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DEPARTMENT OF TRANSPORTATION
RESEARCH SERVICES & LIBRARY

mndot.gov/research

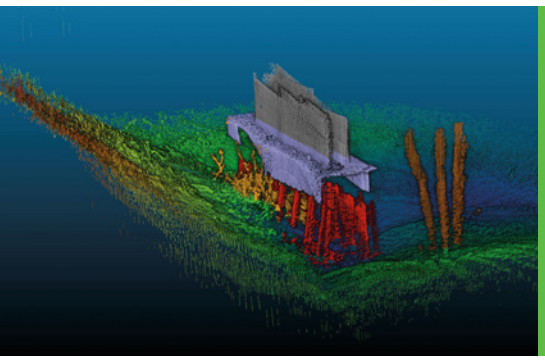
FY2017: JULY 1, 2016 – JUNE 30, 2017

RESEARCH AT-A-GLANCE

Solving Problems Through Innovation

A one-stop oversize/overweight permitting process will save haulers time and money by consolidating jurisdiction requirements.
Report 2017-26

A new field guide presents cost-effective methods for stabilizing roadside slopes damaged by storms and erosion.
Report 2017-17



Underwater 3-D sonar imaging will save money on bridge inspections and pre- and post-construction surveys.
Report 2017-40

A new guide describes enhanced culvert inspection methods, such as the low-cost, MnDOT-developed HIVE inspection robot.
Report 2017-16

We welcome your feedback, research requests and involvement on Technical Advisory Panels.

Linda Taylor
Director, MnDOT Research Services & Library
Linda.Taylor@state.mn.us

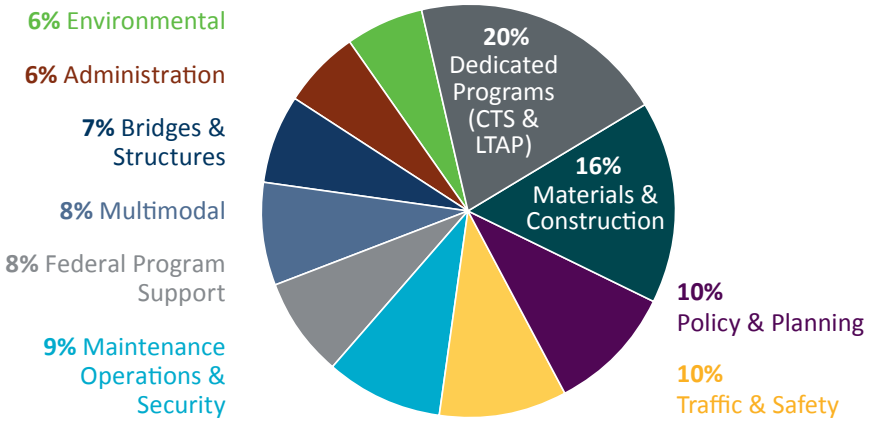
OUR MISSION

MnDOT Research Services & Library helps transportation practitioners solve problems through research and innovation.

With funding from state, local and federal research programs, we administer more than 200 research projects annually. This includes research we manage for the Minnesota Local Road Research Board (LRRB) on behalf of Minnesota city and county engineers.

Our goal is to create a better transportation network that moves Minnesota residents more safely and efficiently with less environmental impact.

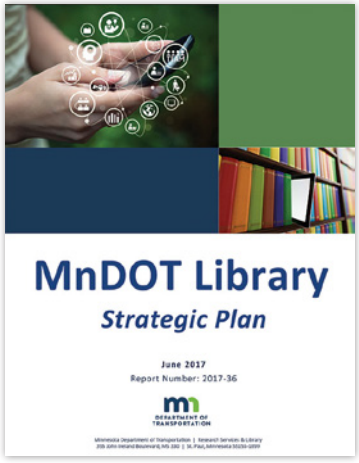
MnDOT RESEARCH BY TOPIC AREA



Total: $10,651,597

PROGRAM IMPROVEMENTS

Research Program Strategic Plan provides a vision for greater integration of MnDOT priorities into the selection of research projects.



Library Strategic Plan is our blueprint for modernizing library operations to meet future information needs.

KEY SUCCESSES

Over the past year, numerous media stories covering MnDOT innovations have spread the word about **drone use for bridge inspections**, **automated vehicle location technology for grass mowers** and **living snow fences**.

Our homegrown **culvert inspection vehicle** (pictured on the cover) earned multiple awards in 2017, including AASHTO's High-Value Research Award.

The Office of Traffic & Safety plans to **demonstrate an autonomous bus** at Super Bowl LII in Minneapolis in February 2018. The electric shuttle bus is being tested in winter weather conditions for the first time at MnROAD, Minnesota's cold weather pavement testing facility.

MnDOT FY2017 RESEARCH HIGHLIGHTS

Improving Operations

Trisha Stefanski, Metro District asset management engineer, discusses the mowing operations pilot project using AVL technology, which she hopes may cut herbicide use in half.

Efficient Mowing — A pilot project equipped Metro District mowers with automated vehicle location (AVL) technology to guide mowing operations. A video screen shows operators where noxious weeds are on the roadside. By avoiding these patches, operators can avoid spreading the weeds, which reduces herbicide use. The technology also helps supervisors track maintenance activity. This project **was highlighted in Roads & Bridges** magazine and in a video on **the MnDOT Research YouTube Channel** (**2017-11**).

A metal rack (right) within the mower cab houses the AVL unit.

Unified Permitting of Overweight Vehicles — MnDOT is developing a one-stop permitting process to allow commercial haulers to plan a travel route and secure all required permits from a single source. This process will be a first of its kind, consolidating the requirements of every jurisdiction in the state. MnDOT has also begun research into a new information system to combine freight route-builder functions and motor carrier credential information (**2017-26**, **TRS 1704**).

Bicycle and Pedestrian Travel — MnDOT is committed to supporting all modes of travel. The **Bicycle and Pedestrian Data Collection Manual** and a related research implementation effort are helping institutionalize **nonmotorized traffic data collection**. More than 25 permanent count sites were established, and a program was created to lend counting equipment to local agencies (**2017-02**). A new analysis quantified the **health and economic impacts of bicycling** in Minnesota (**2016-36**). And researchers evaluated the **traffic impacts of various bike lane and shoulder designs** to improve multimodal planning (**2017-23**).

Harnessing Technology

Minneapolis TV station KARE 11 reported on the app alerting drivers to construction zones. Watch the story at ***kare11.com/article/news/local/outreach/eyes-up/new-u-of-m-app-alerts-drivers-to-construction-zones/443007423****.*

Work Zone Safety — Several technology-enabled safety solutions are being developed to reduce accidents in construction zones. An alert system (beta form) uses Bluetooth wireless technology to warn drivers of upcoming work zone activity through their smartphones (**2017-19**). A wearable **GPS-equipped safety vest** (prototype system) detects the presence of construction workers (**2016-27**). And **Automatic Flagger Assistance Devices**, which keep workers away from traffic while providing highly visible signage around work zones, could soon be self-propelled, supporting moving operations like pavement crack sealing (**2017-09**).

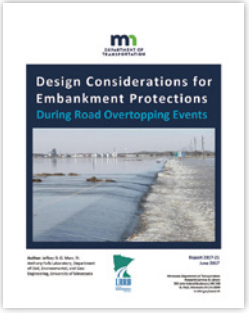
Smart Bridge Inspections — Technology is making bridge inspections more efficient and effective, as well as safer. MnDOT hydraulics engineers honed techniques for **underwater sonar investigation**, showing that 3-D imaging is highly effective for inspecting bridge piers in conditions unsuitable for diving inspection (**2017-40**). They also **piloted phased array ultrasonic 3-D scanning** for corrosion mapping (**2017-33**) and continue to advance the use of **unmanned aircraft systems** (UAS) (**2017-18**). A **current project** will test a **collision-tolerant drone** for confined space inspections and develop a statewide UAS bridge inspection plan for state and local bridges.

Autonomous Technology — MnDOT is positioning itself to meet the future of transportation. We will be **demonstrating an autonomous bus** at the Super Bowl, after testing it in winter conditions. Current research is developing an **in-vehicle system** to warn drivers when a vehicle starts to drift out of its lane. A study also began this year to **help local agencies engage in the planning required to accommodate autonomous vehicles**.

An autonomous shuttle bus is being tested at MnROAD to see how it handles Minnesota's winter weather.

