Vermont Fluvial Erosion Hazard Program

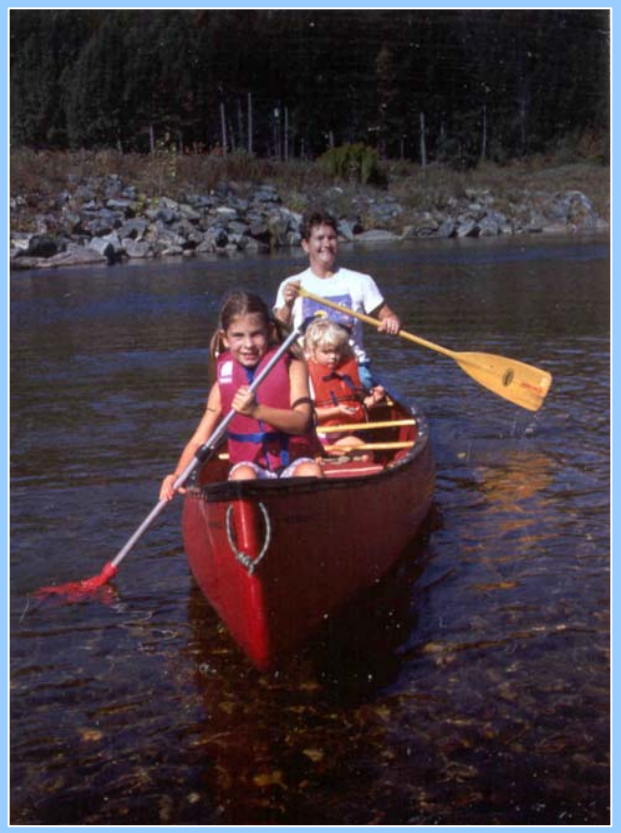
Reducing Fluvial Erosion Hazards and Restoring Healthy River Conditions in Vermont

Functions/Values of Healthy Floodplains

- Flood Storage and Conveyance
- Water Quality Maintenance
- Water Absorption, Groundwater Recharge, and Discharge
- Biologic Resources, Functions
- Community Resources
- Economic Resources

Functions/Values of Healthy Streams

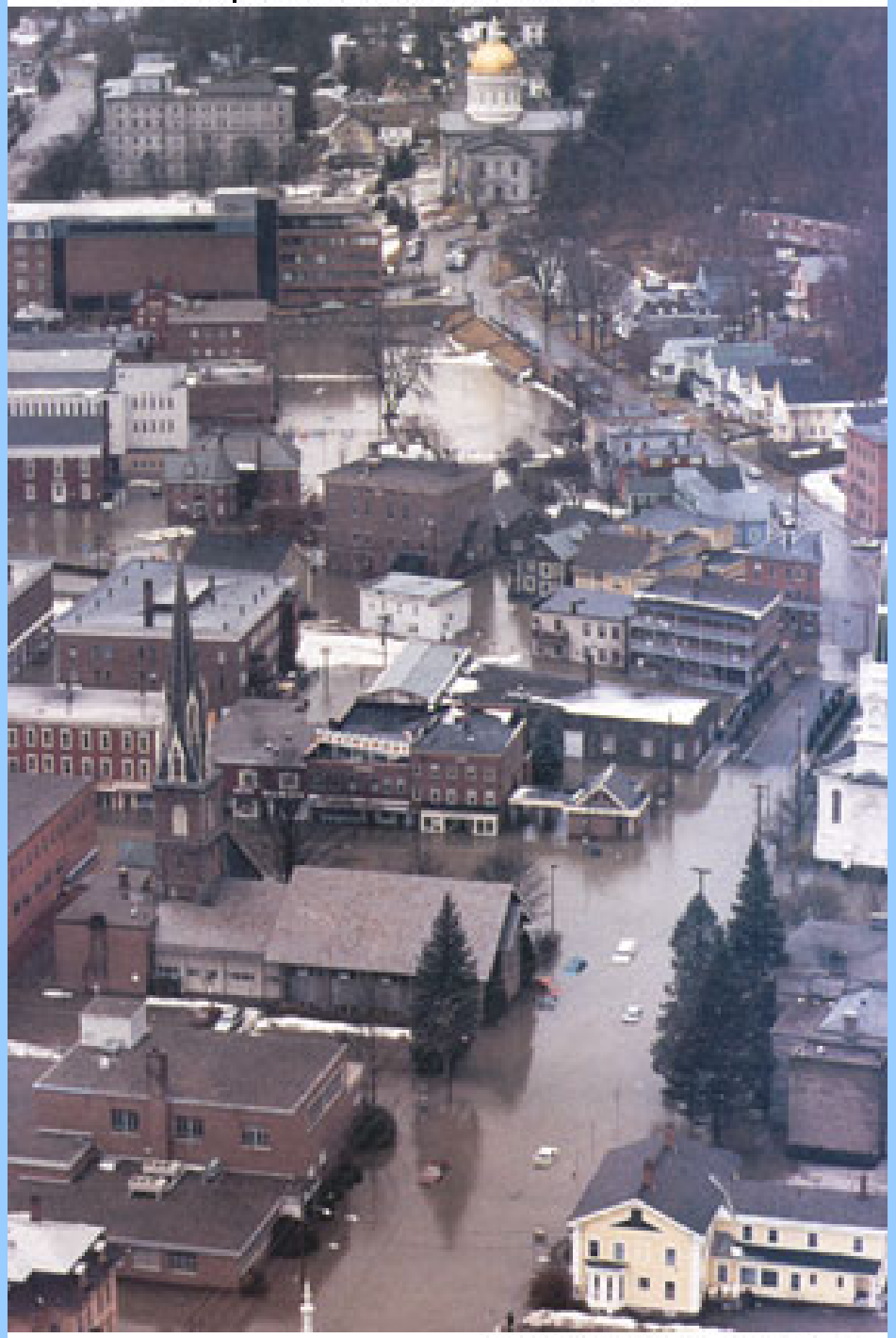
- Flood mitigation
- Water supply
- Water quality
- Sediment storage and transport
- Habitat
- Recreation
- Transportation
- Aesthetic qualities



Flooding

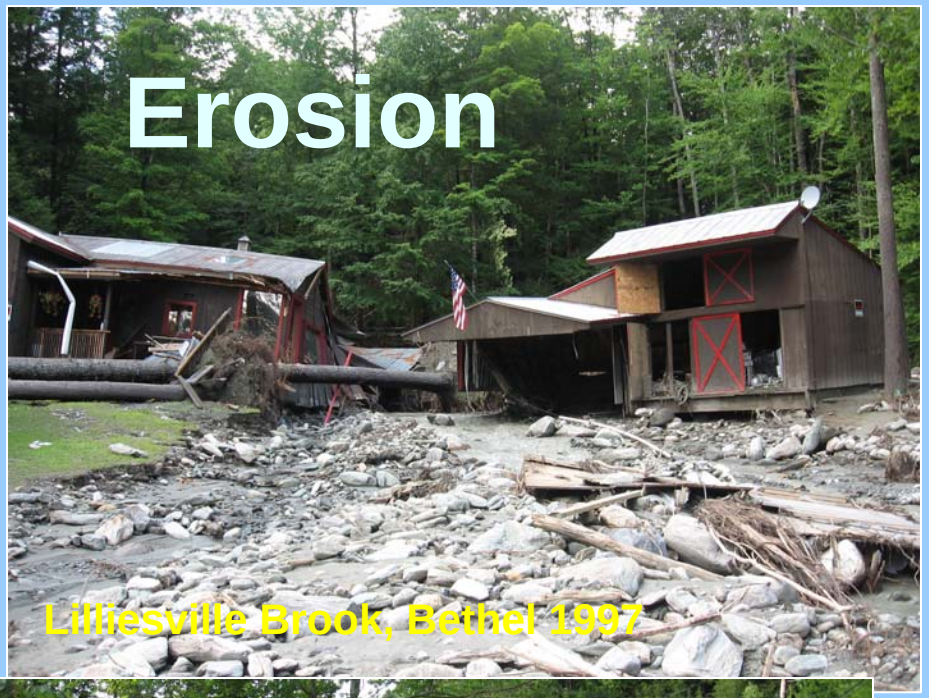
- VT's Most common type of natural disaster
- Caused by:
  - Rain
  - Melting Snow
  - Ice Jams
  - Debris jams

Aerial view of the Montpelier 1992 flood.
Cover photo of the *Ice and Water* book.



Jim Cole, Associated Press

Flood Damages can occur due to:



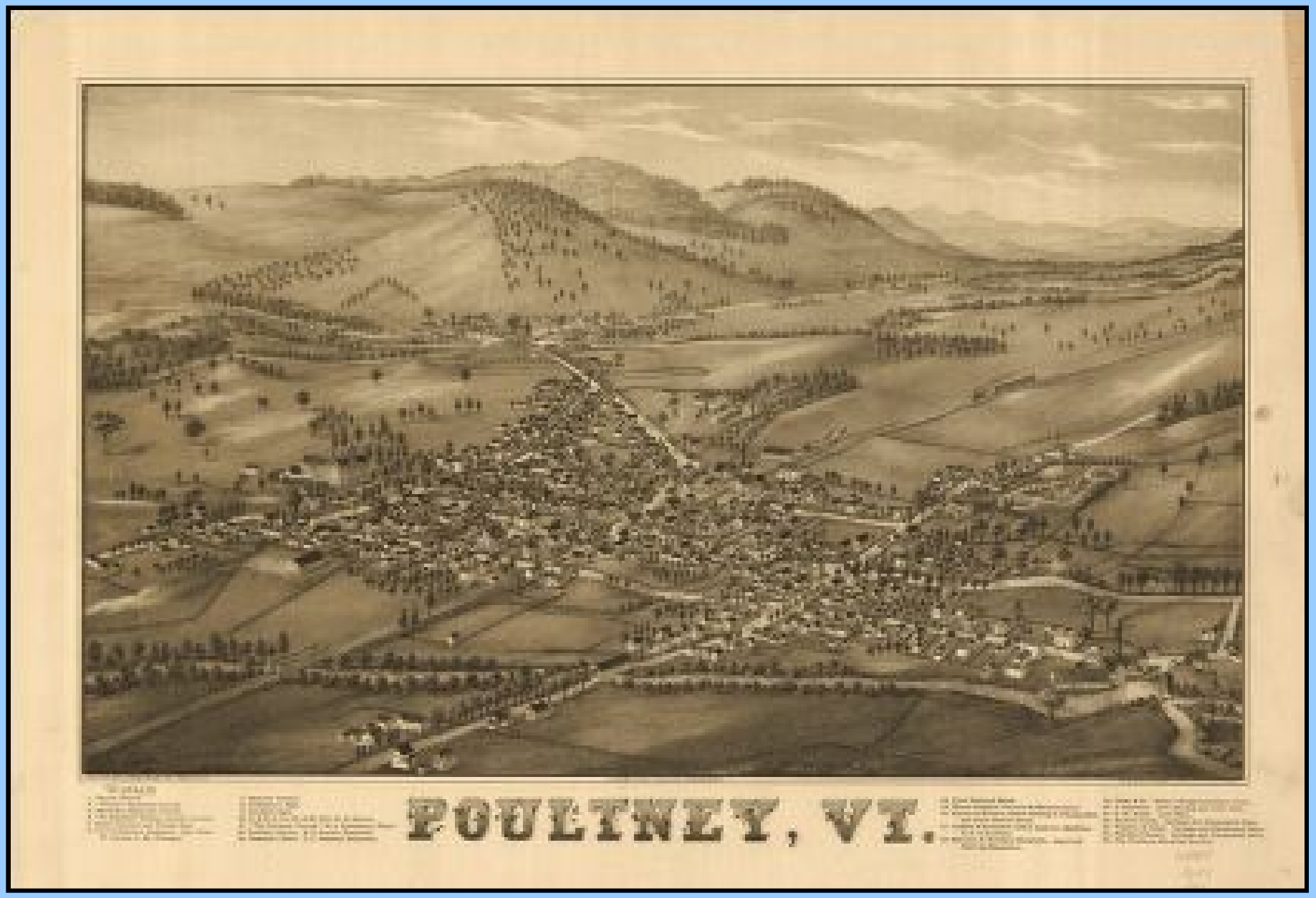
In Vermont, most flood damages are caused by **Fluvial Erosion**

