Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Benefit / Cost Analysis of AVL/GPS Systems Implementation	$150,000	12 months	New features and technological advancements in AVL/GPS technology and services provide improved services than were available a decade ago. State DOTs have been adopting different services provided by different vendors, with new features introduced and new methods and ways of implementation. Agencies have different AVL/GPS needs, and with the high capital cost of AVL implementation, a study of the true cost of implementation and the benefits they provide can give agencies information that will help them decide. The goal of the project is to provide agencies with a guide that can help them make decisions regarding AVL/GPS systems implementation.	Group 1 Emil Juni, Wisconsin DOT	8
2	Updated Training Videos and Manual for Best Practices and Techniques in Clearing Different Interchange Configurations and Other Geometric Layouts	$75,000	12 months	Clear Roads project 14-03 addressed the many existing and then-new interchange configurations (Diverging Diamond, Roundabout, SPUI, etc.) that can be challenging for operators and managers to clear. Training materials including a manual, reference cards, and videos were developed to address many intersection types. An update is necessary given that it has been 10 years since this project was proposed and other intersection types exist (RCUT, Continuous Green T, etc.). The goal of this project is to create updated training deliverables to address any new types of interchanges or updated best practices.	Group 1 Randi Feltner, Kentucky TC	10

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
3	Synthesis – Use and Performance of Bridge Deicing Systems, to include Fixed Automated Spray Technology (FAST) Systems, Geothermal anti-icing and use of Non-Chloride De-Icers on Bridge Decks to Reduce Corrosion to Bridge Components			This synthesis will identify manufacturers of FAST/Geothermal/Icephobic coating application systems; survey DOTs, larger municipalities (APWA), PIARC, and NPRA to determine current practice related to the use of FAST/Geothermal/Icephobic coating application systems and/or alternatives to chloride-based deicers; and provide case studies on agency experience with the use of FAST/Geothermal systems.	Group 2 Mark Goldstein, Massachusetts DOT Todd Law, Vermont AOT	12
4	Considerations and Technical Requirements for a Weather Services Contract Request for Proposals (RFP)	$75,000	15 months	A state DOT winter maintenance program's best friend is a reliable weather forecasting partner. To optimize weather forecasting services contract's value, it is important to consider what services to request and the resultant contract's related technical requirements. The purpose of this project is to develop an RFP that maximizes the value of the weather forecasting services provided to state DOTs.	Group 2 Mark Goldstein, Massachusetts	14

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
5	Synthesis – Best Practices for Usage of AVL and Other Vehicle Monitoring Technologies in Employee Relations			AVL technology is often implemented without fully considering its potential impacts on employee relations and workforce management, as well as the potential unintended uses of the data it generates. This synthesis will compile the current status of AVL policies related to employee relations and workforce management, while also identifying best practices and usage guidelines. The report will explore whether such data is utilized in cases of disciplinary actions regarding policy violations, illegal behavior, or low productivity, as well as whether it is employed to reward good practices.	Group 3 Andrew Lawrence, Neveda DOT	16
6	Synthesis – Post-Storm Snow Removal			During a snowstorm, snow gets pushed to areas of the right-of-way where it accumulates. The purpose of the synthesis is to gather recommended practices, policies, or training resources employed by state and other road-maintenance agencies related to how they manage post-storm snow removal. What practices and equipment are utilized? What are the resource costs and timeframes used to clear gore areas and shoulders, which include bridge decks, median barrier walls, and guardrails? Also, what are the factors that drive each agency's policy on post-storm / beyond traveled lanes clearing?	Group 3 Carl Fedders, Michigan DOT	17

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
7	Zero-Velocity Spreader Savings Quantification	$50,000	6 months	MDOT is currently studying Winter Maintenance Truck consistency to ease training and truck maintenance statewide. Zero-velocity spreaders are utilized within one of the seven MDOT regions and opinions on the value differ greatly among supervisors, operators, and mechanics. MDOT is interested in quantifying and justifying their use along with identifying use cases. The goal of this project is to Quantify the savings related to the application of salt, if any, experienced using a zero-velocity spreader compared to a traditional spreader and identify optimal use cases.	Group 3 Carl Fedders, Michigan DOT	18
8	Snowplow Truck Washing Facility Design Templates and Snowplow Truck Washing RFQ Contract Template	$125,000	18 months	Snowplow trucks operate in harsh environments and it's a constant challenge to clean plow trucks efficiently and effectively in between storms and at the end of the winter season. Building off Clear Roads Project 16-S1 (Snowplow Truck Washing Practices), the goal of the project is to Evaluate and develop a set of two scalable truck washing facility designs that can be used to further develop and bid out truck washing facility construction projects; and evaluate and develop performance criteria, technical requirements and other considerations that can be used to develop Request for Quotes (RFQ) contracts to procure truck washing vendors.	Group 4 Matthew Ouelette, Rhode Island DOT	20

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
9	Ice Melting Capacity Test Method for Solid Deicers	$150,000	18 months	An Ice Melting Capacity test method has been developed, with high repeatability/reproducibility, for liquid deicers that is rugged and low cost. Currently, the standard referenced test method for solid deicers is SHRP H-205.1; however, the variance of test results is quite high. A new or modified test method should be developed with improved variance. The goal of this project is to develop a new test method or modify an existing test method to determine ice melting capacity for solid deicers that has high repeatability/reproducibility.	Group 4 Patti Caswell, Oregon DOT	
10	Update to Test Method 5 (Corrosion Effectiveness)	$150,000	18 months	The purpose of this project is to establish coupon MPY (corrosion rate) variation limits and corrosion effectiveness repeatability/reproducibility requirements that can be incorporated into Test Method 5 from the Clear Roads Guidance Document for Material Qualified Projects List, Specifications, Test Methods and Product Purchasing. The project will address three issues with the current test method.	Group 4 Patti Caswell, Oregon DOT	
11	Synthesis – Friction Test Method			At certain temperatures and humidity conditions some deicers may reduce friction, causing slippery conditions. Therefore, in order to be included on the Clear Roads QPL liquid deicers must undergo friction testing. This synthesis will summarize friction test methods available. Currently, Clear Roads is not able to include frictional analysis in its evaluation of liquid deicers for inclusion on the QPL. A friction test method that can be conducted and referenced by the QPL will allow the QPL to resume evaluating new products for this characteristic. A survey will provide current friction testing practices.	Group 4 Patti Caswell, Oregon DOT	

