Clear Roads Research Proposals
2016

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Stockpile Reports, Stockpile Measurement and Volume Calculation Application	$150,000	18 months	Evaluate the usability of the Stockpile measurement technology to asses a more accurate inventory of current stockpile volumes.	Tom Aguilar/ Kyle Lester, Colorado DOT	4
2	Friction and Temperature Sensors - Mobile and Stationary Weather Stations	$150,000	18 months	Determine mobile and stationary road weather stations that will provide an accurate measurement of the presence of ice, water, snow, relative humidity, visibility, wind speed, atmospheric pressure, surface air and depth temperature, and road grip or friction.	Tom Aguilar/ Kyle Lester, Colorado DOT	6
3	Identification of Technologies for the Assessment of Winter Roads Conditions	$150,000	18 months	Identify, compare, and evaluate technology that can objectively assess and report roads conditions.	Phillip Anderle, Indiana DOT	8
4	Weather Event Reconstruction & Analysis Tool	$60,000	12 months	The purpose of this research project would be to build a weather event reconstruction tool that can pull together various pieces of official information to help agencies conduct after-action studies and prepare after-action reports.	Brian Burne, Maine DOT	10
5	Aurora WSI Update/Enhancement Partnership	$20,000	12 months	The goal of this project would be to partner with Aurora to update the programming for the Winter Severity Index (WSI) System, discuss the possibility of a WSI estimator tool, and to develop a strategy for ongoing operation.	Brian Burne, Maine DOT	12
6	Effectiveness of Residual Salt on the Roadway	$150,000-$200,000	18 months	Provide timeframes that residual salt remains effective for various application rates, road types, and weather conditions. Evaluate sensors that detect salt levels.	Justin Droste, Michigan DOT	14

Clear Roads Research Proposals
2016

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
7	Utilization of AVL/GPS Technology: Case Studies	$50,000	12 months	The goal of the project is to document case studies of agencies that have implemented an automatic data collection system for winter maintenance. Document lessons learned, the key factors that influenced the decision to pursue AVL/GPS, at what level it was implemented, and how to share the data internally and externally.	Tim Chojnacki, Missouri DOT	16
8	Emergency Operations Methodology for Extreme Winter Storm Events	$75,000	12 months	The goal of this project is to identify how states currently handle pre-storm and during-storm planning and execution of plans to improve the management and response to severe and extreme winter weather events, as well as provide guidance to develop comprehensive response plans.	Mike Lashmet, New York State DOT	18
9	Study to Identify the Complexities on Winter Levels of Service	$80,000	12 months	To identify the complexities that are involved in setting and achieving winter maintenance Levels of Service.	Brad Darr, North Dakota DOT	20
10	Use of Sacrificial Coatings to Protect Equipment from Deicer Corrosion	$150,000	12 months	Identify various sacrificial coating options and evaluate their performance and cost benefits as a function of typical equipment and exposure scenarios of interest. The goal is to develop guidelines for DOTs to adopt the cost-effective sacrificial coating treatments to reduce the corrosion effects of deicers to equipment assets and extend their service life.	Patti Caswell, Oregon DOT	22

Clear Roads Research Proposals
2016

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
11	Evaluating Methods for Pre-Wetting Abrasives	$125,000	12 months	Evaluate various setups to determine the most effective way to pre-wet at the chute. Factors to evaluate include: where the pre-wet comes in, how many source points are ideal, type of nozzle, for set pre-wet amounts (5-12 gallons per mile), for both cinder and ¼" minus quarry rock, and up to two additional commonly used abrasive materials (or solid salt).	Patti Caswell, Oregon DOT	24
12	Accuracy of Liquid and Granular Spreaders to Apply and Record Targeted Quantities of Material	$125,000	12 months	To test various calibrated liquid and granular spreaders to determine their ability to apply targeted quantities of various materials for extended periods of time and record accurately to the controller.	Allen Williams, Virginia DOT	26
13	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.	Allen Williams, Virginia DOT	28
14	Training Video for the Implementation of Liquid Only Plow Routes	$30,000	6 months	The goal is to be able to effectively implement liquid only plow routes utilizing experiences from agencies already using the practice.	Jeff Pifer, West Virginia DOT	30

