

Driving Efficiency and Safety:

Exploring the Benefits of Transportation Management Centers and Intelligent Transportation Systems

2023 Vermont Emergency Preparedness Conference



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Operations and Safety Bureau (OSB)
Vermont Agency of Transportation

TMC Mission

Detect, verify, and respond to incidents affecting mobility on Vermont's transportation infrastructure. Provide the public, State and municipal agencies timely, accurate, and impactful travel information to promote safe and efficient travel 24-hours per day.



TMC Overview

- Monitor mobility related incidents and trips on State of Vermont maintained roadways
- Disseminate travel information
- Maintain 24/7/365 Operations
- Central hub for information flow internally and externally for the Agency
- Assume Situation Unit Lead role for ICS activations

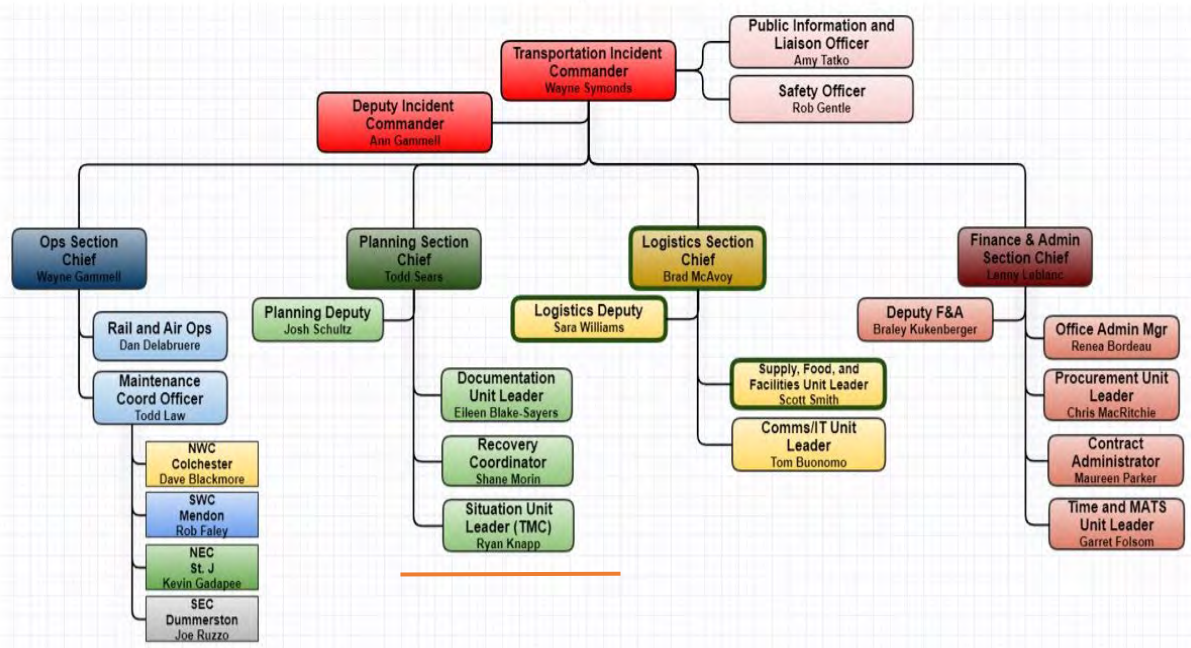


TMC Customers

- Provide timely, accurate, and impactful travel information to:
 - AOT District Maintenance, Fleet, and Executive leadership
 - Vermont State Police
 - State Agencies
 - Traveling public

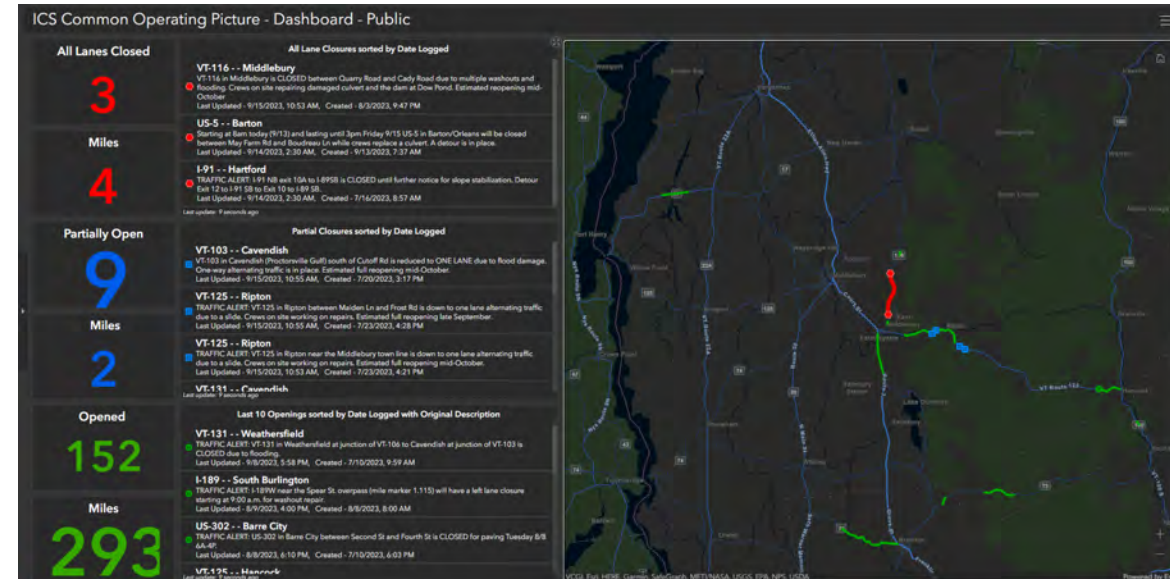


ICS Activations



Common Operating Picture (COP)

- 1) Situation Unit Leader
- 2) TMC Operator(s)
- 3) GIS Professional
- 4) AOT ↔ VEM/SEOC



Intelligent Transportation Systems (ITS)

- Advanced application to provide innovative and integrated technologies to provide safer, more coordinated, and smarter use of transportation networks.
- Enabling motorists and stakeholders to be more informed.



