

# Aurora Program

minutes

**Board Meeting  
October 7-9, 2014 – Ithaca, New York, USA**

## **Individuals Participating in the Meeting:**

Travis Lutman, North Dakota DOT  
Jason Norville, Pennsylvania DOT  
Jimmy White, Virginia DOT  
Dawn Gustafson, Michigan DOT  
Mike Adams, Wisconsin DOT  
David Wieder, Colorado DOT  
Ron Hall, Kansas DOT  
Tina Greenfield, Iowa DOT  
Curt Pape, Minnesota DOT  
Joe Doherty, New York State DOT  
Jack Stickel, Alaska DOT&PF  
Thomas Lyden, Ohio DOT  
Jeff Baker, Ontario MOT  
Anita Bush, Nevada DOT  
Tracy Larkin Thomason, Nevada DOT  
Chris Albrecht, Iowa State University – InTrans  
Keith Eggleston, Cornell University (Tuesday only)  
Maureen Kestler, USDA (Wednesday only)  
Dillon Ulrich, SUNY Oswego (Wednesday only)  
Andrew Janiszski, SUNY Oswego (Wednesday only)

Chris Albrecht welcomed the attendees and noted that a working session and conference call for Aurora Project 2011-02, a website review, FY2015 project proposals, a site visit and equipment demonstrations at the Ithaca facilities of Innovative Dynamics Inc., and a presentation by Keith Eggleston from Cornell University were held on Tuesday, October 7.

## **I. Open and General Items**

Aurora Program chair Travis Lutman began the meeting by briefly reviewing the agenda, which was then formally approved by the board as the meeting's order of business. Chris Albrecht noted that all previous meeting minutes had been approved. *A copy of the agenda is attached to these minutes.*

## II. Project Updates

Chris Albrecht provided a detailed summary of the program's 13 ongoing research projects from the "old" Aurora research program, SPR-3(042), as well as four newer FY2014 and FY2015 projects funded under the "new" TPF-5(290) number. *A copy of the summary is attached to these minutes as Attachment A.* Details of resulting project discussions follow:

**Project 2009-01 – Summary and Comparison of Agency Experiences with Sensors:** Both Chris Albrecht and Dawn Gustafson briefly reviewed progress on this project, noting that Curt Pape was currently updating the project spreadsheet with Minnesota DOT's experiences. Chris also noted that most members had submitted information on this spreadsheet to date. After a short discussion, the board agreed that the spreadsheet should be added to the "members only" side of the program website and a brief summary should be added to the website project list by Chris Albrecht. The board then voted to close this project and consider it complete. Chris also noted that this effort would not be using the \$5,000 in allocated funds, which he would allocate back into the general program fund.

**Project 2010-03 – Results-Based Winter Road Maintenance Standards:** Chris Albrecht and Jeff Baker reviewed the latest progress on this project provided by Max Perchanok, noting that the project was now funded for a total of \$260,000 from the SPR-3(042) account. A lengthy discussion followed concerning several aspects of this effort. Finally, Chris noted that the new tasks funded by the additional \$105,000 were just underway.

**Project 2010-04 – RWIS Sensor Density and Location:** Tae Kwon from the University of Waterloo called in to the meeting via a web meeting to provide an update on this research. Tae reviewed some background and progress to date on the different analysis approaches. *A copy of his presentation is attached to these minutes as Attachment B.* Tae also reviewed the status of additional datasets provided by Iowa, Ohio, and Utah. Chris noted that this effort should be completed in by early 2015.

**Project 2011-02 – RWIS Training Tool:** Tina Greenfield reported on this research effort, noting that the project team had met with the Iteris/Meridian consultant team via web meeting on October 7. She added that the project was well underway and progressing smoothly. She added that the estimated project completion date was the end of June 2016. In addition, a few project details were discussed by the attendees, and Chris Albrecht also noted that the project allocation/budget was \$265,000.

**Project 2012-01 – Validate the Accuracy of Pavement Condition Predictions from Various Sources, Phase 1:** Jeff Baker briefly reviewed the background on this effort, noting that the project was still in the RFP stage. Chris Albrecht noted that \$100,000 had originally been allocated for this overall effort, but that this project number, Aurora Project 2012-01, should now cover only the first phase of \$30,000. He also noted that the second phase is funded for \$105,000 under Aurora Project 2014-03.

**Project 2012-03 – Cameras and Operational Impacts of Remote Road Conditions:** Travis Lutman and Chris Albrecht both discussed this project, noting that the research team from BYU had submitted the final report this summer. After a lengthy discussion of this report, the board voted to close out this effort as complete.

**Project 2012-04 – Communicating and Publicizing Road Weather and Operations Information:** Chris Albrecht noted that he had sent a revised scope for this effort to Joe Doherty, which he was reviewing. A short Discussion followed, concerning the extent of the state-of-the-practice review. Chris noted that this effort had been narrowed in scope, with \$15,000 allocated toward this phase that could serve as a basis for further research.

**Project 2012-05 – Seasonal Weight Restrictions Demonstration:** Chris Albrecht introduced Maureen Kestler from the USDA, who was serving as the contractor for this research. Maureen gave a detailed presentation on the latest with this project. Overall, it was agreed that the researchers had made good progress to date.

### **III. Meet with SUNY Oswego Staff**

Next, the board listened to a presentation by Dillon Ulrich and Andrew Janiszkeski with the Lake Effect Storm Prediction and Research Center (LESPaRC) at the State University of New York – Oswego. Their presentation covered their work in forecasting lake effect storms for the New York State DOT and several local school districts. *A copy of their presentation is attached to these minutes as Attachment C.*

### **IV. Project Updates (continued)**

**Project 2013-02 – Transition of Clarus to MADIS:** Jack Stickel briefly reviewed the overall intent of this effort, noting that it included adding missing RWIS sites to the MADIS system, updating metadata, and participating in the MADIS Surface System web reviews. He also reviewed the MADIS website and noted that they are waiting on some final metadata before the official rollout. Chris Albrecht noted that the project would likely not be using the \$5,000 in allocated funds.

**Project 2013-03 – Improving Real-Time Traffic Speeds for Performance Measurement:** Tina Greenfield reviewed this effort. She noted that a sole-source contract with Iowa State University's Statistics Department was in place and work was being done. A lengthy discussion followed concerning details of the research plan. Chris Albrecht also noted that the project could likely involve a second phase of additional work, but that no funds have been approved or allocated to date. Tina also noted that this effort should be completed by the end of March 2015.

**Project 2013-04 – Quantifying Salt Concentration on Pavement, Phase 1:** Chris Albrecht and Jeff Baker briefly reviewed this effort, noting that a contractor had been selected. Chris also noted that the allocation for this first phase was \$35,000, with a second phase funded for an additional \$115,000 under the new TPF number as Project 2014-02.

**Project 2013-05 – Knowledge Base Content Management:** Chris Albrecht noted that the initial part of this project, updating the knowledge base site with a new format, was completed by InTrans under the administrative contract. Chris also noted that he had sent a scope to cover the remaining transfer of content and ongoing maintenance to Tina Greenfield for review. Chris also noted that the \$10,000 project allocation alone would likely not be enough to keep the site active for the next few years.

**Project 2013-06 – Make Aurora Severity Index Available to Other Agencies:** Tina Greenfield reviewed progress on this effort, noting that \$23,000 had been expended to date.

**Project 2014-01 – Seasonal Weight Restrictions Demonstration, Phase 2:** Chris Albrecht noted that \$200,000 had been allocated for this second phase under FY2014.

**Project 2014-02 – Quantifying Salt Concentration on Pavement, Phase 2:** Chris also re-iterated that this second phase was funded for an additional \$115,000 under the new TPF number as Project 2014-02.

**Project 2014-03 – Validate the Accuracy of Pavement Condition Predictions from Various Sources, Phase 2:** Chris noted that the \$105,000 second phase would be completed under the new TPF program number.

## **V. Future Meetings and Calls**

Next, the board discussed potential locations and dates for the next on-site board meeting. After a short discussion, the board agreed to meet in Nevada in March 2015. Chris Albrecht noted that he would investigate several locations with help from the attendees from Nevada DOT; including Reno, Carson City, and the Tahoe area.

The board then discussed dates and times of future web-based conference calls. After a short discussion, they decided on the following:

- Board web meeting on Tuesday, November 18, 2014 (1:00 p.m. CST)
- Board web meeting on Tuesday, January 6, 2015 (1:00 p.m. CST)

A Friends of Aurora event was also discussed, but no definitive plans were made. Chris noted that he would also arrange additional calls as needed.

## **VI. Program Administration and Financials**

Chris Albrecht briefly reviewed the program's finances; including the close-out of the "old Aurora" SP&R number, administrative contract expenses, and membership payments. Handouts covering these financials were provided.

## VII. Member Agency Updates

Next, the agencies in attendance each gave a brief review of their recent winter maintenance and road weather-related activities. *A handout summarizing many of these activities is attached to these minutes as Attachment D.*

**Alaska Department of Transportation and Public Facilities** – Jack Stickel reviewed recent activities in Alaska, noting issues with open polling of ESS devices and new sites to be deployed around the state. He also noted that Alaska is moving ahead with an RWIS avalanche detection camera system. He then showed several images related to the avalanche system.

**Wisconsin Department of Transportation** – Mike Adams discussed WisDOT’s newest RWIS sites, power issues, and several RFP’s that will be coming out soon. Mike also noted increased use of and issues with MDSS.

**New York State Department of Transportation** – Joe Doherty noted several developments with his state’s RWIS network, including a recent project with the New Jersey Institute of Technology to produce an “RWIS Statewide Implementation Plan”. He also noted that a copy of the final report was available to Aurora members on the website. Although not in a form that allows immediate implementation, it does contain some useful “technical approaches” for helping determine where RWIS sites could/should be placed, Joe added. After discussing the plan in some detail, Joe also discussed the “adoption” of NYSDOT’s RWIS network their Office of Traffic Safety & Mobility and the New York Statewide Mesonet project.

**North Dakota Department of Transportation** – Travis Lutman reported that North Dakota has continued to install Delcan ATMS software, but has run into some issues with compatibility. Travis also noted that NDDOT plans to move to more noninvasive technology in 2015. He also noted that their ITS budget had been increased, which should allow them to update remaining old sites in the next 2-3 years. Finally, Travis discussed AVL and a possible citizen reporting system.

**Iowa Department of Transportation** – Tina Greenfield gave a detailed overview of Iowa’s most recent activities. She reported on their RWIS-based salt dashboard, mini-RWIS, a survey on the need for more RWIS sites, and details of a new RWIS maintenance contract.

**Pennsylvania Department of Transportation** – Jason Norville reported that PennDOT had moved ITS activities under a new area as part of a top to bottom review of the entire department. He also discussed other issues with PennDOT’s RWIS, road condition categories, and bridge scour forecasting with the University of Pittsburgh.

**Virginia Department of Transportation** – Jimmy White briefly reviewed the latest news in Virginia; including the use of cameras along interstates, MDSS issues, and salt runoff. He also noted that VDOT now had about 100 RWIS statewide.

**Ohio Department of Transportation** – Thomas Lyden briefly reviewed the latest in Ohio. *A copy of his presentation is attached to these minutes as Attachment E.*

## **VIII. Member Agency Updates (continued)**

**Ontario Ministry of Transportation** – Jeff Baker briefly reviewed MTO activities, noting that they had recently added rain gauge observations and intensity-duration curves to RWIS web site. He also discussed the Transportation Association of Canada winter road condition classification, RWIS seasonal loads advisories, and an internal review of their operations. Finally, he noted that the province now had 149 RWIS and 9 spring load sites.

**Minnesota Department of Transportation** – Curt Pape reviewed the status of recent activities in Minnesota. He noted the expanded use of cameras at their sites, as well as infrared illuminators and replacement of precipitation sensors. Curt also noted that Minnesota now had 95 full RWIS sites throughout the state.

**Colorado Department of Transportation** – Dave Weider noted that CDOT has about 120 sites, which they are currently upgrading. He also discussed mobile RWIS, thermal mapping activities, mobile apps, and the addition of 8 new RWIS in the northwestern part of Colorado.

**Kansas Department of Transportation** – Ron Hall reviewed recent KDOT activity; including cellular communications, upgrading/changing RPU's and some sensors, and overall network health.

**Michigan Department of Transportation** – Dawn Gustafson reviewed a few items from the ITS World Congress held in September 2014, adding that MDOT had put a lot of resources into the event. She also noted that they are moving toward forward with evaluating and installing additional ESS in the Upper Peninsula along with multiple projects down state. In addition, she reviewed MDSS and noted that Michigan has approximately 55 RWIS sites statewide.

**Nevada Department of Transportation** – Anita Bush and Tracy Larkin Thomason briefly provided an update on Nevada's RWIS and winter-related activities. They noted communications issues, the 511 update, research initiatives, and a new wind warning system on Interstate 580. They also noted that Nevada now has 84 sites.

## **IX. 2015 Work Plan**

**Plan Sections** – Chris Albrecht noted that the FY2015 work plan was currently in the process of being updated, then went through a handout of the plan's overall outline. After a short discussion amongst the board, it was agreed that no major changes to the previous plan were needed. Chris also asked for input on the contacts section, and members provided a few changes and additions.

**Budget** – Chris also went over the FY2015 budget, noting that the projected budget available for research was \$270,000. Chris also noted that this amount reflected income of \$375,000, minus \$70,000 set aside for Project 2014-03 and \$30,000 set aside for Project 2015-01.