- VT Geography/Climate
  - Mountainous, Narrow valleys
  - Steep/powerful streams
  - Intense rainstorms/deep snows
  - Destructive Ice jams
- Historic Patterns of Human Settlement, Stream Alteration


Rowell Brook, Bradford, 1998

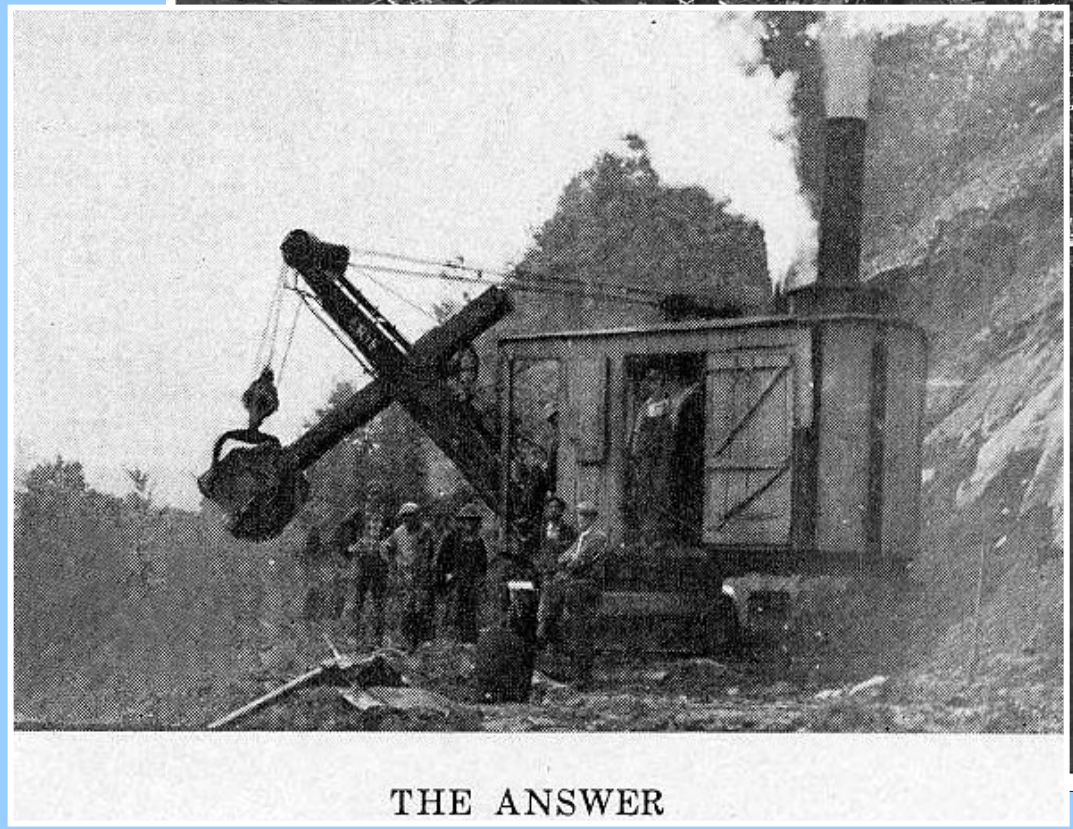

Kate Brook, Hardwick, 1995

Present-day channel adjustments date back to watershed changes associated with early settlement



…and the modification of channels and floodplains.

Major Floods



THE ANSWER

BETHEL, VT.

VERMONT HISTORICAL SOCIETY

Traditional Approach to River Management:

Contain flows within the straightened channel

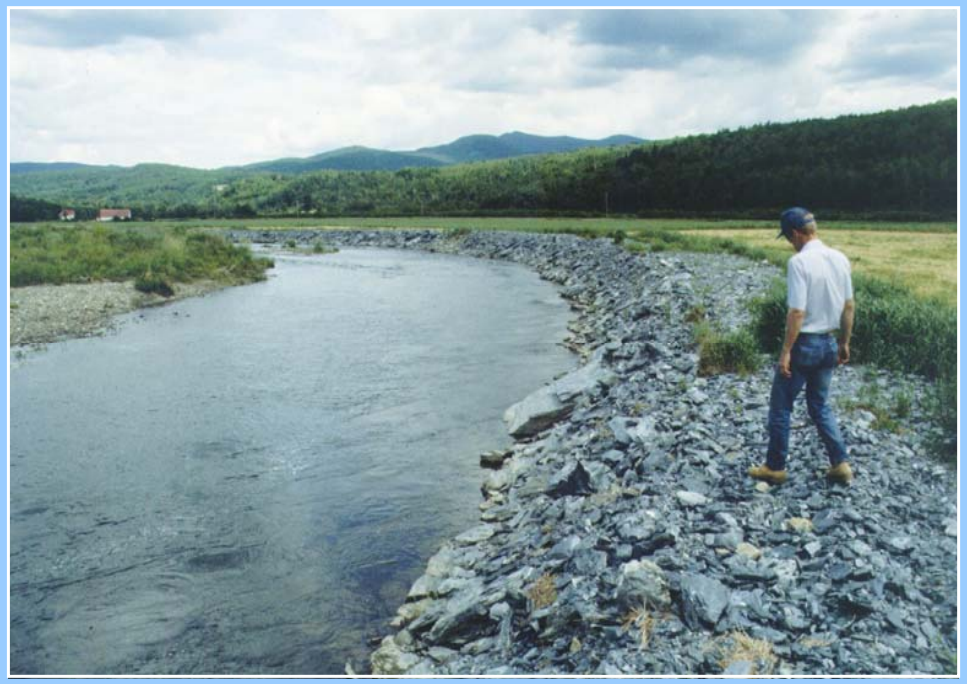
Result

High flows result in high erosive power kept in the channel,

instead of allowing the energy of the water to flow onto floodplain

Structural Mitigation Still Dominates

Armor to Withstand Increased Stream Power



Channel adjustments during floods can have devastating consequences

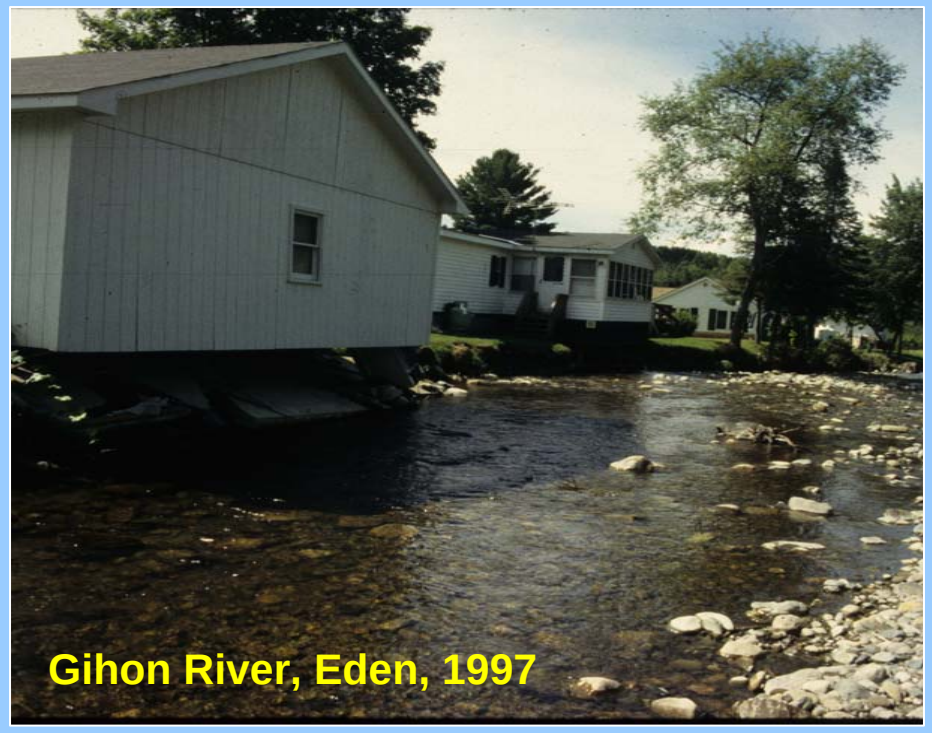
Greatest Damage is to Transportation Systems