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
12	Developing a Road Condition Standard			Many states and locales have developed a color scheme to relay road weather conditions to road users. The colors used are at the discretion of each agency which can certainly lead to confusion and possibly safety concerns during severe weather. The goal of this project would be for the state DOTs to develop a standard road condition index through consensus which can then be adopted and promoted at the national level	Group 4 Doug McBroom, Montana DOT Jeremy McGuffey, FHWA	28
13	Synthesis – Accuracy in Winter Weather Forecasting			The purpose of the synthesis is to gather information on other DOTs experience with missed weather forecasts. Which is the most accurate forecast source? How do weather services determine the likelihood of a forecast? A possible addition could be information on the financial impacts to inaccurate forecasts.	Group 5 Matthew Heinze, Texas DOT	29
14	Synthesis – Public Outreach on Snowplow Safety			TxDOT has seen an increase in the number of incidents involving 3rd party motorists striking state DOT snowplows and winter weather equipment. Some of these incidents involved less experienced drivers, or drivers that had not seen snowplows. There seems to be some disconnect with the public and the proper safety measures to take around winter weather equipment. The purpose of the synthesis is to gather recommended practices, policies, or resources employed by state and other road-maintenance agencies related to public outreach/education on winter weather equipment safety.	Group 5 Matthew Heinze, Texas DOT	30

Clear Roads Research and Synthesis Proposals
2025

	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
15	Correlating Lab Testing and Field Performance for Deicing and Anti-icing Chemicals (Phase II)	$275,000	24 month	Phase I of this project, Clear Roads 09-01 was completed in August 2010. Phase II and Phase III were proposed in that project. Determine Statistical Analysis for Correlating Laboratory and Field data and Begin Laboratory testing using Factorial Design were to be addressed in Phase II. Phase II has not been initiated. This would be a multi-phase project to develop a test method that identifies the effects of many factors and variables on performance and friction and can also be correlated to field performance. Phase I started with a comprehensive literature search to develop recommendations on how to proceed with laboratory testing methods and design.	Group 5 Michael Mattison, Nebraska DOT	31

2025 Research Proposal Form

Proposer name: Emil Juni
Organization: Wisconsin DOT (Group 1)

Title of proposed research project: Benefit / Cost Analysis of AVL/GPS Systems Implementation

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

1) **Explain the specific problem or issue to address**.
   AVL/GPS technology and services have changed in the last decade. New features and technological advancements in recent years provide improved services than were available a decade ago. State DOTs have been adopting different services provided by different vendors, with new features introduced and new methods and ways of implementation. Agencies have different AVL/GPS needs, and with the high capital cost of AVL implementation, a study of the true cost of implementation and the benefits they provide can give agencies information that will help them make a decision.

2) **What is the goal of the project?**
   The goal of the project is to provide agencies with a guide that can help them make a decision regarding AVL/GPS systems implementation.

3) **Describe the expected products/deliverables of the research.**
   Comparison of currently available AVL/GPS providers, their features, what they can be used for, and what are currently being implemented by agencies. This includes the features offered and capital costs and the type of subscription models (as applicable). Benefit-cost analysis of AVL system implementation. Estimation of long-term / lifetime AVL implementation costs.

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?)**
   - Agencies survey of AVL/GPS implementation, including long term / life-cycle cost.
   - Independent review of available AVL/GPS services.
   - Analysis of the benefit / cost of implementation / adoption of a new AVL/GPS system.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Agencies adopting AVL/GPS for the first time or looking into updating their current services.

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.**
   AVL/GPS system is an important part of best maintenance practices of winter maintenance. Adopting and implementing a new system requires a commitment with significant capital costs up front, installation, and potentially recurring expenses in a subscription model. A guide that details available systems, their features, and their long-time costs and benefits will be very helpful for agencies to make a decision regarding AVL/GPS implementation.

7) **How will you measure the success of this project?**
The project is a success if it can produce a usable and practical guide for agencies wanting to adopt new AVL/GPS system.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
CR 14-01 - Synthesis on GPS/AVL Equipment Used for Winter Maintenance
CR 16-01 - Utilization of AVL/GPS Technology: Case Studies
CR 24-S1 - Update on Status of AVL/GPS for Winter Operations

research for winter highway maintenance

2025 Research Proposal Form

Proposer name: Randi Feltner
Organization: Kentucky Transportation Cabinet (Group 1)

Title of proposed research project: Updated Training Videos and Manual for Best Practices and Techniques in Clearing Different Interchange Configurations and Other Geometric Layouts

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

1) **Explain the specific problem or issue to address**.
   A Clear Roads project (14-03) addressed the many existing and then-new interchange configurations (Diverging Diamond, Roundabout, SPUI, etc.) that can be challenging for operators and managers to clear. Training materials including a manual, reference cards, and videos were developed to address many intersection types. An update is necessary given that it has been 10 years since this project was proposed and other intersection types exist (RCUT, Continuous Green T, etc.).

2) **What is the goal of the project?**
   To create updated training deliverables to address any new types of interchanges or updated best practices.

3) **Describe the expected products/deliverables of the research.**
   - Updated survey for best methods to clear these intersections.
   - Updated training handouts / manual.
   - Updated short videos.