## X. 2015 Work Plan

Next, the board discussed the latest on new project ideas for FY2015. First, Chris briefly reviewed the most recent list:

- ***Candidate A: Review and Application of Pavement Forecast Models*** – This potential project would look at past experience of various agencies with using the available pavement forecast models or virtual RWIS (Metro, SnowTherm, FAST, etc.).
- ***Candidate B: Review of Alternate Power Supplies*** – This effort would involve a small-scale state-of-the-practice review of available “off the grid” power options for RWIS operating in remote areas.
- ***Candidate E: Quality Checking of AVL Data*** – This proposed project would focus on ways to quality check AVL data to ensure useable data is obtained.
- ***Candidate F: Best Practices in Data Storage*** – This likely small effort would review the past and current best practices by state in storing and archiving RWIS data.
- ***Candidate G: Investigating Trends and Practices of Non-Traditional RWIS*** – This idea involves looking at the current trends, practices, and instrumentation options in the emerging use of non-traditional (compact, low-power, etc.) RWIS “Lite”.
- ***Candidate H: Further Integration of the Knowledge Base and SICOP List*** – This effort would address integration of the functions found in the SICOP List Serve with the existing Knowledge Base for Road Weather and Winter Maintenance.
- ***Candidate J: 2015 Peer Exchange*** – This effort would address the next peer exchange to be held in late 2015.

Chris also again noted that one project had already been funded for FY2015, Project 2015-01: Snow Liquid Water Equivalent for Forward Scatter PWD Series Sensors. In addition, he asked that the board review and comment on the proposed projects before the November board web meeting.

Finally, the board also voted to make Jeff Williams the next program vice chair.

## XI. National Initiatives and Partnerships

The group then briefly reviewed national-level initiatives, including NTCIP and PIARC activities. It was noted that Curt and Jack would be the best people to track NTCIP activities in the future. The board also discussed upcoming TRB, AMS, and Clear Roads meetings to make sure involvement was covered.

## XII. Communications and Marketing

The board also discussed contacting several potential new members; including Indiana, Nevada, Washington, Oregon, and Arizona. Chris Albrecht also noted that the e-news now has a new format and that the issues would be published after each spring and fall on-site board meeting.

### **XIII. Other Business**

The board also briefly reviewed a few other items; including the Iwapi MDSS lawsuit, MDSS, and new AVL products.

No further items were discussed, and the board meeting was adjourned.

# Agenda

# Aurora Program Board Meeting

October 7-9, 2014

La Tourelle Hotel, Ithaca, New York, USA

## *AGENDA*

### Tuesday, October 7, 2014:

*7:00a Breakfast*

**8:00a Project Mini-Meetings**

**10:30a Meet with Cornell Univ. Environmental & Atmospheric Sciences Staff**

*12:00p Lunch*

**1:00p Depart for Innovative Dynamics, Inc. Ithaca Facility**

**1:30p Tour of Innovative Dynamics, Inc. Ithaca Facility**

**3:30p Project 2011-02 Web Meeting**

*5:00p Adjourn*

*6:00p Dinner*

### Wednesday, October 8, 2014:

*7:00a Breakfast*

#### **I. 8:00a Open and General Items**

8:00a Review and approval of formal meeting agenda

Jason Norville

8:05a Review of previous minutes and actions

Chris Albrecht

#### **II. 8:15a Project Updates**

8:15a 2012-05 - Seasonal Weight Restrictions

Maureen Kestler

8:40a 2009-01 - Comparison of Sensors

Dawn Gustafson

8:45a 2010-03 - Results Based Maintenance Standards

Max Perchanok

8:50a 2010-04 - RWIS Sensor Density Study

Max Perchanok

9:10a 2011-02 - RWIS Training Tool

Tina Greenfield

#### **III. 9:15a Meet with SUNY Oswego Staff**

*10:00a Break*

- IV. 10:15a Project Updates (continued)**
- |        |   |                 |
|--------|---|-----------------|
| 10:15a | 2012-01 - Validate Predictions              | Max Perchanok   |
| 10:40a | 2012-03 - Cameras and Remote Conditions     | Travis Lutman   |
| 10:45a | 2012-04 - Communicating Information         | Joe Doherty     |
| 10:50a | 2013-02 - Transition Clarus to MADIS        | Jack Stickel    |
| 10:55a | 2013-03 - Improving Estimation of Speed     | Tina Greenfield |
| 11:00a | 2013-04 - Quantifying Salt Concentration    | Max Perchanok   |
| 11:10a | 2013-05 - Knowledge Base Content Management | Tina Greenfield |
| 11:20a | 2013-06 - Weather Index Expansion           | Tina Greenfield |
| 11:30a | 2012-05 - Seasonal Weight Restrictions 2    | Max Perchanok   |
| 11:40a | 2013-04 - Quantifying Salt Concentration 2  | Max Perchanok   |
| 11:50a | 2012-01 - Validate Predictions 2            | Max Perchanok   |

*12:00p Lunch*

- V. 1:00p Future Meetings and Calls** Jason Norville and Chris Albrecht

- VI. 1:20p Program Administration and Financials** Chris Albrecht
- |       |   |
|-------|---|
| 1:20p | Discussion of membership payments                           |
| 1:25p | Discussion of program expenditures and contracting          |
| 1:40p | Discussion of management contract and old/new program split |

- VII. 2:00p Round Robin/Member Agency RWIS Updates** All Participants

*3:15p Break*

- VIII. 3:30p Round Robin/Member Agency RWIS Updates (continued)** All Participants

*5:00p Adjourn*

*6:00p Dinner*

**Thursday, October 9, 2014:**

*7:00a Breakfast*

- IX. 8:00a 2015 Work Plan** Chris Albrecht
- |       |   |
|-------|---|
| 8:00a | Discussion of plan sections                     |
| 8:15a | Review of estimated budget for FY2015 projects  |
| 8:45a | Final review and discussion of FY 2015 projects |

*10:00a Break*

- X. 10:15a 2015 Work Plan (continued)** Chris Albrecht
- |        |                                     |
|--------|-------------------------------------|
| 10:15a | Discussion of FY 2015 project teams |
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|--|--|
| <p><b>XI. 10:30a National Initiatives and Partnerships (5 minutes each)</b><br/>         FHWA Weather Team<br/>         ITS America<br/>         TRB Task Forces and Committees<br/>         AASHTO/SICOP, PIARC, SIRWEC<br/>         AMS<br/>         Clear Roads, PNS<br/>         ENTERPRISE, MDSS Pooled Fund, NTCIP<br/>         Other Initiatives/Groups</p> | <p>Roemer Alfelor<br/>         Dawn Gustafson<br/>         Max Perchanok<br/>         Max Perchanok<br/>         Mike Adams<br/>         Tina Greenfield<br/>         Curt Pape<br/>         All</p> |
| <p><b>XII. 11:00 Aurora Communications and Marketing</b><br/>         New members and associates<br/>         Aurora E-News, banner, other materials, etc.<br/>         Friends of Aurora in 2015</p>  | <p>Chris Albrecht</p>  |
| <p><b>XIII. 11:20 Other Business</b></p>   | <p>All Participants</p>  |
| <p><i>11:30 Adjourn</i></p>  |  |

# **Attachment A**

# **Aurora Program - Ongoing Project Status**

October 3, 2014

## **SPR-3(042)**

### **FY2009 through FY2011**

- 2009-01: Summary and Comparison of Agency Experience w/ Sensors (\$5,000) = 95% complete
- 2010-03: Results-Based Winter Road Maintenance Standards (\$260,000) = 65% complete
- 2010-04: RWIS Sensor Density and Location (\$100,000) = 80% complete
- 2011-02: RWIS Training Tool (\$265,000) = 30% complete

### **FY2012**

- 2012-01: Validate Accuracy of Pavement ... Predictions, Phase 1 (\$30,000) = 5% complete
- 2012-03: Cameras and Operational Impact of ... Monitoring (\$25,000) = 100% complete
- 2012-04: Communicating and Publicizing Information (\$15,000) = 5% complete
- 2012-05: Seasonal Weight Restrictions Demonstration, Phase 1 (\$80,000) = 20% complete

### **FY2013**

- 2013-02: Transition of Clarus to MADIS (\$5,000) = 85% complete
- 2013-03: Improving Estimation ... for Performance Measurement (\$130,000) = 5% complete
- 2013-04: Quantifying Salt Concentration on Pavement, Phase 1 (\$35,000) = 5% complete
- 2013-05: Knowledge Base Content Management and Marketing (\$10,000) = 10% complete
- 2013-06: Make the Aurora Winter Severity Index Available to All (\$30,000) = 60% complete

## **TPF-5(290)**

### **FY2014**

- 2014-01: Seasonal Weight Restrictions Demonstration, Phase 2 (\$200,000) = 0% complete
- 2014-02: Quantifying Salt Concentration on Pavement, Phase 2 (\$115,000) = 0% complete
- 2014-03: Validate Accuracy of Pavement ... Predictions, Phase 2 (\$105,000) = 0% complete

### **FY2015**

- 2015-01: Snow Liquid Water Equivalent for ... PWD Sensors (\$35,000) = 0% complete

## **Project Status Report**

October 3, 2014

**Project:** 2009-01: Summary and Comparison of Agency Experience with Sensors

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**Champion:** Dawn Gustafson, Michigan Department of Transportation

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**Background:** This project was originally established to summarize and compare the Lufft R2S. Before this project began, several states had obtained and installed sensors. Ultimately, the team decided to proceed with this project as a summary of sensors Aurora members have installed and their experiences with them.

**Objective:** The objective of this project is to develop and maintain a matrix that will summarize different agencies' experiences with sensors used in road weather information data collection.

**Status:**

- A final detailed scope was developed and approved by the board in October 2012.
- A comparison matrix was developed and sent to the team for review and modified from comments received. A tab was added to the bottom of the spreadsheet for sensor types.
- The spreadsheet was sent to all Aurora members for their input.
- The spreadsheet will also include information on the life expectancy of ITS devices, such as RWIS RPU's and sensors, which would help agencies anticipate the mean time between failures and help agencies plan for funding, maintenance, procurement, and replacement.
- Joe Doherty, Dawn Gustafson, Jeff Williams, Jason Norville, Mike Adams, Travis Lutman, and Tina Greenfield have updated the project spreadsheet.
- The spreadsheet is currently being updated by Curt Pape.
- This project should be closed out by the end of 2014, with possible vote at Ithaca meeting.

**Approximate % Complete:** 95 %

**Recommendations:**     continue as planned  
                                   continue with modifications  
                                   discontinue

**Additional Comments:**

- The board agreed to reduce project funding to \$5,000.
- This project has also absorbed the goals of Project 2010-05, which was discontinued.
- Project Team: Dawn Gustafson (champion), Curt Pape, Jack Stickel, Joe Doherty, Tina Greenfield, Jason Norville

## **Project Status Report**

October 3, 2014

**Project:** 2010-03: Results-Based Winter Road Maintenance Standards

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**Champion:** Max Perchanok, Ontario Ministry of Transportation

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### **Status:**

- Both the Safety and Mobility analyses and modelling: 100%.
- Performance measures and service standards: 90%
- Road Surface Condition Monitoring, Technology, Tools 90%
- Earlier status reports incorrectly listed a cost model as a deliverable for this project, however, the research group is developing a cost model using other resources (MTO HIIFP for 2013-14) that will support the work done in this project.
- University of Waterloo sent details on additional tasks they will undertake for just under \$105,000.
- Max forwarded supplementary scope to the entire board, which was approved the funding increase in March.
- Tina Greenfield and Curt Pape were added to the project team.

**Approximate % Complete (original scope):**      98 %

**Approximate % Complete (additional scope):**      5 %

**Approximate % Complete (overall):**              65 %

**Barriers / Issues:** The original partnership agreement for this project ended on September 20, 2013. It was extended at no cost to September 2014.

**Recommendations:**     continue as planned  
                                   continue with modifications  
                                   discontinue

### **Additional Comments:**

- Project Team: Max Perchanok (Champion), Dawn Gustafson, Joe Doherty, Curt Pape, Sheldon Drobot, Neal Hawkins, Tina Greenfield, Chris Albrecht
- MTO contributed an additional \$50,000 for data collection related to this project, in 2013-14.
- Results of an initial cost-benefit analysis were presented at PIARC 2014 Winter Roads Conference in Andorra.
- The original funding amount was \$155,000.
- Up to \$105,000 additional from remaining SPR-3(042) funding has also been approved.

## **Project Status Report**

October 3, 2014

**Project:** 2010-04: RWIS Sensor Network Density and Location

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**Champion:** Max Perchanok, Ontario Ministry of Transportation

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### **Status:**

- A 2 year contract was signed on September 28, 2012
- Work completed: literature review, preliminary data collection, exploratory analysis including matching road friction and temperature data with topographical and geographical features.
- Analyses were completed using data from Ontario and from Minnesota using a gridded, approach to find the maximum benefit solution to RWIS spacing, considering the benefit of RWIS to minimizing maintenance costs and accidents.
- A new, more theoretical approach is being planned that uses kriging, an analysis of the relationship between estimation error and spacing, to estimate optimum spacing. The analysis will be underway by fall 2014 and the project is expected to be completed by fall 2015.
- This effort should be completed in by the end of March 2015.
- PI will report to Aurora at the October 2014 on-site meeting.

**Approximate % Complete:** 80 %

**Barriers/Issues:** Work plan requires interaction with Aurora members at several intervals and will require scheduling at future meetings.