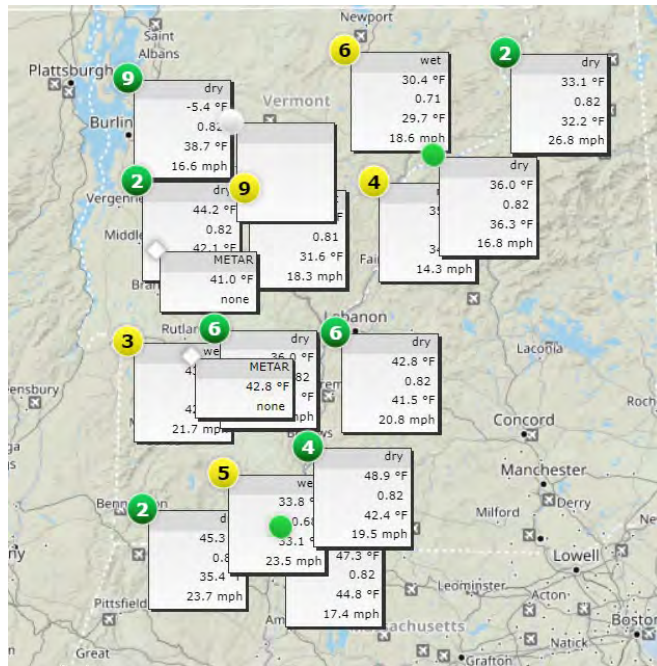
Systems



- RWIS, CCTV, CMS, traffic heat maps
- Weigh-in motion Systems (WIMS)
- Traffic counting devices
- Traffic signals
- Big transportation data (probe data)
- Radar feedback signs
- Pedestrian crossing buttons



Road Weather Information System (RWIS) & CCTV



VTRANS - I-89 Berlin MM 50.10 (Show station on map)

Coordinates: 72° 35' 0" W 44° 12' 44" N
Altitude: 1040 ft

Nearest stations:
 VTRANS - I-89 Middlesex MM 55.8 5.1 mi
 VTRANS - I-89 Waterbury MM 61.1 19.9 mi
 VTRANS - I-89 Brookfield MM 10.2 mi 39.4
 VTRANS - I-89 Brookfield 11.8 mi
 Guardian MM 37.8
 VTRANS - I-89 Waterbury Exit 12.0 mi

Groups:
 District 4 - OPS - Randolph
 District 4 - OPS - Rochester
 District 4 - OPS - Royalton
 District 4 - OPS - Thetford
 ... and 5 more.

Station Overview | Graph | Camera History | History Table


Current conditions 02.08.2023 03:10 PM

- Air Temp: **39.6 °F**
- Dew Temp: **22.6 °F**
- Visibility: **—**
- Level of grip: **0.82**
- Surface State: **moist**
- Surface Temp: **36.3 °F**

Wind 02.08.2023 03:10 PM

Wind direction: **290°**
 Wind speed: **4.5 mph**

Roadside camera 02.08.2023 03:13 PM



Traffic counting

	Timestamp	Average/5min Vehicle Speed (mph)	Average/5min Occupancy of road (%)	Traffic Volume
I-89 SB Travel Lane - Traffic	02.08.2023 03:05 PM	80.3	3	42
I-89 SB Passing Lane - Traffic	02.08.2023 03:05 PM	81.8	1	17
I-89 NB Passing lane - Traffic	02.08.2023 03:05 PM	74.0	3	37
I-89 NB Travel Lane - Traffic	02.08.2023 03:05 PM	58.1	2	16

Road Weather Information System (RWIS) & CCTV

Station Name	Timestamp	Surface Temp	Surface Sta...	Air Temp	Dew Temp	Grip	Water Layer	Ice Layer	Snow Layer	Rel Humidity	Rain State	Wind Speed...	Wind Direct...	Visibility	AvgSpd
VTRANS - I-89 Colchester MM 95.3	02.08.2023 04:05 PM	-11.7 °F	dry	42.1 °F	24.6 °F	0.82	0.01 mm	0.00 mm	0.00 mm	50 %	none	3.1 mph	W	6562 ft	70.2 mph
VTRANS - RT 17 Buels Gore MM 2.1	02.08.2023 03:59 PM	27.3 °F	moist	31.3 °F	21.7 °F	0.81	0.00 mm	0.00 mm	0.00 mm	67 %	none	3.4 mph	E	6562 ft	— mph
VTRANS - RT 242 Westfield MM 2.5	02.08.2023 04:00 PM	28.2 °F	wet	29.1 °F	24.3 °F	0.76	0.17 mm	0.00 mm	0.00 mm	82 %	—	8.7 mph	N	— ft	— mph
VTRANS - RT 114 Canaan MM 0.6	02.08.2023 04:00 PM	31.1 °F	dry	31.6 °F	23.4 °F	0.82	0.00 mm	0.00 mm	0.00 mm	71 %	none	4.0 mph	W	6562 ft	52.9 mph
VTRANS - RT 9 Marlboro MM 0.4	02.08.2023 04:00 PM	31.8 °F	moist	33.1 °F	24.8 °F	0.82	0.04 mm	0.00 mm	0.00 mm	71 %	none	10.1 mph	N	6562 ft	— mph
VTRANS - RT 100 Lowell MM 1.1	02.08.2023 04:00 PM	32.2 °F	wet	36.1 °F	23.9 °F	0.81	0.08 mm	0.00 mm	0.00 mm	61 %	none	2.9 mph	S	6562 ft	60.0 mph
VTRANS - RT 5A Westmore MM 1.5	02.08.2023 03:50 PM	32.4 °F	wet	35.4 °F	23.9 °F	0.78	0.14 mm	0.00 mm	0.00 mm	63 %	none	4.3 mph	N	6562 ft	— mph
VTRANS - RT 9 Searsburg MM 2.1	02.08.2023 04:00 PM	33.4 °F	moist	33.1 °F	25.2 °F	0.82	0.03 mm	0.00 mm	0.00 mm	73 %	none	6.9 mph	W	6562 ft	54.3 mph
VTRANS - RT 102 Maidstone MM 5.1	02.08.2023 04:00 PM	33.8 °F	dry	37.6 °F	22.5 °F	0.82	0.00 mm	0.00 mm	0.00 mm	54 %	none	2.5 mph	W	6562 ft	47.1 mph
VTRANS - US 2 Cabot MM 1.90	02.08.2023 04:00 PM	34.3 °F	moist	37.4 °F	23.0 °F	0.81	0.00 mm	0.00 mm	0.00 mm	55 %	none	2.7 mph	W	65617 ft	57.5 mph
VTRANS - I-93/RT 18 Waterford MM 1.1	02.08.2023 04:00 PM	34.7 °F	dry	36.9 °F	21.7 °F	0.82	0.00 mm	0.00 mm	0.00 mm	54 %	none	8.1 mph	NW	6562 ft	67.6 mph
VTRANS - RT 103 Mount Holly MM 1.1	02.08.2023 03:59 PM	34.9 °F	dry	38.5 °F	23.5 °F	0.82	0.00 mm	0.00 mm	0.00 mm	54 %	—	6.3 mph	N	— ft	— mph



Road Weather Information System (RWIS) & CCTV

- Environmental sensors, communication systems, and central systems to collect data.
- CCTV cameras incorporated with each site
 - CCTV allows for real-time imaging to help inform AOT and the public to current road conditions
- Sensors
 - Thermometer – air temperature
 - Anemometer – wind speeds
 - Wind vane – wind directions
 - Visibility – site distance
 - Surface sensors – measuring road surface temperature, dry or wet states, and water depth
 - Precipitation type – depicting light rain, rain, heavy rain, snow, sleet, freezing rain, etc.
 - Other – dew point, road friction coefficient, humidity
 - Wavetronix – traffic volume, speed data, occupancy rate

