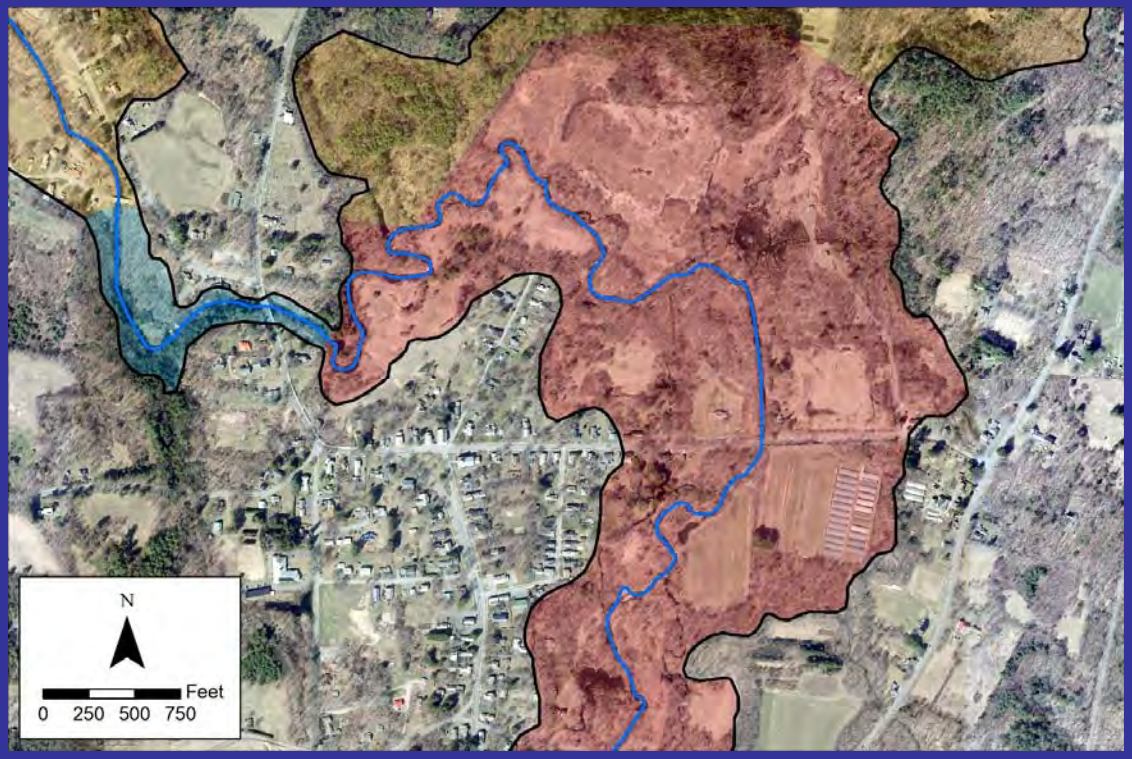
Sawmill River Corridor

Mapping and Outreach



Nicolas Miller – Field Geology Services

Montague, MA - May 24th, 2023

Presentation Outline

- Background – streams in New England
- What is a river corridor and how is it defined?
- Corridor delineation steps and methodology
- Fluvial Erosion hazards
- Potential uses of river corridor and fluvial erosion hazard data
- Outreach and future work

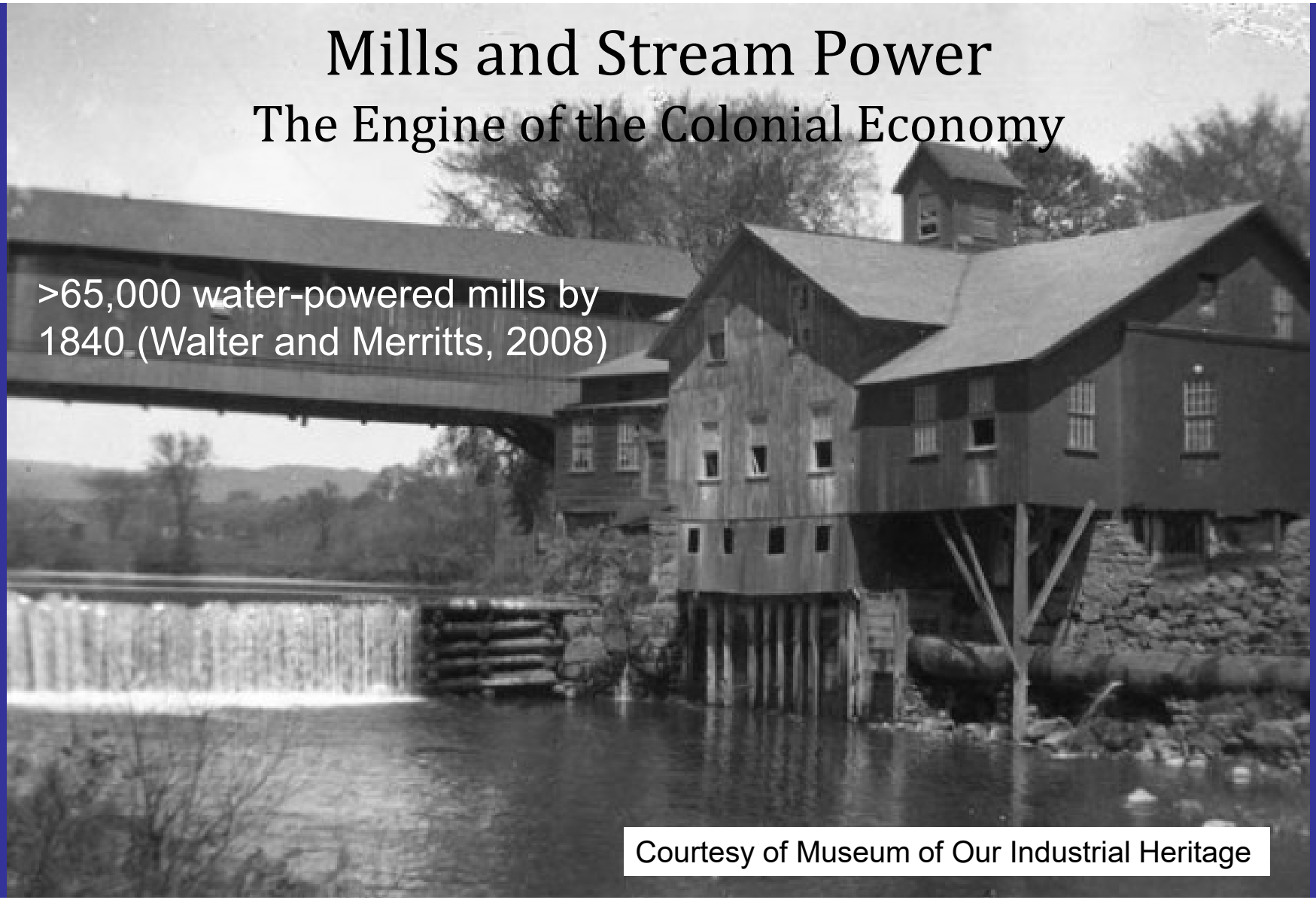
Land Clearance

Near-total deforestation (Cronon, 1983)

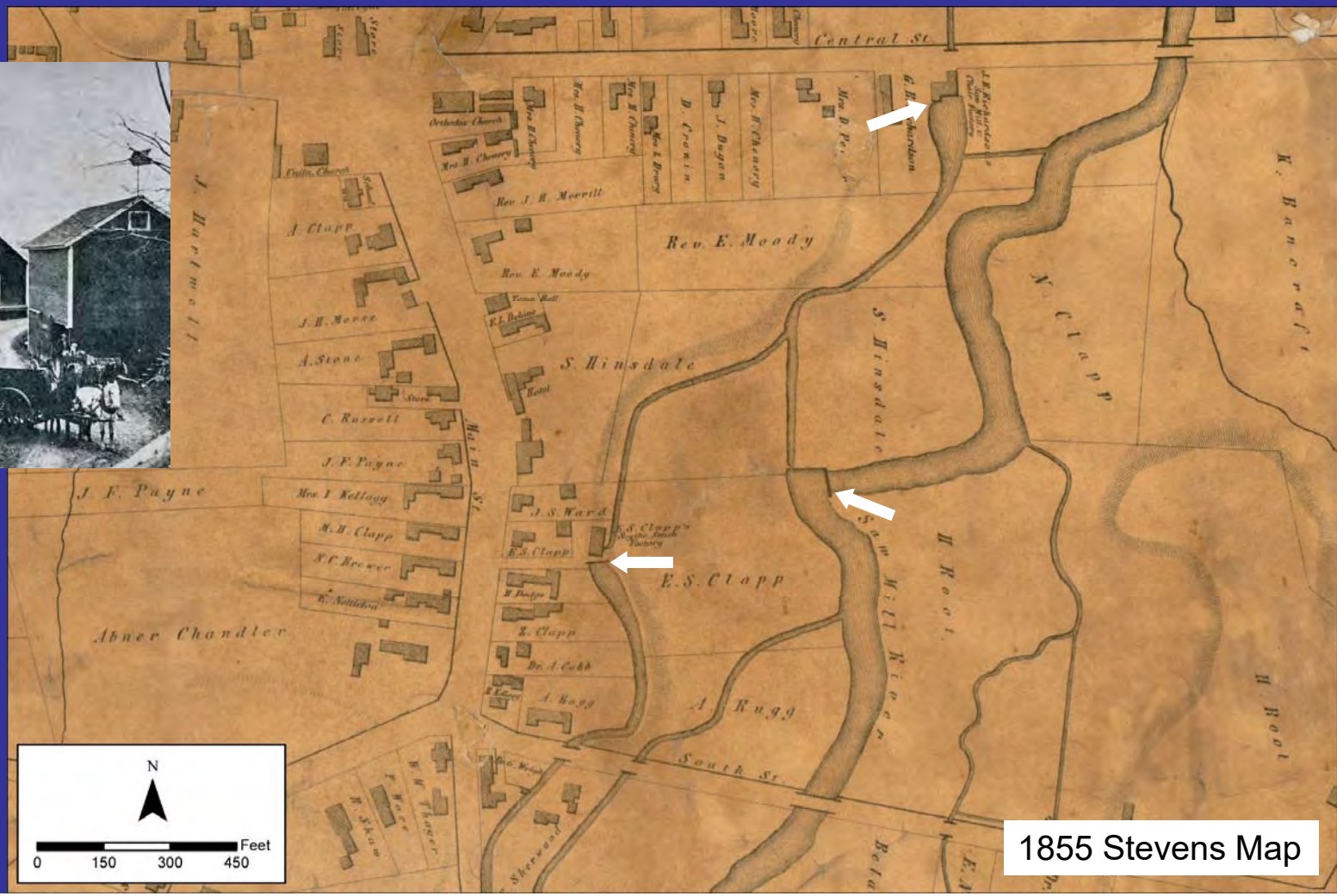
http://www.uvm.edu/landscape

Mills and Stream Power

The Engine of the Colonial Economy



Sawmill River – Montague, MA



1855 Stevens Map

Legacy sediments

Channel Straightening

Channel Straightening

Berms / Loss of Floodplain Connection

Encroachments

Development

Watershed Assessment Findings

Straightened channels

- 67 - 72% straightened

Unstable banks

- 25 - 29% eroding
- 9 - 14% armored

Mill dam legacy

Legacy of straightened channels

In Summary: It's all about the Sediment!

