



VERMONT AGENCY OF TRANSPORTATION FLOOD RECOVERY AND RESILIENCE WORK

SENATE TRANSPORTATION COMMITTEE

1/9/2024

VTrans RESILIENCE

“The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions” (FHWA Order 5520)



Emergency Response and Recovery

COOP
ICS
VT FHWA-ER Manual
Rapid Response



Planning and Programming

Training
Tool Development
Prioritization




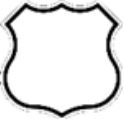


Design and Engineering

Design Standards Update
Hydraulics Manual Update
TH Road and Bridge
Standards



Infrastructure Investments

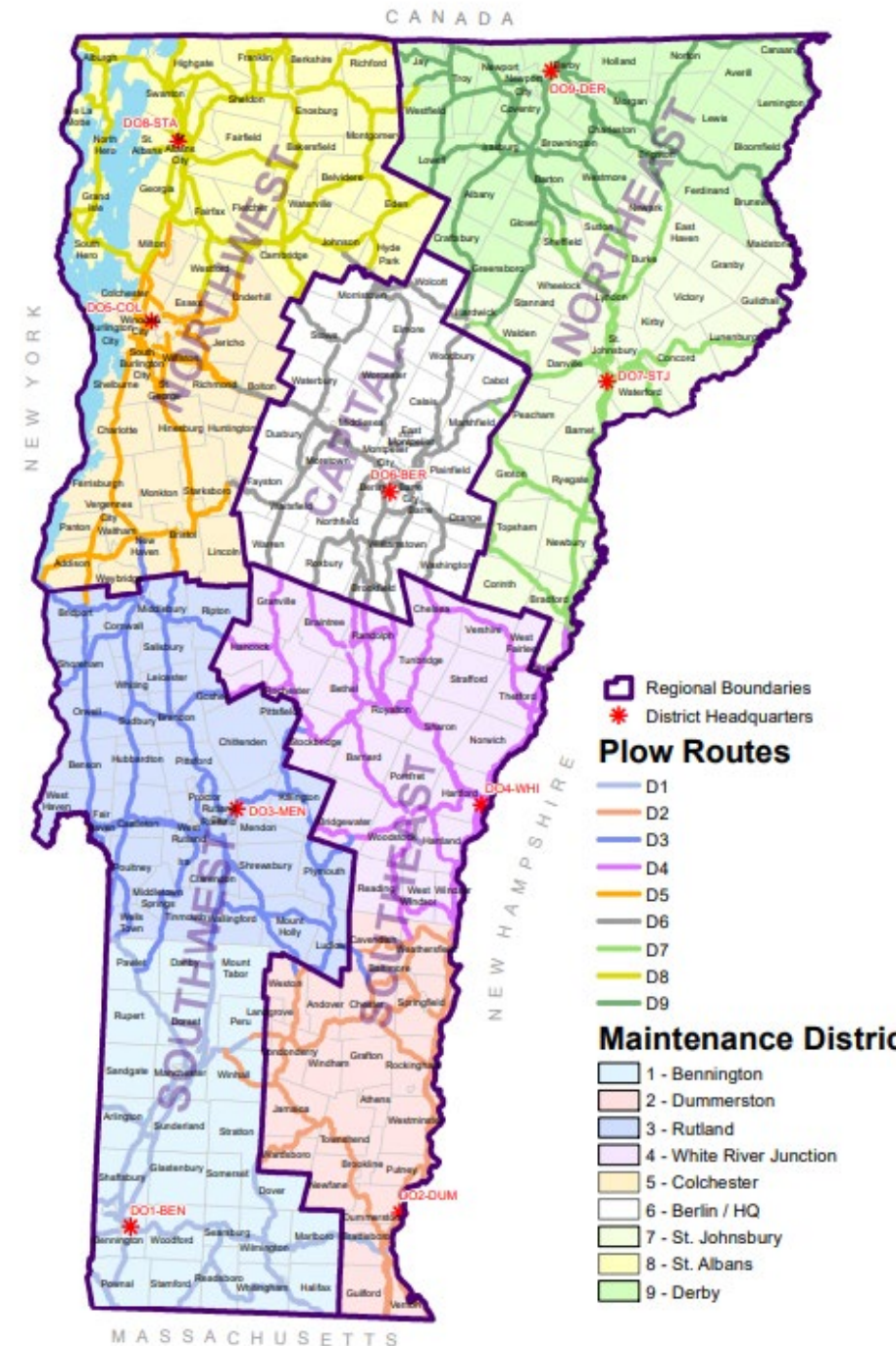
Rail and Road Structures
Slope Stability
Nature Based Designs

	Road Type	Total Mileage
	Interstate Highway	378.14
	US Highway	575.14
	State Highway	1755.11
	Class 1 Town Highway	139.96
	Class 2 Town Highway	2790.55
	Class 3 Town Highway	8539.84
	Class 4 Town Highway	1584.01

State vs Municipality

Incident Command Structure(ICS)

1. The Transportation Incident Command Center (TICC)
2. All 5 Maintenance Regions
3. Rail & Aviation Command Structure



ICS Common Operating Picture - Dashboard - Public

All Lanes Closed

9

Miles

14

Partially Open

10

Miles

6

Opened

129

Miles

272

All Lane Closures sorted by Date Logged

VT-122 - - Lyndon

● VT-122 in Lyndon/Wheelock is CLOSED between Matthewson Hill Rd and Sutton Rd while crews work to replace a flood damaged culvert. Expect delays in the area and seek an alternate route.
Last Updated - 7/25/2023, 9:31 AM, Created - 7/25/2023, 8:26 AM

