

# Western Transportation Institute University Transportation Center

2007 Annual Report  
*(For the period October 1, 2006 - September 30, 2007)*

College of Engineering  
Montana State University



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Front & Back Cover *Neil Hetherington*  
Inside photos: *WTI Staff & Neil Hetherington*

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# Mission Statement

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*To lead the nation in “making rural travel and transportation across all surface transportation modes safer, more efficient and more convenient.”*

## Message from the Director

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The year 2007 has been a watershed year for the Western Transportation Institute, and for transportation in general. For WTI, it has been the first full year of our second grant under the University Transportation Center program. With this federally authorized status has come an increasing recognition of our position as a leading national research center.



At the same time, national policymakers are moving transportation to the top of their priority list. Leading advocacy organizations and advisory bodies are recognizing that an efficient transportation system is critical to everything from nurturing a healthy economy to protecting homeland security.

As a result, WTI is frequently called upon to contribute to and advise upon the development of national transportation policy. In the last year alone, I have been invited to provide testimony to the National Surface Transportation Policy & Revenue Study Commission and policy recommendations to the Western Governors Association, and Secretary of Transportation Mary Peters appointed me to serve on the Intelligent Transportation Systems (ITS) Advisory Committee.

For our part, WTI is committed to UTC programs that contribute to national research objectives and ultimately improve the entire transportation infrastructure.

This is most evident in our research agenda. As you look at the strategic goals established by the USDOT – Safety, Mobility, Global Connectivity, Environmental Stewardship and Security – you’ll see that each of them is served by at least two of WTI’s research focus areas. For example, both our Road Ecology program and our Winter Maintenance and Effects program conduct projects to preserve resources and therefore promote Environmental Stewardship; our Systems Integration researchers frequently work with our Safety and Operations researchers on projects to enhance Safety, and so on.

Furthermore, our individual research projects are achieving increasing national prominence. First of all, we are being selected to lead nationwide studies, such as the Wildlife-Vehicle Collision Reduction Study that we are conducting for the Federal Highway Administration. This project is notable because WTI was selected to conduct a federally mandated study that was included in the transportation reauthorization bill (SAFETEA-LU). This year, our researchers completed the report for FHWA, and Secretary Peters recently submitted it to Congress.

Secondly, while our projects often start as targeted solutions for individual states, they later become models for the rest of the country. In this report, for instance, you’ll read about new wildlife monitoring projects in three different states and Canada, which could eventually provide solutions for other areas with similar challenges.

Third, we are proud that WTI projects are being



considered for prestigious national awards. At the 2007 Annual Meeting of the Intelligent Transportation Society of America (ITSA), the evaluation that WTI conducted for the Utah Department of Transportation on the benefits of its RWIS/Weather Operations program was selected for a “Best of ITS” award, in the category of “Best Return on Investment.” The Redding Responder system, a mobile communications system that WTI developed for the California Department of Transportation, was a finalist for another “Best of ITS” award.

Our education and technology transfer programs are also forward thinking, with an eye toward improving the transportation system as a whole well into the future. Many of our education activities are geared toward long-term workforce development, to ensure that the United States will continue to have trained transportation professionals who can work toward strategic goals as well as everyday operations. A primary focus of our education program is introducing transportation as a fulfilling career option to students at the primary and secondary levels to complement our ongoing efforts at the university level. An example of this is our Summer Transportation Institute, which began as a program for undergraduates, but is now offered to high school students.



As our research agenda has grown, we recognize a responsibility to expand our technology transfer efforts to ensure that transportation practitioners around the country have access to the latest research findings. To achieve a nationwide reach, we approach technology transfer on many fronts, such as co-sponsoring a traditional “face-to-face” forum like the Snow and Ice Peer Exchange, and exploring new technologies such as information clearing-houses and blogs.

None of our efforts to advance transportation research, programs, or policy would be possible without the support of the Research and Innovative Technologies Administration of the U.S. Department of Transportation and our Governing Board members: the Montana Department of Transportation, the California Department of Transportation, and Montana State University’s College of Engineering and Civil Engineering Department. We thank them for their past assistance, and look forward to our continued partnership in efforts to provide a safe and efficient transportation system for the entire nation.

A handwritten signature in black ink, appearing to read "Stephen Albert". The signature is fluid and cursive, written on a white background.

Steve Albert  
Director

# Administration

The following section provides an overview of the administrative functions, structure, achievements and initiatives of the Western Transportation Institute.

## Management Structure

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

- to provide for high-quality, multi-discipline 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 of 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. The specific direction and oversight of the Center is accomplished through management of three areas (outlined in the following paragraphs): financial, personnel and program/projects.

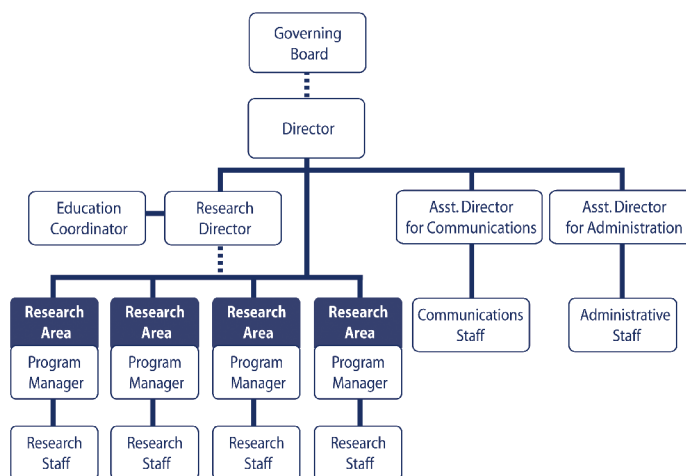
Financial administration of Center monies occurs both in-house and through the MSU Office of Sponsored Programs (OSP). The two entities perform different yet complementary aspects of financial management. The Director and Center Management rely on both sources

of information to make financial decisions and oversee program development.

In learning from past experience, an organization must be streamlined and have personnel accountable for their actions at all levels. In the past, the Center had a relatively flat organizational structure, with most personnel reporting predominantly to the Director. As the organization grown, a more "pyramid" structure has been implemented, with the following roles, responsibilities, structure and protocols in place to support long-term sustainability as well as quality assurance and control.

The Center Director manages personnel both directly and through a team approach that follows the chain of command given in the figure. To assure communication, the Director has and will continue to conduct meetings as described below on a regular basis. In addition, 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 (Research Director, Assistant Directors, and Program Managers) are required to meet annually with the Director for performance reviews. This review provides the Director with the opportunity to assess the employee's performance in the preceding year. In addition, employees are 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

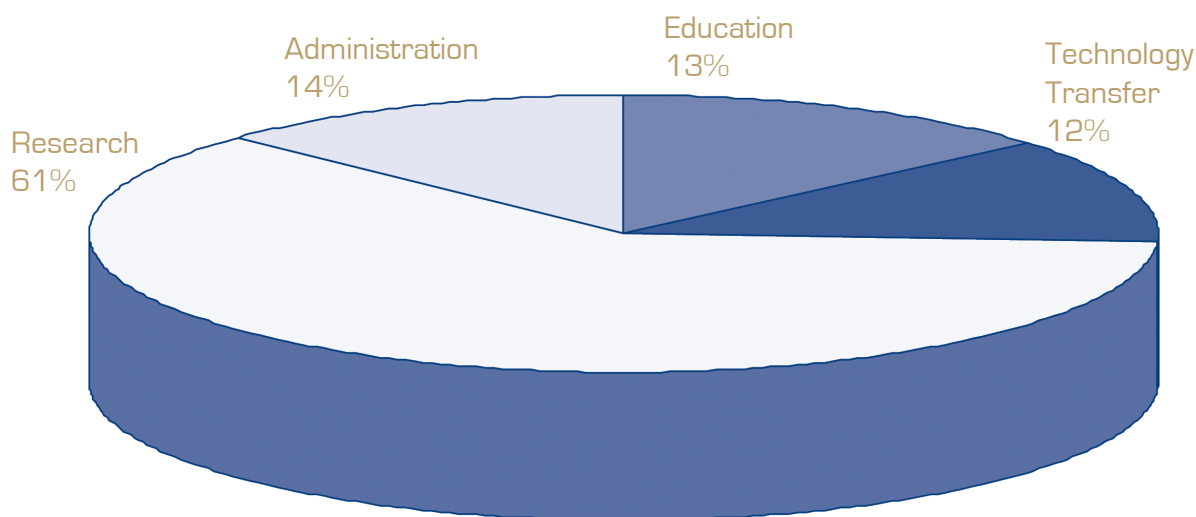
The following pie charts illustrate allocations and funding sources for the Western Transportation Institute's UTC programs during Year 1. Figure 1 shows the breakdown of expenditures and allocations of the federal portion (\$3,010,000) of the UTC program for Year 1. Approximately \$387,000 was allocated for the Education Program and \$1,846,000 has been committed for research project and laboratory/equipment funding. The remain-

ing \$777,000 supports the administrative and technology transfer function of WTI.

The second figure depicts the Year 1 funding sources for the WTI UTC Program. The match for the USDOT portion is by Montana State University and the Civil Engineering Department, state Departments of Transportation, and through the support of various foundations.

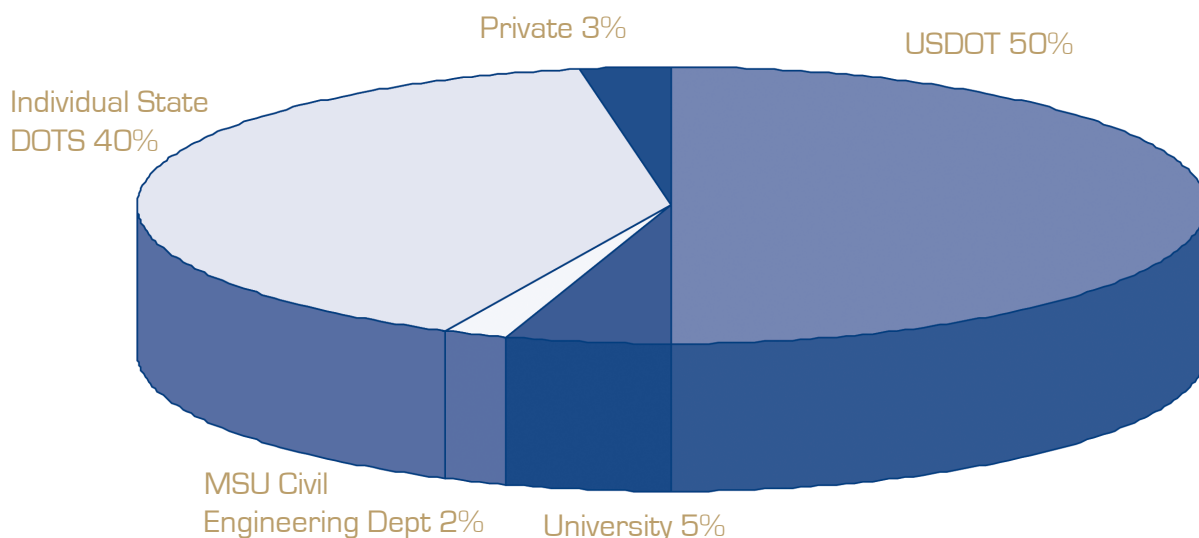
## Allocations for Year 1:

October 1, 2006 - September 30, 2007



## Funding Sources for Year 1:

October 1, 2006 - September 30, 2007





# Research Staff



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*Director*



**Ed Adams**  
*Professor, Civil Engineering*



**Michelle Akin**  
*Research Associate*



**Ahmed Al-Kaisy**  
*Assistant Professor,  
Civil Engineering*



**Rob Ament**  
*Research Scientist*



**Matt Blank**  
*Research Scientist*



**Joel Cahoon**  
*Associate Professor,  
Civil Engineering*



**Tony Clevenger**  
*Senior Research Scientist*



**Mike Cole**  
*Assistant Professor,  
Mechanical Industrial Engineering*



**Eli Cuelho**  
*Research Engineer*



**Laura Fay**  
*Research Scientist*



**Doug Galarus**  
*Senior Research Associate*



**Rebecca Gleason**  
*Research Engineer*



**Larry Hayden**  
*Research Associate II*



**Marcel Huijser**  
*Research Scientist II*



**Bill Jameson**  
*Senior Research Scientist*



**David Kack**  
*Research Associate II*



**Mike Kelly**  
*Senior Research Scientist*



**Angela Kociolek**  
*Research Scientist*



**Rob Larson**  
*Assistant Professor,  
Mechanical Industrial Engineering*





**Suzy Lassacher**  
*Research Associate II*



**Robert Long**  
*Research Scientist*



**Robert Marley**  
*Dean, College of Engineering*



**Pat McGowen**  
*Assistant Professor,  
Civil Engineering*



**Ladean McKittrick**  
*Associate Research Professor,  
Civil Engineering*



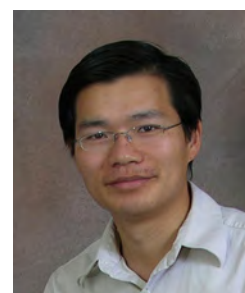
**Robert Mokwa**  
*Assistant Professor,  
Civil Engineering*



**Tongyan Pan**  
*Research Engineer*



**Steve Perkins**  
*Associate Professor,  
Civil Engineering*



**Xianming Shi**  
*Associate Research  
Professor*



**Otto Stein**  
*Associate Professor,  
Civil Engineering*



**Jerry Stephens**  
*Associate Professor,  
Civil Engineering*



**Christopher Strong**  
*Research Engineer II*



**David Veneziano**  
*Research Scientist*



**Shaowei Wang**  
*Research Engineer*



**Richard Wolff**  
*Professor,  
Electrical and  
Computer Engineering*

## Program Managers

*Eli Cuelho*

**Infrastructure Maintenance and Materials**

*Rob Ament*

**Road Ecology**

*Doug Galarus*

**Systems Engineering Development and Integration**

*Chris Strong*

**Safety and Operations**

*Xianming Shi*

**Winter Maintenance and Effects**

*David Kack*

**Mobility and Public Transportation**

## Principle Center Staff

**Jeralyn Brodowy**

*Assistant Director  
of Administration*

**Susan Gallagher**

*Education Program Coordinator*

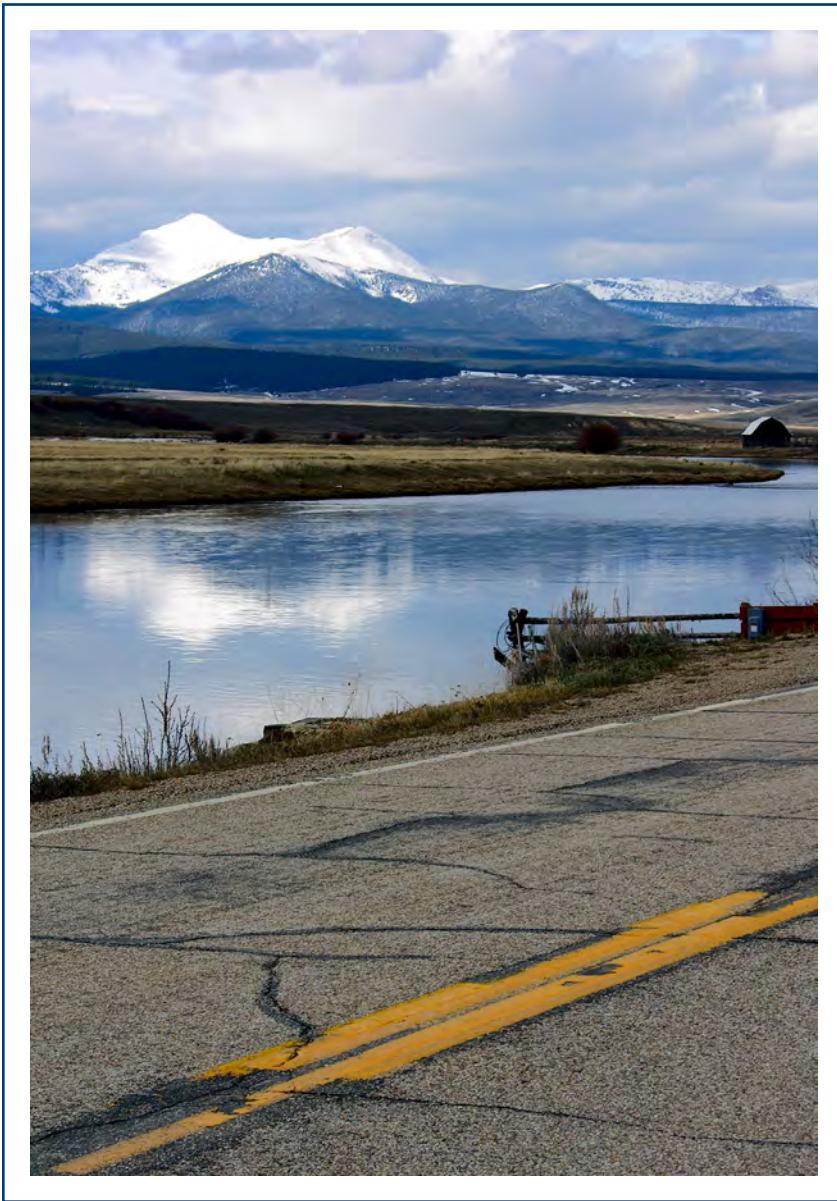
**Catherine Heidkamp**

*Technology Transfer Coordinator*

# Research

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*“To create areas of excellence with a multidisciplinary focus that will produce high quality research that leads to a demonstration of solutions and to invest in laboratories to perform better research that will meet our mission.”*



