Western Transportation Institute
Montana State University

Western Transportation Institute
University Transportation Center
2004 Annual Report

(For the period October 1, 2003 - September 30, 2004)

College of Engineering
Montana State University

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Mission Statement

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

I am pleased to present the Western Transportation Institute's UTC Annual Report for 2004. We are proud of our six years of work as a University Transportation Center to advance the state of the practice in research, develop innovative solutions to real challenges in rural America, and enhance educational opportunities in the field of transportation.

Through the years, WTI has developed its research program by defining focus areas that build on project experience and staff expertise. With a foundation in each of these areas firmly established, WTI can now effectively explore rural transportation challenges that involve overlapping or "cross-cutting" issues. To thoroughly investigate a safety issue like winter accident reduction, for example, WTI can build a team of research professionals from several focus areas, such as weather, highway maintenance, and rural applications of advanced technologies. In another example, WTI is expanding its research into the field of Vehicle-Infrastructure Integration by combining staff from several focus areas with facilities like the Driving Simulation Laboratory and the Cold Regions Testbed in Lewistown, Montana.

WTI has attained a depth of technical expertise that increases our research flexibility. Many state departments of transportation look to us to identify and respond to their emerging rural transportation issues. We currently have research and deployment projects in 30 states. For smaller states, we provide research services that might not otherwise be possible within their state's structure or resources. For larger states that tend to focus on urban issues, we can champion rural issues that might otherwise be overlooked or underserved.

This year we are also very proud of our newly created research laboratories. Our Driving Simulation Laboratory and our Materials Corrosion Laboratory are not only up and running, they are attracting projects from around the state and the Western region. We are steadily growing our in-house equipment and facilities uniquely suited to rural transportation research.

The strength of our research program continues to enhance our education program and our status as a University Transportation Center. We not only attract more students and faculty to the Montana State University campus, we improve the depth of transportation learning and quality of hands-on research opportunities. In this way, the UTC program plays a critical role in the development of the future transportation workforce.

Thanks to the Research and Special Program Administration of the U.S. Department of Transportation, WTI has achieved national recognition as a University Transportation Center and leader in rural transportation research. We look forward to our ongoing collaboration in the future.

Sincerely,

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

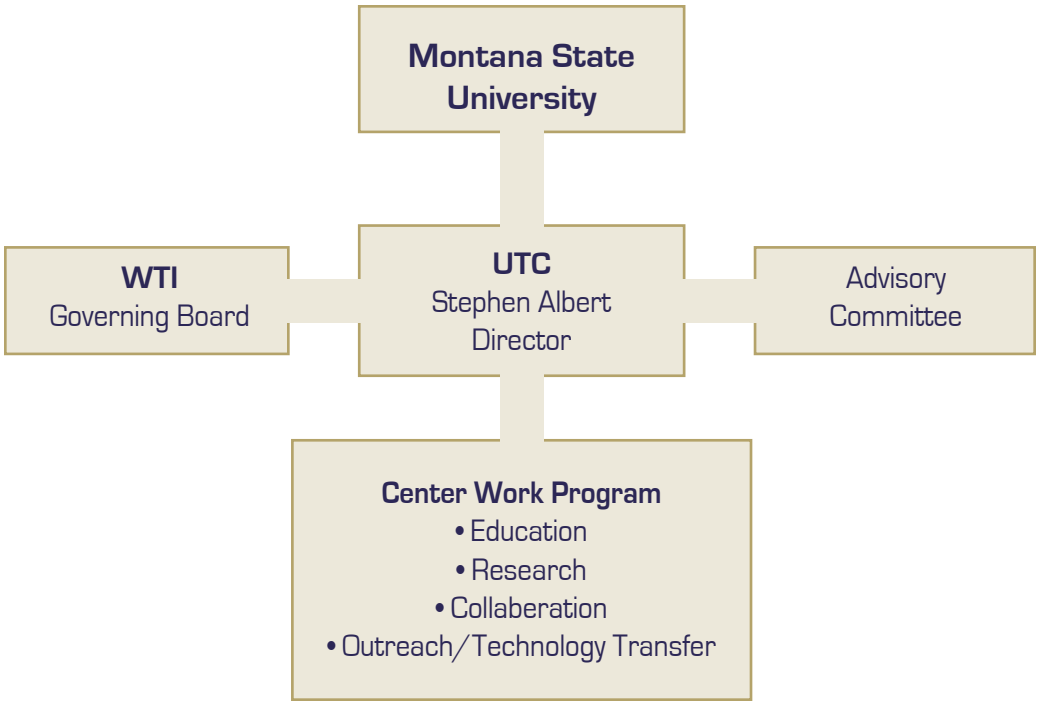
As the Montana State University (MSU) focal point for transportation research and technology transfer, the Western Transportation Institute's (WTI) University Transportation Center (UTC) mission is "advancing rural transportation through research and education." Established in 1994 by the Montana and California Departments of Transportation, in cooperation with MSU, WTI has focused on rural transportation challenges for ten years. Now recognized as a leader in rural deployment of Intelligent Transportation Systems, WTI currently has research projects in 30 states.

Physically located in the College of Engineering, WTI has a 58 person multidisciplinary research staff of students, professionals and associated faculty from engineering (mechanical/industrial/civil), computer science, psychology, fish and wildlife, land resources and environmental sciences, business, biology and economics. Our professional staff alone has more than 150 years of experience in the field of rural transportation research, with technical expertise in such areas as rural tourism, traveler information, communications, small transit systems, weather and mobility, and infrastructure materials and design. WTI concentrates on meeting the growing demands for additional transportation professionals by providing students with "hands-on" experience, and conducting research that will make a difference in the everyday lives of the people of Montana and rural America.

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

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

The administrative staff manages the Center's research, education, and technology transfer activities and utilizes the systems, policies, and procedures already in place at MSU to manage funds, equipment and personnel.



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Administrative Success Story

Strategic Planning Implementation

Strategic Planning has always driven WTI's efforts to achieve excellence in its internal and external relationships, as well as staff development. In 2003, WTI significantly modified and updated its Strategic Goals and Objectives to reflect WTI's elevated position within the University (departmental status in the College of Engineering) and the needs of a rapidly expanding sponsor base. In 2004 - the first year of implementation - WTI successfully completed nine of the ten objectives, and initiated the remaining one. The implemented objectives include the following.

- Developing a hiring policy and staff compensation plan based on skills, experience, education and other key factors, and defining career track opportunities
- Identifying skill sets of WTI staff and affiliated faculty, and conducting annual management skills assessments
- Developing protocols and procedures for interaction of WTI staff and affiliated faculty
- Identifying software applications and developing a document system to accurately track the progress of research projects

These objectives enhance staff development and resource management in many ways. The development of a compensation plan and career track opportunities helps WTI to attract and retain talented research professionals. By identifying and assessing skill sets, WTI can increase its ability to use in-house resources instead of paying for outside contract services. This skill identification, in conjunction with formalized procedures for working with affiliated faculty, also facilitates multidisciplinary research on the MSU campus. Finally, the improved methods for tracking research projects ensure efficient use of resources and on-time completion of projects. All of the objectives working together contribute to successful, high quality rural transportation research on an ongoing basis.

Administrative Initiatives for 2005

External Strategic Planning Implementation

With internal Strategic Planning close to completion, WTI has initiated an External Strategic Planning process. Under the guidance of an executive committee, the entire WTI staff will participate in an effort to analyze the future of transportation research in order to identify stakeholders, potential partners, emerging issues, and research opportunities.

This process is intended to collect information and analyze trends that will help WTI to:

- Match WTI's research and technical strengths to emerging issues and client needs
- Identify funding resources so that research dollars can be leveraged and used to their greatest potential
- Identify new collaborations to coordinate similar research efforts and strengthen technical expertise
- Conduct relevant research that reflects issues of a national priority

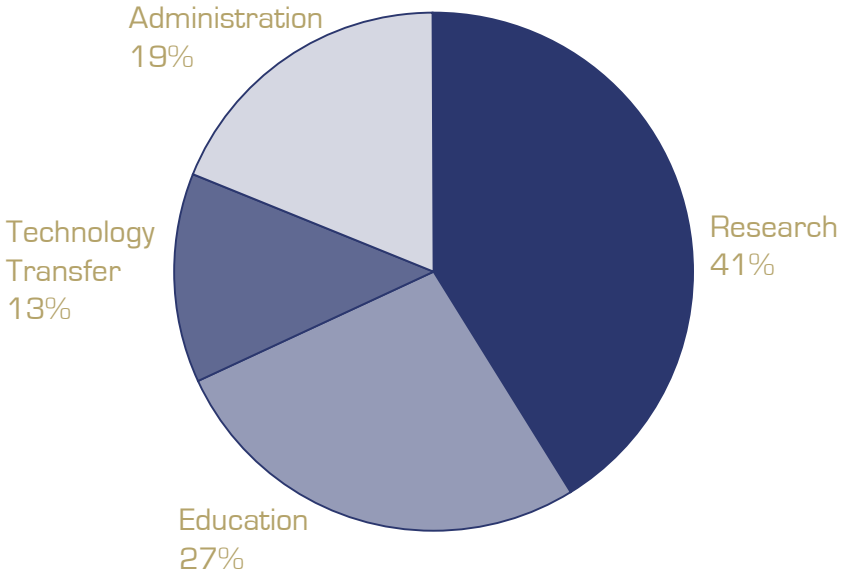
Financial Statement

The following pie charts illustrate expenditures and funding sources for the Western Transportation Institute's UTC programs during the last year. Figure 1 shows the breakdown of expenditures and allocations of the Federal portion ($1,812,000) of the UTC program for Year 6. Approximately $488,000 was allocated for the Education Program, and $743,000 has been committed for research funding. The remaining $426,000 supports the administrative and technology transfer function of WTI.

The second figure depicts the Year 6 funding sources for the WTI UTC program. The match for the USDOT portion is provided by the Montana Local Technical Assistance Program, the MSU Civil Engineering Department, pooled research and demonstration projects, as well as individual state Departments of Transportation.

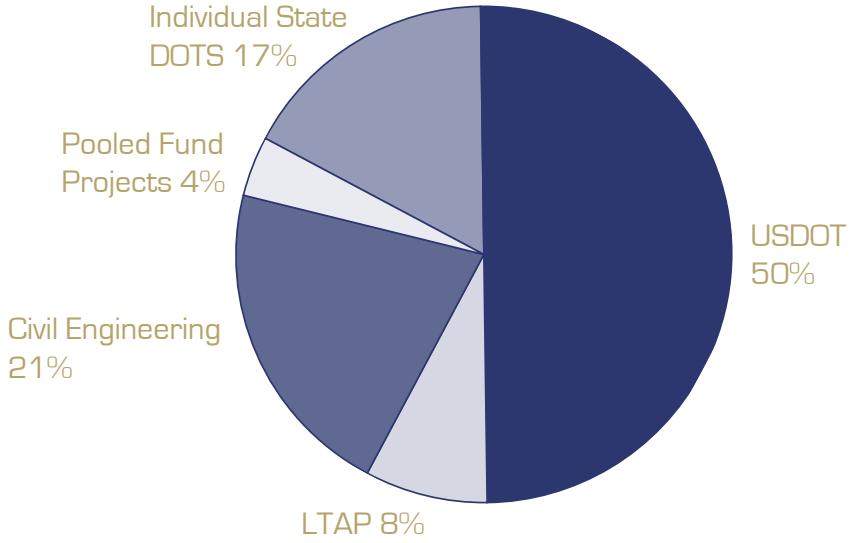
Expenditures for Year 6:

October 1, 2003 - September 30, 2004



Funding Sources for Year 6:

October 1, 2003 - September 30, 2004



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Research

"To create an ongoing program of basic and applied research, the products of which are judged by peers or other experts in the field to advance the body of knowledge in transportation"

Research Program

Through the years, WTI has developed its research program by defining focus areas that reflect priority issues in rural transportation. In its first decade, WTI successfully established staff expertise and project experience in each of these areas. Building on that foundation, WTI is further enhancing its research program by bolstering its on-site testing facilities and by developing "cross-cutting" projects that integrate resources from more than one focus area. The following section provides details on all of WTI's new, ongoing and completed UTC research projects, and highlights this year's successful efforts to expand our in-house research laboratories.

Transportation System Wildlife Ecology Interactions

Integrating research, education and training to provide world-class surface transportation and environmental solutions for mitigating animal vehicle collisions and habitat connectivity.

Highway Infrastructure Design and Maintenance

Using progressive research to improve the design and maintenance of rural highway infrastructure…

Weather and Winter Mobility

Improving traveler safety and operating agency effectiveness to address weather and winter mobility challenges.

Rural Applications of Advanced Technology

Evolving the state of the practice in advanced technology to meet rural transportation challenges and constraints.

Public Transportation and Mobility

Improving people's lives by addressing rural public transportation challenges

New Research Projects

Project Name	Principal Investigator
Implementation of a Driving Simulation Laboratory	Mike Kelly
Materials Corrosion Laboratory: Evaluating Common Corrosion-Inhibited Deicers	Xianming Shi
Investigating Innovative Research Opportunities Related to Highway Infrastructure Design & Maintenance	Eli Cuelho
Evaluation of Driver Distraction During Mobile Phone Interaction with the 511 Information System	Mike Kelly
Development of a Prototype Integrated PDA/GPS System to Collect Roadkill Data	Marcel Huijser
National Center for Integration and Systems Engineering of Transportation Technology Feasibility Study	Doug Galarus
Evaluation of Montana Department of Transportation's Transportation Awareness Program	Jaime Eidswick
Evaluation of Reinforcement Strain Growth During Traffic Loading	Steve Perkins

Implementation of a Driving Simulation Laboratory

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A high-fidelity driving simulation laboratory allows testing of driver performance and behavior in the safety and controlled environment of the laboratory. Collection of data related to driving hazards and unsafe conditions is dangerous and time consuming if done on actual highways or test tracks. Because of the changing nature of environmental conditions and traffic, it is impossible to maintain the full control and repeatability of driving scenarios necessary for experimental precision. This can be accomplished safely and easily in a simulation laboratory designed to collect detailed measures of driver performance during high fidelity, realistic driving scenarios.