VT-155 - - Weston

● VT-155 in Weston is CLOSED at the Mount Holly/Weston Line to Shattuck/Ettinger Rd while crews work to replace a flood damaged culvert. please seek an alternate route and expect delays in the area.
Last Updated - 7/25/2023, 9:31 AM, Created - 7/25/2023, 7:04 AM

US-302 - - Barre City

● US-302 in Barre City is CLOSED at Richardson Rd due to flooding.
Last update: 10 seconds ago

Partial Closures sorted by Date Logged

VT-15 - - Johnson

■ TRAFFIC ALERT: VT-15 in Johnson by Nadeau's is open to ONE LANE due to a slide. Barriers in place and crews will be on site.
Last Updated - 7/25/2023, 12:42 AM, Created - 7/24/2023, 4:28 PM

US-4 - - Hartford

■ US-4 in Hartford is down to one lane while crews work on repairing flood damage. A temporary signal is in place. Expect delays in the area.
Last Updated - 7/25/2023, 12:42 AM, Created - 7/24/2023, 9:51 AM

VT-125 - - Ripton

■ TRAFFIC ALERT: VT-125 in Ripton between Maiden Ln and Frost Rd is down to one lane alternating traffic due to a slide.
Last Updated - 7/25/2023, 12:42 AM, Created - 7/23/2023, 4:28 PM
Last update: 10 seconds ago

Last 10 Openings sorted by Date Logged with Original Description

I-91 - - Hartford

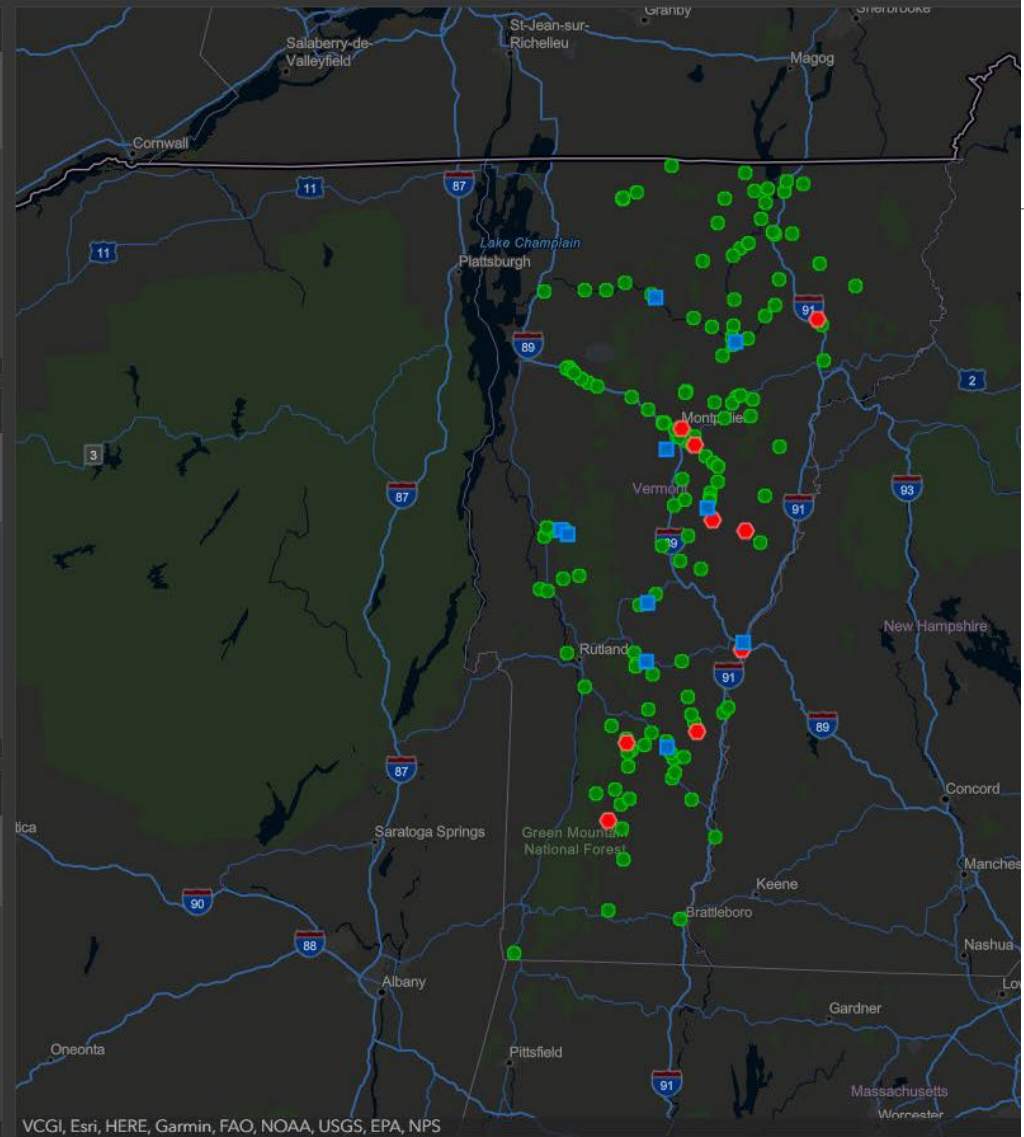
● Single lane closure on the I-89 NB to I-91 NB ramp in Hartford (WRJ) while crews work to repair a flood damaged culvert. Expect crews in the area and drive with care.
Last Updated - 7/25/2023, 11:43 AM, Created - 7/21/2023, 11:35 AM

