

# Bilateral Coordination and Collaboration for Climate Services: Delivery Decisions Before and After Tropical Storm Irene



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Vermont Agency of Transportation  
September 11, 2013



## The Problem:

Climate change in the northeast means more intense and frequent storm events and the associated flooding of inland waterways.

The state of Vermont's response at this time – **Flood Resilience**



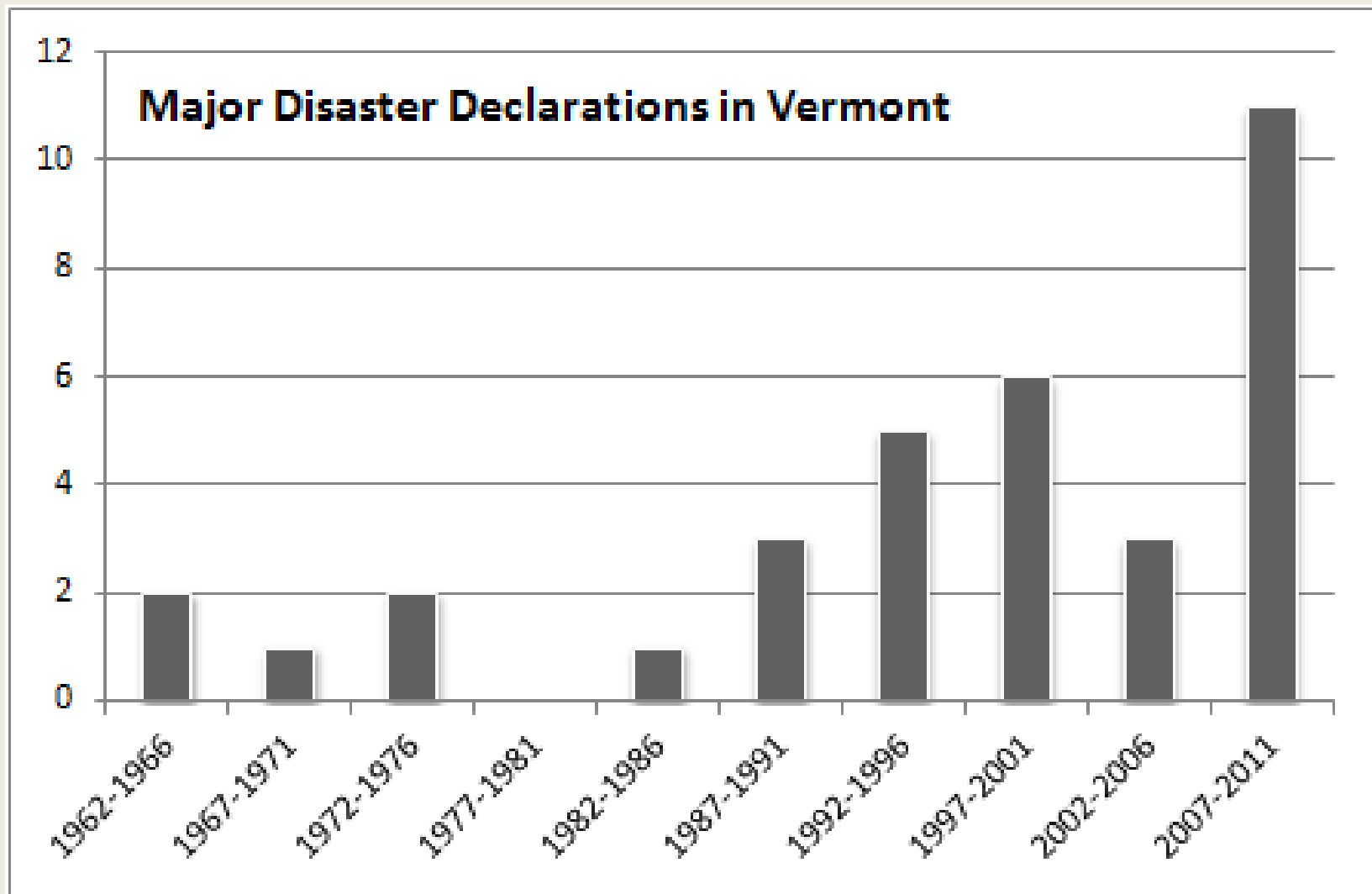
## Framing:

1. Response –emergency preparedness
2. Recovery – put back in order after the event
3. Resilience – build and act in such a way as to mitigate the problem in the future  
– The outcome: No disruptions to transportation needs



Transportation infrastructure typically bears the greatest proportion of economic costs from flood disasters in Vermont





Number of FEMA major disaster declarations in Vermont in 5 year increments. The upward trend is attributable to an increase in storm frequency and continuing development in vulnerable areas. (FEMA, 2012)



# The Floods of 2011 in Dollars and Cents

2011 Flood Events	FEMA PA Estimate Town Infrast.	FHWA ER Estimated Impact on State Infrast.
Lake Flooding (April/May)	\$13,578,922	\$12,000,000
Central VT/NEK Flash Floods (May 26-27)	\$11,644,268	
TS Irene (August)	\$147,193,246	\$172,000,000
Franklin/Windham Flash Flood (May 20)	\$1,292,261	
Totals:	\$173,708,697	\$184,000,000
Total Known Cost in 2011:		\$357,708,697

.HYDROLOGY...

AS OF 509 AM EDT THURSDAY...ADDITIONAL HEAVY RAINFALL IS LIKELY LATE THIS AFTERNOON THROUGH FRIDAY MORNING...WITH 2 TO 3 INCHES OF RAIN EXPECTED ACROSS THE ADIRONDACKS AND CENTRAL VERMONT...WITH SOME ISOLATED AMOUNTS OF 4 INCHES OR MORE POSSIBLE...ESPECIALLY IN THE UPSLOPE AREAS OF THE ADIRONDACKS. THE REMAINDER OF THE REGION WILL 1.5 TO 2.5 INCHES OF RAINFALL...WITH SOME ISOLATED AMOUNTS OF 3 INCHES POSSIBLE. IF OVER 2 INCHES OF RAIN MATERIALISES...FLOODING IS LIKELY. THE GROUND IS SO SATURATED IT SIMPLY CANNOT HANDLE ADDITIONAL RAINFALL...AND ANY RAIN WILL RUN OFF IMMEDIATELY. ANY PLACE THAT RECEIVES AN INCH OF RAIN IN HALF AN HOUR...OR 1.5 INCH IN AN HOUR WILL LIKELY SEE FLOODING. IN ADDITION...MANY AREAS SINCE LATE MAY HAVE EXPERIENCED FLOODING OF SOME FORM OR ANOTHER...AND THOSE LOCATIONS WILL REMAIN PARTICULARLY VULNERABLE TO RENEWED FLOODING.