- Land clearance mobilized sediments from the uplands and delivered them to valley bottoms
- Sediment trapped in old mill ponds
- Straightened channels increased sediment transport
- Impaired floodplain connection = reduced sediment storage opportunities

Benefits of Floodplains to Stream

- Act as safety valve during floods by reducing velocities and the stream's power to erode
- Provide sediment storage
- Reduce flood peaks and increase base flow
- Provide access to side channel and wetlands habitat and velocity refuge during high flows

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River Corridor

- The area the river requires to achieve equilibrium conditions
- Includes active channel, associated bars and wetlands and portion of the floodplain, terrace or adjacent slope

Equilibrium

River channel dimensions adjusted to prevailing watershed conditions - through erosion and deposition of bed and banks

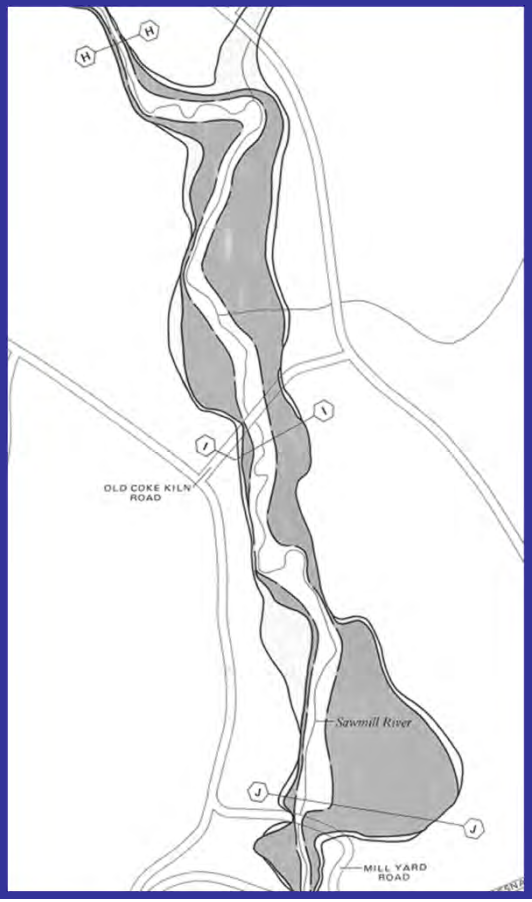
Post-Irene = Rivers continue to adjust

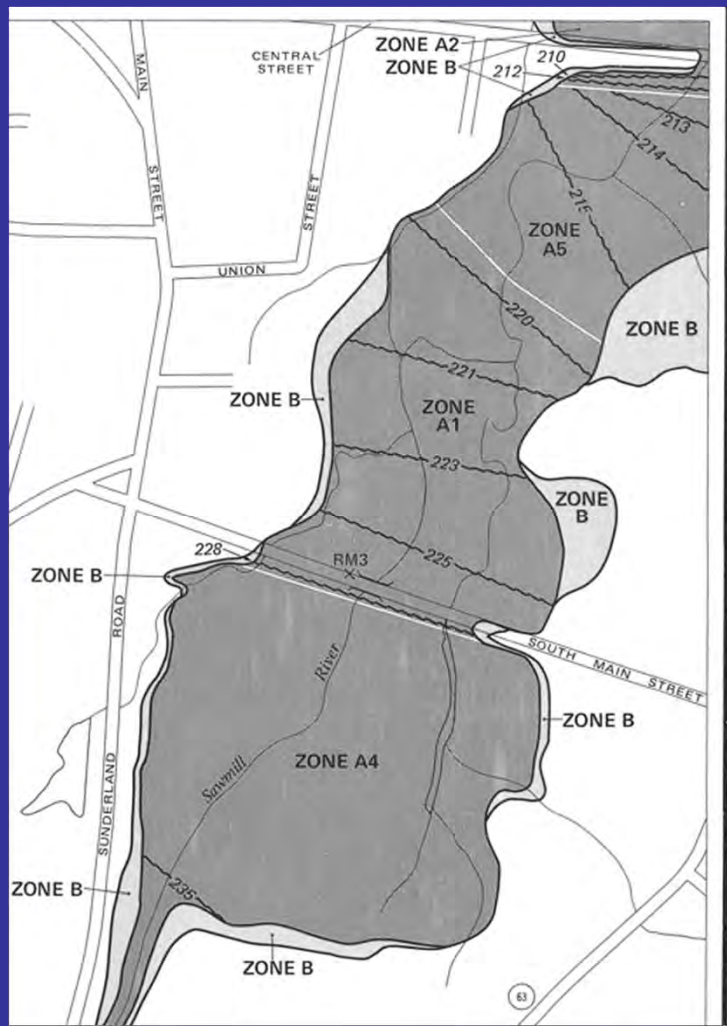
River Corridor

- Varies in width depending on stream size, valley conditions (slope and confinement), sediment load and other factors

Types of Corridors / How to Define Corridor

FEMA Flood maps





KEY TO MAP

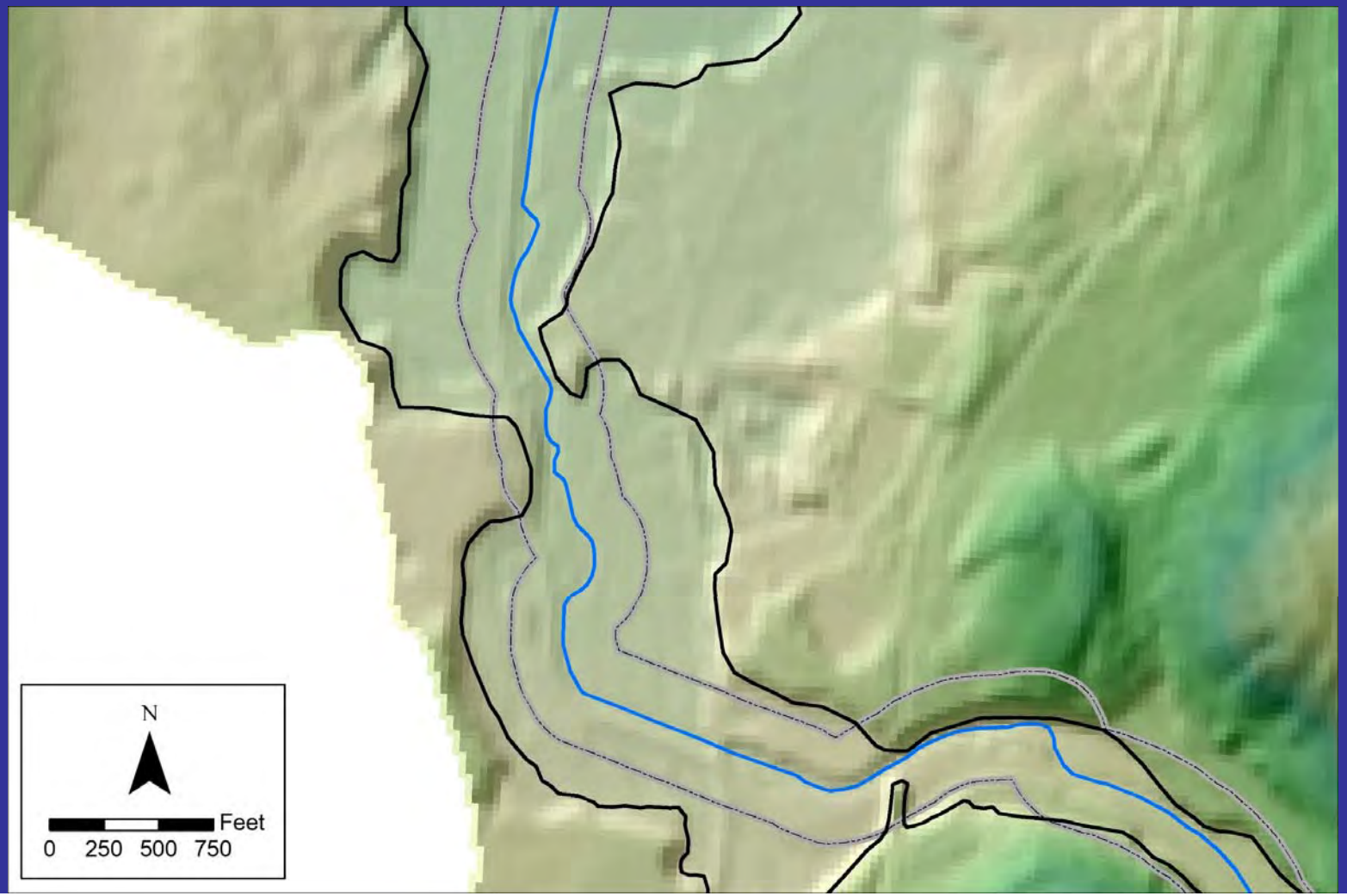
500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1 DATE / ZONE A5 DATE
Zone Designations* With Date of Identification e.g., 12/2/74	
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7 ×
River Mile	• M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