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
   - Survey other agencies
   - Determine the most efficient clearing method for each Interchange/geometric configuration.
   - Provide updated training materials and videos.

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

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
   The deliverables would be used during annual or onboard training. They could be viewed as a refresher course for veteran drivers and could especially be useful for new drivers. This material could also help ensure consistency across an agency's jurisdiction with how treatment is performed.

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

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Completed CR 14-03

2025 Synthesis Proposal Form

Requestor name: Todd Law / Mark Goldstein
Organization: Vermont AOT/ Massachusetts DOT (Group 2)

Title of proposed synthesis project: Synthesis on the Use and Performance of Bridge Deicing Systems, to include Fixed Automated Spray Technology (FAST) Systems, Geothermal anti-icing and use of Non-Chloride De-Icers on Bridge Decks to Reduce Corrosion to Bridge Components.

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

1) **Explain the specific problem or issue to address**.
    The current practice for many DOTs is to use chloride deicers on bridge decks while applying to the adjacent roadways. Sodium and Magnesium Chloride cause corrosion to the bridge components, including steel and concrete. In the past, a Fixed Automated Spray Technology (FAST) system utilizing Acetates and / or Formates has been used for deicing with reduced corrosion to the bridge decks. Many of these systems were removed due to difficulties in application methods and needed repairs.

    As an additional portion of this research / synthesis, we are looking for the possibility of Geothermal anti-icing system introduction and icephobic coating applications as an alternative to deicing concepts reliant on chemicals.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
    - Literature search to include…
        - FAST systems
        - Geothermal anti-icing systems
        - Icephobic coating applications
    - Identify manufacturers of FAST/Geothermal/Icephobic coating application systems.
        - Collect information from manufacturers – product reviews to include system specifications, performance specifications, and material use (excludes Geothermal).
        - Have improvements been made in response to agencies discontinuing use of FAST systems? If so, can agencies who have used the new systems share their experiences?
    - Survey DOTs, larger municipalities (APWA), PIARC, and NPRA to determine current practice related to the use of FAST/Geothermal/Icephobic coating application systems and / or alternatives to chloride-based deicers.
    - Case studies to include agency experiences with FAST/Geothermal systems.
        - How / where were they used?
        - What materials did the FAST systems apply.
        - Performance as compared to traditional methods of material application.
        - Reliability / durability of the FAST/Geothermal systems?
        - Were these FAST systems worth the cost of purchase, installation, maintenance / repair?

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
Bridges can be significantly impacted by winter weather - as depicted by signs stating that bridges may freeze before the roadway. They are an expensive asset and chloride-based deicers cause significant damage to bridge components. Having an automated system that is reliable and cost-effective, along with being less corrosive, provides multiple benefits to the DOTs. Furthermore, regionally-available geothermal heat resource access can provide a chemical-free alternative.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
CR 21-03 Efficacy, Cost, and Impacts of Non-Chloride Deicers

Geothermal - 2 related articles:
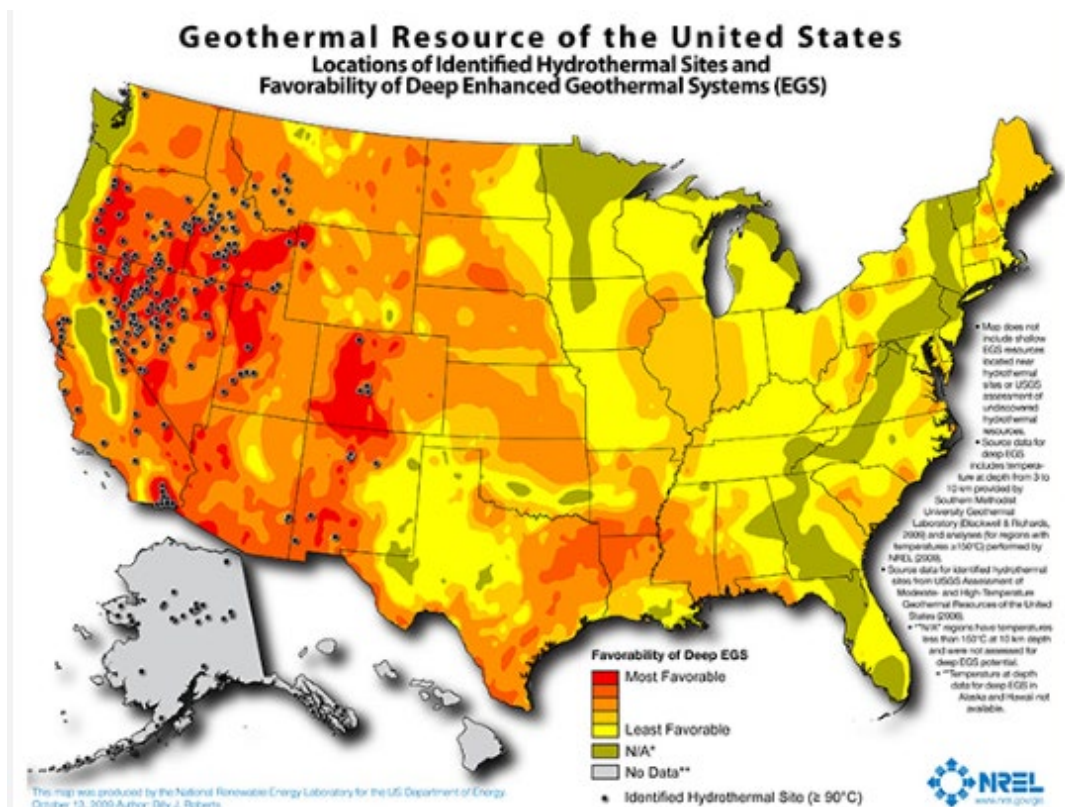https://www.sciencedirect.com/science/article/abs/pii/S2352380824000698

https://www.energy.gov/eere/geothermal/geothermal-heat-pump-case-study-dallas-fort-worth-us-287-bridge

https://journals.sagepub.com/doi/full/10.1177/03611981221088212

Virginia Tech Transportation Institute 2016: https://onlinepubs.trb.org/onlinepubs/webinars/160721.pdf