## Message from the Research Director

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As Research Director at WTI, I have been asked to make several presentations over the past year to faculty, student, and other groups within the university with the objective of stimulating their interest and participation in WTI's UTC program. These presentations are easy to give, because

1) our overall mission is compelling and personal – that is, to investigate critical national priorities that will improve the performance of the transportation system they use every day;

2) the research projects we work on are challenging, as our project partners/sponsors are confronted with increasingly complex problems associated with providing transportation services in the contemporary world;

3) the research projects we work on are rewarding – that is, all research is performed with the clear intention of ultimately implementing results;

4) the research projects we work on are diverse in nature, ranging from basic research on new concepts to applied research on technologies and methodologies on the edge of implementation;

5) our expertise in our areas of specialization is outstanding, as we have assembled a very capable and motivated research staff and have further extended their capabilities by partnering with and supporting academic faculty from across the campus; and

6) our research facilities are exceptional – that is, we have purposefully developed state-of-the-art laboratories as a national asset to support research in our areas of specialization.

While I could offer additional observations on all of these points, they are nicely spoken to in a collective sense by a simple review of some of the cutting edge research being done in our laboratories – research of national import that we can only do because we have these state-of-the-art facilities. A key example is our Corrosion Lab, in which we are conducting three of the new UTC projects described later in this report:

- Electrochemical Rehabilitation of Salt Contaminated Concrete,
- Mitigation of Moisture and Deicer Effects on Asphalt Thermal Cracking,
- Innovative Coating System for the Corrosion Prevention of Galvanized Steel.

Corrosion is a critical issue for the long-term strength and viability of the national transportation infrastructure, and it has implications for safety, mobility of freight, and even homeland security. These projects are basic in nature, with the intention of obtaining a better fundamental understanding of the physical phenomena involved, which will lead to better solutions of corrosion issues.

Other efforts that use our advanced laboratories include two research projects on communication systems: Mobile Communications Briefcase and Ant Colony Optimization for Transportation Problems. Both projects, applied in nature and designed to address communications issues in remote areas, will use the Systems Engineering Lab. The genesis of these projects was our earlier involvement in an effort supported by the California Department of Transportation to develop innovative tools for incident response/incident management on rural roads.

The capabilities and applications of our laboratories are further enhanced through our access to and coordination with complementary WTI/MSU facilities, such as the Lewistown Field Test Site being developed by WTI for large-scale transportation field testing, and the Sub-Zero Environmental Chamber Complex being developed by the Civil Engineering Department. We already, for example, are planning a deicer performance project that involves the development of test protocols under the controlled conditions of the Corrosion Lab that will subsequently be used in a field test at Lewistown.

Thus, our research facilities are among several things that ensure WTI can best contribute to addressing current national transportation research priorities. We look forward to continuing to develop these facilities as a national research resource in the coming years so that we are equally prepared to address the transportation challenges of the future. And, as I say in concluding my presentations on WTI, the UTC Program is the foundation for making all of this (and more) happen.



# New Research Projects

Project Name	Principal Investigator
Impacts of Barriers on Topeka Shiner Populations	Matt Blank
California Oregon Advanced Transportation System Phase 3	Chris Strong
Effects of 4 Lane Highways on Desert Kit Fox and Swift Fox	Tony Clevenger
Automated Cost Recovery	David Kack
Blaine County State Highway 75 Wildlife Data Collection and Mitigation Research Project	Marcel Huijser
Mitigation of Moisture and Deicer Effects on Asphalt Thermal Cracking	Tongyan Pan
An Autonomous and Self Sustained Sensing System to Monitor Water Quality Near Highways	Xianming Shi
Innovative Coating System for the Corrosion Prevention of Galvanized Steel	Xianming Shi
Ant Colony Optimization for Transportation Optimization Problems	Doug Galarus
Developing a Standard Test Method for Measuring Geosynthetic Soil Resilient Interface Shear	Eli Cuelho
Banff Wildlife Crossing Project	Tony Clevenger
Mobile Communications Briefcase	Doug Galarus
Electrochemical Rehabilitation of Salt Contaminated Concrete – A Lab Study	Xianming Shi
Effects of Defensive Vehicle Handling, Phase 3	Mike Kelly

## Impacts of Barriers on Topeka Shiner Populations

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Humans are increasingly aware of our impact on the natural world. This includes, among other activities, the effects of roads, highways, and associated culverts on wildlife. The impacts of roadways that dissect large animal habitat and migration routes are well known. Lesser known is the impact of culverts and roads on less visible organisms such as fish. The Western Transportation Institute with its motivated and highly knowledgeable research staff is attempting to remedy the impact of roadways for one small aquatic species. The Topeka shiner (*Notropis topeka*) is a small fish, which historically, lived in creeks and streams that exhibit perennial or near-perennial flow of high quality water in South Dakota, Minnesota, Kansas, Iowa, Nebraska and Missouri. This fish has been placed on the endangered species list due to a reduction in population in its historic range, primarily from stream destruction, habitat fragmentation, siltation and animal waste contamination. Although its Topeka shiner population is still high in the shiner's historical range, South Dakota has taken a proactive stance in ensuring the shiner and its habitat remain viably healthy.

In an effort to understand the effects of roadway

culverts on the Topeka shiner and to meet the national research priority of understanding and mitigating transportation impacts on the environment, WTI and the South Dakota Department of Transportation have joined in a project led by WTI researcher Matthew Blank. This project will attempt to add knowledge of the factors influencing the movement of Topeka shiners through culverts in eastern South Dakota. It will also investigate the effect of culverts as barriers on the distribution and genetic diversity of Topeka shiners.

Culvert types and designs as well as in-place characteristics that may be making culverts permanent or intermittent barriers to movement of the Topeka shiner will be identified. The effects of culvert types, designs and flow characteristics on movement through and distribution upstream and downstream of culverts will be clarified. The WTI team will also develop strategies for mitigating existing culverts and improving new culvert designs to improve passage of this and, subsequently, other small aquatic species.

The results from this research will be useful to other Departments of Transportation tasked with building and maintaining roads and crossings that are safe for humans yet not destructive to aquatic connectivity.



## COATS Project Enters Third Phase to Improve Rural ITS Planning

The third phase of the California and Oregon Advanced Transportation Systems (COATS) project is under way, continuing to promote bi-state cooperation and communication that will develop, deploy and coordinate cost-effective and environmentally agreeable intelligent transportation systems.

From 1998 until 2001, WTI worked with the California and Oregon transportation departments in the first phase of COATS. The project was designed to encourage regional, public and private sector cooperation between California and Oregon organizations to better facilitate the planning and implementation of intelligent transportation systems (ITS) in a rural bi-state area. The study area for COATS focuses on roadways between Eugene,

Oregon and Redding, California.

The second phase of the project, COATS Showcase, resulted in a number of research and evaluation activities that improved the performance of existing ITS elements and also provided data to justify, support, or direct future deployment of ITS in the COATS study area.

The current phase of COATS will foster cooperation and communication between the two states, promote technology transfer, assist in ITS planning, and provide assistance to mainstream deployment of field-tested technologies.

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## WTI Researchers Study the Effects of Four-Lane Highways on Desert Kit Fox and Swift Fox

The endangered San Joaquin kit fox is found in 16 California counties, where its habitat is threatened by encroaching civilization. More than 340 miles of highways are scheduled for major widening projects within the kit fox habitat range starting this year, with most of the projects turning two-lane roads into four-lane highways. State and federal wildlife officials are concerned about the effects these widening projects will have on the kit fox's populations by restricting their movements.

But while incorporating culverts to facilitate wildlife movement is an option to mitigate these effects, there is no information available on whether the endangered kit fox would use culverts for crossing the highways, or what culvert design attributes would be most attractive to them.

With limited opportunities to study the endangered fox, the Caltrans Offices of Materials and Infrastructure Research has contracted with WTI to conduct field studies on how four-lane highways affect the range and distribution of the desert kit fox and swift fox, ecologically similar species whose numbers would permit a more thorough investigation. These studies could offer valuable information that would then be applied to the San Joaquin kit fox.

WTI's Dr. Anthony Clevenger and Dr. Brian Cypher from the California State University, Stanislaus, Endangered Species Recovery Program will conduct

the study to determine the effects of four-lane highways on fox movements and monitor fox usage of existing below-grade passages.

Information gathered in the study will be used to ensure that highway funds are used most effectively to promote the long-term recovery and sustainability of the San Joaquin kit fox populations.

The researchers will identify sites where five desert kit foxes and ten swift foxes are found within a half mile of four-lane highways. They will trap foxes at each site, and fit them with Global Positioning System (GPS) collars. They will also gather information on existing passage dimensions, road design characteristics, presence of possible barriers to passage such as median barriers, guardrails or fencing, and types of human activity in the area.

By monitoring the travel habits of the foxes through collection of the GPS data and observation by remote-trigger cameras or track pads mounted at the below-grade passages, the researchers hope to offer recommendations to Caltrans for the design, installation and monitoring of kit fox culverts.

*Tony Clevenger*  
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## Automated Cost Recovery: A Feasibility Study

David Kack  
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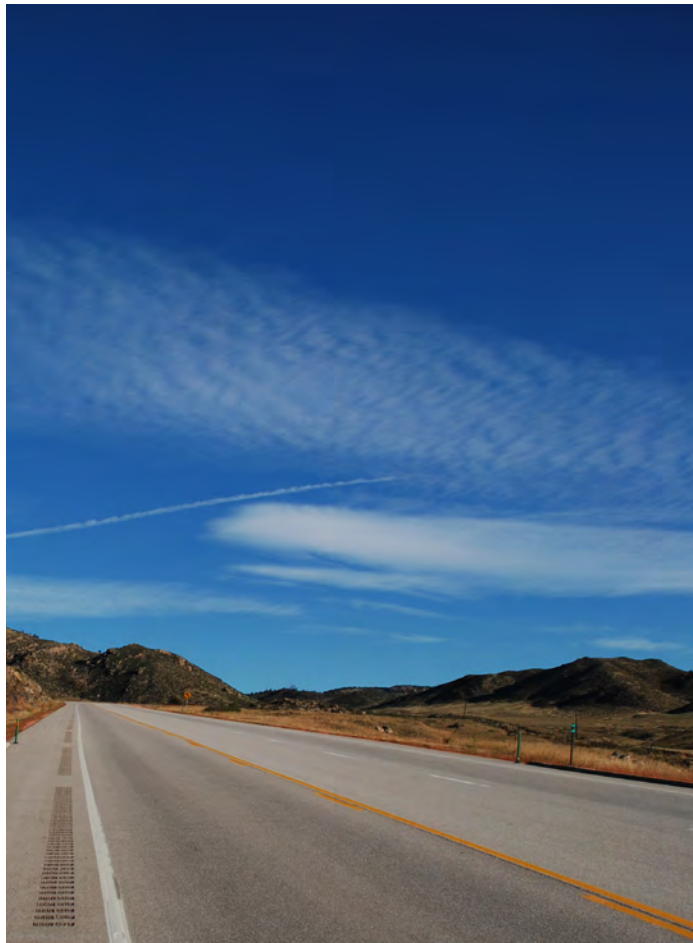
Public and specialized transportation providers in Montana and across the nation use a variety of methods to collect fares from riders, invoice agencies that pay for rides and collect ridership information. These vary from basic pen and paper documentation to the use of automated business processes. Communities and sometimes entire states have implemented software solutions in an attempt to automate data collection, analysis and reporting. Providers use magnetic strip cards, smart cards and stored value cards. CRRAFT (Client Ridership Referral and Financial Tracking) was implemented in New Mexico to assist the state in automated data collection, analysis and reporting. Western Transportation Institute and MET Transit of Billings, MT collaborated on an effort to identify the benefits of using Computer-Aided Scheduling and Dispatching Software in MET Transit's management practices. Software packages such as these help transportation businesses collect and analyze data and provide more efficient invoicing, fare collection, scheduling, and in other management applications. This project will determine if technologies exist that could make the process of collecting fares and reporting information more effective and efficient for Montana transportation providers.

Western Transportation Institute's David Kack (transportation coordination, management, and planning), as Principal Investigator, will collaborate with WTI researcher Doug Galarus (information technology, testing and implementation experience) and Utah private transpor-

tation consultant Mr. Richard Hodges on this project. The Montana Department of Transportation will provide data and assist in procuring information from providers and other organizations or agencies that currently use automated cost recovery technologies.

The WTI team will review existing automated cost recovery system practices in the transportation industry and their applicability to Montana. Current technologies being used in Montana will be examined to determine if these systems could be augmented by the inclusion of automated cost recovery methods. A requirements analysis for payment methods, reporting requirements and other business practices that might affect an automated fare-recovery system will be completed. The team will identify crucial issues and barriers that would need to be addressed if an automated system were implemented and will complete a cost/benefit analysis to determine the feasibility of implementing an automated system.

Results of this study will be used by the Montana Department of Transportation to decide if sufficient benefits exist to implement an automated cost recovery system in Montana. Results will also be of interest to various agencies and organizations (e.g., Montana Department of Public Health and Human Services). In addition, the final report will address critical implementation issues and provide for the coordination of efforts between MDT, interested agencies or organizations and transportation providers, should the outcome of the project be to implement new technologies in the state, even on a trial basis.



