



WTI  
Western Transportation  
INSTITUTE

University Transportation Center  
2011 Annual Report

# Western Transportation Institute University Transportation Center

2011 Annual Report

*(For the period October 1, 2010 - September 30, 2011)*

College of Engineering  
Montana State University

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# MESSAGE FROM THE DIRECTOR

## **Building global connections**

“Think globally, act locally” is a popular call to arms for environmental interests, designed to encourage people to take actions in their own communities that protect the long-term interests and health of the entire planet. I would propose that “thinking globally” is also a wise approach for transportation development.

From a literal perspective, thinking globally means ensuring that our transportation systems not only connect us to the next city or state, but also to anywhere in the nation or world. To revitalize an increasingly global economy, we must be able to move people and goods quickly and efficiently, wherever business opportunities await. So we need to work with transportation leaders at every level – local, state, national, and international – to develop a seamless transportation network.

In addition, “thinking globally” represents an effective problem solving approach that we use for our research – holistic, integrated investigations that consider multiple aspects of one problem in order to develop a comprehensive solution. At WTI, we have found this to be a particularly successful approach to our research. With our multi-disciplinary staff, we can use this “big picture” approach to create and implement innovative solutions that address critical safety, infrastructure, and ecological challenges facing transportation agencies on a day-to-day basis.

I hope you enjoy the latest UTC Annual Report from WTI that provides an overview of our research, education and technology transfer activities from the past year.

*Steve Albert, Director*





# MANAGEMENT STRUCTURE

The University Transportation Center management approach is designed to accomplish the following objectives:

- to provide for high quality, multi-disciplinary research, education, and technology transfer;
- to provide the Center's oversight members with clear, concise and accurate reports of Center activities so that they may adequately guide the long-term development of the Center;
- to utilize WTI/MSU resources (research and training facilities, human resources, physical facilities and institutional support capabilities) to maximize efficiency; and
- to establish clearly-defined roles, responsibilities, policies and procedures for all staff.

Management of the Center requires attention to the selection and conduct of research, education, and technology transfer activities, as well as careful control of expenditures. WTI has established a process for management of the Center's research, education, and technology transfer activities and utilizes the systems, policies, and procedures already in place that have been developed by WTI or that have been in place at MSU to manage funds, equipment, and personnel.

Financial administration of Center monies occurs both in-house and through the MSU Office of Sponsored Programs (OSP). The two entities perform different yet complementary aspects of financial management. The Director and Center Management rely on both sources of information to make financial decisions and oversee program development.

The Center Director manages personnel both directly and through a team approach that follows the chain of command shown in the accompanying

figure. In addition to regular meetings with key staff, the Director maintains an open door policy to address conflicts or problems of a more sensitive or serious nature. Personnel are encouraged to express their concerns and provide input both in writing and verbally. WTI management staff members (Research Director, Assistant Directors, and Program Managers) are required to meet annually with the Director for a performance review. This review provides the Director with the opportunity to assess the employee's performance in the preceding year. In addition, the employee is provided the opportunity to assess their satisfaction or displeasure with their level of responsibility, challenges, workload, compensation and other issues related to WTI and Center management.



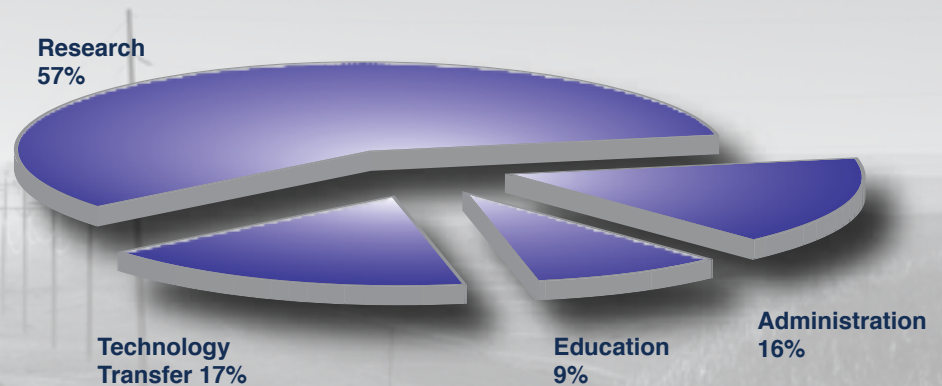
# FINANCIAL STATEMENT

The following pie charts illustrate allocations and funding sources for the Western Transportation Institute's UTC programs during Year 5. The first figure shows the breakdown of expenditures and allocations of the federal portion (\$3,239,900) of the UTC program for Year 5. Approximately \$297,000 was allocated for the Education Program and \$1,861,000 has been committed for research projects and laboratory/equipment funding. The remaining \$1,081,900 supports the administrative and technology transfer functions of WTI.

The second figure depicts the Year 5 funding sources for the WTI UTC Program. The match for the USDOT portion is provided by state departments of transportation, Montana LTAP, Montana State University, industry, and various private foundations.

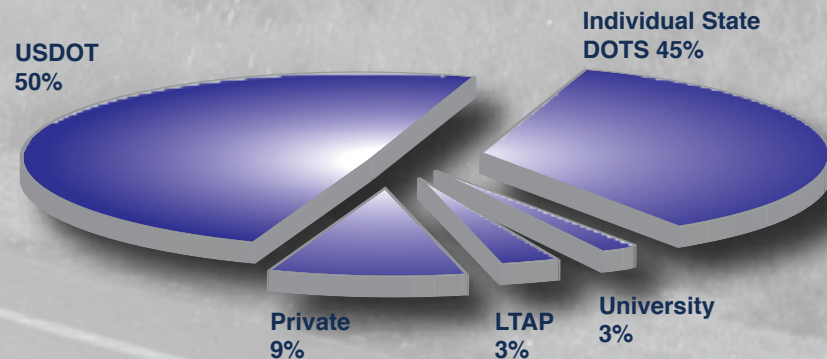
## Allocations for Year 5:

October 1, 2010 - September 30, 2011



## Funding Sources for Year 5:

October 1, 2010 - September 30, 2011





# RESEARCH

## Featured Projects

Highlighted below are projects illustrating WTI thinking globally and acting locally, both literally and figuratively. Whether it is lending expertise over international borders, or helping small local groups share lessons learned and best practices, WTI is connecting networks along the way.

### **Inhibitor Longevity and Deicer Performance Study**

WTI's Winter Maintenance and Effects (WME) program has worked very hard over the last several years to understand and mitigate the effects of winter weather and corrosion on transportation systems and to address associated challenges and concerns through innovation and multi-disciplinary partnerships. The program serves as a bridge between industry and academia and conducts problem driven research, emphasizing the development and evaluation of materials, technologies and systems to support winter maintenance best practices and decision making for sustainable transportation systems.

WME investigators have a unique opportunity to conduct comprehensive research in the WTI Corrosion and Sustainable Infrastructure Laboratory and the Montana State University Subzero Science and Engineering Research Facility, then test their results at TRANSCEND, WTI's outdoor test track. TRANSCEND includes a state-of-the-art snow making system, which allows researchers to simulate winter conditions in a controlled field setting. The team has systematically evaluated the performance attributes and impacts of alternative deicers as well as traditional chloride-based deicers, under research sponsored by Colorado, Washington, California and other state DOTs along with the U.S. DOT Research and Innovative Technology Administration (RITA).

The WME Program recently completed a pooled fund study on inhibitor longevity and deicer performance. The study was funded by RITA and the Pacific Northwest Snowfighters Pooled Fund- including eleven state DOTs (WA, ID, OR, MT, CO, IN, IO, MN, ND, UT, and VA), Redmond Minerals, America West, and Tetra Technologies - to evaluate the longevity and performance of corrosion inhibitors in deicing chemicals when in storage or on the road.

*"The investigation of inhibitor longevity and deicer performance is very important to the multiple agencies and private entities which contributed to this project. This research is the first such comprehensive effort to quantify the benefits of corrosion inhibitors when added to common deicer products. The results of this research will help these agencies and others to determine how best to proceed in the purchase and application of inhibited products."*

■ Monty Mills,  
WSDOT Maintenance Operations  
Branch Manager

# RESEARCH

## Featured Projects *(continued)*

### **Best Practices for Protecting DOT Equipment from the Corrosion Effect of Chemical Deicers**

Another new research project sponsored by RITA, the Alaska University Transportation Center, Oregon DOT, Washington State DOT, and the Clear Roads Pooled Fund will develop locally sourced salt brine additives for anti-icing, understand and mitigate effects of chloride deicer exposure on concrete, and establish best-practice guidelines for protecting DOT equipment from deicer corrosion.

This research will enable agencies to make informed and better choices on selecting corrosion prevention or corrosion control techniques and products. Best practices of corrosion management will lead to prolonged service life and enhanced operating efficiency and reliability of application equipment. By improving the equipment asset management, agencies can reduce equipment repairs and replacements and reap cost savings. As such, the saved DOT budget can be used for other costs associated with snow and ice program delivery (and thus achieve a higher level of service), which helps address strategic objectives related to the safety, preservation, mobility, and stewardship of the transportation system.

