

WisDOT RESEARCH PROGRAM



2009 ANNUAL REPORT



This is a report of research and technology transfer activities carried out by the Wisconsin Department of Transportation through the Part II research portion of the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation. The report describes activities during Federal Fiscal Year 2009, covering October 1, 2008, through September 30, 2009.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ARRA	American Recovery and Reinvestment Act (2009)
CFIRE	National Center for Freight & Infrastructure Research & Education
CMSC	Construction and Materials Support Center
DBE	Disadvantaged Business Enterprise
DOT	Department of Transportation
FFY	Federal Fiscal Year
FHWA	Federal Highway Administration
ISTEA	Intermodal Surface Transportation Efficiency Act (1991)
MRUTC	Midwest Regional University Transportation Center
NCHRP	National Cooperative Highway Research Program
R&L UNIT	Research & Library Unit
RLAC	Research & Library Advisory Committee
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
SPR	State Planning and Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TOC	Technical Oversight Committee
TPF	Transportation Pooled Fund Program
TRB	Transportation Research Board
UW	University of Wisconsin
WHRP	Wisconsin Highway Research Program
WisDOT	Wisconsin Department of Transportation

WisDOT
RESEARCH
· **PROGRAM** ·
2009
ANNUAL REPORT



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A photograph of a concrete bridge over a river. The bridge has multiple concrete piers and a series of horizontal concrete beams supporting the deck. In the background, there is a forest of bare trees. A deer is visible on the grassy bank near the river. The water reflects the bridge and the surrounding landscape.

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From the Research Administrator



To the transportation research community:

I am pleased to present to you the Wisconsin Department of Transportation's 2009 Annual Report on research activities. This report focuses on the programs and activities managed by the Research & Communication Services Section while also describing partnership efforts across the department, state and nation.

Over the past year, WisDOT and the national transportation community have lived in uncertain times. The prospect of uncertainty can be a challenge in managing research programs, but it can also be a great opportunity. Uncertainty causes agencies to ask "What if?" and a well-focused research program can help provide the answers.

In Wisconsin, the research program is seeking answers to the "What if?" questions on a variety of fronts: highway materials, construction processes, knowledge retention, driver education and economic value of programs, to name a few. By analyzing these and other issues, the research program can contribute to the immediate needs of the department and the transportation community and help weather the uncertainty.

I encourage you to review this report, share its findings with your colleagues and continue your involvement with WisDOT's research activities. The department welcomes the feedback and collaboration of many partners to answer those "What if?" questions.

Finally, on a personal note, I thank everyone in the research community for support and encouragement in my own first year in this position. From working with the national stakeholders to locally-based researchers, I have greatly appreciated the partnerships that have continued over time. I also want to acknowledge the efforts of the research staff and managers at WisDOT whose fine work have greatly eased my transition. I look forward to another great year of research activities to improve transportation in Wisconsin and elsewhere.

Sincerely,

Daniel Yeh
Research Administrator



Research & Library Unit

The Research and Library team oversees several programs within the department and serves as a resource to all WisDOT employees. The staff is available to help employees who need information on any transportation topic or who have a suggestion for needed research to help employees do their work.



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Bringing Innovation to WisDOT

WisDOT's vision is "Dedicated people creating transportation solutions through innovation and exceptional service." To help generate this innovation, the Research & Library Unit oversees several formal research programs, provides information services to WisDOT employees and collaborates with other research organizations to solve problems of common concern. The emphasis areas of the department's strategic plan guide the efforts of the research program:

- Value and develop employees
- Anticipate and meet customers' needs
- Continually improve processes and partnerships
- Provide and operate a safe and secure transportation system
- Enhance opportunities for mobility and economic growth

The research program's goal is to deliver research results and supporting activities that address specific, identified needs in these emphasis areas across all five WisDOT divisions.

Research Management Throughout the Research Cycle

The R&L Unit manages the research portion (Part II) of the State Planning and Research Program, provided for in the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (currently extended beyond its September 30, 2009, expiration date). Research program management encompasses the entire cycle of research: identification of the

highest-priority needs, selection of investigators, monitoring of research and financial progress, review and approval of deliverables, and dissemination of results with a goal of implementation for beneficial change.

Measuring Results

The Research & Library staff, with the assistance of in-house consultants, provides literature searches, synthesis reports, research briefs, newsletters, surveys, peer exchanges and related services. At the problem identification stage these services aim to avoid duplication, leverage research already done and identify successful practices already in place. At the dissemination stage the services aim to speed implementation of research findings and build support for a robust research program at WisDOT.

Return on Investment—Value of Research

This annual report is one of many efforts the R&L Unit engages in each year to measure the value of research activities and describe the impact of both the research program and individual projects on the day-to-day decisions of WisDOT employees. How has research made a difference? What are the savings in time or dollars from research that explores new ways of doing things? How have the lives of Wisconsin drivers, transit users, construction workers, pedestrians and cyclists been made safer through research?



Research & Library Services

Research Program Administration

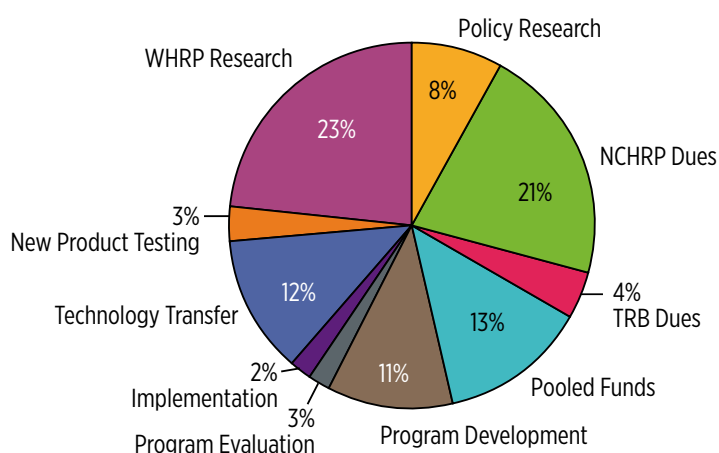
The R&L Unit guides the investment of approximately \$3.5 million each year to support a robust research program addressing department needs. The Annual Work Program, approved by Federal Highway Administration–Wisconsin, directs funds to the development, oversight, transfer, implementation and evaluation of needed research activities. Federal Fiscal Year 2009 funding awards included projects in several established program areas (Wisconsin Highway Research Program, Policy Research Program, pooled fund studies) as well as investments in national transportation research (National Cooperative Highway Research Program and Transportation Research Board) and technology transfer of completed research.

Research Project Oversight

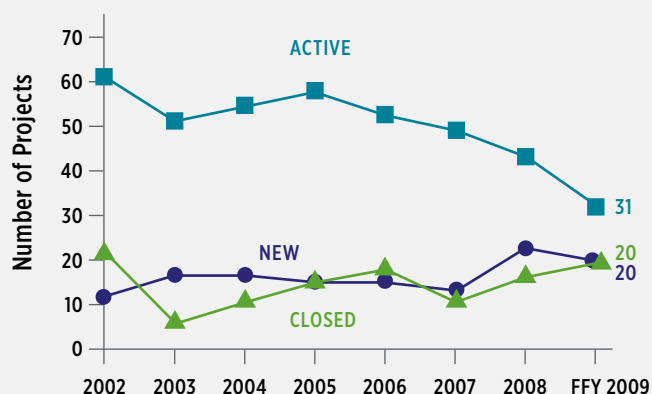
The R&L Unit oversaw more than 50 active research projects this year, with 20 new projects funded and 20 brought to completion. Summaries of completed projects and their impacts are given on pages 17 to 23 of this report, and details of all projects are in the Project Reference Guide. The unit continues to look for better ways to manage research and bring innovation to the department. Initiatives during 2009 are described on pages 13 to 15.

WisDOT's participation in pooled fund studies grew in FFY 2009, with the department now participating in 46 projects. Research topics address pavements, structures, traffic management, work zone safety, knowledge management, winter maintenance and many other issues. Several pooled fund projects and their benefits are summarized on pages 24 to 29, with information on all currently funded projects provided in the Project Reference Guide.

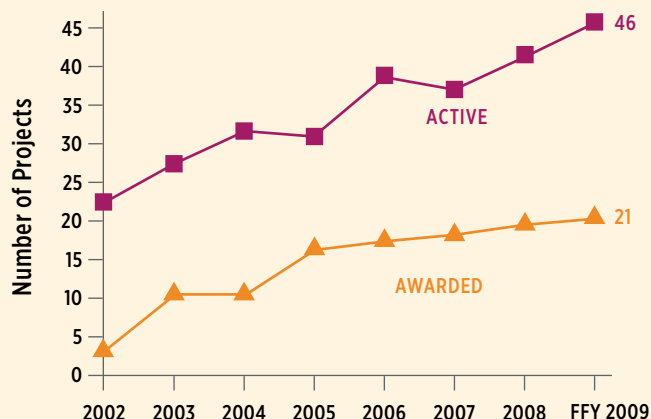
FFY 2009 Funding Awards



Wisconsin Research Projects



Pooled Fund Projects



WisDOT Library

The WisDOT Library is home to one of the largest state DOT collections of books, reports, electronic files, journals and other materials related to transportation research and practice. Materials include current and historical information from within Wisconsin as well as high-value materials from international, national, state and local institutions.

More importantly, the library staff is available to help WisDOT staff find information from anywhere in the world that can help improve the state's transportation system. In addition to serving WisDOT staff, the library assists the general public, university professors and students, law firms, local government and consultants with 75 percent of service requests now coming from these groups.

Information Commons Study

In 2009, the WisDOT library staff concluded a three-year pilot to explore the benefits of implementing an iCommons concept at WisDOT. Initiatives included relocating and redesigning the library space for accessibility, comfort and collaboration; launching digital archive repositories; providing computers with access to specialized databases; and providing enhanced reference and research services. Statistics show that use of library services by WisDOT staff and the public have increased significantly since the pilot began. See page 14 for more information: Library Makeover Results in Increased Usage.

Library Video

The WisDOT Library created a video about its services featuring interviews with department managers. Library products and services were highlighted through additional interviews with various WisDOT employees, including an attorney, engineer and transportation planner. The video will be shown routinely during new employee orientations and supervisor seminars to promote the library's services to both new and current employees.

Collections Merger

Migration of materials from the WisDOT Southeast Region Library to the Hill Farms Library began in 2007 and was expanded in 2009 when the part-time SE Region librarian retired. A total of 144 boxes of materials have been transferred to keep these materials accessible to all department employees, as well as to preserve institutional knowledge.

National Networking

Head Librarian John Cherney keeps WisDOT in the loop on important national trends through his active participation in several groups and committees related to transportation knowledge, including the Midwestern Transportation Knowledge Network, the Transportation Library Connectivity pooled fund study, the TRB committee on Library and Information Science for Transportation, the Special Libraries Association Transportation Division and the AASHTO Research Advisory Committee Transportation Knowledge Network Task Force.



