Clear Roads Research and Synthesis Proposals
2021

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Synthesis – Best Practices for Managing Impurities in Liquid Deicers			As liquid deicers settle in their holding tanks, sediments fall out of suspension. Whether the sediment was part of the deicers or foreign objects, materials that fall out of suspension can cause issues. They can form a layer of slime or hard pack that must be physically removed from the bottom of the tank or they can plug application filters and nozzles. This causes extra work with crews for cleanup and can cause breakdowns during snow and ice operations if the materials plug application equipment. The mixing of deicers can also cause the "fallout" of material in the application equipment or storage tanks as well. Knowing which materials will cause a fallout issue, at what concentration and at what temperature, is important.	Group 1 Scott Lucas, Ohio DOT	6
2	Synthesis – Evaluation of Electric Vehicle Technologies for Winter Operations *NOTE: This synthesis project may expand its reach to include alternative fuels as well.*			With auto industry moving to electric (GM plans to have entire electric fleet by 2040), what is the future for larger equipment including winter maintenance trucks? A better understanding of the inventory of current technologies and industry objectives for implementing electric replacement of current diesel large fleet is desired, with particular emphasis on considerations for winter maintenance environment and operations.	Group 1 Justin Droste, Michigan DOT	7
3	PSA Library	$100,000	15 months	The goal of this project is to host a library of Clear Roads videos that a state can pick from to post to their social media accounts. They would be short "Winter Maintenance 101" style videos that would be posted on the Clear Roads Winter Preparedness website, whose audience is the traveling public.	Groups 1 and 4 David Gray, New Hampshire DOT and Scott Lucas, Ohio DOT	8

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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
4	Synthesis – Dynamic Message Signs and Connected Vehicle Alert Systems			Caltrans experiences delays notifying the public of changes in road conditions/restrictions due to weather as we rely on manual sign changes at many locations. Law enforcement is limited by delays in manual sign changes. Caltrans would like to achieve public and worker safety through remotely programmed changeable electronic signage that immediately and simultaneously alerts connected vehicle operators of restrictions or conditions.	Group 1, Mark Peters, Caltrans	10
5	Calculating Plow Cycle Times from AVL Data	$100,000	18 months	The goal of this project is to develop a methodology and map-based tool and dashboard to quickly and easily calculate plow cycle times from AVL data for post-storm analysis and also view in a real-time dashboard display.	Group 2 Jamie Yount, Colorado DOT	11
6	Extendable Plow Pilot Study	$25,000 - $100,000	24 months	This project will evaluate the use of a recently developed extendable plow as an alternative to a standard right side wing plow. Identify operational applications and procedures for the extendable plow. Evaluate the current design and make design modifications as appropriate. Provide a cost benefit analysis of the extendable plow compared to: • Standard front plow • Combination front plow/wing plow	Group 2 James Morin, Washington State DOT	13

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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
7	Training Module Development for Evaluation of SSI/WSI Variables (CR 18-03)	$50,000	18 months	The goal of this project is to develop training modules and materials to address Evaluation of SSI/WSI Variables for three general audiences. While the topic is the same, the audiences require varying degrees of specificity. This material could be applied to a number of different formats. For instance, the second bullet (Manager) could be incorporated into the NHI Leadership training curriculum as part of their snow and ice topic coverage. The third bullet (Supervisor) could be incorporated into the APWA Supervisor Training program. Both of these could be incorporated into TC-3. Ideally, we would include representatives from NHI and APWA and TC-3 in this effort. • Division Director/Manager • Snow and Ice Manager (state or local) • Supervisor	Group 2 James Morin, Washington State DOT	15
8	Friction Data Use in Winter Maintenance Programs	$50,000 - $70,000	18 months	This project will investigate the current state of friction data use in the snow and ice industry in the US and other countries. The research team would evaluate the use, develop case studies and recommendations and best practices for the use of friction data for winter maintenance operations in the United States.	Group 2 James Morin, Washington State DOT	17
9	Evaluation of Most Effective DOT Vehicle Lighting	$125,000	18 months	The goal of this project is to determine the most effective (visibility, conspicuity) colors and configurations of vehicle safety lighting for DOT vehicles.	Group 2 Jeff Pifer, West Virginia DOT	19
10	Create a QPL for Carbide Plow Blades	$75,000	12 months	This project will provide a list of quality assured and quality controlled vendor products for carbide plow blades. In the future, the same guidance will be applied for new blade types or high performance blades.	Group 2 Cliff Spoonemore, Wyoming DOT	21

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
11	Using Rear-facing Radar to Avoid Collisions with Motoring Public	$175,000	24 months	The goal of this project is to reduce snow plow rear end crashes. A system that would potentially alert the driver of the vehicle behind the plow, and the plow operator, to the approaching vehicle. With better notification methods, rear end collisions should be reduced or even eliminated.	Group 2 Cliff Spoonemore, Wyoming DOT	23
12	Grip Sensor Technology and Salt Applications	$150,000	18 months	This project will develop a program/matrix that can ingest road data from mobile grip sensors and to utilize that data in real-time for plow drivers along with recommendations. Recommendations would also be based off of the precipitation type, black Ice, freezing rain, light, medium and heavy snow, temps.	Group 3 Kevin Duby, Arizona DOT	26
13	Determining Best Practices for the Management of Fuels for Winter Maintenance Equipment	$80,000	15 months	The goal of this project is to determine the best methods of sampling and testing fuel for winter use. To determine how to troubleshoot fuel issues in trucks and in storage tanks. To test different methods of maintaining tanks so the fuel we put in them does not degrade.	Group 3 Clay Adams, Kansas DOT	28
14	Update to CR 13-04: Best Practices for Protecting DOT Equipment from the Corrosive Effect of Chemical Deicers	$50,000	12 months	This project would update the section of Chapter 5.4 of the guidance document with a comparison of the many coatings available to provide resistance to corrosion due to salt and other chemicals used in snow and ice control.	Group 3 Todd Law, Vermont Agency of Transportation	30
15	Update to CR 14-02: Quantifying the Impact that New Capital Projects will have on Roadway Snow and Ice Control Operations	$100,000	24 months	This project would 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.	Group 3 Todd Law, Vermont Agency of Transportation	32

