

USING RWIS DATA FOR WINTER MAINTENANCE DECISIONS



Today's Presenters

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TODAYS FORMAT

WHAT IS RWIS DATA?

HOW CAN THE DATA BE USED?

HOW DO WE USE IT IN WINTER MAINTENANCE?

LETS CHECK IT OUT



WHAT IS DATA?

Def: facts and statistics collected together for reference or analysis

Perhaps a more practical definition is:

Data is information that has been translated into a form that is more convenient to move or process

We need data that is useful information!



So how can we use RWIS data to help us in winter operations?

It can help plan our operations – help us make decisions

It can help us (and others) during operations – make adjustments

It can help us evaluate our performance



RWIS Hardware

ROADSIDE TOWER

Sensors Measure:

- Wind Speed, Gusts & Direction
- Precipitation
- Temperature & Humidity

Cabinet Contains:

- Processing Unit
- Telecommunications & Power Connections
- Digital Barometer Pressure

Optional Equipment:

• Visibility, Cameras, Traffic Counters, Precipitation Type and Amounts



Fixed RWIS: Why?

- Provide road conditions 24/7
- Most accurate way to obtain road conditions ands be alerted on them
- Improves a road weather forecast





Timing of freezing/thawing

Aids in chemical decisions

Improves a weather forecast



Non-invasive sensors are what is trending and offer a friction reading

REAL TIME INFORMATION IS NOT JUST TO CREATE THE FORECAST, IT CAN HELP YOU



PRIOR TO EVENTS



What do we need?

Weather information – forecasting and current conditions, why?

- ➤What is the event
- ≻Can we pre-treat
- ≻When will it begin
- ➤What will it begin as
- >What type of conditions will prevail (precp type, winds temps etc.)
- ≻When will it end
- >What will pavement temperatures do
- ➤What will winds do
- >When is the next event



Forecasting

- Everyone relies on forecasting
- Where do you get your forecast?
- How and when are they made?
- Is it really what you need?



Where do you get your forecast?

TV and Radio have gotten better but are always looking at the bigger picture and ratings



Ask yourself, when was that forecast made and where did it come from?



Is this really relevant to your job?

Right Now	Next 36 Hours		
	Tonight	Tomorrow	Tomorrow Night
Cloudy	Rain / Snow Showers / Wind	AM Snow Showers	Snow Showers Late
43°F Feels Like: 36° Get FREE weather on your desktop	33° Low	49° High	31° Low
Past 24-hr Snow: 0 in Past 24-hr Precip: 0.95 in (est.)	Snowfall: 0 in No significant snow accumulations <u>Chance of Precip:</u> 50%	Snowfall: 0 in No significant snow accumulations Chance of Snow: 30%	Snowfall: 0 in No significant snow accumulations Chance of Snow: 30%
Wind: From SW at 12mph	Wind: SW at 19 mph	Wind: SSW at 11 mph	Wind: ESE at 4 mph
Hourly Text Forecast Video	Hourly Graph		10-Day Forecast

None of them focus on Road Conditions



These are good source but do you get what you need?









Winter Operations Conference

October 15-16, 2019 | Shanty Creek Resorts – Bellaire, Michigan

Value Added Forecast



Specific to your needs and help in planning



What should you focus on?

- Conditions at the ground
 - Pavement temperatures (you and around you)
 - Winds (direction and speed)
 - Precipitation type and rate
 - Any significant changes (front, storm changes)



Many of you have access to MDSS (Maintenance Decision Support System)



All forecasts begin with data

• All forecast models begin with balloon data

Sent up twice a day all around the globe





Real time Observations are used as well





States, Counties and Cities that have RWIS all contribute to forecasting. Every airport does as well









We need data that includes what the road conditions and pavement temperatures are predicated to be