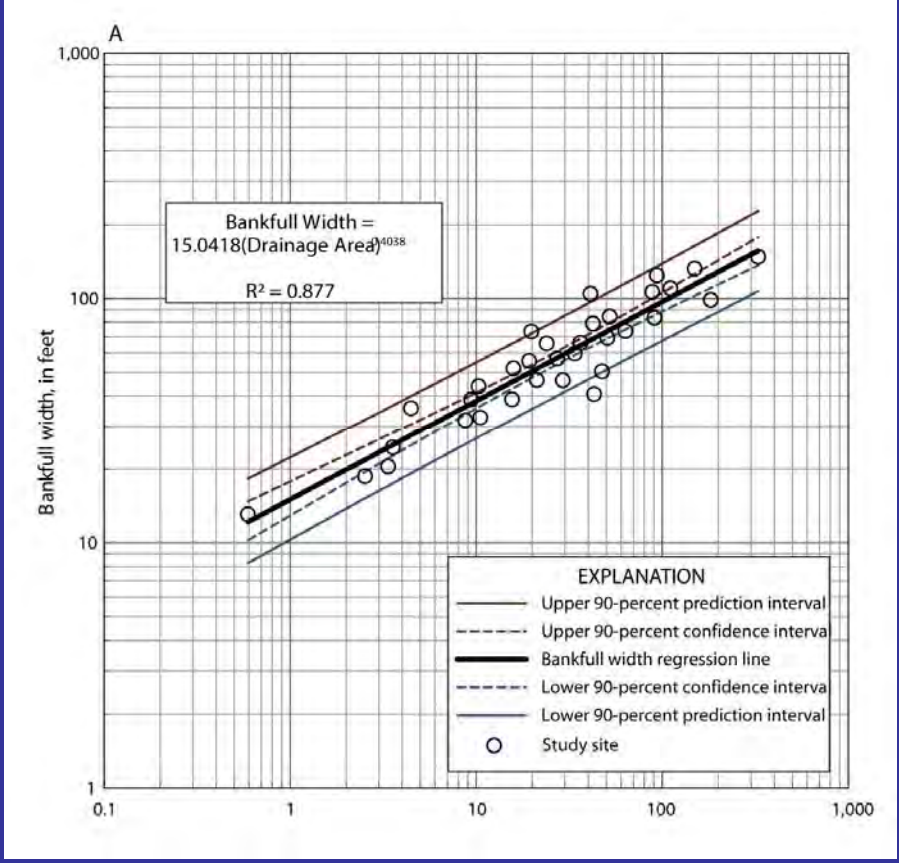
*EXPLANATION OF ZONE DESIGNATIONS

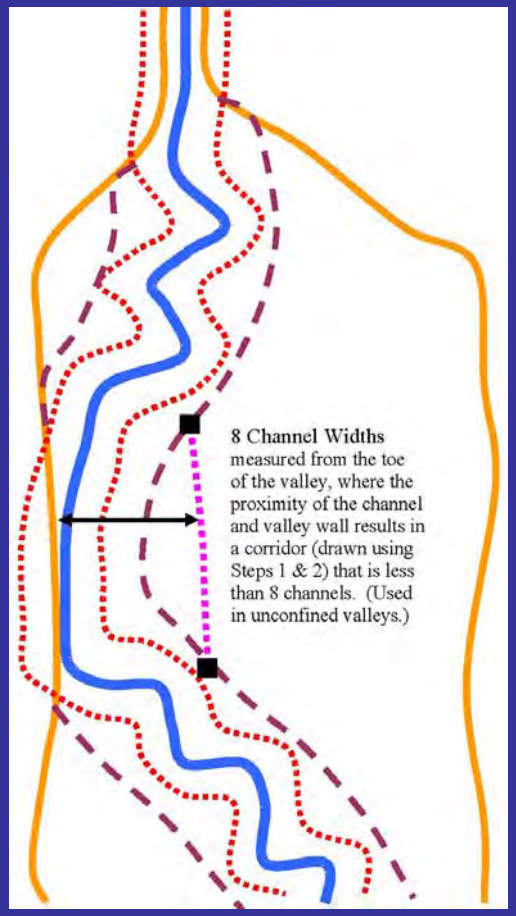
ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

Rivers Protection Act



Vermont River Corridor





Existing Geomorphic Stream Type[1]	Sensitivity		
	Reference or Good Condition	Fair-Poor Condition in Major Adjustment	Poor Condition, Represents a Stream Type Departure
A1, A2, B1, B2	Very Low	Very Low	Low
C1, C2	Very Low	Low	Moderate
G1, G2	Low	Moderate	High
F1, F2	Low	Moderate	High
B3, B4, B5	Moderate	*Moderate (changed from High)	High
B3c, C3, E3	Moderate	*Moderate (changed from High)	High
C4, C5, B4c, B5c	High	Very High	Very High
A3, A4, A5, G3, F3	High	Very High	Extreme
G4, G5, F4, F5	Very High	Very High	Extreme
D3, D4, D5	Extreme	Extreme	Extreme
C6, E4, E5, E6	High	Extreme	Extreme

& 6, the sensitivity has been changed to "moderate" to provide a 4 x
ultiplier when the reference stream type is maintained in Phase 2. A "high"

determining River Extent by Assessing Landforms

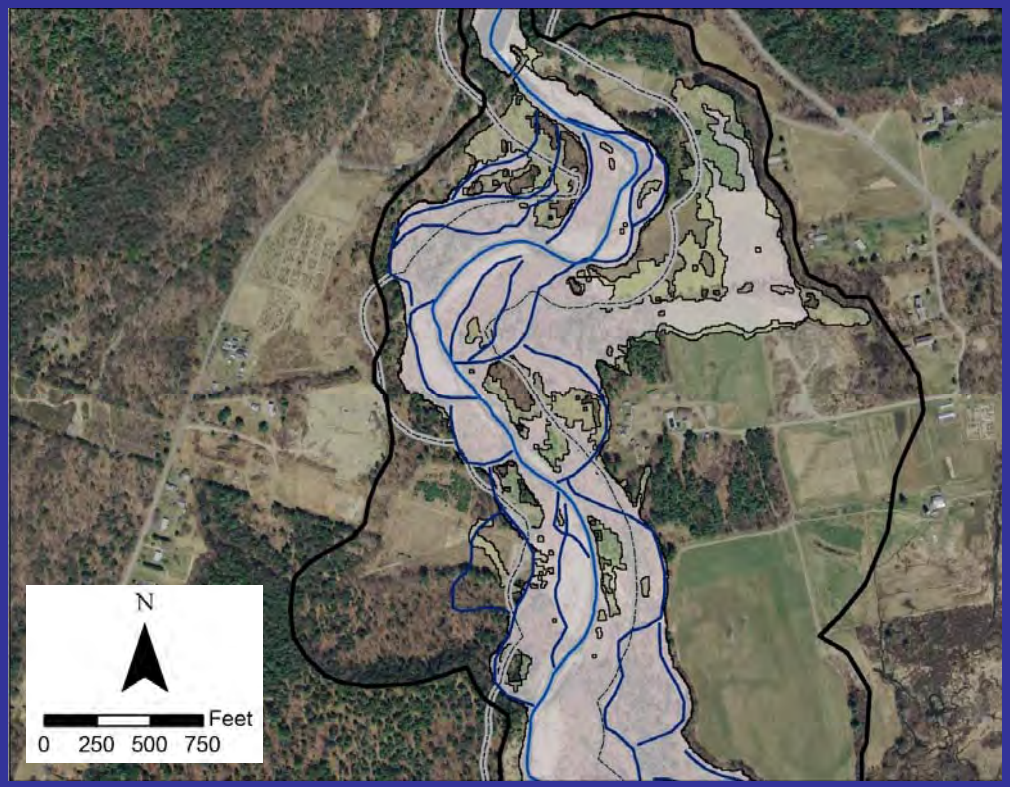
or

REAL Corridor Maps

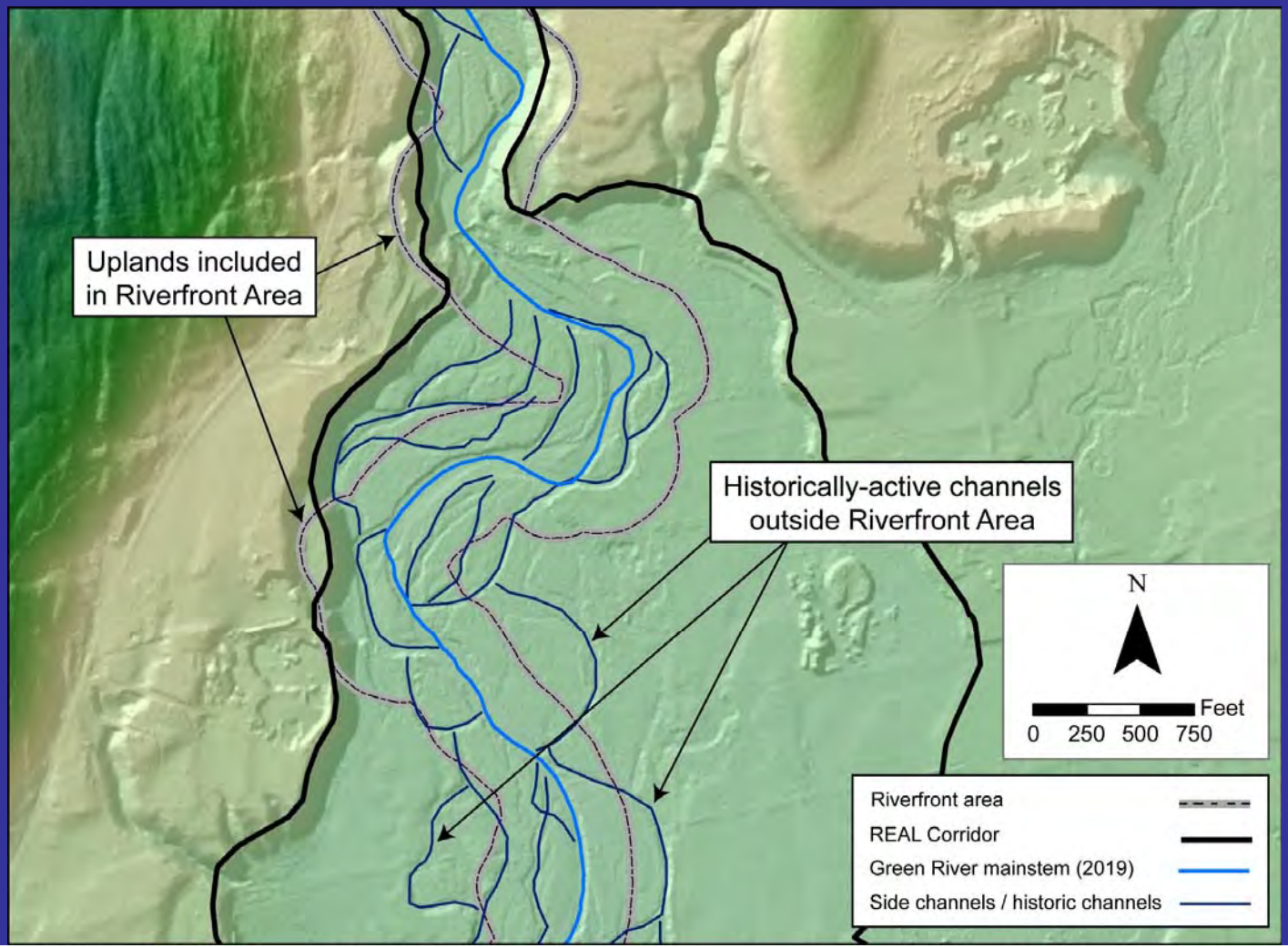
REAL Corridor Maps

- More readily understandable
- Based on physical features observable on the ground
- Local residents more likely to “buy in” to approach