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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
16	Determining the Migration of Chloride-based Deicers through Different Soil Types Adjacent to Chloride-treated Roadways	$100,000	18 months	The goal of this project is to determine the migration of chlorides in different soil types used by most of the Clear Roads states. The research should include no more than three different chloride-based deicers, a lab-based study to assess how chlorides migrate through different surface and subsurface materials commonly found in Clear Roads states.	Group 4 Aidan Neely, Connecticut DOT	34
17	Synthesis – Plowing Coordination between Jurisdictions			Many times when traveling between States, districts, and maintenance sheds, there is a drastic difference in road conditions during a storm. Due to the difference in time when roads are plowed or treated between sections this can cause safety issues to the public. When the neighboring sheds, districts, or states do not coordinate plow and treatment plans road surfaces can go from black and wet to snow covered with several inches at the lines of treatment areas.	Group 4, David Gray, New Hampshire DOT	36
18	OGFC vs HMA and Winter Performance Metrics	$125,000	18 months	This project will compare roadway surface performance parameters (i.e., grip, surface condition) under similar deicing treatment regimens performed on adjacent installations of OGFC and hot-mix asphalt (HMA) pavements.	Group 5 Mark Goldstein, Massachusetts DOT	37
19	Snow Plow Blade Cutting Edge Videos	$50,000	12 months	This project is about education. The goal of the project is to allow people to easily understand what's available on the market, what it is intended to do, and what some of the trade-offs might be.	Group 5 Brian Burne, Maine DOT	39
20	The Efficacy and Environmental Impact of Non-Chloride Deicers	$100,000	18 months	The goal of this project is to identify as many non-chloride-based deicers and determine their efficacy for winter snow and icer removal operations. Additionally, research and testing should be done to determine the environmental risks.	Group 5 Doug McBroom, Montana DOT	41

2021 Synthesis Request Form

Requestor name: Scott Lucas
Organization: Ohio DOT; Group 1

Title of proposed synthesis project: Best Practices for Managing Impurities in Liquid Deicers

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

1) **Explain the specific problem or issue to address**.
As liquid deicers settle in their holding tanks, sediments fall out of suspension. Whether the sediment was part of the deicers or foreign objects, materials that fall out of suspension can cause issues. They can form a layer of slime or hard pack that must be physically removed from the bottom of the tank or they can plug application filters and nozzles. This causes extra work with crews for cleanup and can cause breakdowns during snow and ice operations if the materials plug application equipment. The mixing of deicers can also cause the "fallout" of material in the application equipment or storage tanks as well. Knowing which materials will cause a fallout issue, at what concentration and at what temperature, is important.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
The synthesis will collect information from Clear Roads states and beyond the membership, if possible. If states have issues with sediment or fallout, how do they prevent the issues from turning into operations problems? Do they prevent the sediment through strict specifications; do they use filtration; do they cycle the material in their tanks on a regular basis to keep the materials in suspension; do they only use "clean" salt to make their brine? This synthesis will also gather information from state DOTs on reactions they have had with mixing deicers and information from manufactures on how to prevent negative chemical reactions that will cause fallout.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
The information will be shared with other states that deal with sediment and fallout issues in their deicers and describe how others have filtered sediment, prevented sediment build up, or dealt with the effects of fallout when blending deicers.

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

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2021 Synthesis Request Form

Requestor name: Justin Droste
Organization: Michigan DOT, Group 1

Title of proposed synthesis project: Evaluation of Electric Vehicle Technologies for Winter Operations
***NOTE: This synthesis project may expand its reach to include alternative fuels as well.*

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

1) **Explain the specific problem or issue to address**.
With auto industry moving to electric (GM plans to have entire electric fleet by 2040), what is the future for larger equipment including winter maintenance trucks? A better understanding of the inventory of current technologies and industry objectives for implementing electric replacement of current diesel large fleet is desired, with particular emphasis on considerations for winter maintenance environment and operations.

[FUTURE PROJECT]
Planning tool to evaluate costs/benefits of replacing traditional diesel with electric vehicles.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
This synthesis seeks a better understanding of the items industry will need to consider for conversion of winter fleet from diesel to electric. This may include…
   - Considerations for exposure of electrical components to extreme weather and snow and ice control chemicals.
   - Considerations for garage facilities to adapt for electric vehicles and charging stations.
   - Mechanic training needed to maintain electric fleet.
   - Environmental Impacts (carbon footprint of current diesel vs electric).
   - How long can batteries support operations, and down time for charging?

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
Information gathered will help agencies evaluate the feasibility of converting diesel to electric fleets for winter operations.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
There is some research in this area, though not focused on winter maintenance concerns.

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2021 Research Proposal Form

Proposers' names: David Gray and Scott Lucas
Organizations: NHDOT and OHDOT; Groups 1 and 4.

Title of proposed research project: 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. Part of this issue is that there is difficulty with statewide distribution of information on storms that may be specific to only one part of state.

2) **What is the goal of the project?**
To host a library of Clear Roads videos that a state can pick from to post to their social media accounts. They would be short "Winter Maintenance 101" style videos that would be posted on the Clear Roads Winter Preparedness website, whose audience is the traveling public.

3) **Describe the expected products/deliverables of the research.**
Short (30 second to 3 minute) videos that will be posted on Clear Road website that will describe items such as 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 what videos exist and need to be created.
   - Gathering content.
   - Development of outlines and scripts.
   - Production of videos.
   - Post on the Winter Preparedness website.

