Western Transportation Insititute
MSU-Bozeman
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NEW YEAR, NEW PROJECTS

By Steve Albert, Director

2004 is a landmark year for the Western Transportation Institute. It marks the 10th anniversary of our inception, as well as the fifth year of our designation as a University Transportation Center.

However, instead of looking back, we are focused on looking forward towards our latest opportunities for innovative research.

Where do our new reseatrch projects come from? At WTI, our most successful projects come from capitalizing on our staff expertise, building on previous project experience, and documenting the successes and lessons learned from sponsors and research partners.

Staff, faculty and students from all over the MSU Bozeman campus are excited about the opening of our Driving Simulation Laboratory. Several of our researchers with specialized backgrounds in Human Factors testing and Computer Science joined forces to select and install a high fidelity, realistic driving simulator for transportation research. The only one of its kind in the Pacific Northwest, the Laboratory will allow WTI to do a wide variety of studies or prototype testing for sponsors who cannot safely or cost-effectively do the research on actual roadways.

WTI is also finding an increasing number of research opportunities that fit into our Transportation and Wildlife Interactions research focus area. In this issue, you'll read about a new project to develop guidelines for designing and evaluating North American wildlife crossing systems, a natural for WTI Research Scientist Dr. Anthony Clevenger, who has been on the leading edge of this research for over a decade.

WTI has begun a comprehensive assessment of current and future infrastructure needs for Gallatin County, Montana. This project gives us the opportunity to build on our local public mobility research, and at the same time, respond to the needs of our own community.

If, after reading our newsletter, you have research ideas that correspond with our laboratory facilities, previous research, or the technical expertise of our staff, please contact me at (406) 994-6114 (or at stevea@coe.montana.edu), and we can discuss future opportunities to work together.

We've Moved!

WTI has moved their main facilities to a new suite of offices in Technology Park, just west of the MSU-Bozeman main campus (960-B Technology Boulevard). Phone numbers for all research staff remain the same, but please change your records to reflect our new mailing address:

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Advancing rural transportation through research and education...

Driving Simulation Laboratory: An Exciting and Economical Research Tool

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Drivers, start your engines . . .

WTI is pleased to announce that its new Driving Simulation Laboratory is fully installed and ready for use. The Lab will support a variety of transportation-related research projects and provide valuable educational experiences for students and the community. The simulator is the only one of its kind in the Pacific Northwest. It allows testing of driver performance and behavior in the safety and controlled environment of the laboratory. It is also a cost-effective tool researchers can use in their studies of highway safety, control theory, psychology, wildlife interactions, driver fatigue and other topics that are difficult or dangerous to study in low fidelity laboratory simulations or on actual roadways. Because exploratory research on new traffic engineering practices and devices often cannot be performed in real world traffic scenarios, the simulator will allow testing and development of prototype systems before they are fielded. The simulator will be available to support faculty, undergraduate, and graduate student research projects from numerous departments across the MSU-Bozeman campus.

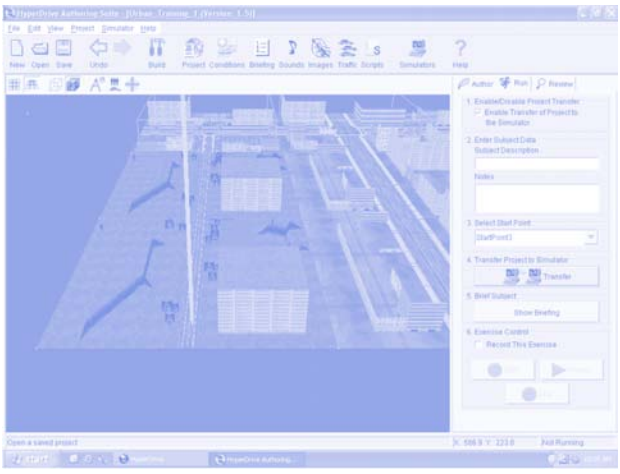
Features of the Lab

The DriveSafety DS500C Vection simulator features five visual channels providing approximately 140-degrees of view, plus rear-view and side mirrors. The driving cab was once a real 1996 Saturn sedan. It contains the driver seat and fully functional displays and controls, and drivers still need to turn on the ignition and even buckle up before driving. The controls, are now connected to the computer, instead of being connected to the engine, wheels, and brakes.