Through this project, WTI created and implemented a high-fidelity simulation laboratory that can be used to investigate issues in driver performance related to distraction, aging, training, and infrastructure design. A research simulator will allow testing and development of prototype systems before they can be fielded. The laboratory will economically support research in safety, control theory, psychology, driver fatigue, alcohol and OTC drugs effects, and other topics that are difficult to study in low fidelity laboratory simulations or on the real roadways.

The simulation laboratory, the only one of its kind in the Pacific Northwest, will be available to support data collection for a large number of multi-disciplinary projects.

Initial research in the simulator will address issues of driver performance and safety related to aging and to distraction caused by in-vehicle communications, navigation, and entertainment devices. Pilot studies in these areas will be conducted and reported in a format suitable for conference presentation.

Material Corrosion Laboratory: Evaluating Common Corrosion-Inhibited Deicers

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To minimize the adverse impacts that highway winter maintenance activities pose on vehicles and transportation infrastructures, it is a popular practice to add corrosion inhibitors into the deicers. The Pacific Northwest Snowfighters (PNS), an association of transportation agency technical experts from British Columbia, Idaho, Montana, Oregon, and Washington, has implemented testing protocols and guidelines for new deicer product qualification. A central feature of these requirements is the presence of corrosion inhibitor in all deicers, and the qualification of all deicers by a NACE/PNS corrosion test before such chemicals can be approved for sale in PNS states.

The Laboratory will have the capabilities to conduct a wide-range of future research, including quality control of deicer products, evaluation of corrosion-inhibiting admixtures for concrete, application of electrochemical protection for highway structures, and development of alternative deicers.

In conjunction with the Montana Department of Transportation (MDT), WTI has created a Materials Corrosion Laboratory to establish the corrosion research capabilities at WTI and to establish protocols for evaluating the corrosion rate of materials and performance of corrosion inhibitors. In light of the NACE/PNS protocol, researchers will establish an improved chemical protocol for evaluating the corrosivity of chemical deicers. WTI will also establish electrochemical protocols for evaluating the corrosion rate of materials and performance of corrosion inhibitors. It may supplement the Chemical Analysis Protocol and will be faster and more reliable. Once the protocols are established, various corrosion-inhibited deicers will be evaluated in the laboratory. Some of the initial research will be conducted in partnership with Nanyang Technological University, Singapore.

Investigating Innovative Research Opportunities Related to Highway Infrastructure Design and Maintenance

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This project aims at proactively addressing the nation's failing infrastructure through innovative and practical research. Many Departments of Transportation are looking for new methods and technologies to better build and maintain highway infrastructure. Creative ideas must be employed to ensure that 1) new designs are adequate to meet the heavy demands and 2) longevity of new infrastructure is assured. Due to the depth and breadth of this work, it is necessary to develop partnerships and relationships with multiple DOTs, research institutes and academic institutions.

This project will enhance the Highway Infrastructure Design and Maintenance program area at the Western Transportation Institute by generating new partners and strengthening partnerships that currently exist.

The primary task for this project is to promote research opportunities that identify highway infrastructure field instrumentation related to design and maintenance, create partnerships with several state departments of transportation to foster state-of-the-art research related to geosynthetic pavement design, and initiate new research that utilizes technological solutions and high performance materials in design. To accomplish this work, WTI will diligently pursue funding and partnerships from a variety of sources, including the reauthorization of TEA-21, state-supported pooled fund studies, the Strategic Highway Research Program (SHRP), the National Cooperative Highway Research Program (NCHRP), state departments of transportation or FHWA. Recent activities have included: development of a pooled-fund study to determine geosynthetic material properties pertinent to reinforced flexible pavement design, and the promotion of research to determine the cost-benefit of specific pavement preservation techniques.

Evaluation of Driver Distraction During Mobile Phone Interaction with the 511 Information System

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A significant body of research has indicated that the use of hand-held cellular phones in moving vehicles can create a dangerous distraction to drivers in urban areas. Cellular phones with headphone interfaces may create a lesser, but still significant distraction. No research had yet explored the use of these phones by drivers on less congested rural roads where the driver's workload is lower. Likewise, no research had specifically addressed the use of cellular phones by drivers accessing the "511" highway information system.

The first study in WTI's new Driving Simulation Laboratory, this research provides early data on a high-visibility topic.

This project used the WTI Driving Simulation Laboratory to collect data addressing driver distraction while using two common mobile phone interfaces in rural and urban traffic, and to collect data addressing the usability of the 511 information system while being accessed by mobile telephone from a moving vehicle.

The thirty-six test subjects ("drivers") were assigned to three equal groups: a hand-held telephone group, a handsfree telephone group, and a control group. They were tested driving through a series of scenarios during which they obtained specific information about road conditions from the 511 information system. Researchers measured performance on tasks such as headway/following distance, lane maintenance, and responses to obstacles, then evaluated results based on the accuracy of information reported by the user; the amount of time required to obtain the information; and survey/interview information concerning problems, comments, and suggestions about the interface design.

Evaluation of Reinforcement Strain Growth During Traffic Loading

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A recently completed project for FHWA has resulted in a proposed mechanistic-empirical design method for reinforced pavements that is compatible with the American Association of State Highway and Transportation Officials (AASHTO) 2002 Pavement Design Guide currently in development. A critical component of this design method is a relationship between the ratio of permanent to resilient strain and a normalized measure of traffic passes. This relationship was determined for several reinforcement products from previously constructed test sections and appeared to provide reasonable relationships that predicted acceptable levels of performance.

Researchers will have the opportunity to evaluate the feasibility of using this type of data in reinforced pavement design methods.

To more fully establish the feasibility of using data from test sections to describe this relationship, this project will examine data from approximately 18 other reinforced test sections. Evaluation of this data will determine if this relationship is unique for any aggregate type and pavement cross section geometry and whether the relationships for different geosynthetics are distinct and consistent with the reinforcement benefit seen from these test sections. This project is considered a seed project in that its successful completion will lead to new proposals that fully establish these relationships for use in design.

National Center for Integration and Systems Engineering of Transportation Technology Feasability Study

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Development and deployment of advanced transportation technologies is, of necessity, a multidisciplinary process requiring the application of advanced skills in civil engineering, computer science, electrical and computer engineering, industrial engineering, mechanical engineering, human factors engineering, and sciences such as ecology, chemistry, and economics. Currently, the transportation industry has a severe shortage of personnel who have the knowledge and experience to bring these disciplines together into effective teams and solutions, particularly in rural and small urban settings. There is also a lack of knowledge about best management practices for integrating the products of these disciplines.

Development and deployment of advanced transportation technology is a process of seven interdependent steps: (1) identify the need for a technological solution to a problem, (2) research the underlying technical questions about the operational principles of the technology, (3) engineer to convert the underlying principles of the technology into practice, (4) deploy the technology into the transportation infrastructure, (5) operate and maintain the technology, (6) evaluate the technology, and (7) decommission the technology when its useful life is completed. Systems engineering and integration link these steps together as a structured engineering process. This process is often neglected due to lack of resources such as funding, time, manpower, and expertise necessary to bring together an effective, multidisciplinary team.

This center will be dedicated to developing and promoting a systems engineering approach to the integration, deployment and evaluation of complex transportation technologies.

To address this problem, the Western Transportation Institute at Montana State University proposes to leverage its existing status and expertise to form a Systems Engineering and Integration of Transportation Technology Program (SEITTP). This program will bring together a multidisciplinary team of engineers, scientists and students from a broad range of university departments to address the education, research, and application issues of systems engineering and integration in relation to advanced transportation technology.

Through this project, WTI and the MSU College of Engineering will refine the concept for a Systems Integration (SI) Program, and determine the feasibility of creating such a center, by analyzing the competition, potential customer base, stakeholders, potential sources of revenue, and other critical factors.

WTI, through the SEITTP and in conjunction with the Montana State University College of Engineering, would provide education, research and application support for systems engineering and integration to client organizations by:

• providing workforce development and continuing education opportunities in systems engineering and integration for transportation professionals. It will promote systems engineering and integration training as part of the undergraduate and graduate engineering curriculum, and will provide students with the opportunity to apply what they've learned in the classroom to "real-world" problems.

• providing multidisciplinary transportation-related research and development opportunities for engineering and science faculty, staff and students, and will use and promote WTI, COE and other MSU labs and facilities for systems integration efforts. It will use technology transfer and the publishing of research results to promote the application of transportation-related research in systems engineering and integration.

• supporting the development of emerging transportation technologies, and assisting to evaluate and implement state-of-the-art technology, evaluating existing conceptual design products under actual use conditions, and developing and providing best management practices for integration of these technologies.

Evaluation of Montana Department of Transportation Awareness Program

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The Montana Department of Transportation (MDT) has a Transportation Awareness Program (TAP) that promotes MDT and its programs to the public. The TAP staff conducts outreach at schools, driver education classes, and large public events, and provides information about topics such as fuel tax, the 511 traveler information system, noxious weeds, snowplow safety, and workzone safety. Through these outreach efforts, MDT seeks to improve public safety, reduce liability claims, and improve community relations.

The survey data will be used to identify and prioritize program improvements.

WTI is conducting an evaluation of TAP for MDT to determine how many Montanans know about the program, to identify its benefits, and to measure its effectiveness. WTI will develop both a phone and mail survey to administer to Montana residents. The survey data will be summarized and analyzed in a final report that will be made available to both MDT and the Montana Legislature.

Development of a Prototype Integrated PDA/GPS System to Collect Roadkill Data

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There are approximately 725,000-1,500,000 crashes between vehicles and ungulates (large hoofed animals) in the U.S. annually. These collisions are estimated to cause more than 200 human fatalities and over one billion dollars in property damage a year. In order to avoid or reduce animal-vehicle collisions, basic data need to be recorded and analyzed. However, not all state Departments of Transportation record animal-vehicle collision data. Furthermore, the DOT's that do record such data often use different methods. A national standard for the recording of animal-vehicle collisions may encourage DOT's and other organizations to collect these data and allow for more effective analyses and application of the data.

This project will help develop a tool for collecting standardized animal road kill data with a system that is spatially accurate, easy to use, and has a data format that is easy to integrate and analyze.

The main purpose of this project is to develop a standard for the collection of animal-vehicle collision data and to show how Personal Data Assistants (PDA's) in combination with a Global Positioning System (GPS) can help researchers to collect accurate and standardized data. If successful the system will help collect, analyze and interpret data on animal road kill locations. These data will help pinpoint high-risk locations and will allow for the prioritization of mitigation measures. Ultimately, the work may contribute to reducing the number of animal-vehicle collisions while continuing to allow animals to move across the landscape.

Through this project, WTI has developed software that allows for easy, standardized and spatially precise collection of animal-vehicle collision data. The software runs on a pocket PC that is linked to a GPS (Global Positioning System). WTI will test the prototype in the field, customize the software, modify software based on feedback, and develop procedures that allow for easy data management and analyses and integration with other spatial data.

On-Going Research Projects

Project Name	Principal Investigator
California - Oregon Advanced Transportation System (COATS) Program Showcase	Christopher Strong
ODOT ITS Performance and Benefit Plan	Christopher Strong
ITS Applications in Golden Gate National Recreation Area, Phase I, Muir Woods	Christopher Strong
Geosynthetic Pullout Behavior under Small Displacements	Eli Cuelho
Impacts of Weather on Rural Highway Operations	Manju Kumar
Evaluating the Accuracy of RWIS Sensors	Christopher Strong
Communications and Power Improvements for Rural ITS Field Devices	Christopher Strong
Case Studies of Maintaining ITS Devices in Rural Areas	Manju Kumar
Tribal Automated Accident Reporting System	Gary Harkin
Saco Bridge Field Evaluation	Eli Cuelho
Compressibility and Heave Characteristics of Subgrade Soils Exposed to Freeze/Thaw Conditions	Robert Mokwa
Comparative Evaluation of Wind Warning Systems	Manju Kumar
Development of a Roadway Weather Severity Index	Christopher Strong
Transportation Toolkit for Federal Lands Managers	David Kack
Video Surveillance Trailer Equipment	Christopher Strong
Mitigating Wildlife Mortality and Habitat Fragmentation	Tony Clevenger
Bozeman Transportation Research, Applications, and Instrumentation Laboratory (TRAIL)	Suzanne Lassacher
Mobile Laboratory	Robb Larson
Demonstration and Evaluation of ITS on the Rural Highway Environment (Frontier)	Patrick Wright
Development of Test Protocols for Characterization of Soil/Geosynthetic Interaction and Intrinsic Geosynthetic Material Properties	Eli Cuelho
Animal - Vehicle Crash Mitigation	Marcel Huijser

California/Oregon Advanced Transportation Systems (COATS) Showcase

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The California/Oregon Advanced Transportation Systems (COATS) project began in 1998 as a bi-state partnership to improve rural transportation through the demonstration and evaluation of intelligent transportation systems (ITS). The first phase resulted in the successful completion of an ITS Strategic Deployment Plan in 2001. The California Department of Transportation (Caltrans) and the Oregon Department of Transportation (ODOT) decided to continue their partnership, enabling the project to continue in the form of COATS Showcase.

By providing more credible and detailed information about ITS benefits, COATS Showcase can help to create broader awareness and acceptance of the potential of ITS.

COATS Showcase is comprised of a set of evaluations that seek to clarify the benefits associated with ITS investment, and to identify lessons learned from demonstration projects that may help to improve future deployment. Evaluations are developed to cover the broad geographic area of the COATS study region - an 80,000 square mile area encompassing the southern half of Oregon and the northern third of California - and the comprehensive, multimodal nature of the COATS project's goals and objectives. Once designed and selected, the evaluations become independent projects.

On-going Showcase evaluations are described in this section on pages 21,22,27 and 28.

Oregon ITS Performance and Benefit Plan

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The Oregon Department of Transportation (ODOT) has implemented many intelligent transportation system (ITS) projects and services throughout the state, including an Advanced Transportation Management System (ATMS), Advanced Travel Information Systems (TripCheck), Highway Travel Condition Reporting System (HTCRS), Road and Weather Information Systems (RWIS), Variable Message Signs (VMS), and others.

In order to ensure support for ongoing ITS investment, ODOT is working to evaluate the performance of ITS, document the benefits, and educate the public about how ITS enhances transportation safety, mobility and efficiency. Through this project, WTI is conducting a series of individual research tasks that will assist ODOT with this effort.

By documenting and showcasing the benefits of current ITS systems, ODOT can begin to build public and institutional support for future ITS expansion.

