Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
7	Synthesis of Best Practices for Pass Operations	$75,000	12 months	The goal of this project is to identify best practices for winter operations dedicated to keeping mountain pass highways open to travel. Mountain states dedicate a large part of their winter budget to these operations, so there are also large opportunities for savings. The project would explore bank cutting, shoulder widening, drift prevention, avalanche mitigation and other practices used on mountain pass highways.	David Wieder, Colorado DOT	This was identified as Research need #25 at the 2011 Peer Exchange.
8	Installation and Evaluation of Mobile Salinity Sensors and Data Integration	$150,000	18 months	This project would examine international salinity sensor systems technology. Specifically it would look at freeze/thaw technology being used in Sweden and refractometer technology being used in Japan. These technologies have been employed in both countries for several years to help optimize their snow and ice control operations. The tasks would include installing sensors and related equipment, integrating data flow into maintenance management systems, and performing field evaluations.	Annette Dunn, Iowa DOT	The need for measuring salinity of the moisture on the road surface has been identified as an unmet research need at three Winter Maintenance Peer Exchanges. This need ranked #9 In 2007, #12 in 2009 and #9 in 2011.
10	Improving Snow Plow Design	$50,000	9 months	The goal of this project is to identify new materials, technologies, designs and other components for snow plows and rate them according to performance criteria. Researchers would develop a matrix of the designs, materials and technologies tested and their performance characteristics. The proposed matrix would help agencies determine which of the latest commercially available innovations could be used to optimize their snow removal operations.	Annette Dunn, Iowa DOT	

Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
12	Snow and Ice Chemical Application Rate on Open Graded Friction Course Pavements, Gap Graded Pavements and Nova Chip Treated Roads.	$200,000	18 months	The goal of this project is to identify the best methods for treating Open Graded Friction Course pavements, Gap Graded pavements and Nova Chip treated roads. Currently, field personnel are reporting several issues relating to pavement performance when applying deicing chemicals on these pavements. For example, the road appears to refreeze more quickly, stays wet longer, and requires 25-30% more de-icing chemical. This project would investigate these concerns and propose mitigating treatment options.	Paul Brown, Massachusetts DOT; Mike Lashmet, New York State DOT	This was identified as Research need #10 at the 2011 Peer Exchange.
14	Establishing Effective Salt and Anti-icing Application Rates	$150,000	18 months	This goal of this project is to establish new guidelines for applying the latest methods, procedures and materials available in snow and ice operations. Researchers would establish effective material application rates for a broad range of chloride-based anti-icing and de-icing products, develop a crosscheck list to recommend alternative products to chlorides that provide similar results, and develop guidelines for the use of these products, including when best to apply them and how much is effective for specified winter storm categories.	Paul Brown, Massachusetts DOT; Monty Mills, Washington State DOT	This was identified as the #1 research need at the 2007, 2009 and 2011 Peer Exchanges.

Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
17	Comparison of Salt Distribution Systems	$250,000	18 months	The goal of this project is to determine which salt distribution systems are the most effective at reducing bounce and scatter. The scope would involve finding as many types of salt distributions systems in use as possible and then picking several of the most common types of systems to perform a field evaluation at different application speeds.	Tim Croze, Michigan DOT	
19	Plowing During Whiteout Conditions	$50,000	12 months	The objective of this research is to identify the technology available to equip a snowplow truck to operate in "auto pilot" during conditions of zero or near zero visibility. Such technology would keep the vehicle moving in the predetermined path and also include crash avoidance capabilities.	Tim Chojnacki, Missouri DOT	
21	Determining the Effect of Pavement Surface Type on Snowplow Blade Life	TBD	TBD	This project will compare blade life in controlled field tests on chip sealed highways for different types of aggregates. Based on the results researchers will develop strategies to mitigate the impacts of the aggregates on blade life, such as through blade selection, operator technique, skid plates and other solutions. The cost of more frequent blade replacement will be compared with the cost of aggregate options and mitigation strategies. The project will also document advantages and trade-offs of the various options, as well as the effect of each mitigation strategy on snow plow damage to road surfaces.	Mike Mattison, Nebraska DOR; Troy Whitworth, Kansas DOT	This was identified as Research need #23 at the 2011 Peer Exchange.

Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
23	Sustainable Snow Removal System	$100,000	12 months	This goal of this study is to design a Sustainable Snow Removal System that: • Reduces the use of chemicals • Reduces the energy it takes to perform services • Reduces highway accidents/fatalities • Maintains or increases the level of winter service • Increases the life of pavement markings-RPMs-paint lines • Reduces the damage to pavement surfaces, and • Reduces deleterious impacts to the environment, highways, bridges, appurtenances and equipment. The researcher would work with pavement and materials engineers, truck/body manufacturers, plow/blade manufactures, pavement marking firms, spreader control manufactures, weather forecasters or MDSS providers, etc. to develop and design a Sustainable Snow Removal System.	Charles Goodhart, Pennsylvania DOT	This was identified as Research need #8 at the 2011 Peer Exchange.
25	Measuring Road Surface Friction from Tire Slip Differential	$150,000	12 months	The goal of this project is to identify a reliable and repeatable means of measuring road surface friction that would provide roadway maintenance organizations with the data to better measure performance and direct snow/ice removal operations. Researchers would collect tire slippage data from thousands of vehicles on the roadways and use it to develop an indication of road surface friction.	Allen Williams, Virginia DOT	

Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
27	Suitability of Salt Loving Plantings along Roadways and Their Usability to Recycle for Deicing	$125,000	18 months	This study would determine if plants that absorb and hold salts within their biological structure (halophytic plants) could be planted along roadsides, harvested after absorbing salt from winter operations, and then converted into a de-icing agent (biochar) as a means of recycling the salts placed on the roadways. The scope would include a field evaluation of four roadway treatments (biochar only, salt-rich biochar only, biochar combined with salt, and salt only).	Allen Williams, Virginia DOT	
29	Pacific Northwest Snowfighters (PNS)	$50,000 per year	24 months	The purpose of this project is to identify funding for PNS and to structure a relationship between PNS and Clear Roads. Without a steady and reliable source of funding to continue its core mission, PNS could lose the ability to keep the specifications and the Qualified Product List (QPL) viable as a standard for other states and provinces to rely upon. This project would ensure that PNS could continue to coordinate materials testing and standards for deicing chemicals.	Monty Mills, Washington DOT	
31	Snowplow Operator and Supervisor Training	$100,000	12 months	The objective of this project is to create training courses for operators and supervisors using all the best training materials and practices from all the Clear Roads states. It would organize them into classroom courses that could be utilized by any Clear Roads member state.	Michael Sproul, Wisconsin DOT	

