MILONE & MACBROOM

TRIBUTARIES WORKSHOP

PLATTEKILL AND SAWKILL CREEKS

Plattekill Creek in West Saugerties

Sawkill Creek in Woodstock

PRESENTED BY: Jim MacBroom, PE & Mark Carabetta

SPONSORED BY: The Town of Saugerties

FUNDED BY: The New York Governor's Office of Storm Recovery | January 31, 2018

MEET YOUR PRESENTERS

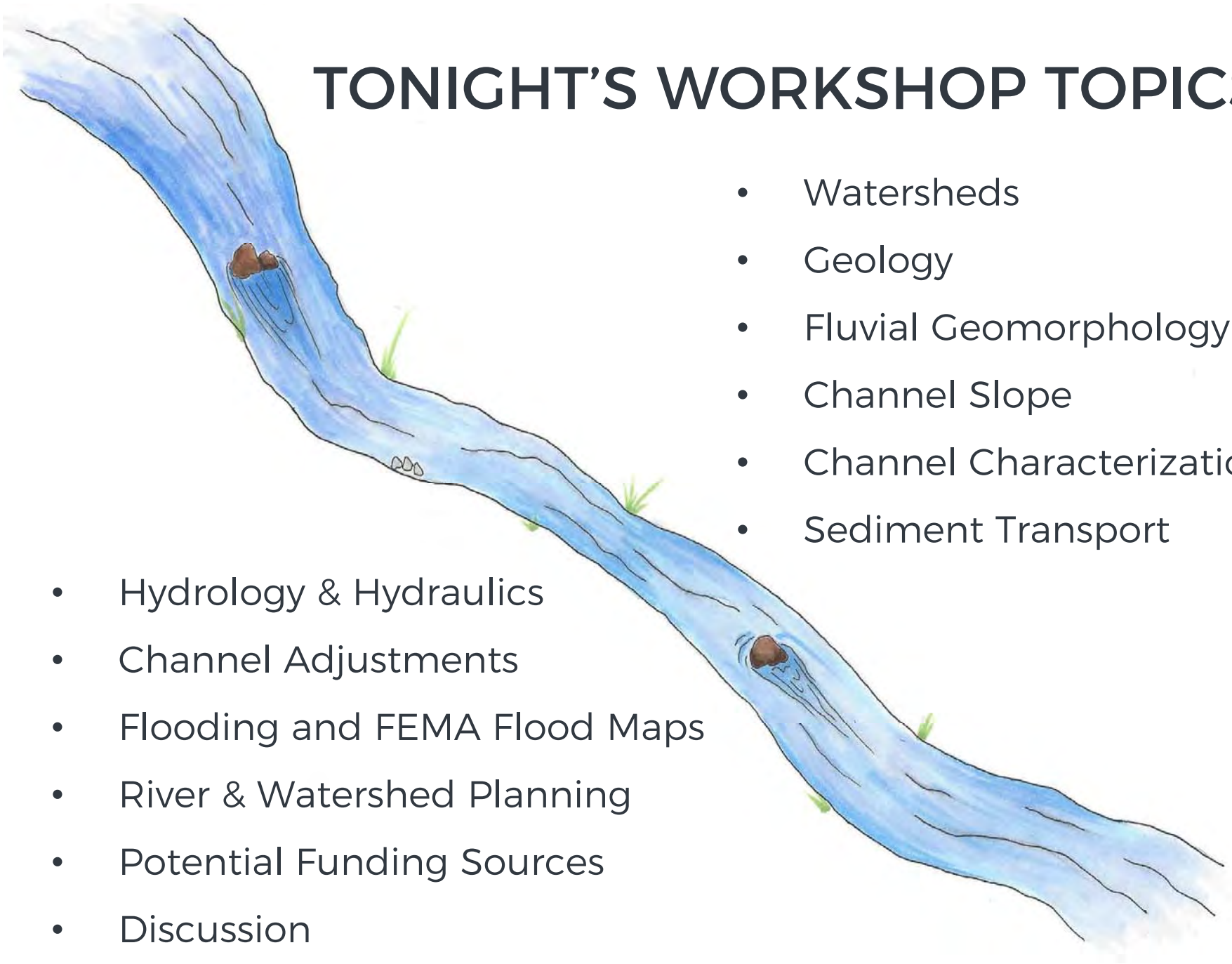
JIM MACBROOM, PE

Water Resource Engineer

MARK CARABETTA

