Idaho's Winter Performance Measures

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Topics

- **Resources**
- **Background**
- **Development Process**
- **Partnership with Vaisala**
- **Methodology**
- **Results**
- **Future developments**

Resources

- ITD spends $30 Million on Winter Maintenance for labor, materials and equipment
- 500 vehicles statewide
- Salt, salt brine, magnesium chloride, anti-skid
- 2011 85 RWIS locations with 58 measuring Grip.
- Differences in geography, terrain and weather patterns among the 6 districts created various Best Maintenance Practices (BMP's)
- ITD needed a uniform approach for measuring winter maintenance performance

The Birth of Idaho's WPM

- Ed Bala District 5 Administrator developed the storm severity and performance index in 2008
- Dennis Jensen District 4 foreman was using the RWIS data to evaluate various treatment success to improve grip
- 2009-10 Ed and Dennis shared ideas and worked out a system to evaluate winter maintenance
- 2011 the new ITD director Brian Ness instructed the districts to develop a statewide performance measure for winter maintenance.
- Upgrades to existing sites began utilizing End of Year (EOY) and redirected funds

Developing the Initial Process

- Ed worked with the other district administrators and managers while Dennis worked with field personnel to attain buy in and understanding
- The process met with much apprehension and goals were set to be easily met
- BMP's that were not designed around deicing were still utilized in some areas and the Winter Performance Measures (WPM) results varied greatly throughout the state
- Apprehension turned to defensive posturing in some locations
- The first year all data was gathered through graphical reports open to human interpretation, this was also very labor intensive

Continued Development

- Several RWIS locations did not have good polling areas for the non invasive sensors or operators were missing the polling location on their first pass
- January 2012 all established Performance Measure Reporting (PMR) RWIS locations had been visited and new polling areas located
- Validation of chloride treatments started to be recognized throughout the state and acceptance in these areas quickly gained support
- Traditional antiskid locations met with resistance
- Fall 2012 Districts moved to more aggressive treatment products and started looking at new BMP's

Development Process For 2012

- Forecasting became more important to crews as they moved from reactive to proactive resulting in a stronger relationship with the National Weather Service (NWS) and higher performance scores
- Crews that had develop very good deicing practices prior to the WPM were not always getting recognized since the WPM was based upon ice reduction and not prevention
- Fall of 2012 seen a second performance index developed and implemented as the Mobility Index
- The Winter Performance Index and the Mobility index now captured the entire storm event duration
- The graphical data was incorporated into a automated work sheet report eliminating the need for human graph interpretations

Methodology for Idaho's WPM

- How everything works
  - RWIS network with non-invasive sensors
  - Storm severity index (multiple available)
    - Performance Measurements for Highway Winter Maintenance operations (QUI 2008)
    - Developing of a Roadway Weather Severity Index (Strong et al. 2005)
    - Local Storm Scale (Cerruti and Decker, 2001)
    - SHRP (Boselly et al.)
    - States; Idaho, Wisconsin, Indiana, Iowa, Ontario, Utah, California
  - Time element for grip recovery

Idaho's Storm Severity Index

- Storm Severity Index rates three storm values based on individual lap times
- **FORMULA:** Winds speed max + Precept Max + 300/Surface temp Minimum = Storm severity Index
- Lower values from index indicate light events, this will typically range from 80-500

Severity Index

max(WindSpeed) + max(LayerThickness) + 300 / min(SurfaceTemp)

io	Date	Time Range	Event	Duration (hours)	Max Wind Speed (mph)	Max Ice Layer (mm)	Max Snow Layer (mm)	Max Water Layer (mm)	Min Surface Temp (°F)	Severity Index	P In	
Lolo Pass												
	29.04.2013	05:19 - 06:19	TREATED	1.00	6.04	0.15	0.01	0.61	31.64	16.13	0	
	29.04.2013	06:19 - 07:19	GRIP<.6	1.00	4.25	0.15	0.12	0.23	32.00	13.86	0.07	80%
	29.04.2013	07:19 - 10:19	TREATED	3.00	5.59	0.43	0.00	0.79	31.10	16.03	0	

The Formula is highlighted on the report in the red comment box. Notice the severity changes is recomputed each time there is a change in condition. This event is broke into three segments with the blue section representing good grip, green loss of grip then blue again for grip recovery. The severity varied some during these transitions.