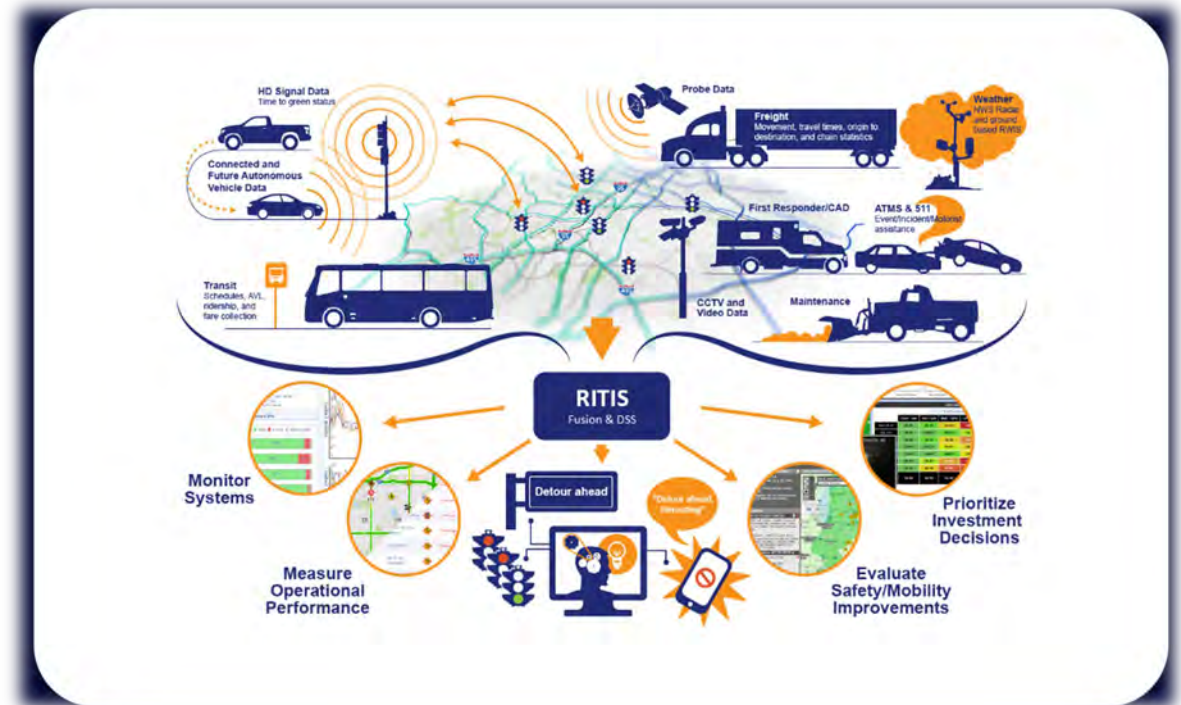
Big Transportation Data & RITIS

- **Data Types:** Travel Time & Speed, Origin/Destination, Volume, Conflation (mapping)

- **Analytic Tool:** RITIS

Use Cases

- Incident Detection and Response
- Integration into existing ITS structure
- Inform Crash and Network Screening Analysis
- Improve Project Development
- Improve fidelity to:
 - Statewide Speed analysis
 - Statewide Traffic volume analysis
 - Statewide Mobility analysis
- Increase border traffic understanding and fidelity
- Enable real time data visualization and support to Execs
- Use freight information to improve economy



What Are the Sources of This Data?



Connected Devices
(e.g. cell phones, watches, & tablets)



Navigation Systems, including various types for cars & trucks



Toll Tag Transponders
(e.g. E-Z Pass)



Connected Vehicles



Automated Vehicle Locator (AVL) Systems, including on trucks & buses

Big transportation data is anonymized aggregated GPS readings on the public road network 24/7/365. This is different than traditional transportation data measured at a specific place for a defined time.



I-89

[+ Create PM3 report](#)

[+ Add widget](#)

Select a dashboard...

I-89 Southbound Canada to Exit 16

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 SB between United States/Canada Border and US-7/Exit 22	↓ 7	4 mph	11 mph	↑ 4	7 m	3 m
I-89 SB between US-7/Exit 22 and VT-78/Exit 21	↑ 1	65 mph	64 mph	0	6 m	6 m
I-89 SB between VT-78/Exit 21 and VT-207/Exit 20	↑ 2	68 mph	66 mph	0	5 m	5 m
I-89 SB between VT-207/Exit 20 and VT-104/Exit 19	↑ 5	69 mph	64 mph	↓ 1	3 m	4 m
I-89 SB between VT-104/Exit 19 and US-7/VT-104A/Exit 18	0	69 mph	69 mph	0	6 m	6 m
I-89 SB between US-7/VT-104A/Exit 18 and US-2/Exit 17	↑ 1	71 mph	70 mph	0	8 m	8 m
I-89 SB between US-2/Exit 17 and US-7/US-2/Exit 16	↑ 3	71 mph	68 mph	↓ 1	5 m	6 m

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

I-89 Northbound Exit 16 to Canada

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 NB between US-7/Exit 22 and CAN--USA NATIONAL BORDER	0	47 mph	47 mph	0	1 m	1 m
I-89 NB between VT-78/Exit 21 and US-7/Exit 22	↓ 1	70 mph	71 mph	0	5 m	5 m
I-89 NB between VT-207/Exit 20 and VT-78/Exit 21	↑ 2	69 mph	67 mph	0	5 m	5 m
I-89 NB between VT-104/Exit 19 and VT-207/Exit 20	↑ 6	74 mph	68 mph	0	3 m	3 m
I-89 NB between US-7/VT-104A/Exit 18 and VT-104/Exit 19	↑ 3	71 mph	68 mph	0	6 m	6 m
I-89 NB between US-2/Exit 17 and US-7/VT-104A/Exit 18	↓ 2	66 mph	68 mph	↑ 1	8 m	7 m
I-89 NB between US-7/US-2/Exit 16 and US-2/Exit 17	↑ 2	69 mph	67 mph	0	6 m	6 m

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

I-89 Southbound Exit 8 to Exit 16

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 SB between US-7/US-2/Exit 16 and VT-15/Exit 15	↑ 3	64 mph	61 mph	0	1 m	1 m
I-89 SB between VT-15/Exit 15 and US-2/Exit 14	0	60 mph	60 mph	0	1 m	1 m
I-89 SB between US-2/Exit 14 and I-189/Exit 13	↑ 1	61 mph	60 mph	0	1 m	1 m
I-89 SB between I-189/Exit 13 and VT-2A/Exit 12	0	65 mph	65 mph	0	3 m	3 m
I-89 SB between VT-2A/Exit 12 and US-2/Exit 11	↑ 1	68 mph	67 mph	0	5 m	5 m
I-89 SB between US-2/Exit 11 and VT-100/Exit 10	↑ 7	73 mph	66 mph	↓ 1	12 m	13 m
I-89 SB between VT-100/Exit 10 and Center Rd/Exit 9	↑ 1	70 mph	69 mph	0	4 m	4 m
I-89 SB between Center Rd/Exit 9 and Memorial Dr/Exit 8	↑ 5	75 mph	70 mph	0	5 m	5 m

