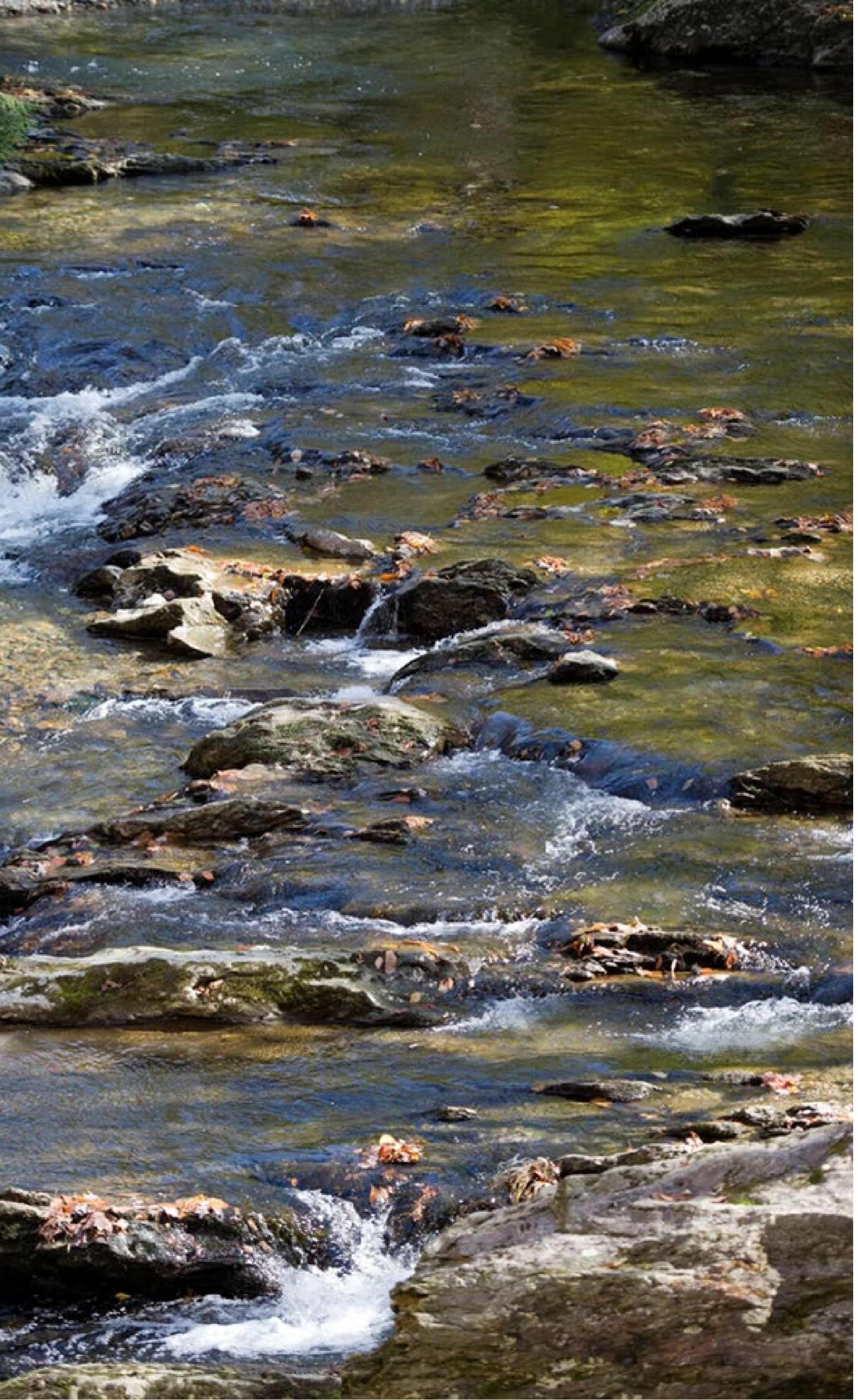

GARAGE
THE GARAGE CULTURAL CENTER
STONECLIFF
THE GARAGE CULTURAL CENTER



Flood Safety Act for the Coast Smart Council - Q4 Meeting

December 3, 2025

Ned Swanberg

Vermont Flood Hazard Mapping Coordinator

ned.swanberg@vermont.gov

VERMONT

AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Vermont Agency of Natural Resources

Department of Environmental Conservation

Watershed Management Division

Rivers Program

River Corridor & Floodplain Protection

Flood Safety Act of 2024

Reducing Flood Damage to Vermont Communities

1. Establishes statewide regulation of development in Mapped River Corridors

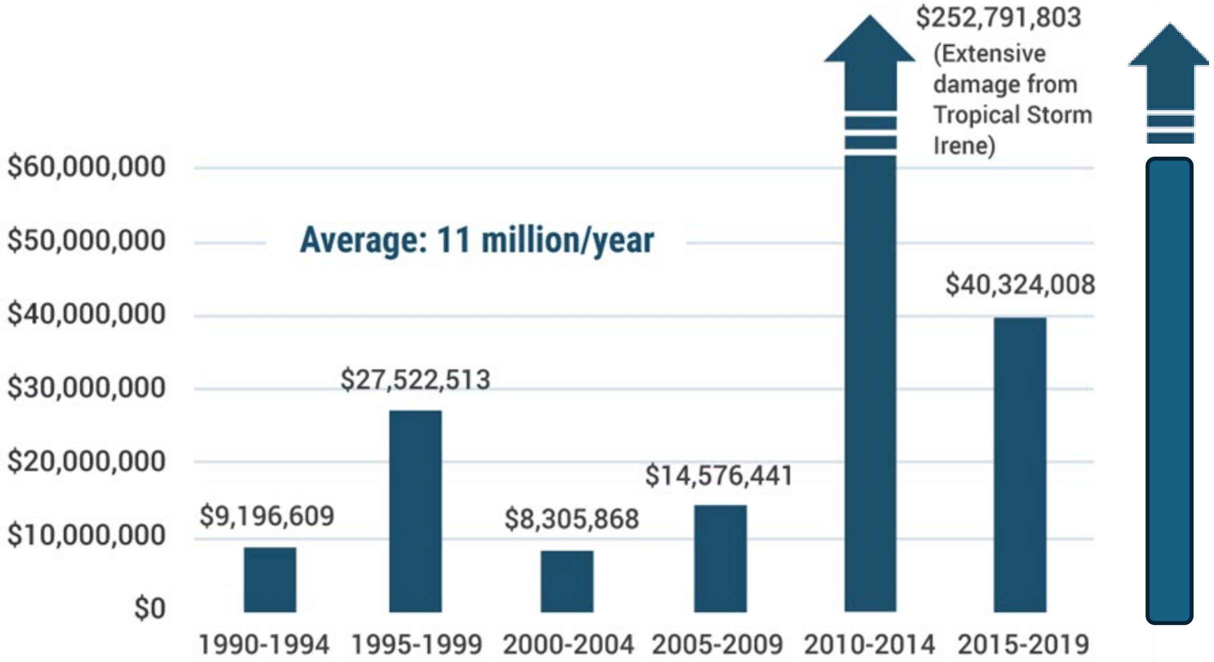
2. Establishes minimum no adverse impact standards for development in floodplains