VAISALA / Navigator City of Wes v			10:29 AM	« 📑 » + 🗍 Archive Logout
Map Station Summary Station Wall Stations Fored	cast Alerts Reports A	dmin		🕶 Tools 🛛 😯 Help
▼ Jordan Creek Parkway @ Woodland Ave (Show station on the station of the statio	map)			
Coordinates Nea 93° 48' 32" W 41° 35' 5" N Wes Altitude Wes 301 m	Intest stations St Des Moines East 8.1 St Des Moines West 8.1	Groups km km		
Station Overview Graph Camera History History	Y Table Forecast Text			
Surface Temperature - Surface site 1 (+Icebreak 11.1)	9.2015 10:17 AM) 🕒 Dew P	Point Temperature - Atmospheric site (+Icebreak 11.19.2015 10:17 AM)	Level of grip - Surface site 1 (+Icebreak 11.19.2015 10:17	AM) +
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Getting a pavement temperature forecast is key to making decisions



### PRIOR TO EVENTS



### FROST

Frost will form when the dew point falls below the pavement temperature and if the temperatures are below 32 F. Pavement forecasts can help us make decisions prior to it occurring. When dew point and surface temperature get close we can be alerted if we have a value added service so we can take measures before the event happens





Subsurface temperatures play a key role in what happens on the pavement



## When the surface temperature falls below the dew point and the temperature is below freezing, frost will form



If this happens and we have not pre-treated, we are to late. The next set of data we may be looking at is crash data!



## Pre-Treating Roadways using Anti-icing

Here we need real time data to make decisions prior to beginning the operation.



### REAL TIME OBSERVATIONS

The data you need may come from a value added service but all real time observations are measured by systems along roads and at airports.

Todays systems are for any size and type of agency and real value is having a system that measures pavement on your roadways.







#### So snow is predicted can we pre-treat the roads?

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					Oct 11 63° F Thundershowers Likely 80 % SE @ 15 mph Total Precip: 0.31 in	Oct 12 39° F Good Chance of Flurries 60 % SSW @ 16 mph/G 23 mph Total Snow: 0.08 in
					27° F Chance of Wintry Mix 30 % SW @ 12 mph/G 20 mph Total Snow: 0.04 in	28° F Light Snow Likely 70 % S @ 9 mph Total Snow: 0.5 in
<u>Oct 13</u> 41° F	<u>Oct 14</u> 45° F	<u>Oct 15</u> 41° F	<u>Oct 16</u> 45° F	<u>Oct 17</u> 48° F	<u>Oct 18</u> 51° F	<u>Oct 19</u> 54° F
Light Snow Likely	Chance of Wintry Mix	Wintry Mix Likely	Light Rain Likely	Chance of Wintry Mix	Mostly Cloudy	Chance of Light Rain
WSW @ 11 mph Total Snow: 0.1 in	50 % W @ 9 mph/G 17 mph Total Snow: 0.01 in	Variable @ 4 mph Total Snow: 0.08 in	NW @ 7 mph/G 21 mph Total Precip: 0.05 in	SW @ 9 mph/G 25 mph Total Snow: 0.03 in	S @ 9 mph/G 31 mph	W @ 4 mph Total Precip: 0.03 in
30° F	28° F	32° F	32° F	31° F	39° F	36° F
Light Snow Likely 70 %	Partly Cloudy	Light Rain Likely 80 %	Chance of Wintry Mix 40 %	Chance of Sprinkles 35 %	Good Chance of Light Rain 50 %	Chance of Light Rain 40 %
W @ 7 mph Total Snow: 0.2 in	Variable @ 3 mph	NNW @ 5 mph/G 20 mph Total Precip: 0.12 in	Variable @ 3 mph Total Snow: 0.2 in	S @ 7 mph/G 28 mph Total Precip: 0.008 in	S @ 6 mph/G 28 mph Total Precip: 0.05 in	ESE @ 7 mph/G 13 mph Total Precip: 0.23 in
Oct 20 63° F						
50 % S @ 9 mph/G 24 mph						
Total Precip: 0.02 in						