*"Delivering the right type and amount of materials in the right place at the right time for snow and ice control is the ultimate goal. Our research helps to establish best practices that are expected to improve the effectiveness and efficiency of winter operations, to optimize material usage, and to reduce associated annual spending and corrosion and environmental impacts."*

■ *Dr. Xianming Shi,  
P.E., Principal Investigator*



# RESEARCH

## Featured Projects *(continued)*

### **Carnivore Mortality and Movement On and Across the Transportation Corridors in Jasper National and Mount Robson Provincial Park**

The Road Ecology team at WTI has expanded its international research portfolio with a new habitat connectivity plan in the Canadian Rockies. Jasper National Park (JNP) and Mount Robson Provincial Park (MRPP), located along the border between British Columbia and Alberta in Western Canada, are home to numerous species of large animals, including coyotes, wolves and bears. Park and wildlife officials have concerns about the impacts that two of the major transportation corridors — Highway 16 and a railroad that runs parallel to it — are having on the populations of some of these species.

The Trans Mountain Legacy Fund, which was founded to improve the ecological integrity of the parks, selected WTI to identify mitigation efforts that will help reduce collisions and preserve habitat connectivity for medium and large-sized carnivore species. Researchers are collecting and analyzing data to identify high mortality and movement areas, and select locations where mitigation efforts will have the greatest benefit. The team will also identify suitable site specific mitigation measures, including cost estimates. “Some major mitigation efforts like wildlife overpasses are very effective, but they are also a significant investment and are built to last for 75 years,” Huijser explained; “so you need to make sure that you are not only picking the right tool, but putting it in exactly the right place so that animals will use it on a long-term basis.”

*“When a road or a railroad runs through the middle of an animal’s habitat, it can have numerous consequences. The most obvious is that animals may be hurt or killed trying to cross the corridor, but it can cause other changes too, such as blocking their access to food and water sources or isolating them from other animals, effectively creating smaller populations with reduced survival probability.”*

■ *Dr. Marcel Huijser, the WTI Research Ecologist leading the study*

In addition to the benefits for the targeted carnivore species, animal-vehicle collision mitigation efforts enhance safety and reduce costs for motorists and transportation agencies. In a national park setting, these efforts also help public land managers preserve the wildlife and natural resources that attract visitors to these facilities.

### **Cost Effective and Sustainable Road Slope Stabilization and Erosion Control**

The Transportation Research Board selected WTI to compile a national synthesis of available knowledge on, and related, cost effective practices for roadway slope stabilization and erosion control. This synthesis will be a useful resource to public road engineers and managers who wish to enhance slope protection on low-volume roads. Slope protection reduces maintenance needs and costs, and helps prevent the operational, environmental, and safety problems associated with erosion and slope failures.

In the U.S., there are approximately 3 million miles of rural low-volume roads, which are maintained by some 35,000 local agencies. These agencies often have limited resources for building and maintaining roadways, and in some cases, they may omit surface slope protections commonly included along high-volume roads.

Low-volume road engineers and managers around the world are implementing solutions that are successful and cost-effective, but not well-

*“Even with lower levels of traffic, these low volume roads can be subject to erosion, slope failure, and even landslides. When erosion occurs, agencies must deal with increased road maintenance, delays and safety issues for motorists, and potential environmental damage.”*

■ *Laura Fay, WTI Research Scientist*

known, and successful practices are not being shared with other locations. Drawing on national and international research, as well as interviews with experts, WTI will develop a user-friendly report that focuses on environmen-

# RESEARCH

## Featured Projects *(continued)*

tally-friendly and sustainable practices for slope stabilization and erosion control, which are also suitable for implementation in rural locations. A wide range of techniques, such as soil bioengineering, drainage options, live planting, and structural fixes will be included.

The final synthesis will be organized so that the practices will be categorized by climate, topography and failure mechanisms. The report will also include detailed and illustrative case studies. Additional benefits of slope stabilization and erosion control include rural employment generation opportunity involving both skilled and unskilled labor, protection of land and water resources, and preservation of local biodiversity as native grass and plant species are used in bioremediation applications.

# RESEARCH

## Awards and Recognition

### **WTI Presented with FHWA Environmental Excellence Award**

The Federal Highway Administration (FHWA) has recognized WTI, along with Washington State Department of Transportation, Washington Department of Fish and Wildlife, and multiple conservation partners for their exemplary achievements on the Washington Connected Landscapes Project. The 2011 Environmental Excellence Award was presented to the partners in August at the International Conference on Ecology and Transportation in Seattle, Washington.

WTI's contributions included assisting with a geographic information system analysis of habitat conditions in Washington and portions of adjacent jurisdictions. The analysis incorporated habitat and movement needs of 16 focal species and also produced maps of connected habitat networks based on landscape integrity. The results of the analysis will be useful in a wide variety of future conservation related actions.

Road Ecologist, Robert Long, served as the lead for WTI on the project. "It's been a delight to be able to participate in such a comprehensive, partnership-driven project that will have far-reaching consequences for habitat connectivity across the Pacific Northwest," said Long.

The statewide habitat connectivity assessment will influence many aspects

of construction and maintenance of Washington's highway system, and will be used as one element of a ranking method to identify which highway segments will receive funds for wildlife friendly improvements. This project demonstrates that protection of habitats and providing wildlife friendly solutions for highway improvements and maintenance are integral in our work to meet the Nation's growing transportation needs.

The FHWA Environmental Excellence Award recognizes partners, projects, and processes that enhance awareness of the environment and how they do business. Winning entries are selected based on building partnerships, creatively meeting environmental challenges, enhancing interagency coordination in ways that go beyond environmental "business as usual," and achieving environmental excellence.

*"The Washington Connected Landscapes Project brought a variety of partners to the table. WTI lent Robert Long's expertise in landscape ecology and roads, two of the core elements of our project," said Kelly McAllister, Wildlife Biologist for the Washington Department of Transportation. "We appreciated Robert's contributions as a representative of WTI."*



# RESEARCH

## Success Story

### ARC: International Wildlife Crossing Infrastructure Design Competition

*New Methods – New Materials – New Thinking*

Initiated by the Western Transportation Institute and the Woodcock Foundation, ARC was a partnership-driven wildlife crossing design competition that engaged the best and most innovative international, interdisciplinary design teams—comprised of landscape designers, architects, engineers, ecologists, and other experts—to create the next generation of wildlife crossings for North America's, and perhaps the world's, roadways. The project drew mounting support throughout the course of the competition, bringing together thirty two sponsors from federal and state agencies, universities, professional associations and non-profit organizations in the U.S. and Canada including FHWA, RITA, and AASHTO.

*"I think the next generation of these structures can be built for less, can be more innovative, and have better ecological sensitivities."*

■ *Tony Clevenger,  
WTI Research Ecologist, who initiated  
the concept of the ARC competition*

Growing scientific research shows the importance of wildlife crossings and their effectiveness at reducing wildlife-vehicle collisions. In Banff National Park in Alberta, Canada, a continuous series of 22 underpasses and two overpasses has resulted in an 80 percent reduction in total wildlife fatalities because wildlife was allowed to roam free, uninterrupted by a major Canadian transportation corridor. There have been approximately 240,000 documented crossings of these structures by 11 species of large mammals, - including wolf, grizzly bear, elk, lynx, mountain lion, and moose . While crossing structures have demonstrated great success in protecting both wildlife and drivers, their use in the U.S. is limited, due in large part to the high cost and long design and construction process.

Launched in June 2010, the competition raised international awareness around wildlife movement and protection while promoting feasible, buildable, context-sensitive and compelling design solutions for safe, efficient, cost-effective, and ecologically responsive wildlife crossings. In the first phase of the competition, thirty-six interdisciplinary teams submitted Expressions of Interest describing their approaches for designing an overpass for West Vail



*Graphic rendition of winning entry submitted by HNTB with Michael Van Valkenburgh Associates, Inc.*



# RESEARCH

## Success Story *(continued)*



*"This international competition both establishes and inspires a new category of public infrastructure that is both responsive and responsible to environmental concerns. The ARC competition addresses a global problem with a Colorado-based solution that will demonstrate the importance of international cooperation."*

■ Jared Polis (D-CO),  
Colorado Congressman

Pass on I-70 in Colorado. This mountainous site was chosen for the competition due to its challenging location along a busy, high elevation interstate highway in the midst of the Rocky Mountains and its function as a migration corridor for numerous species of wildlife including wolves and Canada lynx. In September 2010, ARC announced the selection of five finalist teams whose members represented more than

a dozen firms in four countries. The teams traveled to Colorado to view the West Vail Pass site in person. After carefully studying the road features and geometry, as well as the wildlife habitats, the finalists created their final designs.

A world-class jury of five leading experts in landscape architecture, engineering, transportation, and ecology, chaired by Harvard University Graduate School of Design's Charles

Waldheim, unanimously selected HNTB with Michael Van Valkenburgh Associates, Inc. (HNTB+MVVA) as the competition winner. The New York City design firm was chosen for their use of ordinary materials, such as concrete, in an extraordinary way. Their design was cost-effective, modular, easy to construct, provided greater material control, and used a unique built-in drainage system. The award was presented at the National Academies' Transportation Research Board's 90th Annual Meeting in Washington, D. C. last January.

While the 2010 competition has concluded, ARC continues to be an interdisciplinary partnership working to facilitate new thinking, new methods, new materials, and new solutions for wildlife crossing structures. The goal is to ensure safe passage for both humans and animals on and across our roads. Through science, design, and strong, diverse partnerships, ARC will remain a forum for creative collaborations and surprising synergies.



# Research

## Project Status 2011

Following is a list of Center research projects. New projects were selected between October 1, 2010 and September 30, 2011.