REAL Corridor



Corridor comparison



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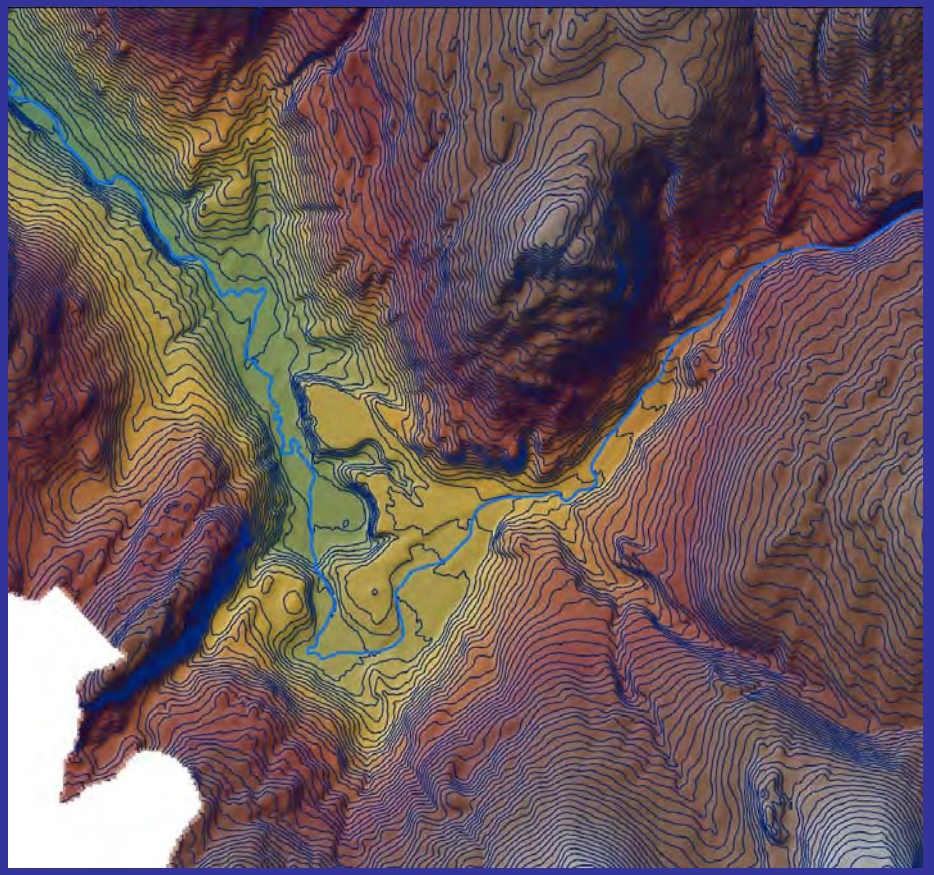
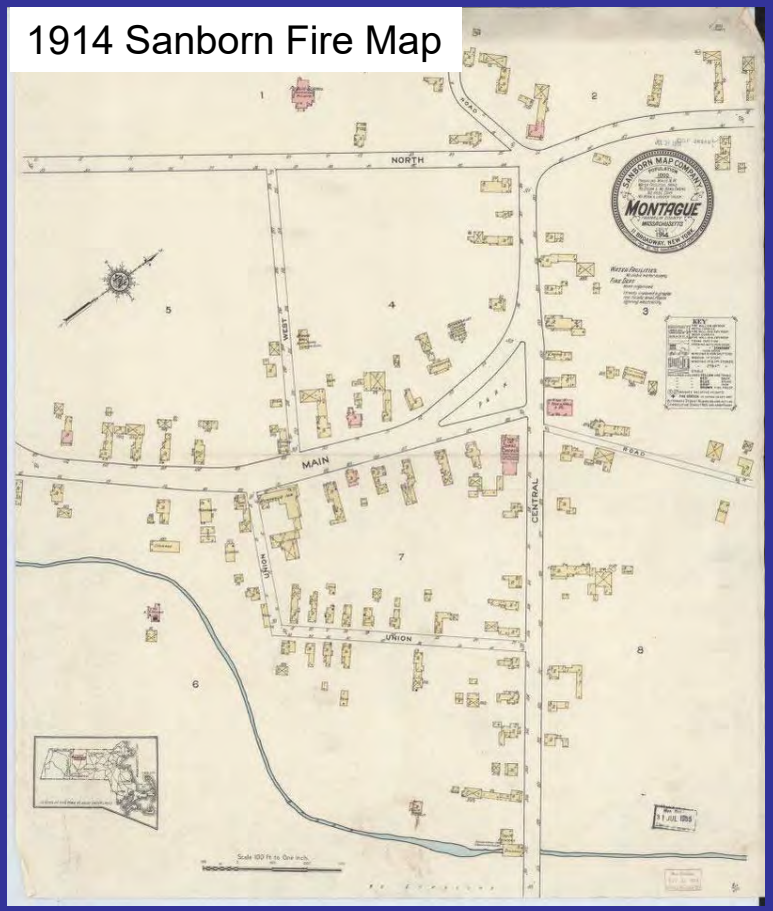
Step 1 – Gathering resources

- Topographic maps
- Aerial photographs
- Archival information
- Soils and surficial geology maps
- FEMA studies
- LiDAR data