#### **ANTI-ICING**

#### PRO-ACTIVE TREATMENT PRIOR TO AN EVENT



**CONDITIONS MUST BE CORRECT TO ANTI-ICE** 

Review/monitor weather forecast.       Image: construct of the second seco	Anti-Icing /	Applicatio	on Deci	sion Flowcł	nart	
Review/monitor weather forecast.       Image: construction of the second s						
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Has a visual inspection or RWIS confirmed	Has a visual inspection or RWIS confirmed					
sufficient anti-icing material residue does not	sufficient anti-icing material residue does not		$\longrightarrow$	Do not apply a	anti-icing materials.	>
exist on the pavement? No	exist on the pavement?	No				
Yes Yes	Yes					
	<u> </u>					
Apply anti-icing material (brine or brine blend)	Apply anti-icing material (brine or brine blend)					
	at 50-50 gallons per lane fille of follow					



### All the data you need can be found in one place

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VAISALA / Navigator	Washington												17	:45	• ]	<b>1</b> • •	1
Map Station Summary	Station Wall Stations	Forecast	Alerts	Reports	Admin											• Tools 🕜	Help
Station Summary Tab	le 🔅 Table Settings	5how sen	sor sites														
Station Name	Timestamp	Surf Temp	Surf State	Air Temp	Dew Temp	Grip	Water Layer	Ice Layer	Snow Layer	Rel Humidity	Rain State	Wind Speed	WD	Visibility	LigFrz Temp	Max Wind S.	Wate
Varden Intershange	18-Oct-2015 17:38	23.9 °C	dry	17.1 °C	13.1 ~					77 %	none	2.4 m/s	230 *		= ×C	3,4 m/s	
Dryden Road	18-Oct-2015 17:36	16.5 ~	wet	15.2 °C	12.9 ℃					86 %	none	1.4 m/s	310 *	— m	- ~c	2.9 m/s	
alisades	18-Oct-2015 17:36	17.0 °C	dry	14.9 °C	12.3 ℃					84 %	none	0.1 m/s	185 *	1770 m	- 10	0.8 m/s	
Nuncy Rest Area	18-0:4-2015 17:36	15.4 °C	short	14.4 %	14.4 ℃					99 %	-	0.9 m/s	10 *	- 0	- 40	1.5 m/s	
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laterville	18-Oct-2015 17:38	15.4 %	moist	12,4 %	12.1 *0					97 %	none	1.5 m/s	70 *	2000 m	- *0	2.3 m/s	
fansfield	18-Oct-2015 17:36	14.8 ℃	moist	11.6 ℃	10.9 🗠					94 %	none	0.0 m/s	40 1	480 m		0.0 m/s	
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iverside																	
antage	18-Oct-2015 17:38	22.4 10	dry	16.6 °C	11.0 °C					69 %	none	3.2 m/s	345 +	315 m	- *C	3.9 m/s	
thele	18-Oct-2015 17:38	27.0 °C	dry	19.0 °C	10.6 ℃					50 N	none	0,0 m/s	10 *	1770 m	^C	0.0 m/s	
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eneas Valley Road		- 10		- 40	- 10					54	-	- //1	1.00		- 10	-n/s	
erry County Line																	
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napps Tunnel	18-Oct-2015 17:37	15.2 -⊂	moist	11.8 10	11.0 <			- 1110		95 ~	none	0.0 m/s	200 -	1770	+c	1.7 m/s	
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tock Candy Mountain	18-Oct-2015 17:40	17.5 °C	wet	15.5 °C	12.2 °C					81 %	-	0.0 m/s	230 *		0.0 *c	0.0 m/s	
teckelville Shed	18-Oct-2015 17:42	19.5 °C	dry	15.6 °C	10.6 ℃					72.%	none	1.4 m/s	20 *	2000 m	*C	2.4 m/s	
ear Creek Bridge																	
ape Horn																	
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-24	h							1111									+24h





#### **Bonding Prevention**



IT TAKES 4 TIMES MORE SALT TO REMOVE ICE THAN PREVENT IT! ANTI-ICING IS A VALUABLE TOOL WHEN DONE CORRECTLY



#### Treated vs. Untreated



THE SAME EVENT, ONE ROADWAY ANTI-ICED, ONE NOT TREATED.