VT-100 - - Bridgewater

● VT-100 in (West) Bridgewater is CLOSED from the intersection of US-4 to Farm and Wilderness Rd due to flooding. Please seek an alternate route and expect delays in the area.
Last Updated - 7/24/2023, 7:30 PM, Created - 7/7/2023, 6:40 PM

VT-100 - - Jamaica

● TRAFFIC ALERT: VT-100 in Jamaica from VT-30 to Meadow Wood Ln. in Wardsboro is down to one lane due to flooding. Drive with caution.
Last Updated - 7/24/2023, 7:30 PM, Created - 7/11/2023, 9:00 AM
Last update: 39 seconds ago





Eligibility

July 2023 Flooding Emergency



Up to 9 inches of rain in
48 hours



State of Emergency Declaration by Vermont Governor Phil Scott on Sunday afternoon, 9 July 2023, for the "imminent likelihood of excessive rain" and associated threat to property and public safety.

By July 14th, at least **212 urban and swift water rescues** had been performed across Vermont.

Impacts to Transportation Systems

Over 2,000 unique Damage Sites identified from initial damage assessments

Roughly 300 miles of roadway were closed

149 miles of rail trails were closed, 93 were LVRT

409 miles of rail were closed

29 Temporary Bridge Requests throughout the state

Temporary Bridge Requests from Towns

29

Requests Made to the State

14

State-Owned Bridges Deployed

Cabot, Chelsea, Greensboro, Hardwick (3), Jamaica, Marshfield (4), Randolph, Washington, Vershire

3

Rental Bridges Deployed

Bridgewater (2), Ludlow

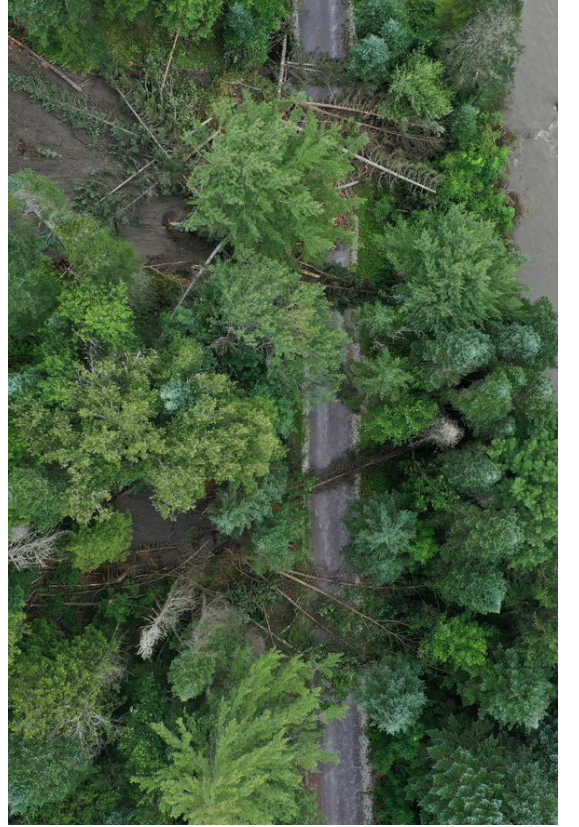
FHWA:

- Estimated 374 projects, \$157M
 - 352 Emergency Repairs - \$61M
 - 73 Permanent Repairs - \$96M

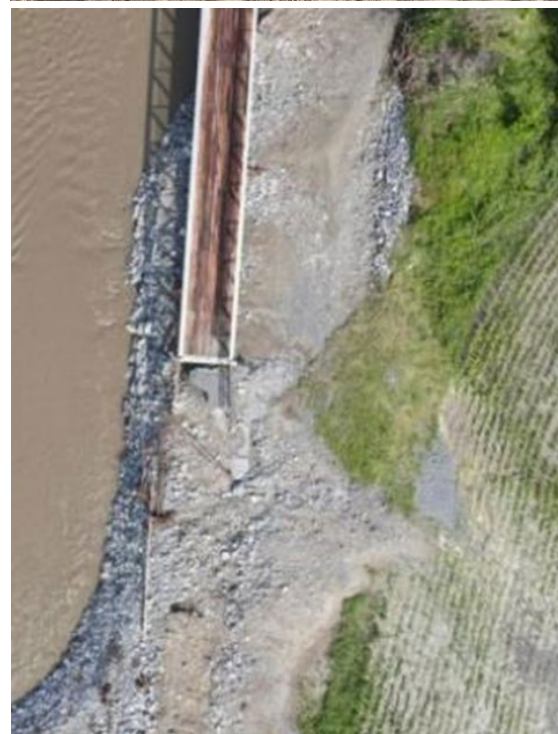
FEMA:

- Town Public Assistance
- Debris Removal
- Rail
- Rail Trail
- US 302 Complex





Lamoille Valley Rail Trail Damage



Lamoille Valley Rail Trail Damage

- Significant damage occurred to the LVRT, estimated at \$16 million in repairs.
- Many damages were concentrated in Lamoille and Caledonia Counties with the hardest hit towns being Hardwick and Wolcott.
- 138 individual sites were damaged, and 93 miles closed.
- 79.5 miles have been opened with 14.7 miles to be open soon.