Geothermal Location Favorability Map

Solar concepts: Interesting piece highlights limitations of solar anti-icing, and espouses future efforts involving ice-phobic surfaces: https://pmc.ncbi.nlm.nih.gov/articles/PMC9287796/

2025 Research Proposal Form

Proposer name: Mark Goldstein
Organization: Massachusetts DOT (Group 2)

Title of proposed research project: Considerations and Technical Requirements for a Weather Services Contract Request for Proposals (RFP)

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

1) **Explain the specific problem or issue to address**.
   A state DOT winter maintenance program's best friend is a reliable weather forecasting partner. To optimize weather forecasting services contract's value, it is important to consider what services to request and the resultant contract's related technical requirements.

2) **What is the goal of the project?**
   To develop an RFP that maximizes the value of the weather forecasting services provided to state DOTs.

3) **Describe the expected products/deliverables of the research.**
   An RFP template and a document that details the technical requirements and considerations that feed into development of the RFP.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Conduct a Literature Review.
   - Survey states to determine weather forecasting services needed.
   - Conduct follow-up interviews to obtain details beyond the survey.
   - Develop recommendations for items and specifications to be included in the RFP.
   - Develop an RFP template with Decision Support Guide.
   - Draft final report and conduct the project closeout webinar.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Many transportation agencies contract for tailored weather forecasting services. It is in agencies' best interest for the contract to consider year-round weather forecasting needs and assign a contract manager who is responsible for integrating agency needs into a single contract. Annually the contract may address needs related to snow and ice, dust and hurricanes, fog and frost. Every state gets unique weather, so the services requested for a weather forecasting contract should consider this. Any training necessary for users of the deliverables would ideally be included within the deliverables, such as the RFP template and its decision support guide. The belief is that a professional should be able to develop a competent RFP for weather forecasting services by engaging the deliverables.

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**.
   A good weather forecaster can narrow down hours and localize the scope of snowfall threat. The best details on intensity, location and storm duration are key to minimizing snowfighting equipment and deicer / sand usage. However, there are some services that might not be common practice to request that could provide great benefit.

   Example: My RWIS provider can send text or email messages concerning frost alerts. Frosting happens when a road's temperature slips below the dew and frost points, while both are below freezing. We can lose a road, and it didn't snow or rain. Cars start slipping.

   A logical solution for me would be for frost alerts to be funneled to our Highway Operations Center's Supervisors' email. In absence of that option, I am considering adding this responsibility to my weather forecasting entity. They are polling our RWIS locations currently and hopefully can interpret and relay frost alerts via phone calls to the appropriate Districts' Snow & Ice Engineers.

   Another possible service we hope to secure for our next weather forecasting contract involved hydrological watershed forecasting (river heights, etc.) to highlight times when our roads and bridges could be susceptible to overwashing and scour, respectively from flooding conditions.

7) **How will you measure the success of this project?**
   If the project is selected for funding, supporters will be interested in accessing the deliverables to strengthen their next weather forecasting services contract. Since weather contracts typically last years, it may take several years for all Clear Roads members to fully utilize the deliverables to bolster their next weather services contract.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
    Not currently.

CLEAR ROADS
research for winter highway maintenance

2025 Synthesis Proposal Form

Requestor name: Andrew Lawrence
Organization: Nevada DOT (Group 3)

Title of proposed synthesis project: Best Practices for Usage of AVL and Other Vehicle Monitoring Technologies in Employee Relations

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

1) **Explain the specific problem or issue to address**.
   Many states, local agencies, and private organizations are increasingly adopting Automatic Vehicle Location (AVL) and other technology for fleet management and to improve the efficiency of their vehicle operations. However, this technology is often implemented without fully considering its potential impacts on employee relations and workforce management, as well as the potential unintended uses of the data it generates. By understanding how other agencies use this data for employee relations like corrective actions, disciplinary measures, or positive rewards, each agency can adopt best practices that align with its goals and organizational culture.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   This synthesis will compile the current status of AVL policies related to employee relations and workforce management, while also identifying best practices and usage guidelines. The report will explore whether such data is utilized in cases of disciplinary actions regarding policy violations, illegal behavior, or low productivity, as well as whether it is employed to reward good practices. Additionally, the report will address legal standards, privacy concerns, state-specific policies, and the ways in which certain unions or collective bargaining agreements address AVL usage in employee relations. It will also gather information about who has access to this data and any limitations in place to mitigate concerns. Furthermore, the report will review any relevant administrative policies, procedures, and data retention standards.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   Establishing clear and transparent policies and guidelines for the use of monitoring technology attached to vehicles can foster buy-in and support data collection and its benefits. This synthesis could serve as a practical guide for agencies to avoid unnecessary resistance or roll back of certain functionalities due to privacy or employee relation objections.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   Yes, Synthesis 23-S1 evaluates the management of data collected by AVL. This synthesis could add to the information gathered to include additional legislation, policies, and BMPs for using this data in employee relations and workforce management.

