The Vermont Transportation Resilience Planning Tool





2018 NEW ENGLAND TRANPORTATION AND WILDLIFE CONFERENCE | September 11, 2018

Project Team

Joe Segale

Roy Schiff

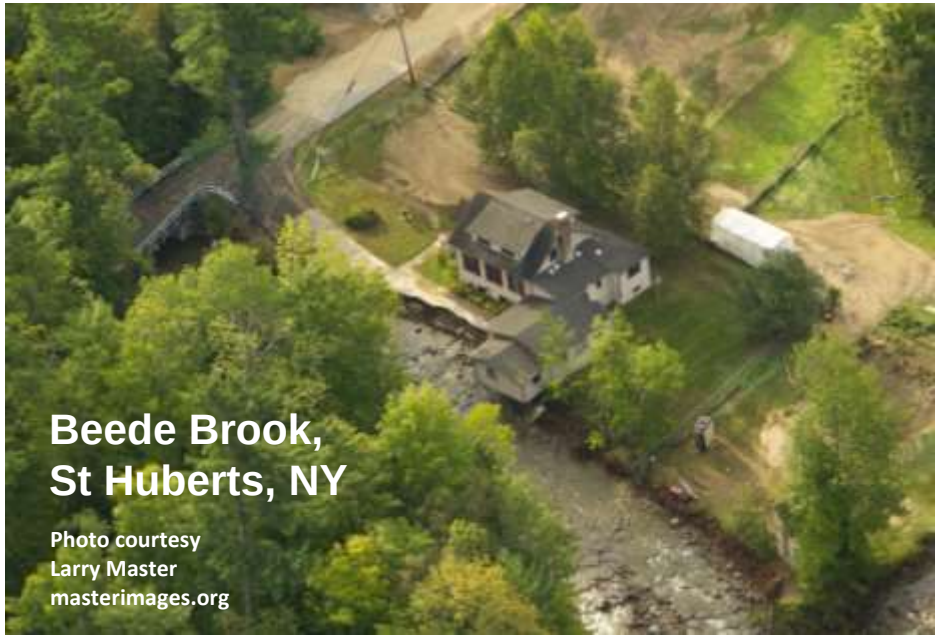
Evan Fitzgerald

Norm Marshall

Lucy Gibson

Lauren Padilla

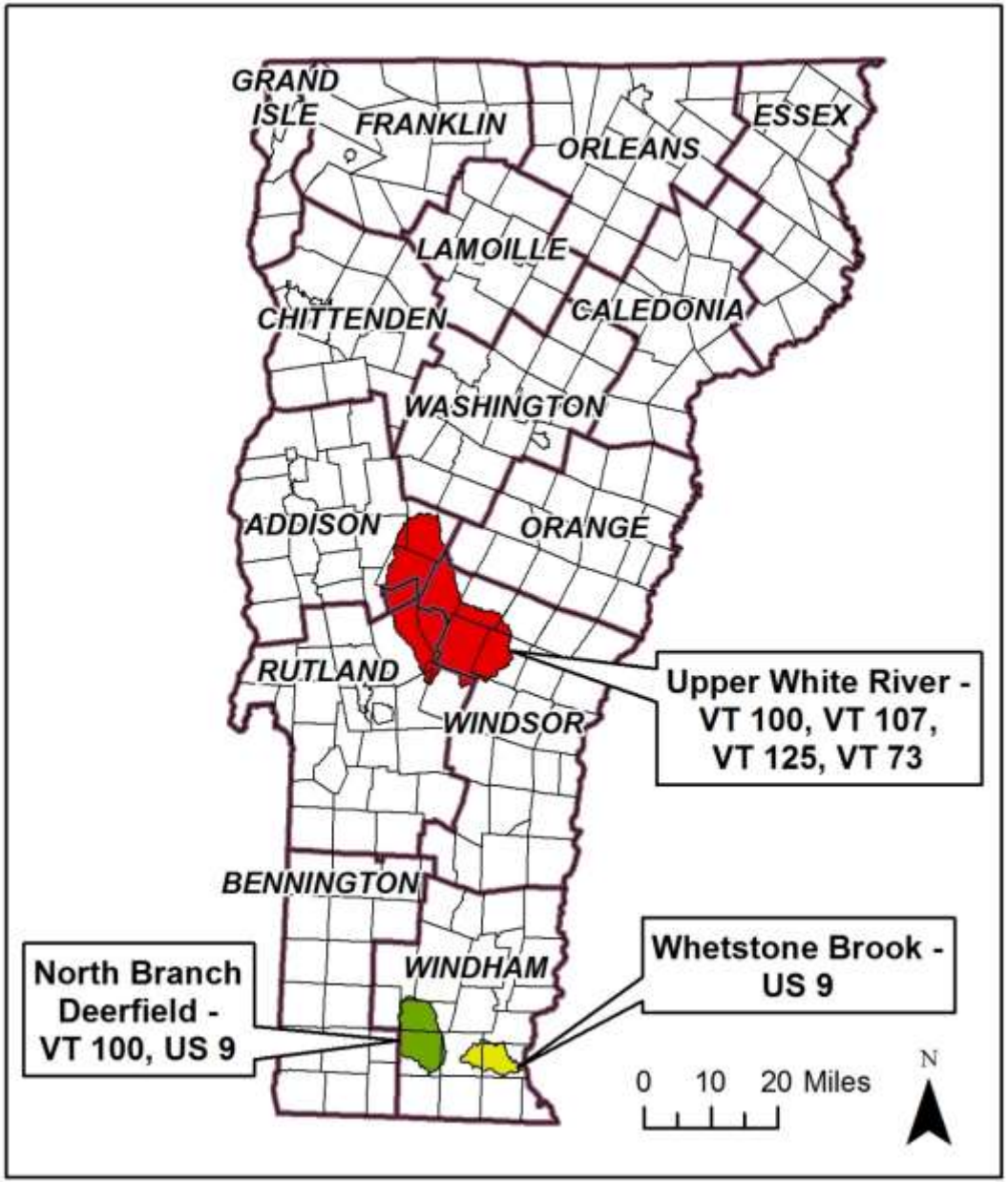
Tropical Storm Irene Flood, Aug 2011



Project Goals

- **A method to systematically identify road segments, bridges, and culverts that are vulnerable to flood and erosion damages**
- **A screening tool to pinpoint the most critical locations and mitigation options on the transportation network**
- **A web-based application to display risk information**

Pilot Watersheds



Definitions

Vulnerability: The extent that a transportation asset is exposed to a threat from inundation, erosion, or deposition.

Criticality: How important is the transportation asset and the effect of the disruption to mobility due to damage.

Risk: The combination of the probability of vulnerability and criticality.

