

Research Program

Fiscal Year 2010



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2010 Local Road Research Board Program

INV	TITLE	Project Total	LRRB Total
645	Implementation of Research Findings 2009-2011	645,000	645,000
668*	Technology Transfer Center, U of M – Base 2010	256,000	116,000
883	Circuit Training & Assistance Program (CTAP), Instructor-\$74,500, T ² Center-\$84,000	158,500	158,500
	Minnesota Maintenance Research Expos	26,000	26,000
676	MN Road Research: Facility Support - \$500,000, Staff Support -\$70,000 – 2010	570,000	570,000
745	Library Services for Local Governments – 2010	70,000	70,000
768	Geosynthetics in Roadway Design	30,000	30,000
825*	Performance Monitoring of Olmsted CR 177/104 & Aggregate Base Material Update	60,000	40,000
840	Performance of PG 52-34 Oil	76,200	76,200
843	Predicting Bumps in Overlays	64,540	64,540
851*	Allowable Axle Loads on Pavements	126,042	110,000
854*	Pavement Performance/Failure under Overweight Farm Loads - Pooled Fund Project	1,023,464	105,000
855*	A Property-Based Spec for Coarse Aggregate in Pavement Apps	92,624	46,312
863*	Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements-Pooled Fund Project	286,145	57,237
864*	Recycled Asphalt Pavements-Pooled Fund Project	392,000	75,000
865*	Low Temp Cracking in Asphalt Phase II-Pooled Fund Project	856,736	50,000
867*	Composite Pavements - Pooled Fund Project	651,800	50,000
868*	HMA Surface Characteristics - Pooled Fund Project	300,000	75,000
869 *	TERRA Board Support, FY 2010	25,000	12,500
872*	MnROAD Data Mining, Evaluation, and Qualification – Phase I	63,500	27,500
875*	Estimating the Size Distribution of Suspended Sediments in Minnesota Storm Water	55,000	55,000
877	Develop & Field Test of Dynamic Led Advanced Warning Signals for Unsignalized High-Speed Rural Blind Intersections	125,476	125,476
878	Porous Asphalt Pavement Performance in Cold Regions	82,400	82,400
879*	Pervious Concrete Pavement in MnROAD Low-Volume Road	171,493	50,000
885*	Research Test Section Tracking Phase II	130,000	55,000
886*	Cost-Effective Pavement Preservation Solutions for the Real World	109,984	54,992
887*	Structural Evaluation of Asphalt Pavements with Full-Depth Reclaimed Base	79,808	39,904
889	Performance of Recycled Asphalt and High RAP Asphalt Mixtures	60,000	60,000
890	Speed Impacts of Occasional Hazard Residential Street Warning Signs	79,647	79,647
891*	Performance Assessment of Oversized Culverts to Accommodate Fish Passage	83,428	41,714
892	Develop Outreach Program for a Thoughtful Street Tree Master Plan	20,000	20,000
893	Optimal contract Mechanism Design for Performance Based Contracts	30,000	30,000
895	Traffic Generating Developments and Roadway Life Consumption	37,038	37,038
900	Hennepin/Minneapolis LED Light Study	50,000	50,000
901*	Evaluation of Concrete Admixtures to Increase Delivery Time	99,998	49,999
998	Operational Research Program for Local Transportation Groups 2009-2010	90,000	90,000
999	Program Administration 2010	112,329	112,329

*Projects co-funded from other sources

Investigation Number 645: Implementation of Research Findings (2009-2011)

Project Description

Continue to identify new topics and emphasize research implementation efforts of the Minnesota Local Road Research Board (LRRB). Investigation Number 645 helps county and city agencies put new research, including Minnesota Department of Transportation (Mn/DOT) research, into practice. Research implementation methods include abstracts of research reports, presentations, preparation of audio-visual aids, distribution of summary reports, and field demonstrations.

LRRB's Research Implementation Committee (RIC) directs and oversees the project. A standing committee, the RIC consists of county and city engineers, representatives from the University of Minnesota Technology Transfer Center and Mn/DOT. Based on input from city and county engineers throughout Minnesota, the RIC will select the implementation tasks for the 2009/2010 program.

Funding

LRRB Total	<u>\$645,000</u>
Project Total	\$645,000

* SRF contract is for \$497,697. The balance of funds are available to RIC for dissemination of products and additional tasks outside of initial contract.

Technical Advisory Panel

Research Implementation Committee (RIC)

NOTE: This is an ongoing program budgeted in two-year increments. Duration and funding are descriptive for the current program only. Budgeted for three years to coordinate Outreach activities into the same contract.

Investigation Number 668: Technology Transfer – 2010

Project Description

Minnesota Technology Transfer (T² / LTAP) Program – Base Funding

Provide funding for the Minnesota T²/LTAP Program at the University of Minnesota Center for Transportation Studies. The Local Technical Assistance Program (LTAP) is co-funded by the Federal Highway Administration (FHWA) and the LRRB.

The Federal Highway Administration requires the following program tasks: maintain mailing list; publish quarterly newsletter; provide technology-transfer information services and materials; provide technical assistance; administer courses and provide related conference support; and complete evaluation and program needs assessment.

The focus of the LTAP base program in 2009 will be on continuing to provide training and informational resources for local agencies, serving as a resource for technical assistance/referral, facilitating the exchange of best practices, providing the transfer of new technology innovations and materials, and promoting the implementation of transportation research results. Electronic and web-based information delivery mechanisms will be updated as new technologies emerge and maintenance is done quarterly. The LTAP two-year course plan for Minnesota's local transportation personnel will also be provided to allow for planning and budgeting of training activities.

The T² program staff will continue to educate and promote LTAP resources and services to Minnesota congressional delegates and their staff. Minnesota LTAP will continue its support of national workforce development initiatives.

Project Duration

2008

Funding

FHWA Total	\$140,000
LRRB Total	<u>\$185,000</u>
Project Total	\$325,000

Other Funding Sources

Participant Registration Fees

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Mn/DOT
Technical Liaison:	Julie Skallman – Mn/DOT
Panel:	Minnesota T ² /LTAP Steering Committee

Investigation Number 668: Technology Transfer – 2010

Project Description

Transportation Student Development

This project offers transportation students exposure to transportation career opportunities, information on career-preparation strategies, and networking and employment seeking opportunities. The LRRB, in cooperation with the Women's Transportation Seminar (WTS) and CTS education and T² programs, sponsors this student event to highlight transportation career opportunities with Minnesota's counties and cities.

The event features interactive panel discussions on topics such as transportation career opportunities and alternatives, resume presentation, interview skills, desired entry-level candidate qualities, and job requirements. A job fair and a reception follow the sessions, providing students an opportunity to network.

The University of Minnesota conducts this project.

Project Duration

2008

Funding

LRRB Total	<u>\$5,500</u>
Project Total	\$5,500

Other Funding Source

ITS Institute, Center for Transportation Studies

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

CTS Education/Outreach Council

Investigation Number 668: Technology Transfer – 2010

Project Description

Minnesota Technology Transfer (T² / LTAP) Program – Base Funding

Provide funding for the Minnesota T²/LTAP Program at the University of Minnesota Center for Transportation Studies. The Local Technical Assistance Program (LTAP) is co-funded by the Federal Highway Administration (FHWA) and the LRRB.

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The T² program staff will continue to educate and promote LTAP resources and services to Minnesota congressional delegates and their staff. Minnesota LTAP will continue its support of national workforce development initiatives.

Project Duration

2010

Funding

FHWA Total	\$140,000
LRRB Total	<u>\$116,000</u>
Project Total	\$256,000

Other Funding Sources

Participant Registration Fees

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Mn/DOT
Technical Liaison:	Julie Skallman – Mn/DOT
Panel:	Minnesota T ² /LTAP Steering Committee

Investigation Number 883: Technology Transfer – 2010

Project Description

T² Circuit Training and Assistance Program (CTAP)

Operated in partnership with the Mn/DOT Maintenance Research Office, this project provides training for maintenance personnel in the latest practices, products, and technologies. It brings training to the participants, offering an interactive, hands-on, and informal learning environment. Through the T² Circuit Training and Assistance Program (CTAP), instructors with firsthand knowledge and experience in maintenance tasks share the latest in applied practice with small peer groups of maintenance workers.

Started in 1995, the CTAP program continues evolving to reflect new technology and products and the changing needs of its customers. In 1998, CTAP hired a full-time instructor to meet the increased demand for the mobile training program and to improve customized training in response to individual agency requests.

The University of Minnesota conducts the program in partnership with Mn/DOT's Office of Maintenance Research.

Project Duration

2008

Funding

LTAP Center- LRRB	\$84,000
CTAP Instructor- LRRB	<u>\$74,500</u>
Project Total	\$158,500

Other Funding Sources

Participant registration fees
Mn/DOT (Van purchase and maintenance)

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Minnesota T²/LTAP Steering Committee
Kathleen Schaefer – Maintenance – Mn/DOT

Investigation Number 883: Technology Transfer – 2010

Project Description

Annual Spring and Fall Maintenance Expos

This project promotes the transfer and exchange of new maintenance research results, technology, innovations, and practices among maintenance personnel from local and state government. The net result of the spring and fall Maintenance Research Expos is a greater return on maintenance research investments by promoting the practical application of research results, as well as promoting the exchange of best practices and useful innovations created by maintenance personnel.

The Spring Maintenance Training Expo features spring maintenance topics such as low-volume road maintenance, roadside vegetation management and control, traffic safety and signing, work-zone safety, bridge and concrete maintenance, and maintenance management systems. The Expo also offers educational sessions on a variety of topics and attendees can earn credits toward the Roads Scholar Program.

The Minnesota Fall Maintenance Expo features snow and ice control topics such as salt solutions, pre-wetting, de-icing, anti-icing, driver visibility, and snow fence placement and design. Additional topics include health and safety, and motor grader and loader training. The Expo also features the popular snowplow rodeo and an equipment-vendor display.

The University of Minnesota conducts this project in partnership with Mn/DOT's Office of Maintenance Research.

Project Duration

2010

Funding

LRRB Total	<u>\$26,000</u>
Project Total	\$26,000

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Minnesota Fall Maintenance Expo Planning Committee
Minnesota Spring Maintenance Training Expo Planning Committee

Other Funding Sources

Mn/DOT Office of Maintenance
Participant Registration Fees

Investigation Number 676: Minnesota Road Research Facility – 2010

Project Description

This project provides funding, along with state funds, for the development and operation of the Minnesota Road Research Facility (MnROAD), the nation's first cold-region pavement test facility. Construction began in 1990 with the vision that the facility will operate for the next 50 years to meet the transportation industry's demand for transportation answers and for improved pavement technology.

This project accelerates the State's research program by providing for the study of a wide range of pavements at the same time. It makes possible controlled pavement research on new and rehabilitated interstate pavement sections under actual traffic conditions and new low-volume pavement sections under known test loadings. In addition, the facility allows Mn/DOT to control and monitor the many variables that affect pavements.

Mn/DOT and the University of Minnesota are both seeking a stronger role to better understand pavement performance. The University of Minnesota provides valuable support in various activities associated with the facility. The facility helps bring together University researchers, Mn/DOT engineers, and local practitioners.

Beginning Date	1989
Ending Date	Ongoing

Funding

LRRB Total	<u>\$570,000</u>
Project Total	\$570,000

* (Funds will be applied to various studies and operation of the MnROAD facility on an as-needed basis.)

Technical Advisory Panel

MnROAD Technical Advisory Committee

Investigation Number 745: Library Services for Local Governments 2010

Project Description

This project provides funding support for continuing and expanding the information services of Mn/DOT's Library to local government and transportation officials. The Mn/DOT Library traditionally has supported local agencies by providing county and municipal officials access to the same information services available to department employees. These services to local officials currently account for approximately 10 percent of all services provided by Mn/DOT's Library:

- Assistance with reference questions
- On-line database searches
- Assistance in locating and acquiring standards and other published materials
- Loans of videotapes
- Loans of materials from other libraries and information sources

Mn/DOT Library collaborates with the CTS Library at the University of Minnesota in developing expanded services as a component of the state's LTAP Center. Recent developments include:

- Creation of the Midwest Transportation Knowledge Network (MTKN). The network is intended to increase access for state and local transportation officials to information resources held by DOTs and universities throughout FHWA's Region 3.
- Development of TL Cat, a free to the user, online service, accessible to local transportation officials, that combines the catalogs of 20 of the nation's largest transportation libraries. The TL Cat database of transportation information resources is second in size only to TRB's TRIS Online service and lists many resources not included in TRIS.
- Participation in a pooled fund study aimed at developing transportation libraries in other state DOTs and creating a national network of transportation libraries modeled on the successes of MTKN to further improve access to transportation information for state and local transportation officials.

Beginning Date	January 1, 1995
Ending Date	Ongoing

Funding

LRRB Total	<u>\$70,000</u>
Project Total	\$70,000

Program Manager

Sheila Hatchell, Mn/DOT's Research Services Section, serves as Library Director.

Technical Advisory Panel

Technology Transfer Coordinating Committee

Investigation Number 768: Geosynthetics in Roadway Design Research

Project Description

Approximately 42 miles of County State Aid Highways (CSAH) in Lake of the Woods, Polk, Roseau and Hubbard counties have geosynthetics installed in them for separation and strength. Five miles of CSAH in the same areas were installed without the geosynthetics to use for comparison. The goal of this study is to determine if the geosynthetics decrease cracking and rutting while improving its ride.

Annual surveys of each road segment will be completed with Mn/DOT's Pavetech van. In addition, strength tests at designated intervals along the roadways will be conducted every 5 years. Mn/DOT Materials Laboratory personnel will analyze the data and post the results on the LRRB web site.

