



2009–2011



Office of
Maintenance

STATEWIDE
BIENNIAL

Maintenance
Operations
Research Report

Your Destination...Our Priority



DISCLAIMER

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 and Security 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/maintenance/research/research.html>

Mn/DOT Research Services Section:
<http://www.dot.state.mn.us/research/index.html>

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

Office of Maintenance

**STATEWIDE BIENNIAL
Maintenance Operations Research Report**

2009–2011



Prepared by CTC & Associates LLC and shu shu design
June 2011

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(Left to Right) Row 1: Wet Cut, Tow Plow Granular; Row 2: Snap On Scan Tool, GPR, Concrete Chuter; Row 3: Rotary Screener, Centri-Pipe, Core Drill

CONTENTS

Introduction	1
About the Program	2
Background.....	2
Goals & objectives.....	2
Research Unit Staff	3
NTREC members	3
Research Project Selection	4
Selection criteria	4
Funding distribution	4
Implementing results	6
Implementation selection process	6
2010-2011 Implementation projects.....	7
2009–2011 Highlights	10
Trends in research.....	10
Featured projects	11
2009–2011 Completed Projects	12
EQUIPMENT - TOOLS	
Bevel-Mill Model 8000	13
Blue Tork	14
Diagnostic Scan Tool.....	15
EnviroTabs.....	16
ROAD AND BRIDGE MAINTENANCE	
Concrete Batch Plant.....	17
Concrete Chuter	18
Hitch Mounted Core Drill.....	19
ROADSIDE MAINTENANCE	
Concrete Pipe Joint Sealer	20
LIMBHOG.....	21
Magnetic Manhole Cover Removal	22
Propane Hammer.....	23
Rotary Screener	24
Weed Wiper	25

SAFETY, TRAFFIC CONTROL AND WORK ZONE SAFETY

LED Lights for Stop/Slow Paddles 26
LED Solar Barricade Flashers 27

WINTER MAINTENANCE

Air Foil 28
Air Vizion 29
Blending Station 30
Calibration Scales 31
Crystal Fusion 32
I.C.E Blades 33
LED Sander Lights 34
Manhole Protection Ring 35
Molded Slurry Tanks 36
Rock Salt Moisture Tester 37

WINTER MATERIAL

ArctiClear Gold 38
GeoMelt 39
IceBan 200 40
Thawrox Treated Salt 41
Road Guard Plus 8 42
MeltDown Apex 43

2009–2011 Research In Progress.....44

EQUIPMENT - TOOLS

Anti-Corrosion 45
Cab Cam Wireless Cameras 46
Diesel Induction Service Tool 47
Induction Heating System 48
IRISPen 49
MetalGard 50
Q Star FlashCam 51
Tire-SafeGuard Tire Monitoring System 52
TruckOffice 53

ROAD AND BRIDGE MAINTENANCE

Ground Penetrating Radar Bridge Scan System 54
HawksHead HD Plus Tire Monitoring System 55
Heated Mix Asphalt Recycler 56
Material Control Gate 57
Motor Grade Wedger 58
Slip-In Pre-Mix Heater 59

ROADSIDE MAINTENANCE	
Centri-Pipe	60
Gravel-Pro	61
Juno Data Collector	62
Laser for Determining Sign Height	63
Rota-Jetter	64
Side Shift Mower	65
Soda Blaster	66
Wet Cut System	67
SAFETY, TRAFFIC CONTROL AND WORK ZONE SAFETY	
RoadQuake Rumble Strips	68
WINTER MAINTENANCE	
Bag Reel	69
First Response System	70
LED Headlights	71
LED Warning Lights for Plow Trucks	72
Monroe Roller Mill	73
Mr. Slick	74
NEUTRO-WASH	75
Polyurethane Cutting Edge	76
Salt Brine Flow Meters	77
Salt Skirt	78
Snow Drift Control	79
Stainless Steel Hydraulic Couplers	80
Tow Plow with Granular Capabilities	81
Winter® Snowplow Cutting Edges	82
WINTER MATERIAL	
Liquid Chemical Blending and Dispensing Unit	83
SOS Salt Pretreatment	84
Previous Statewide MOR/NTREC Project Reports	85



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 2009–2011 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 2009–2011.
- **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 FY2010 and FY2011.
- **2009–2011 Highlights** describes the program’s research focus areas and highlights some of the most valuable products to be selected for implementation in recent years.
- **2009–2011 Projects** reports on every completed and in progress research project for FY2010 and FY2011. 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 it 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 2010 and 2011 was \$500,000, 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.



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Superintendent

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TGS

Mark Vogel
Environmental Services

Mike Bauer
Shop Supervisor

Greg Mensen
Bridge Supervisor

Research Project Selection

Selection criteria

Maintenance Operations Research 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 2010 was \$500,000, 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).

Annual program funding breakdown

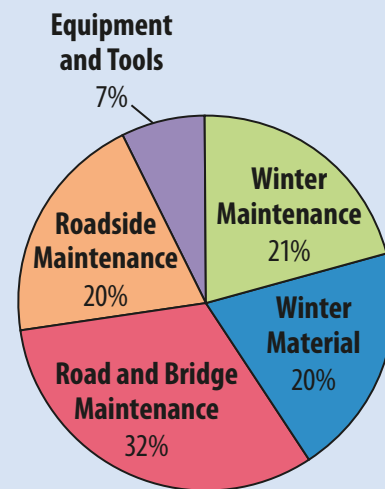
Research projects:	\$200,000
Implementation:	\$100,000
Staff salaries:	\$200,000
Total:	\$500,000

The base program budget was the same in FY 2011, with additional funding added to the budget from the sale of a Research Innovation Truck. 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 FY2010/2011 distribution of funds by research category.

FY2010–FY2011 Funding Distribution by Research Category

Winter Maintenance	\$105,356.87
Winter Material	\$103,443.57
Road and Bridge Maintenance	\$160,542.50
Roadside Maintenance	\$100,721.96
Equipment and Tools	\$36,670.68
Total	\$506,735.59



Budgets for FY 2010 and FY 2011 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. FY2010 and 2011 MOR/NTREC Budget per District

Districts	# of Projects/ Districts	Dollars/ District	% Dollars/ District
1	8	\$32,153.50	6
2	7	\$36,128.69	7
3	13	\$76,394.44	15
4	4	\$10,898.33	2
6	22	\$131,500.59	26
7	4	\$70,280.00	14
8	2	\$9,957.00	2
Metro	11	\$139,423.00	28
Total	71	\$506,735.59	100

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

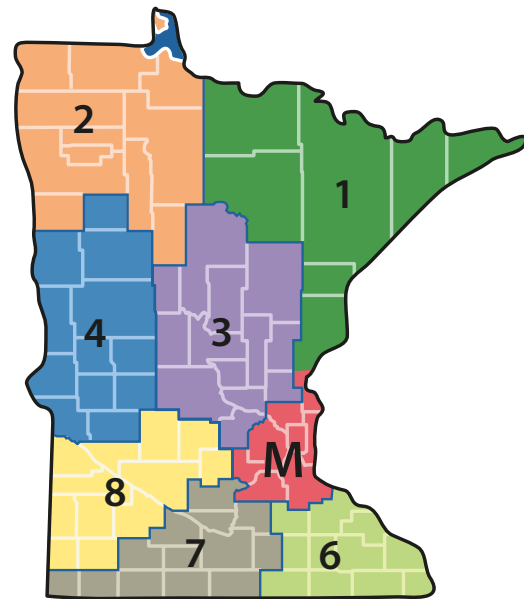


Figure 1. Minnesota Department of transportation Districts

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

Table 2. FY2010 and 2011 MOR/NTREC Budget per CATEGORIES

Categories	# of Projects/ Districts	Dollars/ District	% Dollars/ District
Winter Maintenance	14	\$105,356.87	21
Winter Material	10	\$103,443.57	20
Road and Bridge Maintenance	9	\$160,542.50	32
Roadside Maintenance	8	\$100,721.96	20
Equipment and Tools	30	\$36,670.68	7
Total	71	\$506,735.59	100

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 additional funding from the sale of a maintenance research truck that was used toward implementation. 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 2010 and FY 2011 implementation projects

See page 10 for the list of projects funded for implementation in FY 2010 (Table 3) and FY 2011 (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 2010 MOR/NTREC Implementation Projects

Project Name	Description	District	Unit Cost
Magnetic Manhole cover remover	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.	1	\$5,000
Slurry Auger	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.	6W	\$2,300
Slurry System, Tanks and delivery system	Using a 70% granular and a 30% liquid ratio for applying the deicing chemicals, which has been proven to result in an overall reduction in materials used, the system super saturates the salt in the auger and places it on the road using a chute, spinner or zero velocity sander. The material starts to work immediately because of the high content of salt brine or other liquid de-icing chemical added to it. This system includes two inbox tanks, a delivery system (pre-set to make the 70-30 ratio), liquid valve driver and plumbing.	6W	\$3,600
LED Sander/wing light	During snow and ice night operations it is critical for operators to be able to see their sander to make sure material is being dispensed and placed in the target areas. The LED Sander/Wing lights are brighter than the incandescent lights currently used, are more durable, use less power, and require less maintenance.	Statewide	\$150
Air Foils	Air Foils improve the air flow in the back of trucks to help prevent the buildup of snow and dust. This means that the truck's strobe lights, turn signals and reflective materials remain visible to the motoring public.	2, 4	\$645
Salt Skirts	The Salt Skirt is a cup brush mounted about an inch below the spinner that helps direct the salt being dispensed to the target area. Keeping the salt on target helps save money and resources. The Skirt is 24 inches in diameter and has 16-inch-long bristles.	7	\$90
Air Vizion	The Air Vizion system uses a burst of compressed air to remove water droplets and snow that has accumulated on mirrors.	Metro	\$150
Horizon Portable Traffic Signals	The selected device has three 12-inch lights (red, yellow and green), programmable times, unit-to-unit communication (three-mile range), conflict monitoring and other advanced features to ensure the safety of both of bridge maintenance crews and the traveling public.	7	\$30,000
Crystal Fusion	Crystal Fusion bonds with windshield glass at the molecular level. It changes the surface of the glass by increasing its strength and clarity, decreasing the likelihood of dirt and moisture clinging to it. This improves visibility during inclement weather and reduces the likelihood of damage from small road debris such as sand.	Metro	\$250
HID Headlights	High Intensity Discharge headlights evenly spread light with greater intensity overall and no hot spots. These headlights make plowing snow both easier and safer. Plow operators reported better visibility and reduced fatigue with no adverse affects on oncoming traffic.	6E	\$750