Unnamed tributary, Braintree 2007


Jay Branch, Jay, 1991


Burgess Branch, Lowell, 1997

Five Floods in ’90s
Resulting in Over $60 Million in Damages


Gihon River, Eden, 1997

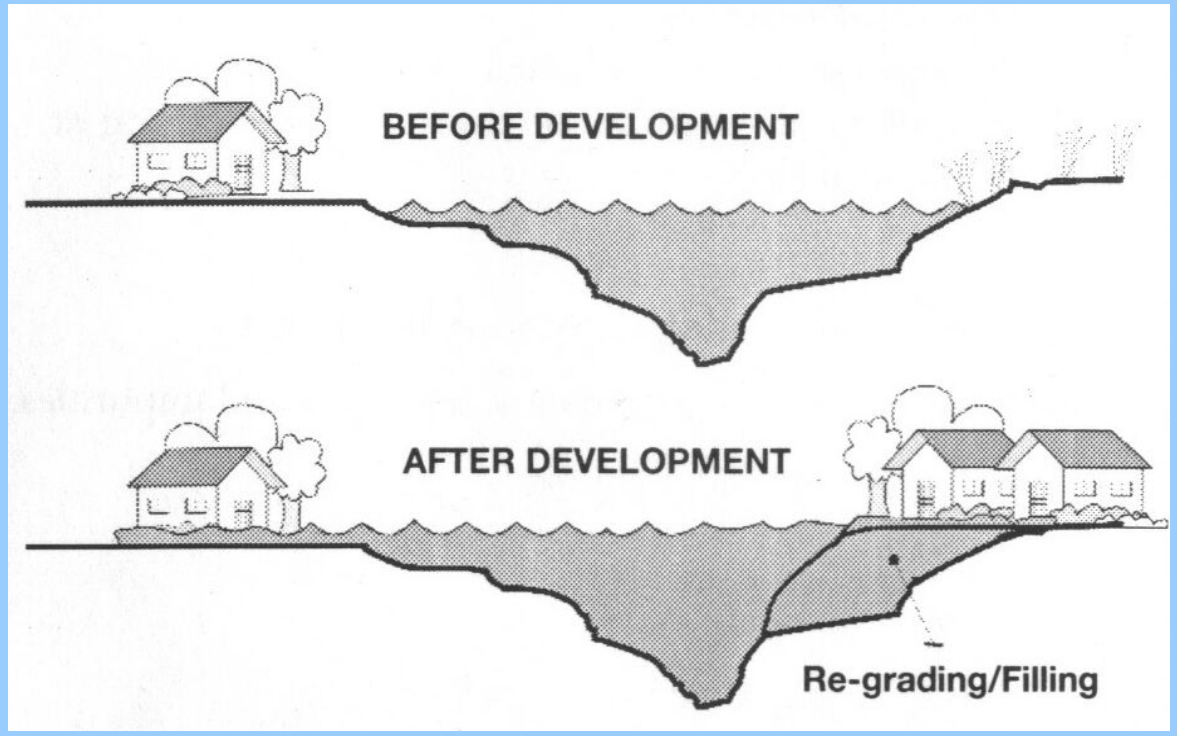

Tyler Branch, Enosburg, 1997


Trout River, Montgomery, 1997


West Hill Brook, Montgomery, 1997

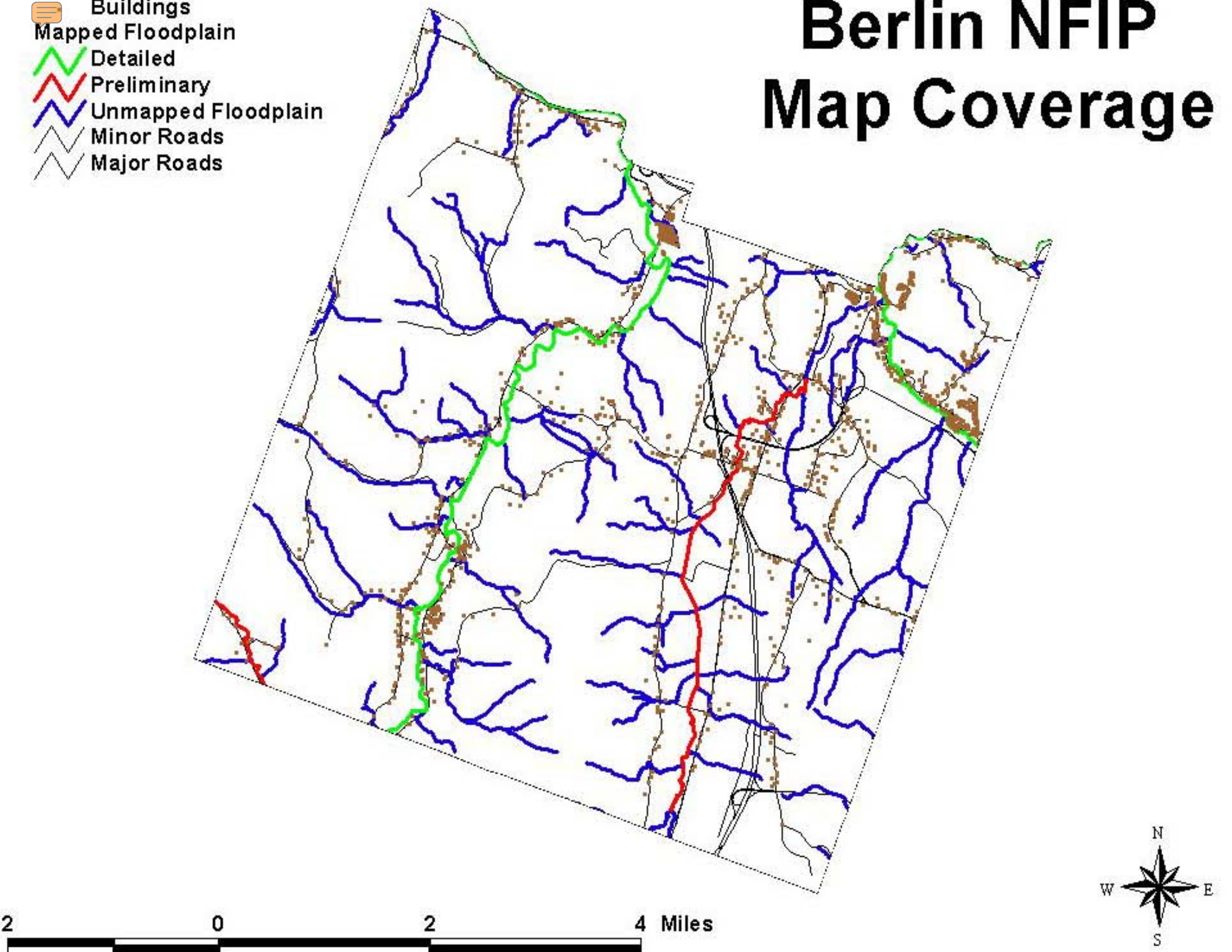

National Flood Insurance Program
maps focus on *inundation* risks
Roaring Brook, Underhill, 1998

Effects of Floodplain Encroachment – May Exacerbate Flood Hazards



- Filling reduces floodplain's ability to store water
- Floodwaters rise to higher levels causing properties that were once flood-free to now be flood-prone
- Rise in floodwaters increases velocity of flood waters and therefore increases the potential to erode stream banks
- Encroachment may prevent river from reaching equilibrium

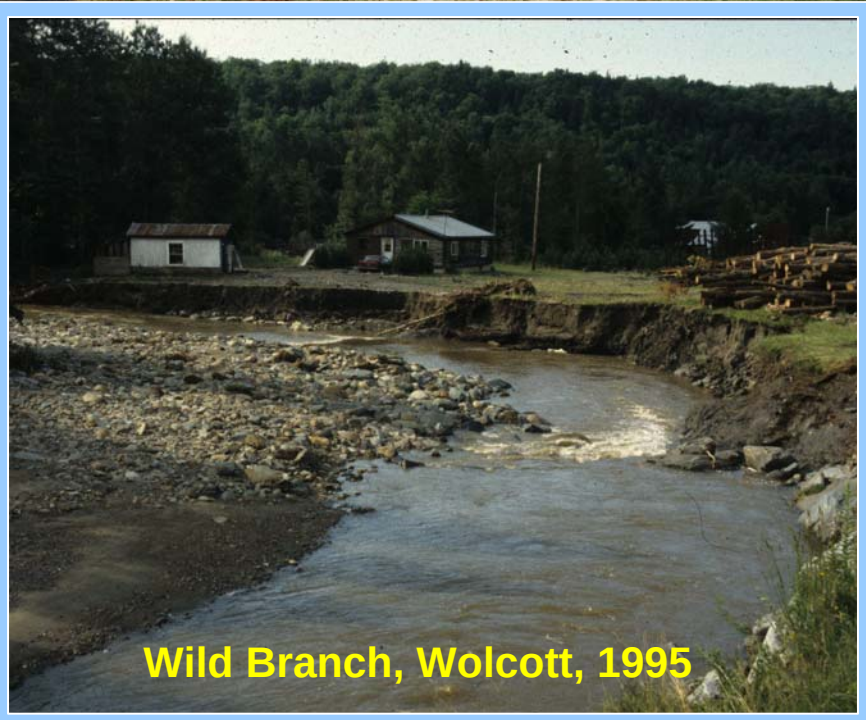
Berlin NFIP Map Coverage



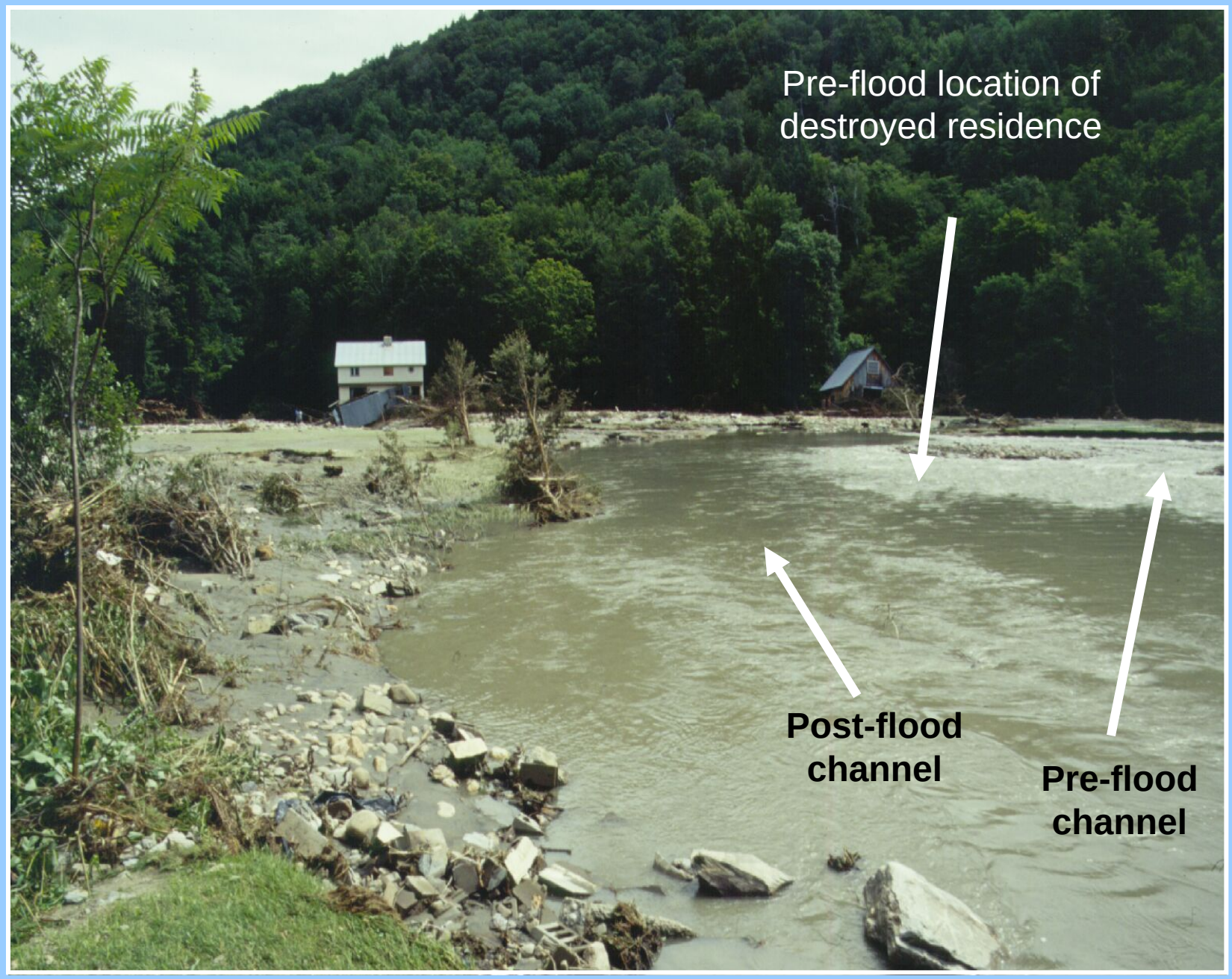
Many flood risks to investments are **NOT** identified by NFIP floodway delineations