Clear Roads Research Proposals
2012

Page	Title	Est. Cost	Est. Duration	Summary	Proposed by	Peer Exchange Problem
33	Salt Brine Primer	$65,000	6 months	The goal of this project is to consolidate information on the formulation, production, storage, application, methods and application rates for sodium chloride brine. Researchers would gather the best available information on salt brine, including the identification of brine blends, admixtures, enhancements, etc. that may be used as a guide for future research and reference.	Kyle Stollings, West Virginia DOT	This was identified as Research need #14 at the 2011 Peer Exchange.
35	LOS for Winter Mobility	$75,000	18 months	The goal of this project is to develop a level of service (LOS) for snow and ice control based on traffic speed and congestion. RWIS data, traffic speed measurements and traffic counts can all be used to relate road and weather conditions to speed and congestion. This will enable DOTs to have a clearer picture of the impacts and costs associated with varying levels of service during snow and ice operations.	David Wieder, Colorado DOT	

2012 Research Proposal Form

Proposer name: David C. Wieder
Organization: Colorado DOT
E-mail address: david.wieder@dot.state.co.us

Title of proposed research synthesis or project: Synthesis of Best Practices for Pass Operations

Topic Area :   <u>**Methods**</u>   Equipment   Materials   Training   Technology

1) Explain the specific problem or issue.
   There is a need to identify best practices for winter operations dedicated to keeping mountain pass highways open to travel. Much of the winter budget in states with mountain passes is obligated to this function.

2) List the proposed research objectives.
   Identify Snow states with mountain passes, and solicit from them their best practices in maintaining operations during winter weather. Bank cutting, shoulder widening, drift prevention, avalanche mitigation are a few of the practices which need to be explored.

3) List the tasks that would form the scope of work.
   - Literature search for mountain pass winter operations
   - Identify best practices
   - Identify snow states with mountain passes
   - Develop questionnaire, or survey tool regarding winter operations on mountain passes
   - Meld the results into a synthesis report

3) Describe the expected outcomes of the research?
   - **What products would result from the project?**
     Synthesis report

   - **What audience(s) would the product(s) be intended for?**
     DOTs and other Public Works departments responsible for Winter Operations of Mountain Passes

   - **How would the results benefit DOTs?**
     By introducing new or better methods of providing winter maintenance operations on mountain passes. This may allow more efficient and cost effective delivery of winter maintenance operations.

   - **How would they be used?**

4) Estimated funding needed. $75,000

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

6) Are you aware of any similar or related research on this topic? If so, please list below.
   Not to my knowledge.

2012 Research Proposal Form

Proposer name: Annette Dunn
Organization: Iowa DOT
E-mail address: Annette.Dunn@dot.iowa.gov

Title of proposed research synthesis or project:
Installation and Evaluation of Mobile Salinity Sensors and Data Integration

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

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

Transportation agencies are attempting to optimize chemical usage in snow and ice control operations. There have been steady improvements in decision making methods, spreader equipment, chemistry, and road weather forecasting, each resulting in improving the efficiency and effectiveness of snow and ice control operations. However, only a few sensors have been developed to measure the treatment outcomes. The chemical sensors installed with RWIS stations do not produce reliable data so are seldom used in measuring the treatment outcomes. Manually operated sensors appear to provide reliable measurements, but are very labor intensive and operators are constantly in harm's way.

The need for measuring salinity of the moisture on the road surface has been identified as an unmet research need at three Winter Maintenance Peer Exchanges. In 2007 this need was ranked #9, in 2009 received a ranking of #12 and in 2010 ranked #9. The need to measure salinity and develop a chemical trace for the roadway is essential to optimizing subsequent treatment recommendations.

An on-vehicle salinity sensor was developed and evaluated on the Highway Maintenance Concept Vehicle and worked successfully in determining salinity of road surface moisture during snow and ice control operations. Details can be found in the "Highway Maintenance Concept Vehicle, Final Report: Phase Four", June 2002, pages 43-54. The report can be found at www.intrans.iastate.edu/reports/concept4pdf . Minor design changes were needed in the sensor cleaning system before it would be ready for deployment.

A world-wide search for existing technology using the SICOP List-Serve has been made and several mobile technologies using mobile, fixed, and portable sensors have been identified as market-ready.   Information has been gathered on freeze/thaw technology being used in Sweden and refractometer technology being used in Japan. These technologies have been employed in both countries for several years to help optimize their snow and ice control operations.

2) **List the proposed research objectives**

Purchase international salinity sensor systems technology, install sensors and related equipment, integrate data flow into maintenance management systems, perform field evaluations beginning with the 2012-2013 winter. Document results of findings

3) **List the tasks that would form the scope of work**

Negotiate contracts with the two companies (one in Sweden and one in Japan) for the purchase of two salinity sensors systems and the technical support for installation and integration with Iowa DOTs AVL/GPS and maintenance management systems.

4) Describe the expected outcomes of the research

- What products would result from the project?

The product would be a mobile freezing point surveillance system that would accurately measure the freezing point of the pavement surface moisture, report the data through an existing AVL/GPS system and integrate with the agency's data reporting system. All public agencies and private contractors

- How would the results benefit DOTs?
- Provide feedback on the effectiveness of their chemical applications,
- Provide accurate freeze point data for determining subsequent application rates
- Improve the efficiency and effectiveness of snow and ice control operations
- Optimize the use of chemistry
- Minimize negative impact to the receiving environment

- How would they be used?

The freezing point surveillance system would provide chemical traces on the roadways for use by snow and ice control operations personnel, new media, road condition reporting.

5) Estimated funding needed. $150,000.

6) Estimated timeline for completion of the research.
- Six (6) months _____
- Twelve (12) months _____
- **Eighteen (18) months __X___**
- Other: ____ months

7) Are you aware of any similar or related research on this topic?

"Highway Maintenance Concept Vehicle, Final Report: Phase Four", June 2002, pages 43-54, www.intrans.iastate.edu/research/concept4.pdf

2012 Research Proposal Form

Proposer name: Annette Dunn
Organization: Iowa DOT
E-mail address: Annette.Dunn@dot.iowa.gov

Title of proposed research synthesis or project: Improving Snow Plow Design

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

1) Explain the specific problem or issue.

New materials are continually being developed that are lighter and stronger than the materials currently used in most snow plows built today. Many agencies are still specifying plows that are based on 1950's needs for brute strength to clear heavy snowfalls even though they are now more proactive in their operations and the need for brute strength may no longer be appropriate. Most agencies are also not waiting until snow piles up deep on the roads before they begin their plowing operations. Snow plow designs need to be updated and optimized to reflect the latest practices and make the best use of the latest materials, technologies, designs and other components for snow plows.

2) List the proposed research objectives.

The goal of this project is to identify new materials, technologies, designs and other components for snow plows and rate them according to performance criteria. This would help agencies determine which of the latest commercially available innovations could be used to optimize their snow removal operations. This project will look at both front plow and under body materials, technologies and designs and include the hitch and hydraulic power connections, the moldboard, and the cutting edge(s). The results should give DOTs the necessary tools to improve specifications and drive the industry to produce products that best satisfy agency needs.