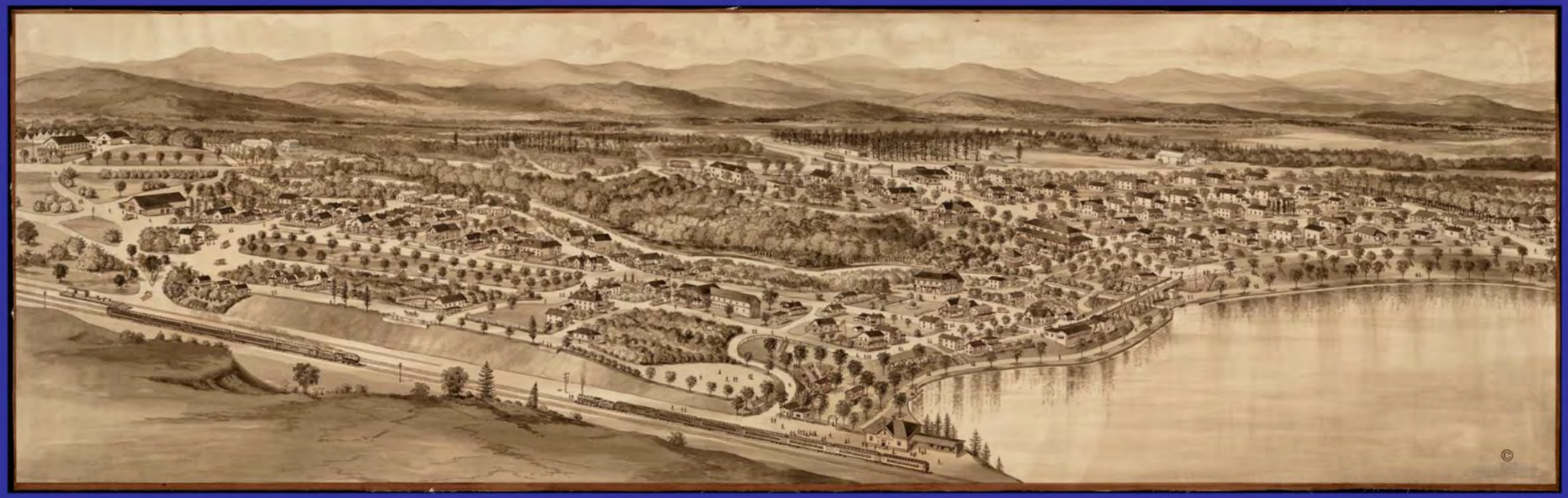
Historic maps and archival sources

1914 Sanborn Fire Map



1830 Leverett Map

Historic maps and archival sources



Oblique aerial view of Lake Pleasant circa 1900

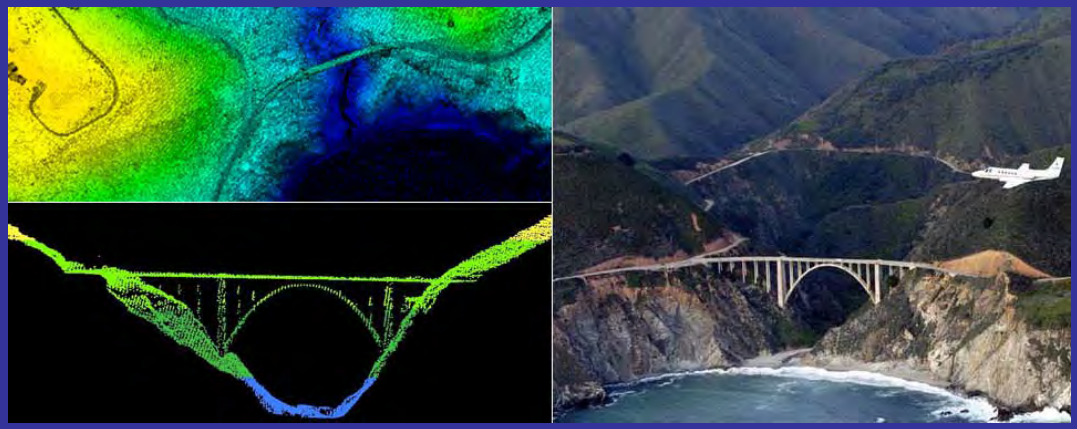
Historic maps and archival sources

Millers River 1938

Montague City 1936

Courtesy of Montague Historical Society: https://montaguearchive.org/

LiDAR = Light Detection and Ranging

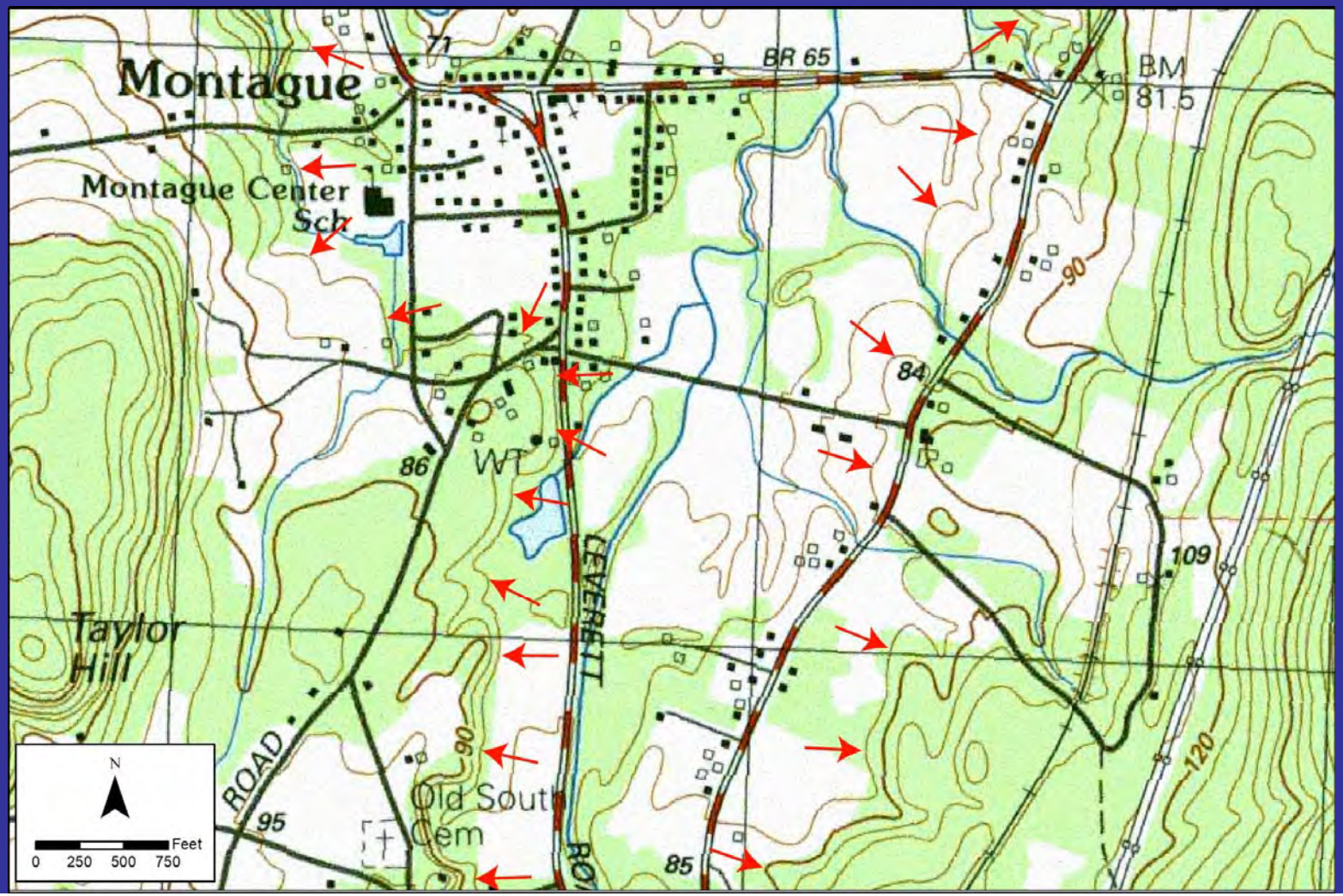


https://oceanservice.noaa.gov/facts/lidar.html

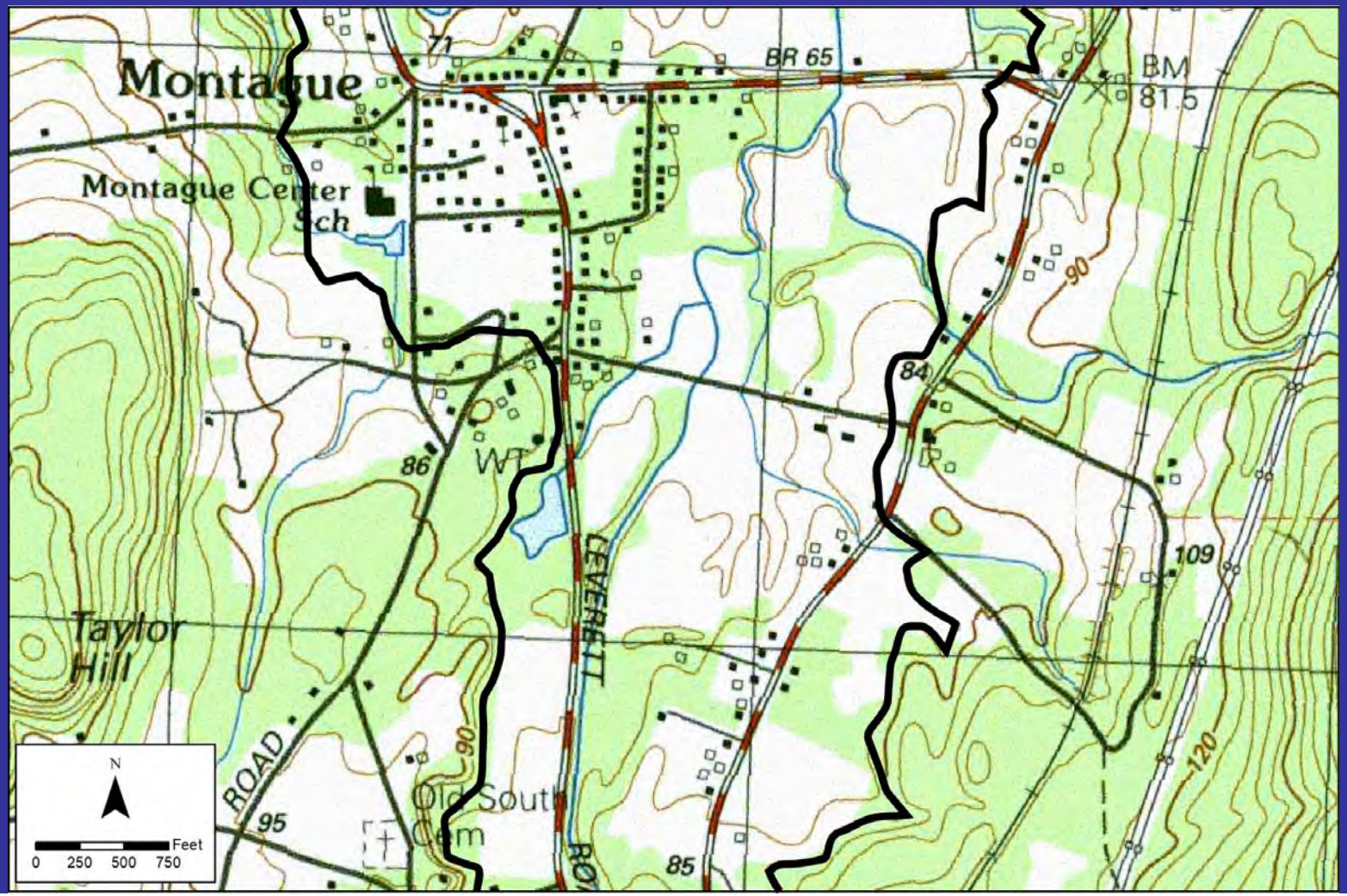
- "Remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth." (noaa.gov)

- Instrument consists of laser, scanner, and specialized GPS to generate point cloud.

