and several federal laboratories—the Army Cold Regions Research and Engineering Laboratory (CRREL), the National Center for Atmospheric Research (NCAR), the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL), the NOAA Forecast Systems Laboratory (FSL), and the NOAA National Severe Storms Laboratory (NSSL). The initiative developed a "Functional Prototype" that was successfully tested by the Iowa DOT in 2003. A group of eight states—South Dakota, North Dakota, Minnesota, Iowa, Indiana, Colorado, Kansas, and Wyoming—and the Federal Highway Administration have worked since then to advance the MDSS from the prototype stage into a fully functional product. They have invested about $1 million to develop a capable, mature system that can be deployed on a statewide basis.		
State of Development	6. For how long and in approximately how many applications has your organization used this technology? The first six states involved in the pooled fund study have used MDSS in expanding trial deployments during the past three winters. During the winter of 2005-2006, the system will be used on approximately 200 highway segments on 75 distinct maintenance routes distributed throughout the eight states now involved.		
	7. What additional development is necessary to enable routine deployment of the technology? The multi-state effort has produced Version 2 of the Pooled Fund MDSS, a full-functioned software release, for use during the winter of 2005-2006. Only minor corrections and refinements are anticipated prior to release of Version 3 in the spring of 2006. At that time, MDSS will be a commercially viable product that can be applied in any state concerned with winter maintenance.		

8. Have other organizations used this technology? If so, please list organization names and contacts.

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North Dakota DOT	Jerry Horner	701.328.4443	jhorner@state.nd.us
Minnesota DOT	Curt Pape	651.297.1798	curt.pape@dot.state.mn.us
Iowa DOT	Jim Dowd	515.233.7753	jim.dowd@dot.iowa.gov
Indiana DOT	Tony McClellen	317.753.6620	tmcclellen@indot.state.in.us
Colorado DOT	Wayne Lupton	303.273.1840	wayne.lupton@dot.state.co.us
Kansas DOT	Ron Hall	620.276.3241	ron.hall@ksdot.org
Wyoming DOT	Mark Wingate	307.777.4056	mark.wingate@dot.state.wy.us

Potential for Payoff

9. What benefits has your organization realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or other advantages over other existing technologies. Benefits that have been realized include: more proactive and effective winter maintenance strategies, resulting in improved traveler safety and customer satisfaction; reduced use of deicing chemicals, resulting in lower costs and less environmental impact; better allocation of personnel and equipment resources, resulting in lower operational costs. The potential value of the benefits is enormous. Reductions in winter maintenance material and operational costs of 10-15% appear very achievable. Use of MDSS in other seasons could also save costly construction problems arising from unexpected unfavorable weather.

Implementation Potential

10. Please describe what actions another transportation agency would need to take to adopt this technology. To use this technology, other transportation agencies would need to acquire and install the MDSS software. They would also need to provide basic information about their highway segments, their winter maintenance practices, and available resources so the MDSS could recommend appropriate treatment strategies. Maintenance supervisors and crews would require training, which has also been developed in the MDSS pooled fund study. Finally, states would want to consider staged deployment of automatic vehicle location on their winter maintenance equipment, to ultimately realize the full benefit of MDSS.

11. What is the estimated cost, effort, and length of time required for procurement or adoption by another transportation agency? From the experience of the pooled fund states, it appears that staged deployment over a period of 2-4 years might be appropriate for most states. In the first year, MDSS would be acquired and set up for a number of pilot road segments. In the second year, MDSS would be expanded to larger geographical or organizational units (regions or districts). In the third year, statewide deployment could be targeted. Initial costs of software acquisition, installation, and configuration are estimated to be around $200-300K. Total deployment costs will depend upon the number of routes and maintenance units, and upon whether automatic vehicle location is used.

12. What organization(s) currently supply and provide technical support for this technology? The Maintenance Decision Support System developed in the pooled fund study is provided by Meridian Environmental Technology, Inc. of Grand Forks, ND. Other private entities also are working on similar systems based on the Functional Prototype MDSS, which is supplied by the Federal Highway Administration and the involved federal labs.

	13. Please describe any legal, regulatory, social, intellectual property, or other issues that could affect ease of implementation. The only identified issue concerns ownership of the intellectual property developed in the pooled fund study. The pooled fund states, Meridian Environmental Technology, and the Federal Highway Administration are establishing a framework to: ▪ ensure the long-range technical viability of the MDSS product; ▪ provide equitable licensing terms to pooled fund participants as well as other transportation agencies; ▪ comply with federal regulations regarding assignment of intellectual property rights; ▪ define an open software architecture that allows transportation agencies to bid and acquire MDSS components from multiple vendors. No legal, regulatory, or social risks have been identified during the course of this work.
Willingness to Champion	14. Is the sponsoring DOT willing to promote this technology to other states, if partially supported by the AASHTO Task Force on Technology Implementation? ☑ Yes ☐ No
Date Submitted	15. Date: September 9, 2005