New Research Projects	Principal Investigator		
Livability Benchmarks for Montana Transportation	Steve Albert	Professional Capacity Building for Communication Systems, Phase 2	Doug Galarus
Evaluation of the Reliability and Effectiveness of an Animal Detection System	Marcel Huijser	A Smart Phone Application for a National Transportation Data Collection System (ROCS, Phase 4)	Doug Galarus
Carnivore Mortality and Movement On and Across the Transportation Corridors in Jasper National Park and Mount Robson Provincial Park	Marcel Huijser	Pilot Study of Traffic Safety Culture	Nic Ward
Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control	Laura Fay	Methods for Estimating the Benefits for Winter Maintenance Operations	David Veneziano
Jackson Hole Highways: Animal Movement & Wildlife-Vehicle Collisions	Marcel Huijser	Cost-Effective Local Road Safety Planning and Implementation Solutions	David Veneziano
Testing and Evaluation of Recovered Traction Sanding Material	Robert Mokwa	Understanding and Mitigating the Effects of Chloride Deicer Exposure on Concrete	Xianming Shi
Corrosion Monitoring System for Existing Reinforced Concrete Structures	Xianming Shi	Determination of Material Properties and Deflection Behaviors for Contemporary Prestressed Beam Design	Jerry Stephens
Evaluating the Effectiveness of Winter Chemicals on Reducing Crashes in Idaho	Jared Ye		
California & Oregon Advanced Transportation System (COATS) Phase 5	David Veneziano		
Best Practices and Guidelines for Protecting DOT Equipment from the Corrosive Effect of Chemical Deicers	Xianming Shi		
The Road to Zero: Impacting Motor Vehicle Safety in Ontario's Workplaces	Jeff Linkenbach		
Review and Update of AKDOT&PF Geosynthetic Design Guidelines and Construction Specifications	Eli Cuelho		
Variable Speed Limit System for Wet and Extreme Weather Conditions	Ahmed Al-Kaisy		
Integration of AWOS w/RWIS, Phase 2	Doug Galarus		



# Research

## Project Status 2011 *(continued)*

### Ongoing Research Projects *(continued)*

### Principal Investigator

Effects of Defensive Vehicle Handling, Phase 3	Laura Stanley	Montana Fuel Tax Refunds	Pat McGowen
Banff Wildlife Crossings	Tony Clevenger	Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements	Michael Berry
Ant Colony Optimization for Transportation Optimization Problems	Doug Galarus	US 93 Post Construction Wildlife-Vehicle Collision and Wildlife Crossing Monitoring and Research	Marcel Huijser
Snoqualmie Pass Monitoring Plan	Tony Clevenger	Responder Phase 3, Deployment Assistance	Doug Galarus
US 93 Wildlife Monitoring	Marcel Huijser/ Rob Ament	Automated Safety Warning System Controller Phase 2, Deployment Preparation	Doug Galarus
Developing Regional Ecosystem Framework for Terrestrial & Aquatic Resources along the I-70 Corridor, Colorado	Marcel Huijser	Modeling Effective, Efficient, and Sustainable Emergency Medical Services Systems for Rural Areas	Shaowei Wang
Validation of Rehabilitation Strategies to Extend the Service Life of Concrete Bridge Decks	Eli Cuelho		
I-90 Snoqualmie Pass East: Pre-Construction Wildlife Monitoring of Fish Passage	Matt Blank		
An Assessment of Habitat Connectivity and Fracture Zones for Carnivores Within & Between the I-90 & US 2 Corridors, Washington	Robert Long		
Animal Detection System for Reliability Testing	Marcel Huijser		
Highway 3 Transportation Corridor: Wildlife Movement & Mitigation Assessment	Tony Clevenger		
Using Naturalistic Data to Evaluate Safety & Operational Characteristics of Highways	Pat McGowen		
Evaluation of an Animal Warning System Effectiveness	Marcel Huijser		
An Experimental Assessment of Swimming Capabilities of Selected Trout Species for Barrier Assessment, Barrier Design, Fishway and Culvert Design, and Retrofits	Matt Blank		
Steel Pipe Pile/Concrete Pile Cap Bridge Support Systems: Confirmation of Connection Performance	Michael Berry		



# Research

## Project Status 2011 *(continued)*

### Completed Research Projects

### Principal Investigator

Weathershare - Phase 2	Doug Galarus
Redding Responder - Phase 2	Doug Galarus
Automated Safety Warning System Controller	Doug Galarus
Wildlife-Highway Crossing Mitigation Measures and Associated Costs/Benefits: A Toolbox for MDT	Marcel Huijser
Electrochemical Rehabilitation of Salt Contaminated Concrete – A Lab Study	Xianming Shi
Automated Cost Recovery	David Kack
Mitigation of Moisture & Deicer Effects on Asphalt Thermal Cracking.	Tongyan Pan
Bozeman Pass Post Fencing Monitoring	Angela Kociolek
Impacts of Barriers on Topeka Shiner Populations	Matt Blank
Innovative Coating System for the Corrosion Prevention of Galvanized Steel	Xianming Shi
Durability of Corrosion Resistant Mineral Admixture Concrete	Xianming Shi
Blaine County State Highway 75 Wildlife Data Collection and Mitigation Research Project	Marcel Huijser
Rural Transportation and ITS Outreach and Assessment	Steve Albert
California Oregon Advanced Transportation System Phase 3	DAVID VENEZIANO
National Wildlife Collision Study	Marcel Huijser
Effects of 4 Lane Highways on Desert Kit Fox and Swift Fox	Tony Clevenger
Integration of Aviation Automated Weather Observation (AWOS) w/RWIS	Doug Galarus
An Autonomous & Self Sustained Sensing System to Monitor Water Quality Near Highways	Xianming Shi

Developing a Standard Test Method for Measuring Geosynthetic Soil Resilient Interface Shear	Eli Cuelho
Mobile Communications Briefcase	Doug Galarus
Inhibitor Longevity and Deicer Performance Study	Xianming Shi
Facilitating Special Event Congestion	Suzanne Lassacher
Development of Standardized Test Procedures for Deicing Compounds-Clear Roads	Xianming Shi
WTI System Engineering & Integration of Transportation Technology SEITTP	Doug Galarus
Establishing Best Practices of Removing Snow and Ice from California Highways	Eli Cuelho
Lab Investigation of Deicer Impacts on Concrete Microstructure and Pavement Friction Coefficient	Xianming Shi
Rural EMS Driver Safety Research Program: Phase I, Feasibility Study	Nic Ward
Field Investigation of Geosynthetics Used for Subgrade Stabilization	Eli Cuelho
Highway 93 South Mitigation Feasibility Study in Kootenay National Park	Marcel Huijser
Portable TMC-TMS Communications Demonstration	Doug Galarus
Benefit-Cost Analysis of Maintenance Decision Support System: A Case Study for the State of Colorado	Jared Ye
Roadkill Observation Collection System (ROCS), Phase III	Rob Ament

# Research

## Project Status 2011 *(continued)*

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COATS Phase IV	David Veneziano
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Replacing Thermal Sprayed Zinc Anodes on Cathodically Protected Steel Reinforced Concrete Bridges	Xianming Shi
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Deicer Interaction with Portland Cement Concrete Pavements and Bridge Decks	Xianming Shi
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Examining Paved Road Impacts on Birds	Angela Kociolek
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Development of a Toolkit for Cost-Benefit Analysis of Specific Winter Maintenance Practices, Equipment and Operations	Xianming Shi
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Laboratory Testing of Mixed Liquid Deicers and Use of Multiple Performance Characteristics for Deicer Selection/Design	Xianming Shi
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Northwest Passage Rural Vehicle Infrastructure Integration Demonstration Project	Gary Schoep
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Channelized Right-Turn Lanes at Signalized Intersections: Traffic Control Empirical Investigation	Ahmed Al-Kaisy
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Warm Mix Asphalt Paving Strategies for Use in Montana Highway Construction	Steve Perkins
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Best Management Practices to Mitigate Burrowing Mammal Impacts on Montana's Highways	Angela Kociolek
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Interim Evaluation of Three Instrumented Bridges in Saco, Montana	Eli Cuelho
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Naturalistic Safety Evaluation of a Medic's Work Environment during rural Emergency Response	Laura Stanley
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An Experiment in Integrating an Engineering Communications Toolkit into the Industrial Engineering Curriculum	Laura Stanley
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Montana Rest Area Usage: Data Acquisition and Usage Estimation	Ahmed Al-Kaisy
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Developing a Testing Methodology that Correlates Laboratory Testing and Field Performance in Measuring Performance Characteristics and the Friction Coefficient of Deicing and Anti-icing Chemicals	Laura Fay
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# EDUCATION

## Program Overview

WTI promotes transportation workforce development by adopting a holistic view of the education-career continuum. WTI targets education and outreach opportunities from K-12 (recruitment) through career-level professional development (life-long learning). Within this continuum, the cornerstone of WTI's activities continues to be providing quality experiential learning opportunities at the university level. These opportunities consist of multidisciplinary course offerings in transportation, a rich array of research experiences at both the undergraduate and graduate levels, and opportunities for professional placement and advancement. All activities are focused on advancing transportation education and interest of the participants with a unique emphasis on rural transportation issues.