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

I-89 Northbound Exit 8 to Exit 16

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 NB between VT-15/Exit 15 and US-7/US-2/Exit 16	↑ 4	64 mph	60 mph	0	1 m	1 m
I-89 NB between US-2/Exit 14 and VT-15/Exit 15	↑ 7	66 mph	59 mph	0	2 m	2 m
I-89 NB between I-189/Exit 13 and US-2/Exit 14	↑ 8	68 mph	60 mph	0	1 m	1 m
I-89 NB between VT-2A/Exit 12 and I-189/Exit 13	↑ 2	69 mph	67 mph	0	3 m	3 m
I-89 NB between US-2/Exit 11 and VT-2A/Exit 12	↑ 2	70 mph	68 mph	0	5 m	5 m
I-89 NB between VT-100/Exit 10 and US-2/Exit 11	↑ 3	70 mph	67 mph	0	13 m	13 m
I-89 NB between Center Rd/Exit 9 and VT-100/Exit 10	↓ 2	67 mph	69 mph	0	4 m	4 m
I-89 NB between Memorial Dr/Exit 8 and Center Rd/Exit 9	0	69 mph	69 mph	0	5 m	5 m

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

I-89 Southbound Exit 8 to NH border

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 SB between Memorial Dr/Exit 8 and VT-62/Exit 7	↑ 3	70 mph	67 mph	0	2 m	2 m
I-89 SB between VT-62/Exit 7 and VT-63/Exit 6	↑ 2	72 mph	70 mph	0	3 m	3 m
I-89 SB between VT-63/Exit 6 and VT-64/Exit 5	↑ 2	73 mph	71 mph	0	3 m	3 m
I-89 SB between VT-64/Exit 5 and VT-66/Exit 4	↓ 5	77 mph	72 mph	↓ 1	9 m	10 m
I-89 SB between VT-66/Exit 4 and VT-107/Exit 3	↑ 4	76 mph	72 mph	0	7 m	7 m
I-89 SB between VT-107/Exit 3 and VT-132/Exit 2	↑ 8	75 mph	67 mph	↓ 1	7 m	8 m
I-89 SB between VT-132/Exit 2 and US-4/Exit 1	↑ 2	73 mph	71 mph	0	8 m	8 m
I-89 SB between US-4/Exit 1 and I-91	0	70 mph	70 mph	0	3 m	3 m
I-89 SB between I-91 and VT--NH STATE BORDER	↓ 1	62 mph	63 mph	0	1 m	1 m

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

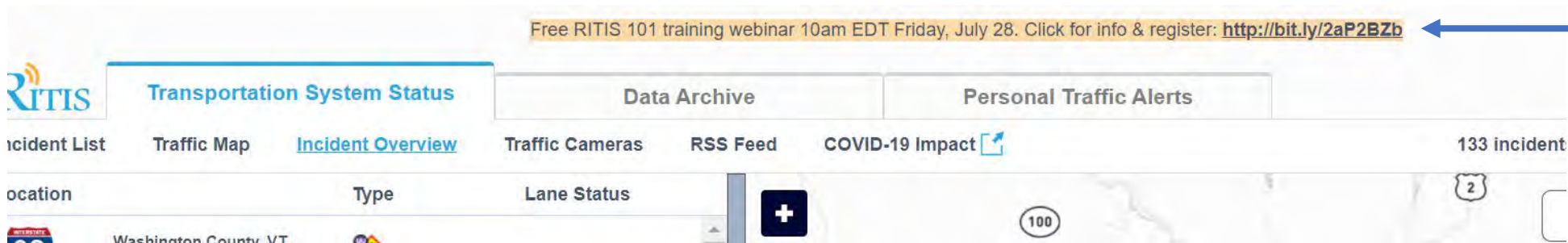
I-89 Northbound NH Border to Exit 8

Corridor	Average Speed			Travel Time		
	Differential	Current	Historical	Differential	Current	Historical
I-89 NB between VT-62/Exit 7 and Memorial Dr/Exit 8	↓ 2	67 mph	69 mph	0	2 m	2 m
I-89 NB between VT-63/Exit 6 and VT-62/Exit 7	↓ 5	65 mph	70 mph	0	3 m	3 m
I-89 NB between VT-64/Exit 5 and VT-63/Exit 6	↓ 4	66 mph	70 mph	↑ 1	4 m	3 m
I-89 NB between VT-66/Exit 4 and VT-64/Exit 5	↓ 5	75 mph	70 mph	0	10 m	10 m
I-89 NB between VT-107/Exit 3 and VT-66/Exit 4	↓ 2	70 mph	68 mph	0	7 m	7 m
I-89 NB between VT-132/Exit 2 and VT-107/Exit 3	↓ 2	69 mph	67 mph	↓ 1	16 m	17 m
I-89 NB between US-4/Exit 1 and VT-132/Exit 2	0	68 mph	68 mph	0	9 m	9 m
I-89 NB between I-91 and US-4/Exit 1	↓ 3	68 mph	65 mph	0	3 m	3 m
I-89 NB between VT--NH STATE BORDER and I-91	↓ 2	61 mph	59 mph	-	0 m	-

Using INRIX data Updated Sep 11, 2023 10:17 AM (3s ago)

How Do I Learn More?

- [Big Data Teams site](#) chat and resources
- Quarterly AOT Users Group: mini-trainings and work sessions
- Tutorial videos, resources, and trainings at [RITIS.org](#) and [TETCoalition.org](#) (and highlighted at the top of the RITIS screen)
- Contact RITIS directly: Info@CATTlab.umd.edu
- Vermont trainings led by RITIS and INRIX live and through VTTC



The screenshot shows the RITIS website interface. At the top, there is a yellow banner with the text: "Free RITIS 101 training webinar 10am EDT Friday, July 28. Click for info & register: <http://bit.ly/2aP2BZb>". A blue arrow points from the right side of the slide to this banner. Below the banner is the RITIS logo and a navigation menu with the following items: "Transportation System Status", "Data Archive", and "Personal Traffic Alerts". Underneath, there are more navigation options: "Incident List", "Traffic Map", "Incident Overview", "Traffic Cameras", "RSS Feed", and "COVID-19 Impact". On the right side of the navigation bar, it says "133 incident". Below the navigation bar, there is a table with columns for "Location", "Type", and "Lane Status". The first row shows "Washington County VT" under the "Location" column. To the right of the table, there is a map showing a road with a "100" speed limit sign and a "2" route sign.