Strengthening Infrastructure

Protecting Roadsides from Flooding — Multiple efforts are underway to protect and repair roadways from flood damage. **Design Considerations for Embankment Protection During Road Overtopping Events** (2017-21) describes a matrix of cost-effective erosion protection measures, such as flexible geogrid. The **Slope Stabilization Guide for Minnesota Local Government Engineers** (2017-17), sponsored by the Local Road Research Board (LRRB), provides simple, cost-effective methods for stabilizing slopes using locally available materials and equipment. Building on a **related study by the LRRB**, MnDOT has an **analysis** underway to identify, map and rank vulnerable slopes in targeted areas near state highways. For other efforts, see **mndot.gov/research/projects/slopes.html**.



This culvert inspection vehicle, invented by MnDOT staff, is featured in a new handbook on enhanced inspection methods. Photo courtesy of KAAL-TV.

Pothole Prevention and Repair — Investigators identified **pothole repair methods** that work for Minnesota's climate and created decision trees to help engineers choose the right method for each situation (2017-25). MnDOT is also **investigating** innovative pothole repair techniques and evaluating **pavement preservation activities** to prevent potholes from forming.

*One of **the most exciting recent advances** in pothole repair was the evaluation of taconite-based pothole patching methods that use a truck-mounted microwave unit to heat pavement and the new patching material.*

Quality Control — Improved density monitoring during asphalt paving could significantly reduce premature pavement failures, saving millions annually. In 2018, MnDOT plans to require **intelligent compaction** on all significant asphalt projects. A vehicle-mounted mobile imaging device is being piloted to collect necessary supportive roadway alignment data without the need for survey crews. **This current initiative** is part of MnDOT's long-running research effort into intelligent compaction.

Extending Culvert Life — To see into small culverts without expensive equipment, MnDOT District 6 developed an inexpensive, remote-controlled **Hydraulic Inspection Vehicle Explorer** (HIVE), which takes lights and a camera into the culvert and transmits data wirelessly to a tablet. This effort received the **2016 Governor's Better Government Award** and was recognized by AASHTO as one of the top state transportation research projects in the country. The HIVE is just one of the advanced inspection technologies covered in MnDOT's new **Enhanced Culvert Inspections—Best Practices Guidebook**. The guide helps identify when conventional methods work best and when enhanced technologies may offer value (2017-16).

LEVERAGING OUR RESEARCH DOLLARS

National Partnerships

$ For every $1 invested in a pooled fund study with other states, MnDOT gains another $3 worth of research.

The Transportation Pooled Fund (TPF) Program allows federal, state and local agencies and other organizations to combine resources to support research into shared transportation priorities.

Minnesota leads six pooled fund studies and participates in another 21. Find a summary of all pooled fund activity at **mndot.gov/research/pooled.html**.

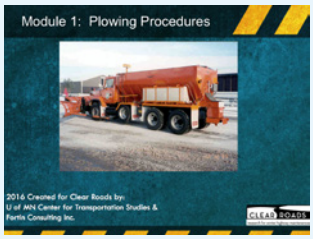
Three of our largest studies are:

Clear Roads — The Clear Roads research program brings together transportation professionals and researchers from around the country to drive innovation in winter maintenance. By evaluating materials, equipment and methods in real-world conditions, the program identifies the most effective techniques and technologies to save agencies money, improve safety and increase efficiency. **clearroads.org**

National Road Research Alliance — MnDOT created the National Road Research Alliance (NRRA) to help fund and direct research at the MnROAD cold-weather pavement test track. NRRA finds ways to build roads faster, with lower construction and maintenance costs, longer service lives, better performance and less impact on the environment. **mndot.gov/mnroad/nrra**

North/West Passage — Minnesota initiated this pooled fund to investigate intelligent transportation systems solutions to traffic management, traveler information and commercial vehicle operations on Interstates 90 and 94 between Washington state and Minnesota. **nwpassage.info**

NEW — Clear Roads Report 12-04, Training for Winter Maintenance Supervisors and Operators, developed a comprehensive training program for snowplow operators and supervisors. The program has 22 modules that cover equipment, materials, techniques and procedures.



How to Participate in National Research Projects

Pooled Funds — If your research idea addresses an issue that affects multiple states, we can help establish a **TPF project** to leverage resources and collaborate with other state DOTs to solve a problem. Find guidance at **mndot.gov/research/pooled.html**.

Track National Trends

Get the latest research news in your subject area from across the country by searching the national database (**trid.trb.org**), watching webinars (**webinar.mytrb.org**) or getting regular alerts via a **trb.org** RSS feed.

NCHRP Research — If you are trying to solve a problem of regional or national significance, we can help you develop a problem statement through the National Cooperative Highway Research Program (NCHRP). Contact us at **research.dot@state.mn.us**.

Each research topic area includes two tables:

- Research reports completed in FY2017, followed by other research contracts active during FY2017, sorted by contract end date.
- Multi-state pooled funds and American Association of State Highway and Transportation Officials (AASHTO) projects, with MnDOT-led pooled funds listed first.

Prefixes in project titles indicate funding for projects not supported entirely by the MnDOT State Research Program:

- **INV** – Partial or full Local Road Research Board funded
- **MPR/MP** – 80% federally funded/20% state funded
- **TPF** – MnDOT-administered pooled fund (100% federal funds)

For more information about projects, including two-page Technical Summaries for completed reports, search by the title on the "Projects" tab at **mndot.gov/research**. For more information about pooled funds, search at **pooledfund.org**.

BRIDGES & STRUCTURES

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2016-22	MPR-4(036): MnDOT Fracture-Critical System Analysis for Steel Bridges	Barritt Lovelace, Collins Engineers, Inc.	Jennifer Wells	1/31/17	$99,999
2016-32	Investigation of Shear Distribution Factors in Prestressed Concrete Girder Bridges	Cathy French, University of Minnesota	Yihong Gao	9/26/16	$363,000
2017-01	Feasibility of Vibration-Based Long-Term Bridge Monitoring Using the I-35W St. Anthony Falls Bridge	Lauren Linderman, University of Minnesota	Benjamin Jilk	1/31/17	$30,000
2017-04	Considerations for Development of Inspection and Remedial Grouting Contracts for Post-Tensioned Bridges	Mark Chauvin, Wiss, Janney, Elstner Associates, Inc.	Dustin Thomas	1/31/17	$134,807
2017-16	MPR-5(010): Enhanced Culvert Inspections Best Practices Guidebook	Steven Wolsfeld, CDM Smith	Andrea Hendrickson	7/31/17	$118,470
2017-18	MPR-5(015): Unmanned Aircraft System Bridge Inspection Demonstration Project—Phase II	Barritt Lovelace, Collins Engineers, Inc.	Jennifer Wells	10/31/17	$95,898
2017-33	Phased Array Ultrasonic Steel Corrosion Mapping for Bridges and Ancillary Structures	Barritt Lovelace, Collins Engineers, Inc.	Kenneth Rand	6/30/17	$24,784
2017-40	Multi-Beam Sonar Infrastructure Mapping Research	Barritt Lovelace, Collins Engineers, Inc.	Petronella DeWall	9/30/17	$29,993
2017-48	MP-16(003): Prestressed Concrete Beam Shear Rating	Jamison Beisswenger, SRF Consulting Group, Inc.	Yihong Gao	11/30/17	$96,364
TRS 1212	MPR-1(009): TRS: Ultra-Thin Polymer Concrete Overlays for Bridge Decks	Farhad Reza, Minnesota State University, Mankato	Edward Lutgen	7/31/16	$9,930
TRS 1702	INV 1021: TRS: Local Bridge Removal Policies and Programs	Patrick Casey, CTC & Associates LLC	Kelvin Howieson	5/31/17	$10,002

cont. ➡

BRIDGES & STRUCTURES [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	INV 976: Development and Integration of Advanced Timber Bridge Inspection Techniques for NBIS—Purchase Equipment and Train Users	Victor Krause, University of Minnesota Duluth	David Conkel, Peter Wilson	2/28/18	$42,794
	Bridge Construction Time and Costs	Ross Jentink, WSB & Associates, Inc.	Paul Johns	5/31/18	$95,141
	Prestressed Beam End Repair Testing: BR27568 Experimental Shear Capacity Comparison Between Repaired and Unrepaired Girder Ends	Carol Shield, University of Minnesota	Paul Pilarski	5/31/18	$65,090
	Retightening the Large Anchor Bolts of Support Structures for Signs and Luminaires	An Chen, Iowa State University	Jihshya Lin	8/31/18	$145,238
	A Rational Method of Surface Treatment Selection for Concrete Bridge Deck Thin Polymer Overlays	Kevin MacDonald, Beton Consulting	Paul Pilarski, Nathan Schutte	8/31/18	$94,523
	MP-16(008): Improving Quality of Bridge Inspections Using Unmanned Aircraft Systems (UAS)	Barritt Lovelace, Collins Engineers, Inc.	Jennifer Wells	9/30/18	$99,980
	Bridge Maintenance Painting Guidance, Training and Test Site	Jeff Johnson, Short Elliott Hendrickson, Inc.	Sarah Sondag	10/31/18	$94,738
	Displacement Monitoring of I-35W Bridge with Current Vibration-Based System	Lauren Linderman, University of Minnesota	Benjamin Jilk	2/28/19	$141,114
	MP-17(004): Understanding and Mitigating the Dynamic Behavior of RICWS and DMS Under Wind Loading	Lauren Linderman, University of Minnesota	Jihshya Lin	3/31/19	$173,271
	INV 983: Cost-Competitive Timber Bridge Designs for Long-Term Performance	Don Fosnacht, University of Minnesota Duluth	David Conkel	6/30/19	$212,883
	INV 1009: Field Investigation of Bridge Deck Reinforced with GFRP Rebar	Behrouz Shafei, Iowa State University	Paul Rowekamp	8/31/19	$88,000