continued, next page

Project Name	Description	District	Unit Cost
Tow Plow	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 snow at normal plowing speeds. The Tow Plow gives the operator the ability to move snow efficiently and safely from two lanes of roadway in one pass with no more difficulty than pulling a trailer down the road.	Metro	\$70,000
Nitrogen Tire Inflation System	Air-filled tires lose about two pounds of inflation per month on average due to small oxygen molecules passing through the sidewalls of the tires causing. Nitrogen is dry, inflammable, and has a larger molecular structure, so it doesn't permeate through the sidewalls as fast.	3	\$8,000
Road Shoulder Groomer	District 4 said they are able to reclaim gravel on about 40-60 miles of road a day using the Road Groom compared to 20 miles a day (and more fuel) using a motor grader. The front cutting blade on the Road Shoulder Groomer cuts down the high spots and loosens the roadbed while reclaiming rock and gravel that has been pushed below the surface. The system pulls gravel from the edge of the shoulder towards the road surface and then distributes the materials across the shoulder to fill in the low spots. Two four-foot magnets at the front also pick up metal objects from the shoulder.	4	\$12,000
Apache Bullseye6 Laser	The Bullseye 6 Laser automatically calculates and corrects the grade display for the angle of the dipper arm. It has a plumb indicator for quick and accurate grade checking for excavators and backhoes, up to eight channels of grade information and directional out-of-beam indicators.	6W	\$6,000
Reflective Mn/DOT T-Shirts w/logo	Maintenance employees tested several shirts aimed at improving comfort, visibility and durability. The shirt from 3D Specialties with 3M comfort trim reflective material received the highest ratings.	Statewide	\$22
Swift Hitch Cameras	The Swift Hitch Camera helps eliminate backing accidents by providing operators with a visual image behind them when backing into a tight space, performing backing maneuvers or hooking up a piece of equipment. The camera is held in place by a magnetic strip rather than being permanently mounted.	Metro	\$375
Blending Station	The Blending Station is a trailer mounted, self-contained mobile unit that combines both liquid and granular de-icing materials for a uniform coat and consistency. With its own power source and onboard liquid tank, it can be used to create limited quantities of treated material or to create larger stockpiles of treated material for entire sub areas or districts.	Metro	\$130,000

Table 4. FY 2011 MOR/NTREC Implementation Projects

Project Name	Description	District	Unit Price
Air Vizion	The Air Vizion system uses a burst of compressed air to remove water droplets and snow that has accumulated on passenger side, hood mounted mirrors. These mirrors are critical for helping the operator know the position of the wing plow during winging operations.	Metro	\$150
Calibration Scales	The lack of proper sander calibration is a major concern for Mn/DOT and is one of the leading reasons material is being wasted. Not knowing the exact amount of material going out the back of the truck can lead to extra trips on routes or an over saturation of salt, leading to extra material costs and environmental issues. Calibrating sanders can be a cumbersome job without the proper weighing equipment. These new calibration scales will help ensure proper and consistent calibration statewide with ease.	All	\$2800
Concrete Trailer	With this concrete trailer, District 6 bridge and maintenance crews will mix concrete on the job site and mix whatever quantity needed to complete the repairs. Rotating drum trailers replicate what happens at a typical ready mix operation, allowing chemicals and fiber to be added to the mix. The concrete is completely mixed and requires no remixing at the jobsite. This piece of equipment is used for bridge concrete deck repairs, bridge concrete railing repairs, maintenance concrete curbing repairs, and maintenance water concrete inlet repairs. It will replace the need to call a concrete truck and eliminate the small order charge.	6W	\$35,000
Frameless Wiper Blades	The revolutionary aerodynamic design of these wiper blades results in reduced vibration and judder. There are no frame joints or other components that could freeze or become clogged with ice or snow, making the wipers ideal for winter use.	6W	\$20
LED Solar Assist Barricade Flasher	The LED Solar Assist flasher is brighter than non-LED flashers and will cut battery cost by over 90%. The flasher uses D-cell alkaline batteries with solar assist, making the flasher last for months.	6W	\$80
NEXIQ Industrial Diagnostic Scan Tool	The Pro-Link iQ diagnostic scan tool from NEXIQ Technologies is a portable and powerful hand-held unit that helps diagnose engine, brake and transmission failures by guiding mechanics through even the most complicated vehicle tests. This unit is easy to use, provides fast data downloads, has color graphics and provides clear information displays. The tool will also eliminate the need for Mn/DOT service trucks to carry cumbersome laptops, which they currently use to troubleshoot mechanical issues with the trucks.	3B	\$5000
Hitch Mounted Core Drill	This core drill is attached to the receiver hitch on any half-ton or larger truck, is powered by a 16HP gas engine and can drill holes from 2" up to 16" in diameter. The positioning arm swings up to 180 degrees for precision drilling. The drill head has the ability to extend about 36" beyond the side of the vehicle to drill on curbs for future sign installation.	6E	\$8500
Rock Salt Moisture Tester	This tester gives an accurate reading of moisture in our rock salt in a short amount of time. It takes half as long to test the salt as it does with the microwave, there is no need to handle hot containers, and there is no popping of the salt that would require retesting.	1	\$3200

2009-2011 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



Mr. Slick



Material Control Gate

Featured projects

High-impact projects for 2009-2011 include:

- **Alternative Winter Chemicals:** In order to keep the travelling public safe on Mn/DOT's 30,000 lane miles of state Highways during snow and ice operations, Mn/DOT took the lead in using less sand and salt and introducing alternative chemicals. These chemicals are used for anti-icing, de-icing and pre-wetting methods.
- **Salt Slurry System:** Salt Slurry Tanks and Delivery System are two inbox tanks that fit into both elliptical and rectangular dump bodies and each has 400 gallons capacity. The end product is 70/30 granular (salt) to liquid (brine) ratio of a fast acting de-icing chemical.
- **Portable Blending Station:** The Blending Station is a trailer mounted, self contained mobile unit with its own powered source that combines both liquid and granular de-icing materials to a uniform coat and consistency. Using this piece of equipment will eliminate the need to purchase pretreated salt at high vendor prices.
- **Centri-Pipe Culvert Repair (Spincast Culvert Repair):** This spincast method of pipe repair has minimal effects on water movement and volume through the pipe. This system does not require pipe extraction and will not reduce water flow through the pipe. The early results are promising.
- **NEXIQ Industrial Diagnostic Scan Tool:** This easy-to-use diagnostic tool provides fast data downloads, has color graphics, provides clear information displays and helps diagnose engine, brake and Transmission failures.
- **Asphalt Recycler:** This system recycles millings and turns them back into a workable hot mix for patching holes. Crews can repair potholes quick and easy by using hot mix year round. This system eliminates the need for costly cold mix in the winter which generally will not last in the potholes more than a couple of days.



Clockwise from top left: Blending Station, Salt Slurry System Tanks, Asphalt Recycler, Industrial Diagnostic Tool, CentriPipe

2009-2011 Completed Projects



Maintenance Research

Equipment - Tools

District/Office:
3B Mechanic Shop

Contact:
Darryl Cameron
(320) 223-6561

Project Cost:
\$3,000

Start Date:
February 2010

Vendor:
[http://heckind.net/bevelmill_p
late_bever.htm](http://heckind.net/bevelmill_p
late_bever.htm)

Bevel-Mill Model 8000 *Completed Research*



Project Description: Grinding wheels, cut-off wheels and cutting torches currently used for plow repair make for a time consuming process that also warps the moldboards and generates a lot of dust. The Bevel-Mill can bevel mild steel, aluminum and stainless steel up to 7/8" thick faster and more efficiently, working the way a router bevels the edges of wood.

Purpose: District 3B hopes to use the Bevel-Mill to prepare metal for replacing worn out moldboards, to bevel plates for fabrication and to prepare edges on bridge pilings to be welded together.

Test Procedure: The district will evaluate the Bevel-Mill for six months to document the time saved in using the tool and the cost of materials saved by avoiding grinding and additional rounds of plow repairs.

Conclusions: Labor savings averaged between one-half hour and two hours depending on the job size. Material costs for grinding discs and welding gas were eliminated and additional time was saved not having to stop the operation to change discs and gas tanks. Higher quality repairs resulted from the material not warping from use of a cutting torch. The Bevel-Mill tool is heavy and starting and stopping is critical to blade life.

Recommendations: The district recommended the tool for shops that perform extensive welding repairs on plow moldboards.

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



Maintenance Research

Equipment - Tools

District/Office:
3B Mechanics Shop

Contact:
Ken Richart
(320) 223-6561

Project Cost:
\$5,265

Start Date:
August 2009

Vendor:
bluetork.com

Blue Tork Pneumatic Wrench *Completed Research*



Project Description: The Blue Tork installs and tightens lug nuts to the proper torque when replacing tires on trucks. The air impact wrenches currently in use are heavy, noisy and carry a shock load that can cause injuries to workers over time. The Blue Tork is a promising alternative to the air impact wrenches.

Purpose: The Blue Tork has the potential to reduce long-term hearing loss and wrist/hand injuries among workers, as well as save time by reducing the steps required to replace a tire.

Test Procedure: Staff used the Blue Tork for six months to replace tires on snowplow trucks. The wrench was used to complete all the steps in tire replacement (removing the lug nuts to remove the wheels, reinstalling the wheels, tightening the lug nuts and hand torquing the nuts.)

Conclusions: The Blue Tork reduced the arm twisting typical when hand torquing and eliminated the vibration and shock previously absorbed when reaching torque. The wrench exposed technicians to fewer than 85 decibels, eliminating the need for hearing protection. In addition, the tire replacement time was reduced by 50% while maintaining torque accuracy.

Recommendations: This wrench could be a benefit to every shop.

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



Maintenance Research

Equipment - Tools

District/Office:
3B/St. Cloud

Contact:
Kelvin Smith
(320) 223-6560

Mark Loxtercamp
(620) 223-6606

Project Cost:
\$3,000

Start Date:
March 2010

Completion Date:
January 2011

Vendor:
snaapon.com

Diagnostic Scan Tool *Completed Research*



Project Description: The Pro-Link iQ diagnostic scan tool is a portable and powerful handheld unit that helps diagnose engine, brake and transmission failures by guiding mechanics through even the most complicated vehicle tests.

Purpose: Currently, Mn/DOT service trucks carry cumbersome laptops loaded with diagnostic software to troubleshoot mechanical issues. Expensive cabling and software and the detailed knowledge required to use the software programs led Mn/DOT to investigate a more user-friendly, cost-effective platform for diagnostics.

Test Procedure: Field tests of the scan tool for heavy-duty truck applications will assess this diagnostic tool's versatility and ease of use.

Conclusions: This easy-to-use scan tool performed flawlessly, required minimal training and exhibited greater versatility than initially expected. The tool automatically searches the transmission, engine and truck and displays any fault codes. The time required to acquire vehicle data and unit information is reduced to minutes from the hour or more required for a laptop-based diagnosis. This translates to cost savings by reducing both diagnostic time and unit downtime.

Recommendations: The district recommends this tool and suggests that future purchases include all available software.

Implementation: This project appears on the statewide implementation list.



Maintenance Research

Equipment - Tools

District/Office:
D6W

Contact:
Nancy Skalicky
(507) 466-5518

Project Cost:
\$200

Start Date:
October 2010

Vendor:
www.greenfootglobal.com

EnviroTabs Completed Research



Project Description: EnviroTabs added to a vehicle's engine fuel are claimed to burn off carbon deposits and make fuel particles combust at lower temperatures. This is supposed to translate to a cleaner engine, improved fuel economy and improved engine performance.