16. Please include image(s) of sketches or photographs, if available ☑ Image(s) are attached.*

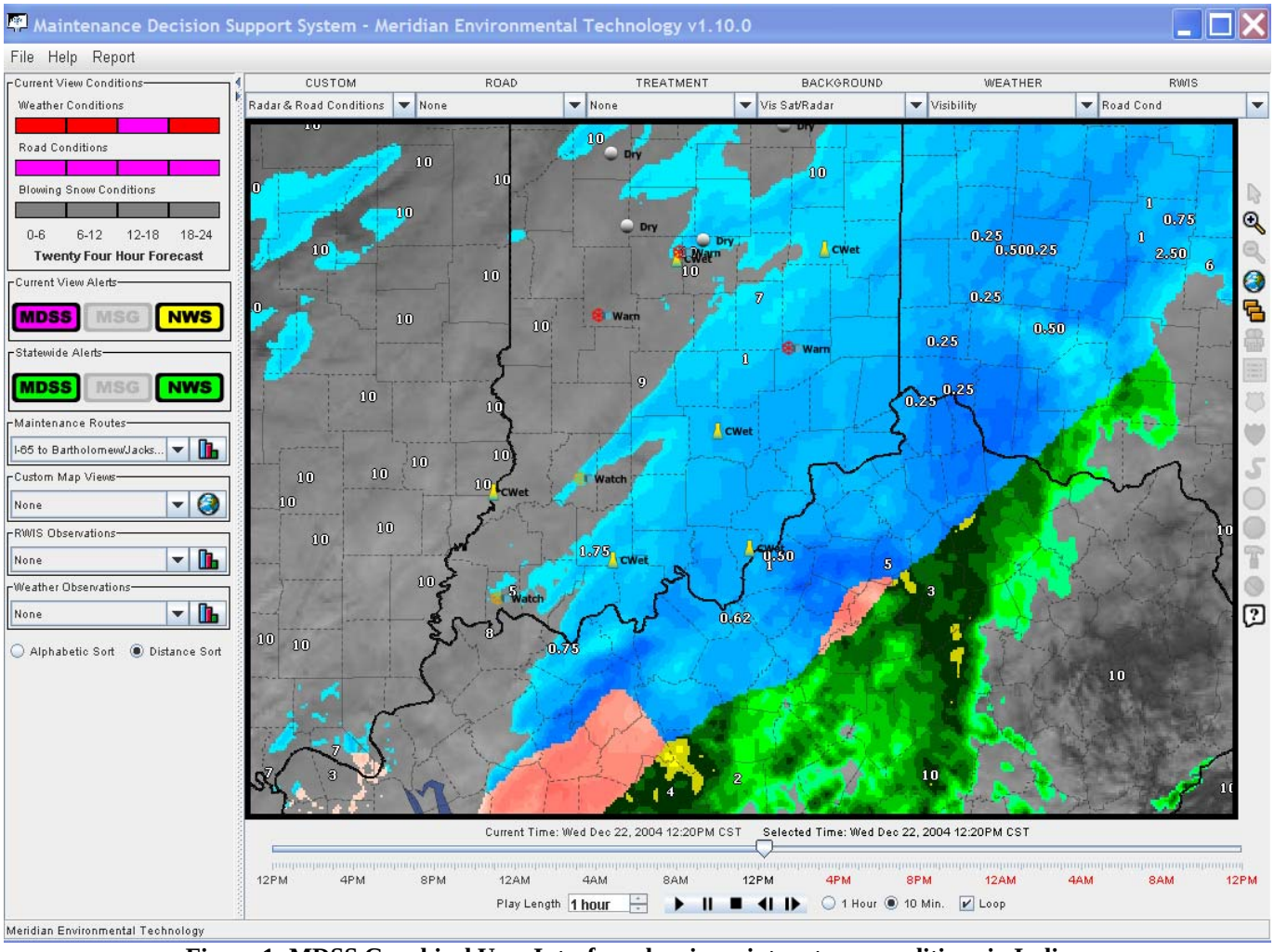


Figure 1: MDSS Graphical User Interface showing winter storm conditions in Indiana