2016 Research Proposal Form

Proposer name: Tom Aguilar / Kyle Lester
Organization: Colorado DOT

Title of proposed research synthesis or project: Stockpile Reports, Stockpile Measurement and Volume Calculation Application

Topic Area: Methods **Equipment** Materials Training **Technology** Safety

1) **Explain the specific problem or issue**.
Several Stockpile Report applications offer a web-based application utilizing an iPhone 2, solid orange traffic cones, and a 25 foot length of rope to create a video image of a stockpile. The video is used to create a 3D model of the stockpile for calculating its volume. The resulting volume calculation report is overlaid on Google Maps within 24 hours giving management visibility into location and an accurate volume of existing inventory.

2) **What is the goal of the project?**
A Stockpile Report application would calculate stockpile volume as accurately as our GPS survey method and provides several financial benefits; it saves over one million dollars per year in measurement cost. This technology is more accurate and improves employee cubic yard estimates by 27% as well as 20 FTEs per year in measurement time.

3) **Describe the expected products/deliverables of the research?**
This application will be used to verify vendor deliveries, procurement needs, and annual inventories. We would like an easy-to-use software, which can accurately measure winter materials to assist in both reactive and proactive responses to upcoming weather events.

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?**
Evaluate the usability of the measurement technology throughout the state to asses a more accurate inventory of current stockpile volumes. This would include a scan of how other agencies are using this technology.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The desired audience will be Maintenance Winter Operations and storeroom staff who are responsible for tracking and maintaining stock piles.

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.**
Each maintenance section is unique and will create its own adoption plan for utilizing this technology, but the ultimate goal will be to enable winter operations staff to more accurately

verify materials on hand and calculate monthly pay estimates on materials for more efficient budgeting.

7) **How will you measure the success of this project?**
The success will be measured by the accuracy of the applications in terms of stock pile read outs, improvement in cost accounting and any noticeable inventory reductions.

8) **Estimated funding needed. ?**
$150,000

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.**
No

2016 Research Proposal Form

Proposer name: Tom Aguilar / Kyle Lester
Organization: Colorado DOT

Title of proposed research synthesis or project: Friction and Temperature Sensors - Mobile and Stationary Weather Stations

Topic Area: Methods **Equipment** Materials Training **Technology** Safety

1) **Explain the specific problem or issue**.
Winter road condition/friction sensors & winter road temperature sensors.

2) **What is the goal of the project?**
Mobile and stationary road weather stations that will provide an accurate measurement of the presence of ice, water, snow, relative humidity, visibility, wind speed, atmospheric pressure, surface air and depth temperature, and road grip or friction. Also, how to incorporate friction sensors and WeatherCloud sensors into MDSS to make the data operational.

3) **Describe the expected products/deliverables of the research?**
Easy integration with current road weather technologies in place. Accurate and precise readings of road conditions and remote temperature measurements.

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?**
Conduct a product and literature search on viable vendors. Evaluate the usability of the measurement technology throughout the state. Demonstrate proven capabilities in accurate weather readings in both mobile and stationary equipment. Conduct a scan of other agencies to determine how they are using this technology.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The desired audience will be Maintenance Operations for all DOTs.

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.**
To enable Maintenance staff to more accurately and efficiently maintain safe and clear roadways during winter operations. The technology should provide a cost effective way to measure meteorological events throughout the state, which in turn will enable the staff to apply appropriate actions to the road ways.

7) **How will you measure the success of this project?**
The success will be measured by the accuracy of the applications in terms of accurate readouts by both mobile and stationary weather stations.

8) **Estimated funding needed.**
$150,000

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.**
No

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Phillip Anderle
Organization: Indiana DOT

Title of proposed research project: Identification of Technologies for the Assessment of Winter Roads Conditions

Topic Area (highlight one):
Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
Subjectivity of human assessment of road conditions.