Research Briefs

The R&L Unit produced 16 research briefs in 2009 on projects completed through WHRP and the Policy Research Program (listed in the Project Reference Guide). These two-page summaries outline research objectives, findings and recommendations, and plans for implementation. Briefs are available online, organized by topic area and year, at on.dot.wi.gov/wisdotresearch/compresprojs.htm.

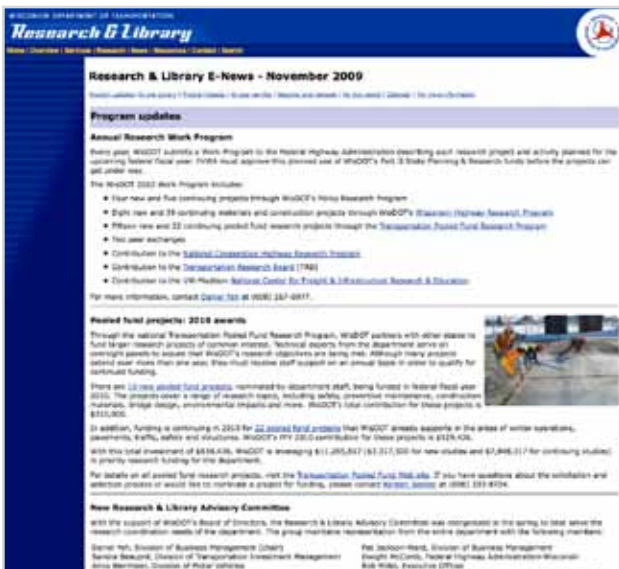
Impact: Research briefs save time for WisDOT staff and investigators in reviewing completed research, provide an easy way for project managers to share results with staff in other areas, and capture the views of both investigators and project managers. In an annual survey of readers of research briefs, 22 of 30 respondents rated the briefs a 4 or 5 on their overall effectiveness at “providing a concise, easy-to-understand summary” of the research. Twenty eight of 30 respondents said that research briefs are helpful in summarizing key objectives, research results and the value of projects.

Distributing Other States’ Research

WisDOT receives hard copies of state DOT research reports from around the country in all subject areas—from pavements, bridges and soils to maintenance, traffic operations and environmental issues. These reports are added to the WisDOT Library collection. To make sure reports reach WisDOT employees who work in related areas, R&L routes new reports to appropriate staff members as the reports are received.

Impact: This service is another way to keep WisDOT staff members informed of the latest research in their fields, and helps ensure that the department doesn’t duplicate work already performed at other agencies. Responses to the service for 2009 (total of 49 responses) were very positive:

- 43 of 49 respondents said that the state reports they reviewed were helpful.
- 43 of 49 respondents indicated that the research was applicable to WisDOT.



Research & Library E-Newsletter

The Research & Library E-News is published biannually to update WisDOT staff and stakeholders on recent activities and useful information. Each issue features program updates, project impacts, outreach activities, and research and library services. Past issues of the newsletter are available online at on.dot.wi.gov/wisdotresearch/news.htm.

Impact: Current information on WisDOT research activities promotes involvement in the research process from across the department and encourages use of research results. The “success stories” of staff experiences with R&L services help raise awareness and demonstrate value to its customers.

Wisconsin TRB Guide

The Wisconsin Guide to the TRB Annual Meeting highlights the contributions of WisDOT staff and Wisconsin university researchers who authored technical papers and served as presenters and session leaders. TRB committee and panel members are also listed.

Impact: The annual TRB Guide showcases the breadth and depth of Wisconsin transportation research for state, national and international audiences. The guide helps staff attendees find Wisconsin sessions easily and facilitates dialogue among WisDOT, academic and private-sector transportation professionals about the state's growing research expertise. At the January 2010 meeting, more than 60 representatives of Wisconsin institutions made presentations on their latest transportation research findings. See the guide at on.dot.wi.gov/wisdotresearch/database/reports/trbguide2010.pdf.

WHRP E-Newsletter

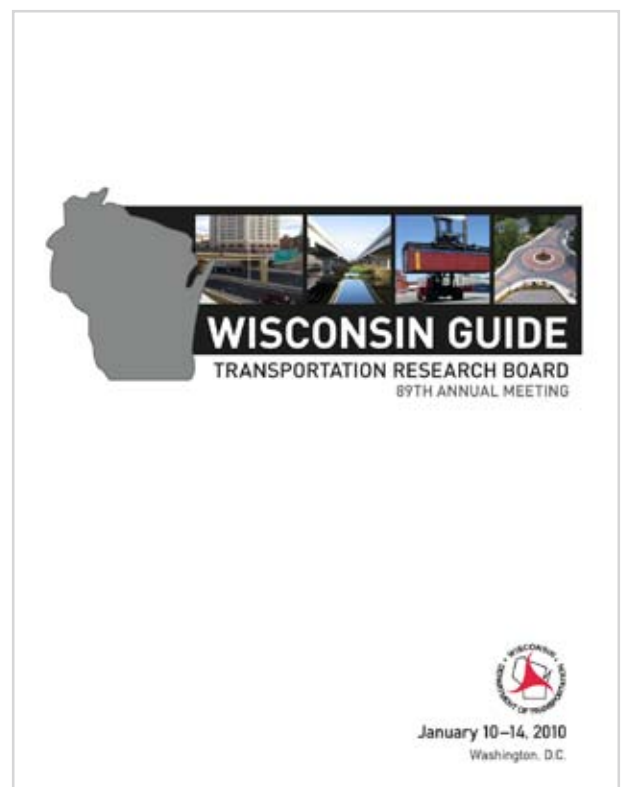
The quarterly WHRP E-News features articles on recently completed research, implementation of completed projects and an update on current project status. The newsletter also highlights regional and national activities of WHRP and its representatives, including participation in pooled fund studies, advisory groups and conferences.

Impact: The e-newsletter provides information about WHRP's research and outreach activities to a wide audience, including WisDOT staff, university and private-sector investigators, contractors, consultants and policymakers. The projects and initiatives described in the newsletter underscore the value of WisDOT's investment in WHRP. Recent issues have kept readers informed about such topics as a 10-year assessment of WHRP implementation, selection of projects and investigators for the coming year, and the institution of a committee co-chair system. WHRP E-News is available at www.whrpnews.org.

Literature Searches

R&L staff prepares literature searches on topics requested by WisDOT managers and technical staff. These targeted keyword searches identify a representative bibliography of studies available on the requested topics. The R&L Unit produced 52 literature searches in FFY 2009.

Impact: WisDOT staff use literature searches to scope research proposals and work plans, avoid duplicating research, and identify investigators and organizations with specialized expertise in a subject area. Each citation includes the title, author, date and source for obtaining the full document online, in the WisDOT Library or through interlibrary loan.



Transportation Synthesis Reports

Transportation Synthesis Reports are annotated, quick-response reports requested by WisDOT technical staff and managers from every business area of the department. Based on Internet, library and telephone research, TSRs provide pertinent research and practices compiled and organized in a concise, readable format. In FFY 2009, the R&L Unit produced 34 TSRs, 16 of which are available at on.dot.wi.gov/wisdotresearch/comptsrs.htm, along with many TSRs from previous years.

Business Management	<ul style="list-style-type: none">• Training Supervisors in Winter Maintenance Operations: A Survey of State DOT Practices, Training Tools and Programs• Electronic Plan Rooms for Highway Project Bidding
Environment	<ul style="list-style-type: none">• Use of Compost for Erosion Control: A Survey of State Practice• Lead-Based Bridge Paint Sampling and Disposal: A Survey of State Practice• Selecting Flocculants for Transportation Sites
Modal	<ul style="list-style-type: none">• Economic Impact of Air Cargo Operations• CCTV Installations in General Aviation Airports
Pavements	<ul style="list-style-type: none">• Layer Coefficient Values for Cracked and Sealed Concrete
Roadways	<ul style="list-style-type: none">• On-Road Operation of ATVs• Recording Material Usage in Winter Maintenance Operations: A Survey of State Practice• Limitations of the Use of Abrasives in Winter Maintenance Operations
Safety and Mobility	<ul style="list-style-type: none">• Traversable Grate Design for Box Culverts and Large Pipes• Median Construction Crossover Design• Aggressive Driving: Definitions, Laws and Prevalence• Post-Storm Meetings: A Survey of State and Local Practice
Structures	<ul style="list-style-type: none">• Pile/Footing Connections: A Survey of State Practice

Impact: TSRs allow WisDOT staff to learn from the experiences of other state DOTs, avoid duplicating research, identify new technologies and practices that save time or money or enhance safety, make better investment decisions, and monitor federal guidelines and key transportation trends. In the 2009 R&L survey of users:

- 16 out of 17 of respondents indicated they “would not have had the time or resources to conduct the research themselves.”
- 12 out of 17 of respondents indicated they “applied or anticipated applying information in the TSR to improve processes, make decisions, implement technology or make other changes.”
- 14 out of 17 respondents rated the TSRs a 4 or 5 on how well they met information needs.

Initiatives in 2009

In 2009 the R&L Unit made a number of improvements to existing programs and services. WisDOT customers are asked to give their ideas on how the unit can do even better: How can the R&L Unit help WisDOT employees get needed research funded, bring innovation to the department, save time and dollars, and improve safety? Employees are encouraged to send their thoughts and service requests to research@dot.wi.gov.

Maximizing Pooled Fund Investments

WisDOT sees great value in participating in jointly funded research projects with other states and FHWA. The department was a partner in 46 pooled fund studies in FFY 2009. However, benefits often depend on the technical representatives who bring the department's needs and objectives to discussions with investigators and partners. To support these key volunteers, the R&L Unit has initiated orientation sessions for new technical representatives to:

- Explain the pooled fund program (sponsored by FHWA, TRB and AASHTO) and the rules under which WisDOT participates, along with tips on how to find information on the Transportation Pooled Fund Web site (www.pooledfund.org).
- Outline the role and responsibilities of technical representatives when meeting with other states, reviewing interim deliverables from the investigator and approving the final report.

In addition, the R&L Unit meets with technical representatives at the conclusion of a pooled fund project to assist with completing close-out and implementation forms, which document the degree of success of the project and lay the groundwork for putting the results to work in Wisconsin.

WHRP Web Site Enhancements at www.whrp.org

In the fall of 2009, WHRP reorganized its Web site and improved the look and feel—with the goal of helping users find information easily. All of the research findings from 10 years of completed WHRP research and information on in-progress research are now readily available from the WHRP home page under “Research Areas.” Current and prospective investigators can now find information under “RFPs & Guidelines,” and a “News & Outreach” section leads to e-newsletters, PowerPoint presentations and videos.

WHRP Knowledge Transfer Workshop and Video

In keeping with its mission of “delivering thoughtful and timely research findings for implementation,” WHRP has begun featuring selected project results in Knowledge Transfer Workshops. In July 2009, the Flexible Pavements Technical Oversight Committee hosted a workshop to provide the background, research results and next steps for a project that explored use of the Asphalt Mixture Performance Tester. The event was simulcast as an online webinar; recordings of the live webinar and PowerPoint presentations are available on the WHRP Web site under “News & Outreach.”



