

Clear Roads Research Proposals 2018

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Automated Snowplow Route Optimization Project	\$75,000 - \$400,000	18 months	The goal of this project is to develop a program that will automate snow & ice route optimization giving the DOT's the ability to analyze routes quickly and provide a tool for administrators to not only plan snow & ice routes but also assist in choosing new facility locations, optimize fleet size and select the best routes for street sweeping, storm sewer cleaning, mowing, herbicide spraying, lane line striping and other route specific tasks.	Group 1 Scott Lucas, Ohio DOT	6
2	Pacific Northwest Snowfighters QPL	\$60,000	5 years	The goal of this project is: a) the formation of a formal CR Technical Advisory Committee for the PNS, b) update/overhaul of the website, specification sheets, c) support for chemist to attend the spring CR meeting, d) maintenance of the QPL.	Group 1 James Morin, Washington DOT Doug McBroom, Montana DOT Patti Caswell, Oregon DOT	8
3	Liquid Deicer Performance Testing Protocol and Handbook	\$100,000	12 months	The goal of this project is to identify currently available scientific testing and results, and determine the most effective brine blends.	Group 1 Jeff Pifer, West Virginia DOH	10
4	Pre-wetting Solid Materials for the Pre-Treatment of Roadways	\$75,000	12 months	The goal of this project is to: a) reduce bounce and scatter, b) activate salt, c) inhibit corrosion.	Group 1 James Morin, Washington State DOT	12

Clear Roads Research Proposals 2018

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5	Effectiveness of Residual Salt on the Roadway	\$150,000	18 months	It is not unusual to expect to see residual salt on the road surface when it dries out after a storm. The purpose of this project is to quantify how much residual salt is left after the pavement dries. This will assist in making decisions on pretreating and on initial applications.	Group 2 John DeCastro, Connecticut DOT Patti Caswell, Oregon DOT	14
6	Mechanic/Operator Training for Upkeep of Winter Maintenance Equipment	\$100,000	12 months	The goal of this research is to improve the competencies of winter maintenance mechanics related to maintenance and repair of snow fighting equipment's mechanical systems and the simple troubleshooting and repair of electronic systems, therefore resulting in better overall maintenance programs and improving the service life of snow fighting equipment.	Group 2 Larry Gangl, Brad Darr, North Dakota DOT	16
7	Evaluation of Storm Severity Indexes (SSI) and Winter Severity (WSI) Indexes and Most Reliable Variables for Those Indexes	\$125,000	12 months	The goal of this research is to find all agencies (national and international) utilizing SSI and/or WSI, determine their variables with measurement methods, statistically analyze each variable for consistency and variability, and recommend the most reliable variables for developing SSI and WSI.	Group 2 Allen Williams, Virginia DOT	18
8	Reducing Snow Plow Driver Fatigue by Modifying Human Behavior	\$200,000	18 months	This project would confirm or reject the link between drivers' quality of rest and driver fatigue. If confirmed, the investigator would develop a series of training materials for managers and drivers to help improve the quality of rest for drivers as well as practices managers can use during operations to identify and relieve the fatigue in drivers.	Group 2 Allen Williams, Virginia DOT	20

Clear Roads Research Proposals 2018

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9	Using Reclaimed Water and Excess Retention Pond Water for Salt Brine Production	\$100,000	18 months	The potential to use reclaimed water from various sources in the production of salt brine should be researched. The results of this research could provide winter maintenance managers, as well as public and private parties responsible for planning the disposal of wastewater, valuable information on the opportunities and challenges of using reclaimed water in the production of salt brine.	Group 3 Ryan Ferrin, Utah DOT Sandi Sauter, Maryland DOT Michael Lashmet, New York State DOT	22
10	Improved Metrics and Scoring Criteria for Winter Maintenance Materials	\$100,000	6 months	Meet our winter maintenance material requirements with the lowest cost by objectively weighing quality and performance, and increasing opportunities for competition.	Group 3 Ty Barger, Nebraska DOT	24
11	Better Retention and Recruitment for Highway Maintenance Workers	\$100,000	12 months	To inform decision-makers, negotiators, and legislative bodies of the pay disparity between highway maintenance workers in the public and private sector, and in many instances, the disparity between highway maintenance workers and other similar job classifications within the state systems. Convince decision-makers of the need for better pay for government highway workers. Recruit and keep trained and licensed personnel. Long term goal: better retention and recruitment of a more qualified workforce.	Group 4 Russell Modrell, CALTRANS Tom Renninger, Alaska DOT&PF	34

Clear Roads Research Proposals 2018

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
12	High Performance Blade Evaluation	\$50,000	12 months <i>(This could potentially be an ongoing synthesis project.)</i>	To better understand the amount of life we are achieving with high-performance blades on the various road surface types. This information can then be used to perform a cost/benefit to assist states in making more informed decisions in blade procurement.	Group 4 Craig Bargfrede, Iowa DOT	36
13	Alternatives for De-icing Materials	\$100,000	12 months <i>(Two consecutive six month winter periods.)</i>	The goal of this project is To develop a list of best practices focused on alternative materials/methods to meet performance level expectations for maintaining roads clear of snow/ice while keeping environmental concerns and costs in check.	Group 4 Russell Modrell, CALTRANS Joe Bucci, Rhode Island DOT	38
14	Quantifying the Considerations Associated with Urban and Rural Snow and Ice Control	\$70,000	12 months	There are a lot of informal observations and anecdotal opinions about how traffic impacts snow and ice control activities, including chemical applications. The goal of this project would be to capture those items and try to prove or disprove, and quantify them. Additionally, the project would synthesize state DOTs' guidelines related to urban vs rural tactics.	Group 5 Brian Burne, Marine DOT Mike Lashmet, New York State DOT	40
15	Determining Impacts of Chloride-based Deicers on the Environment	\$100,000	18 months	To determine the environmental impacts of several chloride-based deicers used by most of the Clear Road states. The research should include no more than three different chloride-based deicers; take samples from the road at different distances in different environments to determine the concentrations of the substrates in those deicers. From those concentrations determine the potential impact to the environment.	Group 5 Doug McBroom, Montana DOT	42

Clear Roads Research Proposals 2018

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
16	Defensive Driving for Snowplow Operators	\$70,000	12 months	Determine the root cause of different types of accidents and determine if there are any defensive driving skills, strategies, or changes in operations to prevent accidents and decrease risk to our plow drivers and traveling public alike.	Group 5 Doug McBroom, Montana DOT	44
17	Vehicle Corrosion Ratings	\$100,000	12 months	The goal of this project is to better understand which vehicle makes and models have issues in which areas of the vehicle. This project will also have a geographical component where the data can be sorted or mapped by zip code.	Group 5 Brian Burne, Maine DOT	46



2018 Research Proposal Form

Proposer name: Scott Lucas (Group 1)

Organization: Ohio Department of Transportation

Title of proposed research project: Automated Snowplow Route Optimization Project

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

- 1) **Explain the specific problem or issue to address.** Nationally DOT's are looking to optimize their fleet sizing, facility locations, and snow & ice routes. Several DOT's have already completed proof of concept research that accomplished this manually but, it is very time consuming. The projects have demonstrated there is a substantial potential for cost savings and return on investment for the DOT's with the programs. Automation will allow managers to use route optimization software more often and provide additional cost savings in a variety of different real time scenarios.
- 2) **What is the goal of the project?** Develop a program that will automate snow & ice route optimization giving the DOT's the ability to analyze routes quickly and provide a tool for administrators to not only plan snow & ice routes but also assist in choosing new facility locations, optimize fleet size and select the best routes for street sweeping, storm sewer cleaning, mowing, herbicide spraying, lane line striping and other route specific tasks.
- 3) **Describe the expected products/deliverables of the research.** Provide an automated snow and ice routing tool that will work with a host of mapping software to allow any DOT or municipality the ability to access and use the program to optimize snow & ice routes.
- 4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
 - Alternative #1:**
 - Perform a literature search and survey of all DOT's currently doing or have done Proof of Concept work for manual and or automated route optimization program. Refer also to Clear Roads project 14-07 *Identifying Best Practices for Snowplow Route Optimization*.
 - Define variables (priority routes, current facility locations, equipment material capacity, route time and other data specific to the DOT or municipality)
 - Develop an automated tool (software develop tool)
 - Test and deliver tool.
 - Develop guidance and training materials.
 - Provide continuing support as needed for 6 months to 1 year.
 - Alternative #2:**
 - Use funds to obtain licenses for Clear Roads from vendor. Then, each state would pay additional funds to vendor for data storage, application install, training, and support.

- This would require vendors to submit proposal describing their software features and how they would benefit Clear Roads members.

- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** All DOT's and municipalities that are involved in snow & ice removal and asset management.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.** Improved asset management. The program will enable managers to better deploy their snow and ice fleets, choose the best locations for new facilities to best serve the area and determine the best number of snow and ice vehicle to take care of the area they serve.
- 7) **How will you measure the success of this project?** Successful development of a tool that can be utilized by any DOT or municipality. Any other metrics we can use to survey states about, such as salt use, fuel used, miles serviced, etc? Additional uses for the tool such as assistance in new facility site locating, fleet reduction, and additional route optimization such as street sweeping, storm sewer cleaning, mowing, herbicide spraying, lane line striping and other route specific tasks.
- 8) **Estimated funding needed.** \$75,000 to \$400,000.
- 9) **Estimated timeline for completing the research.**
 - Six (6) months _____
 - Twelve (12) months _____
 - Eighteen (18) months x
 - Other: _____ months
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Ohio, Indiana, City of Centennial, Colorado, Vermont AOT, Village of Niles, Illinois, Wisconsin, Pennsylvania, Utah, Kentucky and Iowa have done or are currently doing manual proof of concept route optimization projects.