Purpose: If effective, EnviroTabs will help Mn/DOT extend the life of its fleet and reduce fuel costs.

Test Procedure: District D6W will test EnviroTabs in light, medium and heavy trucks. Staff will record the starting odometer, ending odometer, miles, and gallons of fuel used to compare fuel economy of the test vehicles with other vehicles in the fleet.

Conclusions: Drivers on the light and heavy trucks reported they saw no improvement in gas mileage. Drivers on the heavy truck thought there may have been a slight emission improvement. There was incomplete data from the medium truck test.

Recommendations: The district did not recommend the product for statewide implementation.

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



Maintenance Research

Road and Bridge Maintenance

District/Office:
6W/Albert Lea

Contact:
Thomas Johnson
(507) 456-5350

Dennis Iverson
(507) 446-5515

Project Cost:
\$35,000

Start Date:
October 2009

Completion Date:
October 2010

Vendor:
cart-away.com

Concrete Batch Plant *Completed Research*



Project Description: The Cart-Away concrete mixing trailer allows bridge crews and maintenance forces to mix concrete on the job site in the quantity needed to complete specific repairs. This equipment can be used to prepare concrete for bridge deck, railing repairs, and curbing repairs and water inlets.

Purpose: With this product's rotating drum trailer, work crews can produce ready-mix concrete on-site rather than waiting for concrete ready-mix from a vendor. The portable trailer also allows for concrete to be mixed closer to the job site than heavy delivery trucks can reach.

Test Procedure: The district will evaluate the savings in time, material and cost by comparing on-site mixing with vendor delivery of concrete.

Conclusions: The Cart-Away concrete mixing trailer with loading system worked well, allowing concrete to be mixed on-site without delay and waste, and eliminating the small-order charge applied by vendors. The loading system is mobile and easy to set up, and controls on the mixer are user-friendly. Initial tests of the Cart-Away indicate a 3-to-1 ratio of cost savings per cubic yard of concrete when compared to vendor-supplied concrete. The district also reports a 7-to-1 ratio of time savings and the elimination of up to 25 percent of excess vendor-supplied concrete that is typically ordered to ensure projects will not run short.

Recommendations: The district recommends this equipment for all districts using concrete on a weekly basis.

Implementation: This project appears on the statewide implementation list.



Maintenance Research

Road and Bridge Maintenance

District/Office:
6W/Owatonna

Contact:
Tom Johnson
(507) 379-3414

Project Cost:
\$2,500

Start Date:
February 2009

Completion Date:
September 2010

Vendor:
bobcat.com

Concrete Chuter *Completed Research*



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.

Conclusions: The chuter proved to be less functional than the district had hoped. The chuter's capacity was too large for the size of the district's skid loaders, and the concrete mixer could not dump into the chuter because the chuter's side walls are too high. Mn/DOT specifications call for a low-slump concrete; however, the district found that concrete must have a very high slump to run easily out of the chute.

Recommendations: The district concluded that the chuter is not a cost-effective alternative to the skid loader bucket and does not recommend the product for implementation.

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

Hitch Mounted Core Drill

Completed Research



Maintenance Research

Road and Bridge Maintenance

District/Office:
6 East/Materials

Contact:
Chris Dulian
(507) 286-7579

Project Cost:
\$10,349

Start Date:
June 2010

Vendor:
www.kor-it.net



Project Description:

This core drill is attached to the receiver hitch on any half-ton or larger truck, is powered by a 16HP gas engine and can drill holes from 2” up to 16” in diameter. The positioning arm swings up to 180 degrees for precision drilling. The drill head has the ability to extend about 36” beyond the side of the vehicle to drill on curbs for future sign installation.

Purpose: This drill is mounted to the receiver hitch of Mn/DOT’s existing pick-up truck and can be easily removed and stored in the garage. District 6 Materials Office staff is responsible for all of the coring activities within District 6. They also assist the bridge crews, sign crews and maintenance crews.

Test Procedure: The Hitch Mounted Core Drill will be evaluated for six months in the field for speed, ease of use and effectiveness.

Conclusions: The equipment is less costly and does not need to be mounted to a three-quarter-ton required for a larger coring rig. Coring can be accomplished in half the time, saving operator hours as well as maintenance personnel time for providing traffic control. The articulating frame allows the operator to easily and precisely position the core drill. Easy to use and store.

Recommendations: The district highly recommends this product.

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



Maintenance Research

Roadside Maintenance

District/Office:
2B/Thief River Falls

Contact:
Stephen Hufnagle
(218) 683-8016

Project Cost:
\$9,653

Start Date:
Summer 2011

Vendor:
cretexseals.com

Concrete Pipe Joint Sealer *Completed Research*



Project Description: With limited funds available for replacing concrete centerline pipes under state highways, a method is needed to seal leaking joints to extend the life of concrete pipes that are otherwise in good condition. A possible solution: internal joint seals. These watertight compression seals reduce groundwater infiltration and are easily installed to the inside of existing pipe using mechanical means. The mechanical seal does not rely on a chemical bond.

Purpose: This project will test a new method of sealing concrete pipes with leaking joints to extend the life of the pipe. The new method will allow repairs to be completed while roadways remain open to the traveling public.

Test Procedure: The district will assess the ability of internal joint seals to extend the life of existing concrete pipe. If effective, the seals will save time and money by eliminating the need to install new concrete pipe.

Conclusions: Crews installed 24" and 36" joint seals in several concrete pipes and found them quicker, easier and safer to install than metal joint sealers. They are expected to outlast metal joint sealers which corrode and require replacement.

Recommendations: The district recommended this product for statewide implementation.

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



Maintenance Research

Roadside Maintenance

District/Office:
6W/Red Wing

Contact:
Gary Siebenaler
(507) 732-7112

Project Cost:
\$2,495

Start Date:
October 2009

Vendor:
limbhog.com

LIMBHOG *Completed Research*



Project Description: The LIMBHOG is a chain saw that attaches to a skid-steer bucket and allows an operator to trim limbs 8 feet higher than the bucket can reach.

Purpose: The district's current practice in opening up areas is to clear-cut them. The LIMBHOG allows for trimming in hard-to-reach places so that crews can trim only the branches that require it without cutting down the entire tree, retaining trees and saving time that would be spent chipping downed trees.

Test Procedure: The district will assess the product's effectiveness in:

- Reducing labor costs by requiring only one person to operate the skid-steer loader rather than an entire crew of chain saw operators.
- Increasing the number of problem areas crews can manage by trimming rather than felling trees.
- Reducing the potential for injuries by limiting the amount of cutting now required while operating a protected piece of equipment.

Conclusions: Fewer people were needed and the job can be done in half the time since the tree is trimmed rather than being completely removed. The equipment is lightweight, easy to handle, and permits trimming in high, hard-to-reach areas.

Recommendations: The district recommends this product for statewide implementation.

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



Maintenance Research

Roadside Maintenance

District/Office:
1/Virginia

Contact:
Greg Pierzina
(218) 742-1082

Wendy Frederickson
(218) 742-1100

Project Cost:
\$4,950

Start Date:
October 2008

Completion Date:
February 2009

Magnetic Manhole Cover Remover

Completed Research



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.

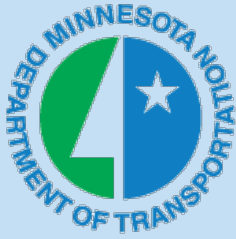
Purpose: This system may reduce the risk of painful and costly injuries and lost-time accidents.

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.

Conclusions: After initial removal of the grates, manhole covers moved in and out of the holes easily with use of the magnetic lifter. However, maintenance staff testing this equipment were lukewarm in their support for this hands-free lifting tool, reporting a preference for continuing the use of manual efforts to remove manhole covers. Future testing may benefit from placing the lifter unit on the front of the pickup rather than the rear.

Recommendations: Further testing is recommended to determine if the unit is an effective alternative to the use of manual efforts to remove manhole covers.

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



Maintenance Research

Roadside Maintenance

District/Office:
4/Morris

Contact:
Brent Holland
(320) 208-7022

Project Cost:
\$2,095

Start Date:
November 2008

Completion Date:
November 2010

Vendor:
propanehammer.com

Propane Hammer *Completed Research*



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 teardown 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.

Conclusions: The propane hammer functioned properly, but operators found that the unit operated more slowly and was just as heavy as an air-powered hammer, and lacked the power to drive posts through frost. Even with little or no setup time, the overall operation took much longer.

Recommendations: The district does not recommend this product for statewide implementation.

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



Maintenance Research

Roadside Maintenance

District/Office:

1/Virginia

Contact:

Wendy Frederickson
(218) 742-1100

Greg Pierzina
(320) 251-4558

Project Cost:

\$4,657

Start Date:

April 2009

Completion Date:

June 2009

Vendor:

bobcat.com

Rotary Screener *Completed Research*



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.

Conclusions: The district tested a ¾-inch screen and found that it was easy to install and worked well, with the screened dirt free of debris, rocks and chunks of grass and mat. With a ready-to-use, screened fill pile, crews reported that less manual labor was required to handle, store and deliver fill to the job site.

Recommendations: The district recommends this product for statewide implementation.

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



Maintenance Research

Roadside Maintenance

District/Office:
6/Austin

Contact:
David Williamson
(507) 433-0554

Project Cost:
\$3,000

Start Date:
March 2008

Completion Date:
June 2010

Vendor:
weedwiper.com

Weed Wiper *Completed Research*



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.

Conclusions: The weed wiper operated in an acceptable manner, but effectiveness appeared to be dependent on the density of weeds. The equipment can be used in any weather conditions, and material savings are realized by targeting placement of the chemical where it is needed. The design could be improved by centering the hookup and folding the wings up, not back.

Recommendations: The district is uncertain of the product's durability and does not recommend it for statewide implementation.

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



Maintenance Research

Safety, Traffic Control and Work Zone Safety

District/Office:
6/Cannon Falls

Contact:
Gary Siebenaler
(507) 263-2323

Project Cost:
\$432 (54 units)

Start Date:
April 2009

Completion Date:
September 2009

LED Lights for Stop/Slow Paddles

Completed Research



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 two AAA 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.

Conclusions: The LED-lit paddles were inexpensive to produce and worked well. The lights proved to be especially effective at night and on cloudy days. Flaggers reported a range of visibility from 300 feet in sunny conditions to 800 feet when skies are overcast. Installation of a visor over the light is recommended to help reflect the sun.

Recommendations: The district concluded that the LED-lit stop/slow paddles improved safety for the traveling public, flaggers and workers and recommends statewide implementation.

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



Maintenance Research

Safety, Traffic Control and Work Zone Safety

District/Office:
6/Albert Lea

Contact:
Thomas Johnson
(507) 456-5350

Project Cost:
\$4,000 (80 units)

Start Date:
October 2008

Completion Date:
July 2009

Vendor:
empco-lite.com

LED Solar Barricade Flashers *Completed Research*



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.