Beginning Date	October 2000
Ending Date	September 2010

Funding

LRRB Total	<u>\$30,000</u>
Project Total	\$30,000

Principal Investigator

Timothy Clyne – Materials and Road Research – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Lou Tasa – D2 – Mn/DOT
Panel Members:	Walter Leu – D1 – Mn/DOT
	John Siekmeier – Materials – Mn/DOT

Investigation Number 825: Performance Monitoring of Olmsted CR 117/104 and Aggregate Base Material Update

Project Description

Investigation Number 767 Flexible Pavement Performance in Relation to Aggregate Base and Asphalt Mixture Low-temp Characteristics was funded jointly in 2000 by LRRB and Mn/DOT to evaluate the constructability of three aggregate base types and two asphalt mixtures to:

- Evaluate the properties (permeability, strength, and resilient modulus) of these material types in relation to freeze-thaw cycles
- Evaluate the low-temperature cracking resistance of the asphalt binders to saw-and-seal construction.

The objective of this proposal is to perform a follow-up performance monitoring survey over a 5 year period, since no distress was developed during the initial study. Performance monitoring tests would include traffic counts, FWD, GPR, and rutting surveys at various times of the year to measure the effects of temperature and time on the measured results. The research would incorporate the results of these above-mentioned field tests into MnPAVE. In addition, a member of the Norwegian delegation currently visiting Mn/DOT (Karl Melby) has indicated a willingness to cooperate on an international effort to increase Minnesota's understanding of the spring-thaw performance of open-graded base materials.

Beginning Date	June 2005
Ending Date	June 2010

Funding

LRRB Total	\$40,000
Mn/DOT soft match	<u>\$20,000</u>
Project Total	\$60,000

Principal Investigator

Matthew Lebens – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research – Mn/DOT
Technical Liaison:	Mike Sheehan – Olmsted County Engineer
Panel Members:	Lou Tasa – State Aid D2 – Mn/DOT
	Bruce Tanquist – Materials – Mn/DOT
	Shongtao Dai – Materials – Mn/DOT

Approvals:

December 2004 Meeting for 2005 Program

Investigation Number 840: Performance of PG 52-34 Oil on Local Roads

Project Description

Currently, Mn/DOT PG binder guideline recommends that PG 58-28, PG58-34 and PG64-28 be used for pavements with ESALs less than 3 million. The guideline does not make any recommendations of PG binder usage for low volume roads, such as roads with 150,000 ESALs. Some local agencies have had success using PG 52-34 for low volume road construction. Research is needed to determine at which traffic level PG52-34 can be used as an effective asphalt grade without being susceptible to rutting.

Beginning Date	June 2006
Ending Date	September 2009
Amended End Date	July 2011

Funding

LRRB Total	<u>\$76,200</u>
Project Total	\$76,200

Principal Investigator

Shongtao Dai – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Brian Noetzelman – Pope County Engineer

Approved:

December 2005 Meeting

Investigation Number 843: Predicting the Occurrence of Bumps in Overlays

Project Description

Based on the previous work conducted under LRRB INV 802, some specific mechanisms were identified that seem to be common to many overlay projects that develop these bumps. The primary objective of this project is to develop improved methods for predicting and minimizing the probability of these bumps occurring, and for mitigation of the problem if it does occur.

Beginning Date	August 2006
Ending Date	January 2010
Amended End Date	September 2010

Funding

LRRB Total	<u>\$64,540</u>
Project Total	<u>\$64,540</u>

Principal Investigator

James Wilde – Mankato State University

Co-Principal Investigator:

Eddie Johnson – Materials - Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	John Brunkhorst – McLeod County Engineer
Panel Members:	Art Bolland – D8 Materials – Mn/DOT
	Michael Flaagen – Pennington County Engineer
	John Garrity – Materials – Mn/DOT
	Jim McGraw – Materials – Mn/DOT
	Roger Olson – Materials – Mn/DOT

Approved:

December 2005 Meeting

Investigation Number 851: Allowable Axle Loads on Pavements (Subgrade Analysis)

Project Description

Deflection testing and analysis is routinely used to evaluate the spring load capacity of pavements and to design structural overlays. The current process used by Mn/DOT and implemented into the computer program TONN is not very reliable. The program underestimates the allowable axle load for soft clay subgrades and may overestimate it for stiff sand or granular subgrades. The objective of this study is to upgrade the TONN program. The final product of this study will be an analysis process that results in an allowable axle load and a functional stand alone software package that Mn/DOT and the cities and counties could use on their own or provide to firms hired to do deflection testing.

Beginning Date	November 2006
Ending Date	July 2009
Amended End Date	August 2010

Funding

Outfield of material	\$ 16,042
LRRB Total	<u>\$110,000</u>
Project Total	\$126,042

Principal Investigator

Lev Khazanovich – Civil Engineering - U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Jerry Geib – Materials – Mn/DOT
Panel Members:	Dave Bullock – Engineering Services – Mn/DOT
	David Van Deusen – Materials – Mn/DOT
	Maureen Jensen – Materials – Mn/DOT
	Roger Olson – Materials – Mn/DOT
	Bruce Tanquist – Materials – Mn/DOT
	Darrell Pettis – Le Sueur County Engineer
	Kelly Bengtson – Kittson County Engineer
	Darin Mielke – Sibley County – Public Works Engineer
	Erland Lukenan – Pavement Institute – U of M
	Gordon Bergstrom – State Aid – Mn/DOT
	Matthew Oman – Materials – Mn/DOT
	Dave Johnson – Consultant
	Rich Sanders – Polk County Engineer

Approved:

December 2005 Meeting

Investigation Number 854: Pavement Performance / Failure under Overweight Farm Loads (Pooled Fund Study)

Project Description

The objectives of this study are to determine the pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) and to compare this response to that under a typical 5-axle semi tractor-trailer. This may be accomplished by constructing new instrumented test sections at MnROAD and/or to retrofit instrumentation into the existing test sections. The final scope and work plan for the study will be developed by the participating agencies.

Beginning Date	October 2007
Ending Date	January 2011

Funding

LRRB Total	\$105,000
Pooled Fund – Mn/DOT	<u>\$918,464</u>
Project Total	\$1,023,464

Principal Investigator

Shongtao Dai – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison: Bruce Holdhusen – Research – Mn/DOT
Technical Liaison: Lev Khazanovich – Civil Engineering – U of M
Panel Members:

Approved:

December 2005 Meeting

Note:

FWHA has approved as Pooled Fund; project started with partner states. TPF 5 (148)

Investigation Number 855: A Property-Based Specification for Coarse Aggregate in Pavement Applications

Project Description

Current MN DOT coarse aggregate specification for concrete and bituminous mixes dates back to 1930's and has been updated as more knowledge has become available. This study will develop a set of restructured coarse aggregate specifications that are based on aggregate properties as related to the performance of asphalt and concrete mixes in pavement applications and availability at construction sites.

Beginning Date	November 2006
Original End Date	October 2008
Amended End Date	October 2010

Original Funding

Original Amount	<u>\$65,549</u>
Project Total	\$65,549

Amended Funding

LRRB Total	\$46,312
MnDOT Total	<u>\$46,312</u>
Total Amount	\$92,624

Principal Investigator

Magdy Abdelrahman – North Dakota State University

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	John Grindeland – Fillmore County
Panel Members:	Gary Bruggeman – Steele County Engineer
	Dan Boerner – Materials – Mn/DOT
	Chuck Howe – Geology Lab – Mn/DOT
	Wayne Olson – Carlton County
	Bernard Izevbekhai – Materials – Mn/DOT
	Doug Schwartz – Materials – Mn/DOT

Approved:

December 2005 Meeting

Investigation Number 863: Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements (Pooled Fund Project)

Project Description

One of the major tasks in any transportation agency pavement management system is to select the appropriate alternative for rehabilitation and maintenance. There is a need to understand how preventive maintenance improves the performance of the existing pavements, to develop new techniques, and to determine the optimal timing for the application of these treatments.

Perhaps the main reason to apply a preventive maintenance treatment to an HMA pavement is to reduce the aging of the asphalt binder and therefore maintain a higher level of pavement performance. Some research has documented the aging to asphalt through traffic loadings. However, the mechanisms that cause environmental aging are not well understood. This research aims to better understand the mechanisms behind aging and therefore apply the right surface treatment at the right time.

The goal of this study is to determine the proper timing of preventive maintenance treatments in order to optimize life cycle costs and pavement performance. Environmental aging of the asphalt binder in the underlying pavement is not well understood, and this project will seek to better understand the aging mechanism and how it can be reduced through pavement preservation.

Beginning Date	April 2010
Ending Date	November 2013

Funding

SPR Total	\$228,948
LRRB Total	<u>\$ 57,237</u>
Project Total	\$286,145

Principal Investigator

Mike Anderson, Asphalt Institute, Inc.

Technical Advisory Panel

Administrative Liaison:	Bruce Holdhusen – Research – Mn/DOT
Technical Liaison:	Tom Wood – Materials – Mn/DOT
Panel Members:	Maureen Jensen – Materials – Mn/DOT
	Roger Olson – Materials – Mn/DOT

Approvals:

March 2006 Meeting

Note:

Commitment level has been met for a Mn/DOT Pooled Fund Study. TPF-5(153) RFP completed. Contract executed April 2010.

Investigation Number 864: Recycled Asphalt Pavements (Pooled Fund Project)

Project Description

The use of reclaimed asphalt pavement (RAP) has become a part of the daily practice in the construction of hot mix asphalt pavements. Besides the cost savings on materials, the use of RAP represents an environmentally positive method of recycling. Significant experimental work has been performed in the lab to evaluate the asphalt mixtures modified with RAP materials. However, the performance of pavements built with RAP is very hard to come by. Many pavements have been built in Minnesota and around the United States using RAP, but very few have been monitored closely to provide useful performance data. Questions remain about the viability of using RAP in a wearing course.

The main idea of the project is to monitor several sections built at the Minnesota Road Research Facility (MnROAD) specifically to study RAP under controlled testing conditions. The sections may contain identical structural designs and hot mix asphalt mix designs, with the only variable being the percentage of RAP in each of the mixes. The final scope and work plan for the study will be developed by the participating states.

Beginning Date	January 2008
Ending Date	December 2012

Funding

LRRB Total	\$ 75,000
SPR Total	<u>\$110,000</u>
	\$185,000

Principal Investigator

Eddie Johnson – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison: Bruce Holdhusen – Research – Mn/DOT

Technical Liaison: Greg Johnson – Materials – Mn/DOT

Panel Members:

Approvals:

March 2006 Meeting

Note:

Commitment level has been met for a Mn/DOT Pooled Fund Study. TPF-6(022)

Investigation Number 865: Low Temp Cracking in Asphalt Phase II (Pooled Fund Project)

Project Description

Low temperature cracking is the most prevalent distress found in asphalt pavements built in cold weather climates. As the temperature drops the restrained pavement tries to shrink. The tensile stresses build up to a critical point at which a crack is formed. The current Superpave specification attempts to address this issue by specifying a limiting low temperature for the asphalt binder. The specification does a reasonable job predicting performance of conventional asphalt cements, but this does not hold true to polymer-modified asphalt binders that are manufactured to reach very cold temperature grades needed in cold climates. Currently the low temperature specification considers only the asphalt binder. Specifications must be developed for the asphalt mixture as well. It is very important to understand the mechanism of crack initiation and propagation.

The main objective of this study is to validate the laboratory test procedures, models, and pavement design procedures that come out of Phase I of this study. This will be accomplished by monitoring two new test sections at the Minnesota Road Research Facility (MnROAD).

Beginning Date	June 2008
Ending Date	January 2012

Funding

LRRB Total	\$ 50,000
SPR Total	<u>\$ 856,736</u>
Project Total	\$ 906,736

Principal Investigator

Mihai Marasteanu – Civil Engineering – U of M

Co-Principal Investigator

Timothy Clyne – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Bruce Holdhusen – Research – Mn/DOT
Technical Liaison:	Ben Worel – Materials – Mn/DOT
Panel Members:	Roger Olson – Materials – Mn/DOT
	James McGraw – Materials – Mn/DOT
	Ron Horner – North Dakota DOT
	Tim Clyne – Materials – Mn/DOT
	Eddie Johnson – Materials – Mn/DOT
	Dave Kilpatrick – Connecticut DOT
	Leonard Makowski – Wisconsin DOT
	Mark Watson – Materials – Mn/DOT
	Scott Schram – Iowa DOT

Approvals:

March 2006 Meeting

Note:

Commitment level has been met for a Mn/DOT Pooled Fund Study. TPF-5(132)

Investigation Number 867: Composite Pavements (Pooled Fund Project)

Project Description

Thermally insulated concrete pavements (TICP) consist of a concrete pavement structure (jointed or continuously reinforced) covered by an asphalt layer during construction (before to opening to traffic) or soon after construction to address ride quality or surface characteristic issues. The reverse process of constructing concrete over an asphalt pavement is basically the idea of whitetopping, and it will be considered in other projects outside of this proposed study. Thin asphalt overlays encompass many of the same ideas as TICPs, and they will also be considered in this pooled fund study.

Beginning Date	January 2008
Ending Date	January 2011

Funding

LRRB Total	\$ 50,000
SPR Total	<u>\$601,800</u>
Project Total	\$651,800

Principal Investigator

Lev Khazanovich – Civil Engineering - U of M

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research Services – Mn/DOT
Technical Liaison:	Timothy Clyne – Materials – Mn/DOT
Panel Members:	Ben Worel – Materials – Mn/DOT
	Thomas Burnham – Materials – Mn/DOT
	Bruce Holdhusen Research Services – Mn/DOT

Note:

Commitment level has been met for a Mn/DOT Pooled Fund Study. TPF-5(149)

Investigation Number 868: HMA Surface Characteristics

Project Description

The recent nationwide interest in pavement surface characteristics has resulted in emphasis on safety in the current Federal initiative Safe Accountable Flexible Efficient Transportation Equity Act – a Legacy for Users (SAFETEA-LU). Growing concerns about road traffic noise and skid resistance have generated increased awareness and interest in the interaction of pavement surface and automobile tires. It has also resulted in increased experimentation and field performance observations of texture, noise, friction, ride, and hydroplaning potential. The current Traffic Noise Model (TNM) does not account for or provide yet for the usage of attenuating and absorbing pavements. There is a need to characterize the co-dependant pavement surface parameters. The need is especially great in Minnesota because MNDOT is beginning to use innovative HMA designs such as stone matrix asphalt (SMA) and porous asphalt mixtures. This study focuses on key pavement surface characteristics like noise and friction while also studying their relationship to ride quality, texture, and mixture durability.