Winter Performance Index

- Winter Performance Index rates the treatment effectiveness to the storm (recovery time to safe grip)
- **FORMULA:** Ice up time / severity = Winter Performance Measures Index
- Ice up time is the duration of the event when the grip is below .60 for more than ½ hour

Winter Performance Index

Min Surface Temp (°F)	Severity Index	Performance Index	M In	GRIP<.6 Duration / Severity Index
31.64	16.13	0		
32.00	13.86	0.07	80%	
31.10	16.03	0		

The Winter Performance index is Identified by a numerical value as such in the green box. In this case green represents a very successful treatment. The Blue boxes is where loss of grip was prevented to a state of water only.

The Scale

Storm Performance Index Legend	
0	Successfully treated
0.00 - 0.30	Significantly accelerated grip recovery
0.31 - 0.49	Some success at grip recovery
0.50 - 0.69	Very little success at deicing
0.70 -	Limited maintenance or no deicer success
	Observation data / parameter missing or temp is below threshold

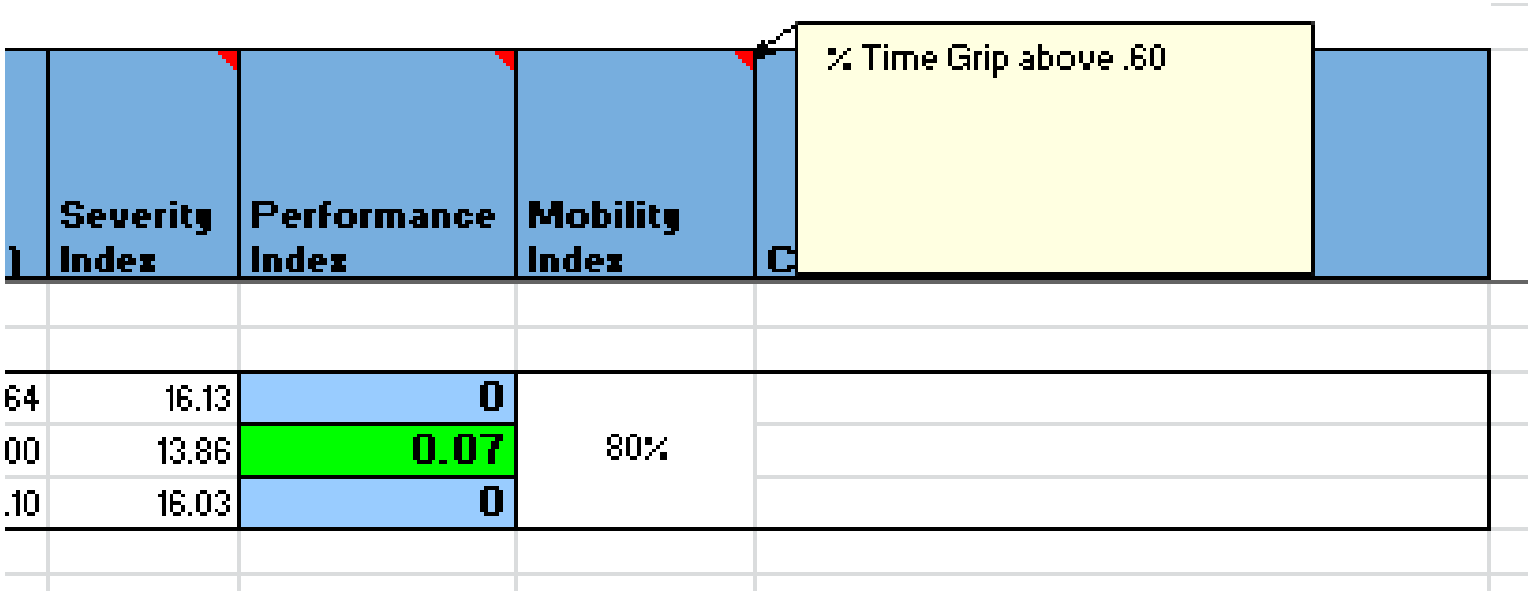
The brackets were developed through hundreds of graph comparisons, interviews and observations in the field. Storm response and product selection was key in this development.