### WHEN YOU MAY NOT WANT TO ANTI-ICE



RAIN



#### FOG/HUMID





### **DURING A STORM**



### WHEN DO WE DEPLOY

## Knowing not just when the storm will hit but when it will actually affect the pavement is vital.



Go sit out there and wait?



### The storm started at 5:30pm and did not have an effect on the pavement till 6:54 pm





#### WHAT SHOULD DICTATE HOW MUCH MATERIAL WE APPLY?

Pavement temperature Weather Condition Type of De-Icer

#### Follow De-Icing Application Rate Guidelines 100 to 300 lbs/ln mile of pre-wetted salt in most situations

THE PRICE OF SALT SHOULD NOT DICTATE HOW MUCH WE APPLY!!!

#### A GUIDE FOR OPERATORS IN THEIR VEHICLES

	Salt Applica	tion Rat	e Guidel	ines						
Prewetted salt @ 12' side lane (assume 2-hr route)										
Surface Temperature	(Fahrenheit)	32-30	29-27	26-24	23-21	20-18	17-15			
	Heavy Frost, Mist, Light Snow	50	75	95	120	140	170			
lbs of salt to be	Drizzle, Medium Snow ½" per hour	75	100	120	145	165	200			
mile	Light Rain, Heavy Snow 1" per hour	100	140	182	250	300	350			
Р	rewetted salt @ 12' wide lane (assume 3-hr route)									
Surface Temperature	(Fahrenheit)	32-30	29-27	26-24	23-21	20-18	17-15			
like of colt to bo	Heavy Frost, Mist, Light Snow	75	115	145	180	210	255			
applied per lane	Drizzle, Medium Snow ½" per hour	115	150	180	220	250	300			
mie	Light Rain, Heavy Snow 1″ per hour	150	210	275	375	450	525			

-		PAVEMENT	WEATHER CONDITION	POUNDS PRE WET SALT *	PER 2 LANE MILE	ACTIONS & APPLICATION RECOMMENDED								
Ľ	g		SNOW	150	NOT RECOMMENDED	PLOW, TREAT HAZARDS ONLY								
	RISIN		FREEZING RAIN	150	NOT RECOMMENDED	APPLY AS NEEDED								
Γ	5 NIC	- ABOVE 30° -	SNOW	150-300	NOT RECOMMENDED	PLOW & APPLY AS NEEDED								
	DROPI	<b>1</b>	FREEZING RAIN 150-300 NOT RECOMMENDED APPLY AS NEEDED											
	۶ N	$\mathbf{\uparrow}$	SNOW	150-300	NOT RECOMMENDED	PLOW & APPLY AS NEEDED								
	VE         FREEZING RAIN         150-300         NOT RECOMMENDED         APPLY AS NEEDED													
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	DROP		FREEZING RAIN	300-350	400	APPLY AS NEEDED								
	NG	$\uparrow$	SNOW / FREEZING RAIN	150-300	400	PLOW & APPLY AS NEEDED								
	PING RIS	- 20° to 25° -	SNOW	225-300	NOT RECOMMENDED	PLOW & APPLY AS NEEDED								
	DROP	₩ -	FREEZING RAIN	300-350	400	APPLY AS NEEDED								
Γ	UQ N	$\mathbf{\uparrow}$	SNOW	225-300	NOT RECOMMENDED	PLOW & APPLY AS NEEDED								
	SE         FREEZING RAIN         300-350         500-750         APPLY AS NEEDED													
	DROP	₹₽ -	SNOW / FREEZING RAIN	350	500-750	PLOW & APPLY AS NEEDED								
BELOW 15* SNOW NOT RECOMMENDED NOT RECOMMENDED PLOW, TREAT HAZARDS AS NEEDED														
FROST: 15* & RISING: TREAT BY ANTI-ICING (BRINE 20-40 GAL/LnMi) OR 15* & FALLING: PRE WET SALT @ 150#/LnMi. WIND CONDITION: PLOW, TREAT (TROUBLE SPOTS ONLY) @ 200-400#/LnMi.														