Beginning Date	September 2007
Ending Date	November 2012

Funding

LRRB Total	\$ 75,000
SPR Total	<u>\$225,000</u>
Project Total	\$300,000

Principal Investigator

Timothy Clyne – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Bruce Holdhusen – Research Services – Mn/DOT
Technical Liaison:	Greg Johnson – Bridge – Mn/DOT
Panel Members:	Roger Olson – Materials – Mn/DOT
	Bernard Izevbekhai – Materials, Mn/DOT
	Thomas Wood – Materials – Mn/DOT
	Mark Watson – Metro – Mn/DOT

Notes:

MPR-6(029)

Investigation Number 869: TERRA Board Support, FY2010

Project Description

Formed in 2004, the Transportation Engineering and Road Research Alliance (TERRA) is a research governance structure that brings together government, industry, and academia in a dynamic partnership to advance innovations in road engineering and construction. TERRA seeks to develop, sustain, and communicate a comprehensive program of research on pavement, materials, and related transportation engineering challenges, including cold climate issues. TERRA maximizes the unique capabilities of MnROAD to advance research.

Results

This project supported the organizational development of TERRA, including four board meetings, a strategic planning session, committee activities, financial report development and tracking, and communication strategies. As a result, TERRA developed three major strategic directions: Expand productive research partnerships; provide effective transportation engineering and road research; and communicate transportation engineering and road research activities, benefits, and results. The TERRA strategic plan and business plan outline additional details.

Beginning Date	July 2009
End Date	July 2010

Funding

LRRB Total	\$12,500
MnDOT Total	<u>\$12,500</u>
Project Total	\$25,000

Principal Investigator

Laurie McGinnis – CTS – U of Mn

Technical Advisory Panel

Administrative Liaison:	Linda Taylor – Research – Mn/DOT
Technical Liaison:	Julie Skallman – State Aid – Mn/DOT
	Mark Maloney – City of Shoreview

TERRA Board Members (Organizations)

Aggregate and Ready Mix Association of Minnesota
American Concrete Pavement Association
Associated General Contractors of Minnesota
Concrete Paving Association of Minnesota
Iowa State University
Michigan Department of Transportation
Minnesota Asphalt Pavement Association
Minnesota Department of Transportation
Minnesota Local Road Research Board
Norwegian Public Roads Administration
RMS Research Foundation
U.S. Federal Highway Administration
University of Minnesota

Investigation Number 872: MnROAD Data Mining, Evaluation and Qualification – Phase 1

Project Description

The MnROAD project produces valuable pavement performance and response data, but several aspects of the current database remain largely unverified and inefficient. This project involves mining and classifying historical data to improve access to the vast amount of available information. Because of the large size of the MnROAD database, the project will occur in phases. The ultimate aim is to create a trusted pavement performance database to advance the work of pavement designers and researchers.

Beginning Date	April 2008
Ending Date	December 2009
Amended End Date	July 2010

Funding

LRRB Total	\$27,500
SPR Project Total	\$ 8,500
Mn/DOT Total	<u>\$27,500</u>
Project Total	\$63,500

Principal Investigator

Randal Barnes – Civil Engineering – U of M

Co-Principal Investigator

Lev Khazanovich – Civil Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Tom Burnham – Materials – Mn/DOT
Panel Members:	Dennis Carroll – Materials – Mn/DOT
	Peter Davich – Materials – Mn/DOT
	Jerry Geib – Materials – Mn/DOT
	Bernard Izevbekhai – Materials – Mn/DOT
	Greg Johnson – Materials – Mn/DOT
	Leonard Palek – Materials – Mn/DOT
	John Siekmeier – Materials – Mn/DOT
	Ben Worel – Materials – Mn/DOT

Approvals:

December 2006 meeting for 2007 Program

Investigation Number 875: Estimating the Size Distribution of Suspended Sediments in Minnesota Stormwater

Project Description

Cities and counties in Minnesota are implementing many storm water treatment best management practices (BMPs) to remove suspended sediments and pollutants from storm water runoff. The removal efficiency of the BMPs depends on the size distribution of the suspended sediments in storm water runoff, which is a function of land use, soil type, and the climate of a region. To design these BMPs or assess their level of performance, monitoring programs have been developed and implemented. The technology in these monitoring programs is not capable of providing any reliable data regarding suspended sediment removal due to poor sampling of suspended sediments from the water column. In Minnesota, there is no information regarding the suspended sediment size distributions in storm water; therefore, it is almost impossible to design or assess the performance of some of these BMPs, specifically the underground proprietary devices. This research will seek to improve the current technology in collecting representative samples of the suspended sediment in storm water runoff and to develop a methodology to determine the suspended sediment size distribution in storm water runoff across the state. The results of this study will be incorporated into the Stormwater BMP Assessment Protocol.

Beginning Date	December 2007
Ending Date	May 2010
Amended End Date	January 2011

Funding

LRRB Total	<u>\$55,000</u>
Project Total	\$55,000

Principal Investigator

John Gulliver – Civil Engineering – U of M

Co-Principal Investigator

Omid Mohseni – St. Anthony Falls Laboratory – U of M

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Marilyn Jordahl-Larson – Environmental Services – Mn/DOT
Panel Members:	Scott Carlstrom – Metro District Water Resources – Mn/DOT
	Jack Frost – Metropolitan Council
	Julie Johnson – Environmental Services – Mn/DOT
	Sue McDermott – City of Mendota Heights

Investigation Number 877: Level & Field Test of Dynamic LED Advanced Warning Signals for Unsignalized High-Speed Rural Blind Intersections

Project Description

Many locations in rural areas have blind intersections, as well as horizontal and/or vertical curves, which present safety hazards for the driving public. Standard advanced warning signs aren't always effective. This project looks at the potential of LED advanced warning signs in increasing safety on rural roadways and involves installing LED enhanced signage at a blind intersection, horizontal or vertical curve to capture the driver's attention.

Beginning Date	February 2008
Ending Date	August 2010
Amended End Date	February 2011

Funding

LRRB Total	<u>\$125,476</u>
Project Total	\$125,476

Principal Investigator

Taek Kwon – Computer Engineering - UMD

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research - Mn/DOT
Technical Liaisons:	Brian Boder – St. Louis County Traffic Engineer
Panel Members:	Jerry Kotzenmacher – Traffic & Security Operations - Mn/DOT
	Robert Ege – Traffic & Security Operations - Mn/DOT
	Gregory Nikodym – Kanabec County Engineer
	Dennis Luebbe – Rice County Engineer
	Dharam Bobra – Hennepin County Traffic Engineer
	John Hourdos – Civil Engineering – U of M
	Darin Mielke – Sibley County – Public Works
	Matt Gjersvik – Traffic & Security Operations - Mn/DOT
	David Kramer – Winona County Highway Engineer
	Ted Schoenecker – Washington County Traffic Engineer
	Joe Gustafson – Scott County
	Suzanne Danen – Dakota County Traffic Engineer

Approvals:

December 2006 meeting for 2007 Program

Investigation Number 878: Porous Asphalt Pavement Performance in Cold Regions

Project Description

The bituminous and concrete industries are both promoting a new mix design that allows water to easily pass through the paved surface, which improves infiltration to treat storm water and reduces impervious surfaces. Because these new pavements do not have a long history in cold climates, they may fail before their design life from the freeze-thaw cycles, from improper maintenance, or from durability issues. This project involves installation on a test MnROAD section or on a voluntary project to document the durability and performance and develop various maintenance methods. The project will help define the design life of these pavements in cold regions and recommended maintenance practices in cold regions.

Beginning Date	July 2007
Ending Date	September 2010

Funding

LRRB Total	<u>\$82,400</u>
Project Total	\$82,400

Principal Investigator

Matthew Lebens – Materials – Mn/DOT

Co-Principal Investigators

Brett Troyer – Water Resources – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Bruce Holdhusen – Research – Mn/DOT
Technical Liaison:	Larry Matsumoto – City of Minneapolis
Panel Members:	Shongtao Dai – Materials – Mn/DOT
	John Gorder – Eagan City Engineer
	Shawn Sanders – Public Works – City of Stillwater
	Bob Lisi – LHB, Inc
	Mark Doneux – Capitol Region Watershed District
	Larry Lueth – City of St. Paul

Approvals:

December 2006 meeting for 2007 Program

Investigation Number 879: Pervious Concrete Pavement in MnROAD Low-Volume Road

Project Description

The reduction of pervious surfaces is an issue of concern with the construction of bound pavement surfacing. Some cities in the metro area have been forced to improvise methods of minimizing storm water intrusion from developments that are in proximity to wetlands or some trout streams. Runoff from impervious surfaces has been known to distort the thermal balance of streams when extreme temperatures precede heavy rains. In solving this problem, some communities have made various attempts to encourage some infiltration by constructing pervious concrete on porous bases. While their understanding of the performance of pervious concrete in northern climates is still rudimentary, Mn/DOT, in collaboration with the Aggregate Ready Mixed Association of Minnesota, provide leadership in this technology. The partnership resulted in the construction of a pervious concrete pavement in a parking lot in MnROAD in 2005 and a pedestrian walkway in 2006. This research involves more detailed study of the performance of pervious concrete in roadways. By adequately evaluating pervious concrete in this climate, the study also will provide long-term performance monitoring as the changes in porosity and infiltration can be monitored over time under standard measurable traffic loads, environmental effects, and deicing operations.

Beginning Date	July 2007
Ending Date	July 2010

Funding

LRRB Total	\$50,000
SPR Total	\$93,930
Mn/DOT Total	<u>\$27,563</u>
Project Total	\$171,493

Principal Investigator

Bernard I. Izevbehal – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Bruce Holdhusen – Research – Mn/DOT
Technical Liaison:	Mark Maloney – Public Works Director – City of Shoreview
Panel Members:	Doug Schwartz – Materials – Mn/DOT
	Gary Person – Materials- Mn/DOT
	Shongtao Dai – Materials – Mn/DOT
	Ben Worel – Research – Mn/DOT
	Benjamin Timerson – Materials – Mn/DOT
	Matthew Lebens – Materials – Mn/DOT

Investigation Number 885: Research Test Section Tracking – Phase II

Project Description:

Mn/DOT, along with Minnesota cities and counties, has developed hundreds of test sections and projects relating to every aspect of roadway design. These projects typically have a local champion who sees the value in field validation of both new designs and materials. The problem with our current system is that projects tend to be forgotten before the benefits of research are learned. This is primarily due to the time it takes to develop results since pavements tend to deteriorate very slowly. During this time the locations and purpose of the test sections are lost as the champion changes jobs, becomes busy with other responsibilities, or the results are only reported to a limited number of people.

The Materials, Road Research Section developed a research tracking system through an initial LRRB project that allows each individual champion to collectively enter a project name, purpose, locations, and comments for each test section developed. The system archives information for others to build upon with the use of other test sections or performance or material testing databases being developed within the state. Stated simply, this system and assistance from our office will benefit our state by having less research projects or sections forgotten. The current web site is <http://www.mrrapps.dot.state.mn.us/mrrapps/tracking/tracking.asp>, which can be accessed by anyone.

Beginning Date	December 2009
End Date	December 2014

Original Funding

LRRB Total	\$ <u>55,000</u>
Project Total	\$ 55,000

Principal Investigator

Timothy Clyne – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Luane Tasa – District 2 – Mn/DOT
Panel Members:	Benjamin Worel – Research – Mn/DOT

Approvals:

September 2007 meeting

Investigation Number 886: Cost-Effective Pavement Preservation Solutions for the Real World

Project Description:

This project will research the costs and benefits, timing, longevity and decision-making process to assist local agencies in determining the best options for pavement maintenance. The project team will identify the available data in the pavement management systems owned by several local highway agencies (primarily counties and some cities) as well as that maintained by Mn/DOT's Pavement Management Unit. This information will be analyzed along with the experience and expertise of local (city and county) engineers and maintenance supervisors. The combination of this empirical data will provide an invaluable tool for developing maintenance strategies at the project level as well as information that can be used at the network level. The primary product of this research project will be a decision support system, accompanied with training sessions, to provide these local engineers the information and knowledge when making these important decisions.

Beginning Date	September 2009
End Date	February 2012

Original Funding

LRRB Total	\$ 54,992
Mn/DOT Total	<u>\$ 54,992</u>
Project Total	\$109,984

Principal Investigator

W. James Wilde – Minnesota State University, Mankato

Co-Principal Investigator

Thomas Wood – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	Greg Coughlin – Metro State Aid – Mn/DOT
Panel Members:	Jennifer Levitt – City Engineer – City of Cottage Grove
	Mary Krause – City of Eden Prairie
	Shane Nelson – HAA, Inc.

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 887: Structural Evaluation of Asphalt Pavements with Full-Depth Reclaimed Base

Project Description:

Full depth reclamation has been widely used in the state as a rehabilitation method. Recently, stabilized FDR using various stabilizing agents has been increasingly used by cities and counties. Currently, Mn/DOT pavement design recommends GE of 1 for non-stabilized FDR material, which is equivalent to class 5 material. For stabilized FDR, there is no guideline on GE value. Some local engineers believe that GE of FDR material should be higher than 1, especially for stabilized FDR.