2) **What is the goal of the project?**
Identify, compare, and evaluate technology that can objectively assess and report roads conditions.

3) **Describe the expected products/deliverables of the research.**
Compare and evaluate the available technologies. Determine correlation of sensor readings to reported road conditions. Suggest deployment and integration practices to utilize this technology.

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?)**
Evaluate equipment, interface, and usability.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State DOTs responsible for snow and ice 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**.
Consistent and objective road conditions assessments. Possibility of using data for improving overall operations and to use on LOS.

7) **How will you measure the success of this project?**
By having implementable recommendations for deployment and utilization of the technology or reasons that it's a bad idea.

8) **Estimated funding needed.**
$150,000?

9) **Estimated timeline for completing the research.**
   - Six (6) months _____
   - Twelve (12) months _____
   - **Eighteen (18) months __X___ (2 winter seasons)**
   - Other: _____ months

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

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Brian Burne
Organization: Maine DOT

Title of proposed research project: Weather Event Reconstruction & Analysis Tool

Topic Area (highlight one):
Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
The purpose of this research project would be to build a weather event reconstruction tool that can pull together various pieces of official information to help agencies conduct after-action studies and prepare after-action reports.

2) **What is the goal of the project?**
To make life a little easier. This tool will greatly reduce the amount of time spent pulling data together – leaving more time for storm and response analysis.

3) **Describe the expected products/deliverables of the research.**
The user would provide a specific geographic area and time frame to be studied. The tool will pull all pertinent weather data, including: all applicable NWS forecasts, a video file of the applicable radar images, hourly tables of the observed conditions from surrounding weather stations (temperature, dew point, humidity, precipitation, wind, conditions), snowfall and/or precipitation intensities, any applicable images, and any other useful data that may be available.

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 investigate which datasets are available and reliable over the long-term. I have listed some of the items this tool should include above, but the researcher should also propose other data that would be useful in reconstructing an event and assessing its impacts.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Me (and others like me). Anyone that needs to analyze their agency's response to an event and better understand what occurred and how it could be better handled in the future.

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 tool would provide an excellent way for an agency to quickly "snapshot" a storm event for either immediate or future analysis. Once a winter ends, events quickly fade in our memories. This will help capture the pertinent facts.

7) **How will you measure the success of this project?**
If I can run this tool and have the pertinent data within 15-20 minutes, it will be a success. Scrounging around for this information now can take a few hours.

8) **Estimated funding needed.**
Maybe $60,000? Potentially more depending upon how fancy the tool is and whether or not new archives become necessary.

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**.
I am not, but some resources I have used for this purpose in the past include:
- https://www.wunderground.com/wundermap/
- http://mesonet.agron.iastate.edu/wx/afos/list.phtml
- http://www.weather.gov/

2016 Research Proposal Form

Proposer name: Brian Burne
Organization: MaineDOT

Title of proposed research project: Aurora WSI Update/Enhancement Partnership

Topic Area (highlight one): Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
A few years back, Aurora worked with AccuWeather to develop a standardized Winter Severity Index (WSI) System that would work throughout the United States. The system has worked well and the following Clear Roads states have made use of this system in the past: Deleware DOT, Vermont DOT, New Hampshire DOT, Connecticut DOT, Missouri DOT, New Jersey DOT, Rhode Island DOT, Oregon DOT, Maine DOT. Unfortunately, funding for the system ran out as of December 2015 and now it needs some software updates to work completely once again.

2) **What is the goal of the project?**
This WSI tool provides a standardized method to determine and compare the winter severity nationwide. The goal is to partner with Aurora to update the programming for the Winter Severity Index (WSI) System, discuss the possibility of a WSI estimator tool, and to develop a strategy for ongoing operation.

3) **Describe the expected products/deliverables of the research.**
It will continue to be a web based system that will provide a standardized WSI to use nationwide.

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 project will require the development of a plan to make the system available and sustainable over the long-term. For the estimator tool, the researcher will need to look at which short-term variables could be plugged into the WSI equation to estimate the severity of a particular event, before the long-term numbers are available.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State DOTs, however, the system could potentially be opened up for broader use by municipalities, counties and other entities.