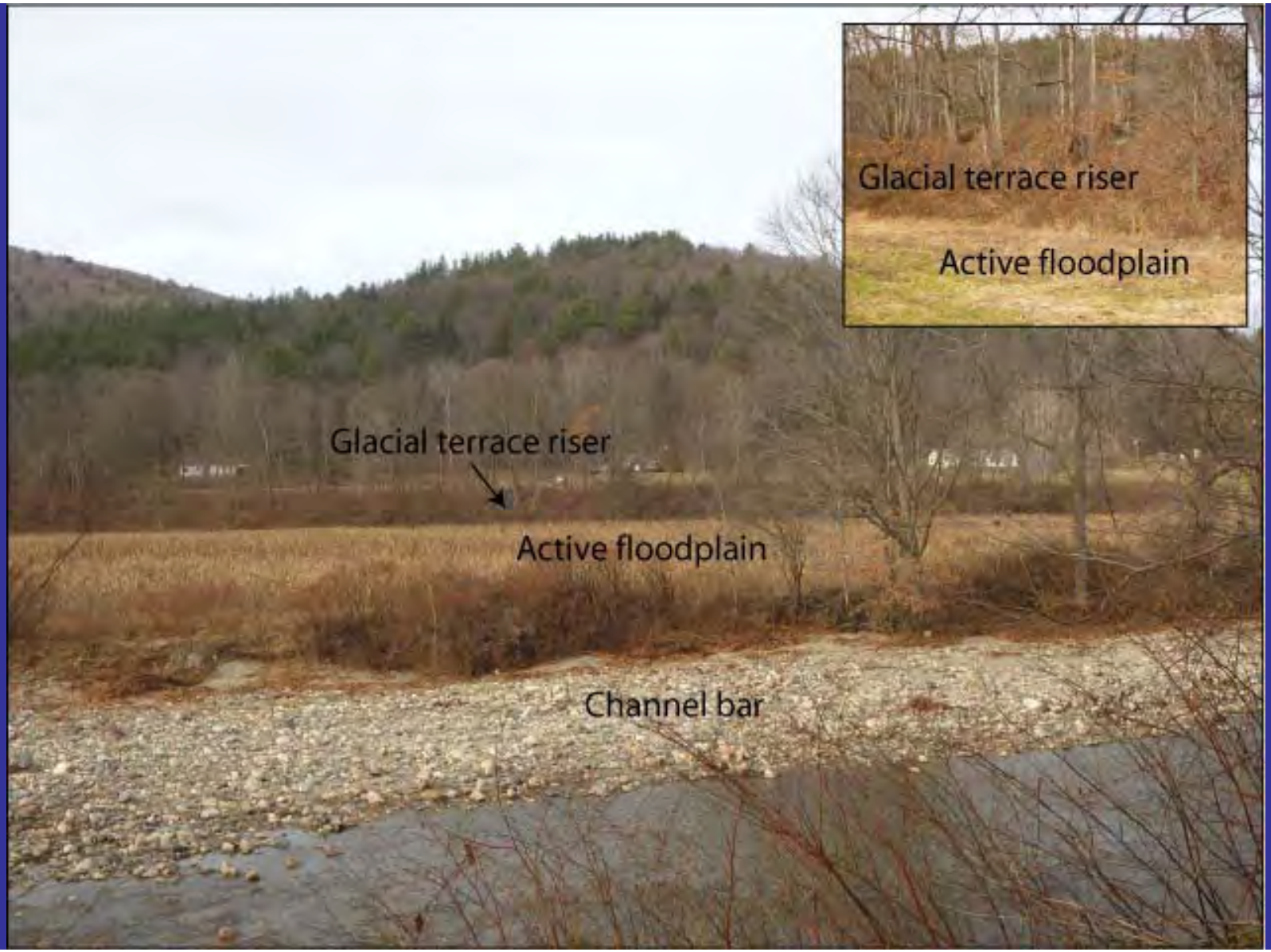
Step 2 – Delineate the valley margins



Step 2 – Delineate the valley margins

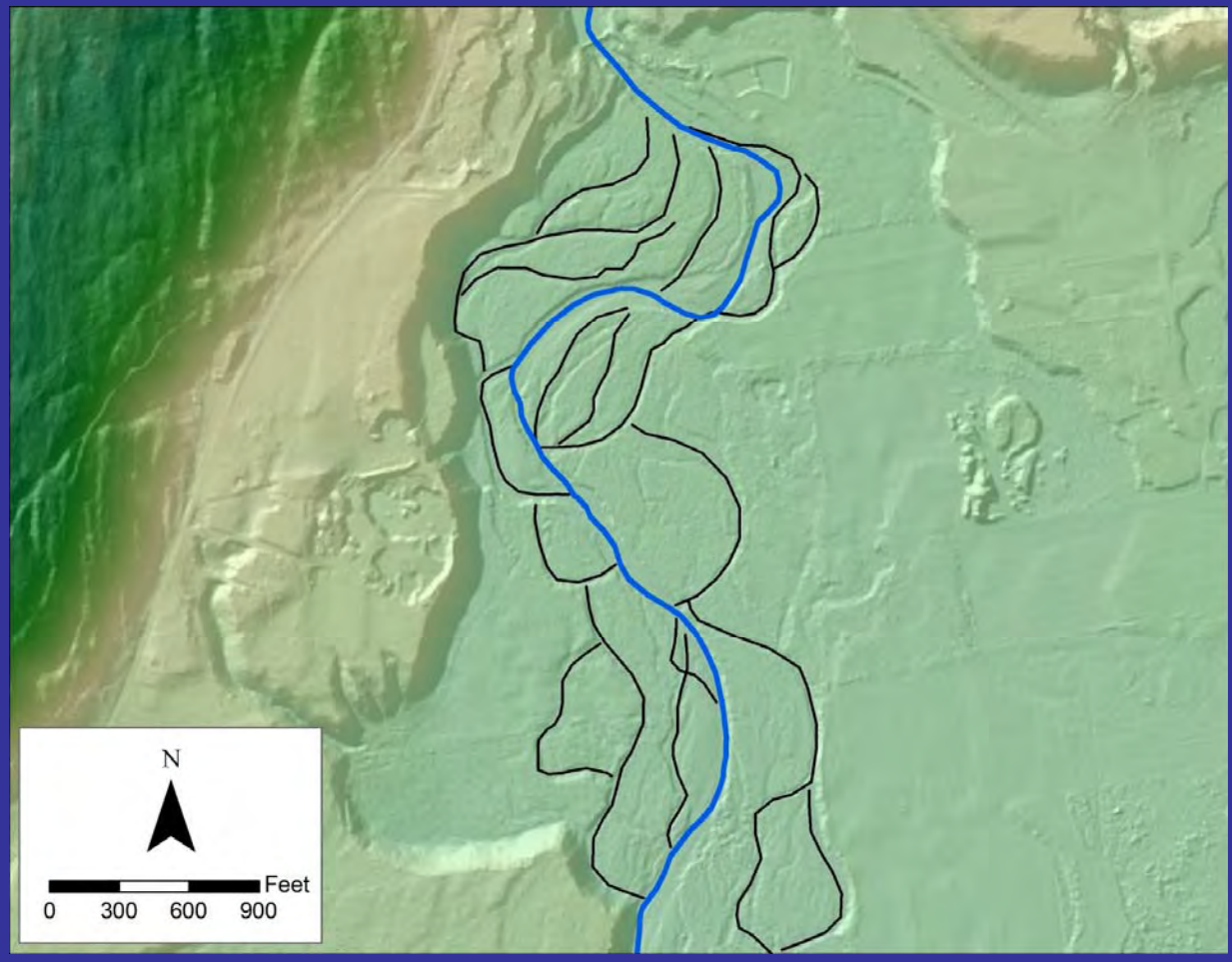


Step 3 – Delineate terraces


Glacial terrace riser
Active floodplain
Glacial terrace riser
Active floodplain
Channel bar

Step 4 – Identify former channel positions

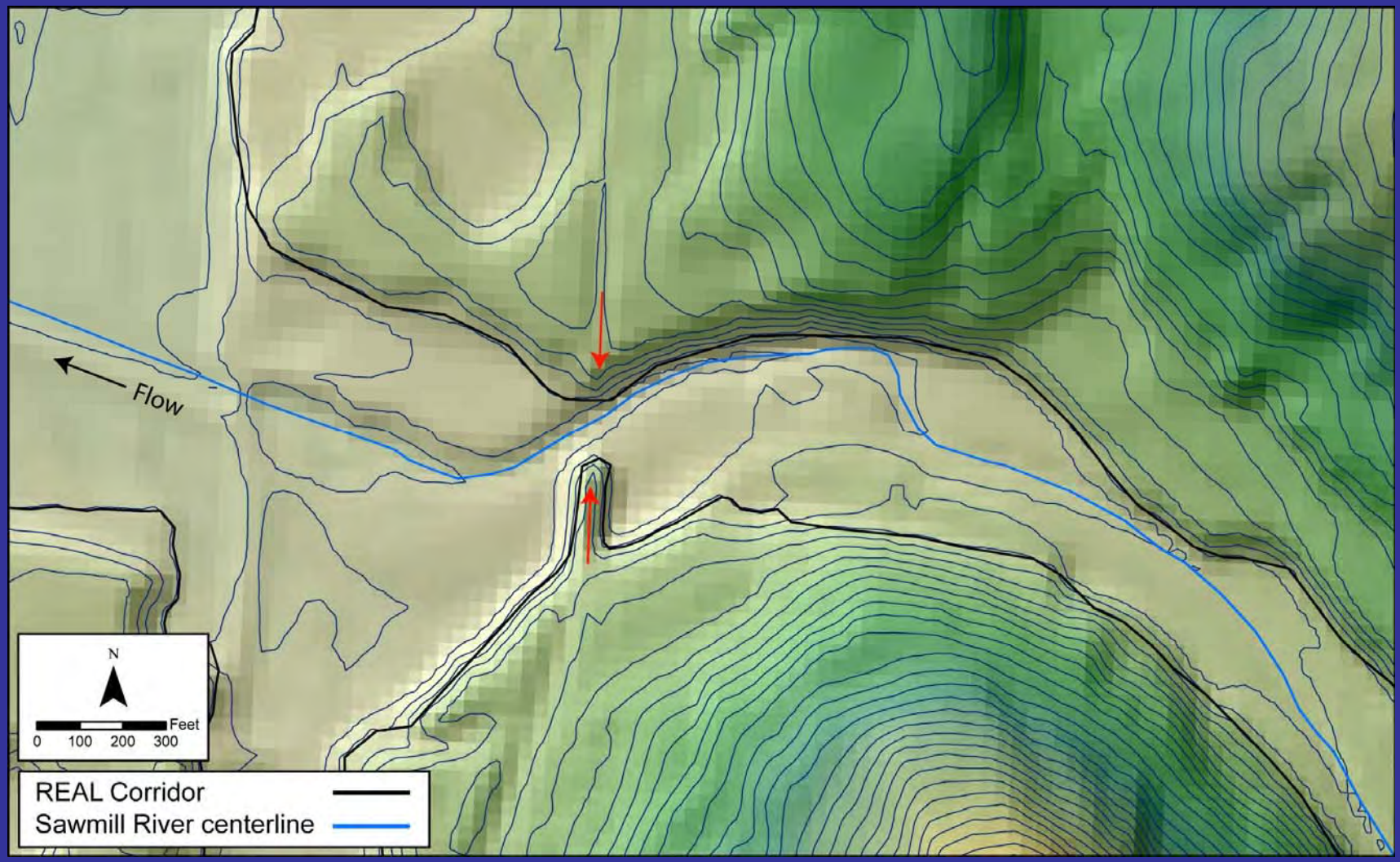
- Demarcate outer limits to define the river corridor



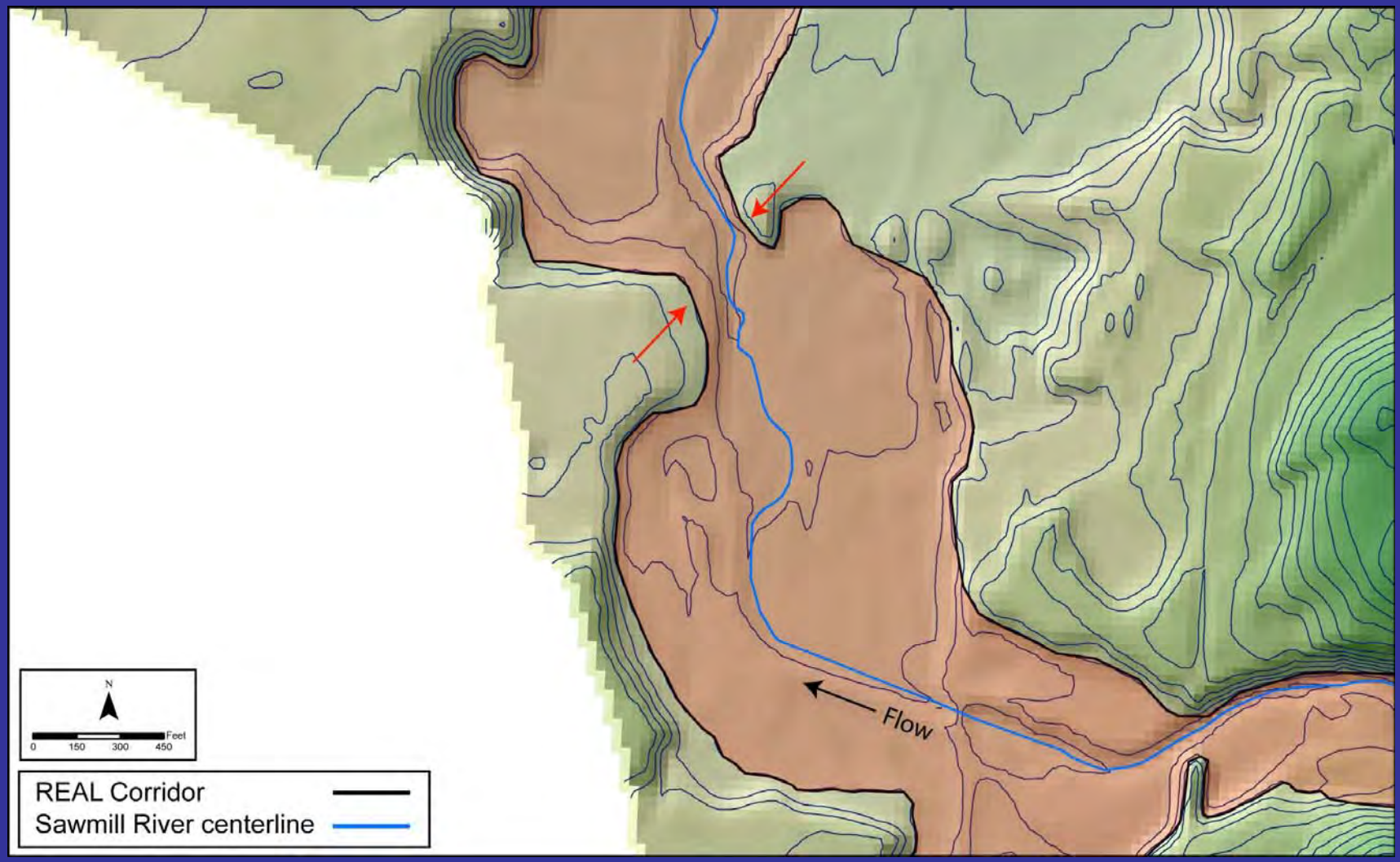
Step 5 – Highlight high risk areas

- Valley and channel constrictions
- Adjacent to straightened channels
- Tributary confluences