In addition, previous research has demonstrated that the strength of a traditional aggregate base (such as class 5) normally shows a weakening during the springtime thaw period. It is part of the reason that spring load restrictions (SLR) have been applied on most of the flexible pavement during each year's spring thaw weakening period. However, not much research has been done on seasonal effects on FDR base, especially on stabilized FDR base. Since stabilized FDR contains less moisture and has higher stiffness (modulus) measured in laboratory than aggregate base, it is believed that stabilized FDR should be less susceptible to springtime thawing. But research is needed to verify and quantify contributions of FDR to the overall pavement structure.

Beginning Date	June 2009
End Date	March 2013

Original Funding

State Aid	\$ 38,654
LRRB Total	<u>\$ 38,654</u>
Project Total	\$ 77,308

Principal Investigator

Shongtao Dai – Materials – Mn/DOT

Co-Principal Investigator

Erland Lukanen – Pavement Institute – U of M

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Merle Earley – District 4 – Mn/DOT
Panel Members:	Ron Wagner – City Engineer – City of Otsego

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 889: Performance of Recycled Asphalt and High RAP Asphalt Mixtures

Project Description:

The availability and cost of asphalt binder and the polymers used for binder modification have increased the attractiveness of using recycled asphalt binder from recycled asphalt pavement (RAP) and shingles in asphalt pavement designs. Since RAP material contains aggregates of high quality that are coated with asphalt cement it is economically beneficial to maximize the amount of recycling.

It is widely accepted that using RAP in asphalt pavement is the highest and best use of the material. Mn/DOT has traditionally employed permissive RAP specifications for asphalt pavements, and currently allows 30 to 40 percent RAP depending on design method and location of use within the pavement structure.

A survey of Minnesota local governments show counties frequently restrict or prohibit the incorporation of RAP in wear course mixtures. This practice is reversed in some regions of the United States, where local recycling levels exceed that found in state departments. Additionally, some Minnesota producers report the use of recycle levels exceeding Minnesota limits on their private and municipal projects.

In order to increase recycling and maximize the use of RAP in asphalt mixtures, research is needed to verify and quantify high-RAP mixture properties and design high-RAP/shingles mixtures meeting highway specifications. A mixture review phase should be included to compare performance, percentage of RAP in the mixture and percentage of new asphalt binder in the mixture.

Beginning Date	February 2010
End Date	February 2013

Original Funding

LRRB Total	<u>\$ 60,000</u>
Project Total	\$ 60,000

Principal Investigator

Eddie Johnson – Materials – Mn/DOT

Co-Principal Investigator

Roger Olson – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Greg Coughlin – State Aid – Mn/DOT
Panel Members:	Jim McGraw – Materials – Mn/DOT

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 890: Speed Impacts of Occasional Hazard Residential Street Warning Signs

Project Description:

Local governments throughout Minnesota receive requests for a number of residential street warning signs for hazards that often only occur occasionally (sometimes randomly) from the driver's point of view. Similar signs are also installed along rural roadways. The general objective of these signs is to change driver behavior. Vehicle speed reductions, or at least increased driver attentiveness, are desired. Little research, particularly along residential streets, has been completed to evaluate whether these types of signs actually have these impacts.

The objectives of this proposed project are to evaluate the impact of occasional hazard warning signs on vehicle speed and/or other driver behaviors/choices along residential streets. Vehicle speed choice will be measured in the field and both measures (along with several others) will also be collected from subjects within a simulator (if Task 2 is funded as proposed). Comparisons of driver behavior measures at locations with and without this type of warning sign will be made. In addition, it is proposed that an attempt be made to compare the difference in driver behavior measures with and without the occasional hazard (when the signs are in place). Other driver behaviors (e.g., eye scanning, lane placement, etc.) would be quantified in the simulator. Guidance for the installation of these types of warning signs along residential streets will be suggested based on the results of this work. This guidance could be used by local jurisdictions in their decision-making and, if appropriate, text will be suggested for possible inclusion in the Minnesota and/or national *Manual on Uniform Traffic Control Devices*.

Beginning Date	June 2009
End Date	February 2011

Original Funding

LRRB Total	<u>\$ 79,647</u>
Project Total	\$ 79,647

Principal Investigator

Ed Johnson – Materials – Mn/DOT

Co-Principal Investigator

Roger Olson – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Amy Marohn – City of Bloomington Engineer
Panel Members:	Deb Bloom – City of Roseville Engineer
	Mike Weiss – Traffic, Safety & Technology – Mn/DOT
	Tim Plath – City of Eagan
	Craig Jochum – East Bethel City Engineer
	Mark Vizecky – State Aid – Mn/DOT

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 891: Performance Assessment of Oversized Culverts to Accommodate Fish Passage

Project Description:

Many smaller bridges in Minnesota are reaching the end of their life expectancy. The standard alternative to bridge replacement is currently the concrete box culvert. In an ongoing Mn/DOT research project, we have found that new culvert installations were prompted by the need for bridge replacement at 8 out of 12 culvert sampling sites. Box culverts have advantages over bridges in terms of lower installation and maintenance costs, farm machinery passage and snow removal. The main disadvantage is culverts can pose as a barrier for aquatic life passage and they might also detrimentally affect the natural sediment passage function of streams. Minnesota has a strong tourism industry, much of which is based on the continued health of the many natural streams and rivers in the state. To address this concern, Mn/DOT has been using the practice of burying culverts about 1 foot below the channel bottom elevation. This allows natural sediment to accumulate in the culvert to facilitate fish passage. This practice results in the loss of culvert capacity, thus requiring an oversized culvert to safely pass the intended fold event. Since the cost of the culvert can range from 50-80% of the total installation cost, it is important that the effectiveness of this practice be evaluated both from an economic and ecological standpoint.

Beginning Date	August 2009
End Date	August 2011

Original Funding

LRRB Total	\$ 41,714
Mn/DOT Total	<u>\$ 41,714</u>
Total Amended Amount	\$ 83,428

Principal Investigator

John Nieber – Bioproduct and Biosystems Engineering – U of M

Co-Principal Investigator

Jeffrey Marr – National Center for Earth-Surface Dynamics

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	Petra DeWall – Bridge Office – Mn/DOT
Panel Members:	Bruce Holdhusen – Research – Mn/DOT

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 892: Develop Outreach Program for a Thoughtful Street Tree Master Plan

Project Description:

A previously-funded research and development project (LRRB project INV 823) culminated in the production of “The Thoughtful Street Tree Master Plan,” a revolutionary manual on urban transportation corridor landscape development concept, the only one of its kind. Part of the development of said manual involved several brief workshops that employed the manual and it was realized that the full benefit of the manual could only be realized with a more detailed, lengthy training period. Therefore, a strategy to promote both the manual and the use of the manual was determined to be necessary. Along with this promotional and training strategy, the concept of a certification program associated with street tree design was identified as a potential incentive for completing the training programs.

This project will help decision-makers be better informed in selecting the best plants for an area and ensure that issues of spacing, relative placement to travel corridors, and a variety of design elements will be satisfied. Thoughtful planning will help eliminate or at least minimize many future tree infrastructure problems, allowing the street tree population to grow gracefully and flourish requiring less maintenance overall.

Beginning Date	April 2010
End Date	July 2011

Original Funding

LRRB Total	<u>\$ 20,000</u>
Project Total	\$ 20,000

Principal Investigator

Gary Johnson – Forest Resources – U of M

Technical Advisory Panel

Administrative Liaison:	Debra Fick – Research – Mn/DOT
Technical Liaison:	Dan Gullickson – Environmental Services – Mn/DOT
Panel Members:	

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 893: Optimal Contract Mechanism Design for Performance Based Contracts

Project Description

A performance-based contract (PBC) in the transportation construction industry is envisaged to work as follows. A state transportation agency would specify a set of performance/quality metrics (short, medium and long-term) that is a structure to be built by the contractor (e.g. a pavement, a bridge, or a building) is meant to deliver over its planned life.

Beginning Date	November 2009
End Date	March 2011

Funding

LRRB Total	<u>\$30,000</u>
Project Total	\$30,000

Principal Investigator

Diwakar Gupta – Industrial & Systems Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Richard Kjonaas – State Aid – Mn/DOT
Panel Members:	

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 895: Traffic Generating Developments and Roadway Life Consumption

Project Description

Typically, local road are not designed to handle heavy, large, unanticipated loads. When a new facility is built that generates large amounts of heavy vehicles, whether temporarily or permanently, the pavement on a road and other items associated with it (corner turning radii, geometric design, utilities, etc.) is often inadequate, and pavement or other failures may occur long before originally anticipated. The costs associated with these early pavement failures and the maintenance and rehabilitation that they necessitate are almost always borne by the local highway agency. This project focuses on the infrastructure impact of new traffic generating sites, including pavement deterioration and other associated costs.

Beginning Date	January 2010
End Date	May 2012

Funding

LRRB Total	<u>\$37,038</u>
Project Total	\$37,038

Principal Investigator

W. James Wilde – Minnesota State University, Mankato

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Sue Miller – Freeborn County Engineer
Panel Members:	Gary Danielson – Kandiyohi County Engineer
	Tim Stahl – Jackson County Highway Department
	Rich Sanders – Polk County Engineer

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 900: Hennepin/Minneapolis LED Light Study

Project Description

Provide data on operational characteristics, life-cycle costs, and public perception and acceptance of LED and induction lights (including cold weather operation) that can be used by the state, counties, and cities to evaluate use of these technologies in their jurisdictions.

Beginning Date	May 2010
End Date	October 2012

Funding

LRRB Total	<u>\$50,000</u>
Project Total	<u>\$50,000</u>

Principal Investigator

Robert Luckow – Hennepin County

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Pending
Panel Members:	

Approvals:

December 2009 meeting for Fiscal Year 2010 program

Investigation Number 901: Evaluation of Concrete Admixtures to Increase Delivery Time

Project Description

Currently, most ready mix plants will hold back on all available water to ensure the concrete does not exceed the slump maximum on site. Both air content and slump can be increased at the point of delivery without a rejected load, but if the maximum is exceeded, the truck will be rejected. It is for this reason that we would hold back on water and air entrainment during our initial batching and then add the amount of each ingredient needed at 60 minutes or at 90 minutes to meet slump requirements (after slump tests are taken prior to water addition). Develop performance tests for the design and field verification for concrete mixes so durability is assured.

Beginning Date	March 2010
End Date	February 2011

Funding

LRRB Total	\$49,999
State Total	<u>\$49,999</u>
Project Total	\$99,998

Principal Investigator

Dan Vruno – American Engineering Testing, Inc.

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Maria Masten – Research – Mn/DOT
Panel Members:	Ron Mulvaney – Materials – Mn/DOT
	Wendy Garr – Materials – Mn/DOT

Approvals:

December 2009 meeting for Fiscal Year 2010 program

Investigation Number 998: Operational Research Program for Local Transportation Groups – 2010

Project Description

The Operational Research Program for Local Transportation Groups (OPERA) promotes innovation in operations and maintenance related to methods, materials, and equipment; creates an environment for intelligent improvements to maintenance operations; and supports a safe, efficient, and environmentally sound transportation network. OPERA encourages maintenance staff from all cities and counties to propose their own operational or hands-on research.

Beginning Date	January 2010
End Date	December 2010

Funding

LRRB Total	<u>\$90,000</u>
Project Total	\$90,000

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Mark Maloney – City of Shoreview
Panel Members:	Julie Skallman – State Aid – Mn/DOT
	Linda Taylor – Research – Mn/DOT

Approvals:

December 2008 meeting for 2010 Fiscal Year

Investigation Number 999: Program Development and Work Not Covered by Specific Projects - 2010

Project Description

This project provides funding for the administrative support of the Local Road Research Board. Work and activities under this project will include:

- LRRB, RIC, and staff expenses to attend meetings and conferences
- Research program development and management
- Special travel for research project development before programming
- Publication of reports from LRRB research
- Purchasing of published reports for distribution to LRRB constituents
- Special expenses for LRRB authorized activity for input to research in progress and technology transfer to LRRB constituents
- Project development before programming

Ongoing

Funding

LRRB Total	<u>\$107,975</u>
Project Total	\$107,975

Approvals:

December 2008 meeting for 2010 Fiscal Year



PENDING PROJECTS
Fiscal Year 2011

FY 2011 Local Road Research Board Program

	TITLE	Project Total	LRRB Total
668	Local Technical Assistance Program (LTAP) – 2010	515,000	375,000
675	Salary for two Research Services positions - 2009	160,000	160,000
676	MN Road Research: Facility Sprt-\$500,000, Tech Transfer & Support \$70,000 - 2010	570,000	570,000
745	Library Services - 2010	70,000	70,000
869	TERRA Board Support – 2010	25,000	12,500
894	Storm Water Pollutant Removal Characteristics of Roadside Vegetated Swales (Ditches and Medians)	312,000	312,000
896*	Quantifying Moisture Affects in DCP and LWD Tests Using Unsaturated Mechanics	109,900	54,950
897	Developing Salt-Tolerant Sod Mixtures for Use as Roadside Turf in Minnesota	176,516	176,516
898*	Estimating the Crash Reduction and Vehicle Dynamic Effects of Flashing LED Stop Signs	112,000	37,333
899	Performance Monitoring of Olmsted CR 117/104 and Aggregate Base Material Update	36,000	36,000
902	Material Control Testing Rates for Low Volume Roads	25,000	25,000
998	Operational Research Program for Local Transportation Groups – 2010	90,000	90,000
999	Program Administration - 2010	107,975	107,975

Investigation Number 668: Technology Transfer – 2011

Project Description

Minnesota Technology Transfer (T² / LTAP) Program – Base Funding

Provide funding for the Minnesota T²/LTAP Program at the University of Minnesota Center for Transportation Studies. The Local Technical Assistance Program (LTAP) is co-funded by the Federal Highway Administration (FHWA) and the LRRB.