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

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
These Standardized PSA's can be posted via states' social media accounts during winter to ensure consistent 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 for the production of 10 videos may cost about $100k, which includes non-production costs.

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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2021 Synthesis Request Form

Requestor name: Mark Peters
Organization: Caltrans, Group 1

Title of proposed synthesis project: Dynamic Message Signs and Connected Vehicle Alert Systems

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

1) **Explain the specific problem or issue to address**.
Caltrans experiences delays notifying the public of changes in road conditions/restrictions due to weather as we rely on manual sign changes at many locations. Law enforcement is limited by delays in manual sign changes. Caltrans would like to achieve public and worker safety through remotely programmed changeable electronic signage that immediately and simultaneously alerts connected vehicle operators of restrictions or conditions.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
- Inventory of the changeable electronic sign manufacturers and their products. Focus on equipment capable of V2I communications.
- Electronic sign features and capabilities.
    - Particular emphasis placed on communication between the vehicles and signage (V2I).
- How have states used these signs to warn the traveling public of roadway conditions, especially through connected vehicle technology?
    - What are the successes / challenges experienced? Best practices?
- What are the costs and considerations to be aware of when implementing this type of technology?

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
The public users would be made aware of messages pertaining to the roadway conditions or restrictions in real time as conditions/restrictions change. It would create a safer roadway for both the public and DOT workers through awareness of conditions.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
Caltrans may take on a pilot project in this area.

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2021 Research Proposal Form

Proposer name: Jamie Yount
Organization: Colorado DOT, Group 2

Title of proposed research project: Calculating Plow Cycle Times from AVL Data

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

1) **Explain the specific problem or issue to address**.
How often does a snowplow cycle through a given point on a highway? This is a subjective question that changes based on weather and road conditions but a long term average of this data could be an interesting and useful metric for snow and ice performance evaluation, route optimization, and resource allocation.

2) **What is the goal of the project?**
The goal of this project is to develop a methodology and map-based tool and dashboard to quickly and easily calculate plow cycle times from AVL data for post-storm analysis and also view in a real-time dashboard display.

3) **Describe the expected products/deliverables of the research.**
This project would deliver a tool that can be used by mangers to calculate plow cycle time for a geographic point on a route for a user-defined time period. This tool would be a map-based product and be available online. This tool would also have a dashboard-type functionality for real-time plow cycle time information for user-defined routes or geographic points.

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?)**
   - Develop a user story to capture information to be included in real-time dashboard and post-storm analysis application development.
   - Develop a methodology to collect, compile, and process plow AVL data. This task would also develop a methodology to determine plow cycle times on multi-lane roads.
   - Develop a web-based map user interface/tool. This interface would have a real-time dashboard and post-storm analysis capabilities.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Transportation managers that track snow and ice performance metrics and goals. Training would be required on the functionality and use of this tool.

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**.
How often does a plow cycle through a route and how does that change with traffic volume, precipitation intensity, and storm duration? Having an answer to these questions would help CDOT with resource allocation and should help answer lingering questions about snow and ice removal on several key stretches of highways that frequently close during storm events.

7) **How will you measure the success of this project?**
This project will be successful if it accomplishes one or all of the following.
    - Is this a useful metric?
    - Can these cycle times can be reliably calculated and displayed in near real-time?
    - Develop a methodology to determine plow cycle times on multi-lane roads.
    - Develop a user interface that displays this data in a useful and meaningful way.

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

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.**
I am not aware of anything related to this proposal.

2021 Research Proposal Form

Proposer name: James Morin
Organization: Washington State DOT, Group 2

Title of proposed research project: Extendable Plow Pilot Study

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

1) **Explain the specific problem or issue to address**.
WA State has approximately 100 wing plows in active use across the state. While wings provide an important multiplier to the standard front plow, this does come with certain challenges. These challenges include reduced visibility for the operator, high initial cost, propensity for damage as a result of plow strikes on stationary objects and, on occasion, tort liability associated with a several plow vs vehicle incidents. It is proposed that the extendable plow may not have some of these liabilities along with a lower lifecycle cost.

2) **What is the goal of the project?**
Evaluate the use of a recently developed extendable plow as an alternative to a standard right side wing plow. Identify operational applications and procedures for the extendable plow. Evaluate the current design and make design modifications as appropriate. Provide a cost benefit analysis of the extendable plow compared to:
   - Standard front plow
   - Combination front plow/wing plow

3) **Describe the expected products/deliverables of the research.**
A thorough evaluation of the concept with detailed operational recommendations, design improvements and cost benefit analysis. Ultimately this project would provide a potential user with enough information that they can judge the value and location where this technology would be likely to be successful in their fleet.

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?)**
   - Evaluation of existing prototype based on operator and mechanic feedback.
   - Construction of new extendable plows incorporating lessons learned from prototype.
   - Installation and evaluation of extendable plows over a two-year timeframe in a variety of settings including urban, rural, mountain, dry snow, wet snow, two lane, four lane and high/low traffic volumes.
   - Conduct the cost-benefit analysis.
   - Develop operational procedures and recommendations based on operator and mechanic interviews.
   - Final report and webinar.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The audience for this project would initially be Clear Roads states. This information would be of interest to cities and county operations as well.

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 benefit of this tool would likely be reduced initial cost, reduced operational cost, improved safety for operators, reduced tort liability as well as other ancillary benefits such as reduced stress on drivers and reduce vehicle size.

7) **How will you measure the success of this project?**
Success of this project is not so much in positive findings related to this tool as much as a thorough real-world evaluation. Certainly, a finding of a positive cost benefit analysis and a broad operational range is hopeful but isn't necessarily the only measure of success.

8) **Estimated funding needed.**
WSDOT received $53,500 to conduct a pilot on two trucks in WA State. Additional support of approximately **$25,000** would allow for conducting the cost benefit analysis and performing the evaluation. If we wanted to add additional plows in other states to this evaluation, the cost would be approximately $30k per truck plus evaluation/documentation time…so maybe 50k total. So depending on what we want to do, the cost would be $25-100k.