3. Provides 2 to 1 wetland mitigation

4. Strengthens dam safety oversight

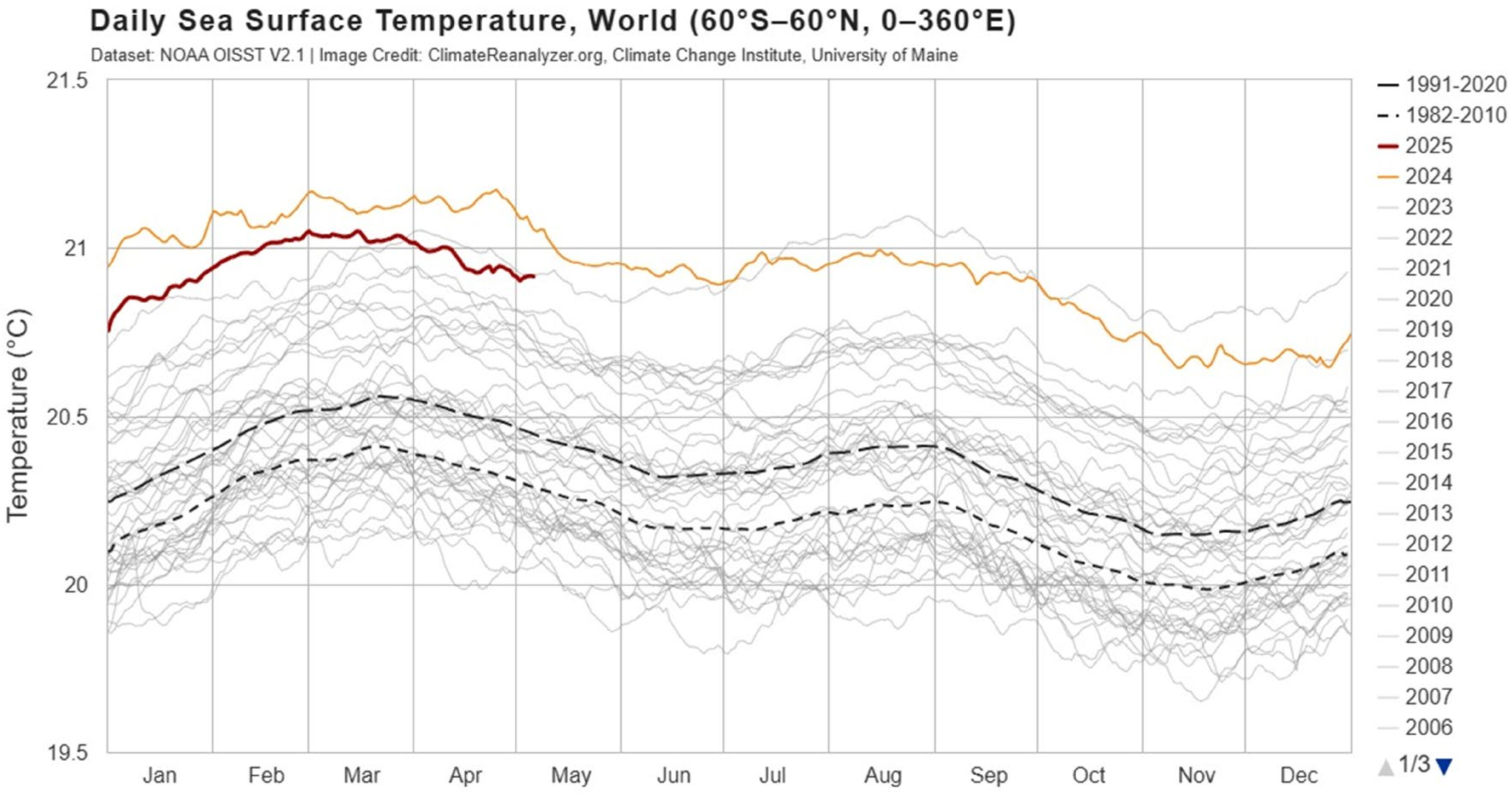
FEMA Public Assistance to VT
1990-2019

$233 m + July 2023 & July 2024 +



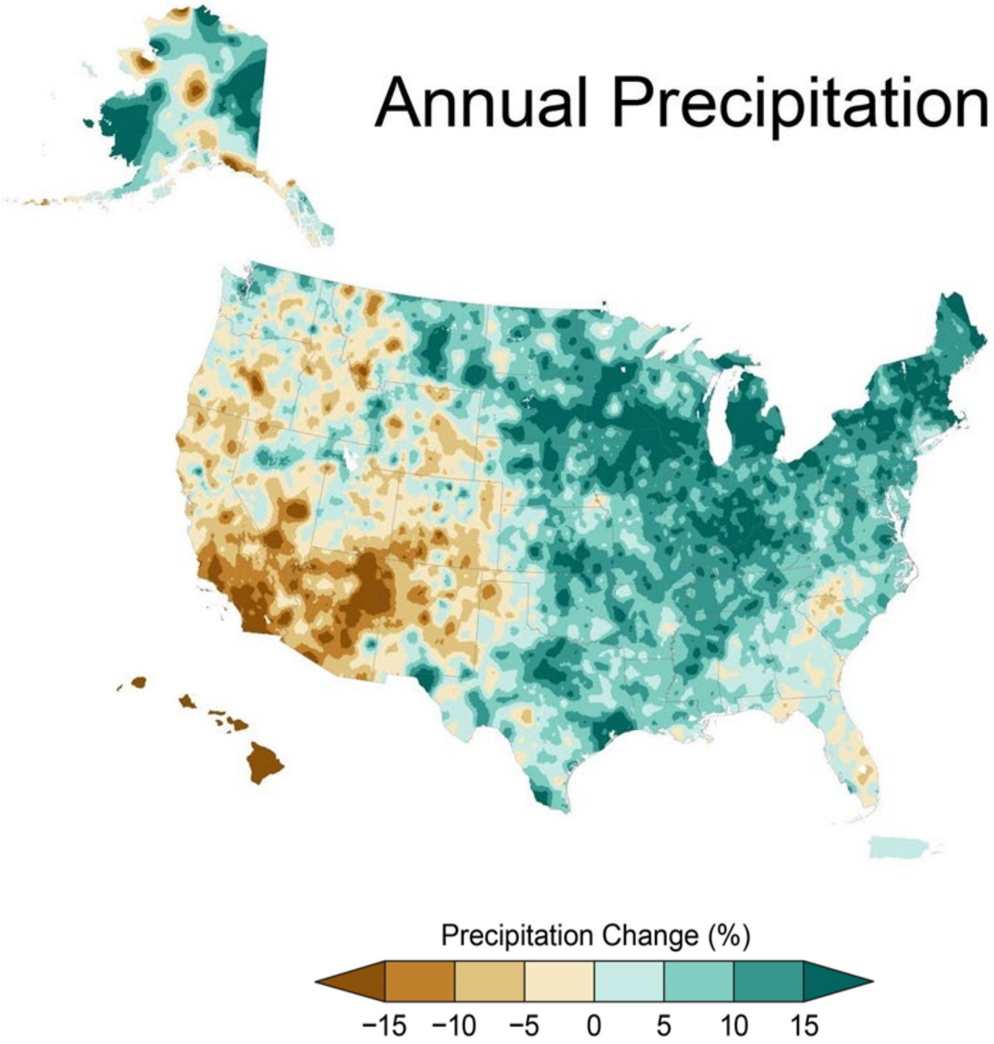
FEMA Public Assistance to Vermont for Flood and Severe Storms

These amounts represents 75-90% of the actual costs that municipalities face from storms. And they're increasing. This doesn't include private property.

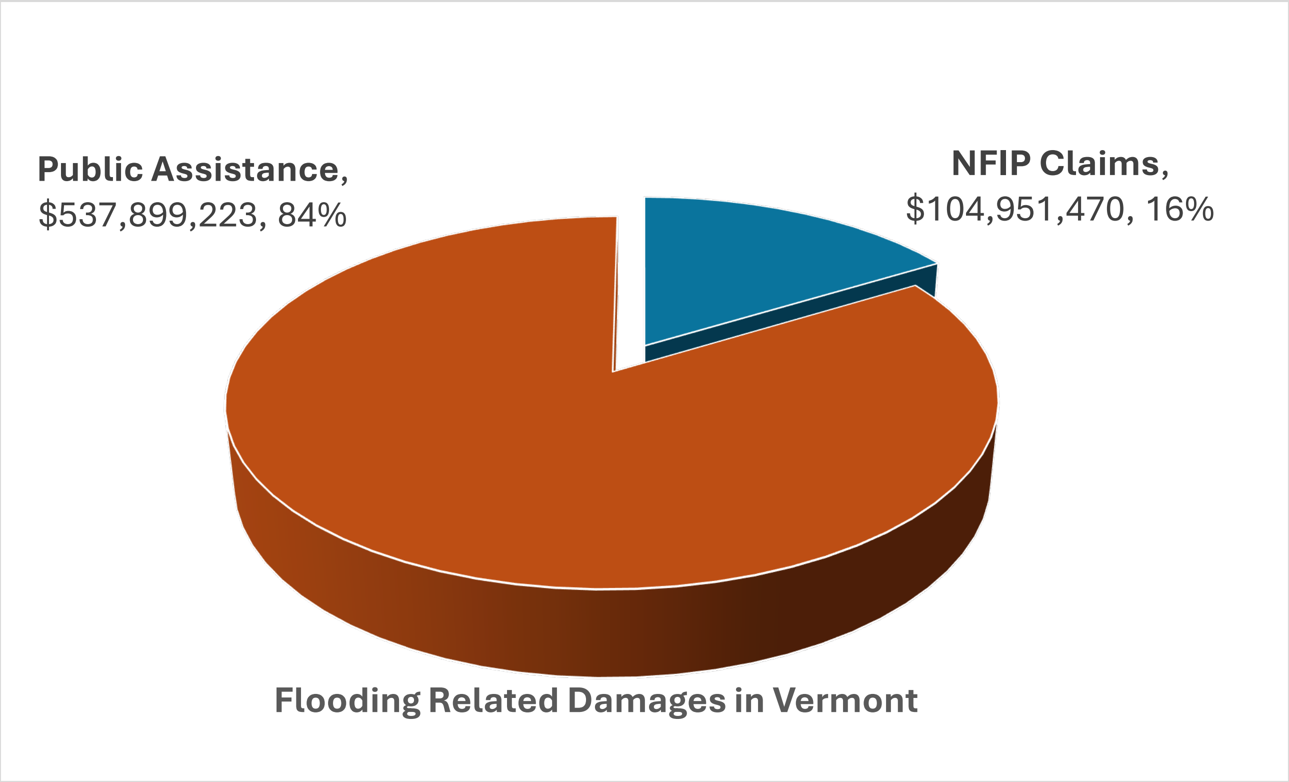

Daily Sea Surface Temperature, World (60°S–60°N, 0–360°E)
Dataset: NOAA OISST V2.1 | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine
Temperature (°C)
21.5
21
20.5
20
19.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1991-2020
1982-2010
2025
2024
2023
2022
2021
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
1/3

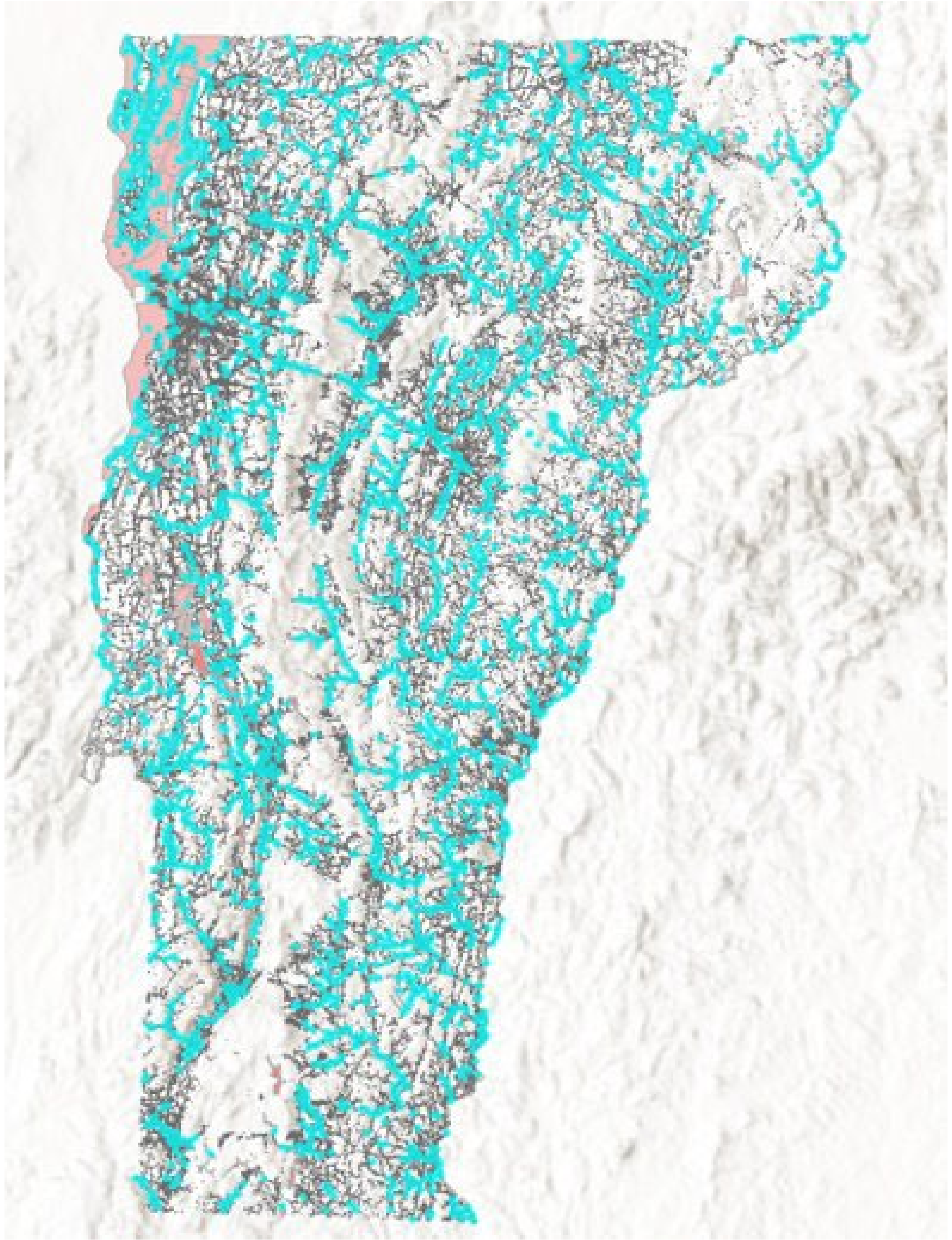
Observed Changes in Annual Precipitation

Figure Credit: NOAA NECI and CISESS NC



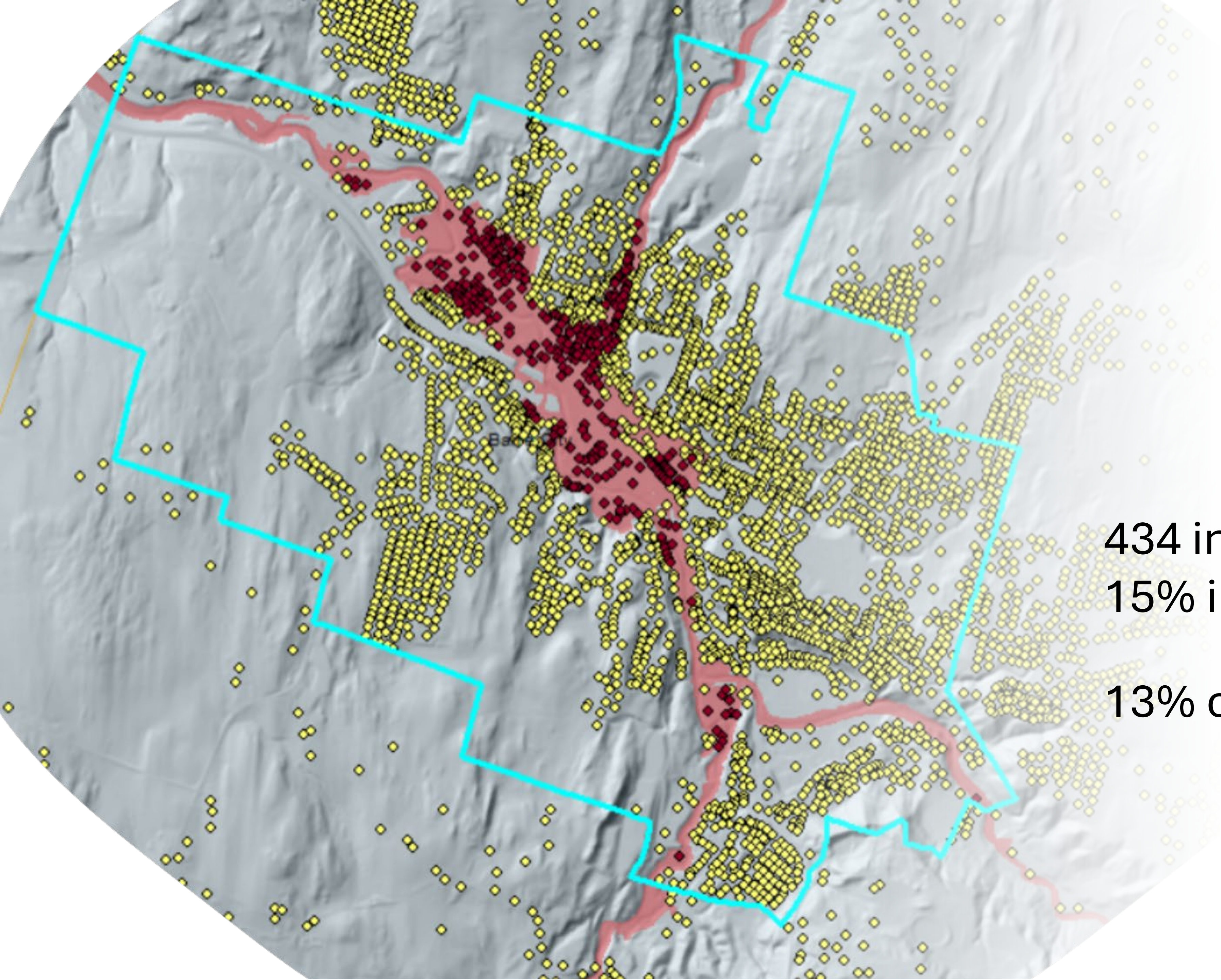
Compares data for the 2002–2021 period to the average for the period of 1901–1960