Bridges & Structures Pooled Fund Studies and AASHTO Projects

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(283)	The Influence of Vehicular Live Loads on Bridge Performance	Yihong Gao	FHWA	7	$1,265,000	$50,000	$250,000	2017
TPF-5(328)	Strain-Based Fatigue Crack Monitoring of Steel Bridges Using Wireless Elastomeric Skin Sensors	Joseph Fishbein	KS	6	$465,000	$25,000	$75,000	2017
TPF-5(336)	Construction of Low-Cracking, High-Performance Bridge Decks Incorporating New Technology	Paul Rowekamp	KS	2	$270,000	$45,000	$135,000	2018

cont. ➡

ENVIRONMENTAL

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2017-17, 2017-17G	INV 979: Slope Stabilization Guide for Minnesota Local Government Engineers	David Saftner, University of Minnesota Duluth	Blake Nelson	8/31/17	$78,124
2017-32	MPR-5(003): Tailgate Test Kit for Determining Appropriate Sediment Reducing Chemicals and Dose Rates	Joel Toso, Wenck Associates, Inc.	Dwayne Stenlund	7/31/17	$53,313
2017-44	MPR-4(035): Culvert Length and Interior Lighting Impacts to Topeka Shiner Passage	Jessica Kozarek, University of Minnesota	Scott Morgan	11/30/17	$154,854
	INV 965: Study of Deicing Salt Accumulation and Transport Through a Watershed	William Herb, University of Minnesota	Wayne Sandberg	12/31/17	$164,043
	INV 1003: NPDES Stormwater Post-Construction Design Guidebook	Randy Neprash, Stantec Consulting, Inc.	Michael Flaagan	1/31/18	$89,745
	Use of Mussel Spat Rope for Fish Passage	Jessica Kozarek, University of Minnesota	Petronella DeWall	3/31/18	$135,625
	Sediment Control Log (SCL) Performance, Design and Decision Matrix for Field Applications	Bruce Wilson, University of Minnesota	Dwayne Stenlund	7/31/18	$101,814
	INV 1006: Regional Optimization of Roadside Turfgrass Seed Mixtures	Eric Watkins, University of Minnesota	Dwayne Stenlund	8/31/18	$142,346
	INV 1007, MP-16(005): Minnesota Culvert Manual to Accommodate Aquatic Species Passage	Jeff Marr, University of Minnesota	Petronella DeWall	12/31/18	$164,353
	Assessment of Field Infiltration Performance of Swales in Comparison to Minnesota Swales Calculator Estimates	Joel Toso, Wenck Associates, Inc.	Nicklas Tiedeken	2/28/19	$99,897
	Concrete Grinding Residue: Its Effect on Roadside Vegetation and Soil Properties	Halil Ceylan, Iowa State University	David Hanson	4/30/19	$154,996
	INV 984: Expanding the Success of Salt-Tolerant Roadside Turfgrasses Through Innovation and Education	Sam Bauer, University of Minnesota	Dwayne Stenlund	6/30/19	$168,974
	INV 1017: Iron-Enhanced Swale Ditch Checks for Phosphorus Removal	John Gulliver, University of Minnesota	Barbara Loida	8/31/19	$200,036
	INV 1016: Permeable Pavement for Road Salt Reduction	John Gulliver, University of Minnesota	Richard McCoy	8/31/19	$197,835
	Monitoring and Habitat Assessment of Declining Bumble Bees in Twin Cities Metro Roadsides	Daniel Cariveau, University of Minnesota	Christopher Smith	8/31/19	$111,264
	TPF-5(346): Regional Roadside Turfgrass Performance Testing Program	Eric Watkins, University of Minnesota	Dwayne Stenlund	10/31/19	$200,000
	MPR-5(006): Monitoring Iron-Enhanced Stormwater Infiltration Basin in the Real World	Omid Mohseni, Barr Engineering Company	Barbara Loida	8/31/20	$65,001

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Environmental Pooled Fund Studies

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(346)	Regional Roadside Turfgrass Performance Testing Program	Dwayne Stenlund	MN	5	$240,000	$20,000	$40,000	2017
TPF-5(356)	Structural Design Methodology for Spray-Applied Liners in Gravity Stormwater Conveyance Conduits	Paul Rowekamp	OH	6	$450,000	$25,000	$75,000	2019
TPF-5(358)	Wildlife Vehicle Collision Reduction and Habitat Connectivity	Christopher Smith	NV	10	$905,000	$20,000	$20,000	2019

MAINTENANCE OPERATIONS

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2016-20	INV 974: Evaluation of Bio-Fog Sealants for Pavement Preservation	Mihai Marasteanu, University of Minnesota	Eddie Johnson	8/31/16	$93,969
2017-11	An Innovative Approach to Smarter Mowing: Utilizing Automated Vehicle Location to Enhance Mowing Operations	Adrian Potter, SRF Consulting Group, Inc.	Trisha Stefanski	6/30/17	$17,320
2017-25	MPR-4(023): Comprehensive Field Evaluation of Asphalt Patching Methods and Development of Simple Decision Trees and a Best Practices Manual	Manik Barman, University of Minnesota Duluth	Susan Lodahl, Perry Collins	8/31/17	$87,106
2017-31	INV 952: Best Management Practices for Establishment of Salt-Tolerant Grasses on Roadsides	Eric Watkins, University of Minnesota	Dwayne Stenlund	9/30/17	$193,677
2017-41	MPR-5(005): Installing Snowplow Cameras and Integrating Images into MnDOT's Traveler Information System	Patrick Casey, CTC & Associates LLC	Joseph Huneke	10/31/17	$28,888
2017-42	MPR-5(008): Expanding the Adoption on Private Lands: Blowing and Drifting Snow Control Treatments and the Cost-Effectiveness of Permanent Versus Nonpermanent Treatment Options	Dean Current, University of Minnesota	Daniel Gullickson	10/31/17	$99,988
2017-45	Salt Brine Blending to Optimize Deicing and Anti-Icing Performance and Cost-Effectiveness—Phase III	Stephen Druschel, Minnesota State University, Mankato	Thomas Peters	12/31/17	$168,700
2017RIC01	INV 645: Fleet Management Systems for All Sizes of Local Agencies	Mike Marti, SRF Consulting Group, Inc.	Guy Kohlnhofer	7/31/19	$26,437
TRS 1605	MP-16(002): TRS: Asset Management Building Services Comparative Scoping Methodology	Patrick Casey, CTC & Associates LLC	Christopher Moates	2/28/17	$8,286
TRS 1706	INV 1018: TRS: Field Usage of Alternative Deicers for Snow and Ice Control	Laura Fay, Montana State University, Western Transportation Institute	Ryan Peterson	11/30/17	$30,016
	TPF-5(218): Clear Roads: Synthesis on GPS/AVL Equipment Used for Winter Maintenance	George Stuempfig, SRF Consulting Group, Inc.	Thomas Peters	9/30/16	$59,376
	TPF-5(218): Clear Roads: Plug-and-Play Initiative—Phase II: Developing Recommendations Regarding Transmission Methods and Protocols for the Transmission of Data for Winter Operations	Erik Minge, SRF Consulting Group, Inc.	Thomas Peters	1/31/17	$81,690