## Blaine County Idaho Seeks to Improve Roadway Safety by Mitigating Animal-Vehicle Collisions.

Standard wildlife warning signs, oversized warning signs with warning flags and permanently flashing beacons are the mainstay of many departments of transportation warning systems to help drivers avoid wildlife-vehicle collisions. However, such warning signs appear to have only limited effect because drivers habituate to them. With wildlife-vehicle collisions becoming one of the top safety issues that generate interest and concern with the public and media, the need to find a more effective way of warning drivers of possible wildlife on the road became apparent.

Blaine County, Idaho, is a rural area bisected by State Highway 75 – a two-lane highway that has relatively many collisions between vehicles and mule deer and elk. With the help of the public, WTI will investigate the road section

between the junction with Highway 20 (Timmerman Junction) and Ketchum with respect to animal-vehicle collisions, successful animal crossings, and potential mitigation measures.

The overall purpose of the effort is to contribute to a reduction in animal-vehicle collisions, especially with larger animals such as mule deer and elk, which translates into increased public safety, reduced wildlife mortality, and reduced economic losses due to property damage along the road section concerned.

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## Mitigation of Moisture & Deicer Effects on Asphalt Thermal Cracking through Polymer Modification

Thermal cracking (low temperature cracking) is a major contributor to asphalt pavement deterioration at low temperatures, leading to increased structural distresses and reduced serviceability in asphalt pavements. Changes in moisture levels are known to put extra load on the low-temperature properties and the thermal-cracking performance of asphalt mixtures. Deicers and anti-icers help ensure safety and mobility on winter highways by lowering the freezing point and dissolving ice and snow on the pavement surface. However, they also add additional factors to pavement deterioration such as the extended exposure to moisture and accelerated freeze-thaw cycles. In addition, winter deicer/anti-icer application can also lead to exacerbated deterioration of asphalt pavements resulting from the seepage of dissolved chemicals.

The Western Transportation Institute's researchers Dr. Tongyan Pan (Principal Investigator) and Dr. Xianming Shi (Co-PI) are investigating the details of asphalt pavement deterioration – the physicochemical processes that happen in mastic and the asphalt mixture's smallest spaces (i.e., the mastic and interface-interphase zone (IIZ)). Of particular significance in this study is the IIZ that may be at the core of asphalt mixture deterioration

at low temperatures when exposed to the presence of moisture and deicing chemicals.

The team will use the Discrete Element Method (DEM) approach to develop a micro-mechanistic based thermal-cracking model that incorporates moisture and deicer deteriorating mechanisms. Recent evidence points to the possibility that thermal cracking of asphalt mixes in the presence of moisture and deicers may be mitigated by polymer modification. The addition of appropriate polymers to the binder could improve tensile stress resistance in mastic and the asphalt-aggregate bonding strength in IIZ. This research will explore the prospect of using polymers in mitigating the moisture and deicer impacts on asphalt mixture serving at low temperatures.

This project could help explain accelerated deterioration of asphalt pavements exposed to moisture and deicers at low temperatures, and may help identify suitable polymers to mitigate the deterioration. Reducing disintegration of asphalt pavements due to low temperature and winter maintenance activities would bring considerable benefits in cost, time and effort, and reduce driver frustration.

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## An Autonomous and Self-Sustained Sensing System to Monitor Water Quality

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As a major component of non-point-source pollution, highway runoff has adverse effects on the adjacent aquatic resources if no measures are taken to remove the excessive

contaminants accumulated from highway construction, operation and maintenance. Highway runoff often carries sediments, nutrients, heavy metals, petroleum-related compounds, deicers and other chemicals before it reaches the receiving water body. To comply with water quality regulations and minimize adverse environmental impacts of highway operations, state departments of transportation need accurate and cost-effective methods to monitor water quality along roadways.

A multi-disciplinary team from Montana State University is developing a self-sustained system, using novel devices (such as microbial fuel cells (MFCs)), in conjunction with sensors, microcontrollers and transceivers, to in situ monitor and collect real-time measurements for continuous water quality monitoring. The system will be capable of measuring chloride concentration, pH, dissolved oxygen, and temperature for the specified location.

The project will be conducted in multiple stages. This year, the Electrical and Computer Engineering team has completed all of its tasks from the first stage of the project, which included selection of the sensors, communication devices, and micro-controller that will be used in the sensing system, as well as analyzing the voltage, current and power requirements for all of these components. This team also provided design guidelines for the fuel cells and designed an electric current converter specifically for the system.

A second team from the Western Transportation Institute has designed a microbial fuel cell (MFC) and tested its performance. The preliminary testing results indicated that with some improvements this MFC design will be able to provide desired power to the sensors, the micro controller, and the communication devices. With

Stage 1 successfully completed, researchers can move to Stage 2 (Fabrication of components) and Stage 3 (Assembly and testing of system). “We are working closely with end users from several DOTs to identify requirements and areas for improvement,” said Principal Investigator Dr. Xianming Shi. “We want to deliver a system that truly meets their needs.”

The potential benefits of this project are many. While the current practice for water quality monitoring (i.e., manual data-collection) provides many environmental benefits, the proposed system has numerous additional advantages. First of all, the autonomous feature of the system minimizes the need for frequent manual sampling and testing, a time-consuming, costly, and sometimes dangerous task. Second, the self-sustainability of the system promises a reliable solution to long-term, wide-area monitoring of water quality along highways, as the system will demand a minimum amount of maintenance or can operate in a reliable manner without any servicing. Third, the in-situ feature of the system will enable near-real-time monitoring of water quality, and minimize the possibility of missing short-lived events due to the need to collect water samples or to change batteries. Such near-real-time data on water quality at distributed locations along highways, transmitted via telecommunication, will enable state DOTs to promptly detect and mitigate toxins and pollutants in highway runoff. Finally, the system provides state DOTs with an efficient tool to identify seasonal trends in selected parameters of water quality (such as chloride and sediment loadings) along highways, to assess the impact of various highway activities on the water quality, and to evaluate the performance of various highway-runoff best management practices over time.

“Deploying such systems at distributed locations of concern may require a relatively high capital investment at first,” concluded Shi. “In the long run however, it should be more cost-effective than manual data-collection activities, because it really cuts down on the labor hours required for water quality monitoring.”



## An Innovative Coating System for the Corrosion Prevention of Galvanized Steel

Carbon steel has been widely used for steel bridges or as reinforcing bar for concrete structures but it is prone to corrosion. The annual direct cost of metallic corrosion amounts to \$276 billion per year to the U.S. economy. Galvanized steel has been used in steel bridges for improved corrosion resistance and the galvanizing of steel rebar has been shown to extend the service life of reinforced concrete structures.

Organic coatings on galvanized steel have been shown to enhance the corrosion resistance of steel, but conventional chromate conversion coatings (CCCs) that perform well in preventing corrosion use Cr6+, which is toxic to the environment. The most promising alternative to CCCs is the rare-earth corrosion inhibitors. Research has demonstrated that silicates/silanes could protect metals against different forms of corrosion but that silicate/silane sol-gel films alone cannot provide adequate barrier properties. They also cannot provide active corrosion protection and cannot stop the development of corrosion processes once a defect occurs. Incorporation of nanoparticles in the hybrid sol-gel system enhances the corrosion protection properties but these nanocomposite hybrid films still cannot provide effective long-term corrosion protection without a self-repairing effect. One way to improve the self-repair properties of hybrid films is the addition of a corrosion inhibitor, which can suppress corrosion initiated at the coating defect. The inhibitors, however, tend to decrease the stability and consequently the barrier properties of the film and, release of inhibitors from coatings is relatively fast and uncontrollable.

It is desirable to replace CCCs and other synthetic polymers in anti-corrosion

coatings with biodegradable natural polymers (e.g., polysaccharides) while maintaining a comparable level of corrosion resistance for the coatings. Integrating polysaccharides into silicate/silane polymers through chemical bonds will introduce biodegradability and minimize environmental impacts may help improve the mechanical properties of coatings as flexible molecular chains, and act to relax stresses induced by freeze-thaw cycles or mechanical damage. Polysaccharide structures may be used to form an electroactive polymer (EAP), which would allow charge to flow along the molecular chain and offer a mechanism for corrosion inhibition.

Western Transportation Institute researchers Dr. Xianming Shi and Dr. Xiaodong He, will explore development of a three-coat corrosion prevention system consisting of a polysaccharide/silicate/silane film as a primer (providing good adhesion to the substrate and biodegradability); an ordered nanoparticle coating with encapsulated corrosion inhibitors and repairing agent as the interlayer (to repair scratches and maintain the structural integrity of the coating); and a silicate/silane sol-gel film as the topcoat (transparency and scratch-resistant properties). This self-repairing mechanism is expected to extend the service life of the coatings and to minimize maintenance costs associated with corrosion of galvanized steels as well as aluminum alloys.

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## Ant Colony Optimization for Transportation Optimization Problems

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WTI leads numerous research projects to improve transportation in rural areas. A typical

challenge in rural locations is the absence of seamless or reliable communication, due to the difficulty of effectively placing infrastructure in remote areas or rugged terrain.

In 2006, WTI awarded a fellowship to Jeff Sharkey, a first year Master's student in Computer Science at MSU, to conduct preliminary research into the use of an optimization technique called "Ant Colony Optimization," in order to investigate whether it can be applied to select optimal placement of communications infrastructure along a roadside. The initial research has included computational analysis, integration of digital elevation models, and development of a working algorithm.

Ant Colony Optimization (ACO) is an artificial intelligence algorithm and is a form of "Swarm Intelligence." Ant Colony Optimization algorithms mimic the behavior of ants searching for food. Ants deposit pheromones on the paths they follow when searching for food. The ants that find food survive and retrace their paths back to their homes, making the pheromone deposited along trails leading to food even stronger. Other ants follow pheromone-laden trails leading to food, and ultimately the shortest paths to food are found by the collective ant colony. Similarly, ACO explores potential paths to solutions of problems and increases the weights of paths leading to good solutions. Ultimately, ACO algorithms converge to near-optimal solutions for very complex problems, such as the infrastructure placement problem.

This project will allow Jeff to work with the researchers of the Systems Engineering Group to build on the previous research, through enhancement of the estimation techniques and algorithm, generation of test

cases based on real locations and equipment, and identification of other applications for the techniques used in the research.

This project offers a broad range of potential benefits. In the short term, it may provide an improved tool for optimal placement of infrastructure within a roadside communications network. WTI has an opportunity to put this tool into immediate use in a project with the California Department of Transportation, in which the two agencies are working to improve communication options for Transportation Management Centers and Traffic Monitoring Systems in remote locations.

In the long term, however, the optimization techniques have many other potential applications. "I can foresee ACO being used to improve multiple vehicle scheduling and dynamic traffic routing, which could lead to advancements in many areas, including safety, operations, winter maintenance, public transportation, and freight management," said Principal Investigator Doug Galarus. "By determining 'visibility' within a communications network, these techniques could also be applied to roadway design projects and improvements."

The project has also presented an opportunity to promote integration of WTI's research and education programs. "By bringing this research into the Systems and Integration group, our researchers can provide Jeff with technical expertise and professional mentorship as he conducts research that will form the basis of his thesis," said Galarus. "At the same time, we are excited about applying his findings to a number of current and future WTI projects."

## WTI's Materials Laboratory Develops a Standard Test Method for Measuring Geosynthetic Soil Resilient Interface Shear

The national movement to develop a mechanistic-empirical design guide for pavements requires that the fundamental material properties for all components of the design be quantified. When geosynthetics are used to reinforce the base course layers of flexible pavements, one of the two main design parameters is the interaction between the geosynthetic and the surrounding aggregates. Interaction at this interface can be quantified in terms of a stiffness parameter,  $G_i$ , the resilient interface shear stiffness. The most relevant interaction tests use cyclic loads like those experienced in transportation applications. Currently, however, there is no standard test to quantify soil/geosynthetic interaction using cyclic loads.

Eli Cuelho and researchers working in the Materials Laboratory will use the updated cyclic pullout test facility at WTI to establish specific test protocols to determine parameters pertinent to geosynthetic reinforced pavement design (i.e., the resilient interface shear stiffness,  $G_i$ ). These testing protocols will be used to investigate and establish best practices for conducting cyclic pullout tests such that these protocols can be incorporated into American Society for Testing Materials (ASTM) testing standards which can then be used with consistency by testing laboratories.

Three different reinforcement products will be used in the cyclic pullout tests. One of the factors being considered in these tests is the variability in the test results for different base aggregate materials and grid combinations. To examine this, the soil material used for the first series of tests will be Ottawa sand, which will provide results with the least amount of variability due to the confining soil. Later tests will use coarser aggregates, and will be compared to the tests with Ottawa sand to establish this variability.

Through the development of cyclic pullout test methods to accurately determine the resilient interface shear stiffness needed for mechanistic-empirical base-reinforced pavement design procedures, the anticipated benefits for state transportation departments include:

- Development of performance based properties which form the basis for appropriate generic specifications of geosynthetic products used in pavement reinforcement applications,
- The ability to have base-reinforced pavements designed using the properties from the test methods developed in this project,
- The development of consistent testing methods to determine resilient interface shear stiffness,
- The development of ASTM testing standards for these test methods by the involvement of the research team in the ASTM D35 Committee on Geosynthetics, Subcommittee D35.01 on Mechanical Properties, Task Group on Subgrade Reinforcement,
- The establishment of testing methods that can be referenced when work is performed to incorporate reinforced pavement design into a national mechanistic-empirical design guide, and
- Standardization of design models for reinforced pavement that center around consistent design properties derived from this work.

Progress towards the establishment of a nationally accepted mechanistic-empirical reinforced design method will allow reinforced pavements to be routinely designed and compared to other design alternatives with the potential of saving construction and maintenance costs.

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## Maintaining Ecological Connectivity across Transportation Corridors in Mountain Landscapes

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Over the past 10 years Dr. Tony Clevenger has overseen construction of more than 24 wildlife crossings both above and below the Trans-Canada Highway (TCH) in Banff National Park, creating the only large-scale complex of highway mitigation of this kind in the world. In essence, Dr. Clevenger and his team of WTI researchers have created the perfect natural laboratory for understanding the impact of highway overpasses and underpasses on a variety of wildlife species.

Monitoring the track pads at each of the crossings has shown that since 1996, 10 species of large mammals, such as grizzly bears, mountain lions, moose, elk and bighorn sheep, had used Banff's 24 crossings more than 90,000 times by January 2007. The research suggests that there is a learning curve and animals need time to locate the wildlife crossings and feel secure using them before doing so regularly. As an example, grizzly bear use has increased each year from just seven crossings in 1996 to more than 100 crossings by grizzlies in 2006. Long-term

monitoring has been able to demonstrate that the TCH mitigation has reduced traffic-related mortality of all large mammals by more than 80% – a significant boost to maintaining viable wildlife populations and providing for motorist safety.

The main strategies of the Banff Wildlife Crossings Project are:

- To continue field research measuring gene flow of grizzly and black bears using the crossings,
- To continue monitoring and research of Banff wildlife crossings and other mitigation tools as a means of developing science-based guidelines for designing effective mitigation in transportation projects,
- To present findings in major international journals, books and conferences on transportation and ecology.

The resulting research will mark a major advancement as the first study to ever scientifically measure and collect data to understand levels of connectivity at wildlife crossings and their long-term conservation benefits to wildlife populations.