Rail Line Damages



Pictured Here: Ludlow Rail Line

Initial Damage



After Recovery



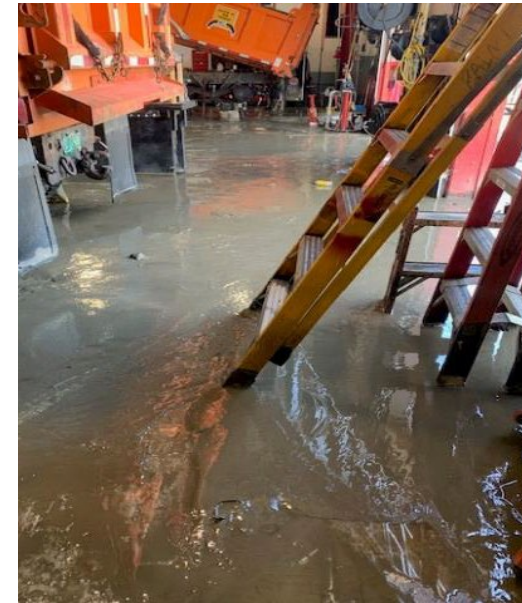
Washington County Railroad (WACR)
Montpelier & Barre in Barre City

Rail - Emergency Projects Undertaken

- Rail damages are estimated at \$70 million
- Statewide State-owned Rail Lines had damage at 237 sites.
- Rail damage occurred in 23 towns and cities in Bennington, Caledonia, Orleans, Rutland, Washington, Windham and Windsor Counties
- Damages spanned 123 miles out of the 298 miles of state-owned rail lines, or 41%.
- 25 bridges and 32 culverts were affected.

Impacts to Transportation Facilities

- **Route 302 (Berlin) Central Garage and Training Center Facilities Impacts**
 - 6 structures impacted, 1 total loss, 5 significantly impacted.
 - 14 vehicles impacted, 3 total losses, 11 repairable
 - As of Sept 15, the Central Garage facility is partially operational in temporary quarters within the current location. Operationally, the functions of the Central Garage will be sustained by sharing workloads across the other locations.





Cavendish VT106 Washout



Reading VT106



Reading VT106 Washout



Damage Repaired

- **825** Individual Sites
- **153,460** LF Ditching
- **34** Miles Paved
- **14** Temporary Bridges deployed
- **94** Culverts Replaced (839 Cleaned)
- **214** Slopes/Slides Repaired
- **426,453** Tons of Stone
- **14,132** LF Guardrail


July 2023 Recovery

Permanent Work- 65 sites remaining

- Bridge Replacement- 16
- Culvert Replacement- 37
- Slope Repairs- 10
- Ledge Repair – 1
- Retaining Wall repair - 1



Burlington had never seen as much rainfall on Dec. 18 as it did this year. At 2.2 inches, the city broke its previous record of 0.85 inches, set in 1954.



Also, in Burlington, the minimum temperature of 44 degrees broke the previous record of 39 degrees, set in 1996.



At 59 degrees, the temperature in Montpelier on Monday broke the old record of 50 set in 1949.

December Storm

Roughly 150
Individual
Damage Sites

At least 12
urban and swift
water rescues

40 roadways
closures

Only minor
damages on the
LVRT.

No damage to
the rail

No temporary
bridge requests

December 2023 Flooding Emergency



VTrans Design Standards for Resiliency

Design culverts to satisfy the hydraulic performance criteria required for the roadway classification.

Design Storm Event based on roadway classification

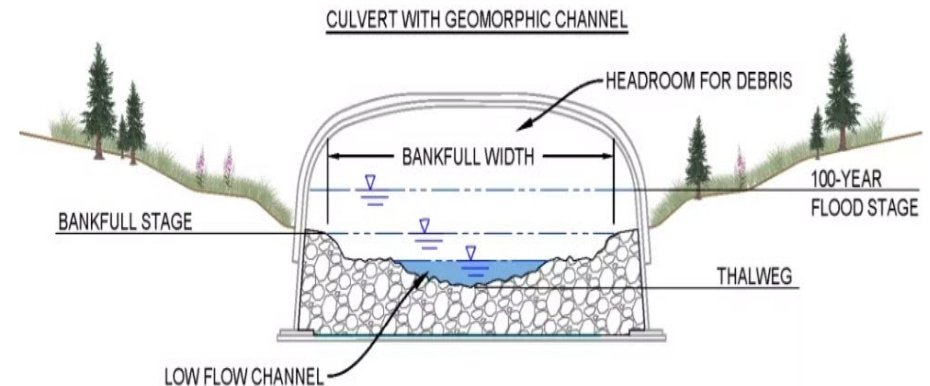
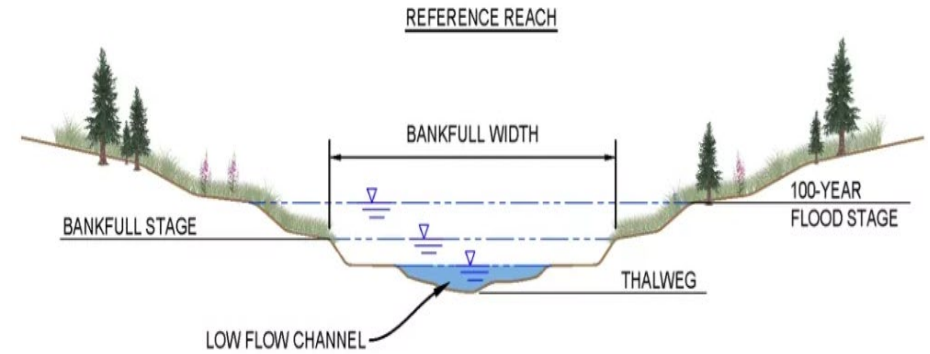
- **Interstate** = 100-yr flood event/200-yr flood check
- **State Highway** = 50-yr flood event/100-yr flood check
- **Local Road** = 25-yr flood event/100-yr flood check