The Federal Highway Administration requires the following program tasks: maintain mailing list; publish quarterly newsletter; provide technology-transfer information services and materials; provide technical assistance; administer courses and provide related conference support; and complete evaluation and program needs assessment.

The focus of the LTAP base program in 2009 will be on continuing to provide training and informational resources for local agencies, serving as a resource for technical assistance/referral, facilitating the exchange of best practices, providing the transfer of new technology innovations and materials, and promoting the implementation of transportation research results. Electronic and web-based information delivery mechanisms will be updated as new technologies emerge and maintenance is done quarterly. The LTAP two-year course plan for Minnesota's local transportation personnel will also be provided to allow for planning and budgeting of training activities.

The T² program staff will continue to educate and promote LTAP resources and services to Minnesota congressional delegates and their staff. Minnesota LTAP will continue its support of national workforce development initiatives.

Project Duration

2010

Funding

FHWA Total	\$140,000
LRRB Total	<u>\$375,000</u>
Project Total	\$515,000

Other Funding Sources

Participant Registration Fees

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Mn/DOT
Technical Liaison:	Julie Skallman – Mn/DOT
Panel:	Minnesota T ² /LTAP Steering Committee

Investigation Number 675: Salary for Two Positions for Research Services

The following are the services that are provided to the LRRB:

- Administrative Liaison for 50 LRRB funded research projects
- Proposal coordination and development
- Contract and amendment processing and processing contract invoices
- Final report publishing coordination, including brochure/CD/DVD publishing and bid coordination
- LRRB quarterly meeting preparation
 - agenda creation
 - scheduling the meetings
 - determining food and creating purchase requests
 - creating specifications for bids for meeting rooms, hotel rooms, and food
 - presenter coordination
 - creation of meeting books
 - creating the budget, conference lists, INV999 tracking
 - writing meeting minutes
 - ordering plaques and creating thank you and welcome letters
 - Proposal coordination
- Coordinating Roadmap process
- Meet with the Office of Materials Lab quarterly and maintaining tracking spreadsheet
- Meet with CTS regularly to review contracts and discuss process improvements
- LTAP project coordination, including getting into STIP program book, PPMS, creating federal authorization
- RIC program and meeting coordination
- Travel coordination for LRRB contracts
- Administrative Liaison for Outreach task
- Innovation Update work
- Printing of manuals, brochures, meeting books, and strategic plan books through Mn/DOT's reprographics
- Technical Synthesis reports
- LRRB Program book creation
- Travel coordination for LRRB conferences adhering to new travel rules
- Annual report

Funding

LRRB Total	<u>\$160,000</u>
Project Total	\$160,000

Investigation Number 676: Minnesota Road Research Facility – 2011

Project Description

This project provides funding, along with state funds, for the development and operation of the Minnesota Road Research Facility (MnROAD), the nation's first cold-region pavement test facility. Construction began in 1990 with the vision that the facility will operate for the next 50 years to meet the transportation industry's demand for transportation answers and for improved pavement technology.

This project accelerates the State's research program by providing for the study of a wide range of pavements at the same time. It makes possible controlled pavement research on new and rehabilitated interstate pavement sections under actual traffic conditions and new low-volume pavement sections under known test loadings. In addition, the facility allows Mn/DOT to control and monitor the many variables that affect pavements.

Mn/DOT and the University of Minnesota are both seeking a stronger role to better understand pavement performance. The University of Minnesota provides valuable support in various activities associated with the facility. The facility helps bring together University researchers, Mn/DOT engineers, and local practitioners.

Beginning Date	1989
Ending Date	Ongoing
Mn/ROAD	\$500,000
Mn/ROAD Technology Transfer and Support	\$ 70,000

Funding

LRRB Total	<u>\$570,000</u>
Project Total	\$570,000

* (Funds will be applied to various studies and operation of the MnROAD facility on an as-needed basis.)

Technical Advisory Panel

MnROAD Technical Advisory Committee

Investigation Number 745: Library Services for Local Governments 2011

Project Description

This project provides funding support for continuing and expanding the information services of Mn/DOT's Library to local government and transportation officials. The Mn/DOT Library traditionally has supported local agencies by providing county and municipal officials with access to the same information services available to department employees. These services to local officials currently account for approximately 10 percent of all services provided by Mn/DOT's Library:

- Assistance with reference questions
- On-line database searches
- Assistance in locating and acquiring standards and other published materials
- Loans of videotapes
- Loans of materials from other libraries and information sources

Mn/DOT Library collaborates with the CTS Library at the University of Minnesota in developing expanded services as a component of the state's LTAP Center. Recent developments include:

- Creation of the Midwest Transportation Knowledge Network (MTKN). The network is intended to increase access for state and local transportation officials to information resources held by DOTs and universities throughout FHWA's Region 3.
- Development of TL Cat, a free to the user, online service, accessible to local transportation officials, that combines the catalogs of 20 of the nation's largest transportation libraries. The TL Cat database of transportation information resources is second in size only to TRB's TRIS Online service and lists many resources not included in TRIS.
- Participation in a pooled fund study aimed at developing transportation libraries in other state DOTs and creating a national network of transportation libraries modeled on the successes of MTKN to further improve access to transportation information for state and local transportation officials.

Beginning Date	January 1, 1995
Ending Date	Ongoing

Funding

LRRB Total	<u>\$70,000</u>
Project Total	\$70,000

Program Manager

Sheila Hatchell, Mn/DOT's Research Services Section, serves as Library Director.

Technical Advisory Panel

Technology Transfer Coordinating Committee

Investigation Number 869: TERRA Board Support – 2011

Project Description

Formed in 2004, the Transportation Engineering and Road Research Alliance (TERRA) is a research governance structure that brings together government, industry, and academia in a dynamic partnership to advance innovations in road engineering and construction. TERRA seeks to develop, sustain, and communicate a comprehensive program of research on pavement, materials, and related transportation engineering challenges, including cold climate issues. TERRA maximizes the unique capabilities of MnROAD to advance research.

Results

This project supported the organizational development of TERRA, including four board meetings, a strategic planning session, committee activities, financial report development and tracking, and communication strategies. As a result, TERRA developed three major strategic directions: Expand productive research partnerships; provide effective transportation engineering and road research; and communicate transportation engineering and road research activities, benefits, and results. The TERRA strategic plan and business plan outline additional details.

Beginning Date	Pending
End Date	

Funding

LRRB Total	\$12,500
MnDOT Total	<u>\$12,500</u>
Project Total	<u>\$25,000</u>

Principal Investigator

Robert Johns – CTS – U of Mn

Technical Advisory Panel

Administrative Liaison:	Cory Johnson – Research – Mn/DOT
Technical Liaison:	Julie Skallman – State Aid – Mn/DOT

TERRA Board Members (Organizations)

Aggregate and Ready Mix Association of Minnesota
American Concrete Pavement Association
Associated General Contractors of Minnesota
Concrete Paving Association of Minnesota
Iowa State University
Michigan Department of Transportation
Minnesota Asphalt Pavement Association
Minnesota Department of Transportation
Minnesota Local Road Research Board
Norwegian Public Roads Administration
RMS Research Foundation
U.S. Federal Highway Administration
University of Minnesota

Investigation Number 894: Storm Water Pollutant Removal Characteristics of Roadside Vegetated Swales (Ditches and Medians)

Project Description

Swales and/or drainage ditches for linear road projects have excellent potential for storm water treatment. They can infiltrate water into the soil, filter sediments and associated pollutants out of the water, and settle solids to the bottom of the swale. Currently, however, there is little information that can be used to gain pollution prevention credits with State of Minnesota agencies, and meet permit requirements of watershed districts and other municipalities. This research will 1) document the pollution prevention available through infiltration into the soil of swales, and develop practical soil modifications which will make it possible to utilize existing right-of-way to meet permit requirements and 2) develop methods to remove dissolved phosphorus and heavy metals in swales. Maintenance requirements will also be documented, demonstrating another advantage in using swales for pollution prevention and for runoff volume control. We need to utilize our drainage ditches to their full pollution prevention potential, before building other, more expensive storm water treatment practices. This research will document the swale potential of drainage ditches, and enable them to be given credit for the pollution prevention that they are already achieving, guide the conversion of drainage ditches into swales that can remove dissolved constituents and provide the information necessary to develop design standards for swales along our linear road projects. Results from this study can be used to design systems for use along roadways throughout Minnesota and the United States. Results can also be used to estimate load reductions due to infiltration in Total Maximum Daily Load (TMDL) studies for future installations of roadside swales.

Beginning Date
End Date

Pending

Funding

LRRB Total
Project Total

\$312,000
\$312,000

Principal Investigator

John Gulliver – U of Mn

Technical Advisory Panel

Administrative Liaison: Bruce Holdhusen – Research – Mn/DOT
Technical Liaison: Barb Loida – Water Resources – Mn/DOT
Panel Members: Brian Kelly – Water Resources – Mn/DOT

Approvals

Reviewed at December 2009 meeting; approved at March 2010 meeting for the FY11 program.

Investigation Number 896: Quantifying Moisture Affects in DCP and LWD Tests Using Unsaturated Mechanics

Project Description

The objective of this research is to build on a mechanistic model for DCP, MR and CBR tests developed for dry aggregate bases under LRRB INV 850 to increase its range of applicability to more materials and tests used in Minnesota in three ways: (1) A model for the LWD test will be added. (2) Moisture will be included as one of many existing material input parameters. (3) Analogous algorithms will be developed for PFC3D, a commercial code maintained by Itasca.

Beginning Date	Pending
End Date	

Funding

LRRB Total	\$ 54,950
State Total	<u>\$ 54,950</u>
Project Total	\$109,900

Principal Investigator

Kimberly Hill – Civil Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Pending
Panel Members:	

Approvals:

December 2009 meeting for Fiscal Year 2011 program

Investigation Number 897: Developing Salt-Tolerant Sod Mixtures for Use as Roadside Turf in Minnesota

Project Description

The current Mn/DOT recommendation for salt resistant sod (Table 3878-1) is in need of re-evaluation. Recently, a number of sod installations conforming to the Mn/DOT specifications have failed. It is critical that additional grass species and cultivars are evaluated under high-salt conditions so that the best salt-tolerant sod can be produced. Several species that are not currently included in the recommendations have performed well in low-input turfgrass evaluations in Minnesota and should be evaluated for salt tolerance in roadside environments. The goal of the proposed research is to develop a recommended mixture or a set of mixtures that provide salt-tolerant sod by utilizing the most recently-developed turfgrass cultivars.

Beginning Date	Pending
End Date	

Funding

LRRB Total	<u>\$176,516</u>
Project Total	<u>\$176,516</u>

Principal Investigator

Eric Watkins – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Adam Popenhagen – Environmental Services – Mn/DOT
Panel Members:	Pending

Approvals:

December 2009 meeting for Fiscal Year 2011 program

Investigation Number 898: Estimating the Crash Reduction and Vehicle Dynamic Effects of Flashing LED Stop Signs

Project Description

Results from this research project can be used to develop a guideline to estimate the crash reduction and human behavior impacts of installing a flashing LED stop sign. The research findings will support Mn/DOT and other public agencies seeking to further deploy these systems.

Beginning Date	Pending
End Date	

Funding

LRRB Total	\$ 37,333
State Total	<u>\$ 74,667</u>
Project Total	\$112,000

Principal Investigator

Gary Davis – Civil Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Pending
Panel Members:	David Engstrom – OTSO – Mn/DOT
	Ray Starr – OTSO – Mn/DOT
	Brad Estoche – OTSO – Mn/DOT
	Mark Vizecky – State Aid – Mn/DOT
	Chen-Fu Liao – Civil Engineering – U of M
	Keith Knapp – Humphrey Institute – U of M
	Aland Rindels – Research – Mn/DOT

Approvals:

December 2009 meeting for Fiscal Year 2011 program

Investigation Number 899: Performance Monitoring of Olmsted CR 117/104 and Aggregate Base Material Update

Project Description

Monitor these roads over a longer time period (i.e., five years) to study the effects of temperature (freeze-thaw), time (rutting and/or stripping) and traffic conditions (i.e., traffic counts and types) on the long-term performance. Monitor the spring-thaw performance of the three base types selected in the previous study, over two spring-thaw cycles, in order to quantify the benefits of these materials under spring thaw conditions. Update the material models for strength and modulus to consider these effects and ultimately implemented into Mn/PAVE. Continue the current "information exchange" with Norway, where open-graded bases are commonly and successfully used to alleviate spring-thaw concerns, by allowing for proper horizontal drainage into the ditches and minimizing the moisture exchange between the subgrade and base layers, as the frost interfaces from both layers approach each other.

Beginning Date	Pending
End Date	

Funding

LRRB Total	<u>\$36,000</u>
Project Total	\$36,000

Principal Investigator

Matthew Lebens – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Pending
Technical Liaison:	Pending
Panel Members:	Mike Sheehan – Olmsted County Engineer Shongtao Dai – Materials – Mn/DOT Lu Tasa – District 2 Bruce Tanquist – Materials – Mn/DOT Alan Rindels – Research – Mn/DOT

Approvals:

December 2009 meeting for Fiscal Year 2011 program

Investigation Number 902: Material Control Testing Rates for Low Volume Roads

Accepted testing rates for larger projects do not necessarily translate into effective testing rates for smaller projects. Too little or too much testing will be addressed in the research in order to establish a more reasonable measurement for testing rates on low volume road projects. This research will review best practices on low volume roads and then produce draft specifications for use on low volume road project in Minnesota.

This project should reduce testing rates for low volume roads without an unacceptable increase in risks. Update the materials control spreadsheet and then create and deliver a training program to the local agencies.