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

### **Additional Comments:**

- This project was funded for \$100,000 in FY 2010
- The Board voted to amalgamate 2000-01 and 2010-04 at the spring 2011 meeting because both the data and methods of analysis used in 2000-01 are highly suited to the objectives of 2010-04.
- U Waterloo was asked to include a proposal for 2010-04 with the report for 2000-01. The completed report for 2000-01 fulfilled MTO's in-kind obligation for that project. After reviewing the proposal, the Board agreed to fund 2010-04 as an ongoing project.
- MTO funding of \$55,000 for field data collection is proposed as an MTO in-kind contribution.
- Project Team: Max Perchanok (champion), Jack Stickel, Curt Pape, Dawn Gustafson, Mike Adams, Jason Norville, Tina Greenfield, Sheldon Drobot, Travis Lutman

## **Project Status Report**

October 3, 2014

**Project:** 2011-02: RWIS Training Tool

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**Champion:** Tina Greenfield, Iowa Department of Transportation

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**Background:** It is often the case across states and even within states that winter maintenance supervisors or foremen do not have a consistent understanding of RWIS and weather information in real-world decision making. Training may be administered but it is difficult to determine how much is retained, whether understanding was reached, and which parts of the training were successfully integrated into decision making practice. Therefore it is difficult to assess supervisor/foremen competency and it is difficult to tailor training to their needs. This is especially a problem when hiring new staff or hiring contractors because there are few tools to evaluate their ability to perform as required. This project involves the creation of a supervisor evaluation tool which can measure a supervisor's ability to incorporate RWIS and risk management into their decision making process.

**Status:**

- This project is estimated to last 3 years.
- The project is now under contract with Iteris/Meridian.
- A project kickoff conference call was held on April 26, 2013.
- The project allocation/budget was \$265,000, with only a relatively small portion of that being spent and billed so far.
- The estimated project completion is June 30, 2016.
- A project meeting with Iteris is scheduled for October 7.

**Approximate % Complete:** 30 %

**Barriers/Issues:** None

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$265,000 under FY2011.
- The estimated project completion date is the end of June 2016.
- Project Team: Tina Greenfield (champion), Max Perchanok, Mike Kisse, Jack Stickel, Mike Adams

## Project Status Report

October 3, 2014

**Project:** 2012-01: Validate Accuracy of Pavement Condition Predictions, Phase 1

**Champion:** Max Perchanok, Ontario Ministry of Transportation

**Objective:** This project would validate the accuracy of the pavement condition predictions and provide confidence in the MDSS recommendations.

### **Status:**

- The project team identified a large number of clarifications required in the RFP and is now working on draft #4.
- The current scope:
  - Requires special, iterative forecasts including both the recommended treatments and the actual treatments (extra cost to be paid by the highway agency with possible help from Aurora).
  - To be undertaken at 1 patrol route in Wisconsin and 1 in Minnesota, where the Pooled Fund MDSS is currently running.
  - Investigating whether Vaisala and Federal MDSS can be included for comparison (Costs be paid by the highway agency with possible assistance from Aurora)..
  - RFP will list the sites and all data to be provided by the highway agencies.
  - RFP will focus on the desired outcome. Bidders will be evaluated on their proposed methodology.
  - *NO progress in summer 2014. RFP to be completed and released.*
- Project 2012-01 will now cover only the first phase of this effort and cost approximately \$30,000 in order to accommodate the schedule for the close-out of the “old” Aurora program.
- The second phase will be completed under the new TPF program number and will be funded for \$105,000.

**Approximate % Complete:** 5 %

**Barriers/Issues:** Complex logistics involving multiple MDSS providers and multiple highway agencies. Delay in finalizing RFP may postpone the project by a year, since all aspect must be in place by late fall to collect winter data.

**Recommendations:** X continue as planned  
     continue with modifications  
     discontinue

### **Additional Comments:**

- The board voted to approve additional funding, with \$30,000 allocated for the first phase under Project 2012-01, and \$105,000 allocated for a second phase under the new TPF number.
- Project Team: Max Perchanok (champion), Dawn Gustafson, Tim Peters, Curt Pape, Mike Adams, Tina Greenfield, Gabe Guevera

## **Project Status Report**

September 25, 2014

**Project:** 2012-03: Cameras and Operational Impact of Remote Road Condition Monitoring

**Champion:** Travis Lutman, North Dakota Department of Transportation

**Background:** This idea came out of the September 2011 peer exchange in Montana. Utah DOT and a private contractor have developed a low-cost live PTZ camera system to monitor road conditions at locations not covered by conventional traffic cameras or RWIS sites. The purpose of this is to identify if treatment is needed or not. The outcome is that the local manager can decide whether a truck needs to go out or not. The system has had impacts on how and when dispatch is done. It has also enhanced road condition observation in rural areas for the purposes of traffic management.

**Objective:** This project would identify efficiencies gained, impacts on road condition, costs, cost avoidance, and document the model for other agencies to follow.

**Status:**

- No additional funding was needed past the \$25,000 original allocation/budget.
- The research team from BYU has completed this project.
- Final approval is needed.

**Approximate % Complete:** 100 %

**Barriers/Issues:** None

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$25,000 under the FY2012 program.
- Project Team: Travis Lutman (champion), Ron Hall, Mike Kisse, Curt Pape, Jimmy White

## **Project Status Report**

October 3, 2014

**Project:** 2012-04: Communicating and Publicizing Road Weather and Operations Information

**Champion:** Joe Doherty, New York State Department of Transportation

**Background:** This idea came out of the 2011 and 2013 peer exchanges. Road weather systems are designed to meet a broad set of stakeholder needs. Key stakeholders include winter weather maintenance operations, traffic operations, first responders and emergency managers, value-added forecast providers, commercial trucking operations, transit, and the traveling public. Information delivery to stakeholders may include data feeds, tabular listings, graphical presentations, and weather data integrated with other data sources (real-time traffic data, for example). Having an understanding of the stakeholder's key operational weather thresholds and how stakeholders make decisions based on these thresholds can help transportation agencies tailor a road weather information system program to meet the stakeholder needs.

**Objective:** This research would ultimately compile best practices on how road weather information is being transferred to stakeholders. It is also important to identify the best method(s) for notifying the public/media and operations staff of current RWIS data. It is unclear how much information is needed to inform the public and government officials of "current" operations during a storm. Research should look at how new operational processes and sensor output can be quickly adopted.

**Status:**

- Chris Albrecht worked with Joe Doherty to develop a revised objective and research scope that would include a state-of-the-practice review on what states are doing to communicate road weather information.
- Due to the close-out of the "old" Aurora Program, this effort was narrowed in scope, with \$15,000 allocated to a literature search or state-of-the-practice review that could serve as a basis for further research. Future funding and work will be contingent on results of this search.
- Chris Albrecht has drafted a scope of for the initial literature review for this effort.

**Approximate % Complete:** 5 %

**Barriers/Issues:** None

**Recommendations:**  X  continue as planned  
    continue with modifications  
    discontinue

**Additional Comments:**

- This project was funded for \$30,000 in FY2012, but was reduced to \$15,000 as of March 2014.
- Project Team: Joe Doherty (champion), Jack Stickel, Jason Norville, Dawn Gustafson, Tim Peters

## **Project Status Report**

October 3, 2014

**Project:** 2012-05: Seasonal Weight Restrictions, Phase 1

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**Champion:** Max Perchanok, Ontario Ministry of Transportation

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**Objective:** The overall objective of this research is to validate the predicted thaw depths and restriction dates recommended using the *Clarus* EICM approach and alternative, degree-day based approaches to provide an understanding of reliability of different approaches in setting load restriction dates.

**Status:**

- Contract in place with Maureen Kestler represented by USDA, with subcontracts to FROST Associates.
- Iowa DOT had asked that this effort be split into two phases.
- Maureen Kestler from USDA and their sub-consultant had noted a need for unanticipated additional funding of \$30,000 to utilize the Meridian model in the initial stages.
- Consultant requested that Phase 2 work related to the CLARUS model be advanced into Phase I (approx. \$30,000 value) to avoid delay in implementation for this winter.
- The board approved an increase in the funding for this first phase from \$50,000 to \$80,000.
- Project was divided into Phase 1, project planning, to be completed by March 2015, and Phase 2, Implementation, to be assigned after completion of Phase I.
- Maureen has agreed to write a paper on the project plan, which can be presented by Aurora or by her at the upcoming ITS America conference in Michigan.
- Phase 1 is underway and progressing well.

**Approximate % Complete:** 20 %

**Barriers/Issues:** Consideration of advance funding to implement CLARUS model this year.

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$80,000 (updated from \$50,000) under FY 2012, with a second phase (Project 2014-01) funded for \$200,000.
- Project Team: Max Perchanok (champion), Mike Adams, Jack Stickel, Dawn Gustafson, Travis Lutman, Mike Kisse
- TRB Winter Maintenance Committee submitted a proposal for an NCHRP synthesis on spring load restrictions. If funded it would provide useful input to Phase 1.
- TRB Winter Maintenance Committee is sponsoring a joint session on spring load restrictions, with the Low Volume Roads Committee and the Climate Change Committee, at the 2015 TRB Annual Meeting in DC.

## **Project Status Report**

September 18, 2014

**Project:** 2013-02: Transition of Clarus to MADIS

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**Champion:** Jack Stickel, Alaska Department of Transportation and Public Facilities

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**Background:** The Clarus System functionality (observations, quality checks, metadata, and spatial location) is transitioning to the MADIS System. Aurora needs to materially participate in the transition to ensure the Clarus functionality is captured in the new MADIS system. There will be four phases in the transition: (each transportation agency's RWIS network will be added as a mesonet, a metadata interface to add and modify RWIS site information will be added, the Clarus quality checks for atmospheric and surface observations will be added, and subscription services similar to Clarus will be added. The initial MADIS Surface Display web site has been established. No specific Aurora funding opportunities to assist in the transition have been identified as of yet. There potentially could be assistance requests or design review meetings.

**Objective:** The objective of this project is to participate in the transition of the Clarus System to the NOAA's ESRL Meteorological Assimilation Data Ingest System (MADIS) system.

**Status:**

- The effort would include adding missing RWIS sites to the MADIS system, updating metadata, and participating in the MADIS Surface System web reviews.
- Research Approach:
  1. Add missing RWIS sites to the new MADIS system.
  2. Update RWIS metadata through Mixon Hill.
  3. Participate in MADIS Surface System web site reviews for a) how well it captures the Clarus System functionality, and b) how efficient the web site operates.
- The project will be closed out by the end of September 2014.

**Approximate % Complete:** 85 %

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$5,000 in FY2013.
- The project is almost complete and will not be using the \$5,000 in allocated funds.
- Project Team: Jack Stickel (champion), Mike Adams, Ron Hall

## **Project Status Report**

October 3, 2014

**Project:** 2013-03: Improving Traffic Speed Estimations for Winter Maintenance Performance

**Champion:** Tina Greenfield, Iowa Department of Transportation

**Background:** The Iowa DOT is interested in developing a dynamic model capable of predicting in real time acceptable drops in traffic speed at major highway during major weather events with realistic uncertainty measures. The primary usage of such model is to evaluate the performance of highway winter maintenance operations and optimize resource allocation.

**Objective:** The objective of this project is to develop point level performance measurements based on an improved model which can produce real time prediction of traffic speed drops with uncertainty measures. This model will be tested and improved based on traffic, weather, and maintenance activity data from several different states/regions.

**Status:**

- Future funding and work will be contingent on results of this initial effort.
- Sole-source contract with Iowa State University's Statistics Department for \$117,457 was now in place.
- Likely involve a second phase of additional work, but that no funds have been approved or allocated to date.
- This effort should be completed by the end of March 2015.

**Approximate % Complete:** 5 %

**Barriers/Issues:** None

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- Project Team: Tina Greenfield (champion), Max Perchanok, Jack Stickel, Ron Hall
- This project was originally funded for \$130,000.

## **Project Status Report**

September 30, 2014

**Project:** 2013-04: Quantifying Salt Concentration on Pavement, Phase 1

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**Champion:** Max Perchanok, Ontario Ministry of Transportation

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**Background:** Peer exchanges have shown the need for a mobile and/or more accurate surface salinity sensor. An alternative is to develop a better way to predict the salt concentration on the pavement considering the records of application rate, time plowing, precipitation type and rate, surface temperature, traffic, pavement type, wind speed, etc. Road salt management is a key issue for highway agencies that are required to provide safe roads during winter storms while protecting the natural environment. Critical methods to manage salt loadings are by applying the right amount of salt at the right place and the right time, and this requires accurate knowledge of how much salt is already on the road before re-applying during a storm. To develop a better way to build upon and combine previously attempted approaches to measure or predict representative salt concentration on the pavement to a precision that can be used for tactical planning of salt application rates in advance of and during winter storms. It should consider past applications and timing, plowing, precipitation type and rate, surface temperature, traffic, pavement type, wind speed, etc. The pooled fund MDSS initiative should do a lot of this for its surface condition and treatment predictions, so this effort could just focus on just what MDSS may be lacking.

### **Status:**

- Budget: \$35,000 under Phase 1.
- Phase 2 will be funded for \$115,000 as Project 2014-02.
- Two innovations were presented at PIARC 2014 conference; a prediction approach from Sweden and a mobile measuring approach from Japan.
- On February 25, it was decided to contract this project in two parts, Phase 1 literature review and Phase 2 demonstration and evaluation.
- The RFP (to cover a literature search and technology review) has been advertised, with proposals due on July 25, and planned start date of October 15.
- Project was split into 2 phases. Phase 1 is technology review, recommendation and planning. Phase 2 is comparative field demonstration/evaluation.

