

Office of Maintenance

STATEWIDE BIENNIAL  
Maintenance Operations Research Report

2007–2009



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*Trade names are used on occasions in this report to better identify the type or use of a product or material involved in field research. However, use of these names in no way implies Minnesota Department of Transportation's (Mn/DOT) endorsement of the product or material discussed unless there is a specific Mn/DOT recommendation to that effect. No attempt was made to identify which product or material had registered trade mark associated with it.*

#### ACKNOWLEDGMENTS

The Maintenance Operations Research program is able to make a significant impact on the efficiency, safety, and cost of state maintenance operations. Many thanks to the Area Maintenance Engineers and District champions for their enthusiastic involvement. We sincerely appreciate these contributions, as well as the strong support of Mn/DOT's Office of Maintenance in advancing technology implementation.

Thanks very much to all who contributed content to this biennial report, including writing summaries, submitting photographs and compiling data.

For more information, please visit:

Minnesota Department of Transportation:

<http://www.dot.state.mn.us/>

Mn/DOT Office of Maintenance Research Unit:

<http://www.dot.state.mn.us/maint/research.html>

Mn/DOT Research Services Section:

<http://www.research.dot.state.mn.us/>

Mn/DOT Library:

<http://www.dot.state.mn.us/library/>

**Office of Maintenance**

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Maintenance Operations Research Report

2007–2009



Prepared by CTC & Associates LLC and shu shu design  
January 2010

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Clockwise from top left: Guardrail Sprayer, Mud Cannon, Calibration Scale, Rubber Cutting Edges, HID Lights and Zero Velocity Sander



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## Introduction

The Maintenance Operations Research program is a unique statewide collaboration focused on identifying and applying real-world solutions to highway maintenance operations. Managed by the Mn/DOT Office of Maintenance, the program funds the testing and evaluation of innovative products and practices that have the potential to significantly improve the efficiency and safety of Mn/DOT maintenance activities. This report presents the program and project highlights of the 2007-2009 funding biennium.

The report includes five sections:

- **About the Program** looks at the history of the Maintenance Operations Research Program, its goals and objectives and the staff throughout Mn/DOT who make it a success.
- **Research Project Selection** describes the criteria used to evaluate proposed research projects and the funding breakdown for 2007-2009.
- **Implementing Results** presents the process for selecting high-impact products for implementation among the many tested in the field, along with the full list of products selected for FY2008 and FY2009.
- **2007-2009 Highlights** describes the program's research focus areas and highlights some of the most valuable products to be selected for implementation in recent years.
- **2007-2009 Projects** reports on every completed and in progress research project for FY2008 and FY2009. Each project summary includes an overview of the product tested, the expected benefits and any results documented to date.



# About the Program

## Background

The Minnesota Maintenance Operations Research program was initiated more than twenty years ago to study the effectiveness of salt additives in reducing the corrosiveness of road salt. A chemist had approached Mn/DOT with a sample of road salt treated with an additive he had developed and claimed made the salt less corrosive. Driven by the possibility of the legislature mandating the use of this new, less corrosive salt, which would have had a profound impact on Mn/DOT's snow and ice budget, the Office of Maintenance received \$1.5 million for a two-year field study to determine how effective salt additives really were. The Maintenance Operations Research Program was created, and this proactive study was just the beginning. Mn/DOT continued to receive \$750,000 in additional annual funding, allowing the Maintenance Office to establish a robust maintenance research program.

Mn/DOT created a part-time maintenance operations research engineer position to direct the program in 1990. A full-time position and additional staff soon followed. The maintenance operations research engineer now works closely with the New Technology, Research and Equipment Committee; area maintenance engineers, superintendents and supervisors; Mn/DOT's Research Services Section; and other Mn/DOT offices. NTREC, which oversees the Maintenance Operations Research Program, has approximately 20 members representing a range of specialties and offices within Mn/DOT.

MOR's annual budget each year for 2008 and 2009 was \$475,000, which includes the salaries of the maintenance operations research engineer, the maintenance operations research project manager and 25 percent of the maintenance operations research and training engineer. Although budget cuts and downsizing have made the current program budget noticeably lower than the original \$750,000, the commitment to improving highway maintenance operations throughout the state remains strong.

## Goals and objectives

The Maintenance Operations Research program strives to maintain an active and visible applied research effort that involves all Mn/DOT maintenance areas, including snow and ice control technology/winter maintenance, road and bridge maintenance, roadside maintenance, work zone safety and traffic control, advanced technologies and technology transfer. The goal is to identify, develop and implement the most effective maintenance procedures, materials and equipment throughout the state.

Building on research conducted by others, like Federal Highway Administration (FHWA), Local Road Research Board (LRRB), Transportation Research Board (TRB), universities and industry, the program encourages and funds innovative, real-world studies aimed at improving highway operations. The program's proactive approach to identifying and implementing solutions is driven by the desire of Mn/DOT Maintenance staff to save money, lives and time.



## Research Unit Staff



Sue Lodahl  
*Assistant State Maintenance  
Engineer*

[sue.lodahl@state.mn.us](mailto:sue.lodahl@state.mn.us)  
(651) 366-3549



Ryan Otte  
*Maintenance Operations Research  
Manager*

[ryan.otte@state.mn.us](mailto:ryan.otte@state.mn.us)  
(651) 366-3585



Farideh Amiri  
*Maintenance Operations Research  
Engineer*

[farideh.amiri@state.mn.us](mailto:farideh.amiri@state.mn.us)  
(651) 366-3545



Linda Taylor  
*Maintenance Operations Research  
and Training Engineer*

[linda.taylor@state.mn.us](mailto:linda.taylor@state.mn.us)  
(651) 366-3578

## NTREC Committee Members and Guests, 2007- 2009

Farideh Amiri  
*Maintenance Research*

John Benson  
*OTST*

Gordon Bergstrom  
*Metro Research Engineer*

Randy Cameron  
*Maintenance Equipment*

Tom Deurr  
*Shop Supervisor*

Gary Dirlam  
*AME*

Curt Gobeli  
*Maintenance  
2007-2008 Chair*

Bruce Holdhusen  
*Research Services*

Eddie Johnson  
*Material Lab*

Ron Lagerquist  
*Facility Supervisor*

Sue Lodahl  
*Maintenance  
2009 Chair*

Ken Nelson  
*Maintenance*

Ryan Otte  
*Maintenance Research*

Dennis Redig  
*Superintendent*

Gordon Regenscheid  
*AME*

Bill Roen  
*Information Technology*

Paul Rowekamp  
*Bridge and Structures*

Kathy Schaefer  
*Training/CTAP Instructor*

Rick Shomion  
*Maintenance Training*

Linda Taylor  
*Maintenance*

Howard Van Vleet  
*TGS*

Mark Vogel  
*Environmental Services*

Stanley Waletko  
*Shop/Equipment Supervisor*

Lawrence Waletzki  
*Bridge Supervisor*

Erik Wolhowe  
*Bridge and Structures*

# Research Project Selection

## Selection criteria

Mn/DOT staff, with assistance from NTREC program members, developed a set of criteria to ensure that research proposals submitted meet the goals and the purpose of the Maintenance Operations Research Program. Projects submitted for funding consideration are evaluated based on the following criteria:

- Availability of funding and matching resources
- Expected benefits or return on investment
- Potential for improving safety in the field
- Opportunity for statewide implementation
- Innovation

Research proposals with funding requests of more than \$12,000 require approval from NTREC, which meets twice a year to consider proposals. Funding requests of less than \$12,000 require approval from the maintenance operations research engineer.

## Funding distribution

The budget for the Maintenance Operations Research Program in FY 2008 was \$425,000, which funded maintenance research projects, product implementation and staff salaries (the maintenance operations research engineer, the maintenance operations research project manager and 25 percent of the maintenance operations research and training engineer).

### FY 2008 program funding breakdown

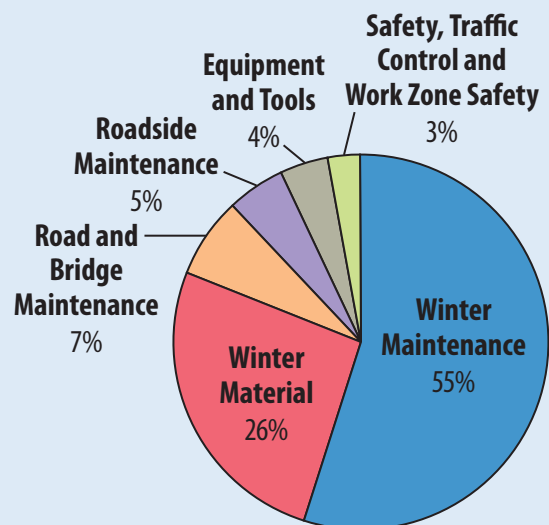
Research projects:	\$245,000
Implementation:	\$61,250
Staff salaries:	\$118,750
<b>Total:</b>	<b>\$425,000</b>

The base program budget was the same in FY 2009, with an additional \$50,000 added by the Transportation Finance Chapter 152. This additional funding allowed for expanded research and implementation efforts.

The Maintenance Operations Research program funds research projects across the state in the areas of Winter Maintenance; Winter Material; Road and Bridge Maintenance; Roadside Maintenance; Equipment and Tools; and Safety, Traffic Control and Work Zone Safety. See the chart at right for the FY2008/2009 distribution of funds by research category.

### FY2008-FY2009 Funding Distribution by Research Category

Winter Maintenance	\$263,373.59
Winter Material	\$123,861.70
Road and Bridge Maintenance	\$33,050.50
Roadside Maintenance	\$25,915.44
Equipment and Tools	\$21,918.44
Safety, Traffic Control and Work Zone Safety	\$11,634.00
<b>Total</b>	<b>\$479,753.67</b>

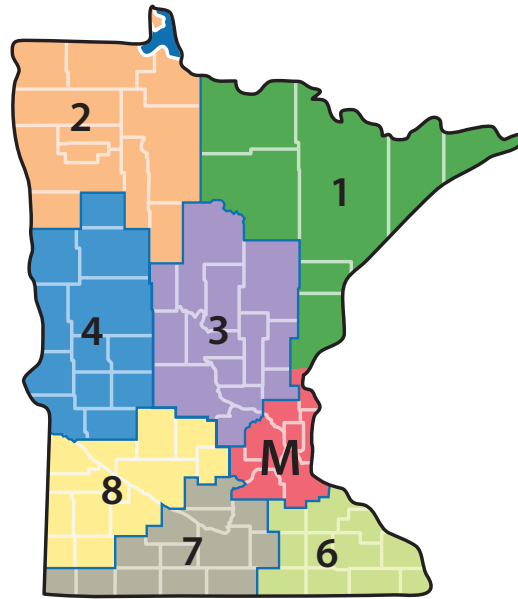


Budgets for FY 2008 and FY 2009 are summarized in Table 1 (by district) and Table 2 (by category). See the location of districts throughout the state in Figure 1.

**Table 1.**  
**2008-2009 Budget by District**

Districts	# of Projects/ Districts	Dollars/ District	% Dollars/ District
1	6	\$28,888.88	6
2	2	\$7,795.00	2
3	2	\$4,900.00	1
4	4	\$15,565.00	3
6	17	\$78,945.27	16
7	6	\$47,839.60	10
8	4	\$20,254.10	4
Metro	7	\$213,532.68	45
CO	11	\$64,032.64	13
<b>Total</b>	<b>59</b>	<b>\$479,753.17</b>	<b>100</b>

NOTE: Projects initiated by central office and distributed to the districts.



**Figure 1. Minnesota Department of transportation Districts**

- 1 Duluth
- 2 Bemidji
- 3 Brainerd
- 4 Detroit Lakes
- 6 Rochester
- 7 Mankato
- 8 Wilmar
- Metro

**Table 2. 2008-2009 Budget by Category**

Categories	# of Projects/ Districts	Dollars/ District	% Dollars/ District
Winter Maintenance	24	\$263,373.59	55
Winter Material	11	\$123,861.70	26
Road and Bridge Maintenance	4	\$33,050.00	7
Roadside Maintenance	7	\$25,915.44	5
Equipment and Tools	8	\$21,918.44	5
Safety, Traffic Control and Work Zone Safety	5	\$11,634.00	2
<b>Total</b>	<b>59</b>	<b>\$479,753.17</b>	<b>100</b>



# Implementing Results

The Maintenance Operations Research program uses a structured implementation process to ensure that the results of successful maintenance research projects get incorporated into field operations. To optimize the return on the research investment, the program contributes 25% of the available budget for projects in implementation. There was \$61,250 available for implementation in FY 2008 (25 percent of \$245,000) and \$73,750 available in FY 2009 (25 percent of \$295,000). Implementation activities that are eligible for partial or full funding include the development of demonstrations, show casing, training and technical assistance, and distribution of products statewide.

## Implementation selection process

Mn/DOT tests numerous products each year, but funding is available to implement only a portion of them. The following steps are taken to develop a list of high-value products that will receive implementation funding assistance from the Maintenance Operations Research program.

1. **Field reports completed.** Each district completes a field report describing the goals and results of the products they tested.
2. **Unit makes recommendations.** The Maintenance Research Unit develops a list of research projects recommended for implementation based on a review of the field reports completed. Products that have become available on the state's contract list are available for purchase by the districts directly. Products that are not yet available on the state contract list can be considered for implementation funding by the Unit.
3. **Implementation Subcommittee makes final selection.** The Implementation Subcommittee reviews the list of promising products developed by the Maintenance Research Unit to develop a final list of approved products for the year. This subcommittee, created three years ago, includes three representatives from the Maintenance Research Unit, one from Research Services Section, three from NTREC and one district representative.
4. **NTREC final review & approval.**
5. **Division of funding and distribution of products.** Implementation funding is divided up equally among the districts. They choose which products on the implementation list to implement with the funds they have available. The Maintenance Research Unit then assists in ordering and distributing the selected products.

## FY 2008 and FY 2009 implementation projects

See page 10 for the list of projects funded for implementation in FY 2008 (Table 3) and FY 2009 (Table 4). District staff may select from any of these projects or previous years' implementation projects when deciding how to use their implementation funding.