One of the principal accomplishments has been the development of a web page that documents some of the primary benefits of ODOT's ITS deployments. The web page contains a comprehensive list of projects in Oregon, grouped by purpose of the project, such as Traveler Information, Safety, and Public Transportation. The introductory page also has links to detailed information on specific systems, including documented benefits with supporting numbers and performance data. The intent of the web page is to make information on the benefits of Oregon ITS systems readily available to the public. The page has been incorporated into the ODOT website at www.odot.state.or.us/its.

WTI also evaluated an infrared camera that could be used for detecting ice on roadways. The evaluation used MSU's cold weather chamber to generate a variety of weather conditions, in order to examine how quickly and accurately the camera detected phase change. The results of this evaluation will help ODOT to more accurately detect when roadways require winter maintenance.

In 2004, WTI began a new study to develop guidelines that would assist ODOT in making decisions on where ITS field elements should be placed statewide. A list of prioritized, potential locations will be provided in a geographic information systems (GIS) format that will make it easier to visualize where technologies should be deployed.

ITS Applications in Golden Gate National Recreation Area Phase I: Muir Woods

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As visitation to national parks increases, the transportation system in the parks and surrounding communities may suffer from congestion, lack of parking, deteriorating infrastructure, poor traveler information, and other factors that may affect the public's enjoyment of these unique resources. The challenge for the National Park Service is to find a way to execute its dual mission of preserving the historic, cultural and national resources under its control while promoting the enjoyment of these resources by the American public.

This project seeks to overcome this problem at one particular location, the Golden Gate National Recreation Area (GGNRA). Each year, GGNRA attracts more than 14 million visitors from local communities as well as other states and countries to enjoy the many unique cultural, historic, and natural features in the area near San Francisco Bay. The resulting traffic challenges the National Park Service in providing adequate pre-trip traveler information, relieving traffic congestion, having sufficient parking, and promoting alternative access modes. This park represents a unique location where intelligent transportation systems (ITS) applications have the potential to help the NPS address their challenges, and produce findings that may be useful and applicable to many other parks and recreational lands across the country.

This project will test whether advanced technologies can help manage the impacts of increased visitation at our National Parks.

The goal of this project is to develop an "early-winner" project focusing on access to Muir Woods, an old-growth redwood area in Marin County, California. Projects will reflect challenges based on the potential for benefits, cost, institutional issues, and other factors. Research will be conducted in partnership with the California Department of Transportation, NPS, and other stakeholders.

Geosynthetic Pullout Behavior Under Small Displacements

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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, Gi, the resilient interface shear modulus. 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. This research effort modified the standard pullout test protocol to resemble the resilient modulus tests for unbound aggregates which utilizes cyclic loads at various levels of normal confinement. The resilient modulus for unbound aggregates (MR) closely resembles Gi, since they are both simultaneously dependent on shear load and confinement. Overall, the results from the cyclic pullout tests conducted on six geosynthetics showed that cyclic pullout testing has great potential for describing a stress dependent interface shear modulus. A three-parameter, log-log equation developed in the NCHRP Project 1-28a was used to predict Gi. Correlations between predicted and measured values were somewhat erratic. Additional research is planned to improve the test equipment and establish specific test protocols.

By studying the interaction between geosynthetic materials and the surrounding soil using cyclic loads, this project will provide valuable data that can be applied to future pavement design standards.

COATS SHOWCASE:
Impacts of Weather on Rural Highway Operations

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Weather poses a significant challenge to rural highway operations. In many cases, the operation of the transportation system under severe weather can be improved through the strategic use of advanced operational strategies, including the use of intelligent transportation systems (ITS). To estimate the benefit of ITS or other solutions requires accurate estimates of the pre-deployment, baseline conditions for roadway operations. However, very little baseline data exists for highway capacity and speeds in rural environments during weather events, such as snow, heavy rain, and fog.

The objective of this project is to develop a method for estimating the road capacity reduction effects of weather on rural highway, through the correlation of data collected from automatic traffic recorders with information about weather conditions and other factors such as road grades. This project will provide valuable information that may be used to assess the benefits of a variety of transportation system improvement projects, including the use of intelligent transportation systems (ITS) during severe weather conditions.

This project will provide foundational data that will help evaluate the effectiveness of future road safety technologies and improvements.

Several data collection sites have been selected within the COATS study area and Montana. These sites have both road weather information systems (RWIS) and detection systems to measure vehicle volume and speed under various severe weather conditions. The entire set of locations will include sites subject to a variety of weather conditions, and sites with a variety of grades and geometric characteristics. Traffic and weather data have been collected for the past two years, in order to capture a variety of weather events. Statistical comparisons between periods of free flow traffic and periods of adverse weather conditions will be conducted to isolate the effects of various weather events on roadway capacity and speed. A series of models will then be developed to help assess the baseline capacity and speed conditions under various weather conditions.

COATS SHOWCASE:
Evaluating the accuracy of RWIS Sensors

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Many transportation agencies use Road Weather Information Systems (RWIS) to make critical decisions regarding road maintenance and use, especially during severe weather conditions. RWIS include an assortment of integrated sensors that measure air temperature, precipitation, visibility, wind speed, pavement temperature, and other parameters of interest.

Most RWIS sensors have been used in non-road applications with high levels of accuracy. However, there is concern about the accuracy of pavement sensors in detecting whether the roadway is icy, snow-covered, wet or dry. Sensors mounted in the pavement also require re-installation when a road is resurfaced or rehabilitated. Infrared (IR) camera technology, which does not require intrusion into the pavement, has been increasingly used to detect the presence of ice or snow on the road. Lab testing in Montana State University's Cold Regions Laboratory indicated that the IR camera would accurately predict surface conditions and temperature phase changes. However, as a newer technology, there has been limited field testing of IR cameras for measuring pavement condition. For RWIS to provide quality and accurate data for maintenance personnel and the traveling public, it is important that transportation agencies know which sensing methods will provide reliable data on a consistent basis.

This project will provide transportation agencies with independent research results regarding the accuracy of RWIS sensors.

The techniques for testing and calibrating sensors have traditionally been the responsibility of vendors contracted for RWIS maintenance. For this evaluation, WTI will evaluate the accuracy of in-pavement RWIS sensors at Bozeman Pass in Montana and compare it with the accuracy of an IR camera, acquired by the Oregon Department of Transportation (ODOT) to detect ice formation on the pavement. Sensors will be evaluated for accuracy during the wintertime (December 2004 through March 2005) in California and Oregon. The camera will be installed on top of a 30-foot mast on roadway shoulders to record the phase change of ice/snow on the pavement. The camera's recorded data will be compared to the actual temperature readings of the selected in-place pavement sensors and visual recordings, conducted by an observer. Data will be recorded under different traffic and weather conditions. Appropriate statistical data analyses to determine whether there are significant differences between the recorded camera and sensors data will be conducted. The outcome will determine the accuracy of the selected field sensors.

COATS SHOWCASE:
Communications and Power Improvements for Field Devices

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Intelligent transportation systems use advanced computer, electronics and communications technologies to improve the operation of the surface transportation system. However, many rural areas lack an integrated communications or power infrastructure that can support the deployment of ITS, so agencies are typically forced to improvise a solution.

The purpose of this project is to document case studies of innovative solutions for addressing the communications and power needs of ITS field devices deployed in a rural environment. By documenting and building upon the lessons learned from past deployments, the reliability and effectiveness of future ITS deployments may be significantly improved.

This project will provide an important informational resource to rural areas trying to address transportation challenges with a limited communications or power infrastructure.

A web-based survey was conducted among the 50 state Departments of Transportation to inquire about their experiences in the deployment of video and non-video applications and alternative power sources in rural areas. Upon receiving and reviewing the responses, the promising alternative power sources were identified. No case studies were selected among the communication technologies as none were found to be new applications. A second survey was distributed via email among the states that indicated employing alternative power sources to obtain additional information on the functionality, application, cost, and lessons learned of their systems.

Case Studies of Maintaining ITS Devices in Rural Areas

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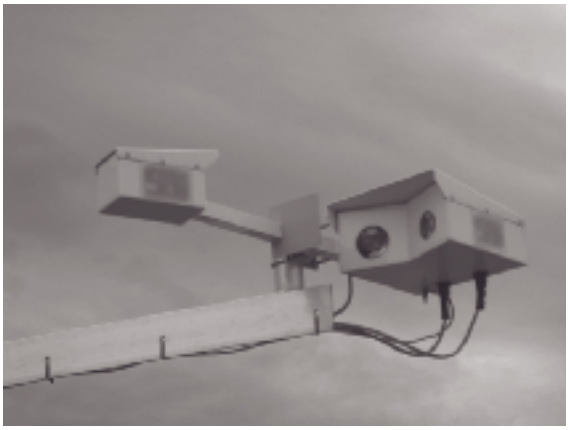
Proper maintenance of intelligent transportation systems (ITS) elements is crucial because it can extend the useful life of the ITS infrastructure, help increase reliability, reduce long-term costs, and build public confidence in ITS deployments. ITS maintenance in rural environments has unique challenges compared to urban areas, due to the reduced availability or greater expense of maintenance through contracting, long distances separating field devices from trained maintenance staff, specialized training needs for ITS maintenance, and limited system redundancy.

As more ITS technologies are employed in the COATS study area, a rich repository of information on actual maintenance becomes available, offering the opportunity to collect pertinent cost data and develop best practices. The objective of this project, therefore, is to document case studies of ITS maintenance to guide future ITS deployments in the COATS study area, improve maintainability of field devices in the design and procurement stages, and generate more accurate information on maintenance costs.

This evaluation should provide several tangible benefits to local and national stakeholders, including improved design and procurement processes that account for maintenance concerns, better budgeting by gathering more accurate information on maintenance costs, improved scheduling of maintenance staff, and more realistic estimation of reliability and life time of field devices.

A literature review was conducted to help assess the maintenance needs of ITS elements. Based on input from local stakeholders, several ITS technologies and deployment locations were identified for case studies. Locations were selected based on the availability of adequate experience and record keeping, in order to document maintenance history and develop lessons learned. Data have been collected from maintenance staff for each device to gain an overall understanding of the systems/devices, their perceived usage and maintenance history. A detailed review of maintenance records will also be used to identify primary maintenance concerns from technical and institutional perspectives. The results of this effort will be compiled, summarizing major findings and providing recommendations for improved maintenance procedures.



Tribal Automated Accident Reporting System

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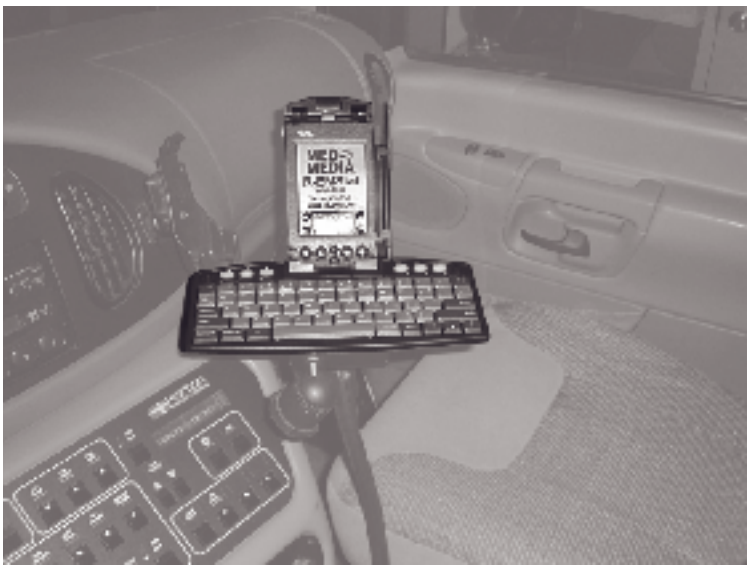
Accident data is a useful tool for transportation and emergency response planning. In Montana, the availability of quality data is limited due to several factors related to the current reporting system: the inaccuracy of data, the incompleteness of the data and the potential errors associated with transcribing and communicating the data.

The purpose of this project is to improve accident reporting in the State of Montana through the application of advanced technologies. The basis of the improvement is the use of mobile computing systems to collect the data at the accident scene and the use of Global Position System (GPS) units to identify the accident locations with greater precision.

Collecting accurate crash data is a fundamental component of research to develop and test transportation safety advancements.

Researchers developed two prototype systems. The first included a mobile data collection application and a database interface. The initial target platform for the mobile product was a Pocket PC coupled with a GPS unit. However, limited screen space made it difficult to implement complex form elements on this platform. Thus, further development on the first prototype was conducted on a desktop PC, with the intent of compatibility with notebook or tablet systems. The mobile data collection application provided a user interface that mimics the current State of Montana paper reporting system to maximize user acceptance and minimize errors. The database interface was intended to demonstrate the ability to operate on current computing systems, to interoperate with current database mechanisms supported by local and State of Montana agencies for accident reporting, and to provide an opportunity to perform validity checking on the report data. The first prototype demonstrates the potential for creating an accident reporting system with a corresponding database; however further research is needed to address compatibility issues between the GPS systems and PC systems as well as limitations of the Pocket PC.



Tablet PCs offer greater flexibility for creating forms that mirror their paper counterparts than Pocket PCs or even standard notebook computers. WTI investigated the viability of a Tablet PC implementation by developing a second prototype specifically targeting the Tablet PC platform. This prototype focused on ease-of-use and increased accuracy. Pen input was incorporated into this prototype, which provided a functional grouping of form elements and auto-population of location fields, date and time fields. Text could be handwritten, typed or entered using an onscreen keyboard. Hand-drawn incident sketch capability was also implemented.

An added outreach component of this project has been a targeted effort to meet with Native American leaders in Montana, to identify the reasons for low accident reporting on reservations and investigate whether advanced technologies such as these can facilitate increased reporting. The outreach effort has identified important obstacles to increased data collection and reporting, such as a lack of clearly established policy on the traffic accident reporting process. In addition, there is not yet agreement among the tribes about which data should be reported to the state. Ongoing efforts to create new technology solutions will have to be flexible enough to be adapted to the needs of individual tribes.

Saco Bridge Field Evaluation

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One major area of concern regarding concrete bridge deck performance is durability. It is generally acknowledged across the country that the service life of bridge decks designed by traditional procedures is often shorter than desired. The construction of three new bridges near Saco, Montana on Montana Route State 243 provides a unique opportunity for bridge engineers at the Montana Department of Transportation (MDT) to study various techniques for extending the service life of reinforced concrete bridge decks.