Library Makeover Results in Increased Usage

Key service measures in the WisDOT Library at the Hill Farms State Transportation Building have increased dramatically since the library's move to the first floor and enhancements made as a result of the iCommons initiative launched in 2006. The commitment of WisDOT leadership and the dedicated work of Research & Library staff have made the following gains possible:



- Walk-in traffic by WisDOT staff has tripled, and walk-in traffic by the general public has more than quadrupled, underscoring the importance of the move to the first-floor main entrance, close to the Division of Motor Vehicles customer service center.
- Item checkout from the library's physical collection has tripled, with increased use of physical space for meetings, Web conferences, reading and study.
- Document delivery through FTP, scanning and photocopying have tripled, thanks to the new copier/scanner/fax machine.
- Internet terminal use by WisDOT staff and the public has quadrupled due to five computers and a more user-friendly environment.
- Use of reference services has quadrupled, with doubling of requests for literature searches and in-depth reference.

Bringing TRB Information Back to Wisconsin

The TRB Annual Meeting, attended by 10,000 practitioners and researchers, is unrivaled in the breadth and depth of information presented. To help all WisDOT staff (not just the few who are able to attend) benefit from the technical papers, workshops and presentations of this four-day meeting, R&L Unit staff mounts an organized effort to bring relevant information back to the department. Before the meeting WisDOT managers are invited to request coverage at specific TRB sessions likely to have high value for the department. Research staff members then attend these sessions, take notes, and gather handouts and copies of presentations. After the meeting they post this information on the department intranet site according to topic for easy access by any WisDOT employee.

Plugged-in Regionally and Nationally

Transportation research does not take place in a vacuum. To learn about the recent discoveries and advancements of other agencies, the R&L Unit participates in annual meetings of TRB and of the AASHTO Research Advisory Committee, composed of research directors from the 50 state DOTs, Puerto Rico, the District of Columbia and several Canadian provinces. Research staff members also attend local and regional conferences, such as those sponsored by the National Center for Freight & Infrastructure Research & Education at the University of Wisconsin–Madison or the Mid-Continent Transportation Research Symposium, which alternates between Madison and Ames, Iowa.

Developing a National Transportation Knowledge Network

WisDOT is entering its fifth year as the lead agency of a national pooled fund study aimed at developing better ways to move research findings and other transportation information into practice. The 22 members of the Transportation Library Connectivity pooled fund study (www.libraryconnectivity.org) are working to speed access to newly developed technologies and make it easier and less expensive to find critical information. The R&L Unit oversees contracted technical services and special projects aimed at connecting transportation librarians and other information providers across the country as a step toward a National Transportation Knowledge Network recommended by the National Academies.

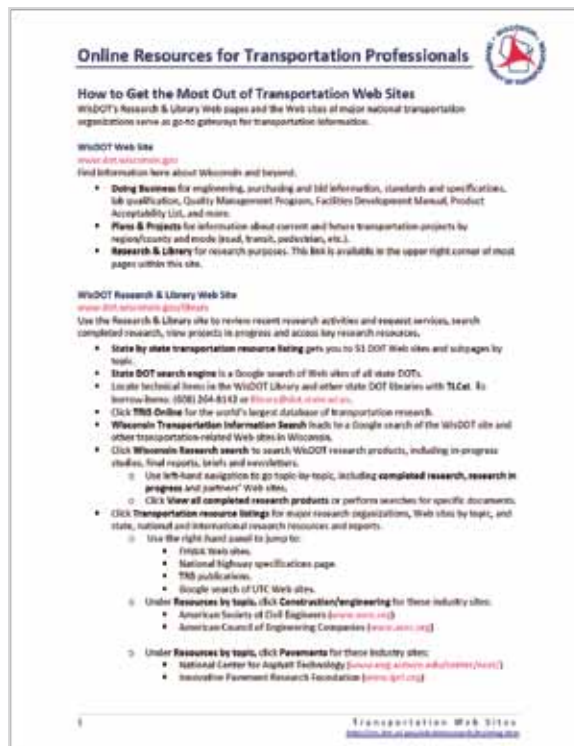
Updating SPR-Track Database

In 2009, the Research and Library Unit launched an effort to update its critical SPR-Track database, which houses detailed financial and project management information on every funded research project. SPR-Track enables staff to monitor the status of projects and generate reports on contracting information, funding, key contacts, final reports and more.

The current version of SPR-Track was originally developed in 2002. Although there have been ongoing efforts to maintain the database, changes in technology and program structure have rendered it inadequate for efficiently tracking WisDOT's multi-million dollar research program. The updating effort currently underway is focused on creating a flexible data model to support the increasingly complex structure of research projects and funding for many years to come. In 2010, the R&L Unit looks forward to completing the update effort with final development of the new database.

Helping DOT Staff Find Online Answers

The Research Unit has begun offering three-hour training sessions several times per year to help WisDOT staff in the statewide bureaus and regional offices find technical information on the Internet. While any WisDOT employee can request a literature search or transportation synthesis report from the R&L Unit, this training helps interested employees learn to do at least some of their own searching. Topics covered include navigating the top transportation-related Web sites, effective use of search engines and exploring specialized information databases. The classes are also available via webinar.



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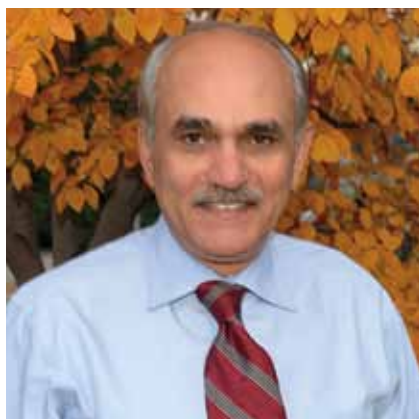
William Jason Weiss
NEXTRANS Center at Purdue University

WisDOT Research Programs

Wisconsin Highway Research Program

www.whrp.org

WisDOT is committed to the development of strong civil engineering programs at Wisconsin universities. It uses the expertise of university professors and students throughout the state to conduct needed research. WisDOT also contracts with the UW–Madison to manage WHRP, whose mission is to improve Wisconsin's roads through thoughtful and timely research. Multipartnered committees representing WisDOT, industry, academia and FHWA help assure that the most appropriate research is funded and that each project is carried out rigorously to meet agreed-upon objectives.



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WHRP Project Impacts

0092-04-10 - Monitoring and Evaluation of Fly Ash Stabilized Subgrade Constructed by Wisconsin DOT

Final report and brief:

www.whrp.org/research-areas/geotechnics/geotechnics_0092-04-10.html

WisDOT is interested in using cost-effective, recycled materials to increase the performance of Wisconsin roads. One such material is fly ash, a byproduct of coal-burning power plants that can be used to stiffen and strengthen subgrade soils underlying the upper pavement layers. While fly ash is a promising technology used with success by several other states, there was little field research on its effectiveness for stabilizing subgrades in Wisconsin.

Impact: Researchers monitored several highway segments constructed with fly ash stabilized subgrades and found that their performance was significantly improved, even over a number of freeze-thaw cycles and in soils with varying moisture contents. They also found that the use of fly ash is likely to meet Wisconsin's environmental standards while reducing construction costs and increasing service life.



0092-06-05 - Comparison of Basic Lab Test Results with More Sophisticated Lab and In-Situ Tests Methods on Soils in Southeastern Wisconsin

Final report and brief:

www.whrp.org/research-areas/geotechnics/geotechnics_0092-06-05.html

Highways and overpass structures require solid, stable foundations. The soil tests used to assess the structural properties of underlying soils can be costly, especially if sophisticated laboratory and in situ field testing is used. Researchers saw an opportunity to use soils data from WisDOT's Marquette Interchange project in Milwaukee to determine if future design work in southeastern Wisconsin could be based on more routine soil tests, reducing design costs.

Impact: Researchers identified a series of correlation equations that rely on a soil's index properties and geological origin to arrive at geotechnical design parameters using lower-cost field and laboratory tests. The correlations give designers a more accurate basis for presumptive test values in preliminary design and can verify subsurface investigation test results using a relatively small number of samples. Use of these correlations will save taxpayer dollars on future projects.



0092-07-01 - Investigation of the Use of Open-Graded Friction Courses in Wisconsin

Final report and brief:

www.whrp.org/research-areas/flex/flex_0092-07-01.html

Open-graded friction courses are pavements designed with porous asphalts that quickly drain water from road surfaces—increasing tire traction, reducing the frequency of wet-weather accidents caused by hydroplaning, and minimizing tire spray and noise. Research was needed concerning whether the latest OGFC technologies could be used in Wisconsin's winter climate.

Impact: Researchers found that in cold weather environments, the costs of OGFCs outweigh their benefits. Because they freeze more quickly than other pavements, removing snow and ice from OGFCs is more difficult, requiring much heavier and more frequent applications of deicing salts. It was recommended that Wisconsin not make use of OGFCs until the technology is enhanced for viability in colder weather.





0092-07-04 - Comparison of Three Different Methods for Determining Pile Bearing Capacities

Final report and brief:

www.whrp.org/research-areas/geotechnics/geotechnics_0092-07-04.html

Engineers predict axial pile capacities to determine what force to use in driving the piles that support Wisconsin's bridges and other structures. In light of AASHTO's change in highway bridge specifications to include the Load and Resistance Factor Design Bridge Specification, Wisconsin DOT needed to compare its current formula for predicting capacity with alternatives to maximize pile driving efficiency. This study compared the predictions of the various formulas to real-world capacity measurements from Wisconsin databases.

Impact: If actual pile capacity differs from predicted capacity, then either the piles may not be installed deep enough to meet desired safety levels, or they are driven too deep, wasting time, labor and materials. Investigators determined that a modified version of the formula developed by FHWA and one developed by Washington DOT are significantly more accurate than WisDOT's current formula.



0092-07-05 - Development of Testing Methods to Determine Interaction of Geogrid-Reinforced Granular Material for Mechanistic Pavement Analysis

Final report and brief:

www.whrp.org/research-areas/geotechnics/geotechnics_0092-07-05.html

DOTs are increasingly using geogrids to strengthen the foundations of roads. Consisting of geosynthetic polymers formed into mesh-like configurations, geogrids can improve the durability of a road when placed between the subgrade and base course. However, Wisconsin had not established an empirical-mechanistic method for determining the optimum thickness of the subgrade and base course materials surrounding geogrids.

Impact: Researchers used seismic measurements and wave propagation tests to determine the effects of a geogrid reinforcing layer on the structure and stiffness of surrounding soils, and used these results to establish its most effective position in the pavement foundation. They also developed a new method for field measurements of the stiffness of granular soils, which cannot easily be measured using traditional resilient modulus tests.