2018 Research Proposal Form

Proposer name: James Morin, Doug McBroom, Patti Caswell (Group 1)

Organization: Washington DOT, Montana DOT, Oregon DOT

Title of proposed research project: Pacific Northwest Snowfighters QPL

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

- 1) **Explain the specific problem or issue to address.** The Pacific Northwest Snowfighters has been a partnership 'project' with Clear Roads for many years now. Until recently, the PNS maintained their own pooled fund site and sought funding from CR to conduct sample analysis for the QPL. The amount of funds required has varied over the years. With the closing of the PNS pooled fund, funds are in the process of being transferred back to the contributing states and hopefully on to CR pooled fund. It was discussed at the fall meeting that PNS would submit a project request to continue to maintain the QPL. Since Ron Wright's retirement, the PNS has an opportunity to restructure. The current structure is limited to Pacific Northwest states, but other states are also relying on the QPL and may wish to have a stronger voice. The current structure has resulted in a lack of overall knowledge in the QPL approval process and review by most members except for Ron Wright. This project proposal wishes to modify the structure to a formal TAC that will be more involved in the day to day running of the QPL. This structure change is appropriate with the closing of the PNS pooled fund and the transition of the QPL duties to Clear Roads.
- 2) **What is the goal of the project?** This project request includes:
 - a. The formation of a formal CR Technical Advisory Committee for the PNS:
 - i. Washington, Montana, Oregon, Idaho, (Colorado?)
 - ii. One Midwest CR state
 - iii. One east coast/New England CR state
 - b. An update/overhaul of the website,
 - c. Updated specification sheets,
 - d. Process update(s) (how to get products on the QPL, how to remove products from the QPL)
 - e. Vendor communication,
 - f. Support for a chemist to attend the spring CR meeting if the chemist is not a voting CR member already,
 - g. Maintenance of the QPL including sample testing.
- 3) **Describe the expected products/deliverables of the research.**
 - a) Revised website
 - b) Updates specification sheets/test methods
 - c) Documentation of process for getting on the QPL/off the QPL
 - d) Maintenance of the QPL
- 4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
 - a. **Revised website (CTC? \$10k?):** currently the website is pushed from CR main website to a standalone PNS website. TAC requests that the CR website includes a page for PNS and information on the external PNS website is merged onto the CR website PNS page, including the PNS logo.

- b. **Review and update the specification sheets/test methods (Contractor such as Analytical or TAC chemist; \$10k):** someone needs to verify the test methods and document what we use and why; chemist or consultant will recommend test methods that should be updated to better reflect industry standards and the TAC will review/approve recommendation.
 - c. **Documented process for getting on the QPL/off the QPL (TAC?):** all TAC members need to have a good understanding of how products get on the QPL and the process needs to be transparent; there are a lot of older products on the QPL that it is unclear if they are still made or used.
 - d. **Communication with vendors (TAC; \$5k if special meetings required):** communication with vendors is important. We need to tell them what we want and ask if they can make it. They like to know what we are doing and what we need to better shape their business to meet our needs. There are other states that if they use the QPL would want to get in on this communication. Typically, the PNS would meet at least annually (all five states) with vendors and provide state updates and offer an opportunity for vendors to ask questions or raise concerns. This could happen as part of the Peer Exchange (every two years at CR/Aurora/SICOP fall meeting location), at the PNS Conference (every two years in a PNW state), or individually by vendors visiting states. There may be additional value in having the TAC meet in person—this would be discussed by the TAC and a recommendation made to CR if appropriate based on funding needs.
 - e. **Maintenance of QPL (\$5k/year:** includes testing samples to verify specifications met, when needed. Samples are tested by Analytical Laboratories.
 - f. **Support one chemist attending the spring meeting (\$1.5k/year):** it was valuable having Ron on the CR team as he could speak as a voting state and as a chemist. Often the chemical nature of deicing products comes up in discussion either generally or as part of a proposed project. To our knowledge there are no current CR members that are functioning as chemists for their state.
- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** State DOTs and local municipalities that use the PNS QPL to bid deicing products all benefit from having standard specifications. Training on how to use the QPL shouldn't be necessary.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.** Maintaining the QPL ensures product consistency, promotes competition, reduces prices, eases procurement because specifications are already developed, and levels the playing field for vendors. Having the process(s) documented provides transparency and accountability.
- 7) **How will you measure the success of this project?** Tasks will be completed and Clear Roads will host a clean website that reflects transparent procedures.
- 8) **Estimated funding needed.** \$60,000 for five years. Project is being proposed for five years because of the ongoing nature of the work and the need. We can dedicate the appropriate amount each year rather than up front to leave the funds for research projects. We would provide an annual report out, report on funds needed and any variation from this being proposed.
- 9) **Estimated timeline for completing the research.**
- Six (6) months _____
 - Twelve (12) months _____
 - Eighteen (18) months _____
 - Other: 5 years (\$30k year 1, \$7.5k each year for last 4 years)
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
No- the Pacific Northwest Snowfighters Qualified Products List is unique.



2018 Research Proposal Form

Proposer name: Jeff Pifer (Group 1)

Organization: West Virginia Division of Highways

Title of proposed research project: Liquid Deicer Performance Testing Protocol and Handbook

Topic Area (highlight one):

Methods Equipment **Materials** Training Technology Safety

- 1) **Explain the specific problem or issue to address.** During the process of developing the project 16-06 DLA Video and Best Practices Handbook, it was noted that there is little information available regarding deicing liquid blends. Combinations of deicing salt brines, agricultural admixtures and anti-corrosion admixtures have, for the most part, only been defined with anecdotal experience.
- 2) **What is the goal of the project?** Identify currently available scientific testing and results, and determine the most effective brine blends.
- 3) **Describe the expected products/deliverables of the research.** A testing protocol that can be used to measure the effectiveness of various admixtures of materials and brine. A definitive handbook of liquid deicing brines and admixture blends with recommended usage and parameters.
- 4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

Perform a literature search and survey all DOT's and municipalities currently utilizing liquid deicing blends. This will assist in determining which material blends are used with salt brine; what their concentration rates are; at what temperature range they will use the blends; and what is their application rate of blend during: anti-icing, at the spinner or auger, and deicing.

Define all brines and admixtures currently being used in de-icing blends to improve the performance of brine.

Perform laboratory testing of material blends to confirm/provide data and parameters and **develop standard testing protocols.** The standards and laboratory testing will show the "performance" of the material in a lab. Performance could be defined as how much ice a blend will melt at a certain temperature during a specific amount of time, how far a deicer penetrates into an ice disk at a certain temperature during a specific amount of time, or other repeatable accepted tests to rank deicers in the lab.

Create a definitive handbook that defines the most effective admixture combinations with recommended usage and parameters.

- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** All Dot's and municipalities that engage in winter SRIC operations.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.** Improved material usage and Snow Removal Ice Control (SRIC) program efficiency.
- 7) **How will you measure the success of this project?** Development of a comprehensive handbook of SRIC liquid brine blending that will take the guesswork, assumptions, and "voodoo science" out of the process. Development of the testing protocol will enable manufactures of new products the abilities of testing their products to the same standards as products tested earlier.
- 8) **Estimated funding needed.** \$100,000
- 9) **Estimated timeline for completing the research.**
 - Six (6) months _____
 - Twelve (12) months X
 - Eighteen (18) months _____
 - Other: _____ months
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
 Yes, the Ohio Department of Transportation did a similar project, Evaluation and Analysis of Liquid Deicers for Winter Maintenance.

<http://cdm16007.contentdm.oclc.org/cdm/ref/collection/p267401ccp2/id/15502>

Minnesota Department of Transportation recently completed "Salt Brine Blending to Optimize Deicing and Anti-icing Performance and Cost Effectiveness: Phase III.

<http://www.dot.state.mn.us/research/reports/2017/201745.pdf>



2018 Synthesis Request Form

Requestor name: James Morin (Group 1)
Organization: Washington State DOT

Title of proposed synthesis project:
Pre-wetting Solid Materials for the Pre-Treatment of Roadways

Topic area(s):
Methods Equipment Materials Training Technology Safety

1) Explain the specific problem or issue to address.

Pre-Wet is widely used in the snow and ice industry to achieve three goals:

1. Reduce bounce and scatter
2. Activate Salt
3. Inhibit corrosion

While research has been done on this topic we believe that further research is needed that will help agencies identify appropriate methods, rates and materials to meet the above purposes. Ultimately, we would like to develop a comprehensive guide to pre-wet, however this first step is to complete a thorough review of existing practice and research both nationally and internationally and identify needed research on this topic that would lead to development of a comprehensive guide to pre-wet.

Methods: Specifically we are interested in industry practice and research that would help identify the best methods to apply pre-wet materials, such as:

- Rate of application- How many gallons per ton are used, why was this rate selected, what is the optimal rate given current research. Ideally we would find research that would help us identify ideal pre-wet rates. *For example: At 10 gpt all three purposes (bounce and scatter, salt activation, corrosion inhibition) are accomplished with a loss of 10% of salt off of the roadway and reduction of corrosion by 20%. At 20 gpt the salt loss is reduced to 5% and salt is 40% less corrosive etc.*
- At what point should liquid be applied to solid salt- Should material be applied at the time of application, prior to the application, at the spinner or before the spinner.
- What is the relationship between vehicle speed and product loss at different pre-wet rates?