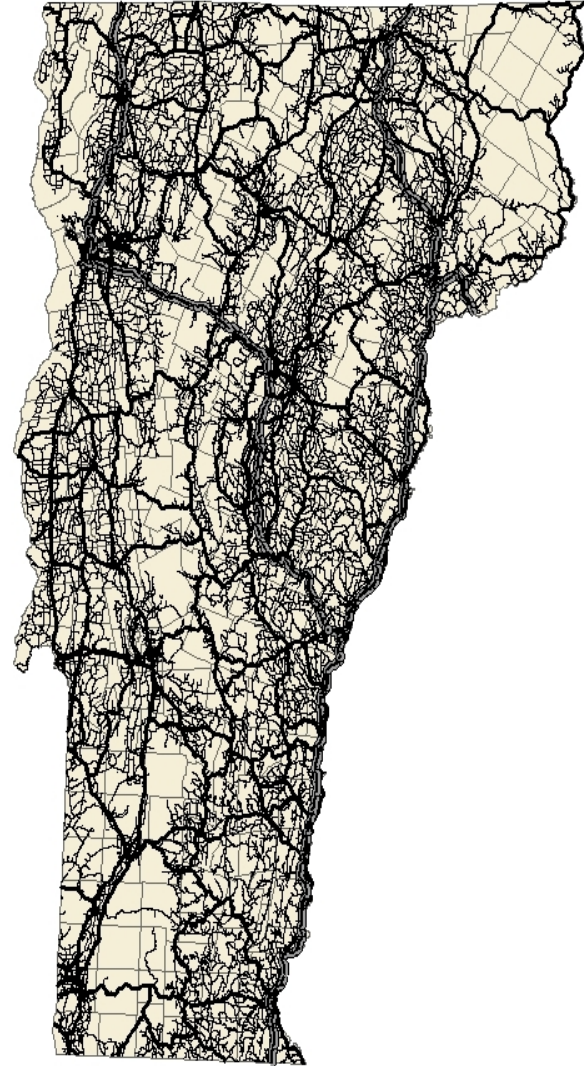
A FLOOD WATCH IS IN EFFECT BASED ON THE SYNOPTIC SCALE RAINFALL EVENT. HOWEVER...FLASH FLOODING AT THE ONSET THURSDAY NIGHT CANNOT BE RULED OUT. THE EVENT IS EXPECTED TO TRANSITION INTO MORE WIDESPREAD MAIN-STEM RIVER FLOODING...THUS THE ISSUANCE OF THE FLOOD WATCH RATHER THAN FLASH FLOOD WATCH.

## National Weather Service Flood Warning for Vermont and the Adirondacks June 27, 2013





Vermont Watersheds



Vermont Road Network





# The problem and solution as articulated by UVM scientists speaking before the VT Legislature in 2012:

1. Climate change means more intense and frequent storm events and thus big changes in the timing and amount of stream flow
2. Confined and straightened rivers have greater power and erosive force while access to flood plains dissipates energy
3. Imperviousness of the landscape increases discharge

## The Basic Approach:

- Give rivers more room to move
- Elevate bridges and take abutments and fill and out of the active belt width
- Slow stormwater flow and allow for infiltration