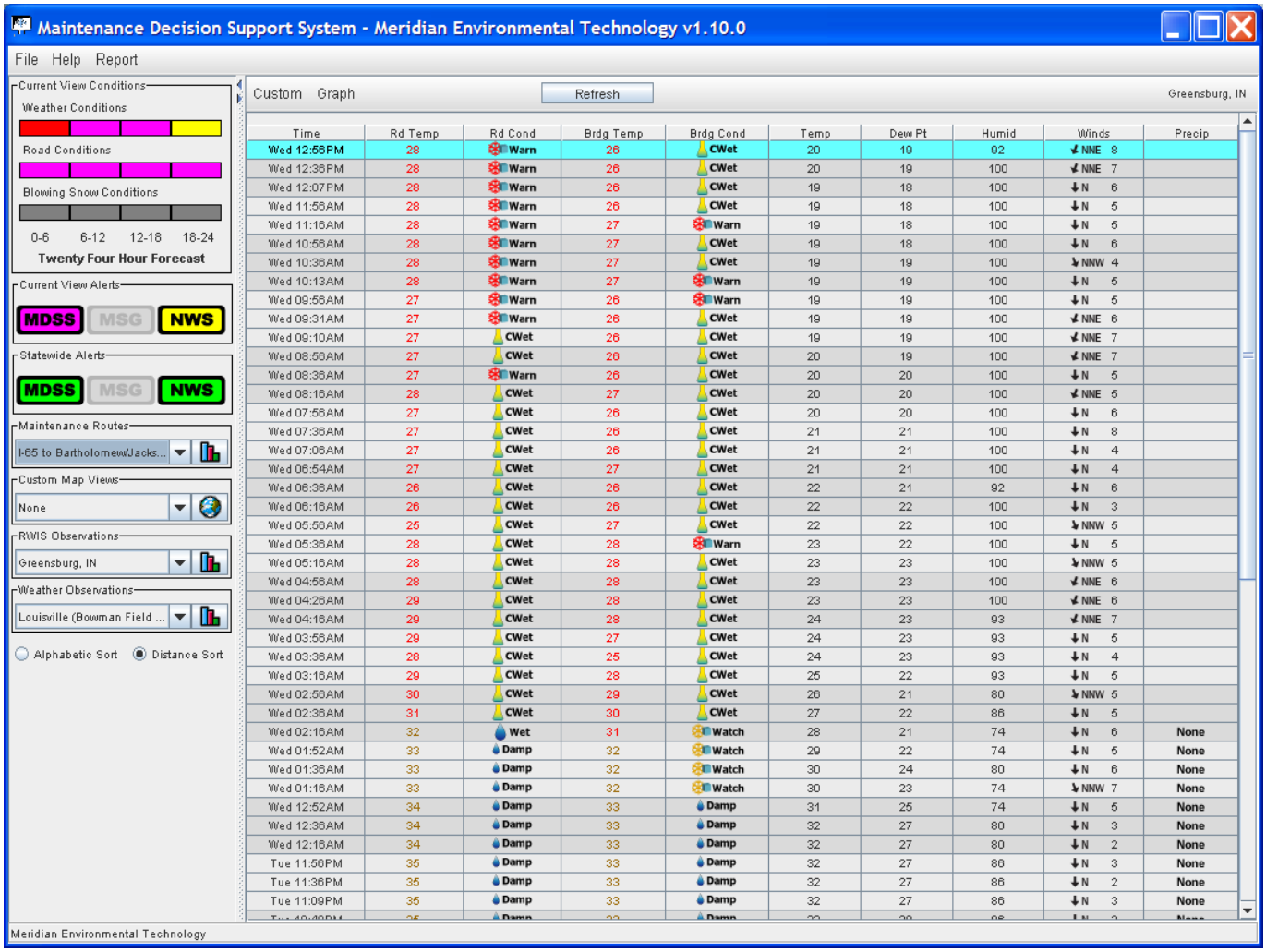


Figure 2: MDSS Graphical User Interface showing observed and predicted weather and road conditions