Equipment: Pre-wet liquid delivery systems are designed in many different ways and incorporated into a variety of spreader configurations. Some systems apply liquid at the spinner while others apply liquid at the flight chain or along the auger inside a mix chamber. Some systems rely on electric pumps; others use hydraulic pumps, other

factors include nozzle selection, optimum pressure, screen size, hose diameter and flow meter design. The synthesis, would identify use practices currently in place as well as review research that has been completed on effectiveness of different delivery systems. **Materials:** A variety of liquids are used for pre-wet including MgCl, CaCl and inhibited Brine. This synthesis would document current use and identify and summarize research that has been completed on liquid material used for pre-wet operations.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**

Through a comprehensive synthesis of best practices via a literature review, survey, and follow up interviews, Clear Roads intends to...

- Conduct a literature review to identify, categorize, and summarize domestic and international research/literature on the topic of pre-wetting solid materials.
- From the literature review – as well as a survey of the Clear Roads states and identified international sources – identify state and international best practices for pre-wetting solid materials.
- From the previous steps, determine best candidates for – and perform – interviews to more fully detail best practices in the areas of methods, equipment, and material use.
- Summarize and document the project findings in the areas of methods, equipment, and materials in a synthesis report.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems?**

Serve as a basis to evaluate the need for further targeted research on the topic in order to develop a comprehensive guide to pre-wet for maintenance practitioners.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**

Yes, research has been completed by several entities including Pennsylvania DOT, Minnesota DOT, Michigan DOT, Ohio DOT.

http://www.michigan.gov/documents/mdot/Final_ReportNov2012_404228_7.pdf



2018 Research Proposal Form

Proposer name: John DeCastro, Patti Caswell (Group 2)

Organization: Connecticut DOT, Oregon DOT

Title of proposed research project: Effectiveness of Residual Salt on the Roadway

Topic Area (highlight one):

Methods Equipment **Materials** **Training** **Technology** Safety

1) **Explain the specific problem or issue to address.**

Residual salt is observed at the end of a storm when the road surface dries. Is this expected even when using recommended application rates? If so, how much residual is expected to remain on the road surface after applying salt at the recommended rate for a particular storm, and what is the minimum or maximum amount one can expect to remain? A better understanding of this dynamic will provide information to an operator/manager such as when and how much over application of salt occurs. For example, a two-inch per hour storm—200 pounds of salt per lane mile, and a four-hour plow cycle time... How much residual is left after snow is plowed off and the pavement dries? Evaluate 2-3 typical pavement designs.

2) **Describe the expected products/deliverables of the research.**

A report with tables showing different application rates, pavement types, storm types (precipitation type and amount), and the amount of salt concentration left on the road.

3) **What is the goal of the project?**

It is not unusual to expect to see residual salt on the road surface when it dries out after a storm. The purpose of this project is to quantify how much residual salt is left after the pavement dries. This will assist in making decisions on pretreating and on initial applications.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

Literature Search (example:

<http://www.sciencedirect.com/science/article/pii/S0925400513011957>)

Develop a test plan and conduct tests to determine the amount of residual salt on the road surface after a storm passes. The particular snow event will need to be reviewed and the application rates utilized for the event will need to be documented and noted in order to effectively evaluate. The baseline application rates and storm types will likely be determined after the literature search but we would recommend considering using the Updated Guidelines from CR 12-02 Establishing Effective Salt and Anti-icing Application Rates, which was completed in 2015.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

State or local DOT Managers, supervisors, and operators.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

Findings could be used to educate the public on expectation for seeing residual salt after a storm, and to inform managers and operators to use less salt in situations where residual salt is present, saving on budget and creating less impacts to the environment.

7) **How will you measure the success of this project?**

If successful this project would inform best application rates or at least what one can expect to see on the highway after a storm in terms of residual salt. This could help evaluate whether pre-treatment is required or recommended prior to next storm or if first application rate may be reduced.

8) **Estimated funding needed.** \$150K to research and test salt conditions for tables.

9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months X
- Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**

Nordic research (2013)

http://nordfou.org/documents/mors/Informationsblad_MORS.pdf

https://westerntransportationinstitute.org/research_projects/quantifying-salt-concentration-on-pavement-phase-2/

<https://trrjournalonline.trb.org/doi/pdf/10.3141/2329-04>

https://westerntransportationinstitute.org/research_projects/quantifying-salt-concentration-on-pavement-phase-2/

Spanish research, sensors (2014)

<https://www.sciencedaily.com/releases/2014/01/140128094622.htm>





2018 Research Proposal Form

Proposer name: Larry Gangl/Brad Darr

Organization: North Dakota Department of Transportation

Title of proposed research project: Mechanic/Operator Training for Upkeep of Winter Maintenance Equipment

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

- 1) **Explain the specific problem or issue to address.** Lack of available training options for maintaining snow fighting equipment which includes but is not limited to trucks, snow blowers, loaders, tow plows, etc.

Winter maintenance mechanics need the expertise to troubleshoot, repair, and maintain not only mechanical systems affiliated with snow fighting equipment but also the electronics that are part of the truck control systems.

- 2) **What is the goal of the project?** Improve the competencies of winter maintenance mechanics related to maintenance and repair of snow fighting equipment's mechanical systems and the simple troubleshooting and repair of electronic systems, therefore resulting in better overall maintenance programs and improving the service life of snow fighting equipment.

Some of those competencies may include...

- How to provide Preventative Maintenance on the trucks specifically evaluating these systems in a pre-trip and post-trip inspection.
- How to diagnose issues in the field focusing on the systems named below.
- How to repair components at an operator level, and then at the mechanic level, if a more complex repair.
- What are the best practices to prevent failure? Focus will be on simple actions an operator can perform.

The intent will be to provide training in a manner that is similar to the Snow Plow Operator and Supervisor Training project.

- 3) **Describe the expected products/deliverables of the research.** Training modules will include an instructor guide, student evaluations, and the primary component of the training will be PowerPoint presentations. Each of the modules will contain training on simple and more complex repairs, preventative maintenance, and best practices for low cost methods to prevent component failure.

Suggested modules may include...

- Controller systems/spreader controls
- Lighting
- AVL

- Braking systems
- Hydraulics systems
- Others?

- 4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)** Identify opportunities for training on practices and techniques used to clean, maintain, troubleshoot and repair snow fighting equipment. This will likely include...
- Literature search and survey agencies and organizations for existing training programs,
 - Review existing training programs and consult project subcommittee to determine what should be included in the Clear Roads training,
 - Develop training materials
- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Winter maintenance supervisors, mechanics, and operators.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.** Any training practices or techniques would improve the service life and decrease overall cost for the equipment users.
- 7) **How will you measure the success of this project?** NA
- 8) **Estimated funding needed.** \$100,000
- 9) **Estimated timeline for completing the research.**
- Six (6) months _____
 - Twelve (12) months ___X___
 - Eighteen (18) months _____
 - Other: _____ months
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**



2018 Research Proposal Form

Proposer name: Allen Williams (Group 2)

Organization: Virginia DOT

Title of proposed research project: Evaluation of Storm Severity Indexes (SSI) and Winter Severity (WSI) Indexes and Most Reliable Variables for Those Indexes

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

- 1) **Explain the specific problem or issue to address.** SSI and WSI are important measures in comparing winter weather events and well as individual storms. Currently, there is no agreed upon set of variables used to arrive at these indexes. Agencies can compare within their agency and possibly with agencies using similar variable but until there is a uniform set of variables measure in a consistent manner, agencies will not be able to effectively compare winter related measures such as labor use, materials use, etc. for winter weather.
- 2) **What is the goal of the project?** To find all agencies (national and international) utilizing SSI and/or WSI, determine their variables with measurement methods, statistically analyze each variable for consistency and variability, and recommend the most reliable variables for developing SSI and WSI.
- 3) **Describe the expected products/deliverables of the research.** A listing of all agencies utilizing some form of SSI and /or WSI together with the variables being used, the variable collection method, statistical analysis of each variable and a recommended list of the most reliable variables and collection methods.
- 4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
 - I. National and International Literature Research
 - II. Survey national and International agencies to determine their use of SSI/WSI, their variables and variable collection methods.
 - III. Follow-up survey to obtain more detailed Information to perform analysis of variables
 - IV. Perform the appropriate statistical analysis to fully understand each variable's reliability
 - V. Recommend the most reliable variables for predicting severity
 - VI. Follow-up with each responding agency to obtain their feedback to findings
 - VII. Final report listing all the variables utilized, collection methods, reliability in collection of variable data, significance of each variable as a predictor and recommendation for a standard SSI/WSI
- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** All levels of management within agencies involved in winter operations and well as research agencies/projects.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.** Managers, researchers and agencies will be able to more effectively compare their

winter operations between localities, Districts, and between states. Agencies will be able to compare between storms and between years to evaluate innovations and new methods.

7) **How will you measure the success of this project?** The delivery of a SSI/WSI model which is repeatable, acceptable to most of the agencies and reasonably easy to use.

8) **Estimated funding needed. \$125,000**

9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months _____
- Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**



2018 Research Proposal Form

Proposer name: Allen Williams (Group 2)
Organization: Virginia DOT

Title of proposed research synthesis or project:
Reducing Snow Plow Driver Fatigue by Modifying Human Behavior

Topic Area: Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue.**

In the previous study on Snow Plow Driver Fatigue, the investigator found there was a probable link between drivers' quality of rest and fatigue during snow operations. Driver fatigue can be a major cause of accidents and low productivity.

2) **What is the goal of the project?**

This project would confirm or reject the link between drivers' quality of rest and driver fatigue. If confirmed, the investigator would develop a series of training materials for managers and drivers to help improve the quality of rest for drivers as well as practices managers can use during operations to identify and relieve the fatigue in drivers.

3) **Describe the expected products/deliverables of the research?**

The investigator would provide a report first confirming or rejecting the link between drivers' quality of rest and driver fatigue during winter operations based upon field research with a statistically significant sample of snow plow operators.