**Approximate % Complete:** 5 %

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

### **Additional Comments:**

- This project was funded for a total of \$150,000 in FY2013 and FY2014 (new TPF number).
- This project was given a high priority at the National Winter Maintenance Peer Exchange.
- Project Team: Max Perchanok (champion), Tina Greenfield, Jason Norville, Tim Peters, Curt Pape, Lee Smithson

## **Project Status Report**

October 3, 2014

Project: 2013-05: Knowledge Base Content Management and Marketing

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**Champion:** Tina Greenfield, Iowa Department of Transportation

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**Background:** This idea was suggested by Tina Greenfield as a way to help populate and maintain the knowledge base website with several of the smaller Aurora projects that do not fall under the management contract. Periodically, certain road weather topics arise that seem well suited to be added to the site. If the information is easily available it can simply be posted by Aurora members or administration. Sometimes the topic requires a little bit of work before a good product can be posted, such as collecting opinions from a survey, literature reviews, and other analysis. Other topics may require regular reviews and updates in order for the information to stay pertinent.

**Objective:** To create a mechanism by which topics requiring extra work can be added to the knowledge base website.

**Status:**

- Chris Albrecht and Neal Hawkins have produced a draft scope and plan for this effort to be done through ISU. With a \$10,000 budget, this funding will not be enough to keep the site active for the next few years
- A webinar was scheduled for November 18 with SICOP and Clear Roads members to discuss their involvement in this effort.
- The initial part of this project, updating the knowledge base site with a new format, was done by InTrans under the administrative contract.
- Once the old content is all moved to the new site, ongoing maintenance and marketing will still be needed. The use of a professional web design group could be very helpful to get the site more activity and keep its content fresh.
- \$10,000 project allocation alone would likely not be enough to keep the site active for the next few years, but Chris Albrecht put together a scope/plan to utilize this money in the interim.

**Approximate % Complete:** 10 %

**Barriers/Issues:** Funding for a long-term approach

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$10,000 in FY 2013.
- Project Team: Tina Greenfield (champion), Jack Stickel, Jason Norville

## **Project Status Report**

September 29, 2014

Project: 2013-06: Make the Aurora Winter Severity Index Available to All

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**Champion:** Tina Greenfield, Iowa Department of Transportation

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**Background:** This idea also came out of the September 2011 peer exchange in Montana. This effort would involve making the Aurora winter index available to anyone and extend the length of the record from the current period (2002-2008). Another component would be to develop technology transfer sessions at APWA or AASHTO.

**Objective:** This effort would involve making the Aurora winter index available to anyone and extend the length of the record from the current period (from now back to the 2008-2002 period as well).

**Status:**

- An extension with AccuWeather is now in place through 2015.
- Approximately \$22,000 has been spent to date.
- No other planned expenditures toward the \$30,000 original allocation/budget.
- This effort should be completed by the end of December 2014.
- To date, \$23,193 had been expended.

**Approximate % Complete:** 60 %

**Barriers/Issues:** None

**Recommendations:**  X  continue as planned  
    continue with modifications  
    discontinue

**Additional Comments:**

- Project Team: Tina Greenfield (champion), Mike Adams, Curt Pape, Jack Stickel, Jason Norville
- This project was funded for \$30,000 in FY 2013.

## **Project Status Report**

October 3, 2014

**Project:** 2014-01: Seasonal Weight Restrictions, Phase 2

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**Champion:** Max Perchanok, Ontario Ministry of Transportation

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**Objective:** The overall objective of this research is to validate the predicted thaw depths and restriction dates recommended using the *Clarus* EICM approach and alternative, degree-day based approaches to provide an understanding of reliability of different approaches in setting load restriction dates.

**Status:**

- Under Phase 1, IHRB is negotiating a contract with Maureen Kestler represented by USDA, with subcontracts to FROST Associates. Maureen has agreed to write a paper on the project plan, which can be presented by Aurora or by her at the upcoming ITS America conference in Michigan.
- There has been some difficulty in the contracting process. If contractual issues cannot be worked out, the project team will consider moving on to the second highest ranking proposal to put under contract.
- Iowa DOT had asked that this effort be split into two phases to accommodate the “old” Aurora close-out, with \$50,000 allocated for a first phase and another \$200,000 allocated under FY2014 for the second phase.

**Approximate % Complete:** 0 %

**Barriers/Issues:** None.

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for \$200,000 under FY2014.
- Project Team: Max Perchanok (champion), Mike Adams, Jack Stickel, Dawn Gustafson, Travis Lutman, Mike Kisse
- TRB Winter Maintenance Committee is sponsoring a joint session on spring load restrictions, with the Low Volume Roads Committee and the Climate Change Committee, at the 2015 TRB Annual Meeting in DC.

## **Project Status Report**

September 18, 2014

**Project:** 2014-02: Quantifying Salt Concentration on Pavement, Phase 2

---

**Champion:** Max Perchanok, Ontario Ministry of Transportation

---

**Background:** Peer exchanges have shown the need for a mobile and/or more accurate surface salinity sensor. An alternative is to develop a better way to predict the salt concentration on the pavement considering the records of application rate, time plowing, precipitation type and rate, surface temperature, traffic, pavement type, wind speed, etc. Road salt management is a key issue for highway agencies that are required to provide safe roads during winter storms while protecting the natural environment. Critical methods to manage salt loadings are by applying the right amount of salt at the right place and the right time, and this requires accurate knowledge of how much salt is already on the road before re-applying during a storm. To develop a better way to build upon and combine previously attempted approaches to measure or predict representative salt concentration on the pavement to a precision that can be used for tactical planning of salt application rates in advance of and during winter storms. It should consider past applications and timing, plowing, precipitation type and rate, surface temperature, traffic, pavement type, wind speed, etc. The pooled fund MDSS initiative should do a lot of this for its surface condition and treatment predictions, so this effort could just focus on just what MDSS may be lacking.

**Status:**

- Phase 1 will cover the literature review.
- Phase 2 will include the demonstration and evaluation.
- This this second phase was funded for an additional \$115,000 under the new TPF number as Project 2014-02.

**Approximate % Complete:** 0 %

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- This project was funded for a total of \$115,000 in FY2014 (new TPF number).
- This project was given a high priority at the National Winter Maintenance Peer Exchange.
- Project Team: Max Perchanok (champion), Tina Greenfield, Jason Norville, Tim Peters, Curt Pape, Lee Smithson

## **Project Status Report**

September 18, 2014

**Project:** 2014-03: Validate Accuracy of Pavement Condition Predictions, Phase 2

---

**Champion:** Max Perchanok, Ontario Ministry of Transportation

---

**Objective:** This project would validate the accuracy of the pavement condition predictions and provide confidence in the MDSS recommendations.

**Status:**

- The project team identified a large number of clarifications required in the Phase 1 RFP.
- The working scope (including both phases):
  - Requires special, iterative forecasts including both the recommended and actual treatments (extra cost to be paid by the highway agency with possible help from Aurora).
  - To be undertaken at 1 patrol route in Wisconsin and 1 in Minnesota, where the Pooled Fund MDSS is currently running.
  - AMEC now has their own MDSS running in Canada.
  - Investigating whether Vaisala and Federal MDSS can be included for comparison (costs paid by the highway agency with possible assistance from Aurora).
  - RFP will list the sites and all data to be provided by the highway agencies.
  - RFP will focus on the desired outcome. Bidders will be evaluated on proposed methodology.
  - Newly available monitoring technology should make the field component easier.
- The second phase will be completed under the new TPF program number and will be funded for \$105,000.

**Approximate % Complete:** 0 %

**Barriers/Issues:** None.

**Recommendations:**  X  continue as planned  
    continue with modifications  
    discontinue

**Additional Comments:**

- The board voted to approve \$105,000 for this second phase under FY2014.
- Project Team: Max Perchanok (champion), Dawn Gustafson, Tim Peters, Curt Pape, Mike Adams, Tina Greenfield, Gabe Guevera

## **Project Status Report**

October 3, 2014

**Project:** 2015-01: Snow Liquid Water Equivalent for Forward Scatter PWD Series Sensors

**Champion:** Jack Stickel, Alaska Department of Transportation and Public Facilities

**Objective:** The key objectives of this research would be to: 1) Assess the PWD12 performance for measuring LWE under various precipitation type and temperature scenarios: dry snow, wet snow, mixed precipitation, and light precipitation. This will be done using a hotplate precipitation gauge for a side-by-side comparison at the Thane Road full service ESS. A second hotplate and PWD12 sensor will be installed at the mid-elevation weather station near the Mt Roberts Tram. The combination of the sensors at mid-elevation and base-elevation stations will allow for an additional dataset for comparison, as well as provide information on events where the rain/snow line may be located at some elevation between the sites. This may prove useful in the avalanche threat assessment. (Note: Alaska DOT&PF will provide a second PWD12 and the National Center for Atmospheric Research will provide two hot plates for the project at no cost) 2) Provide an analysis on the observed differences between the base-elevation and mid-elevation LWE and how the differences could impact the avalanche hazard assessment and 3) Develop recommendations on alternate sensors, i.e., snow depth sensor, or operational changes in determining LWE using the PWD suite of sensors.

**Status:**

- The project team needs to be established.
- This project is being pushed through contracting with Iowa DOT.

**Approximate % Complete:** 0 %

**Barriers/Issues:** None.

**Recommendations:**  continue as planned  
 continue with modifications  
 discontinue

**Additional Comments:**

- The board voted to approve \$35,000 under FY2015.
- Project Team: Jack Stickel (champion), NCAR, TBD

# **Attachment B**

Aurora Project: 2010-04

# Project Progress Report on *“RWIS Sensor Density and Location”*

UNIVERSITY OF  
**WATERLOO**

[uwaterloo.ca](http://uwaterloo.ca)

Oct. 8<sup>th</sup> 2014

- Progress Report: **Project Overview**

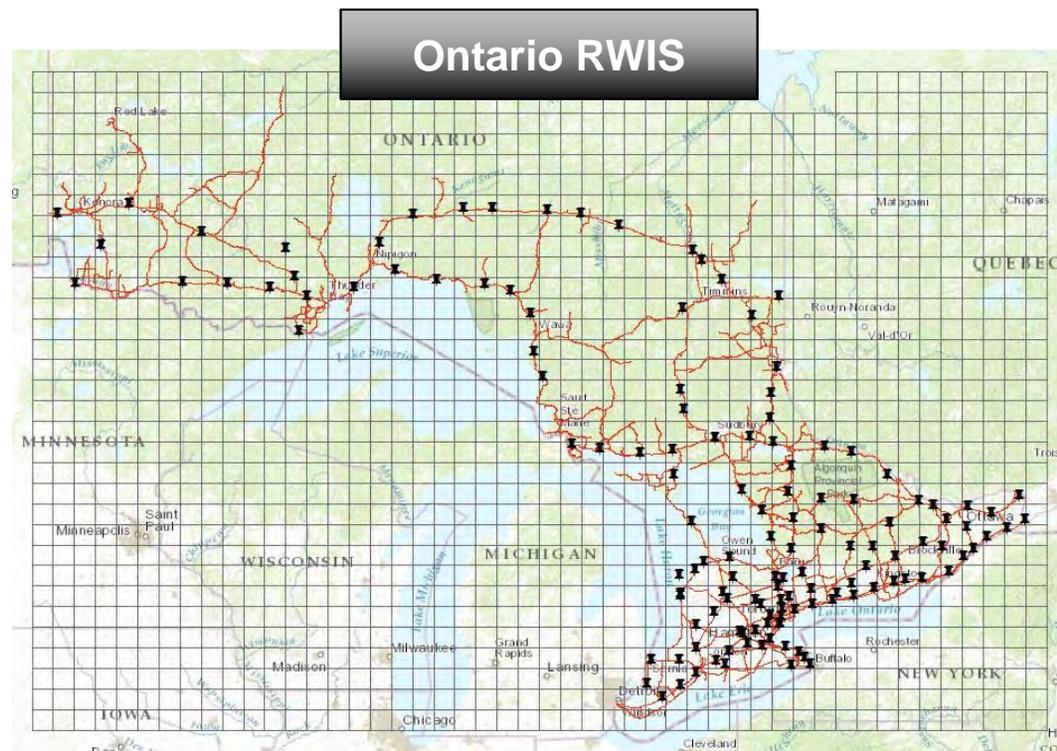
## **Research Objectives / Progress**

- **Conduct a thorough review on literature (**completed**)**
- **Synthesize the current best practice and guidelines for locating and expanding RWIS network (**completed**)**
- **Develop a quantitative understanding of spatial variation of road weather and surface conditions (**in-progress**)**
- **Develop guidelines and an optimization model for determining the density and location of RWIS stations (**in-progress**)**