# EDUCATION

## Student Research and Support

Each year, WTI offers experiential learning opportunities to a large number of both undergraduate and graduate students. In addition to project-sponsored research assistantships, the UTC program supports two student research programs.

The Undergraduate Research Experience (URE) program competitively selects four undergraduates each year to participate in a unique academic yearlong research opportunity. The program provides a one-on-one mentoring relationship with a professional researcher at WTI, paid hands-on research experience, and assistance in developing valuable skills in data collection, analysis, interpretation, and presentation. The goal is to foster interest in transportation career fields, as well as possible pursuit of graduate study of transportation related research issues. The students produce a research work plan, submit a final research report, and present their research to WTI staff and students at the end of the program. Three undergraduate students from Mechanical Engineering and one Civil Engineering undergraduate participated in the 2010-2011 URE program. Projects explored rural airport management issues and best practices, development of "smart cones" to enhance worker safety in construction zones, green concrete, and distracted driving.

At the graduate level, the Graduate Transportation Award provides tuition support and a monthly stipend to a cohort of competitively selected students pursuing advanced degrees on a transportation topic. The multidisciplinary nature of transportation research is reflected in the make-up of award recipients. Five graduate students representing five different academic departments received Transportation Awards over the past year. An additional eighteen graduate students served as research assistants on WTI projects. Eight transportation graduate students received advanced degrees this year. Students completing their programs of study are listed below (Transportation Award recipients are marked with an asterisk).

1. \*Jessica Mueller, MS, Industrial Engineering  
Thesis: Safety Evaluation of a Medic's Work Environment during Rural Emergency Response
2. \*Joe Smith, MS, Ecology  
Thesis: Movement and Gene Flow of Northern Flying Squirrels Across an Interstate Highway
3. \*Tiffany Allen, MS, Ecology  
Thesis: The Use of Wildlife Underpasses and the Barrier Effect of Wildlife Guards for Deer and Black Bear

# EDUCATION

## Student Research and Support

4. Zachary Kirkemo, MS, Civil Engineering

Thesis: Montana Rest Area Usage: Data Acquisition and Usage Estimation

5. Bethany Bermel, MS, Civil Engineering

Thesis: Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavement

6. \*Sommer Roefaro, MS, Civil Engineering

Thesis: Channelized Right-Turning Lanes: A Review of Practice and an Empirical Study

7. Zachary Zupan, MS, Civil Engineering

Professional Paper: Extending the Service Life of Concrete Bridge Decks

8. Janelle Booth, MPA, Public Administration

Professional Paper: Montana Fuel Tax Refunds

Two Masters degree recipients plan to continue their education at the PhD level. Jessica Mueller was a recipient of the WTI Graduate Transportation Award and was selected as the 2009 UTC Student of the Year. After completing her Masters, she continued as a research assistant on WTI human factors projects and plans to return to the MSU Industrial Engineering department to pursue a PhD beginning spring 2012. Joe Smith, also a Graduate Transportation Awardee, enrolled in the Ecology PhD program at the University of Montana after completing his Masters at MSU. Three additional degree recipients have continued making contributions to transportation research efforts at WTI following graduation. Tiffany Allen, Sommer Roefaro, and Zachary Zupan have all been engaged as research staff on WTI projects.. Program graduate Bethany Bermel began a position with the Montana Department of Transportation Bridge Bureau after her graduation.

Considered collectively, WTI engaged 17 undergraduates and 23 graduate students on transportation research projects. Research assistants added value to twenty-nine different projects (as summarized in the table on the next page).



# EDUCATION

## Student Research Involvement

Project	Undergraduate	Graduate
Animal Detection System Project		1
Best Practices & Guidelines for Protecting DOT Equipment from Deicer Corrosion	2	
Building Green: Environmentally Friendly Concrete	2	1
Cold Temperature on Deep Water Soft Marine Clays		1
Coordinated Speed Management Systems to Reduce Crashes on Rural Roadways (aSE)	3	
Effects of Defensive Vehicle Handling Training		1
Extend the Service Life of Concrete Bridge Decks		2
Hands-free (voice activated) texting while driving – is it safe? (URE)	2	
I-90 Snoqualmie Pass -Pre-Construction Wildlife Monitoring Program, 2009-2010		1
Integrating an Engineering Communication Toolkit into IE Curriculum		1
Lab Investigation of Prewet Solid Deicing Salts Exposed to Traffic		1
Livability Benchmarks for Montana Transportation		1
Modeling the Validity and Transfer of Eye Scanning Patterns for Hazard Perception from Virtual Reality Training Environment to Reality	1	1
Montana Fuel Tax Refunds	1	1
Montana Rest Area Usage: Data Acquisition & Usage Estimation		1
National Technical Assistance Center for Parks and Public Lands	2	
Non-motorized Use: Post Pathway 2010		1
Reclaimed Asphalt Pavement in Portland Cement Concrete Pavements	2	2
Rural Airport Issues and Best Asset Management Practices (URE)	1	
Steel Pipe Pile/Concrete Pile Cap Bridge Support System	1	1
Travel Demand Forecasting for Gallatin County		1
Understanding and Mitigating Effects of Chloride Deicer Exposure on Concrete	1	
US 93 Wildlife Mitigation Measures Post Construction Evaluation		2
UTC Medic Work Environment During Rural Emergency Response		2

# EDUCATION

## Student Research Involvement

Project	Undergraduate	Graduate
UTC Mobile Communication Briefcase	1	
UTC Right-Turn Lanes at Signalized Intersections: Traffic Control		1
UTC Swimming Capabilities of Selected Trout Species for Barrier Assessment		1
Variable Speed Limit System for Wet and Extreme Weather Conditions		1
Washington DOT Protecting DOT Equipment from Corrosive Chemical Deicers		1

These students also came from a myriad of academic disciplines. WTI fosters the multidisciplinary nature of the transportation workforce with the understanding that significant improvements in the transportation system can only be made when professionals of many different disciplines work together. Students that work on transportation research at WTI are spread across almost every college on the MSU campus as a result. At the graduate level, WTI offered a weekly non-credit transportation seminar during the 2011 spring semester to foster

collaboration across disciplines and to give transportation graduates a broader knowledge and understanding of the transportation field as a whole (beyond their own specific research question). Additionally, WTI sponsored a monthly Student Research Showcase to give WTI student research assistants sponsored directly through UTC funded education programs an opportunity to hone their presentation skills, receive feedback on research approaches and outcomes, and learn more about the research efforts of their peers and at WTI as a whole.



# EDUCATION

## UTC Outstanding Student of the Year

Janelle Booth was selected as WTI's 2011 University Transportation Center Student of the Year. Janelle was a graduate research assistant at WTI and completed her Masters degree in Public Administration from Montana State University in May 2011. During her time at WTI, she worked on projects involving the evacuation preparedness of school buses and public transportation systems in rural coastal communities, an evaluation of the rural transportation infrastructure in evacuation operations for the Northern Gulf of Mexico, and a study of the Montana fuel tax refund system. Janelle presented papers at a number of conferences, and received an award at one such conference for her paper on The Role of School Buses In Rural Evacuations. Her research on evacuation and public transportation was also highlighted in the National Commission on Children and Disasters 2010 report to the President and Congress. Outside of her graduate work, Janelle was a youth mentor for the Child Advancement Program at the local high school. She served as the U.S. representative at an international symposium in Aegina, Greece on the politics of Eastern Europe and the Black Sea region and as the Montana Associated Students lobbyist for the 2011 Montana legislative session. Booth represented WTI at the 2010 WTS Advancing Women in Transportation Annual Conference and hopes to find work in transportation policy-making at the federal level after graduation.

# EDUCATION

## Outreach

Over the past year, the WTI participated in a number of outreach activities aimed at engaging pre-college aged youth. The activities were designed to encourage youngsters to think about transportation issues and solutions and to consider transportation as a potential career. In particular, several outreach events specifically focused on engaging groups underrepresented in the engineering and transportation professions.

### **Super Science Saturday**

Over 250 community members attended Super Science Saturday, a free event hosted at Montana State University featuring a variety of hands-on, inquiry-based science and engineering activities for kids of all ages. WTI's table-top demonstration of an Animal Detection System (ADS) constructed with a Lego MindStorm™ kit was a big hit. Participants asked questions about animal and driver safety, where ADS has been tried, and how effective it is. They also learned about other methods to reduce animal-vehicle collisions, including fencing and wildlife under and overpasses. The children were able to view video taken by WTI researchers of wildlife using underpasses along the TransCanada Highway in Banff National Park.

### **Girl Scouts Engineering Day**

Approximately one hundred Girl Scouts from Bozeman and surrounding communities visited MSU to explore engineering careers and activities. The event was held to commemorate Introduce a Girl to Engineering Day during National Engineering Week. The girls (fourth through sixth graders) had the opportunity to interact with MSU engineering students during fifteen-minute hands-on activities that introduced them to Civil, Electrical, Industrial, Environmental, and Chemical Engineering. WTI, the College of Engineering, and Girl Scouts of Montana and Wyoming jointly coordinated the event. Participants traveled from Bozeman, Pony, Livingston, Belgrade, Whitehall, Norris, and Harrison to attend.