**Table 3. FY 2008 Implementation Projects**

Project Name	Description	District	Unit Price
Pro Press Crimping Tool	A solderless fitting used with copper piping. The system uses compression crimping with o-ring seal fittings. A special crimping tool is needed for installations.	D1	\$2,474
Portable Wheel Stud Remover	Saves time and improves productivity by using compressed air to remove old studs and insert replacements.	D2	\$2,195
Gooseneck Lamps	Improves visibility in plow truck cabs for nighttime operators.	D3	\$89
Clear Fast	Uses hot washer fluid system to improve operators' visibility.	D6	\$180
Safety Work Platform	A one-piece lightweight portable platform that folds for compact storage. Unit has adjustable height increments of 7" to accommodate various tasks on equipment. Height adjustment from 16" to 5'10" with a working platform deck of 5'L x 18"W. Working load capacity is 500 pounds.	D7	\$1,816
Wiper Shakers	Helps remove snow and ice buildup from the windshield, improving the drivers' visibility and safety.	Metro	\$54
Temperature Sensors	Gives the operator real-time air and pavement temperatures, resulting in materials savings.	Best Practices	\$531
Auger Sensors	Identifies the amount of material applied to roadways, resulting in materials savings.	Best Practices	\$235

**Table 4. FY 2009 Implementation Projects**

Project Name	Description	District	Unit Price
Auto Grease System	Greases banks on trucks to reduce breakdown. Saves time, ensures proper greasing and is very easy to use.	D7	\$6,500
Guardrail Sprayer	Sprays chemical on both sides of guardrail for long distances in one pass. High-pressure nozzles are mounted to the side of a tractor.	D6	\$6,000
Guidance Laser	Shows future path of wing plow. Reduces costs related to wing accidents with cars, signposts and guardrails. Recommended for specialty equipment and problematic areas.	D7	\$4,500
Joma Blades	Uses rubber-coated segmented plow cutting edges, increasing the life of blades when used on asphalt.	D3	\$100/foot
Landscape Stapler	Uses auto stapling system to install landscape fabric. Reduces employee back injuries and strain.	D6	\$840 +
GPS Control	Gopher One call to record the coordinates for future reporting, reduces human error.	D7	\$6,250
Herbicide Head/Pump	Uses two herbicide heads with injection heads and injection pumps on 6,000-gallon water tankers to spray herbicides. Increases employee safety and reduces chemical waste.	D7	\$6,300
GPS Speed Control Head	Works with the herbicide head and pump to control and adjust the herbicide speed and truck speed.	D7	\$5,400
Forward Looking Sonar	Gathers data to monitor and evaluate bridge scouring.	D7	\$2,100
Zero Velocity Sander	Places material accurately at higher rates of speed. Improves public safety and operator productivity.	Metro & D7	\$3,416
Calibration Scales	Saves material, time and resources.	D7	\$2,980

## 2007-2009 Highlights

### Trends in research

Over the years, the Maintenance Operations Research program has evolved from a singular focus on salt testing to a broader analysis of all elements in maintenance operations. The program works closely with other research organizations and programs statewide and nationally, bringing diverse research fields together to find needed solutions. Mn/DOT actively supports the Clear Roads pooled fund research program, the Highway Safety Operations Program, FHWA, LRRB, and TRB. The Maintenance Operations Research program actively supports research in the following areas:

- **Winter maintenance:** deicing and anti-icing methods, equipment and materials; snow and ice removal; sand/salt mixing, storage and handling systems; snow fence (blowing snow) systems; vehicle conspicuity studies
- **Road and bridge maintenance:** slurry seal patching and microsurfacing; pavement resurfacing options; pothole repair technology; culvert maintenance and rehabilitation; road striping performance and measurements; road shoulder maintenance; low-volume road applications; debris removal from roadway; bridge paint removal and handling; bridge deck and approach slab repair
- **Roadside maintenance:** roadside vegetation management; roadside sign maintenance; graffiti removal
- **Work zone safety:** field test and evaluation of all work zone safety products
- **Maintenance management:** maintenance management systems; transportation information systems; pavement management systems interface; hazardous waste tracking; automated route planning and optimization systems; road and weather information systems; automated crew call-out system; testing and evaluation of various cost- and productivity-saving systems
- **Technology transfer:** maintenance biennial report; maintenance bulletins; EXPOS, Mn/DOT Rodeos and Tech Fair; one-pagers; state, national and international conferences



Joma Blade



Calibration Scale

## Featured projects

High-impact projects for 2007-2009 include:

- **Zero Velocity Sander:** The zero velocity sander accurately places material while allowing maintenance vehicles to operate at faster speeds (35 mph to 40 mph). The sander leaves more material in the target area and loses little to no material to the shoulder of the road.
- **Tow Plow:** The trailer-mounted tow plow allows operators to clear multilane interstate roads with fewer trucks, completing the work faster and freeing up equipment to work on additional routes.
- **Landscape Stapler:** The Landscape Stapler makes installing erosion control fabric easier and safer. Only one person is required for operation, and workers experience fewer back injuries. In addition, the Stapler works effectively on hard or lumpy ground.
- **Slurry Auger:** The slurry auger system uses less material per lane mile and provides a slurry mixture better-suited for Mn/DOT roads.
- **Salt Skirt:** The salt skirt enables vehicles to place salt on or near the centerline. This practice reduces material bouncing and scatter, retaining more salt on the road near the centerline and reducing the per lane mile salt usage.
- **Air Vizion:** The Air Vizion mirror cleaning system removes water droplets and snow from mirrors, enhancing driver visibility, improving vehicle safety, reducing accidents and their associated damage, and relieving drivers from manually wiping mirrors.
- **Calibration Scales:** Calibration scales help to ensure proper calibration consistency, reducing material and labor costs as well as environmental concerns.



Clockwise from top left: Air Vizion, Salt Skirt and Tow Plow



## **2007-2009 Completed Projects**



## Maintenance Research

### Winter Maintenance

**District/Office:**  
7W/Mankato

**Contact:**  
Randy Glaser  
(507) 389-2848

**Project Cost:**  
\$3,995

**MOR Funds:**  
\$3,995

**Start Date:**  
January 2007

**Completion Date:**  
April 2008

**Vendor:**  
laserguidance.com

## Guidance Laser Completed Research



**Project Description:** The guidance laser allows the operator to “see ahead” by displaying the future path of the wing. The laser unit is mounted under the cab shield and the direction of the laser is preset by the operator. A switch inside the cab turns the unit on which then projects a green dot in front of the truck. The laser system features a lens heating system to help keep it clear of freezing precipitation.

**Purpose:** The guidance laser will be used to estimate the future path of the wing plow so the operator can allow proper distance to avoid obstacles such as signposts and curbs.

**Test Procedure:** Mn/DOT will test the laser unit’s usefulness to determine whether operators can actually see it and also if it will reduce the number of accidents involving wings and fixed objects.

**Conclusions:** District 7 had some problems with the first laser but worked with the vendor to resolve them. The laser was sent back over the summer and replaced with a new, improved model that not only works better in the winter but also works for summer use.

**Recommendations:** Because of the laser’s cost, District 7 may only equip trucks with benching wings or trucks used by operators who have difficulty judging the location of the wing tip.

**Implementation:** This item has been placed on the statewide implementation list.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro/District 7

**Contact:**  
Cliff Gergen (Metro)  
(952) 435-6480

Randy Glaser (District 7)  
(507) 389-2848

**Project Cost:**  
\$4,000

**MOR Funds:**  
\$4,000

**Start Date:**  
January 2006

**Completion Date:**  
April 2008

**Vendor:**  
henderson-mfg.com

## Henderson Zero Velocity Sander *Completed Research*



**Project Description:** This project reviewed the performance and cost-effectiveness of current sanders (which use a spinner) and direct placement sanders. The Henderson HTS55 Direct Placement Sander can place material directly on the centerline of the highway at the equivalent speed of the truck. This capability minimizes material loss from the roadways by reducing material bounce.

**Purpose:** Mn/DOT tested these direct placement sanders and greatly reduced material loss to the shoulders of the road. Unlike current trucks which use a spinner, the new sander is mounted inches from the road surface, allowing operators to control the exact placement of material at higher speeds.

**Test Procedure:** Mn/DOT has used sanders similar to the Henderson HTS55 in the past with great results, allowing operators to cover Minnesota roadways faster with less salt loss. The new technology in the Henderson HTS55 has great potential to surpass the sanders currently used.

**Conclusions:** The zero velocity sander makes for a much faster operation. Normal speeds during snow and ice operations are about 20 mph to 25 mph; the zero velocity sander speeds can exceed 35 mph to 40 mph. The sander worked well at high speed spreading (30 mph to 35 mph); material stayed on the crown of road where it was placed. During a recent sander demo, the zero velocity system operating at 35 mph left 95 percent of the material in the target area (within 4 feet either side of the skip strip).

**Recommendations:** While leaving more material in the target area the zero velocity sander loses little to no material to the shoulder of the road. This system saves time and material.

**Implementation:** This project is on the statewide implementation list.



## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6/Rochester

**Contact:**  
Joel Rissor

**Project Cost:**  
\$1,500 for 2 sets

**MOR Funds:**  
\$1500

**Start Date:**  
March 2007

**Completion Date:**  
April 2008

**Vendor:**  
brighthouse.com

## HID Headlights Completed Research



**Project Description:** HID headlights have a high-intensity discharge for improved visibility. Mounted to the hood, the lights shine ahead of the plow for better visibility. These DOT-approved lights will replace the OEM lights that are currently used.

**Purpose:** District 6 will evaluate HID headlights for their ability to improve snowplow operators' visibility and safety in whiteout conditions.

**Test Procedure:** District 6 requested two sets of headlights—New Generation XE7R and the New Generation XE7—for testing on interstate and non-interstate roadways to see if they are accepted by operators as well as the general public. Snowplow operators will report their preference for the old style headlights or new HID headlights for visibility and for safety.

**Conclusions:** Snowplow operators in District 6 agreed that both styles of headlights worked effectively. The reflector beam and projector beam of both sets provided the same level of quality, making plowing operations easier and safer with HID lights. Operators also reported less eye fatigue with the HID lights also. The response of oncoming traffic was no different between the old style headlights and the new HIDs. The reflectivity of the headlights was also no different between the old and new as well.

**Recommendations:** District 6 recommends these lights be implemented statewide for improved visibility and safety.

**Implementation:** This project has not been placed on the statewide implementation list at this time.





## Maintenance Research

### Winter Maintenance

**District/Office:**  
6E/Rochester

**Contact:**  
Dave Redig  
(507) 285-7361

**Project Cost:**  
\$8,650

**MOR Funds:**  
\$8,650

**Start Date:**  
April 2007

**Completion Date:**  
April 2008

**Vendor:**  
henderson-mfg.com

## Iowa Snow and Ice Innovative Equipment Completed Research



**Project Description:** This project tested a live bottom tandem truck box with two in-box 450-gallon saddle tanks and a tailgate brine tank/sander combination. This system can apply brine at the recommended 80 gallons per ton of abrasive instead of the present 8 to 10 gallons and/or anti-ice a route with brine only.

**Purpose:** This project will evaluate the practice of applying more liquid to roadway salt which would activate the salt sooner and could make snow and ice operations much more efficient and effective. The district speculates that the more brine that is applied with chemical abrasives (80 gallons per ton), the better the salt will work on the road. The real test would be how much effect this would have on the regain times of the road.

**Test Procedure:** An existing snowplow truck chassis is equipped with stainless steel chutes, allowing the chemical abrasive and brine to be applied near the road surface rather than being thrown onto the ground with the current spinner application system. A pressure pump brine application system replaces the current gravity/flow system which only allows minimal brine application. The district will visually observe how well the equipment works and how much repair is needed during the course of the testing.

**Conclusions:** The salt slurry system worked as the maintenance dashboards stated the regain times were the same with the reduced salt amounts. The district needs more time to evaluate whether this is a complete and workable delivery system. The delivery system is a simple relocation process; testing should not stop the salt slurry from moving forward.

**Recommendations:** With more testing this project may offer a more efficient system for snow and ice removal, with the potential for cost and materials savings.

**Implementation:** Pending.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
2, 6, 7

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$7,000

**MOR Funds:**  
\$7,000

**Start Date:**  
September 2007

**Completion Date:**  
April 2009

**Vendor:**  
henderson-mfg.com

## Modified Augers Completed Research



**Project Description:** Applying snow and ice control chemicals at lower rates while operating vehicles at lower road speeds is below the mechanical limitations of current equipment (such as pumps and hydraulic motors). Modified augers will enable road crews to apply smaller amounts of chemical materials at lower driving speeds, resulting in a much lower cost per lane mile. Using the augers will also put less of a demand on equipment and reduce the wear and tear on sanders, motors and controls by allowing them to operate in a smooth, continuous manner rather than in the current stop and start manner that puts large amounts of material in some areas and none in others.

**Purpose:** Maintenance Research will purchase 10 modified augers to test application ability on roadways. The augers will be installed in trucks from different state districts. Repair costs and material usages will be recorded and compared to similar routes in the same districts for a complete side-by-side comparison.

**Test Procedure:** At present road crews are applying chemicals at a minimum rate of 38.7 pounds per minute, which at 10 mph equals 232 pounds per lane mile. According to application charts, crews would have to drive vehicles at almost 29 mph to cover two lanes (24 feet wide) with 40 pounds each at 30 degrees, and this is if the vehicle hydraulics and electronics are working at peak efficiency. The modified augers should be able to apply material at a rate of 14 pounds per minute, which equals 40 pounds per lane mile at 10 mph, yet still avoid bridging of the material.

**Conclusions:** Overall the augers performed well. In areas where salt is the prevalent material of choice, operators did not experience bridging or jams caused by large chunks getting lodged in the auger. These augers did not slug or stop when applying material at slower speeds. Because of the larger 5-inch center (rather than the current 2-inch center) these augers carry less material and make more revolutions than current augers, although they still are able to dispense more than 800 pounds per lane mile.

**Recommendations:** Modifications to the system were not necessary, although Mn/DOT has only used the augers for a year. Additional modifications may be needed in the future.

**Implementation:** Pending.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Norm Ashfeld  
(651) 234-7907

**Project Cost:**  
\$1,512

**MOR Funds:**  
\$1,512

**Start Date:**  
August 2006

**Completion Date:**  
April 2008

## Rubber Cutting Edges Completed Research



**Project Description:** Mn/DOT currently uses all steel cutting edges along with carbide blades. The steel cutting edges tend to remove pavement markings and also wear off the reflectivity of the pavement markings. Rubber blades are softer, glide over the pavement markings without harming them, and still remove snow and slush effectively.

**Purpose:** Mn/DOT will test the new rubber blades to potentially decrease the frequency of reinstalling pavement markings.

**Test Procedure:** Road crews will monitor and compare rubber plow blades and steel blades for performance, cost-effectiveness and reflectivity of the existing skip stripes.

**Conclusions:** In dry snow, the rubber blades were hard to push and wore out faster because of friction between the rubber blades and the dry road surface. This resulted in increased fuel consumption. When used in wet snow, the rubber blades did not clean the roadway as well as a steel blade. They would ride up on the snow, creating more of a “polished roadway” or icy surface, which called for extra material to break. The snow would actually collect on the plow blade instead of being thrown, which required additional labor time to maintain the blades instead of plowing snow. Costs actually increased (fuel, labor and material) with rubber blades because of poor performance.

**Recommendations:** These blades would perform better as a slush blade. It would be located about a foot behind the steel blade and would clean any snow or slush left in the wheel tracks or on the road surface.

**Implementation:** This project is not recommended for implementation at this time.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
7W/Worthington

**Contact:**  
Ron Gaffke  
(507) 831-8020

**Project Cost:**  
\$1,000

**MOR Funds:**  
\$1,000

**Start Date:**  
August 2006

**Completion Date:**  
April 2009

**Vendor:**  
industrialbrush.com

## Salt Skirt Completed Research



**Project Description:** The salt skirt is a cup brush that is mounted around the spinner. The unit is 24 inches in diameter and has 16-inch-long bristles.

**Purpose:** The salt skirt will be used to place salt on or near the centerline. Through better placement, this practice will reduce material bouncing and scattering, retaining more salt on the road near the centerline and reducing the per lane mile salt usage.

**Test Procedure:** Mn/DOT will monitor salt usage per lane mile through video and photo observation as well as operator feedback.

**Conclusions:** Although not necessarily quantified at this time, the salt skirt appears to have saved time, salt and equipment by requiring fewer repeat applications. An improved service to the public is expected as well. The cost savings is best described as fewer repeat applications. In the past, crews have had to re-treat roads when some of the salt blew off or was not concentrated sufficiently to soften the ice. This doesn't happen as often with the salt skirt. The unit is quite durable with virtually no moving parts. When properly installed, it will withstand wind, weight of salt, snow, slush and other elements of winter operations.

**Recommendations:** The district recommends the salt skirt, particularly in parts of the state that experience windy conditions often. While it is best suited for these areas, the unit keeps material placed in the target area under most circumstances.

**Implementation:** Not at this time.



## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6W/Owatonna

**Contact:**  
Steve Lueken  
(507) 446-5530

**Project Cost:**  
\$2,500

**MOR Funds:**  
\$2,500

**Start Date:**  
November 2008

**Completion Date:**  
April 2009

## Slurry Auger Completed Research



**Project Description:** Last winter, Mn/DOT used the Iowa salt slurry system and it performed as well as the regular spreader systems with a savings of about 100 pounds per lane mile. With the slurry auger, brine is pumped to the center of the auger and then forced into the salt from the center of the auger out. Using an auger of this design may save even more material and should provide a slurry mixture better suited for Mn/DOT roads.