- Not all rivers have been mapped
- Not all rivers have been mapped accurately
- Streams may have moved
- NFIP maps do not consider erosion hazards
- NFIP maps do not account for effects of urbanization on future flood levels


Tyler Branch, Enosburg, 1997


Wild Branch, Wolcott, 1995

Elevation to avoid inundation is often ineffective in protecting structures from flood damage

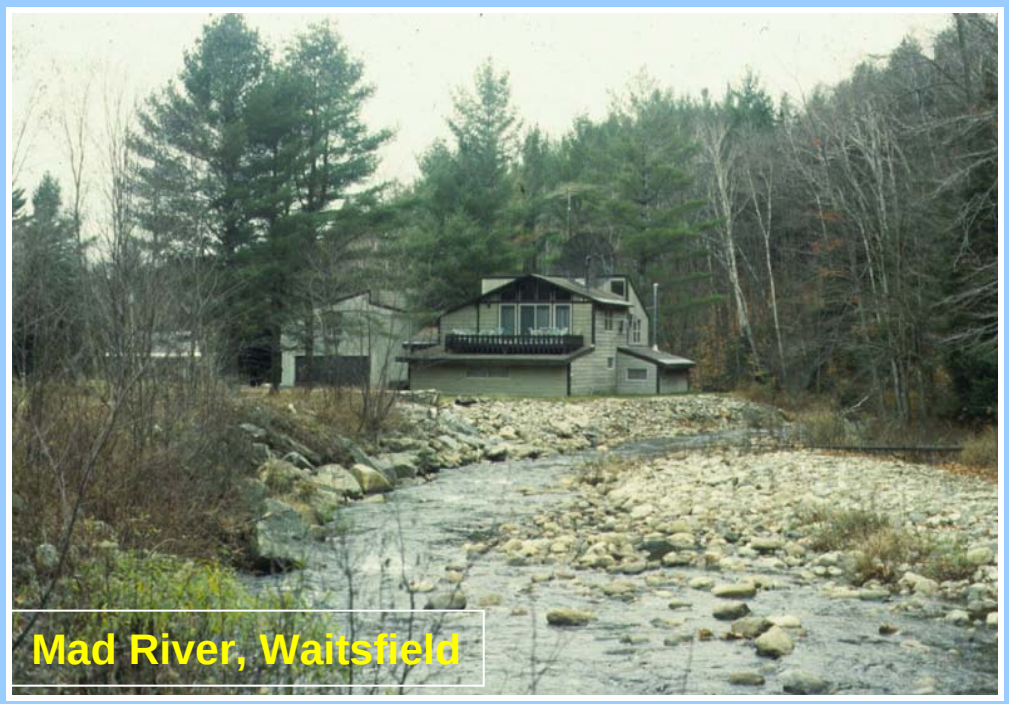


Mad River, Warren, 1998

Not in the NFIP Floodplain

Home built 100 ft from NFIP Floodway and 8 ft Above Q100; Channel Adjustment Occurred Overnight

Proof that Minimum FEMA Standards are not Effective Enough to Protect Public Safety and Minimize Losses



Exposure to flood events is increasing due to:

- Greater land development in susceptible areas

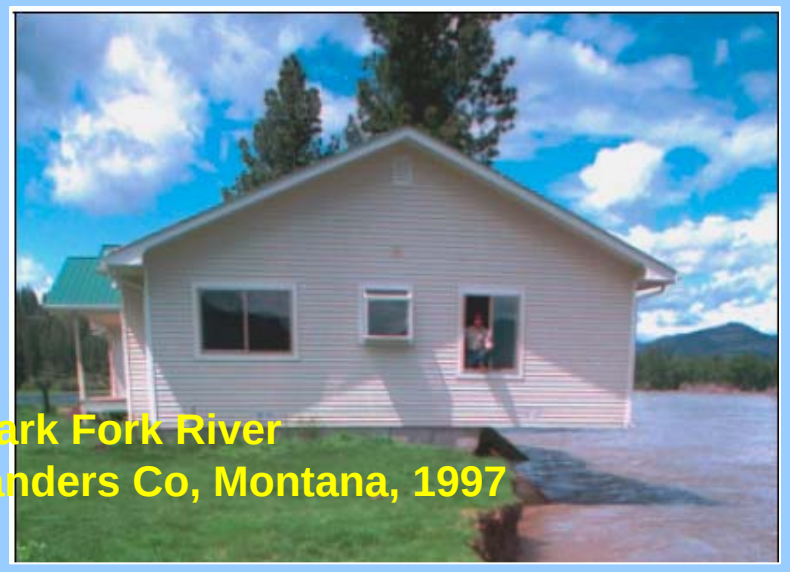
- Channels are enlarging due to stormwater conveyance

- Potential global climate shifts or cycles

Photo courtesy of Smart Growth Vermont

Riverine Erosion Hazards - a National Concern

- 1/3 of the Nation's Streams Experience Severe Erosion (National Research Council, 1999)
- Catastrophic Erosion Costs $595 Million/year (2008 dollars)



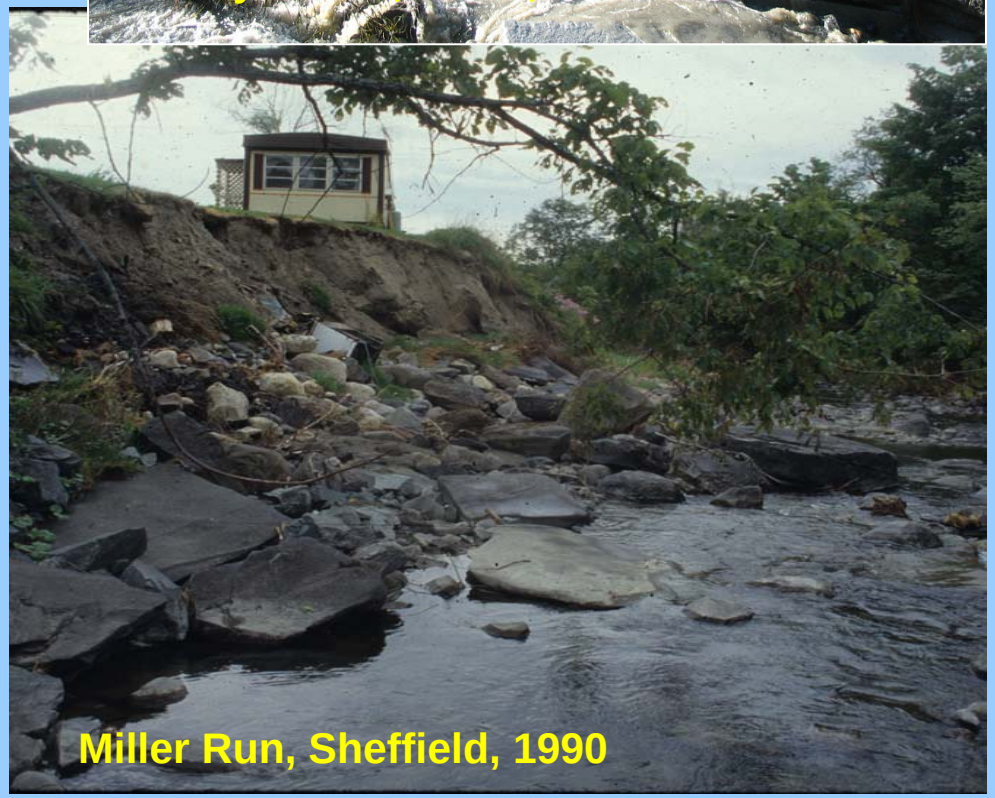
Clark Fork River
Sanders Co, Montana, 1997

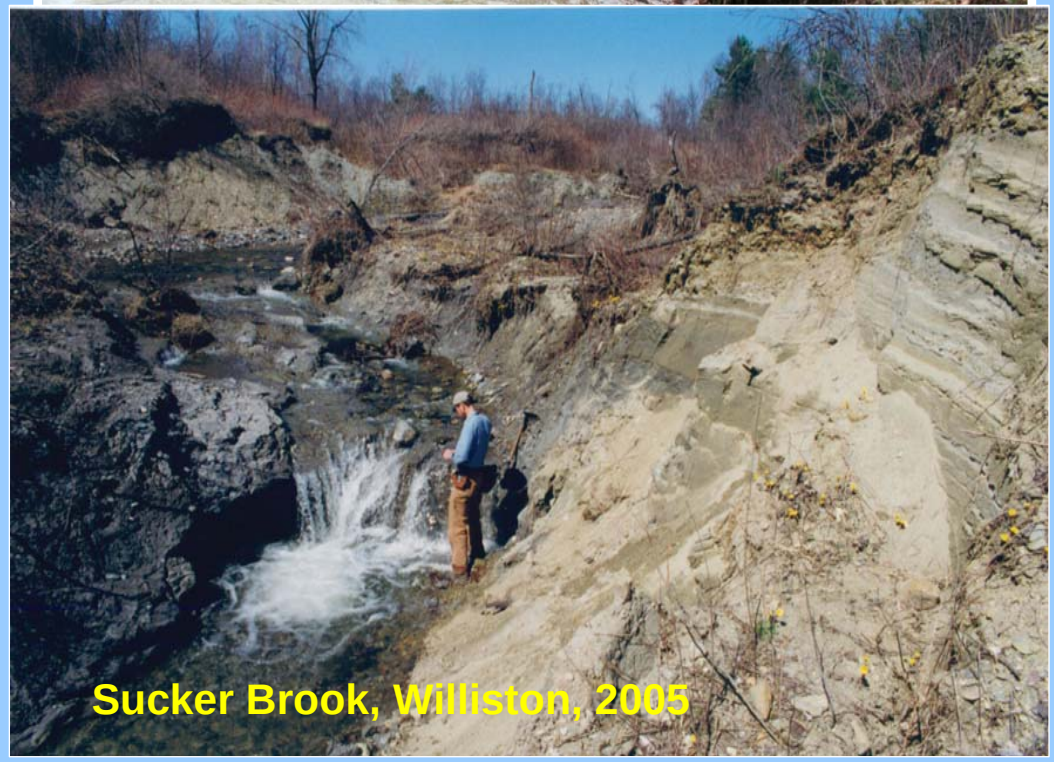
Cimarron River
Logan Co, Oklahoma, 1998

Cold River
Alstead, New Hampshire, 2005

Chapel Hill, NC, 2000

How Can We Mitigate These Impacts?