Public Assistance,
$537,899,223, 84%
NFIP Claims,
$104,951,470, 16%
Flooding Related Damages in Vermont



Structures in the Floodplain

- Over 20,000 structures in the high-risk Special Flood Hazard Area
- Roughly 5% of all structures in Vermont
  - Most built before flood maps
- 90% without insurance



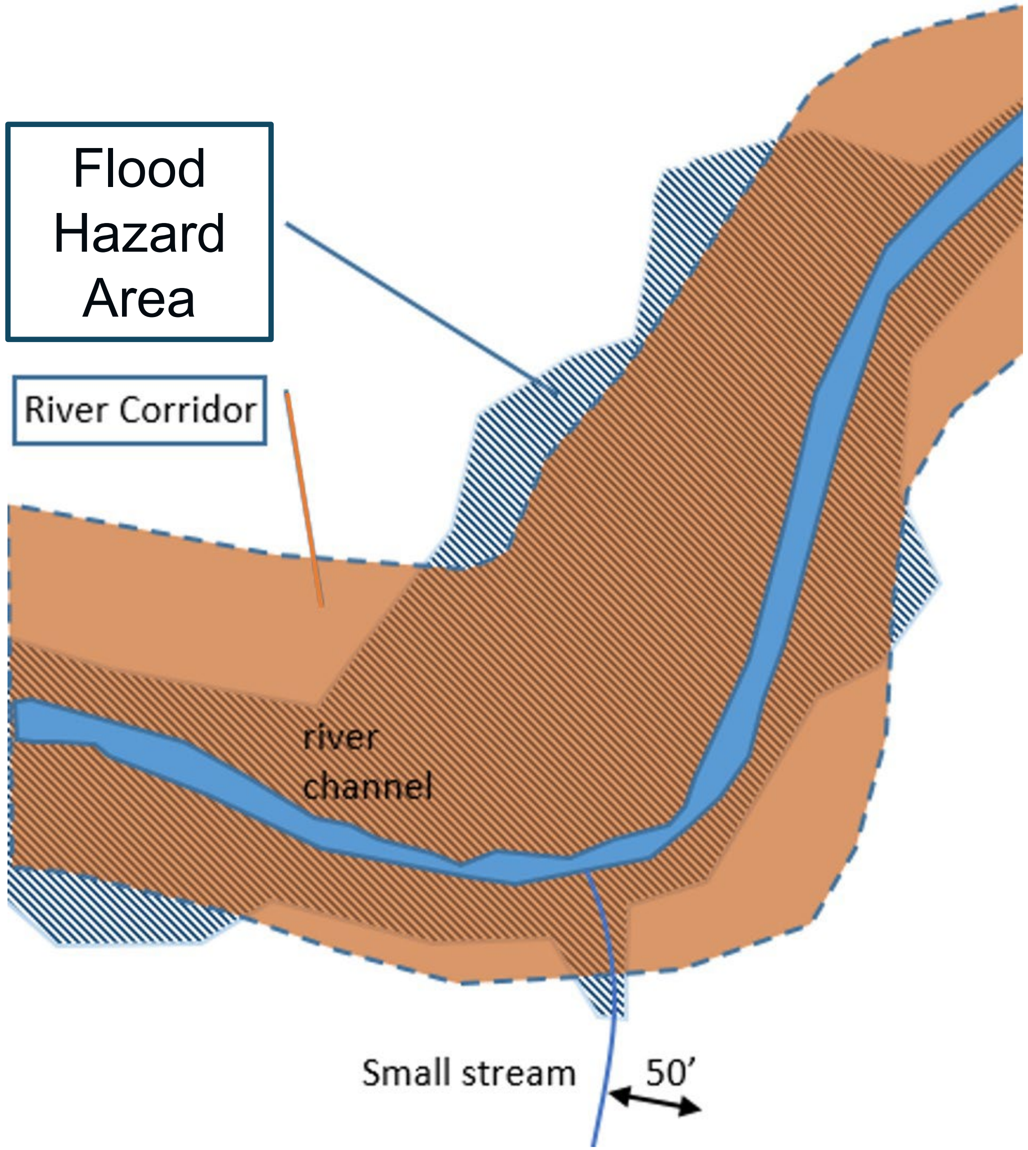
434 in high-risk zone
15% insured

13% of all structures

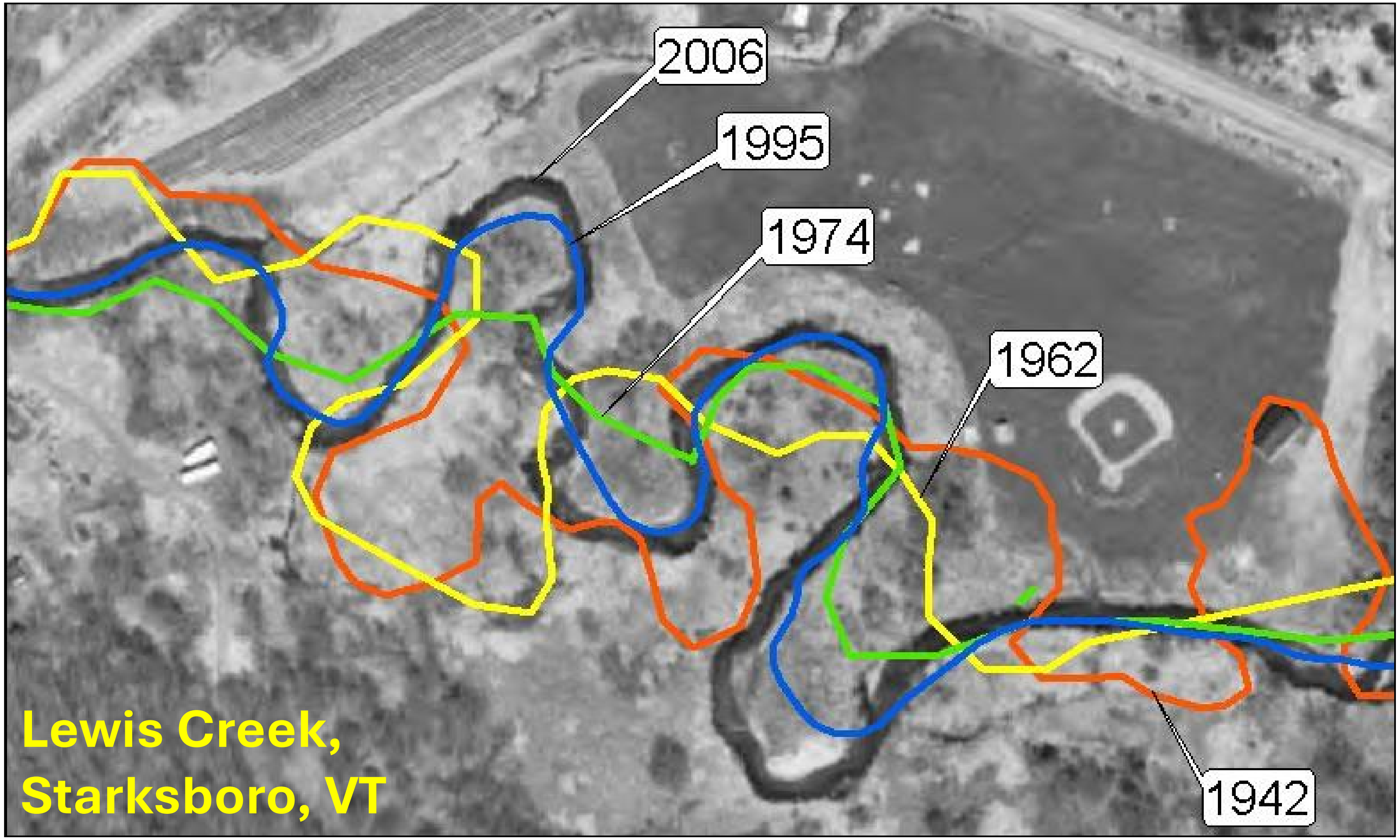

Base Flood Elevation ?

- *Protect our communities*
- *Protect the room needed by the river*
- *Protect floodplain functions*

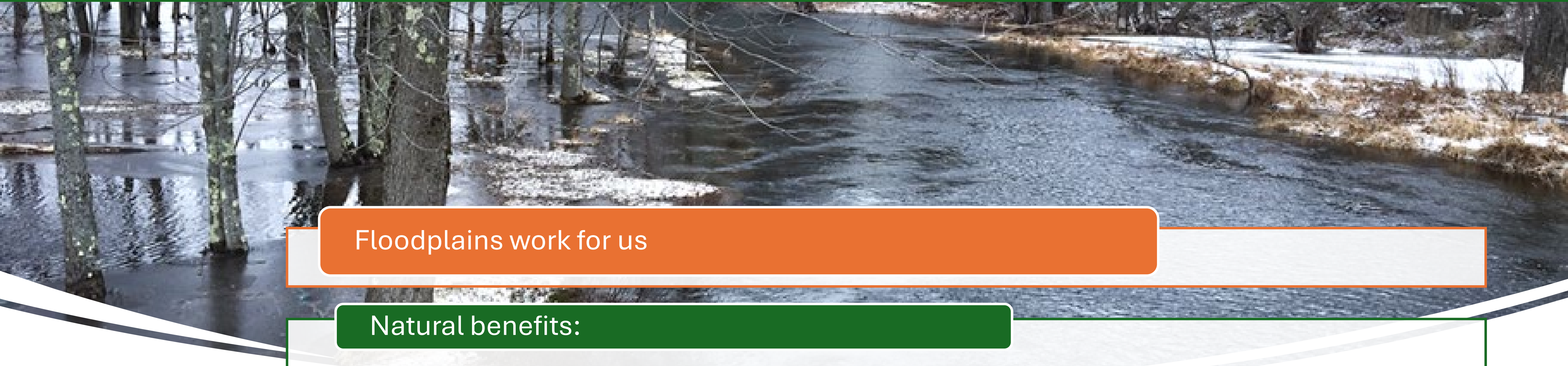
- ***No adverse impact***



[Rivers through time, as seen in Landsat images]