The Western Transportation Institute at Montana State University was contracted to conduct a comparative study of the performance of three bridge decks in Saco, Montana and assess their long term durability. To accomplish the research objectives, an array of strain and temperature instrumentation was embedded in each of the bridge decks prior to placing the deck concrete. Basic structural behavior of the decks is being characterized by subjecting the decks to controlled live load tests in which vehicles with known characteristics and weights are driven across the bridges while simultaneously monitoring the strain response. During the live load tests conducted in July 2003, two heavily loaded three-axle dump trucks (~285 kN or ~64 kip) were used to load each of the bridge structures along nine longitudinal paths.

This project will allow MDT to conduct a nearly "side-by-side" field comparison of three different types of bridge deck construction.

The analysis of live load data concentrated on transverse deck response, since it was believed to be most significantly affected by the design configuration of each bridge deck. Because the bridges are relatively young, only subtle behavioral differences have emerged to date from the data collected and analyzed from the live load tests. Nevertheless, throughout the preceding analyses of live load test data, it was determined that all three decks exhibit similar global behaviors in the longitudinal direction, and that these behaviors agree with expected behaviors. Overall, for the parameters analyzed in this research, no difference in performance (i.e., occurrence of cracking, non-linear behavior, or possible indication of accumulating damage) was observed between the three bridge decks.

In addition, approximately sixteen months of long-term data has been collected from embedded sensors in each of the bridge decks. Baseline corrosion tests, topographic surveys, and crack and delamination surveys have been conducted on each of the bridge decks. As expected, obvious differences between the different deck designs have not been observed in the results of these activities, although, recent crack formations may be showing preliminary behaviors unique to each of the designs. Data collected to-date serves as a baseline to establish the condition of the three bridges before further exposure to traffic and the environment. Data obtained from long term monitoring and the second live load test will help substantiate any conclusions made thus far, and will hopefully provide a more comprehensive body of evidence by which to judge deck design superiority.

Compressibility and Heave Characteristics of Subgrade Soils Exposed to Freeze/Thaw Conditions

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Frost action below road pavements and structures supported on shallow foundations results in significant long-term maintenance problems in most temperate zones in which seasonal soil freezing occurs. The problem is widespread, and is becoming increasingly important as wheel loadings, traffic frequency, and costs of pavement structures increase. A practical approach is needed for evaluating the frost susceptibility of soils and for predicting the magnitude of strength reduction, heave, and settlement of soils exposed to repeated freeze-thaw cycles.

This project could lead to highway construction methods that decrease the number of long-term maintenance problems resulting from severe winter weather.

This project addresses the problem of quantifying effects of frost action including heave that occurs during the freezing process, and settlement that occurs during thaw. Geotechnical and engineering mechanics principles will be used to develop practical methods for investigating and analyzing the long-term behavior of soils subjected to repeated cycles of freezing and thawing, with an emphasis on frost heave aspects related to construction and performance of pavement structures. Compressibility and settlement characteristics of thawing soils will also be addressed, with an emphasis in developing practical methods and correlations using in situ devices and laboratory tests.

Experimental and analytical research is proposed to develop systematic and practical methods that can be applied to the analysis and design of highway pavement sections and shallow foundations constructed in cold climates. The research will focus on regional soil conditions and seasonal variations that are common to the state of Montana and the inter-mountain region of the United States. The project will make extensive use of unique and specialized geotechnical and snow mechanics equipment currently available in the Civil Engineering Department at Montana State University (MSU), including a customized cone penetrometer and a Cold Region Laboratory Weather Chamber.

Transportation Toolkit for Federal Land Managers

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The Federal government manages significant portions of rural land, much of which serves as destinations for tourism and recreation. Unlike many tourist destinations, Federal lands are mandated to preserve and protect unique natural, cultural and historical resources. Maintaining the balance between the demand for increased visitation and the need to preserve resources can be challenging.

This project will help federal land managers match their transportation challenges with appropriate and innovative solutions.

One area in which this balancing act has important consequences is the transportation system. Within a Federal land, there may be significant constraints on the transportation infrastructure, including gate capacity, air and noise pollution, right-of-way limits, lack of ability to expand parking and similar issues. Unless these problems are addressed, they may result in potential resource damage and a degraded visitor experience. If Federal Land Managers lack a background in transportation, they may not consider various transportation solutions - both "traditional" traffic engineering measures as well as advanced technology or intelligent transportation systems (ITS) system improvements - that may allow for both increased visitation and resource preservation.

The purpose of this project is to provide Federal land managers with greater awareness of the tools available to solve transportation challenges in their jurisdiction, and to understand the next steps needed to pursue implementation of these solutions. The project seeks to develop a system that will help managers identify possible transportation system improvements based on user input related to characteristics of their specific land. WTI is leading this effort to prioritize the key types of transportation challenges facing Federal lands, identifying and classifying appropriate solutions, and programming the software system. In 2004, an initial prototype of the system was completed.

COATS SHOWCASE:
Roadway Severity Index

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Weather can have a significant impact on rural highway operations, as it may increase crash frequencies on roadways. It is difficult to correct for the effects of weather when identifying the advantages and disadvantages of operational and safety improvements. A weather index for roadways could help in such situations. Severe weather indices have been developed for other fields, such as wildlife management, household utilities and inland maritime icebreaking operations. These indices tend to have higher values with more extreme weather. For surface transportation however, extreme conditions may not be the best measure of weather severity.

A weather severity index will help transportation officials to isolate the effects of weather on roadway safety and winter maintenance costs.

The purpose of this study is to research and develop a weather severity index appropriate for surface transportation, ideally providing correlations with both winter maintenance costs and roadway crash frequency. The project will begin with a review of weather indices that have been developed in other fields, and a review of available data, including weather data, crash data and winter maintenance cost data. Various statistical analyses will be used to identify those factors that seem to be most influential in safety and maintenance costs.

WTI will use statistical methods to model crash frequency as a function of various weather parameters. Once reasonable model forms are developed, these models will be transformed into indices, which will be validated against historical data, and perhaps tested using weather forecast data to determine their accuracy, effectiveness, and usefulness. The final report will document all information collected and will also present a refined version of the indices, with detailed descriptions of data sources, interpretation guidelines, and results of calibration and validation.

COATS SHOWCASE:
Comparative Evaluation of Wind Warning Systems

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High crosswinds can cause high-profile vehicles -- such as commercial vehicles and recreational vehicles -- to overturn and lower-profile vehicles to leave their lanes. These conditions pose a serious threat to traveler safety. The Oregon and California Departments of Transportation have used ITS installations to continually measure wind speed and direction and automatically warn motorists when hazardous windy conditions are present. Three such systems have been deployed:

- US Route 101 between Port Orford and Gold Beach, Oregon;
- Yaquina Bay Bridge (US Route 101) in Newport, Oregon; and
- Interstate 5 between Yreka and Weed, California.

This project will evaluate automated wind warning systems to facilitate deployment of similar systems. This project also provides a unique opportunity to compare the relative effectiveness of three different types of wind warning systems.

The objective of this evaluation is to assess the safety benefits, motorist satisfaction and operational benefits associated with automated wind warning systems installed in the COATS region, and contrast the relative merits of each system type. This evaluation will assess whether these different systems have resulted in a reduction in the frequency and severity of crashes involving high profile vehicles, and will also identify other benefits.

The evaluation includes a nationwide survey to identify comparable systems; an analysis of crash data; developing and testing hypotheses for the types of crashes which could most likely be avoided through use of these systems; a motorist survey to determine public perception of these systems; an assessment of the operational benefits related to these systems; and an assessment of their technological performance. Because these systems have unique aspects - including project justification and the "best" measures of effectiveness, method of motorist information, and integration with other types of traveler information - this project will assess the relative merits of different types of system concepts, and make recommendations that may guide future design and implementation of these systems.

COATS SHOWCASE:
Video Surveillance Trailer Equipment

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WTI conducts transportation research throughout the western United States. The variety of project locations and relative distance to WTI's base in Montana can make data collection difficult. For this reason, WTI purchased three custom-designed video surveillance trailers to use in COATS Showcase evaluation activities. These trailers were custom-built for long-term surveillance activities with a minimum of maintenance. The equipment includes the following characteristics:

• autonomous power, through an integrated solar panel and battery system, to allow for up to 30 days of continuous operation;
• trailer-mounted, to allow for ease of mobility and adjustment;
• microwave sensor input, to activate video recording only when vehicles are approaching the camera location;
• a mast-mounted closed-circuit television camera, which can record real-time black-and-white from up to 25 feet above ground; and
• a time-lapse video recorder, which can record at variable speeds up to real-time (30 frames per second).

WTI developed initial requirements for these trailers and has used them in several research projects.

These trailers will expand WTI's technical resources and capabilities, by facilitating long-term evaluations of its research projects, regardless of where they are located.

Through this COATS Showcase project, WTI has sought to expand the capabilities and usefulness of these trailers. This year, the mast system was extended on each of the trailers to permit a greater height from which to view traffic. On one trailer, WTI doubled the size of the solar panel to increase the recharge rate of the trailer. A weather system was also purchased to provide additional data regarding current field conditions. WTI is continuing to pursue ways to enhance the trailers to make them suitable for a broader range of research applications.

The trailers were first used for the evaluation of an icy curve warning system in northern California. They were deployed to measure vehicle speeds in a non-intrusive way during a variety of weather and lighting conditions. A paper presented at the 2003 Transportation Research Board annual meeting, based in part on that evaluation, showed that the trailers proved to be effective in accurately and precisely measuring vehicle speed. Since then, the trailers have been used to record queue lengths and to assist in measurements of vehicle width and length for other research projects.

Mitigating Wildlife Mortality and Habitat Fragmentation Due to Transportation Infrastructure

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The purpose of this collaborative project is to continue landmark wildlife mitigation research in Banff National Park begun by Dr. Anthony Clevenger. In 1996, Dr. Clevenger initiated an intensive five-year research program in Banff. The study focused on wildlife crossing structures and fencing on the Trans-Canada Highway, in order to address permeability for wildlife, animal-vehicle mortalities, wildlife movements, and habitat connectivity in the Bow River Valley. The research team evaluated means of mitigating road effects on wildlife and made recommendations for future transportation planning efforts in the mountain parks.

The findings from the Banff research are helping to guide the design of mitigation measures for wildlife on future highway construction and reconstruction projects in the United States.

The Banff-Bow Valley provides an unrivalled environment for research on the efficacy of wildlife crossing structures and reducing wildlife-vehicle collisions. There is a variety of wildlife crossing structure designs built during two time periods as well as numerous park-supported wildlife research studies. Banff mitigation research has the world's longest, year-round monitoring program and largest dataset on passage use by wildlife.

The new partnership with WTI enables Dr. Clevenger to continue his research in Banff beyond the original five-year program and to secure additional long-term funding. Additional goals of this project are the integration of Banff research with the US 93 reconstruction project in Montana, the development of partnerships with Canadian and US agencies, and the establishment of a long-term collaborative research project in Banff.

Transportation Research, Applications and Instrumentation Laboratory

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The Transportation Research, Applications, and Instrumentation Laboratory (TRAIL) will demonstrate and evaluate various data acquisition, control systems, information delivery, and management systems in small urban and rural environments. The laboratory would provide a test bed for the various types of research currently being conducted by WTI, including weather and winter mobility, highway infrastructure design and maintenance, wildlife and ecology, commercial vehicle operations, emergency medical services and public transportation.

The TRAIL laboratory will serve as a test bed for a variety of new human factors, weather, pavement, animal detection and traffic technologies.

TRAIL will be developed and deployed in multiple phases, with the initial phases being deployed locally at Montana State University - Bozeman. The first phase of this project will be to develop the requirements and determine the potential partnerships for a local component of the transportation laboratory, including instrumentation, communication, and a data processing and management center. The goal of the second phase is to establish a "smart travel corridor" for 19th Street in Bozeman, Montana, a primary traffic corridor in the city that is experiencing a high rate of development and a rapid increase in traffic volumes and congestion. Deployment of traffic, weather, and road condition sensors will allow WTI to obtain real-time and summary data on travel conditions, which can be communicated to the TRAIL data management center for processing and archiving.

Future phases will seek to implement new systems and technologies, in collaboration with national and international research partners. The long-term goal of the project is to open a facility where a wide range of new technologies research can be conducted, where students have hands-on learning opportunities, and where technology transfer can be expedited through facilitated data collection and sharing.

Mobile Laboratory

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WTI has created a mobile laboratory to support transportation-related research projects, in compliance with WTI's mission to make rural transportation and travel safer, more efficient, and more convenient. The Mobile Laboratory supports research, evaluation and development of new products and technologies for transportation, evaluation of prototype devices and systems, and testing of commercially available systems. It is an ideal tool for outreach and for undergraduate research opportunities.

The Lab supports three usage modes:

1. Fixed Site mode: Usage includes measurement and recording of site-specific data such as traffic counts & classification, weather conditions, and animal-vehicle interactions. The lab features dual mast-mounted traffic cameras with video recording and data logging equipment. The deployable pneumatic mast can alternatively be topped with a weather station for climate condition data acquisition.
2. Roving Mode: Location-dependent roadway data can also be gathered real-time using a variety of on-board sensors. Sub-meter accurate GPS coordinate and time stamping of acquired data is supported. Examples of this operational mode include thermal mapping of road surface temperatures, road surface roughness or reflectivity studies and logging of highway surface or roadside features.
3. Mixed Mode: Mixed-mode studies such as inter-vehicle fleet communication and roadside-to-vehicle communications research, development and testing projects are possible.

The Mobile Laboratory is not only a valuable research facility; it also provides unique learning opportunities to many students at the university.

The vehicle can serve as a portable environmental shelter and field laboratory with most of the tools and facilities found in a conventional laboratory. The 1-ton, four-wheel-drive "cube van" lab houses a large selection of equipment, including two laptop computers with docking stations, a high-speed multi-channel data acquisition system with dedicated computer, and 120-volt A/C power supplied by a deep-cycle storage battery bank feeding a 3000 watt DC-to-AC power inverter, and a 4 KW RV-style generator. Web-enabled cell phone service and a 2-way radio provide communication support.