Cycle of Escalating Costs, Risks, and Ecosystem Degradation

Floods and Property Damage

Roaring Branch, Bennington, 1987

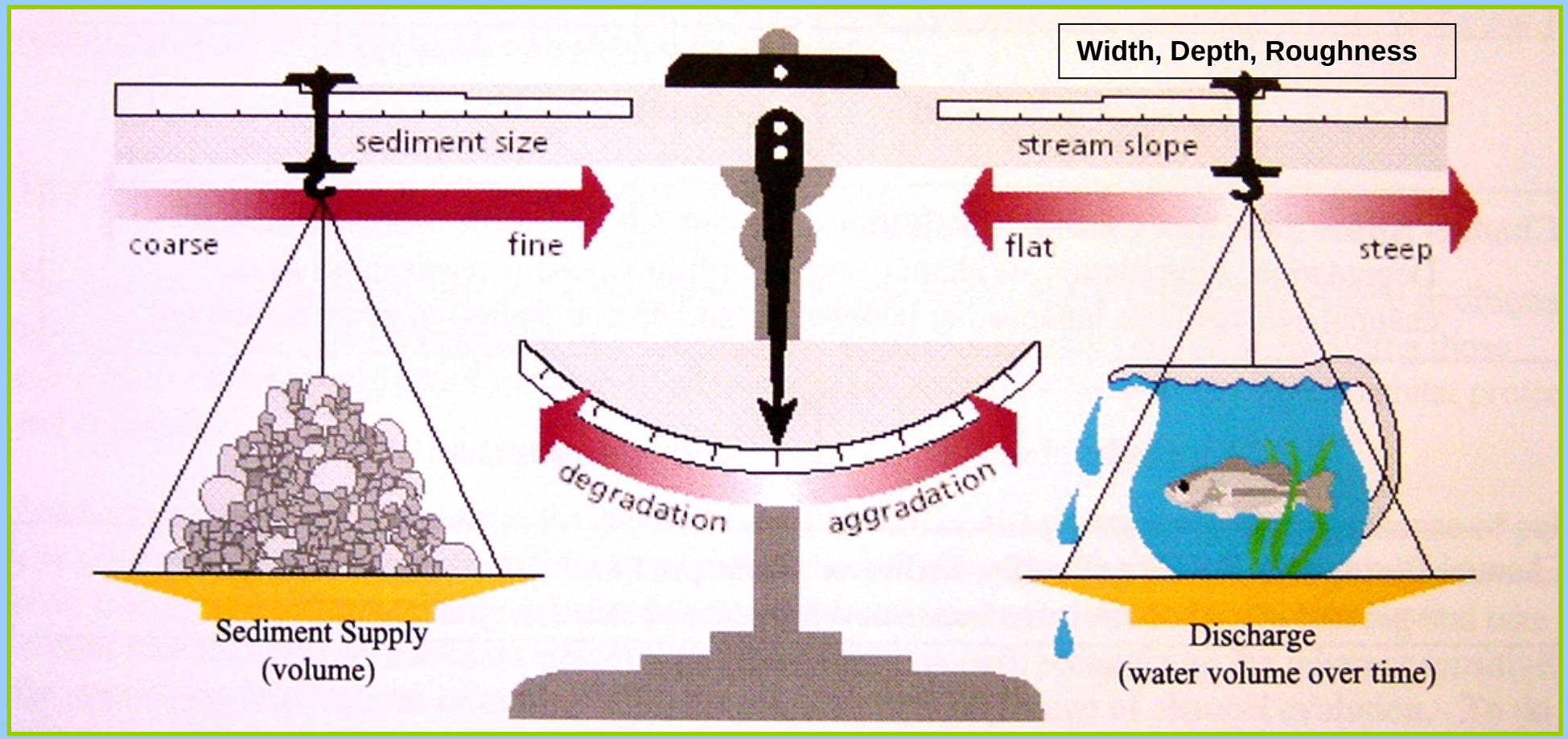
Dredge, Berm and Armor

Encroachment

Channel Equilibrium

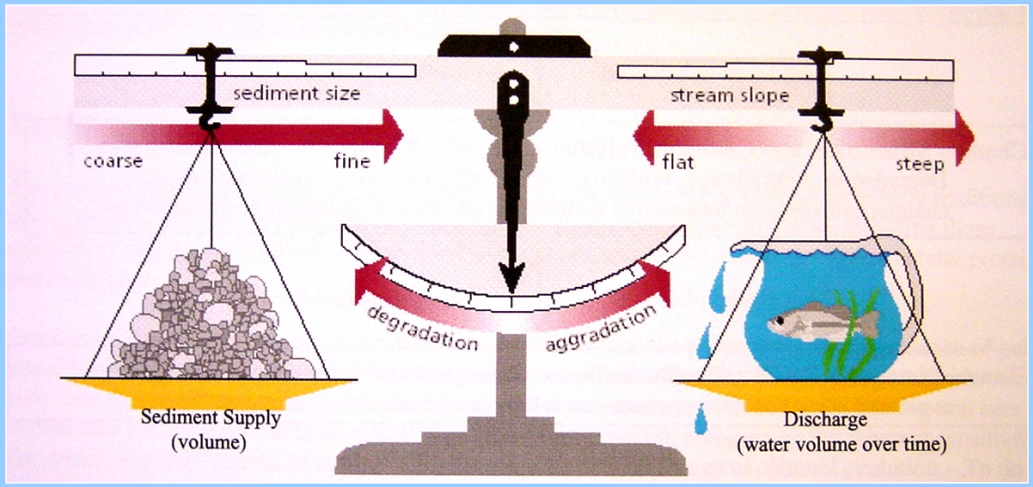
Sediment Load

Transport Capacity

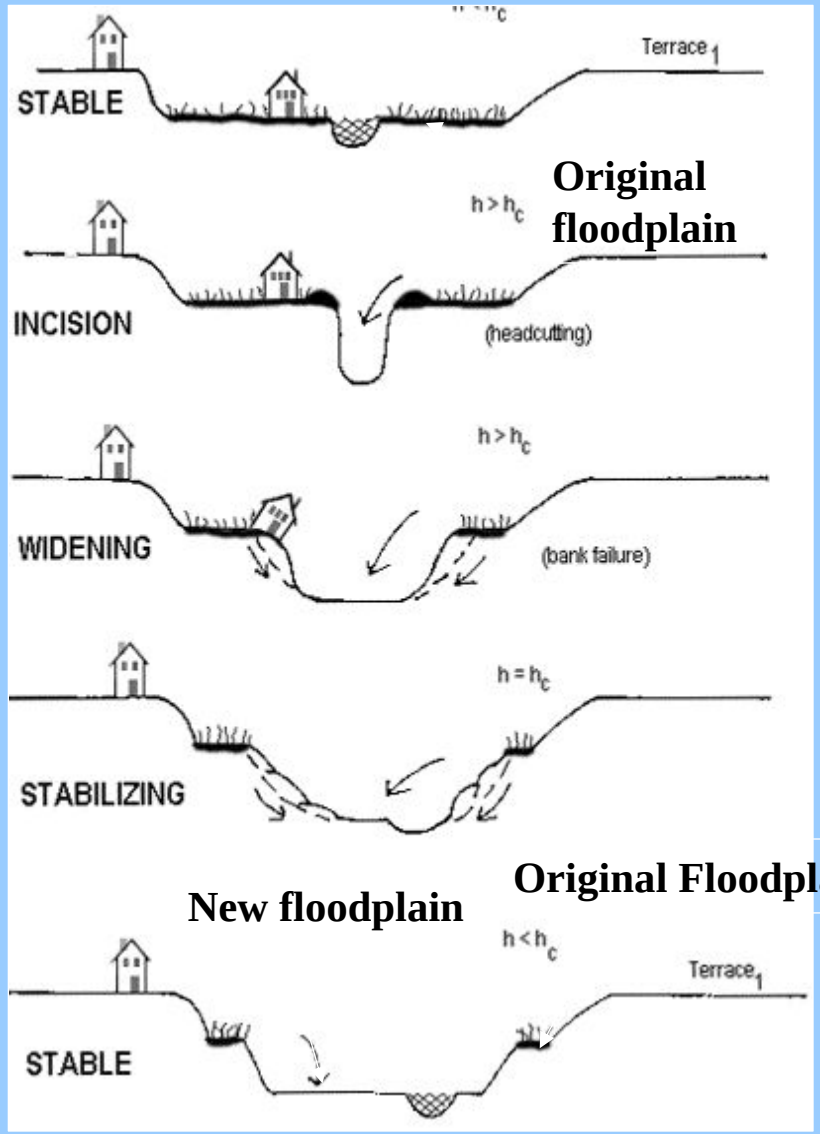


Lane (1955)

Channel Evolution



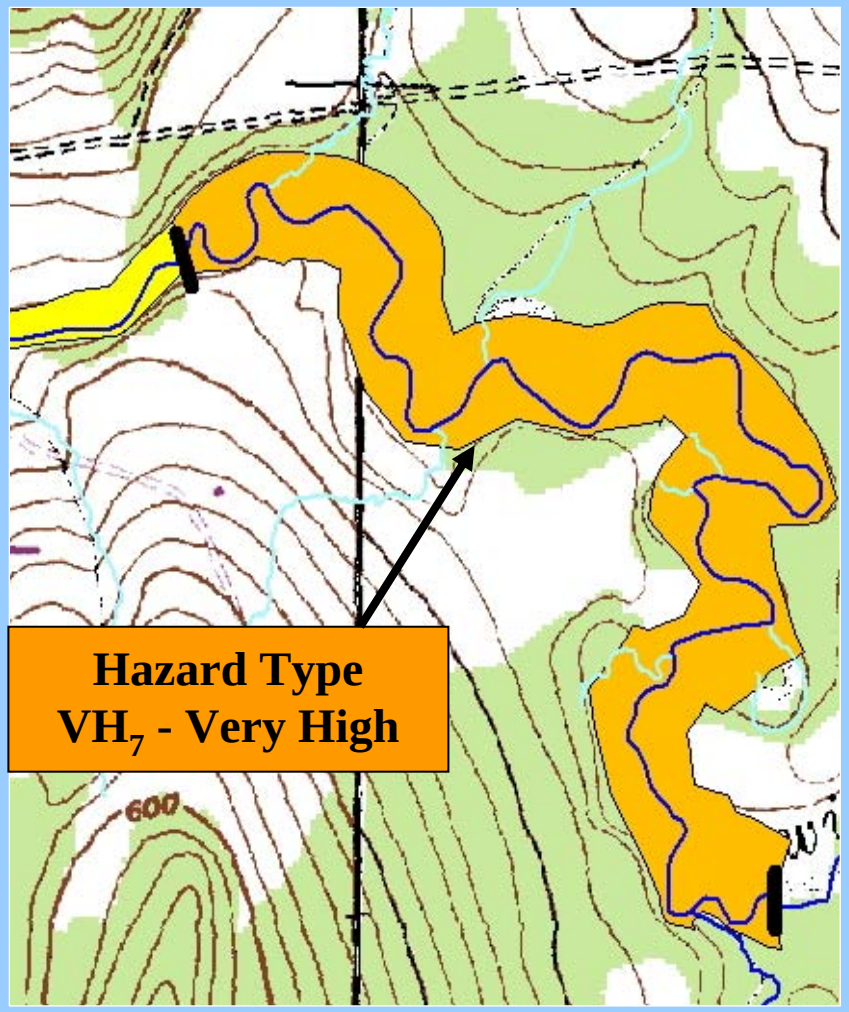
- Caused by changes to:
- Flow regime
- Sediment regime
- Slope
- Cross section
- Boundary condition
- Channel Roughness



Breaking the Cycle Through Corridor Protection

- **Avoids** Land Use Constraints Which Prevent Maintenance or Achievement of the Equilibrium Condition
- Provides Low Cost Solution
- Enhances Public Safety
- Minimizes Economic Losses
- Manages towards Sustainable Healthy Stream Conditions

Fluvial Erosion Hazard Program



Uses geomorphic assessment data to mitigate flood-related erosion hazards by identifying, mapping and protecting river corridors