- Progress: **Approach 1**

## “Surrogate Measures” Based Approach

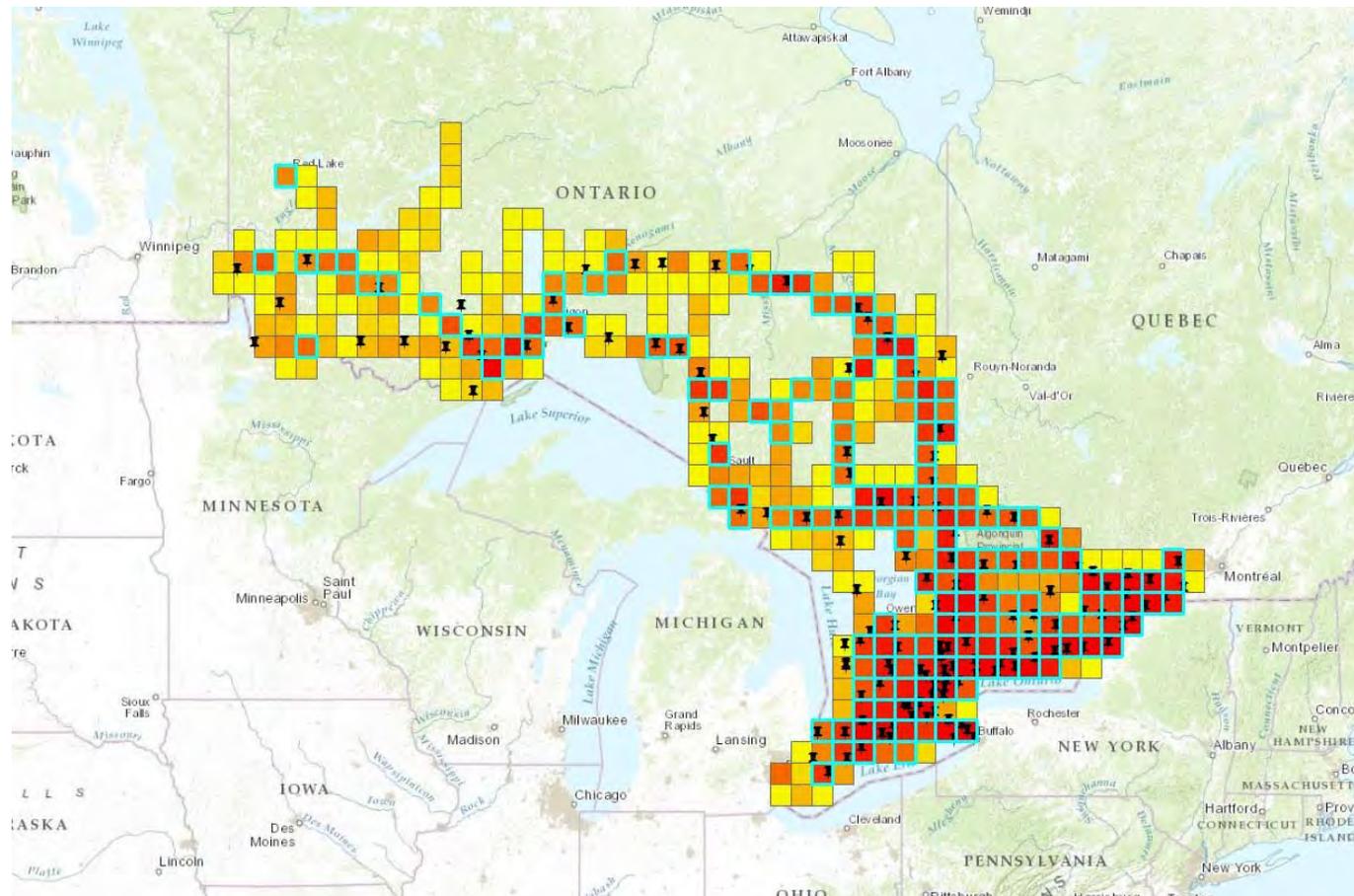
- Experience- / Intuition-based Approach
- Systematic framework capturing the factors being considered in practice
- Analysis of “**goodness**” of locations based on **weather** and **traffic** factors



- Progress: **Approach 1**

## Surrogate Measures Based Approach

- The model recommended RWIS station locations

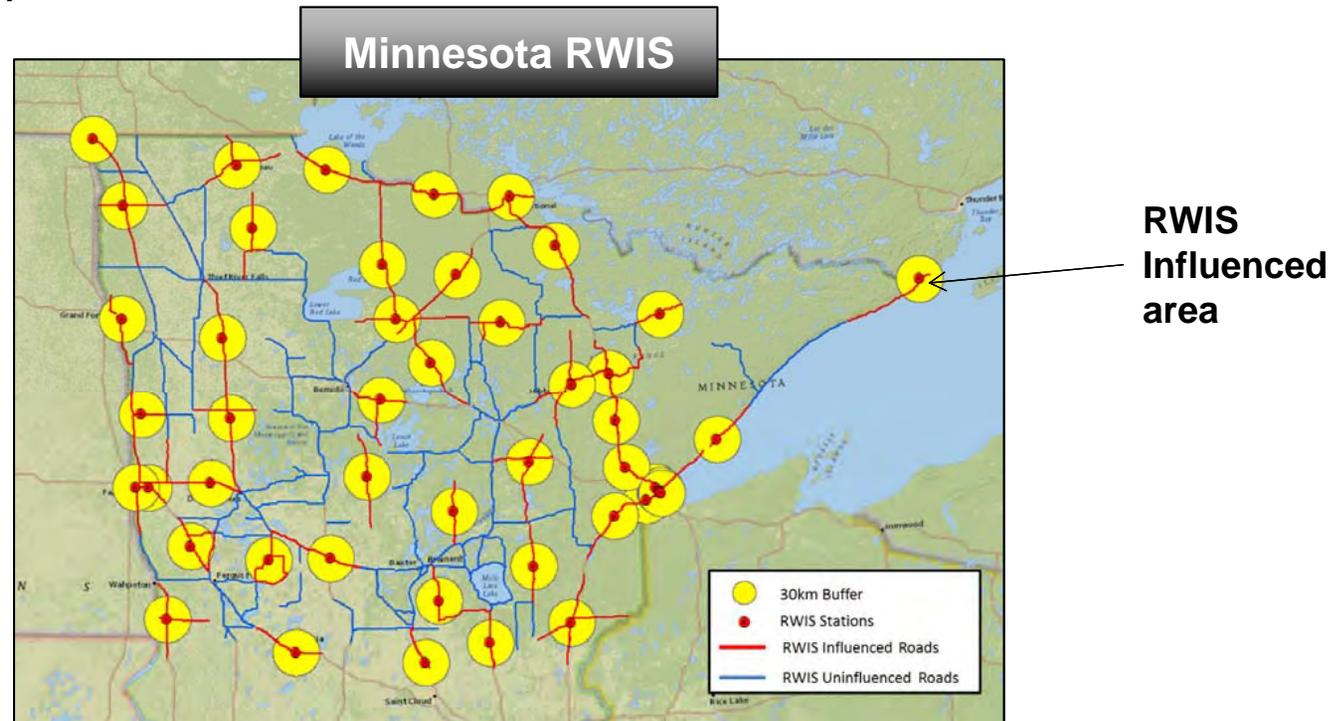


Percent of Matching: 85%

- Progress: **Alternative 2**

## “Cost-Benefit” Based Approach

- Provision of more meaningful measure
- Identification of locations with high estimated monetary benefits (i.e., maintenance and collisions)

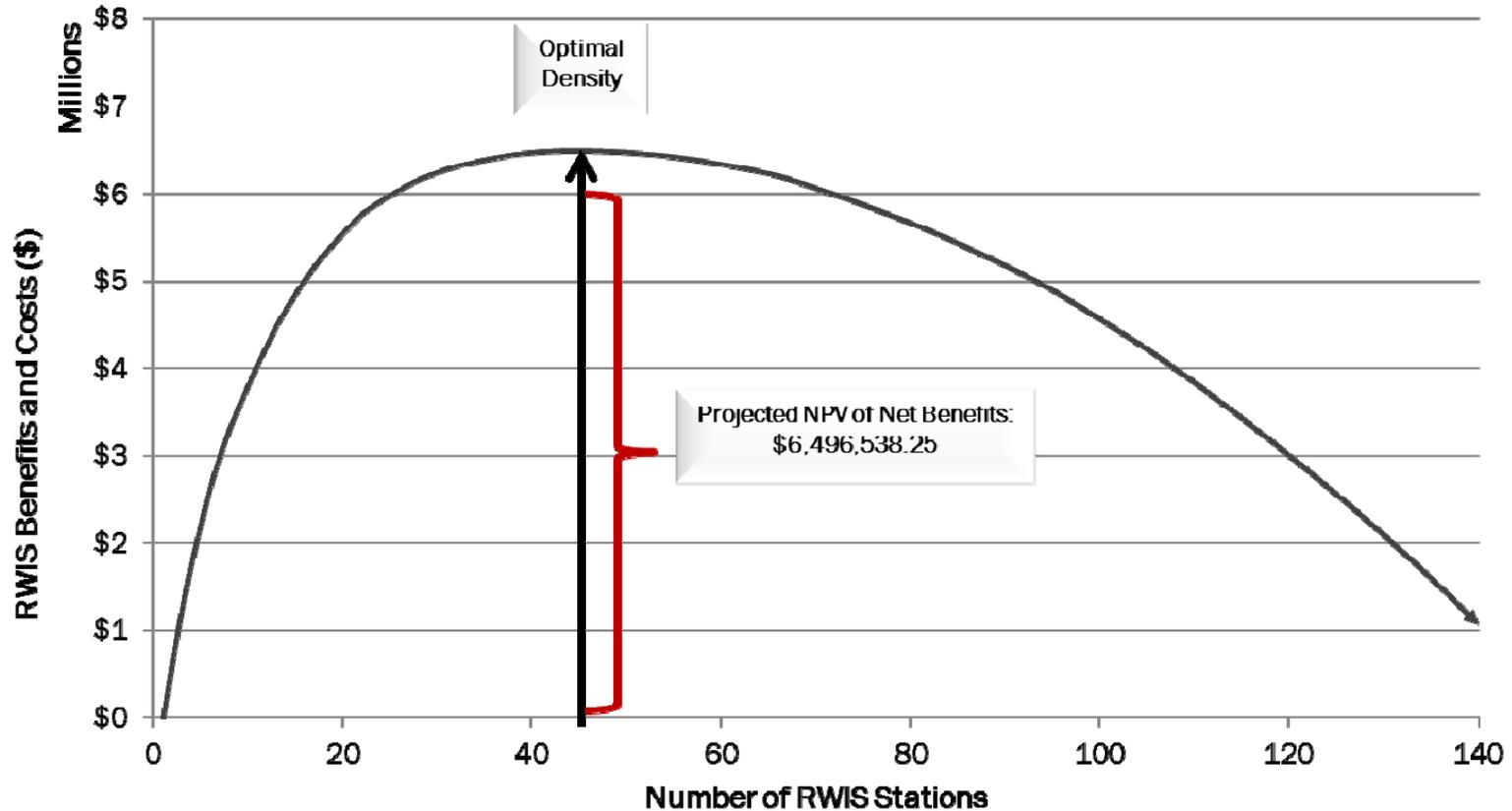


Rationale: a highway section covered by an RWIS station is more likely to receive more enhanced WRM operations.

- Progress: **Alternative 2**

## Cost-Benefit Based Approach

The Net Present Value of 25-year Life Cycle RWIS Net Benefits

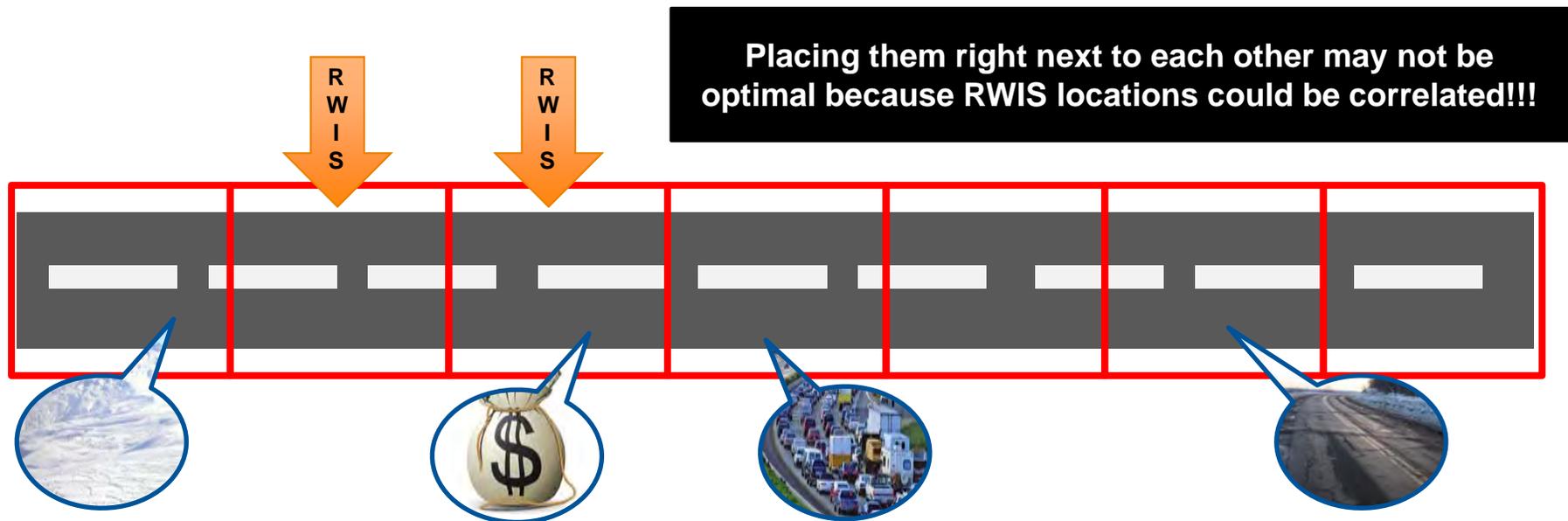


- Progress:

## Limitations of the 1<sup>st</sup>/2<sup>nd</sup> Approaches

### Example: 1-D Highway

- Discretization of a highway network
- Analysis of RWIS allocation criteria (e.g., collision rates, benefits / costs)
- Selection of the location



- Proposed Methodology: **Alternative 3**

## “Estimation Error” Based Approach

### Assumption:

- **An increase in monitoring capability** of hazardous road weather conditions will contribute to improving the WRM operations.