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 tool allows agencies to make comparisons between events and seasons to gauge their efficiency against an unbiased baseline.

7) **How will you measure the success of this project?**
If I can run this tool and get reasonable results, it will be a success.

8) **Estimated funding needed.** Maybe $20,000

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**.
Aurora would have quite a bit of background information.

2016 Research Proposal Form

Proposer name: Justin Droste
Organization: Michigan 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**.
   How long does residual salt on roadway remain effective after initial application?

2) **What is the goal of the project?**
   Provide timeframes that residual salt remains effective for various application rates, road types, and weather conditions. Perhaps evaluate sensors that detect salt levels.

3) **Describe the expected products/deliverables of the research.**
   A report with tables showing different application rates, pavement types, different weather exposures, and expected duration of residual salt effectiveness (What is the effective app rate still on pavement?).

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?)**
   Lit research (example:
   http://www.sciencedirect.com/science/article/pii/S0925400513011957)

   Test plan and testing of residual salt effectiveness. Compare saline sensors for accuracy and usefulness. Report and presentation on findings.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   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 operators to use less salt in situations where residual salt is present.

7) **How will you measure the success of this project?**
   Use of residual tables in winter operations. Use of sensing technology to make better salt application decisions.

8) **Estimated funding needed.**
($150K-$200K) $150,000 to research and test salt conditions for tables. Additional $50,000 to test saline sensors.

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

Spanish research, sensors (2014)
https://www.sciencedaily.com/releases/2014/01/140128094622.htm

2016 Research Proposal Form

Proposer name: Tim Chojnacki
Organization: Missouri DOT

Title of proposed research project: Utilization of AVL/GPS Technology: Case Studies

Topic Area (highlight one):
Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
The use of AVL/GPS in winter maintenance operations can prove beneficial. The benefits of the technology can vary greatly, as can the costs. Guidance would be helpful to determine which data items an agency should pursue, how to plan to share the information (both internally and externally), and how to plan/procure the system for future expansion.

2) **What is the goal of the project?**
The goal of the project would be to document a number of case studies of agencies that have implemented an automatic data collection system for winter maintenance so other states that have not yet implemented, or considered implementing automatic data collection, can learn from others. There is value is establishing case studies that document lessons learned through implementation of this technology as well as what key factors influenced the decision of the agency to pursue AVL/GPS, at what level it would be implemented, and how to share the data internally and externally.

3) **Describe the expected products/deliverables of the research.**
Each case study would describe the program from concept of operations through implementation and system maintenance (e.g. life cycle), including roles/responsibilities for program oversight and the day-to-day system management. The case studies should cover a range of implementation and data collection approaches. For example: some agencies expect only very basic data from their system; others incorporate the vehicle diagnostics/fleet management, material usage, or other auxiliary sensor data; others are sharing the data publicly, through social media or other means; and still others are using the automated data to support or populate their agencies' performance measures.

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 states (or international agencies) that would qualify as good subjects for this effort.
   - Review results of previous Clear Roads "Synthesis on GPS/AVL Equipment Used for Winter Maintenance".
   - In conjunction with the technical advisory committee, develop interview questions that will result in a robust case study.
   - Complete the case studies via interviews with key agency personnel.

- Document any lessons learned with the various implementations and including cost/benefit.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State DOTs (both fleet managers and maintenance managers)

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**.
With so much potential data to be gathered, systems to be integrated, information to be shared, it is difficult to anticipate pitfalls or issues that may delay or hinder implementation of AVL/GPS in an agency. If we can learn from others who may have experienced delays or false starts, we may have better success identifying the proper goals and limitations of implementing a solution in our agency.

7) **How will you measure the success of this project?**
The success of this project could be measured by how many states or agencies review the results before making a decision about implementing or expanding their use of AVL/GPS. A survey of those states or agencies could gather information about what value was gleaned from the case studies completed for this project.

8) **Estimated funding needed.**
$50,000

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.**
There is other AVL/GPS information, but this project would focus on lessons learned through implementation, specifically to help decision making by those pursuing the technology.