Mobility Index

- Winter Mobility Index rates the percentage of time of wet pavement with below freezing conditions
- **FORMULA:** % Time Grip.60 > when surface precept below freezing

Mobility Index

n data / parameter missing or temp is below threshold



The Grip is the Grip Coefficient with .82 being the best and .00 no grip at all. The .82 indicates a dry surface and some sliding when braking hard. A grip value of .60 indicates the water equivalent layer(s) are thick enough to effect not only braking but also the control of the vehicle.

Partnership with Vaisala

- ITD Collaborated with Vaisala during the development of the project to automated the WPM calculations

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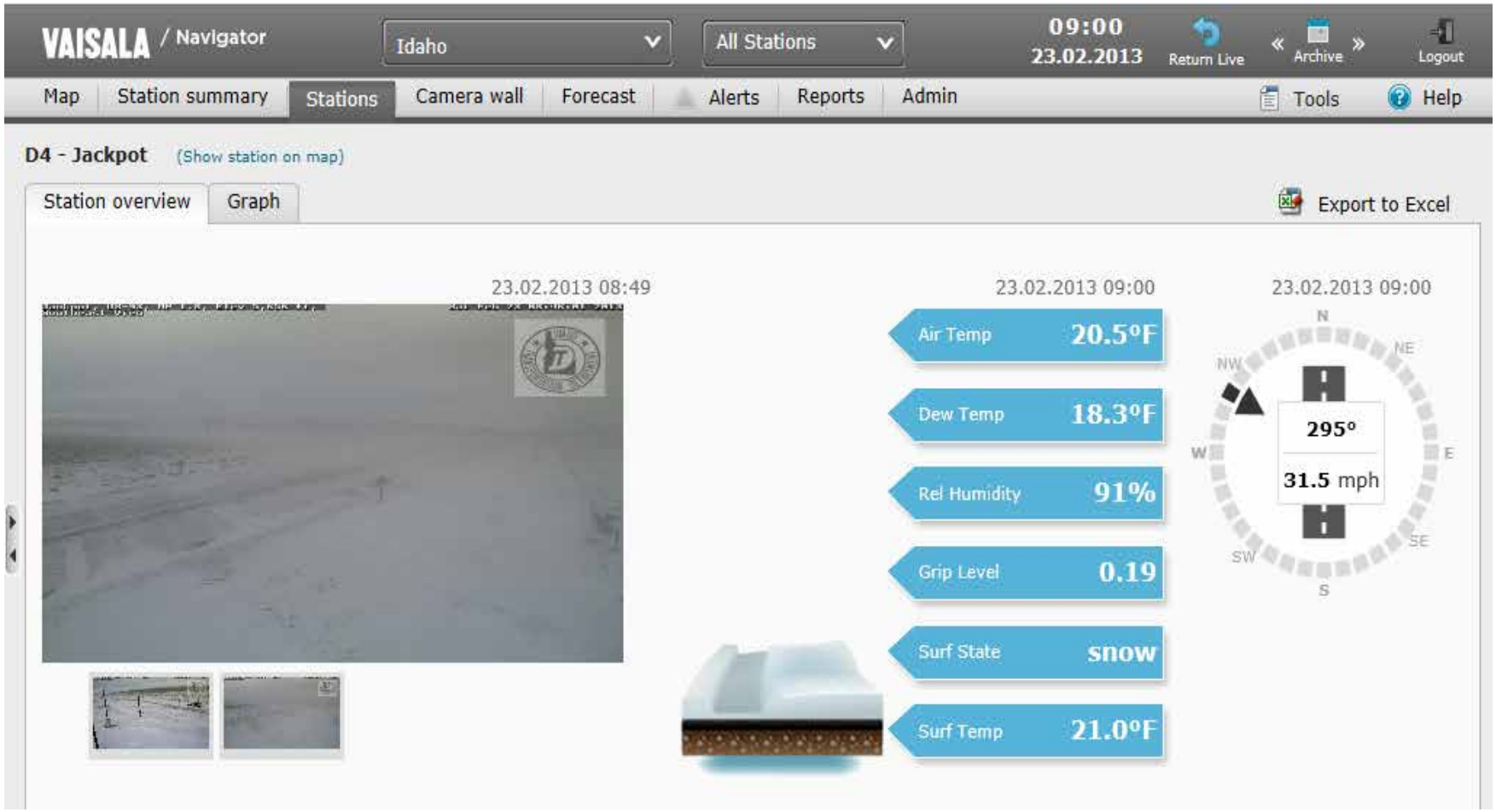
	Observation data / parameter missing or temp is below threshold