8' culvert



16' x 6' box culvert



VTrans Culvert Sizing Criteria

VTrans Resilient Bridge Sizing

- Design bridges to satisfy the hydraulic performance criteria required for the roadway classification (risk-based priority system)
- Design Events:
 - Interstate 100-yr flood event/200-yr flood check
 - State Highway = 50-yr flood event/100-yr flood check
 - Local Road = 25-yr flood event/100-yr flood check



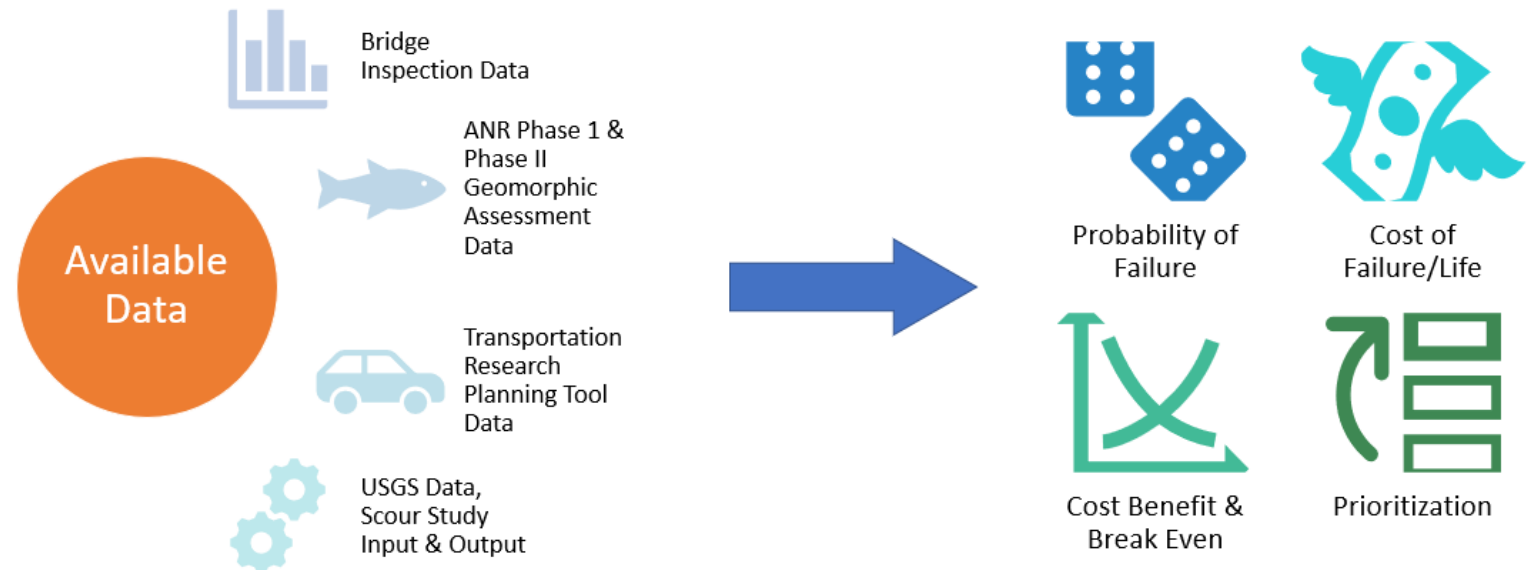
An example of a bridge that was damaged, but the deep foundations allowed the bridge to be repaired and put back in service after TS Irene.

