Clear Roads Research and Synthesis Proposals
2023

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Synthesis – UAV Uses for Winter Maintenance			With Unmanned Arial Vehicles (UAV) technologies being adopted by state departments of transportation within the USA, there is very little known in terms of what, how and even if this technology is being used for winter maintenance purposes. The purpose of this synthesis is to identify any uses and gaps of UAV in winter maintenance. Additionally, this synthesis will gather information on DOTs' general use of UAV technologies within their agencies. Understanding general uses will allow DOTs to determine if any of the uses are transferable for winter maintenance uses. Understanding how states are using UAV for winter maintenance will allow Clear Road members to incorporate them into their own programs, identify gaps in uses, and possibly lead to a Clear Roads project on UAV use for winter maintenance.	Group 1 Doug McBroom, Montana DOT	10
2	Synthesis – Management (retention, legislation, policies, BMPs) of Video Recordings and Images Taken from Truck-Mounted Cameras			With the ability to record events through AVL (dash cameras and or rear facing cameras) the subsequent questions of best practices of retention and dissemination of video recordings and images can be both a help and/or a hindrance for several aspects to operations. These include, but are not limited to, FOIL requests, training aids, social media, technologies for interpreting road conditions, emergency operations, and situational awareness. This report will be a reference for snow and ice program managers when developing policy and best practice. Additionally, road condition video/images are a source for documenting the effectiveness of snow and ice practice, as well as level of service and performance management measurements.	Group 1 Joe Thompson, New York State DOT	11

Clear Roads Research and Synthesis Proposals
2023

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
3	Synthesis – Using Detention Pond Evaporator Byproduct in Brine			Detention Ponds in maintenance station yards are slow to evaporate naturally and some DOTs have opted to install Evaporator Units to keep ponds at manageable water levels. Hauling away water is an expensive practice and Evap Units provide a solution. This evaporation process produces a salty byproduct that must then be disposed of. With the express permission of the Department of Environmental Quality one special usage of this byproduct is to mix it into the regular brine solution and use it on the roadways for snow and ice control. This report will explore the past or current usage of the evaporation byproduct in brine solutions for the use of snow and ice control on roadways.	Group 1 Ryan Ferrin/ Jessica Andrews, Utah DOT	12
4	The Use of Traction Control Materials (including Clinoptilolite Zeolites) for Snow and Ice Control	$125,000	18 months	Salt can be environmentally unfriendly and corrosive to vehicles, roadways, and surrounding features/assets when used for snow and ice control. Traction materials also have environmental impacts such as air and water quality issues. Traction materials are also blown off the road by traffic sometimes in as little as 3 to 4 passes which then need to be reapplied. There has been little research by Clear Roads investigating traction materials effectiveness and impact to the roadway surfaces. Additionally other traction materials such as clinoptilolite zeolites may be an alternative solution for snow and ice control in place of traditional salt products. This project will study the effectiveness of traction control materials such as clinoptilolite zeolites, for snow and ice control as an alternative to standard salt and brine applications, as well as assessing its environmental impacts.	Group 1 Doug McBroom, Montana DOT Jessica Andrews, Utah DOT	13

Clear Roads Research and Synthesis Proposals
2023

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
5	Synthesis – Methods for Pretreatment Using Salt Brine/Blends Prior to Rain that Leads to Snow			The majority of winter weather events in Kentucky begin as rain followed by a transition to wintry mix/snow. When an event is expected to begin as rain, the current practice in Kentucky is to not pre-treat (anti-ice) with salt brine with the reason being that the brine will not be effective as it is not expected that much material will remain on the roadway surface. Questions have come recently to deliberate if that is really the case and does any residue remain on the roadway surface. KYTC also receives media inquiries prior to most winter events to address the application and methodology of brine application for anti-icing.	Group 2 Randi Feltner, Kentucky Transportation Cabinet	15
6	Synthesis – Best Management Practices to Incentivize Vendor Winter Maintenance Contracts			States such as VA and MA primarily utilize Hired Equipment Contractors for snow removal services. In recent years, the recruitment of these contractors has shrunk causing VDOT to review the terms, conditions, and incentives for snow vendors. To retain vendors, VA has introduced contractual tools such as minimum guaranteed payments, bonuses, and other incentives to keep vendors in the statewide Snow Removal Program. Within VDOT, individual districts have used these incentives to solve issues that other districts have but didn't know a solution existed. To overcome this, VA compiled all contractual tools and incentives that Districts use and shared them with the rest of the state. Something similar should occur between the Clear Roads Member States to encourage the sharing of solutions for shared problems. The compiled contractual language will provide State DOTs with insight into the methods and approaches other states use for snow removal contracting.	Group 2 A.J. Younes, Virginia DOT	16

Clear Roads Research and Synthesis Proposals
2023

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
7	Development of a Public Service Announcement (PSA) Library	$100,000 - $150,000	15 months	There is a lack of consistent messaging for the public concerning why and how states perform winter maintenance. Additionally, some messages are being distributed statewide regarding storms that may be specific to only one part of the state. State DOT Public Information Officers need a resource of prepared communication products that have been reviewed and approved by experienced winter maintenance managers. This project would create a library of Clear Roads videos and prepared messaging that a state can choose from to communicate important topics to the traveling public. These communication products (PSAs) would be short “Winter Maintenance 101” style videos / messages that would be posted on the Clear Roads Winter Driving Safety website, whose audience is the traveling public and state Public Information Officers.	Group 2 David Gray, New Hampshire DOT Group 3 Scott Lucas, Ohio DOT Jeff Pifer, West Virginia DOT Group 5 Steeve Spoor, Idaho TD	17
8	Synthesis – Solid and Liquid Deicer Output Confirmation			The amount of deicing material placed on the road is critical to snow and ice operations. If too much is applied, it is a waste of money and increases environmental concerns. Too little deicer may be a wasted effort and can slow down the road clearing process. This synthesis will identify and gather information about equipment and/or processes to measure dry and liquid deicer application output amounts and to feed that information back into the application hydraulics.	Group 3 Scott Lucas, Ohio DOT	19