Conclusions: Testing indicated that the LED technology provides a brighter flasher, and solar power provides a longer-lasting power source in the D-cell battery. Installation is easy, requiring attachment of a single bolt. Delayed battery replacement for the LED solar-assisted flashers provides an 8-to-1 ratio of cost savings over the 6-volt lantern flasher batteries currently in use.

Recommendations: The district recommends this product for statewide implementation.

Implementation: This project appears on the statewide implementation list.



Maintenance Research

Winter Maintenance

District/Office:
2/Bemidji
4/Detroit Lakes

Contact:
Joe Huneke
(651) 366-3586

Project Cost:
\$2,168

Start Date:
December 2009

Completion Date:
April 2010

Vendor:
henderson-mfg.com

Air Foil Completed Research



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.

Conclusions: The air foil worked well in keeping the rear area of plow trucks free of snow buildup during winter events and dust in the summer. Installation was quick and easy, and the time operators had spent cleaning off the backs of their trucks was eliminated.

Recommendations: The district recommends consideration of air foils as a permanent addition to all new trucks.

Implementation: This project has been selected for the statewide implementation list.



Maintenance Research

Winter Maintenance

District/Office:
Metro

Contact:
Tom Osthoff
(612) 520-3560

Project Cost:
\$1,500

Start Date:
January 2008

Completion Date:
April 2010

Vendor:
airvizion.com

Air Vizion Completed Research



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.

Conclusions: The Air Vizion system did not operate as predicted. The district found that moisture accumulated in the nozzle, and when air blew over the mirror in cold temperatures, moisture spread over the mirror and froze. This interfered with usage of the mirrors and created problems with visibility during snow and ice operations.

Recommendations: The district does not recommend this product for statewide implementation.

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:
\$140,000

Start Date:
September 2007

Blending Station *Completed Research*



Project Description: The Blending Station is a trailer mounted, self-contained mobile unit that blends liquid and granular deicing materials for a uniform coat and consistency. With its own power source and onboard liquid tank, it can be used to create limited quantities of treated material. It can also be connected to a larger tanker and be used for days in one location to create larger stockpiles of treated material for entire sub areas or districts. Using a machine of this kind could result in a savings of \$250,000 per year statewide.

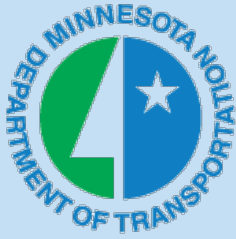
Purpose: If successful, the Blending Station would not only be a huge cost savings for Mn/DOT, but would give the department flexibility on where and when to treat the salt in-house. It would also provide a partnership opportunity with counties and cities.

Test Procedure: Operators injected approximately six to seven 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 was then used at colder temperatures and at lower application rates.

Conclusions: Set up and tear down takes just minutes, and setting the machine for different blends is simple because of the liquid flow meters and the belt scale. The Blending Station saves an average of \$15.00 per ton according to contract prices for treated salt. The Station has blended over 30,000 ton of salt for a cost savings of nearly a half a million dollars. This system can and will save cities, counties and Mn/DOT millions of dollars a year.

Recommendations: The district recommended this product for statewide implementation.

Implementation: This project has been selected for the statewide implementation list.



Maintenance Research

Winter Maintenance

District/Office:
Central Office

Contact:
Ryan Otte
(651) 366-3585

Project Cost:
\$2,980 (each)

Start Date:
August 2009

Completion Date:
May 2010

Vendor:
scale-tec.com

Calibration Scales *Completed Research*



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 scales 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.

Conclusions: In the areas where the calibration scales were used, district personnel found that scales were easy to use and trucks could be calibrated more quickly and efficiently. With use of the scales, the districts can maintain properly calibrated trucks that use the right amount of material at the right time—saving time, money and material.

Recommendations: Central Office recommends this product for statewide implementation.

Implementation: This project appears on the statewide implementation list.



Maintenance Research

Winter Maintenance

District/Office:
Metro

Contact:
Mark Fischbach
(651) 234-7907

Project Cost:
\$5,000

Start Date:
February 2009

Vendor:
cftproducts.com

Crystal Fusion Completed Research



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 was applied to 10 snowplows and eight supervisor vehicles. Employees documented performance and visibility through observation during regular use.

Conclusions: The product was easy to apply and reapply and was effective at shedding rain, snow and ice. The windshield glass and wipers showed less deterioration during use, and less windshield washer fluid was needed. Crystal Fusion could also be useful on the domes of the traffic cameras, keeping them free of snow and ice.

Recommendations: The district recommended this product for statewide implementation.

Implementation: This project has been selected for the statewide implementation list.



Maintenance Research

Winter Maintenance

District/Office:
2/Thief River Falls

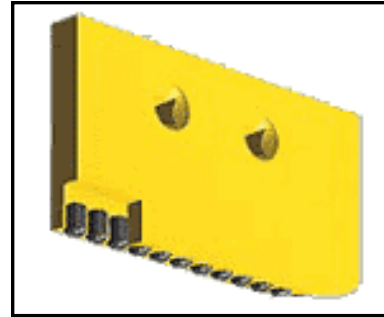
Contact:
Ronny Thramer
(218) 463-2821

Project Cost:
\$2,675

Start Date:
September 2009

Completion Date:
September 2010

I.C.E. Blades Completed Research



Project Description: The new I.C.E. (Isolated Carbide-Edged) 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 deicing materials more effectively on the road surface.

Purpose: The new technology in I.C.E. Series 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."

Conclusions: The district reported no savings in time, material or costs with use of the I.C.E. Series blades. The blades were effective in cutting grooves in ice and compacted snow when new, but as the blades wore the grooves became almost nonexistent. After use during a couple of storms, the I.C.E. Series blades operated in the same manner as the district's standard edges.

Recommendations: The I.C.E. Series blades are twice the cost of regular blades and, contrary to initial expectations, cannot be refurbished after initial wear at a lower cost than new blades. The district does not recommend the product for implementation.

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



Maintenance Research

Winter Maintenance

District/Office:
Central Office

Contact:
Ryan Otte
(651) 366-3585

Project Cost:
\$1,120

Start Date:
January 2009

Completion Date:
April 2010

Vendor:
whelen.com

LED Sander Lights *Completed Research*



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 alternator's 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.

Conclusions: Overall, the LED lights outperformed the incandescent lights now in use, requiring only one-third of the energy and proving to be better able to withstand abuse, jarring and the corrosive environment. Installation is easy, and the wiring used for current incandescent lights can be hooked up to the LED lights.

Recommendations: This research proved the effectiveness of LED lights as a work/sander light, giving operators a clearer view of sanders, spinners and material output and providing performance superior to that of standard incandescent lights.

Implementation: This product has been placed on the statewide implementation list and has become standard on all Mn/DOT plow trucks.



Maintenance Research

Winter Maintenance

District/Office:
6W/Austin, Dodge Center

Contact:
Dennis Distad
(507) 374-6373

Project Cost:
\$800

Start Date:
January 2010

Vendor:
efa-mn.com

Manhole Protection Ring *Completed Research*



Project Description: Road construction, resurfacing and sewer maintenance can result in manhole covers no longer matching the grade and crown of the road, which can be a nuisance and maintenance concern for snowplows. The manhole protection ring kit is an effective, durable system to safely transition from the road surface to the top of the manhole cover, with a subtle incline that provides a smooth, damage-free ride for daily traffic.

Purpose: The manhole protection ring system will protect the plows, underbodies and alignments of Mn/DOT trucks as well as other motorists' vehicles.

Test Procedure: The district will evaluate the ability of the manhole protection ring to produce savings in time, manpower and equipment by avoiding the maintenance or equipment replacement required when vehicles impact a manhole cover.

Conclusions: The manhole protection rings were quick and easy to install, and somewhat less expensive than an asphalt patch. They prevented damage to plows and underbodies as intended but didn't last as long as expected (only one season).

Recommendations: The district is reserving judgment on recommending the product until another winter's observation.

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



Maintenance Research

Winter Maintenance

District/Office:
6/Owatonna

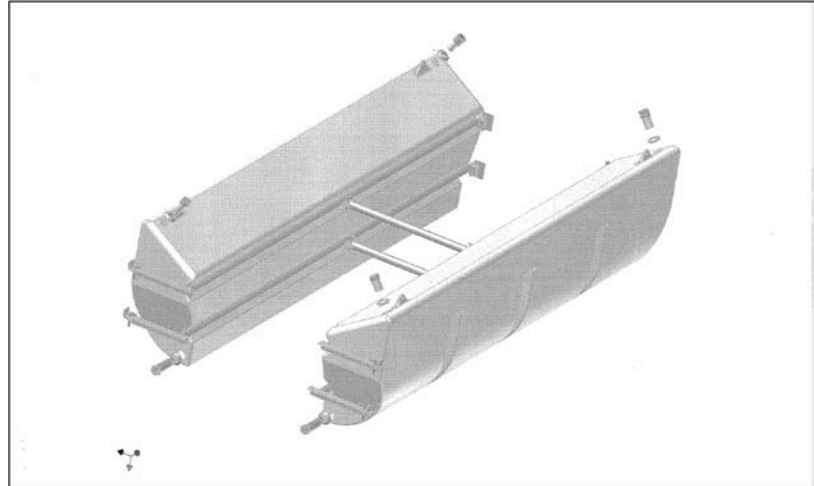
Contact:
Steve Lueken
(507) 446-5532

Project Cost:
\$40,000

Start Date:
October 2008

Vendor:
henderson-mfg.com

Molded Slurry Tanks *Completed Research*



Project Description: Using a 70 percent granular/30 percent liquid slurry for applying deicing chemicals has been proven to reduce material use. To facilitate salt saturation, Mn/DOT will add two in-box molded tanks to a truck, each holding 400 gallons of liquid. This liquid will be pumped not gravity fed to achieve the 70/30 ratio.

Purpose: This system is designed to reduce material use and scatter as compared with dry material. Fuel savings are expected because fewer rounds will be needed, and the system will increase the overall level of service to the public. In initial tests of this system, operators reported that they could often see the slurry begin to work immediately, which does not happen with standard prewetted salt.

Test Procedure: The performance of the salt slurry will be observed compared to the standard system of prewetting a maximum delivery of 500 pounds of salt per lane mile. The slurry maximum delivery was 350 pounds of salt and 150 pounds of liquid (brine) per lane mile.

Conclusions: The slurry system performed as well if not better than the standard salt system. The regain times were much faster with the reduced salt amounts in the slurry.

Recommendations: The district recommended the system for statewide implementation.

Implementation: This project has not been selected for the statewide implementation list at this time.



Maintenance Research

Winter
Maintenance

District/Office:
1/Virginia

Contact:
Wendy Frederickson
(218) 742-1100

Project Cost:
\$3,700

Start Date:
November 2008

Completion Date:
June 2010

Vendor:
coleparmer.com

Rock Salt Moisture Tester *Completed Research*



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.