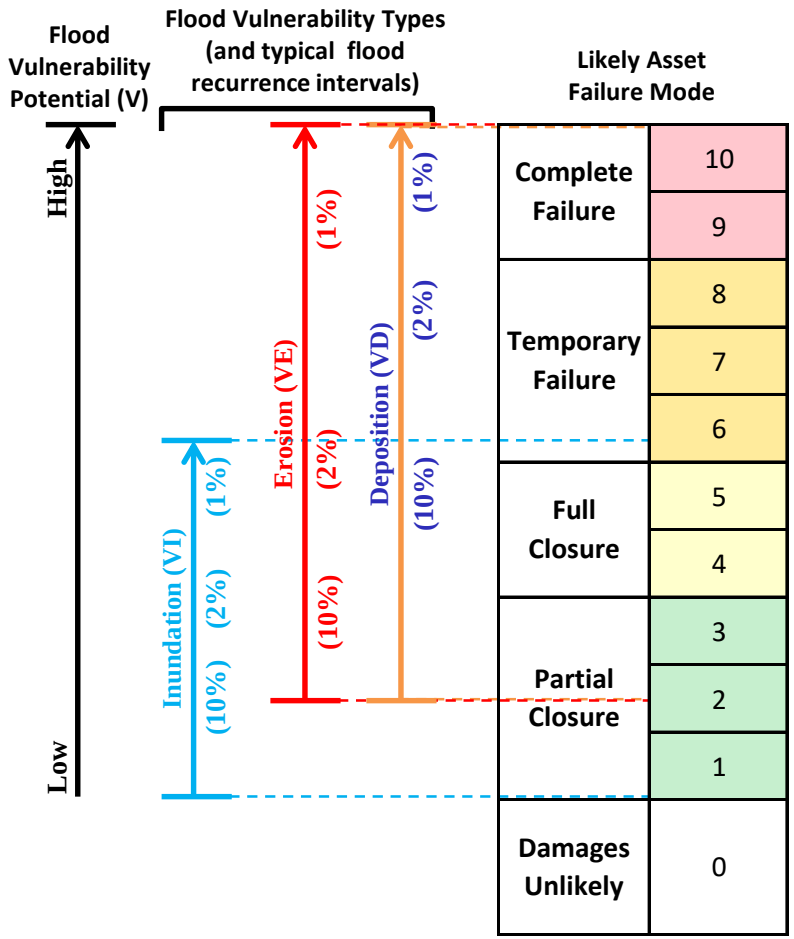
Vulnerability

Process	Example
Inundation *Other Names:* *Flooding* *Submergence* *Ponding*	*Flooding of an Elm Street parking lot in Brattleboro, VT along Whetstone Brook* *(Photo Courtesy Town of Brattleboro)* 
Erosion *Other Names:* *Undercutting* *Scour* *Washout* *Downcutting*	*Washout of US Route 4 in Mendon, VT* *(Photo Courtesy of J. Louisos)* 