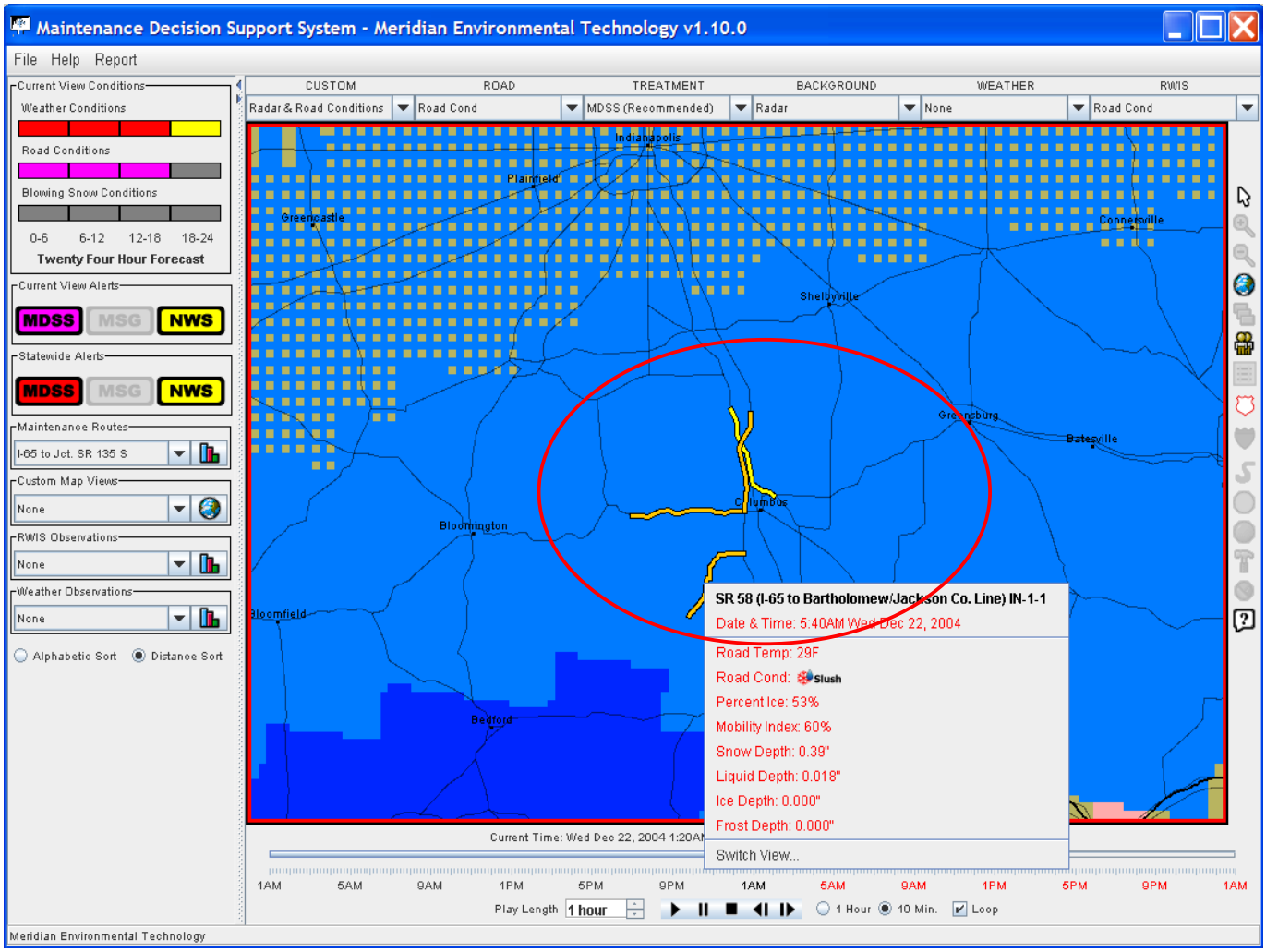
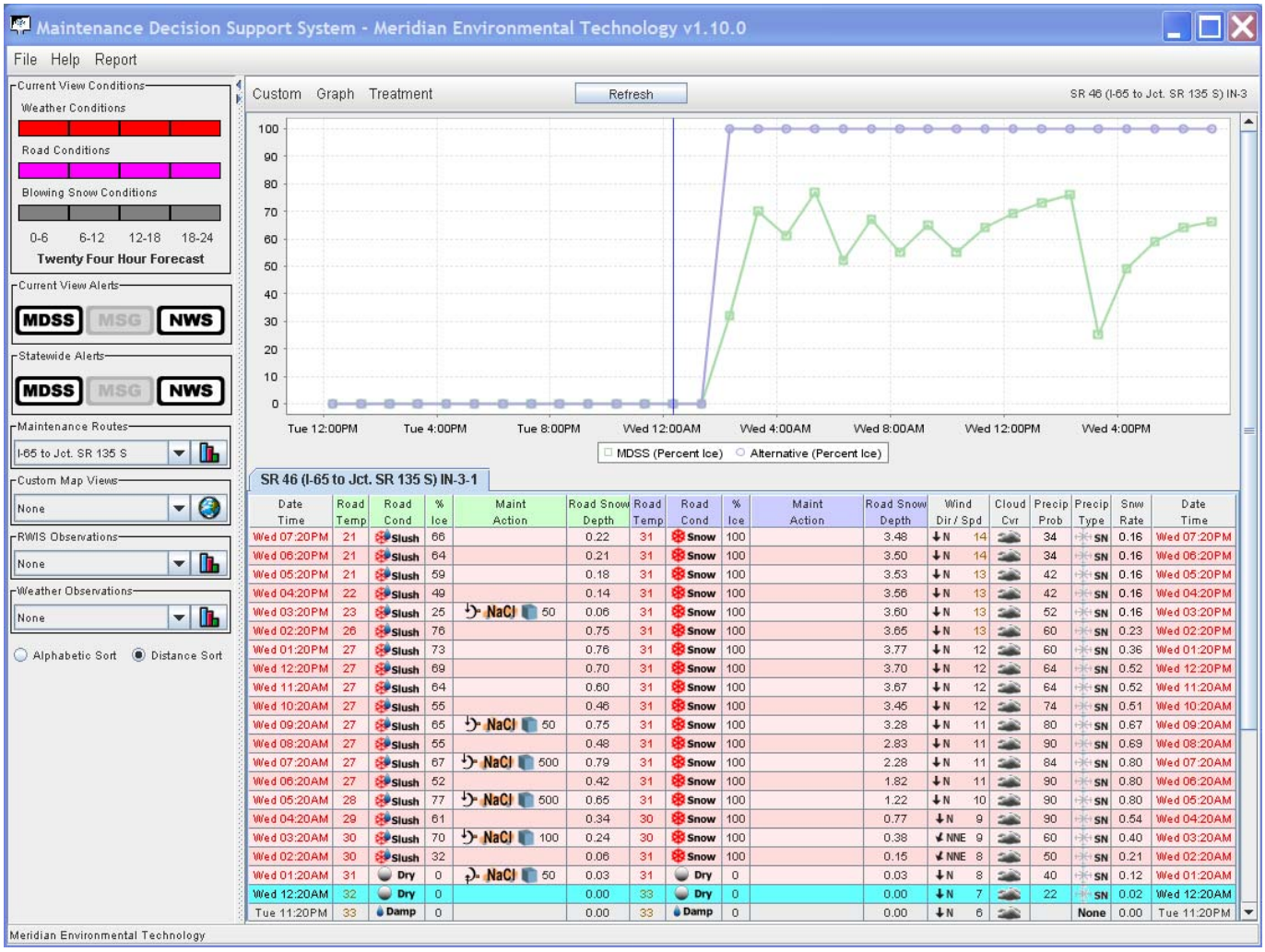


Figure 3: MDSS Graphical User Interface depicting conditions on maintenance road segments