The investigator would develop training guides, DVD's, and classroom training materials for managers and drivers to improve drivers' behavior to get better quality of rest before and during winter operations.

In addition, the investigator shall provide detailed recommendations of the most effective rest period (both in duration of actual rest and rest intervals) along with specific recommendations on ways operators can achieve high quality rest. The investigator would also provide ways to identify fatigue during operations and techniques/practices to relieve fatigue during operations.

4) **List the specific research tasks that would form the scope of work, ie. What steps will the researcher need to take to develop the deliverables?**

- a. Investigator shall build off of the work by Virginia Tech Transportation Institute to perform a literature search nationally and internationally,
- b. Investigator shall conduct field research of a statistically significant number of snow plow drivers to confirm or reject the link between driver rest and driver fatigue. Provide a detailed report of the findings from the field research,
- c. If confirmed, the investigator shall develop training materials to reduce driver fatigue, identify driver fatigue and develop techniques/practices to relieve fatigue during operations.

- 5) **Who is the intended audience for the products/deliverables?**
 DOT field management, snow plow drivers and senior management in setting practices to provide drivers the greatest opportunities for quality rest.
- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**
 The findings of this research and subsequent training materials will provide DOTs with the resources to reduce fatigue in snow plow drivers during winter operations. Field managers and drivers will have the ability to identify fatigue during operations and have the tools to alleviate the fatigue. This will reduce accidents caused by driver fatigue and increase productivity as drivers will be more alert, thus making better decisions.
- 7) **How will you measure the success of this project?**
 A reduction in the number of accidents involving snow plow drivers during winter operations and increased productivity during operations. Feedback from drivers on their levels of fatigue during winter operations.
- 8) **Estimated funding needed.** \$200,000
- 9) **Estimated timeline for completing the research.**
- Six (6) months _____
 - Twelve (12) months _____
 - Eighteen (18) months XXX__
 - Other: ___24 months
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
 Environmental Factors Causing Fatigue in Snow Plow Drivers – VTTI (2014)
 Identification and Recommendations for Correction of Equipment Factors Causing Fatigue in Snowplow Operators – VTTI (2017)



2018 Research Proposal Form

Proposer's names: Ryan Ferrin, Sandi Sauter, Michael Lashmet (Group 3)

Organizations: Utah Department of Transportation (UDOT), Maryland Department of Transportation (MDOT), New York State Department of Transportation (NYSDOT)

Title of proposed research project: Using Reclaimed Water and Excess Retention Pond Water for Salt Brine Production

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

With the nationwide trend of environmental groups leaning towards the reduction in use of granular salt material on the roadways for ice removal, the use of salt brine will become a more prevalent alternative for pretreatment (anti-icing) and deicing operations. An increase in the manufacturing of salt brine for winter maintenance operations could put a strain on local water resources.

Additionally, limitations on available water resources, particularly in areas prone to drought or served by wells, could prevent some DOTs from expanding their use of salt brine. Meanwhile, many local governments and private industries are challenged with the responsible disposal of wastewater effluent which could be a possible source of water for brine making operations. Another possible source of water for brine making could come from maintenance stations that are having overflow issues with their retention ponds spilling over into adjacent properties.

2) **What is the goal of the project?**

The potential to use reclaimed water from various sources in the production of salt brine should be researched. The results of this research could provide winter maintenance managers, as well as public and private parties responsible for planning the disposal of wastewater, valuable information on the opportunities and challenges of using reclaimed water in the production of salt brine.

Also, the potential to use excess retention pond water for salt brine making could serve three purposes: 1) to prevent overflow of retention ponds onto adjacent properties or facilities, 2) to utilize water already in the possession of DOT's, public, and private entities to make salt brine which reduces the cost of purchasing additional culinary water, 3) reduce costs of disposal of wastewater.

3) **Describe the expected products/deliverables of the research.**

This research would deliver written material on the possibilities, limitations and general guidelines for the use of reclaimed water and retention pond water in salt brine production.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

- a. Synthesis of current sources of water for creating salt brine solutions
- b. Review other uses of reclaimed water and retention pond water on public infrastructure projects and demonstrate proven applications of both types of water
- c. From a scientific standpoint, the chemical composition of wastewater effluent and retention pond water would be researched to determine its suitability for creating salt brine solutions capable of treating roads
- d. The environmental regulations placed on winter maintenance activities, as well as those of wastewater discharge permits would be explored

- e. Infrastructure needs for transporting reclaimed water to brine manufacturing facilities would need to be understood
- f. Demonstrate if other State DOTs are already using either of these methods to make salt brine.
- g. Explore steps that would need to be taken to remediate and treat any retention pond water or reclaimed water that does not meet the criteria for making salt brine i.e. oil/water separators, filters for heavy metals, etc.
- h. Examples of Reclaimed Water are: wash bay water, irrigation water, gray water, cooling water, treated effluent from wastewater facilities, etc.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

The material resulting from this research would be shared with maintenance managers of all DOTs and would be made available to any public and private entity interested in partnering with the highway maintenance professionals.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

The information garnered from this study may make brine production possible to DOTs in areas where water resources have been a limiting factor. The use of reclaimed water may assist DOTs in meeting targets of environmental regulations on impaired waterways, such as Total Maximum Daily Load (TMDL) requirements for pollutants such as nitrogen and chloride. Another benefit to DOTs would be that they would now have a methodology to prevent overflows from their retention ponds by simply turning their pond water into salt brine and then storing it in already existing brine tanks. This may be a more cost-effective source of water which would eliminate or reduce the need to purchase additional culinary water to make brine. This would be particularly beneficial in states that are prone to drought, water shortages, or supplied by well water.

7) **How will you measure the success of this project?**

Successful research would lead to a better understanding by the DOTs on the potential to use reclaimed water and excess retention pond water in salt brine production. This research may also lead to the use/increased use of wastewater and pond water for brine production if environmental regulations are able to be met post-water treatment.

8) **Estimated funding needed.**

\$100,000???

9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months _____
- Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**

There are examples in which reclaimed wastewater is used in winter operations:

<http://www.newsweek.com/oil-and-gas-wastewater-used-de-ice-roads-new-york-and-pennsylvania-little-310684>

Some other states already turn their excess retention pond water into salt brine. Ohio uses this method after running the pond water through oil/water separators and filters for heavy metals as can be seen in the document below.

[http://www.dot.state.oh.us/Divisions/Planning/LocalPrograms/LTAP/Documents/Brine_Enhanced_with_Additive\(s\)_-_Snow_and_Ice_Control_Treatments.pdf](http://www.dot.state.oh.us/Divisions/Planning/LocalPrograms/LTAP/Documents/Brine_Enhanced_with_Additive(s)_-_Snow_and_Ice_Control_Treatments.pdf)



2018 Research Proposal Form

Proposer name: Ty Barger (Group 3)
Organization: Nebraska DOT

Title of proposed research project: Improved Metrics and Scoring Criteria for Winter Maintenance Materials

Topic Area (highlight one):

Methods Equipment **Materials** Training Technology Safety

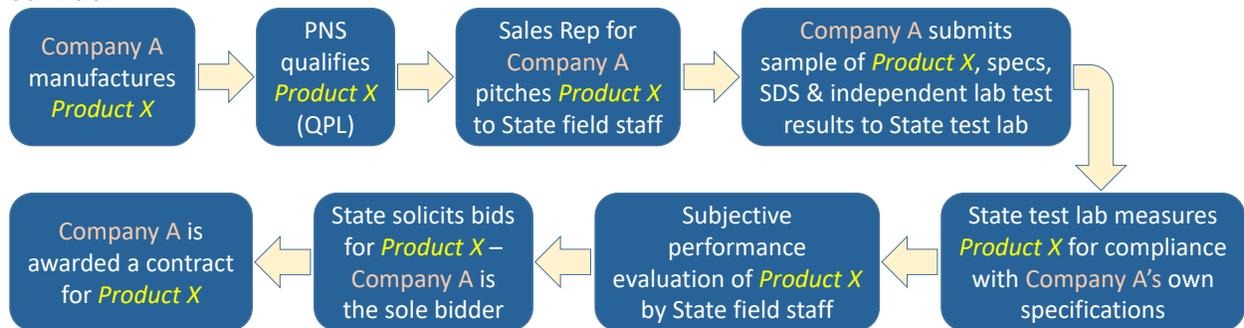
- Ref: (a) Performance Rating of De-icing Chemicals for Winter Operations
<http://dot.nebraska.gov/media/5753/final-report-p328.pdf>
 (b) Mechanical Rocker Test Procedure for Ice Melting Capacity Evaluation
<http://dot.nebraska.gov/media/5752/final-report-m322.pdf>

- Encl: (1) Proposed General Specifications (an abridged version of *PNS Testing Protocols*)
 (2) Proposed Product Sample Checklist (an abridged version of the PNS document)
 (3) Proposed Scoring Criteria for Corrosion Inhibited Liquid Magnesium Chloride
 (4) Proposed Scoring Criteria for Liquid Sucrose Additive

1. Explain the specific problem or issue to address.

The Clear Roads consortium requires a consistent method to effectively evaluate the winter maintenance materials on the market, and to do so in a way that can fully inform the business decisions of its Member States.

Previously, many States have had an open-door policy for any authorized vendor of any of the (100+) products that appear on the PNS Qualified Product List (QPL). States have also expressly excluded from invitations-to-bid products that were not included on the PNS QPL. The following diagram illustrates some common steps that product vendors could follow in their pursuit of a State contract:



The intent of a process like what's illustrated above is two-fold:

- a. Simplify procurement efforts by eliminating the States' need to develop detailed product specifications, and
- b. Acquire quality products while alleviating the need for the States' test labs to resource the required staff, budget and equipment to perform all equivalent testing.