2025 Synthesis Proposal Form

Requestor name: Carl Fedders
Organization: Michigan DOT (Group 3)

Title of proposed synthesis project: Post-Storm Snow Removal

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

1) **Explain the specific problem or issue to address**.
   During a snowstorm, the main goal is to remove the snow and ice from the roadway to keep traffic moving. In doing so, snow gets pushed to areas of the right-of-way where it accumulates. During the day when temperatures rise, the snow melts and causes water to flow across the roadway. As night falls, the water freezes and causes slick spots. The accumulated piles of snow melt and become denser. The piles refreeze and form solid blocks of ice along the roadway. The blocks of ice can form ramps on the side of bridges and barrier wall. Vehicles have run into ice ramps and have been launched over the sides of bridges. Ice block obstructions in front of crash barrier and guardrail end-treatments interfere with the proper function of guardrail and can cause more damage than they were designed to prevent. Accumulated snow piles can block drainage inlets and cause flooding on the roadway. The accumulated snow and ice also occupy storage room for the next storm. Accumulated snow on a gore point can cause a driver to spin out and lose control if the driver attempts to drive through the snow pile. Removing the snow and ice from these areas may require specialized equipment and many workers. The process also impacts drivers.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   The purpose of the synthesis is to gather recommended practices, policies, or training resources employed by state and other road-maintenance agencies related to how they manage post-storm snow removal. Resources can be written documents or video / animation on cleaning techniques and practices. What practices and equipment are utilized? What are the resource costs and timeframes used to clear gore areas and shoulders, which include bridge decks, median barrier walls, and guardrails? Also, what are the factors that drive each agency's policy on post-storm / beyond traveled lanes clearing?

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   Users will be able to review the methods and equipment used by other agencies to determine what they may utilize to improve their practices, thus preventing additional snow and ice-related crashes after the storm.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   Michigan DOT questioned the Clear Roads states to determine how each of them removed accumulated snow on bridge decks. They were able to get a few responses. Also project 14-03 provided reference animations / diagrams on clearing different interchange / intersection types (not much focus given to gores and railings with these). Iowa DOT may have some videos. This synthesis project was proposed in 2022 but was not funded.

2025 Research Proposal Form

Proposer name: Carl Fedders
Organization: Michigan DOT (Group 3)

Title of proposed research project: Zero-Velocity Spreader Savings Quantification

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

1) **Explain the specific problem or issue to address**.
   MDOT is currently studying Winter Maintenance Truck consistency to ease training and truck maintenance statewide. Zero-velocity spreaders are utilized within one of the seven MDOT regions and opinions on the value differ greatly among supervisors, operators, and mechanics. MDOT is interested in quantifying and justifying their use along with identifying use cases.

2) **What is the goal of the project?**
   Quantify the savings related to the application of salt, if any, experienced using a zero-velocity spreader compared to a traditional spreader and identify optimal use cases.

3) **Describe the expected products/deliverables of the research.**
   - Literature search and product review
   - Test plan
   - Test results
   - A comparison of salt used – and any savings experienced – using a zero-velocity spreader to that of a traditional spreader.

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
   - Market availability / product review
   - Determine equipment to be tested
   - Develop a test plan, including bounce and scatter testing
   - Conduct testing
   - Final report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   All municipalities and DOTs are considering using a zero-velocity spreader to quantify savings.

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**.
Savings can be quantified by using a zero-velocity spreader.

7) **How will you measure the success of this project?**
Accurate quantification of savings.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
This topic was originally submitted in 2022 by Todd Miller from Missouri who sited the potential for similar research conducted by Iowa in 2015, but none could be found. Studies were proposed in 2009 through 2011 and in 2012 Clear roads funded 12-05 Comparison of Salt Distribution Systems, which resulted in a catalog of spreader types but stopped short of a quantitative comparison of effectiveness.

2025 Research Proposal Form

Proposer name: Matthew Ouellette
Organization: Rhode Island DOT (Group 4)

Title of proposed research project: Snowplow Truck Washing Facility Design Templates and Snowplow Truck Washing RFQ Contract Template

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

1) **Explain the specific problem or issue to address**.
Snowplow trucks operate in harsh environments and it's a constant challenge to clean plow trucks efficiently and effectively in between storms and at the end of the winter season. Frequent and effective washing of snowplow trucks during and after the winter maintenance season can help reduce corrosion and prolong the life of winter maintenance equipment. Challenges include time to clean the trucks, sufficient water pressure, access to all areas within the truck bodies that salt and other materials accumulate, etc. Snowplow truck repairs and replacements are costly, and many states have limited fleet budgets. Some states have constructed truck washing facilities (in-house wash bays) and / or contracted out truck washing. Truck washing facility designs and truck washing RFQ contracts must be cost-effective and environmentally sensitive.

2) **What is the goal of the project?**
Build off Clear Roads Project 16-S1 (Snowplow Truck Washing Practices). The goal of the project is to:
   1. Evaluate and develop a set of two (2) scalable truck washing facility designs (plans, details, specs) that can be used to further develop and bid out truck washing facility construction projects (types of designs to be determined during the project, maybe an inside garage bay facility and an outside facility??); and
   2. Evaluate and develop performance criteria, technical requirements and other considerations that can be used to develop Request for Quotes (RFQ) contracts to procure truck washing vendors.

Developing facility designs and / or RFQ contracts are time-consuming. Part of the goal of the project is also to expedite the processes for states to procure truck washing facility construction and / or truck washing vendors. The above can be used as templates to meet the needs of a variety of sites throughout Clear Roads member states. The facility designs and RFQ contract templates will take into account existing building codes, maintenance friendly designs, and state and federal regulations associated with environmental and related concerns.

3) **Describe the expected products/deliverables of the research.**
The templates for truck washing facilities should provide a set of two (2) scalable designs appropriate for a range of truck washing capabilities (plans, details, specs), drawings (including CAD files) and cost estimates for each design, and associated operations and maintenance plans. With scalable components, the designs should provide basic templates for member states to use as a starting point for further design modifications and bidding for truck washing facility construction. Evaluating and including sewer connection option and non-sewer connection option for the wastewater is a key element and interest to the member states.

The template for a truck washing RFQ contract should provide a set of performance criteria, technical requirements and other considerations (water pressure, cleaning products, parts and components of trucks to clean, state and federal regulations including environmental, etc.) for member states to use as a starting point for further modifications and bidding.