Beginning Date	Pending
End Date	

Funding

LRRB Total	<u>\$25,000</u>
Project Total	\$25,000

Principal Investigator

Brian Wasserman – MN State University – Mankato

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Julie Skallman – SALT – Mn/DOT
Panel Members:	

Approvals:

March 2010 meeting for Fiscal Year 2011 program



2010 COMPLETED PROJECTS

2010 Local Road Research Board Completed Projects

INV	TITLE	Project Total	LRRB Total
645	Implementation of Research Findings 2007-2008	400,000	400,000
668*	Technology Transfer Center, U of M – Base 2009	325,000	185,000
883	Circuit Training & Assist.Program (CTAP), Instructor-\$74,500, T ² Center-\$84,000	158,500	158,500
	Minnesota Maintenance Research Expos	26,000	26,000
	Transportation Student Development	5,500	5,500
668*	Technology Transfer Center, U of M – Base 2010	50,345	50,345
676	MN Road Research: Facility Sprt-\$500,000, Staff Sprt-\$70,000 – 2010	570,000	570,000
745	Library Services for Local Governments – 2010	70,000	70,000
844*	Update of Vehicle Classification for County Road Pavement Design	92,749	47,749
845*	Analysis of Highway Design and Geometric Effects on Crashes - Part I and Part II	144,155	74,310
846	Hydraulic, Mechanical, and Leaching Characteristics of Recycled Materials	155,225	155,225
847	Use of Fly Ash for Reconstruction of Bituminous Roads	170,055	170,055
850	Mechanistic Modeling of DCP Test	105,000	105,000
852	Subsurface Drainage Manual for Pavements in Minnesota	71,638	71,638
853	Development of Flexural Vibration Equipment Phase II	52,980	52,980
856*	Investigation Number of In-Place Asphalt Film Thickness and Performance of MN Hot Mix Asphalt Mixtures	77,905	38,905
858*	Crack & Concrete Deck Sealant Performance	75,000	37,500
860	Compaction Specifications for Unbound Materials	105,000	105,000
861	Best Mgmt Practices for Pavement Preservation of Hot mix Asphalt	71,050	71,050
869	TERRA Board Support – 2009	112,500	12,500
870	The Impact of Stream Geomorphology and Fish Passage Requirements on Construction Costs of Culvert Structures in Minnesota	50,663	50,663
871*	Statistical Methods for Materials Testing	94,876	47,438
874*	Assessment of the Underground Storm Water Management Devices Under High Flow Conditions	123,000	61,499
876	Best Preventive Maintenance Treatment for Recreational Trails	53,569	53,569
880	Optimal Manpower Planning and Shift Scheduling for Snow and Ice Removal	45,000	45,000
881	LRRB Annual Program / Technical Synthesis Reports	17,910	10,000
888	Minnesota Local Agency Pavement Marking Practices – Phase I	18,720	18,720
998	Operational Research Program for Local Transportation Groups	90,000	90,000
999	Program Administration 2009	259,975	259,975

Investigation Number 645: Implementation of Research Findings (2007-2008)

Project Description

Continue to identify new topics and emphasize research implementation efforts of the Minnesota Local Road Research Board (LRRB). Investigation Number 645 helps county and city agencies put new research, including Minnesota Department of Transportation (Mn/DOT) research, into practice. Research implementation methods include abstracts of research reports, presentations, preparation of audio-visual aids, distribution of summary reports, and field demonstrations.

LRRB's Research Implementation Committee (RIC) directs and oversees the project. A standing committee, the RIC consists of county and city engineers, representatives from the University of Minnesota Technology Transfer Center and Mn/DOT. Based on input from city and county engineers throughout Minnesota, the RIC selected the following implementation tasks for the 2007/2008 program:

- Innovative Contracting Methods for Local Agencies
- Rural Safety Synthesis and Seminar
- Training Module for Pavement Rehabilitation
- Evaluation of LRRB Research Projects
- Street Sweeping Best Practices
- Guardrail Workshop
- Storm Water Runoff
- Pavement Management

Funding

LRRB Total	<u>\$400,000</u>
Project Total	\$400,000*

* SRF contract is for \$339,486. The balance of funds are available to RIC for dissemination of products and additional tasks outside of initial contract.

Technical Advisory Panel

Research Implementation Committee (RIC)

NOTE: This is an ongoing program budgeted in two-year increments. Duration and funding are descriptive for the current program only.

Investigation Number 668: Technology Transfer – 2008

Project Description

Minnesota Technology Transfer (T² / LTAP) Program – Base Funding

Provide funding for the Minnesota T²/LTAP Program at the University of Minnesota Center for Transportation Studies. The Local Technical Assistance Program (LTAP) is co-funded by the Federal Highway Administration (FHWA) and the LRRB.

The Federal Highway Administration requires the following program tasks: maintain mailing list; publish quarterly newsletter; provide technology-transfer information services and materials; provide technical assistance; administer courses and provide related conference support; and complete evaluation and program needs assessment.

The focus of the LTAP base program in 2009 will be on continuing to provide training and informational resources for local agencies, serving as a resource for technical assistance/referral, facilitating the exchange of best practices, providing the transfer of new technology innovations and materials, and promoting the implementation of transportation research results. Electronic and web-based information delivery mechanisms will be updated as new technologies emerge and maintenance is done quarterly. The LTAP two-year course plan for Minnesota's local transportation personnel will also be provided to allow for planning and budgeting of training activities.

The T² program staff will continue to educate and promote LTAP resources and services to Minnesota congressional delegates and their staff. Minnesota LTAP will continue its support of national workforce development initiatives.

Project Duration

2008

Funding

FHWA Total	\$140,000
LRRB Total	<u>\$185,000</u>
Project Total	\$325,000

Other Funding Sources

Participant Registration Fees

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Mn/DOT
Technical Liaison:	Julie Skallman – Mn/DOT
Panel:	Minnesota T ² /LTAP Steering Committee

Investigation Number 668: Technology Transfer – 2008

Project Description

Transportation Student Development

This project offers transportation students exposure to transportation career opportunities, information on career-preparation strategies, and networking and employment seeking opportunities. The LRRB, in cooperation with the Women's Transportation Seminar (WTS) and CTS education and T² programs, sponsors this student event to highlight transportation career opportunities with Minnesota's counties and cities.

The event features interactive panel discussions on topics such as transportation career opportunities and alternatives, resume presentation, interview skills, desired entry-level candidate qualities, and job requirements. A job fair and a reception follow the sessions, providing students an opportunity to network.

The University of Minnesota conducts this project.

Project Duration

2008

Funding

LRRB Total	<u>\$5,500</u>
Project Total	\$5,500

Other Funding Source

ITS Institute, Center for Transportation Studies

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

CTS Education/Outreach Council

Investigation Number 676: Minnesota Road Research Facility – 2009

Project Description

This project provides funding, along with state funds, for the development and operation of the Minnesota Road Research Facility (MnROAD), the nation's first cold-region pavement test facility. Construction began in 1990 with the vision that the facility will operate for the next 50 years to meet the transportation industry's demand for transportation answers and for improved pavement technology.

This project accelerates the State's research program by providing for the study of a wide range of pavements at the same time. It makes possible controlled pavement research on new and rehabilitated interstate pavement sections under actual traffic conditions and new low-volume pavement sections under known test loadings. In addition, the facility allows Mn/DOT to control and monitor the many variables that affect pavements.

Mn/DOT and the University of Minnesota are both seeking a stronger role to better understand pavement performance. The University of Minnesota provides valuable support in various activities associated with the facility. The facility helps bring together University researchers, Mn/DOT engineers, and local practitioners.

Beginning Date	1989
Ending Date	Ongoing

Funding

LRRB Total	<u>\$560,000</u>
Project Total	\$560,000

* (Funds will be applied to various studies and operation of the MnROAD facility on an as-needed basis.)

Technical Advisory Panel

MnROAD Technical Advisory Committee

Investigation Number 745: Library Services for Local Governments 2008

Project Description

This project provides funding support for continuing and expanding the information services of Mn/DOT's Library to local government and transportation officials. The Mn/DOT Library traditionally has supported local agencies by providing county and municipal officials with access to the same information services available to department employees. These services to local officials currently account for approximately 10 percent of all services provided by Mn/DOT's Library:

- Assistance with reference questions
- On-line database searches
- Assistance in locating and acquiring standards and other published materials
- Loans of videotapes
- Loans of materials from other libraries and information sources

Mn/DOT Library collaborates with the CTS Library at the University of Minnesota in developing expanded services as a component of the state's LTAP Center. Recent developments include:

- Creation of the Midwest Transportation Knowledge Network (MTKN). The network is intended to increase access for state and local transportation officials to information resources held by DOTs and universities throughout FHWA's Region 3.
- Development of TL Cat, a free to the user, online service, accessible to local transportation officials, that combines the catalogs of 20 of the nation's largest transportation libraries. The TL Cat database of transportation information resources is second in size only to TRB's TRIS Online service and lists many resources not included in TRIS.
- Participation in a pooled fund study aimed at developing transportation libraries in other state DOTs and creating a national network of transportation libraries modeled on the successes of MTKN to further improve access to transportation information for state and local transportation officials.

Beginning Date	January 1, 1995
Ending Date	Ongoing

Funding

LRRB Total	<u>\$60,000</u>
Project Total	\$60,000

Program Manager

Jerry Baldwin, Mn/DOT's Research Service's Section, serves as Library Director.

Technical Advisory Panel

Technology Transfer Coordinating Committee

Investigation Number 844: Update of Vehicle Classification for County Road Pavement Design

Project Description

The primary objective of this research is to update the vehicle classification and distribution that counties use when designing pavement structures to characterize the traffic more accurately. Since the 1977 traffic distribution, which was revised in 1997, there has been a continued shift in vehicle distribution, especially in the rural, agricultural areas of the state. For example, more farmers have acquired tractor semi-trailers to transport their grain to be processed. With the proposed 10-ton intercounty road network, it will be important to distinguish between functional classifications when estimating vehicle distributions. This project will allow local agencies to customize a spreadsheet that will more accurately reflect vehicle classification in their area.

Beginning Date	August 2006
Ending Date	March 2008
Amended End Date	May 2010

Original Funding

LRRB Total	<u>\$54,094</u>
Project Total	\$54,094

Amended Funding

LRRB Total	\$94,094
State Aid	<u>\$45,000</u>
Project Total	\$139,094

Amended Funding

LRRB Total	\$47,749
State Aid	<u>\$45,000</u>
Project Total	\$92,749

Principal Investigator

W. James Wilde – Mankato State University

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	Tim Stahl – Jackson County Engineer
Panel Members:	Marcus Flygare – Traffic Engineer – Mn/DOT
	George Cypress – Mn/DOT
	Rick Kjonaas – State Aid – Mn/DOT
	Jim Koivisto – State Aid – Mn/DOT
	Bill Martinson – TDA – Mn/DOT
	Matt Oman – Materials – Mn/DOT

Approved:

December 2005 Meeting

Amendment: December 2007 Meeting

Investigation Number 845: Analysis of Highway Design and Geometric Effects on Crashes - Part I and Part II

Project Description

It has been reported that 40 percent of fatal crashes in Minnesota involved road departure crashes. Of these, 40 percent appear to have occurred on horizontal curves. The proposed research is intended to develop an understanding of the crash differences between tangent sections and horizontal curves specific to Minnesota's rural two-lane highways. With a better understanding of the crash problem on Minnesota's horizontal curves, Mn/DOT and its safety partners can be more effective at addressing the State's crash problem, accelerating the Towards Zeros Deaths initiative.

Beginning Date	August 2007
Ending Date	July 2009
Amended End Date	March 2010

Funding

LRRB Total	\$74,310
Mn/DOT Total	<u>\$69,805</u>
Project Total	\$144,115

Co-Principal Investigators

Craig Shankwitz – U of M
Howard Preston – CH2M Hill

Technical Advisory Panel

Administrative Liaison: Shirlee Sherkow – Research – Mn/DOT
Technical Liaison: Glen Ellis – State Design Engineer – Mn/DOT
Panel Member: John Hourdos – Civil Engineering – U of M
Kathryn Swanson – Department of Public Safety
Jim Rosenow – Geometrics - Mn/DOT
Rich Sanders – Polk County Highway Department
William Rabenberg – Redwood County Highway Department
Scott Wahl – Minnesota State Patrol

Approved:

December 2005 Meeting
March 2007 – Combining with similar project funded by Mn/DOT

Final Report:

#2009-39 or <http://www.lrrb.org/pdf/200939.pdf>

Investigation Number 846: Hydraulic, Mechanical and Leaching Characteristics of Recycled Materials

Project Description

The study aims at characterizing water retention, hydraulic conductivity, shear strength, resilient modulus, and leaching characteristics of several recycled materials used in roadbed construction. These materials include reclaimed concrete, recycled asphalt pavement (type 1 and 2), asphalt shingles, shredded tires, fly ash, and municipal solid waste (MSW) bottom ash. All properties will be measured on pure and mixtures containing recyclable materials. Hydraulic, mechanical, and leaching characteristics will then be used to delineate the suitability of recycled materials in pavement construction.

Beginning Date	September 2006
Ending Date	November 2008
Amended End Date	October 2009

Funding

LRRB Total	\$135,000
Amendment Total	<u>\$ 20,225</u>
Project Total	\$155,225

Principal Investigator

Satish Gupta – Soil, Water and Climate – U of M

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	John Siekmeier – Materials – Mn/DOT
Panel Members:	Maureen Jensen – Materials – Mn/DOT
	Shongtao Dai – Materials – Mn/DOT
	Bruce Chadbourn – Materials – Mn/DOT
	Bernard Izevbekhai – Materials – Mn/DOT
	Eddie Johnson – Materials – Mn/DOT
	Tim Anderson – Materials – Mn/DOT
	Dong-hee Kang – Graduate Student - U of M
	Mindy Erickson – MN Pollution Control Agency

Approved:

December 2005 Meeting

Final Report:

#2009-32 or <http://www.lrrb.org/pdf/200932.pdf>

Investigation Number 847: Use of Fly Ash for Reconstruction of Bituminous Roads

Project Description

This project builds off previous LRRB Investigation Numbers that examined the feasibility of using fly ash in stabilizing soils and the potential environmental impacts. In this project, the gravel equivalency, life expectancy, and potential environmental impacts of fly ash stabilized recycled pavement materials will be assessed through large-scale laboratory experiments, small-scale laboratory tests typically used for design and analysis, and continued monitoring of two existing instrumented roads where fly ash stabilization has been conducted and extensively documented. Data obtained from the laboratory tests and the lysimeters will be compared with predictions from the models STUWMPP and WiscLEACH, which were specifically designed to assess potential groundwater impacts from projects where industrial byproducts are used in construction. Results of the study will have a direct impact on the ability to design and evaluate bituminous roads and streets in Minnesota where fly ash is used for in situ base stabilization.