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.**
Not at this time.

2021 Research Proposal Form

Proposer name: James Morin
Organization: Washington State DOT, Group 2

Title of proposed research project: Training Module Development for Evaluation of SSI/WSI Variables (CR 18-03)

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

1) **Explain the specific problem or issue to address**.
Clear Roads project 18-03 Evaluation of Storm Severity Index and Winter Severity Index Variables was completed in December of 2020. The final report represents the most comprehensive work on this complicated topic and was very informative. The report is, however, rather lengthy and complex. The complexity and size of the report present a hurdle to managers' and practitioners' ability to understand and apply these findings to their operations. This topic is very important and is increasingly a topic of concern amongst snow and ice managers as they attempt to develop accurate level of service measurements. There is a need to disseminate this data to high level transportation directors, snow and ice managers, and supervisors alike.

2) **What is the goal of the project?**
The goal of this project is to develop training modules and materials to address this topic for three general audiences. While the topic is the same, the audiences require varying degrees of specificity. This material could be applied to a number of different formats. For instance, the second bullet (Manager) could be incorporated into the NHI Leadership training curriculum as part of their snow and ice topic coverage. The third bullet (Supervisor) could be incorporated into the APWA Supervisor Training program. Both of these could be incorporated into TC-3. Ideally, we would include representatives from NHI and APWA and TC-3 in this effort.
    - Division Director/Manager
    - Snow and Ice Manager (state or local)
    - Supervisor

3) **Describe the expected products/deliverables of the research.**
Detailed training modules that synthesize the material in CR18-03 into 30-60 min segments targeting the three audiences. These materials would include audio/visual material, discussion topics, and interactive exercises required to provide complete training on this topic.
    a) **Division Director**- Develop a module that could be completed in 30 minutes that would be interactive and self-directed for a high-level manager. It would incorporate short video clips and audio/visual material, reference material, and demonstrate the use of the tool.
    b) **Snow and Ice Manager**- Develop a module that could be completed in 60 minutes that would be suitable for a TC-3 type class. This would include audio/visual material and be incorporated into the TC-3 format but also be adaptable to the NHI training format with pre-study material as well as the 60 minute in-person format.

c) **Supervisor-** Develop a 30 minute module that could be incorporated into the existing APWA Supervisor training program. This would include development of audio/visual material focused on a practical, operations level needs.

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 audience specific needs for training.
   - Identify training venues where this material would be used.
   - Coordinate with representatives of these groups (TC-3, NHI, APWA) to ensure that the information fits into their curriculum and achieves appropriate learning objectives.
   - Develop materials including short videos, audio and visual materials.
   - Test curriculum with targeted audiences.
   - Transfer materials to CR and appropriate groups.

5) **Who is the intended audience for the products/deliverables?**
   State, County, City and Airport leaders that are responsible for snow and ice control within their jurisdictions at a variety of levels.

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**.
   Provide training on this topic in order to help individuals select the appropriate tool for their jurisdiction. Ultimately understanding WSI as it relates to the specific jurisdiction is an important tool to help manage staffing levels and budget allocation.

7) **How will you measure the success of this project?**
   By the number of venues that incorporate this material into their training programs.

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

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.**
    CR 18-03

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: James Morin
Organization: Washington State DOT, Group 2

Title of proposed research project: Friction Data Use in Winter Maintenance Programs

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

1) **Explain the specific problem or issue to address.**
Over 20 years ago, friction data was identified as a potential method to assess winter road condition and was anticipated for use as a performance metric for winter maintenance operations. Yet, while this method has taken off in Scandinavian countries, at this time, only a few state departments of transportation (DOTs) have actively documented their incorporation of friction data into winter maintenance operations and performance metrics (Idaho Transportation Department, Colorado DOT). In 2009, Zein provided an assessment of friction data use in Canada and internationally, in which many US state DOTs indicated they were interested in using friction data in winter maintenance operations. In the 12 years since Zein (2009) was published, there have been significant advancements in friction sensor technologies including both mobile and stationary sensors, have improved reliability (or accuracy) of friction data, and have become increasingly available and more cost effective.

Due to these changes and the amount of time that has passed since this topic was reviewed, there is a need to reassess the use of friction data in winter maintenance operations.

2) **What is the goal of the project?**
Investigate current state of friction data use in the snow and ice industry in the US and other countries. The research team would evaluate the use, develop case studies and recommendations and best practices for the use of friction data for winter maintenance operations in the United States.

3) **Describe the expected products/deliverables of the research.**
   a) Synthesis on current use
   b) A set of case studies where friction is being used
   c) Identify benefits that can be realized through the use of this technology
   d) Recommendations and best practices for the use of friction devices in Clear Roads states

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

- Complete a literature review that will be used to identify states and countries that use/have used friction data in winter maintenance operations and performance metrics.
- Perform an extensive survey that reports on level of use of friction data in US states and other countries.
- Hold follow up interviews to capture additional information on methods used to incorporate friction into winter maintenance operations.
- Use information gathered in previous tasks to develop a set of case studies.
- Provide recommendations and best practices on how to incorporate friction data into winter maintenance operations.

5) **Who is the intended audience for the products/deliverables?**
State, County, City and Airport leaders that are responsible for snow and ice control within their jurisdictions.

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 synthesis and recommendations would identify the benefits and procedures for incorporating this technology into current operations. Some of the expected benefits would be improving LOS measurements, improving response to adverse road conditions, improved road hazard weather notification and better management of snow and ice contracts.

7) **How will you measure the success of this project?**
Use of the data over time.

8) **Estimated funding needed. $**50-75,000

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

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Jeff Pifer
Organization: West Virginia DOH

Title of proposed research project: Evaluation of Most Effective DOT Vehicle Lighting

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

1) **Explain the specific problem or issue to address**.
What are the most effective colors and configurations of vehicle safety lighting for DOT vehicles?