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?)**
Task 1 - Search and review of the pertinent literature: studies and other documentation relating to minimizing negative environmental impacts due to truck washing operations and wastewater; studies and other documentation examining the optimal design and placement of truck washing facilities within an area of operations that the facility will serve (including looking for commonality in their construction); and past RFQ contracts for truck washing services (including looking for commonality). This literature is to be examined to provide guidance on the development of design tools and templates.

Task 2 - National survey of current practices in truck washing facility design and construction, and survey to identify agencies that have developed RFQ contracts for truck washing services, including state and local agencies. The intent of this task is to identify good or best practices in the design of such facilities and contracts and obtaining copies of any relevant contract documents.

Task 3 - Analysis of the information collected in Tasks 1 and 2, including follow-up interviews (phone or videoconference), with the goal of identifying overarching insights, capturing technical requirements and considerations, and providing guidance that can all then be incorporated into the design tools and templates that are to be developed as part of the project.

Task 4 - Development of design tools, templates and guidance documents using the results of the previous tasks. This task should develop the following deliverables:
   A. Templates, drawings and cost estimates for two (2) scalable designs of truck washing facilities, including the appropriate sizing, design and components of the facilities (of various types) to wash trucks;
   B. Guidance document and detailed checklist of steps that must be taken as part of the truck washing facility design process;
   C. Guidance document and detailed checklist of the associated facility operations and maintenance plan (including management of the wastewater); and
   D. Guidance document and template including performance criteria, technical requirements and other considerations for a truck washing RFQ contract, written using standard contractual language.

Task 5 - Preparation of final report that incorporates the results and end products / deliverables for Tasks 1 through 4 of the project. Draft versions of the deliverables from Task 4 will be reviewed and commented on by the Clear Roads project committee, and the final revised versions (approved by the project committee) shall be included as part of the final report (Task 5). Also, preparation and presentation of final project closeout webinar.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Transportation entities including State and Local Agencies' Planning, Project Management, Engineering and Maintenance Operations 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**.
The products/deliverables would be used to initiate projects and funding to construct truck washing facilities and/or to bid out RFQ contracts for truck washing services with proven templates, and to

help streamline the projects. They would benefit DOTs by helping prolong the life of winter maintenance equipment and reduce fleet repair and replacement costs, especially when agencies go through budget constraints and/or cuts.

7) **How will you measure the success of this project?**
Developing usable design tools, templates and guidance documents that member states and other agencies can use. Tracking the number of future projects and contracts that are able to utilize this project's end products/deliverables.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
16-S1 Snowplow Truck Washing Practices

2025 Research Proposal Form

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

Title of proposed research project: Ice Melting Capacity Test Method for Solid Deicers

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

1) **Explain the specific problem or issue to address**.
   An Ice Melting Capacity test method has been developed, with high repeatability / reproducibility, for liquid deicers that is rugged and low cost. Currently, the standard referenced test method for solid deicers is SHRP H-205.1; however, the variance of test results is quite high. A new or modified test method should be developed with improved variance.

2) **What is the goal of the project?**
   To develop a new test method or modify an existing test method to determine ice melting capacity for solid deicers that has high repeatability / reproducibility.

3) **Describe the expected products/deliverables of the research.**
   - A literature review for ice melting capacity test methods.
   - Development of a new test method or modification of an existing test method with established repeatability/reproducibility limits.

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 – A review of current test methods, including published repeatability/reproducibility limits.
   - Test Method Development – Development of a new test method or modification of an existing test method that would include ruggedness evaluation.
   - Round-Robin Testing – Design and execute a round-robin test that would establish variation, repeatability, and reproducibility requirements.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Any lab that would evaluate solid deicer performance based on ice melting capability – DOT's, vendors, 3rd party labs, etc.

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 successful completion of the project would allow the improvement of the ability to evaluate solid deicer products on quality and performance.

7) **How will you measure the success of this project?**
   A test method to evaluate the ice melting capacity of solid deicers will be established and will be the referenced standard test method in the deicer industry.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
    Clear Roads 18-06
    Clear Roads 22-03

2025 Research Proposal Form

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

Title of proposed research project: Update to Test Method 5 (Corrosion Effectiveness)

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

1) **Explain the specific problem or issue to address**.
   Products that include a corrosion inhibitor must pass the category specific limits of corrosion effectiveness, following Test Method 5, in the Clear Roads Guidance Document for Material Qualified Projects List, Specifications, Test Methods and Product Purchasing. This test involves immersing steel coupons (washers) in different flasks containing water, reagent grade NaCl, and product samples. Each flask contains three coupons. The coupons are measured and weighed before the test and after the test. The loss in mass due to corrosion is used to calculate a corrosion rate (MPY) for each coupon. The MPY of the three coupons in each flask are averaged. The Corrosion Percent Effectiveness is then calculated by subtracting the MPY due to water from both the sample and the NaCl, then dividing the corrected sample MPY by the corrected NaCl MPY and multiplying by 100%:

$$Percent\ Effectiveness\ = \frac{\{MPY\ (Sample) - MPY\ (Water)\}}{\{MPY\ (NaCl) - MPY\ (Water)\}} \times 100\%$$

Issue #1: The test method states "Typically, coupon variation may run plus or minus 3 MPY." This is referring to the variation between the three coupons in the same flask. However, this is not an actual variation limit requirement of the method.

Issue #2: The test method doesn't address variability within the lab or between labs. There are not currently any repeatability or reproducibility requirements.

Issue #3: Variability due to the MPY's of the water and NaCl can have a large impact on results. NDOT has had a typical MPY range of 4-7 for water and 55-75 for NaCl, but a lower water value doesn't necessarily happen with a comparably low NaCl value. Using those ranges, this table illustrates the potential **corrosion effectiveness** result variation for a sample with an MPY of 20.