Fluvial Geomorphology

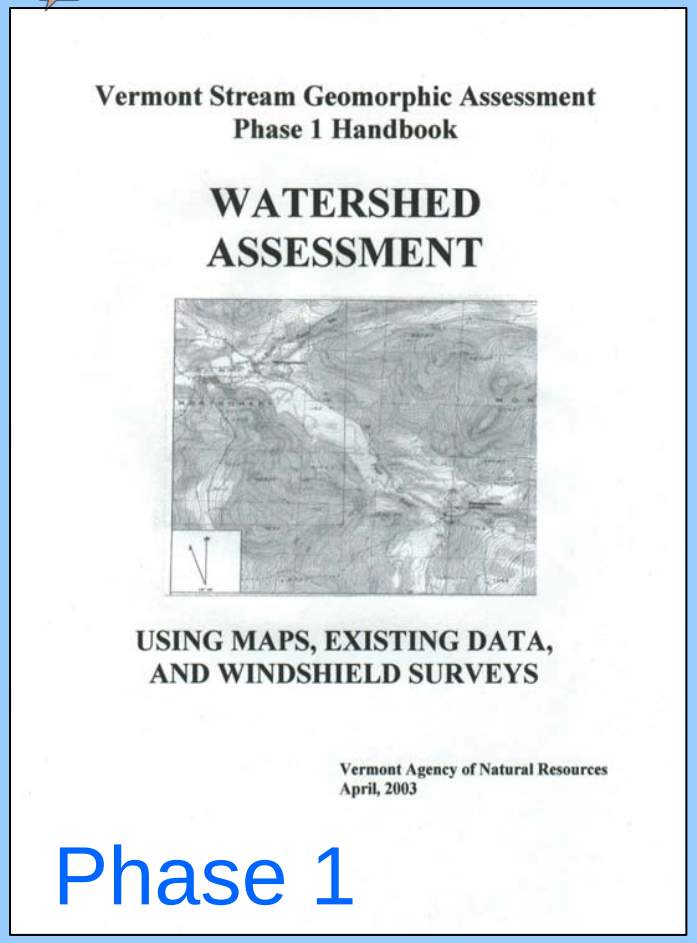
Fluvial =

Geo =

Morphology =

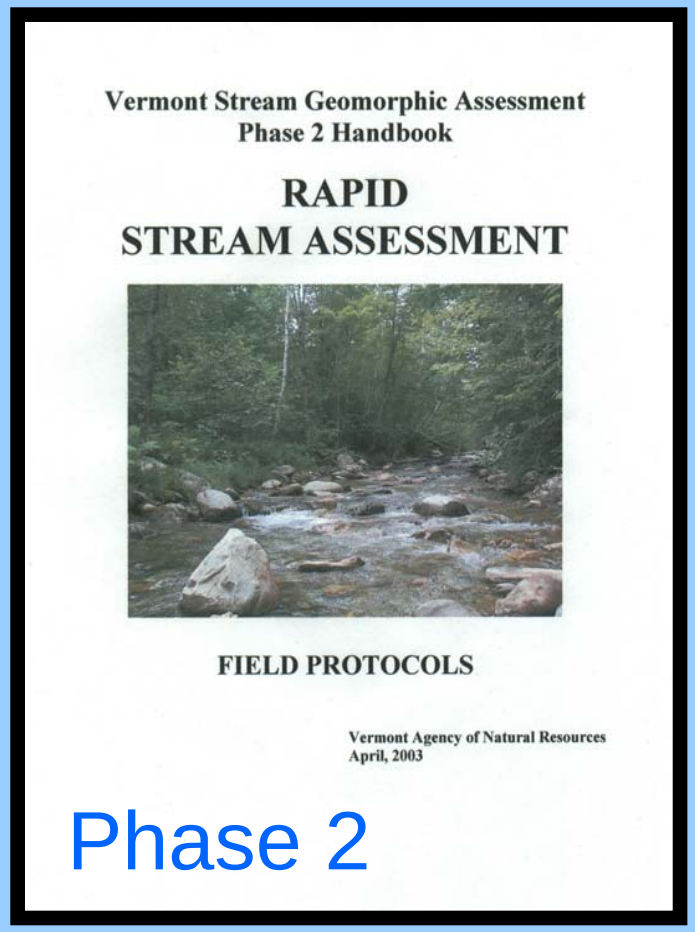
Fluvial Geomorphology = The Interaction of Water and the Landscape through which it Works