Clear Roads Research and Synthesis Proposals
2023

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
9	Understanding the Performance of Various Liquid Deicing Blends	$125,000	18 months	Given various available deicing products that can be blended with salt (NaCl), it would be helpful to have guidance developed to help winter maintenance professionals be wiser with their planning and decisions regarding acquisition and application of liquid deicing blends. We need to ensure the right blend of chemicals for weather and pavement conditions, so we are efficient and cost effective when treating highways.	Group 3 Tom Peters, Minnesota DOT	20
10	Computer Based Training (CBT) for the Clear Roads ELDT Modules	$100,000	10 months	Currently the Clear Roads ELDT training modules are to be used by an in-person trainer. These slides can be customized for each individual agency to provide face-to-face training with that agency's equipment. Not everyone has a trainer available to provide the ELDT training for the operators that need to obtain their CLP. There are commercial vendors that provide ELDT Theory Training for the agency operator. Having CBT modules of the ELDT theory training would allow the hiring agency to provide online training of ELDT theory material. The individual can progress at their own pace. The agency would not have to hire an ELDT theory trainer if they don't already have a trainer assigned to this task. Completing the CBT version of the ELDT theory may make it easier for the individual to pass the DMV testing for the learners permit (CLP) for the CDL.	Group 3 Cliff Spoonemore, Wyoming DOT	22

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
11	Synthesis – Brine-Making Practices			Brine-making is picking up in the United States as a means for state DOTs to minimize the use of road salt by using liquid applications when/where appropriate. Brine makers have improved in automation over time and are largely hands off. Many DOTs are making their own salt brine for road applications. As more states join the cast of brine makers, it would be helpful to have an understanding of what is needed and ways the process can be improved based on lessons learned. This synthesis will provide states that are interested in brine making a good baseline understanding of the associated challenges, benefits, limitations, and range of options available.	Group 4 Patti Caswell, Oregon DOT	25
12	Solar Radiation Benefits/Chloride Reduction Potential Associated with the Use of Vegetation Management Practices Near Roads	$100,000 - $125,000	15 months	Many states are experiencing push back from environmental groups, regulation, and legislation policy that conflicts with vegetation management practices near highways and clear zones. It has been argued that removing vegetation near highways can raise solar radiational benefits potentially resulting in reduction of snow bonding at the start of storms and increased melting times post storm, both potentially reducing chloride use. Quantifying these assumptions with research would help stabilize some vegetation management debates and give states scientific research to build vegetation management practices based on results of this study. This project would study before and after results of roadway temperatures and chloride use to gather related data to prove or disprove the assumption that vegetation management adjacent to roads does or doesn't have a direct effect on solar radiation and potential chloride use.	Group 4 Aidan Neely, Connecticut DOT	26

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
13	Development of a Chloride Reduction Playbook	$100,000	15 months	Many states are experiencing legislation or governmental policy that is effectively meant to regulate or reduce the amount of salt used for roadway deicing. Eventually this level of regulation is expected to reach all states whether it be from a national or local directive. This project would develop a playbook that provides all known and proven strategies that can be deployed to reduce salt usage.	Group 4 Jeremy McGuffey, Indiana DOT	28
14	Development of Open-Source Artificial Intelligence to Report on Road Conditions	$150,000	24 months	As we move to increase our capabilities and situational awareness, we can leverage technology to do things that we previously needed humans to do. Winter road condition reporting can be automated to provide management and decision makers with better situational awareness and can improve DOT response times. This project would develop an open-source artificial intelligence (AI) program that can use existing DOT data sources to predict, and map, winter road conditions. The program would use available data sources such as, RWIS, ITS cameras, and plow dash cams to assign a road condition value.	Group 4 Jeremy McGuffey, Indiana DOT	30
15	Salt Dye Investigation	$125,000	18 months	Follow-up to existing research. Ex. Clear Roads 13-02 and Gerbino-Bevins 2011 (UNL) Darker colored salt has proven to absorb more sunlight in the form of heat and, in turn, is more efficient at melting ice in sunny conditions regardless of the ambient temperature. The goal of this project is to determine if there are any environmentally friendly and cost-effective ways of dyeing salt and salt brine a darker color.	Group 4 Jeremy McGuffey, Indiana DOT	32

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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
16	Update to CR 14-02 Quantifying the Impact that New Capital Projects will have on Roadway Snow and Ice Control Operations	$150,000	24 months	This would be an update to CR 14-02 to include including additional capital project types in the analysis which would be included in the tool for quantifying additional resource needs. It would also review and potentially update the tool if possible.	Group 4, Todd Law, Vermont Agency of Transportation	34
17	Alternative Sources for Brine and Brine-Making	$100,000	12 months	Brine making is picking up in the United States as a means for states to minimize the use of road salt by using liquid applications when/where appropriate. Brine makers basically take clean, drinking water and add salt to reach the appropriate concentration for road applications. Other materials may be added to the salt brine as it is loaded into the application truck, such as corrosion inhibitors. Some states have looked at and may be successfully reusing wastewater, which requires permitting to determine that the waste has a beneficial use. Many state DOTs get inquiries from various manufacturers to use their waste stream including cheese, pickle, and vodka manufacturers. Still other sources could include mineral well brine (naturally occurring), oil well brine (byproduct of fracking industry), and reclaimed truck wash water. The concern is that these water sources may contain various elements and potential pollutants that may require treatment in order to meet state specifications or specifications for the Clear Roads Qualified Products List. This project will Identify various recycled or alternative water sources for use in brine-making and determine their feasibility of use.	Group 4 Patti Caswell, Oregon DOT Group 1 Justin Droste, Michigan DOT	36

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
18	Synthesis – Investigation of Non-Destructive De-Icing Chemicals for Preservation of Concrete Bridge Decks			It is common practice in South Dakota to utilize chlorides to remove ice from roads and bridges. Chlorides work by lowering the freezing point of the surface. For example, ice that would normally form and create a driving hazard at 30 degrees, now, will not form until 25 degrees. While removing ice from the travel way is a necessity for safe travels, chlorides and especially chloride mixes, seep into concrete surfaces and cause damage. This is major concern for bridge decks. Damage to the concrete deck and eventual steel corrosion reduce the life of the structure. There are alternative chemicals, which also lower the surface freezing point, without causing damage to the concrete surface. The report would provide solutions and best practices for use of non-chloride chemicals on concrete bridge decks.	Group 5, Dan Varilek, South Dakota DOT	38
19	Quantifying the Economic Value of Snow and Ice Operational Success	$100,000	15 months	Snow and ice budget allocations may seem high to the layperson; however, the economic benefits of these expenditures may dwarf the outlay. The goal of this project will be to compare costs associated with a state's snow and ice program to the benefits gained from those expenditures. This analysis will be applied to different regions of the U.S to demonstrate the value of Clear Roads' states' snow and ice budgets at a time when these budgets are stretched thin.	Group 5 Mark Goldstein, Massachusetts DOT	39