### **Expanding Your Horizons**

Approximately 45 girls explored the use of virtual reality simulators to study transportation safety issues as part of Expanding Your Horizons – A Day of Science and Math Exploration for girls in grades 6, 7, and 8. The girls learned how to build a simulated world and then viewed their models of a road network displayed on WTI's fixed base driving

# EDUCATION

## Outreach (continued)

simulator. They were then able to get behind the wheel to study real-world situations from the driver's seat. How does time of day affect driving behavior? How about weather? What can we learn about the safety impacts of common driver distractions like texting or cell phones using the driving simulator? Two female graduate students from the Industrial Engineering Department facilitated the activity.

### Summer Transportation Institute

WTI hosted eighteen high school students during the 2011 Summer Transportation Institute (STI). The program is funded by the Federal Highway Administration and administered by the Montana Department of Transportation (MDT) and is designed to introduce students to transportation as a possible college and career path. Survey data from past STI participants indicate that students felt the camp enabled them to make informed decisions about college and career options. Twenty past participants from the 2007-2010 programs (out of forty-one total) responded to an STI alumni survey mailed to them following their high school graduation. All twenty respondents applied to college after high school completion. Fourteen enrolled in engineering programs, nine of which are currently enrolled in the MSU College of Engineering. Narrative comments indicate that the STI program had a positive impact on this outcome. Examples include,

*Attending the Summer Transportation Institute enhanced my knowledge of the broad engineering spectrum. I was exposed to transportation-related career fields that I could be involved with if I earned a degree in civil, environmental, or chemical engineering, among others. Before STI, my knowledge of a transportation-related career was limited, but afterwards, I had a much greater understanding....*

■ 2011 STI participant

*The Summer Transportation Institute was a fun way to explore the different aspects and areas of transportation related engineering, while also getting an inside view of campus life and MSU Bozeman. I believe the camp was a major factor contributing why I wanted to go to school in Bozeman as well as create an interest in transportation, especially in the area of aeronautics.*

■ 2011 STI participant

While many of the STI alumni are currently enrolled in engineering programs and may potentially focus on transportation applications and careers, a few are already engaged in transportation specific pursuits. One respondent is currently enrolled in an Aerospace Engineering program and has an internship at NASA for three semesters working on operations engineering and flight testing. One student is enrolled in a two-year program focusing on transportation communications and railways.



# EDUCATION

## Student Success Stories

Student competitions and conference presentations provide students with professional development and networking opportunities, and provide national exposure for WTI research efforts. As in past years, WTI graduate and undergraduate students were very productive in this arena.

Two WTI Graduate Transportation Award recipients, Tawny Hoyt and Jessica Mueller, advanced to the regional level in the national Student Safety Technology Design Competition for their project entitled “Improving Restraint Feasibility through Ambulance Layout Redesign.” The competition is part of the 22nd International Technical Conference on the Enhanced Safety of Vehicles. The MSU student team received \$2000 in funds from the National Highway Traffic Safety Administration (NHTSA) to design and build a full-scale altered ambulance layout that will allow EMS workers to provide care from a restrained position during transport of patients. The goal of the project is to minimize EMS worker injuries and fatalities during transport via creation of an altered work environment where seat belt usage is more feasible.

Two former Undergraduate Research Experience (URE) Program participants, David Schroeder and Brett Larabee, traveled with their research advisor to the American Concrete Institute’s 2010 Fall Convention in Pittsburgh, Pennsylvania to present preliminary results of an ongoing research effort focused on the development and characterization of an environmentally friendly concrete made with 100 percent fly ash as the sole binder and glass as the sole aggregate.

Tawny Hoyt, Industrial Engineering graduate student, traveled to Las Vegas, Nevada to present at the 2010 Association for the Advancement of Automotive Medicine (AAAM) annual conference. Her co-written paper was additionally accepted for publication.

\*Hoyt, T., Stanley, L., and Sanddal, N. Rural EMS Worker Restraint Usage and Feasibility in Emergency Response Vehicles, *Annals of Advances in Automotive Medicine*, 2010.

Two student papers were presented at the 2011 Transportation Research Board Annual Meeting in Washington, DC. Civil Engineering graduate student Sommer Roefaro presented Effectiveness of Signal Control at Channelized Right Turning Lanes: An Empirical Study during a poster session. Civil Engineering student Zachary Kirkemo’s thesis research was incorporated into a successful TRB paper submission.

Al-Kaisy, A., Kirkemo, Z., Veneziano, D. and Dorrington, C. “Traffic Usage of Rest Areas on Rural Highways: A Recent Empirical Study” Presented at the 90th TRB Annual meeting, January 23-27, 2011 and accepted for publication in the Transportation Research Records, 2011.

Civil Engineering graduate research assistant Colter Roskos presented a poster at the National Science Foundation’s Civil, Mechanical and Manufacturing Innovation Division Grantees Conference, which was held in Atlanta, Georgia. Colter’s paper on “Building Green: Development and Evaluation of the Design Properties of an Environmentally Friendly Concrete” was also published in the conference proceedings. Colter additionally traveled to the World of Coal Ash conference in May to present a paper entitled Identification and Verification of Self-Cementing Fly Ash Binders for “Green” Concrete.

# EDUCATION





# TECHNOLOGY TRANSFER

## Program Overview

The goal of WTI's technology transfer program is to “increase availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.” Effective technology transfer is flexible and always evolving, taking advantage of new opportunities that complement or enhance established programs and delivery methods. WTI takes a proactive approach, and is willing to develop or sponsor specialized forums that reflect our expertise or address underserved needs of the stakeholders in the rural transportation community. As a result, our technology transfer program incorporates a variety of approaches, including:

- Conferences and Workshops – in addition to sponsoring traditional face-to-face forums, we are expanding our use of webinars as a cost-effective method of connecting experts with local practitioners.
- Publications and Presentations – WTI researchers continue to expand audiences for their publications and presentations, with a growing participation in the international research community.
- Electronic Information Resources – Research resources on the WTI website continue to develop and the WTI newsletter readership continues to increase.

# TECHNOLOGY TRANSFER

## Conferences and Workshops

### 6th Annual Western States Rural Transportation Technology Implementers Forum

The 2011 Western States Rural Transportation Technology Implementers Forum was held June 14 – 16, in Yreka, California. Engineers, technicians, researchers, and students involved in rural intelligent transportation systems (ITS) gathered for the two-day Forum to learn about and discuss rural ITS projects with practitioners from the western states. The 31 participants hailed from California, Montana, Nevada, and Washington. Representatives included participants from Nevada and Washington DOTs, five Caltrans districts, four Caltrans divisions/offices, the California Highway Patrol, and the US DOT ITS Joint Program Office. The Advanced Highway Maintenance and Construction Technology Research Center at University of California-Davis, Oregon State University, UC Irvine, University of Washington, and Montana State University were also represented.

The Forum is designed to foster transparency and trust by providing an informal atmosphere where rural ITS engineers and technicians can share dialogue about actual projects that have been implemented, discussing what worked and what did not.

The Forum's Day 1 presentations were in depth, two hour technical presentations, allowing speakers ample time to present detailed information and delve into the nuts and bolts of a project. Questions and discussion are encouraged throughout the presentations and are continued during the extended breaks and networking sessions. On Day 2, presenters incorporated hands-on demonstrations during hour long presentations. Speakers and participants brought actual components of their equipment and technology to display and demonstrate, spurring immediate technology transfer across state borders.

The Forum continues to be an excellent opportunity to learn from and network with other ITS professionals who are implementing ITS projects in rural areas.

### National Summit for Rural Traffic Safety Culture

The 2011 National Summit for Rural Traffic Safety Culture convened July 11-13 in Big Sky, Montana. Building upon the successes of the last two Summits, this year's theme "Towards Zero Deaths: Knowledge to Action (TZD K2A)" focused on developing an action plan to transform rural driving culture Towards Zero Deaths (TZD), emphasizing the role of culture in improving the effectiveness of traffic safety systems. This year's attendees included 34 participants representing various transportation departments and related agencies, universities, medical professionals, and law enforcement in 14 states and two Canadian provinces.

The intention for the 2011 Summit was to move beyond informative presentations directly into putting TZD into action. Day one of the Summit, led by Jeff Linkenbach, Director of the Center for Health and Safety Culture at WTI, concentrated on developing a common understanding of the Positive Community Norms (PCN) model, introduced by Linkenbach at the 2010 Summit. Steps of the PCN process were illustrated by a wide range of experts, including research scientists, sociologists, and law enforcement personnel in presentations on Days 2 and 3. Danny Nashman, nationally recognized facilitator and founder of The Potential Group, led participants in developing an action plan to shift rural driving culture Towards Zero Deaths.

The 2011 Summit combined informative presentations and interactive work sessions which resulted in important foundational work to guide efforts over the next several years towards the overall goal. Participants gained valuable skills which can be implemented to influence culture within their own organizations.

*"The Safety Summit was one of the most interesting conferences I've been to in many years. I learned a lot and am thinking about other applications."*

■ Dr. Richard F. Pain  
Senior Program Officer - Transportation  
Safety Coordinator  
Transportation Research Board

The 2011 National Summit for Rural Traffic Safety Culture was



# TECHNOLOGY TRANSFER

## Conferences and Workshops *(Continued)*

held in conjunction with the Montana Summer Institute for Positive Community Norms. Both events were hosted by the Center for Health and Safety Culture at WTI with support from AAA Foundation for Traffic Safety, Transportation Research Board, National Highway Traffic Safety Administration, Centers for Disease Control and Prevention, and American Traffic Safety Services Association.