Inter-agency love



# What we thought was true is no longer true







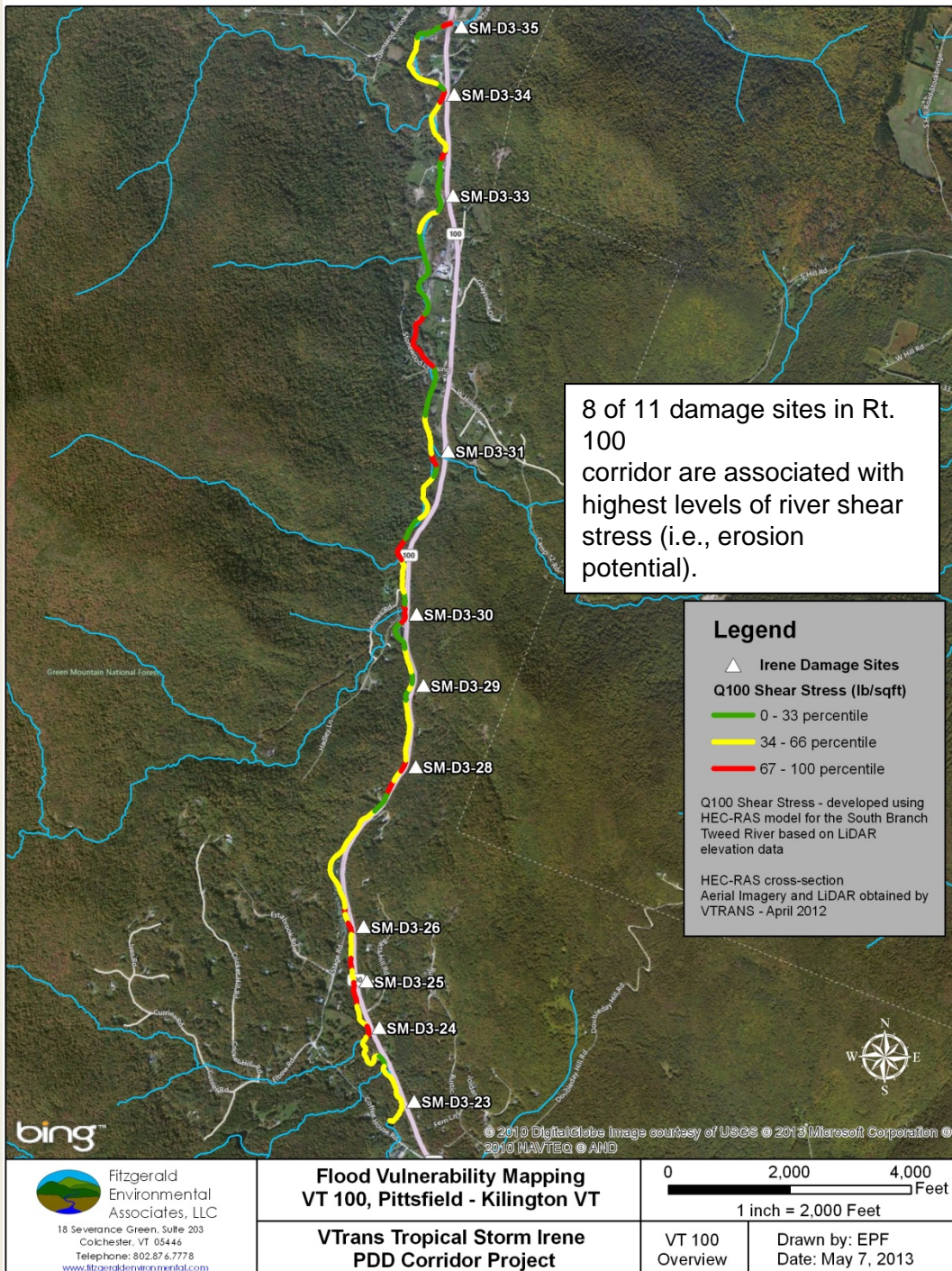




**ANR/VTrans Roads and Rivers Training:**  
**<http://wsmd.vt.gov/rivers/roadstraining/>**



# FORCASTING: Flood Vulnerability Mapping Using LiDAR Data







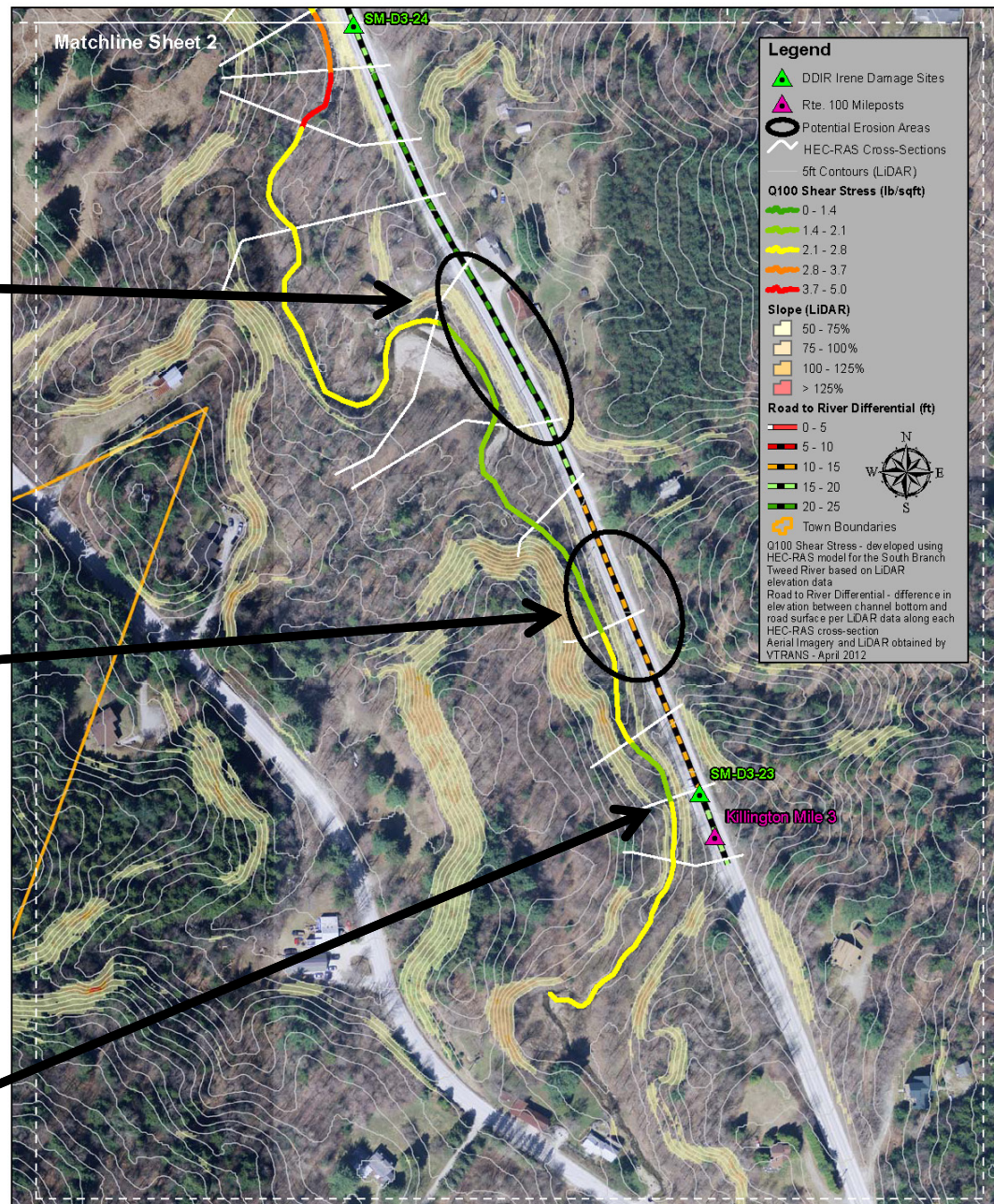
Previously armored site



Unknown erosion site



Known damage site