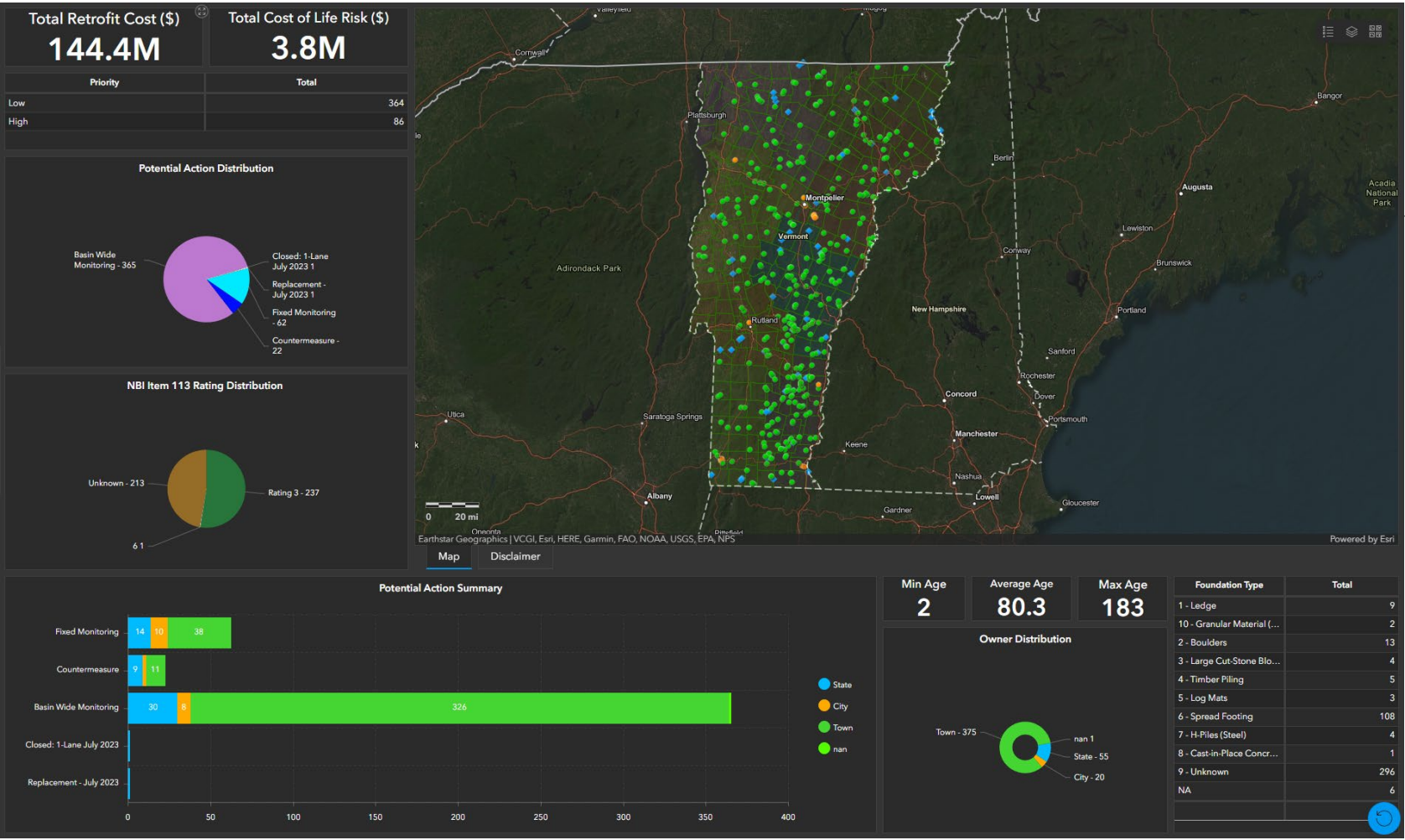
Resilience of bridges on National Highway System

Building Bridge Resilience through Scour Evaluations

Scour Critical Bridges Dashboard & Risk Based Assessment

- VTrans evaluates all new bridge replacement designs for predicted scour depths.
- VTrans also performs a risk-based assessment on all scour critical bridges.
 - All capital projects are checked for scour criticality
 - Bridges are considered for scour countermeasures as necessary





Scour Critical Bridges Dashboard & Risk Based Assessment

Newer flood resilient bridge Bethel VT Route 12 over the Gilead Brook



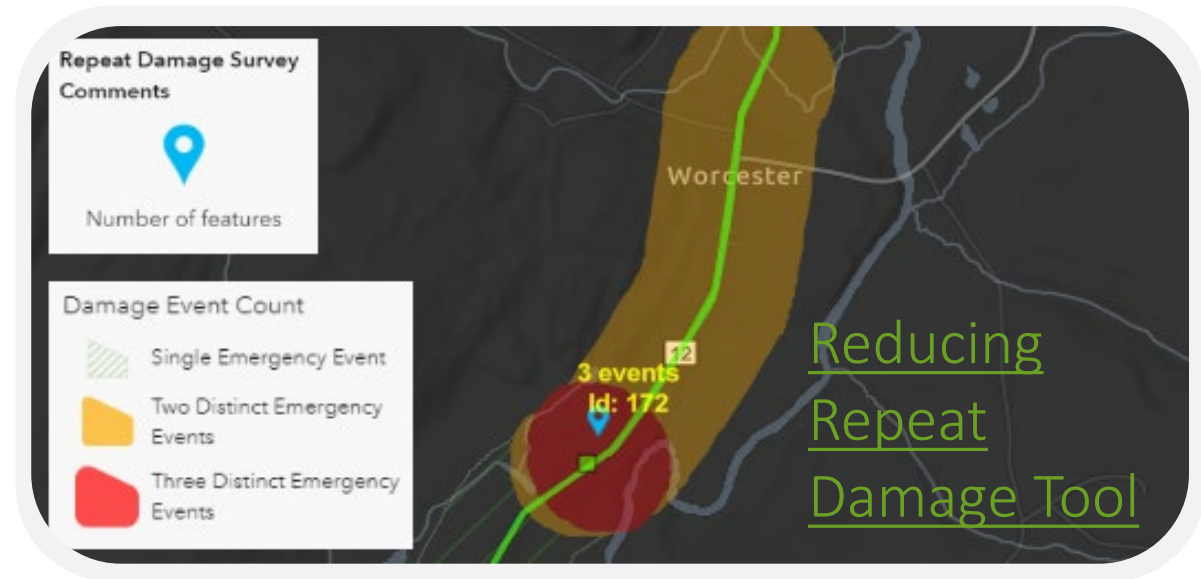
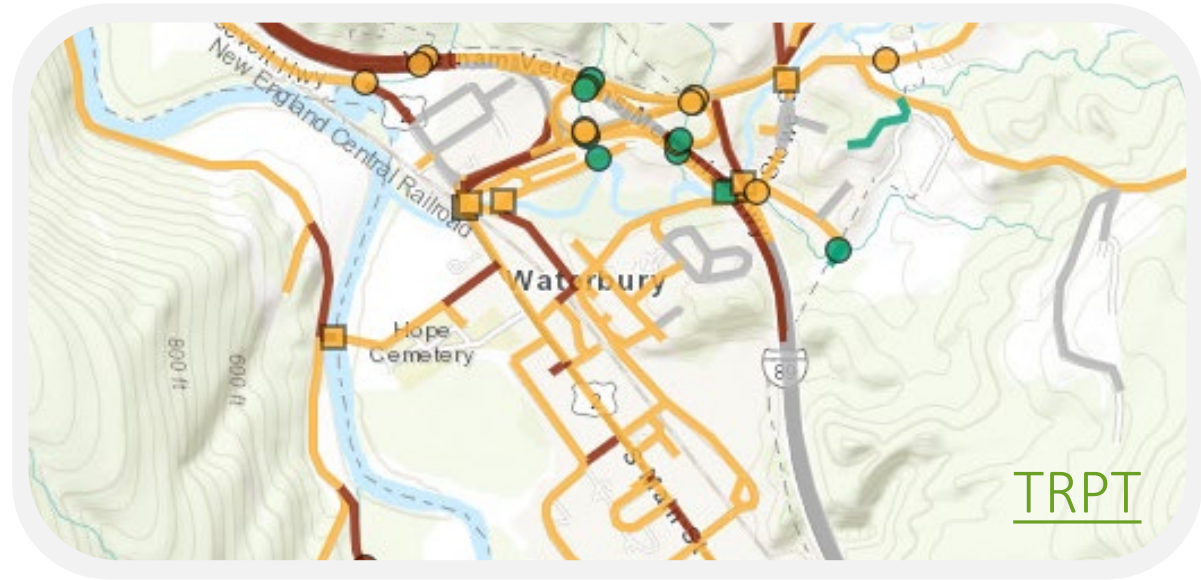
bridge pier on a
deep foundation