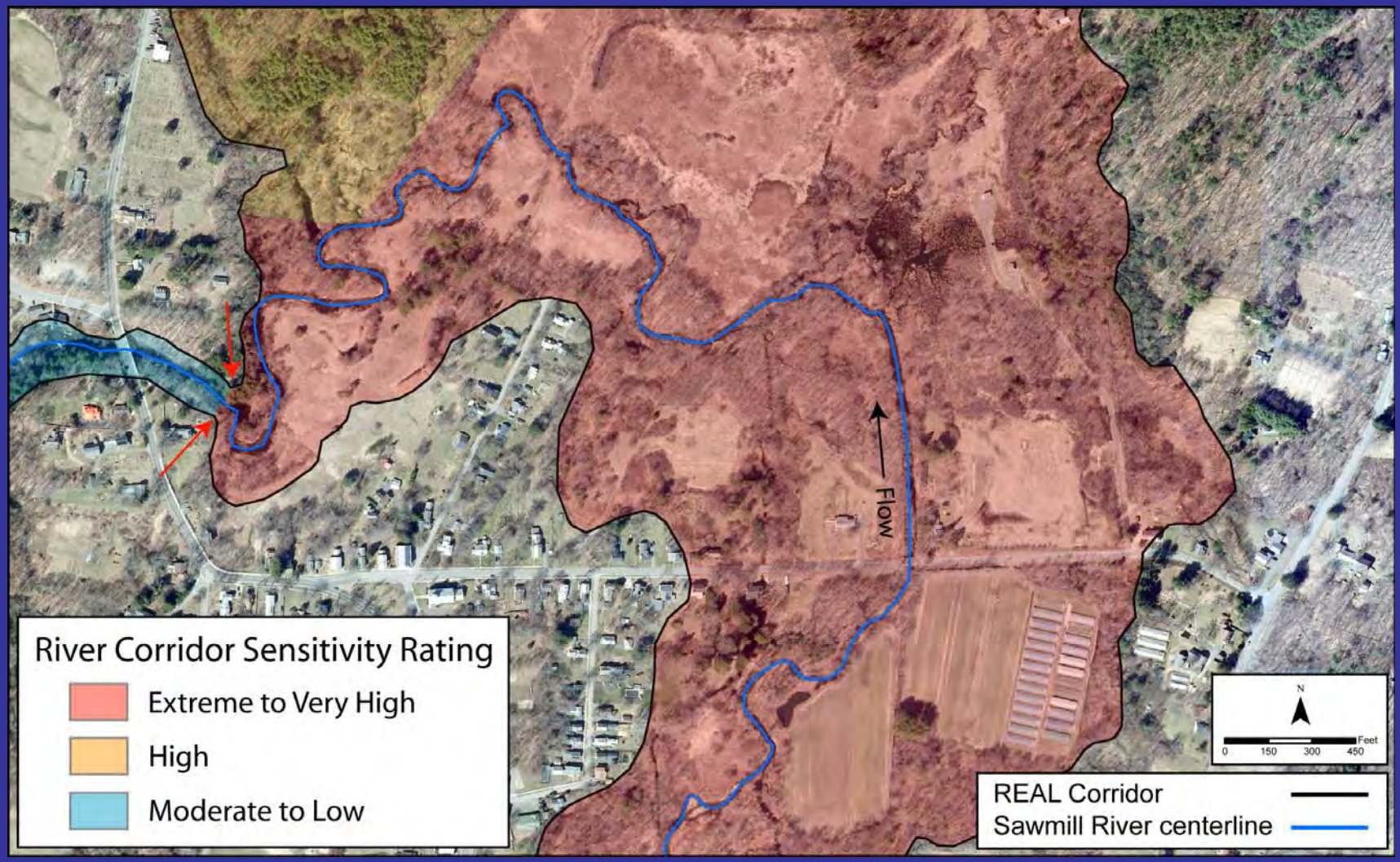
Channel constriction



Valley constriction

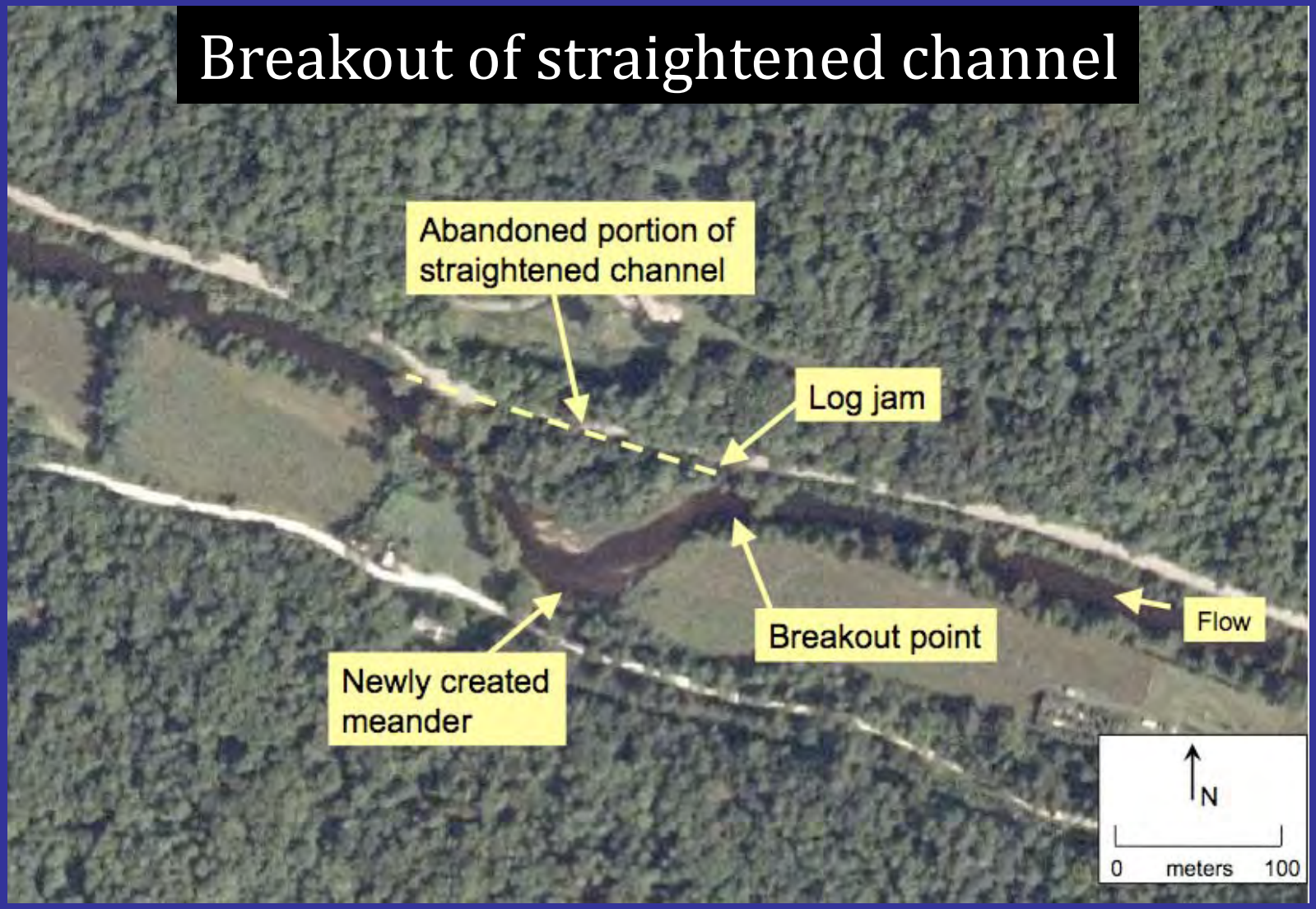


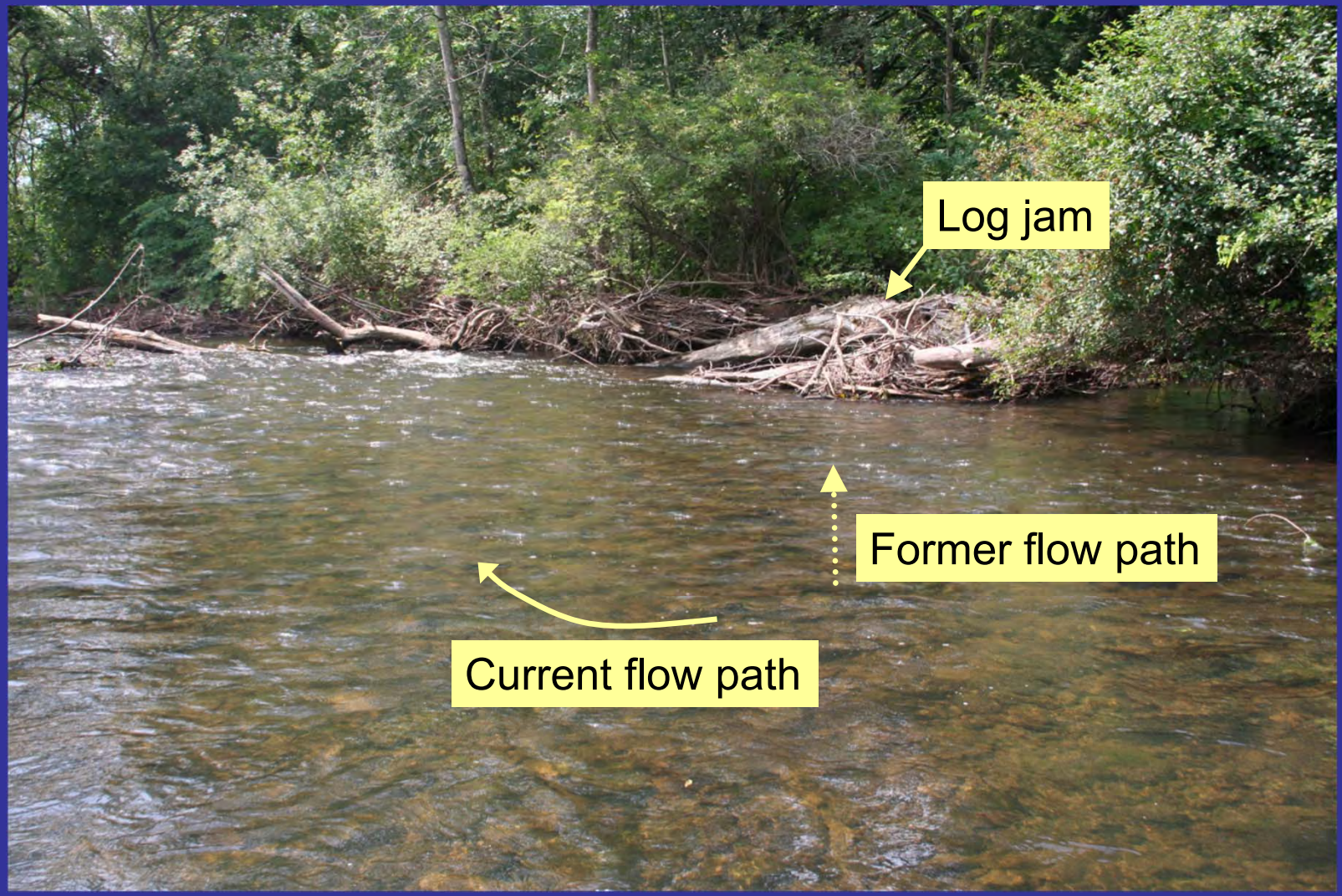
Valley constriction

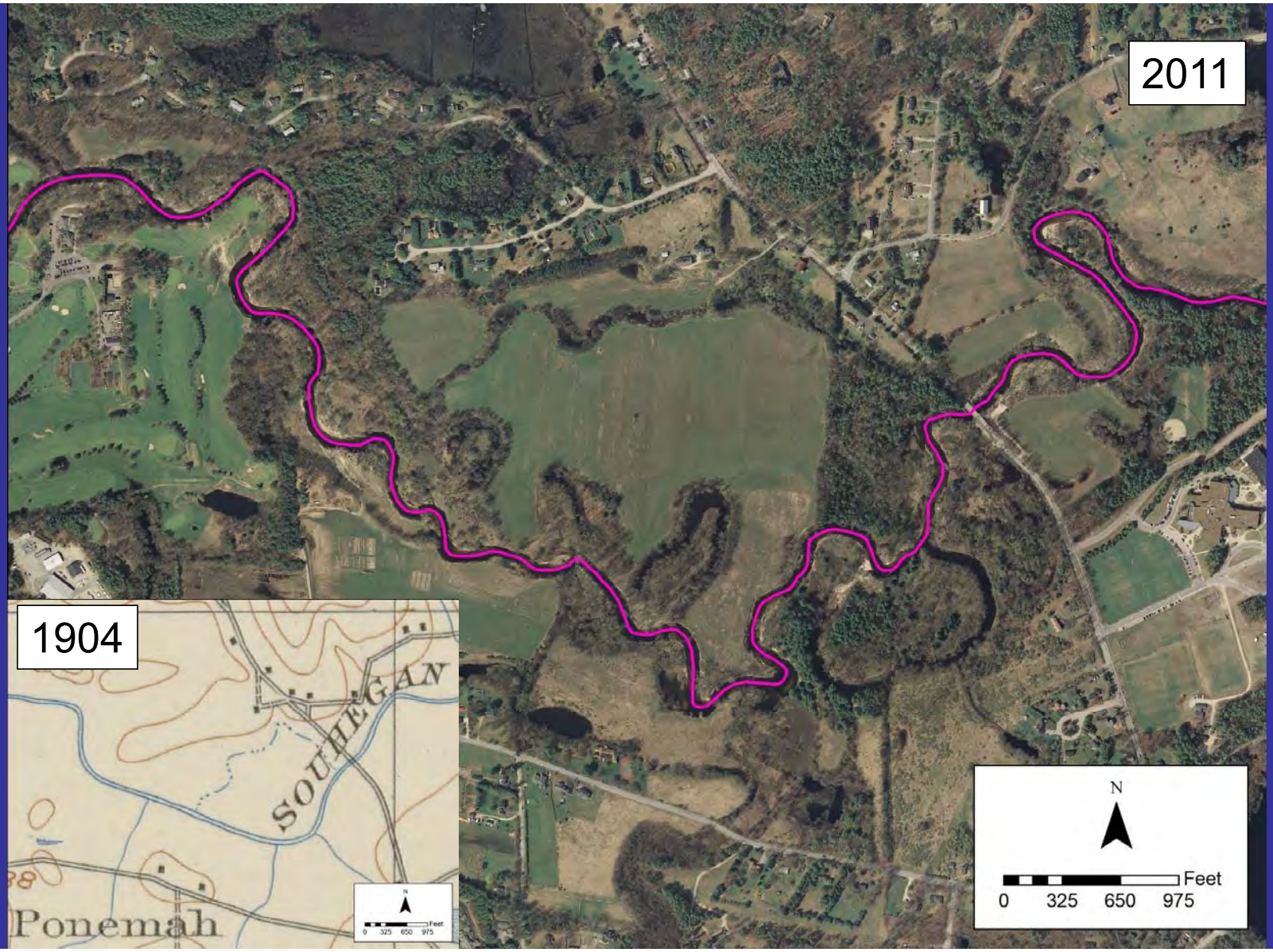


Tributary confluence

Breakout of straightened channel




Log jam
Former flow path
Current flow path


2011
1904
SOUHEGAN
Ponemah
N
Feet
0 325 650 975

Step 6 – Field verification of corridor boundaries

- Presence of terraces
- Evidence of channel migration / flow paths


Side channel
Main channel
Side channel


http://www.watershedmanagement.vt.gov/rivers/docs/rv_ireneimages.pdf

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Inundation hazards

Erosion hazards

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Potential Uses of River Corridor and Fluvial Erosion Hazard Data

- Mitigate risks of fluvial erosion
- Minimize impacts of flood inundation

River Corridors as a Tool to Minimize Risk

- Avoiding conflicts is the most cost-effective strategy for mitigating fluvial erosion hazards
- Repairing and replacing infrastructure is expensive

How?

- Identify areas susceptible to erosion
- Identify sediment sources and storage opportunities
- River corridor protection opportunities
- Identify stream and floodplain restoration projects

River Corridor Easement – Bristol, VT

- 40.1 acres on New Haven River
- 3,900 ft river frontage
- Managed hayfield, floodplain forest and actively meandering, avulsing stream channel
- Landowner, who had farmed land for generations, pursued easement after damages from Tropical Storm Irene
- Town has protected land with goals of building flood resiliency and providing public river recreation

Restoration Projects