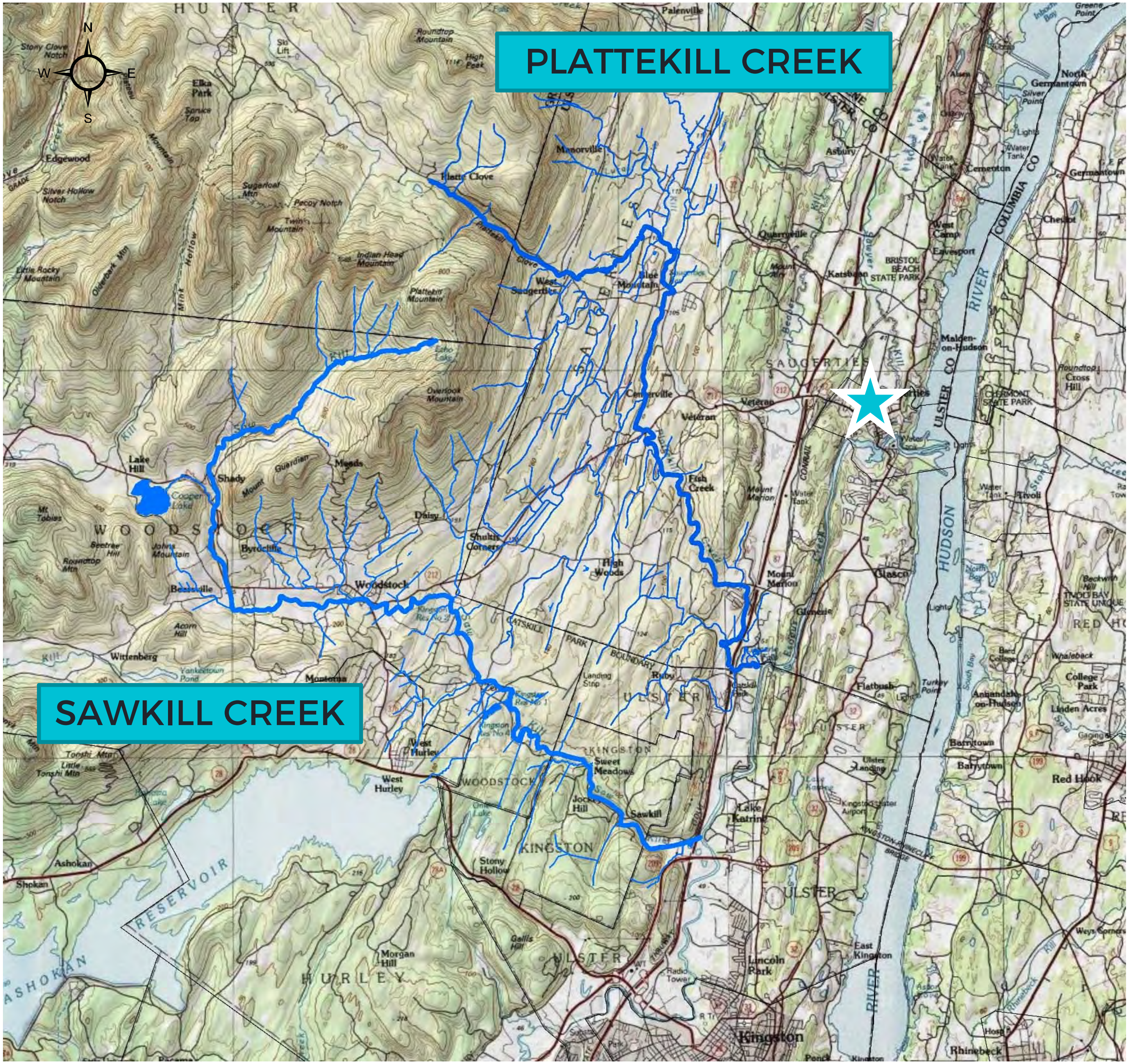
Environmental Scientist

TONIGHT'S WORKSHOP TOPICS



- Watersheds
- Geology
- Fluvial Geomorphology
- Channel Slope
- Channel Characterization
- Sediment Transport

- Hydrology & Hydraulics
- Channel Adjustments
- Flooding and FEMA Flood Maps
- River & Watershed Planning
- Potential Funding Sources
- Discussion


PLATTEKILL CREEK
SAWKILL CREEK
N
S
E
W
HUDSON RIVER
ASHOKAN RESERVOIR
Woodstock
Kingston
Saugerties