The mobile laboratory became operational in the summer of 2002, and is available to MSU faculty and student researchers from many disciplines across campus. Several WTI projects have utilized the van for research and support, and researchers from MSU's Center for Biofilm Engineering, the Thermal Biology Institute, and the department of Mechanical and Industrial Engineering are among the growing list of users. The lab should continue to support these and similar projects throughout its predicted operational life of 10 years.

Frontier

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Research and demonstration projects involving Intelligent Transportation Systems (ITS) technologies have primarily focused on applications of this technology in metropolitan environments to address problems such as congestion, mobility and incident management. The nation's rural highway system (two-lane highways) -- which comprises over 80 percent of road mileage in the U.S. and accounts for approximately 40 percent of all vehicle miles traveled each year - has largely been ignored with respect to ITS. An unproven assumption has been made that urban ITS applications are directly transferable to the rural highway environment to meet rural traveler needs.

Frontier deployments will help fill a major gap in ITS research by generating valuable data regarding the cost-effectiveness of using advanced technologies to address rural transportation issues.

The primary objective of this research effort is to prove that advanced technologies can be successfully transferred to rural environments. The project's approach is to deploy, on a small scale, appropriate ITS technologies in rural areas and document the resulting benefits. This information, when shared with other rural areas, can help to encourage rural travelers to embrace ITS solutions. Secondary objectives of this project are to encourage multi-state communication, cooperation and coordination; improve efficiency by reducing the tendency to "re-invent the wheel" from state-to-state; and advance the state-of-the-practice in rural ITS with regional deployment.

Phase I research has been completed and Phase II demonstration is currently in progress. The eight participating DOT's that comprise the Technical Advisory Committee selected two demonstration projects from 16 proposals, as follows:

- Rural Travel Time Estimation Project (Oregon), using Automatic License Plate Readers
- High Water Level Sensor Project (Texas), to notify maintenance personnel of impending flooding

Each of the projects has been deployed, and Phase III evaluation is under way, which will focus on the effectiveness of each concept, including traveler benefits, maintenance issues, and feasibility in rural environments.

Development of Test Protocols for Determining Intrinsic Geosynthetic Material Properties

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When designing any civil structure, it is necessary to determine the properties of the various material components under conditions pertinent to their eventual use. Geosynthetic reinforced earthen structures are no different. Standard tension tests currently exist to determine basic material properties of geosynthetics used to construct reinforced walls, slopes, embankments and other static structures. However, because these material tests apply slow monotonic loads at room temperature, they may not properly represent conditions pertinent to geosynthetic reinforced pavements. A number of research projects have been conducted in the past to investigate possible differences in material properties using various temperatures, confinements, load types, and strain rates. This research effort conducted an extensive literature review to study the effects of these four parameters on geosynthetic material properties. Additionally, material tests were conducted to determine how cyclic loading affects geosynthetic material properties. Modifications were made to the existing wide-width test protocols (ASTM D4595 for geotextiles, and ASTM D6637 for geogrids) to incorporate cyclic loads. These dynamic wide-width strain-controlled tension tests demonstrated great promise for providing values of elastic material properties. The results from these tests showed that the modulus of the geotextile materials changed at various levels of initial permanent strain, while the modulus of the geogrids remained relatively constant. Future testing will be conducted to further examine similar effects due to temperature, strain rate, load type and confinement.

These test protocols will allow researchers to more accurately characterize geosynthetic materials used as reinforcement in flexible pavements.

Animal-vehicle Crash Mitigation Using Advanced Technologies Pooled Fund Study

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Three methods have typically been used to reduce animal-vehicle collisions: (1) warn the driver of the hazard through warning signs or public education; (2) improve the driver's ability to react through reduced speed zones, vegetation clearances or improved lighting; or (3) limit animal presence on the roadway using fences, sometimes in combination with over- and underpasses, reflectors, scent and sound-based repellents, or reduced herd size.

With the advent of Intelligent Transportation Systems and an increased focus on technological solutions, many feel that alternative solutions to animal-vehicle crashes should be examined. The "Animal-vehicle Crash Mitigation Using Advanced Technologies Pooled Fund Study" was initiated to investigate the most promising roadway animal detection/driver warning systems. This study is funded by the Departments of Transportation of 15 states and the Federal Highway Administration.

This project evaluates whether new technologies are indeed a valuable addition to the existing spectrum of mitigation measures.

The Oregon Department of Transportation (ODOT), in cooperation with WTI, is the lead state for this research and demonstration project, which will result in the installation of prototype animal detection and driver warning systems and an evaluation of their effectiveness in reducing animal-vehicle crashes. The sites selected for demonstration are:

• Site #1 Montana, US 191, about 50 miles south of Bozeman/ Belgrade, MT where the predominate challenge is elk-vehicle collisions in the winter months. The system at this site was designed by Sensor Technology Systems.

• Site #2, Pennsylvania, US 322, about 35 miles northwest of Harrisburg, at a location with a known concentration of deer-vehicle collisions. The system at this site was designed by Oh Deer, Inc.

Progress in the past year has consisted of the following activities:

• The installation of an animal detection system along Hwy 322 in PA

• A series of modifications to both the MT and PA system.

• A follow-up project has been started that compares animal detection system technologies from different vendors under similar circumstances at the same location (Phase II).

• The publication of two papers on animal detection systems

Important lessons have been learned already regarding the design of animal detection systems, the partnership with vendors of experimental technologies, and the installation of these systems. Furthermore, a broad overview of experiences with operation and maintenance and other issues has been obtained from other sites throughout Europe and North America.

Completed Research Projects

Project Name	Principal Investigator
Canamex Smart Tourist Corridor	John Taylor
Statewide Demand-Response Software	David Kack
National Park Service Sustainable Transportation	Mike Kelly
Paratransit Operations Review	David Kack
Artemis Clearinghouse	Amanda Hardy
Winter Surface Condition Forecasting	Ed Adams

CANAMEX Smart Tourist Corridor

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As part of the North American Free Trade Agreement (NAFTA), Congress designated a number of trade corridors to stimulate economic development among Mexico, the United States and Canada. Ultimately the CANAMEX corridor will extend from Edmonton, Alberta to Mexico City. Within the U.S., the Corridor generally follows the Interstate System from the Canadian border at Sweetgrass, Montana, through Idaho, Utah, Nevada and ends at Nogales, Arizona - a distance of 1500 miles. The Governors of the five states created the CANAMEX Corridor Coalition (CCC), a policy level body, made up of a senior transportation official and a highly regarded entrepreneur from each state. The CCC commissioned the CANAMEX Corridor Plan with the goal of stimulating economic development, particularly in rural areas along the Corridor. The Plan, published in April 2001, identified a number of important initiatives that, if carried out, would achieve the overall goal.

By improving services to all travelers along a major trade corridor, this project developed and identified actions to enhance transportation safety and improve economic activity at the local, state and international level.

The CCC selected the initiative "Smart Tourist Corridor" to launch implementation of the Plan. This initiative utilizes Intelligent Transportation Systems (ITS) to significantly enhance information available to tourists and other Corridor travelers, as well as improve their safety. The CCC selected WTI to develop the Smart Tourist Corridor Action Plan.

This project has been completed. Three Technical Memoranda and the Final Report Plan were published. First, an array of services that must be available to tourists and other travelers was defined, and preliminary concepts were developed for innovative ways to make the information readily available (TM 1). Secondly, a Corridor Operations Plan was prepared; this element of the Plan inventoried what ITS devices and systems were available; analyzed existing operations on the Corridor; and made recommendations for improving incident management strategies, information exchange, telecommunications, and telematics (TM 2).

The final component identified the technological communications infrastructure necessary to assure that the elements of the Smart Tourist Corridor Action Plan provide the above services conveniently, efficiently and effectively. It also presented a prioritized list of recommended ITS deployments; these were published in TM 3 and the Final Report.

Statewide Demand-Responsive Software

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WTI recently completed a five-year service improvement plan for GALAVAN, a paratransit provider in Bozeman, Montana. One of the outcomes of that project was the development of a tailored client management software package for GALAVAN.

The software has the potential to assist other demand-responsive transit providers in Montana that have inadequate resources for efficiently tracking their clients and operations. Many of these providers are currently performing these data collection and reporting tasks by hand. The purpose of this project was to provide a one-year test of the GALAVAN client management software.

Tracking software will help small transit providers to measure the effectiveness of their operations, identify opportunities for improvement, and facilitate coordination of services.

In addition to GALAVAN, three other demand-responsive transportation providers in Montana were selected to participate in the test. At each site, WTI installed the software and provided technical training and assistance. WTI also evaluated the performance of the software and perform revisions based on input from users at the test site.

Information Technology to Support National Parks Alternative Transportation

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The National Parks are becoming increasingly crowded and congested, and the National Park Service is exploring ways to motivate visitors to use alternate forms of transportation (e.g., busses and trams). A recent survey of park visitors by WTI found that a significant percentage of visitor would be willing to ride on a more flexible system of transit busses in Yellowstone Park if it allowed riders to set their own itineraries and schedules.

Advances in computer and display technology may also provide a path to this goal. Portable computing and display devices are becoming increasingly common for travel and tourism applications such as location, route selection, and identifying nearby destinations and attractions, and can be expanded to provide interactive information concerning the flora, fauna, geography, geology, ecology, history, and culture of a tourism site.

This project is a preliminary step in designing an alternative transportation system that will be embraced and fully utilized by National Park visitors.

This project developed an innovative approach and survey methodology for exploring visitors' motivations for visiting recreational facilities such as National Parks. This methodology was then applied to a closely related WTI project exploring the features of an alternative transportation system, especially the information system component, for Yellowstone National Park.

During the initial effort, WTI developed a low-level prototype of a candidate Yellowstone Park portable information system based on the results of the completed front-end analysis. This project continued that effort through an additional design cycle to produce a higher quality and fidelity prototype. Additional functionalities were identified for an Internet-based prototype. The functionalities may be updated according to decisions made by the NPS on the operational philosophy of the alternative transportation systems. As part of this project, WTI became involved with the NPS alternative transportation process, and participated in three important outreach activities: (1) a national design symposium that developed requirements for the new NPS vehicles, (2) a symposium on information technology to support tourism and environmental education in the National Parks, and (3) a conference on advances in user interfaces to information technology. During this project, WTI maintained contact with NPS headquarters staff to remain abreast of design decisions that would affect the functional requirements for the portable information system, and to provide design inputs, based on the surveys and focus groups completed this summer.

Paratransit Operations Review (MET Transit)

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The purpose of this project was to identify technologies and other service improvements that could improve the effectiveness and efficiency of the MET Transit paratransit system in Billings, Montana. In particular, MET transit was interested in assessing the potential value of technologies such as new computer-aided scheduling and dispatching software, Automatic Vehicle Location (AVL) and Mobile Data Communications (MDC).

The technology plan developed through this project will likely serve as a model to many other paratransit providers in small urban or rural areas.

WTI conducted a review of MET Transit's operations and work flow, with particular emphasis on how rides are requested and assigned to vehicles. Researchers identified technologies that may enhance the efficiency of MET's operations, and surveyed other providers to document the benefits gained by and lessons learned from using those technologies.

The final report includes recommended strategies for the selection and purchase of technologies for a possible system for Billings.

ARTEMIS Clearinghouse

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Animal-vehicle collisions (AVCs) are an important issue in North America. The number of ungulate-vehicle crashes is estimated at 725,000-1,500,000 annually in the US, and these collisions cause a minimum of over 200 human fatalities, 29,000 human injuries and over one billion dollars in property damage a year, and these figures are likely to increase in the future. In addition to safety and economic impacts, there are ecological effects due to animal mortalities that result from these collisions. Some species may be affected at the population level and may face increased risk of local or regional extinction due to the high number of road-kills and other negative effects of roads and traffic.

Understanding the relationship between transportation systems, wildlife, and effective mitigation strategies is important in order to plan for safe and ecologically sustainable roadways. Various countermeasures such as signing, fencing and animal crossings are being applied and evaluated by state departments of transportation and other organizations. These mitigation measures can vary greatly in effectiveness but unfortunately, many agencies attempting to deal with animal-vehicle collisions do not have readily available information regarding mitigation options, their effectiveness and "lessons learned" from other deployments.

The ARTEMIS Clearinghouse efforts incorporated into the Wildlife Crossing Structures Toolkit will greatly expand the information resources available to transportation agencies trying to research and evaluate wildlife mitigation options. These coordination efforts also build a foundation for ongoing research and information exchange in the field of wildlife mitigation.

The Western Transportation Institute (WTI) created the Artemis Clearinghouse to provide an on-line searchable database of information about animal-vehicle collisions and mitigation options. The intent of Artemis was to serve other universities and research institutes, transportation professionals and resource managers that may be considering techniques to mitigate animal-vehicle collisions.

While WTI was developing the Artemis Clearinghouse, other institutions were simultaneously developing similar on-line searchable databases. Recognizing the opportunity to maximize resources, build synergy, and create a more comprehensive and useful product, WTI, the USDA Forest Service, and Utah State University partnered to modify Artemis from a centralized clearinghouse into a collaborative and nationally coordinated effort. Throughout 2003, WTI worked with these partners to merge 62 case studies from Artemis into The Wildlife Crossing Toolkit (http://www.wildlifecrossings.info). Users can find information on wildlife mitigation deployments, including the location of the project, general description, benefits, costs, issues, and contacts.

Winter Surface Condition Forecasting

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The Western Transportation Institute and Civil Engineering faculty at MSU, in consort with external partners, is in an ongoing development of a pavement temperature model for highways. The goal of the University Transportation Center's (UTC) winter surface condition program was to extend the knowledge that has been gained in the winter highway forecasting of pavement temperatures modeling and draw upon the well established snow and ice competency which has historically been a strength at MSU.

The practical highway safety concern with regard to the thermal modeling effort is not temperature per se, but the associated icing conditions that may result. The highway thermal model is a state of the art development that is (to our knowledge) leading the field in this type of analysis. The project began "operational" testing with the Montana Department of Transportation on Bozeman Pass in the winter of 2001- 2002. It now runs in a forecast mode that utilizes a National Weather Service forecast that is, subsequently, spatially refined to yield a weather forecast at the 1 km2 scale. The actual terrain/road surface forecast is finally accomplished at a 30 m resolution; a scale based on standard U.S. Geologic Survey digital elevation maps. The strength of the model is the ability to deal with the effect of topography, including influences such as shadowing and wind. This is a computationally expensive analysis; however, new equipment reduced the pressure on the College of Engineering computers and provides faster calculations. Funding for the computational equipment was pooled between a National Science Foundation grant, the Civil Engineering Department and the Western Transportation Institute (UTC) funds.