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MAINTENANCE OPERATIONS [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	TPF-5(218): Identifying Best Practices for Snowplow Route Optimization RFP	Jonathan Dowds, University of Vermont	Thomas Peters	1/31/17	$68,305
	TPF-5(218): Clear Roads: North American Study on Contracting Snow and Ice Response	Laura Fay, Montana State University, Western Transportation Institute	Thomas Peters	2/28/17	$74,983
	TPF-5(218): Training for Supervisors and Operators	Jim Grothaus, University of Minnesota–CTS	Thomas Peters	4/30/17	$123,857
	MPR-5(005): Collection and Display of Images from MnDOT Snowplows—Phase II: CARS-snoPIC	Peter Davies, Castle Rock Consultants, Inc.	Joseph Huneke	6/30/17	$100,000
	TPF-5(218): Clear Roads: Snow Removal Performance Metrics	Xianming Shi, Washington State University	Thomas Peters	6/30/17	$74,640
	TPF-5(218): Clear Roads: Quantifying the Impact That New Capital Projects Will Have on Roadway Snow and Ice Control (RSIC) Operations RFP	James Sullivan, University of Vermont	Thomas Peters	11/30/17	$145,622
	TPF-5(218): Clear Roads: Identification and Recommendations for Correction of Equipment Factors Causing Fatigue in Snowplow Operators RFP	Frank Fitzgerald, Virginia Polytechnic Institute and State University	Thomas Peters	12/31/17	$200,000
	MPR-5(007): Development of a Road Condition Recovery Time Estimation System for Winter Snow Events	Eil Kwon, University of Minnesota Duluth	John Bieniek	12/31/17	$106,500
	TPF-5(218): Clear Roads: Develop a Training Video and Manual for Best Practices and Techniques in Clearing Different Interchange Configurations and Other Geometric Layouts RFP	Yan Qi, Southern Illinois University Edwardsville	Thomas Peters	12/31/17	$99,994
	TPF-5(218): Understanding the Chemical and Mechanical Performance of Snow and Ice Control Agents on Porous Permeable Pavements	Michelle Akin, Montana State University, Western Transportation Institute	Thomas Peters	1/27/18	$185,000
	INV 980: Pothole Prevention and Innovative Repair	Mihai Marasteanu, University of Minnesota	Todd Howard	5/31/18	$129,914
	TPF-5(218): Clear Roads: Synthesis of Material Application Methodologies for Winter Operations RFP	Xianming Shi, Washington State University	Thomas Peters	5/31/18	$117,658
	INV 998: Operational Research Program for Local Transportation Groups (OPERA) (FY2017-2018)	Jim Grothaus, University of Minnesota–CTS	Mitchell Rasmussen	6/30/18	$160,000
	TPF-5(218): Clear Roads: Training Video for the Implementation of Liquid-Only Plow Routes	Chad Seaman, Stonebrooke Engineering, Inc.	Thomas Peters	6/30/18	$71,161
	TPF-5(218): Clear Roads: Emergency Operations Methodology for Extreme Winter Storm Events	James Sullivan, University of Vermont	Thomas Peters	6/30/18	$59,030
	INV 974: Bio-Fog Seal Field Evaluation	Eddie Johnson, MnDOT Office of Materials and Road Research	Bruce Hasbargen	6/30/18	$20,000
	TPF-5(218): Clear Roads: Administration and Information Services	Patrick Casey, CTC & Associates LLC	Thomas Peters	7/7/18	$743,730
	TPF-5(218): Clear Roads: Utilization of AVL/GPS Technology: Case Studies	Ming Shiun Lee, AECOM Technical Services, Inc.	Thomas Peters	7/31/18	$113,698

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MAINTENANCE OPERATIONS [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	TPF-5(218): Clear Roads: Weather Event Reconstruction and Analysis Tool	Chris Albrecht, The Narwhal Group	Thomas Peters	1/31/19	$57,549
	INV 1015: Optimized Taconite-Based Pavement Repair Compound and Deployment System	Lawrence Zanko, University of Minnesota Duluth	Perry Collins	2/28/19	$100,000
	TPF-5(218): Clear Roads: Standards and Guidance for Using Mobile Sensor Technology to Assess Winter Road Conditions	Erik Minge, SRF Consulting Group, Inc.	Thomas Peters	4/30/19	$152,379
	Investigating Wastewater Reuse at Safety Rest Areas and Truck Stations	Sara Heger, University of Minnesota	Neile Reider	8/31/19	$150,301
	INV 1034: Adaptive Management to Improve Deicing Operations	Larry Baker, University of Minnesota	Ross Bintner	7/31/20	$204,000

Maintenance Operations Pooled Fund Studies and AASHTO Projects

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(353)	Clear Roads	Thomas Peters	MN	36	$2,400,000	$25,000	$325,000	2018
TPF-5(035)	Pacific Northwest Snowfighters	Susan Lodahl	WA	10	$325,000	$0	$60,000	2016
TPF-5(290)	Aurora Program	Joseph Huneke	IA	17	$1,700,000	$25,000	$500,000	2017
TPF-5(347)	Development of Maintenance Decision Support System	Joseph Huneke	SD	13	$7,165,414	$25,000	$327,500	2017
MP-16(009)	AASHTO Winter Maintenance Technical Services Program: Snow and Ice Cooperative (SICOP)	Steve Lund	AASHTO	1	N/A	$4,000	$4,000	2017
MP-16(010)	AASHTO Equipment Management Technical Services Program (EMTSP)	Steve Lund	AASHTO	1	N/A	$3,000	$3,000	2017

MATERIALS & CONSTRUCTION

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2016-26	MPR-4(002): Development of a MnDOT Foundation Boring Mobile Application Gateway, GeoApp	Allan Hart, Minnesota State University, Mankato	Derrick Dasenbrock	9/30/16	$35,000
2016-29	INV 968: Modernizing Road Construction Plans and Documentation	Jennifer Shane, Iowa State University	Lyndon Robjent	10/31/16	$146,022
2016-30	MPR-4(034): Portland Cement Concrete Pavement Thickness Variation Versus Observed Pavement Distress	Lev Khazanovich, University of Minnesota	Thomas Burnham	10/31/16	$110,000
2016-37	INV 967: Full-Depth Reclamation (FDR) for Suburban/Urban and Local Roads Application	Mihai Marasteanu, University of Minnesota	Mark Maloney	2/28/17	$93,969

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MATERIALS & CONSTRUCTION [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2017-21	INV 935: Design Considerations for Embankment Protection During Road Overtopping Events	Jeff Marr, University of Minnesota	John Anderson	8/31/17	$194,787
2017-24	MPR-5(004): MnDOT Thin Whitetopping Selection Procedures	Peter Taylor, Iowa State University	Timothy Andersen	8/31/17	$60,000
2017-27	MPR-4(011): Impact of Low Asphalt Binder for Coarse HMA Mixes	Eshan Dave, University of Minnesota Duluth	Gerard Geib	7/31/17	$89,910
2017-35	INV 975: Prevention of Stripping Under Chip Seals	Dave Rettner, American Engineering Testing, Inc.	Klayton Eckles	10/31/17	$18,942
2017RIC02	INV 645 Task 2: Base Stabilization Additives for Pavement Design	Daniel Wegman, Braun Intertec Corporation, and Renae Kuehl, SRF Consulting Group, Inc.	Ben Worel	7/31/19	$29,476
TRS 1604	INV 1001: TRS: Recycled Materials in Unbound Aggregate Base Layers in Minnesota	W. James Wilde, Minnesota State University, Mankato	Joel Ulring	10/31/16	$14,418
	TPF-5(269): Development of an Improved Design Procedure for Unbonded Concrete Overlays	Lev Khazanovich, University of Minnesota	Thomas Burnham	5/31/17	$345,471
	MPR-2(013): Veda Enhancements	George Chang, Transtec Group, Inc.	Rebecca Embacher	7/31/17	$150,924
	MnPAVE—Rigid 2.0	Lev Khazanovich, University of Minnesota	Timothy Andersen	8/31/17	$78,000
	INV 989: Slope Failure Risk Analysis	Omid Mohseni, Barr Engineering Company	Paul Stine	11/30/17	$85,000
	Disk-Shaped Compact Tension (DCT) Specifications Development for Asphalt Pavement	Andrea Schokker, University of Minnesota Duluth	Shongtao Dai	12/31/17	$172,728
	INV 885: Research Test Section Tracking—Phase II	David Van Deusen, MnDOT Office of Materials and Road Research	Luane Tasa	12/31/17	$55,000
	Designing Base and Subbase to Resist Environmental Effects on Pavements	Matthew Oman, Braun Intertec Corporation	Steven Henrichs	1/31/18	$66,504
	Comparing Properties of Water Absorbing/Filtering Media for Bioslope/Bioswale Design	Kurt Johnson, University of Minnesota Duluth	Dwayne Stenlund	2/28/18	$178,051
	TPF-5(334): Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation—Phase I	George Chang, Transtec Group, Inc.	Rebecca Embacher	2/28/18	$170,004
	A Mechanistic Design Approach for Graphite Nanoplatelet (GNP) Reinforced Asphalt Mixtures for Low-Temperature Applications	Jialiang Le, University of Minnesota	Shongtao Dai	2/28/18	$125,963
	Geogrid Specification for Aggregate Base Reinforcement	David Potyondy, Itasca Consulting Group, Inc.	John Siekmeier	2/28/18	$74,946
	INV 985: Life-Cycle Cost Analysis Tool for Minnesota Pavements	Derek Tompkins, University of Minnesota	John Brunkhorst	2/28/18	$54,682
	INV 981: Evaluation of Stabilized Full-Depth Reclamation (SFDR)	Charles Jahren, Iowa State University	Guy Kohlnhofer	4/30/18	$126,991