3) List the tasks that would form the scope of work.

Task #1: Synthesis Report
Conduct a thorough literature search and survey maintenance staff at national and international agencies to identify innovative, commercially available technologies, designs, materials and other components used in snow plows or similar equipment. Research the aircraft, aerospace, and other similar industries for the materials they use that might be applied to snow plow designs.

Task #2: Develop a Rating Methodology
Develop a methodology for evaluating products identified in Task 1 according to performance criteria developed in consultation with the project subcommittee (weight, strength, vibration, visibility, etc). The goal of the methodology will be to develop a rating system that would allow DOTs to select the materials, technologies, designs and other components for snow plows (or develop a specification) that will satisfy the optimization criteria most important to their operations.

Task #3: Product Testing
Conduct physical testing or develop CAD models to evaluate the performance of selected products according to the performance criteria established in Task 2.

Task #4: Develop Final Matrix of Designs, Materials and Technologies.
Develop a matrix of the designs, materials and technologies tested and their performance characteristics. The proposed matrix would allow DOTs to select the design or develop a specification to best satisfy the criteria most critical to their operational needs.

3) Describe the expected outcomes of the research?
- **What products would result from the project?**

Task 1 Deliverable:
1. A synthesis report that summarizes the findings of the literature search, survey and other efforts to identify the latest innovations.

Task 2 Deliverable:
1. Concise Memorandum of Findings that outlines the rating methodology and the matrix.

Task 3 Deliverables:
1. Compile a list of products and components identified in Task 1 and their structural characteristics.
2. A Concise Memorandum of Findings that describes the testing methods applied to the selected products and the findings.

Task 4 Deliverables:
1. A matrix of the designs, materials and technologies tested and their performance characteristics.
2. A final report that includes an executive summary and summarizes the findings of Tasks 1-4.

- **What audience(s) would the product(s) be intended for?**
Winter maintenance decision makers at state, local, federal agencies, as well as equipment manufacturers.

- **How would the results benefit DOTs?**
Help drive the industry towards a more efficient snow plow design.

- **How would they be used?**
To develop specifications for ordering future snow plows and to help guide manufacturers in understand design changes that would be useful to DOTs.

4) Estimated funding needed. $50,000

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

6) Are you aware of any similar or related research on this topic? If so, please list below.
The multiple blade plow project made some headway on this topic. We are not aware of other current efforts though.

2012 Research Proposal Form

Proposer name: Paul G Brown and Mike Lashmet
Organization: MassDOT and NYDOT
E-mail address: Paul.Brown@state.ma.us and mlashmet@dot.state.ny.us

Title of proposed research synthesis or project: Snow and Ice Chemical Application Rate on Open Graded Friction Course Pavements, Gap Graded Pavements, Ultrathin Bonded, Gap-Graded Wearing Course (Nova Chip)

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

1) Explain the specific problem or issue:

When applying de-icing chemicals on open the above mentioned pavements, field personnel are reporting several issues relating to pavement performance. Road appears to refreeze quicker, stays wet longer, require 25-30% more de-icing chemical.

2) List the proposed research objectives.

This research proposal will answer several important questions relative to using the following pavement types Open Graded Friction Course Pavements, Gap Graded Pavements, ultrathin bonded, gap-graded wearing course (Nova Chip). If a state chooses these types of pavements a guideline will be available.

3) List the tasks that would form the scope of work.

- Do a complete literature search, including the European research Community.
- Establish what best methods work on these types of pavements,(Pre-Treating, Slurry Spreading, Pre-Wetted, Solid Materials.
- Identify and actually explain exactly what happens (to the applied Chemicals) with these types of pavements
- Create guidelines on application rates (Amounts)
- Guidelines of when to achieve best results (Timing)

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  Guidelines on best practices, application rates and what materials would perform.

- **What audience(s) would the product(s) be intended for?**
  This will be directed towards DOT's but would not be limited to County, Cities

- **How would the results benefit DOTs?**
  Establish best methods to treat Open Graded Friction Course Pavements, Gap Graded pavements and Nova Chip treated roads

- **How would they be used?**
  They will produce either a booklet of best methods, video possibly and best application methods

4) Estimated funding needed. $200,000

5) Estimated timeline for completing the research.
- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months _____
- **Other: __24___ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
Yes a couple of papers were written in Europe. Do not believe any physical research has been done in cold regions of North America.

2012 Research Proposal Form

Proposer name: Paul Brown and Monty Mills
Organization: MassDOT and Washington DOT
E-mail address: Paul.Brown@State.ma.us and MillsM@wsdot.wa.gov

Title of proposed research synthesis or project:
Establishing Effective Salt and Anti-icing Application Rates

Topic Area: <u>**Methods**</u>   Equipment   <u>**Materials**</u>   Training   Technology

1) Explain the specific problem or issue.

Transportation agencies have been using salt and liquid anti-icing applications for many years based on results from the FHWA TE 28 Project, the NCHRP Report #526, and many other sources of information either in published form or anecdotal form from agency experience. Extensive field testing during the TE 28 Project resulted in the Manual of Practice for an Effective Anti-icing Program. This has been the basis for more area specific guidelines since its publication in 1996.

In the 16 years that have elapsed since the publication of that manual, more sophisticated methods and procedures have been developed in the field of salt (chlorides) and anti-icing applications. This would include the use of slurry, enhanced brine blends, agricultural by-products as inhibitors or adjuvants, and the growing use of chloride alternatives such as acetates and glycols.

Additionally, the awareness and concern about chloride loading in the environment has caused many agencies to reevaluate their practices with respect to solid and liquid chloride applications. Agencies are being tasked with maintaining historical and expected service levels without relying solely (or at all) on chloride based products.

Given these challenges, and the growing complexity of material use in winter operations, it is time to update traditionally held ideas about snow and ice material applications. Using the aforementioned guidelines as a basis, newer guidelines are needed to accommodate current expectations, and to guide the use of snow and ice products not previously known.

2) List the proposed research objectives.

Establish effective material application rates for a broad range of chloride-based anti-icing and de-icing products, methods and operations.

Use the approved products list established by the Pacific Northwest Snowfighters as the starting point for product categories that are related to their snow melting performance and environmental impacts.

Establish a crosscheck list that recommends alternative products to chlorides which will provide similar results.

Create guidelines for the use these products (When best to apply them and how much is effective under specified winter storm categories.

3) List the tasks that would form the scope of work.

Complete Literature search from around the world for alternative products and applications recommendations and for field-based test and validation studies on the effectiveness of alternative practices and products under field conditions, and structured interviews of practitioners across North America to obtain details on rules of practice under various weather scenarios.

Provide guidelines for selecting proper sequence of operations, application rates and timing for different:
- Weather Patterns
- Temperatures
- Pavement Types
- Storm Scenarios
- Route lengths and thus cycle times

3) Describe the expected outcomes of the research?