Conclusions: The easy-to-use unit was tested districtwide with great success. The moisture tester, which is the same type of testing unit used by salt vendors, provided accurate readings in half the time needed for the tri-bar scale and microwave test. The new unit also eliminated the retesting required when popping of salt occurs in the microwave test.

Recommendations: The district recommends placing a moisture testing unit in every area throughout the state that receives salt deliveries. Limiting movement of testing units is recommended to retain unit calibration.

Implementation: This project appears on the statewide implementation list.



Maintenance Research

Winter Material

District/Office:
Metro
6/Cannon Falls

Contact:
Tim Zierden
(651) 385-6416

Terry Schmitt
(507) 263-2323

Project Cost:
\$8,000

Start Date:
December 2009

Completion Date:
April 2011

Vendor:
nasalt.com

ArctiClear Gold Completed Research



Project Description: This project will compare the effectiveness of ArctiClear Gold salt brine additive to the district's current product, liquid corn salt.

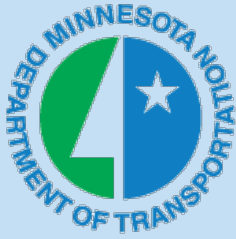
Purpose: ArctiClear Gold salt brine additive may help reduce the amount of salt needed to apply to the road surface. It may provide a lower working temperature, reduce the corrosiveness of salt and give the district another prewetting and deicing resource.

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

Conclusions: ArctiClear Gold proved to be effective as a prewetting agent when used as an 80/20 mix with salt, holding the salt on the road better than conventional prewetting agents. The same benefits were not found when ArctiClear Gold was used as anti-icer. The district reported no savings in cost, time or material with the use of ArctiClear Gold.

Recommendations: The district does not recommend this product for statewide implementation.

Implementation: This project appears on the statewide alternative chemical list.



Maintenance Research

Winter Material

District/Office:
1

Contact:
Wendy Frederickson
District 1
(218) 742-1094

Project Cost:
\$7,600 (District 1)

Start Date:
March 2010

Vendor:
snisolutions.com

GEOMELT 55 *Completed Research*



Project Description: GEOMELT 55 is a deicing liquid that can lower working temperatures and improve adhesion to the road surface when blended with salt. It can also be used to keep salt piles from hardening, saving time and money in breaking them up prior to use.

Purpose: When blended with rock salt, GEOMELT 55 promises to improve sticking ability to the road surface compared to conventional salt alone. With less bounce and scatter and more product staying in the driving lane, less overall product will need to be applied, saving materials, equipment and labor while being environmentally friendly.

Test Procedure: The district premixed the salt stockpile with GEOMELT 55 using a blending machine, mixing about two gallons per ton. The application rates varied by temperature, and staff used the guidance provided in the trucks.

Conclusions: The blended salt worked better in lower temperatures than the untreated salt did. This allowed for lower salt consumption and a faster return to bare wet pavement.

Recommendations: The district plans to use GEOMELT 55 again in the 2011-2012 winter while reducing the application rate by 25%.

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



Maintenance Research

Winter Material

District/Office:
6E

Contact:
David Redig
(507) 286-7575

Project Cost:
\$4,954

Start Date:
November 2010

Vendor:
scotwoodindustries.com

IceBan 200 Completed Research



Project Description: IceBan 200 is an organic, direct-spray liquid and stockpile treatment used for anti-icing and deicing. IceBan's increased working range is supposed to reduce the likelihood that melted snow and ice will refreeze between applications, reducing the need for excess treatments and additional trips by maintenance staff.

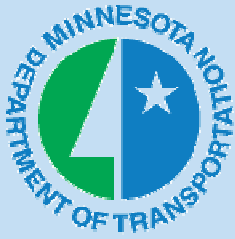
Purpose: Recently approved as an alternative salt product, the district will use IceBan 200 for anti-icing and deicing when road temperatures are below 15 F. At these temperatures, the chemical properties of sodium chloride render it ineffective.

Test Procedure: The district will compare the performance of IceBan 200 with roadways treated with sodium chloride or left untreated because of the cold conditions.

Conclusions: The product did not perform any better than sodium chloride at temperatures below 15 F, either in melting the snow/ice or in preventing refreezing. Testing at slightly higher temperatures might yield better results. Care must be taken in product storage to keep it dry; otherwise it tends to clump and freeze.

Recommendations: The district does not recommend the product for statewide implementation.

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



Maintenance Research

Winter Material

District/Office:

Metro

Contact:

Mark Fischbach
(651) 234-7907

Project Cost:

\$6,603

Start Date:

May 2008

Completion Date:

June 2011

Vendor:

thawrox.com

Thawrox Treated Salt *Completed Research*



Project Description: The districts have purchased Compass Minerals' magnesium-chloride treated salt to augment previous purchases of the magnesium-chloride product from Cargill.

Purpose: This project will compare the effectiveness of Compass Minerals' Thawrox treated salt with the districts' current anti-icing practices.

Test Procedure: The districts will prepare performance comparison reports of Thawrox and current practices to assess product effectiveness.

Conclusions: The product is easy to use and stores well if kept under cover. The Metro district reports moderate-to-good results in subzero weather using 30 percent less material than typical salt application rates require. Reaction time is moderate-to-good as well. Prewetting is not required, and the treated salt flows freely out of the trucks in cold weather.

Recommendations: The district recommends this product for statewide implementation.

Implementation: This product has been selected for the statewide salt alternative list.



Maintenance Research

Winter Material

District/Office:
6W/Austin, Red Wing

Contact:
Derrick Crews
(507) 433-0554

Project Cost:
\$5,000

Start Date:
November 2008

Completion Date:
June 2011

Vendor:
tigercalcium.com

Road Guard Plus 8 *Completed Research*



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 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.

Conclusions: The district tested Road Guard Plus 8 during two snow and ice seasons. Operators found that the product works well in low temperatures and is effective at breaking up the crust that forms on pretreated salt stockpiles. When used with sand, Road Guard Plus 8 cut wheel-track glazing, which is caused by warm tires trapping ground-level blowing snow. Treated material sticks to the pavement, even in windy conditions, and melts snow quickly. A 10 percent reduction in salt use in one of the test locations translated to \$25,000 in cost savings.

Recommendations: The district found Road Guard Plus 8 to be an effective chemical for anti-icing and prewetting at temperatures below 20 F and recommends its use in other districts.

Implementation: This product is on the statewide alternative chemical list.



Maintenance Research

Winter Material

District/Office:
3A

Contact:
Mandy Uhrich
(218) 828-5572

Project Cost:
\$5,040

Start Date:
November 2010

Vendor:
www.envirotechservices.com

MeltDown Apex Completed Research



Project Description: This liquid anti-icing and deicing chemical is intended for severe winter conditions, preventing snow and ice buildup, increasing snow and ice melt and lowering the refreeze point.

Purpose: MeltDown Apex (magnesium chloride with corn based inhibitor) has the potential to improve snow removal, lower the refreeze point and reduce the amount of sodium chloride needed (thereby reducing related corrosion) to help Mn/DOT decrease overall snow and ice costs and make snow removal efforts more environmentally friendly.

Test Procedure: District 3A plans to test the effectiveness of MeltDown Apex for one year as a pre-storm, anti-frost treatment for roadways, super elevated curves and bridges in severe winter weather occurrences.

Conclusions: Single applications of the product performed well in extreme cold temperatures with no refreeze. Where applied on icy bridge decks no overtime callouts were needed, equipment and fuel usage was reduced, and material costs were reduced because no additional chemical was needed. Drawbacks are that the chemical cannot be cut and is very expensive.

Recommendations: The district recommended this product for statewide implementation.

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

2009-2011 Research in Progress



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)

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 electrochemical 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

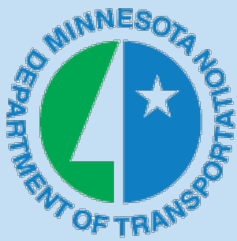
Cab Cam Wireless Cameras *Research in Progress*



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:
D3A/Baxter

Contact:
Jim Anderson
(218) 828-5729

Project Cost:
\$3,209

Start Date:
August 2010

Vendor:
www.bgauto.net

Diesel Induction Service Tool

Research in Progress



Project Description: Diesel engine emission standards are directing engine manufactures to use different procedures and engine components to provide cleaner running engines. These changes have resulted in deposits building up on components like exhaust gas recirculation valves, intake manifolds, and fuel injectors. District 3A would like investigate using a cleaning system that does not require disassembly of the engine to accomplish the necessary maintenance.

Purpose: The new Diesel Induction Service Tool chemically cleans the engine parts to decrease emissions, restore fuel efficiency and keep diesel engines running longer.

Test Procedure: District 3A will monitor fuel consumption, emissions and fuel injection component parts replacement costs using their M5 Fleet Management System for one year. The results will be compared to like vehicles within Mn/DOT.



Maintenance Research

Equipment - Tools

District/Office:
1/Virginia

Contact:
Dave Ollila
(218) 742-1078

Project Cost:
\$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 ¼-inch steel to 1300 F 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:
Metro

Contact:
Marv Hayes
(651) 366-5248

Project Cost:
\$610 (3 units)

Start Date:
June 2010

Vendor:
irislink.com

IRISPen *Research in Progress*



Project Description: The IRISPen Executive 6 is full-featured optical character recognition scanning pen that works like a highlighter—simply slide it over printed information and the pen instantly types and displays editable text on your computer screen.

Purpose: The Metro district will use the IRISPen to transfer handwritten trainers' notes electronically rather than manually. This product may lower labor and material costs by reducing the number of clerical personnel needed and office supplies used at training classes.

Test Procedure: Metro maintenance training staff will conduct a daily evaluation of the product's effectiveness, quality of reproduction, and time and labor cost savings. The IRISPen will also be evaluated for its electronic compatibility with district equipment, ease of use and the amount of time required to become proficient in the use of the device.



Maintenance Research

Equipment - Tools

District/Office:
3A

Contact:
Gary Dirlam
(218) 828-5705

Jim Anderson
(218) 828-5819

Project Cost:
\$4,000

Start Date:
October 2009

MetalGard *Research in Progress*



Project Description: MetalGard is a biobased coating made from natural oils and resins that provides protection against rust and corrosion. The product penetrates into the substrate to create a permanent, flexible and nonporous barrier to roadway deicing chemicals. MetalGard also cuts through existing rust to terminate corrosion at its source.

Purpose: Rust is a major contributing factor to the overall cost of maintaining Mn/DOT's snowplow fleet. Reducing the effects of rust has the potential to save on downtime and parts and labor costs.

Test Procedure: The district will apply MetalGard on two new tandem trucks, two 2002 tandem trucks, and several sanders that have been sandblasted and repainted; a metro conveyor may also be included in the test. Annual reviews will be conducted after each snow season to compare rust formation on the treated units with the frames of similar untreated units. The district will also compare electrical/mechanical repair costs for the treated and untreated units.