A network of five graphics computers generate the views seen out-of-the-window and the sounds heard by the driver through five speakers. A sixth computer coordinates the five scene generators, converts the driver's control actions into realistic vehicle responses using accurate vehicle dynamics models, and generates the driving scenarios specified by the researcher.

The visual simulation allows the test subject to drive through scenarios that include roadways, buildings, traffic signs and signals, other vehicles, trees, rain, snow, fog, and even animals in the roadway. The speakers provide a realistic sound environment, including engine noise, wind, traffic, sirens, tire screeches and horns, and any other sounds the researcher wants to enter. An automated performance measurement system collects a broad range of data on the driver's control inputs and performance. "If we test drivers outdoors, we cannot control the scenario," says Mike Kelly, Director of the Driver Simulator Laboratory. "Here we have collected about 75 different measurements from position in lanes, to speed, brake application and what a driver does in response to different situations."

The simulator operator station allows the researcher to develop and control research scenarios. With this station the researcher can design and implement a custom driving environment through the use of "tiles". Each "tile" represents an assortment of freeways and freeway junctions, different types of surface streets and intersections, and a wide variety of environmental models. Researchers can implement ambient traffic, which can drive autonomously or follow scripting provided by the programmer. With the use of "Virtual Triggers" behaviors of vehicles, pedestrians and animals can be programmed to follow any behavior selected by the programmer.



"We see many possible applications for the simulator," said Kelly. "We have received requests to look into simulations that include snowplows and driver response to animals in the roadway." Some specific research projects that have been proposed include

- Driver distraction (e.g., with mobile phones) as a major cause of accidents.
- Driver understanding of dynamic messaging systems.
- Aging related deficits in driving performance.
- Winter driving performance and weather warning systems.
- Computer-based systems to assist driving performance.
- Driver behavior and safety in the rural versus urban environment.
- Driver behavior when encountering obstacles such as large animals.
- Young driver education programs in conjunction with the Cold Regions Test-bed at Lewistown Airport.

The Research Team

Mike Kelly will be leading several of the simulator's planned studies, along with Laura Stanley, Industrial & Management Engineering PhD candidate. Kelly, Stanley, and WTI Research Associate Suzy Lassacher are currently conducting a project entitled "Evaluation of Driver Distraction during Mobile Phone Interaction with the 511 Information System". The purpose of this study is to collect empirical data addressing driver distraction while using two common mobile phone interfaces in rural and urban traffic, and to address the usability of the 511-information system while being accessed by a mobile telephone from a moving vehicle.

Kelly, Senior Research Scientist and Research Director of the WTI, has 28 years experience in performing and directing human factors research; Lassacher has an extensive background in Computer Science, and is also the Principal Investigator on another WTI project to establish the Transportation, Research, Applications and Instrumentation (TRAIL) Laboratory. Stanley has research experience from Montana State University's Human Factors and Ergonomics Lab, Virginia Tech Transportation Institute, and IBM-Research Triangle Park, NC.

The US Department of Transportation, Dr. Tom McCoy, Vice President of Research and Creativity, and Dr. Robert Marley, Dean of College of Engineering, provided funding for the Driving Simulator.

New Guidelines For Wildlife Crossing Structures

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A growing number of transportation planning agencies are incorporating wildlife fencing and crossing systems into highway and road designs to reduce the harmful impacts of transportation facilities on wildlife. However, after nearly a decade of increased activity building crossing structures, engineers and land managers still lack guiding principles for selecting functional designs that meet their criteria.