- **What products would result from the project?**

    A tool which can be used by snow and ice response practitioners to select tactical anti-icing, plowing and de-icing practices, materials, and application rates for a wide variety of product categories applicable to the key weather scenarios that occur in North America [or snow states].

- **What audience(s) would the product(s) be intended for?**

    Tool should be available for all involved in Snow and Ice control operations.

- **How would the results benefit DOTs?**
    - Increase and improve snow and ice fighting capabilities.
    - Potential for lower costs through more efficient operations.
    - Ability to meet environmental standards.
    - Identify the minimum effective rates for individual chemical applications and total for a particular type of storm.

- **How would they be used?**
    - This tool could be used in establishing guidelines to fit the proper pavement type, storm conditions or weather conditions
    - Used to review its existing snow and ice control practices against practices used by other agencies that experience similar storm conditions and operational constraints.

4) Estimated funding needed. $150,000

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

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

TE 28 – Manual of Practice for an Effective Anti-icing Program
NCHRP Report 526
NCHRP Synthesis 344
NCHRP Report 577
Effectiveness of Alternative Chemicals for Snow Removal on Highways", L. Fu , R. Sooklall and M. Perchanok,. TRB, Transportation Research Record, January 2006

Field Test of Organic Deicers as Prewetting and Anti-icing Agents for Winter Road Maintenance, R. Omer, TRB Annual Meeting, January 2012.

2012 Research Proposal Form

Proposer name: Tim Croze
Organization: Michigan DOT
E-mail address: crozet@michigan.gov

Title of proposed research synthesis or project:
Comparison of Salt Distribution Systems

Topic Area: Methods   **<u>Equipment</u>**   Materials   Training   Technology

1) Explain the specific problem or issue.
There are possibly dozens of different types of material delivery systems such as chutes, spinners, zero velocity, augers, etc. The spreading systems can have a wide range of costs and effectiveness. Some agencies even make their own systems out of scrap material available at a maintenance garage. We do not know which of the delivery systems are the most effective so a test is necessary to assist DOTs in ensuring that we are using the most effective system.

2) List the proposed research objectives.
The object is to find as many types of delivery systems in use as possible through a survey and document all of these in a report with pictures and contact names.

Pick several of the most common types of systems and perform a field evaluation at different application speeds to determine which systems are the most effective at reducing bounce and scatter.

3) List the tasks that would form the scope of work.
- Survey of agencies on their current delivery systems
- Pictures and contact names for the different types of systems in use
- Literature search for related research
- Field test and evaluation of several different delivery systems at different speeds to determine which systems are the most effective at reducing bounce and scatter of salt.
- Possibly a sample specification for purchasing the recommended type of delivery system

4) Describe the expected outcomes of the research?
   - **What products would result from the project?**
      Literature search
      Recommendation on the most effective type of salt delivery system.

   - **What audience(s) would the product(s) be intended for?**
      Fleet managers
      Maintenance managers

   - **How would the results benefit DOTs?**
      Help with making purchasing decisions on equipment

   - **How would they be used?**

4) Estimated funding needed. $250,000

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

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

2012 Research Proposal Form

Proposer name: Tim Chojnacki
Organization: MoDOT
E-mail address: Tim.Chojnacki@modot.mo.gov

Title of proposed research synthesis or project: Plowing During Whiteout Conditions

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

1) Explain the specific problem or issue.

When conditions exist that produce zero or near zero visibility it is unsafe or impossible for snowplow operators to continue to plow. During these times when snowplows are not plowing, roads quickly become covered and often times blocked by stranded or disabled vehicles. This dangerous condition could be improved if plows could continue to operate regardless of weather and visibility conditions.

2) List the proposed research objectives.

The objectives of this research would be to identify the technology available to equip a snowplow truck to operate in "auto pilot" during extreme conditions. The technology would keep the vehicle moving in the predetermined path and also include crash avoidance capabilities. It is believed that such as system would be used on a limited basis, only on highly travelled significant corridors such as interstate highways.

3) List the tasks that would form the scope of work.

- Identify technologies used in other industries (airlines, construction, mining, etc) that regularly move or control vehicle functions without operator input.
- Determine the reliability of such technologies to operate correctly and safely during zero visibility conditions.
- Explore existing crash avoidance systems to determine if the technology exists to prevent remotely operated vehicles from encountering disabled vehicles in their path
- Propose a prototype or pilot vehicle to be tested in a controlled environment in a future study.

3) Describe the expected outcomes of the research?

- What products would result from the project?

A report describing findings of research

- What audience(s) would the product(s) be intended for?

State Highway Agencies, Toll Authorities

- How would the results benefit DOTs?

If the technology exists, agencies could more safely provide reliable transportation corridors to the public.

- How would they be used?

The results could be put in place if the technology exists – or shared with industry to develop future technologies that may provide this capability.

4) Estimated funding needed. $50,000

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

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

2012 Research Proposal Form

Proposer name: Mike Mattison and Troy Whitworth
Organization: Nebraska DOT and Kansas DOT
E-mail address: mike.mattison@nebraska.gov and Troy@ksdot.org

Title of proposed research synthesis or project: Determining the Effect of Pavement Surface Type on Snowplow Blade Life

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

1) Explain the specific problem or issue.

Snow plow blades are a significant cost in winter highway maintenance programs. State agencies may spend $500,000 to $1,000,000 per year on plow blades. Carbide inserts, skid plates, alternative materials, and flexible blade designs have all been used to improve performance and extend the life of plow blades. The useful life of snow plow blades is affected by several factors, including the blade type and quality, operator techniques, and road condition.

Reports from field personnel indicate the type of aggregate on the pavement can have a significant impact on the longevity of plow blades. In particular, chip seals using hard, highly angular ledge rock chips may reduce the blade life more than those that use gravel or lightweight aggregates. The size of the aggregate may also play a role in the rate of deterioration of plow blades.

2) List the proposed research objectives.

The proposed project will compare blade life in controlled field tests on chip sealed highways with different types of aggregates. Mitigation strategies including blade selection, operator technique, skid plates and other solutions will be identified and tested for effectiveness. The cost of more frequent blade replacement will be compared with the cost of aggregate options and mitigation strategies. Advantages and trade-offs of the various options will be documented. The effect of each mitigation strategy on snow plow damage to road surfaces should also be documented.

3) List the tasks that would form the scope of work.

Compare the relative effect of several types of pavement aggregates on plow blade life, primarily focused on chipseals. The potential cost impact should be considered.

Compare mitigation strategies to extend plow blade life on chip seals with aggregates that are detrimental to plow blade life. Advantages, tradeoffs, and lifecycle costs should be included.

3) Describe the expected outcomes of the research?
- What products would result from the project?