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Michael Lashmet
Organization: NYSDOT

Title of proposed research project: Emergency Operations Methodology for Extreme Winter Storm Events

Topic Area (highlight one):
Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
Many states are faced with an increase of significant and extreme weather events, not only during winter but year-round. Many times, commercial and commuter travelers become stranded on highway systems that become impassible due to extreme winter weather. Limited state and local resources become overwhelmed and emergency managers may lack a comprehensive plan to handle such incidents.

2) **What is the goal of the project?**
The goal of this project is to identify how states currently handle pre-storm and during-storm planning and execution of plans to improve the management and response to severe and extreme winter weather events, as well as provide guidance to develop comprehensive response plans. Such guidance would address systematic road closures, shifting of resources, public outreach, operations center involvement, stand-by towing services, shared services with other governmental agencies, roles of partner agencies like NWS, law enforcement, and emergency services, use of incident command system, etc.

3) **Describe the expected products/deliverables of the research.**
Deliverables include a literature search, survey of states' current practices, recommendations of BMPs in managing winter weather response incidents, comprehensive planning recommendations, etc.

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?)**
Conduct a literature search, develop and coordinate survey to gather and evaluate pertinent information, identify BMPs, provide constructive and detailed information to help develop states comprehensive response planning document, etc.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The intended audiences are state and local transportations agencies, and emergency transportation operations managers. The deliverables would help agencies develop or enhance their response plans.

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 help emergency and winter maintenance managers improve current planning tools and identify efficiencies to further advance response capabilities during extreme winter weather situations in many states.

7) **How will you measure the success of this project?**
The delivery of a well organized and detailed product that would benefit any state in their efforts to improve maintain passable transportation networks in response to severe winter weather events.

8) **Estimated funding needed.**
$75,000

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.

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Brad Darr
Organization: North Dakota DOT

Title of proposed research project: Study to Identify the Complexities on Winter Levels of Service

Topic Area (highlight one):
Methods Equipment Materials **Training** Technology Safety

1) **Explain the specific problem or issue to address**.
Defining Levels of Service for winter maintenance represents a complex interaction between political policy, environmental impact, agency cost, and available resources. Agencies that consistently over or under perform with respect to their established LOS may create unintended consequences.

2) **What is the goal of the project?**
To identify the complexities that are involved in setting and achieving winter maintenance Levels of Service.

3) **Describe the expected products/deliverables of the research.**
A policy guide that lays out recommendations for meeting, but not exceeding LOS, while taking into consideration the complexities involved.

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 literature search and survey of state agencies to determine which factors come to bear on determining and achieving LOS and how those factors may be weighted.

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

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 policy guide may get incorporated into a training/presentation materials for states to use.

7) **How will you measure the success of this project?**
States no longer over or under performing with respect to this established Level of Service.

8) **Estimated funding needed.**
$80,000

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

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Patti Caswell
Organization: Oregon DOT

Title of proposed research project: Use of Sacrificial Coatings to Protect Equipment from Deicer Corrosion

Topic Area (highlight one):
Methods **Equipment** Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
The costs associated with corrosion to DOT equipment are substantial as metallic corrosion increases maintenance and repair costs, reduces vehicle life, and results in equipment down time. Studies have shown that preventative maintenance (frequent washing, anti-corrosion coatings, corrosion inhibitors, salt removers) can preserve the quality and life of metals in chloride-laden environments. Oregon has used MgCl2 for more than a decade and as other states implement anti-icing with liquids, MgCl2 use will increase. Relative to rock salt and salt brine, MgCl2 products tend to migrate more into hidden areas and are more difficult to be cleaned from the vehicles. The exposure to these products poses a significant cost to the hundreds of separate pieces of ODOT maintenance equipment.

2) **What is the goal of the project?**
Identify various sacrificial coating options and evaluate their performance and cost benefits as a function of typical equipment and exposure scenarios of interest. The goal is to develop guidelines for DOTs to adopt the cost-effective sacrificial coating treatments to reduce the corrosion effects of deicers to equipment assets and extend their service life.