This project developed testing procedures, equipment and models that improve our ability to identify and analyze the factors that affect road surface conditions during winter weather.

The UTC plan allowed WTI and MSU to pursue some of the more fundamental work required to work toward an ever more robust thermodynamic analysis of winter conditions along roads and highways. To this end, a specially designed low temperature environmental chamber was developed. The purpose of the chamber is to provide a means to examine the influence of environmental and meteorological parameters that influence winter road and adjoining terrain conditions. The chamber provides a test area on the order of 1 m2 on which experiments may be conducted. The unit provides fully programmable temperature and solar radiation input to allow for simulation of, for example, an ice-covered or wet road subjected to diurnal cycling. Albedo, which is a measure of the amount of radiation absorbed or reflected from a surface, is a necessary parameter when computing the thermal calculation for a material. Realistic values of the highly variable and dynamic properties of snow or ice covered pavements are paramount to modeled accuracy. Contaminants such as sand or chemicals used in maintenance operations may be considered in regard to albedo and how and where melting or potential disbanding of ice may take place on a road. The test apparatus will be of great potential benefit to the field of winter highway safety. Changing surface conditions on snow surrounding a roadway is also significant, since the albedo of a snowcover directly influences reflected energy available to the road. These textural changes also influence the potential for avalanches and flooding due to snowmelt. The cold chamber will be of long term utility potentially for such studies as thermal shock on pavement, springtime break-up and deterioration due to freeze thaw and solar radiation.

Cumulative List of Completed Research Projects (10/1/1991 - 9/30/2004

Statewide Demand-Response Software	David Kack
Winter Surface Condition Forecasting	Ed Adams
Galavan Service Improvement Plan	Lisa Ballard
Canamex Smart Tourist Corridor	John Taylor
Personal Digital Assistants for Emergency Medical Services Providers	Steve Albert
National Park Service Sustainable Transportation	Mike Kelly
Paratransit Systems Operation Model	Ed Mooney
Montana Department of Transportation Maintenance Process Improvements	Steve Albert
Public Safety & Communications State of the Practice	Greg Cross
Paratransit Operations Review	David Kack
Artemis Clearinghouse	Amanda Hardy
Tribal Transportation and Safety Needs Survey	Christopher Strong
Numerical Modeling and Design Development of Geosynthetic Reinforced Flexible Pavements	Steve Perkins
Safe Passage: Development and Demonstration of a Rural Weather Prediction Model and Motorist Communication System for Safe and Efficient Traffic Management/Infrastructure Maintenance	John Mounce
Application of CT Scanning Technology to Highway Icing	Ed Adams
Field Study to Evaluate Intrusion Detection Technology: Intersection Crash Avoidance	Kate Hunter-Zaworski
Development of a Surface Transportation and Weather Decision Support Tool and Strategic Plan for Improved Highway Operations in Montana	Lisa Ballard
A Rating System for Rural Culvert Crossing Repair and Maintenance	Joel Cahoon
Characterizing Commercial Vehicle Safety in Rural Montana	Jodi Carson

Summaries of these completed projects are included in this or previous editions of the WTI - UTC annual report.

Laboratories Enhance WTI's Ability to Conduct Rural Transportation Research

WTI made significant expansions to its onsite research facilities this year through the creation of two new research laboratories:

• The Driving Simulation Laboratory - the only one of its kind in the Pacific Northwest - allows testing of driver performance and behavior in the safe and controlled environment of the laboratory.

• The Materials Corrosion Laboratory allows WTI to study transportation-related corrosion issues, such as the corrosive effect of deicers to vehicles, pavements, and rebars in concrete structures.

The addition of these laboratories further develops WTI's research "infrastructure" - facilities and equipment uniquely suited to conducting rural transportation research. When combined with other successful laboratories - a customized Cold Region Laboratory Weather Chamber, a mobile laboratory for field research, and custom-designed video surveillance trailers - these facilities establish WTI as a premier center for investigating and resolving rural transportation challenges.

These laboratories have benefits for all aspects of the UTC program. The ability to conduct specialized research facilitates collaborations and attracts multi-disciplinary projects from around the country. The presence of these laboratories on a university campus enhances WTI's educational program, and makes MSU a destination campus for students and faculty specializing in transportation. The ability to continually test new technologies in an on-site laboratory setting accelerates the transfer of findings and products to real transportation challenges.

Research Forum to Identify Emerging Rural Needs

One of WTI's strengths is our ability to conduct rural research on behalf of departments of transportation (DOT's) that are small or whose research is focused on the urban environment. Through the years, WTI has successfully responded to numerous requests to develop practical solutions to rural transportation challenges faced by these DOT's. WTI has the in-house skills, resources and flexibility to address these needs as they arise.

WTI is now working to develop a more strategic, long-term approach to identifying the rural research needs of state DOT's. In the upcoming year, WTI will host and lead a forum in which DOT representatives from several states and WTI staff will exchange and develop research ideas. The DOT staff members will bring their firsthand knowledge of challenges that exist in the field, so that WTI can understand exactly what research needs to be done and why.

This forum has many potential benefits, including:

- Identifying emerging needs in at state DOT's, so that WTI's research can move from a reactive approach to a proactive approach
- Identifying common needs among states, in order to pool research efforts and resources
- Involving DOT technical and maintenance staff early in the research process, to facilitate the transition from design to successful implementation of new technologies
- Matching research needs to WTI's large network of multi-disciplinary resources within WTI and Montana State University
- Providing improved service to state DOT's, as well as strategic direction and leadership to the field of rural transportation research.

Education

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

Education Program

The Western Transportation Institute offers students a diversity of unique opportunities to explore the field of transportation through research, education, and professional development activities. The Civil Engineering Department at Montana State University offers transportation coursework in a variety of areas, including highway and traffic engineering, transportation planning, infrastructure design, geotechnical engineering, and transportation safety. Student classroom learning is enhanced through research activities at WTI, which offer experiential learning. Paid research opportunities, opportunities for student travel to professional conferences, sponsorship of organized transportation technical tours, and support of other professional development activities for students in transportation facilitate recruitment efforts. In order to encourage greater diversity among students entering the transportation field, K-12 outreach efforts focus on underrepresented groups in engineering.

Student Research Involvement

WTI provides students with opportunities to produce useful real-world research in areas relevant to improving rural transportation. Students are able to fund their education through paid research assistantships; undergraduate scholarships; and graduate and professional advancement fellowships. At the same time, they gain invaluable experience working on innovative interdisciplinary research projects at WTI under the mentoring of experienced faculty and professional research staff.

Transportation research is a multidisciplinary field; as such, WTI student researchers represent a variety of academic departments, including: civil, mechanical, industrial, and electrical engineering, computer science, and ecology. In 2003-2004, thirty undergraduates and twenty-four graduate students were involved in transportation research projects at WTI, providing research assistance on 42 different projects. Fifteen graduate students directly benefited from WTI's graduate fellowship program, which is intended for exceptional students interested in pursuing a transportation-related degree. Fellowship students receive a full tuition and fee waiver for three academic semesters as well as a monthly stipend.

A new fellowship opportunity was developed in 2003 in cooperation with the Wildlife Conservation Society (WCS). WCS and WTI pooled funds in order to provide two years of academic support to a Native American graduate student from the Flathead Reservation of the Confederated Salish and Kootenai Tribes (CSKT). The fellowship recipient will study wildlife crossing issues along U.S. Highway 93, which cuts through the Flathead Reservation.

Eight undergraduate students were given the opportunity to participate in transportation research at WTI through the Research Experience for Undergraduates (REU) program. The REU program is partially funded by the National Science Foundation (NSF) and brings undergraduates from various universities nationwide to WTI for a ten-week intensive summer research program. The REU program serves to attract high quality and diverse undergraduate students from outside MSU to participate in innovative interdisciplinary research projects while learning more about the transportation field.

Student Research Involvement

Project	Undergraduate	Graduate
Assessment of Wildlife-Transportation Impacts and Prioritization of Potential Migration Efforts in the Greater Yellowstone Ecosystem	1	
Assessment of Road Impacts on Wildlife Populations in U.S. National Parks	1	
Big Sky Snow Express	1	
Bozeman Pass Wildlife	3	6
Canamex Smart Tourist Corridor	1	
Compressibility and Heave Characteristics		2
Crack Sealing Cost Effectiveness		1
Development of Test Protocols for Determining Intrinsic Geosynthetic Material Properties		1
Economic Feasibility of Biodiesel in Montana	1	
Evaluating Driver Distraction		1
Evaluating RWIS Pavement Sensors		1
Evaluation and Assessment of the Permeability Characteristics of RAP/Aggregate Blends for Use as Sub-base in Highway Pavement Sections	1	
Fish Passage at Road Crossings in Montana Watersheds Providing Bull and Cutthroat Trout Habitat	1	
Fredonyer Summit Evaluation (COATS Showcase)	1	
Geosynthetic Pullout Behavior	2	1
Greater Yellowstone Rural Intelligent Transportation Systems Corridor	1	1
Greater Yellowstone Regional Traveler and Weather Information System		2
Guidelines for Bilingual Traffic Signs	1	
Investigation of Traffic Control Operations at Single Lane Closures on Two-Lane, Two-Way Rural Highways	1	
ITS Applications in California National Parks		1
Maintaining ITS Devices (COATS Showcase)	2	1
MDT Emergency Operations and Disaster Plan		1
Mobile Laboratory	2	
Montana Three City Parking Generation/Land Use Correlation Study	1	
MPART Biodiesel		1
North American Wildlife Crossing Structures	3	1
NOVIS Evaluation (COATS Showcase)	1	1
ODOT/UTC Showcase #21	1	
Operational Impacts of Weather on Highway (COATS Showcase)		2
Pavement Marking Feasibility Study	1	
Redding Incident Management Responder		1
Saco Bridge Instrumentation	1	2
State Trucking Activities Reporting System (STARS) Evaluation	1	
Systems Change		1
Timely and Effective Dissemination of Traveler Information in Rural Areas		1
Transportation Toolkit for Federal Lands Managers	1	
Urban Traffic Classification Study	7	2
US 93 Wildlife Crossing Structures	2	2
Video Surveillance Trailers		1
Weather Severity Index	1	
Wind Warning Evaluation (COATS Showcase)		3
Winter Traction Materials	1	1

Student Professional Development Activities

Conferences and Travel

WTI seeks to attract and prepare students for careers in the transportation field by sponsoring student professional development activities. Student participation at professional conferences exposes students to the latest developments in transportation research and facilitates student interaction with professionals currently working in the transportation field. WTI sponsored travel for 47 students to attend a number of professional conferences and meetings over the past year. Student professional conference and meeting attendance in 2003-2004 is detailed in the table below.

Date	Conference/Meeting	Student Attendance
November 2-5, 2003	ITE field trip and technical tours; Phoenix, AZ	18
January 10-15, 2004	TRB Annual Meeting, Washington, DC	7
May 20-23, 2004	ITE Intermountain Section Meeting; Jackson, WY	16
June 5-10, 2004	Transportation Research Board 6th Symposium on Snow Removal and Ice Control Technology; Spokane, WA	1
June 6-10, 2004	Women in Engineering Programs and Advocates Network (WEPAN) Annual Meeting; Albuquerque, NM	1
June 19-23, 2004	REU field trip and technical tours; Seattle, WA	8
June 19-23, 2004	ITE District 6 Meeting	6
July 20-23, 2004	TRB Task Force Meeting on Transportation Needs of National Parks and Public Lands	8
July 30-August 4, 2004	ITE International Annual Meeting; Orlando, FL	8

In addition to conference participation, students had the opportunity to visit transportation facilities, meet with transportation professionals at their work place, and see transportation technologies in action during two field trips sponsored by WTI. Eighteen MSU students had the opportunity to tour transportation facilities in Phoenix, Arizona during the ITE Student Chapter's field trip in November 2003. Eight students visited various transportation agencies in Seattle, Washington during technical tours organized for 2004 REU program participants. Additional details on these field trips are provided below.

Phoenix, Arizona

Eighteen MSU-ITE Chapter members traveled to Phoenix, Arizona in order to view a traffic operation center (TOC) still under construction in the City of Glendale and a completed TOC in Phoenix. The students also attended an informational presentation on light rail implementation in Phoenix and toured the Valley Metro Transit Operations Center. During the field trip, students were able to meet ITE members from the University of Arizona.

Seattle, Washington

Eight REU participants toured the Washington Department of Transportation Seattle Area Traffic Management Center, the King County Transit Center, and the Ferry Systems Operation Center during technical tours in Seattle that introduced them to intermodal traffic management strategies. Transportation professionals from King County Transit also presented information to the students on their development of an innovative on-line transit trip planner. Finally, students were able to see the manufacturing process for commercial aircraft at the Boeing Everett Center.

Professional Speakers

Additional professional development opportunities for MSU students included guest speaker presentations. In February, John Mounce from the Texas Transportation Institute spoke to the MSU-ITE student chapter about traffic safety challenges for rural states like Montana.

Outreach

WTI continues to actively participate in K-12 outreach events, particularly those aimed at recruiting underrepresented groups in engineering to the transportation field. A number of hands-on activities were developed in order to excite students at various grade levels about possible careers in transportation engineering. Over the past year, approximately 300 elementary and middle school aged pupils were presented with various transportation challenges and had the opportunity to design, build, and test their own solutions to these challenges during organized events. These activities are described in greater detail below.

Bridges and Dams

Undergraduate and graduate level female engineering students at MSU were trained to facilitate hands-on workshops for Brownie troops and second and third graders at rural schools in Montana as part of an eighteen month outreach initiative to interest young girls and Native American youngsters in engineering. The "Bridges and Dams" workshops incorporated a number of activities and demonstrations to illustrate how civil engineers use science and math to design solutions to everyday problems. Twenty-four engineering students from MSU participated as facilitators and approximately four-hundred second and third graders attended workshops over the course of the program.