Deliverable 1: A report comparing the relative effect of several types of pavement aggregates on plow blade life, primarily focused on chipseals. The potential cost impact should be considered.
Deliverable 2: A report comparing mitigation strategies to extend plow blade life on chip seals with aggregates that are detrimental to plow blade life. Advantages, tradeoffs, and lifecycle costs should be included.

- What audience(s) would the product(s) be intended for?

Agency maintenance, design and construction personnel.

- How would the results benefit DOTs?
Help identify ways to save money.

- How would they be used?
Analyze the costs involved in mitigation strategies to extend plow blade life on chip seals with aggregates that are detrimental to plow blade life.

4) Estimated funding needed. $TBD

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

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

2012 Research Proposal Form

Proposer name: Charles C Goodhart
Organization: Pennsylvania Department of Transportation; Bureau of Maintenance & Operations
E-mail address: cgoodhart@pa.gov

Title of proposed research synthesis or project: Sustainable Snow Removal System

Topic Area: __Methods__   Equipment   Materials   Training   Technology

1) Explain the specific problem or issue.

The current practice for snow and ice control is to apply chemicals, let them work and then plow them off. This cycle is then repeated as much as necessary during a winter storm event to provide safe and passable roadways for customers. Although in recent years there has been more concentration on finding the ways and means to remove snow and ice more effectively with plows and chemicals, we have not looked at a total sustainable systematic process to remove snow and ice from pavements.

This study would research how to design a Sustainable Snow Removal System that would require fewer chemicals, fuels, energy, etc. and allow for easier mechanical removal of snow and ice from the pavement surface. The researcher would work with pavement and materials engineers, truck/body manufacturers, plow manufactures, plow blade manufacturers, pavement marking firms, spreader control manufactures, weather forecasters or MDSS providers, etc. to develop and design a Sustainable Snow Removal System to more efficiently and effectively remove snow and ice from pavements.

2) List the proposed research objectives.

The objective of the research would be to study all the various sundry components of removing snow and ice from pavements and come up with a sustainable system approach that reduces the use of chemicals, reduces the energy it takes to perform winter services, reduces highway accidents/fatalities, maintains or increases the level of winter service, increases the life of pavement markings-RPMs-paint lines, reduces the damage to pavement surfaces and reduces deleterious impacts to the environment, highways, bridges, appurtenances and equipment.

3) List the tasks that would form the scope of work.

A. Literature Search and state of the art/practice report
B. Survey of States, Countries, Associations, Industries, etc. to ascertain if they have any past or present projects to develop a Sustainable Snow Removal System or another system like this that could be studied to gain knowledge and insight into its development, implementation and efficacy.
C. Report on how developed the concept of a Sustainable Snow Removal System is and what gaps in knowledge/technology would need to be bridged to implement the System.
D. Design of a pilot project to test whether a Sustainable Snow Removal System is cost beneficial.

3) Describe the expected outcomes of the research?
- What products would result from the project?
A Sustainable Snow Removal System

- **What audience(s) would the product(s) be intended for?**
  State DOT's, Municipalities, etc. engaged in winter operations

- **How would the results benefit DOTs?**
  Reduction in the use of chemicals, reduction in the energy it takes to perform winter services, reduction in highway accidents/fatalities, preservation or increase in the level of winter service, increase in the life of pavement markings-RPMs-paint lines, reduction in the damage and or deleterious impacts to pavements, bridges, appurtenances, the environment and equipment.

- **How would they be used?**
  Over time, State DOT's could implement this system which would allow for benefits as described above.

4) Estimated funding needed. $100,000

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

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

2012 Research Proposal Form

Proposer name: Allen Williams
Organization: VDOT
E-mail address: allen.williams@VDOT.Virginia.gov

Title of proposed research synthesis or project: Measuring Road Surface Friction from Tire Slip Differential

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

1) Explain the specific problem or issue.

Road surface friction is an important measure in the performance of snow/ice control operations. Having a good/reliable/repeatable means of measuring road surface friction would provide roadway maintenance organizations with the data to better measure performance and direct snow/ice removal operations. The latest vehicle breaking and stability control systems measure tire slippage. Knowing the differential between the number of drive wheel rotations and non-drive wheel rotations in comparison to differential GPS distance traveled, the amount of slippage can be determine and translated into a friction factor. If this information can be collected from the thousands of vehicles using the roadways at any one time, we can quickly develop an indication of the road surface friction.

2) List the proposed research objectives.

1. Determine the ability to collect tire rotation data from vehicles for both the drive axle and non-drive axle,
2. Determine how the slippage between drive axle and non-drive axle wheels translates to road surface friction,
3. Provide recommendations for implementation of a performance standards by which to snow/ice control operations and future research need to make this method of measuring road surface friction a usable indicator for performance measurement.

3) List the tasks that would form the scope of work.

1. Literature search
2. Investigate the automobile and trucking industry to determine the type of differential wheel rotation/slippage data being collected.
3. Correlate differential wheel rotation/slippage data to roadway surface friction.
4. Determine a means of collecting wheel rotation data in a manner it can be analyzed to provide a road surface friction factor.
5. Provide a recommended set of performance standards based upon this research
6. Provide a recommended implementation plan
7. Provide recommended future research to make this method of measuring roadway surface friction a usable means of measuring performance of snow/ice control operations.

3) Describe the expected outcomes of the research?
- What products would result from the project?
1. A report on an exhaustive literature search on the subject
2. The type and format of differential tire rotation/slippage data available from vehicles
3. A correlation between differential tire rotation/slippage and roadway surface friction
4. A set of performance standards based upon road surface friction
5. An implementation plan for obtaining vehicle data, processing the data and utilizing the data to determine snow/ice control performance

6. Suggested future research for making this means of measuring snow/ice control operations a reality

- **What audience(s) would the product(s) be intended for?**
    1. State Departments of Transportation
    2. Municipal Public Works

- **How would the results benefit DOTs?**
    1. Provide a means of measuring performance of snow/ice control operations
    2. Provide a means for determining where roadways are becoming impacted due to snow and icy conditions

- **How would they be used?**
    1. Provide a means of measuring state force and contractor snow/ice control operations
    2. Provide real-time roadway information so crews can be dispatched to the most impacted roadways first
    3. Provide real-time information about roadway conditions so different treatment options can be assessed

4) Estimated funding needed. $150,000

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

6) Are you aware of any similar or related research on this topic? If so, please list below.
1. Previous research for Plug and Play Instrumentation looked at the vehicle buss systems and how information can be obtained from vehicle manufactures
2. Numerous studies to determine means of measuring reliable and repeatable road surface friction during snow removal

2012 Research Proposal Form

Proposer name: Allen Williams
Organization: VDOT
E-mail address: allen.williams@VDOT.Virginia.gov

Title of proposed research synthesis or project: Suitability of Salt Loving Plantings along Roadways and Their Usability to Recycle for Deicing

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

1) Explain the specific problem or issue.