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MATERIALS & CONSTRUCTION [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	Research on Composite Pile Behavior and Development of a Rock Strength Database	Joseph Labuz, University of Minnesota	Derrick Dasenbrock	6/30/18	$198,000
	Balanced Design of Asphalt Mixtures	Dave Newcomb, Texas A&M Transportation Institute	David Van Deusen	6/30/18	$140,000
	MnPAVE—Rigid 2.0	Derek Tompkins, American Engineering Testing, Inc.	Timothy Andersen	7/31/18	$24,000
	INV 1013, MP-16(007): Comparison of Performances of Structural Fibers and Development of a Specification for Using Structural Fibers in Thin Concrete Overlays	Manik Barman, University of Minnesota Duluth	Maria Masten	8/31/18	$153,792
	Investigation of Cracking Resistance of Asphalt Mixtures and Binders	Mihai Marasteanu, University of Minnesota	David Van Deusen	8/31/18	$149,762
	INV 971: Optimal RAP Content for Minnesota Gravel Roads	Charles Jahren, Iowa State University	Joel Ulring	8/31/18	$92,538
	MP-17(002): Remaining Service Life Asset Measure—Phase I	Mihai Marasteanu, University of Minnesota	Glenn Engstrom	8/31/18	$61,379
	Geogrid Specification for Aggregate Base Reinforcement	John Siekmeier, MnDOT Office of Materials and Road Research	Bruce Tanquist	9/30/18	$40,000
	Cone Penetration Testing (CPT) Design Manual for State Geotechnical Engineers	David Saftner, University of Minnesota Duluth	Derrick Dasenbrock	12/31/18	$100,000
	INV 1023: Experimental and Computational Investigations of High-Density Asphalt Mixtures	Mihai Marasteanu, University of Minnesota	Eddie Johnson	8/31/19	$150,935
	INV 986: Performance Monitoring of Olmsted CR 117/104 and Aggregate Base Material Update	Kyle Hoegh, MnDOT Office of Materials and Road Research	Kaye Bieniek	6/30/20	$44,000
	Cold In-Place Recycling (CIR) for Bituminous Over Concrete (BOC)	Dave Rettner, American Engineering Testing, Inc.	Terrence Beaudry	8/31/21	$39,995

Materials & Construction Pooled Fund Studies

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(334)	Enhancement to the Intelligent Construction Data Management System (Veta) and Implementation	Rebecca Embacher	MN	12	$651,000	$50,000	$100,000	2018
TPF-5(341)	National Road Research Alliance (NRRA)	Benjamin Worel	MN	6	$2,550,000	$150,000	$450,000	2018
TPF-5(267)	Accelerated Performance Testing for the NCAT Pavement Test Track	Benjamin Worel	AL	20	$28,909,706	$330,000	$990,000	2017
TPF-5(297)	Improving Solicitations to Resist Frost Damage in Modern Concrete Mixtures	Maria Masten	OK	19	$1,202,500	$17,500	$87,500	2018
TPF-5(313)	Technology Transfer Concrete Consortium (TCCC)	Maria Masten	IA	33	$1,504,000	$12,000	$52,000	2019

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Materials & Construction Pooled Fund Studies [cont.]

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(352)	Recycled Materials Resource Center—Fourth Generation	Brian Kamnikar	WI	7	$1,055,000	$40,000	$200,000	2020

MULTIMODAL

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2016-36	Assessing the Economic Impact and Health Effects of Bicycling in Minnesota	Xinyi Qian, University of Minnesota	Sara Dunlap	2/28/17	$132,285
2017-02, 2017-03	MPR-4(038): The Minnesota Bicycle and Pedestrian Counting Initiative: Institutionalizing Bicycle and Pedestrian Monitoring	Greg Lindsey, University of Minnesota	Amber Dallman	1/31/17	$120,000
2017-23	INV 964: Traffic Impacts of Bicycle Facilities	Greg Lindsey, University of Minnesota	James Rosenow	7/31/17	$138,914
2017-26	INV 645: Oversize/Overweight Vehicle Unified Permitting Process—Phase I	Mike Marti, SRF Consulting Group, Inc.	Rich Sanders	8/31/17	$50,176
2017-29	Exploring the Walking Tolerance of Transitway Users	Jason Cao, University of Minnesota	Gina Mitteco	9/30/17	$93,124
TRS 1704	TRS: Online Systems for Oversize and Overweight Freight Permitting and Motor Carrier Credentialing	Patrick Casey, CTC & Associates LLC	Shelly Meyer	11/30/17	$14,450
	INV 645: HCV Unified Permitting Process—Phase II	Annette Theroux, Pro-West & Associates, Inc.	Rich Sanders	8/31/17	$17,548
	Measuring Truck Delay and Reliability at Corridor Level	Chen-Fu Liao, University of Minnesota	Andrew Andrusko	8/31/18	$87,760
	TPF-5(315): National Accessibility Lab Pool Fund Project	Andrew Owen, University of Minnesota	Deanna Belden	11/30/18	$1,198,500
	Understanding Pedestrian Travel Behavior and Safety in Rural Settings	Greg Lindsey, University of Minnesota	Michael Petesch	12/31/18	$150,000
	Accessibility and Behavior Impacts of Bus-Highway System Interactions	Andrew Owen, University of Minnesota	Jim Henricksen	2/28/19	$152,458
	After Study of the Bus Rapid Transit (BRT) A Line Impacts	Alireza Khani, University of Minnesota	Carl Jensen	2/28/19	$105,687
	MP-17(003): Evaluation of Sustained Enforcement, Education and Engineering Measures on Pedestrian Crossings	Nichole Morris, University of Minnesota	Melissa Barnes	8/31/19	$177,226

Multimodal Pooled Fund Studies

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(315)	National Accessibility Evaluation	Deanna Belden	MN	11	$1,690,000	$40,000	$200,000	2019
TPF-5(293)	Mid-America Freight Coalition	Andrew Andrusko	WI	10	$2,500,000	$50,000	$275,000	2017