2) **What is the goal of the project?**
To determine the most effective (visibility, conspicuity) colors and configurations of vehicle safety lighting for DOT vehicles.

3) **Describe the expected products/deliverables of the research.**
A detailed report of findings including a quick reference chart of effectiveness of colors and configurations covered in the study.

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 past studies
   - Review current best practices
   - Research and experimentation
   - Analysis
   - Final report of findings with presentation.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
All DOT agencies utilizing maintenance equipment on roads and highways. Would allow agencies to make educated decisions on how to specify maintenance fleet equipment safety lighting.

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**.
Will give fleet managers the information necessary to make educated decisions about safety lighting packages as well as provide hard facts to use in educating and convincing management, legislature, and the public of the benefits of best colors and configurations.

7) **How will you measure the success of this project?**
If a sound conclusion can be reached providing the foundation of a best lighting package standard.

8) **Estimated funding needed.** $125,000.00

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 16-S3.
- AASHTO MAC (EMTSP) might be a resource.

2021 Research Proposal Form

Proposer name: Cliff Spoonemore
Organization: Wyoming DOT, Group 2

Title of proposed research project: Create a QPL for Carbide Plow Blades

Within Clear Roads, there is an effort to be a one-stop shop for all items concerning snow and ice control. Clear Roads has the Qualified Products List (QPL) for deicing chemicals and their specifications.

Clear Roads has now created a specification for carbide plow blades. The next step is to create a list of carbide plow blades that meets these specifications. This project would set up a process in which vendors can submit independent lab testing results that follow the developed specification. This list would follow a similar format as the current QPL for deicing chemicals, but would also expandable to include newer blade configurations and types of blades.

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

1) **Explain the specific problem or issue to address**.
   All vendors for carbide blades claim their blades are the best. Creation of a Carbide Plow Blade QPL will ensure they have met the minimum requirements for acceptable use by Clear Roads states. This will help each state in their open bid process. If they use the NASPO or other approved unit bid prices they can ask the vendor to be on the Carbide Plow Blade QPL.

   This may take some time as the National Association of State Procurement Officials unit bid price is not set on a yearly basis. The next time this bid is conducted, they can require that the vendors be on the Carbide Plow Blade QPL.

2) **What is the goal of the project?**
   To provide a list of quality assured and quality controlled vendor products for carbide plow blades. In the future, the same guidance will be applied for new blade types or high performance blades.

3) **Describe the expected products/deliverables of the research.**
   A comprehensive list of vendors and their carbide plow blade products that meet the minimum requirements of the Clear Roads specification for carbide plow blades.

4) **List the specific research tasks that would form the scope of work, i.e.. What steps will the researcher need to take to develop the deliverables?**
   - Review existing research on this topic.
   - Incorporate the specification written in Clear Roads projects 17-02 and 07-01.

- Formulate the process for receiving data, test results, and approval to be added or removed from the Carbide Plow Blade QPL.
- Make recommendations as to how and who will evaluate, maintain, and update this technology. Is it by committee, and what information is required to evaluate a requested product for inclusion on the QPL?

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 city, county, municipality, and state agency that desires to purchase QC/QA vendor-approved carbide 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**.
Using the Carbide Plow Blade QPL will allow any agency to reference this QPL for their bid process. They will know that the products that are presented for bid meet a standard desired by the state of practice.

7) **How will you measure the success of this project?**
The measurement will be the accumulation of approved vendors and products that meet the Clear Roads carbide plow blade specifications defined in Clear Roads project 17-02.

8) Estimated funding needed. $75,000 (This may be high, as they are not providing testing. Only the process in which a vendor must pass through to be accepted on the Carbide Plow Blade QPL.)

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.**
Only the existing Clear Roads QPL for deicing chemicals.

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Cliff Spoonemore
Organization: Wyoming DOT, Group 2

Title of proposed research project: Using Rear-facing Radar to Avoid Collisions with Motoring Public

The potential idea is to have technology that will activate if a vehicle enters within a designated distance behind the plow. Once a vehicle is within this designated area, the LED lights would become larger than the normal lights on the back of the sander. They would also become brighter. If this did not alert the vehicle behind the plow, and it continued to get closer, a warning light would alert the plow operator a rear facing air horn would sound. The plow operator could then raise the plow, and hopefully, significantly reduce or eliminate the snow cloud behind the plow. This action would allow the oncoming vehicle to see the plow and avoid a collision.

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

1) **Explain the specific problem or issue**.
   Public driving into a snow cloud, not realizing they are following too close to the plow, and hitting the backend of the operating truck.

2) **What is the goal of the project?**
   Reduce snow plow rear end crashes.

3) **Describe the expected products/deliverables of the research?**
   A system that would potentially alert the driver of the vehicle behind the plow, and the plow operator, to the approaching vehicle. With better notification methods, rear end collisions should be reduced or even eliminated.

4) **List the specific research tasks that would form the scope of work, i.e.. What steps will the researcher need to take to develop the deliverables?**
   - Review existing research on this topic.
   - Review available technology and its effectiveness. Is there existing Radar that can be used effectively to reduce rear end collisions?
   - Survey DOTs regarding similar operational technology.
   - Field testing:
     - Determine the effectiveness of distance measurements by radar to allow the operator or the approaching vehicle to avoid a crash. What steps can be taken at each distance milestone.
     - Determine best radar setup for both tilt beds and those with mechanical V-box spreaders. Consider the effects of radar reflecting off of the salt or sand being dispensed by the operation.
   - Determine the cost of purchasing, installing, and training the operator in this technology.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Plow operators and the traveling public. Create a list of either actions that the system will trigger or cause action by the operator, such as a vehicle approaches from the rear and once it is 2000 ft away, the lights become brighter. Then once it is 1000 ft away, the warning light is activated inside the cab and the operator raises the plow. This should provide some time for the cloud to clear the back end. This research will also need to determine the distances for any action recommended by either the system or the operator. Plow operators would need to know how to calibrate the equipment, inspect it to make sure it is working properly, and actions that need to be taken once a vehicle activates the warning light.