## Mobile Communications Briefcase to Benefit Rural Transportation

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Data communication in rural areas presents numerous challenges for both fixed and mobile deployment. At present, department of transportation staff either have no equipment for data communication in these areas, or have separate, redundant equipment for multiple service providers. The Mobile Communication Briefcase project will produce and test a system which will consist of integrated cellular radios/modems, networking equipment (switch/router/bridge), GPS, and associated antennas, power, connectors, etc. The communication briefcase will provide, in a small and portable form, a communications platform that will be of general use for transportation applications and related research in both rural and urban settings.

In particular, the system could be applied to safety and operations applications for ITS development / evaluation and incident management. WTI has investigated, with Caltrans, the use of portable signs for delay time

estimates in rural work zones. The communication briefcase could be used to provide communication capability from the work zone to the TMC and for general dissemination to traveler information systems. The briefcase could also be used as a general communications device for mobile data terminals used by first responders.

This project dovetails nicely with past, present and anticipated future work by WTI and the Systems Engineering groups specifically on transportation-related communications systems for a broad spectrum of applications (e.g., traveler information systems, communications with traffic management centers, first-responder communications, data collection from remote sensors, communications in remote areas, security communications, etc.). It will allow the project team to extend research beyond existing projects and provide a beneficial tool and experience for future research in addition to addressing UTC strategic goals of safety and global connectivity.



## WTI Researchers Study the Effects of Electrochemical Rehabilitation of Salt Contaminated Concrete

Corrosion of reinforced and prestressed concrete structures is a worldwide problem. Approximately half of the 500,000 bridges in the United States require immediate attention and the total repair bill is estimated at \$90 billion. The traditional repair method consists of the replacement of corrosion-damaged concrete with chloride-free concrete. However, this is a short-term solution as chloride is pervasive; the reinforcing steel may already be contaminated.

Extensive research has indicated that once chloride-induced corrosion of the reinforcing steel has initiated in the concrete structure, the only effective means of stopping corrosion is through electrochemical methods such as cathodic protection (CP) and electrochemical chloride extraction (ECE). A relatively new technique that has proven to work is electrical injection of corrosion inhibitors (EICI). However, there has been limited research and field trials of ECE or EICI, and widespread applications are hampered by the lack of detailed information on the underlying mechanisms and relevant rate-limiting steps.

Principal Investigator Dr. Xianming Shi led researchers in the Winter Maintenance and Effects Program to validate a two-dimensional FEM model that was used to evaluate the coupled chloride extraction and electrical injection of corrosion inhibitors. The effects of applied current density, treatment time and initial inhibitor

concentration on the performance of electrochemical treatment were studied. Based

on the numerical results predicted by the FEM model, the coupled ECE and EICI showed obvious advantages in corrosion protection of reinforced concrete. ECE was found to be a very effective technique in removing chloride and generating high hydroxyl concentration on the rebar surface in a short period, while the EICI technique could potentially extend the longevity of decontaminated concrete after ECE if a corrosion inhibitor with a high diffusion coefficient is used.

The results of these experiments will be incorporated into an improved FEM model to predict not only the migration of species in concrete during ECE/EICI, but also the remigration of both the aggressive species (Cl<sup>-</sup>) and protective species (OH<sup>-</sup> and Inhibitor<sup>+</sup>) subsequent to the EICI process and how that would affect the beneficial life gained from the electrochemical treatment as a rehabilitation measure. Such research would help with more accurate prediction of the service life of the rehabilitated concrete structure and thus a cost-benefit analysis of the treatment.

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## Effects of Defensive Vehicle Training: Phase 3

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There is considerable anecdotal evidence that training in advanced vehicle handling for young drivers can reduce the incidence of crashes, but there have been few controlled studies to back up that evidence. WTI is in the third phase of a three-part study to determine the effectiveness of defensive driving training workshops for young Montana drivers.

Phase 1 of the effort, begun in 2005, included the development of a training curriculum and the recruitment of about 400 teenaged drivers from central Montana who had completed high school driver education classes and were willing to participate in the study. During Phase 2, half of the teen volunteers participated in a one-day training workshop, which included both classroom and behind-the-wheel instruction in vehicle handling, skid recovery and defensive driving techniques. These classes were conducted in groups of 12, with the facilities and instructors provided by the Montana Office of Public Instruction (OPI).

All the volunteers, both those who completed the training course and those who didn't, completed a detailed questionnaire developed by the Montana OPI, seeking data on their driving history and experiences since completing their high school driver education classes. These surveys demonstrated that the two groups had similar experiences with accidents and violations during the period before the workshops were presented.

Phase 3 of the project calls for all the teen drivers to be tracked for four years to compare the driving experience, accidents and violations between those who completed the defensive driving course and those who did not. At the end of

the first year after the training was conducted, another, similar, survey was sent to the participants and a \$20 payment was offered to encourage their response. After two follow-up mailings, an 80 percent response rate was achieved.

Preliminary analyses of the survey data suggest a correlation between receiving the training and a reduced accident and violation rate. Of the teens who took the course, 31 percent reported having a single- or multiple-vehicle crash, compared to 35 percent of those who did not take the course. The vast majority of the reported crashes involved no injuries and minimal property damage and were not reported to authorities. Also, about 31 percent of the trained drivers reported receiving citations or warnings, compared to 45 percent of the non-trained drivers. While these results are consistent with WTI's original projections, it remains to be determined whether comparative advantage continues beyond the first year.

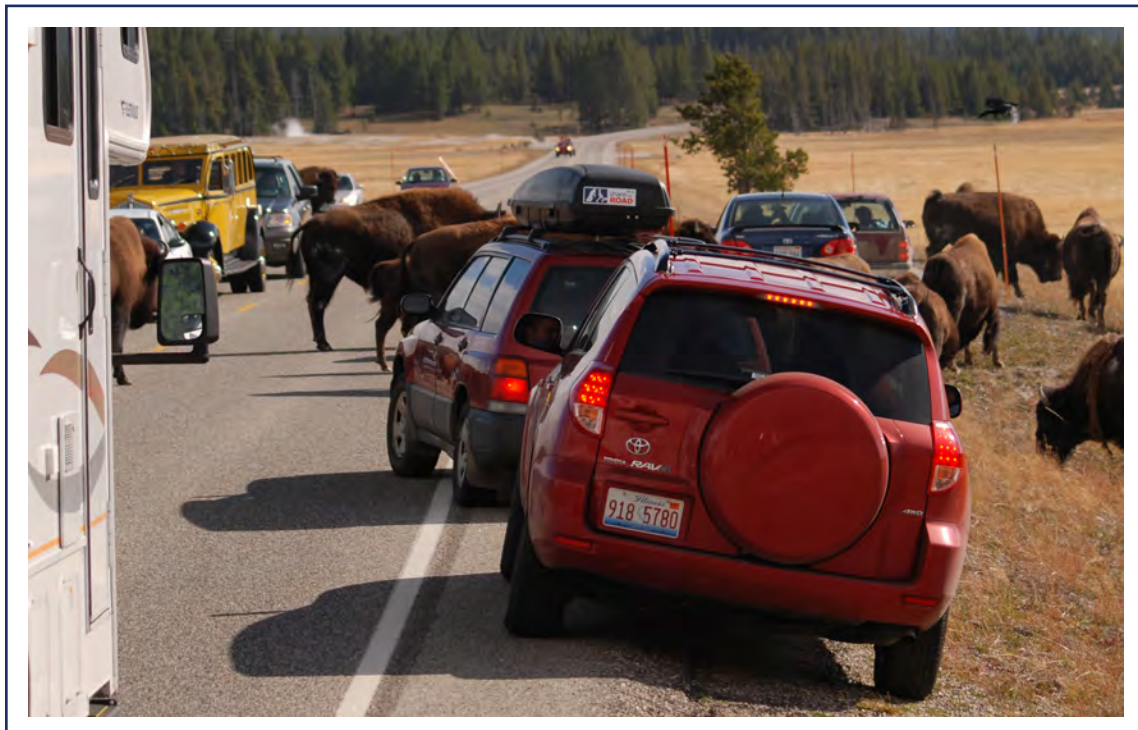
The young driver defensive driving workshops have been adopted by OPI and are now being presented as part of their program at the DRIVE center in Lewistown, MT. The nature of reported crashes is being examined by OPI to fine-tune the defensive driving workshops to better address crash causes.

Researchers will use the data collected annually through 2009 to calculate the frequency of accidents, degree of injury and property damage, and number of violations for each of the two groups. Differences between the two groups will be reported on an annual basis. After the final year, a detailed report will be prepared to summarize the data and offer recommendations.



## Cumulative List of Research Projects (10/1/2006 - 9/30/2007)

Project Name	Principal Investigator
Impacts of Barriers on Topeka Shiner Populations	Matt Blank
California Oregon Advanced Transportation System Phase 3	Chris Strong
Effects of 4 Lane Highways on Desert Kit Fox and Swift Fox	Tony Clevenger
Automated Cost Recovery	David Kack
Blaine County State Highway 75 Wildlife Data Collection and Mitigation Research Project	Marcel Huijser
Mitigation of Moisture and Deicer Effects on Asphalt Thermal Cracking.	Tongyan Pan
An Autonomous and Self Sustained Sensing System to Monitor Water Quality Near Highways	Xianming Shi
Innovative Coating System for the Corrosion Prevention of Galvanized Steel	Xianming Shi
Ant Colony Optimization for Transportation Optimization Problems	Doug Galarus
Developing a Standard Test Method for Measuring Geosynthetic Soil Resilient Interface Shear	Eli Cuelho
Banff Wildlife Crossing Project	Tony Clevenger
Mobile Communications Briefcase	Doug Galarus
Electrochemical Rehabilitation of Salt Contaminated Concrete – A Lab Study	Xianming Shi
Effects of Defensive Vehicle Handling, Phase 3	Mike Kelly





## Awards and Recognition

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WTI prides itself on producing quality research with findings that are nationally and internationally relevant. In the past year, WTI has been honored with the following awards and special recognitions for our research activities and products.

### **ITS America: Best of ITS Awards**

At its June 2007 annual meeting, the Intelligent Transportation Society of America (ITS America) announced its “Best of ITS” awards. These awards honor “the organizations and agencies that demonstrated the most innovative and effective uses of advanced technologies in surface transportation.” The five winning programs were selected from more than 60 entries from around the country.

- The Utah Department of Transportation (UDOT) received a “Best of ITS” award for the Evaluation of its Weather Operations/RWIS Program, conducted in partnership with WTI. Utah’s program assists the DOT operations, maintenance, and construction functions by providing detailed, often customized, area-specific weather forecasts. WTI’s evaluation estimated that the program saves the UDOT maintenance sheds \$2.2 million per year for snow and ice control activities. The program and evaluation received the award in the category of “Best Return on Investment.”
- The California Department of Transportation’s Responder System was a finalist for a “Best of ITS” award in the category of “Best New Product, Service, or Application.” WTI developed the Responder System for Caltrans; it is a mobile communications tool that allows first responders in remote locations to collect and communicate at-scene information with their secondary responders and Traffic Management Center (TMC). Responder is a valuable tool for improving safety and incident response, particularly in rural areas where communication coverage is sparse, or after major incidents (such as landslides, floods and earthquakes) where road damage is extensive.

### **Responder Project Video Selected for International Conference**

In August, the Association of Public Safety Communications Officials – International (APCO International) also showcased the Caltrans/WTI Responder project (described above) at its annual conference in Bal-

timore, Maryland, as part of “APCO TV.” A five-minute video, shot on location in California, was exhibited at the conference as a featured example of “putting research into practice.” The video, produced by HBL Media in London, featured footage of the Responder system in use at the scene of a simulated incident, as well as interviews of project principals. This forum allows WTI to expand our technology transfer beyond traditional transportation venues in order to reach other professional organizations with an interest in our research.

### **Excellence in Regional Transportation Awards**

The National Association of Development Organizations (NADO) RPO America and the NADO Research Foundation’s Center for Transportation Advancement and Regional Development initiated a new awards program this year to recognize noteworthy projects in rural and small metropolitan transportation planning. The Streamline Transportation System in Bozeman, Montana, and the Skyline Public Transportation System in Big Sky, Montana, were each selected as winners of 2007 Excellence in Regional Transportation Awards. WTI received specific recognition for its involvement in both projects; the staff of WTI’s Mobility and Public Transportation Program provided substantial technical assistance to the local transit agencies during the formation, implementation, and initial operation of both of these new systems.

### **Award-winning Museum Exhibit Showcases Wildlife Crossings Project**

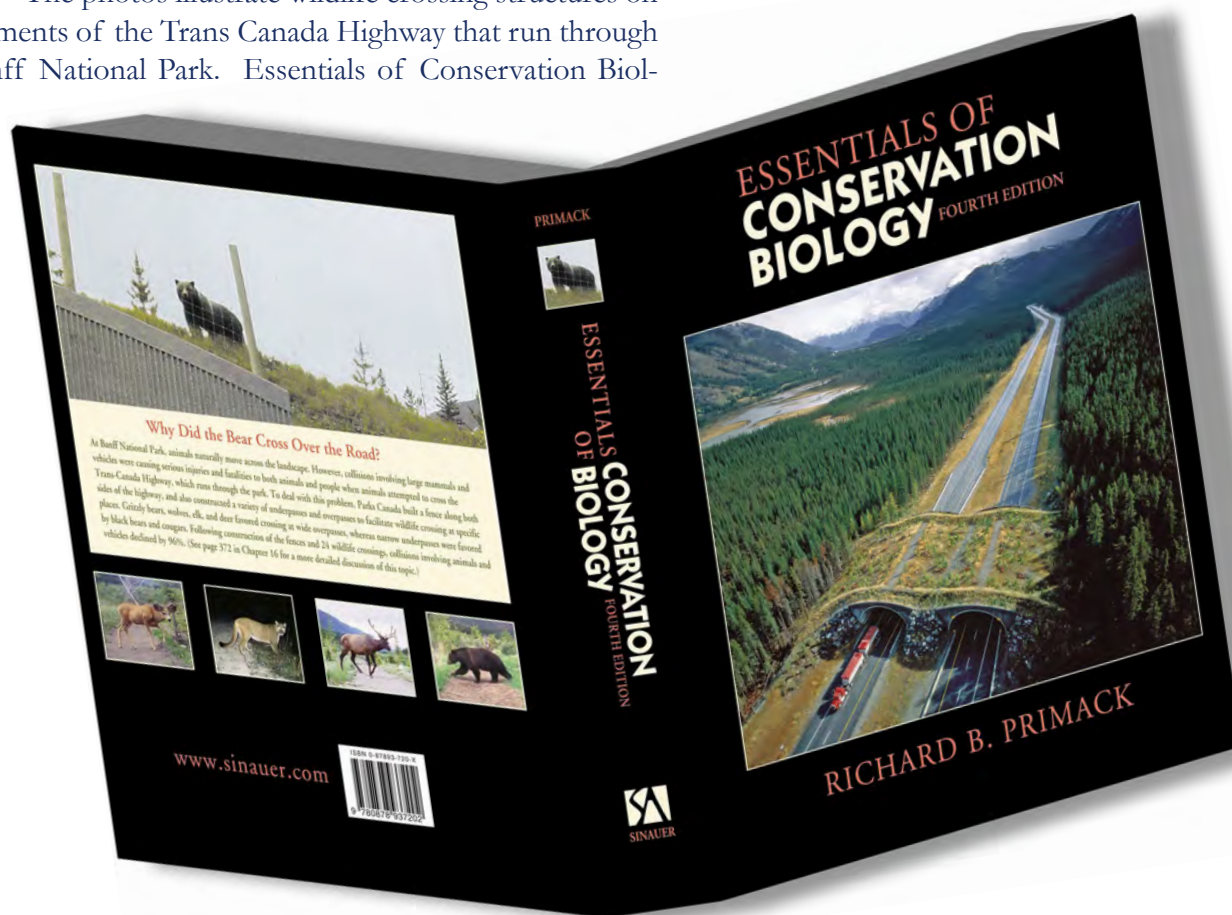
The Whyte Museum of the Canadian Rockies in Banff, Alberta, hosted an exhibit of the Banff Wildlife Crossings Project, a major, multi-year research collaboration between Banff National Park and WTI to monitor animal use of the many wildlife crossing structures in the Park, and their impact on reducing animal-vehicle collisions. The museum exhibit presents and illustrates the research through videos, maps, photos and user-interactive games. The exhibit was in the museum throughout the 2006 tourist season (May-October). Over 19,000 visitors attended the exhibit and many signed into the register at the exhibit. The Whyte exhibit won a “Banff Tourism Heritage Award” for “Most Innovative Commitment to National Park and World Heritage Site Awareness.”