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POLICY & PLANNING

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2016-28	INV 969: Barriers to Right of Way Acquisition and Recommendations for Change	H. David Jeong, Iowa State University	Patrick Lambert	8/31/16	$133,895
2016-34A, 2016-34B	INV 922: Systems Preservation Guide: A Planning Process for Local Government Management of Transportation Networks—Interactive Presentation	Lance Bernard, SRF Consulting Group, Inc.	Susan Miller	7/31/16	$708,172
2016-35	Mobility Mindset of Millennials in Small Urban and Rural Areas	Natalie Villwock-Witte, Montana State University, Western Transportation Institute	Jeanne Aamodt	11/30/16	$20,000
2017-34	Enhanced Capabilities of BullReporter and BullConverter	Taek Kwon, University of Minnesota Duluth	Benjamin Timerson	2/28/18	$42,351
2017-37	Refining Return on Investment Methodology/Tool for MnPASS	Laura Fay, Montana State University, Western Transportation Institute	Bradley Larsen, John Wilson	8/31/17	$147,675
2017-39	INV 963: Stakeholder Attitudes, Knowledge and Engagement in Local Road Systems Planning and Decision Making	Guillermo Narvaez, University of Minnesota	Bruce Hasbargen	9/30/17	$139,793
TRS 1603	INV 1002: TRS: Consolidated Asset Management for Minnesota Local Agencies	Patrick Casey, CTC & Associates LLC	Lyndon Robjent	7/31/16	$9,840
TRS 1701	TRS: Managing Unspent Federal Metropolitan Planning Funds	Patrick Casey, CTC & Associates LLC	Roberta Retzlaff	5/31/17	$7,573
TRS 1705	TRS: Internal Communication Practices of State Transportation Agencies	Tina Roelofs, Athey Creek Consultants, LLC	Richard Kemp	6/30/17	$14,511
TRS 1708	TRS: Cost Participation Policy for Detours	Patrick Casey, CTC & Associates LLC	Timothy Andersen	12/31/17	$9,984
	One-Year Pilot Test and Evaluation of ASTM DOT Package Compass Portal	Dean Deeter, Athey Creek Consultants, LLC	Marilee Tuite	1/31/18	$21,883
	Evaluation of Low-Cost, Centimeter-Level Accuracy OEM GNSS Receivers	Demoz Gebre-Egziabher, University of Minnesota	Nathan Anderson	2/28/18	$90,000
	Weigh-in-Motion Sensor and Controller Operation and Performance Comparison	Diwakar Gupta, University of Minnesota	Benjamin Timerson	2/28/18	$80,000
	INV 1014: Transportation Investment and Job Creation in Minnesota Counties	Zhirong Jerry Zhao, University of Minnesota	Bruce Hasbargen	3/31/18	$110,350
	INV 1008: Effective Social Media Engagement Options for Minnesota's Diversifying Population	Ingrid Schneider, University of Minnesota	Renee Raduenz	4/30/18	$163,783
	INV 1020: LRRB Strategic Plan Update	Donald Ludlow, CPCS Transcom, Inc.	Lyndon Robjent	9/30/18	$62,734
	INV 965: Training Workshop: Americans with Disability Act (ADA) for Local Agencies	Mike Marti, SRF Consulting Group, Inc.	Ted Schoenecker	7/31/19	$36,289

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Policy & Planning Pooled Fund Studies

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(198)	Urban Mobility Study	Paul Czech	TX	15	$3,485,000	$25,000	$280,000	2017
TPF-5(326)	Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs	Deanna Belden	RI	24	$540,000	$10,000	$30,000	2018

TRAFFIC & SAFETY

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2014-44, 2017-09	Development of a Moving Automatic Flagger Assistance Device (AFAD) for Moving Work Zone Operations	Edward Terhaar, Wenck Associates, Inc.	Thomas Dumont	5/31/17	$84,753
2016-18	INV 973: Risk Evaluation for In-Vehicle Sign Information	Nichole Morris, University of Minnesota	Victor Lund	7/31/16	$29,365
2016-19	INV 977: Innovative Technology Workshop on 3-D Lidar	Brian Davis, University of Minnesota	Kaye Bieniek	8/31/16	$92,140
2016-23	MPR-4(037): Sinusoidal Rumble Strip Design Optimization Study	Edward Terhaar, Wenck Associates, Inc.	Kenneth Johnson	9/30/16	$97,775
2016-25	Railroad Grade Crossing Safety Project Selection	Howard Preston, CH2M Hill, Inc.	Maureen Jensen	7/31/16	$99,224
2016-27	MPR-4(029): Visual Warning System for Worker Safety on Roadside Work Zones	Imran Hayee, University of Minnesota Duluth	Robert Vasek	8/31/16	$129,431
2016-31	MPR-1(010): Robotic Roadway Message and Symbol Painter Implementation	Ryan Rosandich, University of Minnesota Duluth	Jeremy Gjovik	12/31/16	$6,500
2016-38	Investigating the Effectiveness of Using Bluetooth Low-Energy Technology to Trigger In-Vehicle Messages in Work Zones	Chen-Fu Liao, University of Minnesota	Kenneth Johnson	2/28/17	$99,650
2017-05	MPR-4(022): Sensing for HOV/HOT Lanes Enforcement	Nikos Papanikolopoulos, University of Minnesota	Brian Kary	2/28/17	$97,200
2017-07	INV 948, MPR-4(017): Flagger Operations: Investigating Their Effectiveness in Capturing Driver Attention	Kathleen Harder, University of Minnesota	Robert Vasek	2/28/17	$270,351
2017-08	MPR-4(033): Estimation of Crossing Conflict at Signalized Intersection Using High-Resolution Traffic Data	Gary Davis, University of Minnesota	Steven Misgen	3/31/17	$150,000
2017-10	MPR-4(032): Framework and Guidelines for the Development of a Twin Cities Mesoscopic DTA Model	John Hourdos, University of Minnesota	Jim Henricksen	5/31/17	$110,318
2017-14	INV 1010: Strategies for Effective Roundabout Approach Speed Reduction	Susan Chrysler, Texas A&M Transportation Institute	Joe Gustafson	7/31/17	$74,989
2017-19	INV 978: In-Vehicle Work Zone Messages	Nichole Morris, University of Minnesota	Kenneth Johnson	8/31/17	$105,167
2017-20	Development of a Queue Warning System Utilizing ATM Infrastructure System Development and Field Testing	John Hourdos, University of Minnesota	Brian Kary	6/30/17	$300,000
2017-22	MPR-4(030): Safety Impacts of the I-35W Improvements Done Under Minnesota's Urban Partnership Agreement (UPA) Project	Gary Davis, University of Minnesota	Brian Kary	8/31/17	$105,000

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TRAFFIC & SAFETY [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2017-30	INV 962: Evaluation of Safety and Mobility of Two-Lane Roundabouts	John Hourdos, University of Minnesota	Joe Gustafson	8/31/17	$124,920
2017-38	MPR-4(031): Evaluation of Intersection Collision Warning Systems in Minnesota	Shauna Hallmark, Iowa State University	Cory Johnson, Michael Kronzer	6/30/18	$278,516
2017-43	INV 972: Minnesota Local Agency Pavement Marking: Mining Existing Data	Omar Smadi, Iowa State University	Kate Miner	10/31/17	$65,000
2017RIC05	Addressing Citizen Requests for Traffic Safety Concerns	Renae Kuehl, SRF Consulting Group, Inc.	Steven Bot	7/31/19	$25,157
TRS 1703	TRS: Use of Positive Protection in Work Zones	Patrick Casey, CTC & Associates LLC	Jeffrey Morey	6/30/17	$10,023
TRS 1707	TRS: Sign Life-Cycle Policies and Practices	Patrick Casey, CTC & Associates LLC	Josephine Tayse	12/31/17	$9,905
	TPF-5(190): North/West Passage Program Support and Technical Writing	Dean Deeter, Athey Creek Consultants, LLC	Cory Johnson	8/31/16	$99,890
	INV 943: Traffic Sign Life Expectancy	Kyle Hoegh, MnDOT Office of Materials and Road Research	Tim Plath	11/30/16	$37,935
	TPF-5(190): North/West Passage—Phase III	Mohammad Smadi, North Dakota State University	Cory Johnson	5/28/17	$19,707
	TPF-5(190), TPF-5(190) 98044, TPF-5(190) 00712, T: North/West Passage Project 10.4: Freight Task Force—Year 2	Donald Ludlow, CPCS Transcom, Inc.	Cory Johnson	7/31/17	$59,866
	TPF-5(190), TPF-5(190) 98044, TPF-5(190) 93139, T: North/West Passage—Phase III, Project 10.6: Multi-State Assessment of Interstate Speed Limit Impacts	Jason Bittner, Applied Research Associates, Inc.	Cory Johnson	7/31/17	$47,982
	TPF-5(190), TPF-5(190) 93139, TPF-5(190) 98044, T: Program Support Services and Technical Writing for the North/West Passage Pooled Fund Research Program—Work Plan 11	Dean Deeter, Athey Creek Consultants, LLC	Cory Johnson	8/31/17	$99,984
	INV 1012: Investigating the Necessity and Prioritizing Pavement Markings on Low-Volume Roads	David Veneziano, Iowa State University	Bruce Hasbargen	2/28/18	$71,475
	Rest Area Electronic Customer Feedback System	Robert Williams, MnDOT Office of Project Management and Technical Support	Mitchell Rasmussen	2/28/18	$33,072
	MPR-5(019): Using Mobile Device Samples to Estimate Traffic Volumes	Shawn Turner, Texas A&M Transportation Institute	Gene Hicks	3/31/18	$113,346
	MPR-5(009): Develop a Tool to Determine MnPASS Access Spacing	John Hourdos, University of Minnesota	Brian Kary	3/31/18	$80,000
	INV 1011, MP-16(006): Work Zone Intrusion Report Interface Design	Nichole Morris, University of Minnesota	Todd Haglin	4/30/18	$200,638
	INV 1005, MP-16(004): In-Vehicle Dynamic Curve Speed Warnings at High-Risk Rural Curves	Brian Davis, University of Minnesota	Bradley Estochen	4/30/18	$161,803

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TRAFFIC & SAFETY [cont.]