### How to assess/quantify the monitoring capability?

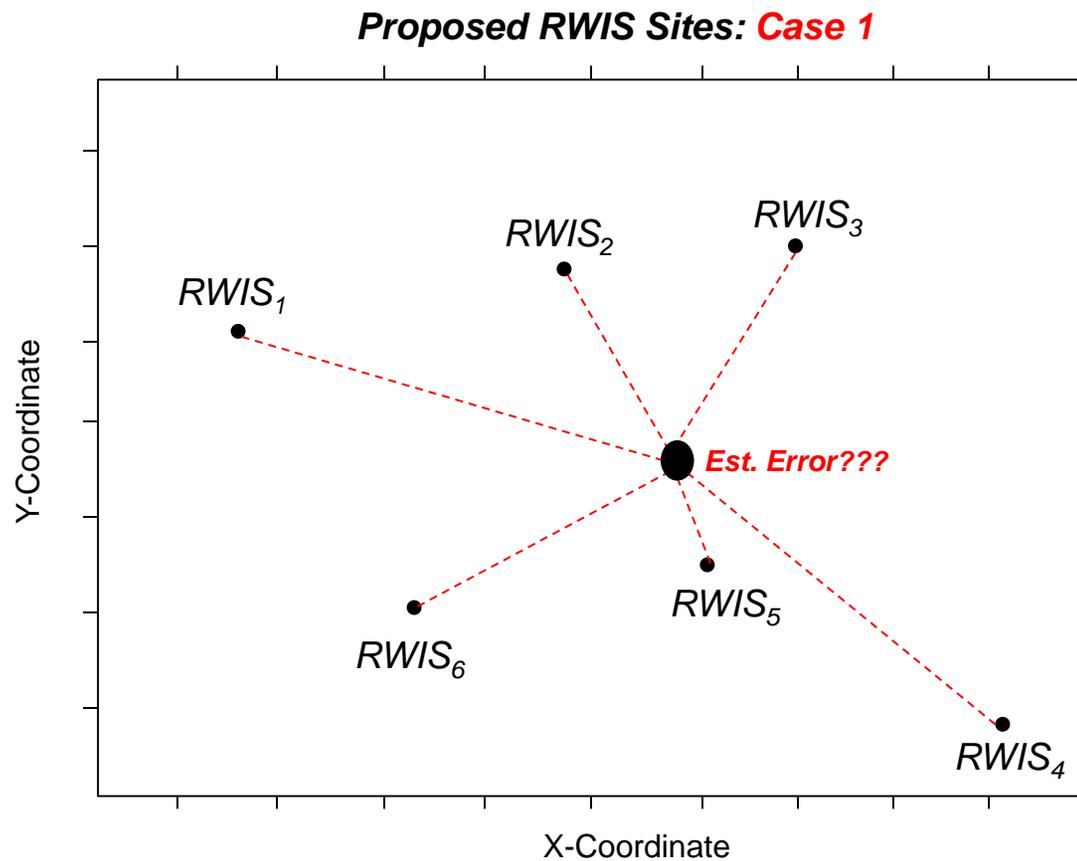
- Via geostatistical **Kriging** analyses.

Provides an all new alternative to the previous two approaches with improved generalization potential

# Geostatistics: What is Kriging?

## Definition:

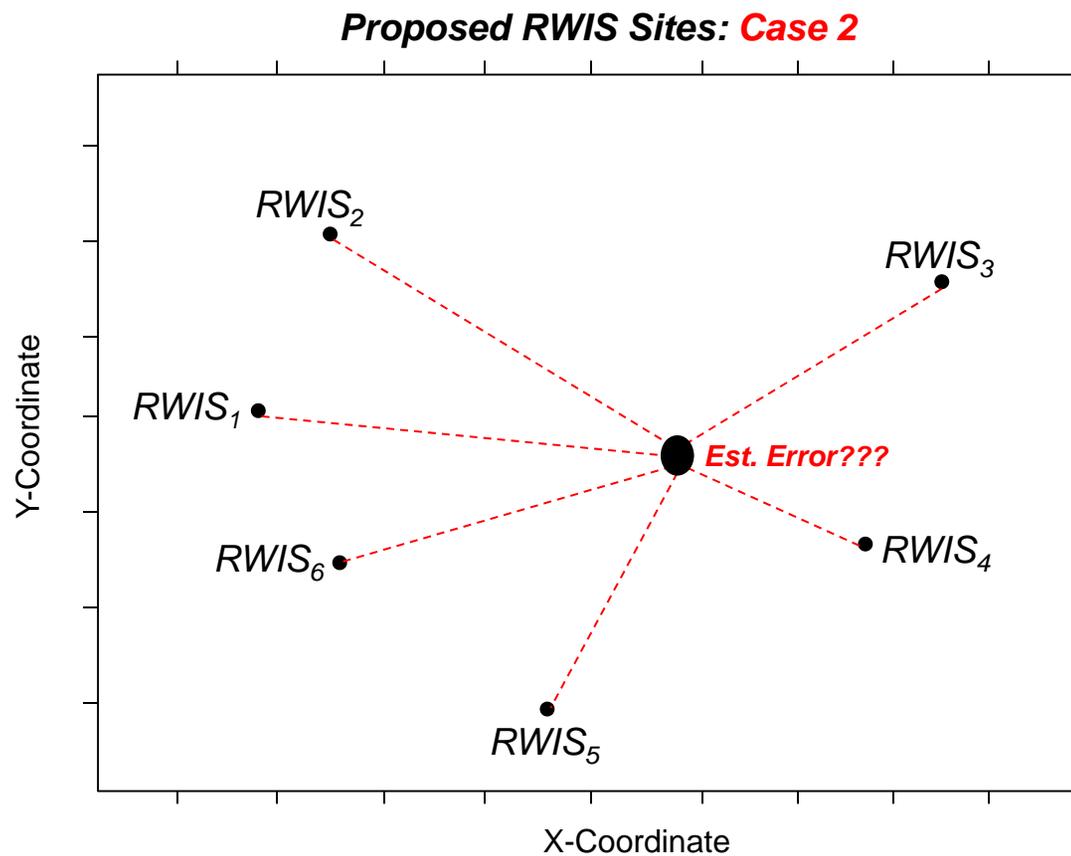
- Kriging provides **spatial prediction** and **estimation error** at a potential RWIS station location based on a known set of observations from existing RWIS stations.



# Geostatistics: **What is Kriging?**

## **Definition:**

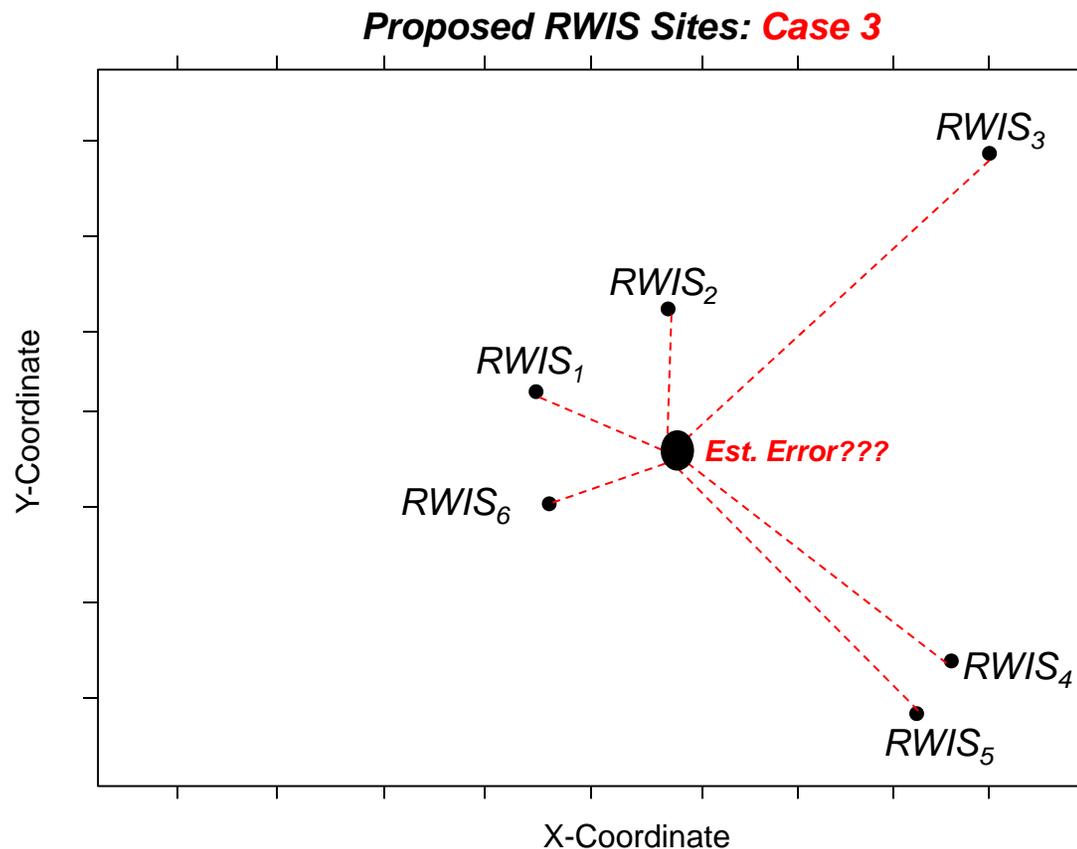
- Kriging provides **spatial prediction** and **estimation error** at a potential RWIS station location based on a known set of observations from existing RWIS stations.



# Geostatistics: What is Kriging?

## Definition:

- Kriging provides **spatial prediction** and **estimation error** at a potential RWIS station location based on a known set of observations from existing RWIS stations.



Try all possible combinations and choose the one that produces “minimum” estimation error

# Geostatistics, Kriging

## What are the benefit ???

- Much less data is needed (i.e., less preparation),
- Has a greater generalization power (i.e., can easily be applied to other regions),
- Takes account for spatial variability / correlation of the effects caused by multiple RWIS stations

- Future Plans

## Tentative Plans for the next few months...

- (Geo)processing of RWIS dataset (provided by Mn/DOT)
- Characterizing the spatial patterns of various hazardous RSC variables,
- Developing and testing the solution algorithms, and
- Comparing and evaluating the alternatives

- Request of Additional Data

- ✓ Ontario (1<sup>st</sup> Approach)
- ✓ Minnesota (1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> Approach)
- ✓ Iowa???
- ✓ Utah???

- Proposal on the Next Phase

## What could be done in the Next Phase...

- Test the usability of the methods with other regions
- “Easy-to-use” RWIS Network Analysis and Allocation Optimization Tool

## • Research Contributions

### Referred Journal/Conference Papers Published

**Kwon, T. J.**, Fu, L., & Jiang, C. (2014). RWIS Stations – Where and How Many to Install: A Cost Benefit Analysis Approach. *Proceedings of the 93rd Annual TRB conference*, Washington D.C., Jan 12-16.

**Kwon, T. J.**, & Fu, L. (2013). Evaluation of alternative criteria for determining the optimal location of RWIS stations. *Journal of Modern Transportation*, vol. 21., pp 17-27

**Kwon, T. J.**, Fu, L., Perchanok, M. S., & McClintock, H. (2013). A Systematic Approach for Locating Road Weather Information System (RWIS) Stations in Canada. *Proceedings of 2013 TAC Conference and Exhibition*, Winnipeg, Manitoba, September 22-25.