**Purpose:** The auger will be used to make a better slurry mixture.

**Test Procedure:** District 6 will compare the slurry mixture from spray to brine above the auger to delivering the brine through the slurry auger and determine which method makes the better slurry.

**Conclusions:** The 70/30 slurry saved 100 pounds of material per lane mile on a regular basis, if mixed properly, and the slurry auger is the only way to get a complete slurry mixture with Mn/DOT's type of sander. The slurry auger is the necessary component needed to make a complete 70/30 slurry mixture in the tailgate-mounted sanders.

**Recommendations:** The slurry auger should be integral to any 70/30 salt slurry system and be mounted on Mn/DOT trucks.

**Implementation:** Pending for 2010.





## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6E/Rochester

**Contact:**  
Bob Langanki  
(507) 286-7576

**Project Cost:**  
\$500

**MOR Funds:**  
\$500

**Start Date:**  
January 2008

**Completion Date:**  
April 2009

## SNO-FLO *Completed Research*

# Sno-Flo

**Project Description:** Sno-Flo prevents sticky snow and slush from building up on plow equipment and on warning lights so they remain visible to motorists. Sno-Flo works in any temperature, preventing soils such as clay and waste sludge from freezing and sticking in dump beds, backhoes and loader buckets.

**Purpose:** The district will evaluate Sno-Flo's ability to work in any temperature, preventing snow and ice from accumulating on various components of the plow trucks. This will allow the general public to see trucks lights clearly and relieve extra weight of snow and ice that builds up on vehicles during snow and ice operations.

**Test Procedure:** The district will spray the chemical on some of its plow trucks. At the end of each shift, operators will visually inspect the trucks that were sprayed and those that were not sprayed.

**Conclusions:** Sno-Flo failed to produce any positive results. Even when the product was applied a few times, snow and ice still accumulated on the entire truck.

**Recommendations:** This product is not recommended by the district.

**Implementation:** This product will not be selected for statewide implementation.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
7E/Mankato

**Contact:**  
Randy Glacier  
(507) 398-2848

**Project Cost:**  
\$900

**MOR Funds:**  
\$900

**Start Date:**  
January 2007

**Completion Date:**  
May 2008

**Vendor:**  
spray.com

## Spray Nozzles Completed Research



**Project Description:** The district will evaluate the variable orifice nozzles to see if they can spray salt brine in multiple lanes at high speed without the drifting or misting problems usually associated with multiple-lane, high-speed applications. Applying liquid salt to multiple lanes simultaneously will save time and money, and will make applications safer for the public as well as the operator.

**Purpose:** This project will evaluate how well the nozzles spray multiple lanes in one pass, which will save time and money and will increase safety.

**Test Procedure:** The district will mount 12 nozzles on its semi tanker and spray liquid salt brine at high speeds (50 mph to 65 mph) across up to three lanes at once. Most nozzles will not work in this application because of the drifting that occurs at high speeds. The district's semi tanker has the capability to control the flow to the nozzles at any speed.

**Conclusions:** By eliminating multiple passes on most routes, the district made a significant savings in cost, labor and equipment. In some two-lane roadways and most four-lane roads, operators were able to make a pass in one direction and spray all lanes at once.

**Recommendations:** These nozzles perform well in high-speed applications, keeping material from forming a mist during application. Vehicles that followed the semi tanker reported little or no moisture on their windshields.

**Implementation:** This project has not been selected for the statewide implementation list.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Norm Ashfeld  
(651) 234-7907

**Project Cost:**  
\$63,900

**NTREC Funds:**  
\$30,000

**Start Date:**  
July 2007

**Completion Date:**  
April 2009

**Vendor:**  
vikingvices.com

## Tow Plow Completed Research



**Project Description:** This project will determine the feasibility of a 26-foot-wide plow operating on the Minnesota freeway system. The tow plow is a trailer-mounted plow that is pulled and operated from a class 35 tandem truck. It operates at any angle up to 30 degrees and is capable of plowing at normal speeds.

**Purpose:** The district will evaluate the tow plow's ability to move snow with fewer resources.

If successful, one truck equipped with the tow plow should remove the same amount of snow that two or more snowplows would remove, eliminating a truck and an operator.

**Test Procedure:** The tow plow is operated by two levers within the cab of the towing vehicle. Operating the tow plow is no more difficult than pulling a trailer down the road.

**Conclusions:** Overall the operators thought the plow was very easy to use. They felt the learning curve was normal as with any new piece of equipment. When Maple Grove was short staffed for an event, operators were able to clear a two-lane route with only one truck. When Maple Grove was fully staffed, operators were able to clear multi-lane interstate (wider) roads with fewer trucks, completing the work faster and freeing up other equipment to work on additional routes. Cost savings were achieved because operators were able to clear more of the road with only one truck; however the amount of savings has not yet been determined.

**Recommendations:** The tow plow is highly recommended by Mn/DOT, which now owns five tow plows statewide. Future improvements would include a sander and/or an anti-icing tank.

**Implementation:** This project has not been recommended for statewide implementation.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
District 7/Mankato

**Contact:**  
Randy Glaser  
(507) 389-2848

**Project Cost:**  
\$11,242

**MOR Funds:**  
\$11,242

**Start Date:**  
July 2006

**Completion Date:**  
June 2008

**Vendor:**  
tufftechbag.com

## Tuff Tech Bag Completed Research



**Project Description:** The Tuff Tech Bag will allow operators to apply deicing chemicals (salt brine) instead of granular material at a rate of speed that makes it safer for the traveling public as well as the operator.

**Purpose:** The district will evaluate the amount of liquid that can be applied to the road surface while maintaining the same results as similar routes. The cost savings will be determined based on the reduced applications of a less expensive product; the number of passes that need to be made; regain time, which reduces interruptions to the traveling public; and the reliability of the bags.

**Test Procedure:** The Tuff Tech Bag will be installed in a class 35 plow truck that is assigned to a high-volume, high-speed route. The pump will plug in to the control point sander controls making it completely ground orientated. Because the deicer is in liquid form, it is active as soon as it is applied to the road surface. The bag can be removed easily so that if conditions warrant, operators can use granular material by simply unloading the bag and attaching the sander. The district will also use the bag in the summer for dust control and herbicide use.

**Conclusions:** Based on research, the district believes that this system can be used on most routes under most conditions. The bag will fit any of the new elliptical boxes with no modifications needed to the truck, making this bag truly universal.

**Recommendations:** Tuff Tech Bags have been used in Canada for deicing chemicals with great success. They also have been used by the military for fuel storage. This is a very sturdy bag that should perform well for the district.

**Implementation:** The district recommends this project in some applications but has not decided at this time to recommend for statewide implementation.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro-Camden Truck Station

**Contact:**  
Tom Osthoff  
(612) 520-3560

**Project Cost:**  
\$400

**MOR Funds:**  
\$400

**Start Date:**  
November 2006

**Completion Date:**  
April 2008

**Vendor:**  
wipershaker.com

## Wiper Shakers Completed Research



**Project Description:** Wiper Shakers help remove snow and ice buildup from a truck's windshield, improving the driver's visibility and safety. Four sets will be installed on the existing wiper blade arms of four state snowplow trucks.

**Purpose:** The Wiper Shakers will be used to keep windshield wipers clear of snow and ice during plowing operations. The product will save time and increase safety since operators will not have to get out of their trucks to clean frozen snow and ice from the wipers.

**Test Procedure:** The Wiper Shakers connect to the existing wiper blade arm; wiring is run through the firewall of the plow to a power supply or the cigarette lighter. Drivers will provide feedback about the product's ability to perform and withstand the rigors of Mn/DOT's harsh environment.

**Conclusions:** All of the operators who used the Wiper Shakers provided positive feedback about the product. They said the product does remove snow and ice from the wiper blades, allowing the wiper blades to function properly. By keeping snow and ice from collecting on wiper blades, the Wiper Shakers also extended the lifetime of wiper blades.

**Recommendation:** The Wiper Shakers come highly recommended for use on all Mn/DOT plow trucks. This product performed very well and made for an overall safer operation. Drivers recommended this product for the entire fleet of snowplow trucks.

**Implementation:** This product has been placed on the statewide implementation list. Currently Mn/DOT has them on about 200 of its 820 trucks.





## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
8/Marshall

**Contact:**  
Craig Gertsema  
(507) 537-2059

**Project Cost:**  
\$8,600

**MOR Funds:**  
\$8,600

**Start Date:**  
July 2007

**Completion Date:**  
July 2008

**Vendor:**  
chemgrout.com

## ChemGrout Completed Research



**Project Description:** The ChemGrout is a compact unit (fits in a pickup) that will be used to grout culvert liners. It will mix and pump the grout with enough pressure to fill the void caused by the liner. Mn/DOT currently has one outdated mudjacker for use throughout the state. If the ChemGrout performs as expected, it will increase efficiency by eliminating the need to schedule the mudjacker for repairs.

**Purpose:** The ChemGrout will be used in the entire southwest corner of the state, freeing up the Metro crew to do more work in the metro area and elsewhere. As the district moves from replacing pipes and instead using liners, the ChemGrout could be useful for years to come.

**Test Procedure:** District 8 will compare this unit to the current mudjacker for performance and cost savings. In addition to scheduling its use with Metro, the mudjacker is quite technical and requires two workers to operate the machine. The ChemGrout could be used in-house and should be easily used by anyone without much training.

**Conclusions:** The ChemGrout is not as fast as the mudjacker but does perform according to manufacturer specifications. If the district were to replace the mudjacker, it would need a unit with a bigger pump. However, the ChemGrout is able to pump and fill any liner that the district has installed. While employees haven't used it for any type of mudjacking (raising concrete road panels), they are satisfied with its overall performance.

**Recommendations:** This machine's ability to pump grout for culvert liners is a good fit for the district. The expense is reasonable and if an area installs an extensive number of liners, the unit could be very useful.

**Implementation:** This unit has not been placed on the statewide implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
4

**Contact:**  
Jeff Reuss  
(320) 843-3682

**Project Cost:**  
\$12,400

**NTREC Funds:**  
\$7,500

**Start Date:**  
February 2008

**Completion Date:**  
April 2009

**Vendor:**  
roadgroom.com

## Road Shoulder Groomer *Completed Research*



**Project Description:** The Road Groom is a shoulder maintenance machine that will maintain roadways more quickly than a road grader, saving fuel, labor and maintenance costs. It will help reclaim gravel fines that separate and wash away from the rock. These fines usually settle in the bottom of a ditch and eventually land in catch basins, which then require maintenance. The Road Groom distributes serrated blends, mixes them with fines and puts the materials back on the road bed.

**Purpose:** Mn/DOT has a small time frame when conditions are right for shouldering. District 4 will evaluate the Road Groom for its ability to groom more miles of roadway in less time than current methods.

**Test Procedure:** The Road Groom is very user friendly and does not require experienced operators. Employees will measure miles, maintenance issues and overall satisfaction.

**Conclusions:** District 4 was able to accomplish more miles with a tractor and the Road Groom compared to a road grader. With the Road Groom, employees repaired 40 to 60 lane miles per 7-hour day; a road grader repairs about 20 lane miles in that same time. The tractor pulling the Road Groomer covered 105 lane miles and used 35 gallons of fuel; the road grader covered 50 lane miles and used 35 gallons of fuel. The Road Groomer worked best when the shoulders were moist; it did not perform as well when the shoulders were hard and dry (as was reported by the manufacturer). However, the blade of a road grader doesn't perform as well when the shoulders are hard and dry.

**Recommendations:** The district recommends this project for statewide implementation, especially in districts with narrow shoulders of 8.5 feet or less.

**Implementation:** Pending for 2010.



## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6 Rochester

**Contact:**  
Ed Vitse  
(507) 533-4413

**Project Cost:**  
\$1,295

**MOR Funds:**  
\$1,295

**Start Date:**  
February 2007

**Completion Date:**  
April 2009

**Vendor:**  
newstripe.com

## Roll Master 5000 Completed Research



**Project Description:** The Roll Master 5000 is an economical, easy to use, portable pavement marker. It is battery powered and easy to recharge.

**Purpose:** The Roll Master 5000 will be used for striping small maintenance and building projects (such as parking lots). It will be evaluated for ease of operation and cleanup, appearance of striping and longevity along with overall performance.

**Test Procedure:** The unit pumps paint directly from a standard 5-gallon pail so there is no tank to clean. It has a peristaltic pump driven by a 12-volt gear motor with a built-in charger. After one charge, the unit will stripe for more than 24 hours.

**Conclusions:** The marker worked best on a clean, smooth surface such as concrete or new blacktop. A rough surface yielded poor paint coverage. Thinning paint did help some. However, if the surface had any debris, the roller picked it up and would stop rolling. The application speed was slow because it was limited by the ability of the pump to supply paint to the roller head. The machine has no measure of distance traveled, so obtaining a consistent space between skips and skip length was difficult. Unless there were old markings to use as a guide or a seam on the roadway, it was almost impossible to achieve a straight line of any length. The pavement marker as built paints only off the right side, which puts the operator facing traffic left of the centerline.

**Recommendations:** District 6 had much higher expectations for this piece. It did not paint well at all, and left skips and gaps. Because this machine uses a roller rather than spraying paint, a lot of sand and gravel collected on the roller. The machine is best suited for building or parking lot painting, not roadway use.

**Implementation:** This project is not recommended for implementation.



## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6W/ Owatonna

**Contact:**  
Steve Lueken  
(507) 446-5530

**Project Cost:**  
\$11,225

**MOR Funds:**  
\$11,225

**Start Date:**  
March 2008

**Completion Date:**  
April 2009

**Vendor:**  
bobcat.com

## Wheel Saw Completed Research



**Project Description:** The wheel saw model WS18 is a skid-steer attachment cutting wheel made to cut concrete, blacktop and frozen ground. This unit can be used for cutting out patches in blacktop, cutting out culverts and cutting grooves in paving material before trenching is done. The district would use the WS18 in place of a standard walk-behind concrete saw, which has a diamond blade and is used solely for concrete. A concrete saw also requires a water supply for cutting and the wheel saw does not. Because the wheel saw is also an attachment and does not have its own engine, it has fewer mechanical breakdowns.

**Purpose:** The WS18 will be used primarily for cutting blacktop patches, culverts and grooves in paving material before trenching.

**Test Procedure:** The main test will be the unit's ability to cut concrete, which is the toughest material that workers will be cutting.

**Conclusions:** The WS18 performed beyond expectations in concrete with rebar. The WS18 could make deeper cuts than recommended by the manufacturer. It is an extremely valuable piece of equipment and allowed crews to perform concrete and asphalt cuts faster and easier. The WS18 is more versatile than a standard concrete saw and is also less expensive than a self-propelled concrete saw that is a single-use piece of equipment.

**Recommendations:** The district has highly recommended this unit because of the cost savings in labor. With the WS18, road crews can cut out pavement sections in less time compared to other methods.

**Implementation:** This project has not been placed on the statewide implementation list because it is on contract.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6W/Owatonna

**Contact:**  
Andrew Kubista  
(651) 366-3560

**Project Cost:**  
\$30,000

**NTREC Funds:**  
\$30,000

**Start Date:**  
April 2006

**Completion Date:**  
Summer 2007

## Three-Point Jetter *Completed Research*



**Project Description:** The jetter is a hydraulically driven, three-point hitch tractor/skid-steer-mounted unit used to clean and open culverts. Because it can be easily transported using a pickup or van (no lowboy trailer needed), the jetter can be shared with other offices and sub-areas within the district.

**Purpose:** The jetter will be used to clean and open culverts that are clogged or plugged by silt, gravel or other granular residues; trash; or ice. It will also be used to clean culverts that are in hard-to-access locations.

**Test Procedure:** Mn/DOT will monitor the jetter's hourly water usage and compare it to the cost per hour of a truck-mounted and trailer-mounted unit operated by a city worker or contractor. The jetter's "nurse" tanker holds 1,500 to 6,000 gallons of water. The type of road and culvert conditions where the unit is used will determine its workability in less-than-perfect operating conditions.