WTI is leading a FHWA-funded project to develop guidelines for designing and evaluating North American wildlife crossing systems. The goal of this project is to provide transportation professionals with the best available information and current technologies on wildlife crossing systems for transportation projects.

"This work will provide practitioners and managers with much-needed information,"

To achieve this goal, WTI Research Ecologists will review and synthesize current knowledge of North American wildlife crossing systems as it pertains to their design, monitoring and performance criteria. "We believe this is the first attempt to gather, review and critically analyze current information on ecological criteria and design attributes of wildlife crossing structure planning and performance," stated Dr. Tony Clevenger, Principal Investigator. From this baseline information, researchers will develop guidelines for planning and designing functional wildlife crossing structures as they relate to key regional wildlife communities, fragmentation-sensitive species, and transportation management concerns (e.g. National Environmental Policy Act [NEPA], Endangered Species Act [ESA], wetlands, public safety, etc).

The final report will provide examples from representative case studies that measured wildlife crossing structure performance using a variety of study methods pre- and/or post-construction. It will also include protocols for passage monitoring programs, elaborate on specific crossing structure design issues, and identify priority areas for continued research. The study will focus on terrestrial wildlife (mammals, amphibians and reptiles).

The project will be completed in early 2005, and WTI plans to present results at two important venues that serve as key information sources for transportation practitioners: The Transportation Research Board annual meeting and the International Conference on Ecology and Transportation. "This work will provide practitioners and managers with much-needed information," concluded Clevenger. "The results will provide a sound scientific basis for effective planning and well-founded decision-making."

DNA Sampling Techniques to be Tested

WTI recently received funding from the Woodcock Foundation, Wilburforce Foundation and U.S. Humane Society to conduct a pilot study to test techniques for using DNA sampling to identify individual animals that use wildlife crossing structures.

Roads obstruct animal movements, fragment habitats, and reduce landscape connectivity. This can result in higher mortality, lower reproduction, and ultimately smaller populations and lower population viability. Up until now, most highway research and assessments of mitigation effectiveness has been focused at the level of individual animals and not their populations. Healthy functioning ecosystems require viable wildlife populations. In order to accurately assess the demographic consequences of roads, it is critical to know the performance of highway mitigation crossings at the population level.

At present, the most reliable method of obtaining population information is by live-trapping and mark-recapture analysis, but for logistical reasons this is impractical. Recent developments in molecular techniques allow for species-specific DNA from hair samples, making it possible to identify individual animals, their sex, and genetic relatedness.

Through this study, WTI will test techniques and develop a protocol for systematically sampling and genotyping of hairs "captured" from passing animals at wildlife crossings. The goal is to acquire a simple and non-invasive method to identify and quantify animals using wildlife crossing structures. WTI will conduct the research in cooperation with Parks Canada (Banff National Park) and the Wildlife Genetics International Laboratory in Nelson, British Columbia.

If successful, the technique will enable the measurement and analysis of parameters related to the movement of individuals and their populations, in a timely, cost-effective, and non-intrusive manner. "With this, I am confident there will be great potential for future research that focuses more specifically on population viability questions related to transportation networks and corridors, and that's the Holy Grail-information we're searching for," said Principal Investigator Tony Clevenger. "This type of information from long-lived, slow-reproducing large carnivores normally would require several decades of intensive study, whereas the DNA profiling method would provide adequate information in 3-5 years".

This project provides a unique opportunity to utilize Clevenger's extensive knowledge of the crossing structures, while testing a new research tool.