Deposition *Other Names:* *Debris buildup* *Clogging* *Accumulation*	*Deposition along Route 100 from Money Brook in Plymouth, VT* *(Photo Courtesy of M. Tucker)* 

Vulnerability

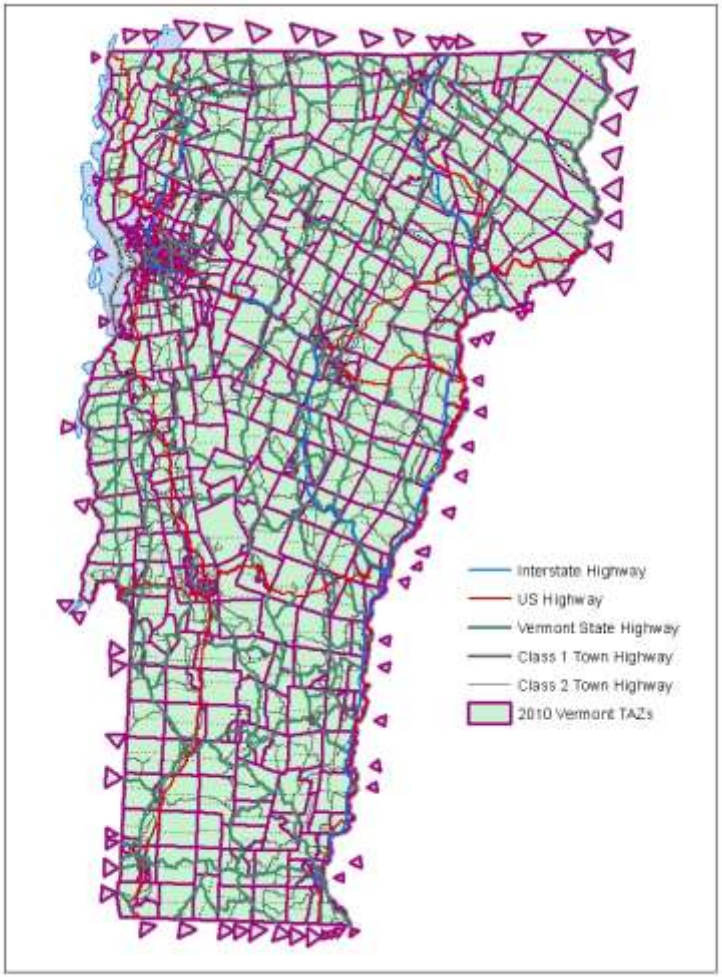
$$V_{ROAD\ EMBANKMENT} = MAX(V_{I,ROAD}; V_{E,ROAD}; V_{D,ROAD})$$
$$V_{BRIDGES} = MAX(V_{I,\ BRIDGES}; V_{E,BRIDGES}; V_{D,BRIDGES})$$
$$V_{CULVERTS} = MAX(V_{I,CULVERTS}; V_{E,CULVERTS}; V_{D,CULVERTS})$$