VTrans Resilience Planning

Resilience Planning

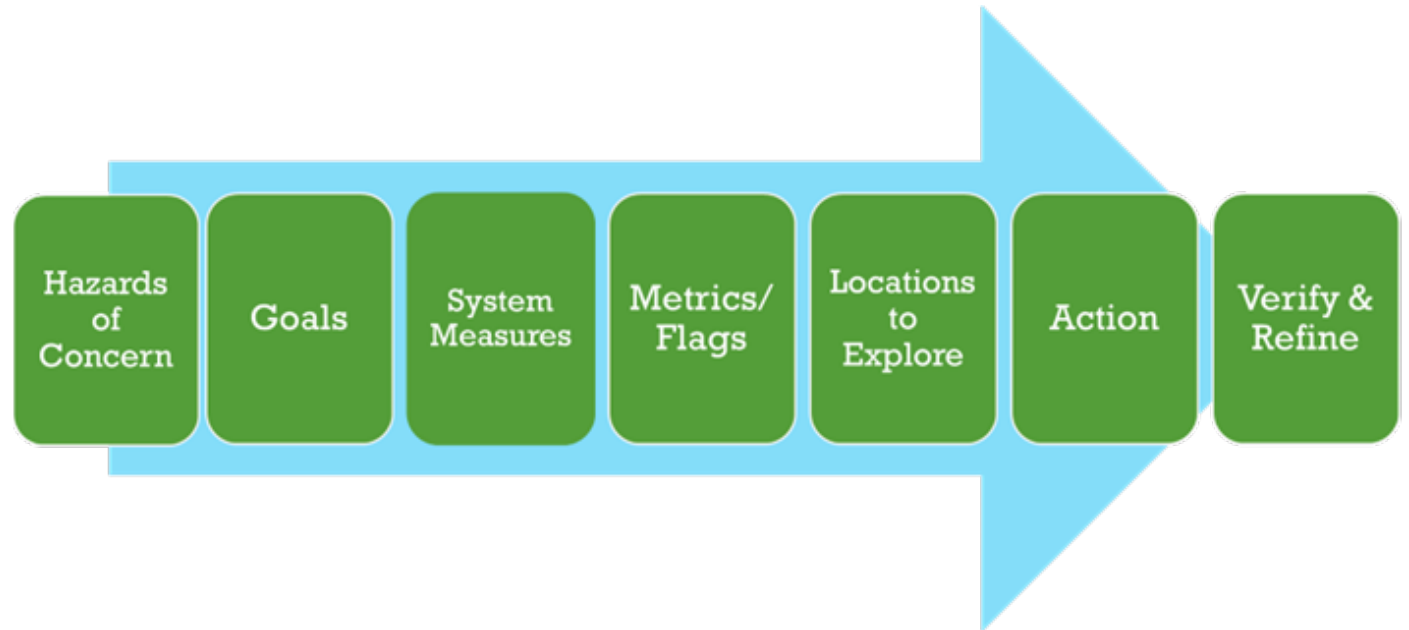
-Tools -



Resilience Planning

VT PROTECT
Formula - \$37 million
Discretionary Grants

Resilience Improvement Plan (RIP)



Resilience Planning RIP Project Prioritization

GOALS

1. Less damage in the future.
2. Systems return to normal quickly.
3. Vermont is Resilient for all people.
4. Essential Freight moves.
5. Resilience efforts are coordinated.