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Gallatin County Looks To The Future

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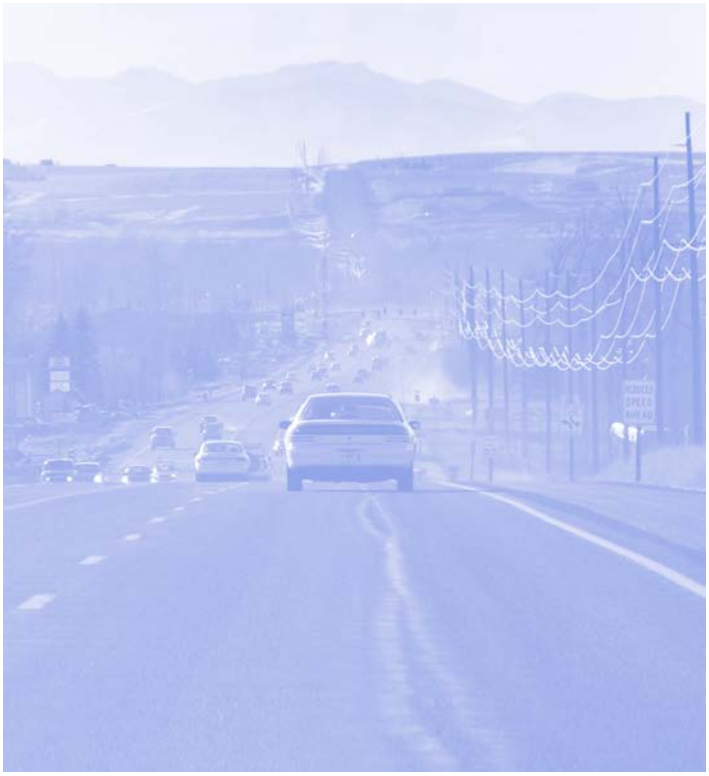
WTI will help guide transportation planning in its own backyard when it conducts an infrastructure assessment for Gallatin County, Montana.

Gallatin County is currently the fastest growing county in Montana. Its population grew by 41% between 1990 and 2002, and by 5% between 2000 and 2002. This compares to a state population growth of 0.79% in 2002, and a national projected population growth of 0.89% for the same year. This rapid growth in Gallatin County is straining the capacity and accelerating the deterioration of the county's transportation infrastructure.

The Greater Bozeman Transportation Coordination Committee has completed "Greater Bozeman Area Transportation Plan Update 2001". The update is the first step toward developing a countywide transportation plan. The County recently selected WTI to draft a supplement to existing transportation plans in Bozeman and Belgrade that will serve as the basis for developing the countywide plan. The objectives of this project are to:

- Evaluate the current condition of the transportation infrastructure;
- Evaluate the condition of the transportation infrastructure reflecting future land use and traffic volumes in the County ;
- Estimate the cost of implementing recommendations of the final report; and
- Recommend potential funding alternatives and schedules for implementing recommendations in the Final Report.

WTI will conduct the project in two phases. Phase 1 will identify and prioritize existing needs for critical transportation infrastructure improvements. Phase 2 will forecast future demands on the infrastructure, estimate the future condition of existing facilities, and finally, identify future needed transportation infrastructure improvements and prioritize them.



A key part of this project will be the development of two advanced analytical tools for Gallatin County. In the first phase, researchers will create a Geographic Information Systems (GIS) based analytical tool that portrays the current transportation infrastructure condition, including such information as a roadway inventory, existing traffic volumes, and previous infrastructure failures. In the second phase, researchers will create a second, more advanced GIS tool that can be used to present and analyze projected needs resulting from growth in population and anticipated economic development for one, two, five, and ten years.

"The GIS tools and the resulting needs assessment will help the County to develop a realistic capital program to respond to the most critical infrastructure needs," says Manju Kumar, Principal Investigator. "The financial plan will also evaluate various options to generate funds required to implement the recommendations."

WTI plans to present its final report and recommendations to Gallatin County this summer.

Managing Highway Runoff in Cold Regions

WTI is working with the Montana Department of Transportation (MDT) to develop effective practices for the management of winter traction materials on roadways that are adjacent to bodies of water.