## WTI Research Selected for Cover of Major Textbook

Photos by WTI researcher Tony Clevenger are showcased on the front and back covers of the textbook *Essentials of Conservation Biology* (4th edition), written by Richard B. Primack and published by Sinauer Associates, Inc. The photos illustrate wildlife crossing structures on segments of the Trans Canada Highway that run through Banff National Park. *Essentials of Conservation Biol-*

*ogy* is the most widely used textbook for Conservation Biology courses at universities in North America, providing WTI with a significant opportunity to broaden the audience for road ecology research and education.



## Research Success Story

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In a real world setting, successful operation and advancement of our transportation system requires not only knowledge of engineering principles, but also expertise in a host of other disciplines, including planning, economics, politics, and environmental sciences. Therefore, effective transportation research should also examine challenges and potential solutions using a multidisciplinary and collaborative process.

As an established UTC with technical expertise in numerous transportation fields, WTI has begun to move beyond discrete research projects. In the past year, WTI has placed greater emphasis on conducting research that examines problems and identifies solutions from a comprehensive and interdisciplinary perspective as shown in the figure opposite.

A good example is WTI's national leadership in addressing the issue of animal-vehicle collisions (AVCs). WTI created a road ecology program area, assembled a team of leading national and international experts, and has conducted numerous state-of-the-practice studies on mitigation techniques to reduce AVCs. More recently, however, WTI has encouraged collaborations between road ecology researchers and researchers in other program areas, which can result in unforeseen yet positive outcomes.

The figure illustrates how this approach was applied to the issue of reducing AVCs. When WTI first began to study AVCs, researchers asked questions such as: Where is the problem? Can data be collected? What mitigation will be most effective? To address this complex issue, WTI brought together researchers from three program areas: Road Ecology, Safety and Operations, and Systems Engineering and Integration. Road Ecology researchers had identified critical ecology and wildlife issues, but they couldn't pinpoint specific high accident locations using standard traffic safety data. Given that countermeasures are most effective when information is known in discrete increments (1/10 mile), the Systems Engineering and Integration researchers created a Roadkill Observations Collection System (ROCS) to better identify the exact location of AVCs.

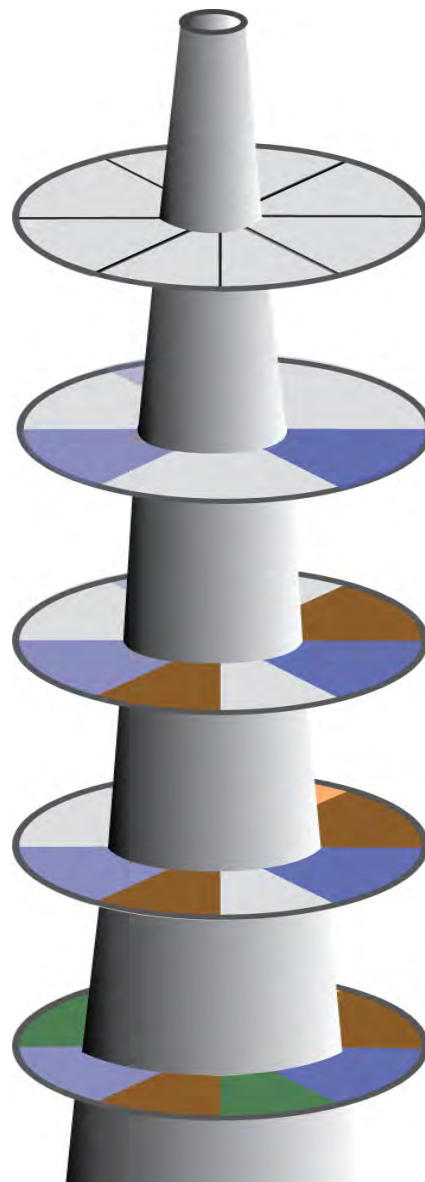
As ROCS began to collect more complete and accurate data, researchers were also able to identify research needs related to traffic safety, driver behavior, and other issues associated with developing effective measures to mitigate AVCs in problem locations. This led to a collaborative research project in which road ecology, systems integration, and human factors researchers used WTI's high fidelity driving simulator to test the effectiveness of wildlife advisory messages. The study resulted in recommendations for the usage of enhanced wildlife advisory signs to alert drivers to locations with a high risk for AVCs.

The multidisciplinary dimensions of this problem have further extended into the activities of other program areas at WTI. Staff, for example, in WTI's Winter Maintenance and Effects area are frequently involved in deicer evaluations. While traditional deicer performance evaluations focus on such things as the longevity of their effect and their corrosivity, their possible function as an attractant for animals (and thus an increase in AVCs) and other environmental effects are increasingly being considered in the evaluation process.

In a larger sense, these projects provide new tools and specific guidance that DOTs around the country can begin to use in their efforts to identify locations where AVCs are occurring, and plan mitigation efforts that may reduce the number of AVCs. Because AVC reduction can prevent accidents that endanger both motorists and wildlife, this multidisciplinary research also helps advance multiple national strategic goals, in particular safety and environmental stewardship. In an even larger sense, these projects and their multidisciplinary evolution provide an example of the integrated nature of transportation problems and the importance and value of pursuing comprehensive multi-dimensioned solutions. Such are made possible by the diverse expertise and research resources assembled through the support of the UTC program.

## Research Approach

Challenge
Multi-faceted review
Multi-disciplinary collaboration
Incorporation of existing, on-going or related project(s)
Access to established labs and facilities
Opportunities for additional partners with similar challenges



## Integrated Solutions

## Research Example

Reduce animal-vehicle collisions
Where is the problem occurring? Can data be collected? What mitigation will be most effective?
Collaboration between Safety & Operations Road Ecology Systems Engineering
For Data Collection: Use of Roadkill Observations Collection System
For Mitigation Evaluation: Perform human factor research using driving simulator laboratory
Seek additional partnership opportunities with DOTs

### Project outcomes:

Evaluation of habitat connectivity  
 Development and evaluation of wildlife crossing structures  
 Development and use of GPS Roadkill Observations Collection System  
 Human factors evaluation of animal-vehicle warning signs  
 Evaluation of animal detection systems  
 FHWA Deicer Best Management Practices  
 FHWA National Animal-Vehicle Collision Study  
 Impact of chemicals on roadway attracting wildlife

## Research Initiatives

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One of WTI's primary research initiatives over the next year will be to increase student involvement in WTI's research activities. While often the research, education, and tech transfer activities of a UTC are referred to independently, they are inherently and synergistically interrelated. In this regard, WTI has a substantial professional staff and portfolio of projects that offer significant opportunities for student mentoring in fields of study not directly accessible through the university's traditional academic programs. These opportunities, however, often are under exploited due to a lack of student awareness of their availability. The generally limited exposure of students to WTI and its professional staff in the course of their regular curricular activities contributes to this problem. Over the next year, WTI will refocus its efforts to involve students in research activities by a) reviewing and revising as appropriate its existing programs for this purpose, b) engaging in new activities to advertise research opportunities to students, and c) increasing, as possible, its direct presence in the classroom.

In addition to employing students as research assistants on projects, WTI has two programs that directly recruit students for research experiences, namely, a graduate fellowship program and an undergraduate research experience (URE) program. Despite active marketing efforts in which faculty members are requested to announce these programs in their classes, the number of applicants can be small. Applicant recruitment procedures will be reviewed and innovative approaches to advertising these programs will be explored (such as exhibits/stands in the Student Union, advertisements in the student newspaper, etc.).

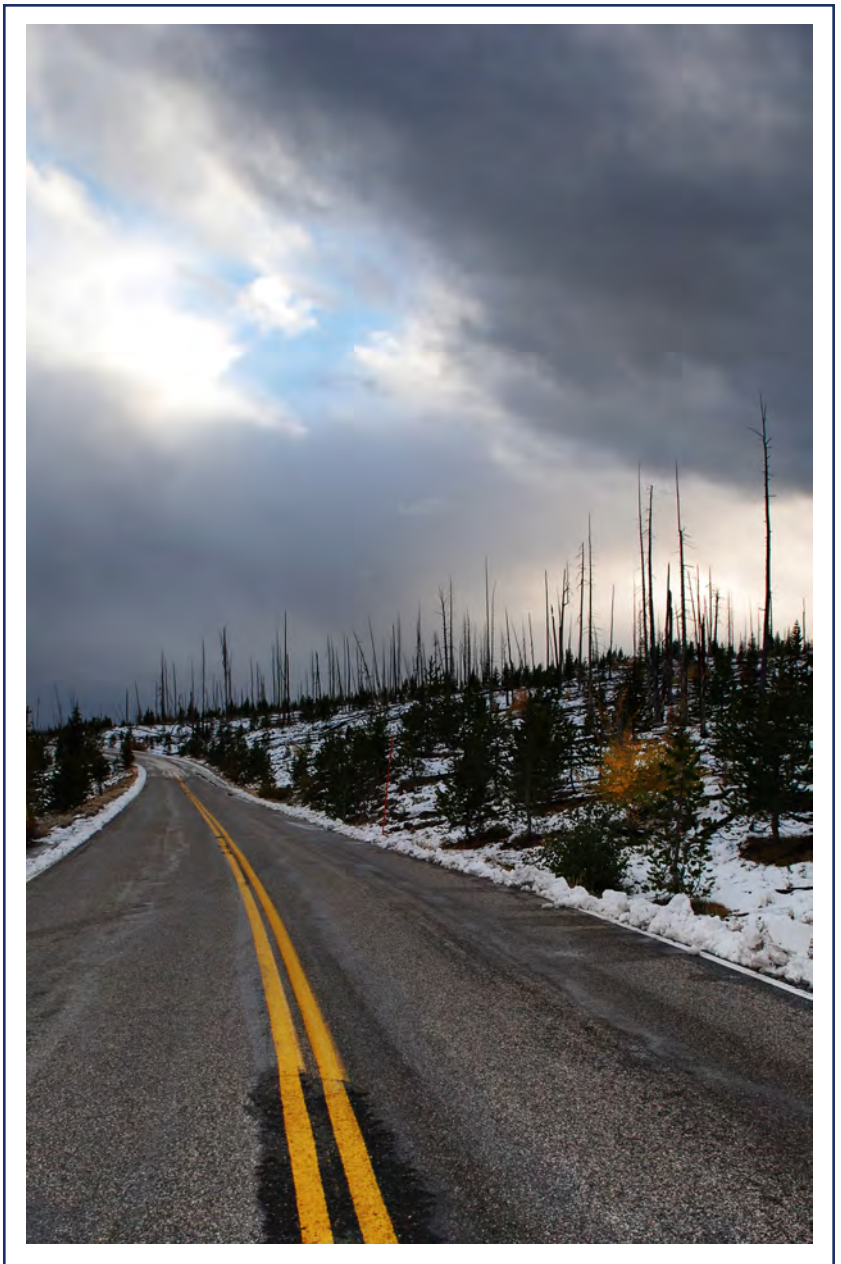
While WTI already takes advantage of several opportunities to directly address students about its mission, research activities, and research openings, efforts will be made to improve the effectiveness and number of these opportunities. In one such new program being consid-

ered, for example, WTI will co-host a group of students each semester from a freshman engineering dormitory for an evening of transportation-related presentations, demonstrations, and tours. This program was suggested by personnel from a student-staffed design unit of the Montana Department of Transportation that is co-located with WTI, and this group would co-host the events.

One of the best places to build relationships with students is directly in the classroom. WTI professional staff can enter the classroom through a variety of avenues, e.g., as team teachers, guest lecturers, etc. As WTI's visibility steadily increases on campus as a result of its research activities, such opportunities are also expected to increase. WTI will explore mechanisms to proactively create and pursue these opportunities. One such mechanism is to approach academic departments and colleges about co-sponsoring a series of WTI-delivered seminars that target the connection between WTI's research activities and student's academic interests.

Through the various strategies described above, WTI should successfully increase student involvement in its research activities. Correspondingly, the students' talent and enthusiasm will enrich WTI's research efforts, and some of these same students may well develop into the transportation research leaders of the future.





# Education

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*“To develop a multidisciplinary program of coursework and experiential learning that reinforces the transportation theme of the center.”*

## Education Program

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The Western Transportation Institute's Education Program deploys a variety of strategies to foster the flow of new professionals into the transportation workforce. A comprehensive K-12 outreach program exposes and excites primary and secondary school students to opportunities in the transportation field. Outreach efforts range from short hands-on workshops with second graders to multi-week intensive residential programs for high school students. Outreach programs are designed to spark interest in transportation issues, to enhance creative thought and problem-solving skills, and to encourage youth to consider transportation academic programs and careers.

Students who enter transportation track academic programs at Montana State University can choose from a growing core of available courses. A rich variety of research opportunities at the WTI supplement coursework by providing experiential learning opportunities. Student research involvement at both the undergraduate and graduate levels is a priority at WTI. Paid student research opportunities are supported through sponsored project work as well as undergraduate and graduate fel-

lowships supported by the UTC program.

WTI continues to support extracurricular activities that promote interest and excitement about the transportation field. Student chapters of professional organizations have the opportunity to participate in transportation-related research projects, to attend presentations and technical tours, and to travel on field trips. These activities serve to expose students from a broad range of academic disciplines to transportation technologies, applications, and careers. Travel to transportation professional meetings and conferences provides students with additional opportunities to learn about diverse transportation research efforts, to build relationships within the field that may aid in job placement, and to develop professional networking skills.

The combined initiatives of the Education Program are designed to ensure a steady flow of capable new professionals into the nation's transportation work force with the requisite skills demanded in this dynamic environment.

## Curriculum

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The Western Transportation Institute seeks creative ways to broaden the number and diversity of transportation course offerings. MSU has recently adopted a new core curriculum that requires undergraduates to have a substantial research experience as part of their undergraduate course work. In keeping with this philosophy, undergraduate fellowship recipients at WTI enrolled in independent research credits as part of their project requirements.