Beginning Date	September 2006
Ending Date	January 2009
Amended End Date	August 2009

Funding

LRRB Total	<u>\$170,055</u>
Project Total	\$170,055

Principal Investigator

Paul Bloom – Soil, Water and Climate - U of M

Co-Principal Investigator:

Tuncer Edil – Civil Engineering – University of Madison

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	John Siekmeier – Materials – Mn/DOT
Panel Members:	Alan Rindels – Research – Mn/DOT
	Linda Pieper – Things with a Twist, Inc
	Bill Malin – Chisago County Engineer

Approved:

December 2005 Meeting

Final Report:

#2009-27

or

<http://www.lrrb.org/pdf/200927.pdf>

Investigation Number 850: Mechanistic Modeling of Dynamic Cone Penetrometer Test

Project Description

The dynamic cone penetrometer (DCP) is currently being implemented within Mn/DOT as an important tool for evaluating the condition of soil and aggregate bases. A recently developed guide – *The 2002 Pavement Design Guide for New and Rehabilitated Pavement Structures* – identifies the results of DCP testing as possible design input through the characterization of unbound materials. However, the Guide requires conversion of results from DCP measurements into the resilient modulus, and the empirical relationship provided by the Guide is not very reliable. The objective of this research is to develop a theoretically sound and practical mechanistic model of the DCP test which will provide correlation of DCP test results with the results from other tests of unbound materials.

Beginning Date	July 2006
Ending Date	July 2008
Amended End Date	June 2009

Funding

LRRB Total	<u>\$105,000</u>
Project Total	\$105,000

Principal Investigator

Kimberly Hill – Civil Engineering - U of M

Co-Principal Investigator:

Lev Khazanovich – Dept. of Civil Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	Lee Amundson – Lincoln County Engineer
Panel Member:	John Siekmeier – Materials & Road Research – Mn/DOT
	Bereket Tewoldettrhan – Civil Engineering - U of M

Approved:

December 2005 Meeting

Final Report:

#2009-21 or <http://www.lrrb.org/pdf/200921.pdf>

Investigation Number 852: Subsurface Drainage Manual for Pavements in Minnesota

Project Description

Subsurface drainage removes excess moisture from the base course and the subgrade of highways and thereby increases the overall strength of the pavement structure. Research has shown quite conclusively that effective subsurface drainage provides cost-effective benefits in terms of pavement maintenance and replacement costs. The objective of the proposed project is to develop a design and maintenance manual for pavement subsurface drainage systems in Minnesota. The manual is intended for engineers and managers involved in pavement design, construction, and maintenance decisions.

LRRB is requesting the Research Implementation Committee to oversee.

Beginning Date	September 2006
Ending Date	January 2008
Amended End Date	May 2009

Funding

LRRB Total	<u>\$71,638</u>
Project Total	\$71,638

Principal Investigator

John Nieber – U of M

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research – Mn/DOT
Technical Liaison:	Dan Sauve – Clearwater County Engineer
Panel Members:	Chuck Howe – Geology Lab – Mn/DOT
	Joel Ulring – Highway Engineer Wadena County
	Gabe Guevara – Maintenance – Mn/DOT
	Stephen Schnieder – Nobles County Engineer
	Jim Grothaus – CTS – U of M
	Andrea Hendrickson – State Hydraulics Engineer – Mn/DOT
	Tracy Schmidt – Office of Aeronautics – Mn/DOT

Approved:

December 2005 Meeting

Final Report:

#2009-17 or <http://www.lrrb.org/pdf/200917.pdf> Tech Summary: 200917TS

Investigation Number 853: Development of Flexural Vibration Inspection Equipment and Techniques to Rapidly Assess the Structural Health of Rural Bridge Systems: Phase II

Project Description

This project supplements and continues a UMD NATSRL project, Development of Flexural Vibration Inspection Techniques to Rapidly Assess the Structural Health of Rural Bridge Systems by expanding the bridge type to include dowel laminated bridges and by designing and fabricating an automated testing system. These bridges offer new challenges to vibration techniques because they are considered more of a plate structure than a beam structure, with structural members in both the span and cross-span direction.

Beginning Date	September 2006
Ending Date	March 2008
Amended End Date	December 2009

Funding

LRRB Total	<u>\$52,980</u>
Project Total	<u>\$52,980</u>

Principal Investigator

Brian Brashaw – UMD

Technical Advisory Panel

Administrative Liaison:	Debra Fick – Research – Mn/DOT
Technical Liaison:	Chris Morris – St. Louis County - Bridge Engineer
Panel Member:	Dave Conkel – Bridge & Structures – Mn/DOT

Approved:

December 2005 Meeting

Final Report:

#2009-40 or <http://www.lrrb.org/pdf/200940.pdf>

Investigation Number 856: Investigation Number of In-Place Asphalt Film Thickness and Performance of Minnesota Hot Mix Asphalt Mixtures

Project Description

The successful design of hot mix asphalt (HMA) mixtures should consider mitigating rutting, thermal cracking, fatigue cracking and be durable. A loss in durability often manifests itself as fatigue or thermal cracking, but is generally associated with asphalt aging and/or film thickness. The Minnesota DOT currently uses voids in the mineral aggregate (VMA) as a volumetric criteria to ensure durable HMA in the design and construction process. VMA is simply the air and the non-absorbed asphalt by volume of an HMA. One concept that a limited number of owner agencies specify is film thickness. One of the major benefits of using film thickness as established by Campen (1957) over that of VMA is that the calculation recognizes varying gradations, e.g. fine versus coarse, and the corresponding surface areas.

Beginning Date	October 2006
Ending Date	December 2008
Amended End Date	June 2009

Funding

LRRB Total	\$ 38,905
COPTRS Total	\$ 31,445
Mn/DOT Total	<u>\$ 7,555</u>
Project Total	\$ 77,905

Principal Investigator

Mihai Marasteanu – Civil Engineering - U of M

Technical Advisory Panel

Administrative Liaison:	Dan Warzala – Research – Mn/DOT
Technical Liaison:	John Garrity – Materials – Mn/DOT

Approved:

December 2005 Meeting

Final Report:

Staff Paper P2009-01

Investigation Number 858: Crack and Concrete Deck Sealant Performance

Project Description

Mn/DOT has been using, to a limited extent, crack and concrete sealants as a preventative measure to reduce the likelihood of reinforcement corrosion. As Mn/DOT prepares to expand the usage of sealants as a preventative measure, a state-of-the-art report is needed for guidance. The purpose of this project is to develop such a report which will document previous Investigation Numbers on the effectiveness of the current products used including silane, siloxane, methyl-methacrylates, epoxies and urethanes. The report will also consider issues which have not been addressed in previous research, such as the effectiveness of sealants upon reapplication.

Beginning Date	September 2006
Ending Date	March 2008
Amended End Date	March 2009

Funding

LRRB Total	\$37,500
Mn/DOT Total	<u>\$37,500</u>
Project Total	\$75,000

Principal Investigator

Arturo Schultz – Civil Engineering - U of M

Co-Principal Investigator

Cathy French – Civil Engineering - U of M

Technical Advisory Panel

Administrative Liaison:	Nelson Cruz – Research – Mn/DOT
Technical Liaison:	Gary Peterson – Bridges & Structures – Mn/DOT
Panel Members:	Jim Lilly – Office of Maintenance - Mn/DOT
	Keith Farquhar – Bridge Office - Mn/DOT,
	Bernard Izevbekhai – Materials - Mn/DOT

Approved:

December 2005 Meeting

Final Report:

#2009-13 or <http://www.lrrb.org/pdf/200913.pdf>

Investigation Number 860: Compaction Specifications for Unbound Materials

Project Description

This research is to develop Standard Test Methods for quality control and quality assurance testing utilizing the dynamic cone penetrometer (DCP), light weight deflectometers (LWD), and soil stiffness gauge (SSG). The research will also develop draft specifications for the placement subgrade materials in a highway embankment, and for placement of granular materials, including granular fills, subbase materials, and base materials that utilize these test methods. This work will build on the work currently underway in LRRB Investigation Number 829 "Validation of DCP and LWD Moisture Specifications for Granular Materials."

Beginning Date	September 2006
Ending Date	August 2008
Amended End Date	February 2009

Funding

LRRB Total	<u>\$105,000</u>
Project Total	\$105,000

Principal Investigator

John Siekmeier – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Merle Earley – Engineer – District 4
	Shongtao Dai – Materials – Mn/DOT
	Bruce Chadbourn – Materials – Mn/DOT
	Rebecca Embacher – Materials – Mn/DOT
	Tim Andersen – Materials – Mn/DOT
	Peter Davich – Metro – Mn/DOT
	Andrew Eller – Materials – Mn/DOT

Approvals:

March 2006 Meeting

Final Report:

#2009-12TS or <http://www.lrrb.org/pdf/200912TS.pdf>

Investigation Number 861: Best Management Practices for Pavement Preservation of Hot Mix Asphalt

Project Description

With the advent of new Hot Mix Asphalt (HMA) technology in the last ten years the question about how to best manage the new pavements to yield the maximum useable life has been asked numerous times. No one has determined if these pavements need to have Pavement Preventive Maintenance (PPM) treatments applied to them to yield the most cost effective life. This research will attempt to determine if and when the new types of HMA need to receive PPM treatments. The second part of the research project will develop recommend practices for doing the PPM treatments and make recommendations for the time in the pavement life the treatments should be placed.

Beginning Date	August 2006
Ending Date	February 2009

Funding

LRRB Total	<u>\$71,050</u>
Project Total	\$71,050

Principal Investigator

Tom Wood – Materials – Mn/DOT

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Tim Stahl – Jackson County Engineer
Panel Members:	Erland Lukanen – Pavement Institute – U of M
	Dan Anderson – Maintenance – Mn/DOT
	Wes Smith – Mankato Highway Maint. Supervisor – Mn/DOT

Approvals:

March 2006 Meeting

Final Report:

#2009-18 or <http://www.lrrb.org/pdf/200918.pdf>

Investigation Number 869: TERRA Board Support

Project Description

Formed in 2004, the Transportation Engineering and Road Research Alliance (TERRA) is a research governance structure that brings together government, industry, and academia in a dynamic partnership to advance innovations in road engineering and construction. TERRA seeks to develop, sustain, and communicate a comprehensive program of research on pavement, materials, and related transportation engineering challenges, including cold climate issues. TERRA maximizes the unique capabilities of MnROAD to advance research.

Results

This project supported the organizational development of TERRA, including four board meetings, a strategic planning session, committee activities, financial report development and tracking, and communication strategies. As a result, TERRA developed three major strategic directions: Expand productive research partnerships; provide effective transportation engineering and road research; and communicate transportation engineering and road research activities, benefits, and results. The TERRA strategic plan and business plan outline additional details.

Beginning Date	August 2008
End Date	September 2009
Amended End Date	December 2009

Funding

LRRB Total	\$ 12,500
MnDOT Total	<u>\$100,000</u>
Project Total	\$112,500

Principal Investigator

Robert Johns – CTS – U of Mn

Technical Advisory Panel

Administrative Liaison:	Cory Johnson – Research – Mn/DOT
Technical Liaison:	Julie Skallman – State Aid – Mn/DOT

TERRA Board Members (Organizations)

Aggregate and Ready Mix Association of Minnesota
American Concrete Pavement Association
Associated General Contractors of Minnesota
Concrete Paving Association of Minnesota
Iowa State University
Michigan Department of Transportation
Minnesota Asphalt Pavement Association
Minnesota Department of Transportation
Minnesota Local Road Research Board
Norwegian Public Roads Administration
RMS Research Foundation
U.S. Federal Highway Administration
University of Minnesota

Investigation Number 870: The Impact of Stream Geomorphology and Fish Passage Requirements on Construction Costs of Culvert Structures in Minnesota

Project Description

The standard engineering approach to culvert design and installation has often ignored the impact on aquatic life. Introducing increased water velocities and vertical obstacles has presented a barrier to the passages of fish and other aquatic life. Instability of the channel can result when culvert design and installation ignores the natural hydrology and channel dimensions of a stream, resulting in problems with deposition, sediment transport and erosion, and higher maintenance costs. Minnesota is currently implementing new approaches to culvert installation (MESBOA and weir/baffles), which are designed to maintain a stream's ecological and hydrological function as it passes through the culvert. The functions of these new designs allows adequate fish and aquatic life passage at all life stages, maintain natural sediment transport downstream without excessive deposition or scour, support passage of appropriate range of flows from the watershed and transport of large woody debris without plugging, minimize erosion from the road crossing, and reduce maintenance costs. This research will address the following questions. What are the requirements of the Department of Natural Resources for flow velocities near culverts? Do alternative designs significantly increase the cost of construction? How common is the use of alternative design? Do the alternative designs accomplish the goal of maintaining proper ecological function?