2006
1995
1974
1962
1942
Lewis Creek,
Starksboro, VT

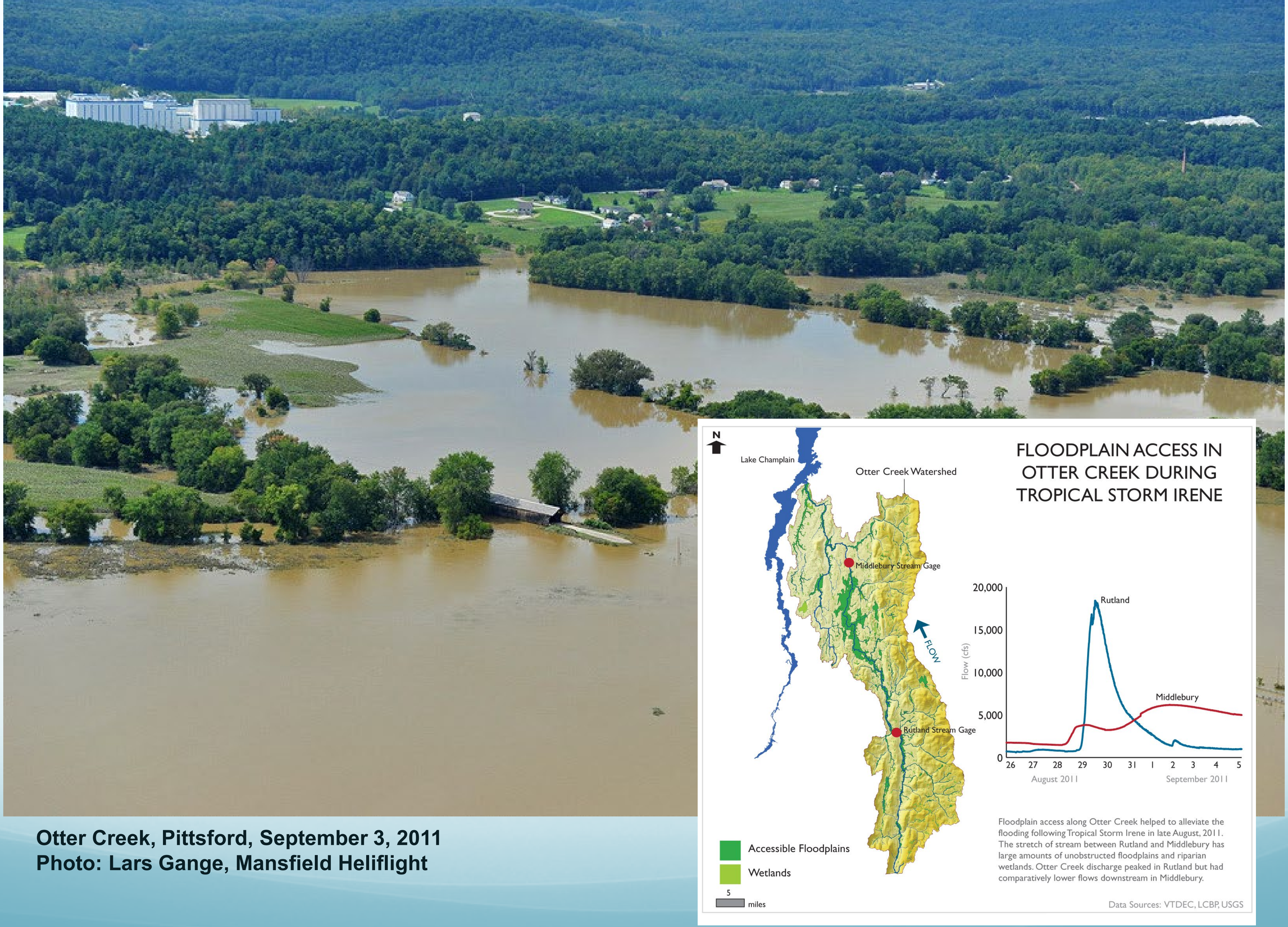

Allen



Floodplains work for us

Natural benefits:

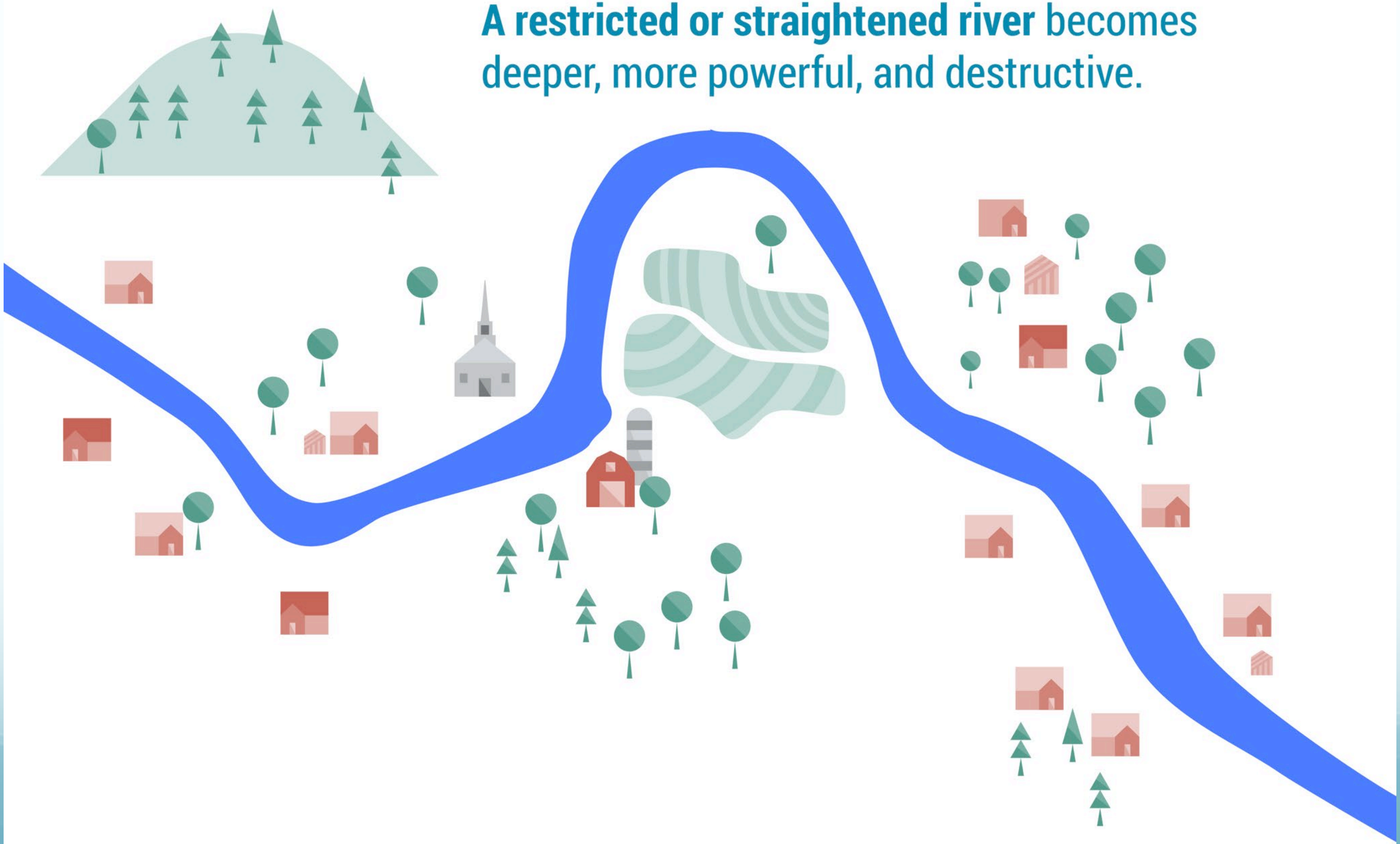
- Store floodwaters
- Reduce flood depths and erosive power
- Recharge groundwater
- Clean water (traps sediment)
- Key habitats
- Community values



Otter Creek, Pittsford, September 3, 2011
Photo: Lars Gange, Mansfield Heliflight

LCBP 2011

A restricted or straightened river becomes deeper, more powerful, and destructive.



A protected River Corridor allows the river to move over time, maintaining the slowest, least erosive path.

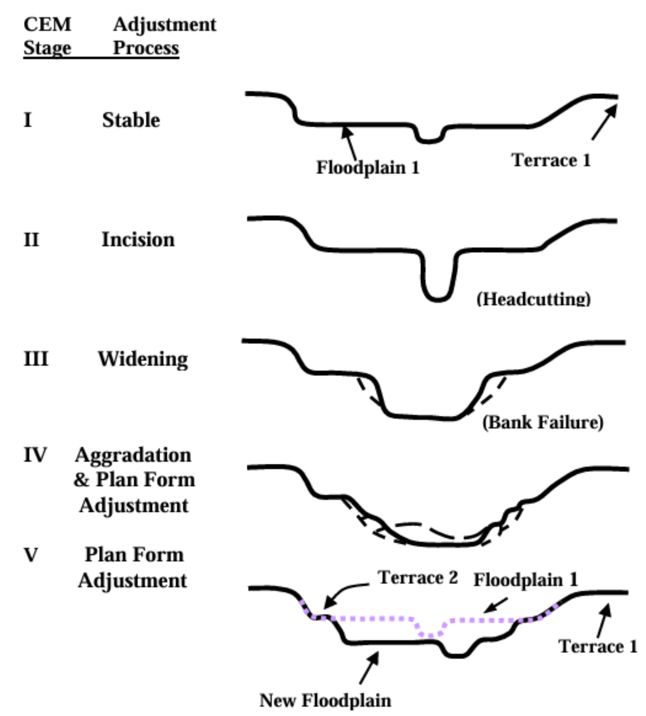


Figure 3: Five Stages of Channel Evolution (CEM) (Schumm, 1984), the channel condition and adjustment often observed during each stage

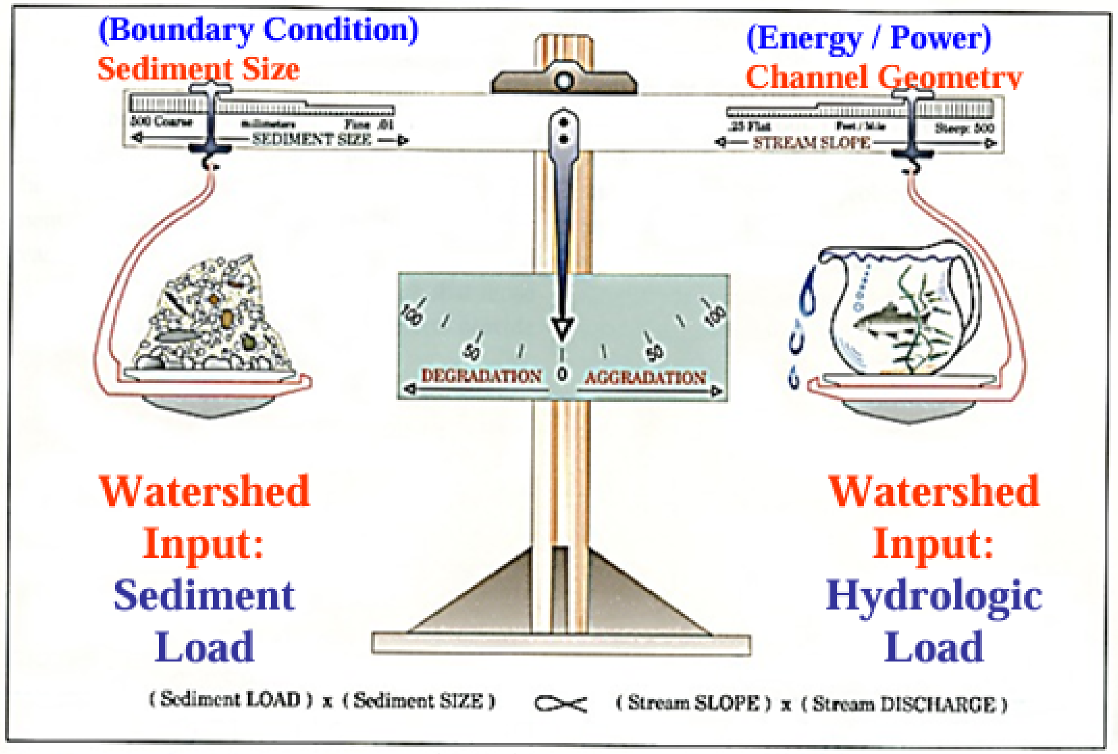
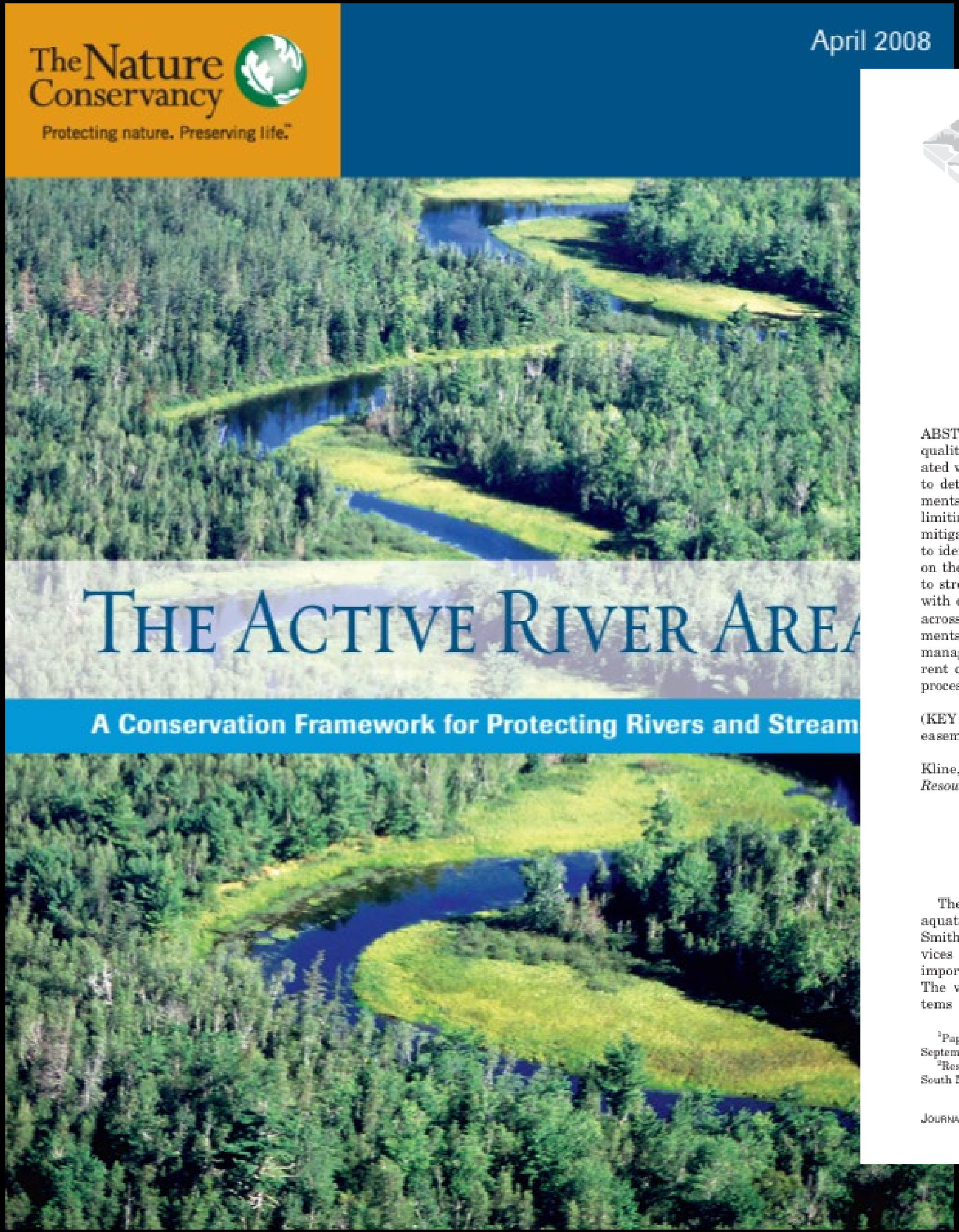