Expanding Your Horizons

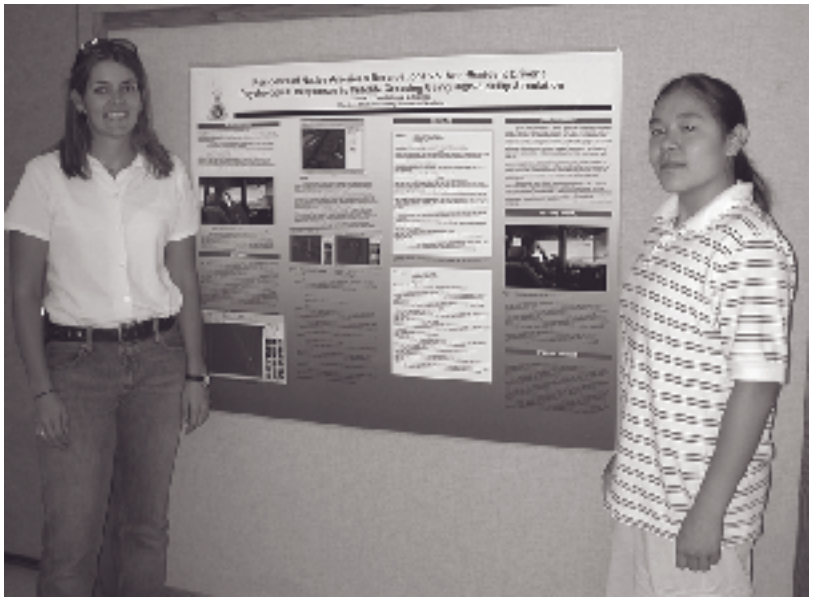
Expanding Your Horizons is a one-day event held on the MSU campus each year to interest junior high school girls in math and science related careers. As part of the event, WTI introduced and demonstrated some basic mechanics principles used in bridge deck design. Using bridge design software, the workshop participants were then able to implement these ideas by designing and testing their own bridge designs using the computer program. Thirty 7th-8th graders participated in the workshops during the event.

Peaks and Potentials

Each summer, junior high school students come to the MSU campus for a week of educational activities during Peaks and Potentials, a program designed to provide a campus experience for students who wish to pursue special topics of interest. In June 2004, sixteen 5th-7th graders explored the world of transportation engineering during a week of activities that explored highway design, highway safety, and bridge design. The following week, nine 8th-9th graders worked as teams of automotive engineers, creating small motorized vehicles while exploring gear ratios and their effect on vehicle performance.

Montana Apprenticeship Program (MAP)

The College of Engineering (COE) at Montana State University is actively recruiting and supporting Native American students through the "Designing Our Communities" and Montana Apprenticeship (MAP) programs. The MAP program brings high school students from tribal regions to the MSU campus for the summer. The students take math and science courses and perform research activities in various MSU laboratories. Zhona Tang, a high school student from Busby, Montana, spent her summer at WTI, conducting a research project entitled "Residents of Native American Reservations vs. Non-Resident Drivers' Psychological Responses to Wildlife Crossings." She worked on her project under the mentorship of WTI fellowship recipient Laura Stanley, who assisted Zhona in designing her research question, testing subjects using the driving simulator, and analyzing her results. Zhona presented her research during a poster session at the conclusion of the program.



Student Project Support

For the second year in a row, WTI supported the MSU American Society of Civil Engineers (ASCE) Student Chapter's bid to construct a winning concrete canoe and steel bridge. After coming home with a second place ribbon last year, the ASCE students paddled to success at the regional ASCE competition in April in Klamath Falls, Oregon, earning them the privilege of traveling to Washington, DC in June to compete at the national level.

In a second student project follow-up, WTI sponsored Phase II of the MSU Electric Vehicle Project. Phase I of the project involved conversion of a truck into an electric, battery-operated vehicle and analysis of performance data. Students from MSU's Technology Education Program designed and implemented the project. Phase II involves the addition of photovoltaic cells to the truck in order to supplement the existing battery system. The addition of solar panels will increase the efficiency and range of the electric vehicle. In addition to students from Technology Education, Electrical Engineering students from MSU will participate in Phase II of the project, which is scheduled to be completed in the spring semester of 2005.

Student Success Stories

Doctoral student Laura Stanley is an excellent example of a student successfully combining academic study with hands-on research experience at WTI. While working towards a Ph.D. in Industrial and Management Engineering, Laura has conducted extensive research in WTI's new Driving Simulation Laboratory. As a result, she has had numerous opportunities to present her findings at professional conferences.

This year, she received the Best Student Paper award at the Institute of Transportation Engineers Intermountain Meeting in Jackson, WY for her paper entitled Shifting the Design Paradigm to Accommodate Older Drivers. She was also named as a finalist for the prestigious Energy Absorption Systems/Quixote Best Student Paper Award and has been nominated for an ENO Transportation Foundation Leadership Development Program Award.

Education Initiatives for 2005

After the successful implementation of the Research Experience for Undergraduates (REU) program over the summers of 2003 and 2004, WTI will use the REU model to develop a year-long research program for high potential undergraduates at MSU. Students selected for the program will learn project management, technical presentation, and technical report writing skills as they work one-on-one with a research mentor from WTI on a transportation research project.

The successful and popular Bridges and Dams outreach program for second graders, which involved MSU students as workshop facilitators, will be used as a model in order to recruit and involve student professional organization chapters on campus in K-12 outreach initiatives.

A course on wildlife crossing structures will be developed to expand knowledge among practicing transportation professionals about best practices and current research in this field. Additional courses will be developed in order to create and implement a road ecology curriculum at Montana State University.

Student of the Year Award

Each year, the Research and Special Programs Administration of the U.S. Department of Transportation presents a "Student of the Year" award to one student from each University Transportation Center. The nominees are selected based on their accomplishments in research, academic performance, professionalism, and leadership. Peter Smolenski received this prestigious award in 2004.

Peter completed his Masters of Science degree in Mechanical Engineering at Montana State University in the summer of 2004. He was supported for two years by a Graduate Fellowship from the Western Transportation Institute (WTI) and was involved in a research project investigating deck responses of three newly-constructed bridges in Montana, designed with different deck compositions. The breadth of skills required for this project served to promote a comprehensive Master's program for Peter. His many contributions began with a focus on the instrumentation and data acquisition components of the project. Later, his efforts were directed toward the analysis of data obtained from the bridges before they were opened to traffic. Peter constructed a finite element model to analyze differences among the three bridge deck types and compiled the results of his analysis into a thesis paper.

Peter's involvement with transportation related research has shown him that the applications of his engineering background extend much further than he imagined. His professional interests now include finite element analysis, structural behaviors, programming and instrumentation. His experience at WTI has inspired him to pursue a career in research. Peter is a member of Pi Tau Sigma, Alpha Lambda Delta and National Society of Collegiate Scholars honoraries.

Technology Transfer

"To increase the availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied."

Technology Transfer Program

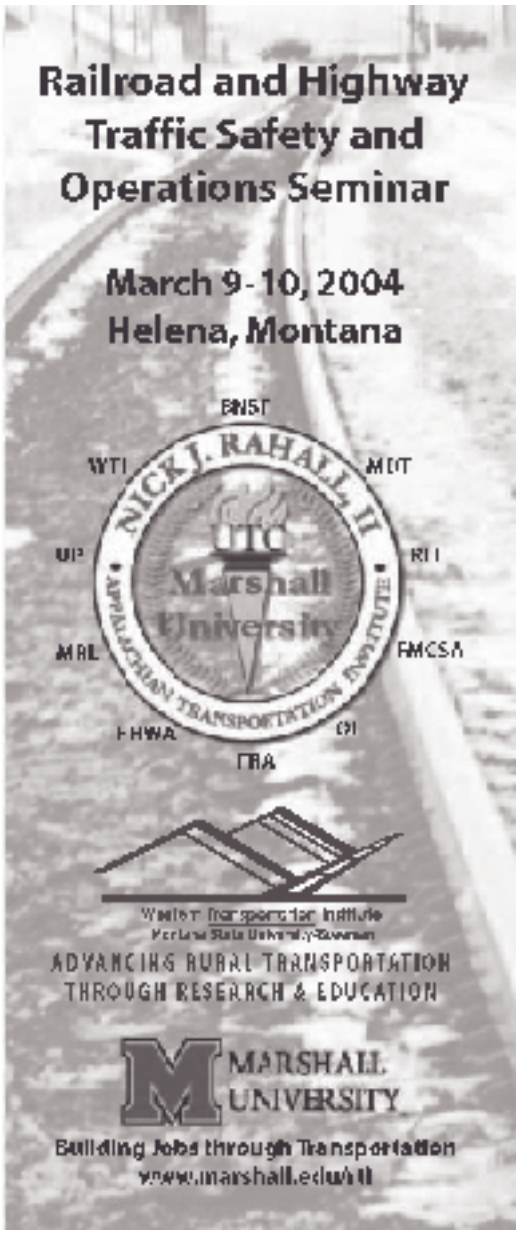
WTI has traditionally conducted technology transfer through presentation of research at national forums, hosting technical workshops, and disseminating information through print and electronic media. This year, WTI continued these successful efforts while investigating refinements that will target information to specific audiences and respond to the current needs of transportation professionals.

Workshops

Traffic Safety and Operations Seminar

In March 2004, the Rahall Transportation Institute (Marshall University) and WTI sponsored a Railroad and Highway Traffic Safety and Operations Seminar in Helena, Montana. Additional sponsors included BNSF Railroad, FHWA, Federal Motor Carrier Safety Administration, Montana Department of Transportation, Montana Rail Link, Operation Lifesaver, and Union Pacific Railroad.

Instructors at the two-day event presented short courses on the key aspects of design, construction, maintenance, and temporary traffic control for both highway and railroad facilities. Fifty-seven participants attended the seminar, which serves as a continuing education course for current transportation practitioners.



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Collecting Vehicle Speed Data by Using Time Lapse Video Recording Equipment. Transportation Research Record 1855, *Transportation Research Board*, National Research Council, Washington DC, 2003, pp. 97-104.

Presentations

Steve Albert
- "CANAMEX Smart Tourist Corridor", WASHTO 2004 Conference, Kalispell, MT, July 2004
- "Improving Highway Safety with ITS", ITS America 2004 Annual Meeting, San Antonio, TX, April 2004
- "Transportation Maintenance and Operations Research", WASHTO Maintenance Conference, Bozeman, MT, March 2004
- "Converting National Visions into Reality", Surface Transportation Weather Workshop, Grand Forks, ND, August 2004

Lisa Ballard
- "Responding to Weather Information", Forum on Weather and Highways, Washington DC, November 2003
- "Basics of the Western Transportation Institute", Forum on Weather and Highways, Missoula, MT, November 2003
- "Coordinating Transportation in Montana", Transportation in Montana Conference, Miles City, MT, April 2004
- "Analysis of RWIS Users in California and Montana", TRB Sixth International Symposium on Snow Removal & Ice Control Technology, Spokane, WA, June 2004

Tony Clevenger
- "Corridor Conservation and Highway Mitigation in the Canadian Rockies", Interstate 90 Wildlife Bridges Coalition, Seattle, WA, August 2004.
- "Research and Monitoring the Effectiveness of Trans-Canada Highway Mitigation Measures in Banff National Park, Alberta, Canada", Annual meeting of Alberta Society of Professional Biologists, Calgary, Alberta, March 2004.
- "Long-term, Year-round Monitoring of Wildlife Crossing Structures and the Importance of Temporal and Spatial Variability in Performance Studies", Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004.

Eli Cuelho
- "Geosynthetics", Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004
- "Saco Bridge Update", Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004

Jaime Eidswick
- "Message Sets for MT DMS", WASHTO 2004 Conference, Kalispell, MT, July 2004
- "511 Travel Information Phone Number" American Business Women's Association Big Sky Chapter Meeting, Helena, MT, September 2004
- "Research Experience for Undergraduates in Rural Transportation", Society of Women Engineers (SWE) Annual National Conference, Birmingham, AL, October 2003
- "511 Montana Evaluation", National511 Conference, Kentucky, October 2003

Susan Gallagher
- "Research Experience for Undergraduates (REU) in Rural Transportation Research", Women in Engineering Programs and Advocates Network (WEPAN) National Conference, Albuquerque, NM, June 2004
- "Research Experience for Undergraduates in Rural Transportation", Society of Women Engineers (SWE) Annual National Conference, Birmingham, AL, October 2003

Amanda Hardy
- "Avoiding, Mitigating, Compensating for Transportation Impacts to Wildlife", Western Conservationists' Wildlife & Highway Workshop, Chico, MT, November 2003
- "Evaluating effectiveness of wildlife crossing structures and fencing on US 93, Flathead Reservation, Montana", Infra Eco Network Europe Conference, Brussels, Belgium, November 2003
- "Wildlife Passages 101", Maine Audubon Society Wildlife & Roads Workshop, Portland, ME, January 2004

Marcel Huijser

- "Overview of Animal Detection and Animal Warning Systems in North America and Europe", International Conference on Habitat Fragmentation due to Transport Infrastructure, Brussels, Belgium, November 2003
- "Overview of Animal Detection and Animal Warning Systems in North America and Europe", Transportation Research Board 83rd Annual Meeting, Washington DC, January 2004
- "Overview of Animal Detection and Animal Warning Systems in North America and Europe", 2004 Western Association of State Highway and Transportation Officials (WASHTO) Conference, Kalispell, MT, July 2004
- "Transportation and Ecology: Effects and Potential Avoidance, Mitigation and Compensation Strategies", Wild Rockies Field Institute, Swan Valley, MT, July 2004

David Kack

- "Overview of WTI", Transportation Summit, Helena, MT, April 2004
- "Transportation Coordination and Technology", Community Transportation Association of America (CTAA) Conference, Seattle, WA, June 2004

Mike Kelly

- "User Requirements for Information Systems to Support Alternative Vehicles in the National Parks", Human Factors and Ergonomics Society Annual Meeting, Denver, CO, October 2003

Manjunathan Kumar

- "Maintenance of ITS Devices in Rural Areas: Case Studies", National Rural ITS Conference 2004, Duluth, MN, August 2004

Pat McGowen

- "Greater Yellowstone Rural ITS (GYRITS) Phase Two Results: Evaluation of Various Demonstrations", National Rural ITS Conference 2004, Duluth, MN, August 2004
- "Narrows Oversize Vehicle Identification Systems", National Rural ITS Conference 2004, Duluth, MN, August 2004

Robert Mokwa

- "Experimental evaluation of the frost heave phenomena". 39th Annual Symposium on Engineering Geology and Geotechnical Engineering, Butte, MT, May 2004