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**.
Reducing rear-end crashes could reduce injuries and damage to vehicles. Keep plow trucks in operation. Plow trucks not taken out of service due to collisions will help keep the roads clear of snow and ice, therefore, reducing collisions and delays due to winter conditions.

The PI will also need to compare costs to DOT vehicles and down time, man-hours lost vs. installation and operation of a protection system. One lost truck at $100,000+ can buy a few protective systems.

7) **How will you measure the success of this project?**
Reduce rear-end collisions. Use cost history to repair rear-end collisions to establish a baseline for individual DOTs, then monitor future repairs and evaluate the cause of those crashes. DOTs have a count for the number of crashes per year. After installation of the protective devices, the DOT can track the number of hits to see if the number declines. The operators can track the number of times they have to lift the plow because of the warning light inside the cab.

8) Estimated funding needed. $175,000 **(**for purchase protective system(s) and research time)

9) **Estimated timeline for completing the research.** 24 months (to cover two winters of testing)

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

The only item I'm aware of is Alaska DOT dash heads-up display of accurate GPS in whiteout conditions.

MnDOT is doing research with Univ of Minn, Dr Max Donath, on front facing radar and collision avoidance. After a conference call he is not convinced that CR can come up with a solution. He states that radar will work in whiteout conditions but LIDAR will not. His research has proven this. His studies also have issues with tilt beds and placing the radar unit. Dr Donath is a great resource and we might be able to ask for his assistance in reviewing our project. Side note he will not submit a proposal with no assurance of granting the research to Univ Minn. I take this to mean we could have success with this project.

There may have been discussion during a CR meeting that equipment is available to detect heat signatures in front of a plow, allowing them to either move over or adjust the front plow to avoid a buried vehicle.

A quick collision avoidance system search on the internet produced several results for front-end and rear-end braking needs. Maybe some of these systems can be modified for this situation. Most of the systems are Forward Collision Warning (FCW) that warns the faster approaching vehicle that a slower vehicle is ahead of them, and warns the driver with the FCW vehicle.

Maybe FCW can be modified to work the other way, by detecting a faster moving vehicle from the rear and warn the slower vehicle in the front.

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Kevin Duby
Organization: Arizona DOT

Title of proposed research project: Grip Sensor Technology and Salt Applications

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

1) **Explain the specific problem or issue to address**.
As technology grows, so will be the opportunities that come with those technologies. One of those technologies is now being used to measure grip/friction during snow and ice events. Some states are currently utilizing friction measurements on their plows. A recommendation treatment plan and matrix based to include grip would be desirable.

2) **What is the goal of the project?**
Develop a program/ matrix that can ingest road data from mobile grip sensors and to utilize that data in real-time for plow drivers along with recommendations. Recommendations would also be based off of the precipitation type, black Ice, freezing rain, light, medium and heavy snow, temps.

3) **Describe the expected products/deliverables of the research.**
   - Develop a recommendation of treatments based off real-time conditions and current mobile friction/grip state along the roadway based on current state of weather event
   - Testing and verification of sensor data
   - Conduct a scan of other agencies to determine how they are using 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?)**
   - Literature search / industry review
   - Survey of CR states
   - Develop testing plan
     - Understand the different grip mobile sensors
     - Understanding the salt diagram, temp and salt efficiency at temps, winds, dew points, etc. (See CR 20-02)
     - Spreader rates or material type being used
     - Cycle times
     - Speeds of the plow
   - Field testing
   - Develop set of recommendations
   - Final report and webinar

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 current road state, which in turn will enable the staff to apply appropriate actions to the road ways. This could have the potential benefit of salt reduction cost, increased LOS and reduced waste in general

7) **How will you measure the success of this project?**
The success will be measured by the accuracy of the applications recommendation in real-time and development of a matrix based on grip values, temps, wind and dew points.

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

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.**
- CR 16-03 looked at the Luft and other devices. We'd need to consider various different sensors to provide the friction data.
- Aurora sponsored project (No. 2020-04)

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Clay Adams
Organization: Kansas DOT, Group 3

Title of proposed research project: Determining Best Practices for the Management of Fuels for Winter Maintenance Equipment

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

1) **Explain the specific problem or issue to address**.
Winter fuel issues can create serious problems during a winter storm event due to frozen pumps and clogged filters at the engine. This can cause plow trucks to be unavailable when they are most needed to clear and treat highways. The problems range from quality of fuel; specifications used; best management practices on sampling, testing, storage, and maintaining clean storage tanks; filters at pumps, Diesel Emission Fluid issues; and Bio-Diesel issues. Basically, all things fuel to keep our trucks running in the winter.

2) **What is the goal of the project?**
To determine the best methods of sampling and testing fuel for winter use. To determine how to troubleshoot fuel issues in trucks and in storage tanks. To test different methods of maintaining tanks so the fuel we put in them does not degrade.

3) **Describe the expected products/deliverables of the research.**
A manual on how to best manage your winter fuel supply from the point of purchase to the point of combustion in your diesel engine.

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 Search
   - Survey
   - Follow Up Interviews
   - Manual Development
   - Final Report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
All State DOT Equipment sections that are involved with winter fuel purchases and or usage.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Improved reliability of winter fuel will enhance our snow and ice operations by making our equipment more reliable and reduce down time due to fuel problems at the engine level. For

those states whose Dept. of Administration (Division of Equipment) control fuel purchases, it may help.

7) **How will you measure the success of this project?**
New information and ideas on how to manage winter fuel.