where I = inundation, E = erosion and D = deposition

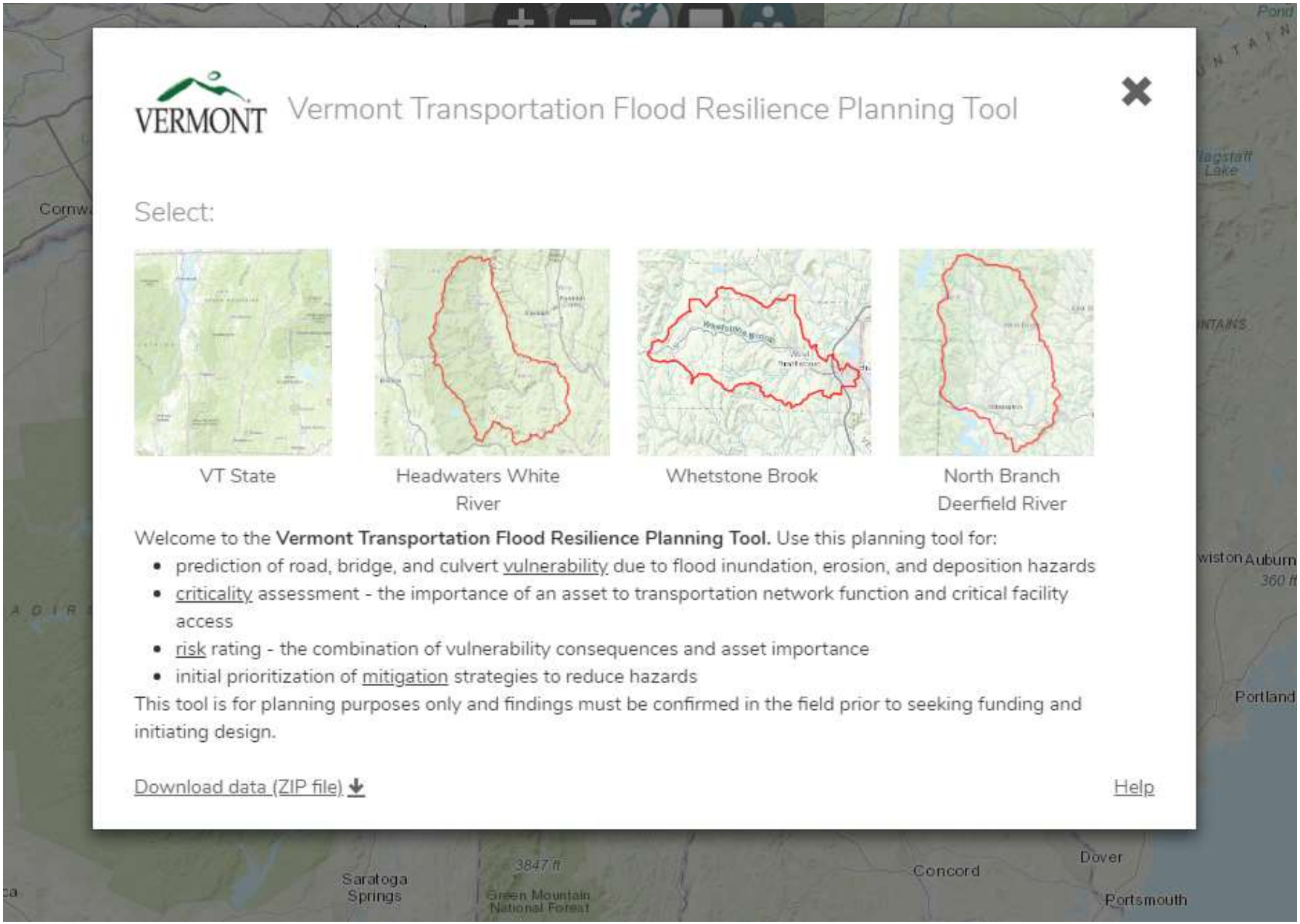


Network Criticality Overview

- Travel impacts
  - Failed trips (per day)
  - Excess travel time (hours per day)
  - Isolated areas ('islands') of roads with limited network travel
- Emergency Services Access
- Local importance



Statewide Travel Demand Model



Vtrans.stone-env.net

http://roadfloodresilience.vermont.gov

TRPT Case Study

TRPT Case Study

TRPT USES

- Planning
  - Emergency and Hazard Mitigation
  - Transportation Corridor Plans
  - Asset Management Plan
  - Conservation planning
  - Planning for continuity of business and future housing
- Project Scoping and Design
  - Initial site assessment
  - Starting the design alternatives analysis
- Budgeting
  - Project Selection and Prioritization

Next Phase of Work

- Four more watersheds
- Train developers
- Assist with data calculations and TRPT update
- Facilitate future TRPT update by State and Regional Planning Commissions

Questions?