Millions of tons of chlorides are placed on the nations roadways annually to keep the roadways passable during winter weather events. Increasing numbers of environmental groups are placing pressure on roadway agencies to reduce or eliminate the amount of chlorides placed in the environment for snow/ice control. Certain plants absorb and hold salts within their biological structure. Such plants can be harvested and converted into a de-icing agent as a means of recycling the salts placed on the roadways.

2) List the proposed research objectives.

1. Halophytic plant species will be identified and evaluated for their suitability as roadside plantings and phytoremediators of salt.
2. Halophytic plants established in salt-rich roadside environments in snow belt states, or simulated conditions within greenhouses, will be harvested and chemically analyzed.
3. Produce biochar from harvested plant tissue using pyrolytic bioconversion processes employed to produce biofuel precursors.
4. Determine the suitability of biochar as a de-icing agent will to be assessed using laboratory measurement of freezing point depression and field evaluation of four roadway treatments; biochar only, salt-rich biochar only, biochar combined with salt, and salt only.

3) List the tasks that would form the scope of work.

1. Literature research
2. Develop a listing of halophytic plants, ability to absorb salts, suitability to various climates and suitability as a roadside planting
3. Establish plantings of those species suitable for snow-belt climates and roadside use
4. Apply chemicals used typically used in the control of snow/ice to plantings and chemically analyze the plants for salt absorption
5. Harvest those plants exhibiting a high level of salt absorption to be converted into an de-icing agent.
6. Analyze each de-icing agent to determine its de-icing capabilities
7. Run comparative field tests of biochar only, salt-rich biochar only, biochar combines with salt and salt reporting results in a manner to determine the effective use of biochar as a de-icing agent
8. Provide a cost analysis of establishing halophytic plants on roadsides, harvesting halophytic plants and converting the plant matter into biochar for use as a deicer
9. Determine the feasibility of state DOT's implementing a roadside program with halophytic plantings

3) Describe the expected outcomes of the research?
> **- What products would result from the project?**
>> 1. Listing of halophytic plant species and their suitability in snow-belt state as roadside plantings
>> 2. The costs associated with planting, cultivating, harvesting and converting halophytic plants into biochar
>> 3. An analyses of the effectiveness of biochar as a de-icing agent
>> 4. An evaluation of the suitability of implementation of roadside planting halophytic planting for recycling as a de-icing agent.
>
> **- What audience(s) would the product(s) be intended for?**
>> 1. State Departments of Transportation
>> 2. Municipal Public Works Departments
>
> **- How would the results benefit DOTs?**
> Having a means of removing de-icing chlorides from the environment would be a positive step toward calming environmentalists' concerns over DOT's introducing too many chlorides into the environment due to snow/ice control operations. The ability to recycle plant material into a de-icing agent would be another step toward movements to limit or prohibit chlorides being used for snow/ice control operations.
>
> **- How would they be used?**
> States could determine their need to implement a program for installing halophytic planting along roadways to abate the amount of chemicals applied for snow/ice control operations. States would have a estimate of the costs associated with planting and cultivating halophytic plants plus the opportunity for recycling the plant material into a de-icing agent.

4) Estimated funding needed. $125,000

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

6) Are you aware of any similar or related research on this topic? If so, please list below.
> Not at this time.

2012 Research Proposal Form

Proposer name: Monty Mills
Organization: WSDOT
E-mail address: millsm@wsdot.wa.gov

Title of proposed research synthesis or project: Pacific Northwest Snowfighters (PNS)

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

1) Explain the specific problem or issue.

PNS is widely recognized as the premier deicer material research, testing, and product approval entity in North America. Many states and provinces rely on the PNS Qualified Products List (QPL) and the PNS Product Specifications as standards for accepting products for bid on their contracts. Additionally, PNS is the clearinghouse for questions regarding deicer characteristics, and a primary sponsor of research into deicer performance.

With the impending conclusion of the Inhibitor Longevity and Deicer Performance research project sponsored by PNS, the organization will soon no longer have a Pooled Fund Project assigned to it, and will begin to function solely as an unaffiliated association of Northwest states and provinces. Without a steady and reliable source of funding to continue the core mission, PNS could lose the ability to keep the specifications and the QPL viable as a standard for other states and provinces to rely upon.

2) List the proposed research objectives.

The objective of this research is to support the continued work and knowledge of PNS in the realm of deicer performance and characteristics. As a Pooled Fund effort, under the auspices of Clear Roads, research can be championed to identify environmentally benign alternatives to chlorides, best practices for deicer applications, innovations in corrosion inhibitor products, deicer enhancement products, and many other aspects of deicer technology. As a sub-set of Clear Roads, PNS can also continue to produce updates to the QPL, field questions on deicer products, and provide deicer testing specifications via an independent web site, or a link within the Clear Roads site.

3) List the tasks that would form the scope of work.
- Prepare and/or review deicer material research problem statements.
- Determine timelines and budgets of approved research.
- Review proposals and recommend research entities to the larger group.
- Serve as the Technical Advisory Committee on deicer research.
- Review research updates and prepare status reports for the larger group.
- Troubleshoot research challenges and work closely with research entities.
- Review draft final reports and address shortcomings or inconsistencies.
- Provide comments to larger group on the research outcome, and recommend approval or rejection of final reports.
- Evaluate the need for further research and provide recommendations.

3) Describe the expected outcomes of the research?
- What products would result from the project?
- Continuous analysis of needs within the realm of deicer research.
- Knowledgeable review of ongoing deicer research.

- Identification of research entities equipped to perform deicer research, and their relative capabilities.
- Analysis of "best fit" products for any given region or climate.
- Continuously updated QPL and testing specifications.
- Central clearinghouse for deicer related questions and concerns.
- Website updates and maintenance.

- What audience(s) would the product(s) be intended for?
All users of deicer products.

- How would the results benefit DOTs?
Through the research analysis, testing, and comparison of deicer products so that DOT managers can make educated decisions on which products are most suited to their specific needs.

- How would they be used?
To determine best-fit products for any given climate or geographical location, assess product specific environmental impacts, compare performance, and provide specific product characteristics and blends.

4) Estimated funding needed. TBD

5) Estimated timeline for completing the research.
- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months _____
- **Other: __24__ months (On a renewable basis.)**

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

2012 Research Proposal Form

Proposer name: Michael Sproul
Organization: WisDOT
E-mail address: Michael.sproul@dot.wi.gov

Title of proposed research synthesis or project: Snowplow Operator and Supervisor Training

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

1) Explain the specific problem or issue.
Every state has some training for snowplow operators and their supervisors. Some of the training is better and more extensive than others. There are also several inconsistencies between states. This project would identify all the best training practices identified by the TAC in organize them into classroom courses that could be utilized by any Clear Roads states.

2) List the proposed research objectives.
The objective would be to create training courses for operators and supervisors that would contain all the best training practices in one location. There would be at a minimum 1 day, 2 day, and 5 day courses for both operators and supervisors.