Station	Date	Time Range	Event	Duration (hours)	Max Wind Speed (mph)	Max Ice Layer (mm)	Max Snow Layer (mm)	Max Water Layer (mm)	Min Surface Temp (°F)	Severity Index	Performance Index	Mobility Index	Comments
D1 - 4th of July Pass													
	22.02.2013	12:45 - 22:00	TREATED	9.25	6.26	0.12	0.11	1.12	29.30	17.62	0		
	22.02.2013	22:00 - 22:30	GRIP<.6	0.50	5.82	0.00	0.00	1.17	31.10	16.63	0.03		
	22.02.2013	22:30 - 07:15	TREATED	8.75	10.96	0.03	0.01	1.02	27.50	22.89	0		
	23.02.2013	07:15 - 08:00	FROST trea	0.75	5.37	0.00	0.00	0.03	27.14	16.45	0	96%	
	23.02.2013	08:00 - 08:45	TREATED	0.75	3.13	0.05	0.14	0.05	27.32	14.25	0		
	23.02.2013	08:45 - 09:15	GRIP<.6	0.50	4.03	0.05	0.20	0.00	26.78	15.43	0.03		
	23.02.2013	09:15 - 11:30	TREATED	2.25	6.71	0.03	0.10	0.32	26.06	18.54	0		
	23.02.2013	18:00 - 21:00	FROST trea	3.00	4.03	0.00	0.00	0.01	26.96	15.16	0	100%	
	25.02.2013	07:00 - 10:15	TREATED	3.25	4.92	0.16	0.21	0.28	26.24	16.63	0		
	25.02.2013	10:15 - 11:30	GRIP<.6	1.25	1.79	0.08	0.27	0.03	28.22	12.69	0.10	80%	
	25.02.2013	11:30 - 13:15	TREATED	1.75	9.84	0.04	0.06	0.59	28.22	21.06	0		

Partnership with Vaisala



Matching the Treatment to the Event

Storm Performance Index Legend

0	Successfully treated
0.00 - 0.30	Significantly accelerated grip recovery
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	Observation data / parameter missing or temp is below threshold

Station	Date	Time Range	Event	Duration (hours)	Max Wind Speed (mph)	Max Ice Lager (mm)	Max Snow Lager (mm)	Max Water Lager (mm)	Min Surface Temp (°F)	Severity Index	Performance Index	Mobility Index	Comments
D1 - 4th of July Pass													
	25.02.2013	09:15 - 10:15	TREATED	1.00	2.24	0.01	0.21	0.28	27.86	13.29	0		antiicing
	25.02.2013	10:15 - 11:30	GRIP<.6	1.25	1.79	0.08	0.27	0.03	28.22	12.69	0.10	69%	change in condition
	25.02.2013	11:30 - 13:15	TREATED	1.75	9.84	0.04	0.06	0.59	28.22	21.06	0		recovery
	25.02.2013	15:30 - 16:00	TREATED	0.50	4.03	0.01	0.02	0.42	30.20	14.38	0	100%	antiicing
	25.02.2013	18:45 - 23:00	TREATED	4.25	5.82	0.00	0.00	0.13	29.66	16.06	0		antiicing
	25.02.2013	23:00 - 00:45	FROST treated	1.75	3.80	0.00	0.00	0.03	29.12	14.13	0		drying out-damp
	26.02.2013	00:45 - 01:45	TREATED	1.00	2.68	0.04	0.02	0.02	27.14	13.78	0	77%	new precept
	26.02.2013	01:45 - 05:15	GRIP<.6	3.50	3.58	0.09	0.03	0.02	26.24	15.10	0.23		change in condition
	26.02.2013	05:15 - 08:00	TREATED	2.75	4.70	0.06	0.02	0.02	27.86	15.53	0		recovery
	26.02.2013	08:00 - 09:45	FROST treated	1.75	2.46	0.00	0.00	0.02	28.22	13.11	0		drying out
	27.02.2013	20:45 - 05:00	FROST treated	8.25	6.93	0.00	0.00	0.03	30.02	16.96	0	100%	antiicing
	28.02.2013	05:15 - 08:45	TREATED	3.50	3.80	0.00	0.00	0.13	30.20	13.87	0		treatment