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

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.**
Bell Performance: https://www.bellperformance.com/commercial-resources
National Biodiesel Board: https://www.biodiesel.org/using-biodiesel/handling-use/cold-weather-guide
Trucking Info: https://www.truckinginfo.com/156490/everything-in-moderation-including-additives
Government Fleet: https://www.government-fleet.com/157049/how-to-maintain-stored-diesel-fuel

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Todd Law
Organization: Vermont AOT, Group 3

Title of proposed research project: Update to CR 13-04: Best Practices for Protecting DOT Equipment from the Corrosive Effect of Chemical Deicers

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 Clear Roads Project 13-04 which will focus on the use of new and improved coatings and their effectiveness in providing corrosion resistance on winter maintenance equipment from the effects of chemical deicers.

2) **What is the goal of the project?**
To update the section of Chapter 5.4 of the guidance document with a comparison of the many coatings available to provide resistance to corrosion due to salt and other chemicals used in snow and ice control.

3) **Describe the expected products/deliverables of the research.**
Comparison of the effectiveness of the coatings to protect our valuable equipment.

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 project, determine if there have been updates/ improvements to the coatings on the list and to see if there are other coatings available to evaluate their effectiveness to prevent corrosion.
   - Data collection.
   - Data modeling.
   - Update to Chapter 5.4 of Clear Roads project 13-04.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Transportation professionals/ fleet maintenance managers who are interested in protecting the winter maintenance fleet from additional corrosion due to the chemical deicers used for roadway snow and ice 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**.
It will preserve one of our most important assets with the exception of our employees and extend the life expectancy and reduce the amount of corrosion in our equipment. It will help to save precious funds in protecting our equipment from corrosion.

7) **How will you measure the success of this project?**
Updating and reviewing the new and existing coatings from the previous project to provide a list and effectiveness of the coatings.

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

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, this is an update to the previous project CR13-04 completed in 2015.

2021 Research Proposal Form

Proposer name: Todd Law
Organization: Vermont AOT, Group 3

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.** $100,000

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.

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research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Aidan Neely
Organization: Connecticut DOT, Group 4

Title of proposed research project: Determining the Migration of Chloride-based Deicers through Different Soil Types Adjacent to Chloride-treated Roadways

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

1) **Explain the specific problem or issue to address**.
With the adoption of chloride deicer programs, the need to understand how those runoff chlorides migrate into the adjacent environment has presented an issue for planners in many organizations. The ability to understand how chloride deicers move, disperse in, or migrate through, varying soil types would help to identify sensitive areas that may need adjustment to chloride deployment rates to help protect public and private aquifers. The results could beneficial when identifying the validity of potential claims against an agency.

2) **What is the goal of the project?**
To determine the migration of chlorides in different soil types used by most of the clear road states. The research should include no more than three different chloride-based deicers, a lab-based study to assess how chlorides migrate through different surface and subsurface materials commonly found in Clear Road states.

3) **Describe the expected products/deliverables of the research.**
A literature review of similar research, a report on the impacts, and a “fact sheet” that DOTs can use to educate legislators and other groups on the impacts of deicers in soils.

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
   - Selection of soil types and deicing products to be tested.
   - Develop test plan.
   - Lab testing and report showing migration through clean soil types and levels of dispersion and migration over time.
   - Development of one-page fact sheets.
   - Final report and webinar.

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

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Would give objective data to the environmental effects of deicers and the balance of those effects to the operations of winter roadway maintenance. Render better tools for planning around sensitive aquifers and areas of environmental concern.

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

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

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

2021 Synthesis Request Form

Requestor name: David Gray
Organization: New Hampshire DOT, Group 4

Title of proposed synthesis project: Plowing Coordination between Jurisdictions

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

1) **Explain the specific problem or issue to address**.
Many times when traveling between States, districts, and maintenance sheds, there is a drastic difference in road conditions during a storm. Due to the difference in time when roads are plowed or treated between sections this can cause safety issues to the public. When the neighboring sheds, districts, or states do not coordinate plow and treatment plans road surfaces can go from black and wet to snow covered with several inches at the lines of treatment areas.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
- State practices currently in place to coordinate winter maintenance efforts to prevent the drastic differences in road conditions from section to section or State to State.
- Products that could be used that are currently owned by States to help to prevent the issue.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
If coordination of winter maintenance between locations is accomplished, the result could be fewer accidents on the roadways at these transition points.

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

CLEAR ROADS
research for winter highway maintenance

2021 Research Proposal Form

Proposer name: Mark Goldstein
Organization: Massachusetts DOT, Group 5

Title of proposed research project: OGFC vs HMA and Winter Performance Metrics

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

1) **Explain the specific problem or issue to address**.
Open graded friction course (OGFC) pavements, aka "Popcorn Mix," are known for promoting drainage via their porous composition. However, with respect to winter maintenance, OGFC raises some issues. While tires ride on the asphalt "peaks", the overall appearance of an OGFC surface during snow events may be whitish even after sufficient roadway deicer applications. This may in and of itself promote additional, excessive deicer application.

[MassDOT has access to a USGS-owned pair of weather stations on I-95 SB in Needham, MA. The stations are outfitted with RWIS technology which could be supplemented with in-road sensors to measure presence/concentration of deicing chemical and use an algorithm to report theoretical roadway freezing point.]

2) **What is the goal of the project?**
To compare roadway surface performance parameters (i.e., grip, surface condition) under similar deicing treatment regimens performed on adjacent installations of OGFC and hot-mix asphalt (HMA) pavements.

3) **Describe the expected products/deliverables of the research.**
   - Raw data from weather stations.
   - A report that highlights the data trends, draws reasonable conclusions and discusses the ramifications of treating OGFC versus HMA pavements during the winter.