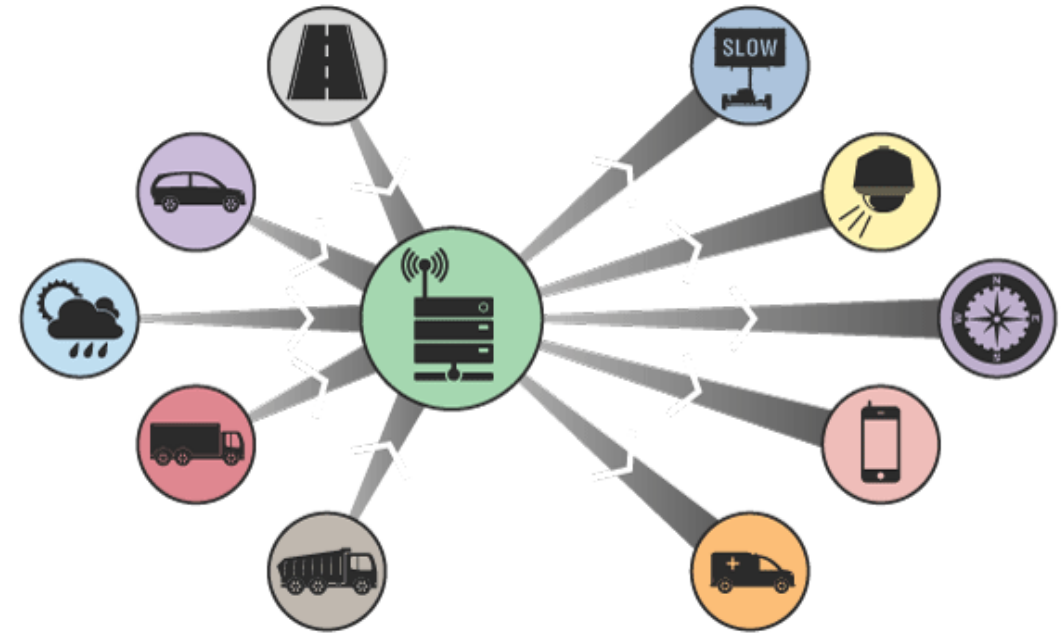
Changeable Message Signs (CMS)

- AOT deploys message signs along state highways and interstates.
- Permanently mounted and portable
- Use cases:
 - Road closure notices
 - Traffic safety messages/safety campaigns
 - AMBER Alerts
 - VT Route 9 Chain-up Law
 - Automated "Low Grip"



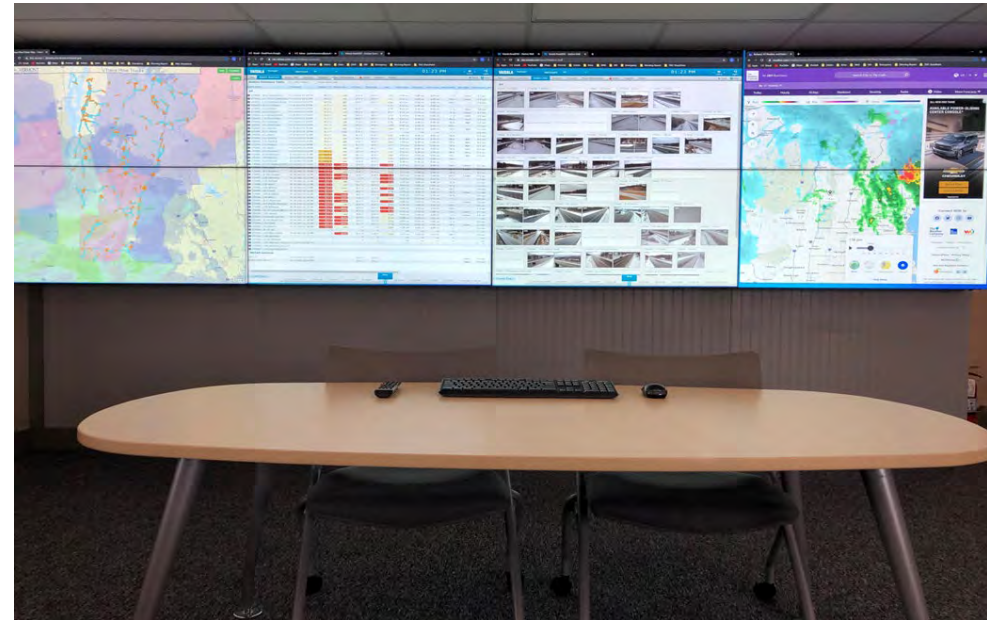
ITS Management Plan

- 5-year plan
 - Mission, Vision, Objectives
 - Statewide Architecture Overview
 - Capability and Maturity Model Assessment
 - Potential ITS Projects and Solutions
 - Project Priorities, Funding, Project Considerations and Criteria



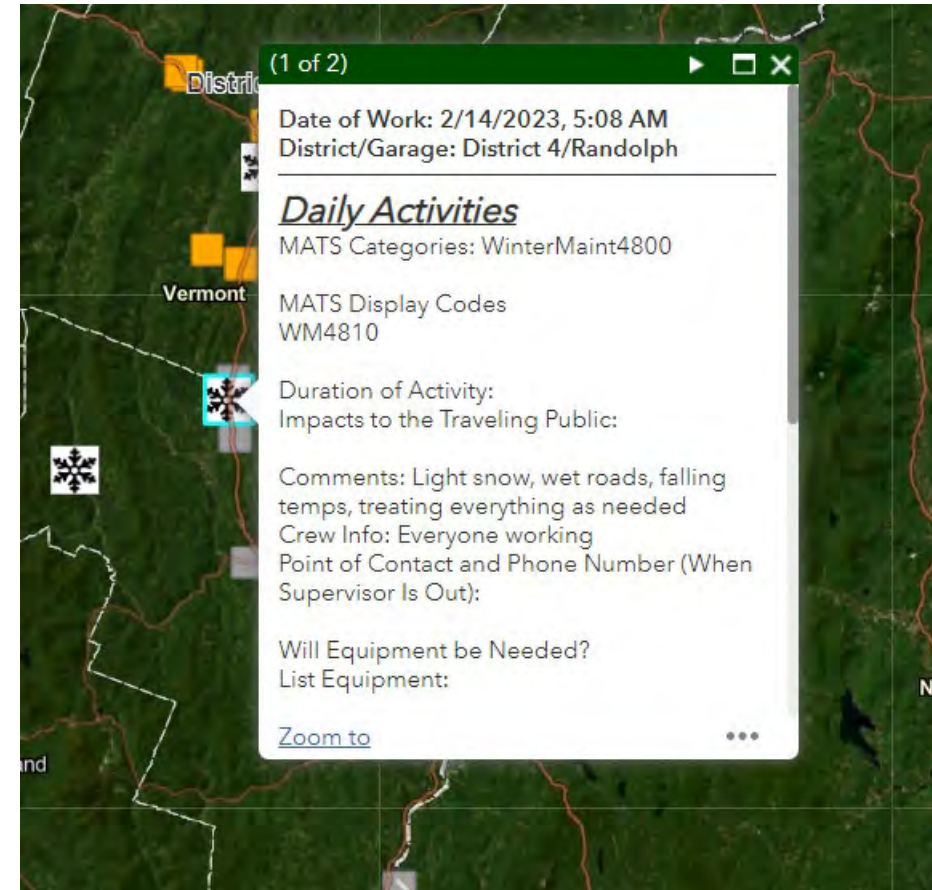
Monitor Transportation Mobility

- Systems utilized
 - Road Weather Information System (RWIS) – Vaisala
 - Closed-circuit TV (CCTV)
 - Google Traffic
 - WAZE
 - Radio communications
 - Telephone
 - Email
 - Social media
 - Survey 123
 - Plow Finder/AVL
 - Changeable Message Signs
 - New England Compass/511
 - VT-Alert
 - Wavetronix