In Fall 2006, the Civil Engineering Department's transportation faculty expanded with the implementation of a new joint WTI research/Civil Engineering faculty position. The addition of new faculty in the

department has allowed for a greater variety of graduate transportation courses to be offered. In Spring 2007, two new graduate courses were offered: Traffic Flow Fundamentals and Road Ecology. Dr. Patrick McGowen (joint appointment, Civil Engineering Department and WTI) taught the Road Ecology course in partnership with landscape ecologist Dr. Dan Smith (WTI staff member). The course is the first of its kind and fuses principles from Civil Engineering, Ecology, and Environmental Science. The course will be offered in the future as an on-line course to broaden student enrollment. It is expected that the course will generate considerable interest among practicing transportation professionals.

## Student Research and Support

A primary goal of WTI's Education Program is to provide undergraduate and graduate students with substantive research experience on real world transportation problems. Over the past year, twenty-eight undergraduates and twenty-four graduate students, representing fif-

teen different academic disciplines, participated as paid research assistants at WTI. In all, students contributed research support on thirty-one different transportation projects. Student research contributions on various funded projects are outlined in the table below.

Student Research Project Involvement	Undergraduate	Graduate
ACRP Synthesis	1	
Advanced CMS		2
Aurora		1
Automated Cost Recovery	1	
Axial Capacity of Piles		1
Bozeman Pass Wildlife Channelization	1	
Comparative Analysis of Course Surfacing Aggregate Using Micro-Deval	1	
Cyclic Pullout Testing		1
Driving Simulator		1
Effect of Chloride-Based Deicers on Reinforced Concrete Structures	1	
Evaluation of the UDOT Weather Operations/RWIS Program		1
Experimental Assessment of Aggregates	1	1
Fish Passage	1	
Fredonyer Summit Evaluation (COATS Showcase)	3	
Gyratory Compactor Feasibility Study		1
Long-term Monitoring and DNA Approaches for Restoring Landscape		1
MANETS	1	3
MDSS		1
Moose-Wilson Transportation Assessment	3	
Optimal Sensor Placement	1	
Performance Measures for Two-Lane Highways		1
Redding Incident Management Responder	1	
Reinforced Native Grass Sod		2
Road Ecology Film		1
TMC-TMS Communications	1	2
TRAIL	3	
US Highway 89	2	
US Highway 93 Animal Crossing Evaluation		1
Validate Percent Wet Time Statewide		3
Validating the Durability of Corrosion-Resistant Mineral Admixture Concrete	2	
WSDOT Concrete Corrosion Study	4	

## Student Research Involvement *(continued)*

Two mechanisms are in place to financially support student research involvement at WTI: project-funded employment and UTC-funded fellowships. Undergraduate fellows participate in a year-long research project under the mentorship of professional research staff at WTI. The students develop a research work plan, produce a final technical report, and present their research findings at a student meeting. Two undergraduate fellowships were awarded during the 2006-2007 academic year. Michael Williams, a senior in Construction Engineering Technology, produced a report entitled Inventory of Culverts on Fish-Bearing Streams in the Pacific Northwest and Rocky Mountain States. Kevin Volkening, a freshman in Chemical Engineering, completed a project

evaluating alternative anti-icing and deicing compounds. A former undergraduate fellowship student, Matthew Reichert, co-authored the final project report submitted to the Washington State Department of Transportation: Transport of Chlorides and Inhibitors in Concrete: A Critical Review (December 2006).

The graduate fellowship provides a tuition waiver and monthly stipend to students pursuing advanced degrees on a transportation topic. The UTC program supported eleven graduate fellowship students from six different academic departments over the past year. Four fellowship students completed their graduate degrees. Thesis titles are provided in the table below.

Student	Degree	Thesis Title
Michael Browne	MS, Civil Engineering	Feasibility of Using a Gyratory Compactor to Determine Compaction Characteristics of Soil
Whisper Camel	MS, Ecology	Road & Land Cover Characteristics Affecting Deer Crossing & Mortality along the US 93 Corridor on the Flathead Reservation Montana
Lance Stott	MS, Plant Sciences	Determining the Suitability of Native Grasses Sod for Highway Revegetation
Nicholas Trimble	MS, Civil Engineering	Experimental Assessment of Aggregate Surface Materials

## Extracurricular Activities

WTI's Education Program supports a number of extracurricular activities designed to generate excitement and interest among students about transportation, create networking and career placement opportunities, and build professional skills. These activities include support for student chapters of transportation-related professional organizations, field trips, technical tours, professional conference travel, and opportunities for student chapter research involvement.

WTI offers small grants to student chapter organizations undertaking a transportation-related activity. This year, WTI sponsored the MSU Society of Automotive Engineers student chapter's participation in the Formula One race car competition. The students designed, built, and tested their Formula One car's performance at a regional competition held in California.

A new Intelligent Transportation Society – Rocky Mountain (ITS-RM) student chapter was formed at

MSU, bringing together students from diverse academic curriculums that share a common interest in advanced transportation technologies and applications. Student research assistants gave an overview of ITS related projects at WTI at the first ITS-RM organizational meeting. WTI sponsored a field trip to Las Vegas, Nevada, for seventeen ITS-RM members. The students visited private transportation providers, government agencies, and consulting firms. They met with transportation professionals, viewed state-of-the-art equipment, and learned about new opportunities in the field.

In addition to the Las Vegas field trip and technical tours, WTI further provided students with opportunities for professional networking by sponsoring student participation at a number of professional conferences. Student conference attendance is outlined in the table on the following page.



Date	Conference/Meeting/Tour	Student Attendance
January 2007	Transportation Research Board Annual Meeting; Washington, D.C.	3
February 2007	ITS-Rocky Mountain Student Chapter Technical Tour/Field Trip to Las Vegas, NV	17
May 2007	ITE Intermountain Section Meeting; Jackson, WY	6
June 2007	ITS America Annual Meeting; Palm Springs, CA	2
July 2007	ITE District 6 Meeting; Portland, OR	3

In order to expose a wider range of students to transportation research, WTI provided a research experience and fundraising opportunity to engineering student chapter organizations. Members of a variety of student chapters participated in a study being conducted by WTI on managing traffic congestion associated with special

events in small/rural communities. The students took traffic counts, conducted surveys, and completed a travel time study to assess the impact MSU football games have on congestion in Bozeman, Montana. Results from the study will be used to plan mitigation measures to improve traffic flow on game days.

## UTC Outstanding Student of the Year

Each year at the Transportation Research Board annual meeting in Washington, D.C., the U.S. Department of Transportation Research and Innovative Technologies Administration honors the most outstanding student from each University Transportation Center (UTC). The UTC Students of the Year are selected based on their accomplishments in research, academics, professionalism, and leadership. The Western Transportation Institute selected Katie O'Keefe as its Outstanding Student for 2006.

Katie O'Keefe is from Casper, Wyoming, and is currently a graduate student at Montana State University where she is pursuing a M.S. in Biomechanics. In December 2004, Katie earned a B.S. in Mechanical Engineering from Montana State University, graduating with honors. Shortly after graduating, she began working as a Research Assistant at WTI.

While at WTI, she has been actively involved with several major projects pertaining to Highway Winter Maintenance, including a report and brochure for the Pacific Northwest Snowfighters Association (Synthesis of Information on Anti-Icing and Pre-Wetting for Winter Highway Maintenance Practices in North America). For this project, she produced the final report and a paper

included in the proceedings CD of the Transportation Research Board (TRB) 2006 annual meeting, on both of which she was the first author. Katie also conducted a presentation on this topic at the TRB annual meeting, invited by the Winter Maintenance Committee.

Most recently, Katie has been a team member on a research project evaluating the Utah DOT Weather Operations Program. For this project, she has been responsible for numerous tasks, including the survey, literature review, technical writing, statistical data analysis, and interviews with hundreds of UDOT maintenance and construction personnel. She presented some of the preliminary findings at the National Rural ITS Conference in Big Sky, Montana, in July 2006, and she is a co-author of the final report and a journal paper being prepared for the ASCE Journal of Transportation Engineering.

"We are always impressed with Katie's work," said Dr. Xianming Shi, Program Manager for Winter Maintenance and Effects Research. "In addition to great communication skills, she demonstrates excellent analytical skills, transportation knowledge, and professionalism. I believe she will have a successful career in the transportation industry."

## Outreach

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WTI pursued a number of outreach initiatives designed to excite K-12 students about transportation career opportunities. Building interest among youth in transportation careers is critical to meeting future transportation workforce needs.

### Bridges and Dams Outreach

WTI partnered with the MSU Engineers Without Borders (EWB) student chapter to conduct two-hour workshops introducing elementary school students to the engineering profession. The workshops demonstrate engineering principles through hands-on exploration. EWB workshop facilitators were able to further spark the youngsters' imaginations by sharing information about an on-going chapter project at a school in Kenya. Eighty-two first through third graders participated in the workshops over the past year together with eighteen MSU student facilitators.

### National Engineering Week – Girl Scout Badge Day

For the third consecutive year, WTI sponsored Girl Scout Badge Day to advance the goals of "Introduce a Girl to Engineering Day," during National Engineers Week. Girl Scouts rotated through eight different activities demonstrating the various fields of engineering. WTI again partnered with MSU student chapter organizations to host the event.

## Job Placement

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Four graduate fellowship recipients completed their Masters degrees over the reporting period. Two of these students acquired positions with private engineering consulting firms and one student extended his research position with the Western Transportation Institute post graduation. Whisper Camel was a recipient of a joint fellowship appointment with the Wildlife Conservation Society and WTI aimed at increasing the representation of Native American students working in tribal agencies. Whisper's



### Expanding Your Horizons (EYH)

Expanding Your Horizons is a one-day event hosted by Montana State University each year to introduce middle-school-aged girls to careers in math and science. Seventh and eighth grade girls had an opportunity to learn about animal-vehicle detection systems and road ecology during the 2007 event. Participants learned the pros and cons of various roadkill mitigation measures and tested a few systems in a hands-on demonstration.

### Summer Transportation Institute (STI)

WTI hosted its third annual Summer Transportation Institute for high school students. The fifteen participants in this year's Institute lived on campus for the two-week program and learned about the transportation field through field trips, presentations by guest speakers and hands-on activities.

### Statewide Career and Education Events

WTI participated in a number of outreach events around the state to foster interest in transportation as a career opportunity and to share information about education opportunities in transportation at MSU. Events included a career fair for middle and high school girls in Miles City, Montana, as well as an education day booth at the Lewistown, Montana, winter fair.

research focused on pre-construction analysis of wildlife crossings on US Highway 93. After completing her thesis this year, Whisper began work as a tribal biologist for the Confederated Salish and Kootenai reservation. Her duties will include post-construction evaluation of wildlife mitigation measures implemented during the US Highway 93 expansion project.

## Student Success Stories

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Positive and lasting relationships are built with WTI during a student's tenure at the institute. Alumni from the WTI continue to support student programs and activities at Montana State University after graduation. Three former Research Experience for Undergraduates (REU) participants have returned to MSU and WTI to pursue graduate degrees. Former graduate fellowship recipient and 2004 UTC Student of the Year award recipient Brandy Sularz took time from her current position as a transportation consultant at DKS Associates in

Portland, Oregon, to visit MSU. She gave a presentation to the Institute of Transportation Engineers (ITE) student chapter on The South Corridor Project: Portland to Milwaukie Light Rail. Former WTI graduate fellowship recipient Danielle Reagor, a consultant at Engineering, Inc. in Billings, Montana, will provide a guest lecture to the undergraduate transportation engineering class during the Fall 2007 semester. Danielle also serves on the advisory board for the Summer Transportation Institute program.

## Education Initiatives for 2008

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Over the next year, WTI will continue to seek creative ways to leverage UTC funds to expand and diversify K-12 outreach, student-based programs, and continuing edu-

cation opportunities for professionals. Notably relative to professional outreach and curriculum development, WTI will continue to expand its activities in the emerging field of road ecology. In 2008, streaming video from a road ecology workshop held at WTI in March 2007 will be made available on-line for professionals. The video highlights mitigation tools for wildlife-vehicle collisions, design protocols to improve fish passage beneath roadways, and information on data collection issues and new technologies. In fall 2008, the graduate Road Ecology seminar will be offered as an on-line course to expand enrollment opportunities beyond MSU students.



cation opportunities for professionals. Notably relative to professional outreach and curriculum development, WTI will continue to expand its activities in the emerging field of road ecology. In 2008, streaming video from





# Technology Transfer

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*“Increasing availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.”*

## Technology Transfer Program

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WTI's technology transfer program is designed to support and bolster the efforts of the USDOT in its mission of “efficient use and conservation of resources” by sharing research results quickly and to the widest possible audience. Cutting edge research as well as outstanding educational opportunities and programs lose their effectiveness if appropriate and expedient dissemination of information does not take place. In short, timely transfer of this information accelerates the advancement of transportation knowledge and minimizes redundancy of research efforts. In a larger sense, effective technology transfer puts transportation improvements into practice more quickly, which will help the USDOT achieve its long-term strategic goals of enhanced safety, mobility, global connectivity, environmental protection and security.

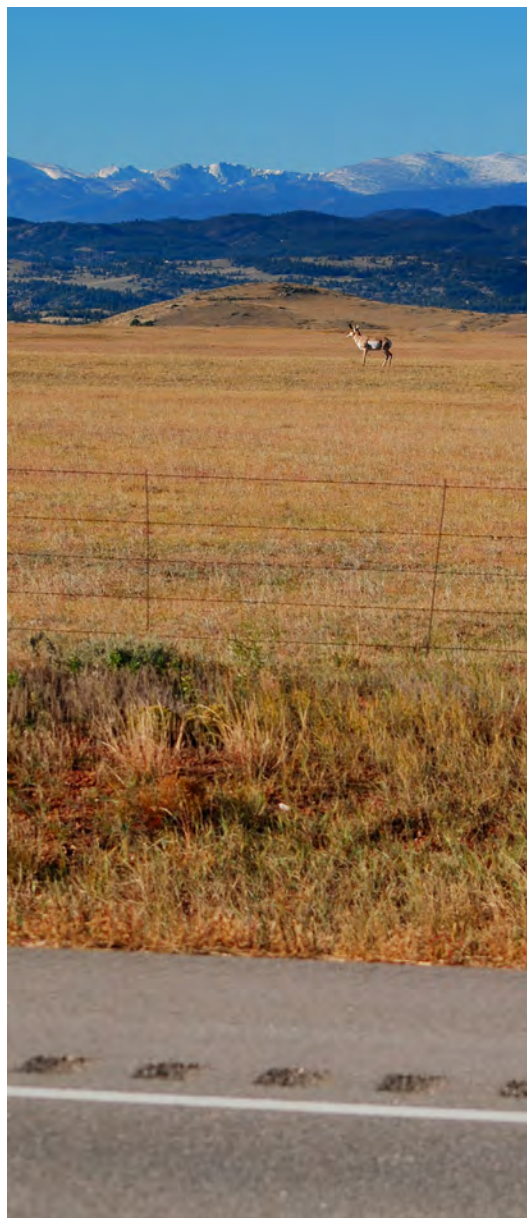
To these ends, the general objectives within the technology transfer program are as follows.

- Increase the national visibility of WTI's technology transfer activities to reach the widest possible audience.
- Increase the availability and speed at which WTI's research results are disseminated.
- Improve the quality of technology transfer activities conducted.

Over the course of the past year, WTI has served as a leading national resource for information on rural

transportation issues. WTI's director testified at a field meeting of the National Surface Transportation Policy and Revenue Study Commission regarding the importance of rural issues, research staff gave 55 presentations at conferences and workshops (see page 37) and hosted five workshops for three hundred seventy-one attendees (see next page).