Date Time	Road Temp	Road Cond	% Ice	Maint Action	Road Snow Depth	Road Temp	Road Cond	% Ice	Maint Action	Road Snow Depth	Wind Dir / Spd	Cloud Cvr	Precip Prob	Precip Type	Snw Rate	Date Time
Wed 07:20PM	21	Slush	66		0.22	31	Snow	100		3.48	N 14		34	SN	0.16	Wed 07:20PM
Wed 06:20PM	21	Slush	64		0.21	31	Snow	100		3.50	N 14		34	SN	0.16	Wed 06:20PM
Wed 05:20PM	21	Slush	59		0.18	31	Snow	100		3.53	N 13		42	SN	0.16	Wed 05:20PM
Wed 04:20PM	22	Slush	49		0.14	31	Snow	100		3.56	N 13		42	SN	0.16	Wed 04:20PM
Wed 03:20PM	23	Slush	25	NaCl 50	0.06	31	Snow	100		3.60	N 13		52	SN	0.16	Wed 03:20PM
Wed 02:20PM	26	Slush	76		0.75	31	Snow	100		3.65	N 13		60	SN	0.23	Wed 02:20PM
Wed 01:20PM	27	Slush	73		0.76	31	Snow	100		3.77	N 12		60	SN	0.36	Wed 01:20PM
Wed 12:20PM	27	Slush	69		0.70	31	Snow	100		3.70	N 12		64	SN	0.52	Wed 12:20PM
Wed 11:20AM	27	Slush	64		0.60	31	Snow	100		3.67	N 12		64	SN	0.52	Wed 11:20AM
Wed 10:20AM	27	Slush	55		0.46	31	Snow	100		3.45	N 12		74	SN	0.51	Wed 10:20AM
Wed 09:20AM	27	Slush	65	NaCl 50	0.75	31	Snow	100		3.28	N 11		80	SN	0.67	Wed 09:20AM
Wed 08:20AM	27	Slush	55		0.48	31	Snow	100		2.83	N 11		90	SN	0.69	Wed 08:20AM
Wed 07:20AM	27	Slush	67	NaCl 500	0.79	31	Snow	100		2.28	N 11		84	SN	0.80	Wed 07:20AM
Wed 06:20AM	27	Slush	52		0.42	31	Snow	100		1.82	N 11		90	SN	0.80	Wed 06:20AM
Wed 05:20AM	28	Slush	77	NaCl 500	0.65	31	Snow	100		1.22	N 10		90	SN	0.80	Wed 05:20AM
Wed 04:20AM	29	Slush	61		0.34	30	Snow	100		0.77	N 9		90	SN	0.54	Wed 04:20AM
Wed 03:20AM	30	Slush	70	NaCl 100	0.24	30	Snow	100		0.38	NNE 9		60	SN	0.40	Wed 03:20AM
Wed 02:20AM	30	Slush	32		0.06	31	Snow	100		0.15	NNE 8		50	SN	0.21	Wed 02:20AM
Wed 01:20AM	31	Dry	0	NaCl 50	0.03	31	Dry	0		0.03	N 8		40	SN	0.12	Wed 01:20AM
Wed 12:20AM	32	Dry	0		0.00	33	Dry	0		0.00	N 7		22	SN	0.02	Wed 12:20AM
Tue 11:20PM	33	Damp	0		0.00	33	Damp	0		0.00	N 6			None	0.00	Tue 11:20PM

Figure 4: MDSS Graphic User Interface depicting predicted road conditions with and without treatment