#### You have an MDSS system to guide you





#### Sensible Salting Thoughts

- Putting down only what is needed.
- Level of service what are we striving to achieve
- When will we achieve it? During the storm, following the storm, how long after the storm?

But sensible salting also means -



## Placing materials at the optimum time, especially in extremely cold situations









### AFTER THE STORM



#### Winter Operations Conference

### **Reviewing data**





#### Would anti-icing have had an impact here?

Image: State Sta	← → VA http://rds.vaisala.com/apps/#archive/2014-11-21T12:54	1:00Z/statir 🔎 🗝 🖒 🗙 🚺 #archive	/2014-11-21T12:54 ×					
Compared for a constraint of a constraint	x				: .			
VISALA / Nevigator       Value       Distance	👍 🗿 Suggested Sites 🗿 Web Slice Gallery				1		Page 🔻 Safety 🔻 Tools 👻 🕢 🦿	
	VAISALA / Navigator Washington 🗸					0 21-i	06:54 🥎 « 📰 Nov-2014 Return Live Archiv	» →
<ul> <li>Uncertained 1296 (Brow data on the intervention of the point of the po</li></ul>	Map Station Summary Station Wall Stations Fo	orecast Alerts Reports	Admin				•	Tools 🕜 Help
Coordinates Tyre 7 38 W 474 20 13 "N Alticade 0.4 = Station Overview Oraph Camera History Table Station Overview Ov	▼ Liberty Lake at 296 (Show station on map)							
Surface State - Surface site 1	Coordinates         II           117° 6' 38'' W         47° 40' 13'' N           Altitude         5           0.4 ml         5           Station Overview         Graph           Camera History         Hist	Nearest stations Garden Springs at 277 Perry Curves SR 395 @ Hastings Rd T.J. Meenach Bridge Waste-Energy Plant	19.1 km 21.1 km 25.7 km 27.4 km 30.1 km	Groups Spokane Region -	Sites			
<pre>und for the state s</pre>	Surface Temperature - Surface s	site 1	Dew Point Ter	nperature - Atmospheric site		Level of grip - S	Surface site 1	+
surface State - Surface site 1			Level of grip - Surface site 1 0.75 20-Nov-2014 14:43 Observation	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	200 210	<u>مر المر المر المر المر المر المر المر ال</u>	\$	0.9 0.8 Level of g 0.6 of g 0.5 Sufface of g 0.4 dig 0.3 state 0.2 dig 0.3 state 0.2 dig 0.2 dig 0.3 state 0.2 dig 0.3 state 0.2 dig 0.3 state 0.2 dig 0.3 state 0.2 dig 0.3 state 0.3 state 0.1 dig 0.3 state 0.2 dig 0.5 state 0.3 state 0.2 dig 0.5 state 0.3 state 0.0 dig 0.0 dig
	Surface State - Surface site 1 dry snow Surface State - Surface site 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		2 3	τ ² wet	2	۰۰۰ ۱۱۱۱۱۱۱۱۱۱۱ ۲۰	<ul> <li>ه. ه.</li> <li< th=""><th>moist</th></li<></ul>	moist
®,100% ~	Δ					-		
		C 0			0 0 📼 💽 0	R R R R R 0 k	3 🏎 🗖 🔈 🗊 🖿 🛱 🖃 d	€ 100% ▼ 14:01

### Storm Performance Index

• The input parameters are run through an algorithm that produces an index......