The Dashboard

Winter Storm Mobility by District

Statewide Goal: Maintain at least 55% unimpeded mobility during winter storms.

Winter Storm Mobility by District
-- Statewide Avg. 2012-2013 --

Why This Is Important

Idaho highways need reliable travel corridors with minimum delays during winter storms which allows for fewer impacts on commerce and increased safety on the roadways.

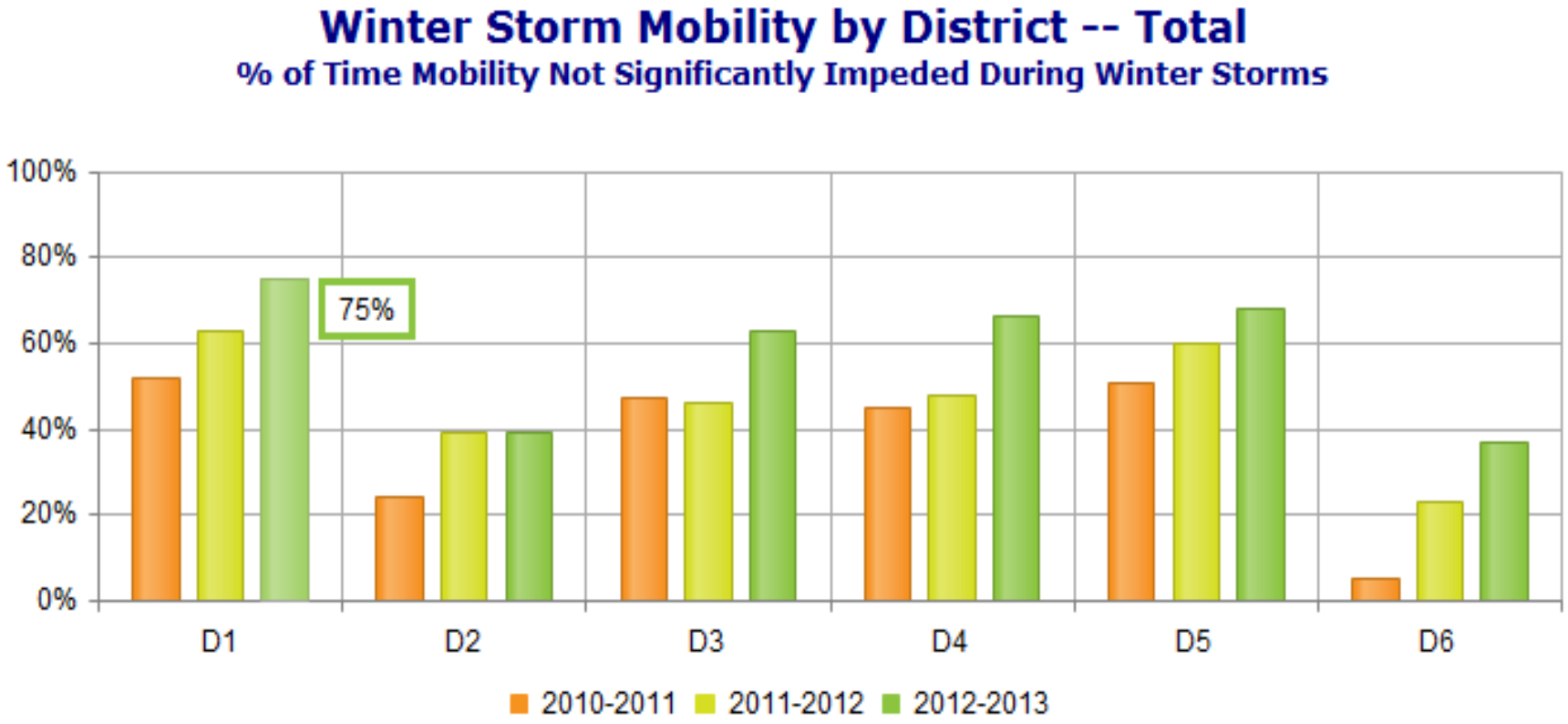
How We Measure It

During winter storms when surface temperatures are below freezing, ITD measures the percentage of time precipitation is on the roadway in a liquid form--water or light slush, versus snow or ice. Water or light slush on the roadway provides reasonable grip and traction. Snow or ice on the roadway results in a significant loss of traction and vehicles are restricted to lower speeds to make it safely to their destinations.

What We're Doing About It

ITD is using a statewide network of sophisticated roadway condition sensors and weather information stations to test and evaluate the effectiveness of snow plowing and different chemical de-icing treatments. Tests are repeated over and over again until reliable best maintenance practices are established for each location. ITD will continually refine these practices through ongoing critiques and the implementation of new technologies and treatments.