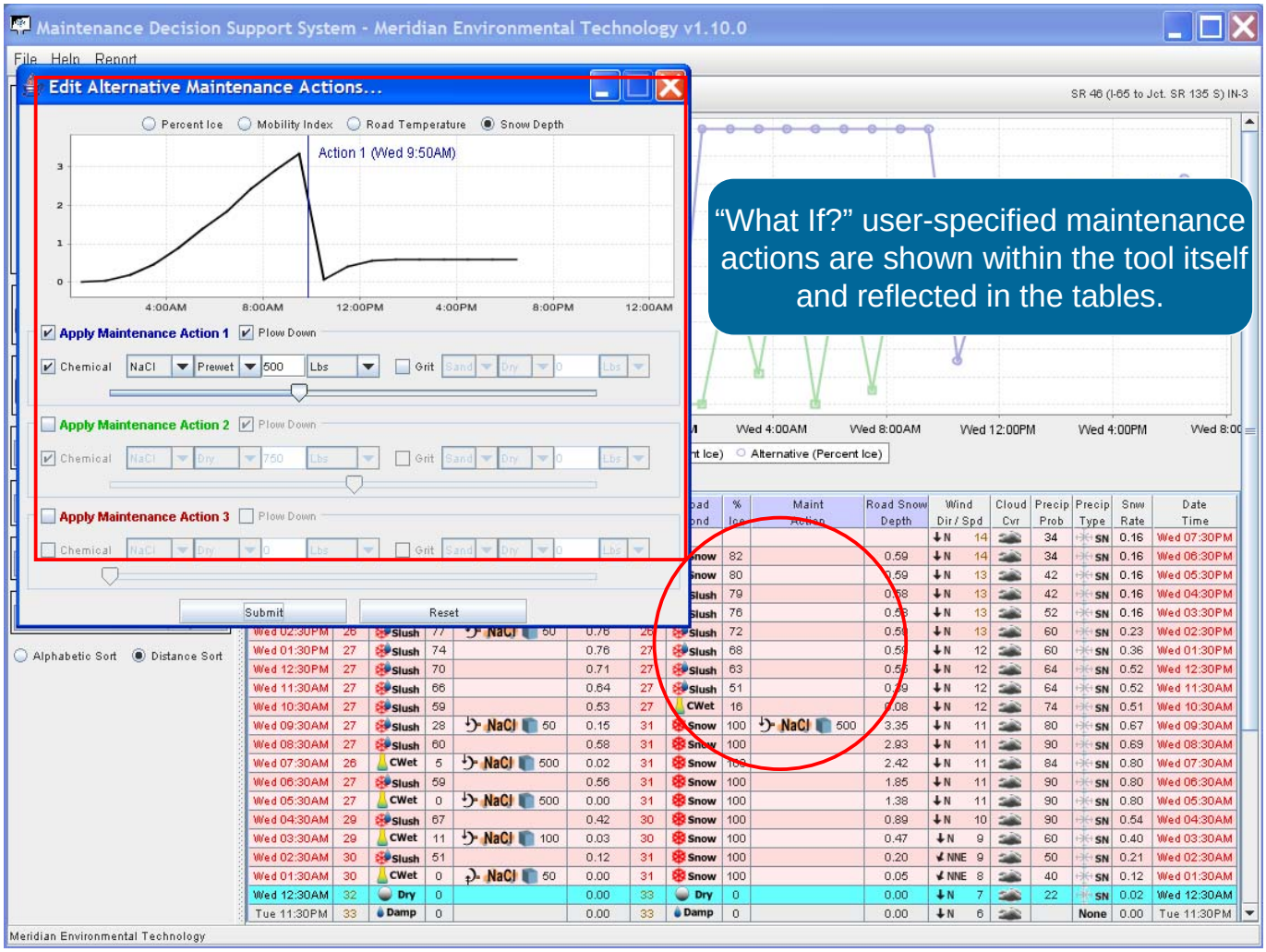


Figure 5: MDSS Graphical User Interface showing analysis of alternative treatment

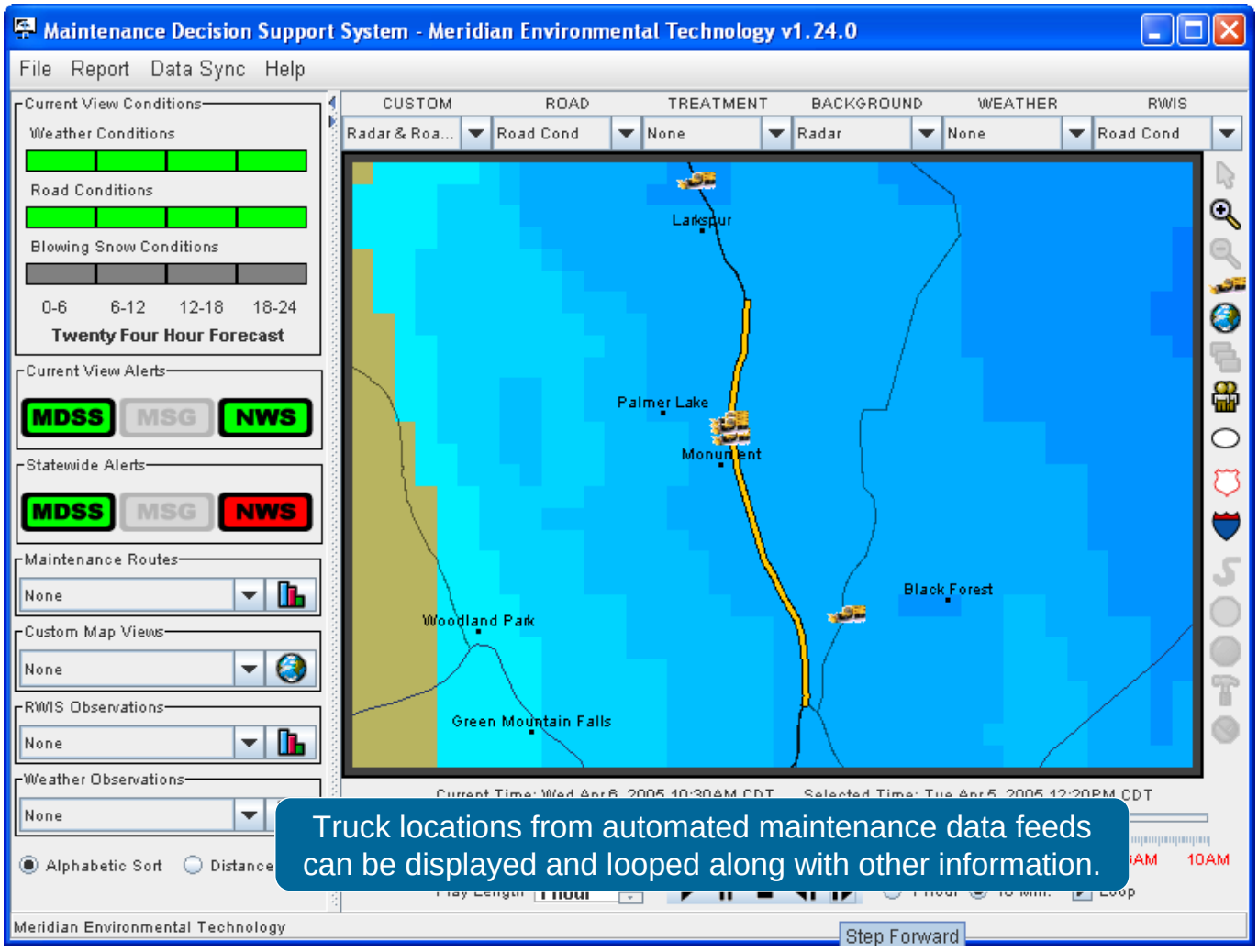


Figure 6: MDSS Graphical User Interface showing road conditions and snowplow locations on a route in Colorado