0092-07-07 - Evaluation of Fiberglass Wrapped Concrete Bridge Columns

Final report and brief:

www.whrp.org/research-areas/structures/structures_0092-07-07.html

Concrete bridge columns deteriorate prematurely when traffic splashes deicing salts on the columns. The chlorides may initiate corrosion of the steel reinforcing bars, especially the uncoated steel used in older construction, resulting in cracking, spalling and delamination. To prevent further chloride intrusion, WisDOT began wrapping fiberglass around the lower portion of deteriorating columns (after repair). This study evaluated the effectiveness of this maintenance practice.

Impact: Investigators found that while the fiberglass wrapping deters the ingress of chloride ions into the repaired concrete, it does not reduce the corrosion rate in the bars if the corrosion conditions remain inside the concrete columns or if moisture and chlorine ions have access to the column above and below the wrap. This study generated valuable data to enable more effective maintenance decisions and greater reliability for Wisconsin's bridges.

0092-07-17 - Development of Recommendations for Compaction Temperatures in the Field to Achieve Density and Limit As-Built Permeability

Final report and brief:

www.whrp.org/research-areas/flex/flex_0092-07-17.html

Hot-mix asphalt pavements must be compacted to the right density so that they are flexible enough to resist cracking, stiff enough to avoid rutting and impermeable enough to stave off the oxidation damage caused by air and water. Research was needed to establish optimum density and permeability values for Wisconsin by relating them mechanistically to pavement performance. Research was also needed to determine the minimum temperature and compaction effort required to achieve target values.

Impact: Researchers monitored 22 HMA construction projects, and used this data to determine the compaction factors affecting density, including mat temperature, number of roller passes, roller type, vibratory setting and PG binder grade. They also created a database relating the performance of HMA pavements in Wisconsin to their density, permeability and mixture characteristics. Data gathered from the study will help improve compaction practices including on pavements constructed with warm-mix asphalt.

0092-08-06 - Wisconsin Mixture Characterization Using the SPT on Historical Aggregate Structures

Final report and brief:

www.whrp.org/research-areas/flex/flex_0092-08-06.html

As WisDOT moves forward in implementing Mechanistic-Empirical Pavement Design, the department needs to understand the characteristics of those pavement mix designs already commonly used in the state. This study tested various asphalt mix formulas—using the Asphalt Mixture Performance Tester or Simple Performance Tester—to produce resilient modulus measurements that can serve as an input to M-E Design.

Impact: This study provided support for WisDOT's current pavement designs, serves as a baseline for identifying successful materials performance, and permits correlation between material properties and available pavement performance data for Wisconsin roads. This data will be helpful in predicting which mix designs are most likely to result in long-lasting asphalt pavements.





0092-08-14 - Fatigue Risks in the Connection of Sign Support Structures: Phase I

Final report and brief:

www.whrp.org/research-areas/structures/structures_0092-08-14.html

Wisconsin has many sign support structures in service that were designed before AASHTO's provisions for fatigue design of structural supports were issued in 2001. Problems encountered with two smaller sign support structures designed before 2001 led WisDOT to investigate design changes and retrofit measures that could have prevented these failures and similar problems in the future.

Impact: In this phase of the project, researchers gathered and synthesized fatigue testing data and developed wind speed and direction models that laid the groundwork for lab and field tests in Phase II, now under way. In Phase III, researchers will produce a handbook of effective retrofit measures and recommended inspection cycle frequencies that can mitigate the risk of fatigue failure—saving money while assuring safety and limiting motorist inconvenience.

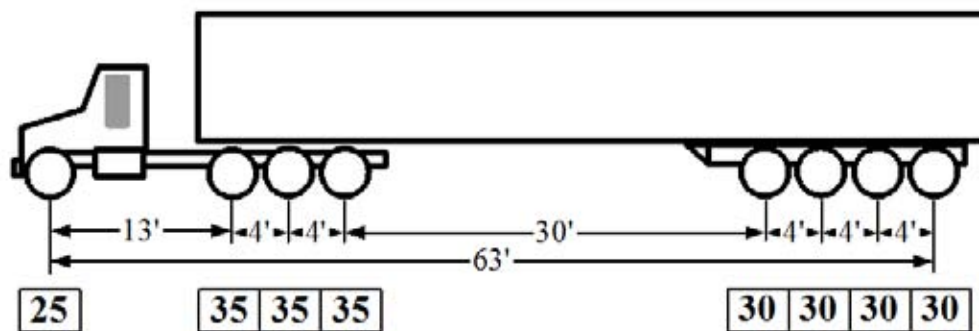
0092-08-15 - Analysis of Permit Vehicle Loads in Wisconsin

Final report and brief:

www.whrp.org/research-areas/structures/structures_0092-08-15.html

In Wisconsin, all structures must be designed to bear vehicles up to a certain weight, length, axle weight, and axle spacing, a limiting configuration defined as a Standard Permit Vehicle. Trucks over these limits, or “oversized overweight” vehicles, require permits from WisDOT to travel within Wisconsin. Because the size and weight of permit vehicles has steadily increased over the years, WisDOT needed to re-evaluate whether they can be accommodated safely on state roads and bridges.

Impact: Researchers used WisDOT permit records and field data to establish Standard Permit Vehicle configurations that would accommodate typical oversized overweight vehicles in Wisconsin. They then analyzed how such vehicles would affect Wisconsin bridges, and based on these results recommended changes to Standard Permit Vehicle specifications and the Wisconsin Bridge Manual. Allowing heavier trucks to operate on its highways will help reduce shipping costs and benefit Wisconsin's economy, while still protecting highways and bridges from premature deterioration.



Policy Research Program

The Policy Research Program was launched in 2007 to address research needs of the department beyond highway materials and construction. The program supports department decision-making by evaluating the technical merit of current and proposed policies and the impact of those policies on Wisconsin's economy, safety, operations, the environment and the agency itself.

WisDOT's Research & Library Advisory Committee, composed of representatives from all five divisions and the executive offices, helps coordinate research and library activities within the department and with external partners. RLAC also gives final approval to each year's policy projects.

Policy Research Project Impacts

Six policy projects were completed in 2009 addressing a range of issues across the department's business areas. Two studies looked at environmental issues: one on highway sweeping as a way to reduce contaminants in stormwater runoff and one on creating tools to track environmental features. Two projects dealt with commercial trucking topics—load size and overnight parking—and one examined the public's compliance with Wisconsin vehicle registration laws. The final study was part of a national examination of work force needs of DOTs in the coming years.

0092-04-04 – Pollutant Loading to Stormwater Runoff from Highways: Impact of a Highway Sweeping—Phase II

Final report: on.dot.wi.gov/wisdotresearch/database/reports/04-04sweeperstudy-f.pdf

Research brief: on.dot.wi.gov/wisdotresearch/database/briefs/04-04sweeperstudy-b.pdf

Pollutants, an inevitable consequence of freeway usage, settle onto roadway surfaces and become attached to pavement dirt particles. When rainwater flows over freeway surfaces, these dirt particles wash off into the storm sewers and waterways. By controlling the level of dirt accumulation on freeways, contamination of stormwater runoff can be minimized. WisDOT looked to high-efficiency street sweepers as a potential method of managing urban freeway dirt and pollutant accumulation.



Impact: Previous research used computer modeling to simulate and validate the effectiveness of a street sweeping program's impact on the quality of stormwater runoff on municipal streets. With the data gathered in this study, WisDOT can now calibrate the computer model for freeways to demonstrate the effectiveness that sweeping would have on urban highways with curbs and consider implementing sweeping as a tool for reducing pollutant runoff into waterways.

Policy Projects Selected for FFY 2009

0092-09-10 - Operational Resilience of the IH 90/94 Corridor

0092-09-11 - Performance Measures for the Long Range Plan

0092-09-14 - Workforce Development Summit for Wisconsin

0092-09-15 - Economic Value of Air Cargo in Wisconsin

Research & Library Advisory Committee

Daniel Yeh, Chair
WisDOT Bureau of Business Services

Sandra Beaupré
WisDOT Division of Transportation Investment Management

Anna Biermeier
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Dennis Hughes
WisDOT Division of State Patrol

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WisDOT Division of Business Management

Dwight McComb
FHWA Wisconsin Division Office

Rob Miller
WisDOT Office of Public Affairs

Rory Rhinesmith
WisDOT Division of Transportation System Development



0092-08-25 – Inventory and Asset Management System for NEPA-Required Environmental Mitigation Projects in Wisconsin

Final report: on.dot.wi.gov/wisdotresearch/database/reports/08-25assetmgmtenvmitigation-f.pdf

WisDOT constructs environmental mitigation features—such as wetland enhancements and wildlife barriers or passages—when it is not feasible to avoid sensitive natural resources or negative environmental impacts during transportation project construction. The principal objective of this research was to develop a centralized, comprehensive approach to manage environmental mitigation installations that require ongoing monitoring or maintenance.

Impact: Researchers developed two tools: an inventory of existing mitigation features in the five WisDOT regions and an Excel-based tracking tool that contains descriptive information about each feature in the inventory. The new tools, under review by WisDOT for implementation, are expected to help identify best practices that improve design and functionality and reduce the cost of future mitigation efforts.



0092-08-26 – Costs and Benefits of Increasing Load Size for Certain Circumstances of Freight in Wisconsin

Final report: on.dot.wi.gov/wisdotresearch/database/reports/08-26increaseloadsize-f.pdf

Intermodal shipping containers, which allow for very efficient loading and unloading of goods, are the primary mode for moving international freight by ship, rail or truck. Container shipments resulting in large gross vehicle weights on trucks must be divided into multiple loads, costing time and money. Following the lead of a few other states, Wisconsin is considering revising current policy to allow GVW values above 80,000 pounds for divisible loads in some cases.

Impact: Researchers compared the load-limit regulations for truck traffic in Wisconsin to those of neighboring and other representative states. They also interviewed relevant players to better understand the economic effects on shippers and carriers operating in the state. Wisconsin does have more stringent load-limit regulations than neighboring states and Canada and, based upon the interviews, could reap some economic benefits by relaxing those regulations. A more detailed analysis of the origins and destinations of goods carried via intermodal containers that will help quantify the economic benefits is pending.

0092-08-28 – Low Cost Strategies to Increase Truck Parking in Wisconsin

Final report: on.dot.wi.gov/wisdotresearch/database/reports/08-28increasetruckparking-f.pdf

With truck traffic increasing at an unprecedented rate, truck parking problems in Wisconsin have become an issue of concern. The shortage of available parking at truck stops and rest areas has prompted drivers to stay on the road for longer than the legally allowed 11 hours per day (resulting in driver fatigue), or to park on highway shoulders and ramps, posing safety concerns for drivers on Wisconsin's highways.

Impact: Researchers surveyed several groups of stakeholders (including truckers, carriers and highway patrol officers) to determine the extent and locations of these truck parking problems. Based on survey results, as well as a review of other similar studies, researchers proposed several low-cost strategies to address the parking needs of Wisconsin's truck drivers.