Sample MPY = 20		Water MPY		
		4	5.5	7
NaCl MPY	55	**31.4**	**29.3**	**27.1**
	65	26.2	24.4	22.4
	75	22.5	20.9	19.1

In this example, if NDOT was performing the testing, the effectiveness of 31.4 would be repeated. Based on our historical data, the second analysis would likely be around 29.3, but this table illustrates the potential for obtaining a result of 19.1. If variation limits were set, there would be greater confidence in reporting results.

This high variability was shown in results from the first round of the Winter Maintenance Products PSP.

2) **What is the goal of the project?**
To establish coupon MPY variation limits and corrosion effectiveness repeatability / reproducibility requirements that can be incorporated into Test Method 5.

3) **Describe the expected products/deliverables of the research.**
- A literature review for corrosion test methods / specifications. This would ideally be primarily focused on deicers, but other methods / specification would be beneficial as it relates to corrosion of steel.
- A survey of labs that perform corrosion testing to compare water and NaCl MPY values.
- A round-robin test that would help establish appropriate variation limits and repeatability / reproducibility requirements.

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 – Test Method 5 is a modification of NACE TM0169/ASTM G31, but more corrosion test procedures would be beneficial to review, especially if there are variation limit requirements.
- Survey – A survey of current labs that perform Test Method 5 and / or similar corrosion testing to determine what their historical values are when it comes to the water and NaCl MPY's. A survey could also indicate other variables that could contribute to variability such as coupon source.
- Round-robin testing – Design and execute a round-robin test that would provide data to support establishing variation, repeatability, and reproducibility requirements.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The Clear Roads QPL Subcommittee as the owners of the test method, as well as independent labs, DOT labs, vendors, and any other entities performing corrosion effectiveness testing of deicers.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Having these requirements incorporated into Test Method 5 would:
- Assist in improved cooperative testing between vendors and end users (DOT's),
- Improve confidence in holding vendors accountable with the quality of their products,
- Provide the QPL Committee with higher confidence in evaluating test results.

7) **How will you measure the success of this project?**
Appropriate repeatability / reproducibility and variation limits will be determined / established, and Test Method 5 will be updated to include these requirements.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
The Nebraska DOT performed a round-robin study with partner labs. Two Category 1 products were analyzed with coupons provided by NDOT as well as the participating lab's coupons to evaluate any variability due to coupon source. Due to the small sample size and number of participating labs, results were inconclusive.

2025 Synthesis Proposal Form

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

Title of proposed synthesis project: Friction Test Method

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

1) **Explain the specific problem or issue to address**.
   At certain temperatures and humidity conditions some deicers may reduce friction, causing slippery conditions. Therefore, in order to be included on the Clear Roads QPL liquid deicers must undergo friction testing:

   "Frictional analysis shall be conducted on products that have been applied at the prescribed application rate to a pavement surface within a sealed and controlled humidity chamber. The frictional coefficient shall be measured on pavement surface as the humidity in the chamber is lowered and raised over the course of time. The data shall show a plot of the humidity curve and a plot of the coefficient of friction curve over time. The device that measures the frictional coefficient shall be calibrated and certified prior to use on the sample analysis."

   Vendors have historically used the same laboratory to send samples to for this testing. This laboratory no longer performs this testing due to equipment failure and are not likely to repair or replace non-functional equipment. Recently, deicers have been accepted to the QPL without requiring this testing, but with an asterisk stating that testing had not been conducted. The QPL should evaluate other friction testing options to determine if there is an appropriate method to cite that could be conducted at various laboratories.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   - A literature review would summarize friction test methods available.
   - A survey would provide current friction testing practices.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   Currently, Clear Roads is not able to include frictional analysis in its evaluation of liquid deicers for inclusion on the QPL. A friction test method that can be conducted and referenced by the QPL will allow the QPL to resume evaluating new products for this characteristic. Having an approved frictional analysis included in evaluating deicing products will provide states with more confidence when choosing liquid deicing products.

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

2025 Research Proposal Form

Proposer name: Doug McBroom / Jeremy McGuffey
Organization: Montana DOT / FHWA (Group 4)

Title of proposed research project: Developing a Road Condition Standard

Topic Area (highlight one):

Planning/Methods   Equipment   Materials   Training   Technology   **Safety**

1) **Explain the specific problem or issue to address**.
   Many states and locales have developed a color scheme to relay road weather conditions to road users. The colors used are at the discretion of each agency which can certainly lead to confusion and possibly safety concerns during severe weather. Imagine you are traveling from one state where purple is "wet roads" to another where it means "travel is not advised". Below are a few examples.
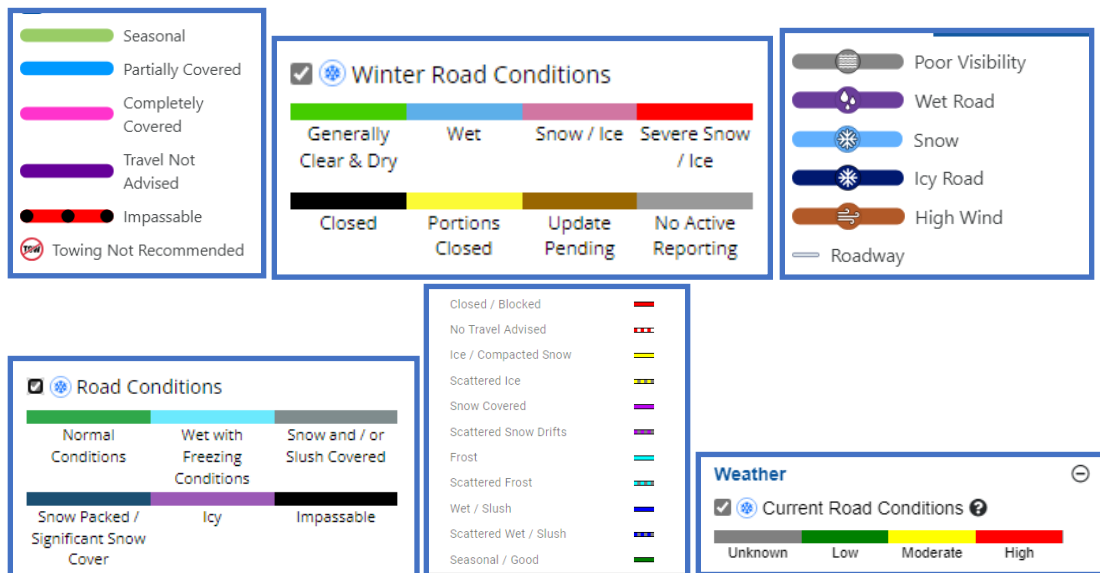
2) **What is the goal of the project?**
   The goal of this project would be for the state DOTs to develop a standard road condition index through consensus which can then be adopted and promoted at the national level.