Figure 2: Lane's Diagram (1955) from Rosgen 1996



JOURNAL OF THE AMERICAN WATER RESOURCES AS
AMERICAN WATER RESOURCES ASSOCIATION

PROTECTING RIVER CORRIDORS IN VERI

Michael Kline and Barry Cahoon[2]

ABSTRACT: The Vermont Agency of Natural Resources' current strategy for
quality, and riparian ecosystem services is the protection of fluvial geomorphic
ated wetland and floodplain attributes and functions. Vermont has assessed ove
to determine how natural processes have been modified by channel managem
ments, and land use/land cover changes. Nearly three quarters of Vermont f
limiting access to floodplains and thus reducing important ecosystem services
mitigation, sediment storage, and nutrient uptake. River corridor planning is
to identify opportunities and constraints to mitigating the effects of physical str
on the meander belt width and assigned a sensitivity rating based on the likel
to stressors. The approach adopted by Vermont is fundamentally based on rest
with dynamic equilibrium, and associated habitat features. Managing toward
across Vermont through adoption of municipal fluvial erosion hazard zoning an
ments, or local channel and floodplain management rights. These tools signify a
management approaches of varying success that largely worked against natural
rent community-based, primarily passive approach to accommodate floodplain
processes.

(KEY TERMS: river corridor protection; river meander belts; floodplain restora
easements.)

Kline, Michael and Barry Cahoon, 2010. Protecting River Corridors in Vermon
Resources Association (JAWRA) 1-10. DOI: 10.1111/j.1752-1688.2010.00417.x

INTRODUCTION

The lands adjacent to river channels are critical to aquatic and terrestrial ecosystems (Allen, 1995; Smith *et al.*, 2008), provide important ecosystem services (Postel and Carpenter, 1997), and are socially important (Millennium Ecosystem Assessment, 2005). The value of river corridors to both aquatic ecosystems and public safety has led the Vermont Agency

of Natural Resourc
time and resources
tection program over
goes beyond the tra
use setbacks to mai
based river corridor
tain natural channe
critical ecosystem se
hazard mitigation.
allowed the Vermo

[1]Paper No. JAWRA-08-0221-P of the *Journal of the American Water Resources Association* (JAW
September 21, 2009. © 2010 American Water Resources Association. **Discussions are open until**
[2]Respectively, State Rivers Program Manager (Kline) and State Rivers Engineer (Cahoon), Ve
South Main, Waterbury, Vermont 05671 (E-Mail/Kline: mike.kline@state.vt.us).

GIVING OUR RIVERS ROOM TO MOVE: A NEW STRATEGY AND CONTRIBUTION TO PROTECTING VERMONT'S COMMUNITIES AND ENSURING CLEAN WATER

By Mike Kline[1]

1. Vermont Department of Environmental Conservation ("DEC") Rivers Program Manager, Mike Kline, received his M.A. in River Ecology from the University of Colorado, Boulder (1986) and has since worked for DEC as a Water Resource Planner, the State River Ecologist, and as the Rivers Program Manager since 2009. Mike has worked for the past thirty years toward the integration of river ecology, stream geomorphology, and river engineering practice. The views expressed in this paper reflect the views of the author only and do not necessarily represent the policies of the State of Vermont.

4.1 Phase 2 SGA Results

A complete summary of the individual Rapid Habitat Assessment (RHA) and Rapid Geomorphic Assessment (RGA) scores are shown below (Table 4.1). Additional, segment-specific data summaries are provided in Appendix A for each reach assessed for Phase 2 data.

Table 4.1 RHA and RGA scores for Phase 2 assessed reaches/segments

Phase 2 Segment ID	RHA Condition	RHA Score	RGA Score	RGA Condition	Stream Sensitivity
M01-A	Fair	0.48	0.55	Fair	Very High
M01-B	Fair	0.41	0.40	Fair	Very High
M01-C	Good	0.65	0.59	Fair	High
M03	Fair	0.58	0.43	Fair	High
M04	Good	0.75	0.50	Fair	High
M05	Good	0.72	0.46	Fair	Extreme
M06	Fair	0.57	0.46	Fair	High
M07-A	Fair	0.48	0.50	Fair	Extreme
M07-B	Fair	0.62	0.63	Fair	Very High
M07-C	Fair	0.42	0.55	Fair	Extreme
M08	Good	0.65	0.60	Fair	High
M09-B	Good	0.65	0.63	Fair	Very High
M10-A	Fair	0.62	0.63	Fair	High

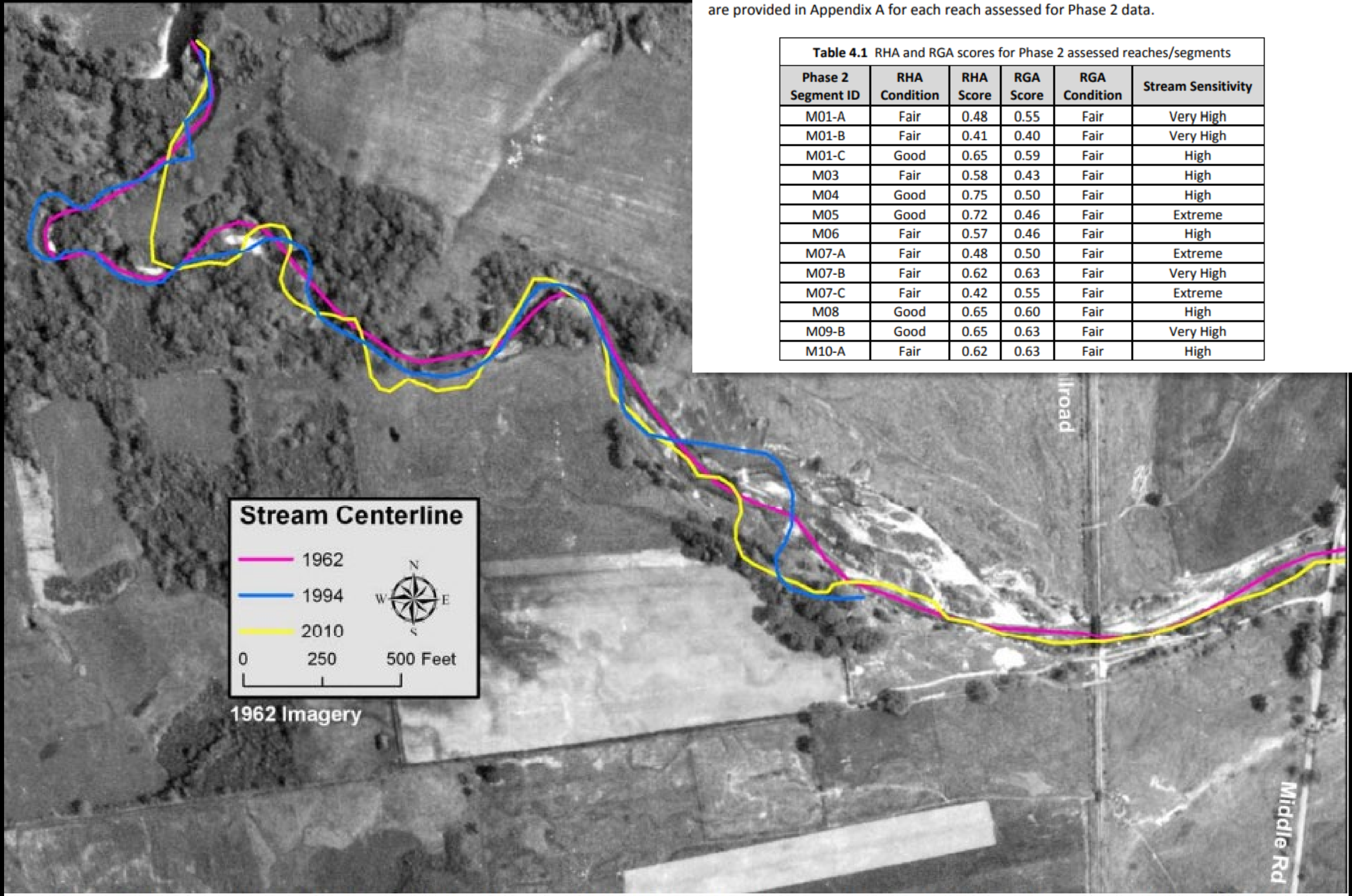


Figure 2.6 Stream centerlines for lower Cold River (Segment M01-A) illustrate the changes in channel planform that have occurred since the 1960's


Upper Otter Creek
Phase 2 Geomorphic Assessment
&
Preliminary Restoration Project Identific
Rutland County, Vermont
FINAL
January 21, 2009
Prepared by:
Round River Design
Michael Blazewicz
Watershed Scientist
www.RoundRiverDesign.com
Prepared for:
Rutland Reg
170 South M
Rutland, VT

Mill River
River Corridor Management Plan
Rutland County, Vermont
FINAL F
FEBRUAR
Prepared by:
Round River Design
Michael Blazewicz
www.RoundRiverDesign.com

Cold River Corridor Plan
Rutland County, Vermont
December 16, 2013
Prepared by:
Fitzgerald Environmental Associates, LLC.
18 Severance Green, Suite 203
Colchester, VT 05446
Fitzgerald Environmental Associates, LLC.
Applied Watershed Science & Ecology
Prepared under contract to:
Rutland Natural
Resources Conservation District
170 South Main Street
Rutland, VT 05701

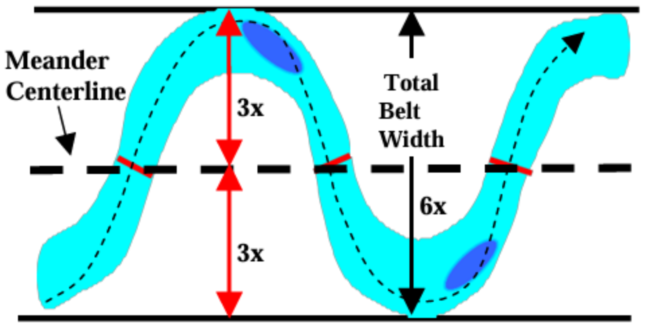


Figure 4. Idealized representation of a river corridor drawn to accommodate the meander belt width, measured out as parallel lines "3 x channel width" either side a meander centerline drawn down valley through the cross-over or inflection points of the river (dotted line).