WTI is committed to exploring new methods to disseminate results quickly and researched the methodology and feasibility of launching a rural transportation clearinghouse as well as hosting a rural transportation blog (see page 44). More traditional methods of information dissemination such as the semi-annual newsletter and website continue to be successful, with consistent growth in readership. In addition, a research project on the Utah Department of Transportation Weather Operations/RWIS Program received a national award at the ITS America Annual Meeting, and a video about the Redding Responder project in California was featured at the Association of Public Safety Officials International Conference, both of which informed new audiences about WTI's research results (see page 24). WTI is proud of the growing national interest in our research and will continue to look for new opportunities to showcase it.





## Conferences and Workshops

Throughout the year, WTI initiates, coordinates, and sponsors conferences and workshops in a variety of formats and sizes, in order to reach a broad range of professionals with an interest in the advancement of transportation research.

### National Winter Maintenance Peer Exchange

WTI recognizes the future of transportation involves the decline of the highway trust fund which will put greater emphasis on how we maintain and operate roadways. Approximately forty states in the United States have to support some level of winter maintenance activities. In these states, winter maintenance is emerging as the new “hot topic” in transportation research. On a largely regional basis, transportation agencies are commissioning pooled fund studies and other collaborative efforts to study new technologies and advancements related to snow and ice removal materials, equipment, methods, and weather forecasting. However, it is unclear whether the findings from these various groups are reaching transportation professionals outside of the regions where the studies are being conducted, or whether the research needs of all states are being addressed.

The National Winter Maintenance Peer Exchange convened for the first time this summer to improve information sharing and research coordination among all states. The forum was sponsored by many of the entities actively involved in winter maintenance research issues, including the Aurora Pooled Fund, Center for Transportation Research and Education (CTRE) at Iowa State University, Clear Roads Pooled Fund, Federal Highway Administration, the Pacific Northwest Snowfighters Association (PNS), the Snow and Ice Pooled Fund Cooperative Program (SICOP) and WTI. Dennis Burkheimer, a Winter Operations Administrator who represents Iowa DOT on the Clear Roads Technical Advisory Committee, co-chaired the conference with Lee Smithson, the Coordinator of the Snow and Ice Pooled Fund Cooperative Program under AASHTO, and Diana Clonch, Snow and Ice Coordinator for the Ohio DOT.

To bridge the communication gap between research organizations and states, organizers invited up to two representatives from the department of transportation in every state. The two-day event featured a variety of forums designed to identify the most critical issues in winter maintenance.

The event opened with presentations by a number of the partner agencies. Representatives from Clear Roads,

Aurora, PNS, FHWA, and SICOP shared findings from their latest research and initiatives, such as Road Weather Information Systems, evaluation of anti-icing and deicing products, Ground Speed Control systems, Maintenance Decision Support Systems and Clarus. Also introduced at the Peer Exchange was a new national winter driver safety initiative, “Ice and Snow...Take it Slow” that all states were encouraged to consider for their winter media efforts.

The core of the conference was a series of roundtable discussions, in which the states were encouraged to describe their winter maintenance needs and suggest topics for future research. To focus the discussion, the roundtables were organized around four tracks. Facilitators from WTI and moderators from state and federal transportation agencies helped to lead and document the exchange of ideas. On the second day, participants voted on the research needs that they believed were most important to their state maintenance operations. In the final session, they had the chance to comment on the results of the voting and on suggested next steps. In another unique aspect of this conference, vendors were invited to participate in this discussion, so they could hear about challenges that need to be addressed.

Response to the event was enthusiastic and positive. Thirty-five states plus Washington D.C. sent representatives; together they identified and prioritized seventy research problem statements. Forum sponsors continue to work on organizing and documenting these priorities. All participants expressed a strong interest in making the forum an annual event.

### Non-Profit Conservationists and Transportation: New Intersections Workshop

Transportation professionals, road ecologists and conservation biologists met at Montana State University, March 28-30, 2007, to learn about the latest in highway wildlife mitigation science, successes in public-private partnerships, and recent innovations in road ecology. The twenty-six workshop presenters included:

- Six research scientists and ecologists from WTI's Road Ecology program;
- Dr. Jodi Hilty of the Wildlife Conservation Society, lead author of the recently published book, “Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation”;
- Dr. Richard T.T. Forman, Harvard Professor, founder of the science of Road Ecology, and lead co-author of “Road Ecology: Science and Solutions.”

## Conferences and Workshops *(continued)*

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Conservation and agency professionals shared examples of successful public-private partnerships in Montana, Colorado, Washington, and British Columbia; innovations in road ecology; and guidance on how to participate in transportation projects and planning. Participants also went on a field trip to view a mitigation project on Interstate Highway 90 at Bozeman Pass.

The primary objective for holding the road ecology workshop was to help improve working relationships between state transportation departments and other organizations, such as other state and federal agencies, NGOs, and citizens groups. In particular, the presentations were targeted at those agencies with less experience in transportation and road ecology, in order to help them learn how to productively interact with highway departments. Four presentations emphasized the success of partnerships between state transportation departments and other institutions. Another set of presentations by road ecologists from WTI discussed the toolbox of mitigation measures used to reduce wildlife conflicts with road development. This toolbox is important because not all transportation departments have the resources to consider high-cost solutions such as wildlife overpasses. It is hoped that educating conservationists on a range of less costly solutions such as retrofitting and signage to alter driver behavior will lead to better relationships with highway departments. Well-informed conservationists can ask for more cost-effective solutions where appropriate. The seventy-five participants included volunteer activists, non-profit conservation staff, consultants, university researchers/professors, and agency biologists and planners.

### **Mitigating Transportation Impacts on Wildlife and Fisheries Training Course**

A two-day workshop for Canadian transportation engineers on the principles and techniques for mitigating highways impacts on wildlife and fisheries was held on October 12-13, 2006, at the Banff Centre. A total of twenty-three transportation engineers primarily from Canada took part. The workshop included a field trip to sequential twinning projects on 75 km of the Trans-Canada Highway in the Banff-Bow Valley, Alberta as well as the current expansion project (phase 3B) near Lake Louise. The course was designed to provide decision makers and transportation professionals field-based knowledge and information on guiding principles for planning, designing, evaluating and maintaining mitigation

measures aimed at reducing animal-vehicle collisions and increasing habitat connectivity for wildlife and fisheries. The workshop brought science and solutions together, described general guidelines used in the planning process, information needs, and practical applications of current state of the art mitigation measures.

### **Making Sense of Sensors Used to Monitor Bridges**

The Dynamics and Field Testing of Bridges Committee of the Transportation Research Board identified a need for its members to better understand how active instrumentation in bridge structures can be properly used and how the data can be interpreted and applied. Consequently, Jerry Stephens, Eli Cuelho and Michelle Akin of WTI developed and moderated a half-day seminar entitled "Making Sense of Sensors Used to Monitor Bridges" as part of the Transportation Research Board annual meeting in Washington, D.C. in January 2007. The workshop provided bridge owners, designers, practitioners and researchers with basic information to develop an instrumentation plan, select sensor technologies, install and maintain sensors, and collect and analyze data. The presentations were made by national experts in the field and included examples of instrumentation projects and extensive technical guidance. By coordinating the event with the TRB meeting, organizers were able to present detailed information on the latest in bridge sensor technologies to 105 transportation practitioners from around the country.

### **Geosynthetics in Roadway Systems**

MSU Engineering Professor and WTI Researcher Steve Perkins served as one of two instructors for an eight-hour short course entitled "Geosynthetics in Roadway Systems" taught in January, 2007, in Washington D.C. The course was taught as a workshop preceding the Geosynthetics Conference 2007 and the Transportation Research Board Annual Meeting. The course reviewed material selection guidelines and design methods for a wide range of geosynthetic materials, which can be used in the construction of roads, airport runways, bridges and related structures, as well as for reinforcement of soil foundations. As a professional development course, participants had the opportunity to receive continuing education credits for completing the class. Approximately thirty-five students consisting of consulting engineers, FHWA and state DOT personnel, USFS personnel and contractors attended the course.

### **International Conference on Ecology and Transportation**

WTI was a sponsor for the International Conference on Ecology and Transportation (ICOET) held May 20 – 25, 2007 in Little Rock, Arkansas. This year's focus was "Bridging The Gaps Naturally" and sought to "identify and share quality research applications and best management practices that address wildlife, habitat, and ecosystem issues related to the delivery of surface transportation systems." Several road ecology research staff members made presentations. This is the third ICOET conference for which WTI has provided sponsorship funds. WTI's support is generally used to broaden dissemination of research findings presented at ICOET. As road ecology is a relatively new field of study in the U.S. as compared to other nations, this sponsorship helps disseminate the latest international research findings to state DOTs on issues such as animal-vehicle collision mitigation techniques and context-sensitive design.

### **IEEE Professional Skills Workshop**

IEEE Montana Section Chair and WTI Program Manager Doug Galarus coordinated a presentation at Montana State University by independent consultant Carl Selinger, Contributing Editor of IEEE's Spectrum Magazine. The seminar, entitled "Stuff You Don't Learn in Engineering School: Skills for Success in the Real World," was aimed at engineering students and young professionals. It was a light-hearted discussion of the importance of non-technical soft skills such as running meetings, listening better, leading teams, dealing with stress, and having fun at work. The workshop complements WTI's education program activities, which provide engineering students with research experience that can prepare them for careers in transportation and related fields.

## **Peer Reviewed Publications**

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### **Tony Clevenger**

Clevenger, Anthony P., and Jack Wierzchowski. "Maintaining and Restoring Connectivity in Landscapes Fragmented by Roads." In *Maintaining Connections for Nature*, edited by Kevin R. Crooks and M. Sanjayan, 502-35. Cambridge: Cambridge University Press, 2006.

### **Eli Cuelho**

Cuelho, Eli, R. Mokwa and M. Akin. "Quantifying the Benefits of Flexible Pavement Preventive Maintenance Techniques: A Synthesis and Survey." In *Proceedings: Fifth International Conference on Maintenance and Rehabilitation of Pavements and Technological Control*. Park City, Utah. August 2007.

### **Laura Fay**

Fay, Laura and M.S. Gustin. "Assessing the Influence of Different Atmospheric and Soil Mercury Concentrations on Foliar Mercury Concentrations." *Water, Air and Soil Pollution* 181 (May 2007): 373-384.

### **Amanda Hardy**

Hardy, Amanda R., S. Lee, and A. F. Al-Kaisy. "Effectiveness of Animal Advisory Messages as a Speed Reduction Tool: A Case Study in Montana." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1973 (2006): 64-72.

Borkowski, J. J., P. J. White, R. A. Garrott, T. Davis, A. R. Hardy, and D. J. Reinhart. 2006. "Behavioral Responses of Bison and Elk in Yellowstone to Snowmobiles and Snow Coaches." *Ecological Applications* 16, no. 5: 1911-1925.

### **Marcel Huijser**

Huijser, Marcel P., and A. P. Clevenger. "Habitat and Corridor Function of Rights-of-Ways." Chap. 11 in *The Ecology of Transportation: Managing Mobility for the Environment*, edited by John Davenport and Julia L. Davenport. London: Springer, 2006.

**Mike Kelly**

Kelly, Mike, S. Lassacher and L. M. Stanley. "Formative Evaluation of Engineering Designs Using Driver Performance in an Immersive Driving Simulator." In *Proceedings of the Fourth International Symposium on Driver Assessment, Training, and Vehicle Design*. University of Iowa. Iowa City, Iowa. June 2007.

Kelly, Mike, and S. Lassacher. "Simulation and Rapid Prototyping to Support Deployment of Advanced Crash Avoidance Systems." In *Proceedings of the TRB Visualization in Transportation Symposium*. Denver. October 2006.

**Robert Long**

Long, Robert A., T. M. Donovan, P. MacKay, W. J. Zielinski, and J. S. Buzas. "Comparing Scat Detection Dogs, Cameras, and Hair Snares for Surveying Carnivores." *Journal of Wildlife Management* 71 (2007): 2018–2025.

Long, Robert A., T. M. Donovan, P. MacKay, W. J. Zielinski, and J. S. Buzas. "Effectiveness of Scat Detection Dogs for Detecting Forest Carnivores." *Journal of Wildlife Management* 71 (2007): 2007–2017.

**Pat McGowen**

McGowen, Patrick, and M. McNally. February 2007. "Evaluating the Potential to Predict Activity Types from GPS and GIS Data." Paper presented at the annual meeting of the Western Regional Science Association, Newport Beach, Calif.

McGowen, Patrick, and M. McNally. January 2007. "Predicting Activity Types from GPS and GIS Data." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

**Tongyan Pan**

Pan, Tongyan, and E. Tutumluer. 2007. "Permanent Deformation and Strength Characterization of Unbound Gravel Blended with Crushed Aggregate." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

**Steve Perkins**

Perkins, Steve W. and E. V. Cuelho. "Mechanistic-Empirical Design Model Predictions for Base-Reinforced Pavements." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1989 (2007): 121-128.

Perkins, Steve W. and E. V. Cuelho. 2007. "Pavement Response Model for Base-Reinforced Flexible Pavements." Paper presented at Conference on Advanced Characterization of Pavement and Soil Engineering Materials, Athens, Greece.

**Xianming Shi**

Shi, Xianming, N. El Ferradi, and C. Strong. 2007. "Fixed Automated Spray Technology for Winter Maintenance: The State of the Practice in North America." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

Shi, Xianming, R. Larson, C. Strong, D. W. Kack, E. V. Cuelho, L. Fay, N. El Ferradi, A. Seshadri and K. O'Keefe. 2007. "Vehicle-Based Sensor Technologies for Winter Maintenance: A Critical Review." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

Strong, C., N. El Ferradi and X. Shi. 2007. "State of The Practice of Automatic Vehicle Location for Winter Maintenance Operations." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

Nguyen, T.A., Y. Lu, S. Song and X. Shi. "Carbon and Steel Surfaces Modified by *Leptothrix discophora* SP-6: Characterization and Implications." In *Proceedings of the Materials Research Society Spring Meeting and Exhibit 'The Nature of Design: Utilizing Biology's Portfolio'*. Volume 1008E, Paper Number 1008-T05-10. San Francisco, Calif. April 9-13, 2007.

**Laura Stanley**

Stanley, Laura, A. R. Hardy and S. Lassacher. "Driver Responses to Enhanced Wildlife Advisories in a Simulated Environment." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1980 (2006): 126-133.



Stanley, Laura, M. J. Kelly and R. J. Marley. "Haptic and Auditory Cues for Roadway Departure Warnings." In Proceedings of the Human Factors and Ergonomics Society Annual Meeting. San Francisco. October 2006.

### **Chris Strong**

Strong, Chris, N. El Ferradi and X. Shi. 2007. "State of The Practice of Automatic Vehicle Location for Winter Maintenance Operations." Paper presented at the annual meeting of the Transportation Research Board, Washington D.C.