Fitzgerald  
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[www.fitzgeraldenvironmental.com](http://www.fitzgeraldenvironmental.com)

Flood Vulnerability Mapping  
VT 100, Pittsfield - Killington VT

VTrans Tropical Storm Irene  
PDD Corridor Project

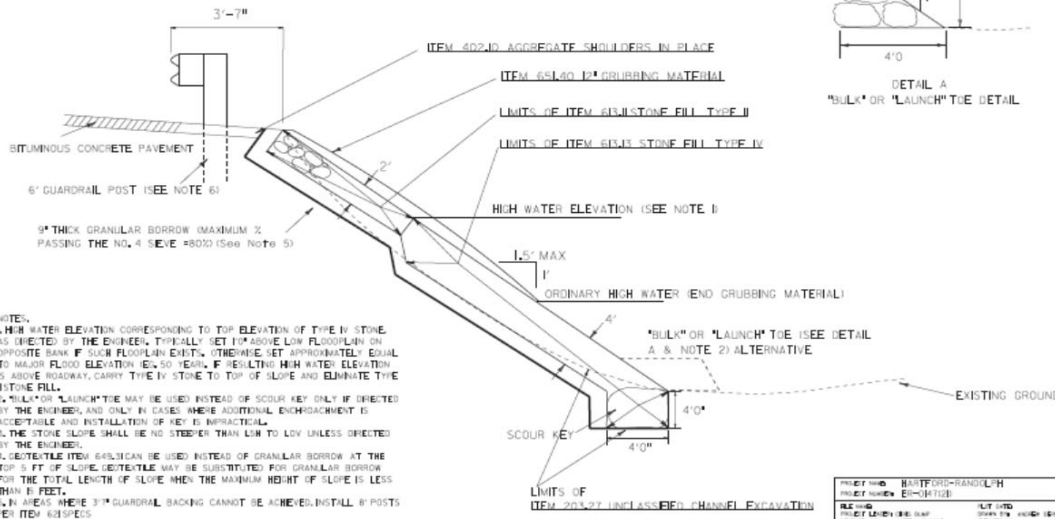
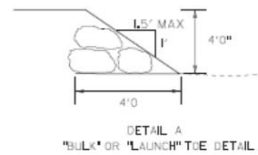
0 200 400  
Feet  
1 inch = 200 Feet