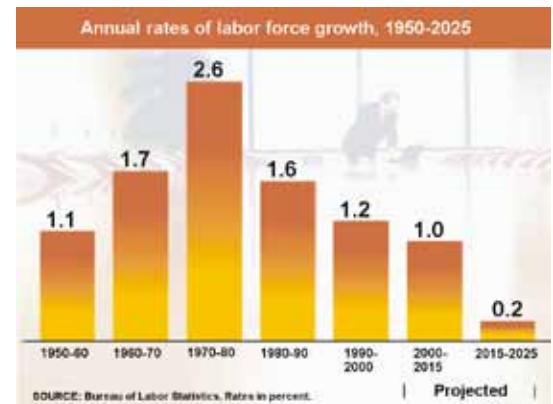


0092-09-14 – Workforce Development Summit for Wisconsin

Final report: on.dot.wi.gov/wisdotresearch/database/reports/09-14workforcedevsummit-f.pdf

Over the next 20 years, 76 million baby boomers will be eligible to consider retirement. But with only 46 million Generation Xers following behind them, a mass exodus from the transportation work force could create significant knowledge gaps at public agencies and threaten their ability to provide services. This situation presents serious challenges for transportation agencies as well as for the consultants and contractors who help them carry out their missions.

Impact: WisDOT, along with representatives from six other state DOTs, 15 educational institutions and six consulting firms, gathered in Madison to examine this issue. Through a series of expert presentations and panel and breakout discussions, participants identified focus areas for addressing the challenge, with suggested next steps.



Transportation Pooled Fund Program

For more than 20 years, FHWA has sponsored the Transportation Pooled Fund Program in cooperation with AASHTO and TRB as a means for interested state DOTs and other organizations to collaborate in solving transportation-related problems of common interest. Each agency that contributes funds to a pooled fund study designates a technical representative to serve on the project's Technical Advisory Committee. The TAC is responsible for guiding and overseeing the project, from drafting the study goals and work plan to reviewing the researchers' final report.

As a member of the project TAC, the WisDOT technical representative has an opportunity to influence the study's scope and deliverables with the agency's goals and interests in mind. By staying actively involved in the project, the representative helps ensure that WisDOT funds are well-spent and serve the department's needs. Responsibilities include attending face-to-face TAC meetings and teleconferences, communicating project progress and results, and leading implementation of the results in Wisconsin.

Impacts of Pooled Fund Projects

WisDOT is the lead state for the first two pooled fund projects summarized below. An additional 11 projects in which WisDOT participated during FFY 2009 are also highlighted.



Clear Roads (Test and Evaluation of Materials, Equipment and Methods for Winter Highway Maintenance) TPF-5(092)

Study link: www.clearroads.org

The Clear Roads pooled fund research program began in 2004 in response to a need for real-world testing in the field of winter highway operations. Led by WisDOT, this ongoing collaboration has grown to include 17 member states who meet twice yearly to identify needed research, select investigators and review results. The group also maintains a Web site and publishes a bimonthly e-newsletter.

Impact: Recent Clear Roads research projects have focused on studying the effectiveness of deicers, both in the field and in the laboratory, and developing standards for their use. During the 2008-2009 winter, the pooled fund also developed and tested four plow prototypes that use multiple blades to address a range of winter conditions. Clear roads continues to support collaborative information sharing and technology transfer, sponsoring the 2009 National Winter Maintenance Peer Exchange and facilitating informal state evaluation and feedback for a variety of winter maintenance products and tools.



Transportation Library Connectivity, TPF-5(105)

Study link: www.libraryconnectivity.org

This WisDOT-led pooled fund study is a grass-roots effort by librarians and information professionals that has grown to 22 members in 19 states. The goals of the study are to support the growth of regional Transportation Knowledge Networks, to be coordinated through the National Transportation Library at U.S. DOT and to promote cooperation among diverse elements of the transportation information community.

Impact: The pooled fund study is helping to connect transportation libraries across the country in a network that can help practitioners find needed research and information more quickly and less expensively. In 2009, pooled fund study members joined representatives of the regional TKNs, state DOT research programs and university transportation centers at the first-ever National Transportation Knowledge Network meeting, hosted by the National Transportation Library. Study members collaborated with the TRB Committee on Library and Information Science for Transportation to contribute to a poster session at the TRB Annual Meeting in January 2009. Member posters demonstrated that partnerships between transportation libraries and research programs are the way of the future.

Transportation Management Center Pooled Fund Study, SPR-2(207)

Study link: tmcdfs.ops.fhwa.dot.gov/

The goal of the Transportation Management Center pooled fund study, composed of regional, state and local transportation management agencies and FHWA, is to identify human-centered and operational issues associated with operating transportation management centers; suggest approaches to addressing identified issues; initiate and monitor projects to address identified issues; provide guidance and recommendations, and disseminate results; provide leadership and coordinate with others with TMC interests; and promote and facilitate technology transfer related to TMC issues nationally.

Impact: The TMC pooled fund study serves as an information-sharing forum for agencies that manage and operate TMCs and as a mechanism to collectively address key issues and challenges. The TMC pooled fund study has completed 16 projects so far and has 11 more in progress that improve upon the current state-of-the-practice related to the management, operation and performance of TMCs.

Animal-Vehicle Crash Mitigation Using Advanced Technologies, SPR-3(076)

Study link: www.pooledfund.org/projectdetails.asp?id=222&status=6

Animal-vehicle crashes are a significant problem on Wisconsin roadways. They result in injuries or fatalities for the vehicle occupants, significant damage to vehicles and usually the death of the animals. This study examined ways to reduce animal-vehicle crashes using the most promising animal detection/driver warning systems. This investigation resulted in the development and installation of a prototype animal detection and driver warning system and an evaluation of its effectiveness in reducing animal-vehicle crashes.

Impact: WisDOT realized considerable cost savings in collaborating on testing the prototype equipment. The project data and analysis demonstrated that the installation of the on-site equipment designed to warn drivers of potential collisions with animals is expensive, requires continual maintenance and is not very reliable. The pooled fund research summary statement supported Wisconsin's current approach to dealing with the problem of animal-vehicle collisions, such as helping maintain the Deer-Vehicle Crash Information Center Web site, developing media campaigns to heighten public awareness and continuing to evaluate new technologies that have the promise of being cost-effective solutions.



Animal crossing detection system in MT.
Copyright Marcel Huijser, WTI-MSU



Improving the Quality of Pavement Profiler Measurement, TPF-5(063)

Study link: www.pooledfund.org/projectdetails.asp?id=280&status=4

This study includes 21 participating state highway agencies with the goal of delivering sample procurement specifications, maintenance guidelines and an analysis software program for pavement profilers.

Impact: One of the major accomplishments for the study is the Profile Viewing and Analysis (ProVAL) software originated with FHWA in 2001. The TAC for this pooled fund study provided the insights and leadership that led to the software being included in agency specifications. WisDOT has also benefited greatly from networking with other state and federal agencies regarding problems associated with pavement profiler engineering and having access to and support from national experts in the pavement profiler measurement and related engineering fields.



Evaluation of Low Cost Safety Improvements, TPF-5(099)

Study link: www.tfhr.gov/safety/evaluations/

The goal of this research project is to develop reliable estimates of the effectiveness of the safety improvements that are identified as strategies in the NCHRP Report 500 Guides. These estimates are determined by conducting scientifically rigorous before and after evaluations at sites in the United States where these strategies are being implemented.

Impact: WisDOT has already benefited from the findings of the Safety Evaluation of Offset Improvements for Left-Turn Lanes study, which uses data from Wisconsin intersections (and other states) to confirm the safety benefits of positive offsets for opposing left turn lanes. This is recommended in WisDOT design guidance and is also one of the recommendations in the FHWA Bypass report. The pooled fund study has also produced many other useful reports and technical briefs, for example:

- Safety Evaluation of Increasing Retroreflectivity of STOP Signs, FHWA-HRT-08-047, March 2008
- Safety Evaluation of STOP AHEAD Pavement Markings, FHWA-HRT-08-045, March 2008
- Safety Evaluation of Flashing Beacons at Stop-Controlled Intersections, FHWA-HRT-08-048, April 2008
- Safety Evaluation of Advance Street Name Signs, FHWA-HRT-09-030, June 2009
- Safety Evaluation of Lane and Shoulder Width Combinations on Rural, Two-Lane, Undivided Roads, FHWA-HRT-09-031, June 2009
- Safety Evaluation of Improved Curve Delineation, FHWA-HRT-09-046, August 2009

Investigation of the Fatigue Life of Steel Base Plate to Pole Connections for Traffic Structures, TPF-5(116)

Study link: www.pooledfund.org/projectdetails.asp?id=348&status=6

The project investigates what improvements can be made to the connections between base plate and pole of traffic sign structures, such as changes in the welded connection detail, plate thickness, bolt pattern and stiffener pattern, to improve fatigue life. More research is needed to develop a better understanding of the effect of such changes and to provide a systematic way that this knowledge can be incorporated into the design process and the AASHTO specifications for signal poles, high mast illumination poles and other traffic structures.

Impact: The result of this study will be a fatigue design guide and a list of proposed changes to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals to be submitted to the AASHTO T-12 Committee. The characterization of fatigue details in the Standard Specifications will offer a significant improvement that will enhance WisDOT design work.

Development of Performance Properties of Ternary Mixes, TPF-5(117)

Study link: www.pooledfund.org/projectdetails.asp?id=349&status=4

The goal of this project is to make a comprehensive study of how supplementary cementitious materials can be used to improve the performance of concrete mixtures, looking at both portland cements and blended cements. This research will enhance the life-cycle performance and cost-effectiveness of concrete pavements and structures.

Impact: Phase I of this project included a brief literature study to summarize the state of the practice in ternary mixtures. Phase II of this study, which is nearing completion, consists of laboratory evaluation of an experimental matrix including 110 to 115 different mixtures. Phase III, scheduled for the 2009 and 2010 construction seasons, consists of field demonstration projects using ternary mixtures in the participating states. The results of all of these activities will create the architecture for predicting the performance of ternary systems based on the material properties of the total cementitious system.

Recycled Unbound Pavement Materials (MnROAD Study), TPF-5(129)

Study link: www.pooledfund.org/projectdetails.asp?id=361&status=4

The objective of this study is to investigate the use of recycled materials in constructing pavement base layers. Investigators will monitor the performance of several test sections constructed using recycled materials in the granular base layers, including some blended with virgin materials as well as 100 percent recycled materials. The material properties will be monitored during construction and throughout the pavement life to determine their effects on pavement performance, especially their variation with changing seasons and moisture conditions.

Impact: The results of this study will identify the critical material properties of these recycled materials (including strength, stiffness, drainage, volume changes and unsaturated properties) and report on testing protocols that can accurately predict pavement performance. The results will also document what, if any, environmental concerns there may be surrounding the use of these recycled materials.





PCC Surface Characteristics: Tire-Pavement Noise Part #3—Innovative Solutions and Current Practices, TPF-5(139)

Study link: www.pooledfund.org/projectdetails.asp?id=368&status=4

The purpose of this pooled fund study is to fully implement the Portland Cement Concrete Surface Characteristics program. Part 3 will continue the comprehensive data collection and analysis program; build on it so that the research results have broader applicability; and develop innovative texturing techniques that have the potential to significantly reduce noise. Part 3 funds target those projects from the earlier phase of the field study (Part 2) that showed good results and are worth further evaluation relative to constructability and consistency. The study continues to look at new, innovative processes and equipment as well.