This process does not reduce procurement workload, but rather results in multiple, redundant (name brand) contracts for each of the States' basic material requirements. For example, Nebraska Department of Transportation alone currently has three separate, statewide contracts for "Category 1" products. Additionally, preliminary testing has shown that the ice melting capacity of each of the "Category 1" products may vary significantly ("*Brand X*" vs "*Brand Y*" ...). The QPL cannot inform us on how these products compare to each other, or on the relative value of each product. Furthermore, without improved metrics and scoring criteria, our laboratory testing processes cannot assure that we are procuring the best value products.

Often, the States' processes for procuring deicing materials limit competition, are subjective on performance, and can become increasingly burdensome for lab, procurement and management staff, as our many locales each pursue different combinations of materials and practices.

While there are virtually countless combinations of materials and practices that could be used with reasonably positive results, the Clear Roads consortium wishes to standardize our best practices and enable its Member States to meet their requirements with the lowest cost. Improved metrics and scoring criteria would provide the Clear Roads Member States with the means to effectively evaluate and compare winter maintenance materials, including products that are not yet PNS-qualified.

2. What is the goal of the project?

Meet our winter maintenance material requirements with the lowest cost by objectively weighing quality and performance, and increasing opportunities for competition.

3. Describe the expected products/deliverables of the research.

- a. Develop a nationally accepted test procedure for measuring ice melting capacity (**Deliverable #1**).
 - (1) Reference (a) is a Nebraska Department of Transportation (NDOT)-sponsored study conducted by the University of Nebraska-Lincoln (UNL) to gather information regarding accepted test methods used to evaluate chemical deicer performance. In their study, UNL found that the *SHRP H-205.2 Ice Melting Capacity Test* included many sources of error, is not repeatable between different laboratories, and results from this test often do not correlate with field observations.
 - (2) The *Mechanical Rocker Test Procedure*, included as reference (b), has been proposed to the consortium. This test procedure has been developed over the past several years by UNL in conjunction with NDOT. NDOT has had validation testing of this procedure underway throughout the 2017/2018 winter season and observed low-variance and repeatable results.
 - (3) The Chairman of the AASHTO Committee on Materials and Pavements would like to see this adopted as an AASHTO test procedure.
- b. Conduct sucrose additive research.
 - (1) Background – Quality and cost concerns are forcing agencies to consider alternative sources for a sucrose additive (AKA "carbohydrate deicers"), such as sugar beet molasses, a waste byproduct of beet sugar refining. Carbohydrate deicers inhibit the ability of liquid water molecules to join the crystal lattice of ice and transition to the solid state. These products tend to prevent a hard-pack ice from forming on the road surface. Additionally, the physical properties of these products help to keep deicer chemicals on the road surface

longer, reducing waste by reducing the need for re-applications. Used either alone or in combination with chlorides, these products are very useful in maintaining roadways during winter storm events.

- (2) Ascertain the availability of alternative sources for sucrose additive (**Deliverable #2**).
- (3) Determine the feasibility of processing raw, unrefined sugar into aqueous sucrose solutions utilizing common brine-making equipment (**Deliverable #3**).

- c. Develop abridged versions of the *PNS Testing Protocols* and the *Product Sample Checklist* in order to provide vendors a means to work directly with the States and bid products that are not yet PNS-qualified (**Deliverable #4**). The *General Specifications* and *Product Sample Checklist*, included as enclosures (1) and (2), have been proposed to the consortium.
- d. Develop standardized scoring criteria for each category of winter maintenance material in order to provide the States with the means to effectively evaluate and compare winter maintenance materials (**Deliverable #5**). The scoring criteria included as enclosures (3) and (4) have been proposed to the consortium.

4. List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)

a. Deliverable #1

- (1) Evaluate reference (b) for efficacy, in accordance with ASTM E2857.
- (2) Modify or affirm the test methods, recommended practices and material specifications included as reference (b).
- (3) Document the development of test methods, recommended practices, and material specifications in the proper AASHTO format – see <https://materials.transportation.org/guidance-documents/>.
- (4) Coordinate with the appropriate Technical Subcommittee (TS) to present the Standard.
 - (a) See the AASHTO Subcommittee on Materials (SOM) website for the related materials TS Chair: <https://materials.transportation.org/technical-subcommittees/>.
 - (b) Provide the properly formatted Standard to the TS Chair with a separate short commentary detailing the benefits and potential uses of the standard, references for the research that developed the standard, and any other pertinent information related to the need for the standard.
 - (c) Present the results to State DOT Materials representatives at a TS meeting, at the annual SOM meeting (held July/August), or through a webinar.
 - (d) If balloted, assist SOM with addressing TS and SOM comments.

- b. Deliverable #2** – Research the sugar industry (beyond sugar beet refineries) in order to ascertain which manufacturers and producers have the ability to supply material that could satisfy the States’ requirement for a sucrose additive (either for active ingredient or whole finished product).

c. Deliverable #3

- (1) Designate at least two test locations with supporting staff and equipment, each with a different brand of operational brine maker.
- (2) Procure sufficient quantities of raw, unrefined sugar.
- (3) Process the sugar into aqueous sucrose solutions.
- (4) Evaluate the effectiveness of the process.
- (5) Conduct quality assurance testing of the finished product.

d. Deliverable #4

- (1) Evaluate enclosures (1) and (2) for efficacy.
- (2) Either affirm enclosures (1) and (2) or modify/develop alternative, abridged versions of the *PNS Testing Protocols* and the *Product Sample Checklist* in order to provide vendors a means to work directly with the States and bid products that are not yet PNS-qualified.

e. Deliverable #5

- (1) Analyze the various categories of materials represented on the QPL to determine the distinctive attributes of each product group.

- (2) Evaluate enclosures (3) and (4) for efficacy.
- (3) Develop scoring criteria for each product group in order to provide the States with the means to effectively evaluate and compare winter maintenance materials.

5. Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.

All States and material vendors.

6. How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.

This project would enable the States to meet winter maintenance material requirements with the lowest cost by objectively weighing quality and performance, and increasing opportunities for competition.

7. How will you measure the success of this project?

Annual cost to purchase, handle, apply, reapply, and evaluate winter maintenance materials.

8. Estimated funding needed.

\$100,000

9. Estimated timeline for completing the research.

- Six (6) months
- Twelve (12) months _____
- Eighteen (18) months _____
- Other: _____ months

10. Are you aware of any similar or related research on this topic? If so, please list below.

Yes. Nebraska Department of Transportation is continuing to collect data from their use of the *Mechanical Rocker Test Procedure*, and they have also commenced sucrose analyses utilizing high-performance liquid chromatography.

Products being submitted for evaluation during a bidding opportunity must be accompanied by two (2) one-gallon containers of the product along with the chemical, biological, and physical analyses performed by an independent laboratory with American Association for Laboratory Accreditation (ISO 17025).

All submitted products will be tested to the standard limits contained within these specifications (see Table 1) in order to assess the products' potential to cause a decrease in the public safety. Analytical results of all constituents for which limits have been set by these General Specifications must reflect testing to the specified limit or below. For example, the specified limit for Cadmium is 0.20 ppm – therefore, a submitted value for Cadmium of *“less than 1.00 ppm”* is not acceptable. Any product that fails to meet the standard limits as specified will be disqualified. The State has the right to accept or reject products based on the materials used to produce the product.

Solid products are to be diluted to a 25% (weight/volume) concentration and then tested as if the material was a liquid sample. Report only the values derived from the 25% solution for all of the standard limits. Do not back calculate the concentration of the parameters to the dry weight of the material.

All products being submitted for evaluation shall be unadulterated and in their finished form, as the products are designed to be applied. Any products purchased in the future will be expected to meet specifications as established in the bid process. All test data that is submitted with each product sample is subject to verification by the State laboratory. Results of testing from the State laboratory shall be verifiable and final.

All samples must be marked with an easily distinguishable name and the associated paperwork must be clearly marked so that the samples and the submitted product information can be easily identified and matched up. Failure to supply the required samples and complete product information will be cause for disqualification.

Specific gravity chart (liquid products only) with correlating weight percentage and freeze point information presented in 1% increments beginning with a five percent solution. The chart must contain information up to, including, and exceeding-by-5% (or the solubility limits of your product) the concentration being submitted for evaluations.

Bids shall be accompanied with the most recent detailed product specification sheet, Safety Data Sheet (SDS) including the SDS of the inhibitor, and the Product Sample Checklist.

All bids and samples shall be delivered by the time and date of the bid opening. Bids and samples that are received late will be disqualified. Mark all samples submitted to the Laboratory in large black lettering as “BID SAMPLES-TIME CRITICAL”.