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2023 Synthesis Request Form

Requestor name: Doug McBroom
Organization: Montana DOT (Group 1)

Title of proposed synthesis project: UAV Uses for Winter Maintenance

Topic area (highlight one):
Planning/Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
With Unmanned Arial Vehicles (UAV) technologies being adopted by state departments of transportation within the USA, there is very little known in terms of what, how and even if this technology is being used for winter maintenance purposes. The purpose of this synthesis is to identify any uses and gaps of UAV in winter maintenance. Additionally, this synthesis will gather information on Departments of Transportation's general use of UAV technologies within their agencies. Understanding general uses will allow departments of transportation to determine if any of the uses are transferable for winter maintenance uses.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
Information to compile for this proposed synthesis, would be a literature review, and a survey of state/local UAV winter maintenance practices. Additionally, this synthesis will compile information on other uses by departments of transportation and will suggest uses that may be transferable to winter maintenance activities.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
By understanding how states are using UAV for winter maintenance will allow Clear Road members to incorporate these in their own programs or it will identify gaps in uses and may lead to a clear roads project to identify different types of UAV use for winter maintenance. Finally, by gathering information on Departments of Transportation's general use of UAV technologies within their agencies, will I allow departments of transportation to determine if any of the uses are transferable for winter maintenance uses.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
I am not aware of any related information on this topic.

2023 Synthesis Request Form

Requestor name: Joe Thompson
Organization: NYSDOT (Group 1)

Title of proposed synthesis project: Management (retention, legislation, policies, BMPs) of Video Recordings and Images Taken from Truck-Mounted Cameras

Topic area (highlight one):
Planning/Methods Equipment Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
With the ability to record events through AVL – dash cameras and or rear facing cameras, the subsequent questions of best practices of retention and dissemination of video recordings and images can be both a help and/or a hindrance for several aspects to operations; including but not limited to: FOIL requests, training aids, social media, technologies for interpreting road conditions, emergency operations and situational awareness.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
Objective of the synthesis would be to compile authoritative policies and best practices, to include how agencies manage the retention and dissemination of videos and/or images, while considering personal privacy and other legal issues. Based on discussions while developing this proposal, a number of case studies highlighting agency best practices may be helpful, while also understanding that not all states are operating under the same legal framework.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
Synthesis report will be a source for snow and ice program managers to reference in developing policy and best practice. Additionally, road condition video/images are a source for documenting the effectiveness of snow and ice practice as well as both level of service and performance management measurements.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
CR17-03 Aftermarket Cameras in Winter Maintenance Vehicles

Installing Snowplow Cameras and Integrating Images into MnDOT's Traveler Information System (Minnesota DOT, October 2017)

2023 Academic Research Idea
Real-Time Road Conditions Using Dashcams (97.40 KB)

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2023 Synthesis Request Form

Requestor name: Ryan Ferrin / Jessica Andrews
Organization: Utah DOT (Group 1)

Title of proposed synthesis project: Using Detention Pond Evaporator Byproduct in Brine

Topic area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
Detention Ponds in maintenance station yards are slow to evaporate naturally and some DOT's have opted to install Evaporator Units to keep ponds at manageable water levels. Hauling away water is an expensive practice and Evap Units provide a solution.

This evaporation process produces a salty byproduct that must then be disposed of. With the express permission of the Department of Environmental Quality one special usage of this byproduct is to mix it into the regular brine solution and use it on the roadways for snow and ice control.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
This report will explore the past or current usage of the evaporation byproduct in brine solutions for the use of snow and ice control on roadways. The compilation would be of literature, studies, state practices, sample policies, sample specifications, lessons learned.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
The goal of the project is to research whether this is being done anywhere else other than Utah and to report on the effectiveness of using the evaporation byproduct as an additive to regular brine.

PROS/CONS table of evaporation byproduct usage, table listing states currently using this practice, lessons learned.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
No, I cannot find any studies on the internet regarding using evaporator byproduct in regular brine solution.

UDOT has 3 Evaporator Units at maintenance stations throughout Utah and this is an idea that we have been trying out.

2023 Research Proposal Form

Proposer name: Doug McBroom and Jessica Andrews
Organization: Montana and Utah DOTs

Title of proposed research project: The Use of Traction Control Materials (including Clinoptilolite Zeolites) for Snow and Ice Control

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

1) **Explain the specific problem or issue to address**.
Salt can be environmentally unfriendly and corrosive to vehicles, roadways, and surrounding features/assets when used for snow and ice control. Traction materials also have environmental impacts such as air and water quality issues. Traction materials are also blown off the road by traffic sometimes in as little as 3 to 4 passes which then need to be reapplied. There has been little research by Clear Roads investigating traction materials effectiveness and impact to the roadway surfaces. Additionally other traction materials such as clinoptilolite zeolites may be an alternative solution for snow and ice control in place of traditional salt products. This mineral is described as a mixture of silica and salt, with the silica being the majority of the composition. Materials such as this have the potential to positively affect snow and ice removal while providing traction for the traveling public.

2) **What is the goal of the project?**
To study the effectiveness of traction control materials such as clinoptilolite zeolites, for snow and ice control as an alternative to standard salt and brine applications, as well as assessing its environmental impacts.

3) **Describe the expected products/deliverables of the research.**
A report detailing the results of the testing of various traction control materials such as clinoptilolite zeolite products and their effectiveness for traction control, snow and ice removal, whether it can provide benefits from low salinity, and any impacts regarding air and water quality.

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 would conduct a comprehensive literature search on traction control materials that has been used or could be available for departments of transportation for traction control.
   - The research would survey the states to determine what is currently being used for traction control materials, and survey industry to determine what is available.
   - From the survey and literature review the research will identify and obtain various products for testing.

- The research will conduct a series of tests through the winter season to compare the effectiveness of these products. These products will be analyzed for any environmental impacts compared to traditional winter materials.
- The researcher would then compile the test data to make conclusions as to the effectiveness of these products.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The intended audience would be Clear Roads members and other interested wintertime maintenance staff.