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?)**
   - PI travel to become familiar with layout of study area and instrumentation available.
   - Gain access to data streams through MassDOT and USGS and coordinate with agency representatives to obtain data from weather stations.
   - Survey winter season(s) data with a focus on days with inclement winter weather.
   - Compare available parameters at adjacent weather stations and spot differences and trends that exist between data generated from respective stations.
   - Prepare a report that highlights the data trends, draws reasonable conclusions and discusses the ramifications of treating OGFC versus HMA pavements during the winter.

[Some of research budget (appx. $35k) will be needed to install in-road "puck"-style sensors. This step could be skipped because grip and roadway condition sensors are already in place. However, the salinity measurements that the in-road pucks would provide would be very valuable since they would be used by the instrumentation to determine freezing point of salt moisture solution at that spot. The hypothesis is that since the OGFC pavement comes first, and the same salt rate will be applied to the HMA which follows the OGFC, the HMA pavement will consistently show a lower practical freezing point than the OGFC. This could then be construed as we are overtreating both pavement sections by treating the OGFC to achieve a treated "look."]

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Other DOTs O&M Sections; DOT pavement management groups; FHWA; Perhaps RWIS vendors.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Accepting the FHWA's subsidy to use OGFC may not be wise for states with winter climates if it is determined that OGFC escalates treatment costs due differences in look, if not performance from traditional HMA. If OGFC's maintenance costs outweigh benefits of the financial subsidy, we would benefit from that knowledge.

7) **How will you measure the success of this project?**
If trends exist in the data, especially if they indicate that we are over-salting HMA because we are trying to achieve a certain treated appearance on the upstream OGFC, it will inspire a discussion about whether OGFC is an appropriate pavement choice in northern latitudes where winter roadway maintenance is required perhaps 5 months per year.

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.**
Not exactly. There is some qualitative research that exists, which describes certain drawbacks of OGFC with respect to winter roadway maintenance, but I do not believe a study such as the one proposed has been executed in the field.

2021 Research Proposal Form

Proposer name: Brian Burne
Organization: Maine DOT, Group 5

Title of proposed research project: Snow Plow Blade Cutting Edge Videos

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

1) **Explain the specific problem or issue to address**.
A plethora of plow blades have been introduced into the snow and ice control market in recent years. Each has been designed to provide specific benefits, but these benefits may not always be well understood by the industry. The purpose of this project is to design a template video to allow plow blade manufacturers to provide specific information about their blades in a short, informative and standardized manner. Conforming videos, accepted by Clear Roads, will be posted (or linked) on the Clear Roads web site.

2) **What is the goal of the project?**
Education. To allow people to easily understand what's available on the market, what it is intended to do, and what some of the trade-offs might be.

3) **Describe the expected products/deliverables of the research.**
A clear outline of the specific items to be addressed in each plow blade video will be developed. This will include items such as: the product name, available options, special features, cost range, bolt torque specs, preferred angle of attack, etc. A maximum video length will be defined and strictly enforced (approx. 2-3 minutes each). No other advertisements or links within the video will be allowed and no reference to other manufacturers' products will be allowed. A "starter pack" of five videos will be developed, working with five different blade manufacturers, presenting only one blade of their choosing. A website will be developed to accommodate the final videos as well as providing the requirements for future videos. The videos will be posted on the Clear Roads project page upon completion.

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?)**
   - Work with Clear Roads members to identify suppliers and blade types.
   - Identify a fair process to select five manufacturers that are willing to provide input.
   - Solicit specific components of a video outline from Clear Roads and the manufacturers.
   - Prepare a final video outline recommendation for Clear Roads to approve.
   - Take the approved outline and develop the five starter videos.
   - Develop the final website that will provide the completed information.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Snow and ice professionals – state DOTs, Municipal PW Departments, and contractors.

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**.
Within any agency, it is important for employees to understand how any piece of equipment should be used and maintained. These videos will address this information in a simple manner that ensures consistency.

7) **How will you measure the success of this project?**
Usage. Web hits and manufacturer participation.

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

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.

2021 Research Proposal Form

Proposer name: Doug McBroom
Organization: Montana DOT, Group 5

Title of proposed research project: The Efficacy and Environmental Impact of Non-Chloride Deicers

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

1) **Explain the specific problem or issue to address**.
There have been multiple issues for DOTs resulting of overuse of chlorides in winter maintenance. These include chloride contamination of road-side wells and salination of waterways. These issues have resulted in DOT's trying to reduce chlorides, and effective use of liquid chloride-based deicers have helped. However there has been a push in some states to ban or reduce chlorides including liquid deicers. This has pushed states to explore non-chloride-based deicers such as Potassium Acetate. There has been little research showing the efficacies of non-chloride-based deicers, and their environmental impacts.

2) **What is the goal of the project?**
The goal of this project is to identify as many non-chloride-based deicers and determine their efficacy for winter snow and icer removal operations. Additionally, research and testing should be done to determine the environmental risks.

3) **Describe the expected products/deliverables of the research.**
A primer should be developed that includes a short description of the deicer, its primary use, recommended application rate, effectiveness as a deicer, and any associated environmental impact.

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 on types of non-chloride-based deicers that are used by other countries, states and cities. This should include a discussion on their efficacy and intended use. Finally, a discussion of cost and availability should be included.
    - From the data in the literature review, a few (up to 5) of the deicers should be selected for a study of their environmental impact. This should include any available information that is already published and select testing such as Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms; 4th ed. (PDF) (350 pp, 5 MB, October 2002, EPA821-R-02-013 and LD50 tests that are part of the Clear Roads QPL.
    - Finally, a primer should be developed that include a short description of the deicer, its primary use, and any environmental Impact.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State DOT's decision makers, state legislative committees, and local agencies.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
This study can be used by DOT's to weigh options for using non-chloride-based deicers. Additionally, this can be used to educate state decision-makers on the cost and environmental impacts of these deicers.

7) **How will you measure the success of this project?**
A comprehensive primer on non-chloride-based deicers that is easy to read and understand.

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

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.**