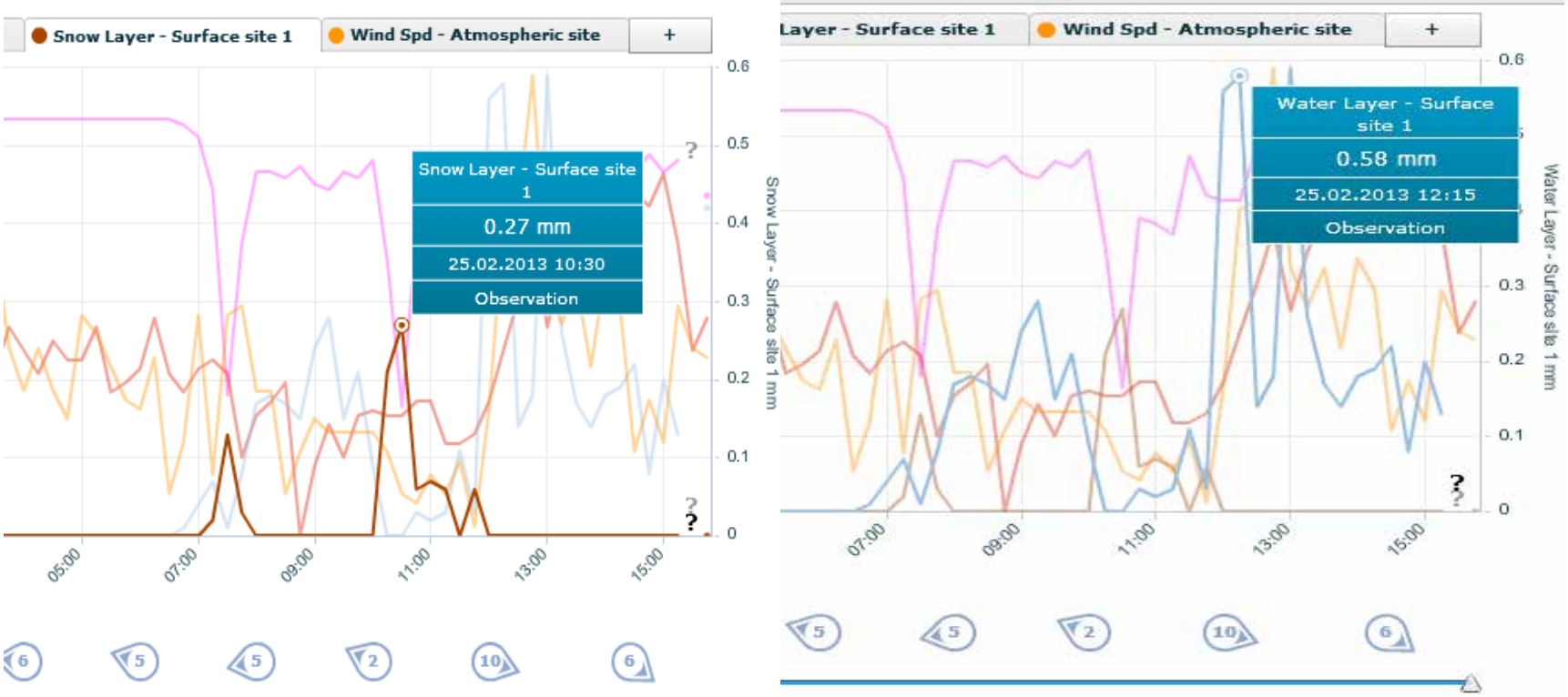
Results 2011-2013



How we achieved the Results 2010-2012

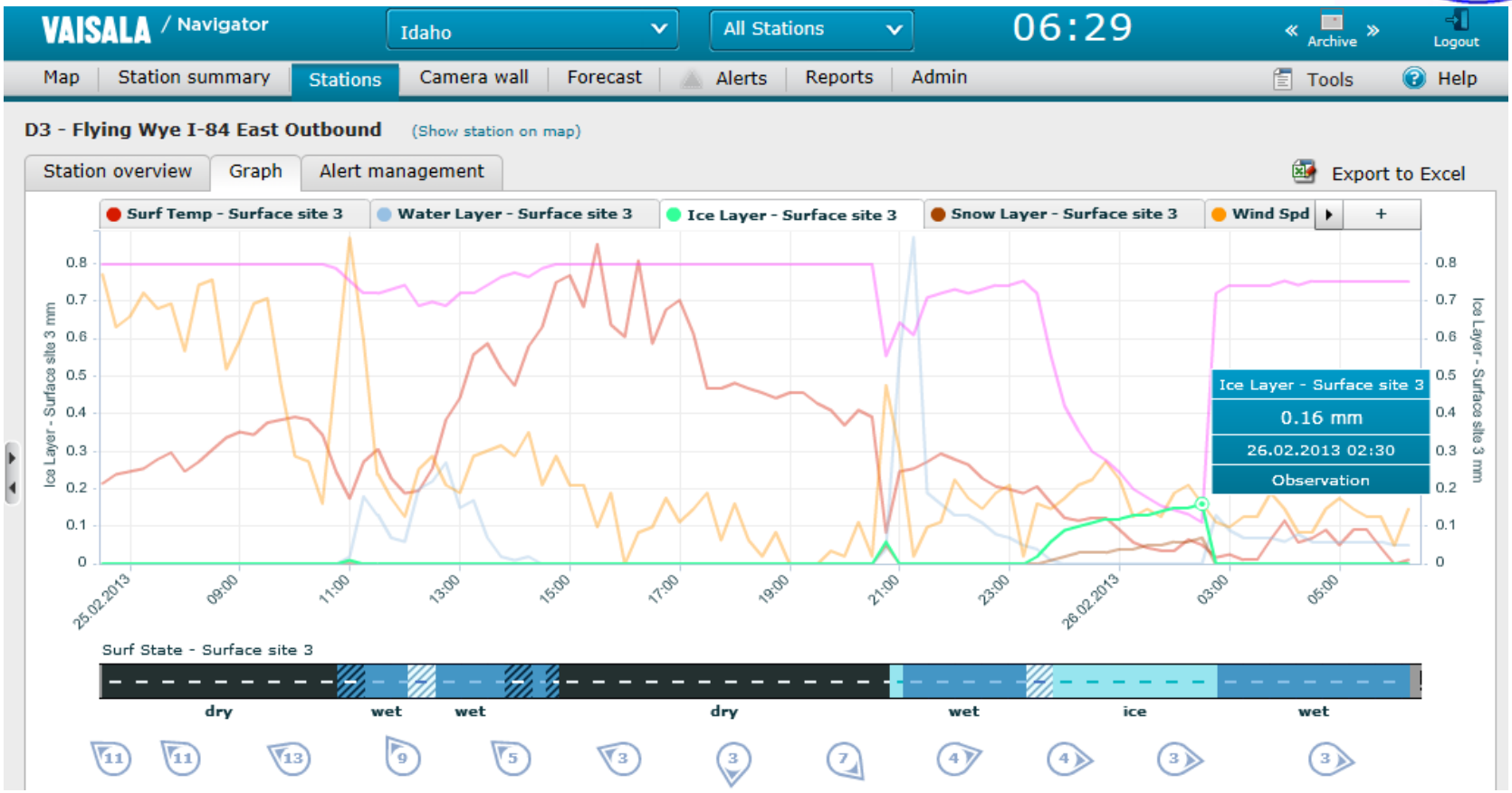
- Positive influences in performance were recognized
- Statewide training was implemented
- Critiquing of graphs allowed crews to evaluate products and timing
- Adaptation of new BMP's
- Feedback and coaching created more communication and a learning environment