### **2011 National Rural ITS Conference**

The 2011 National Rural Intelligent Transportation Systems (NRITS) Conference was held August 28-31 in beautiful Coeur d'Alene, ID. This year's conference, "Adventures in ITS," was attended by 237 participants representing 37 states and four Canadian provinces. Attendees had the opportunity to visit over 30 vendor displays and participate in a wide variety of sessions, professional tours, and activities.

This conference provided participants the opportunity to network and share experiences within and across a wide variety of ITS disciplines. In addition to traditional ITS topics, this event brought together both traditional and non-traditional ITS users to address such issues as rural safety, creating and maintaining livable/sustainable communities, multi-agency coordination, and workforce development, as well as EMS and transit issues.

Many different training and networking opportunities available throughout this event provided participants with the tools necessary to effectively plan and deploy ITS technologies within their own jurisdictions. Those in attendance included: public and private transportation officials, as well as transit, tourism, enforcement, trucking, public safety and medical service professionals engaged in the operations, maintenance, and use of our transportation system.

WTI served as a sponsor of this year's conference, along with Ada County Highway District, Idaho Transportation Department, ITS America, ITS Canada, ITS Joint Program Office - Research and

Innovative Technology Administration (RITA), ITS Rocky Mountain, Open Roads Consulting, Inc., RouteMatch Software, Inc., and Washington State Department of Transportation.

### **2011 Winter Maintenance Peer Exchange**

Providing for safe, reliable and sustainable highway travel during the winter is becoming more challenging due to increased public need and expectation of full use of the highway system independent of weather conditions, coincident with decreasing resources being available to the agencies tasked with providing such service. On September 20-22, in Bozeman, Montana, the 2011 Winter Maintenance Peer Exchange brought together state DOT maintenance personnel, vendors, and researchers to share successes, lessons learned, and determine high priority research needs. This event is unique as maintenance personnel, researchers, and vendors actively participate in brainstorming sessions and discuss frankly the challenges they face during implementation of new technologies and equipment.

The 96 snow and ice experts, researchers, and 26 vendors from 42 states and the District of Columbia built upon the foundation laid at the 2007 and 2009 Peer Exchanges. They worked for two and half days to identify current gaps in winter maintenance communication, knowledge and technology and to develop strategies to bridge these gaps. The end result was a new set of high priority research needs established through a brainstorming and voting process. A tour of the research labs at WTI/MSU was followed by additional brainstorming about how to keep research relevant to stakeholder needs and continue advancing the state of the practice in winter maintenance.

*"WTI did an outstanding job hosting this year's Peer Exchange. By far, it was the best one I have been to - and remembering back to all the various conferences I have attend over the past 27 years with TxDOT, it ranks as one of the best. Great job."*

■ Michael Taylor  
Director of Operation, Texas  
Department of Transportation



# TECHNOLOGY TRAINING

## Conferences and Workshops *(Continued)*

The next steps are for each national research consortium to review the newly identified research needs statements and decide which ones logically fit into the mission of their group. This review will include comparing the new research needs with recently completed work and with projects currently underway to avoid duplication. Each consortium will decide which needs statements they will champion and where each research needs statement might fit into their future program.

Continued progress on the research needs statements from the 2007, 2009 and 2011 Peer Exchanges will be reported and updated semiannually at the following website: <http://www.westerntransportationinstitute.org/professionaldevelopment/peer-exchange/>

### **APBP Bike Sharing Webinar**

The Association of Pedestrian and Bicycle Professionals (APBP) sponsors various webinars throughout the year. These on-line courses provide an excellent opportunity to share knowledge and for high-quality professional training regarding the state-of-the-practice. By hosting a seminar, WTI staff and partner participants obtain training without paying for travel costs, with the added benefit of having the opportunity to directly interact with, and strengthen connections to the local transportation community. In addition, Professional Engineers may use some of these courses to maintain their licenses.

More and more cities around the country are considering bike sharing to help achieve environmental, public health, and transportation related goals while improving a community's livability. APBP presented a 90 minute webinar on Bicycle Sharing Programs on January 19, 2011. WTI served as a host site for the event with eight members of the Bozeman community representing Montana State University, Gallatin Valley Land Trust, Bozeman Area Bicycle Advisory Board, the City of Bozeman, REI, and WTI in attendance.

The webinar presented an overview of bike sharing in the U.S. and other countries, with case studies from Minneapolis and San Anto-

nio and a detailed discussion of the implementation process (building support, funding models, RFPs, contracting, launch, and operations). Participants learned to identify the planning and implementation steps necessary to launch a public bike share system, the different financial models and funding sources, and the positive implications of an exponential increase in bicycle traffic for public infrastructure.

Webinar presenters included Alison Cohen, Program Manager of Alta Bicycle Share, Julia Diana, sustainable transportation analyst for the City of San Antonio's Office of Environmental Policy, and Bill Dossett, Executive Director of Nice Ride Minnesota. Following the presentation, Bozeman participants at WTI engaged in discussions regarding bike share potential at Montana State University and the surrounding Bozeman community. This webinar raised awareness of shared bicycles as a form of public transportation and began a dialogue between the City, University, local businesses and bicycling advocates regarding what type of bike sharing program could benefit the Bozeman area.



# TECHNOLOGY TRANSFER

## Peer-reviewed Publications

### Ahmed Al-Kaisy

- Al-Kaisy, A. and Freedman, Z. (2011), "Estimating Performance on Two-Lane Highways: Case Study Validation of a New Methodology," Transportation Research Record 2173, Journal of the Transportation Research Board, pp. 72-79.
- Al-Kaisy, A. and Freedman, Z. (2010), "Empirical Examination of Passing Lane Operational Benefits on Rural Two-Lane Highways," Journal of Transportation Research Forum, Vol. 49, No. 3, pp. 53-68.

### Michelle Akin

- Goh, S.W., Akin, M., You, Z., and Shi, X. Effect of Deicing Solutions on the Tensile Strength of Micro- or Nano-modified Asphalt Mixture. Construction and Building Materials 2011, 25(1), 195-200.

### Michael Berry

- Berry, M., Stephens, J., and Cross D. (2011), "Performance of 100 percent Fly Ash Concrete with Recycled Glass Aggregate", ACI Materials Journal, 108 (4), July-August 2011.

### Jaydeep Chaudhari

- Chaudhari, Jaydeep and Zhirui Ye. "GIS as a Sketch Plan Tool to Replace Traditional Transit Route Planning Practice for College and University Communities." Planning for Higher Education— The Journal of The Society for College and University Planning. Volume 39, No. 1. (October-December 2010): Pages 39-50.
- Chaudhari Jaydeep, Zhirui Ye., David Kack., and Benedict Posadas. Role and Evacuation Preparedness of Public Transit in Rural Communities- A Case Study of the Northern Gulf of Mexico

Region, United States. Proceedings of the 19th Triennial Conference of the International Federation of Operational Research Societies (IFORS2011), Melbourne, Australia, 2011.

- Chaudhari, Jaydeep, And Zhirui Ye. Investigating Efficiency Benefits of Campus Transit System. Proceedings of The 90th Annual Meeting Of Transportation Research Board, Washington D.C., 2011.

### Laura Fay

- Fay, L., and Shi, X.. Laboratory Investigation of Performance and Impacts of Snow and Ice Control Chemicals for Winter Road Service. ASCE Journal of Cold Regions Engineering, Volume 25, Issue 3, 2011.
- Fay, L., Veneziano, D., Ye, Z., Williams, D., Shi, X. Costs and Benefits of Tools to Maintain Winter Roads: A Renewed Perspective Based on Recent Research. Transportation Research Record 2010, 2169, 174–186.

### Angela Kociolek

- Kociolek, A. V., Clevenger, A. P., St. Clair, C. C. and Proppe, D. S. (2011), Effects of Road Networks on Bird Populations. Conservation Biology, 25: 241–249.

### Robert Long

- Long, R.A., Donovan T.M., MacKay, P., Zielinski, W.J., and J.S. Buzas. Predicting carnivore occurrence with noninvasive surveys and occupancy modeling. Landscape Ecology. Volume 26, Issue 3: 327-340. 2011.

### Xianming Shi

- Xianming Shi, Tuan Anh Nguyen, Prathish Kumar, and Yajun Liu, A phenomenological model

for the chloride threshold of pitting corrosion of steel in simulated concrete pore solutions. Anti-Corrosion Methods and Materials, Volume: 58 Issue: 4 2011.

- Xianming Shi, Zhengxian Yang , Yajun Liu , Doug Cross, Strength and corrosion properties of Portland cement mortar and concrete with mineral admixtures. Construction and Building Materials, volume 25, Issue 8, pages 3245-3256, August 2011.
- Yang, Z., Shi, X., Hollar, J. and He, X., Laboratory Assessment of A Self-healing Cementitious Composite. Transportation Research Record: Journal of the Transportation Research Board, Volume 2142, pp.9-17, 2010.
- Liu, Y., and Shi, X. A Molecular Dynamics Study of Interactions between Corrosion Inhibitors, Nanoparticles and Other Minerals in Hydrated Cement. Transportation Research Record: Journal of the Transportation Research Board, Volume 2142, 2010.
- Yang, Z., Hollar, J., He, X., and Shi, X. A Self-healing Cementitious Composite Using Oil Core/Silica Gel Shell Microcapsules. Cement and Concrete Composites 2011, 33: 506-512.
- Li, J., Zhao, Y., Hu, J., Shu, L., and Shi, X. Anti-icing Performance of a Superhydrophobic PDMS/ Modified Nano-silica Hybrid Coating for Insulators. Journal of Adhesion Science and Technology, 2011.
- Shi, X., Akin, M. A. Holistic Approach to Decision Making in the Formulation and Selection of Anti-icing Products. ASCE Journal of Cold Regions Engineering, 2011.
- Liu, Y., Shi, X. Ionic Transport in Cementitious Materials under an Externally Applied Electric



# TECHNOLOGY TRANSFER

## Peer-reviewed Publications *(continued)*

Field: Experimental Characterization and Finite Element Modeling. Construction and Building Materials, 2011.