Impact: This pooled fund covers the cost of the ongoing technology transfer including on-site meetings with the management-level staff members from each of the participating states as well as technical memorandums, briefs and conference presentations of study results and recommendations. This includes suggesting ways that DOTs can incorporate results into their activities to meet noise, friction and safety requirements. Examples of recent deliverables include a guide that outlines best practices for construction of good texture and a technical brief on diamond grinding.



Extending the Season for Concrete Construction and Repair—Phase III, TPF-5(150)

Study link: www.cptechcenter.org/projects/detail.cfm?projectID=175563032

The goal of this study is to develop tools and guidance to specify dosage levels of antifreeze admixtures used in constructing concrete pavements in varying cold weather conditions experienced at any job location. Phase I demonstrated the feasibility and practicality of using antifreeze admixtures in concrete and devised the tools needed to design, mix, place and cure concrete in below-freezing weather. Phase II defined the effect of the Phase I antifreeze formulations on the freeze-thaw durability of concrete. Phase III will provide the tools necessary to apply the knowledge gained from Phases I and II.

Impact: Both Phases I and II of Extending the Season for Concrete Construction and Repair have proven that the antifreeze approach to cold weather concreting is effective. Phase III will develop easy-to-use tools to aid the implementation of this technology, including a cold weather field guide and a computer-based model. These computer-based tools would potentially allow for real-time monitoring of the temperature within the pavement.

Technology Transfer Concrete Consortium, TPF-5(159)

Study link: www.pooledfund.org/projectdetails.asp?id=390&status=4

This pooled fund study is a partnership of 19 states that continues the collaborative effort begun in TPF-5(066) Materials and Construction Optimization and the Midwest Concrete Consortium. The Technology Transfer Concrete Consortium supports the implementation of current research and the development of longer life concrete pavements by supporting innovative testing, construction optimization technologies and practices, and technology transfer initiatives.

Impact: The TTCC helps foster collaboration between several different studies and provides technology transfer of the results of these other studies, such as a train-the-trainer workshop on the Integrated Materials and Construction Practices for Concrete Pavement manual. The TTCC also gives participating states a role in directing the development and implementation of the Concrete Pavement Road Map. The CP Road Map identifies a coordinated plan at the national level for new concrete pavement research and technology transfer activities for the next several years.

Transportation Security and Emergency Preparedness Professional Capacity Building (PCB) Pooled Fund Study, TPF-5(161)

Study link: www.pooledfund.org/projectdetails.asp?id=385&status=4

The objective of the Transportation Security and Emergency Preparedness Professional Capacity Building pooled fund study is to develop a suite of training materials for state DOTs to enhance their capabilities in emergency transportation operations, infrastructure risk management and evacuation planning. Assistance to state DOTs in security and emergency preparedness, with training or other capacity building efforts, is a focus of the study.

Impact: This study is developing or has developed the following resources that will benefit WisDOT:

- DOT Organizations, Roles and Missions for Security and Emergency Management for managers and senior executives
- Evacuation principles
- Homeland Security Exercise and Evaluation Program
- National Incident Management System for Frontline Transportation Workers
- Component Level Risk Management Introduction/Familiarization for online presentation



Partners and Resources



Bureau of Technical Services

WisDOT's Bureau of Technical Services is home to research-related activities in the areas of new product evaluation and technology transfer. Activities include targeted reviews of technical issues and preparation of WisDOT's Product Acceptability List for erosion control products. In FFY 2009, the Bureau of Technical Services conducted the research study Local Calibration of the Mechanistic-Empirical Pavement Design Guide (MEPDG) software for Wisconsin. In FFY 2010 the bureau will conduct studies on cost-effective concrete pavement cross sections and optimal dowel bar material. BTS will also sponsor the 2010 Annual Geotechnical/Geoenvironmental Conference.

New Product Evaluation/Technology Transfer

Dan McGuire
Director, Bureau of Technical Services

Steve Krebs
Chief, Materials Management Section

Pete Kemp
New Product Engineer

Barry Paye
Research Engineer



Construction and Materials Support Center

cmssc.engr.wisc.edu

This partnership between WisDOT and UW-Madison supports the applied research needs of the department on a rapid-turnaround basis. With the guidance of a steering committee and full-time program manager, the Construction Materials Support Center accesses the expertise of university faculty and students to support WisDOT staff, consultants and contractors in implementing important new technologies and practices.

CMSC Staff

Awad Hanna
Director, UW-Madison

Gary Whited
Program Manager

CMSC Steering Committee

Steve Krebs WisDOT Bureau of Technical Services	Daniel Yeh WisDOT Bureau of Business Services
Dan McGuire WisDOT Bureau of Technical Services	Peg Lafky WisDOT Bureau of Business Services
Don Miller WisDOT Bureau of Project Development	Wes Shemwell FHWA Wisconsin Division Office

Federal Highway Administration

www.fhwa.dot.gov

FHWA provides major funding for WisDOT's research efforts. The State Planning and Research Program under which WisDOT administers these funds was established in the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), continued with the 1998 Transportation Equity Act for the 21st Century (TEA-21), and is currently authorized in the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The R&L Unit works closely with FHWA Wisconsin Division Office to ensure the high quality of the research program. In addition, individual FHWA staff members contribute their expertise as members of policy and project oversight committees and other research work groups.



American Association of State Highway and Transportation Officials

www.transportation.org

Through membership on AASHTO's standing committees and its Research Advisory Committee, WisDOT has the opportunity to help shape the national research agenda. The department benefits from the many programs, services and products of AASHTO, such as the Center for Environmental Excellence, the Technology Implementation Group, the Materials Reference Laboratory, the Product Evaluation Program, and AASHTOWare. AASHTOWare software products are available exclusively to state DOTs for dozens of critical management functions, including all aspects of highway construction products; bridge management, rating and design; pavement analysis and design; survey data management; and safety information management.



Transportation Research Board

www.trb.org

Every business area of WisDOT benefits from TRB's multimillion-dollar annual research program. WisDOT's research administrator serves as the department's official representative to TRB. The continuous stream of research products generated through TRB programs offers immediate and practical solutions to transportation practitioners. WisDOT staff and partners from academia and industry are among the more than 10,000 transportation professionals from around the world who attend the TRB Annual Meeting each January in Washington, D.C. See the Wisconsin TRB Guide at on.dot.wi.gov/wisdotresearch/database/reports/trbguide2010.pdf for Wisconsin TRB committee memberships and for presentations given by Wisconsin investigators, students and practitioners. Many of the technical papers listed in this guide were supported through funding from the WisDOT Research Program.



Transportation Pooled Fund Program

www.pooledfund.org

This valuable program sponsored by FHWA, TRB and AASHTO provides a way for federal, state and local transportation agencies and other organizations to pool their funds in support of research that is important to all of them. FHWA permits the use of 100 percent federal dollars for pooled fund projects. Technical advisory committees composed of representatives from each partner organization oversee projects and disseminate useful results. Information about WisDOT's participation in pooled fund projects is available on pages 24 to 29.





University Transportation Centers

www.wistrans.org/cfire/

Funded from 2000 through 2007, the Midwest Regional University Transportation Center at UW–Madison carried out research, education and technology transfer activities focused on the theme of Optimization of Transportation Investment and Operations. In 2007 the new National Center for Freight & Infrastructure Research & Education was established at UW–Madison with the theme of Sustainable Freight Transportation Infrastructure and Systems. WisDOT partners with CFIRE in the funding and oversight of several policy research projects related to freight, infrastructure and traffic operations, which are listed in the Project Reference Guide. WisDOT also contributes \$100,000 to the following research projects, which are managed by CFIRE: Understanding and Modeling Freight Stakeholder Behavior and Sustainable Freight Infrastructure to Meet Climate and Air Quality Goals.

Research Funding Opportunities

The R&L Unit is working to improve its efforts to alert department staff to research funding opportunities beyond those offered through WisDOT programs. Contact the unit for help in proposing research ideas for national programs, many of which are listed below with the approximate time for submitting problem statements. Detailed information about these and other national programs is available on the following pages and at TRB's Funding Sources for Transportation Research: Competitive Programs at www.trb.org/ResearchFunding/Public/ResearchFunding.aspx.

Deadlines for Proposal Submission

National Research Programs	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
National Cooperative Highway Research Program – Synthesis		*										
Innovations Deserving Exploratory Analysis			*						*			
Transit Cooperative Research Program – Synthesis			*									
Surface Transportation Environment and Planning Cooperative Research Program			*								*	
Commercial Truck and Bus Safety Synthesis Program				*	*							
Airport Cooperative Research Program				*						*		
Transit Cooperative Research Program						*						
Exploratory Advanced Research Program						*						
National Cooperative Freight Research Program							*					
National Cooperative Highway Research Program									*			
Airport Cooperative Research Program – Synthesis										*		
National Cooperative Highway Research Program – Domestic Scans										*	*	
Hazardous Materials Cooperative Research Program	*	*	*	*	*	*	*	*	*	*	*	*

Innovations Deserving Exploratory Analysis

www.trb.org/IDEAProgram/Public/IDEAProgram.aspx

IDEA programs fund research into promising but unproven innovations for highways, transportation safety and transit. The annual Program Announcement provides information about the programs and includes instructions and forms for submitting proposals. Annual progress reports that describe current and completed projects are published for each program.

Surface Transportation Environment and Planning Cooperative Research Program

www.fhwa.dot.gov/HEP/STEP/index.htm

STEP is an FHWA-administered research program aimed at improving the understanding of the relationship between surface transportation, environment and planning. STEP research efforts also help achieve national objectives for environmental stewardship and streamlining, congestion reduction, safety and security. FHWA uses stakeholder input to help identify and prioritize STEP research topics. Stakeholder feedback is also used to help refine and implement the national research agenda and form partnerships to leverage and coordinate other funding sources.

Commercial Truck and Bus Safety Synthesis Program

www.trb.org/SynthesisPrograms/Public/CommercialTruckandBusSafetySynthesisProgram.aspx

This program initiates several synthesis studies annually that address concerns in the area of commercial truck and bus safety. The studies are relatively short documents (40 to 60 pages) that summarize existing practice in a specific technical area based typically on a literature search and a survey of relevant organizations (such as state DOTs, enforcement agencies, commercial truck and bus companies, or other organizations appropriate for the specific topic). The primary users of the syntheses are practitioners who work on issues or problems using diverse approaches in their individual settings.

Airport Cooperative Research Program

www.trb.org/ACRP/Public/ACRP.aspx

ACRP undertakes research of common operating problems and seeks to adapt new technologies and introduce innovations to the airport industry. An applied research program, ACRP focuses on a variety of airport subject areas, including design, construction, maintenance, safety and security. FAA provided \$10 million for ACRP in FFY 2009 through the Vision 100-Century of Aviation Reauthorization Act.