Steven Perkins

- "Design of Reinforced Unbound Base Course Aggregates", European Cooperation in the Field of Scientific and Technical Research, Committee on Reinforcement of Pavements with Steel Meshes and Geosynthetics, Munich Germany, March 2004
- "Evaluation of Base-Reinforced Pavements Using a Heavy Vehicle Simulator", National Research Council, Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004.
- "Flexible Pavement Design", Lund Institute of Technology, Lund Sweden, March 2004

Laura Stanley

- "Shifting the Design Paradigm to Accommodate Older Drivers", Annual National Occupational Research Agenda Symposium, Salt Lake City, UT, April 2004
- "Shifting the Design Paradigm to Accommodate Older Drivers", ITE Intermountain Meeting, Jackson, WY, May 2004
- "Assessing Opinions, Experiences and Perspectives of Females Nationwide Via a Web Based Questionnaire", Women in Engineering Programs and Advocates Network (WEPAN) National Conference, Albuquerque, NM, June 2004

Chris Strong

- "Lessons Learned from Select California National Parks", 2004 National Rural ITS Conference, Duluth, MN, August 2004
- "Rural Toolbox Training", ITS Oregon Annual Meeting, Bend, OR, October 2003
- "Applicability of ITS in National Parks: California Case Studies", ITS America 2004 Annual Meeting, San Antonio, TX, April 2004
- "California-Idaho Advanced Trans System COATS Showcase Projects", ITS Oregon Annual Meeting, Bend, OR, October 2003
- "Tribal Governments Intelligent Transportation Systems Workshop", ITS Workshop for Indian Reservations, Lemoore, CA, January 2004
- "Assessing Needs and Identifying Opportunities for ITS Applications in California's National Parks", Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004
  "Tribal Transportation and Advanced Technology Initiatives in Montana", Transportation Research Board 83rd Annual Meeting, Washington, DC, January 2004

Conference Booths

The WTI booth was displayed at three conferences during the past year. In order to reach a new audience, the WTI booth was displayed at two Western Association of State and Highway Transportation Officials (WASHTO) meetings, which are primarily attended by Department of Transportation employees. These meetings were an excellent opportunity to tell the DOT's about our past work and look for new ways of partnering in the future. WTI also had a booth at the National Rural ITS Conference, which is attended by a wide audience sharing a common interest of advancing the state of the practice in rural transportation.

WASHTO Standing Committee on Maintenance Annual Meeting

The Western Association of State and Highway Transportation Officials (WASHTO) Standing Committee on Maintenance held their annual meeting March 29th- 31st at the Wingate Inn in Bozeman, MT.

General committee business included the state reports from the past year and a business meeting to discuss the selection of presentations for WASHTO National, the report from the nominating committee, locations for future meetings, and other business.

Presentations at this meeting included the following.

- DOT Pavement Preservation Program by Mr. Mike Bousliman, MDT
- MDT Transportation Awareness Program (TAP) by Ms. Prudy Hulman, MDT
- Overview of Current Maintenance Decision Support Systems (MDSS) by Mr. Leon Osborne, UND RWIC
- Traffic Control in Support of Wild Fires by Mr. John Bell, US Forest Service
- WSDOT Vegetation Control (no spray) by Mr. Robert "Chris" Christopher, WSDOT
- US Forest Service Vegetation Control (weed free) by Mr. John Bell, US Forest Service
- NMDOT Pay for Performance Striping by Mr. Ernest Archuleta, NMSHDT
- Transportation Maintenance and Operations Research by Mr. Steve Albert, Western Transportation Institute
- Dynamic Message Signing in Wyoming by Mr. Ken Shultz, WY DOT
- Operational Messaging for Dynamic Message Signs (DMS) by Chris Christopher, WSDOT; John Blacker, MDT; Ken Shultz, WYDOT; John Forman, SDDOT
- NMSHDT Road Features Inventory by Mr. Ernest Archueta, NMSHDT
- SDDOT Deicer Experience by Mr. John Forman, SDDOT
- NDDOT Use of Dozers for Snow Drift Control by Mr. Jerry Horner, NDDOT
- TXDOT Maintenance Supervisor Classification Process by Mr. Joe Graff, TX DOT
- Development/Update Department MMS System by Mr. Dennis Ortiz, NMSHDT
- MDT Maintenance Training Academy for EEO and Construction Technicians by Ms. Lynn Miller, MDT

This was a very productive meeting with extensive open discussion following each presentation, giving attendees an excellent opportunity to share lessons learned. The DMS panel was such a learning experience it was presented again at the WASHTO Annual Meeting. WTI sponsored a group lunch to encourage attendees to stay together and on-site between sessions. The lunch provided an opportunity for attendees to make contacts, identify partnership opportunities, and share information in a casual setting.

WASHTO Annual Meeting

The Annual Western Association of State Highway and Transportation Officials (WASHTO) Meeting was held July 18-21, 2004 in Kalispell, Montana, with a theme of partnering for progress. More than 300 people attended the conference and 40 vendors displayed their products. Several social events were held as well as a technical tour of US 93 where an extensive reconstruction project is being conducted in an environmentally and culturally sensitive corridor.

Sessions included the following.

- Transportation Challenges Due to Changes in Border Security
- Asset Management Advances in WASHTO States
- Innovative Maintenance Practices and Activities
- Transit Coordination - Progress in WASHTO States
- Partnering in Western Corridor Development
- Workshop on Forest Service Transportation Management Systems
- WASHTO Challenge #1 - Management Team Building II
- Innovations in Paving and Plant Mix
- Developments in Expedited Project Delivery
- WASHTO Challenge #2 - Asset Management Self Assessment Workshop
- CEO Roundtable: Lessons Learned in Streamlining & Stewardship
- Comparative Performance Among DOTs - NCHRP Workshop
- Consideration of Environmental Issues in Transportation Planning
- WASHTO Challenge #3 - Progress in Safety: Poster Session
- Accelerated Construction Technology Transfer Update
- Terrestrial Ecosystems Connectivity Through Transportation Corridors
- Issues in Commercial Movement Productivity - SCOH-Transport Sponsored
- Aquatic Ecosystems Connectivity Through Transportation Corridors
- WASHTO Innovations
- Viewpoints on Legislation

WTI staff and affiliated faculty members Steve Albert, Marcel Huijser, Jaime Eidswick and Joel Cahoon presented at this conference. These presentations as well as many others from this conference can be found at: http://www.washto2004.org/net/external/presentations/

National Rural ITS Conference

(Article courtesy of ITS America, www.itsa.org)

The 2004 National Rural ITS Conference (NRITS) was held August 22-24, 2004 in Duluth Minnesota and provided nearly 350 attendees with information on ITS applications for roads and transit in rural areas of the United States. The conference was sponsored by ITS Minnesota with the assistance of ITS America, the U.S. Department of Transportation, the Minnesota DOT and the Center for Transportation Studies at the University of Minnesota. This article provides some highlights from the technical sessions.

The session on Rural Intersection Collision Avoidance featured an interesting report on the University of Minnesota's Rural Intersection Decision Support system (IDS). The Weather and ITS session focused on three different topics that are highly related to rural areas. Leon Osborne of Meridian Environmental Technologies reported on the multi-state Maintenance Decision Support System (MDSS) project in the upper Midwest. Bruce Shiver of ThomTech Design, Inc. reported on his company's automated roadway closure system. Ray Murphy of the Federal Highway Administration's Resource Center reported on the National Highway Visibility Conference that was held in May in Madison, Wisconsin. The conference focused on ITS solutions to visibility issues (especially fog), as well as lessons learned and projects from throughout the U.S. (as well as internationally) dealing with visibility issues on highways and how technology can help. The open forum session featured three different reports. Pete Costello of PBS&J reported on the 511 Deployment Coalition's work. Steve Gordon of the Oak Ridge National Lab-

oratory reported on statewide/rural ITS deployment. Lisa Ballard reported on work she did at the Western Transportation Institute on a concept for the Greater Yellowstone Tour District, which is focused on tourism and transportation issues in the area, including Yellowstone National Park and Grand Teton National Park.

WTI staff members Chris Strong, Pat McGowen, and Manju Kumar presented during several conference sessions. These presentations as well as other conference presentations can be viewed at http://www.itsmn.org/ruralits2004/programdetail.html

NRITS 2004 also featured an exhibit hall, technical tours, and a series of fun social events. The next NRITS Conference will be September 11-14, 2005 in Spokane, Washington. Visit http://www.nrits2005.org for more information. NRITS 2006 will be hosted by WTI in Big Sky, Montana.

Website

WTI continues to develop and enhance its website, focusing on upgrades that ensure that current research results and project information are available quickly in an easily navigated site. Two significant improvements have been implemented in the last year.

First, a new internal procedure has been developed to track each project and to make sure the information posted is timely and accurate. This procedure also ensures the information for each project is consistent and meets the information needs of the sponsoring agency.

Second, web analysis software is improving the quality of the information and the method in which it is presented. This software generates summaries of the most heavily visited pages within the WTI website. Not surprisingly, the most heavily visited page on the WTI website over the past year was the homepage. However, the ranking of the remaining top 20 most visited pages is more informative as to what visitors are looking for once they reach the website. The initial page in which users can begin selecting projects to view is number two on the list. Next in the ranking is the staff page, followed by a page with a dynamic map that allows the user to select research projects by state. The remaining pages on the list are directly related to project reports or publications. These results indicate the WTI website is being used as a source of research information and staff expertise. Users are primarily looking for research project information or results and the correlating staff information.

The page ranking information indicates that improvements such as increased use of dynamic elements would be desirable for current users. Links to more detailed staff information will be posted and then monitored to determine the depth of information that viewers need. Tracking the viewing of individual focus areas will also be monitored in the coming year to determine if dynamic and graphically-oriented focus area pages receive more views than those that are primarily text-based. This software will help WTI identify improvements for the website, and then assess their impact on an ongoing basis.

Newsletters

The WTI newsletter was published in March and September 2004 to inform readers about our latest research, education and outreach activities. Both editions of the newsletter can be downloaded as pdf files from www.coe.montana.edu/wti/what/publications.html. The newsletter was sent to approximately 1850 readers. This surpasses our circulation goal by 23%.

This year, WTI conducted an extensive, detailed review of the distribution lists used to disseminate key technology transfer documents, such as our newsletter. This review included:

- Validation of the roles and responsibilities of each contact within an agency, to ensure that the recipient of our documents is the person most likely to use the information in practice.
- Identification of additional contacts and agencies with whom WTI has shared research interests
- Elimination of incorrect, outdated, and duplicate entries

This is significant because innovations and improvements in transportation can only occur if research findings reach transportation officials who are in a position to implement them. By targeting our publications to specific agency professionals with similar expertise or responsibilities, we increase the chances that the information will be put to good use. Identifying additional contacts with shared research interests also leads to the development of new working partnerships. WTI is committed to sharing information with all agencies - even those with whom we may sometimes compete for funding - because we have found that working together reduces redundant research, advances the state-of-the-practice more quickly, and makes everyone's research stronger and more comprehensive. Finally, conducting periodic reviews of the accuracy of distribution lists reduces costs by eliminating duplicate or incorrect mailings. These efforts increase our ability to effectively and responsibly manage our UTC funds.

March 2004 WTI Newsletter included these articles.

- New Year New Projects
- Driving Simulation Laboratory: An Exciting and Economical Research Tool
- New Guidelines for Wildlife Crossing Structures
- DNA Sampling Techniques to be Tested
- Gallatin County Looks to the Future
- Managing Highway Runoff in Cold Regions
- Materials Corrosion Laboratory Evaluating Common Deicers
- Peter Smolenski Receives UTC Student of the Year Award

September 2004 WTI Newsletter included these articles.

- Baucus: "SAFETEA" Bill Best Way to Bring Jobs, Safe Road to Montana
- ITS Deployments Enhance Safe Travel Throughout Yellowstone Region
- Vehicle-Infrastructure Integration Research and Demonstration
- Safety Improvements Evaluated on California's Siskiyou Pass
- Montana Plans Upgrade to Amber Alert System
- MDT Emergency Operations and Disaster Plan
- Undergraduates Gain Experience in Rural Transportation Research at WTI
- Second Graders and MSU Students Encourage Each Other in Engineering Pursuits
- New Fellowship Opportunity Offered to Native American Students


Western Transportation Institute
MSU Bozeman
BAUCUS: "SAFETEA" BILL BEST WAY TO BRING JOBS, SAFE ROADS TO MONTANA

Technology Transfer Success Story

DOT Staff Input Identifies Lessons Learned and Information Needs

This year, WTI met with several DOT leaders to specifically address technology transfer issues. Participants were asked to evaluate WTI's current technology transfer methods, to identify their own information needs, and discuss the advantages and disadvantages of various dissemination methods.

The discussion was very effective in identifying current obstacles to information sharing, and helped WTI understand how traditional methods of technology transfer may be losing their effectiveness. Some of the challenges faced by transportation professionals include:

- Increased travel restrictions are limiting access to national transportation conferences where research findings are presented.
- Transportation professionals are inundated with print and electronic information on a daily basis.
- Research information that is received is not directed to the staff members who need it most.

Key recommendations resulting from the forum include:

- Transportation officials want information to be disseminated on a personalized basis, so that research is targeted to the correct staff and that they only receive information that is directly relevant to their responsibilities. If this can be accomplished, they can better prioritize and manage the large amount of information available.
- Technology transfer forums should be held at existing technical conferences still attended by staff of all levels (despite travel budget reductions). This will help retain the effective person-to-person sharing and networking that occurs at conferences.

WTI will use the feedback to guide future technology transfer efforts.

Initiatives For 2005

Building on the lessons learned from the technology transfer discussion with DOT leaders, the initiatives for 2005 will focus on exploring new and more effective ways of sharing research results with the greatest number of people:

- Survey a wide range of staff from partner DOTs to determine their research interests and the top resources they use when gathering research information. This will help WTI to target dissemination of our research. Anticipated resources would include decision support tools as well as clearinghouses of research pertaining to a particular area.
- Post all completed research projects on at least two major transportation related online databases. This will put the knowledge into a realm that is easily accessed by all transportation practitioners, not just those who are already aware of WTI.
- Host a forum where key members of DOT staff from several states can share information, lessons learned and collaborate on future research. They can return to their respective states and be champions for implementing the research results. Educating policy makers is a key component to ensuring that the research is used by the largest number of practitioners.