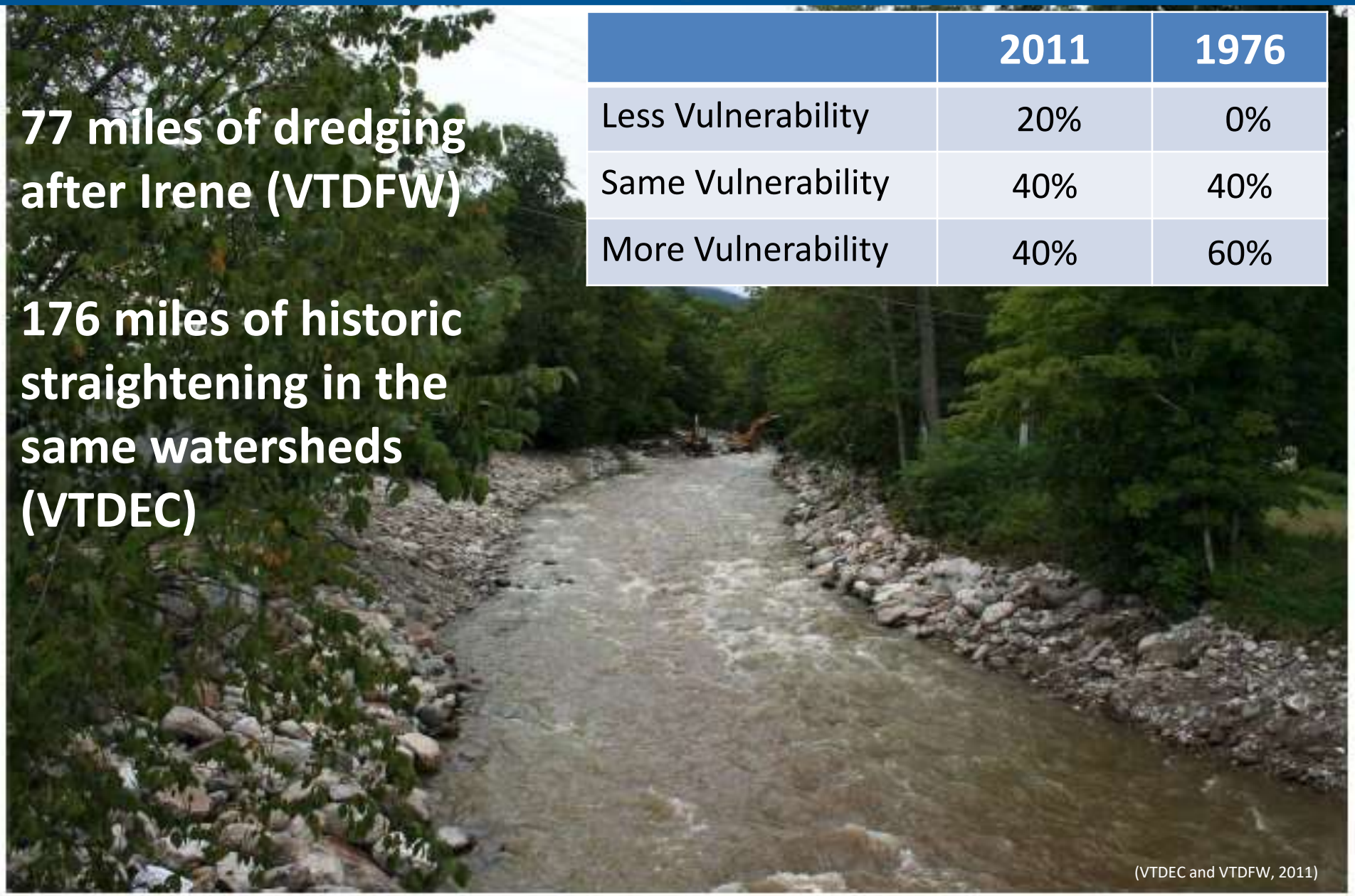
Backup Slides

Vermont Flood Recovery

77 miles of dredging after Irene (VTDFW)

176 miles of historic straightening in the same watersheds (VTDEC)

	2011	1976
Less Vulnerability	20%	0%
Same Vulnerability	40%	40%
More Vulnerability	40%	60%



(VTDEC and VTDFW, 2011)