Sheet 1

Drawn by: JHB  
Date: Mar 18, 2013



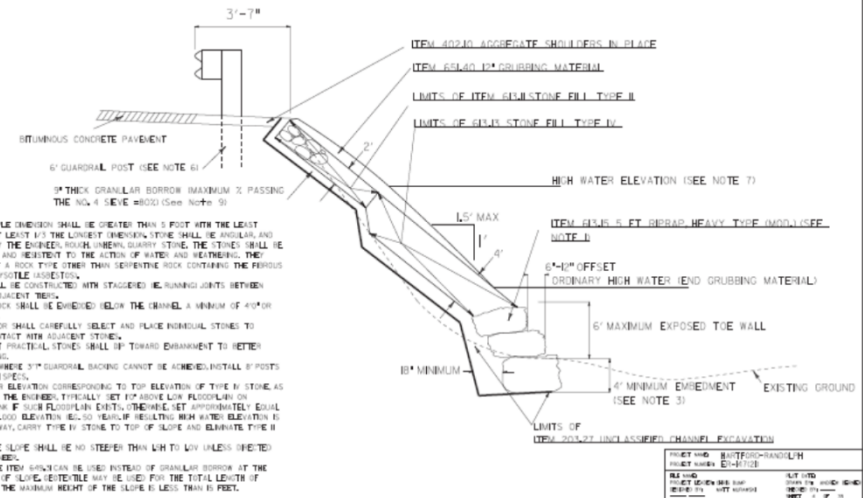
## STONE FILL SLOPE PROTECTION



Before

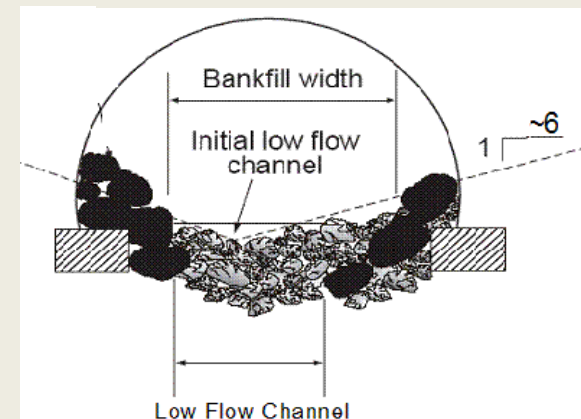
# Side Slope Design

## STONE FILL SLOPE PROTECTION WITH STONE TOE WALL



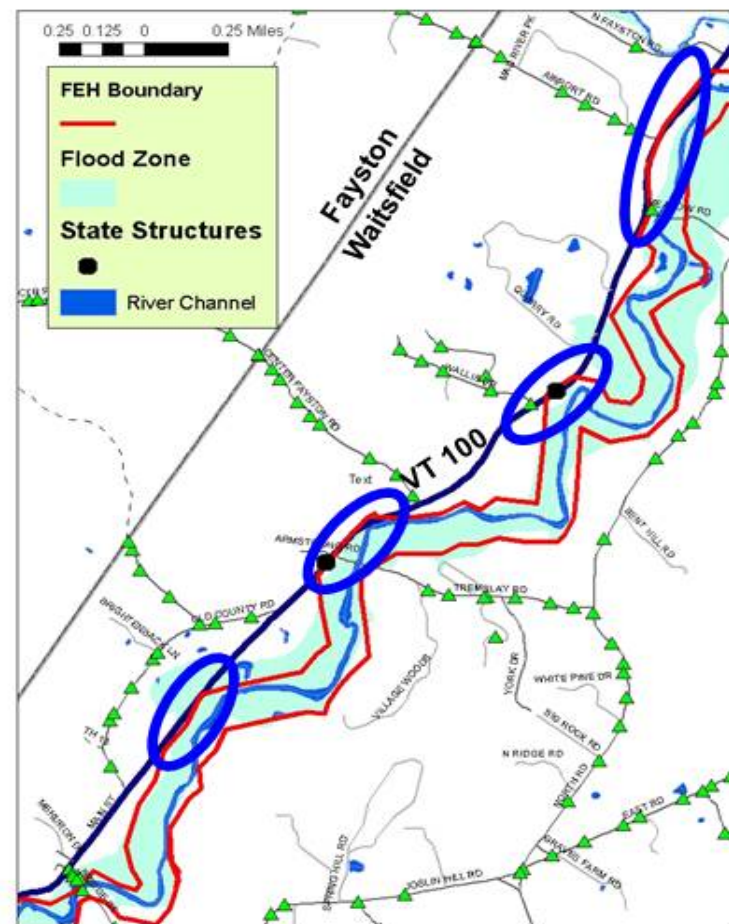
After

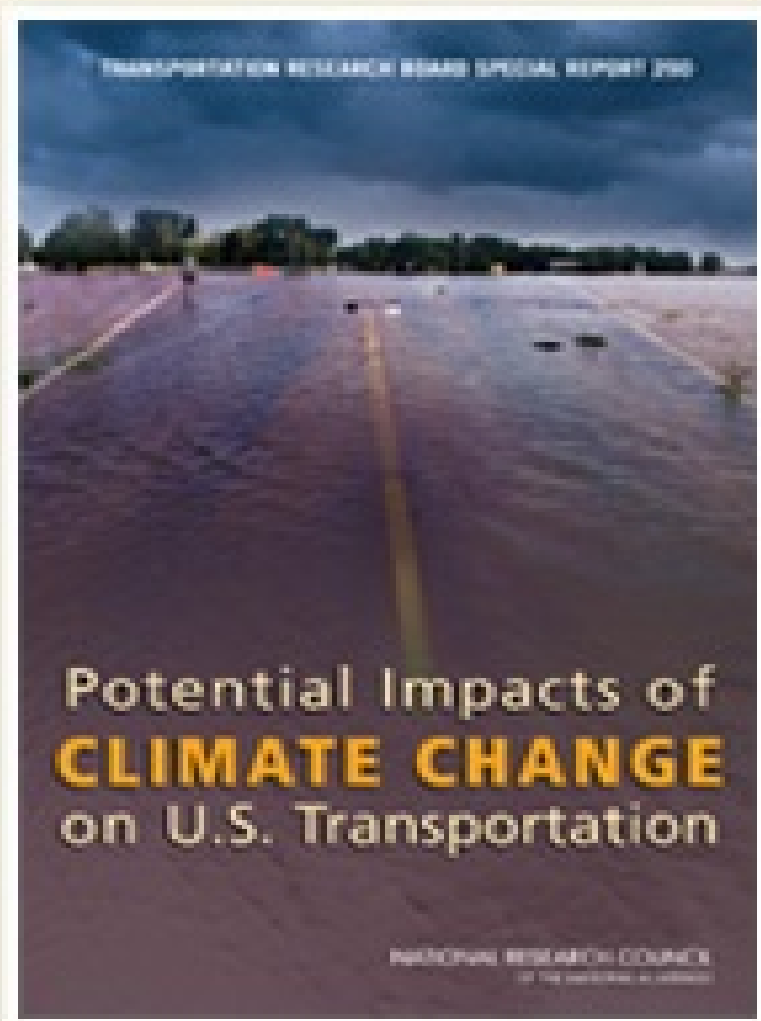
# New VTrans Hydraulics Manual



Washington DOT

# VTrans Transportation Resilience Plan





## **Potential Impact of Climate Change on U.S. Transportation (TRB Special Report 290)**

**Transportation Research Board  
Division on Earth & Life Studies  
National Research Council**

<http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>



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