**Conclusions:** The jetter met all requirements with no failures. Two or three people were able to clean a 60-foot culvert plugged at 80 percent in approximately 30 minutes. Culverts that were 80 percent to 100 percent plugged along Highway 14 W required 500 to 1,000 gallons of water per culvert. In addition, each district's existing power source (tractor or skid loader) was used with the jetter, eliminating the need to purchase another power source (a cost savings of \$50,000 to \$100,000). Project implementation depends on the number of plugged culverts, manpower available to operate the jetter and the power source.

**Recommendations:** The district highly recommends the jetter for statewide use to clear plugged culverts.

**Implementation:** This project has provided Mn/DOT with many benefits and is currently under review for implementation.





## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Dan Ludwig  
(507) 645-8155

**Project Cost:**  
\$6,000

**MOR Funds:**  
\$6,000

**Start Date:**  
January 2007

**Completion Date:**  
September 2007

**Vendor:**  
apache-laser.com

## Apache Bullseye 6 Laser Completed Research



**Project Description:** The Apache Bullseye 6 Laser Receiver is a laser detection technology used on bulldozers, graders, scrapers and box blades during excavation. The detector will automatically calculate and correct the grade display for the angle of the dipper arm. It will check grade with the dipper arm extended or retracted up to 30 degrees. The built-in plumb indication provides quick and accurate grade checking for excavators and backhoes. It also has selectable accuracy and on-grade information plus out-of-beam indication.

**Purpose:** The Bullseye 6 will speed up excavation because operators will be able to check grade as they dig instead of waiting for another worker on the ground to check the grade.

**Test Procedure:** The built-in plumb sensor provides quick, vertical-only grade checking. The Bullseye 6 has ultra-bright LEDs that are easy to see in all light conditions.

The detector has up to eight channels of grade information plus directional out-of-beam indicators. With built-in 360-degree reception, it picks up the laser from all directions. The Bullseye 6 is a one-man setup; no cables and no welding on-board batteries are required.

**Conclusions:** The Bullseye 6 works very well when used for larger projects that need a slope in the ditch or for setting culverts. Since the operator can check grade from inside the excavator or backhoe, safety is enhanced and labor costs are reduced.

**Recommendations:** This product works very well for all grading and sloping needs. It is very easy to set up and use, and will fit into any operation where setting a perfect grade or slope is a must.

**Implementation:** This product is recommended for implementation.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
Metro/Shakopee

**Contact:**  
Tony Johnson  
(952) 492-2160

**Project Cost:**  
\$600

**NTREC Funds:**  
\$600

**Start Date:**  
January 2006

**Completion Date:**  
May 2008

## Compressed Air Bottle *Completed Research*



**Project Description:** The portable compressed air bottle is an effective alternative to using a vehicle with a compressor when air supply is limited or unavailable at a job site.

**Purpose:** Mn/DOT workers currently carry hand tools to repair most guardrails or change tires out on the road. Some shops in the metro area are equipped with a portable compressed air bottle for guardrail repair. Others use a larger scale model that is pulled behind a vehicle. A smaller, portable compressed air bottle would meet the needs of the Shakopee office.

**Test Procedure:** Currently, the office uses the 6-Pack maintenance truck, a second truck holding the guardrail equipment and an additional vehicle transporting a compressor to repair guardrails. The compressed air bottle would eliminate the need for a third vehicle, which would reduce costs and save time.

**Conclusions:** The compressed air bottle is a very convenient and cost-effective way to supply compressed air to job sites where it is unavailable. It would also reduce the time in finding a vehicle with an air compressor on board, or replacing gutter brooms on the sweeper in the field.

**Recommendations:** The district recommends this project for use when compressed air supply is limited or unavailable.

**Implementation:** Because of some safety policies and securing regulations, this project has not been chosen for the implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
7E/Mankato

**Contact:**  
Larry Cooper  
(507) 389-6959

**Project Cost:**  
\$1,615

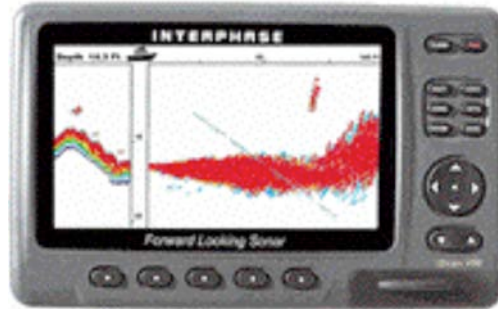
**NTREC Funds:**  
\$1,615

**Start Date:**  
September 2006

**Completion Date:**  
April 2008

**Vendor:**  
interphase-tech.com

## Forward Looking Sonar Completed Research



**Project Description:** District 7 will purchase and install Interphase's new iSCAN V90 Forward Looking Sonar to evaluate bridge scouring. The quality and quantity of data gathered from this monitoring program will be compared with data gathered in previous years, and the amount of time expended will be evaluated.

**Purpose:** The V90 Forward Looking Sonar will be used to capture seasonally low water levels after the next flood season.

**Test Procedure:** With its sweeping vertical scan the Interphase iScan V90 continuously updates the forward-looking display to show changing water depths, shoals, reefs, schools of bait, bottom structure and other suspended objects like fish. Its small, easy-to-install phased-array transducer uses no moving parts and steers a 12-degree acoustic beam in a vertical plane from the surface ahead to 600 feet below.

**Conclusions:** The performance of this unit was outstanding. It gave accurate images and depth readings in any water visibility. The old Lowrance paper graph depth finder only reads directly below the transducer, gives the depth only and records on paper. This device reads the depth directly below with a color pixel graph and also is able to image out up to 240 feet either side of the transducer to see the contour of the river bottom, pier footings and elements of the river bottom (trees, rocks or sand). The unit is user friendly for documentation and for others to review. Imaging, depths and GPS (Global Positioning System) coordinates can be recorded on a computer chip for later viewing and recording on a standard computer or on the system itself. Plotting is also possible.

**Recommendations:** District 7 recommends this system for a scour monitoring program because images can be seen on the screen in real time as can the location of holes, how big they are and what scour is doing to pier footings.

**Implementation:** This system has been placed on the statewide implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Charles Frein  
(507) 379-3414

**Project Cost:**  
\$6,000

**NTREC Funds:**  
\$6,000

**Start Date:**  
January 2007

**Completion Date:**  
November 2007

## Guardrail Sprayer *Completed Research*



**Project Description:** This project reviewed the cost and safety benefits of using a boom-type sprayer mounted on a tractor to spray noxious weeds and grasses. The sprayer can be used on guardrails and concrete center curbing (road dividers) or in any other hard-to-reach areas.

**Purpose:** In the past, employees used a backpack sprayer for these tasks. The guardrail sprayer will eliminate the need for a backpack sprayer, potentially reducing back injuries to employees. This sprayer unit can be easily mounted to a tractor, can be shared with other sub-areas and will free up a tractor when not in use.

**Test Procedure:** The sprayer unit enhances production because it is a quicker way to spray guardrails and reach target areas. In addition to reducing the number of back injuries to employees, the sprayer will allow an employee to stay in the tractor where he is protected from the spray and elements.

**Conclusions:** Using the guardrail sprayer reduced costs by one-third because there was no overlap in chemical usage. Dual chemicals can be used in the tank mix on the new guardrail sprayer versus single applications using the backpack sprayer method. Getting rid of the backpack sprayer will reduce any future back injuries. Man- and equipment-hours were also cut by one-third with this new sprayer.

**Recommendations:** The sprayer would be very effective on the new median cable guardrail. It can also be used in shoulder thistle and weed control by adding a boom buster nozzle to increase the spray pattern of 20 to 30 feet, depending on wind direction and wind speed.

**Implementation:** This product has been placed on the statewide implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
7/Mankato

**Contact:**  
Randy Glaser  
(507) 389-2848

**Project Cost:**  
\$5,500

**MOR Funds:**  
\$5,500

**Start Date:**  
July 2006

**Completion Date:**  
June 2008

## Herbicide Head/Pump Completed Research



**Project Description:** This project will evaluate the savings in time and materials as well as the safety benefits of using tankers for herbicide spraying.

**Purpose:** By using equipment with injection heads and pumps, Mn/DOT employees can apply herbicides more efficiently and safely, as well reduce their exposure to the herbicide.

**Test Procedure:** Mn/DOT will install two herbicide injection heads with injection pumps on 6,000-gallon water tankers for herbicide spraying. The injection pumps allow operators to spray larger areas with a controlled (speed) measuring system, saving time and material. Employees will not have to measure the mix or rinse the herbicides from the equipment. They just have to hook up a 15-gallon container and the head and pump will do the rest with no waste.

**Conclusions:** While getting this project up and running was very labor-intensive, the benefits will be worth it. With 6,000 gallons of water and chemicals that are injected instead of tank-mixed, operators won't have to run water supply trucks for the spray and won't have to tank-mix and triple rinse containers.

**Recommendations:** District 7 is looking for ways to improve this system and does not recommend the project at this time.

**Implementation:** This project will not be placed on the statewide implementation list.





## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Brian Bustad  
(507) 433-0554

**Project Cost:**  
\$6,000

**MOR Funds:**  
\$6,000

**Start Date:**  
March 2007

**Completion Date:**  
November 2007

**Vendor:**  
bobcat.com

## Hydraulic Plate Compactor *Completed Research*



**Project Description:** A hydraulic plate compactor/driver combines high-frequency vibration with high-impact power to make quick work of any compaction or driving task for trenches, around foundations, on slopes and around posts.

**Purpose:** The hydraulic plate compactor will reduce the amount of physical labor required to pack trenches.

**Test Procedure:** District 6 will evaluate the cost and safety benefits of the hydraulic plate compactor. This unit delivers 3,000 pounds of impulse force at 2,000 cycles per minute, assuring maximum lift compaction. A significant time savings is expected since a trench box isn't needed for backfilling trenches or holes.

**Conclusions:** The hydraulic plate compactor was very easy to run and performed well in the field. Test results showed that the unit provided better compaction in less time. Additional cost savings resulted because no trench box or shoring was needed; 1-foot lifts cut compacting time in half; and the crew achieved better density because of size and weight, and increased safety because no one was in the trench.

**Recommendations:** The district recommends the hydraulic plate compactor along with the hydraulic quick attach for ease of hooking and unhooking the unit.

**Implementation:** This project is on the statewide contract; therefore it will not be placed on the implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
4

**Contact:**  
Dennis Redig  
(218) 846-7943

**Project Cost:**  
\$22,000

**NTREC Funds:**  
\$22,000

**Start Date:**  
July 2006

**Completion Date:**  
September 2007

**Vendor:**  
[minimightpatrol.com](http://minimightpatrol.com)

## Mini Might Patrol Completed Research



**Project Description:** The Mini-Might Patrol attachment for a skid-steer loader will replace the current motor grader, which is used for maintaining shoulders and other small motor grader work. With the high cost of purchasing and operating motor graders and the need to more fully use the skid steer loader, this attachment will provide multiple uses for a grader.

**Purpose:** This machine is smaller and more user friendly than a large motor grader. It has a lot of the same capabilities as a full-size motor grader but fits on the front of a skid steer.

**Test Procedure:** The attachment will be evaluated for ease of use in maintaining narrow gravel shoulders. The district anticipates a cost savings by using a smaller unit instead of a large motor grader.

**Conclusions:** The Mini-Might Patrol skid-steer attachment has all the features of a full-size motor grader with the exception of wheel lean to assist in turning. The crews used it for shoulder blading on narrow shoulders and leveling material in the truck station yard. It performed very well in these projects, with the exception of cutting very hard compaction: The machine was somewhat light for hard compacted cutting. In addition to lacking traction, the front end of the machine was light, even with the added 300-pound weights. The crews suggested a few minor modifications to the unit, which can be done in-house.

**Recommendations:** The Mini-Might Patrol is a very useful tool and crews recommend using it for smaller projects in place of large motor graders. The unit also makes use of the skid-steer loader, which will help the district meet its usage performance target for equipment.

**Implementation:** Pending.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
3A/Isle

**Contact:**  
Bryan Karels  
(320) 676-3173

**Project Cost:**  
\$500

**MOR Funds:**  
\$500

**Start Date:**  
April 2005

**Completion Date:**  
April 2008

**Vendor:**  
nomowgrass.com

## No Mow Grass Completed Research



**Project Description:** Instead of using chemicals to control the growth of grass and weeds around guardrails, the district will use a no-mow type of grass that grows slowly and requires very little maintenance.

**Purpose:** Low-mow grass could possibly reduce the man-hours spent mowing and the amount of chemicals sprayed to control weeds around guardrails.

**Test Procedure:** Vegetation will be monitored for growth and height throughout the summer and fall. The district will also evaluate the amount of maintenance required throughout the growing season to see if it is less maintenance than traditional grass.

**Conclusions:** No-mow grass did not perform as well as the district hoped it would. Near regular vegetation management was needed to maintain it. The product did not save time or costs in controlling vegetation around guardrails.

**Recommendations:** This product is not recommended by the district.

**Implementation:** This product has not been placed on the statewide implementation list.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
Metro

**Contact:**  
Dewy Jones  
(651) 234-7944

**Project Cost:**  
\$1,018

**MOR Funds:**  
\$1,018

**Start Date:**  
October 2007

**Completion Date:**  
April 2008

**Vendor:**  
weedender.com

## WeedEnder Completed Research



**Project Description:** WeedEnder is an environmentally safe material designed to control the growth of unwanted vegetation. In this project, a 4-foot-wide by 100-foot-long section of WeedEnder will be placed along existing guardrail on Interstate 35E near the Lexington Bridge/Shepard Road area. If successful, it would reduce man-hours and improve employee safety by eliminating mowing or weed whipping around these structures. It would add approximately \$10 per foot to the initial materials installation cost of guardrail. Labor cost is unknown. Lifetime of the material is 15 years under normal conditions according to the manufacturer.

**Purpose:** If successful, WeedEnder could be the most effective and least labor intensive material to install along new guardrail, signage or fencing.

**Test Procedure:** Mn/DOT Metro district staff will install WeedEnder under the guidance of a U-TECK representative. Photos will be taken at installation, after the snow and ice season (approximately April 2008), in midsummer (approximately July 2008) and at the one-year mark (approximately October/November 2008). The photos will illustrate any damage that occurred during snow and ice season and the effectiveness of the product at inhibiting growth of vegetation.

**Conclusions:** WeedEnder performed very well. This product eliminated the need for chemicals or weed eaters to clear vegetation.

**Recommendations:** The Metro district had great success with this product and recommends installation prior to the installation of the guardrail or fence that it will be placed under.

**Implementation:** This product has not been placed on the implementation list at this time but will be under review.



## Maintenance Research

### Equipment Tools

**District/Office:**  
6/Owatonna

**Contact:**  
Kelvin Smith  
(507) 389-2946

**Project Cost:**  
\$6,500.00

**MOR Funds:**  
\$6,500.00

**Start Date:**  
June 2006

**Completion Date:**  
April 2008

**Vendor:**  
constructionequipment.com

## Auto Greasing System Completed Research



**Project Description:** The auto greasing system is an effective method for lubricating plow trucks. During the lubrication cycle, grease is drawn from the reservoir and pumped to the injectors via the main pipe. The injectors then simultaneously force a predetermined amount of grease through the secondary pipes to the points to be lubricated. When the pressure in the main pipe reaches a preset value, the pressure control valve opens and the grease is pumped back into the tank. This allows the pressure control valve to maintain the preset pressure in the system throughout the entire lubrication cycle.

**Purpose:** Greasing plow trucks is time-consuming, especially in snow and ice conditions. This system would lubricate the trucks automatically.

**Test Procedure:** Mn/DOT will evaluate the cost and time savings of automatically lubricating plow trucks versus manually greasing the unit, which is usually one to two hours per unit every 1,000 miles. Mn/DOT will also evaluate equipment wear, the greasing system and any time spent repairing the system.