- Address local site specific concerns such as stabilizing an eroding bank or reducing threats to infrastructure
- While addressing sediment, water quality, habitat, and other environmental concerns
- Address causes of channel instability in order to reduce stresses on adjacent stream segments
- Move stream towards an equilibrium condition

Restoration Projects - Examples

- Store sediment and water in the headwaters (chop and drop wood additions, wetland restoration)
- Floodplain reconnection (floodplain lowering, berm breaching/removal, side channel activation)
- Riparian buffer establishment/enhancement
- Removing constraints (upsizing bridges and culverts, dam removal)
- Flow deflection techniques as alternative to hard armoring

Chop and drop

Floodplain reconnection

Riparian buffer enhancement

Riparian buffer enhancement

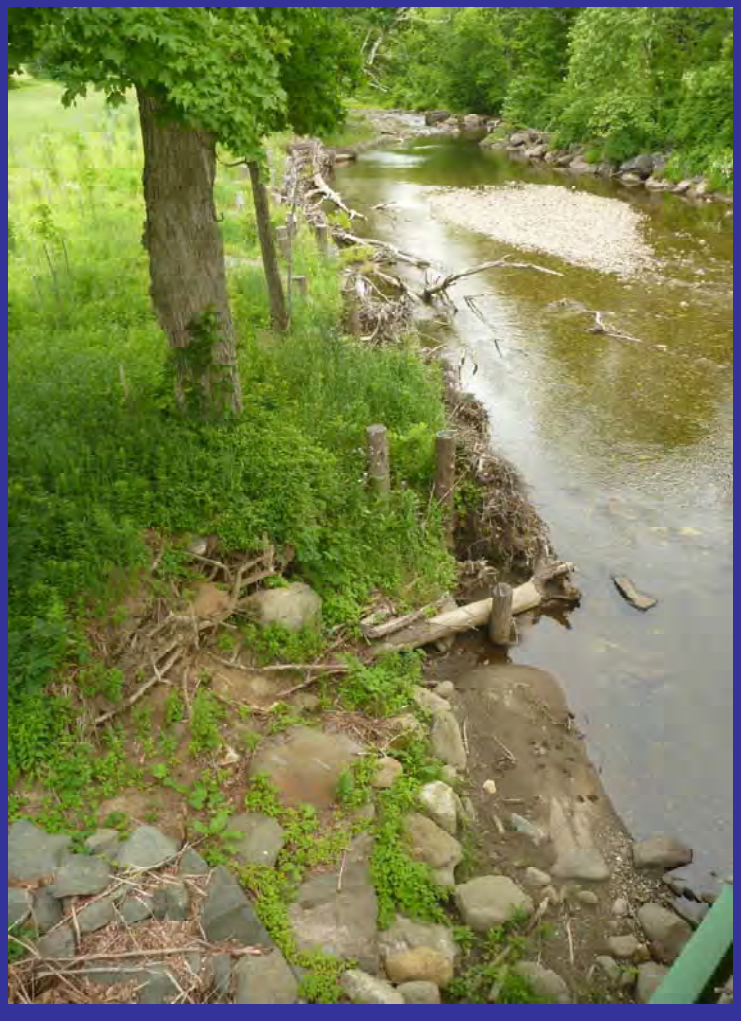
FOREST4_ST1_1_2019

FOREST4_ST1_1_2020

FOREST4_ST1_1_2021

Log jams – Flow deflection

Wood buttress – Flow deflection



Wood buttress – Flow deflection

Before…

…and after

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Outreach and Future Work

- Engage with landowners to learn about their experiences with flooding, erosion, and river-related impacts to land use on their parcel
- Educate about Best Management Practices (ie. riparian buffers) and fluvial geomorphic processes (ie. instream wood is good, so are beavers) that are essential for maintaining good habitat values and building climate resiliency
- Identify opportunities for BMP implementation (ie. restoration and/or enhancement)
- Prioritize stream segments for restoration/enhancement treatments
- Prioritize parcels for conservation
- Work with landowners and local land trusts to advance a selection of the priority restoration and conservation sites

Questions?