Explore the [VTrans RIP!](#)

MEASURES



High Risk & Repeat Damage



Transit Resilience



Social Vulnerability Index (SVI) & TRPT



Resilience for Commodities Distribution



Coordination with Other Plans

METRICS



Each measure has a metric—a definition of what counts as “high”



Locations where the measure is high get a point (or "flag")



Flags can then be viewed or summarized by road segment or structure

Goal

Less damage
in the future.

Major natural events result in *less damage* to the transportation system in the future than in the past.



System Measure: High risk locations are known and have been made more resilient



What is it: Locations damaged in three major events identified from DDIR analysis for Part 667 Reducing Repeat Damage



**Metric: Repeat Damages = 3 (2 flags)
Repeat Damages =2 (1 flag)**



Notes: This gives 64 segments out of 76,120 with flag of 2.

RIP Priority Locations

4.6% of state road miles and
1.2% of state structures

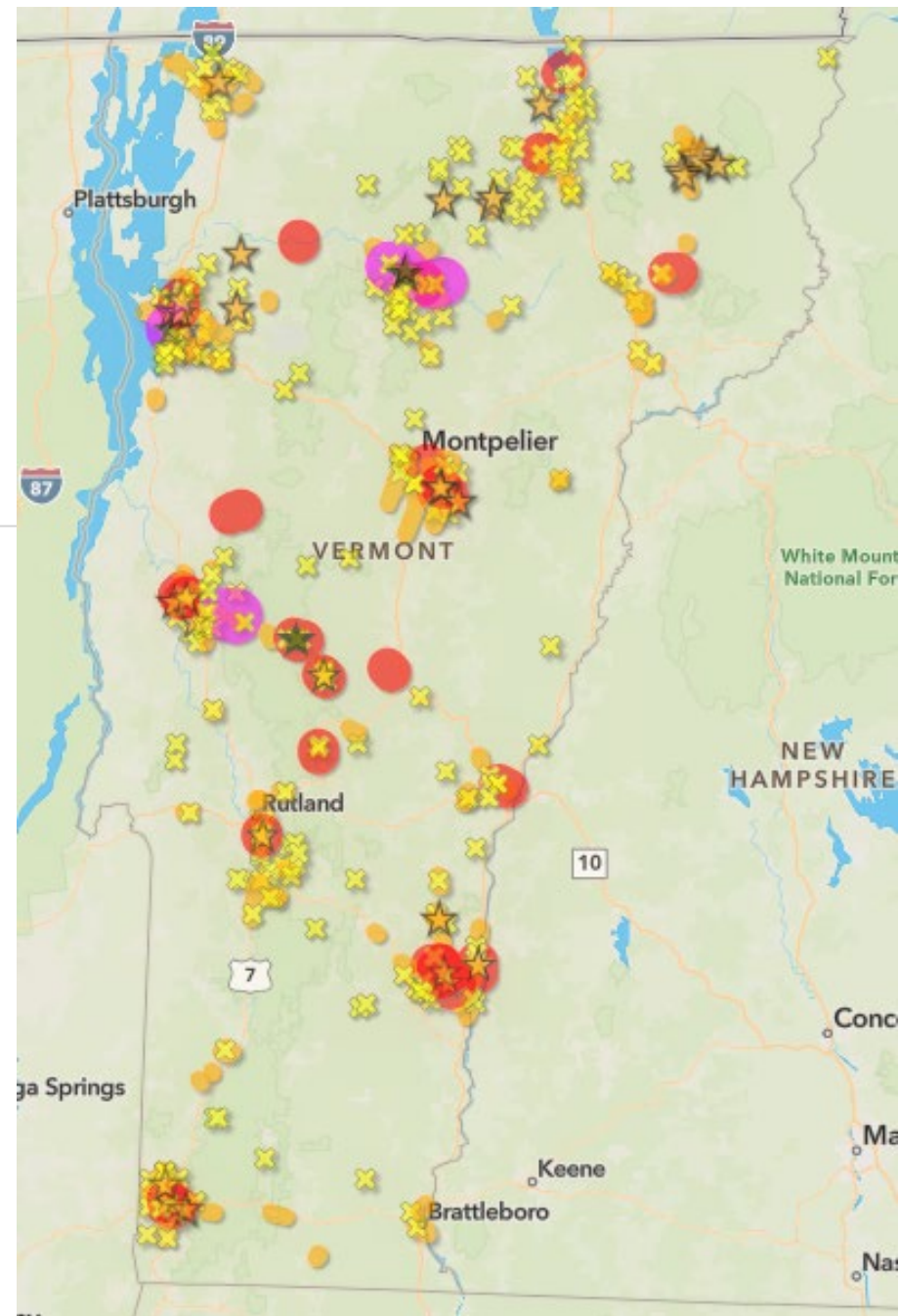
0.4% of local road miles and
0.7% of local structures

Structure Flags

- ★ 4
- ★ 3
- ★ 2

Road Flags

- 6
- 5
- 4
- 3



Explore the [web map](#)

Next Steps



Position for PROTECT and FEMA implementation funding (grants) for priority RIP locations



Establish metrics and track progress



Incorporation of resilience in Agency plans and processes



Interagency coordination

Questions



Andrea Wright, Manager, Environmental Policy and Sustainability

Ashley Atkins, Maintenance Division Manager

Jeremy Reed, Chief Engineer of the Highway Division