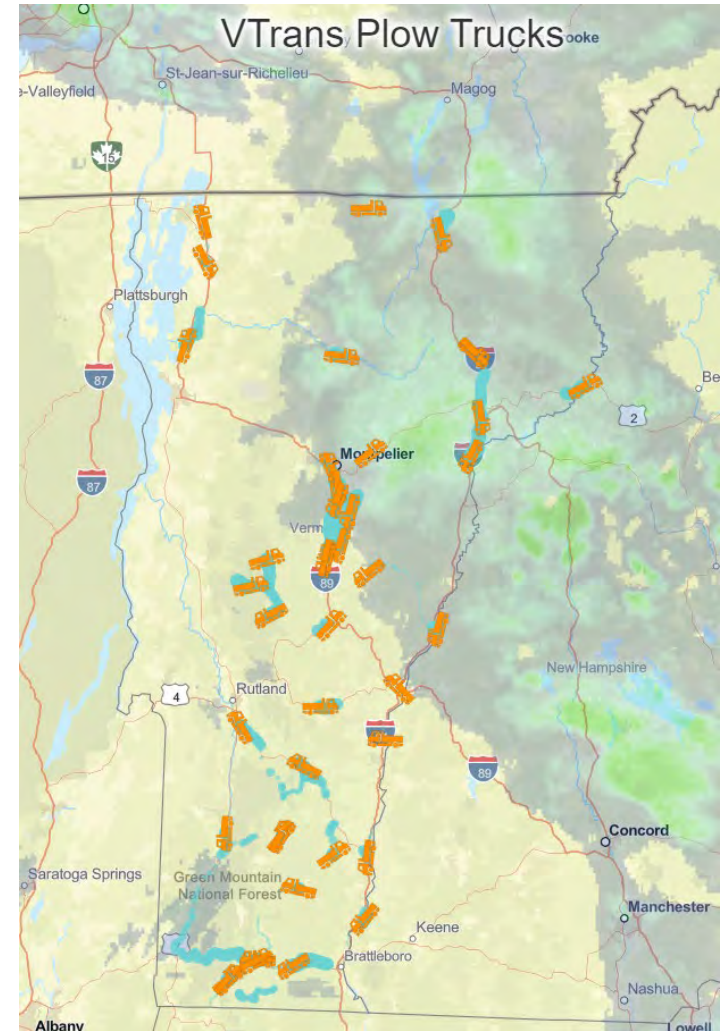
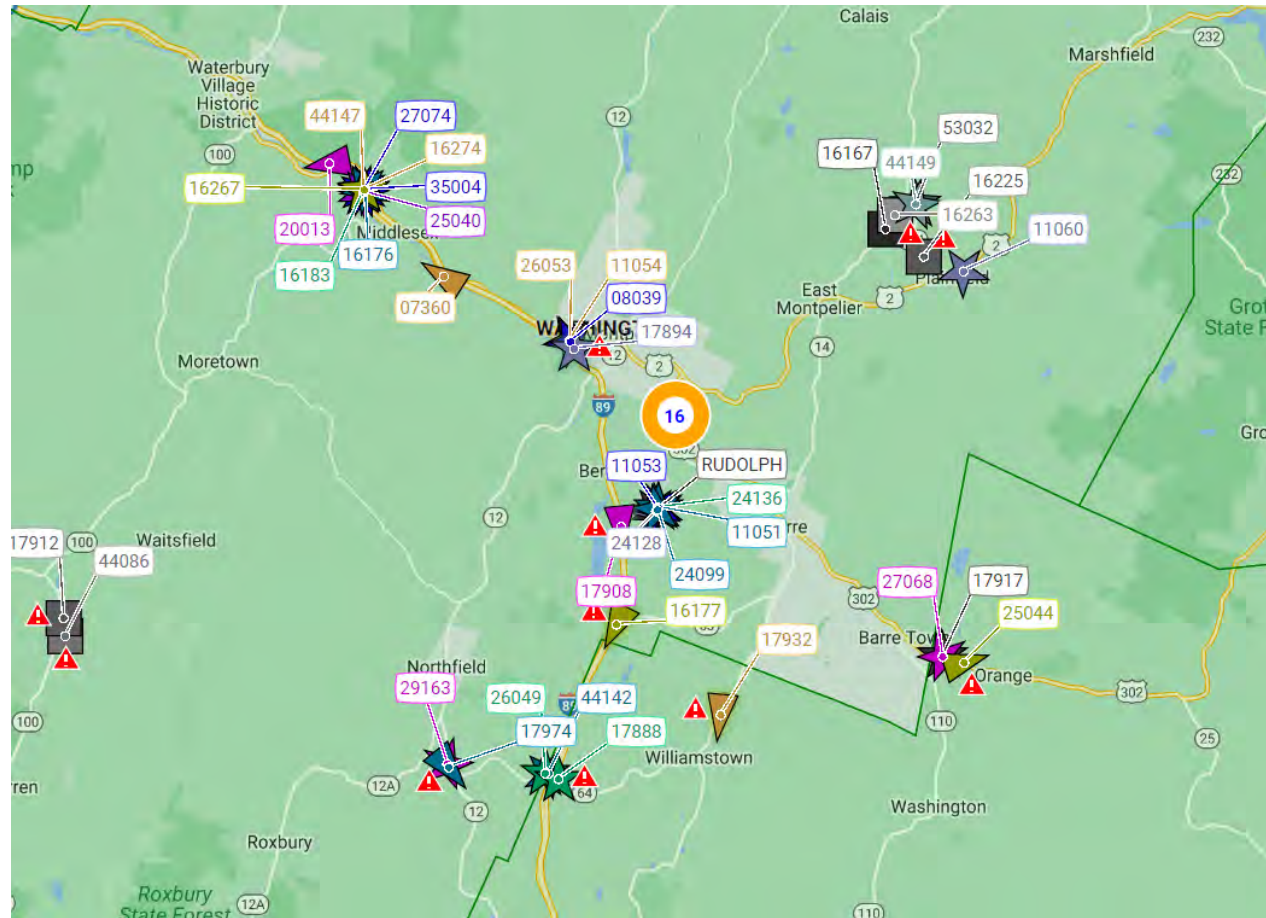