In northern states with severe weather, winter maintenance is often the highest priority activity for their transportation agencies. During the winter season, large amounts of solid and liquid chemicals (known as deicers), along with abrasives, are applied to the roadways to ensure continued mobility, safety, and productivity. The growing use of these chemicals and abrasives has raised concerns about their effects on vegetation, water bodies, aquatic biota, and human health.

Accumulative research indicates that highway-runoff, as one of the non-point pollution sources, may have adverse effects on the adjacent aquatic resources if no measures are taken to remove potential contaminants before the runoff reaches the receiving water. In the State of Montana, frequent salting and sanding activities may impact nearby receiving waters by increasing sediment and contaminant loads. Furthermore, sudden snowmelt and rain-on-snow events can produce large runoff volumes that may overwhelm strategies designed to minimize these impacts.

The impact of highway-runoff on the environment can be mitigated through structural or non-structural best management practices (BMPs) or through a combination of both. A wide spectrum of roadside structural BMPs, including biofiltration, filtration, infiltration, retention, and detention systems are available to treat highway-runoff. To function efficiently and cost-effectively as mitigation measures, these facilities must be sited, designed, installed, and maintained correctly. In Montana, the cold climate may complicate the selection and performance of BMPs and present additional challenges. Non-structural BMPs, also known as preventive measures, include appropriate snow and sand storage, use of better sanding materials and alternative deicers, optimizing the application rates of deicer and sand, ongoing operator training, sand recycling, and "smart" snowplows.

Thanks to funding from MDT, WTI will investigate and identify highway-runoff BMPs for the state. "We will develop these BMPs by reviewing and synthesizing current technologies and management practices, while taking the specific needs and constraints of Montana's affected roadways into consideration," states Dr. Xianming Shi, Principal Investigator. "The project will culminate in a document providing general guidance for the management of winter traction materials on roadways adjacent to streams."

Upon completion, the project may lead to pilot deployment and field evaluation of identified cold-region BMPs by MDT in collaboration with WTI. In addition, the research results will be used to assist in developing portions of Total Maximum Daily Loads (TMDL) plans for Montana, which are designed to protect the quality of aquatic resources and to safeguard a cleaner, healthier environment.

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Materials Corrosion Laboratory: Evaluating Common Deicers

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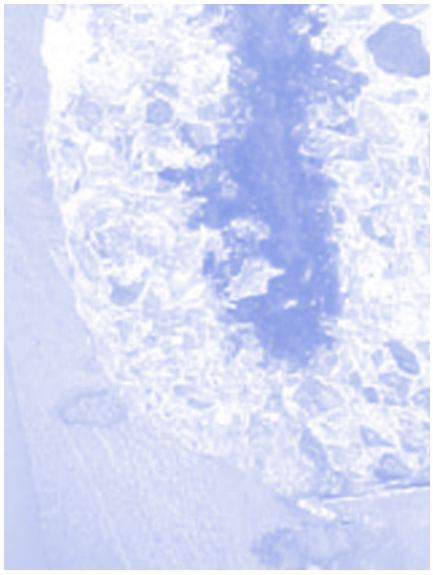
With the establishment of a Materials Corrosion Laboratory, WTI will expand its research in the field of corrosion and protection enabling researchers to address the corrosion issues related to surface transportation.

According to an U.S. Federal Highway Administration (FHWA) study completed in 2002, the direct cost of metallic corrosion in the U.S. is $276 billion on an annual basis, approximately 3.1% of the nation's Gross Domestic Product (GDP). The report also estimated that 25 to 30% of corrosion costs in the U.S. could be saved by employing optimum corrosion management practices.

The FHWA study revealed that the annual cost of corrosion for the transportation and infrastructure sectors alone is $52.3 billion. For instance, corrosion of reinforcing bar (rebar) in concrete structures is a widespread and enormously costly problem, which often causes the deterioration of concrete and thus the decay of key infrastructure facilities including bridges and highways. With the increased use of deicing salts in Snowbelt areas, transportation managers are concerned about the corrosive effects of deicers on reinforced concrete structures, pavements, and vehicles.