Beginning Date	October 2007
Ending Date	September 2009

Funding

LRRB Total	<u>\$50,663</u>
Project Total	\$50,663

Principal Investigator

John L. Nieber – U of M

Co-Principal Investigator

Bruce Wilson – U of M

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research – Mn/DOT
Technical Liaisons:	Alan Forsberg – Blue Earth County Engineer Susan Miller – Freeborn County Engineer
Panel Members:	Frank Pafko – Environmental Services Director- MnDOT Omid Mohseni – SAFL – U of M Todd Campbell – D1 Engineer - Mn/DOT Petronella De Wall – Bridge – Mn/DOT Jon Bergstrand – D1 Hydraulics- Mn/DOT Brian Walter – Hancock Concrete Products Co, Inc. Peter Leete – Environmental Services – Mn/DOT Karl Koller – Department of Natural Resources Bradley Hansen – Agricultural Engineering David Halbersma – Pipestone County Engineer Shae Kosmalski – Cook County Engineer Dave Robley – Douglas County Engineer Rick West – Otter Tail County Engineer

Investigation Number 871: Statistical Methods for Materials Testing

Project Description

Mn/DOT's Materials Control Schedule dictates the testing rates for construction projects. The testing rate schedule, though, can lead to inefficiencies and the possible installation of materials that may not meet specifications. The proposed research will examine Mn/DOT's current testing rates on one or more key items on the Materials Control Schedule, such as density tests on grading materials, bituminous testing, and concrete testing. The research will involve analyzing existing data from Mn/DOT projects and identifying trends in the data to support changing the testing rates to adjust for field conditions. The project will include recommended changes to the Materials Control Schedule.

Beginning Date	August 2007
Ending Date	January 2010

Funding

LRRB Total	\$47,438
Mn/DOT Total	<u>\$47,438</u>
Project Total	\$94,876

Principal Investigator

Diwakar Gupta –Mechanical Engineering – U of M

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research – Mn/DOT
Technical Liaison:	Tom Ravn – Construction – Mn/DOT Jay Hieptas – Construction – Mn/DOT
Panel Members:	Curt Turgeon – Materials – Mn/DOT Dan Boerner – Materials – Mn/DOT John Garrity – Materials- Mn/DOT Mike Gieske – Metro – Mn/DOT

Approvals:

December 2006 meeting for 2007 Program

Final Report:

#2009-41 or <http://www.lrrb.org/pdf/200941.pdf>

Investigation Number 874: Assessment of the Underground Storm Water Management Devices under High Flow Conditions

Project Description

The St. Anthony Falls Laboratory has measured the sediment removal efficiency for many underground treatment devices, but has not evaluated the efficiency of these systems for high flows. In this project, researchers will evaluate the sediment removal efficiency for these same systems under high flows. The results will help storm water engineers in selecting the most efficient system for roadways.

Beginning Date	May 2007
Ending Date	November 2009
Amended End Date	March 2010

Original Funding

LRRB Total	\$ 55,499
Mn/DOT Total	<u>\$ 55,501</u>
Project Total	\$111,000

Amended Funding

LRRB Total	\$ 61,499
Mn/DOT Total	<u>\$ 61,501</u>
Project Total	\$123,000

Principal Investigator

Omid Mohseni – St. Anthony Falls Lab – U of M

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Mike Eastling – City of Richfield Engineer
Panel Members:	Marilyn Jordahl Larson – Environmental Services – Mn/DOT
	John Gulliver – Civil Engineering – U of M
	Kevin Larson – City of Brooklyn Park
	Todd Campbell – Duluth Construction – Mn/DOT
	Andrea Hendrickson – State Hydraulic Engineer – Mn/DOT
	Andrew Erickson – St. Anthony Falls Lab - U of M
	Jack Frost – Metropolitan Council
	Scott Carlstrom – Metro District Water Resources – Mn/DOT
	Julie Johnson – Environmental Services – Mn/DOT
	Sue McDermott – Mendota Heights City Engineer

Approvals:

December 2006 meeting for 2007 Program

Final Report:

#2010-10 or <http://www.lrrb.org/pdf/201010.pdf>

Investigation Number 876: Best Preventive Maintenance Treatment for Recreational Trails

Project Description

The growth of recreational trails in the last 10 years has led to questions about appropriate types of preventive maintenance treatments. A survey of 10 metropolitan suburbs reveals more than 1,900 miles of recreational trails alone. Historically agencies have used preventive maintenance treatments on recreational trails, but those treatments aren't always as successful for recreational trails. This research will determine the most currently acceptable and cost-effective treatments and will include an easy-to-understand guide to preventive maintenance treatments on recreational trails, helping users maximize resources and prolong the life of recreational trails.

Beginning Date	August 2007
Ending Date	August 2009

Funding

LRRB Total	<u>\$53,569</u>
Project Total	\$53,569

Principal Investigator

Roger Olson – Materials & Road Research – Mn/DOT

Co-Principal Investigators

Erland Lukanen – Pavement Institute – U of M

Technical Advisory Panel

Administrative Liaison:	Shirlee Sherkow – Research – Mn/DOT
Technical Liaison:	Doug Schwartz – Materials – Mn/DOT
Panel Members:	Andy Brotzler – City of Rosemount Engineer
	Brent Christensen – Three Rivers Park District
	Michael Marti – SRF Consulting Group
	Richard West – Otter Tail County Engineer
	Mike Rief – Materials- Mn/DOT
	Andy Brotzler – Rosemount City Engineer
	Paul Oehme – Chanhassen City Engineer

Approvals:

December 2006 meeting for 2007 Program

Final Report:

#2009-25 or <http://www.lrrb.org/pdf/200925.pdf>

Investigation Number 880: Snow Plow Optimization

Project Description

Shrinking budgets, aging workforce, and high equipment and fuel costs have raised the importance of manpower planning and efficient workforce deployment during snow and ice storms. Mn/DOT and state counties use different approaches for crew scheduling (split versus standard shifts) and have different Level-of-Service (LOS) goals. It is not clear which approach should be used when. Moreover, there does not appear to be a systematic methodology for estimating manpower needs. These two issues are closely related. This project will respond to two different problem statements. Manpower requirement planning and crew deployment problems will be first formulated as mathematical optimization problems, with appropriate constraints coming from county engineers' expert judgment and union rules. Researchers will then develop solution algorithms using commercially available optimization software. The principal investigator will use a particular county's data to illustrate the proposed methodology. A number of possible storm scenarios will be analyzed and dominant response strategies will be linked with different types of storms. This project will help streamline the work of Mn/DOT and county engineers and provide them with the tools to make better workforce planning and deployment decisions for ice and snow removal operations. Systematic evaluation also will focus attention on the cost impact of different LOS'.

Beginning Date	July 2007
Ending Date	April 2010

Funding

LRRB Total	<u>\$45,000</u>
Project Total	\$45,000

Principal Investigator

Diwakar Gupta – Mechanical Engineering – U of M

Technical Advisory Panel

Administrative Liaison: Dr. Alan Rindels – Research – Mn/DOT

Technical Liaison: Jim Roldesi – Public Works Director – St. Louis County

Panel Members: Pat McCarthy – St. Louis County
Sue Lodahl – Maintenance – Mn/DOT
Curtis Pape – Maintenance – Mn/DOT

Investigation Number 881: LRRB Annual Program / Technical Synthesis Reports

Project Description

This project involves the production of the 2007 Local Road Research Board (LRRB) Research Program Report and of Technical Synthesis Reports on diverse topics. The LRRB Research Program Report describes LRRB-funded projects and costs on an annual basis. The 2007 report features all LRRB research projects, including currently funded and completed projects. Technical Synthesis Reports offer a way to provide information to transportation practitioners about issues that they raise, about best practices, or about hot topics.

Beginning Date	January 2007
End Date	February 2009
Amended End Date	August 2009

Original Funding

LRRB Total	<u>\$ 11,475</u>
Project Total	\$ 11,475

Amended Funding

LRRB Total	\$ 9,775
Mn/DOT Total	<u>\$ 7,910</u>
Project Total	\$17,685

Principal Investigator

Darlene Gorrill – Consultant U of M

Technical Advisory Panel

Administrative Liaison: Sandy McCully – Research – Mn/DOT
Technical Liaison: Linda Taylor – Research – Mn/DOT
Panel Members:

Amendment:

Scope amended for Technical Synthesis Reports in May 2007

Investigation Number 888: Minnesota Local Agency Pavement Marking Practices – Phase I

Project Description:

The quality of pavement marking has a positive impact on safety, so any activity that contributes to better pavement marking has the potential to impact efficiency and safety for the agency and the traveling public. This project has the potential of improving local agency practices related to pavement marking and provide guidance on better pavement marking management.

Beginning Date	April 2009
End Date	February 2010

Original Funding

LRRB Total	<u>\$ 18,720</u>
Project Total	\$ 18,720

Principal Investigator

Omar Smadi – Center for Transportation Research & Education – Iowa State University

Co-Principal Investigator

Neal Hawkins – Center for Transportation Research & Education – Iowa State University

Technical Advisory Panel

Administrative Liaison:	Dr. Alan Rindels – Research – Mn/DOT
Technical Liaison:	Tom Behm – District 8 – Mn/DOT
Panel Members:	Lee Amundson – County Engineer – Lincoln County
	Mark Vizecky – State Aid – Mn/DOT
	Randy Newton – City of Eden Prairie

Approvals:

December 2008 meeting for 2010 Fiscal Year

Final Report:

#2010-05 or <http://www.lrrb.org/pdf/201005.pdf>

Investigation Number 998: Operational Research Program for Local Transportation Groups – 2009

Project Description

The Operational Research Program for Local Transportation Groups (OPERA) promotes innovation in operations and maintenance related to methods, materials, and equipment; creates an environment for intelligent improvements to maintenance operations; and supports a safe, efficient, and environmentally sound transportation network. OPERA encourages maintenance staff from all cities and counties to propose their own operational or hands-on research.

Beginning Date	January 2009
End Date	December 2009

Funding

LRRB Total	<u>\$90,000</u>
Project Total	\$90,000

Principal Investigator

Jim Grothaus – CTS – U of M

Technical Advisory Panel

Administrative Liaison:	Clark Moe – Research – Mn/DOT
Technical Liaison:	Marcus Hall – St. Louis County Engineer
Panel Members:	Julie Skallman – State Aid – Mn/DOT
	Linda Taylor – Maintenance – Mn/DOT
	Mark Maloney – City of Shoreview

Approvals:

December 2007 meeting

Investigation Number 999: Program Development and Work Not Covered by Specific Projects - 2009

Project Description

This project provides funding for the administrative support of the Local Road Research Board. Work and activities under this project will include:

- LRRB, RIC, and staff expenses to attend meetings and conferences
- Research program development and management
- Special travel for research project development before programming
- Publication of reports from LRRB research
- Purchasing of published reports for distribution to LRRB constituents
- Special expenses for LRRB authorized activity for input to research in progress and technology transfer to LRRB constituents
- Project development before programming
- Consultant services for research proposal development, implementation and technology transfer activities
- Monetary support for two positions in Mn/DOT's Research Services Section

Ongoing

Funding

LRRB Total	<u>\$249,975</u>
Project Total	\$249,975

Amended Funding

LRRB Total	<u>\$259,975</u>
Project Total	\$259,975

Approvals:

June 2008 Meeting added \$10,000



2010
LOCAL ROAD RESEARCH BOARD AND
RESEARCH IMPLEMENTATION COMMITTEE
MEMBERSHIP

STATE OF MINNESOTA: DEPARTMENT OF TRANSPORTATION
STATE AID for LOCAL TRANSPORTATION DIVISION
LOCAL ROAD RESEARCH BOARD
YEAR 2010 MEMBERSHIP

APPOINTEE	GOVERNMENT BRANCH	APPOINTMENT DATE	TERM 1 EXPIRATION	TERM 2 EXPIRATION
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4 Counties

Bruce Hasbargen	Lake of the Woods County	1-1-09	21-31-11	
Sue Miller	Freeborn County	9-1-06	12-31-08	12-31-11
		(filled unexpired term of former member)		
Mitch Anderson	Stearns County	10-1-05	12-31-08	12-31-11
		(filled unexpired term of former member)		
Rick West	Otter Tail County	1-1-08	12-31-10	

2 Cities

Deb Bloom	City of Roseville	1-1-06	12-31-08	12/31/11
Steve Koehler	City of New Ulm	4-1-09	12-31-13	

TERM INDEFINITE

Laurie McGinnis	University of Minnesota	6-09		Commissioner's Directive
Keith Shannon	Transportation Department	3-7-03		Commissioner's Directive
Julie Skallman	Transportation Department	1-4-99		Commissioner's Directive
Linda Taylor	Transportation Department (Ex Officio Secretary)	5-1-09		Commissioner's Directive

Updated 3-26-10

STATE OF MINNESOTA: DEPARTMENT OF TRANSPORTATION
STATE AID for LOCAL TRANSPORTATION DIVISION
LOCAL ROAD RESEARCH BOARD
RESEARCH IMPLEMENTATION COMMITTEE
YEAR 2010 MEMBERSHIP

APPOINTEE	GOVERNMENT BRANCH	APPOINTMENT DATE	TERM 1 EXPIRATION	LENGTH OF TERM
Tom Colbert	City of Eagan	1/1/06	12/31/12	6 years
Mel Odens	City of Willmar	1/1/09	12/31/15	
Rich Sanders	Polk County	1/1/08	12/31/14	6 Years
Gary Danielson	Kandiyohi County	1/4/05	12/31/11	6 Years
Rick West	Otter Tail County	9/20/06	12/31/12	6 Years
		(filled unexpired term of former member)		
Mitch Rasmussen	Scott County	1/1/10	12/31/16	6 Years
Walter Leu	DSAE Mn/DOT	1/1/10	12/31/14	4 Years

Rick Kjonaas	Transportation Department	9/1/2001		Indefinite
Maureen Jensen	Transportation Department	9/20/06		Indefinite
Ben Worel	Transportation Department	2/17/10		Indefinite
Clark Moe	Transportation Department	6/1/02		Staff
Jim Grothaus	Center for Transportation Studies	1/1/05		Staff

Updated 3-26-10