The bidder shall furnish analyses of their product, performed by an independent laboratory with American Association for Laboratory Accreditation (ISO 17025), for the following constituents and attributes:

Constituents & Attributes	Standard Limits (or test result)	Test Method
Percent Concentration of Active Ingredient in the Liquid	Sample measurement as determined by an independent lab	Atomic absorption or inductively coupled plasma spectrophotometry as described in "Standard Methods for the Examination of Water and Waste Water", APHA/WWA-WPCF is acceptable. "Test Method A" in Appendix A of the PNS Snow & Ice Control Chemical Products Specifications and Test Protocols (http://pnsassociation.org/wp-content/uploads/PNSSPECS.pdf) is used to determine percent concentration of calcium chloride or magnesium chloride by atomic absorption.
Weight (lbs) per Gallon (liquid products only)	Sample measurement as determined by an independent lab	Specific gravity by ASTM D1429 Test Method A – Pycnometer at 20°C (+/- 1°C).
Corrosion Control Inhibitor Presence and Concentration	Sample measurement as determined by an independent lab	The laboratory may use the test procedures provided by the bidder or manufacturer for testing quantitative concentrations of additives. These same tests can then be used to verify that materials being delivered are the same as those previously tested and approved in the bid process.
pH (liquid products only)	6.0 – 10.0	ASTM D1293, except a dilution shall be made of one part chemical product to four parts distilled water before attempting a reading.
Corrosion Rate (corrosion inhibited products only)	≥ 70% less corrosive than NaCl	NACE Standard TM0169-95 (1995 Revision) as modified by PNS. This procedure is listed as "Test Method B" in Appendix A of the PNS Snow & Ice Control Chemical Products Specifications and Test Protocols (http://pnsassociation.org/wp-content/uploads/PNSSPECS.pdf).
Total Settleable Solids	≤ 1.0%	This procedure is listed as Test Method "C" in Appendix A of the Pacific Northwest Snowfighters (PNS) Snow & Ice Control Chemical Products Specifications and Test Protocols (http://pnsassociation.org/wp-content/uploads/PNSSPECS.pdf).
Solids Passing #10 Sieve	≥ 99.0%	
Phosphorus	≤ 2500.00 ppm	Atomic absorption spectrophotometry or plasma emission spectroscopy, as described in "Standard Methods for the examination of Water and Waste Water", APHA-AWWA-WPCF.
Cyanide	≤ 0.20 ppm	
Arsenic	≤ 5.00 ppm	
Barium	≤ 100.00 ppm	
Cadmium	≤ 0.20 ppm	
Chromium	≤ 1.00 ppm	
Copper	≤ 1.00 ppm	
Lead	≤ 1.00 ppm	
Selenium	≤ 5.00 ppm	
Zinc	≤ 10.00 ppm	
Mercury	≤ 0.05 ppm	Cold vapor atomic absorption spectrophotometry, as described in "Standard Methods for the examination of Water and Waste Water", APHA-AWWA-WPCF.

Table 1

Constituents & Attributes	Standard Limits (or test result)	Test Method
Milliequivalents or "meq"	Sample measurement as determined by an independent lab	This is a measure of the amount of unreacted base in the product. "Meq" means milliequivalents or the milligrams of acetic acid to neutralize 1 gram of unreacted base. Method for measuring unreacted base is a standard acid/base titration procedure. A fixed volume of acid (30ml of 0.1 N HCl) is added to a 1g sample of CMA. The excess acid is titrated with a standard base (0.1 N NaOH) to phenolphthalein endpoint, pH of 8.6.
Moisture Content of Solid Chemical Products	Sample measurement as determined by an independent lab	ASTM E534
Gradation (solid products only)	Sample measurement as determined by an independent lab	ASTM D632
Toxicity	Sample measurement as determined by an independent lab	According to "Short-Term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Waters to Freshwater Organisms", Third Edition, EPA-600/4- 91/002.
Ammonia - Nitrogen Total Kjeldahl Nitrogen NO ₃ ⁻ & NO ₂ ⁻ as Nitrogen Bio. Oxygen Demand Chem. Oxygen Demand	Sample measurement as determined by an independent lab	As described in "Standard Methods for the examination of Water and Waste Water", APHA-AWWA-WPCF.
Frictional Analysis (liquid products only)	Sample measurement as determined by an independent lab	Frictional analysis shall be conducted on products that have been applied at the prescribed application rate to a pavement surface within a sealed and controlled humidity chamber. The frictional coefficient shall be measured on pavement surface as the humidity in the chamber is lowered and raised over the course of time. The data shall show a plot of the humidity curve and a plot of the coefficient of friction curve over time. The device that measures the frictional coefficient shall be calibrated and certified prior to use on the sample analysis.
Insoluble Material	Sample measurement as determined by an independent lab	ASTM E534 "Standard Test Methods for Chemical Analysis of Sodium Chloride". The method shall be modified by dissolving 100g of the sodium chloride sample into the prescribed volume and filtering the entire solution through a Whatman No. 541 (or equal), 125mm diameter filter paper seated in a Büchner funnel.
Chloride	Sample measurement as determined by an independent lab	ASTM D632
Sucrose	Sample measurement as determined by an independent lab	High-performance liquid chromatography, via AOAC 982.14C.

Type or print clearly in ink, *in all fields* (use "N/A" if something does not apply).

1. Name of bidding company: _____
2. Mailing address: _____
3. Email address: _____
4. Phone number with area code: _____
5. Fax number with area code: _____
6. Name of company contact: _____
7. Name of the product: _____
8. Product manufacturer: _____
9. Identify the primary active ingredient that the product can be measured for: _____
10. Test protocols for measuring the primary active ingredient: _____
11. Percent concentration of the primary active ingredient (liquids only):

Manufacturer's Minimum	Manufacturer's Maximum	Independent lab result
____%	____%	____%

12. Corrosion percent effectiveness of the product (corrosion inhibited products only): ____%
13. Product Data Sheet: _____
14. Safety Data Sheets (SDS) for the product and the corrosion inhibitor: _____
15. Specific gravity information for liquid products: _____
16. Eutectic Temperature chart and graphs: _____
17. pH data (liquid products only): _____
18. Independent lab results for each attribute, as specified in the General Specifications: _____
19. Toxicity Report: _____
20. Frictional Analysis Report: _____
21. Proprietary information regarding the corrosion inhibitor shall be included in a separate sealed envelope and marked in large bold lettering "Confidential Information": _____
22. Analytical testing procedures for verifying corrosion inhibitor concentration: _____
23. Two (2) one-gallon container samples of the product included with submittal: _____

Bidder Signature Bidder Printed Name Date Submitted

Bids will be evaluated on the following attributes:

- 1) Coefficient of Friction
- 2) Corrosion Rate
- 3) Extended Price
- 4) Ice Melting Capacity

The Line Items (geographic areas) will be awarded individually to the highest scoring bidder. There are 100 points possible for each of the four attributes, for a combined total of 400 points. The bid with the highest cumulative score for each Line Item (geographic area) will succeed.

Coefficient of Friction	Corrosion Rate	Extended Price		Ice Melting Capacity (IMC)
$\mu = F/L^{(1)}$	% less corrosive than NaCl ⁽¹⁾	per Line Item (geographic area)		g/L ⁽²⁾
<u>score</u>	<u>score</u>	<u>score</u>	<u>score</u>	<u>score</u>
≥ 1.10	$\geq 90.0\%$	Low Bid	100	Best IMC
100	100	All other bids will be scored using the following formula:		All other bids will be scored using the following formula:
1.02 - 1.09	88.0% - 89.9%	$100 - \left(100 \times \left(\frac{a - b}{b} \right) \right)$ <p>"a" = Vendor Bid "b" = Low Bid</p>		$100 - \left(100 \times \left(\frac{c - d}{c} \right) \right)$ <p>"c" = Best IMC "d" = Vendor IMC</p>
97	97			
0.93 - 1.01	86.0% - 87.9%			
94	94			
0.85 - 0.92	84.0% - 85.9%			
91	91			
0.76 - 0.84	82.0% - 83.9%			
88	88			
0.68 - 0.75	80.0% - 81.9%			
85	85			
0.59 - 0.67	78.0% - 79.9%	<p><u>Example:</u></p> <p>Vendor Bid = \$312,167.68 Low Bid = \$276,542.24</p> $100 - \left(100 \times \left(\frac{312167.68 - 276542.24}{276542.24} \right) \right)$ $100 - \left(100 \times \left(\frac{35625.44}{276542.24} \right) \right)$ $100 - (100 \times 0.1288245)$ $100 - 12.88245 = 87.11755$ <p>Rounded to the nearest whole number</p> <p>Score = 87</p>		<p><u>Example:</u></p> <p>Best IMC = 532 g/L Vendor IMC = 437 g/L</p> $100 - \left(100 \times \left(\frac{532 - 437}{532} \right) \right)$ $100 - \left(100 \times \left(\frac{95}{532} \right) \right)$ $100 - (100 \times 0.1785714)$ $100 - 17.85714 = 82.14286$ <p>Rounded to the nearest whole number</p> <p>Score = 82</p>
0.51 - 0.58	76.0% - 77.9%			
79	79			
0.42 - 0.50	74.0% - 75.9%			
76	76			
0.34 - 0.41	72.0% - 73.9%	<p><u>Example:</u></p> <p>Best IMC = 532 g/L Vendor IMC = 437 g/L</p> $100 - \left(100 \times \left(\frac{532 - 437}{532} \right) \right)$ $100 - \left(100 \times \left(\frac{95}{532} \right) \right)$ $100 - (100 \times 0.1785714)$ $100 - 17.85714 = 82.14286$ <p>Rounded to the nearest whole number</p> <p>Score = 82</p>		<p><u>Example:</u></p> <p>Best IMC = 532 g/L Vendor IMC = 437 g/L</p> $100 - \left(100 \times \left(\frac{532 - 437}{532} \right) \right)$ $100 - \left(100 \times \left(\frac{95}{532} \right) \right)$ $100 - (100 \times 0.1785714)$ $100 - 17.85714 = 82.14286$ <p>Rounded to the nearest whole number</p> <p>Score = 82</p>
0.25 - 0.33	70.0% - 71.9%			
70	70			
< 0.25	< 70.0%			
0	0			

Notes:

- (1) The value used in scoring will be the test result from an accredited, independent laboratory that the vendor includes in their bid submission (for both *coefficient of friction* and *corrosion rate*).
- (2) Ice melting capacity will be defined in terms of grams of ice melted per liter of brine, and measured by the State test laboratory in accordance with the *Mechanical Rocker Test* procedure.