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 would help put another tool in the belt of wintertime maintenance personnel to use as an alternative to the standard salt and brine applications. This could also be a good alternative for areas where excess salinity is a concern. Additionally, this will help departments of transportation understand the environmental impacts of these types of materials.

7) **How will you measure the success of this project?**
   Success will be measured by obtaining information needed to determine if these types of materials could be a viable alternative to traditional winter maintenance materials.

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

9) **Estimated timeline for completing the research.** 18 months

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

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2023 Synthesis Request Form

Requestor name: Randi Feltner
Organization: Kentucky TC (Group 2)

Title of proposed synthesis project: Methods for Pretreatment Using Salt Brine/Blends Prior to Rain that Leads to Snow

Topic area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
   The majority of winter weather events in Kentucky begin as rain followed by a transition to wintry mix/snow. When an event is expected to begin as rain, the current practice in Kentucky is to not pre-treat (anti-ice) with salt brine with the reason being that the brine will not be effective as it is not expected that much material will remain on the roadway surface. Questions have come recently to deliberate if that is really the case and does any residue remain on the roadway surface. KYTC also receives media inquiries prior to most winter events to address the application and methodology of brine application for anti-icing.

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

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   KYTC and other state transportation agencies will become aware of the best practices of other states that use brine/brine blends for anti-icing.

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

2023 Synthesis Request Form

Requestor name: A.J. Younes
Organization: Virginia DOT (Group 2)

Title of proposed synthesis project: Best Management Practices to Incentivize Vendor Winter Maintenance Contracts

Topic area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
   States such as Virginia and Massachusetts primarily utilize Hired Equipment Contractors for snow removal services. In recent years, the recruitment of these contractors has shrunk causing VDOT to review our terms, conditions, and incentives for our snow vendors. To retain vendors, we have had to introduce contractual tools such as minimum guaranteed payments, bonuses, and other incentives to keep vendors in the statewide Snow Removal Program. Within VDOT, individual districts have used these incentives to solve issues that other districts have but didn't know a solution existed. To overcome this, we compiled all contractual tools and incentives that our Districts used and shared it with the rest of the state. I believe something similar should occur between the Clear Roads Member States to encourage the sharing of solutions for shared problems.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   State contracting practices/language that aids in the recruiting and retention of snow removal contractors.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   The compiled contractual language will provide State DOTs with insight into the methods and approaches other states use for snow removal contracting. This resource can have a lot of value for a state that is considering contracting snow removal, or that is looking to better incentivize snow contractors.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   CR 15-03 North American Study on Contracting Snow and Ice Response
   CR 19-02 Recruitment and Retention of Highway Maintenance Workers

2023 Research Proposal Form

Proposers' names: David Gray, Scott Lucas, Steve Spoor, and Jeff Pifer
Organizations: NHDOT, OH, ID, WV DOTs (Groups 2, 3, and 5)

Title of proposed research project: Development of a Public Service Announcement (PSA) Library

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

1) **Explain the specific problem or issue to address**.
There is a lack of consistent messaging for the public concerning why and how states perform winter maintenance. Additionally, some messages are being distributed statewide regarding storms that may be specific to only one part of the state. State DOT Public Information Officers need a resource of prepared communication products that have been reviewed and approved by experienced winter maintenance managers.

2) **What is the goal of the project?**
To host a library of Clear Roads videos and prepared messaging that a state can choose from to communicate important topics to the traveling public. These communication products (PSAs) would be short "Winter Maintenance 101" style videos / messages that would be posted on the Clear Roads Winter Driving Safety website, whose audience is the traveling public and state Public Information Officers.

3) **Describe the expected products/deliverables of the research.**
Short (less than 3 minute) videos and prepared topic-specific messages that will be posted on Clear Roads Winter Driving Safety website. These communication products may be used for social media, Dynamic Message Signs, or the like. Products will cover a spectrum of winter maintenance issues that DOTs want the public to be aware of. A few specific examples may include what to know about tandem plowing; why snow is left on the road prior to freezing rain; salt effectiveness in cold weather, 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?)**
   - Industry review / survey of existing videos and other communications products. Identify gaps / determine what communication products are needed.
   - Gather content, while working closely with state Public Information Officers.
   - Development of outlines and scripts for the videos. Draft communication products.
   - Production of videos and communication products.
   - Post on the Clear Roads Winter Driving Safety website (CTC & Assoc).

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

This is to be used by the state's Public Information Officers to distribute to the traveling public via the communication avenue of their choice. This will serve two purposes as it will also draw the attention of the PIOs to Clear Roads Winter Driving Safety website if they weren't already aware.

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**.
These Standardized PSA's can be posted via states' social media accounts during winter to ensure consistent / appropriate messaging. Neighboring states could post the same message / video before a storm, which could cover commuters that travel across state lines.

7) **How will you measure the success of this project?**
Public response to posting of videos; social media data tracking.

8) **Estimated funding needed.**
Based on CR 14-03, approx. $6k of production costs per video. The budget to produce 10 videos may cost about $100k, which includes non-production costs. Adding in the cost to research / produce other communication products may add $50k. The total project budget can be flexible depending on the quality of the videos and the number of topics Clear Roads wishes to pursue. This could also be a staged release of products based on the success of the project.

9) **Estimated timeline for completing the research.** 15 months.

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Clear Roads' Ice and Snow – Take It Slow campaign.

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2023 Synthesis Request Form

Requestor name: Scott Lucas
Organization: Ohio DOT (Group 3)

Title of proposed synthesis project: Solid and Liquid Deicer Output Confirmation

Topic area (highlight one):
Planning/Methods **Equipment** Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
The amount of deicing material placed on the road is critical to snow and ice operations. If too much is applied, it is a waste of money and increases environmental concerns. Too little deicer may be a wasted effort and can slow down the road clearing process. Currently, liquid deicers pass through flow meters with internal turbines to measure the output of the system. These flow meters have internal parts which can seize up and interfere with the flow of the deicer. As for dry deicers like rock salt, there is not a process for confirming output. The use of load cell strain gages can measure the starting weight of a truck which can be compared to the weight of the truck after the material has been applied. Force America and other hydraulic systems can be calibrated to deliver a desired amount of deicer, but they do not confirm the weight of the material being dispensed. Since they do not measure output, they do not have a feedback loop to adjust the application process to ensure the proper amount is being applied.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
This synthesis will identify and gather information about equipment and / or processes to measure dry and liquid deicer application output amounts and to feed that information back into the application hydraulics. This information will come from a review of relevant literature and a survey of state practices.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
If an economical solution is discovered, it is likely ODOT will incorporate the solution. It would ensure the correct amount of deicer is placed on the roadway and when it is needed. If too little deicer is applied, more passes are required to clear the roadway. If too much deicer is applied, money is being wasted on materials and can cause environmental issues.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
Ohio DOT is currently working on a project to determine a device to measure the output of liquid deicers.