Vermont Department of Environmental Conservation

Fluvial Geomorphology: a Foundation for Watershed Protection, Management and Restoration

January 16, 2001

VERMONT
AGENCY OF NATURAL RESOURCES

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FLOOD HAZARD AREA AND RIVER CORRIDOR PROTECTION PROCEDURE

SEPTEMBER 7, 2017

River Dynamics 101 - Fact Sheet

River Management Program
Vermont Agency of Natural Resources

Overview

In the discussion of river, or fluvial systems, and the strategies that may be used in the management of fluvial systems, it is important to have a basic understanding of the fundamental principals of how river systems work. This fact sheet will illustrate how sediment moves in the river, and the general response of the fluvial system when changes are imposed on or occur in the watershed, river channel, and the sediment supply.

The Working River

The complex river network that is an integral component of Vermont's landscape is created as water flows from higher to lower elevations. There is an inherent supply of potential energy in the river systems created by the change in elevation between the beginning and ending points of the river or within any discrete stream reach. This potential energy is expressed in a variety of ways as the river moves through and shapes the landscape, developing a complex fluvial network, with a variety of channel and valley forms and associated aquatic and riparian habitats. Excess energy is dissipated in many ways: contact with vegetation along the banks, in turbulence at steps and riffles in the river profiles, in erosion at meander bends, in irregularities, or roughness of the channel bed and banks, and in sediment, ice and debris transport (Kondolf, 2002).

Sediment Production, Transport, and Storage in the Working River

Sediment production is influenced by many factors, including soil type, vegetation type and coverage, land use, climate, and weathering/erosion rates. Once the sediment enters the fluvial system it will be transported and/or stored within the system including the flood plains.

The watershed through which a river flows or drains dictates the sediment types and amount, that will be transported and/or stored. Within the watershed there are locations where sediment is produced, transported,or stored. These zones are often referred to as: source (production), transfer (transport), and response (storage or deposition) (Figure1).

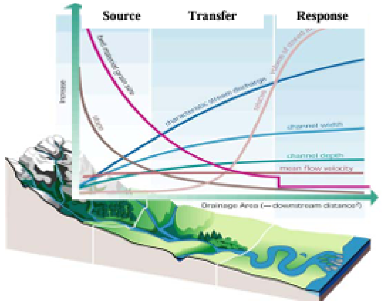
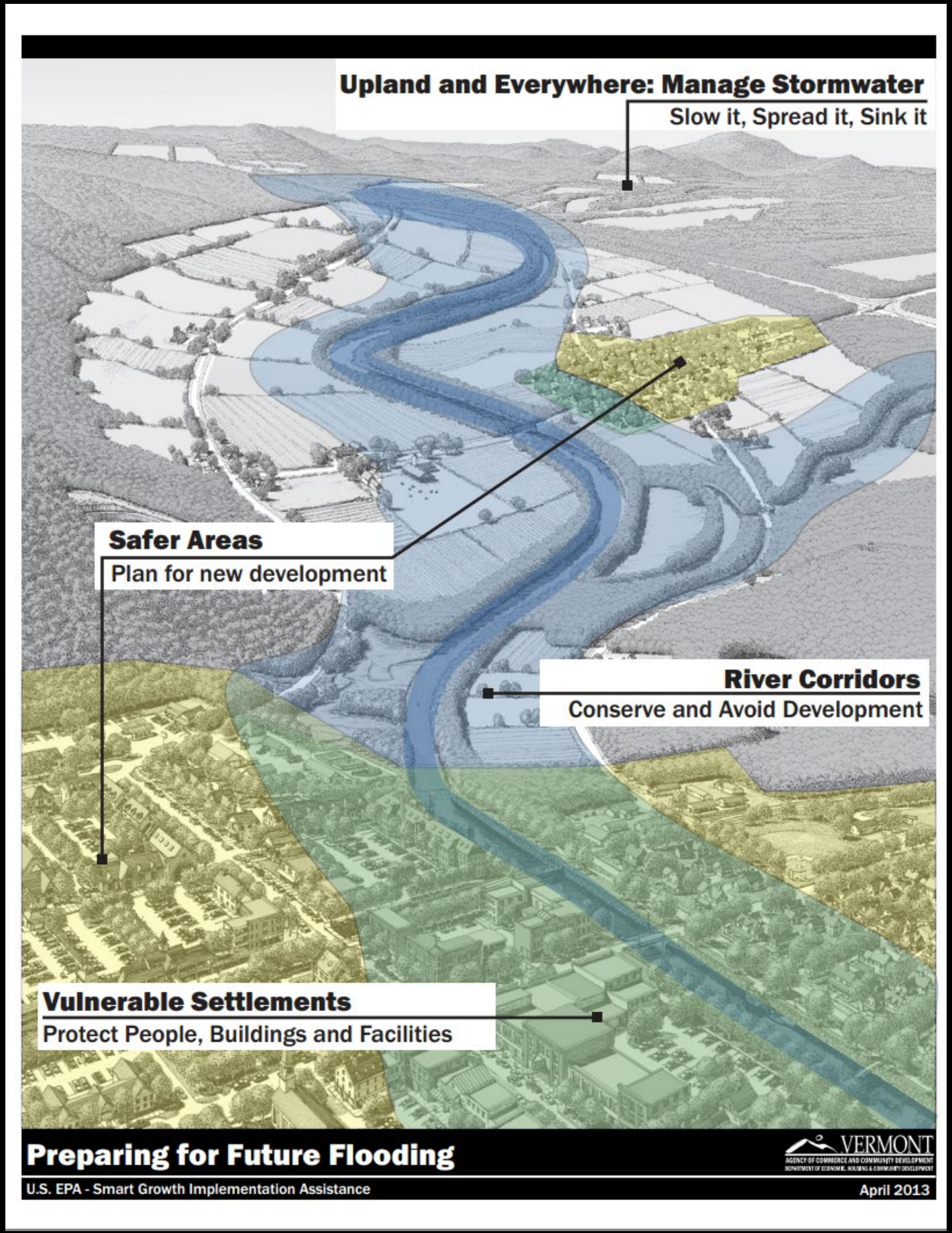
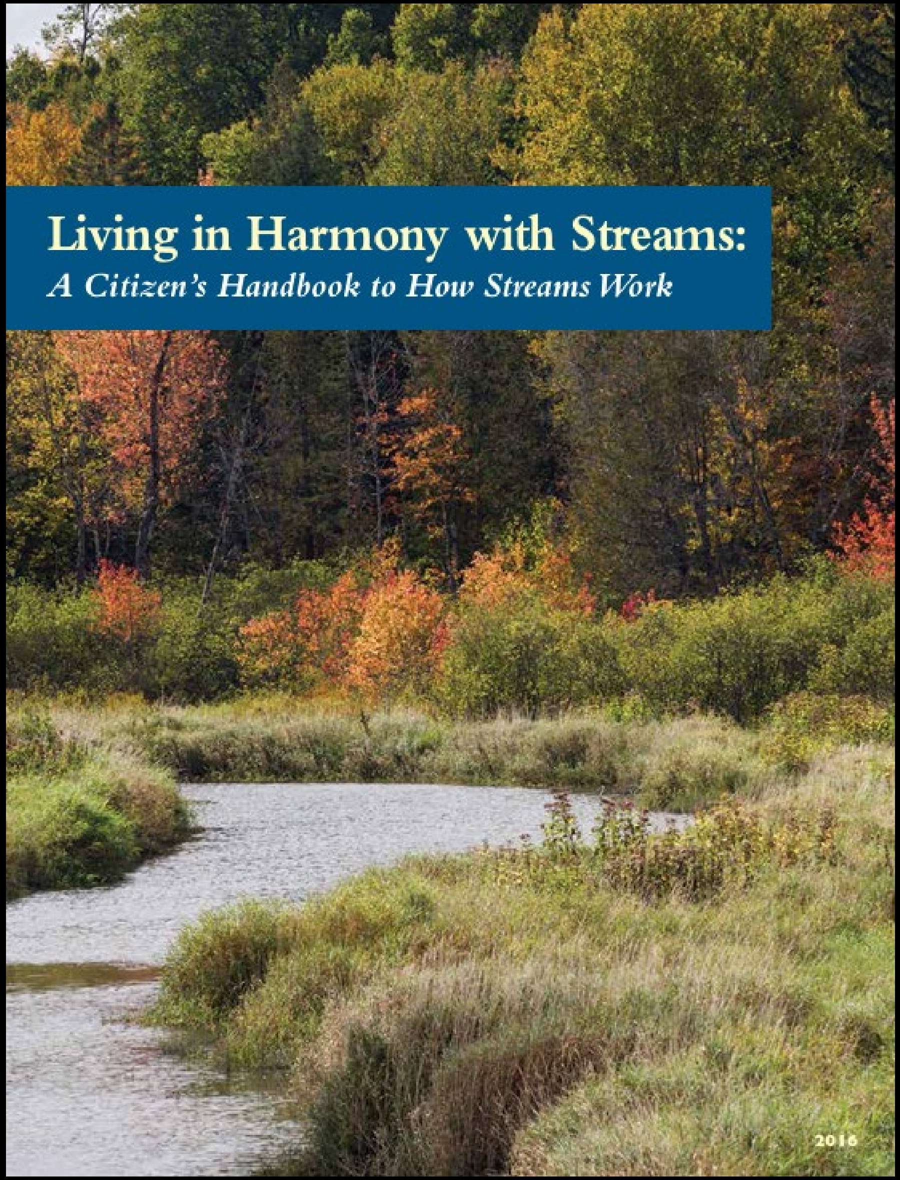


Figure 1 Watershed sediment source, transport and deposition locations. (from the Stream Corridor Restoration Manual, Federal Interagency Stream Restoration Working Group, 1998).

- **Source streams**: Primarily where non-alluvial sediments (colluvial material) enter into the stream system, from landslides and mass wasting failures, and transported with debris during large and infrequent flow events.
- **Transfer streams**: Geomorphically resilient with high sediment transport capacity. These streams are able to convey limited increases in sediment loads and will change little in response to reduction in sediment supply. Generally, the sediment volume supplied to transport reaches is balanced by the sediment exported from the reach.
- **Response streams**: Storage reaches in which significant geomorphic adjustment occurs in response to changes in sediment supply. Zones of transition from transport to response or storage reaches are locations where changes in sediment supply may result in both pronounced and persistent channel instability.

After the sediment enters the fluvial system, the movement of sediment is influenced not only by the zone of the watershed the river is in, but also the local conditions of the river. The sediment transport **capacity** refers to the amount and size of sediment that the river has the ability, or energy to transport. The key components that control the sediment transport capacity, are the **velocity** and depth of the water moving through the channel. Velocity and depth are controlled by the channel slope and dimensions, discharge (volume of flow), and roughness of the channel. Changes in any of these parameters will result in a change in the sediment transport capacity of the river.


Upland and Everywhere: Manage Stormwater
Slow it, Spread it, Sink it
Safer Areas
Plan for new development
River Corridors
Conserve and Avoid Development
Vulnerable Settlements
Protect People, Buildings and Facilities
Preparing for Future Flooding
VERMONT
U.S. EPA - Smart Growth Implementation Assistance
April 2013


Living in Harmony with Streams:
A Citizen's Handbook to How Streams Work
2016

“River Corridor” means the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition and for minimization of fluvial erosion hazards, as delineated by the Agency in accordance with the ANR River Corridor Protection Procedures 10 VSA § 1422(12)


Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

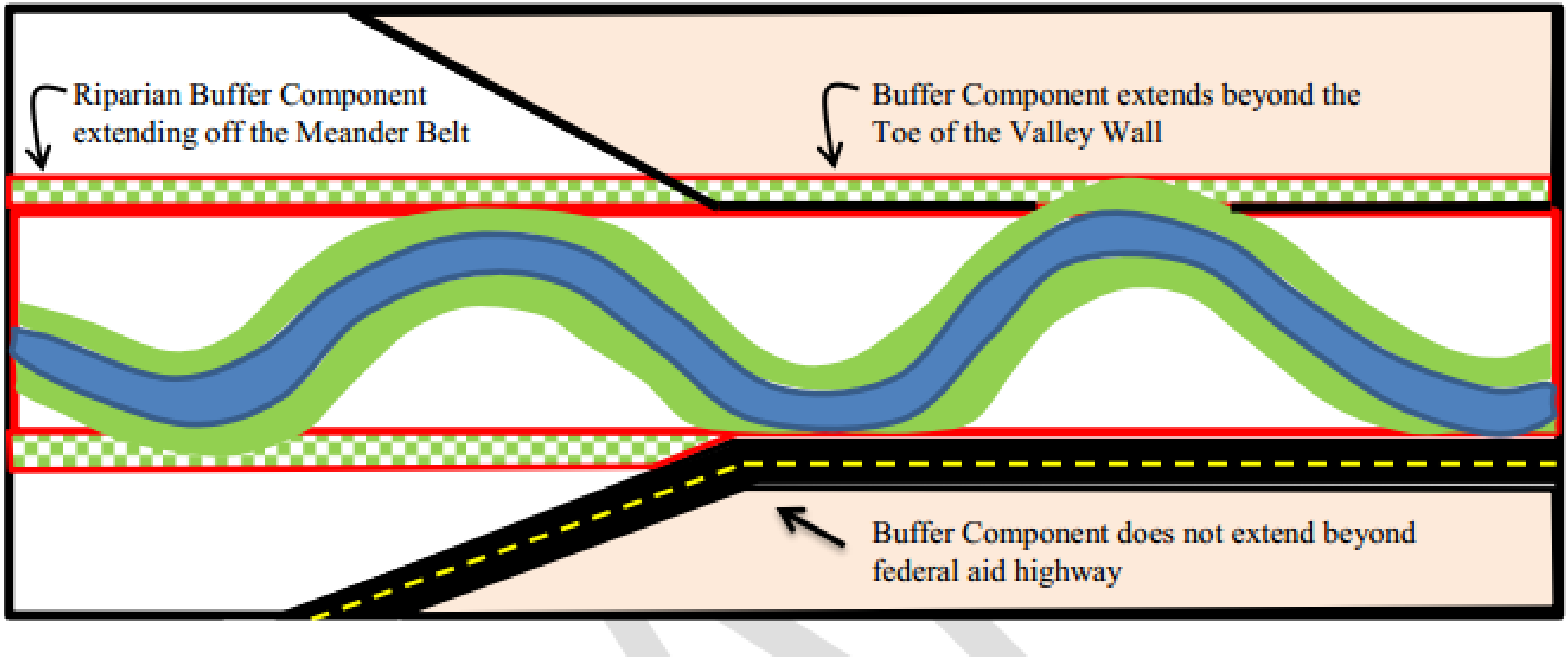
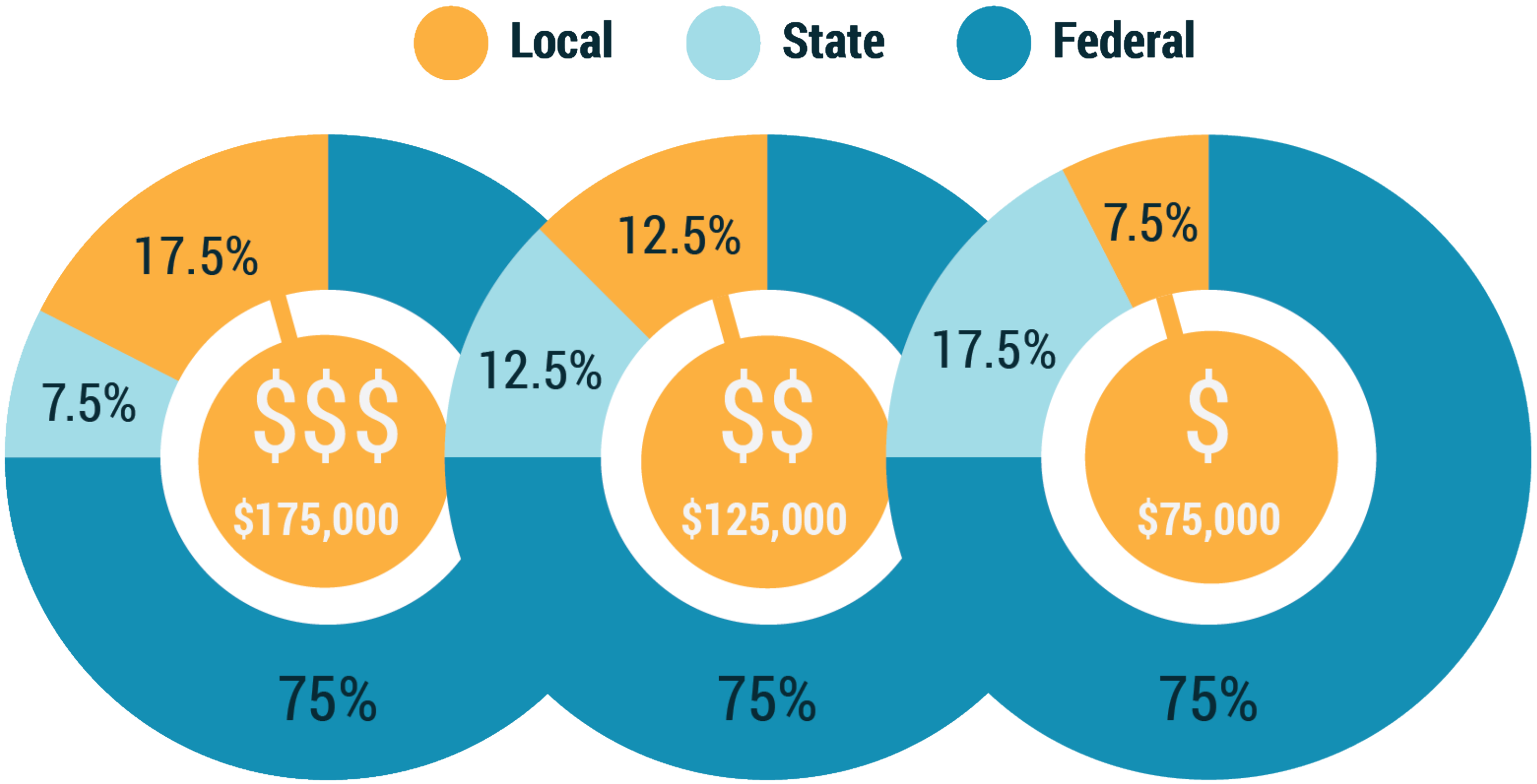


Figure 2. Showing the (green cross-hatched) riparian buffer component of the river corridor, as an extension off the meander belt, to accommodate the actual buffers (green bands) when the stream meanders are at their equilibrium amplitude. Buffer components are drawn beyond natural confining features such as the valley wall but not beyond engineered levees, railroads, or federal aid highways.


Flood Ready Tools
447.8
448
AK
449
450
449.6
AL
Zone A
Zone A
450
450.3
450
AM
450.5
451
Zone AE
AN
Zone
AE
451
451.2
AO

Emergency Relief and Assistance Fund (ERAF) Rates

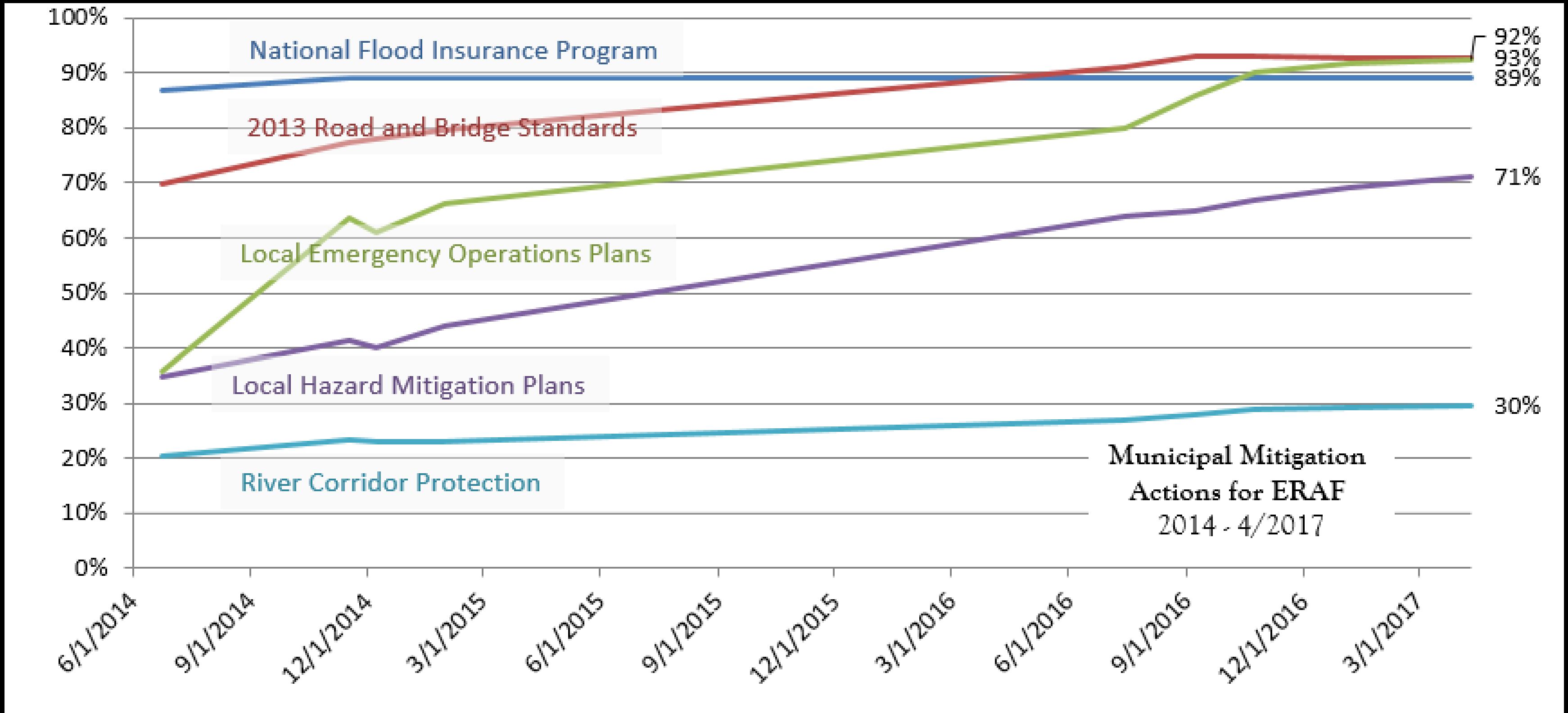


No Mitigation Measures Adopted

NFIP, LEOP, LHMP, Road & Bridge Standards

NFIP, LEOP, LHMP, Road & Bridge Standards, + River Corridor Protection

In the event of a $1,000,000 recovery project, the dollar value shown would be the town's responsibility.



National Flood Insurance Program
2013 Road and Bridge Standards
Local Emergency Operations Plans
Local Hazard Mitigation Plans
River Corridor Protection
92%
93%
89%
71%
30%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6/1/2014
9/1/2014
12/1/2014
3/1/2015
6/1/2015
9/1/2015
12/1/2015
3/1/2016
6/1/2016
9/1/2016
12/1/2016
3/1/2017
Municipal Mitigation
Actions for ERAF
2014 - 4/2017

ENVIRONMENTAL PROTECTION RULE

CHAPTER 29

VERMONT FLOOD HAZARD AREA AND RIVER CORRIDOR RULE

State of Vermont
Agency of Natural Resources
Department of Environmental Conservation

Watershed Management Division
River Corridor & Floodplain Protection Program
1 National Life Drive, Main 2
Montpelier, VT 05620-3522

Adopted October 24, 2014; Effective March 1, 2015

FHARC 2015

No. 121. An act relating to the regulation of wetlands, river corridor development, and dam safety.

(S.213)

It is hereby enacted by the General Assembly of the State of Vermont:

* * * Short Title * * *

Sec. 1. SHORT TITLE

This act may be cited as the "Flood Safety Act."

* * * Development in River Corridors * * *

Sec. 2. FINDINGS

The General Assembly finds that for purposes of Secs. 3–11 of this act:

(1) According to the 2023 National Climate Assessment, the northeastern region of the United States has experienced a 60 percent increase in more extreme precipitation events since 1958, particularly in inland flooding of valleys, where persons, infrastructure, and agriculture tend to be concentrated.

(2) The 2021 Vermont Climate Assessment highlights that Vermont has seen:

(A) a 21 percent increase in average annual precipitation since 1990; and

(B) 2.4 additional days of heavy precipitation since the 1960s.