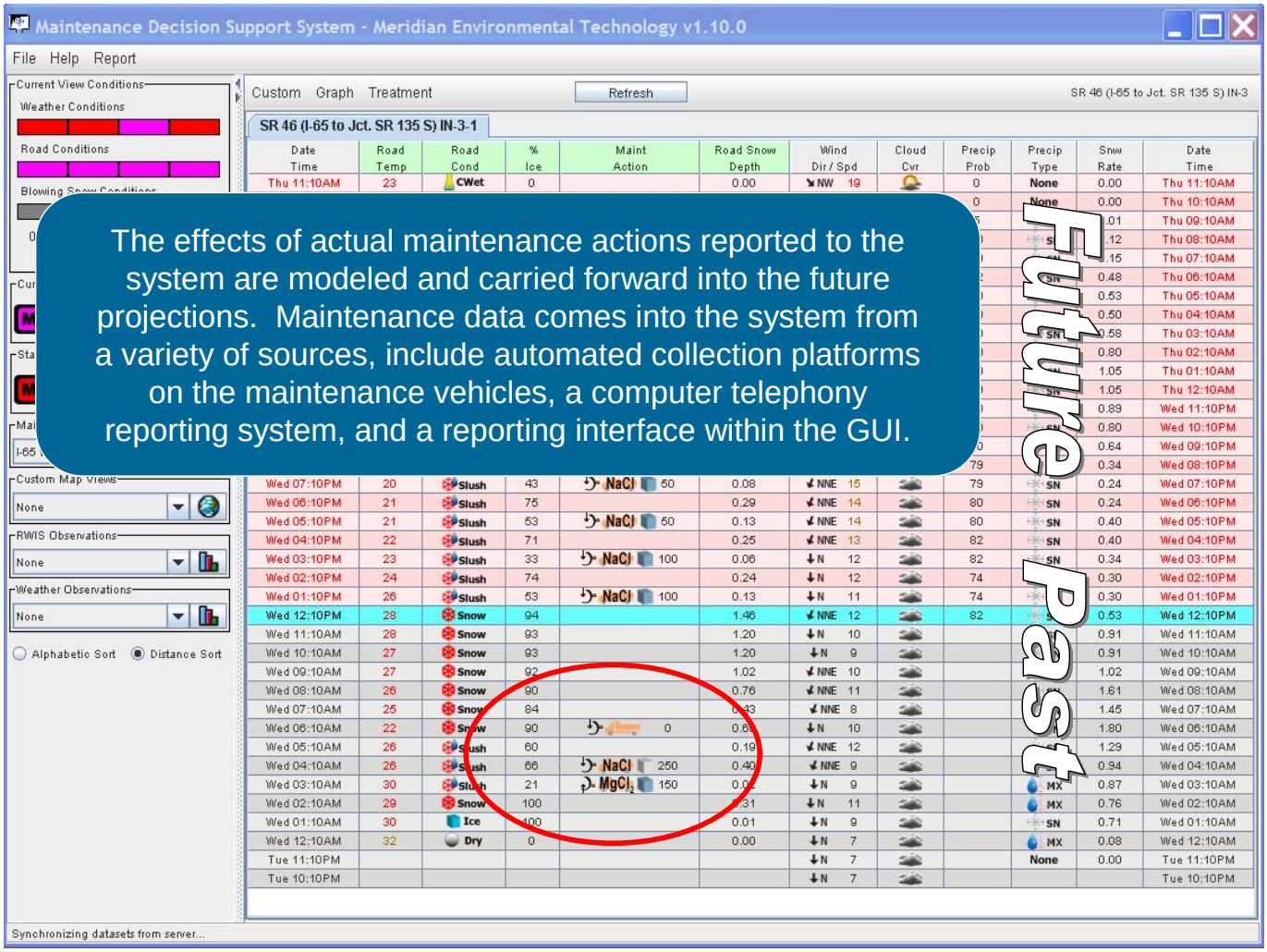


Figure 7: Effects of actual maintenance treatments are incorporated into the prediction of future road conditions

Users are provided a toolset for modifying these guidance constraints as needed. For example, note how changing the hours of operation, min/max material rates, and route traversal/cycle times changes the recommendation.