3) **Describe the expected products/deliverables of the research.**
Evaluate effectiveness of various sacrificial coatings, their cost and recommended preventative maintenance, and report findings.

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 on sacrificial coatings.
   - Identify typical equipment, candidate areas that would receive coating application, and exposure scenarios of interest.
   - Describe sacrificial coating types to be used in the research project, conduct lab investigation, and field verify preliminary results.
   - Coating treatment effectiveness will be measured in terms of how well they slow down metallic corrosion in the presence of MgCl2 applications, wet-dry cycling, and abrasion. The simulation of service conditions (e.g., amount of annual rainfall and temperature cycles) will be incorporated to be part of the testing program. Other variables to explore will include: the type and condition of metal to be protected (aluminum alloys, low-carbon

formable steels, high-strength steels, etc.), the level and frequency of deicer exposure, climatic conditions (time of wetness, temperature, etc.), washing frequencies, and exposure to abrasives. A service life model of various vehicle parts will be developed to link the results of accelerated laboratory tests to field performance of selected coating treatments. Subsequently, the model will be used to establish acceptance tests for selected sacrificial coatings, and to predict the beneficial life of selected coatings and their life cycle cost. For various selected scenarios, the most cost-effective coating treatment will be identified. All the findings from the project will be leveraged to develop guidelines for preserving new and old maintenance equipment exposed to magnesium chloride deicers.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
DOTs, public works 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**.
Reduce cost of corrosion related equipment failures or maintenance requirements (e.g. replacement parts, etc). Reduce equipment down time.

7) **How will you measure the success of this project?**
Sacrificial coatings will be found to extend the life of DOT equipment used in various scenarios and exposure to MgCl2 and abrasives. It will also be determining if maintenance of the sacrificial coatings is cost effective compared to corrosion reduction

8) **Estimated funding needed.**
$150,000 for lit search, laboratory setup, laboratory testing. Field testing would be future phase.

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.**

2016 Research Proposal Form

Proposer name: Patti Caswell
Organization: Oregon DOT

Title of proposed research project: Evaluating Methods for Pre-Wetting Abrasives

Topic Area (highlight one):
Methods **Equipment** Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
Pre-wetting abrasives (and solid salt) is a recommended best management practice. It has been shown that pre-wetting at the chain or spinner can be effective in coating the material but causes costly corrosion impacts. Applying at the chute as the material falls onto the spinner minimizes corrosion to expensive hardware. However, feedback from the field indicates that pre-wetting abrasives is not effective as the abrasives are not adequately coated with liquid deicer.

2) **What is the goal of the project?**
Evaluate various setups to determine the most effective way to pre-wet at the chute including where the pre-wet comes in, how many source points are ideal, type of nozzle, for set pre-wet amounts (5-12 gallons per mile), for both cinder and ¼" minus quarry rock, and up to two additional commonly used abrasive materials (or solid salt).

3) **Describe the expected products/deliverables of the research.**
Diagrams, drawings, specifications for most effective pre-wet setup for truck mounted pre-wet systems.

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 review
   - Determine research field set up that will measure effectiveness of pre-wetting in terms of getting a good coating on the abrasives.
   - Conduct field research and analyze results
   - Finalize results and recommendations

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
DOT and public works managers and staff who use or pay for plow blades.

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**.
ODOT would modify existing pre-wet systems if method proved more effective.

7) **How will you measure the success of this project?**
Recommendations make sense and are easy to implement.

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

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.

2016 Research Proposal Form

Proposer name: Allen Williams
Organization: Virginia DOT

Title of proposed research project: Accuracy of Liquid and Granular Spreaders to Apply and Record Targeted Quantities of Material

Topic Area (highlight one):
Methods **Equipment** Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
With the ever increasing emphasis on protecting the environment from foreign materials and chemicals, reducing the amount of anti-icing and deicing chemicals, and accurately reporting the amounts applied are gaining importance. As agencies fine tune materials placement, so as to reduce the quantities used, the spreaders must be able to accurately apply the target rates and record accurately the actual quantities being applied. This project is intended to address items #2 and #16 of the 2015 National Winter Maintenance Peer Exchange Problem Statements:
   - #2 - Best Management Practices for material application accountability.
   - #16 - Evaluate spreading equipment to determine if they can reliably apply anti-icing and deicing materials at the target application rates.