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	Minnesota Autonomous Bus Pilot	Kian Sabeti, WSB & Associates, Inc.	Michael Kronzer	6/30/18	$574,996
	Assessing the Impact of Pedestrian-Activated Crossing Systems	John Hourdos, University of Minnesota	Melissa Barnes	7/31/18	$153,962
	INV 924: Ineffective Specialty Signs Video for Local Agencies	Bryan Nemeth, Bolton & Menk, Inc. Consulting Engineers & Surveyors	Gary Reihl	8/31/18	$28,569
	INV 1004: Development and Demonstration of a Cost-Effective In-Vehicle Lane Departure and Advanced Curve Speed Warning System	Imran Hayee, University of Minnesota Duluth	Victor Lund	10/31/18	$124,704
	Development of a Travel Time Reliability Measurement System	Eil Kwon, University of Minnesota Duluth	Brian Kary	11/30/18	$176,000
	MPR-5(013): Evaluation of the Smart Work Zone Speed Notification System	John Hourdos, University of Minnesota	Brian Kary	1/31/19	$229,576
	INV 1030: Examining Optimal Sight Distances at Rural Intersections	Nichole Morris, University of Minnesota	Tracey Von Bargen	3/31/19	$170,549
	Improve Traffic Volume Estimates from Regional Transportation Management Center (RTMC)	Taek Kwon, University of Minnesota Duluth	Gene Hicks	8/31/19	$97,484

Traffic & Safety Pooled Fund Studies

Study Number	Title	Technical Liaison	Lead State or Agency	Number of Participating Agencies	Total Cost	MN 2017 Commitment	Total MN Commitment	Current MN Commitment End Date
TPF-5(190)	North/West Passage	Cory Johnson	MN	8	$1,250,000	$25,000	$400,000	2018
TPF-5(193)	Midwest States Pooled Fund Crash Test Program	Michael Elle	NE	22	$10,578,896	$66,000	$653,500	2018
TPF-5(316)	Traffic Control Devices (TCD) Consortium	Janelle Anderson	FHWA	27	$3,995,725	$15,000	$45,000	2017
TPF-5(319)	Transportation Management Center Pooled Fund Study	Brian Kary	FHWA	34	$9,072,267	$0	$450,000	2012
TPF-5(322)	High-Occupancy Vehicle (HOV)/ Managed Use Lane (MUL)	Brian Kary	FHWA	11	$280,000	$25,000	$75,000	2018
TPF-5(343)	Roadside Safety Research for MASH Implementation	Michael Elle	WA	21	$1,470,000	$50,000	$600,000	2017
TPF-5(359)	Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE)	Cory Johnson	MI	7	$5,115,000	$30,000	$420,000	2019

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ADMINISTRATIVE

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
2017-12	MPR-6(004): MnDOT Research Program Strategic Plan (2017-2022)	Vivek Sakhrani, CPCS Transcom, Inc.	Jean Wallace	7/31/17	$94,569
2017-36	MnDOT Library Strategic Plan Report	Kathleen Bedor, Law Library Consultants, Inc.	Sheila Hatchell	6/30/17	$76,750
	INV 916: FY2015 LRRB Technical Transfer Materials Development	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	8/31/16	$99,007
	MPR-3(001): Technical Summaries and Project Evaluation Forms	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	8/31/16	$97,185
	INV 927: LRRB Outreach Website	John Przybylski, HNTB Corporation	Shannon Fiecke	8/31/16	$64,355
	MPR-1(017): ARTS Technical Support and Maintenance Services	Ryan Anderson, Tech-Pro, Inc.	Hafiz Munir	5/3/17	$60,528
	Transportation LibGuides for MnDOT Library	Jason Bittner, Applied Research Associates, Inc.	James Byerly	6/30/17	$28,889
	MPR-5(011): FY2016 Technology Transfer Material Development: RS At-A-Glance and Accelerator Newsletter	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	7/31/17	$95,059
	Research Management Training and Materials	Patrick Casey, CTC & Associates LLC	Hafiz Munir	7/31/17	$70,480
	INV 645: LRRB Outreach and Marketing Support	Renae Kuehl, SRF Consulting Group, Inc.	Shannon Fiecke	7/31/17	$20,000
	INV 936: FY2016 and FY2017 LRRB Focus Groups	Jim Grothaus, University of Minnesota–CTS	Paul Oehme	7/31/17	$29,382
	INV999: FY2016 RSS Report Publication Services	Arlene Mathison, University of Minnesota–CTS	Shannon Fiecke	8/31/17	$73,035
	INV 924, State Aid: Professional Services for Careers in Civil Engineering Video	Renae Kuehl, SRF Consulting Group, Inc.	Mitchell Rasmussen	2/28/18	$82,912
	MP-16(001): ARTS Technical Support and Maintenance Services	Ryan Anderson, Tech-Pro, Inc.	Deborah Sinclair	5/9/18	$78,570
	MnDOT Research Services Drupal Website Development	Andrea Douglas, Nighthawk Marketing	Shannon Fiecke	6/11/18	$24,750
	MPR-16(012): Technical Transfer Material Development: Technical Summaries and Project Evaluation Forms (2017-2018)	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	7/31/18	$99,816
	Research Project Management and Implementation Support	Patrick Casey, CTC & Associates LLC	Hafiz Munir	7/31/18	$99,023
	INV 916: LRRB Technology Transfer Material Development (2017)	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	7/31/18	$98,942
	INV 927: LRRB Website Development and Hosting	Patrick Casey, CTC & Associates LLC	Shannon Fiecke	7/31/18	$39,419
	INV 645: LRRB Outreach and Marketing Support (2017-2018)	Renae Kuehl, SRF Consulting Group, Inc.	Shannon Fiecke	8/31/18	$83,812
	INV 999: FY2018-2019 Research Services & Library Report Publication Services	Arlene Mathison, University of Minnesota–CTS	Shannon Fiecke	6/30/19	$86,329

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DEDICATED PROGRAMS

Report Number	Title	Investigator	Technical Liaison	End Date	Total Cost
	FY2016-2017 CTS Operations	Laurie McGinnis, University of Minnesota–CTS	Linda Taylor	6/30/17	$3,266,696
	INV 668, 0001(217): FY2017 Local Technical Assistance Program (LTAP)	Jim Grothaus, University of Minnesota–CTS	Mitchell Rasmussen	6/30/17	$450,500
	MnDOT Research Librarian Services (2016-2017)	Arlene Mathison, University of Minnesota–CTS	Sheila Hatchell	6/30/18	$78,280

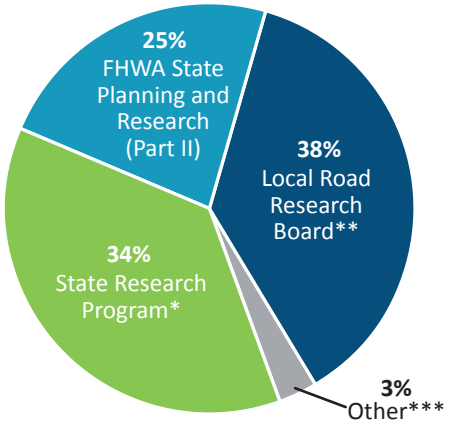
Federal Program Support

Study Number	Title	Technical Liaison	Total MN Commitment
TPF-5(277)	Transportation Research Board (TRB)	Linda Taylor	$131,331
TPF-5(417)	National Cooperative Highway Research Program (NCHRP)	Linda Taylor	$725,962

FY2017 FINANCIAL ACTIVITY

MnDOT research is funded through the MnDOT State Research Program (SRP) and Federal Highway Administration (FHWA) State Planning and Research (SP&R) Program (Part II). MnDOT Research Services & Library also manages research for the Local Road Research Board (LRRB), which was created to facilitate transportation research and information sharing among Minnesota city and county engineers.