**Conclusions:** No breakdowns occurred while using the auto greasing system. This system gives operators the assurance that their equipment is properly lubricated and all grease fittings are lubricated during routine maintenance intervals.

**Recommendations:** This system should be used with vehicles that have many grease fittings or have grease fittings that are hard to reach. Because there is less downtime from improper lubrication, this system saves time and manpower.

**Implementation:** This system is recommended for statewide implementation.





## Maintenance Research

### Equipment Tools

**District/Office:**

Metro

**Contact:**

Dewy Jones  
(651) 234-7944

**Project Cost:**

\$1,500

**MOR Funds:**

\$1,500

**Start Date:**

July 2007

**Completion Date:**

July 2008

**Vendor:**

davidclark.com

## Headset with Foot Switch *Completed Research*



**Project Description:** The headset with foot switch is a safety measure that will allow operators to drive the loader, work the controls and communicate with the haul trucks. The equipment may also eliminate backing accidents.

**Purpose:** This project will evaluate metro loader operators' ability to have both hands available for driving and maneuvering while being in contact with truck drivers through the headset.

**Test Procedure:** Field personnel will evaluate the equipment's performance after two seasons: the snow and ice season (about April 15, 2008) and the sweeping season.

**Conclusions:** The headset provided drivers with hands-free operation of the radio while operating the loader-mounted snow blower. The equipment enhanced communications between the operators and truck drivers while increasing safety.

**Recommendations:** This product performed very well and is highly recommended by the Metro district.

**Implementation:** The headset with foot switch has not been placed on the statewide implementation list.



## Maintenance Research

### Equipment Tools

**District/Office:**  
6 Rochester

**Contact:**  
Adam Miller  
(507) 446-5525

**Project Cost:**  
\$550

**MOR Funds:**  
\$550

**Start Date:**  
April 2008

**Completion Date:**  
April 2009

**Vendor:**  
watercannon.com

## Mud Cannon Completed Research



**Project Description:** The Mud Cannon undercarriage cleaner can be hooked up to a pressure washer hose for various cleaning applications. The unit has a durable stainless steel Mosmatic swivel and spray bar with a spinning four-nozzle rotating assembly that covers an area of approximately 24 inches. A telescopic handle allows operators to get to hard-to-reach places under a truck to remove sand, salt and oil that can damage the underbody of a vehicle.

**Purpose:** The district will use the Mud Cannon to clean hard-to-reach areas under vehicles. By using the Mud Cannon, the district expects to eliminate some of its maintenance costs caused by corrosion.

**Test Procedure:** Trucks will be washed both with and without the undercarriage cleaner to see how much chemical and dirt is removed from the undercarriages. Also, corrosion and rust will be visually monitored to determine if there is a reduction or acceleration of corrosion.

**Conclusions:** The Mud Cannon performed well. It cleaned many areas that are normally difficult to reach with a regular pressure washer wand. The unit had enough pressure to dislodge sand and salt from the truck. It didn't remove grease from the frame area, which was probably too far away from the pressure heads. However it did remove grease and oil from the brake chambers and axles.

**Recommendations:** The Mud Cannon should help crews improve truck and equipment maintenance by removing more salt and preventing more rust.

**Implementation:** Pending.



## Maintenance Research

### Equipment Tools

**District/Office:**  
3/Baxter

**Contact:**  
Dennis Thomsen  
(218) 828-5730

**Project Cost:**  
\$8,000

**MOR Funds:**  
\$6,000

**Start Date:**  
December 2006

**Completion Date:**  
July 2009

**Vendor:**  
getnitrogen.org

## Nitrogen Tires *Completed Research*



**Project Description:** Tires are the second largest expense in maintenance fleet costs. In this project, the Baxter shop purchased and installed a nitrogen-generating tire inflation system to replace air with nitrogen in the fleet's tires for better vehicle handling and reduced tire expenses.

**Purpose:** This project would assess the impact of using nitrogen instead of air to inflate tires. If this practice could extend the service life of the fleet's tires by 10 percent, the department could save \$600,000 every two years.

**Test Procedure:** In the spring of 2008, the department installed a Branick Model 500 nitrogen generator with a 120-gallon reservoir in the Baxter mechanical room. Permanent piping was installed to several areas of the shop. The department will compare vehicle handling, fuel economy, tire performance and life cycle costs in tires inflated with nitrogen against current data for tires inflated with air.

**Conclusions:** To date, approximately 75 percent of the tires in D3A's fleet are running with nitrogen. Results suggest that tires filled with nitrogen maintain pressure for a longer time. The department is anticipating fuel savings and longer tire life, however additional testing is needed to determine if this practice is cost-effective.

**Recommendations:** The generator is working as anticipated, and the department is satisfied with the results.

**Implementation:** Pending.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**  
7B/Window

**Contact:**  
Ron Gaffke  
(507) 831-1227

**Project Cost:**  
\$35,500

**NTREC Funds:**  
\$35,500

**Start Date:**  
April 2007

**Completion Date:**  
April 2008

**Vendor:**  
horizonsignal.com

## Horizon Portable Traffic Control Signal Completed Research



**Project Description:** The SQ2MP Portable Traffic Control System by Horizon Signal would be used on lane closure for bridge maintenance projects on two-lane roads. Currently two bridge maintenance staff direct traffic during a lane closure project. The signal device has three 12-inch lights (red, yellow and green); programmable times; unit-to-unit communication (3-mile range); conflict monitoring; and other advanced features to ensure the safety of both the bridge maintenance crew and the traveling public.

**Purpose:** The SQ2MP Portable Traffic Control System will be used to direct traffic during bridge maintenance, allowing the entire four-person crew to perform the work needed, reducing the lane closure time by half.

**Test Procedure:** The SQ2MP Portable Traffic Control System will be set up on opposite ends of the work area. The traffic control system will be monitored for how well traffic obeys the lights and to make sure the product does not fail during a closure.

**Conclusions:** The Horizon Signal traffic control system allowed at least two more workers to help with the actual repair work rather than flag traffic. The system improved productivity, decreased job completion time and allowed more employees to work on other projects because flaggers were not needed.

**Recommendation:** District 7 recommends this project for any short- or long-term lane closure.

**Implementation:** This project is on the statewide contract; therefore it will not be on the implementation list.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**  
Metro

**Contact:**  
DeWayne Jones  
(651) 234-7944

**Project Cost:**  
\$12,000

**MOR Funds:**  
\$8,700

**Start Date:**  
September 2005

**Completion Date:**  
November 2008

## In-Vehicle Video Camera *Completed Research*



**Project Description:** The in-vehicle video camera can be used for filming road conditions, snow and ice events, incidents, and detour and haul routes prior to construction. The camera, which records to a digital video recorder, can also be used for training purposes.

**Purpose:** The in-vehicle video camera will be evaluated for its usefulness in training (including snow and ice training) and in tort claims or incident management.

**Test Procedure:** Workers will use various camera sizes to see how they worked independently or in conjunction with other cameras. The camera will be mounted inside a maintenance vehicle and can be switched on and off when necessary. The footage will be recorded to the DVR and uploaded to a PC for viewing. The camera also has a GPS (Global Positioning System) receiver, and the coordinates can be determined and recorded.

**Conclusions:** The cameras researched in this project were fixed focal length cameras that they could not zoom or pan out. When the focal length was increased from a 3.6mm to a 6.0mm camera, the camera lost peripheral view but gained zoom power. The same results were obtained when moving from a 6.0mm to a 16.0mm camera. Choosing the right camera is critical to achieving a usable end product, depending on the images the operator is trying to capture. In some situations where more detail was warranted, the operator chose a more focused view, sacrificing the wide angle view and missing critical information that was outside the focal area. With more time and practice, operators become more proficient at choosing the right system. If the application is a fixed system, the operator could experiment with different cameras until an optimal performance for a particular situation was achieved.

**Recommendations:** The Metro district highly recommends this product but suggests investigating various camera systems because many do not meet minimum standards and overall performance may be unsatisfactory.

**Implementation:** At this time this project is not on the statewide implementation list.





## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**  
CO

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$0

**MOR Funds:**  
\$0

**Start Date:**  
April 2007

**Completion Date:**  
April 2009

**Vendor:**  
dakotafence.com

## Reflective Shirts *Completed Research*



**Project Description:** Maintenance employees will wear reflective safety shirts instead of vests for three months to test for comfort, visibility, design and durability. Rather than giving employees a vest for the summer and one for the winter (fits over their coat), employees will receive one vest and two shirts.

**Purpose:** The district will monitor the effectiveness of a reflective safety shirt to see if it gives the same protection as a vest. The benefits of this project could help keep employees cooler during summer maintenance. At the end of three months, employees will evaluate the shirts, and the 3M lab will test their reflectivity and color.

**Test Procedure:** District 2 and Metro will give five maintenance employees a shirt from three vendors. Employees will care for the shirts and evaluate their effectiveness after use and cleaning for three months.

**Conclusions:** The shirts manufactured by 3D Specialties with 3M Comfort Trim reflective material succeeded in all aspects of the test. Employees from both districts said that the shirts were very cool and comfortable to wear. The lab results were also favorable, which has led to the use of these shirts statewide. There was one comment that the shirts were too cool in the early morning hours.

**Recommendations:** This project was driven by maintenance workers.

**Implementation:** Pending for 2010.



## Maintenance Research

Safety Traffic Control  
Workzone Safety

**District/Office:**  
CO

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$1,500

**MOR Funds:**  
\$1,500

**Start Date:**  
April 2008

**Completion Date:**  
April 2009

**Vendor:**  
swifthitch.com

## Swift Hitch Cameras *Completed Research*



**Project Description:** This project reviewed the effectiveness of using the Swift Hitch Camera system in maintenance and backing applications. The Swift Hitch has a magnetic camera that mounts to the hitch or back of a vehicle. Inside the vehicle, the operator uses a handheld screen to view the area. This setup will give operators a perfect view of what is behind them at all times.

**Purpose:** The camera system will be used to help operators who are trying to back into a tight space or are backing in an area when no one is available to assist with the maneuver.

**Test Procedure:** The wireless cameras are not mounted permanently but are held in place by a magnetic strip. They have a 300-foot range and can be recharged in the vehicle's cigarette lighter. Employees will provide feedback about the system's ability to give a clear view of what is behind the vehicle during backing maneuvers.

**Conclusions:** These cameras were used for many maintenance and backing applications with great success. They were used by the mudjacking crew to watch for pipe failure during filling procedures, by the tree crew during cleanup procedures and in many other backing procedures.

**Recommendations:** These cameras were very successful and useful in the maintenance shops, and are highly recommended.

**Implementation:** This project has not been selected for the statewide implementation list.

## **2007-2009 Research in Progress**



## Maintenance Research

### Winter Maintenance

**District/Office:**  
2/Bemidji and  
4/Detroit Lakes

**Contact:**  
Joe Huneke  
(651) 366-3586

**Project Cost:**  
\$2,168

**MOR Funds:**  
\$2,168

**Start Date:**  
December 2009

**Vendor:**  
Henderson  
henderson-mfg.com

## Air Foil *Research in Progress*



**Project Description:** The air foil system will help keep the rear area of the plow trucks free of snow and ice in the winter and dust in the summer, which can limit the public's visibility when approaching the rear of a maintenance vehicle.

**Purpose:** The air foil will be used to improve the air flow in the back of the truck, preventing the buildup of snow and dust. It will also improve the visibility of the motoring public by keeping the strobe lights, turn signals and reflective material more visible.

**Test Procedure:** Two districts will monitor the trucks with air foils and compare the results to trucks without air foils. If the system is successful, maintenance trucks should stay clear of snow and dust buildup.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Tom Osthoff  
(612) 520-3560

**Project Cost:**  
\$1,500

**MOR Funds:**  
\$1,500

**Start Date:**  
January 2008

**Vendor:**  
airvizion.com

## Air Vizion Research in Progress



**Project Description:** The Air Vizion mirror cleaning system removes water droplets and snow that accumulate on Mn/DOT hood-mounted blind spot mirrors. These mirrors are critical for the operator in locating the plow wing, along with checking blind spots, whether in the up or down position. The mirror is cleared by delivering a burst of compressed air to the mirror surface. The compressed air is generated by the truck's engine-mounted air compressor.

**Purpose:** The Air Vizion will be used to remove water droplets or snow from mirrors. The system will enhance driver visibility and improve vehicle safety, reducing accidents and their associated damage, and relieving drivers from manually wiping mirrors.

**Test Procedure:** The drivers will provide feedback after a period of time about the product's performance during snow removal and its ability to withstand the rigors of Minnesota's harsh environment.





## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Norm Ashfeld  
(651) 234-7907

**Project Cost:**  
\$125,000

**NTREC Funds:**  
\$125,000

**Start Date:**  
September 2007

## Blending Station *Research in Progress*



**Project Description:** This project would determine the cost-effectiveness and efficiency of treating the district's salt in-house instead of outsourcing the task. The blender is portable with about a 10-year life cycle. This application method used with the blender would be a substantial improvement over the current method of just spraying the liquid over the salt. Adding a machine of this kind could result in a savings of \$250,000 per year statewide.

**Purpose:** If successful, the blending station would not only be a huge cost savings for Mn/DOT, but would give the department flexibility on where and when to treat the salt in-house. It would also provide a partnership opportunity with counties and cities. (One county has already expressed a desire to partner with Mn/DOT on this project.)

**Test Procedure:** Operators will inject approximately 6 to 7 gallons of a mixture of magnesium chloride, agricultural co-product and a noncorrosive additive into a ton of regular salt inside the blender. The finished product could then be used at colder temperatures and at lower application rates.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Central Office

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$2,980 (each)

**MOR Funds:**  
\$8,940 (3 units)

**Start Date:**  
August 2009

**Vendor:**  
scale-tec.com

## Calibration Scales *Research in Progress*



**Project Description:** The lack of proper sander calibration is a major issue throughout Mn/DOT and is one of the leading reasons material is being wasted. When the exact amount of material leaving the truck is unknown, drivers may make extra passes or oversaturate roads with salt, which increases labor and material costs and causes environmental concerns.

**Purpose:** Calibrating sanders can be a cumbersome job without the proper weighing equipment. The new calibration scale will help to ensure proper calibration consistency statewide with ease. Manual scales will not be needed while calibrating sanders, which will increase sander consistency statewide.

**Test Procedure:** The calibration scales will be evaluated for performance and reliability as well as for their ability to save costs and materials.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Mark Fischbach  
(651) 234-7907

**Project Cost:**  
\$2,500

**MOR Funds:**  
\$2,500 (10 units)

**Start Date:**  
February 2009

**Vendor:**  
cftproducts.com

## Crystal Fusion *Research in Progress*



**Project Description:** Crystal Fusion improves driver reaction time by keeping windshields and glass surfaces cleaner. It improves visibility during inclement weather and reduces the likelihood of damage from small road debris such as sand. Crystal Fusion bonds with glass at the molecular level. It changes the surface of the glass, increasing its strength and clarity, and decreasing the ability of dirt and moisture to cling to the glass.

**Purpose:** Crystal Fusion will give operators a clearer view of the roadway and activities out the front windshield. It will reduce the cost of windshield and wiper replacement, and may prevent accidents.

**Test Procedure:** Crystal Fusion will be applied to 10 snowplows and eight supervisor vehicles. These employees will document performance and visibility through observation during regular use.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Mark Fischbach  
(651) 234-7907

**Project Cost:**  
\$17,500

**NTREC Funds:**  
\$17,500

**Start Date:**  
September 2009

## GPS Route Planning *Research in Progress*



**Project Description:** Each year, the Metro district employs many new drivers and drivers from outside of maintenance to assist in snow and ice operations. These drivers tend to be assigned to different truck stations, and different snow and ice routes within the truck station. Many drivers don't know the routes very well (if at all) and at times, don't know where to apply chemicals. If a predetermined route could be installed in these relatively inexpensive, directional Global Positioning System units, these drivers could just follow the preprogrammed route from the unit. Specific ramps, interchanges and turnaround points could also be programmed into the unit as well as areas where chemicals should be applied.