3) **Are you aware of any similar or related research on this topic? If so, please list below.**
   No, but wanted to note that other areas of the industry have developed color standards for mapping including NWS (atmospheric conditions).

2025 Synthesis Proposal Form

Requestor name: Matthew Heinze
Organization: Texas DOT (Group 5)

Title of proposed synthesis project: Accuracy in Winter Weather Forecasting

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

1) **Explain the specific problem or issue to address**.
   Approximately 10 years ago, winter weather forecasts seemed to be semi-accurate. In the last 3-5 years that accuracy has trended down. The two winter events experienced in Texas this season both had forecasts that were substantially off. This resulted in resources being moved to areas that were forecasted to be impacted with 6-8" of snow that ultimately received less than 2". The area they were moved from was forecasted to have no snow and ended up with 12-14" with whiteout blizzard conditions. This has also impacted pretreatment of areas that then receive no winter precipitation or only rain. One of our meteorology partners stated that it is hard to forecast winter weather in Texas due to little historical data as there are few winter impacts. It was also stated that meteorologists now have over 30 resources to look at and determine which is the most probable forecast.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   The purpose of the synthesis is to gather information on other DOTs experience with missed forecasts; which is the most accurate forecast source; and how do weather services determine the likelihood of a forecast. Also, a possible addition could be information on the financial impacts to inaccurate forecasts.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   State DOTs could use the information to determine the most accurate forecast source. There could also be a piece that shows the financial impacts of incorrect forecasts.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   I am not aware of any that look directly at the accuracy of forecast, or the financial impacts of inaccurate forecast.

2025 Synthesis Proposal Form

Requestor name: Matthew Heinze
Organization: Texas DOT (Group 5)

Title of proposed synthesis project: Public Outreach on Snowplow Safety

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

1) **Explain the specific problem or issue to address**.
    During this winter season TxDOT has seen an increase in the number of incidents involving 3rd party motorists striking state DOT snowplows and winter weather equipment. Some of these incidents involved less experienced drivers, or drivers that had not seen snowplows. There seems to be some disconnect with the public and the proper safety measures to take around winter weather equipment.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
    The purpose of the synthesis is to gather recommended practices, policies, or resources employed by state and other road-maintenance agencies related to public outreach / education on winter weather equipment safety. This would be to the extent of having new drivers sit in the seat of a snowplow to experience the view of the operator; possibly having "social media influencers" participate in a snowplow training simulator. This may also include taking the media, or select individuals, on a ride-a-long in a snowplow to get the full experience.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
    State DOTs could use the information as a pathway to get their administration on board with public outreach, and to demonstrate best practices with public education in a live setting.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
    This would be beyond the public service announcement library (23-01) and be geared toward hands on outreach.

CLEAR ROADS

research for winter highway maintenance

2025 Research Proposal Form

Proposer name: Michael Mattison
Organization: Nebraska DOT (Group 5)

Title of proposed research project: Correlating Lab Testing and Field Performance for Deicing and Anti-icing Chemicals (Phase II)

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

1) **Explain the specific problem or issue to address**.
   Phase I of this project, CR 09-01 was completed in August 2010. Phase II and Phase III were proposed in that project. Determine Statistical Analysis for Correlating Laboratory and Field data and Begin Laboratory testing using Factorial Design were to be addressed in Phase II. Phase II has not been initiated.

2) **What is the goal of the project?**
   A multi-phase research project is needed to develop a test method that identifies the effects of many factors and variables on performance and friction and can also be correlated to field performance. Phase I started with a comprehensive literature search to develop recommendations on how to proceed with laboratory testing methods and design.

3) **Describe the expected products/deliverables of the research.**
   A statistical method for evaluating the new laboratory results with field performance. Design and manufacture laboratory environments and equipment that will be correlated with field performance tests.

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?)**
   - Use the results of Phase I to develop a statistical methodology.
   - Use Design of Experiment to determine combinations of factors used for correlation.
   - Design and build the necessary test equipment.
   - Perform tests on deicing chemicals.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Test laboratories and users of deicing chemicals. Facility and equipment design documents and training materials for laboratories and equipment manufacturers. Laboratory tests will be used for correlation with field testing in Phase III of the project.

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**.
   Deicing chemicals are used by Transportation Departments as a fundamental tool in winter road maintenance. Billions of dollars are spent and environmental costs accrue. A scientific basis for selecting the right amount of the right material for the road condition will save money, reduce environmental impact, and improve safety.

7) **How will you measure the success of this project?**
Laboratory environment, equipment, methods and analysis design will be complete and ready for correlation with field testing in Phase III.

8) **Estimated funding needed.** $275,000

9) **Estimated timeline for completing the research.** Twenty-four (24) months

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