2023 Research Proposal Form

Proposer name: Tom Peters
Organization: Minnesota DOT (Group 3)

Title of proposed research project: Understanding the Performance of Various Liquid Deicing Blends

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

1) **Explain the specific problem or issue to address**.
Given various available deicing products that can be blended with salt (NaCl), it would be helpful to have guidance developed to help winter maintenance professionals be wiser with their planning and decisions regarding acquisition and application of liquid deicing blends. We need to ensure the right blend of chemicals for weather and pavement conditions, so we are efficient and cost effective when treating highways.

2) **What is the goal of the project?**
To determine the ice melting capacity of various products once combined with salt in a brine blend. This would likely include salt brine mixed with products like BEET HEET.

For example: 90% Brine/10% Beet HEET
80% Brine/20% Beet HEET
70% Brine/30% Beet HEET
60% Brine/40% Beet HEET
50% Brine/50% Beet HEET

3) **Describe the expected products/deliverables of the research.**
A set of fact sheets containing diagrams that describe the ice melting capacity, benefit-cost data, and other pertinent information related to the performance of a number of liquid deicing blends at various concentrations.

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.
   - Survey of Clear Roads states.
   - Identification of a number of representative brine blends and the concentrations to be tested. These blends would likely include BEET HEET, BEET 55 and several other more common deicing products revealed through the survey.
   - Develop a test plan to include the Mechanical Rocker Test developed by University of Nebraska and verified through Clear Roads project, CR 18-06.
   - Conduct lab testing.

- A set of fact sheets containing diagrams and other data describing the ice melting capacity of various liquid deicing blends on different pavements and through a range of temperatures. These fact sheets will also include data on the results of a benefit-cost analysis and other pertinent information.
- Final report and webinar.

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

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**.
Minimize confusion and improve decision-making regarding the purchase and application of blended salt materials.

7) **How will you measure the success of this project?**
If the final deliverables are clear and easily understood.

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

9) **Estimated timeline for completing the research.** 18 months.

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Clear Roads Project 20-02 *Understanding the NaCl Phase Diagram*
Clear Roads Project 21-03 Efficacy, Cost, and Impacts of Non-Chloride Deicers
Clear Roads Project 18-06 Standard Test Procedures for Ice Melting Capacity of Deicers

2023 Research Proposal Form

Proposer name: Cliff Spoonemore
Organization: Wyoming DOT (Group 3)

Title of proposed research project: Computer Based Training (CBT) for the Clear Roads ELDT Modules

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

1) **Explain the specific problem or issue to address**.
Currently the Clear Roads ELDT training modules are to be used by an in-person trainer. These slides can be customized for each individual agency to provide face-to-face training with that agency's equipment. Not everyone has a trainer available to provide the ELDT training for the operators that need to obtain their CLP. There are commercial vendors that provide ELDT Theory Training for the agency operator. This training is completely online and submits registration to the FMCSA database. Examples of such online training are JJ Keller and CDL Direct that sells subscriptions for training sessions.

Example of online training is the Computer-Based Training (CBT) training offered by AASHTO/SICOP on "RWIS and Anti-Icing". This training is fully interactive.

The proposed ELDT training would also have to be interactive and vary in the techniques to determine that the individual is actually learning from the online presentation. Plus, there would need to be ways to monitor quizzes and then the final exam(s) to provide documentation for course completion. That documentation would be used by the agency to upload into the FMCSA database for the individual who has completed the ELDT training.

2) **What is the goal of the project?**
Having CBT modules of the ELDT theory training would allow the hiring agency to provide online training of ELDT theory material. The individual can progress at their own pace. The agency would not have to hire an ELDT theory trainer if they don't already have a trainer assigned to this task. Completing the CBT version of the ELDT theory may make it easier for the individual to pass the DMV testing for the learners permit (CLP) for the CDL.

Then the Range and Behind the Wheel training can take place at the agency's shops/training facilities with registered BTW Trainers.

3) **Describe the expected products/deliverables of the research.**
The deliverable would be a set of CBT modules that covers all the existing sessions of the Clear Roads ELDT theory training. The deliverable would be a Master Set of modules and instructions on how to copy or break the training out so that the individual is then responsible for completing the training and supplying the test results to the agency. This will allow the ELDT administrator to input the completion of the ELDT theory into the FMCSA database.

Options for hosting this training include,

- State's IT infrastructure.
- Local Technical Assistance Programs.
- AASHTO's TC3.

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?)**
Take the existing Clear Roads ELDT modules and translate them into a CBT online training set of modules for each topic. Have quizzes, questions, responses to topics, and final module exams (80% or better for passing). Would not be able to move to the next module without passing the current module quiz. Please review the AASHTO/SICOP CBT for "RWIS and Anti-Icing" as an example. This would be a plug and play program that the individual only has to push start and does not have to have special instructions to finish the program. Programs must have intermittent "save" capabilities if the individual cannot finish a module during a single session.

The effort is to allow the individual to control the pace at which they complete the CBT training of the ELDT theory material. The individual must be able to start - save - restart - complete modules. The subject material will come from the existing curriculum of Clear Roads ELDT modules.

It would be helpful to have the following features:

- Program could "read" to the user.
- Include quiz questions throughout the modules to assist with retention.
- Include a timer on slides to ensure the user is spending the necessary time on each topic.
- The CBT program will be available on the Clear Roads website as Zip files or made available to LTAP centers or coordinate with AASHTO's TC3 program to host (similar to the RWIS CBT).

Either have documentation for each module or one final document of the ELDT theory completion to allow the registration of the test results into the FMCSA database.