V	Storm Performance Index Report       Generation date 31-Oct-2012 09:03         24-Oct-2012 09:03 -> 31-Oct-2012 09:03       Generation date 31-Oct-2012 09:03												
	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												threshold
Station	Date	Time Range	Event	Duration (hours)	Max Wind Speed (mph)	Max Ice Laver (mm)	Max Snow Laver (mm)	Max Water Laver (mm)	Min Surface Temp (°E)	Severity Index	Performance Index	Mobility Index	Comments
otation	2010		LTOIR	(incure)	opeed (inpit)	20101 (1111)	20101 (1111)	20101 (1111)		muon	maon	maon	000000
D5 - Ma	lad Summit												
	26-Oct-2012	04:30 - 10:00	FROST treated	5.50	5.59	0.00	0.00	0.02	26.06	17.12	0	100%	
D6 - Ida	ho Falls												
	25-Oct-2012	02:45 - 04:45	GRIP<.6	2.00	3.80	0.14	0.87	0.21	30.56	14.49	0.14		
	25-Oct-2012	04:45 - 06:00	TREATED	1.25	2.91	0.00	0.00	1.18	31.28	13.68	0	38%	
D6 Los	t Trail Dass												
D0 - L0	24-Oct-2012	09-15 - 10-30		1.25	5 14	0.31	0.31	0.12	14 72	25.84	0.05		
	24-Oct-2012	10:30 - 12:00		1.20	5.82	0.51	0.04	1 15	19.72	20.04	0.00	55%	
	25-Oct-2012	02:00 - 11:15	GRIP< 6	9.25	4 47	0.13	0.81	0.00	18.50	21.10	0.43		
	25-Oct-2012	11:15 - 14:00	TREATED	2.75	7 61	0.08	0.16	1.96	20.66	24.09	0		
	25-Oct-2012	14:00 - 23:00	GRIP<.6	9.00	8.05	0.07	0.75	2.36	4.82	72.65	0.12	47%	
	25-Oct-2012	23:00 - 12:45	TREATED	13.75	7.61	0.14	0.00	1.82	16.16	27.99	0		
	26-Oct-2012	15:00 - 16:00	TREATED	1.00	5.14	0.10	0.01	0.34	28.76	15.92	0		
	26-Oct-2012	16:00 - 13:45	GRIP<.6	21.75	7.38	0.26	0.85	3.20	23.00	23.63	0.92	4%	
	27-Oct-2012	16:30 - 17:30	TREATED	1.00	5.59	0.04	0.02	0.27	30.38	15.74	0	2201	
	27-Oct-2012	17:30 - 19:30	GRIP<.6	2.00	6.71	0.11	0.63	0.00	28.22	17.97	0.11	33%	
	27-Oct-2012	22:45 - 06:15	GRIP<.6	7.50	7.83	0.06	0.82	0.00	28.58	19.15	0.39	0%	
	28-Oct-2012	08:15 - 09:15	GRIP<.6	1.00	4.92	0.04	0.78	0.00	28.94	16.07	0.06	0%	
	29-Oct-2012	23:00 - 05:00	TREATED	6.00	4.25	0.00	0.00	0.16	30.38	14.29	0		
	30-Oct-2012	05:00 - 10:00	GRIP<.6	5.00	5.59	0.15	0.05	0.01	27.68	16.58	0.30	57%	
	30-Oct-2012	10:00 - 10:30	TREATED	0.50	8.50	0.00	0.00	0.17	28.04	19.37	0		



### LET'S TAKE A LOOK



#### Winter Operations Conference

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× + •bMDSS* webmdss.com/login/?destination=%2F C ACCESS MDOT RWIS 動 Maintenance 회 Inside DTMB 液 Lookup 📙 Scanners 📙 AVL/MDSS 📒 ArcGIS HRMN » Other bc GLE *Web***MDSS**[™] Login James Roath Username (email) Password **MDOT** Stay logged in Log In RoathJ1@michigan.gov Forgot Password Cell: 517-230-5361 DSS™ is the web-based form of the client-side Maintenance Decision Support System used by state DOTs to better manage roadw ces during inclement weather. WebMDSS™ provides detailed, hour-by-hour weather and pavement forecasts at the maintenance level for greater mobility, safety and decision making needs. iteris MDSS PFS Contact Us Tube in