**Purpose:** The application of this project would enhance the Metro district's ability to provide a superior snow and ice removal plan, as well as reduce the amount of harmful chemicals currently being applied to the metro highways.

**Test Procedure:** The district will evaluate the GPS route planning unit for its ability to help drivers accurately follow the preprogrammed routes.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
2/Thief River Falls

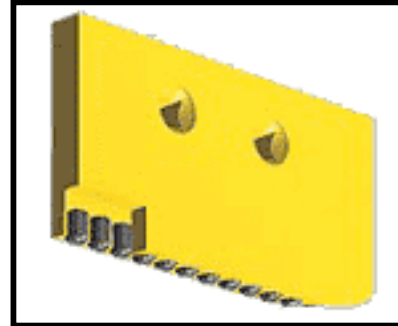
**Contact:**  
Ronny Thramer  
(218) 463-2821

**Project Cost:**  
\$2,675

**MOR Funds:**  
\$2,675 (for 2 sets)

**Start Date:**  
September 2009

## I.C.E. Blades *Research in Progress*



**Project Description:** The new I.C.E. (Isolated Carbide Edge) Series blades feature individual, solid carbide tips in the blade edge for maximum fracture resistance in tough, high-impact road conditions. These bullet-shaped inserts resist fractures better than traditional rectangle and trapezoid styles. Each insert is separated by steel to prevent fractures from traveling between inserts and causing damage along the length of the blade. I.C.E. Series blades are more aggressive in hard-packed snow and ice than straight-edge blades and keep de-icing materials more effectively on the road surface.

**Purpose:** The new technology in I.C.E. Blades will cut ice and compacted snow quicker. The carbide inserts are finger-like inserts that cut grooves into the compacted snow and ice, which will help hold material in place. Once these carbides have worn out, Mn/DOT will send them back to the vendor for reconditioning for only about half of the cost of replacement blades.

**Test Procedure:** Mn/DOT operators will test these new carbides for their cutting ability, material savings, potential fuel savings and number of passes needed to reach “bare lane.”





## Maintenance Research

### Winter Maintenance

**District/Office:**  
Central Office

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$1,120

**MOR Funds:**  
\$1,120 (\$160 each)

**Start Date:**  
January 2009

**Vendor:**  
whelenengineering.com

## LED Sander Lights *Research in Progress*



**Project Description:** During nighttime snow and ice control operations, it is critical for operators to be able to see their sanders to make sure material is being dispensed and placed as intended. Currently, sanders are lighted with an incandescent light, which uses a lot of power, is not very bright, and is susceptible to vibration-induced maintenance issues, such as wires shorting out or falling apart. LED lights are much brighter and come with a five-year warranty.

**Purpose:** LED lights may save material by allowing operators to see their sanders during night operations to assure that sand is being placed properly. In addition, replacing incandescent lights with LED lights will reduce the demand placed on the vehicle's alternator, which supplies power to the lights. This may prolong the alternators' life, which would reduce money spent on replacement alternators and on labor to perform the replacement.

**Test Procedure:** Mn/DOT will evaluate how well the LED lights improve operators' ability to see the material being dispensed while reducing demands on the vehicles' alternators.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Steve Lueken  
(507) 446-5532

**Project Cost:**  
\$40,000

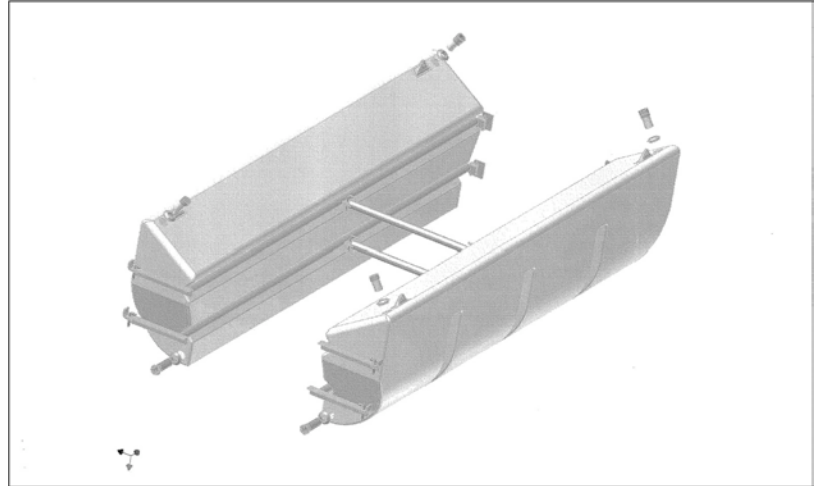
**NTREC Funds:**  
\$40,000

**Start Date:**  
October 2008

**Vendor:**  
henderson-mfg.com

## Molded Slurry Tanks

### Research in Progress



**Project Description:** Using a 70 percent granular/30 percent liquid ratio for applying deicing chemicals has been proven to reduce material use. To achieve this ratio, salt is saturated in the auger and placed on the road using a chute, spinner or zero-velocity sander. Once this material has been applied to the road surface, it starts working immediately because of the high content of salt brine or other liquid deicing chemical. To facilitate this, Mn/DOT will add two in-box molded tanks to a truck, each holding 400 gallons of liquid. The tanks will be hooked up to a pressurized delivery system that is preset to achieve the 70/30 ratio. Project funds will go toward the mold creation, tanks, delivery system, installation, liquid valve driver and plumbing.

**Purpose:** This system will reduce material use, and there will not be as much blow-off or scatter as with dry material. There will be a fuel savings because fewer rounds will be needed, and the system will increase the overall level of service provided to the public. In initial tests of this system, operators reported that they could often see the slurry begin to work in their rearview mirrors as they drove, which does not happen with standard prewetted salt.

**Test Procedure:** This system is being tested using a maximum of 350 pounds of salt and 9 gallons of brine per lane mile, which is equivalent to a slurry combination of 373 to 375 pounds of salt per lane mile. The same truck would normally dispense 500 pounds of salt per lane mile with some brine (gravity flow) for prewetting.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
7/Mankato

**Contact:**  
Randy Glaser  
(507) 304-6235

**Project Cost:**  
\$22,000

**NTREC Funds:**  
\$22,000

**Start Date:**  
August 2008

**Vendor:**  
monroe.com

## Monroe Roller Mill *Research in Progress*



**Project Description:** Demonstrations have shown that applying salt as a slurry mixture reduces salt application rates and improves regain times. The Monroe RTS Replacement Tailgate Sander with roller mill slurry spreader can be used for this type of salt application. While the roller mill slurry spreader was developed for a live bottom V-box spreader, the spreader's manufacturer indicates that the unit can be used with the district's newer elliptical plow trucks.

**Purpose:** The roller mill slurry spreader will be used with the district's elliptical plow trucks. Use of the new system may result in reductions in salt application rates and regain times.

**Test Procedure:** The district will evaluate whether the roller mill slurry spreader, when used on its elliptical plows, is more effective than the units the district currently purchases.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
3/ Monticello

**Contact:**  
Dan Whebbe  
(763) 295-5525

**Project Cost:**  
\$984

**MOR Funds:**  
\$984

**Start Date:**  
November 2008

**Vendor:**  
lord.com

## Motion Master Seat *Research in Progress*



**Project Description:** Rough roads and standard air-suspended seats can work together to result in fatigue and risk of injury for snowplow operators. Seating equipped with the LORD Motion Master Ride Management System that automatically adapts to the driver's body weight and changing levels of shock and road vibration can offer safety and health benefits to the driver.

**Purpose:** This project may reduce snowplow operator fatigue and risk of injury and help operators work multiple shifts more comfortably and safely.

**Test Procedure:** District 3 will evaluate the effectiveness of the Motion Master system by surveying operators after use. Survey questions will address the system's overall comfort, stability and design.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
1/Virginia

**Contact:**  
Wendy Frederickson  
(218) 742-1100

**Project Cost:**  
\$3,700

**MOR Funds:**  
\$3,700

**Start Date:**  
November 2008

## Rock Salt Moisture Tester *Research in Progress*



**Project Description:** Currently, Mn/DOT tests about 75 percent of all loads of salt received. A new rock salt moisture testing system will replace District 1's current method of testing new salt deliveries, which uses a tri-bar scale and microwave or stovetop to test for excess moisture in salt.

**Purpose:** Testing the moisture in salt is important because excessive moisture can result in salt stockpiles freezing, making it difficult to use. The new system is simple and easy to use, and personnel can sample each truck as it arrives without having to use a stove or microwave.

**Test Procedure:** District 1 will compare the new rock salt moisture tester with the current method of testing salt moisture to determine the new method's dependability and accuracy.





## Maintenance Research

### Winter Maintenance

**District/Office:**  
7/Windom

**Contact:**  
Shawn King  
(507) 831-8042

**Project Cost:**  
\$1,065

**MOR Funds:**  
\$1,065 (\$165 each)

**Start Date:**  
April 2009

**Vendor:**  
edgelight.com

## Snow Plow Reflector *Research in Progress*



**Project Description:** Edge-O-Lite snowplow reflectors placed on the outside edges of snowplows may help oncoming traffic determine the location of the edges of the snowplow. The reflectors may also improve the snowplow operators' ability to see the wings during nighttime operations, and prevent operators from hitting mailboxes, signs and vehicles along roadways.

**Purpose:** These snowplow reflectors, used on plows on two- and four-lane highways and Interstate routes, may improve the safety of employees plowing the roads and the traveling public.

**Test Procedure:** District 7 will monitor the behavior of oncoming traffic when approaching plow trucks with and without snowplow reflectors to assess the effectiveness of the system in helping to reduce accidents.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
Metro

**Contact:**  
Mark Fischbach  
(651) 234-7907

**Project Cost:**  
\$15,000

**NTREC Funds:**  
\$15,000

**Start Date:**  
March 2008

**Vendor:**  
vikingvices.com

## Tow Plow with Granular Capabilities

### *Research in Progress*



**Project Description:** The tow plow, a snowplow that can clear two lanes of traffic at once, has proved itself to be roadworthy, versatile and operator-friendly. The second generation of the tow plow includes an option for a granular box that is fitted on the frame of the tow plow that can be used in addition to an anti-ice spray bar for liquid application.

**Purpose:** Preliminary evaluation of the first-generation tow plow indicates a significant savings in equipment and labor costs, and an increase in efficiency in snow removal operations. The second generation of the tow plow, with its granular box, offers more flexibility in material application.

**Test Procedure:** The Metro district will compare the effectiveness of the second-generation tow plow, with its ability to apply granular materials, with first-generation tow plows lacking a granular box to determine whether the extra expense of the second-generation equipment is justified.



## Maintenance Research

### Winter Material

**District/Office:**  
6/Cannon Falls  
Metro

**Contact:**  
Tim Zierden  
(651) 385-6416

Mark Fischbach  
(651) 234-7907

**Project Cost:**  
\$8,000

**MOR Funds:**  
\$8,000

**Start Date:**  
December 2009

**Vendor:**  
ompassmaterials.com

## Articlear Gold *Research in Progress*



**Project Description:** This project will compare the effectiveness of Articlear Gold Salt Brine Additive to the district's current product, liquid corn salt.

**Purpose:** Articlear Gold Salt Brine Additive may help reduce the amount of salt needed to apply to the road surface. It may provide a lower working temperature, reduce the corrosiveness of salt and give the district another prewetting, de-icing resource.

**Test Procedure:** At the end of one year, the district will complete a visual inspection and material usage comparison between Articlear Gold and liquid corn salt. If successful, Articlear Gold could be used statewide.



## Maintenance Research

### Winter Maintenance

**District/Office:**  
2/Bemidji

**Contact:**  
Bob Anderson  
(218) 390-9012

**Project Cost:**  
\$5,000

**MOR Funds:**  
\$5,000 (\$1.07 per gallon)

**Start Date:**  
November 2008

**Vendor:**  
tigercalcium.com

## Road Guard Plus 8 *Research in Progress*



**Project Description:** Road Guard Plus-8 is a corrosion-inhibited liquid form of calcium chloride and magnesium chloride brine developed especially for anti-icing and prewetting at extremely low temperatures down to  $-45^{\circ}\text{C}$ . The active ingredients for deicing are 26.5 percent calcium chloride, 3.1 percent magnesium chloride, 2.2 percent alkaline chlorides including sodium chloride and potassium chloride, and 8 percent highly effective corrosion inhibitors. The corrosion rate is 85 percent lower than sodium chloride.

**Purpose:** Use of Road Guard Plus-8 is expected to result in less corrosion on bridge components, greater effectiveness as an anti-icing and prewetting agent in colder temperatures, and reduced salt usage on bridge decks. The product may also cut severe compaction on roadways.

**Test Procedure:** The district will assess the effectiveness of Road Guard Plus-8 when used to spray bridge decks during conditions when ice and frost forms. The product will also be added to salt brine when severe compaction is present on roadways to help shorten the time to obtain bare lanes.



## Maintenance Research

### Winter Material

**District/Office:**

7, 8, Metro

**Contact:**

Shaw King  
(507) 831-8042

Denny Marty  
(320) 214-6336

Mark Fischbach  
(651) 234-7907

**Project Cost:**

\$80 per ton, 90 ton per district

**MOR Funds:**

\$21,600

**Start Date:**

May 2008

**Vendor:**

[compassmaterials.com](http://compassmaterials.com)

## ThawRox Treated Salt *Research in Progress*



**Project Description:** The districts have purchased Compass Minerals' magnesium-chloride treated salt to augment the magnesium-chloride product from Cargill that was purchased last year.

**Purpose:** This project will compare the effectiveness of Compass Minerals' ThawRox treated salt and Cargill's ClearLane treated salt.

**Test Procedure:** The districts will prepare performance comparison reports of the Compass Minerals product and Cargill's ClearLane treated salt to assess product effectiveness.





## Maintenance Research

### Road/Bridge Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Tom Johnson  
(507) 379-3414

**Project Cost:**  
\$2,500

**MOR Funds:**  
\$2,500

**Start Date:**  
February 2009

**Vendor:**  
bobcat.com

## Concrete Chuter *Research in Progress*



**Project Description:** With this concrete chuter attached to the skid loader, Mn/DOT crews can access hard-to-reach areas at the placement area that the concrete truck cannot reach. The bridge crew can use the attachment to place concrete for concrete slope paving, bridge railing repair and bridge curb repair.

**Purpose:** The concrete chuter will be used to place concrete in areas that are inaccessible to trucks and wheel barrows because of the terrain. The concrete chuter may also reduce back injuries to the bridge crew.

**Test Procedure:** The district will evaluate the concrete chuter for its ability to place concrete in areas that concrete trucks cannot reach.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6/Owatonna

**Contact:**  
Steve Lueken  
(507) 446-5530

**Project Cost:**  
\$25,000

**NTREC Funds:**  
\$5,000

**Start Date:**  
August 2009

**Vendor:**  
diamondmowers.com

## By-Pass Hydraulic Mower *Research in Progress*



**Project Description:** The PTO hydraulic-driven batwing mower includes a bypass on motors for sheer protection. The unit is equipped with flotation tires and a mercury switch shutoff that engages when the wing is raised past 45°. The mower fits to any tractor and isn't dedicated to any one piece of equipment. The machine will provide longer running times with less downtime. The cost is 35 percent higher than comparable units; return on investment will be seen within two to three years.

**Purpose:** This machine will offer a longer running time with less downtime. The district will have lower overhead costs than with the current shaft-driven mowers—no clutches, gear boxes or drive shafts to replace.