There may need to be several different quizzes, questions, and exams to keep from having an individual memorize the answers for a single set of questions. Example: have 5 different sets of exam questions.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The audience is the agency's individual hire as an operator that needs ELDT theory training. This would be a plug and play system presented as a CBT program for the individual to complete the ELDT theory training. Provide documentation concerning the completion of the ELDT theory training to the agency. The agency would then upload the results for that individual into the FMCSA database so that the CLP holder can then complete their range and BTW training to pass the exam and drivers test for their CDL.

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**.
In WYDOT's case we have 2 full time trainers that conduct face-to-face training 48 weeks of the year. This week-long training is on at least 12 different pieces of equipment used by WYDOT, plus they are licensed CDL testers. The ELDT rules do not allow the trainers to

also be the testers for the final CDL exam. WYDOT tests over 50 individuals for their CDL. To allow our trainers the time to train on other equipment we cannot find the time to provide face-to-face training using the existing Clear Roads ELDT modules.

Having the CBT training modules, the individual can do self-paced training. Our shop trainers for range and BTW training could help with specific questions but not provide direct training sessions. This frees up our limited personnel and allows the ELDT material to be taught to the individual for their FMCSA registration and completion for their CDL.

7) **How will you measure the success of this project?**
If the CBT ELDT training is used before the individual takes their exam for the CLP and passes without retaking, the measure would be the percentage of first-time exam passings. Then if the individual passes the final CDL exam on the first attempt that can be measured as compared to others that have to retake the test more than once.

8) **Estimated funding needed.**
With the need for animation of the material, develop the 5 sets of questions, quizzes, and interaction questions. $100,000.

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
As stated above there are at least two vendors that are known to provide online training for the ELDT theory. They are JJ Keller and CDL Direct. A quick Google search came up with more vendors; ELDT.com, Elite ELDT. Plus, the AASHTO/SICOP CBT training modules such as the “RWIS and Anti- Icing”.

Ohio DOT has taken the Clear Roads ELDT Slide Deck and translated them using Articulate training program into a self-paced stand alone. This would be a great starting point for a PI.

Winter Operations training materials (SICOP CBT). A while back during the Covid lockdowns we moved those CBT modules over to the AASHTO TC3 platform so they could get regular care and feeding. We never followed through with the necessary links so folks could easily find the modules. Something that I will rectify shortly. Here is a link to the winter operations subgroup https://store.transportation.org/Trainings?/C_WO [Rick Nelson, PE, SICOP Coordinator] Will need to click on All Categories/ SICOP Winter Operations to gain access to the modules. The PI may need to get permission for access from Rick Nelson.

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2023 Synthesis Request Form

Requestor name: Patti Caswell
Organization: Oregon DOT (Group 4)

Title of proposed synthesis project: Synthesis of Brine-Making Practices

Topic area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
Brine making is picking up in the United States as a means for state DOTs to minimize the use of road salt by using liquid applications when/where appropriate. Brine makers have improved in automation over time and are largely hands off. Many DOTs are making their own salt brine for road applications. As more states join the cast of brine makers, it would be helpful to have an understanding of what is needed and ways the process can be improved based on lessons learned.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   - List of manufacturers that currently provide brine-making equipment and what type of equipment they offer (product sheets).
   - State practices: which DOTs are making brine, type of equipment used, ease of use, hidden or unforeseen costs, maintenance yard constraints (water, power, etc.), benefits realized (cost savings, material availability/reliability), operational and facility needs, lessons learned.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
This synthesis will provide states that are interested in brine making a good baseline understanding of the associated challenges, benefits, limitations, and range of options available.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
I'm not aware of a state scan related to brine making.

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2023 Research Proposal Form

Proposer name: Aidan Neely
Organization: Connecticut DOT (Group 4)

Title of proposed research project: Solar Radiation Benefits/Chloride Reduction Potential Associated with the Use of Vegetation Management Practices Near Roads

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

1) **Explain the specific problem or issue to address**.
Many states are experiencing push back from environmental groups, regulation, and legislation policy that conflicts with vegetation management practices near highways and clear zones. It has been argued that removing vegetation near highways can raise solar radiational benefits potentially resulting in reduction of snow bonding at the start of storms and increased melting times post storm, both potentially reducing chloride use. Quantifying these assumptions with research would help stabilize some vegetation management debates and give states scientific research to build vegetation management practices based on results of this study.

2) **What is the goal of the project?**
This project would study before and after results of roadway temperatures and chloride use to gather related data to prove or disprove the assumption that vegetation management adjacent to roads does or doesn't have a direct effect on solar radiation and potential chloride use.

3) **Describe the expected products/deliverables of the research.**
   - Quantifiable results demonstrating the relation of vegetation management to surface temperatures of roadways.
   - Guide for best practices of vegetation management as it applies to benefits in snow and ice work.

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?)**
   - Literary review of any relevant studies and works.
   - Study selected roads before and after vegetation management practices to report any benefits or changes from management. Also study chloride use in same areas to discover noticeable changes in usage.
   - Produce a guide on best practices as it relates to winter maintenance and benefits of vegetation management practices.

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

This can be implemented by all DOTs and municipalities to help build vegetation policy based on winter maintenance needs and assist environmental groups of interest and Department of Environmental protection offices in states when recommending policy.

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 would help DOTs in their vegetation management practices and policies directly.

7) **How will you measure the success of this project?**
A product is identified that meets the criteria outlined in this project.

8) **Estimated funding needed.** $100 - $125k

9) **Estimated timeline for completing the research.** 15 months

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

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2023 Research Proposal Form

Proposer name: Jeremy McGuffey
Organization: Indiana DOT (Group 4)

Title of proposed research project: Development of a Chloride Reduction Playbook

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

1) **Explain the specific problem or issue to address**.
Many states are experiencing legislation or governmental policy that is effectively meant to regulate or reduce the amount of salt used for roadway deicing. Eventually this level of regulation is expected to reach all states whether it be from a national or local directive.

2) **What is the goal of the project?**
This project would develop a playbook that provides all known and proven strategies that can be deployed to reduce salt usage.

3) **Describe the expected products/deliverables of the research.**
A Chloride Reduction Playbook, that includes tools and support for deployment including (but not limited to) cost, equipment, software, relevant research, and known deployments of the solution.

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, including international sources.
   - Survey of Clear Roads and AAHSTO Snow and Ice Listserv.
   - Gather all relevant chloride reduction strategies from the first two tasks that can be included in the playbook and categorize them by strategy.
   - Build playbook with feedback from the TAC.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
This playbook can be implemented by all DOTs regardless of their level of legislation / chloride control.