### Invited Talks/Presentations

**Kwon, T.J.** (2014). Development and Evaluation of Models and Algorithms for Locating RWIS Stations, Invited Talk at *The 2<sup>nd</sup> International Symposium and Exhibition on Winter Road Maintenance*, Harbin, China, Aug, 2014

**Kwon, T.J.** (2014). RWIS Stations – Where and How Many to Install: A Cost Benefit Analysis Approach, Poster Presentation at *the 93rd Annual TRB conference*, Washington D.C., Jan 12-16

**Kwon, T.J.** (2013). Optimal Density and Location of an RWIS Station. Invited Talk at *the Korean Transport Institute (KOTI)*, Seoul, Korea, August, 2013

**Kwon, T.J.** (2013). A Systematic Approach for Locating Road Weather Information System (RWIS) Stations in Canada. Poster Presentation at *2013 TAC Conference and Exhibition*, Winnipeg, Manitoba, September 22-25

**Kwon, T.J.** (2013). Winter Road Maintenance – a comparison of alternative performance measures and service standards. Poster Presentation at *2013 TAC Conference and Exhibition*, Winnipeg, Manitoba, September 22-25

# **Attachment C**



# LESPaRC - Lake Effect Storm Prediction and Research Center

**Presented By:**

Dillon Ulrich – SUNY Oswego Meteorology Major

Andrew Janiszkeski – SUNY Oswego Meteorology Major

Picture taken in  
Pulaski, NY by local  
resident

# Overview

- 1) What is the LESPaRC?
- 2) Advantages of the LESPaRC over other available weather information.
- 3) Our objective

# Overview

- 1) What is the LESPaRC?
- 2) Advantages of the LESPaRC over other available weather information.
- 3) Our objective

# What is the LESPaRC?

- The LESPaRC was founded in 2008 by Dr. Scott Steiger and is a student run winter weather forecasting service
  - Main clients include local school districts and the New York State Department of Transportation (NYSDOT)
- SUNY Oswego's Meteorology program teaches students how to observe and predict complex weather phenomena such as lake-effect snow
  - The LESPaRC creates opportunities for students to gain real-world research and forecasting experience while applying what they have learned in the classroom

# Overview

- 1) What is the LESPaRC?
- 2) Advantages of the LESPaRC over other available weather information.
- 3) Our objective

# A typical winter forecast map:



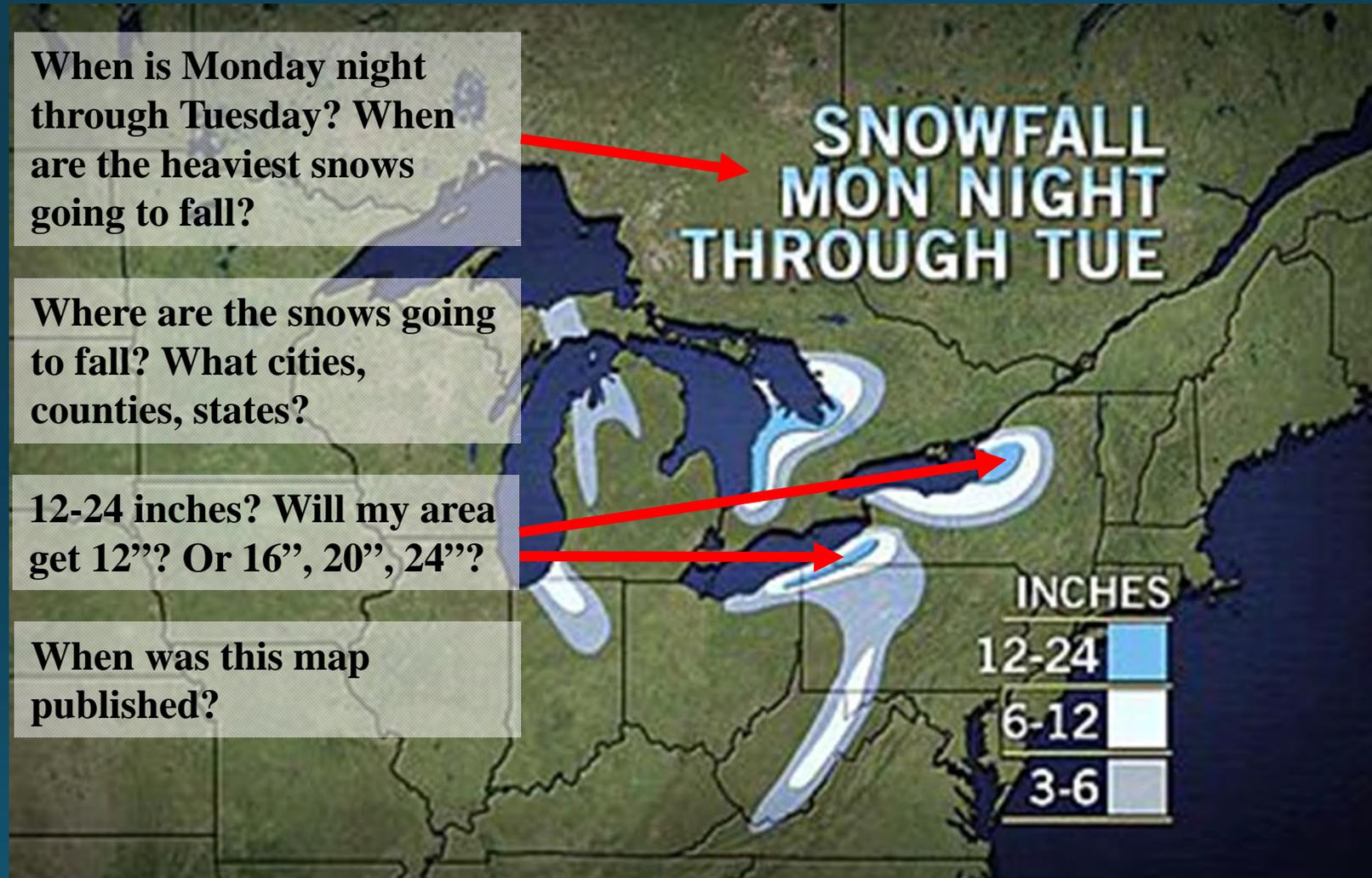
# A typical winter forecast map:

When is Monday night through Tuesday? When are the heaviest snows going to fall?

Where are the snows going to fall? What cities, counties, states?

12-24 inches? Will my area get 12"? Or 16", 20", 24"?

When was this map published?



HAZARDOUS  
WEATHER  
THREAT:

**MEDIUM**

Through Dec 20th

# L.E.S.P.A.R.C.

## LAKE EFFECT STORM PREDICTION AND RESEARCH CENTER

[Home](#)

[NYS-DOT](#)

[On-Call Schedule](#)

[Weekly Forecast Discussion](#)

Detailed Forecasts:

[I-81 @ Route 342](#)

[I-81 @ Adams](#)

[I-81 @ Arsenal Street](#)

[Route 177 @ Barnes Corners](#)

[Central Square](#)

[Hannibal](#)

[Lafayette](#)

[Lowville](#)

[Maple View](#)

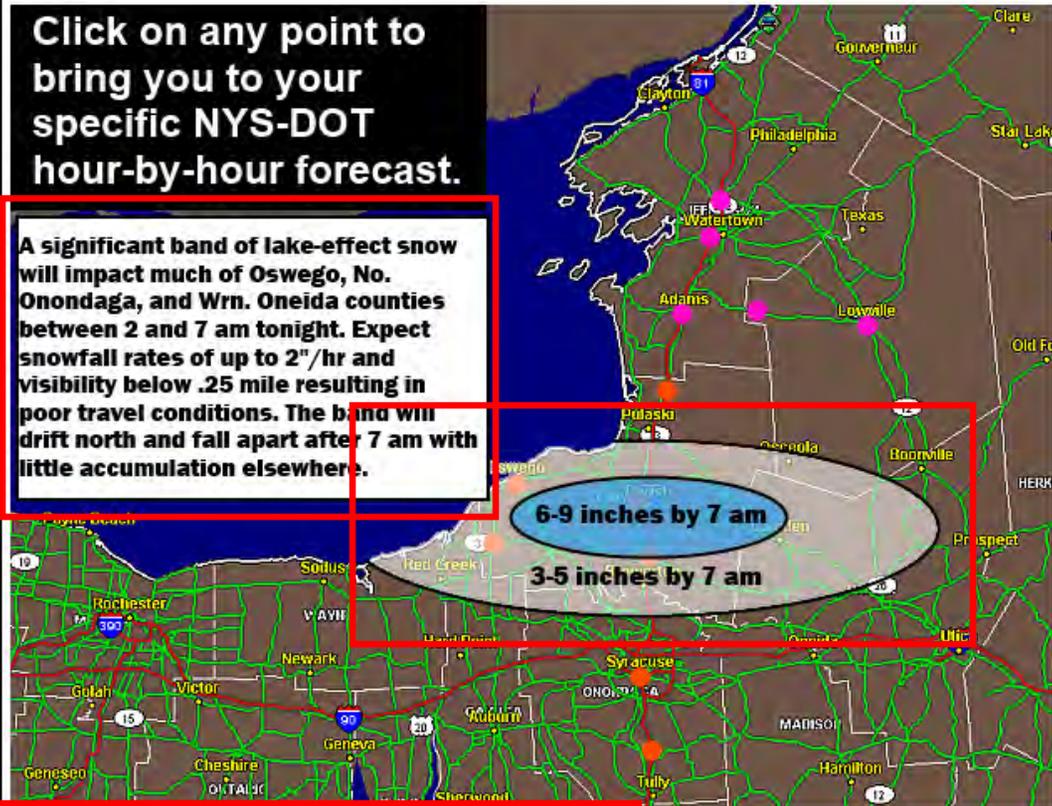
[Sandy Creek](#)

[Syracuse](#)

Welcome to the Lake Effect Storm Prediction and Research Center.

Click on any point to bring you to your specific NYS-DOT hour-by-hour forecast.

A significant band of lake-effect snow will impact much of Oswego, No. Onondaga, and Wrn. Oneida counties between 2 and 7 am tonight. Expect snowfall rates of up to 2"/hr and visibility below .25 mile resulting in poor travel conditions. The band will drift north and fall apart after 7 am with little accumulation elsewhere.



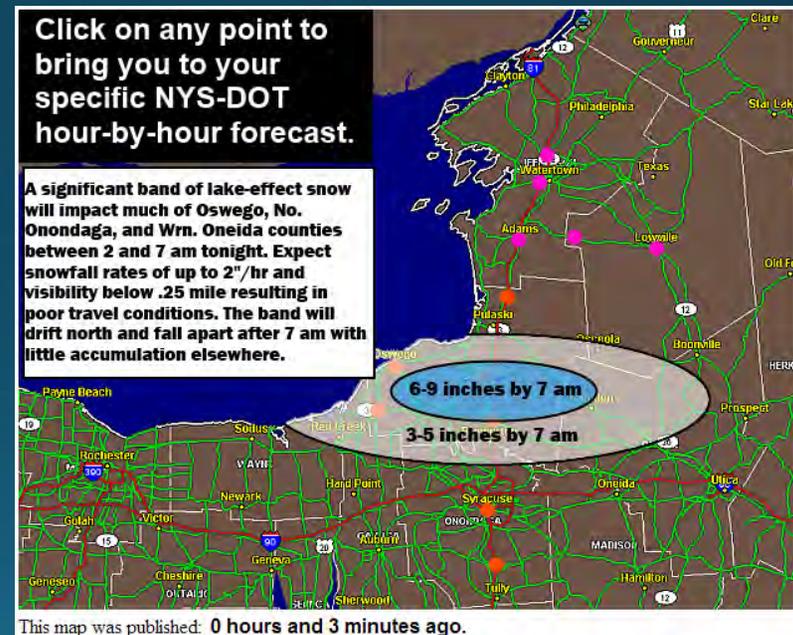
This map was published: 0 hours and 3 minutes ago.

# Which would you rather have?

Typical Forecast Map

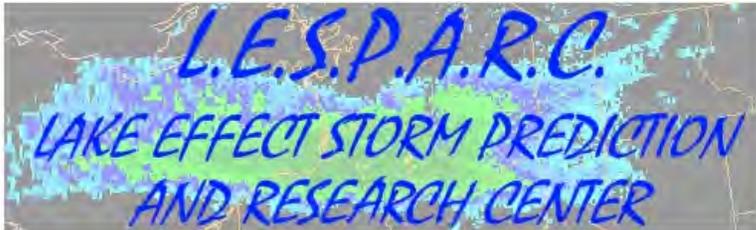


LESPaRC



# Hour-by-hour forecast

HAZARDOUS  
WEATHER  
THREAT:  
**NONE**  
Through Oct 31st



[Home](#)

[NYS-DOT](#)

[On-Call Schedule](#)

[Weekly Forecast Discussion](#)

Detailed Forecasts:

[I-81 @ Route 342](#)

[I-81 @ Adams](#)

[I-81 @ Arsenal Street](#)

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[Sandy Creek](#)

[Syracuse](#)

Syracuse						
Time	Weather Conditions	Snowfall Rates	Temperature	Winds	Wind Chill	Visibility
1 PM	Light Snow	.25"/hr	24	NW 5-10 mph	15-20	2 mi
2 PM	Light Snow	.25"/hr	24	NW @ 10-15 mph	15-20	2 mi
3 PM	Light Snow	.25"/hr	23	NW @ 10-15 mph	15-20	2 mi
4 PM	Flurries	Trace	23	NW @ 10-15 mph	15-20	10 mi
5 PM	Mostly Cloudy	None	23	NW @ 10-15 mph	15-20	10 mi
6 PM	Mostly Cloudy	None	23	NW @ 10-15 mph	15-20	10 mi
7 PM	Mostly Cloudy	None	23	NW @ 10-15 mph	10-15	10 mi
8 PM	Mostly Cloudy	None	22	NW @ 10-15 mph	10-15	10 mi
9 PM	Mostly Cloudy	None	22	NW @ 10-15 mph	10-15	10 mi
10 PM	Mostly Cloudy	None	21	NW @ 10-15 mph	10-15	10 mi
11 PM	Mostly Cloudy	None	20	NW @ 10-15 mph	10-15	10 mi
Midnight	Mostly Cloudy	None	20	NW @ 10-15 mph	10-15	10 mi

[CLICK HERE](#) for the local current radar.

[CLICK HERE](#) for the New York State current radar loop.

Meteorologist on call: Andrew Janiszski; Phone Number: 716-220-4758; Email: [janiszkes@oswego.edu](mailto:janiszkes@oswego.edu)

**Local Forecast Discussion:** A cold northwest flow off of Lake Ontario is resulting in some light snow for the Syracuse region. Expect an inch or two of fluffy, light snow, by 4 pm which will be just enough to make roads slippery. Afterwards, expect mostly cloudy skies and wintry temperatures with readings around 20 degrees and wind chills around 10 courtesy of the brisk northwest wind.