Bids will be evaluated on the following attributes:

- 5) Sucrose Content
- 6) Coefficient of Friction
- 7) Corrosion Rate
- 8) Extended Price

The Line Items (geographic areas) will be awarded individually to the highest scoring bidder. There are 100 points possible for each of the four attributes, for a combined total of 400 points. The bid with the highest cumulative score for each Line Item (geographic area) will succeed.

Sucrose Content		Coefficient of Friction		Corrosion Rate		Extended Price	
% by weight ⁽¹⁾	<u>score</u>	$\mu = F/L^{(2)}$	<u>score</u>	% less corrosive than NaCl ⁽²⁾	<u>score</u>	per Line Item (geographic area)	<u>score</u>
≥ 20.0%	100	≥ 1.10	100	≥ 90.0%	100	Low Bid	100
19.0% - 19.9%	97	1.02 - 1.09	97	88.0% - 89.9%	97	All other bids will be scored using the following formula: $100 - \left(100 \times \left(\frac{a - b}{b} \right) \right)$ "a" = Vendor Bid "b" = Low Bid <u>Example:</u> Vendor Bid = \$161,614.74 Low Bid = \$132,751.52 $100 - \left(100 \times \left(\frac{161614.74 - 132751.52}{132751.52} \right) \right)$ $100 - \left(100 \times \left(\frac{28863.22}{132751.52} \right) \right)$ $100 - (100 \times 0.2174228)$ $100 - 21.74228 = 78.25772$ Rounded to the nearest whole number Score = 78	
18.0% - 18.9%	94	0.93 - 1.01	94	86.0% - 87.9%	94		
17.0% - 17.9%	91	0.85 - 0.92	91	84.0% - 85.9%	91		
16.0% - 16.9%	88	0.76 - 0.84	88	82.0% - 83.9%	88		
15.0% - 15.9%	85	0.68 - 0.75	85	80.0% - 81.9%	85		
14.0% - 14.9%	82	0.59 - 0.67	82	78.0% - 79.9%	82		
13.0% - 13.9%	79	0.51 - 0.58	79	76.0% - 77.9%	79		
12.0% - 12.9%	76	0.42 - 0.50	76	74.0% - 75.9%	76		
11.0% - 11.9%	73	0.34 - 0.41	73	72.0% - 73.9%	73		
10.0% - 10.9%	70	0.25 - 0.33	70	70.0% - 71.9%	70		
< 10.0%	0	< 0.25	0	< 70.0%	0		

Notes:

- (1) For sucrose content, the manufacturer's minimum value of the range included in a vendor bid submission will be used for scoring.
- (2) The value used for scoring will be the test result from an accredited, independent laboratory that the vendor includes in their bid submission (for both *coefficient of friction* and *corrosion rate*).



2018 Research Proposal Form

Proposer name: Russell Modrell and Tom Renninger (Group 4)

Organization: Caltrans and Alaska DOT&PF

Title of proposed research project: Better Retention and Recruitment for Highway Maintenance Workers

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

Low pay levels for highway maintenance workers makes it difficult to retain trained and licensed workers. Can't recruit qualified workers at the pay rates currently offered by most transportation agencies.

2) **What is the goal of the project?**

To inform decision-makers, negotiators, and legislative bodies of the pay disparity between highway maintenance workers in the public and private sector, and in many instances, the disparity between highway maintenance workers and other similar job classifications within the state systems. Convince decision-makers of the need for better pay for government highway workers. Recruit and keep trained and licensed personnel. Long term goal: better retention and recruitment of a more qualified workforce.

3) **Describe the expected products/deliverables of the research.**

- Pay scale comparisons with both private sector and other government agencies for similar work classifications.
- Hiring data from various highway worker agencies to show difficulties with recruitment.
- Best practices from other states' efforts.
- Comparison tables, reference/information card (one-pager).

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

Compare pay scales from both private sector and other government agencies that have classifications similar to highway maintenance worker. Although this is a national problem, these pay comparisons need to be done at a regional level.

- Collect and synthesize data on pay scales between government and private sector industry for highway maintenance workers. Do this on a regional basis to keep cost of living somewhat similar.
- Collect hiring data (as able) from government transportation agencies.
- Survey the Clear Roads states to look for best practices related to the hiring and retention of highway maintenance workers.
- Create a best practices guide of best hiring practices, and salary negotiations in union and non-union settings.
- Create quick reference compensation comparison tables for decision-makers.

- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

State maintenance managers, human resource managers, DOT executives, and legislators.

- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

Most transportation agencies will benefit from this type research, as following this recommendations from this research should lead to improved employee retention and recruitment. The improved recruitment and retention should also create a more stable work environment and may also decrease work place accidents by enlisting better qualified employees.

Although salaries may initially be higher, better employee retention and recruitment will make for a more qualified work force. Keeping trained employees on board saves training dollars. Less accidents form better qualified employees can save dollars. Keeping adequate staff for maintenance operations makes for more efficient and safer maintenance operations.

- 7) **How will you measure the success of this project?**

The number of transportation agencies who adopt higher pay scales for highway maintenance workers. Human resources data related to recruitment and retention of highway maintenance workers. Improved safety via less accidents due to more experienced workers.

- 8) **Estimated funding needed.**

\$100k

- 9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months _____
- Other: _____ months

- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**

No.



2018 Research Proposal Form

Proposer name: Craig Bargfrede (Group 4)

Organization: Iowa DOT

Title of proposed research project: High Performance Blade Evaluation

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

Many DOT's are using various high-performance blades in addition to standard carbide blades but there is not much data/research to indicate how long these high performance blades actually last. There is also limited cost/benefit information available to help making buying decisions.

2) **What is the goal of the project?**

To better understand the amount of life we are achieving with high-performance blades on the various road surface types. This information can then be used to perform a cost/benefit to assist states in making more informed decisions in blade procurement.

3) **Describe the expected products/deliverables of the research.**

- Quick Reference Guide detailing high performance blade performance and life (miles and/or hours) on various road surface types.
- A Cost Benefit Analysis that takes into account the cost of the high performance blades and their duration and compares that to more standard blades upfront cost and life.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

- Survey the Clear Roads states on the use of high performance plow blades.
- Summarize the various high-performance blade types used by DOTs and the road surface types on which these high performance blades are being used.
- From the previous tasks, work with states using high performance blades to develop case studies, which document type of blade used, cost of blade, blade performance, and blade durability.
- Conduct a cost benefit analysis of high performance blades and standard non-high performance blades.
- Create a Quick Reference Guide that details the cost, performance, and life of high performance blades compared to standard non-high performance blades and also presents the results of the cost benefit analysis.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

DOT/DPW winter maintenance managers and purchasing officers.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

Having this information available can assist DOT's in their buying decisions, thus saving money.

7) **How will you measure the success of this project?**

Compare the funds expended on an annual basis on plow blades prior to and after switching over to high performance blades.

8) **Estimated funding needed.**

\$50,000

9) **Estimated timeline for completing the research.**

- Six (6) months _____

- Twelve (12) months XX

- Eighteen (18) months _____

- Other: XX months – This could potentially be an ongoing synthesis project

10) **Are you aware of any similar or related research on this topic? If so, please list below.**

Not aware of any other formal research being conducted.



2018 Research Proposal Form

Proposer name: Russell Modrell and Joe Bucci (Group 4)

Organization: Caltrans and RI DOT

Title of proposed research project: Alternatives for De-icing Materials

Topic Area (highlight one):

Methods

Equipment

Materials

Training

Technology

Safety

1) **Explain the specific problem or issue to address.**

Current state policies on black pavement and ice-free travel ways require DOTs to apply higher amounts of chlorides to achieve these standards. Applying greater amounts of chlorides to meet the black pavement standard results in more funds spent on materials, equipment hours, man hours. There is also a cost to the environment. This project will explore the use of alternatives to chlorides in terms of their performance and cost.

What alternatives to chlorides are out there, how do they perform, what are the benefits, and their costs to use? Environmental concerns (short and long term) with each type of material?

2) **What is the goal of the project?**

To develop a list of best practices focused on alternative materials/methods to meet performance level expectations for maintaining roads clear of snow/ice while keeping environmental concerns and costs in check.

3) **Describe the expected products/deliverables of the research.**

Different types of materials available and some way to measure how well they work compared to chloride products. Measure how environmentally safe they really are compared to chloride products.

- Synthesis report on alternatives to chlorides
- Case study reports from states who have implemented a program of alternatives to chlorides with an emphasis on best practices and lessons learned.
- Summary of the highlights from those case studies to include a matrix of chloride alternatives along with their performance and cost.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

This project will explore what maintenance departments (city, county, state, and province) are using for de-icing materials as alternatives to chlorides. This exploration will include not only cost of the bulk material, cost of application, and their effectiveness, but also include an emphasis on using environmentally safe materials.

- Survey Clear Roads states to learn what they're using as alternatives to chlorides and a summary of findings.

- Propose a list of case studies (5 – 7) that explore the states experiences with that alternative to chloride.
- Conduct case studies of what states' have done to reduce the use of chlorides with alternative chemicals, materials, or methods. The case studies should lead to a greater understanding of the following as they compare to that of chloride use.
 - The performance of those alternatives in reducing snow and ice on the roadway.
 - The cost of the chloride alternative related to its cost per unit amount, but also the cost of application per lane mile.
 - The environmental impact of the chloride alternative.
- Develop best practices for reduced use of chlorides based on the findings from the case studies.

Some of the alternatives to chloride-based deicing materials may include acetates, formates, ureas, glycerols/glycols, succinates, organic additives and abrasives.

Alternative methods may include...

- Help?

One case study should address a state's or municipality's effort to reduce salt use through a reduced level of service, which may or may not include a public education campaign.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

Should be a benefit to all states using de-icing materials. Eventually, training may be necessary to educate maintenance operations about the effectiveness of different types of materials other than chlorides and how to apply them to be most effective.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

Possible savings in material and application costs, while using a product that is less impactful on the environment.