## **Presentations**

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### **Michelle Akin**

- "Development of Lewistown Research Facility," Lewistown Rotary Club Meeting, Lewistown, MT, 2/26/2007

### **Steve Albert**

- "Use of Technology and its Role in Addressing Future Transportation Needs and Meeting the Bottom Line," ITD Project Development Conference, Boise, ID, 4/4/2007
- "Meeting Rural Transportation Needs," National Surface Transportation Policy & Revenue Study, Minneapolis, MN, 4/17/2007
- "Rural Transportation Clearinghouse," ITS America's 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/3/2007

### **Rob Ament**

- "WTT's Road Ecology Program: Past, Present, Future," MDT Briefing on WTT's Road Ecology Program, Helena, MT, 1/19/2007

### **Matt Blank**

- "Engineering Considerations for Fish Passage at Bridges and Culverts," Mitigating Transportation Impacts on Wildlife and Fisheries Training Course, Banff, Canada, 10/12/2006

### **Anthony Clevenger**

- "Existing and Future Projects with WTT," Y2Y Non-Profit and Transportation Workshop, Bozeman, MT, 3/26/2007
- "The Long-term Research in Banff National Park and Lessons Learned That Will Be of Value for the I-90 project," WSDOT I-90 meeting, Yakima, WA, 2/6/2007

Strong, Chris and Y. Shvetsov. "Development of Roadway Weather Severity Index." Transportation Research Record: Journal of the Transportation Research Board, No. 1948 (2006): 161-169.

- "Road Mitigation Techniques for Large Animals: Environmental Treatment of Infrastructure," El Escorial, Spain, 7/16/2007
- "Applications of Local Scale Research for Planning and Evaluating Measures Designed to Restore Regional Landscape Connectivity," 2007 International Conference on Ecology and Transportation, Little Rock, AR, 5/20/2007

### **Eli Cuelho**

- "Installing Lead Wires and Strain Gauges on Geosynthetics," UTC-FHWA Infrastructure meeting, Norfolk, VA, 6/26/2007
- "Qualifying the Benefits of Flexibility Pavements Preventative Maintenance Techniques: A Synthesis and Survey," 5th International Conference on Maintenance and Rehab of Pavement, Park City, UT, 8/8/2007
- "Making Sense of Sensors Used to Monitor Bridges," 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007

### **Laura Fay**

- "Inhibitor Longevity and Deicer Performance Study," PNS Pooled Fund Meeting, Seattle, WA, 8/13/2007

### **Douglas Galarus**

- Poster Session: "Computing and Communication in the Middle of Nowhere," 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007
- WeatherShare Project: "Aggregation and Dissemination of Weather Information for Public Safety," ITS America's 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/1/2007

## Presentations *continued*

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- “Redding Responder: Computing & Communication in the Middle of Nowhere,” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/1/2007
- “Redding Responder: Computing & Communication in the Middle of Nowhere (Poster Session),” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/1/2007
- Promotional Video which highlights the Redding Responder Project, APCO 73rd Annual Conference & Expo 2007, Baltimore, MD, 8/4/2007

### **Susan Gallagher**

- Animal Detection Systems Demonstration, 4-H Youth Education Fair, Lewistown, MT, 1/25/2007

### **Amanda Hardy**

- “Developing the Integrated Transportation and Ecological Enhancements for Montana (ITEEM) Process: Applying the Ecological Approach,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/22/2007
- “An Assessment of Road Impacts on Wildlife in U.S. National Parks,” George Wright Society Meeting: Rethinking Protected Areas, St. Paul, MN 4/16/2007
- “Behavioral Responses of Bison & Elk to Over-snow Vehicles in Yellowstone National Park,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/22/2007

### **Marcel Huijser**

- “Animal-vehicle Collision Data Collection Throughout the United States and Canada,” 2007 International Conference on Ecology and Transportation, Little Rock, AR, 5/20/2007
- “Motorist Safety and Wildlife-Vehicle Collision Reduction Measures,” Road Ecology Workshop, Bozeman, MT, 3/28/2007
- “Motorist Safety and Wildlife-vehicle Collision Reduction Measures,” Mitigating Transportation Impacts on Wildlife and Fisheries Training Course, Banff, Canada, 10/12/2006

### **Bill Jameson**

- “700 MHz CALTRANS, 700 MHz Coverage,” Region 25 700 MHz Committee Meeting, Helena, MT, 2/20/2007

### **David Kack**

- “Planning and Implementing a Public Transportation System in Bozeman, MT,” 17th National TRB Rural Public and Intercity Bus Conference, Portland, OR, 10/22/2006

### **Mike Kelly**

- “Formative Evaluation of Engineering Designs Using Driver Performance in an Immersive Driving Simulator,” 4th International Driving Symposium on Human Factors Conference, Stevenson, WA, 7/9/2007
- “Immersive Driving Simulation and Visualization as an ITS Design Tool,” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/3/2007

### **Angela Kociolek**

- “Highway Median Impacts on Wildlife Movement & Mortality” (Poster Session), 2007 International Conference on Ecology and Transportation, Little Rock, AR, 5/21/2007
- Animal Detection Systems Demonstration, 4-H Youth Education Fair, Lewistown, MT, 1/25/2007

### **Justin Krohn**

- “Redding Responder: Communication in the Middle of Nowhere,” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 5/29/2007

### **Pat McGowen**

- “Evaluating the Potential to Predict Activity Types from GPS & GIS Data,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007
- “Studying Travel Patterns in National Parks,” ITE District 6 Meeting, Portland, OR, 8/14/2007
- “Evaluating the Potential to Predict Activity Types from GPS and GIS Data,” Western Regional Science Association Conference, Newport Beach, CA, 2/21/2007

### **Tongyan Pan**

- “Permanent Deformation and Strength Characteristics of Crushed Aggregate Blended with Gravel,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007

### **Michael Sawaya**

- “Measuring Gene Flow and Population Level Benefits of Wildlife Crossing Structures for Grizzly and Black Bears in Banff National Park” (poster presentation), 2007 International Conference on Ecology and Transportation, Little Rock, AR, 5/21/2007

**Gary Schoep**

- “Redding Responder: Communication in the Middle of Nowhere,” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 5/29/2007

**Jeff Sharkey**

- “Redding Responder: Communications in the Middle of Nowhere,” ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 5/29/2007

**Xianming Shi**

- “Inhibitor Longevity and Deicer Performance Study: A Draft Proposal for the PNS Pooled Fund,” Pacific Northwest Snowfighters Association, Coeur d’Alene, ID, 6/3/2007
- “Developing Anti-icing Liquids with Montana Agricultural Byproducts,” Montana Board of Commercialization and Research Transfer, Billings, MT, 5/31/2007
- “Fixed Automated Spray Technology for Winter Maintenance: The State of the Practice in North America,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007
- “Research & Partnerships at the Corrosion, Electrochemistry and Analysis Laboratory,” Caltrans Project Kick-off Meeting, Sacramento, CA, 2/21/2007
- “Based Sensor Technologies for Winter Maintenance: A Critical Review,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/21/2007
- “Impact of Airport Pavement Deicing Products on Aircraft & Airfield Infrastructure,” 16th Annual AAAE Aircraft and Airfield Deicing and Storm Conference, Baltimore, MD, 8/5/2007
- “Carbon & Steel Surfaces Modified by Leptothrox discophora SP-6,” Material Research Society Spring Meeting, San Francisco, CA, 4/10/2007

**Jerry Stephens**

- “Making Sense of Sensors Used to Monitor Bridges,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/20/2007

**Chris Strong**

- “Analysis of MDSS Benefits and Costs, MDSS Pooled-Fund Study meeting,” Sioux Falls, SD, 10/2/2006
- “Safety Evaluation of Yield-to-Pedestrian Channelizing Devices,” ITE Luncheon, Helena, MT, 7/10/2007
- “State-of-the-Practice of Automatic Vehicle Location for Winter Maintenance Operations,” 86th Annual Transportation Research Board Meeting, Washington, DC, 1/19/2007
- “Safety Evaluation of Yield-to-Pedestrian Channelizing Devices,” 2006 Transportation Engineering & Safety Conference, State College, PA, 12/5/2006
- “Evaluation of the Golden Gate National Recreation Area ITS Pilot Project” (Poster Session), ITS America’s 2007 Annual Meeting and Exposition, Palm Springs, CA, 6/3/2007
- “ITS applications in Rural California,” ITS California Annual Meeting, Sacramento, CA, 1/14/2006
- “Big Ideas Discussion for COATS,” COATS Phase 3 Working Group Meeting, Yreka, CA, 11/13/2006

## Website

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The WTI website is a cornerstone of the Technology Transfer program, as it allows interested parties from anywhere across the country, or internationally, to access the latest information about our research. As such, WTI takes a pro-active approach to continually improve and enhance the website in order to deliver research results quickly and efficiently to the widest possible audience.

Over the past year, the Technology Transfer staff initiated a major site improvement project to upgrade the project database, which drives a majority of the WTI web pages, from a MS Access database to a MS SQL Database. The primary benefit of the upgrade is increased accuracy for users who are searching the WTI website for specific projects or information. Information technology staff members also purchased and configured a new web server, and are conducting final troubleshooting and implementation. The new server was necessary to power the upgraded database; an added benefit will be faster compilation of search results for users.

In the UTC Strategic Plan, WTI identified two opportunities to improve the electronic transfer of research into practice by creating new tools that facilitate partnership and collaboration. The two initiatives are the development of a clearinghouse relating to rural transportation issues, as well as a rural ITS blog. Several preliminary steps were taken this year toward development of the clearinghouse. Technology transfer program staff members selected and contracted the InMagic software company to develop the database and web interface that will support the clearinghouse. WTI's Director and Assistant Director for Communications also conducted two steering committee meetings (via teleconference) with

representatives from state DOTs, FHWA, and the private sector. The two steering committee teleconferences determined that the clearinghouse would be beneficial; however, participants also identified some very realistic constraints. These include the logistics of obtaining research reports in an automated fashion when those reports are saved behind state DOT firewalls, as well as securing copyright permissions for documents made available on the clearinghouse. In addition, ongoing delays by the software vendor have delayed the project. Before proceeding with the next steps to develop this clearinghouse, WTI and other stakeholders must determine the best course of action with the software vendor, and complete a survey of similar efforts to avoid duplicity with other planned projects by organizations such as the National Transportation Library.

The goal of the rural ITS blog is to provide an easy-to-use communication tool for the entire rural ITS community, which would facilitate ongoing dialogue, continual networking, and rapid exchange of information. This year, WTI investigated the requirements for developing and maintaining an accurate and content-rich blog. At this time, we concluded that we do not have the staffing and technical resources necessary to create and monitor a meaningful blog, without negatively impacting the quality of our fundamental transportation research. However, WTI will continue to work with the rural ITS community to explore this idea and similar efforts that promote new venues for communication.



## Newsletters

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The WTI newsletter was published in April and September 2007 to inform readers about our latest research, education and technology transfer activities. Both editions (as well as previous newsletters) can be downloaded as PDF files from [http://www.coe.montana.edu/wti/tech\\_transfer/newsletter.html](http://www.coe.montana.edu/wti/tech_transfer/newsletter.html). The newsletter was sent to approximately 2,531 readers.

### **The April 2007 WTI Newsletter included these articles**

- Moving Transportation Forward – Across the Country and in Our Own Backyard
- WTI to Create Public Transit Business Plan for Grand Teton National Park
- WTI and MSU Work to Improve Rural Emergency Communication
- Saving America's Highways, One Concrete Block at a Time
- Do Drivers Respond to Yield to Pedestrian Signs?
- Controller Will Help Automate ITS Operations in Northern California
- Creating a Toolbox of Wildlife-Highway Crossing Mitigation Measures for the Montana Department of Transportation
- New Telecommunications Technologies Investigated for Remote Areas of California
- WTI to Establish Accelerated Method to Assess the Durability of Mineral Admixture Concretes
- Maintenance Decision Support System to be Analyzed for South Dakota
- Three States and National Park to Field Test New Tool to Record Animal-Vehicle Collision Data
- An Innovative Coating System for the Corrosion Prevention of Galvanized Steel
- Tradition of Leadership Moves Rural Transportation Forward
- Road Ecology Course Debuts at MSU
- Students Explore Opportunities in Transportation in Las Vegas, Nevada
- Katie O'Keefe Selected as "Student of the Year"
- Education Outreach: K-12 Activities

### **The September 2007 WTI Newsletter included these articles**

- Westward Go! Demographic Trends Have Huge Impact on Transportation in Western States
- Diverse Partnership Nurtures Development at Lewistown Facility
- Promoting Use of Bicycles on Federal Lands
- US 93 Field Study Collects Key Wildlife Crossing and Collision Data
- UDOT Weather Operations/RWIS Evaluation Receives National Award
- Impacts of Barriers on Topeka Shiner Populations
- Keeping an Eye on the Weather: Assessing RWIS Network in Alaska
- WTI Holds Key to Improving Traffic Flow After Large Events
- WTI Sponsors SAE Formula West Competition Car
- Popular Summer Program Promotes "Hands-On" Learning
- WTI Director Named to National Transportation Advisory Panel
- Come In From the Cold: States Convene to Prioritize Research
- Redding Responder Video Sponsored at International Conference

## Technology Transfer Success Story

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With our unique understanding of rural transportation challenges and solutions, WTI can lead technology transfer activities that make an important contribution to national transportation policy and practice. In this regard, WTI can work to ensure that rural perspectives and needs are incorporated into federal planning, initiatives and funding packages. WTI can also effectively lead research projects on rural issues that have an impact on the country as a whole.

As an example of the first case, WTI Director Steve Albert has this year participated actively in national level discussions of the future of the U.S. transportation system. In April, he was invited to testify at a hearing of the National Surface Transportation Policy & Revenue Study Commission chaired by U.S. Transportation Secretary Mary Peters, where he presented many examples of how improving the rural transportation infrastructure is essential to ensuring safe and seamless national travel, promoting efficient movement of freight, and protecting national security. As a result of this and other outreach activities this year, Secretary Peters recently selected Albert to serve on the Intelligent Transportation Systems (ITS) Advisory Committee, where he will have the

opportunity to review and make recommendations on the USDOT, as well as on ITS research under consideration for funding, further ensuring that rural needs are taken into account.

As an example of the second case, WTI was selected to conduct the Wildlife Vehicle Collision Reduction Study for the Federal Highway Administration. Formerly considered a “rural” issue, the recent highway reauthorization bill (SAFETEA-LU) acknowledged the increasing number of animal-vehicle collisions throughout the country and their impact on both safety and environmental stewardship. With WTI’s extensive experience in the field of road ecology in general, and animal-vehicle mitigation in particular, we are uniquely qualified to identify key issues, synthesize the body of research, and prepare recommendations that will be useful to Congress, other policy makers, and transportation practitioners. This year, WTI completed the full study, which will be the basis for additional technology transfer products, including an overview for policy makers, and training presentations and materials for practitioners.

## Initiatives For 2008

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The technology transfer initiatives for 2008 will focus on two efforts to get research results into the hands of users more quickly. Both efforts will build on the foundation of successful WTI technology transfer tools, with enhancements that will give users faster access to additional or updated information.

The first initiative will be to develop an electronic format of the WTI newsletter. The newsletter is currently distributed in hard copy to research partners and other interested agencies, and a static PDF version can be read on the website. The new electronic format will allow for the addition of live web links to guide interested readers to more comprehensive and up-to-date information. For example, an article describing a research project could contain a link to a full project description, photos, video clips, and reports.

Through the second initiative, WTI will upgrade the program area pages on the website so that research staff

members will be able to individually maintain the web pages pertaining to their research. Research staff will be able to post new information immediately rather than waiting for the content to be uploaded by an administrative staff member. As researchers will have an expanded, first-hand role in the development of their web pages, it is expected that the quantity and quality of web content may also improve.