- Shi, X., Fay, L., and Mumma, S. Laboratory Investigation into Interactions Among Chemicals Used for Snow and Ice Control. ASTM Journal of Testing and Evaluation, 39(6), 2011.
- Shi, X., Nguyen, T.A., Kumar, P., and Liu, Y. A Phenomenological Model for the Chloride Threshold of Pitting Corrosion of Steel in Simulated Concrete Pore Solutions. Anti-Corrosion Methods and Materials 2011, 58(4), 179-189.
- Shi, X., Fay, L., Peterson, M.M., Berry, M., Mooney, M. A FESEM/EDX Investigation into How Continuous Deicer Exposure Affects the Chemistry of Portland Cement Concrete. Construction and Building Materials 2011, 25(2), 957-966.
- Zhao, Y., Li, J., Hu, J., Shu, L., Shi, X. Fabrication of Super-Hydrophobic Surfaces with Long-Term Stability. Journal of Dispersion Science and Technology 2011, 32(7), 969-974.
- Yang, Z., Shi, X.\*, Hollar, J. and He, X., Laboratory Assessment of A Self-healing Cementitious Composite. Transportation Research Record 2010, 2142, 9-17. DOI: 10.3141/2142-02. PDF
- Liu, Y., and Shi, X.. A Molecular Dynamics Study of Interactions between Corrosion Inhibitors, Nanoparticles and Other Minerals in Hydrated Cement. Transportation Research Record 2010, 2142, 58-66.
- Shi, X., Fay, L., Peterson, M.M., and Yang, Z. Freeze-thaw Damage and Chemical Change of a Portland Cement Concrete In the Presence of Diluted Deicers. Materials and Structures 2010, 43(7): 933-946.

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### **Laura Stanley**

- Stanley, L., Page, L., and Plumb, C. Designing for the Disabled in the Engineering Classroom, Frontiers in Education Conference/American Society of Engineering Education Proceedings, October, 2010.
- Hoyt, T., Stanley, L., and Sanddal, N. Rural EMS Worker Restraint Usage and Feasibility in Emergency Response Vehicles, Annals of Advances in Automotive Medicine, 2010.
- Stanley, L. and Ward, N. An Evaluation of Cooperative Avoidance Warning System. International Journal of Vehicle Safety, Volume 5, Number 1, 2010.

### **Christopher Strong**

- Strong, C.K., Ye, Z., and Shi, X. Safety Effects of Winter Weather: The State of Knowledge and Remaining Challenges. Transport Reviews 2010, 30(6), 677-699.

### **Nic Ward**

- Sanddal T., Sanddal N., Ward N. & Stanley L. Ambulance Crash Characteristics in the U.S. Defined by the Popular Press: A Retrospective Analysis. Emergency Medicine International, vol. 2010, Article ID 525979, 7 pages, 2010.

### **Natalie Villock-Witte**

- Villock-Witte, Natalie. User Satisfaction With a Shuttle Within Valley Forge. ITE Journal, volume 81, issue 8, p. 44. August 2011.

### **Jared Ye**

- Ye, Z., and Y. Zhang. 2010. Speed Estimation from Single Loop Data Using an Unscented Particle Filter, Computer-Aided Civil and Infrastructure Engineering, 25(7): 494-503.
- Ye, Zhirui, Jaydeep Chaudhari, and Steve Albert. Challenges And Research Needs Of Rural Transportation: California Case Study. Proceedings Of The 90th Annual Meeting Of Transportation Research Board, Washington D.C., 2011.



# TECHNOLOGY TRANSFER

## Presentations

### **Ahmed Al-Kaisy**

- International Society of Highway Capacity Conference, 6/26/2011, Stockholm, Sweden, Empirical Examination of Passing Lane Operational Benefits on Rural Two-lane Highways
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Characterization of Cell Phone Use While Driving in Jordan
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Effectiveness of Signal Control at Channelized Left-turn Lanes
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Traffic Usage of Rest Areas on Rural Highways
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Investigation of Parking Dwell Time at Rest Areas
- International Society of Highway Capacity Conference, 6/26/2011, Stockholm, Sweden, Platooning on Two-lane Two-way highways: An Empirical Investigation

### **Tiffany Allen**

- The Wildlife Society Meeting, 2/23/2011, Missoula, MT, Evaluation of Wildlife Guards at Access Roads

### **Rob Ament**

- Blairemore Alberta Municipal Council and Industry Meeting, 1/17/2011, Blairemore, AB, Highway 3: At the Crossroads, Transportation Mitigation for Wildlife and Connectivity
- National Rural ITS Conference, 8/28/2011, Coeur d'Alene, ID, The Roadkill Observation Collection System (ROCS)
- International Conference on Ecology and Transportation, 8/21/2011, Seattle, WA, Highway 3:

Transportation Mitigation for Wildlife and Connectivity in the Crown of the Continent Ecosystem

- Consulting Engineers of Alberta Transportation Conference, 3/14/2011, Red Deer, AB, Making "Cents" of Wildlife Transportation Mitigation; Highway 3 Case Study

### **Matt Blank**

- International Conference on Ecology and Transportation, 8/21/2011, Seattle, WA, Characterizing Volitional and Forced Swimming Abilities Under Changing Flow and Temperature Regimes

### **Jaydeep Chaudhari**

- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Challenges and Research needs of Rural Transportation
- International Federation of Operational Research Society Conference, 7/9/2011, Melbourne, Australia, Role and Evacuation Preparedness of Public Transit in Rural Communities: A Case Study of the Northern Gulf of Mexico Regions
- National Rural Transportation Peer Learning Conference, 10/19/2010, St. Louis, MO, Evacuation Preparedness of Public Transportation in Rural Coastal Communities of the Northern Gulf of Mexico Region
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Investigating Efficiency Benefits of Campus Transit System

### **Anthony Clevenger**

- International Conference on Ecology and Transportation, 8/20/2011, Seattle, WA, Research Needs to be Designed to Inform Management

### **Eli Cuelho**

- GeoFrontiers 2011 Conference, 3/13/2011,

Dallas, TX, Full-scale Field Study of Geosynthetics Used as Subgrade Stabilization

### **Jaime Eidswick**

- 2011 Transportation Research Board Meeting, 1/23/2011, Washington, DC, Lessons Learned from Four Alternative Transportation System Partnership Endeavors in Public Lands

### **Laura Fay**

- 2011 Transportation Research Board Meeting 1/22/2011, Washington, DC, Progress Report for Low Cost Solutions for Stabilization and Erosion Control

### **Douglas Galarus**

- 2011 Road Weather Management Stakeholder meeting 9/6/2011, Albuquerque, NM, Western States Clarus One Stop Shop for Rural Traveler Information
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Integration of Aviation Automated Weather Observation Systems with Roadside Weather Information Systems
- National Rural ITS Conference 8/27/2011, Coeur d'Alene, ID, Augmented Speed Enforcement: Smart Cones from a Technical Perspective
- National Rural ITS Conference, 8/27/2011, Coeur d'Alene, ID, Integration of Aviation Weather Information Systems with Roadside Weather Information Systems for Rural Air Fields and Heliports

### **Rebecca Gleason**

- 2011 Transportation Research Board Meeting, 1/23/2011, Washington, DC, Bike Sharing on Public Lands



# TECHNOLOGY TRANSFER

## Presentations *(continued)*

- Robert Wood Johnson Active Living Conference, 2/22/11, San Diego, CA, Improving Participation in Safe Routes to Schools Programs for Montana Native American Communities
- Bureau of Indian Affairs Transportation Meeting, 6/14/2011, Billings, MT, Complete Streets/Safe Routes to Schools in Rural Communities

### **Marcel Huijser**

- Friends of the Desert meetings, 10/26/2010, Palm Springs, CA, Effects of Roads and Traffic on Wildlife and Mitigation Measures
- International Conference on Ecology & Transportation, 9/27/2010, Velence, Hungary, The Reliability of Animal Detection Systems and Reliability Norms

### **David Kack**

- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Livability-Connecting to Parks and Public Lands

### **Angela Kociolek**

- International Conference on Ecology and Transportation, 8/21/2011, Seattle, WA, ARC: New Methods, New Materials, New Thinking

### **Brett Larabee**

- American Concrete Institute 2010 Fall Convention, 10/23/2010, Pittsburgh, PA, Building Green: Development and Evaluation of an Environmentally Friendly Concrete

### **Robert Long**

- International Conference on Ecology and Transportation, 8/22/2011, Seattle, WA, Evaluating Highway Barriers to Carnivores Movement in the Washington Cascades

### **Taylor Lonsdale**

- Montana Association of Elementary and Middle School Principals Conference, 1/28/2011, Great Falls, MT, Encouraging Safe Routes to Schools Activity