3) List the tasks that would form the scope of work.
- Review snowplow operator training TRS.
- Work with list of best training materials identified by TAC.
- Obtain additional materials from states as necessary.
- Organize materials into 2 sets of courses, one for operators, one for their supervisors.
- Work with each Clear Roads states to identify specific unique state topics and tailor the materials for each state's purposes.
- Provide course guides and materials for each state.

3) Describe the expected outcomes of the research?
    - What products would result from the project?
      The courses would bring the best winter maintenance techniques to the forefront for each state.

    - What audience(s) would the product(s) be intended for?
      Snowplow operators and their supervisors

    - How would the results benefit DOTs?
      We would all have readymade training materials that could be used to certify snowplow operators and their supervisors.

    - How would they be used?

4) Estimated funding needed. $100,000

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

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

No.

2012 Research Proposal Form

Proposer name: Kyle Stollings
Organization: West Virginia DOT
E-mail address: W.Kyle.Stollings@wv.gov

Title of proposed research synthesis or project: Salt Brine Primer

Topic Area: <u>**Methods**</u>   Equipment   Materials   Training   Technology

1) Explain the specific problem or issue.
Sodium chloride brine is the most common brine used in winter operations but there is a lack of consolidated information regarding the formulation, production, storage, application methods, and application rates.

2) List the proposed research objectives.
- Compile current information on formulation, production, storage, application methods, and application rates.
- Identify brine blends, admixtures, enhancements, etc. that may be used as a guide for future research and reference.

3) List the tasks that would form the scope of work.
- Compile current information on formulation, production, storage, application methods, and application rates.
- A suggested list of training materials and methods derived from the above.
- Included as an Appendix; identify brine blends, admixtures, enhancements, etc., that may be used as a guide for future research and reference.
- Write the synthesis.

3) Describe the expected outcomes of the research? What products would result from the project?
- A synthesis report on sodium chloride brine production and use.
- Recommendations for training materials.
- An appendix outlining brine blends, admixtures, enhancements, etc. that may be used as a guide for future research and reference.

   - What products would result from the project?
   All snowbelt DOTs and municipalities from the manager to the operator/driver level.

   - How would the results benefit DOTs?
   Optimized application rates, route cycles, and costs.

   - How would they be used?
   Assessment of current practice and proposed operational changes, planning guide, basis for performance measures, training, other.

4) Estimated funding needed. $65,000

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

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

No.

2012 Research Proposal Form

Proposer name: David C. Wieder
Organization: Colorado DOT
E-mail address: david.wieder@dot.state.co.us

Title of proposed research synthesis or project: LOS for Winter Mobility

1) Explain the specific problem or issue.
Developing a Level of Service for snow and ice control based on travel speed and congestion (LOS for Winter Mobility). We know that traffic speeds are impacted during winter storm events but we don't have a measure for that. Many states have designated levels of service based on bare regain time of the pavement but we have no measure of how we are providing a level of service for in storm events as they relate to traffic speeds and congestion. We have Road Weather Information System (RWIS) networks and we have traffic counting devices, some on RWIS stations that we could readily tie road and or weather conditions to speed and congestion.

2) List the proposed research objectives.
Formulate a tie between how DOTs perform snow and ice operations with traffic speeds and congestion. This will enable DOTs to have a clearer picture of the impacts and costs associated with varying levels of service during snow and ice operations.

3) List the tasks that would form the scope of work.
- Develop a method of gathering the necessary data from RWIS, and traffic speed measuring devices, or traffic counting devices.
- Conduct a literature search for methods of determining LOS in winter operations which factor in congestion and traffic speed.
- Identify best methods to tie LOS in winter operations to congestion and traffic speed.
- Produce report.

3) Describe the expected outcomes of the research?
   - **What products would result from the project?**

   Report

   - What audience(s) would the product(s) be intended for?

   DOT's and other Public Works departments responsible for Winter Operations

   - How would the results benefit DOTs?

   By being better able to assess the LOS their winter maintenance operations provide to their customers. This may allow more efficient and cost effective delivery of winter maintenance operations.

   - How would they be used?

4) Estimated funding needed. $75K_____

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

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

See results of literature search below.

LITERATURE SEARCH – LOS FOR SNOW AND ICE CONTROL

12/13/2011

Title: Analysis of Impact of Adverse Weather on Freeway Free-Flow Speed in Spain

Authors: Camacho, Francisco et al   Polytechnic University of Valencia

Abstract: Weather conditions affect traffic flow characteristics, including speed and capacity. Several studies have stated that rain, snow, wind speed, and visibility loss cause reductions in speed and capacity. Understanding these relationships is important to managing the traffic flow appropriately. This paper presents new research that evaluates the free-flow speed reduction caused by inclement weather conditions, including rain, snow, wind speed, and visibility loss. Fifteen freeway locations in northwestern Spain were selected for the study. Data were collected in 15-min intervals by weather and traffic stations for almost 3 years, from 2006 to 2008. Individual correlations between the weather and traffic variables were examined to select the most important weather variables and to identify speed trends and thresholds. All climate conditions were divided into four groups: no precipitation and temperatures above 0°C, no precipitation and temperatures below 0°C, rain, and snow conditions. A multiple nonlinear regression analysis was performed with the final variables. Results showed that rain and snow both caused a reduction in speed, with a more dramatic reduction during snow conditions. Wind speed over 8 m/s affected traffic speed, while the effect of visibility loss presented a logarithmic form. It was also determined that the location caused the variables to affect the speed differently, so further research should utilize a greater number of sites.   **http://dx.doi.org/10.3141/2169-16**

Title: Estimation of Road Capacity and Free Flow Speed for Urban Roads Under Adverse Weather Conditions

Publication Date: 2010   pp 812-818

Authors: Asamer, Johannes et al. johannes.asamer@ait.ac.at Austrian Institute of Technology

Conference: Intelligent Transportation Systems (ITSC), 2010 13th International IEEE

Location: Funchal, Madeira Island , Portugal   20100919 - 20100922

Abstract: This work aims to estimate changes in traffic characteristics of urban roads in dependence of adverse weather conditions like rain and snow. Investigated traffic characteristics are capacity and free flow speed which are elementary for describing the performance of traffic networks and setting up macroscopic traffic models. The methods are based on aggregated flow and speed measurements from local sensors. Results show a significant reduction of road capacity and free flow speed in dependence of intensity and type of precipitation.

Title: Levels of Service in Winter Maintenance Operations: A Survey of State Practice

Publication Date: 8/2009   278 p.   Clear Roads Pooled Fund Study CTC & Associates LLC

Abstract: Level of service is a measure used by transportation agencies to develop guidelines, classify routes and coordinate winter maintenance activities. The Clear Roads winter maintenance pooled fund is interested in learning how snowy states are using levels of service to provide for motorist safety and make effective use of limited resources. As the lead state for the Clear Roads pooled fund, Wisconsin DOT asked us to document the state of the practice for the use of levels of service in winter maintenance operations. We conducted a brief survey of three groups—SNOW-ICE listserv members, Clear Roads technical advisory committee representatives, and attendees of the 2007 National Winter Maintenance Peer Exchange—consisting of the following questions:

1. What are your agency's service level classifications?

2. What performance measures are used to determine if operations have met level of service guidelines for each classification?