Transit Cooperative Research Program

www.trb.org/TCRP/Public/TCRP.aspx

Established in 1992 under Federal Transit Authority sponsorship, TCRP conducts research focused on four FTA strategic research goals: increasing ridership, improving operating efficiencies, improving safety and security, and protecting the environment and promoting energy independence. The TCRP priorities of customer satisfaction, effective use of technology and ensuring the continuing viability of transit organizations also guide selection of research projects. TCRP was appropriated approximately \$9 million per year under SAFETEA-LU.

Exploratory Advanced Research Program

www.fhwa.dot.gov/advancedresearch

The EAR Program addresses the need to focus on longer term and higher risk breakthrough research with the potential for transformational improvements to plan, build, renew and operate safe, congestion-free and environmentally sound transportation systems. FHWA works with partners in the research community to develop and modify focus areas for the EAR Program. Current areas include:

- Next generation solutions for system operations and reducing congestion
- Next generation pedestrian and driver safety
- Next generation solutions to build, maintain and manage future highways
- Predicting societal and complex natural systems

National Cooperative Freight Research Program

www.trb.org/NCFRP/Public/NCFRP.aspx

Freight transportation in the United States involves all modes of transportation—trucking, rail, waterways, air and pipelines. NCFRP carries out applied research on a broad range of issues related to improving the efficiency, reliability, safety and security of the national freight transportation system. Overseen by a committee composed of public and private freight stakeholders and funded through SAFETEA-LU, NCFRP received approximately \$2.5 million in FFY 2009.

National Cooperative Highway Research Program

www.trb.org/NCHRP/Public/NCHRP.aspx

WisDOT joins other states to cooperatively fund NCHRP at a level of approximately \$30 million per year. NCHRP is an applied research program focused on operational problems of transportation engineers and administrators covering a broad range of transportation research areas. WisDOT has an opportunity to guide project selection and to oversee individual projects by serving on NCHRP project panels. See the Wisconsin TRB Guide at on.dot.wi.gov/wisdotresearch/database/reports/trbguide2010.pdf for current WisDOT panel members.

Hazardous Materials Cooperative Research Program

www.trb.org/HMCRP/Public/HMCRPOverview.aspx

Hazardous material shipments vary in size and type and are moved throughout the country using a variety of modes of freight transportation. Addressing a long-standing need, HMCRP carries out applied research focused on day-to-day operational issues associated with the transportation of hazardous materials. In its current pilot stage HMCRP is guided by TRB panels composed of hazardous materials shippers and carriers, first responders, government officials, nonprofit entities and universities. HMCRP received \$1.25 million per year for FFY 2006-2009.



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PROJECT REFERENCE GUIDE



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Active Pooled Fund Research Projects During FFY 2009

Research Category	Project ID	PROJECT TITLE	WisDOT pledge thru 2009	WisDOT Contact
Asphalt	TPF-5(021)	Base Funding for the North Central Superpave Center	\$240,000	Tom Brokaw
Asphalt	TPF-5(107)	Design, Construction and Performance of 4.75mm Superpave Designed Mixes	\$30,000	Judith Ryan
Asphalt	TPF-5(119)	North Central Pavement Research and Implementation Coordination Partnership	\$60,000	Daniel Yeh
Asphalt	TPF-5(124)	Accelerated Performance Testing on the 2006 NCAT Pavement Test Track	\$5,000	Barry Paye
Asphalt	TPF-5(132)	Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II (MnROAD Study)	\$40,000	Leonard Makowski
Asphalt	TPF-5(178)	Implementation of the Asphalt Mixture Performance Tester for Superpave Validation	\$35,000	Tom Brokaw
Concrete	TPF-5(117)	Development of Performance Properties of Ternary Mixes	\$45,000	James Parry
Concrete	TPF-5(139)	PCC Surface Characteristics: Tire-Pavement Noise Part 3 – Innovative Solutions and Current Practices	\$45,000	James Parry
Concrete	TPF-5(150)	Extending the Season for Concrete Construction and Repair – Phase III	\$20,000	James Parry
Concrete	TPF-5(159)	Technology Transfer Concrete Consortium	\$10,000	James Parry
Concrete	TPF-5(174)	Construction of Crack-Free Bridge Decks – Phase II	\$25,000	Laura Shadewald
Concrete	TPF-5(179)	Evaluation of Test Methods for Permeability and Development of Performance Guidelines for Durability	\$15,000	James Parry
Concrete	TPF-5(188)	Evaluation of Fiber Reinforced Composite Dowel Bars and Stainless Steel Dowel Bars	\$10,800	Deb Bischoff
Concrete	TPF-5(205)	Implementation of Pavement Mixture Design and Analysis Track of Concrete Pavement Road Map	\$10,000	James Parry
Environment	TPF-5(186)	Updating U.S. Precipitation Frequency Estimates for Michigan and Wisconsin	\$100,000	Najoua Ksontini
Geotechnics	SPR-3(072)	Strength and Deformation Analysis of Mechanically Stabilized Earth Walls at Working Loads	\$10,000	Jeff Horsfall
Geotechnics	TPF-5(001)	Soil Mixing Methods for Highway Application	\$60,000	Robert Arndorfer
Geotechnics	TPF-5(128)	Accelerated Implementation of Intelligent Compaction Technology	\$25,000	Robert Arndorfer
Geotechnics	TPF-5(129)	Recycled Unbound Pavement Materials (MnROAD Study)	\$45,000	Tom Brokaw
Geotechnics	TPF-5(177)	Improving Resilient Modulus Test Procedures for Unbound Materials	\$40,000	Tom Brokaw
Operations	SPR-2(207)	Transportation Management Center Pooled Fund Study	\$195,000	Doug Dembowski
Operations	SPR-3(042)	Aurora	\$100,000	Mike Adams
Operations	SPR-3(104)	Computer Based, Self-Operating Training System on Anti-Icing/Road Weather Information Systems	\$30,000	Mike Sproul
Operations	TPF-5(046)	Transportation Curriculum Coordination Council Training Management and Development	\$75,000	Jerry Zogg
Operations	TPF-5(063)	Improving the Quality of Pavement Profiler Measurement	\$90,000	Bill Duckert
Operations	TPF-5(065)	Traffic Control Device Consortium	\$155,000	Tom Notbohm
Operations	TPF-5(081)	Smart Work Zone Deployment Initiative	\$452,780	Tom Notbohm
Operations	TPF-5(092)	Clear Roads (Test and Evaluation of Materials, Equipment and Methods for Winter Highway Maintenance)	\$150,000	Mike Sproul

Active Pooled Fund Research Projects During FFY 2009 (continued)

Research Category	Project ID	PROJECT TITLE	WisDOT pledge thru 2009	WisDOT Contact
Operations	TPF-5(120)	Deer Vehicle Crash Information and Research Center	\$50,000	Jim Merriman
Operations	TPF-5(176)	Traffic Analysis and Simulation	\$50,000	John Shaw
Operations	TPF-5(190)	Northwest Passage – Phase III	\$25,000	Bob Frey
Operations	TPF-5(199)	Recycled Materials Resource Center	\$30,000	Ken Nwankwo
Policy	TPF-5(036)	Transportation Asset Management Research Program	\$1,460,000	Daniel Yeh
Policy	TPF-5(105)	Transportation Library Connectivity	\$250,000	John Cherney
Policy	TPF-5(161)	Transportation Security and Emergency Preparedness Professional Capacity Building	\$100,000	Paul Keltner
Policy	TPF-5(196)	2009 National Asset Management Conference	\$10,000	Scott Bush
Safety	TPF-5(099)	Evaluation of Low Cost Safety Improvements	\$5,000	John Bridwell
Safety	TPF-5(193)	Midwest States Pooled Fund Crash Test Program	\$757,470	Erik Emerson
Structures	TPF-5(005)	FHWA Curved Steel Bridge Test	\$30,000	Scot Becker
Structures	TPF-5(068)	Long-Term Maintenance of Bridge Load Resistance Factor Design Specifications	\$80,000	Scot Becker
Structures	TPF-5(106)	Guidelines for Designing Bridge Piers and Abutments for Vehicle Collisions	\$50,000	Scot Becker
Structures	TPF-5(110)	Validation of Numerical Modeling and Analysis of Steel Bridge Towers Subjected to Blast Loadings	\$45,000	Travis McDaniel
Structures	TPF-5(116)	Investigation of the Fatigue Life of Steel Base Plate to Pole Connections for Traffic Structures	\$50,000	Kent Bahler
Structures	TPF-5(131)	Underwater Inspection of Bridge Substructures Using Underwater Imaging Technology	\$20,000	Dave Babler
Structures	TPF-5(189)	Enhancement of Welded Steel Bridge Girders Susceptible to Distortion-Induced Fatigue	\$15,000	Craig Wehrle
Structures	TPF-5(210)	In-situ Scour Testing Device	\$15,000	Najoua Ksontini



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New Project Awards for FFY 2010

Research Category	Project ID	WISCONSIN PROJECTS	FFY 2010 Award	WisDOT Contact
Asphalt	0092-08-09	Pre-Overlay Repair of Existing Concrete and Asphalt Pavements – Phase I	\$70,000	Leonard Makowski
Asphalt	0092-09-01	Evaluation of Flow Number as a Discriminating HMA Mixture Property	\$25,000	Leonard Makowski
Asphalt	0092-10-06	Effects of Recovered Binders from Recycled Shingles and Increased RAP Percentages on Resultant Binder Performance Grade	\$70,000	Leonard Makowski
Asphalt	0092-10-07	HMA Fatigue and Low Temperature Properties to Support MEPDG	\$70,000	Leonard Makowski
Concrete	0092-08-08	Reduction of Minimum Required Weight of Cementitious Materials in Concrete Mixes	\$71,138	James Parry
Concrete	0092-10-11	Laboratory Study of Concrete Properties to Support Implementation of the new AASHTO Mechanistic Empirical Design Guide	\$180,000	James Parry
Geotechnics	0092-07-06	Development and Full Scale Testing of an Alternate Foundation System for Post and Panel Retaining Walls	\$20,000	Robert Arndorfer
Geotechnics	0092-10-08	Investigation of Testing Methods to Determine Long Term Aggregate Durability of Various Types of Wisconsin Aggregate Sources – Phase II	\$60,000	Robert Arndorfer
Geotechnics	0092-10-09	Comparison of LRFD and LFD Cast-In-Place Pile Design and Construction Methods	\$60,000	Robert Arndorfer
Geotechnics	0092-10-10	Cone Penetrometer Comparison Testing	\$65,000	Robert Arndorfer
Policy	0092-10-15	Best Practices Guidance for Workforce Transition and Succession Planning	\$30,000	Randy Sarver
Policy	0092-10-16	Costs and Benefits of Equipping OWI Offenders with IIDs	\$50,000	Dennis Hughes
Policy	0092-10-19	Mobility Issues for an Aging Population	\$70,000	Daniel Yeh
Policy	0092-10-20	Implementing Best Practices from ARRA and Mega Projects	\$70,000	Daniel Yeh
Structures	0092-04-15	Bridge Integrated Analysis and Decision Support – Case Histories – Additional Phases	\$20,000	Travis McDaniel
Structures	0092-09-07	Fatigue Risks in the Connection of Sign Support Structures – Phase II	\$87,364	Travis McDaniel
Structures	0092-10-12	Finite Element Analysis of Deep Wide-Flanged Prestressed Girders	\$50,000	Travis McDaniel
Structures	0092-10-13	Development of a Bridge Construction Live Load Analysis Guide	\$55,000	Travis McDaniel
TOTAL			\$1,123,502	

For project details and quarterly reports, see on.dot.wi.gov/wisdotresearch/index.htm or www.whrp.org.