Survey 123

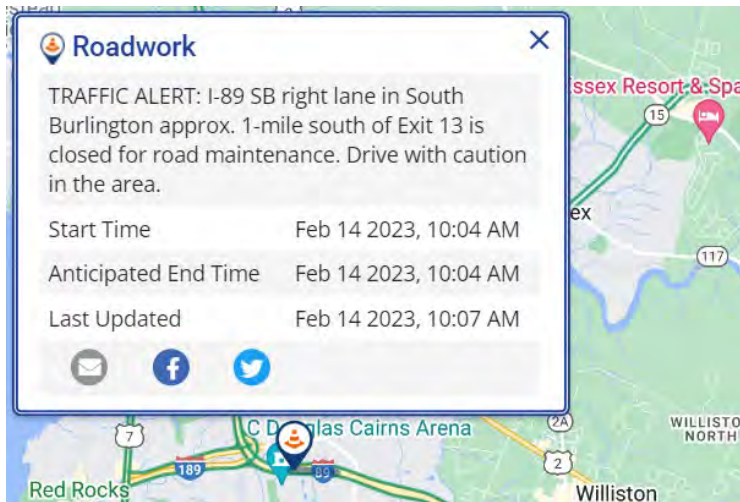
- District Transportation Area Maintenance Supervisors (TAMS) enter information into a Morning Report
- Morning Reports consist of:
 - Road conditions
 - Weather conditions
 - Crew activities
 - Impacts to the public
 - Equipment needs
 - Points of contact



Automatic Vehicle Locating (AVL)/Plow Finder



Disseminate Travel Information



Feb 14, 2023 @ 08:49:30

Traffic Events Within Windham County

You have confirmed, ✓

Event Description: Roadwork Closure - Updated
TRAFFIC ALERT: Today at 9 AM to 3 PM I-91 NB Westminster will be closed to all traffic between Exits 5 & 6 for bridge maintenance. Detour exit 5 to US 5 to Exit 6.
Start Time Feb 14 2023, 9:00 AM
Anticipated End Time Feb 14 2023, 3:00 PM

Area Notification: Windham County

[Click here](#) for all State of Vermont road closures.

New England 511



ADVISORIES MAINE Silver Alert Bangor; Graham K Lacher 37; 5'11" long BRO hair, beard & BLU eyes. Last seen 6/6/22 656 State St. Bangor; black rim glasses, dark Carhartt clothes. Call 911 with any info

MY ROUTES

A Starting Point
B Destination
Reset

MY CAMERAS
Please login to customize My Cameras.

ST S, MM 5.8
NH DOT 09/18/23 10:30:15
Monday, September 18, 2023 10:30:36 AM

Search Map

Traffic Speeds
Closed/Stopped Slow Fast

Driving Conditions
Fair Difficult Ice / Hazardous

Incidents
Full Closures
Roadwork
Full Closures
Future Events
Full Closures

Road Restrictions
Special Events
Waze Reports
Cameras
Message Signs
Mile Markers

Weather
Road Weather Stations
Weather Radar
Weather Alerts
Weather Forecasts

Maine
Park & Ride
Bridge Postings

Map Satellite

Social Media



- Utilizing Agency of Transportation Facebook and Twitter pages to post real-time information about roadway conditions or issues impacting travel
- Monitor social media groups and comments for real-time information about roadway incidents unreported to the TMC

Road Conditions Reports



*** VTrans A.M. Road Conditions Report ***

As of 6:00 a.m. Wednesday, February 15, 2023

Statewide: VTrans "Road Weather Information Systems" (RWIS) showing data of roadways across the state to be mostly bare and dry. However, above-seasonal average air temperatures have caused snow melting making for areas of wet conditions. Temperatures this morning are ranging from the low 20s' to the low 40s' with pavement surface temps from the low 20s to mid-30s'. Above-average temperatures are expected to continue today and tomorrow. Drivers for the morning commute can plan on fairly good travel conditions for this morning but may change over to some wet conditions as some light rain or snow showers are possible during the mid-morning hours.

VTrans: Crews will be out this morning treating roads if necessary and conducting other roadway maintenance. If you happen to encounter maintenance vehicles give them room to work, and don't crowd the plow! Drive Safely.

For additional roadway condition information and roadway alerts:

VTrans website, Winter Weather Central: <https://vtrans.vermont.gov/operations/winter>

Plow Finder: <http://plowtrucks.vtrans.vermont.gov/>

Highway Webcams: <https://vtrans.vermont.gov/operations/rwis>

New England 511: <http://newengland511.org/Home/Index>

VT-Alert: <https://vem.vermont.gov/vtalert>

VTrans on Facebook: <https://www.facebook.com/VTransontheroad/>

VTrans on Twitter: <https://twitter.com/AOTVermont>

Media Inquiries:

During regular business hours (Mon-Fri, 8:00 a.m. – 5:00 p.m.), contact AOT's Director of Communications and Public Outreach at Amy.Tatko@vermont.gov or (802) 498-8025.

At all other times, contact AOT.TMC@vermont.gov.

Next Report: 3:00 p.m. Wednesday, February 15, 2023

###

- Twice daily report issued by the TMC Operators to media contacts
- Summarized road conditions, weather impacts, and implications for the traveling public
- Monday through Friday at 6:00 a.m. and 3:00 p.m. and as needed on the weekends
- November 15th through April 15th

Radio Communications

- AVTEC Radio Consoles
- Maintain direct communication with VTrans' Maintenance staff throughout the state
 - Life safety component
- Monitor Vermont State Police channels for situational awareness