Maintenance Research

Equipment - Tools

District/Office:
Metro

Contact:
Jeff Streeter
(651) 366-5191

Project Cost:
\$24,000

Start Date:
April 2010

Vendor:
qstartech.com

Q Star FlashCam *Research in Progress*



Project Description: The Metro District spends significant time and money each year cleaning up graffiti and dumped materials on or near roadways. The cameras from Q Star Technologies could serve as an effective deterrent to vandals as part of a Graffiti and Illegal Dumping Prevention Public Safety Program for the district.

Purpose: The cameras can be moved from one location to another, discouraging graffiti and illegal dumping with the fear of getting caught on camera. The payoff could be significant. In six months alone, Metro spent more than \$33,000 on materials and labor to clean up graffiti. A reduction in graffiti and illegal dumping would also allow Mn/DOT staff to focus on traffic control and maintenance instead of cleanup efforts.

Test Procedure: Metro will test six Model 770 cameras and two decoy cameras for one year in areas known for repeat graffiti and dumping problems. The district has been tracking graffiti and illegal dumping and will be able to record a change in the frequency of these problems after the cameras are installed.



Maintenance Research

Equipment - Tools

District/Office:
Central Office

Contact:
Andrew Kubista
(651) 366-3560

Project Cost:
\$900

Start Date:
March 2011

Vendor:
tiresafeguard.com

Tire-SafeGuard Tire Monitoring System

Research in Progress



Project Description: The Tire-SafeGuard monitoring and alarm system keeps operators continually informed of tire issues related to under/over inflation, tire leaks and excessive tire temperatures. The unit can quickly check all tires on a vehicle and return the results to the operator on a continuous basis or in an emergency setting.

Purpose: New class 33 and class 35 snowplows with rear-mounted wings provide limited access to check tire pressure. The tire monitoring system solves this problem and allows the operator to more quickly and safely get the vehicle into operation. The system is also expected to reduce the need for tire replacement and repair, and reduce the chance of accidents and injuries resulting from tire failure during operation.

Test Procedure: The Tire-SafeGuard monitoring system will be evaluated for performance and reliability as well as for its ability to save costs and materials. Tire-SafeGuard performance will also be compared to the performance of the HawksHead HD Plus tire monitor.



Maintenance Research

Equipment - Tools

District/Office:
8/Marshall

Contact:
Craig Gertsema
(507) 537-2059

Project Cost:
\$8,177

Start Date:
March 2011

Vendor:
truckoffice.com

TruckOffice *Research in Progress*



Project Description: The back seats of supervisors' pickups can be packed full of supplies, equipment and paperwork. These unsecured objects can be unsafe in the event of an accident and pose a security issue if valuables are in full view of potential thieves. The TruckOffice storage unit organizes paperwork, files and technical data, provides safe, secure laptop storage, and comes with an optional power inverter that can help with the use of electronics and other instruments in the field.

Purpose: The TruckOffice will not replace other equipment, but it is expected to organize contents in pickups, improve safety for drivers and occupants, and enhance security by providing secondary locks on valuables.

Test Procedure: Inspectors and maintenance supervisors in the district will test two storage unit models—TruckOffice and CargoDeck—to determine the effectiveness of the storage units in organizing and securing truck contents.



Maintenance Research

Road and Bridge Maintenance

District/Office:
6/East Rochester Bridge

Contact:
Steve Miller
(507) 286-7697

Project Cost:
\$19,150

Start Date:
March 2010

Vendor:
www.geophysical.com

Ground Penetrating Radar Bridge Scan System

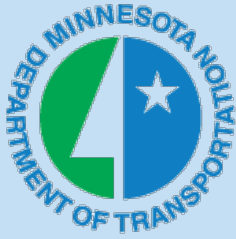
Research in Progress



Project Description: Mn/DOT staff evaluate concrete bridge decks for delaminations on a regular basis using manual detection techniques, such as chain dragging and core sampling. These manual techniques are labor intensive, rely on human interpretation of acoustic feedback and may yield inaccurate results. The Ground Penetrating Radar (GPR) Bridgescan System uses an electromagnetic evaluation technique that could alleviate these problems.

Purpose: The GPR Bridgescan System gathers data about bridge conditions without the need to remove the top layer of pavement. The companion software allows users to complete reports that accurately show the severity of concrete delaminations and the overall deterioration of the bridge deck. This information will help Mn/DOT determine the need for future overlay replacement, deck replacement, and concrete repairs. In addition, the system should allow staff to inspect bridge decks four times as quickly as with manual methods.

Test Procedure: Staff will evaluate the effectiveness of the system for six months when inspecting bridge decks, but the system has potential application in multiple assessment areas: pre-stressed concrete beams, approach panels, concrete culverts, roadways, sidewalks and sound/retaining walls. The system could also be used to determine location, size and depth of rebar, wire mesh, and PVC pipe and obtain overall depth of concrete slabs.



Maintenance Research

Equipment - Tools

District/Office:

1

Contact:

Kevin Abbott
(320) 629-2572

Project Cost:

\$612

Start Date:

October 2010

Vendor:

tpms.ca

HawksHead HD Plus Tire Monitoring System

Research in Progress



Project Description: The HawksHead HD Plus tire pressure monitoring system was developed and tested for extreme environments. The system comes with a monitor that scrolls automatically through each wheel measuring tire pressure and temperature and displays it on the monitor. Wheel sensors are airtight and watertight and have replaceable batteries.

Purpose: Drivers can monitor tire pressure and temperature on tires that have limited accessibility due to rear-mounted wing hardware. By keeping tires properly inflated, Mn/DOT can reduce tire wear and improve fuel consumption, and reduce the possibility of tire failure that can lead to vehicle damage or crashes.

Test Procedure: The HawksHead HD Plus monitoring system will be evaluated for performance and reliability as well as for its ability to save costs and materials. HawksHead HD Plus performance will also be compared to the performance of the Tire-SafeGuard tire monitor.



Maintenance Research

Road and Bridge Maintenance

District/Office:
Metro/Maple Grove

Contact:
Bill Augello
(651) 775-7110

Project Cost:
\$48,000

Start Date:
April 2010

Vendor:
kminb.com

Heated Mix Asphalt Recycler *Research in Progress*



Project Description: A unit that recycles asphalt millings or chunked or broken asphalt and reclaims it as a heated mix provides the Metro district with an alternative to the cold mix used to patch holes during the winter season. The unit tumbles the recycled asphalt while supplying indirect open flame heat that allows the asphalt to be brought up to a workable temperature.

Purpose: Not only is cold mix expensive—\$150 per ton, plus the cost and time for hauling in the mix—it does not produce long-lasting repairs. The asphalt recycler boasts an environmental benefit while producing hot mix for about \$20 a ton at a rate of 2 tons per hour.

Test Procedure: The district will evaluate the asphalt recycling unit's contribution to maintaining or improving its level of service while saving time and money with the use of a more effective patch material.



Maintenance Research

Road and Bridge Maintenance

District/Office:
Metro/Arden Hills

Contact:
Gene Lorentz
(651) 234-7934

Kelly Cramer
(651) 639-4053

Project Cost:
\$8,960

Start Date:
July 2010

Vendor:
j-craftinc.com

Material Control Gate *Research in Progress*



Project Description: The material control gate replaces a conventional tailgate and is used for dispensing hot mix and shouldering material. This multifunction tailgate will be mounted on a class 35 dump truck with an elliptical box.

Purpose: The material control gate controls the amount of material needed for each job, reducing material waste and labor costs.

Test Procedure: The district will assess the ability of the material control gate to reduce material waste and labor costs, increase productivity, and improve safety by reducing the amount of shoveling of excess material, which is expected to reduce workers' back strain.



Maintenance Research

Road and Bridge Maintenance

District/Office:
6W/Austin

Contact:
Curt Kiefer
(507) 676-2555

Project Cost:
\$2,500

Start Date:
August 2010

Motor Grader/Wedger *Research in Progress*



Project Description: The district is building a wedger to fit on its motor grader to provide greater flexibility in repairing shoulders. By mounting the wedger on the blade of the motor grader, the blade can slide left and right to do the shouldering work that is typically performed by a shouldering machine. The grader stays on the mainline pavement while the wedger smooths the shoulder.

Purpose: By mounting a wedger on a motor grader, the district can repair damaged bituminous shoulders using its current motor grader without requiring investment in a shouldering machine at a cost of more than \$100,000. The retrofitted equipment might also be used to perform mainline wedge paving, allowing the operator to go directly from shouldering to mainline wedging in the same lane closure.

Test Procedure: The district will evaluate the ability of the modified motor grader to produce results that compare favorably with those produced by a traditional shouldering machine, and generate time and cost savings by reducing the number of processes required to produce a smooth shoulder.



Maintenance Research

Road and Bridge Maintenance

District/Office:
1A/Lakes

Contact:
Tom Gustin
(218) 768-3043

Project Cost:
\$15,952

Start Date:
July 2010

Vendor:
www.SteppMfg.com

Slip-In Pre-Mix Heater *Research in Progress*



Project Description: Mn/DOT currently uses a bituminous hopper (kettle) trailer pulled behind a truck to apply crack sealant to asphalt roads. The sealant is heated in the kettle on site and then applied. Once the material has been applied, staff must drive back to the shop, load a new supply of material and begin heating it, all of which is time consuming. In addition, the large trailer reduces parking and maneuvering options for drivers, placing them closer to oncoming traffic. The Stepp Slip-In Pre-Mix Heater holds more material right in the back of the truck, allowing for more work between material refills, and multiple features that protect workers in the field.

Purpose: The Stepp Slip-In Pre-Mix Heater sits right on the back of the truck (instead of being pulled as a trailer), allowing for better maneuverability and visibility. Staff will be able to park in driveways instead of roadways, keeping them away from oncoming traffic. In addition, the unit can be stored with the truck indoors, protecting it from the extreme weather. The new equipment provides an adjustable shovel tray, which allows the height from the ground to vary with employees' heights, and hydraulic doors, which reduce required lifting and pulling motions.

Test Procedure: Staff will evaluate the unit for one year, documenting work times, ease of use and worker injuries.



Maintenance Research

Roadside Maintenance

District/Office:
6E/Rochester Sub Area

Contact:
Ruth Betcher
(507) 286-7692

Project Cost:
\$11,500

Start Date:
June 2010

Vendor:
www.permaform.net

Centri-Pipe *Research in Progress*



Project Description: Thousands of centerline roadway pipes are deteriorating in District 6 due to large-scale rust, holes and pipe separation. There is an increased risk of culvert/roadway failures if these defects are not corrected, but it is cost prohibitive to fully replace the pipes. A new culvert lining called the Centri-Pipe, a Centrifugally Cast Concrete Pipe (CCCP), appears to be a cost effective way to extend pipe life by 50 to 100 years.