FEH Assessment & Mapping based on Vermont Stream Geomorphic Assessment Protocols



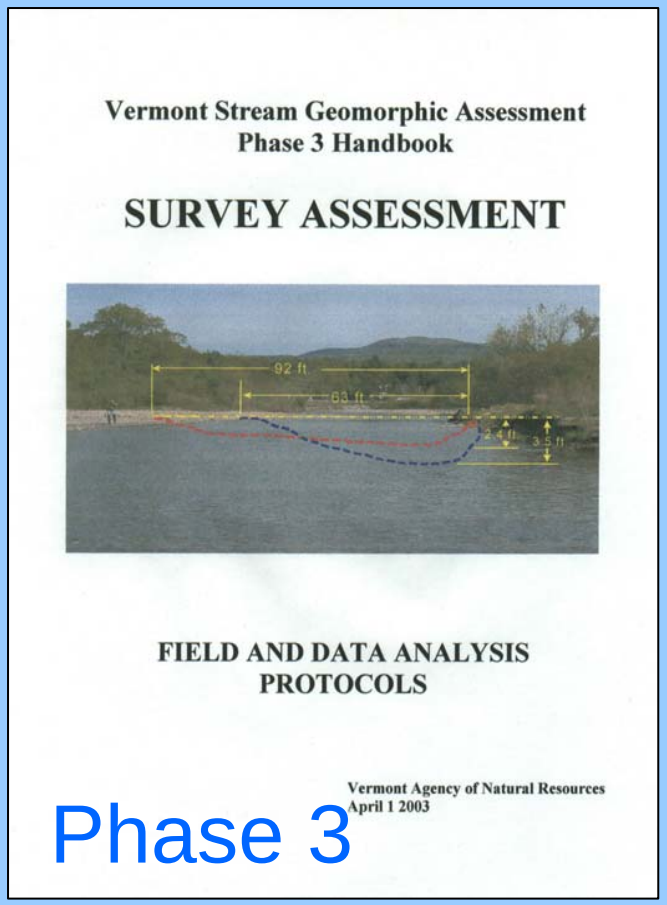
Phase 1

Remote Sensing



Phase 2

Qualitative & Rapid Field Assessment



Phase 3

Quantitative Field Surveys

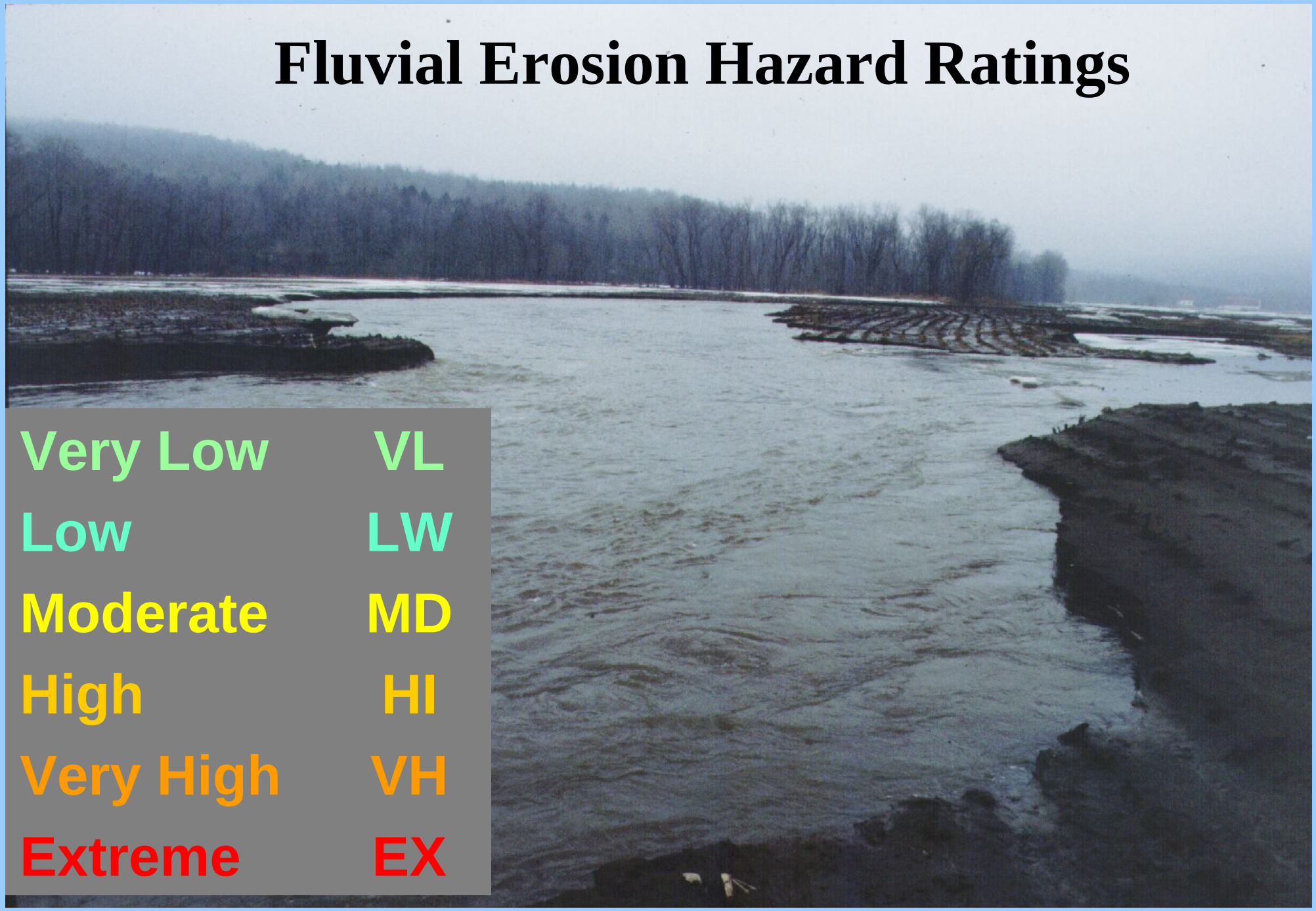
Stream Geomorphic Assessment Objectives

Inherent Sensitivity + **Adjustment Processes**

- Transport Capacity
- Bed and Bank Materials
- Sediment Supply

- Reference Condition
- Major Adjustment
- Stream Type Departure

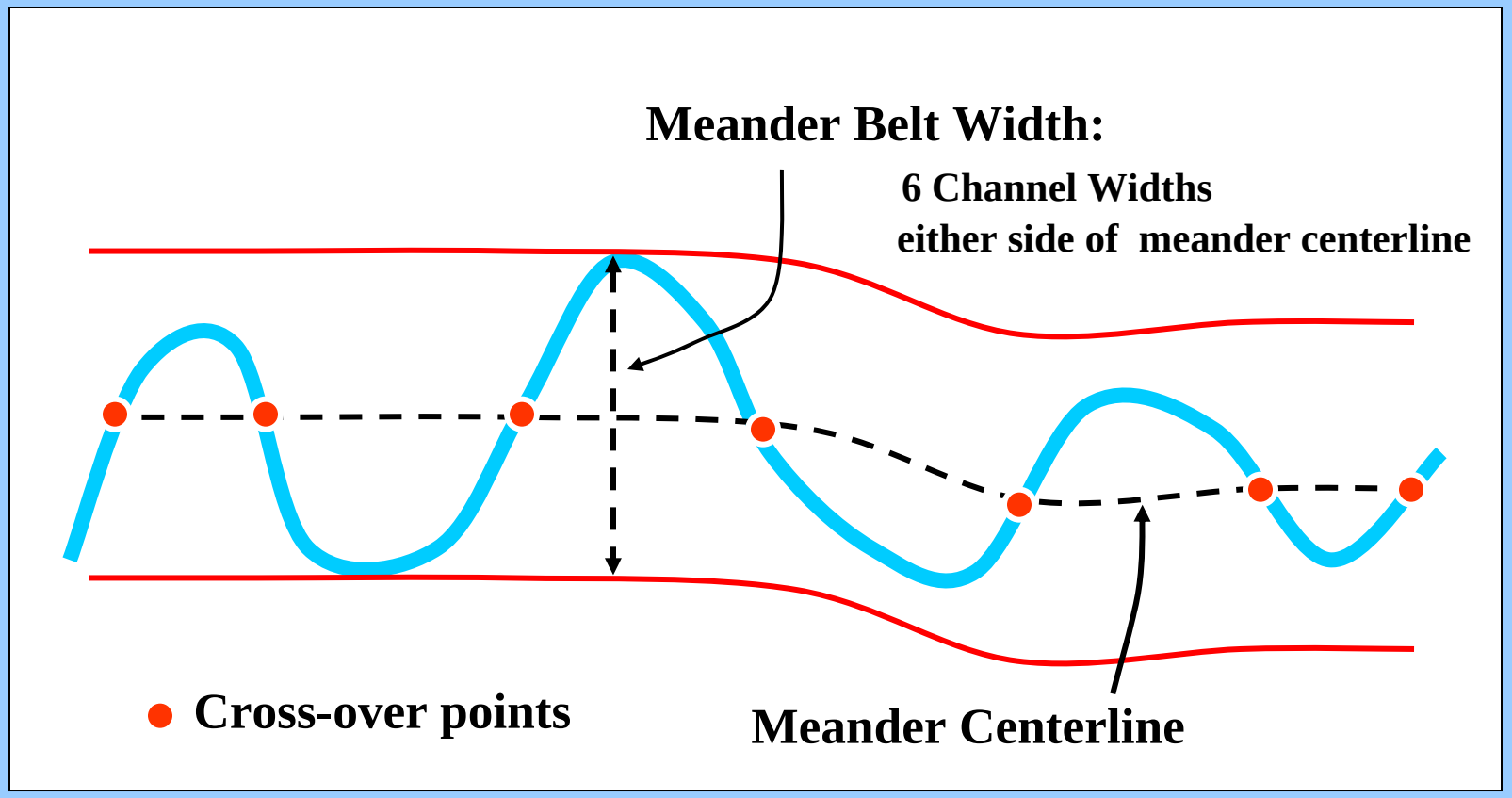
Fluvial Erosion Hazard Ratings



Very Low	VL
Low	LW
Moderate	MD
High	HI
Very High	VH
Extreme	EX

FEH Corridor is a Function of Meander Belt Width

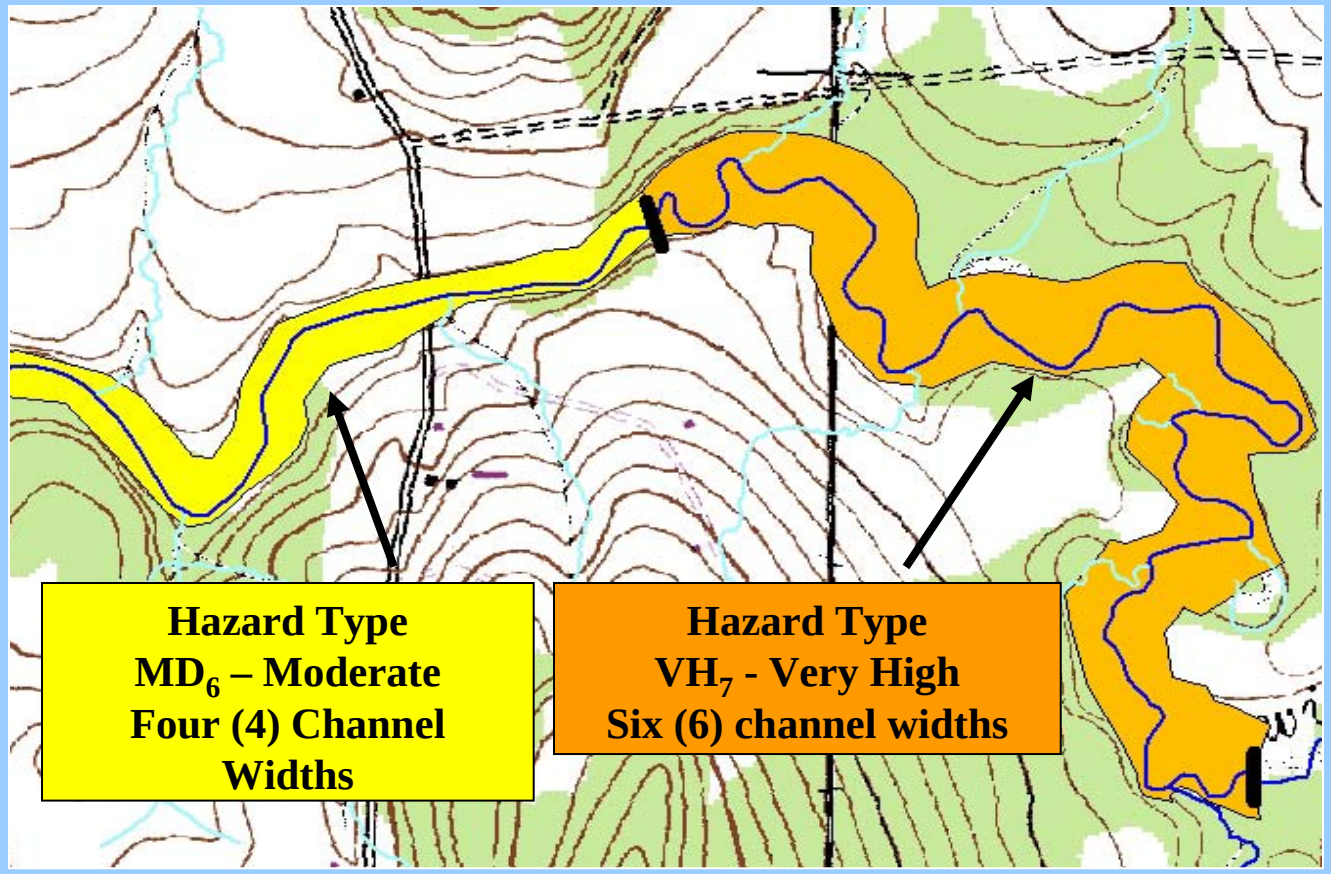
Based on reference channel width
(from regional hydraulic geometry curves)



Williams, 1986

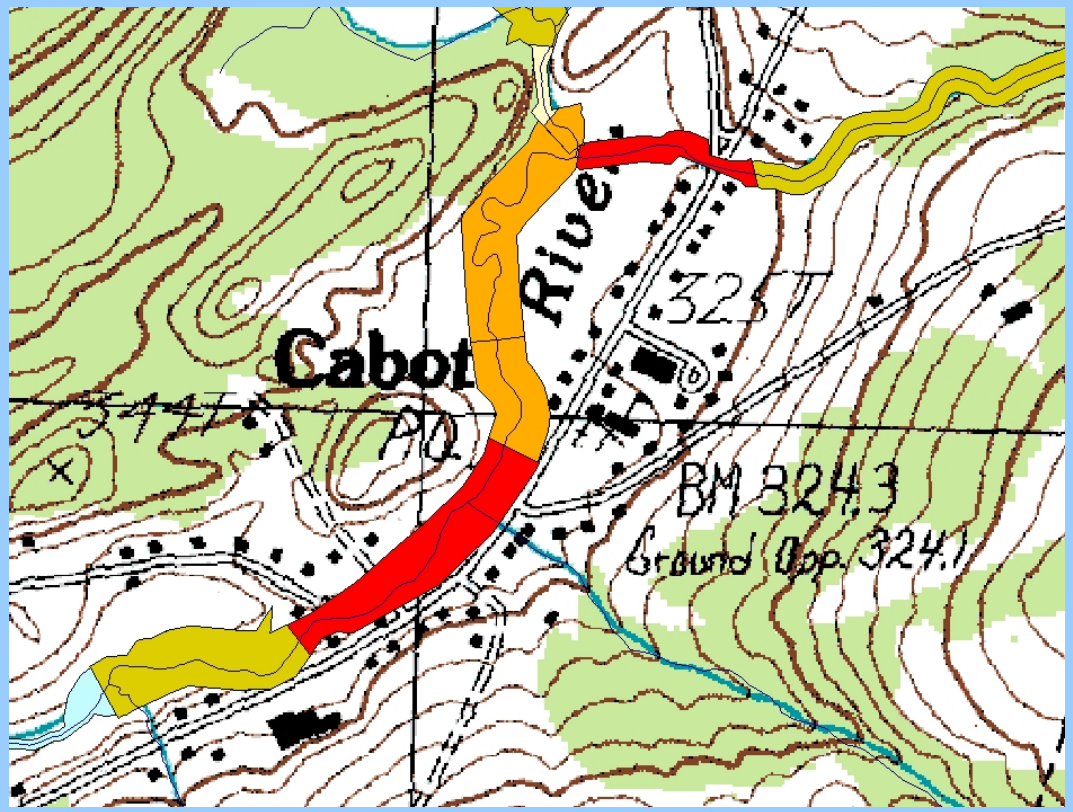
FEH Corridors based on Erosion Hazard Ratings and Belt width