To minimize the adverse impacts that highway winter maintenance activities pose on vehicles and transportation infrastructure, 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 Materials Corrosion Laboratory was funded in late 2003 by WTI through the U.S. DOT University Transportation Center (UTC) research grant. This one-year "early-winner" project aims to establish the corrosion research capabilities at WTI and to establish protocols for evaluating the corrosion rate of materials and performance of corrosion inhibitors.

At this stage, the Materials Corrosion Laboratory is conducting research focusing on the evaluation of corrosion-inhibited deicers. Potential future research topics for the Laboratory include quality control of deicer products, evaluation of corrosion-inhibiting admixtures for concrete, application of electrochemical protection for highway structures, and development of alternative deicers. "This is an exciting new area of research for WTI," says Xianming Shi, Principal Investigator. "New findings from the laboratory could prevent damage to property and the environment, protect public safety, and potentially save billions of dollars."

Peter Smolenski Receives UTC Student of the Year Award

Each year at the Transportation Research Board annual meeting in Washington, DC, the U.S. Department of Transportation Research and Special Programs Administration honors the most outstanding student from each University Transportation Center (UTC). The UTC Students of the Year are selected based on their accomplishments in research, academics, professionalism, and leadership. The Western Transportation Institute selected Peter Smolenski as its 2003 Outstanding Student.

Peter Smolenski is a Master's of Science Degree candidate in Mechanical Engineering at Montana State University, where he also received his Bachelor's of Science degree in 2002 in Mechanical Engineering. He is currently supported by a Graduate Fellowship from the WTI and has been involved in a research project to investigate deck responses of three newly-constructed bridges in Montana, designed with different deck compositions.

The breadth of skills required for this project has served to promote a comprehensive Master's program for Peter while accomplishing many project goals. His contributions to the Saco Bridge project began with a focus on the instrumentation and data acquisition components. More recently, his efforts have been directed toward the analysis of data obtained from live load experiments conducted on the bridges before they were opened to traffic. He has also been constructing a finite element model to analyze differences among the three bridge deck types. Peter will conclude his studies by compiling the results of his analysis into a thesis paper. "Peter has assumed a great deal of responsibility on the Saco Bridge project," says Principal Investigator Eli Cuelho. "Our research has benefited from his precision, diligence and insight."

Peter's involvement with transportation related research has shown him that the applications of his engineering background extend much further than he ever imagined. His professional interests now include finite element analysis, structural behaviors, and 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. Peter is happily married to his lovely wife Casey. He is originally from Billings, Montana and loves to flyfish.

Congratulations, Peter!

Technology Transfer: News and Updates

Coordinated Transportation Handbook Released

The Montana Council on Developmental Disabilities, the Montana Vocational Rehabilitation Program and WTI have completed and released the "Montana Coordinated Transportation Handbook©." The Handbook provides step-by-step planning guidance to social service agencies, transportation providers, and community members throughout Montana who are working to improve transportation services, with an emphasis on services provided to the developmentally disabled.

Project sponsors are distributing the document to each Montana county and each regional council of the Montana Council on Developmental Disabilities (MCDD). MCDD is exploring the possibility of working with the Montana Association of Counties to have WTI conduct training in each county based on the Handbook

Positive initial response to the Handbook has prompted widespread word of mouth referrals. WTI is receiving requests for the document from other states and national transit and human service advocacy organizations.

An online version of the Handbook, as well as other transportation coordination information is available on the Montana Council on Developmental Disabilities website, at www.mtcdd.org.

Wildlife Crossings Toolkit

WTI designed and sponsored the printing of 10,000 brochures and business cards to promote awareness of the Wildlife Crossings Toolkit website. WTI created the materials for distribution by all of the Toolkit sponsors, who include the San Dimas Technology and Development Center, Utah State University, the Center for Transportation and the Environment, the USDOT Federal Highway Administration, and the US Forest Service.