**Test Procedure:** The mower will be evaluated for performance and reliability as well as for its ability to save costs and materials.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
1/Virginia

**Contact:**  
Greg Pierzina  
(218) 742-1082

Wendy Frederickson  
(218) 742-1100

**Project Cost:**  
\$4,950

**MOR Funds:**  
\$4,950

**Start Date:**  
October 2008

## Magnetic Manhole Cover Remover

### *Research in Progress*



**Project Description:** Manhole covers and catch basins are very heavy and cumbersome to move around. Magnetic manhole cover lifts raise heavy manhole covers, minimizing stress and strain for maintenance crews. They also reduce the risk of workers slipping and falling, especially in rainy, snowy or icy conditions.

**Purpose:** This system may reduce the risk of painful and costly injuries and lost-time accidents.

**Test Procedure:** The district will evaluate the effectiveness of the magnetic manhole cover lift system, determining whether it removes and replaces the covers safely and efficiently, and whether it keeps operators out of harm's way.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
4/Morris

**Contact:**  
Brent Holland  
(320) 208-7022

**Project Cost:**  
\$2,095

**MOR Funds:**  
\$2,095

**Start Date:**  
November 2008

**Vendor:**  
[propanehammer.com](http://propanehammer.com)

## Propane Hammer *Research in Progress*



**Project Description:** A propane-powered hammer used to pound culvert markers, guardrail posts and sign posts eliminates the need for an air compressor. Lighter than hammers that use air compressors by approximately 20 to 30 pounds, the propane hammer is capable of pounding 200 posts on a single 14-ounce propane cylinder without use of a hose attachment.

**Purpose:** The propane-powered hammer works like the hammers currently in use but is lighter and eliminates the setup and tear-down time of an air compressor.

**Test Procedure:** The district will evaluate the ability of the propane hammer to save time by eliminating air compressor setup, startup and tear down, reduce workers' back and arm strain and the possibility of injury, and save money by eliminating the need for a diesel or gas compressor.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
1/Virginia

**Contact:**  
Wendy Frederickson  
(218) 742-1100

Greg Pierzina  
(320) 251-4558

**Project Cost:**  
\$4,657

**MOR Funds:**  
\$4,657

**Start Date:**  
April 2009

**Vendor:**  
bobcat.com

## Rotary Screener *Research in Progress*



**Project Description:** A rotary screener can be used to screen topsoil piles to rid them of rock and debris, maintain consistent material size, and screen out unwanted clumps.

**Purpose:** Maintaining consistent ditching or shouldering material is important for proper installation. The rotary screening system is expected to make the material more user-friendly and help ensure consistency in operations. Savings may also be realized by eliminating the need to buy additional shouldering or ditching material.

**Test Procedure:** The district will evaluate the rotary screener for its ability to save time by eliminating the need to sort through dirt by hand to remove debris and clumps.





## Maintenance Research

### Roadside Maintenance

**District/Office:**  
7/Windom

**Contact:**  
Tony Desantınago  
(507) 831-8041

**Project Cost:**  
\$28,300

**NTREC Funds:**  
\$17,000

**Start Date:**  
July 2008

**Vendor:**  
[rotajetter.com](http://rotajetter.com)

## Rota-Jetter *Research in Progress*



**Project Description:** The Rota-JETTER is a culvert cleaning machine that cleans culverts from 8 feet to over 36 feet. The machine's tools, cutting heads, water tank, and 110 feet of cleaning rods are mounted on a trailer; more cleaning rods can be added, up to 200 feet. Tools for smaller culverts are available, and the machine can be used to make horizontal bores of 8 feet or less.

**Purpose:** Currently, District 7 is limited in its options to clean culverts. Hiring or borrowing a culvert cleaning machine is inefficient and, with a culvert drainage inventory in process, the district needed a better method of cleaning culverts so that their condition can be rated.

**Test Procedure:** The district will evaluate the efficiency of the Rota-JETTER by comparing the number of culverts cleaned with and without use of the Rota-JETTER over the same period of time.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
8/Marshall

**Contact:**  
Richard Persoon  
(507) 537-2078

**Project Cost:**  
\$2,982

**MOR Funds:**  
\$2,982

**Start Date:**  
April 2009

## Spectra Precision Laser for Determining Sign Height

*Research in Progress*



**Project Description:** Currently all sign panels must be installed so that the bottom is 7 feet above the roadway and 12 feet out from the traveled way. Currently there is no way to accurately measure these distances. With Spectra Precision Laser, the installer will be able to get an accurate measurement, reducing the time needed to install the panel and, in case of an accident, ensuring that the height is correct.

**Purpose:** This system may improve the productivity of the sign crews because it will save time and improve safety. Workers will spend less time on the roadway and climbing out of ditches.

**Test Procedure:** The district will evaluate the Spectra Precision Laser for its ability to help sign crews accurately install sign panels.



## Maintenance Research

### Roadside Maintenance

**District/Office:**  
6/Austin

**Contact:**  
David Williamson  
(507) 433-0554

**Project Cost:**  
\$3,000

**NTREC Funds:**  
\$3,000

**Start Date:**  
March 2008

**Vendor:**  
weedwiper.com

## Weed Wiper *Research in Progress*



**Project Description:** A three-point weed wiper can be used in almost any kind of weather to kill weeds that tower over grass or protected plants. The weed wiper can also be used to rub over small brush.

**Purpose:** Depending on weed pressure, the weed wiper will use about one-quarter of the chemical required with other units. It can also be used with a range of chemicals to kill various weeds and brush.

**Test Procedure:** The district will evaluate the weed wiper by measuring the amount of chemical saved and the amount of ground covered while managing noxious weeds.



## Maintenance Research

### Equipment Tools

**District/Office:**  
1/Duluth

**Contact:**  
Doug Weitalla  
(218) 742-1080

Chris Vest  
(218) 742-1100

**Project Cost:**  
\$2,117 (2 units)

**MOR Funds:**  
\$2,117

**Start Date:**  
November 2008

**Vendor:**  
anticorrosion.com

## Anti-Corrosion *Research in Progress*



**Project Description:** Applying high voltage (very low amperage) to a truck body can diminish the electro-chemical progress of corrosion. The CounterAct electrostatic corrosion control system creates a negative charge that inhibits the corrosion process and prevents dust particles like salt or other corrosive materials from attaching to vehicles. This system has been used in agriculture, salt mining and other extreme environmental conditions with great success. It comes with a power supply, two capacitive coupler pads and a wiring harness.

**Purpose:** The anti-corrosion properties of the CounterAct electrostatic corrosion control system will be evaluated on two trucks in District 1.

**Test Procedure:** District 1 is testing the system on a new and an older tandem truck. The district will evaluate the new truck for corrosion on various components of the truck, including the door panels, truck body and brake chambers, and the older truck to see if corrosion stops or slows down. This is an ongoing test and will take time to determine its success within Mn/DOT.



## Maintenance Research

### Equipment Tools

**District/Office:**  
Central Office

**Contact:**  
Ryan Otte  
(651) 366-3585

**Project Cost:**  
\$4,072

**NTREC Funds:**  
\$4,072

**Start Date:**  
September 2009

**Vendor:**  
edmaebi.com

## Cab Cam Wireless Cameras *Research in Progress*



**Project Description:** The cab cam wireless cameras will be permanently mounted to help operators who are backing into a tight space or when there is nobody around to assist with backing maneuvers. This multi-camera system can also be used during snow and ice operations to monitor the amount of material in the box, the sander, material output, the wing and clearances around the truck while maneuvering in and out of traffic or tight areas.

**Purpose:** The cab cam wireless cameras will be used to eliminate some of the accidents during backing maneuvers.

**Test Procedure:** Employees will evaluate the cameras for their performance and reliability during snow and ice operations.





## Maintenance Research

### Equipment Tools

**District/Office:**  
1/Virginia

**Contact:**  
Dave Ollila  
(218) 742-1078

**Project Cost:**  
\$3,250

**MOR Funds:**  
\$3,250

**Start Date:**  
August 2008

**Vendor:**  
inductionheating.com

## Induction Heating System *Research in Progress*



**Project Description:** The Autotron 3300 is an induction heating system that supports automobile repair operations. Using the Frame Pro Inductor attachment workers can heat automobile frame rails and structural panels rapidly for straightening and stress relieving. The heat is very focused, easily monitored and controlled by the handheld inductor. The inductor can heat 1/4 inch steel to 1300 degrees Fahrenheit in just a few seconds.

**Purpose:** This induction heating system will give mechanics the ability to heat areas of the vehicle such as frozen nuts and bolts that may be near sensitive materials, wires and hoses without causing damage.

**Test Procedure:** District 1 will evaluate the Autotron 3300 for its ability to speed up windshield replacement and molding repairs.



## Maintenance Research

### Equipment Tools

**District/Office:**  
8/Marshall

**Contact:**  
Mike Cirks  
(507) 537-2074

**Project Cost:**  
\$1,500

**MOR Funds:**  
\$1,500

**Start Date:**  
May 2008

**Vendor:**  
oil-analysis.com

## Spectroscopic Oil Analysis *Research in Progress*



**Project Description:** Spectroscopic oil analysis uses real-time oil condition monitoring that provides the information needed to protect vital engine parts and reduce maintenance costs. Using Bluetooth technology and a Windows-based PDA, smartphone or laptop, the system's IntelliStick measures and reports oil condition in real time.

**Purpose:** This system will help the district monitor the life of oils and lubrication used in fleet equipment and determine whether current lubrication cycles are sufficient. For example, the district's current service interval for its Caterpillar C9 engines, which are more sensitive to oil changes due to their huey pump fuel delivery system, may not be sufficient and expose its engines to premature damage.

**Test Procedure:** The district will compare oil change intervals projected by the spectroscopic oil analysis equipment with standard change intervals to determine the appropriateness of current change intervals.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**

4/Morris

**Contact:**

Robert (Bruce) Olson  
(320) 208-7020

**Project Cost:**

\$620

**MOR Funds:**

\$620

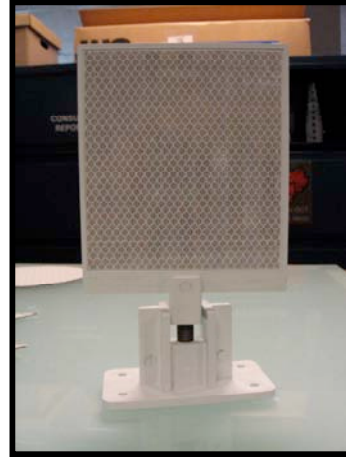
**Start Date:**

February 2008

**Vendor:**

[americanmoldedplastic.com](http://americanmoldedplastic.com)

## Flex D Barrier Delineator *Research in Progress*



**Project Description:** Currently, Mn/DOT's polyurethane-hinged delineator are exhibiting attachment failure (hinge may be too stiff) and the tearing of the hinge itself. Mn/DOT sign crews in Morris will install 100 concrete barrier delineators in various locations and compare their performance with current delineators.

**Purpose:** If District 4 can find a more durable delineator, crews will spend less time in traffic replacing them; drivers will have reflective delineation on barriers, promoting safety; and the district will reduce replacement costs.

**Test Procedure:** District 4 will photograph the delineators at the start of this project and after exposure to the elements for one year. The district will note how many remain, their condition and how the results compare to current delineators.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**  
6/Cannon Falls

**Contact:**  
Gary Siebenaler  
(507) 263-2323

**Project Cost:**  
\$432

**MOR Funds:**  
\$432 (54 units)

**Start Date:**  
April 2009

## LED Lights for Stop/Slow Paddles

### *Research in Progress*



**Project Description:** Stop/slow paddles used by flagging personnel need to be updated to improve their effectiveness. The traveling public no longer notices current signs. District 6 will attach LED lights to the paddles so they will be more noticeable. These LED lights are similar to a bike night shield light with six flash functions. The lights use 2AAA batteries.

**Purpose:** These LED flashers may help flagging personnel be more easily noticed by motorists, enhancing the safety of Mn/DOT employees.

**Test Procedure:** Mn/DOT flagging personnel will survey motorists on the highway to determine if the flashing LED lights enhanced their reactions to the work crew ahead.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**

6/Albert Lea

**Contact:**

Thomas Johnson  
(507) 456-5350

**Project Cost:**

\$4,000

**MOR Funds:**

\$4,000 (\$40 each)

**Start Date:**

October 2008

**Vendor:**

empco-lite.com

## LED Solar Barricade Flashers *Research in Progress*



**Project Description:** The 6-volt batteries used in barricade flashers deployed by Maintenance Operations staff for maintenance projects and winter road closures are expensive and last only a short time. LED solar-assisted barricade flashers, which have never been used in Minnesota, use D-cell batteries that last for months given the flasher's solar-assist feature. The LED solar-assisted flashers can also be used by sign crews for detour setups.

**Purpose:** This new technology will make the flasher more visible and battery costs will be cut over 90 percent.

**Test Procedure:** The district will evaluate the cost-effectiveness of the new LED solar-assisted flashers by determining if the additional cost of the unit is offset by battery savings over the life of the flasher.



## Maintenance Research

### Safety Traffic Control Workzone Safety

**District/Office:**  
3/St. Cloud

**Contact:**  
Randy Reznicek  
(320) 223-6568

**Project Cost:**  
\$3,600

**MOR Funds:**  
\$3,600

**Start Date:**  
April 2009

**Vendor:**  
plasticsafety.com

## RoadQuake Rumble Strips *Research in Progress*



**Project Description:** RoadQuake temporary, portable rumble strips alert drivers to reduce speed. This device can be used in highway and road construction applications, including short-term work zones, temporary lane closures or law enforcement checkpoints. RoadQuake is a temporary device and does not require adhesives or fasteners for installation.

**Purpose:** This project aims to reduce the number of near misses and personal injuries suffered by both Mn/DOT and private contractor personnel by using rumble strips to create a sudden jarring, noisy experience that captures drivers' attention.

**Test Procedure:** The district will evaluate the effectiveness of the rumble strips in alerting drivers that they are approaching a work crew by interviewing flaggers and work crews. A daily review will determine the number of incidents for that day's work zone, including the number of sudden stops by traffic, accidents and near misses.



## Previous Statewide MOR/NTREC Project Reports

In the infancy stages of the MOR/NTREC Program, the initial research focused on snow and ice field studies and projects were very limited. As the MOR/NTREC Program matured and developed, it expanded into other fields of maintenance including roadside and bridges. Other offices became involved with the quality and evaluation of the projects. As projects were completed and possibly implemented, there was a need to communicate these results to the rest of the state and others.

Following is a list of the project reports that have been published since 1992. Some projects had been carried over from year to year due to improvements made as results are reached. The projects listed below are in the report as it was first introduced to the program and may have conclusions in later reports. If you are interested in any of these projects, you may contact the Maintenance Operations Research Engineer.