7) **How will you measure the success of this project?**

The number of maintenance departments to use the data gathered from this study. Cost savings experienced by snow and ice programs. Reductions in chloride concentrations in lakes, rivers, and streams.

8) **Estimated funding needed.**

Approximately \$100k

9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months X Two (2) consecutive six month winter periods.
- Eighteen (18) months _____
- Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**

Yes, See Local Road Research Board's TRS: Chloride Free Snow and Ice Control Material. Available at: <http://www.dot.state.mn.us/research/TRS/2014/TRS1411.pdf>



2018 Research Proposal Form

Proposer name: Brian Burne and Mike Lashmet (Group 5)

Organization: MaineDOT and NYSDOT (respectively)

Title of proposed research project: Quantifying the Considerations Associated with Urban and Rural Snow and Ice Control

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

The intent of this project is to quantify as many of the unique considerations associated with very rural or very urban highways. In many cases, snow and ice control guidelines do not clearly discern different tactics to employ when treating urban high-volume highways as compared to rural, very low-volume highways.

2) **What is the goal of the project?** There are a lot of informal observations and anecdotal opinions about how traffic impacts snow and ice control activities, including chemical applications. The goal of this project would be to capture those items and try to prove or disprove, and quantify them. Additionally, the project would synthesize state DOTs' guidelines related to urban vs rural tactics.

3) **Describe the expected products/deliverables of the research.**

As one example, possibly a table that relates average annual daily traffic (AADT) counts to the quantity of removed chlorides from the road. In other words, how much more of a salt application is required on a high-speed, high-volume road simply due to chloride removal by the traffic? When does too little traffic work against you?

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

The researcher would need to first broadly define the potential categories for different corridor characteristics (e.g. urban Interstates with high-volumes and low speeds; rural Interstates with low-volumes and high speeds; rural secondary highways with low volumes and moderate speeds, etc.). They would then survey and synthesize the various guidelines used by the states for differing highway conditions (where such documentation exists). They would also capture all the theoretical considerations/impacts defined by the crews that operate within the various categories, sort them by category to find commonality, and identify methods to verify the statements and assumptions (propose potential field testing for future efforts).

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

Snow and ice control agencies

- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

This information would ideally help refine performance measures within specific crew areas, help agencies predict how changes over time will impact their snow and ice programs, and modify snow and ice control guidelines as appropriate.

- 7) **How will you measure the success of this project?**

The project should result in specific tables and charts that will help agencies develop guidelines, budgets or make comparisons between areas with significantly different traffic volumes. It should also help practitioners better understand considerations that may otherwise be overlooked.

- 8) **Estimated funding needed.**

\$70,000

- 9) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months ___X___
- Eighteen (18) months _____
- Other: _____ months

- 10) **Are you aware of any similar or related research on this topic? If so, please list below. No**



2018 Research Proposal Form

Proposer name: Doug McBroom (Group 5)

Organization: Montana DOT

Title of proposed research project: Determining Impacts of Chloride-based Deicers on the Environment

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

In 1999 Colorado DOT conducted a study to determine what, if any, effects Magnesium Chloride had on the environment. The overall conclusion of the study is that application of magnesium chloride deicer, having a chemical composition and a consistent application rate as used in Colorado, is highly unlikely to cause or contribute to environmental damage at distances greater than 20 yards from the roadway. Even very close to the roadway, the potential of magnesium chloride deicer to cause environmental damage is probably much smaller than that of other factors related to road use and maintenance, including pollution of highway surfaces by vehicles and use of salt and sand mixtures to promote traction in winter. Magnesium chloride deicer may offer net environmental benefits if its use leads to a reduction in the quantity of salt and sand applied to roadways. Although this study was very useful, it was limited to only magnesium chloride and no other chloride deicers.

In recent years, states have been pushed to reduce the amount of salt on the road with groups citing the deleterious effects chloride-based deicers have on the environment. A study similar to this 20-year-old study is needed, and would need to include several different chloride-based deicers at different concentrations/application rates.

2) **What is the goal of the project?**

To determine the environmental impacts of several chloride-based deicers used by most of the Clear Road states. The research should include no more than three different chloride-based deicers, take samples from the road at different distances in different environments to determine the concentrations of the substrates in those deicers. From those concentrations determine the potential impact to the environment.

3) **Describe the expected products/deliverables of the research.**

A literature review of similar research, a report on the impacts, and a "fact sheet" that DOTs can use to educate legislators and other groups on the impacts of deicers.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

This study would include the following tasks:

1. A literature review
2. States to send in soil samples in early winter after application to lab

3. Reports on the concentrations of the substrates
4. Development of one-page fact sheets for the deicers

- 5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Legislators and DOT managers, environmental groups, general public and drivers.

- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**
Would give objective data to the environmental effects of deicers and the balance of those effects to the operations of winter roadway maintenance.

- 7) **How will you measure the success of this project?**
The ability to use the fact sheets to help educate the public

- 8) **Estimated funding needed.**
\$100,000

- 9) **Estimated timeline for completing the research.**
 - Six (6) months _____
 - Twelve (12) months _____
 - Eighteen (18) months X
 - Other: _____ months

- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
STUDIES OF ENVIRONMENTAL EFFECTS OF MAGNESIUM CHLORIDE DEICER IN COLORADO. 1999 Prof. William M. Lewis, Western Environmental Analysts.



2018 Research Proposal Form

Proposer name: Douglas McBroom (Group 5)

Organization: Montana DOT

Title of proposed research project: Defensive Driving for Snowplow Operators

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

During the 2016-2017 winter and the 2017-2018 winter season, over 14% (72 plows) of the Montana Department of Transportation's fleet was hit by the traveling public. These damages represented lost revenues, slower response times, and plow driver distress.

The accidents recorded were mostly rear-end accidents but there were some turning accidents as well. Although in every instance the traveling public was ticketed for being at fault, we are interested to learn if there are any changes that can be made by the snowplow operator to reduce the number of winter plow accidents.

2) **What is the goal of the project?**

Determine the root cause of different types of accidents and determine if there are any defensive driving skills, strategies, or changes in operations to prevent accidents and decrease risk to our plow drivers and traveling public alike.

3) **Describe the expected products/deliverables of the research.**

Several deliverables to include:

- Root cause analysis
- Mitigation options
- Develop a training program (PPT-based) that will benefit all CR states.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

Researcher should conduct a literature scan to see what other states/countries are doing to mitigate accidents with plows. Next, the researcher will have to randomly select several accidents in different categories (i.e. rear end accidents, turning accidents, etc.) from different states to determine the root cause of the accidents and develop mitigation options to address those causes. Finally, the researcher should develop a training program for any state to implement, if so desired.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

Managers and plow drivers would be the audience for the deliverables. The deliverable is a training program and

- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**
Any reduction in accidents would:
1. Keep the traveling public and plow drivers safer
 2. Reduce costs of winter maintenance by reducing repair costs
 3. Increase response times across the state
- 7) **How will you measure the success of this project?**
Developing a training program and tracking plow hits across clear roads to see if there is a reduction in accidents with states that choose to implement any program developed
- 8) **Estimated funding needed.**
\$70,000
- 9) **Estimated timeline for completing the research.**
- Six (6) months _____
 - Twelve (12) months X
 - Eighteen (18) months _____
 - Other: _____ months
- 10) **Are you aware of any similar or related research on this topic? If so, please list below.**
No



2018 Research Proposal Form

Proposer name: Brian Burne (Group 5)

Organization: Maine DOT

Title of proposed research project: Vehicle Corrosion Ratings

Topic Area (highlight one):

Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address.**

The intent of this project is to compile information about vehicle corrosion nationwide. State DOTs are receiving complaints from legislators and the general public regarding corrosion of their vehicles, yet there are very definite trends in the vehicle makes and models. This research will clarify or disprove those currently perceived trends with a statistically valid survey.

2) **What is the goal of the project?** The goal of this project is to better understand which vehicle makes and models have issues in which areas of the vehicle. This project will also have a geographical component where the data can be sorted or mapped by zip code.

3) **Describe the expected products/deliverables of the research.**

The expected results are as follows: 1) a list showing vehicle makes and models listed from best to worst with regard to vehicle corrosion, 2) Identification of what specific corrosion issues are associated with each make and model of vehicle, 3) a map color-coding the states and regions with the most significant corrosion issues and the least corrosion issues, 4) Possibly identification of how some of the manufacturers were able to minimize the effects of corrosion on their vehicles.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

The researcher will need to conduct a massive, nationwide survey. Therefore, I propose that we enter into a sole-source partnership with Consumer Reports for this project. I envision that this effort can be treated as a more focused version of their annual automobile survey. The fact that they already have the mailing list, the automotive database, and the zip codes, as well as the knowledge of how to best ask the questions, compile the data, and present the results in a simple and understandable format, makes them the best candidate to deliver a cost-effective and successful project.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

Snow and ice control agencies, auto manufacturers, and the general public.

- 6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems.**

The goal is to spotlight the common issues and identify how these issues have been addressed by other manufacturers. The data should help DOTs and the general public make better decisions about trade-offs between cost and durability with regard to the vehicles they choose to buy.

- 160) How will you measure the success of this project?**

If the project successfully identifies wide-spread, statistically valid corrosion trends that correlate to specific makes and models of vehicles in certain regions of the country, it will become a source of reference for car-buyers, as well as the DOTs for their pool vehicles.

- 7) **Estimated funding needed.**

\$100,000

- 8) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months ___X___
- Eighteen (18) months _____
- Other: _____ months

- 9) **Are you aware of any similar or related research on this topic? If so, please list below.** Just the Consumer Reports Annual Auto Issue.