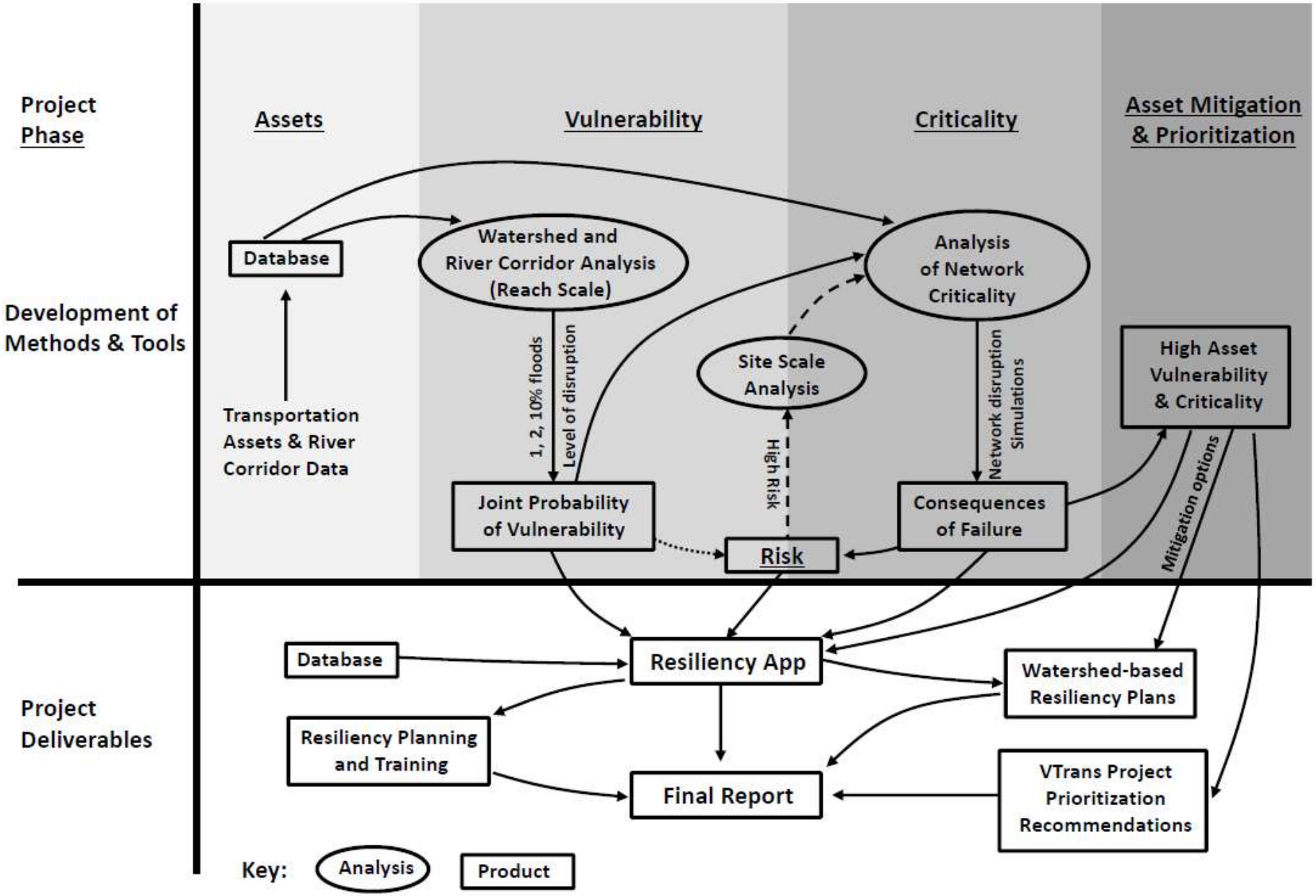
TRPT Case Study

(Source: Mansfield Heliflight, 2011)

TRPT Case Study

TRPT Case Study

(Source: Fitzgerald Environmental, 2013)

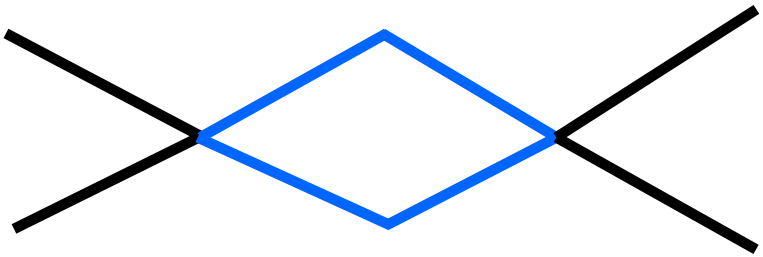


Project Workflow and Products
VTrans Transportation and Resilience Planning Project

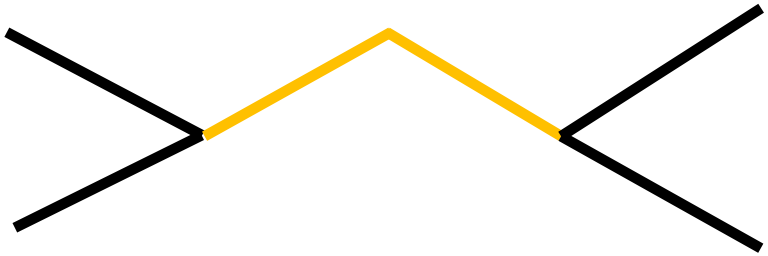
January 14, 2016
Updated figure to accurately reflect definitions.