The Toolkit is an online source of valuable information on wildlife/highway interaction. It contains a fully searchable database of wildlife mitigation project case histories, as well as research articles and links to additional resources. Much of the research information and data developed for WTI's Artemis Clearinghouse project has been incorporated into the Toolkit.

The Wildlife Crossings Toolkit can be found at www.wildlifecrossings.info.

"Making Connections": ICOET Conference Proceedings Available

The full proceedings of the 2003 International Conference on Ecology and Transportation are now in print and available online. WTI provided the financial support for the printing and distribution of 500 copies of the nearly 700-page document. The theme of the conference - held in August 2003 in Lake Placid, New York - was "Making Connections," with the goal of helping participants better understand the relationship between ecology and transportation. The proceedings present the latest research in 17 categories, including habitat connectivity, animal-vehicle collision reduction, technology applications, and planning for sustainable systems. WTI researchers contributed three articles to the volume.

A keyword-searchable version of the complete proceedings is available in Adobe Acrobat PDF format at: www.itre.ncsu.edu/cte/icoet/

Traffic Safety and Operations Seminar

This month, the Rahall Transportation Institute (Marshall University) and WTI sponsored a Railroad and Highway Traffic Safety and Operations Seminar in Helena, Montana. 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. The seminar serves as a continuing education course for current transportation practitioners. Additional sponsors included BNSF Railroad, FHWA, Federal Motor Carrier Safety Administration, Montana Department of Transportation, Montana Rail Link, Operation Lifesaver, and Union Pacific Railroad.

WTI Projects Presented at TRB

In January, WTI had the opportunity to showcase a broad range of research projects at the Transportation Research Board (TRB) Annual Meeting in Washington, D.C. At a workshop called "What's Cooking in Ecology," Research Scientist Anthony Clevenger made a presentation on his research to monitor performance of wildlife passages. In another workshop on wildlife-vehicle collisions (facilitated by WTI Research Scientist Amanda Hardy), Research Ecologist Marcel Huijser presented a paper on animal detection systems.

In TRB committee meetings, Research Engineer Eli Cuelho gave updates on his Saco Bridge reconstruction project and his geosynthetics materials research. In a workshop session on enhancing transportation in national Parks,

Research Engineer Chris Strong presented a paper (co-authored by WTI Research Associate Jamie Eidswick) entitled "Assessing Needs and Opportunities for ITS Applications in California's National Parks." Chris also participated in a poster session entitled "Status of Transportation Serving Tribal Lands and Communities." He presented posters on the Native American Transportation Needs Survey conducted by WTI in 2000, and on more recent projects to identify the reasons for low accident reporting on reservations and investigate advanced technologies that could be used to improve accident reporting.

Popular Summer Research Program Offered

Thanks to a successful first year program, WTI will once again invite college students to spend their summer doing research in Montana.

The Research Experience for Undergraduates (REU) Program in Rural Transportation is designed to expose undergraduate students to real-world, innovative and interdisciplinary transportation research while increasing students' awareness of the scope and breadth of rural transportation issues. WTI's REU program provides support each summer to eight undergraduate students from colleges and universities nationwide to pursue a ten-week research program at Montana State University in Bozeman.

Working under the mentorship of faculty and professional research staff, students have the opportunity to develop both their research and communications skills. Last year, students worked on a wide range of topics, including transit system design, transportation-wildlife interactions, and intelligent transportation system (ITS) deployments.

Response to WTI's first REU program in 2003 was extremely positive from both students and mentors. As a result, WTI is currently conducting preliminary screening of candidates for summer 2004. The program is funded by the National Science Foundation (NSF)/Department of Defense (DOD) and the U.S. Department of Transportation's Research and Special Programs Administration.

For more information, contact Susan Gallagher, Education Coordinator, at (406) 994-6559 (or at sgallagher@coe.montana.edu), or visit the REU page of the WTI website at http://www.coe.montana.edu/wti/how/Education/reu.html

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