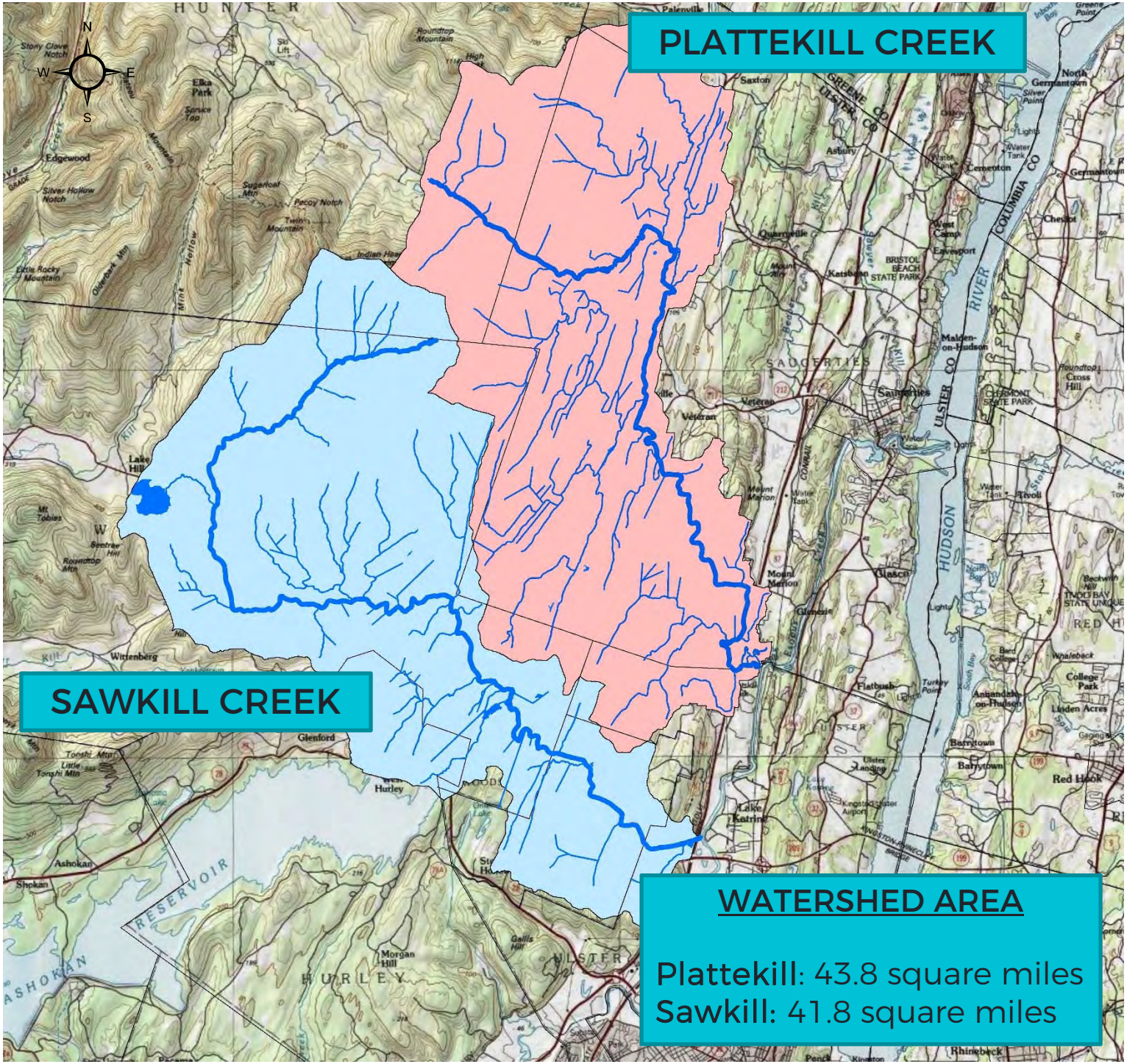
WATERSHED

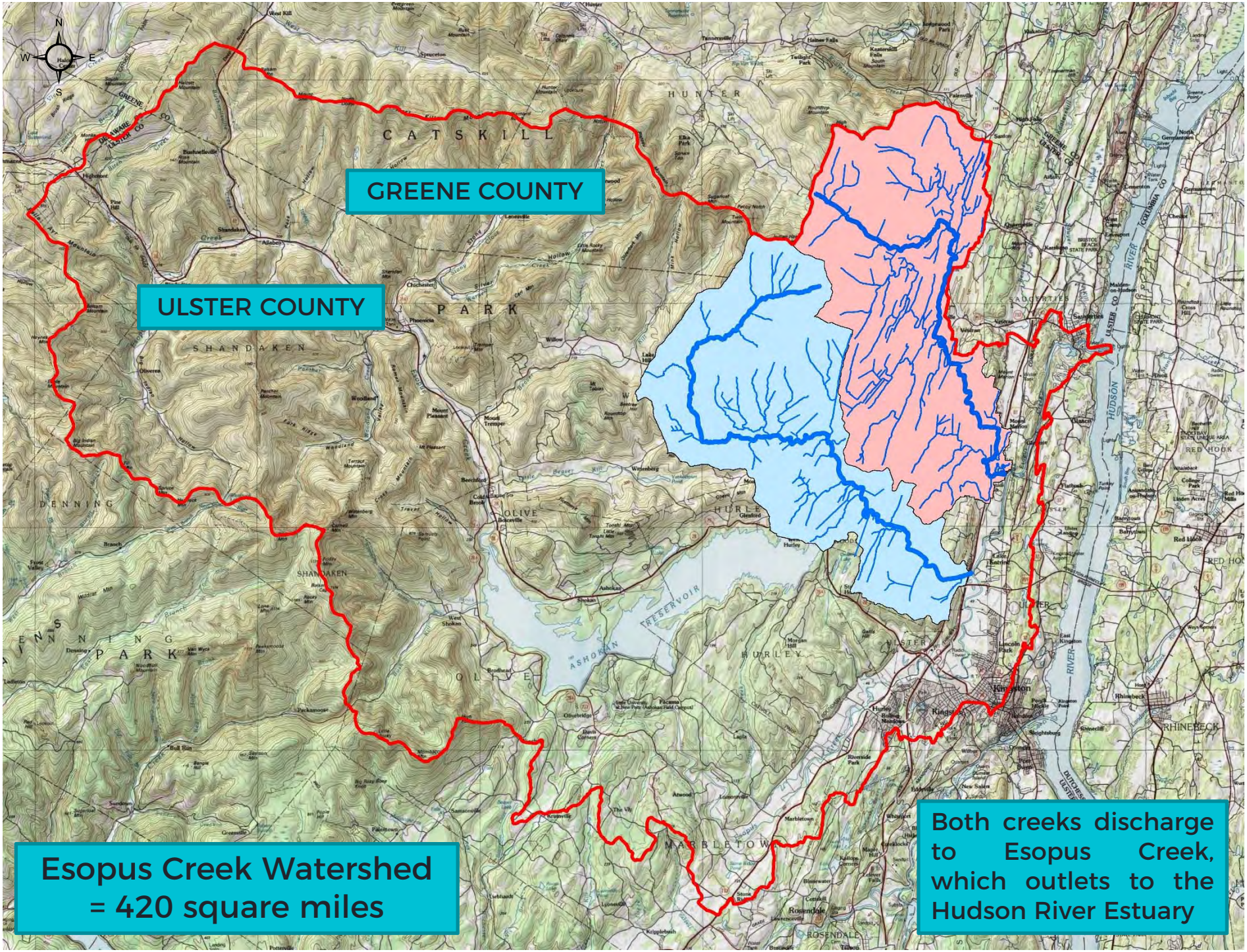
(also called *drainage basin* or *catchment area*)

A watershed is the area of land where all of the water that falls into it and drains off goes to a common outlet.