Purpose: Centri-Pipe lines the entire culvert interior with an engineered mortar that provides defect correction while creating a structural interior pipe. This engineered mortar consists of mixing special high-density polypropylene reinforcing fibers and other additives to provide the mortar with structural properties and an adherence capability to bond the interior culvert surface. The mixture can be sprayed, cast, pumped or gravity-flowed onto any area. Without digging or replacing liners, Centri-Pipe provides quick setting, waterproof protection against corrosion.

Test Procedure: This project will carry out a one-time installation of the Centri-Pipe to measure its success as a cost-effective alternative to pipe replacement and linings.



Maintenance Research

Roadside Maintenance

District/Office:
6W/Owatonna

Contact:
Daryl Johnson
(507) 446-5507

Project Cost:
\$6,500

Start Date:
April 2010

Vendor:
handyhitch.com

Gravel-Pro *Research in Progress*



Project Description: The Gravel-Pro, with its moldboard attachment featuring a grader-style cutting blade, is designed to reclaim roadside gravel, mulch grass, grade and level material and break up large sod clumps.

Purpose: The Gravel-Pro makes roadside maintenance a one-person operation, improving productivity, enhancing safety and reducing truck underbody wear.

Test Procedure: The district will assess the product's performance and its ability to save time, manpower and material and reduce equipment wear by reclaiming shoulder material and allowing for a one-person operation.



Maintenance Research

Roadside Maintenance

District/Office:
6E

Contact:
Shannon Wait
(507) 286-7681

David Redig
(507) 286-7575

Project Cost:
\$9,900

Start Date:
August 2009

Vendor:
trimble.com/junosb.shtml

Juno Data Collector *Research in Progress*



Project Description: Accurate and thorough data collection is an essential part of the job for maintenance staff. The Juno SB handheld is a Global Positioning System data collector that improves and streamlines inventorying of right of way features and the planning and reporting of field operations. Data are post-processed and can be imported into existing software packages such as Excel, Access and ArcGIS for reporting and work planning.

Purpose: Data are gathered, maintained and stored in an easy-to-access digital format that eliminates the use of written field diaries, allowing for the easy transfer of knowledge that may otherwise be lost. The system also permits the attachment of digital images and coordinates to the file, and gives staff the ability to produce work plans in the field.

Test Procedure: The district will assign one unit per truck station (or section) in four of the district's eight subareas to collect project data on a daily or project basis. The system evaluation will consider how well the Juno SB handheld device bridges existing gaps in available data to generate more accurate, thorough and prompt reporting of highway maintenance activities.



Maintenance Research

Roadside
Maintenance

District/Office:
8/Marshall

Contact:
Richard Persoon
(507) 537-2078

Project Cost:
\$2,982

Start Date:
April 2009

Vendor:
spectraprecision.com

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 the 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:
7/Windom

Contact:
Tony Desantinago
(507) 831-8041

Project Cost:
\$28,300

NTREC Funds:
\$17,000

Start Date:
July 2008

Vendor:
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:
6W

Contact:
Steve Lueken
(507) 446-5530

Project Cost:
\$5,000

Start Date:
May 2010

Side Shift Mower *Research in Progress*



Project Description: A side sift mowing system allows mowing crews to mow the entire area next to median cable guardrail in one cut using a tractor mounted with the Spider guardrail mower. The two-disc mowing system can simultaneously cut from both sides and underneath an obstacle.

Purpose: The side shift mowing system will mow areas adjacent to median cable guardrail with a single tractor, eliminating the second mower now required for mowing operations. Less equipment required for mowing operations saves time and money and increases safety by limiting the personnel exposed to roadway traffic.

Test Procedure: The district will evaluate the ability of the side shift mowing system to complete mowing operations next to median cable guardrail in a single cut.



Maintenance Research

Roadside Maintenance

District/Office:
Metro

Contact:
Jeff Streeter
(651) 366-5191

Ron McDeid
(651) 366-5193

Project Cost:
\$58,834

Start Date:
September 2010

Vendor:
sodarestoration.com

Soda Blaster *Research in Progress*



Project Description: Soda blasting is a new paint stripping technology that uses compressed air to propel a bicarbonate of soda-based media onto the surface to be cleaned or stripped.

Purpose: The low-impact, ecofriendly soda blaster can be used to clean and repaint (including graffiti removal) bridges, overpasses, sound walls, pavement, buildings, mechanical equipment and other surfaces for which repainting is not an acceptable option. Although it is similar to traditional sand blasting, soda blasting has the significant advantage of cleaning the surface without causing harm to the substrate or the environment.

Test Procedure: The district will evaluate the soda blaster for performance and reliability. The unit will also be assessed for its ability to save time with a one-step cleaning and decoating process, save material by causing minimum impact to surfaces, and reduce manpower needs with a mobile, often one-person operation.



Maintenance Research

Roadside Maintenance

District/Office:
Metro

Contact:
Dewy Jones
(651) 234-7944

Project Cost:
\$9,807

Start Date:
February 2010

Wet Cut System *Research in Progress*



Project Description: In right of way maintenance, mowing is an expensive and labor-intensive operation. For many years, roadside maintenance programs have used herbicides in an effort to extend the mowing cycle. A wet cut mowing system creates efficiencies by combining the operations of a right of way mower and a chemical applicator for applying chemicals such as herbicides to stubble remaining after the mowing operation has been performed.

Purpose: Extending the mowing cycle will save money and labor and keep rights of way in better condition, which will reduce the amount of wear and tear on other maintenance equipment.

Test Procedure: To assess the effectiveness of the wet cut mowing system, the district tracked vehicle routes, miles, application rates and vegetation heights through the 2010 mowing season. Mowing heights will be measured in 2011 and compared to areas where the wet cut system was not used. Cost savings in personnel and fuel associated with using one piece of equipment versus two will be computed based on vehicle miles.



Maintenance Research

Safety, Traffic Control
and Work Zone Safety

District/Office:
3/St. Cloud

Contact:
Randy Reznicek
(320) 223-6568

Project Cost:
\$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.



Maintenance Research

Winter Maintenance

District/Office:

7

Contact:

Randy Glaser
(507) 304-6235

Project Cost:

\$2,000

Start Date:

December 2009

Vendor:

www.tufftechbags.com

Bag Reel *Research in Progress*



Project Description: While in the field, winter maintenance crews need to move back and forth between liquid and granular applications based on weather conditions. The faster this transition can take place, the more efficiently crews can address current road conditions for the traveling public. The Tuff Tech Bag used by District 7 for liquids can attach to the truck on a reel, allowing the operator to change the type of material being applied without completely removing the bag from the truck.

Purpose: The reel mechanism for the Tuff Tech Bags has the potential to add needed flexibility in how trucks address winter road conditions. Being able to move quickly between 100% liquid and granular applications as needed allows operators to focus on applying the correct materials for the conditions.

Test Procedure: District 7 truck operators will use the reel when moving between liquid and granular applications over one winter to document efficiencies gained in reaching level of service requirements and reducing material waste.



Maintenance Research

Winter Maintenance

District/Office:
Metro

Contact:
Mark Fischbach
(651) 234-7907

Project Cost:
\$20,000

Start Date:
April 2010

Vendor:
<http://www.henderson-mfg.com/liquid.html>

First Response System *Research in Progress*



Project Description: Metro staff currently use a dump box with the tow plow to distribute granular materials on the roadway. However, only a quarter of the material in the box can be used because the tongue of the tow plow prevents raising the box to move material to the spreader. The First Response System is designed to work effectively with a tow plow fleet because it can discharge material in front of the box instead in the rear.

Purpose: The First Response System supports application of granular material, pre-wetting of material (up to 45 gallons per ton) and anti-icing on up to three lanes, all while changing functions on the fly. The unit has 1300 gallons of liquid storage, allowing it to be used in sweeping operations as the water truck. If successful, the system could help Mn/DOT reduce fleet size by combining granular material application anti-icing.

Test Procedure: The system will be evaluated in the field for one year to document material usage, speed of completing operations and ease of use.



Maintenance Research

Winter Maintenance

District/Office:
Central Office

Contact:
Ryan Otte
(651) 366-3585

Project Cost:
\$4,000 (5 sets)

Start Date:
January 2011

Vendor:
truck-lite.com

LED Headlights *Research in Progress*



Project Description: LED lights are slowly becoming the norm across the trucking industry. This project's 12-volt LED headlamp application offers brighter, crisper and whiter light output than incandescent alternatives. LED headlights offer longer life—they are expected to last five years or more—and greater dependability than Mn/DOT's current halogen headlights.

Purpose: LED headlights will give snowplow operators a better view of the road and help identify the potential dangers that lie ahead. LED headlights also reduce the overall energy draw on the truck, which may prolong the life of alternators and reduce downtime for repairs.

Test Procedure: The LED headlights will be evaluated for their dependability, potential for reducing wear on truck components, and effectiveness in providing a safer driving environment.



Maintenance Research

Winter Maintenance

District/Office:
Central Office
6W

Contact:
Ryan Otte
(651) 366-3585

Steve Lueken
(507) 446-5530

Project Cost:
\$8,000

Start Date:
February 2010

Vendor:
whelen.com

LED Warning Lights for Plow Trucks *Research in Progress*



Project Description: The cost of the current strobe light system used on Mn/DOT snowplows is approximately \$300 more than a new LED warning light system. Research indicates that reduced market demand for strobe lights has led to increased prices. To gather information on an alternative to the higher-priced strobe lighting, this project will test the effectiveness of LED warning lights on plow trucks around the state.

Purpose: The visibility of the LED warning light is as good if not better than the present strobe lighting system. With the LED's low amperage draw, Mn/DOT operators can shut down engines while leaving the LED warning lights on, saving on fuel costs and reducing emissions. If test results are promising, Mn/DOT will slowly eliminate the use of strobe lights on plow trucks.

Test Procedure: This project will field-test two LED heads on six snowplows selected on the basis of climate and location. Staff will monitor the lights for their effectiveness during snow and ice operations, night operations and bright, sunny day operations in meeting or exceeding the level of safety provided by the current strobe lights.



Maintenance Research

Winter Maintenance

District/Office:
7/Mankato

Contact:
Randy Glaser
(507) 304-6235

Project Cost:
\$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:
6E/Rochester

Contact:
Kong Donangdy
(507) 286-7577

Project Cost:
\$1,400

Start Date:
November 2010

Vendor:
teamlab.net/TeamWinter.php

Mr. Slick *Research in Progress*



Project Description: Mr. Slick is a snow and ice anti-stick liquid used to prevent snow and slush from sticking to metal surfaces and building up on snowplow equipment. The product is used seasonally as an anti-corrosive protective coating to protect metal on equipment when stored.

Purpose: This product can be used on snowplows, truck boxes, front-end loaders, snowblower chutes and other equipment to prevent snow and ice buildup on the district's snow and ice fleet. The product is expected to inhibit corrosion and reduce shop cleanup efforts, and may prolong the service life of the equipment.

Test Procedure: The district will make visual inspections of snowplows treated with the product at the end of each shift to determine the product's ability to keep the snowplow—including warning lights, marker lights and cab lights—free of snow and ice buildup.