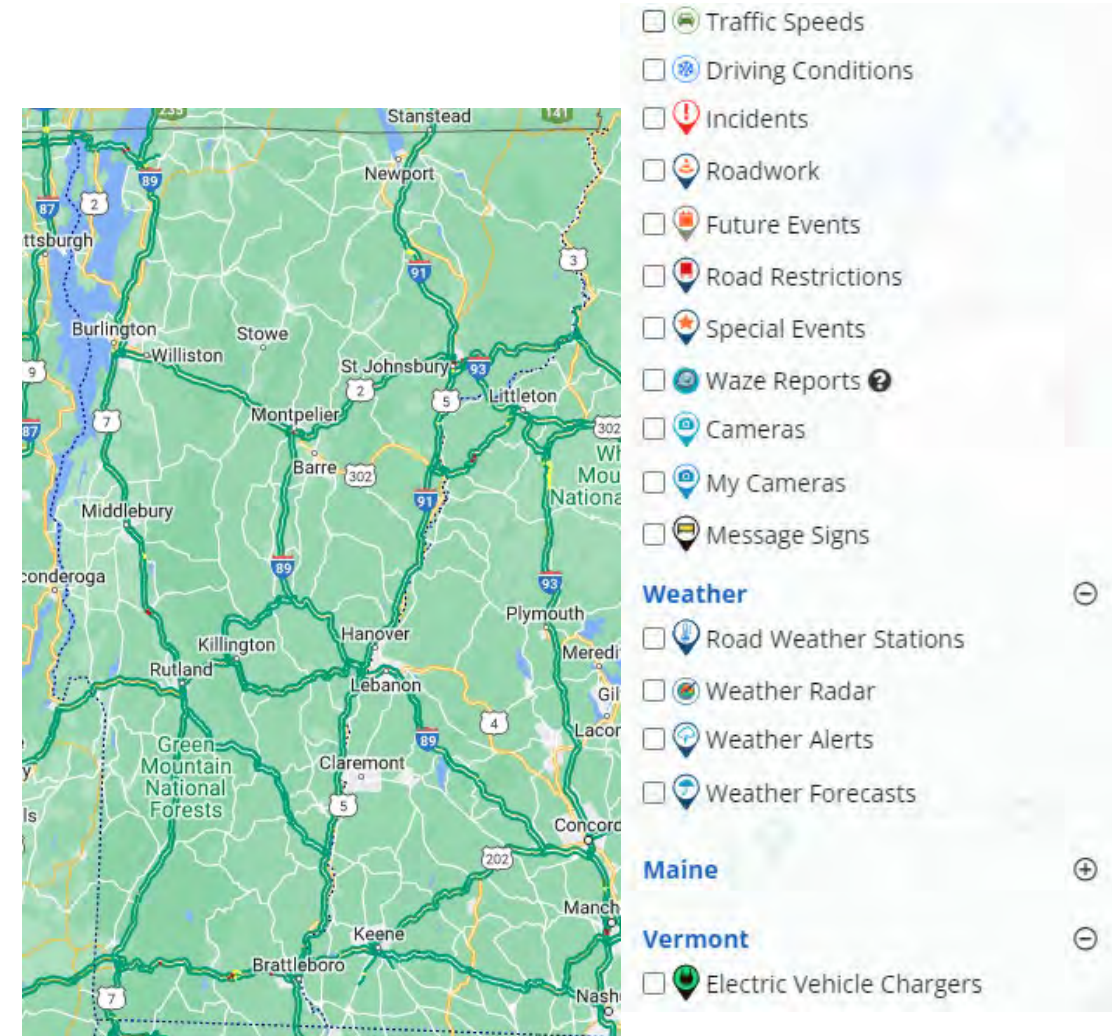
Redundancies

- To maintain operations, the TMC has several redundant communication methods:
 - Satellite phones
 - HAM (Amateur) Radio
 - State Network and back-up internet (x2)
 - Cellular hot spots
 - Portable AVTEC radio consoles
 - Generator power
 - Remote office space



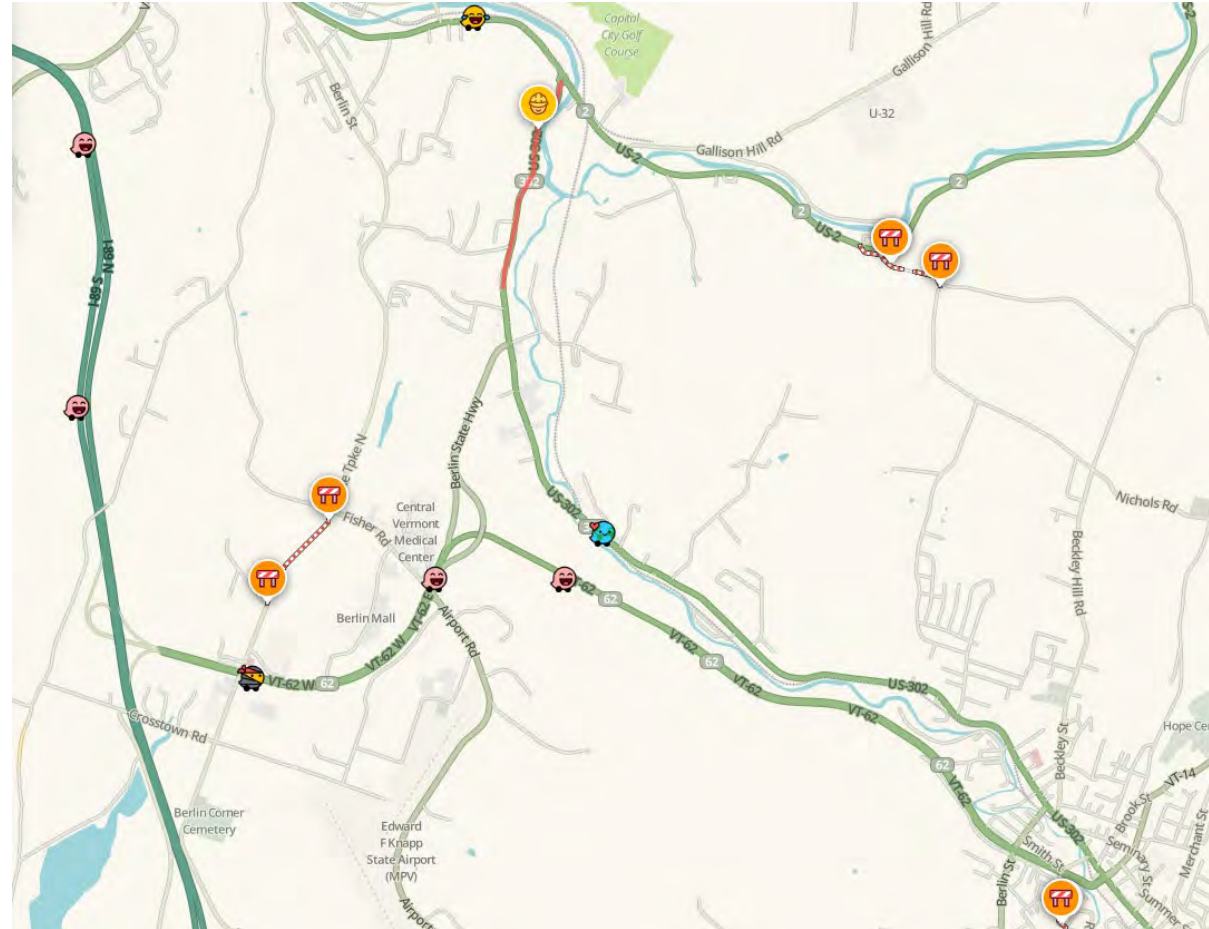
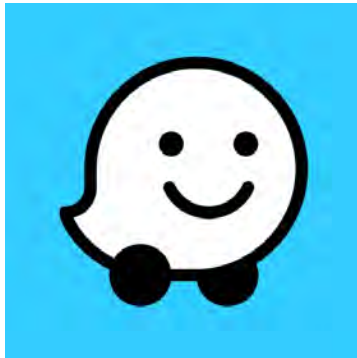
New England Compass Enhancements

- **New and Improved 511 Traveler Information Website**
- Thin Client Application
- ESRI Integration
- Power BI Integration
- Road Condition Forecasting



Local Roads – Closures and Reporting

- Waze for Cities via the Waze Partner Hub
 - Free
 - Two-way communication with drivers
 - Waze Community



Questions



Thank You!