Critiquing



Comparing surface conditions just prior to treatment, in this case the snow floor turned to water after treatment.

Mastering applications



In this case black ice was turned to water after one treatment

Into the Future

- Interfacing between AVL, MMS and RWIS
  - Customized application matrix
  - Cost verse accomplishment
  - Resource reallocation
  - Develop resources for maximum efficiency
  - Legislative reports to attain next level of performance

Recognizing limited resources

Station	Date	Time Range	Event	Duration (hours)	Max Wind Speed (mph)	Max Ice Layer (mm)	Max Snow Layer (mm)	Max Water Layer (mm)	Min Surface Temp (°F)	Severity Index	Performance Index	Mobility Index	Comments
D6 - Lost Trail Pass													
	25.02.2013	10:45 - 14:30	GRIP<.6	27.75	8.05	0.18	0.63	1.82	-3.82			12%	Temp is below the index calculat
	26.02.2013	14:30 - 18:30	TREATED	4.00	4.70	0.08	0.00	1.60	25.34	18.14	0		
	26.02.2013	18:30 - 09:15	GRIP<.6	14.75	7.61	0.31	0.07	0.06	6.98	50.90	0.29		
	27.02.2013	09:15 - 11:15	TREATED	2.00	9.17	0.12	0.01	0.41	16.52	27.74	0		
	28.02.2013	04:00 - 13:15	GRIP<.6	9.25	7.16	0.14	0.66	1.71	6.98	51.85	0.18	17%	Crew working
	28.02.2013	13:15 - 17:15	TREATED	4.00	6.26	0.08	0.02	0.88	28.76	17.57	0		Crew recoverd grip
	28.02.2013	17:15 - 10:15	GRIP<.6	17.00	6.71	0.21	0.89	0.03	20.48	22.25	0.76		No night shift
	01.03.2013	10:15 - 11:45	TREATED	1.50	7.61	0.02	0.00	1.20	25.34	20.64	0		recovery
	01.03.2013	17:45 - 19:30	TREATED	1.75	4.25	0.00	0.00	0.05	26.24	15.73	0	42%	
	01.03.2013	19:30 - 23:00	FROST treated	3.50	5.37	0.00	0.00	0.03	23.36	18.24	0		
	01.03.2013	23:00 - 23:45	TREATED	0.75	4.92	0.02	0.01	0.01	23.00	17.98	0		
	02.03.2013	00:15 - 09:45	GRIP<.6	9.50	8.50	0.21	0.31	0.00	19.58	24.13	0.39		No night shift
	02.03.2013	09:45 - 10:15	TREATED	0.50	8.72	0.00	0.00	0.30	27.68	19.86	0		
	02.03.2013	22:45 - 10:45	GRIP<.6	12.00	11.18	0.12	0.77	0.03	17.06	29.54	0.41	19%	No night shift
	03.03.2013	10:45 - 13:30	TREATED	2.75	14.54	0.00	0.00	0.86	26.42	26.76	0		
	03.03.2013	18:00 - 19:00	GRIP<.6	1.00	4.25	0.01	0.03	0.00	24.62	16.47	0.06	0%	
	03.03.2013	21:15 - 10:30	GRIP<.6	13.25	6.93	0.04	0.60	0.00	12.38	31.77	0.42	0%	No night shift

Thank You

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