Network Criticality

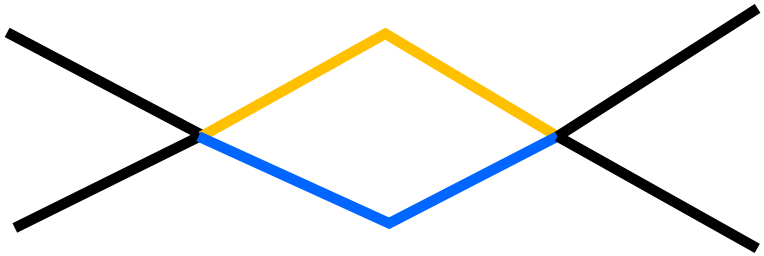
Low criticality – Parallel route



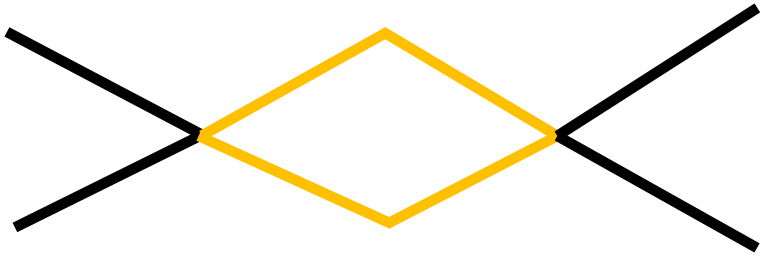
High criticality – No parallel route



Moderate criticality – Parallel route yet one is vulnerable



High criticality – Both routes vulnerable



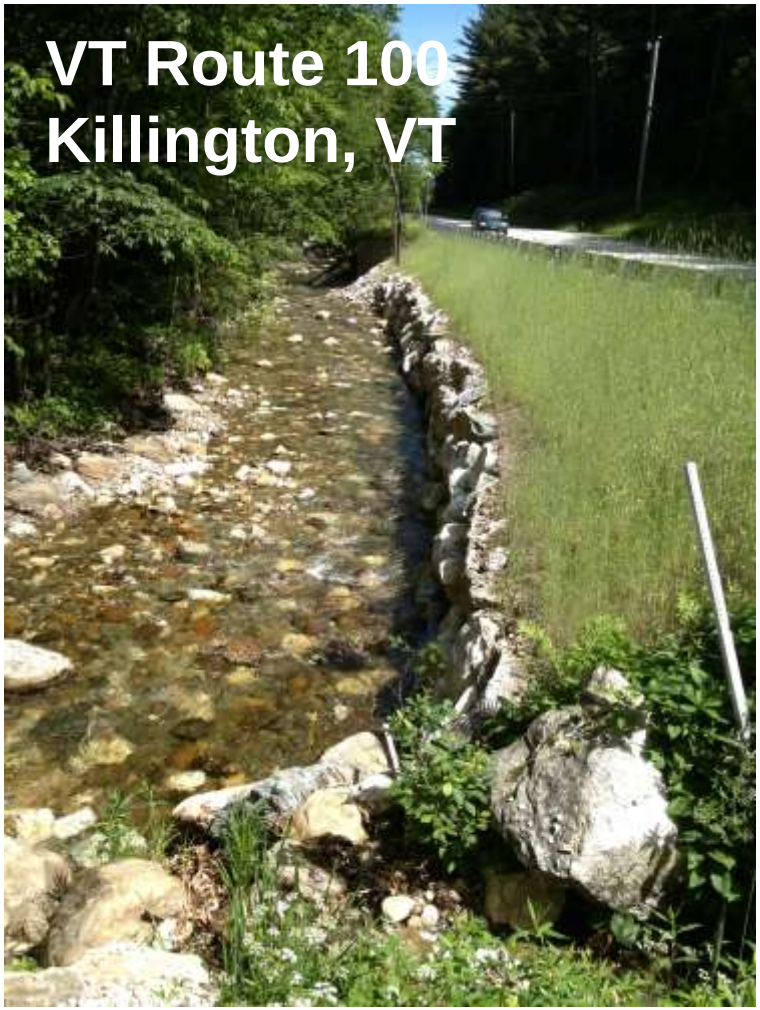
Mitigation

Develop Mitigation Options

- Relocate or Detour
- Fortify Infrastructure
- Address Resiliency
- Restore Floodplain Connection
- Change Land Use
- Conservation
- Preparedness

Mitigation

Placed riprap wall



VT Route 155, Mt. Holly, VT

(E. Fitzgerald, 2013)

Mitigation

Floodplain Restoration Example

Roaring Branch
Bennington, VT
2008

Roaring Branch
Bennington, VT
2010