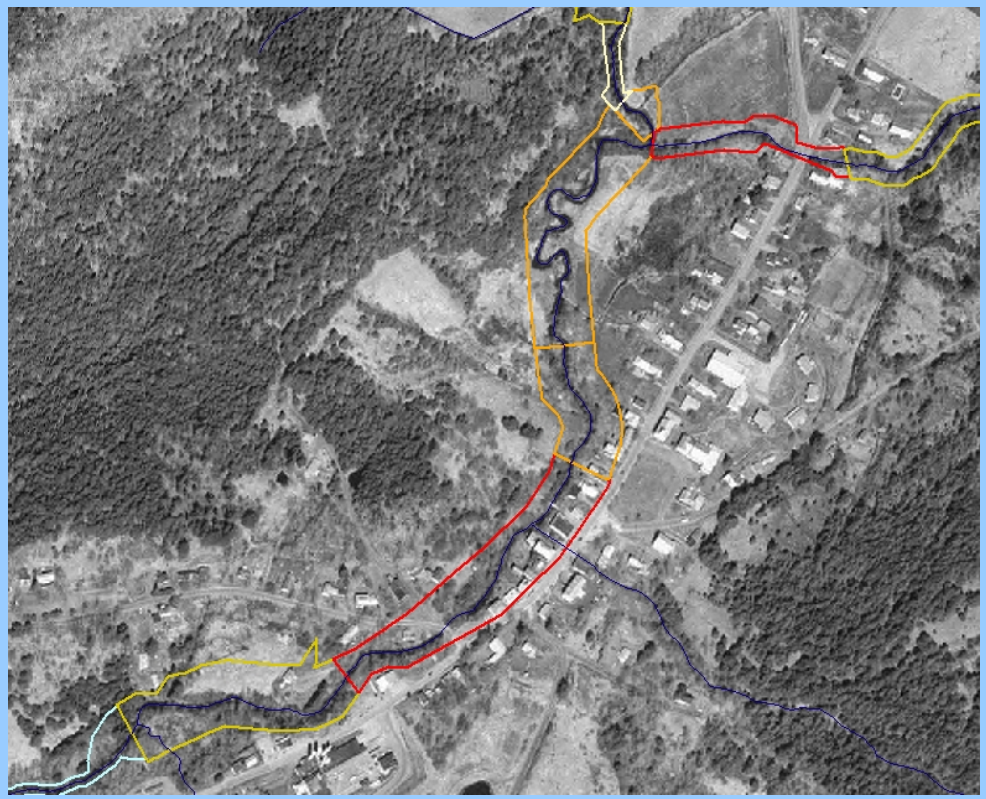
FEH Rating	Belt Widths
Very Low (VL)	Reference channel width
Low (LW)	Reference channel width
Moderate (MD)	Four (4) channel widths
High (HI)	Six (6) channel widths
Very High (VH)	Six (6) channel widths
Extreme (EX)	Six (6) channel widths



Stream Geomorphic Assessment Tool (SGAT)

- A GIS Extension (ArcView 3.x) that Automates Fluvial Erosion Hazard Corridor Delineations
- Currently being upgraded to ArcGIS9





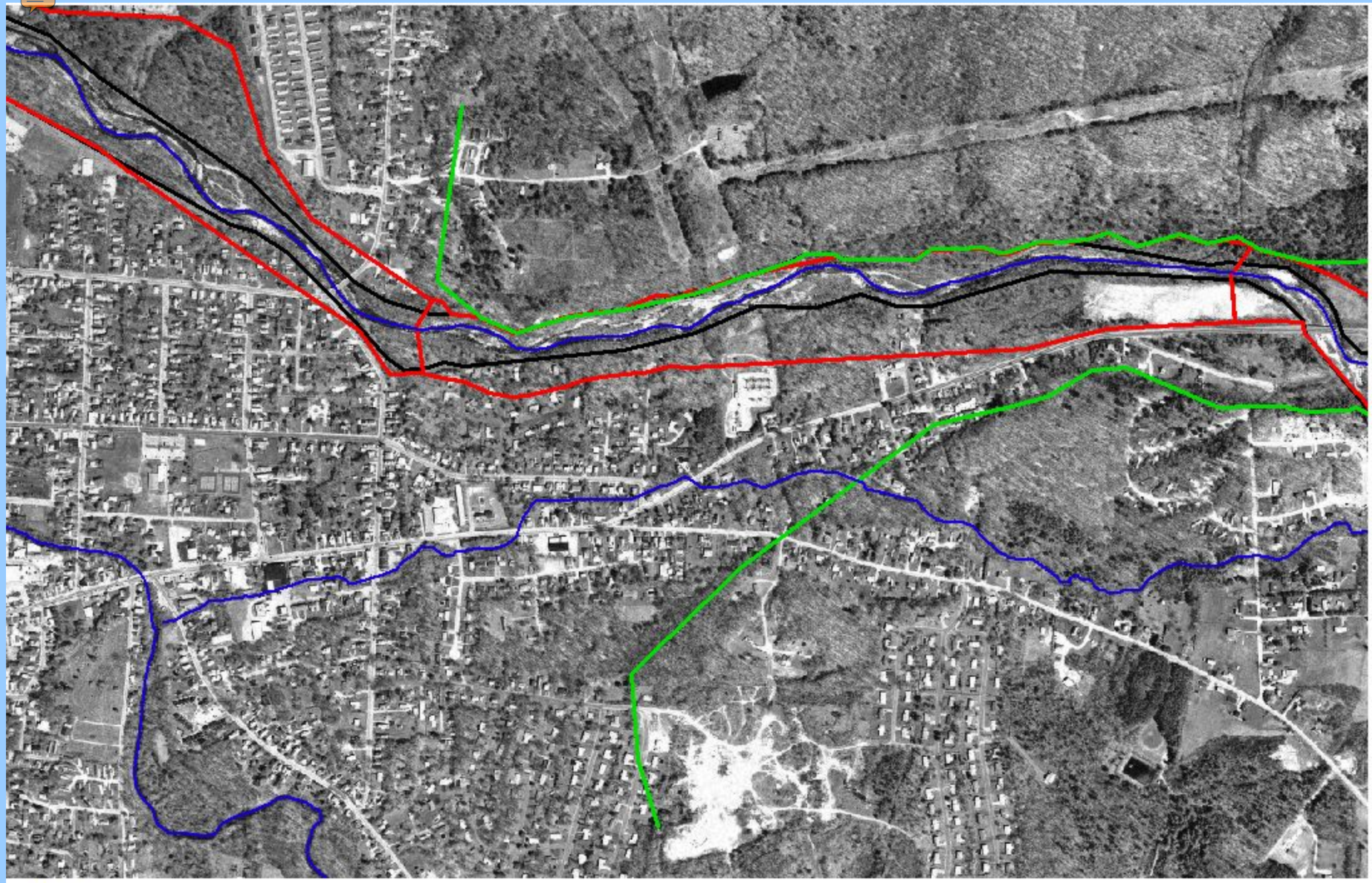
Uses of FEH Maps and Data

- Municipal Planning Tool
  - FEH Overlay District
  - Aid towns in implementing their Pre-Disaster Mitigation Plans
  - Transportation Infrastructure Management
    - Bridge and Culvert Priorities
- Identify River Assets and Problems in River Corridor Plan
  - Corridor Protection Projects
  - Restoration Projects
- Additional Data Layer on NFIP Map
- Act 250 Proceedings

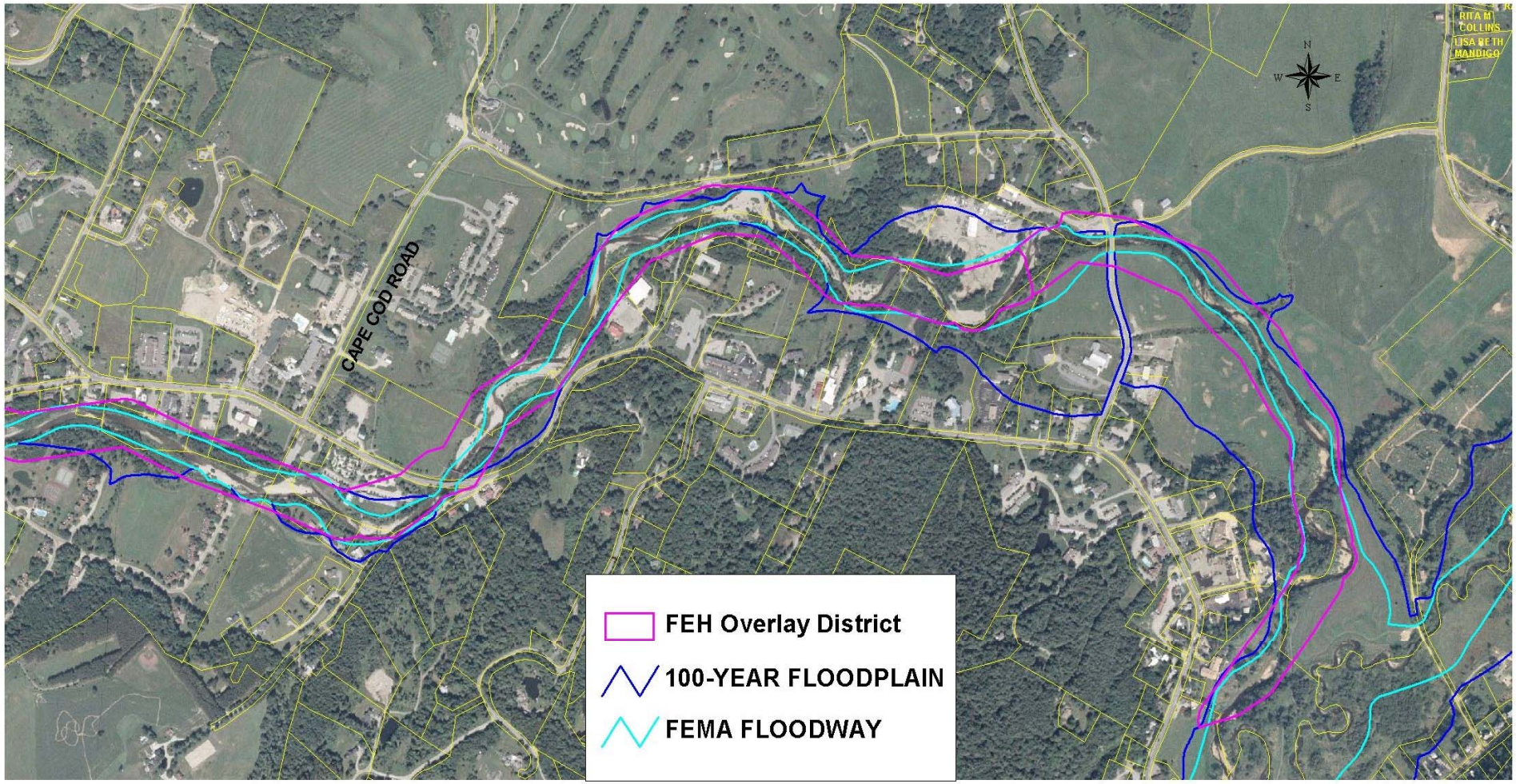
Advantages of an Avoidance Strategy Using the FEH Approach

- Enhances Public Safety
- Minimizes Economic Losses During Floods
- Low Cost Alternative (vs. Remove, Retrofit, Reconstruct, Stabilize Structures)
- Can be Applied at the Watershed Scale
- Healthier River Ecosystems
  - Improved Water Quality
  - Aesthetics
  - Fish & Wildlife Habitat
- VT Aligning Emergency Funding, DEC funding with FEH
- Represents a Mitigation Strategy with Tremendous Benefits Nationally

Whetstone Brook, Brattleboro


River
Natural Confinement
Fluvial Erosion Hazard Area
Extreme
Very High
High
Existing Confinement
Roaring Branch, Bennington
1000 0 1000 2000 Feet
1" = 800'
N
W
E
S

FEH Overlay District
(Proposed)



Further Information on the VT ANR Fluvial Erosion Hazard Program

www.vtwaterquality.org/rivers.htm

- VT Geomorphic Assessment Protocols
- Municipal Guide to Fluvial Erosion Hazard Mitigation
- Model Fluvial Erosion Hazard Overlay District

Contacts

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