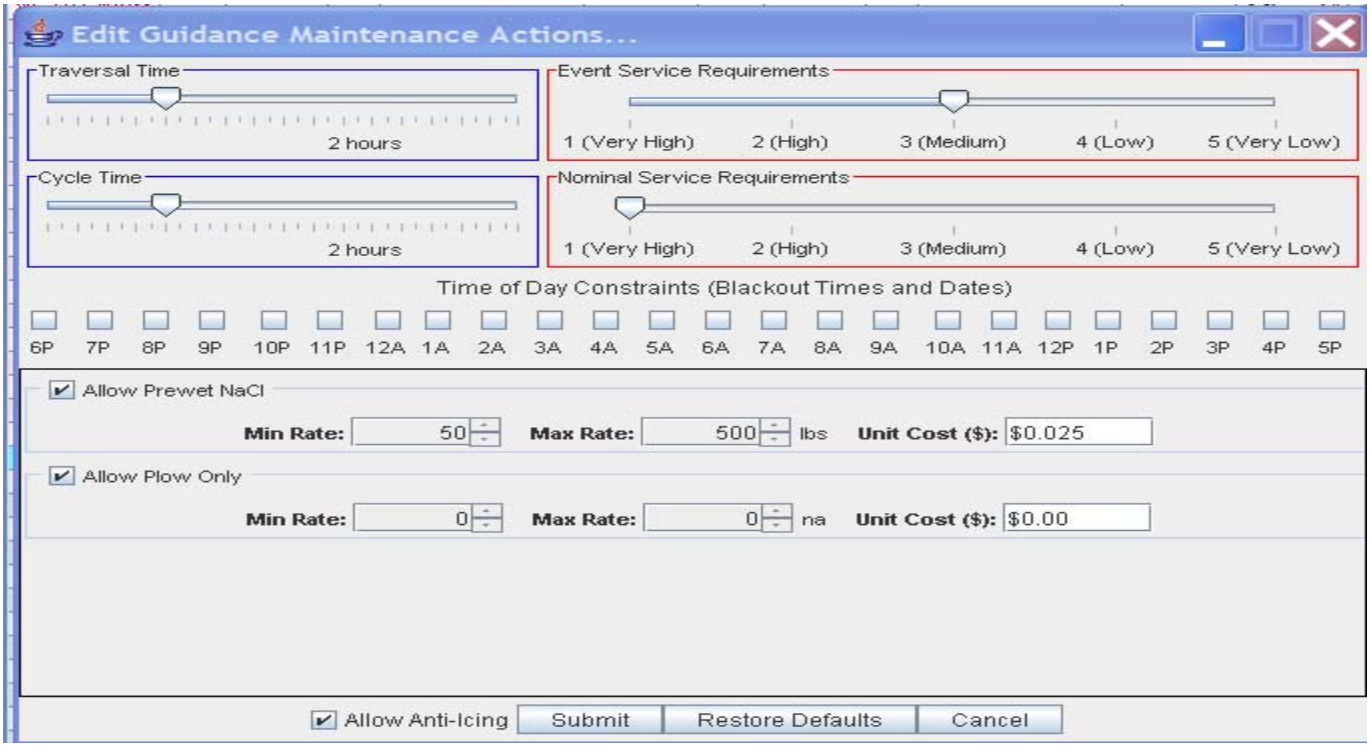


Figure 8: MDSS allows each user to define its hours of operation and other operational constraints

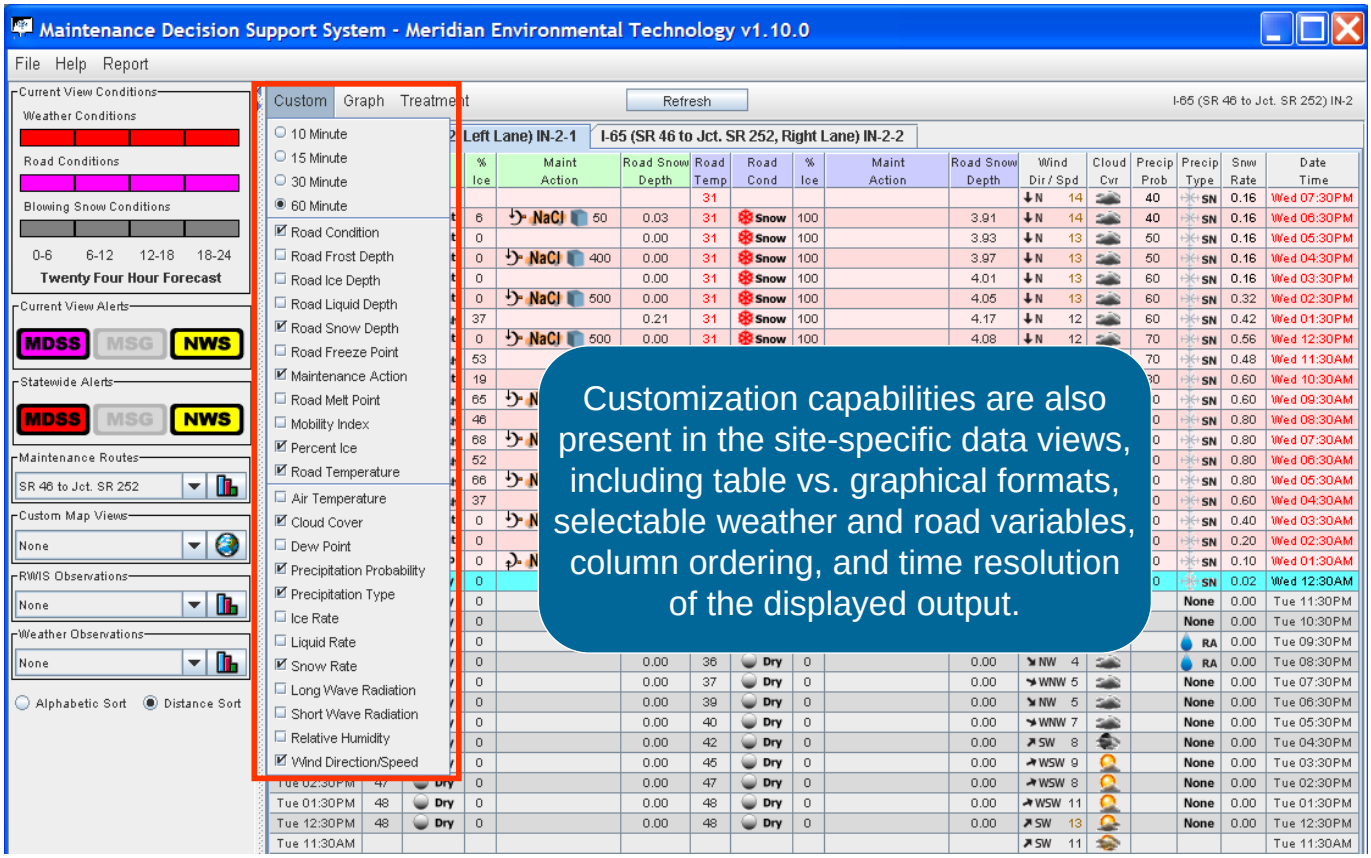


Figure 9: Each MDSS user is allowed to customize his or her screen to show the most pertinent information

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