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**.
INDOT does not have any salt control measures in place by legislation or other agencies. We are seeking to get ahead of any upcoming directives by policing ourselves and creating our own strategic plan for reducing salt usage. This playbook can be used for this purpose by any state DOT or road maintenance entity.

7) **How will you measure the success of this project?**
The project is a success if the playbook is created and contains all known or relevant chloride reductions strategies and provides tools and support for each.

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

9) **Estimated timeline for completing the research.** 15 months.

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

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2023 Research Proposal Form

Proposer name: Jeremy McGuffey
Organization: Indiana DOT (Group 4)

Title of proposed research project: Development of Open-Source Artificial Intelligence to Report on Road Conditions

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

1) **Explain the specific problem or issue to address**.
   As we move to increase our capabilities and situational awareness, we can leverage technology to do things that we previously needed humans to do. Winter road condition reporting can be automated to provide management and decision makers with better situational awareness and can improve DOT response times.

2) **What is the goal of the project?**
   This project would develop an open-source artificial intelligence (AI) program that can use existing DOT data sources to predict, and map, winter road conditions. The program would use available data sources such as, RWIS, ITS cameras, and plow dash cams to assign a road condition value.

3) **Describe the expected products/deliverables of the research.**
   - Open-source AI Road Condition Program
   - Support for program deployment by users

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?)**
   - Research existing methodologies for this type of technology.
   - Determine which data sources can be used from each of the states and how those data sources need to be formatted for the open-source program.
   - Build and train the initial model.
   - Gather feedback from the TAC.
   - Build the final model.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The intended audience is any state or public entity that can provide RWIS data, ITS camera images and plow dash cams with the understanding that more data equals a better model. Users will need training on how to feed data into the model.

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**.

Indiana has nearly 30,000 lane miles. By having a model that predicts road conditions automatically, it would save us a ton of time and allow us to react to changing conditions across the state much quicker.

7) **How will you measure the success of this project?**
Development of road condition prediction program that can be deployed at any state with relative ease. This program will be built to ingest whatever data is available by that state and incorporate it into the model.

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

9) **Estimated timeline for completing the research.** 24 months.

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

2023 Research Proposal Form

Proposer name: Jeremy McGuffey
Organization: Indiana DOT (Group 4)

Title of proposed research project: Salt Dye Investigation

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

1) **Explain the specific problem or issue to address**.
Follow-up to existing research. Ex. Clear Roads 13-02 and Gerbino-Bevins 2011 (UNL) Darker colored salt has proven to absorb more sunlight in the form of heat and, in turn, is more efficient at melting ice in sunny conditions regardless of the ambient temperature.

2) **What is the goal of the project?**
The goal of this project is to determine if there are any environmentally friendly and cost-effective ways of dyeing salt and salt brine a darker color.

3) **Describe the expected products/deliverables of the research.**
At least one dark color dye product that meets our criteria for environmentally friendly and cost effective and can be used on salt / salt brine.

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?)**
   - Through a literature search and survey, researchers would identify a variety of potential products.
   - Develop a test plan.
   - Conduct testing in a controlled environment for effectiveness.
   - Evaluate and document the cost and effectiveness would be provided to the TAC for any potential products.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Intended audience would be any state DOT or public entity involved in deicing 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**.
If a product is found that meets the project criteria of environmentally friendly and cost effective, salt dyeing has the potential to significantly reduce the amount of salt states use.

7) **How will you measure the success of this project?**
A product is identified that meets the criteria outlined in this project.

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

9) **Estimated timeline for completing the research.** 18 months

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

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2023 Research Proposal Form

Proposer name: Todd Law
Organization: Vermont AOT (Group 4)

Title of proposed research project: Update to CR 14-02 Quantifying the Impact that New Capital Projects will have on Roadway Snow and Ice Control Operations

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

1) **Explain the specific problem or issue to address**.
This would be an update to the previous project to include including additional capital project types in the analysis which would be included in the tool for quantifying additional resource needs. It would also review and potentially update the tool if possible.

2) **What is the goal of the project?**
To improve upon the previous project by updating the tool and including additional capital project types into the tool to quantify additional resource needs because of the capital project.

3) **Describe the expected products/deliverables of the research.**
Updated tool which would include additional case studies to provide additional project types into the tool.

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?)**
   - Review of the previous case studies, existing tool and a survey of upcoming projects that could be included into the tool for pre- and post-field data collection to include into the updated tool.
   - Data collection.
   - Data modeling.
   - Tool update/ upgrade for new configurations and potential upgraded functionality or other improvements that might be possible.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Transportation professionals who are interested in determining the need for additional resources with the changes to configurations or additional assets that are included in capital 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**.

To ensure the tool is updated and is continued to be used, it needs to be somewhat inclusive of the configurations that are probable for roadways. It also needs to be fresh and efficient so that the audience finds value in the results from utilizing the tool.

7) **How will you measure the success of this project?**
Adding new configurations to the tool and ensuring that any updates to the tools are performed. Ultimately, the success would be that the tools is or continues to be used frequently for a determination of additional resource needs due to capital projects.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
No, this is an update to the previous project CR14-02 completed in 2017.

2023 Research Proposal Form

Proposer name: Patti Caswell and Justin Droste
Organization: Oregon and Michigan DOTs (Groups 1 and 4)

Title of proposed research project: Alternative Sources for Brine and Brine-Making

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

1) **Explain the specific problem or issue to address**.
Brine making is picking up in the United States as a means for states to minimize the use of road salt by using liquid applications when/where appropriate. Brine makers basically take clean, drinking water and add salt to reach the appropriate concentration for road applications. Other materials may be added to the salt brine as it is loaded into the application truck, such as corrosion inhibitors. Some states have looked at and may be successfully reusing wastewater, which requires permitting to determine that the waste has a beneficial use. Many state DOTs get inquiries from various manufacturers to use their waste stream including cheese, pickle, and vodka manufacturers, to name a few. Still other sources could include mineral well brine (naturally occurring), oil well brine (byproduct of fracking industry), and reclaimed truck wash water. The concern is that these water sources may contain various elements and potential pollutants that may require treatment in order to meet state specifications or specifications for the Clear Roads Qualified Products List. Water that has sediment may clog filters and result in increased maintenance of brine makers.