3. How are routes monitored to determine if LOS guidelines are being met?

4. How much time is devoted to monitoring activities?

http://www.clearroads.org/downloads/tsrlevelsofservice.pdf

Title: Research Studies on Weather and Traffic Flow: Modeling Traffic Response to Adverse Weather

Publication Date: 20091100   FHWA-JPO-10-021   2p   Authors: Alfelor, Roemer M et al.

Abstract: Weather causes a variety of impacts on the transportation system. While severe winter storms, hurricanes, or flooding can result in major stoppages or evacuations and cost millions of dollars, the day-to-day weather events such as rain, fog, snow, and freezing rain can have a serious impact on the mobility and safety of users. The application of IntelliDrive technologies, Road Weather Information Systems (RWIS), and weather/traffic data collection and forecasting technologies, presents new opportunities to improve the safety and mobility of the traveling public through improved knowledge and understanding of how individual drivers behave during adverse weather, and analyzing how their decisions collectively impact traffic flow. This information can then be used to support weather-responsive traffic management strategies such as real-time modification of traffic signal and ramp meter timings, automated deicing systems, and variable speed limits. Despite the documented impacts of adverse weather on transportation, understanding the linkages between inclement weather conditions and traffic flow remain tenuous.

http://ntl.bts.gov/lib/33000/33700/33721/TrafficFlow_508_web/trafficflow_pdf.pdf

Title: Stability and Accuracy of HCM Level of Service in Darkness and Adverse Weather

Publication Date: 20080900   NJDOT-2008-007   78p

Authors: Chien, Steven I et al. chien@njit.edu   New Jersey Institute of Technology

Abstract: The Highway Capacity Manual (HCM) uses average travel speed to assign Level of Service (LOS) to urban streets and arterials. However, the HCM procedure for estimating travel speeds has weaknesses, particularly in the determination of the Free-Flow Speed (FFS), by failing to account for the impact of weather conditions (e.g., rain, snow, ice, etc,) and light conditions (e.g., sunglare, darkness, etc.). In this research, traffic data, under adverse weather, were collected and the impact of weather conditions on speed and density on selected New Jersey highways was investigated. Equations were developed to adjust the capacity estimation formula and figures suggested by HCM (2000) that can be used to accurately estimate travel times for buses and general traffic considering darkness and adverse weather.

http://www.state.nj.us/transportation/refdata/research/reports/FHWA-NJ-2008-007.pdf

Title: Inclement Weather Impacts on Freeway Traffic Stream Behavior

Authors: Rakha, Hesham Ahmed et al.   Virginia Polytechnic Institute and State University

Abstract: The research reported in this paper quantifies the impact of inclement weather (precipitation and visibility) on traffic stream behavior and key traffic stream parameters, including free-flow speed, speed at capacity, capacity, and jam density. The analysis is conducted using weather data (precipitation and visibility) and loop detector data (speed, flow, and density) obtained from the Baltimore, Maryland; Minneapolis–Saint Paul, Minnesota; and Seattle, Washington, areas in the United States. The precipitation data included intensities up to 1.6 and 0.33 cm/h for rain and water equivalent of snow intensity, respectively. The paper demonstrates that the traffic stream jam density is not affected by weather conditions. Snow results in larger reductions in traffic stream free-flow speed and capacity when compared with rain. Reductions in roadway capacity are not affected by the precipitation intensity except in the case of snow. Reductions in free-flow speed and speed at capacity increase as the rain and snow intensities increase. Finally, the paper also develops free-flow speed, speed-at-capacity, and capacity weather adjustment factors that are multiplied by the base clear-condition variables to compute inclement weather parameters. These adjustment factors vary as a function of the precipitation type, precipitation intensity, and visibility level. It is intended that these adjustment factors be incorporated into the "Highway Capacity Manual." **http://dx.doi.org/10.3141/2071-02**

Title: The Use of Average Traffic Speeds to Indicate Level of Roadway Snow and Ice Control Operations *(Available from CDOT Library)*

14p   Authors: Zwahlen, Helmut T et al. zwahlen@ohio.edu Ohio University, Athens

Abstract: A method for the use of the average traffic speeds to indicate the level of snow and ice control operations during a winter storm event is proposed. The winter roadway snow and ice control decision making process is conventionally based on subjective field observations made by the winter maintenance personnel. Almost half of the about 170 RWIS stations deployed in Ohio have pavement sensors which measure the average traffic speeds and the traffic counts in addition to the standard road weather parameters. Drivers were surveyed during winter storm events and the results were used to relate the level of snow and ice control operations to the traffic speeds expressed as a percentage of the average speed during dry conditions in winter as measured by the RWIS pavement sensors. Recommendations relating the percentage ranges of the average RWIS dry surface winter speeds to the level of snow and ice control operations are proposed. Average RWIS traffic speeds can be used to establish a more uniform and consistent level of winter maintenance decisions on an almost real time basis. It will also help to make winter maintenance activity evaluations more comparable across the state of Ohio.

Title: EFFECT OF ENVIRONMENTAL FACTORS ON FREE-FLOW SPEED

Authors: Kyte, M et al.   Fourth International Symposium on Highway Capacity

Abstract: The estimation of free-flow speed is an important part of the process of determining the capacity and level of service for a freeway. The "Highway Capacity Manual" (HCM) notes that the free-flow speed depends on both the traffic and roadway conditions found on a given freeway facility. Particularly important are lane width, lateral clearance, number of lanes, interchange density, and vehicle stream composition. The draft chapter on freeway facilities, to be included as chapter 22 of the HCM 2000, notes that "adverse weather can affect not only capacity, but also reduces operating speeds significantly." The chapter cites several studies that investigated the effects of rain, snow, and fog on both capacity and speed. The authors have studied the effects of a variety of weather-related environmental factors on driver speeds as part of an Intelligent Transportation Systems project that has been on-going in Idaho since 1993. Visibility and roadway sensors were installed on a segment of I-84 in southeastern Idaho in 1995. This project has generated substantial data on traffic flow rates and driver speeds during periods of reduced visibility and other hazardous driving conditions. While capacity is not an issue along this section of rural interstate freeway, the sensor infrastructure now in place provides an opportunity to determine the effects of various factors on free-flow speed. This study reports on data collected during two winter periods, 1997-1998 and 1998-1999.

http://onlinepubs.trb.org/onlinepubs/circulars/ec018/ec018toc.pdf

Submit proposal to:

Colleen Bos at colleen.bos@ctcandassociates.com

Call (608) 577-4805 or e-mail with questions.