FY2017 Research Funds by Funding Source



State Research Program*	$ 5,284,401
FHWA State Planning and Research (Part II)	$ 3,299,830
Local Road Research Board**	$ 5,314,729
Other***	$ 368,413
Total	**$ 14,267,373**

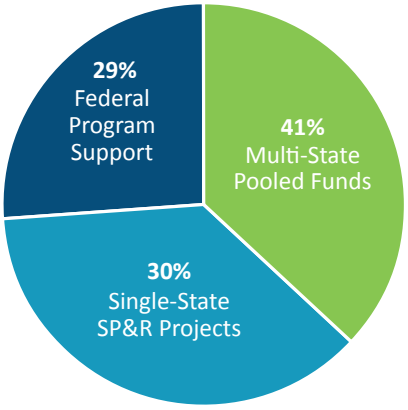
* Includes $855,433 carried over from FY2016.
** Includes $1,679,069 carried over from FY2016.
*** Includes contributions from other MnDOT funds, partnerships with other agencies and other federal sources.

FY2017 SP&R (Part II) Funding Distribution*

SP&R (Part II) funds for research are allocated to meet state-specific needs and are distributed as shown below:

Multi-State Pooled Funds	**$ 1,230,500**
a: Participation in Pooled Funds Led by Other States	$ 910,500
b: MnDOT-Led Pooled Funds	$ 320,000
Single-State SP&R Projects	**$ 1,212,037**
Federal Program Support	**$ 864,293**
a: NCHRP	$ 725,962
b: TRB	$ 131,331
c: AASHTO	$ 7,000
Total	**$ 3,306,830**

*Excludes 2017 commitments that were paid in advance with FY2016 funds.



FY2017 By the Numbers

Active contracts	Research reports and TRSs	Visits to the state research blog	MnDOT-supported active pooled funds	MnDOT-led pooled funds	Technical Advisory Panel members	Active Technical Liaisons
206	51	18,703	21	6	735	150

LOCAL ROAD RESEARCH BOARD:
Helping Cities and Counties Solve Problems

Administered by MnDOT Research Services, the LRRB has been bringing innovations to local Minnesota engineers since 1959. LRRB research ideas come from local Minnesota transportation professionals, either through the **Submit Ideas** button at **lrrb.org** or at LRRB sessions during October State Aid prescreening meetings held at 16 locations around the state. MnDOT Research Services helps to identify existing solutions and formulate a need statement to elicit project proposals. In December, the LRRB evaluates all proposals and selects some for funding.

LRRB's Mission

The mission of the LRRB is to serve local road practitioners through the development of new initiatives, the acquisition and application of new knowledge, and the exploration and implementation of new technologies.

City, county and State Aid staff shared more than 200 needs for research and implementation projects at the October 2017 prescreening meetings.

LRRB Research and Implementation

The LRRB provided funding for 72 of the projects listed in this At-A-Glance. These include projects managed by the LRRB's Research Implementation Committee.

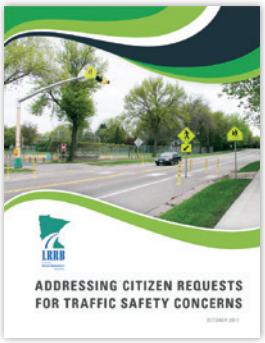
The LRRB partnered with MnDOT on Strategies for Effective Roundabout Approach Speed Reduction, **Report 2017-14**, which developed methodology to select and implement location-specific roundabout safety treatments.

LRRB
LOCAL ROAD RESEARCH BOARD

DEPARTMENT OF TRANSPORTATION
RESEARCH SERVICES & LIBRARY
mndot.gov/research

New LRRB Resources

Addressing Citizen Requests for Traffic Safety Concerns



How should a local engineer respond to area residents who want a Watch for Children sign on their street, even though that sign will not be effective in slowing traffic? The LRRB assembled resources to help city and county engineers respond to traffic safety–related citizen requests.
Report 2017RIC05

Base Stabilization Additives for Pavement Design

A new guide helps city and county engineers determine road projects that are good candidates for base stabilization, stabilizer products to use for individual projects, and best practices for using the products.
Report 2017RIC02

Technical Advisory Panels

As with MnDOT research projects, city and county engineers serve on Technical Advisory Panels (TAPs) to help guide researchers. Participation involves attending a limited number of meetings and reviewing the research results. This puts transportation practitioners in a good position to ensure that the research results will fit their needs and to find the most productive ways to apply the results in the field.

For more information, visit **lrrb.org**.

GET HELP:
HOW TO ACCESS OUR SERVICES

MnDOT Research Services & Library delivers information and innovation to transportation practitioners through a variety of programs and services, including those listed below. Contact us at any time if you need assistance at **research.dot@state.mn.us** or 651-366-3780.

SUBMIT A RESEARCH IDEA

If you need research, we can help you create a proposal and obtain funding. Submit research ideas and vote on those already proposed at **mndot-lrrb.ideascale.com**.

TAP Panels

You can help shape research and innovation projects in your subject area by serving on a Technical Advisory Panel (TAP). Involvement may include a few meetings and assistance developing work plans and reviewing final deliverables.

AASHTO-RAC Surveys

Have a question or two about other state practices in a particular topic area? We can survey other DOTs using the AASHTO-RAC listserv.

MnDOT Library

Our librarians are experts at tracking down hard-to-find information. Request a literature search, interlibrary loan or special publication at 651-366-3791, **library.dot@state.mn.us** or **mndot.gov/library**.

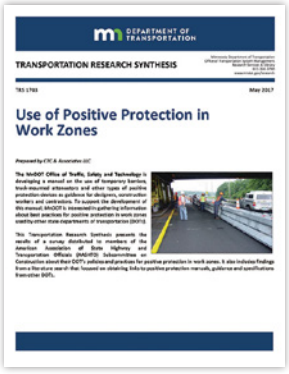
Research Implementation

We provide seed funding to get research results and transportation innovation into practice. Funding is available for small-scale deployment or the development of training materials.

Contact us at 651-366-3780 or **research.dot@state.mn.us** about your implementation needs.

REQUEST A TRS

A TRS is a short-turnaround research report that you can request to answer your research question. TRSs can summarize completed and in-progress research, or report about the state of practice among your peers in Minnesota and other states. For more information or to request a TRS, visit **mndot.gov/research/TRS.html**.



***TRS 1703**, Use of Positive Protection in Work Zones, gathered information about using temporary barriers, truck-mounted attenuators and other types of positive protection devices in work zones. The TRS, which involved a survey of state DOTs and a review of recent literature, is the first step in developing a best practices manual for designers, construction workers and contractors.*

KEEP UP WITH MnDOT RESEARCH

Email Updates and Accelerator Newsletter

Subscribe at **mndot.gov/research**.

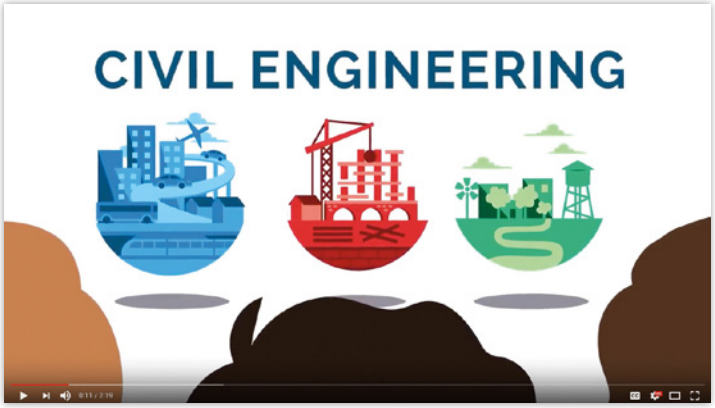
Crossroads Blog

Check out our recent stories on Minnesota transportation research.
mntransportationresearch.org

Presentations

Schedule a visit to learn how the research program or library can help your office or district.

Videos



*A new animated video and website, **becomeacivilengineer.com**, help kids explore the world of civil engineering to spur more students to enter this in-demand field (produced by the LRRB in partnership with MnDOT).*

We highlight research projects and provide educational resources for the public. See **mndot.gov/research/videos.html** or the **MnDOT Research YouTube channel**.

Webinars

A prerecorded video webinar reviews techniques presented in the Enhanced Culvert Inspections—Best Practices Guidebook.

MnDOT offers monthly webinars on innovations in traffic engineering and road research. Sign up for email lists at **mndot.gov/trafficeng/topics** and **mndot.gov/mnroad/researchpaysoff** to stay informed.

Social Media

Connect with us using your favorite social media channels. See upcoming events on our calendar page.

Research Projects

Find active and completed MnDOT research under the "Projects" tab at **mndot.gov/research**.

DEPARTMENT OF TRANSPORTATION
RESEARCH SERVICES & LIBRARY

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Minnesota Department of Transportation: mndot.gov
MnDOT Library: mndot.gov/library
Minnesota Local Road Research Board: lrrb.org