(3) According to the National Oceanic and Atmospheric Administration's National Centers for Environmental Information, average annual damages from flooding and flood-related disasters between 1980 and

FSA 2024

TOWN/ CITY/ VILLAGE OF ________
FLOOD HAZARD BYLAW

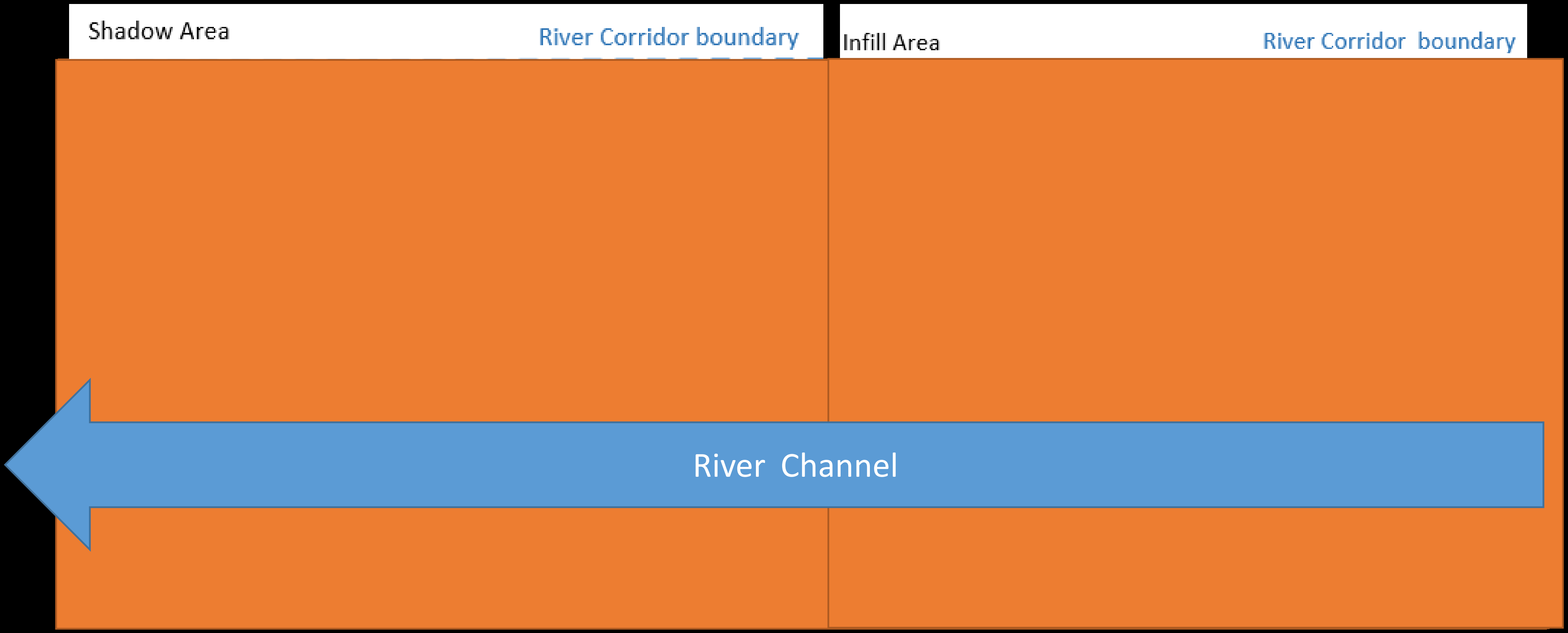
I.	Statutory Authorization and Effect
II.	Statement of Purpose
III.	Other Provisions
IV.	Lands to Which these Regulations Apply
V.	Summary Table: Development Revi
VI.	Development Review in Hazard Areas
VII.	Development Standards
VIII.	Administration
IX.	Certificate of Occupancy
X	Definitions

No new structures
in the River Corridor or
Special Flood Hazard Area

No fill in Flood Hazard Area

Substantial Improvements
one foot above the base flood

No Adverse Impact on River Corridor Functions



Flood Safety Act of 2024

Where Are We Now?

- **Education & Outreach**
  - The Nature Conservancy & Lake Champlain Sea Grant
  - TRORC with WSP and Siler Climate Consulting
  - Flood Safety Act landing page: bit.ly/flood-safety-act
  - And more
- **Infill Mapping**
  - Pilot study by TNC and SLR
- **Rulemaking**
  - Administration
  - Reports to EJAC, House EE, Senate NRE, ICAR, LCAR
  - Statutory target 1/1/2028

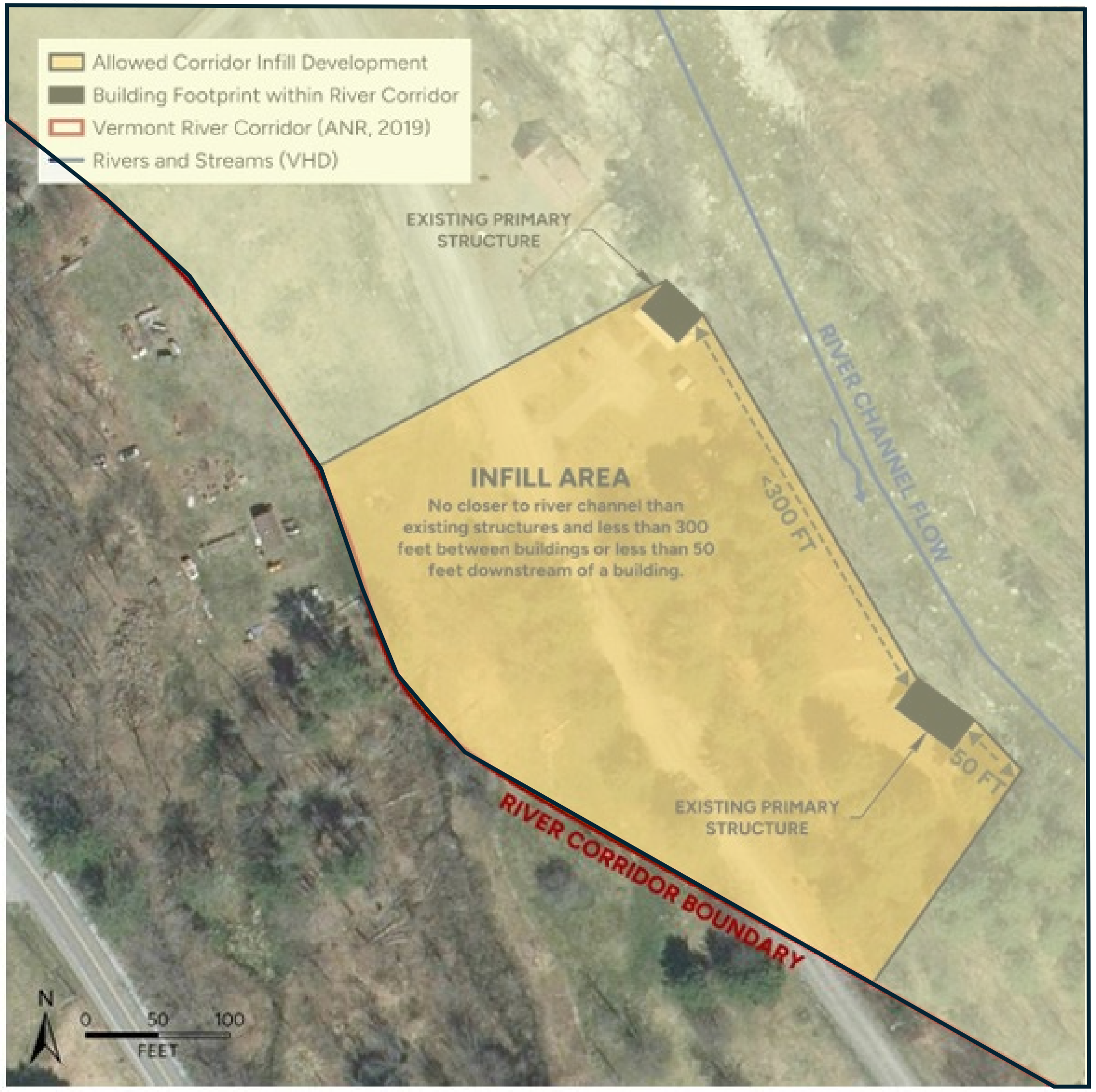


Figure 12: Vermont River Corridor Infill and Shadowing Map Example


Terry Allen
Terry J. Allen

Why Protect River Corridors?

1. Avoid the liability of putting people in harm's way in a known hazard area.

2. Avoid new encroachments that will require bank armoring,
   and result in straightening the channel, increasing the erosive power of floodwater and delivering deeper water sooner downstream.

3. Avoid forcing the channel to cut down until the nearby riverbanks fail along with adjacent town roads, residences, workplaces and critical services.

4. Avoid increasingly costly damages to town roads, culverts, bridges,and services.

Flood Ready Vermont

www.floodready.vermont.gov

Flood Training Vermont

www.floodtraining.vt.gov

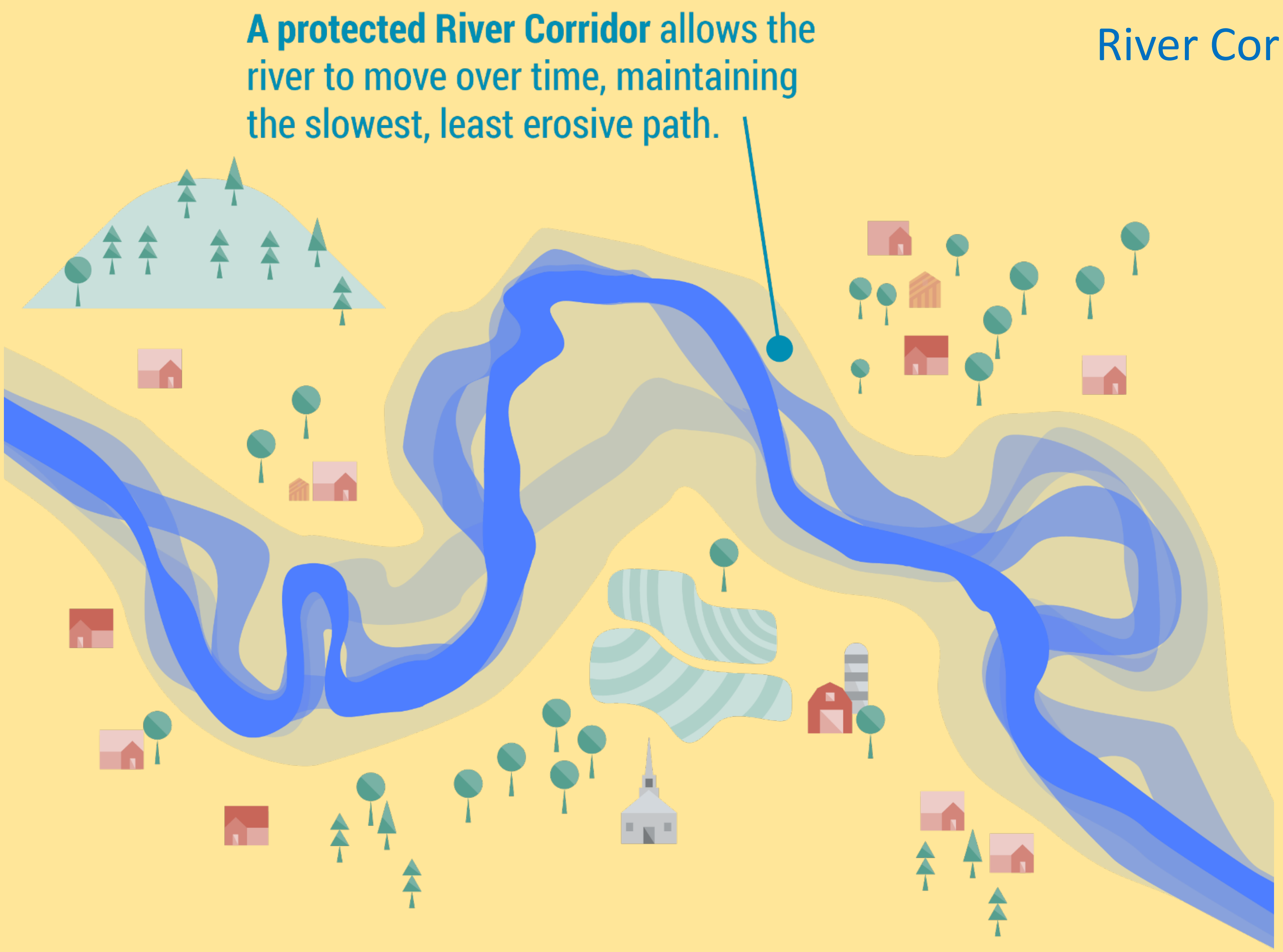
Vermont Flood Atlas

bit.ly/flood-atlas

dec.vermont.gov/watershed/rivers

floodready.vermont.gov/**get_help/resources**

River Corridors protect us.



- *Protect the room needed by the river*
- *Protect floodplain functions*

No adverse impact