2) **What is the goal of the project?**
To test various calibrated liquid and granular spreaders to determine their ability to apply targeted quantities of various materials for extended periods of time and record accurately to the controller.

3) **Describe the expected products/deliverables of the research.**
A breakdown by spreader type and material type of the accuracy of the actual quantity of material applied to the targeted application rate. A similar breakdown for spreader, material and controller type to the accuracy of the reported actual quantity of material applied. Recommendations for calibration frequency by spreader type. Recommendations for specifying reasonable accuracy ranges and testing spreaders and/or controller to apply materials to set targets and record quantities.

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 and findings.
   - Development of test procedures along with selection of spreader types and materials.
   - Perform testing on calibrated equipment.
   - Tabulate findings and confirm data.

- Prepare and present findings and results.
- Prepare specifications and materials for training field personnel.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State and locality Departments of Transportation provided recommended specifications for accuracy ranges and test methods for spreaders and spreader controllers. Recommendations for frequency of recalibrations and expectation of accuracy to targeted application rate for field operations personnel. Webinar for Transportations managers wanting to understand more about the research projects and products developed. PowerPoint presentation used in the webinar provided for use by Clear Roads presentations.

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 products of this research will help transportation agencies specify anti-icing and deicing spreaders to provide more accurate application rates to a target setting and record more accurately actual quantities of materials applied so they can be more effective at reducing the amount of those materials introduced into the environment. Agencies will have more accurate reporting of actual materials applied for tracking purposes.

7) **How will you measure the success of this project?**
The products of the research project can be used by transportation agencies to calibrate anti-icing and deicing spreaders. These spreaders are able to apply material at a targeted rate and are able to accurately record materials being applied. If the materials are not being applied at the targeted rate, the spreader controllers will also provide a recalibration timeframe.

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

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.**
Clear Roads did a calibration study completed in 2010, but this goes beyond that project. There are numerous studies on calibration but this project tests to a targeted application rate and includes the controller's ability to record actual application rates.

2016 Research Proposal Form

Proposer name: Allen Williams
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 statically significant sample of snow plow operators. The investigator would develop training guides, DVDs and classroom training materials for managers and drivers to improve drivers' behavior to get better quality of rest before and during winter operations, 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?**
   - Investigator shall build off of the work by Virginia Tech Transportation Institute to perform a literature search nationally and internationally.
   - Investigator shall conduct field research of a statically significant number of snow plow drivers to confirm or reject the link between driver rest and driver fatigue and provide a detailed report of the findings from the field research.
   - 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? Identify training needed and describe the use of 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.

8) **Estimated funding needed.**
$200,000

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

CLEAR ROADS
research for winter highway maintenance

2016 Research Proposal Form

Proposer name: Jeff Pifer
Organization: West Virginia DOT

Title of proposed research project: Training Video for the Implementation of Liquid Only Plow Routes

Topic Area (highlight one):
Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
Implementing liquid only plow routes.

2) **What is the goal of the project?**
To be able to effectively implement liquid only plow routes utilizing experiences from agencies already using the practice.

3) **Describe the expected products/deliverables of the research.**
Develop a training video to communicate the parameters for effective implementation of liquid only plow 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?)**
Query information from agencies to build a best practices model and literature review to find any other research on the subject.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State agencies and municipalities wanting to start utilizing liquid only plow routes.

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 be used to sell the practice to legislature where approval is need to implement this new practice. Would also be utilized to give an agency confidence to move forward into this new area.

7) **How will you measure the success of this project?**
Successful implementation and acceptance.

8) **Estimated funding needed.**
$30,000

9) **Estimated timeline for completing the research.**
   - **Six (6) months __X___**
   - 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