NOTE: Table shows awards for new research projects only, not for all research activities. Additional awards may be made during the year.

New Project Awards for FFY 2010

Research Category	Project ID	POOLED FUND PROJECTS	FFY 2010 Award	WisDOT Contact
Asphalt	1225	Characterization of Drainage Layer Properties for MEPDG	\$30,000	Laura Fenley
Asphalt	TPF-5(132)	Investigation of Low Temperature Cracking in Asphalt Pavements - Phase II (MnROAD Study)	\$20,000	Leonard Makowski
Asphalt	TPF-5(153)	Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements (MnROAD Study)	\$15,000	Tom Brokaw
Asphalt	TPF-5(178)	Implementation of the Asphalt Mixture Performance Tester for Superpave Validation	\$70,000	Tom Brokaw
Asphalt	TPF-5(213)	Performance of Recycled Asphalt Shingles in Hot Mix Asphalt	\$42,500	Judith Ryan
Concrete	1227	Investigation of Jointed Plain Concrete Pavement Deterioration at Joints and the Potential Contribution of Deicing Chemicals	\$15,000	James Parry
Concrete	1233	Validation and Implementation of Hot-Poured Crack Sealant	\$25,000	Paulette Hanna
Concrete	TPF-5(117)	Development of Performance Properties of Ternary Mixes	\$15,000	Don Miller
Concrete	TPF-5(159)	Technology Transfer Concrete Consortium	\$5,000	James Parry
Concrete	TPF-5(179)	Evaluation of Test Methods for Permeability and Development of Performance Guidelines for Durability	\$15,000	James Parry
Concrete	TPF-(183)	Improving the Foundation Layers for Concrete Pavements	\$35,000	Jeff Horsfall
Concrete	TPF-5(205)	Implementation of Pavement Mixture Design and Analysis Track of Concrete Pavement Road Map	\$10,000	James Parry
Environment	TPF-5(170)	Mobile Source Air Toxics From Major Highways	\$35,000	Patricia Trainer
Environment	TPF-5(186)	Updating U.S. Precipitation Frequency Estimates for Michigan and Wisconsin	\$13,436	Najoua Ksontini
Environment	TPF-5(199)	Recycled Materials Resource Center	\$30,000	Ken Nwankwo
Geotechnics	TPF-5(128)	Accelerated Implementation of Intelligent Compaction Technology	\$25,000	Robert Arndorfer
Geotechnics	TPF-5(129)	Recycled Unbound Pavement Materials (MnROAD Study)	\$15,000	Tom Brokaw
Geotechnics	TPF-5(148)	The Effects of Implements of Husbandry "Farm Equipment" on Pavement Performance (MnROAD Study)	\$5,000	Laura Fenley
Operations	SPR-3(042)	Aurora	\$25,000	Mike Adams
Operations	TPF-5(063)	Improving the Quality of Pavement Profiler Measurement	\$5,000	Bill Duckert
Operations	TPF-5(065)	Traffic Control Device Consortium	\$20,000	Tom Notbohm
Operations	TPF-5(081)	Smart Work Zone Deployment Initiative	\$40,000	Tom Notbohm
Operations	TPF-5(176)	Traffic Analysis and Simulation	\$50,000	John Shaw
Operations	TPF5(218)	Clear Roads Winter Highway Operations Pooled Fund (continued from TPF-5(092))	\$25,000	Mike Sproul
Operations	TPF-5(220)	Accommodating Oversize/Overweight Vehicles at Roundabouts	\$30,000	Patrick Fleming
Policy	TPF-5(215)	Transportation Engineering and Road Research Alliance	\$20,000	Steven Krebs
Safety	1221	Support of the Motorcycle Crash Causation Study	\$15,000	Greg Patzer
Safety	TPF-5(099)	Evaluation of Low Cost Safety Improvements	\$5,000	John Bridwell
Safety	TPF-5(172)	An Analytical Review of Child Mobility Assessments for School Site Programs	\$10,000	Renee Callaway
Safety	TPF-5(193)	Midwest States Pooled Fund Crash Test Program	\$66,000	Erik Emerson
Structures	TPF-5(068)	Long-Term Maintenance of Bridge Load Resistance Factor Design Specifications	\$20,000	Scot Becker
Structures	TPF-5(131)	Underwater Inspection of Bridge Substructures Using Underwater Imaging Technology	\$20,000	Dave Babler
Structures	TPF-5(164)	Fish Passage in Large Culverts with Low Flows	\$15,000	Rodney Taylor
Structures	TPF-5(169)	Investigation of Curved Girder Bridges with Integral Abutments	\$7,500	Dave Kiekbusch
Structures	TPF-5(189)	Enhancement of Welded Steel Bridge Girders Susceptible to Distortion-Induced Fatigue	\$15,000	Craig Wehrle
Structures	TPF-5(202)	HY-8 Culvert Analysis Program - Phase Three of Development Efforts	\$10,000	Rodney Taylor
TOTAL			\$819,436	

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Progress of Active Research Projects — FFY 2009

Project ID	Primary Category	Performing Organization	Investigator	Program	Cost	WisDOT Contact	Project Title	2005	2006	2007	2008	2009	2010	2011	2012
0092-04-04	Environment	United States Geological Survey	Judy Horwach	Policy	\$195,003	dan.scudder@dot.wi.gov	Pollutant Loading to Storm Water Run-Off from Highways: Impact of a Highway Sweeping Program – Phase II	<div><div></div></div>				<div><div></div></div> 100%			
0092-04-10	Geotechnics	University of Wisconsin–Madison	Tuncer Edil	WHRP	\$114,603	robert.arndorfer@dot.wi.gov	Monitoring and Evaluation of a Fly Ash Stabilized Subgrade Constructed by WisDOT	<div><div></div></div>				<div><div></div></div> 99%			
0092-04-15	Structures	University of Wisconsin–Milwaukee	Al Ghorbanpoor	WHRP	\$140,000	scot.becker@dot.wi.gov	Bridge Integrated Analysis and Decision Support – Case Histories – Phase I	<div><div></div></div>				<div><div></div></div> 100%			
0092-04-15	Structures	University of Wisconsin–Milwaukee	Al Ghorbanpoor	WHRP	\$60,000	travis.mcdaniel@dot.wi.gov	Bridge Integrated Analysis and Decision Support – Case Histories – Additional Phases				<div><div></div></div>	<div><div></div></div> 25%			
0092-05-02	Structures	Marquette University	Chris Foley	WHRP	\$95,692	bruce.karow@dot.wi.gov	In-Situ Monitoring and Testing of IBRC Bridges	<div><div></div></div>				<div><div></div></div> 98%			
0092-05-03	Structures	Bentley Systems, Inc.	Shri Bhide	WHRP	\$120,000	scot.becker@dot.wi.gov	Electronic Automation of LRFD Design Programs	<div><div></div></div>				<div><div></div></div> 95%			
0092-06-04	Geotechnics	HNTB	John Siwula	WHRP	\$230,805	robert.arndorfer@dot.wi.gov	Construction Vibration Attenuation with Distance and its Effect on the Quality of Early-Age Concrete		<div><div></div></div>			<div><div></div></div> 62%			
0092-06-05	Geotechnics	University of Wisconsin–Madison	Tuncer Edil	WHRP	\$35,043	robert.arndorfer@dot.wi.gov	Comparison of Basic Lab Test Results with More Sophisticated Lab and In-Situ Test Methods on Soils in Southeastern Wisconsin		<div><div></div></div>			<div><div></div></div> 100%			
0092-06-06	Structures	University of Wisconsin–Madison	Habib Tabatabai	WHRP	\$115,000	scot.becker@dot.wi.gov	Evaluation of Methods of Rebar Protection, Spall Prevention, and Repair Techniques on Concrete Girders		<div><div></div></div>			<div><div></div></div> 98%			
0092-06-08	Geotechnics	Geo Engineering Consulting, Inc.	Tuncer Edil	WHRP	\$13,044	robert.arndorfer@dot.wi.gov	Implementation of Equivalency of Alternative Working Platforms and their Pavement Design Strength Contribution Projects			<div><div></div></div>		<div><div></div></div> 100%			
0092-06-08	Structures	University of Wisconsin–Milwaukee	Al Ghorbanpoor	WHRP	\$15,000	scot.becker@dot.wi.gov	Implementation of Rehabilitation Techniques for Concrete Bridges			<div><div></div></div>		<div><div></div></div> 100%			
0092-07-01	Asphalt Pavement	Root Pavement Technology, Inc.	Richard Root	WHRP	\$46,000	leonard.makowski@dot.wi.gov	Investigation of the Use of Open-Graded Friction Courses in Wisconsin			<div><div></div></div>		<div><div></div></div> 100%			
0092-07-02	Concrete Pavement	University of Wisconsin–Madison	Steve Cramer	WHRP	\$224,999	james.parry@dot.wi.gov	Detecting Deleterious Fine Particles in Concrete Aggregates and Defining their Impact			<div><div></div></div>		<div><div></div></div> 78%			
0092-07-04	Geotechnics	University of Illinois–Champaign/Urbana	James Long	WHRP	\$34,500	robert.arndorfer@dot.wi.gov	Comparison of Three Different Methods for Determining Pile Bearing Capacities			<div><div></div></div>		<div><div></div></div> 100%			
0092-07-05	Geotechnics	University of Wisconsin–Madison	Tuncer Edil	WHRP	\$70,987	robert.arndorfer@dot.wi.gov	Development of Testing Methods to Determine Interaction of Geogrid-Reinforced Granular Material for Mechanistic Pavement Analysis			<div><div></div></div>		<div><div></div></div> 100%			
0092-07-06	Geotechnics	University of Wisconsin–Milwaukee	Sam Helwany	WHRP	\$79,998	robert.arndorfer@dot.wi.gov	Development and Full Scale Testing of an Alternate Foundation System for Post and Panel Retaining Walls			<div><div></div></div>		<div><div></div></div> 76%			
0092-07-07	Structures	University of Wisconsin–Madison	Dante Fratta	WHRP	\$24,995	scot.becker@dot.wi.gov	Evaluation of Fiberglass Wrapped Concrete Bridge Columns			<div><div></div></div>		<div><div></div></div> 100%			

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