Level of Confidence: High

# Other Advantages

- Weekly forecast discussion
- Emails sent out ~24 hours in advance of significant event (7+ inches in 24 hours or 2"/hr snowfall)
- 24/7 on-call Meteorologists
- Pick your preferred subscription dates (i.e. – November 1<sup>st</sup> → April 1<sup>st</sup>)
- Affordable monthly cost
- Profits go towards tools and equipment to assist student research
  - Radiosondes
  - Mobile Threat Net

# Overview

- 1) What is the LESPaRC?
- 2) Advantages of the LESPaRC over other available weather information.
- 3) Our objective

# Our Objective

- Provide clients with forecasts that are:
  - Detailed
  - Accurate
- Frequently updated
- 24/7 availability including:
  - On call meteorologists
  - Text and/or email alerts from forecasters (if requested by client)
- Create opportunities for students to gain research and forecasting experience in a real-world environment
- Better our science for the future

# Questions?

*L.E.S.P.A.R.C.*  
*LAKE EFFECT STORM PREDICTION  
AND RESEARCH CENTER*

# **Attachment D**

# Aurora Program

Member Agency Updates ... for October 2014 Board Meeting

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## North Dakota Department of Transportation (Travis Lutman)

- North Dakota continues to install the ATMS Software from Delcan. We have ran into to several issues with compatibility (Old RPU's mainly) Delcan has been working through these issues well.
- In 2015 NDDOT plans to move to Noninvasive technology.
- Installed a Q6044-E camera (HD). We will continue to install in locations that we do not have limited bandwidth. Very high image quality. In other locations we will install the Q6042-E (SD).
- ITS Budget was increased which should allow us to update our remaining old sites in the next 2-3 years dependent upon cost estimates.
- The AVL contract is moving forward, we are currently bench testing 3 vendor units (Delcan, Ameritrak, and Location Technologies). Once bench testing is completed we will move forward to installations of two devices per vendor if they pass the bench testing. Deployment will vary upon cost, hoping to install 100 units.
- Looking into implementing a Citizen Reporting Program starting with Law Enforcement, Emergency Managers, etc.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_

## Iowa Department of Transportation (Tina Greenfield)

- RWIS-based salt dashboard is going into 4<sup>th</sup> year
- Now have over 20 mini-RWIS around the state
- Polled maintenance supervisors a few weeks ago on their satisfaction with the number/density of RWIS information across the state. Vast majority wanted more RWIS.
- October 1 started a new RWIS maintenance contract. This year the RWIS roles are split between 2 companies. Ordinary communications issues and camera/wavetronix maintenance will be covered by our statewide ITS contract (currently TransCore). Vaisala won the RPU, sensors, and polling software maintenance bid (out of 2). Vaisala was also the vendor for last year's contract.
- Will be trying the High Sierra Surface Sentinel and Vaisala Surface Patrol for replacement truck IR road sensors. Also trying 1 Lufft MARWIS mobile condition/grip/temperature sensor.
- Notes: \_\_\_\_\_  
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**Wisconsin Department of Transportation** (Mike Adams)

- Seven new sites this summer
  - 3 sites included in US41 plan, but prime contractor failed to do all work. Lufft had to do it.
  - Power issues at 2 sites
- No change in MDSS ops this winter—no live vehicle data due to legal issues
- Lots of RFPs in the pipeline
  - RWIS maintenance
  - Rest area weather (internet?)
  - RWIS parts and new sites
- STOC/NWS/BHM cooperation during adverse weather
- Notes: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**New York State Department of Transportation** (Joe Doherty)

- Many limitations and frustrations with our current RWIS network.
- This spring, our project with the New Jersey Institute of Technology titled “RWIS Statewide Implementation Plan” wrapped up. A copy of the final report is available to Aurora members on the group website. Although not in a form that allows immediate implementation (if/when funding ever becomes available), it does contain some useful “technical approaches” for helping determine where RWIS sites could/should be placed.
- NYSDOT’s Office of Transportation Maintenance continues to push for the “adoption” of our RWIS network by our Office of Traffic Safety & Mobility so that it can be folded into their much larger (and better resourced) ITS network.
- One major initiative that shows promise for perhaps incorporating RWIS elements is the NY Statewide Mesonet project which involves the installation of 125 new weather stations. Staff from the University at Albany, the project managers for the Mesonet effort, are scheduled to participate in the Aurora meeting in Ithaca. I’m expecting they will provide us with some good information on the topic.
- Notes: \_\_\_\_\_

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\_\_\_\_\_

**Alaska Department of Transportation and Public Facilities:** (Jack Stickel)

- RWIS Avalanche Detection Camera System installed.
- Open polling of ESS devices and new sites to be deployed in Alaska.
- Also, RWIS Air Quality Non-Attainment System installed
- Two other topics previously mentioned that will undoubtedly be discussed elsewhere
  - The patent infringement case with FHWA & others
  - The new weather and visibility sensor potential testing
- Notes: \_\_\_\_\_

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\_\_\_\_\_  
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**Pennsylvania Department of Transportation** (Jason Norville)

- Change in organization at PennDOT that has moved ITS activities under a new area. This was all part of a top to bottom review of the entire department, he added.
- RWIS RFP, performance measurement, MDSS, and sustainability.
- Significant issues with PennDOT's RWIS RFP. Flooding expected in spring 2014
- Salt storage issues.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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**Utah Department of Transportation** (Jeff Williams)

- In Virginia Beach, Jeff Williams noted that UDOT has been making a push to expand use of traveler information, adding two new positions in this area recently. He also briefly mentioned a new RWIS site near Ogden, 5 other new sites being deployed soon, weather sensitive signal timing, solar power, and fiber optic communications. Jeff then talked about a UDOT effort to utilize variable speed limit posting based on weather conditions.
- Utah DOT has been successfully coordinating with the National Weather Service in Grand Junction, Colorado.
- Utah is continuing to expand the use of traveler information across the state.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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**Virginia Department of Transportation** (Jimmy White)

- Last year in Virginia Beach, Jimmy and Gene discussed recent trends that affected their operations and how traffic volumes were utilized to track winter maintenance performance.
- No other burning issues were reported recently.
- VDOT peer review.
- Cost overruns for winter maintenance.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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**California Department of Transportation** (Steve Hancock)

- State's network consists of 120 sites.
- Replacing several RPU's
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_

**Ontario Ministry of Transportation** (Max Perchanok/Jeff Baker)

- Added rain gauge observations and intensity-duration curves to RWIS web site.
- Adopted the Transportation Association of Canada winter road condition classification, 1<sup>st</sup> season of implementation
- Implemented Phase 3 of RWIS Seasonal Loads Advisory: Predictions of frost and thaw depth, and WWP and SLR on and off dates can be generated for any location in the province.
- Field demo of mobile touch-screen input of road conditions and incidents
- Field demo and correlation tests of web-cam machine vision system for reporting road conditions
- MTO was conducting an internal review of their operations.
- Province has 149 RWIS and 9 spring load sites.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_

**Ohio Department of Transportation** (Thomas Lyden)

- In Virginia Beach, Abner Johnson noted that ODOT was looking at new performance measures that integrate speed data. He also noted that Telvent was recently awarded Ohio’s forecasting services contract. He then reported on the critical success factors (CSF) initiative being undertaken at ODOT.
- Ohio has more than 170 RWIS.
- Replacement of SCAN Web
- Snow and Ice Performance Evaluator
- Upcoming RFP ...
- Combining RWIS data with traffic data.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Minnesota Department of Transportation** (Curt Pape)

- In Virginia Beach, Curt noted that there was little to report concerning system-wide issues, but did discuss platform options as brought up during the Friends of Aurora discussions. Other topics discussed were AVL capabilities on Minnesota’s maintenance vehicles and MDSS. He also noted that he now has nearly 100 RWIS located across Minnesota.
- Expanded use of cameras at their sites, as well as infrared illuminators and replacement of precipitation sensors. Curt also noted that
- Minnesota now has 95 full RWIS sites throughout the state.
- Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Kansas Department of Transportation** (Ron Hall)

- Have been upgrading our RWIS sites that have landlines to Cellular Communications in FY2013. The reason we have been able to do this; the cellular network signal has improved across the state. This transition is creating a savings of almost \$14,000 dollars a year just in communications costs. This has helped create stability in our RWIS network. We have a couple of locations that we are using a 900 MHz radio transmitter for communications. These will also be changed over to Cellular in the future.
- We have been transitioning from ESP RPU's to Linux RPU's. We were no longer able to get repair parts to maintain the ESP equipment. We should have all our sites transitioned to Linux by fiscal year 2014. This has also helped will stabilizing the reliability of our systems.
- We are changing out the widely used break beam Precipitation sensors across the state. These have proven to be unreliable. We are transitioning to the Lufft R2S and the Vaisala DRD11. We will use the R2S on locations that we are getting forecasts (due to the identifier of precipitation types) and the DRD11 at the rest of the locations (due to it showing yes/no for precipitation). We currently have around 32 locations where we receive forecasts and another 11 that don't. This transition should be completed by fiscal year 2015.
- We are planning on turning one RPU into a total Lufft system. Currently the RWIS site in Garden City is operating a Linux and Lufft RPU at the same time. The Lufft is using non-invasive technology for pavement data. The plan is to change to complete Lufft equipment by Fiscal year 2014. We will install Lufft pavement sensors to round out this RPU installation. We have been displaying the Lufft information in ScanWeb since fiscal year 2012.
- We want to test the functionality of a Lufft ISOCON with a Lufft sensor transmitting through a Linux RPU. The ISOCON is supposed to interpret sensor data and transmit a NTCIP compatible data stream. We want to see if this NTCIP compatible data stream will produce coherent information in ScanWeb.
- Notes: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Colorado Department of Transportation** (Dave Wieder)

- CDOT has about 120 sites, which they are currently upgrading.
- Notes: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Illinois Department of Transportation** (Tim Peters)

- Notes: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



# **Attachment E**

# Ohio Department of Transportation

## Ohio Updates



**Thomas Lyden, Administrator  
Maintenance Operations**

*October 6-9, 2014*

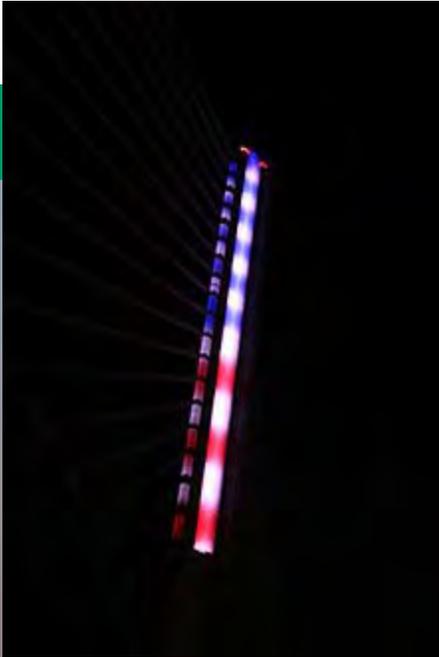
John R. Kasich, *Governor* • Jerry Wray, *Director*

[www.transportation.ohio.gov](http://www.transportation.ohio.gov)

# Veteran's Glass City Bridge



# Pylon LED's



# Bridge Closed

- ④ **TOLEDO, OH -- I-280 northbound is closed at the Veterans' Glass City Skyway bridge due to falling ice. The southbound lane has reopened.**
- ④ **Falling ice from the suspension cables on the Veterans' Glass City Skyway has been a problem with the bridge since it opened in 2007. The Ohio Department of Transportation is working with a team of engineers to develop a solution to the problem.**
- ④ **The bridge will remain closed until further notice.**



# Ice Prevention or Removal on the Veteran's Glass City Bridge

- ① Ice observed at  $\frac{3}{4}$  inch
- ① Shedding of stay can occur <1 minute
- ① Fall up to 250 feet
- ① Large ice sheets crossed all lanes
- ① Requires lane or bridge closure
- ① Two Phase Study
  - ① Potential technologies
  - ① Monitoring system



# Icing Events

- ① Warm air from the Gulf overriding cold air from Canada
- ① Five major icing events, ~ 2 per year
- ① Six hours to form 0.25 inches ice



# Potential Solutions

- ④ **Matrix of over 70 potential technologies**
- ④ **Most viable**
  - ④ Deicing/anti-icing chemicals
  - ④ Anti-icing coatings
  - ④ Heat through hollow stays
- ④ **All deemed impractical**



# Local Weather Station

- ④ **Five Sensors**
  - ④ Thermistors
  - ④ Goodrich ice detector
  - ④ Solar radiation monitor
  - ④ Leaf wetness moisture sensor
  - ④ Tipping rain gauge
- ④ **PTZ Camera**
- ④ **Monitoring system**



# Monitoring System (Icing Dashboard)

- ① **Data from local (bridge and RWIS) sensors and sensors in Toledo area**
- ① **Quantitative guidelines of icing accretion and shedding conditions**
- ① **Dashboard located in county and district facilities**



# Operations

- ④ **Ice accretion**
  - ④ Verification
  - ④ Stage barrels and closure
- ④ **Ice shedding**
  - ④ Close lane(s)
  - ④ Prepare and plow



# GPS/AVL Study

- ④ **Goal – Use GPS/AVL as an enhance method for tracking and management of ODOT’s snow and ice resources**
  - ④ Tier 1 – tracking of snow plows
  - ④ Tier 2 – snow and ice telemetry
  - ④ Tier 3 – resource usage reporting
- ④ **University of Akron**
  - ④ **Medina and Stark Counties, 25 units**



# Snow Plow Cams

- ④ **Model off Iowa**
- ④ **Pilot ~ 50 trucks in 2 counties**
  - ④ Ashland
  - ④ Washington