Maintenance Research

Winter Maintenance

District/Office:
2B

Contact:
Steve Scholand
(218) 277-7966

Project Cost:
\$2,008

Start Date:
November 2009

Vendor:
rhomar.com

NEUTRO-WASH *Research in Progress*



Project Description: Winter maintenance staff regularly wash snow and ice equipment to remove salt, but a corrosive white salt film reappears after the equipment dries. This salt film promotes the rusting process. NEUTRO-WASH neutralizes the corrosive effects of sodium chloride on radiators, condensers and other sensitive equipment parts, allowing the salt residue to be washed away.

Purpose: NEUTRO-WASH will be used to wash the district's snow and ice equipment in an effort to reduce the corrosive effects of winter maintenance materials and prolong the life of its snow and ice fleet.

Test Procedure: The district will evaluate the ability of NEUTRO-WASH to reduce the need to replace parts that are normally subject to corrosion deterioration.



Maintenance Research

Winter Maintenance

District/Office:
1

Contact:
Wendy Frederickson
(218) 742-1094

Chris Vest
(218) 742-1080

Project Cost:
\$375

Start Date:
February 2010

Vendor:
pleiger.com

Polyurethane Cutting Edge *Research in Progress*



Project Description: A polyurethane snowplow cutting blade provides a lightweight alternative to traditional metal cutting blades that reduces chatter and limits damage to plowed surfaces.

Purpose: Easy to handle, polyurethane blades reduce damage to road surfaces while providing excellent abrasion resistance. Less chatter than is produced by metal blades reduces operator fatigue and can lead to longer snowplow service life.

Test Procedure: The district will evaluate the effectiveness of the polyurethane snowplow cutting blade in snow removal operations, comparing results with those produced by traditional metal cutting blades. This evaluation will include an assessment of the ease in changing out the blade, reduction in plow chatter, and the effect of the cutting edge on roadway surfaces.



Maintenance Research

Winter Maintenance

District/Office:
6W

Contact:
Ron Heim
(507) 446-5508

Project Cost:
\$5,268

Start Date:
October 2010

Vendor:
banjocorp.com

Salt Brine Flow Meters *Research in Progress*



Project Description: Flow meters on water lines leading into salt brine generators track the water and brine used to create the salt brine used for anti-icing, pretreating salt and deicing. Current estimates made without the use of such a meter are dependent on operators' perceptions. This can lead to estimating errors, particularly when filling partial tanks.

Purpose: The flow meter is expected to improve tracking of salt brine usage per event and provide an accurate reading of the amount of salt added to make the brine. Better data on salt usage will help winter maintenance managers maintain more accurate material inventories.

Test Procedure: The district will evaluate the ability of the flow meter to save time in maintaining accurate inventory data and reconciling stockpile numbers.



Maintenance Research

Winter Maintenance

District/Office:
Metro/Mendota

Contact:
Joe Godfrey
(651) 406-4734

Project Cost:
\$4,160

Start Date:
December 2009

Salt Skirt

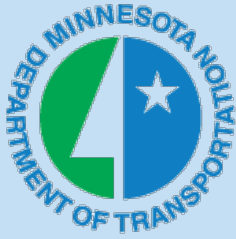
Research in Progress



Project Description: The salt skirt is a cup brush mounted 1 inch below the spinner. Approximately 24 inches in diameter, the salt skirts fabricated by the district have 30-inch bristles or fingers made of a heavy fabric-like product and rubber.

Purpose: The salt skirt enables vehicles to place salt on or near the centerline, keep more material in the target area, and limit bounce off the roadway. With its placement 1 inch below the spinner, the salt skirt gives the operator the ability to broadcast material in intersections and hazard areas.

Test Procedure: The salt skirt will be evaluated for its ability to reduce the amount of salt used, leave more material in the target area, and help prevent material scatter and bounce. The district will test different bristle styles to determine which design helps retain the most salt on the roadway. The Metro district will also compare the effectiveness and durability of the salt skirts it fabricates to the bristle-like skirts used in District 7.



Maintenance Research

Winter Maintenance

District/Office:
6W

Contact:
Tom Johnson
(507) 456-5350

Project Cost:
\$5,000

Start Date:
March 2010

Vendor:
prairiemoonnursery.com

Snow Drift Control *Research in Progress*



Project Description: Keeping snow and ice off of windswept areas of the roadway can be aided by the installation of a traditional snow fence, tree and shrub planting, and by leaving standing corn rows in farm fields. In roadway ditch rights of way where these methods are not an option or have proved to be too expensive to implement, the district will plant a 10-foot-wide swath of tall native grasses and a 5-foot-wide strip of a perennial cone wildflower mix to serve as a windbreak.

Purpose: An effective windbreak can save time and money by requiring fewer passes and less material to clear snow and ice from the roadway. The project plantings have the additional benefit of providing wildlife habitat and an aesthetically pleasing backdrop for the traveling public.

Test Procedure: The district will assess the impact of the planting areas in reducing the time and material required to keep the adjacent roadway free of snow and ice.



Maintenance Research

Winter Maintenance

District/Office:
6W/Zumbrota

Contact:
Ken Peterman
(507) 732-7112

Project Cost:
\$3,000

Start Date:
May 2010

Vendor:
safewayhyd.com

Stainless Steel Hydraulic Couplers

Research in Progress



Project Description: During the winter season couplers are used to attach snow and ice equipment to the hydraulic system of a plow truck. These steel couplers corrode due to the presence of salt and moisture, and they become bonded together. Removing or separating the rusted couplers requires a great deal of force and damages the couplers. To remedy this, the district will test couplers made with 303 stainless steel for general purpose, ball locking, and double shut-off fluid transfer uses. The couplers are supplied with hardened stainless steel locking detent balls and have heat-treated surfaces to resist wear.

Purpose: Using stainless steel couplers on Mn/DOT plow trucks in highly corrosive areas will expedite removal and reattachment of snow and ice components because they will not become corroded and bond together. Stainless steel couplers can also limit costly damage that can be caused when the current steel couplers become bonded or corroded, allowing foreign materials such as dirt, rust and moisture to enter the hydraulic system.

Test Procedure: The district will evaluate whether the stainless steel couplers eliminate corrosion and expedite the attachment and removal of snow and ice components.



Maintenance Research

Winter Maintenance

District/Office:
Metro

Contact:
Mark Fischbach
(651) 234-7907

Project Cost:
\$15,000

Start Date:
March 2008

Vendor:
vikingives.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 Maintenance

District/Office:
4/Detroit Lakes

Contact:
Dennis Redig
(218) 846-7943

Project Cost:
\$3,475

Start Date:
October 2010

Vendor:
winterequipment.com

Winter® Snowplow Cutting Edges

Research in Progress



Project Description: The district's snowplow operators will test two Winter Equipment cutting edges to determine if the blades have a longer wear life than the blades now in use.

- The RAZOR snowplow blade system combines a carbide insert blade with built-in steel cover plate protection to eliminate the need for cover blades.
- The RoadMaxx underbody blade system has a carbide insert blade with a carbide matrix face protecting carbide inserts from washout and the lower front blade face from erosion.

Purpose: Longer-lasting snowplow cutting blades require less frequent replacement, saving money and operator time and reducing the potential of injury in the replacement process.

Test Procedure: The district will equip two snowplows with the RAZOR blade system and three underbody plows with RoadMaxx blades. The cutting edge life of the new blades will be compared with the wear life of the current carbide cutting edge and the JOMA plow blade to identify any cost savings associated with the new blade systems.



Maintenance Research

Winter
Material

District/Office:
7/Window, Mankato

Contact:
Thomas Zimmerman
(507) 831-8038

Anthony DeSantiago
(507) 304-6233

Project Cost:
\$60,000

Start Date:
October 2010

Liquid Chemical Blending and Dispensing Unit *Research in Progress*



Project Description: The district will add a state-of-the-art material dispensing unit to its AccuBrine salt brine generators. The unit consists of a series of pumps equipped with flow meters that allow for accurate blending and dispensing of up to five different chemicals into either the tank on a plow truck or into larger tankers for distribution to other sites. A computer monitors and controls the mixture rate at which the pumps are flowing to give the operator an accurate mixture.

Purpose: With the use of this system, the district will no longer have to blend salt brine with other materials in tanks and store them, which reduces both the amount of storage capacity and the number of different materials the district can have on hand at any one time. It will also allow the district to accurately charge out materials to other agencies or entities currently sharing the district's chemical generation sites.

Test Procedure: The district will test the unit's ability to monitor and control the dispensing sites from a remote office. The evaluation will also include an assessment of the system's ability to generate reports that provide data on the material taken from each site.



Maintenance Research

Winter Material

District/Office:

Metro
2

Contact:

Lynn Tschida
(651) 234-7933

Curt Larson
(218) 683-8023

Project Cost:

\$13,203

Start Date:

December 2010

Vendor:

envirotechseivices.com

SOS Salt Pretreatment *Research in Progress*



Project Description: SOS is liquid product designed for the pretreatment of salt and sand. Pretreatment can improve ice removal practices by reducing application rates and allowing for effective deicing at lower temperatures.

Purpose: This product will be used to pretreat salt to give it additional melting capabilities at lower temperatures, reduce application rates and the scatter and bounce of salt as it hits the roadway, and possibly eliminate the need for prewetting tanks on trucks.

Test Procedure: The districts will monitor for leaching, stockpile workability and working temperatures. The Metro district will compare the effectiveness of SOS as a salt pretreatment with Thawrox, a magnesium-chloride treated salt. District 2 will compare the performance of SOS as a stockpile treatment with prewet salt applications and with a salt blended with Road Guard Plus 8, a corrosion-inhibited liquid form of calcium chloride and magnesium chloride brine.

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 Screenshot
- 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 Report:

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

- Retractableflap
- 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 Report:

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 Report:

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 Report:

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 Intellect Comms
- 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

2007–2009 Report:

Winter Maintenance

- Guidance Laser
- Henderson Zero Velocity Sander
- HID Headlights
- Iowa Snow and Ice Innovative Equipment

- Modified Augers
- Rubber Cutting Edges
- Salt Skirt
- Slurry Auger
- SNO-FLO
- Spray Nozzles
- Tow Plow
- Tuff Tech Bag
- Wiper Shakers.

Road And Bridge Maintenance

- ChemGrout
- Road Shoulder Groomer
- Roll Master 5000
- Wheel Saw

Roadside Maintenance

- Three Point Jetter
- Apache Bullseye 6 Laser
- Compressed Air Bottle
- Forward Looking Sonar
- Guardrail Sprayer
- Herbicide Head/Pump
- Hydraulic Plate Compactor
- Mini Might Patrol
- No Mow Grass
- WeedEnder

Equipment – Tools

- Auto Greasing System
- Headset with Foot Switch
- Mud Cannon
- Nitrogen Tire Inflation System

Safety, Traffic Control And Work Zone Safety

- Horizon Portable Traffic Control Signal
- In Vehicle Video Camera
- Reflective Shirts
- Swift Hitch Wireless 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/>