2) **What is the goal of the project?**
Identify various recycled or alternative water sources for use in brine-making and determine their feasibility of use.

3) **Describe the expected products/deliverables of the research.**
A report that provides a comprehensive description of the various potential sources of water for brine-making and the pros and cons of reuse (e.g., source is great, but it stinks!), constraints, foreseen or unanticipated costs associated with reuse such as analytical testing, additional processes that 'clean' the wastewater, any state or federal regulations that apply. Might include looking at case studies of any states that successfully (or that tried but were unsuccessful and why) reuse water for brine making and how they accomplished their goals.

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?)**
    - Draft and final summary of literature review of alternative brine sources including the use of mineral wells and using recycled water sources to make salt brine for road applications.
    - Draft and final survey questions to send to states to find out if anyone is using alternative sources for brine or using recycled water for salt brine making.

- Draft and final survey results including potential brine sources of water for making brine.
- Identification of different brine sources and water sources for brine making.
- Case studies [potential] and/or analysis including benefit-cost analysis, potential pollutants, consistency of source, treatment needs, etc.
- Draft and final project report.
- Final webinar presentation.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The intended audience is any DOT or municipality interested in, or that implements, brine making. It would also be beneficial for the manufacturing or other industry who may wish to reuse process wastewater or alternative water sources.

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**.
Inform states of opportunity to recycle or reuse water or identify alternative water sources for brine making. Could help states respond to questions about recycling or reusing certain water sources (thank you for your input; we've looked into that, and it isn't feasible due to ….).

7) **How will you measure the success of this project?**
Good information is generated by the literature review, survey of states, and case studies (if any), to share with states. State DOTs are more informed about the potential pros and cons of using recycled or alternative water sources for brine making.

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

9) **Estimated timeline for completing the research.** 12 months

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

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2023 Synthesis Request Form

Requestor name: Dan Varilek
Organization: South Dakota DOT (Group 5)

Title of proposed synthesis project: Investigation of Non-Destructive De-Icing Chemicals for Preservation of Concrete Bridge Decks

Topic area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1. **Explain the specific problem or issue to address**.
   It is common practice in South Dakota to utilize chlorides to remove ice from roads and bridges. Chlorides work by lowering the freezing point of the surface. For example, ice that would normally form and create a driving hazard at 30 degrees, now, will not form until 25 degrees. While removing ice from the travel way is a necessity for safe travels, chlorides and especially chloride mixes, seep into concrete surfaces and cause damage. This is major concern for our bridge decks. Damage to the concrete deck and eventual steel corrosion reduce the life of the structure. There are alternative chemicals, which also lower the surface freezing point, without causing damage to the concrete surface.

2. **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   Solutions and best practices for use of non-chloride chemicals on concrete bridge decks.

3. **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   If alternative de-icing chemicals were used, it would increase the life of bridge decks because of reduced chloride penetration to concrete and reduced oxidization of steel rebar in bridge decks. It may also reduce the number of freeze-thaw cycles that a bridge will experience which will also preserve bridge life**.**

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

2023 Research Proposal Form

Proposer name: Mark Goldstein
Organization: MassDOT (Group 5)

Title of proposed research project: Quantifying the Economic Value of Snow and Ice Operational Success

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

1) **Explain the specific problem or issue to address**.
Snow and ice budget allocations may seem high to the layperson; however, the economic benefits of these expenditures may dwarf the outlay.

2) **What is the goal of the project?**
The goal of this project will be to compare costs associated with a state's snow and ice program to the benefits gained from those expenditures. This analysis will be applied to different regions of the U.S to demonstrate the value of Clear Roads' states' snow and ice budgets at a time when these budgets are stretched thin.

3) **Describe the expected products/deliverables of the research.**
A report documenting the benefit-cost analyses outcomes of case studies conducted within states / regions inside the Clear Roads' footprint.

   The project would develop a benefit-cost analysis approach that may provide an analysis based on cost / lane-mile and roadway classifications. Differences between regions of the U.S. could be normalized by including weather severity factors in the analysis.

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 to reveal any prior existing research.
   - Survey of Clear Roads state to determine appropriate data sources.
   - Identify states / regions to be targeted for case studies.
   - Conduct case studies.
   - Produce final report and webinar.

   Factors to consider as part of the benefit-cost analyses are snow and ice budgets / expenses, lost revenues from the failure to keep roadways in passable condition, healthcare, sanitation, and recreational impacts stemming from the failure to keep (key) roadways open during the winter season.

   A starting point for identification of case study states may be the Clear Roads Annual Survey of State Winter Maintenance Data. The results from this survey may be particularly

helpful as it includes and inventory of Clear Roads states' assets such as total, and centerline, lane miles; equipment inventories; workforce counts; summary of material application; maintenance cost associated with material, labor, equipment and total expenditures. A new feature of this survey – as of the 2021-2022 winter season – is the addition of the Average Accumulated Winter Severity Index (AWSSI) as attributed to each state. By visiting the AWSSI Tool that is hosted by Purdue University, researchers can find winter severity values for a number of locations within each state. This tool and the addition of several stations within each state was something the Clear Roads funded through projects:

CR 16-02 AWSSI Enhancements in Support of Winter Road Maintenance
CR 20-07 AWSSI Enhancements, Phase 2

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Snow and ice maintenance professionals have budgets to work with, but often are subject to the discretion of those in charge of states' fiscal oversight. The economic benefits of a fully funded snow and ice program, as well as the costs of failures to maintain highly functional programs may not be apparent to those in control of budget allocations. This research can describe the value gained from a dollar spent on a state's winter maintenance budget. This kind of information can be valuable to present to those who control budget allocations. I believe any dollar spent on snow and ice in my own state returns well over a dollar of value to the Commonwealth's citizens.

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**.
DOTs can benefit from looser purse strings once fiscal handlers are convinced that investments in snow fighting equipment, modern technologies such as road weather information systems, environmentally friendlier deicing chemicals and roadway treatment programs are worth every penny, and furthermore, provide substantial economic and ecological gains.

7) **How will you measure the success of this project?**
If the research highlights that, especially in certain regions, ensuring sufficient investment in snow and ice control programs provides benefits that exceed costs, to a point, the research will have been successful.

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

9) **Estimated timeline for completing the research.** 15 months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
I am not aware of specific prior similar research.