#### MDOT RWIS

- Approximately 105 Stations
- Various Models and Sensors
- Upcoming Projects



![](_page_47_Picture_0.jpeg)

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#### **RWIS DATA**

- Air Temp
- Dew Point
- Relative Humidity
- Winds
- Precipitation Type
- Road Temp
- Road Condition
- Road Friction

![](_page_47_Figure_12.jpeg)

![](_page_48_Picture_0.jpeg)

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![](_page_48_Figure_3.jpeg)

![](_page_49_Picture_0.jpeg)

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🛐 🖄 🖡	Prese US-23 (	<b>LIE ÍSÍE [MIF</b> ) E Co Rd 63	PRI] 8																		1	ab	le View
	Atmo	ospheric		Sensor 1 Pavement	:	Sensor 1: Subsfc 1: Depth: 0.79"	Sensor 1: Subsfc 2: Depth: 3.79"	Sensor 1: Subsfc 3: Depth: 6.79"	Sensor 1: Subsfc 4: Depth: 9.79"	Sensor 1: Subsfc 5: Depth: 12.79"	Sensor 1: Subsfc 6: Depth: 18.79"	Sensor 1: Subsfc 7: Depth: 24.79"	Sensor 1: Subsfc 8: Depth: 30.79"	Sensor 1: Subsfc 9: Depth: 36.79"	Sensor 1: Subsfc 10: Depth: 42.79"	Sensor 1: Subsfc 11: Depth: 48.79"	Sensor 1: Subsfc 12: Depth: 54.79"	Sensor 1: Subsfc 13: Depth: 60.79"	Sensor 1: Subsfc 14: Depth: 66.79"	Sensor 1: Subsfc 15: Depth: 72.79"	Sensor 2 Pavement		Select Columns
Time (GMT-0400)	Air Temp (°F) Dew Pt (°F) Humidity (%) Whod Direction	Vrind Speed (mph) Gust (mph) Type	Rate (in/hr)	Cond	Temp (°F) Friction	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Temp (°F)	Cond	Temp (°F) Friction	Time (GMT-0400)				
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									Sav	ed Storm: 20	19-01-22 @	Tuesday, Jan	uary 22, 2019	9 8:00 AM ES	ST								

y 23, 2019 7:50 PM EST

![](_page_50_Picture_0.jpeg)

#### Winter Operations Conference

#### 

![](_page_50_Figure_4.jpeg)

![](_page_50_Figure_5.jpeg)

![](_page_51_Picture_0.jpeg)

#### **Winter Operations Conference**

October 15-16, 2019 | Shanty Creek Resorts – Bellaire, Michigan

![](_page_51_Figure_3.jpeg)

📲 Verizon 🗢	7:17 AM	1 💽'
<	RWIS	$\sum$
Site		
Howe/Lagrange		
Atmospheric	Surfac	e
10-	-10-19 6:50 AM (EST)	
Air Temp.		54 °F
Dew Point.		52 °F
Humidity		95%
	$\sim$	5
Table	10-Day Fo	recast

📲 Verizon 😴	7:17 AM	7 💽
<	RWIS	$\sum_{i=1}^{n}$
Site		
Howe/Lagrange		
Atmosphe	Surface	2
Senso	r: 0 / Sfc: approach / Dir: W	,
1	10-10-19 6:50 AM (EST)	
Sfc. Temp		58 F
Sfc. Cond.		Dry
Sfc. Friction		0.82
Sfc. Frz. Temp		32 F
Sfc. Depth		0 In
Sfc. % Ice		0 %
Sub Temp (UN	IK)	68 F
	Switch Sensors	
Table	10-Day For	ecast

### THANKS SNOW MUCH

## **QUESTIONS ?**