### **Sommer Roefaro**

- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Effectiveness of Signal Control at Channelized Right Turning Lanes: An Empirical Study

### **David Schroeder**

- American Concrete Institute 2010 Fall Convention, 10/23/2010, Pittsburgh, PA, Building Green: Development and Evaluation of an Environmentally Friendly Concrete

### **Xianming Shi**

- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Multi-Criteria Decision Making Approach to the Formulation of Selection of Anti-icing Liquids
- American Public Works Association Conference, 4/10/2011, Spokane, WA, Longevity of Corrosion Inhibitors and Performance of Deicer Products Under Storage or After Pavement Application
- National Association of Corrosion Engineers Conference, 3/13/2011, Houston, TX, Stochastic Modeling of Service Life of Concrete Structures in Chloride-laden Environments
- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Laboratory Investigation and Neural Network Modeling of Deicer Ingress into Portland Cement Concrete and its Corrosion Implications

### **Laura Stanley**

- 2011 Transportation Research Board Meeting, 1/22/2011, Washington, DC, Emergency Medical Services Evaluation During Rural Emergency Response
- Human Factors and Ergonomics Society Conference, 9/23/2011 Las Vegas, NV, Service learning in the Ergonomics Classroom, a Case study

### **David Veneziano**

- National Rural ITS Conference, 8/28/2011, Coeur d'Alene, ID, Development of Radar Speed Sign Warrants

### **Natalie Villwock-Witte**

- National Recreation Resource Planning Conference, 5/20/2011, Breckenridge, CO, Rocky Mountain Intelligent Transportation System

### **Nic Ward**

- Driving Assessment 2011 Conference, 6/26/2011, Lake Tahoe, CA, Effect of Driving Simulation Parameters on Speed Perception

### **Jenni West**

- American Byways Annual Conference, 8/21/2011, Minneapolis, MN, Alternative Transportation Systems and Your Byway
- National Recreation Resource Planning Conference, 5/23/2011, Breckenridge, CO, Managing Congestion Through Alternative Transportation in the Colorado Rockies

### **Zhirui Ye**

- 3rd International Conference on Road Safety and Simulation, 9/14/2011, Indianapolis, IN, Goodness-of-fit Testing for Accident Models with Low Means



# TECHNOLOGY TRANSFER

## Website and Internet Resources

Electronic information sharing resources are cost-effective tools for making research findings readily accessible to a wide audience. The WTI website has long been a cornerstone of our technology transfer program. This section summarizes our progress on our website, rural transportation clearinghouse, and rural transportation blog as well as lessons learned, and remaining challenges to full optimization.

### Websites

WTI currently utilizes two websites: a research focused website at [www.westerntransportationinstitute.org](http://www.westerntransportationinstitute.org) to provide current research information, and a complementary education focused website located at [www.wti.montana.edu](http://www.wti.montana.edu). The research site is designed to best serve the needs of research professionals and features descriptions of past and present research projects (and results, as available), and of our laboratory resources. The education focused site uses the same template as the Montana State University and College of Engineering websites and centers primarily on our student related activities, promoting the student fellowship program and employment opportunities.

The research website is designed to be more prominent and accessible for users outside of the MSU campus, with the goal of disseminating our research results to the broadest possible audience. The website has also provided an opportunity to expand the amount of information available about our rural mission, each of our focus areas, and our expanded laboratory facilities. In addition, an unforeseen benefit of splitting the web content into two sites is that WTI is able to generate content targeted to the needs of each audience.

### Rural Transportation Clearinghouse

Creating online forums for research professionals to collaborate and share research results has been a long-term goal of the technology transfer program at WTI. The rural clearinghouse was envisioned to be a one-stop-shop for aggregating documents, conference presentations and other content not currently posted online by RIP or TRIS. On

the surface, creating these online forums appeared to be straightforward; purchase the technology, design the interface and then populate the clearinghouse. However, we learned that developing and managing a quality resource that is accurate and up-to-date on an ongoing basis is a much more complex process than originally anticipated. The challenge of populating the clearinghouse with quality documents with no copyright restrictions proved to be insurmountable, and the clearinghouse was taken offline. Our clearinghouse efforts are now focused on leveraging existing clearinghouses (National LTAP Clearinghouse, NADO Rural Transportation Clearinghouse, and etc.) and pushing out our research results.

### Rural Transportation Blog

In parallel to the clearinghouse project, WTI began developing the rural transportation blog by purchasing and installing a software package that manages online communities. As soon as the blog was launched, a large roadblock appeared--researchers are already very busy conducting their actual research, so they did not have enough time to also write meaningful blog content. The blog was up and running, but with no useful content. As an initial step, an administrative staff member began to post conference presentations and other related content on the blog. This has worked very well and thus was adopted as the new model. The blog has been divided into eight key areas to help browsers find relevant content. The blog is currently limited to one-way communication, due to the tight security restrictions which are necessary to keep out spammers.

### E-newsletter

WTI's quarterly e-newsletter was launched in 2008. In the past year, the newsletter has elevated its readership, as well as its prominence, at the national level. Now at 3318 recipients, reader feedback and requests for additional information on featured research has also grown.

The October 2010 WTI E-Newsletter included the following articles:

- China Transportation Delegation Visits WTI



# TECHNOLOGY TRANSFER

## Website and Internet Resources

- CATS Invites WTI to Beijing
- International Interns
- 5<sup>th</sup> Annual Western States Rural Transportation Technology Implementers Forum
- National Summit for Rural Traffic Safety Culture
- Montana Summer Institute
- National Rural ITS Conference
- Responder System Wins NRITS Award
- Undergraduate Research Highlights
- WTI Graduate Researchers Move into the Professional Sphere
- Advancing Women in Transportation
- MSU Student Chapter Visits Transportation Sites in Salt Lake City, Utah
- MSU Students and Alumni Sweep the Competition at Regional ITE Events
- Best Student Paper Awards

### **The January 2011 WTI E-Newsletter included the following articles:**

- Center for Health and Safety Culture Launched
- Five Finalists Compete for ARC Prize
- New Methods to Shore Up Mountain Roads
- WTI Researchers to Present at Transportation Research Board 90<sup>th</sup>
- National Rural ITS Conference
- 2<sup>nd</sup> Road Dust Best Management Practices Conference—Save the Date!
- Road Dust Institute
- US 93 Excursions
- Student Success
- UTC Student of the Year – Janelle Booth
- Super Science Saturday

### **The April 2011 WTI E-Newsletter included the following articles:**

- Winter Maintenance and Effects - It's not just about moving snow...
- Winter Maintenance and Effects Research
- A View from the Window – the Locomotive Windshield
- “One-Stop Shop” Website to Display Rural Traveler Information

### **Across Four State Region**

- The Road Less Traveled: Can well-informed visitors help ease congestion in gateway communities and near or within our National Park Roads?
- UTC Partnerships Highlighted in National Transportation Magazine
- National Rural ITS Conference
- 2<sup>nd</sup> Road Dust Best Management Practices Conference-Save the Date!
- WTI Hosts Bike Sharing Program Webinar
- Student Successes
- Safe Passages Research Experience for Undergraduates
- Girl Scouts Engineering Day

### **The July 2011 WTI E-Newsletter included the following articles:**

- Building Global Connections
- Multi-disciplinary + Collaborative efforts + Implementation = Keeping Motorists Safe
- Reaching Out Globally
- International Research Highlight: Road Ecologists Develop Wildlife Connectivity Plan for Canadian Parks
- Multi-modal projects help federal lands preserve precious natural resources
- Multi-State Partnerships: Maximizing Resources
- 6<sup>th</sup> Annual Western States Rural Transportation Technology Implementers Forum
- International Researcher Presents at WTI
- National Summit for Rural Traffic Safety Culture
- National Rural ITS Conference
- 2<sup>nd</sup> Road Dust Best Management Practices Conference
- WTI Graduates Cohort of Students with Wide Array of Transportation Expertise
- Student Conference Presentation
- Expanding Your Horizons
- Give it a rest... WTI researcher and students set out to study rest stops across the state of Montana



# TECHNOLOGY TRANSFER

## Technology Transfer Success Story

### **Idaho Transportation Department Recognizes Culture as Safety Mission Critical**

As a result of being introduced to the Positive Community Norms process at the 2010 National Summit for Rural Traffic Safety Culture hosted at Big Sky, MT, the Idaho Transportation Department (ITD) has launched a research project on using this process to address some of their traffic safety issues, specifically, Run off the Road crashes.

*"Idaho is a Toward Zero Deaths state. To get to the finish line, we will have to shift the culture; and change the social acceptance of dangerous behavior. If you want highway safety to increase, relying on scare tactics and tickets alone is not effective. Positive reinforcement messaging is a great tool for public outreach in Idaho and a necessary component in the toolkit for achieving the Toward Zero Deaths goal."*

■ Brent Jennings,  
Highway Safety Manager,  
Idaho Transportation Department

The Rural Traffic Safety Culture Summits have served to invigorate ITD's commitment to moving beyond enforcement-based approaches when addressing traffic safety. There is recognition within ITD that changing the culture of driving is imperative to reducing crashes and fatalities in the state; and a focus on positive rather than negative attitudes and behaviors in the community can be instrumental in achieving that change. To further educate traffic safety leaders in the state, Jay Otto of WTI's Center for Health and Safety Culture has been invited to give a presentation on Positive Community Norms at the Idaho Traffic Safety Commission meeting in October.