### 1992-1993 Winter Season Report:

- Camden Pre-wetting Field Study
- Lakeville Pre-wetting Field Study
- Plymouth Anti-icing Field Study

### 1993 Report:

- Corrosion Research
- Road Weather Information System
- Truck Ergonomics Task Force
- Snow Fence Research
- Vehicle Conspicuity Research
- Solar Powered Culvert Deicer
- Quality Control of Premixed Sand/Salt Blender Hopper
- Laserlux Road Striping Management
- Smooth Pavement Task Force
- Remote Driven Vehicle
- Remote Slope Mower
- Zero Velocity Salt/Sand Spreader
- Timesheet Generated Interface
- Short Grass Research Plots
- Extendable Snow Plows
- Portable Interactive Weather Prediction System
- Municipal Waste Salt Water as a Pre-wetting Agent

### 1994 Report:

- Culvert Rehabilitation
- Thermal Mapping
- Portable Interactive Weather Prediction System
- Temperature Sensors
- Snow Fence Research
- Work Zone Safety Projects
- Circuit Rider Program
- Finnish Emulsion Gravel Pavement
- Automated Call-Out System
- Timesheet Generated Interface & MMS/TIS Interface
- Bar-Coding
- Maintenance Research Project Tracking System
- CB Radios
- Innovative Sprayers
- Band Cleaner
- NIDO Liquid Spreader
- Wash Water Recycling System
- Salt Brine Mixing Systems
- SHRP cutting edges
- Gravel Shoulder Reclaimer

## 1995 Report:

### Winter Maintenance

- Maintenance Concept Vehicle Partnership Project
- System 2000 Stationary Salt Speeder
- Automated Liquid Bridge Deck Deicer
- Brine Applicator
- Power Liquid Spreader Control Unit
- Electronic Pre-wet hang Tanks
- Integrated Tailgates Research
- Improved Snow Plow Design
- Grader End Gates
- Combined Front-Slush Plows
- Ice Buster
- Norsemeter Friction Meter
- Magnetic Pavement Taping Road and Bridge

### Maintenance

- Slurry Seal Patching Machine
- MicroSurfacing
- Automated Pothole Patcher
- Cascadia Enduraseal 300 Asphalt Rejuvenator
- Highlift Flatbed
- Earth Penetrating Radar Concrete Delamination Detecting System
- Lightweight Power Screed
- Retrofit Dowel Bars
- Culvert Rehabilitation Project
- Culvert Grapple Extractor (Beaver Dam Grapple)
- Stenciling Unit for Message Painting

### Maintenance Management

- Thermal Mapping
- Pavement Condition and Weather Reporting
- Interactive Travel Information Systems (Minnesota Travel Partners)
- Travel Partners Demonstration Project
- Mobile Road Weather Information Systems
- Timesheet Generated Interfaces & PMS/MMS/TIS Interface

- Pavement Marking Management System
- Dial in Server for Operations Management System Pilot
- Bar-coding
- Paperless Field Data Collection
- Maintenance Research Project Tracking System

### Roadside Maintenance

- Herbicide Sprayer
- Flexstake Weedmats
- Remote Slope Mower
- Biological Control of Canada Thistle

### General Maintenance Management

- All Terrain Crawler Tractor; Posi-Track
- Tracks and Dozer Blade on Skidsteer Loader
- Kentrol Gate Material Control System
- Tire Experiment, Michelin

### Technology Transfer

- International Worker Exchange Program
- Finnish Emulsion Gravel Partnership Project

## 1996 Report:

### Winter Maintenance

- Heated Truck Box Using Exhaust System
- Truck Box with a Fiberglass Floor
- Snow Shield Research
- Combined Front Slush Plows
- Anti-icing using Brine from Wash Water Recycling (North Branch)
- Anti-icing using a Herbicide Sprayer Attachment, Spraytroics (Metro)
- Mn/DOT – Hennepin County Anti-icing Project
- Fiber Optic Lighting Research
- Wing Plow Research (mounted at the rear of the truck)
- National Friction Measurement Study (FHWA)
- Integrated Tailgate Research
- Extendible Hood Snow Plow

- 21-Foot Snow Plow
- Cutting Edge Research
- Multiple Uses for Low-Boy Tractor
- Dual Spinner
- Elkin Spreader
- Salt Brine Mixing Systems
- Oscillating Underbody Scraper

#### **Road and Bridge Maintenance**

- Evaluation of Radar for Snowplows
- Automatic Pothole Patcher
- Front mounted Shoulder Retriever
- Bunyan Friction Screed
- Crack Sealing
- Color Flexi Probe Inspection System
- Culvert Rehabilitation Project
- Peel-A-Way Lead Paint Removing Process for Bridges
- Lite Stripe Laser and Camera Pointer Systems

#### **Maintenance Management**

- Automatic Low-Visibility Warning System Using Video Cameras
- ARTIC Dispatch Center
- CD Authoring, Writing, and Sharing Project
- Automated Route Planning and Optimizing Software

#### **Roadside Maintenance**

- Boom Sprayer Rebuild
- Hooded Ground Sprayer
- Polecat Obstacle Mower

#### **General Maintenance Research**

- Reusable Energy Absorbing Crash Terminal
- ProPatch Head Cover, Prototype
- Bioremediation Pilot Project
- Portable Hot Water Pressure Washer
- Multi-purpose Utility Vehicle with Electrical Power tool Package

- Demo Maintenance Truck with Updated Hydraulic System

#### **Work Zone Safety**

- Remote Driven Vehicle Unit #3
- Flashing Stop/Slow Paddle Implementation Project

#### **Technology Transfer**

- Maintenance Expos – Fall and Spring
- Saving Salt – Simple Solution

#### **1997-1998 Report:**

#### **General Maintenance**

- Aerosol Alternative
- Drillco Sawblade
- Easy Bend
- Ford Smith Four Post Hydraulics Lift
- Multiple Uses of Hot Water Pressure Washers in Highway Maintenance
- Plasma Cutter
- Remote controller for Boom on Sign Truck
- Vacutec Leak Detector
- Video Image Scope

#### **Maintenance Management**

- Blowing and Drifting Snow Control Market Research
- Evaluating Locating and Record Keeping Technology
- Fleet Management System Coordinator
- GIS Project Specialist
- Maintenance Business Planning: Measuring Quality
- From the Customer's Viewpoint
- Pavement Marking Market Research RFP
- Transmap GIS Mapping for Sign Inventory
- Striper Record Keeping/Downloading Using a Laptop Computer
- Maintenance Business Planning: Winter Operations Survey.

### **Road and Bridge Maintenance**

- Epoxy Striper Research Project
- Heated Dump Box-Tapping System
- Laser Level Plane
- Patchrite Self Propelled Pothole Patching Machine
- Silane
- Vibratory Concrete Floats

### **Roadside Maintenance**

- Box Beam Guardrail
- Contour Tree Planter
- E-Z Dig and E-Z Grader
- Funda Flex
- Power Broom/Trimmer for Light Duty Sweeping
- Weld on Wear Pads
- Wheeled Debris Blower
- Wood Chip Blower

### **Technology Transfer Partnerships**

- DNR Tandem Truck
- Truck Driving Simulator

### **Winter Maintenance**

- ALLU Screen Crusher
- Athey Force Feed Loader
- Automated Data Logger for Odin System
- Blending System for Mixing Sand and Salt
- Chemical Storage Building
- Commercial Visibility Instrument
- Continuous Friction Measurement Techniques Research
- Culvert Deicing Resistance System
- Cutting Edge Study
- Dresbach Anti-Deicer System
- Dual Auger Spinner Sander
- Dual Rear Wing Truck
- Elkin Sander
- Enclosed Salt Brine System

- Enhanced Snowplow Visibility Using Radar Technology
- Etnyre Anti-Icing Unit
- Extendable Hood Snowplow
- Heads Up Research Summary
- Henke Heavy Duty Wing
- Hydraulic Snowblower
- I-35 Fixed Bridge Deicer System
- IceBan (Liquid Deicer)
- Large Capacity Integrated Tailgates
- Nokian Tires Part One and Two
- Pick up mounted Anti-icing units
- Rebuilding Frame Work on CL-35 Snowplow
- Road Closure Gates
- Salt Conveyor
- Salt Solutions
- Snake Creek Bridge
- Stainless Steel Integrated Tailgates
- VLB Industrial Snowblower

### **Work Zone Safety**

- Cone Reflective Spinners
- Cone Setter/Retriever Research Trip
- Message/Arrow Brickboard
- Portable Advisory Roll-Up Sign Assemblies
- React 350 Reusable Energy Absorbing Crash Terminal
- Remotely Driven Vehicle
- Speed Control Display Systems
- Striper Crew-Programmable Light Emitting Diode Sign on Shadow Vehicle

## 1999-2001:

### Winter Maintenance

- Cryogenically Treated Cutting Edges
- Non Rotating Carbide Bit System for Underbody Blades
- Hydraulic Driven Snowblower
- Infrared Ice Detector Maintenance Upgrade
- Swenson Precision Placement System
- Expansion and Implementation of Anti-ice Methods
- Adaptable “Slide-in” Anti-ice/Herbicide Spray Unit
- Critical Area Spot Spreaders
- New Component Test Bed Truck

### Winter Material

- Ice Ban M-50
- Medium Grade Salt (Nu-Salt)
- Anti-icing Liquid (Caliber)

### Road and Bridge Maintenance

- Air Prep System
- Laser Based Clearance measuring System
- For the Birds
- Rubberized Asphalt Melter Applicator
- Aging Optimization Study
- Hot Box
- Spaulding RMV Hot Patcher/Reclaimer

### Traffic/Work Zone Safety

- Smart Arrow Messenger Board
- Scorpion Truck Attenuator
- Solar Powered Warning Signals/Flashers

### Roadside Maintenance

- Noxious Weed GPS/GIS Mapping
- Posi-Track Soil Compaction Reduction Project
- Harley HST 6 Shoulder Reclaimer
- Geotextile Fabric Laying Machine
- Living Snow Fence

- Dynamic GPS Performance Evaluation
- New Holland Disc Mower
- TRACC System
- ET-2000 Guardrail End Treatment
- (GS-ED-60-50) Side Dozer

### Equipment – Tools

- Spray on Box Lining and Irathane Systems
- Wire Feed Welder
- Laxo Quick Lock System
- Brake Watch
- JAGZ Interlocking System
- Retractaflap
- Mud Flap Jack
- Clear View Wiper Mirror
- Lane Scan Mirrors
- Heated Windshield Wiper Blades/Blizzard Blades
- High Intensity Discharge Lighting
- Trailer Safety Lights
- Cordless Impact Drivers
- Mini Skid Loader
- Underbody Grease Banks
- Truck Mounted Roller
- Collision Avoidance Monitors
- Electronic Hearing Protectors
- On-board Truck Scale
- Connect Under Pressure Hydraulic Couplers

### Building

- Pre-cast T Panels for Cover-all Storage Buildings
- Wireless for Truck Stations

### Technology Transfer

- Truck Weight Education Project
- Field Works
- Snow and Ice Pamphlet
- Snowplow Simulator Phase I
- Electronic Multi-meter
- Electronic Technical Data Collection

## 2001-2003:

### Winter Maintenance

- Critical Area Anti-icing D-8
- Dultmeir Brine Production System
- Hydraulic Driven Snowblower
- LED Wing Lights
- Stainless Steel Hopper
- Precision Placement System
- Plow Guards
- GPS Tire Road Friction
- GPS Gang Plowing
- Expansion of Anti-icing Methods
- D-3A Rear Mount Wings
- Micro-Trac Anti-icing
- Blizzard Plow
- Pre-wetting Liquid Storage Tank
- Anti-icing Equipment
- Wing Wheels
- Crash Attenuator Anti-icing
- Dultmeir Anti-ice Unit
- Liquid Chemical Transfer Pump Station
- Dual Carbide Underbody Edges

### Winter Material

- Anti-icing Liquid

### Road and Bridge Maintenance

- Hollow Deck Machine
- Over-height Vehicle Detection System
- Silicone Pump
- High Mast Light Pole Inspection
- Night Time Wet Line Recovery
- Air Prep System
- Laser Based Clearance Measuring System
- GL 3000P Laser Guidance System
- Aging Optimization Study
- Wedge Paver
- Bridge Sweeper

- Universal Maintenance Unit

### Traffic Control and Work Zone Safety

- Voice Activated Message Sign
- Roo Guard Barriers
- Active Portable Warning System
- Emergency traffic Control Truck
- Scorpion Truck Attenuator
- Stabilization of Aggregate Shoulders
- Safety Light Wand

### Roadside Maintenance

- Sprout Guard
- Brown Mower
- Tree Shear
- Erosion Control Equipment
- Noxious Weed GIS/GPS Mapping
- Ditch Hitch
- New Holland Disc Mower
- ATV Swisher Mower

### Equipment – Tools

- Lane Scan Mirrors
- Dynamic Performance Evaluation
- Rear Vision Color Monitor
- Backup Safety Cameras
- Ready Welder
- HID Sander Lights
- Clear View Mirror Wiper
- Underhood Air Compressor
- Protective Coated Oil Pans
- Reiter Plastic Truck Body
- Hydraulic Ground Level Trailer
- Laxo Quick Lock System
- Boss Light
- Mud Flap Jack
- Mini Concrete Mixer
- Trailer Safety Lights
- Test Bed Tandem



- Accu Place Spreader
- Ribbon Lift
- Retro Reflective Mud Flaps
- Electro Luminescence Light Signs
- Open Systems Architecture for RWIS
- RWIS RPU Modifications
- Sylvania Silverstar Lights
- Quicksilver Bed Liner

### **Building**

- Wireless for truck Stations

### **2003-2005:**

#### **Winter Maintenance**

- Dultmeir Brine Production
- Expansion and Implementation of Anti-icing Methods
- Anti-ice Unit and Geomelt M
- Anti Ice Unit
- Joma 6000 Edges
- Salt Brine Injection
- Pre-wet Tanker
- Dual Carbide Underbody Edges
- Hydraulic Wing Push Arm
- KT-90 Active Adapters
- Transfer Pump Station
- Slap Me Wipers
- Quick Edge Replacement
- Mobile Anti-ice System

#### **Winter Material**

- Cargill Clearlane
- Geomelt M
- Geomelt
- LCS 5000
- Andersons Additive

#### **Road and Bridge Maintenance**

- Top Down Cracking
- GPS-GIS Edge Drain Mapping

- Bituminous Thermal Crack Repair
- Tailgate Paver
- Ribbon Lift

#### **Safety Traffic and Work Zone Safety**

- Solar Traffic Lights
- Cone Setter
- El Conspicuity Light Signs
- LED Lighting
- Avoiding Collisions With Plows
- Lighted Vests
- Lighted SMV Signs
- El Lighted Mudflaps

#### **Roadside Maintenance**

- Beaver Abatement
- Just in Time Sign Replacement
- Bobcat Wolf Disc

#### **Equipment – Tools**

- Reiter Plastic Truck Body
- Motorvac MCS245 – 50
- Skidloader Backhoe
- 6 Way Dozer Blade
- Snap-on HD35 Fluid Changer
- Heated Bituminous Box
- 6x9 BDS Mirrors
- Cut Off Saw
- Porta Shear
- Truck Washing Soap

### **2005-2007:**

#### **Winter Maintenance**

- Hot Wash Cleaning Unit
- Slap Me Wiper
- Clear Fast/Hot Shot Comparison
- Joma Blades
- Stainless Steel Water Tank
- Boom Mounted Snow Blower
- Brine Maker Injection

- Dye Injection
- Pre-Wet Tanker
- Dual Carbide Underbody Edges
- Hydraulic Wing Push Arm1
- Granular Spreader Epoke Sirous
- Ecco Wing Lights
- El Tail Light Strip

#### **Winter Material**

- Geomelt
- Andersons Additive

#### **Road And Bridge Maintenance**

- Bypass Scaffold
- Cold Planer
- York Front Mounted Rotary Broom
- Moa Bridge Shark
- Electric Heated Pickup Box
- Epoxy Crack Filling

#### **Safety, Traffic Control And Work Zone Safety**

- Litesys Intellectom Cms
- Mold Board Lights
- Scorpion Truck Attenuator
- Solar Traffic Lights
- Pack A Cone
- Ecco Rear Vision
- Lighted Slow Moving Vehicle (SMV) Signs
- Flame Proof Vest

#### **Roadside Maintenance**

- Shoulder Reclaimer
- Beaver Abatement
- Roo Guard Barrier
- Skid Steer Rubber Tracks
- Stump Grinder
- Wolf Disc
- Loegering Track System
- Auger Bucket
- Skidloader Backhoe

- Rubber Tire Roller
- Rotary Mower

#### **Equipment – Tools**

- Pro Press Crimping Tool
- Portable Wheel Stud Remover
- Wireless Mobile Lift
- Gooseneck Lamps
- Safety Work Platform
- Snap-On Hd35 Fluid Changer
- Tree Puller
- GPS Cameras



For more information, please visit:

Minnesota Department of Transportation:

<http://www.dot.state.mn.us/>

Mn/DOT Office of Maintenance Research Unit:

<http://www.dot.state.mn.us/maint/research.html>

Mn/DOT Research Services Section:

<http://www.research.dot.state.mn.us/>

Mn/DOT Library:

<http://www.dot.state.mn.us/library/>