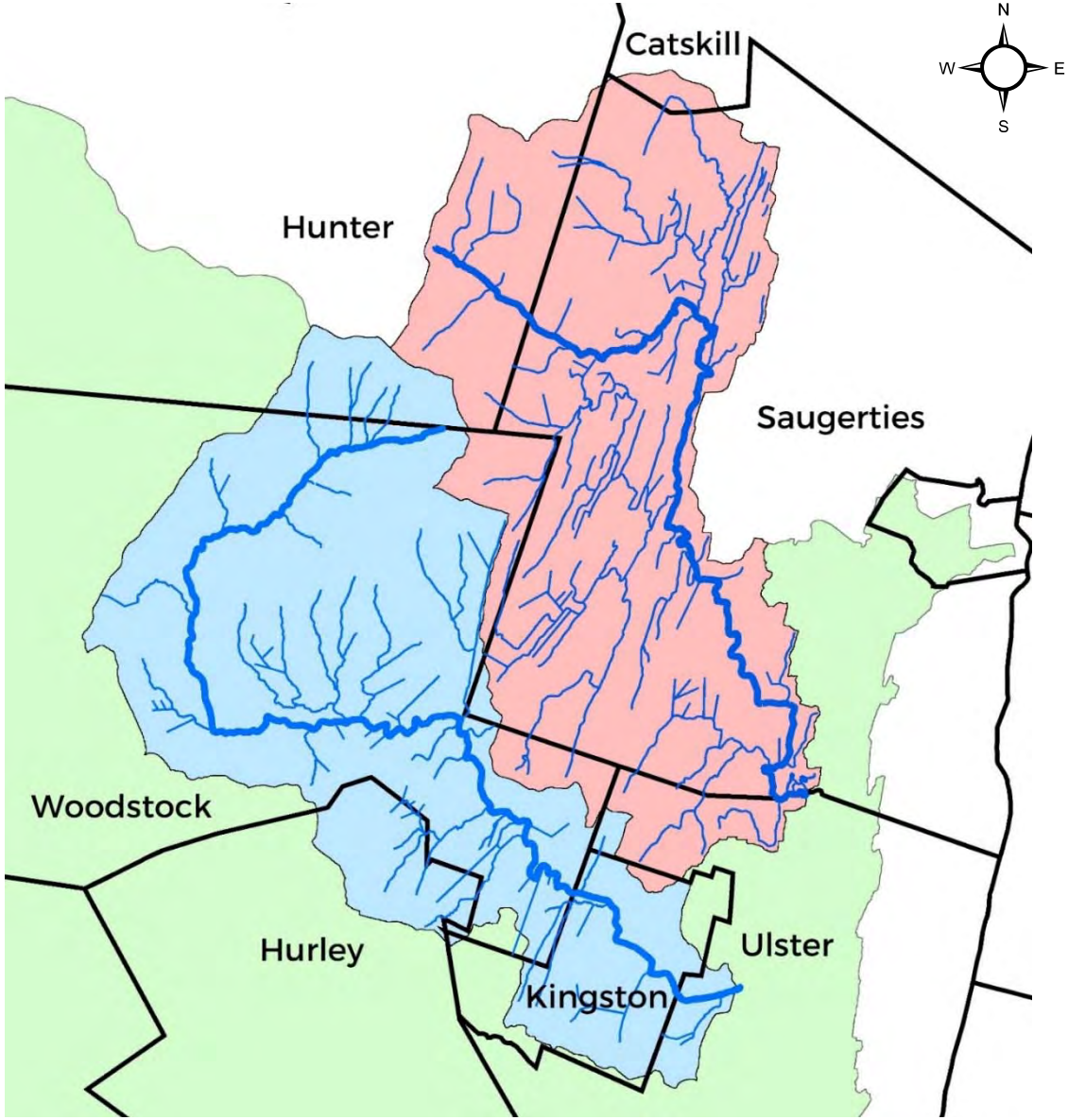
A watershed can be as small as a footprint or large enough to encompass all the land that drains water into a river.

Watersheds come in many shapes


PLATTEKILL CREEK
SAWKILL CREEK
WATERSHED AREA
Plattekill: 43.8 square miles
Sawkill: 41.8 square miles
N
S
E
W
HUNTER
HURLEY
ULSTER
SAUGERTIES
HUDSON
RIVER
RESERVOIR
ASHOKAN
Roundtop Mountain
Elka Park
Spruce Top
Edgewood
Silver Hollow Notch
Sugarloaf Mtn
Pecoy Notch
Twin Mountain
Indian Head Mtn
Overbank Mtn
Mink Hollow
Little Rocky Mountain
Lake Hill
Mt Tobias
Beetree Hill
Wittenberg
Glenford
Tonshi Mtn
Little Tonshi Mtn
Hurley
Ashokan
Shokan
Morgan Hill
Galils Hill
Saxton
Asbury
Germantown
Silver Point
Cemeton
Chestnut
Quarryville
West Camp
Ravenport
Katsbaan
BRISTOL BEACH STATE PARK
Malden-on-Hudson
Veteran
Saugerties
OLIVEBRIDGE STATE PARK
Mount Merion
Glasco
Tivoli
TIVOLI BAY STATE UNIQUE
Bard College
Annandale-on-Hudson
Flatbush
Turkey Point
College Park
Linden Acres
Barrytown
Red Hook
Lake Katrine
Kingston-Ulster Airport
Rhinebeck
Greene Co
Ulster Co
Columbia Co
Conrail


GREENE COUNTY
ULSTER COUNTY
Esopus Creek Watershed
= 420 square miles
Both creeks discharge to Esopus Creek, which outlets to the Hudson River Estuary

WATERSHED TOWNS

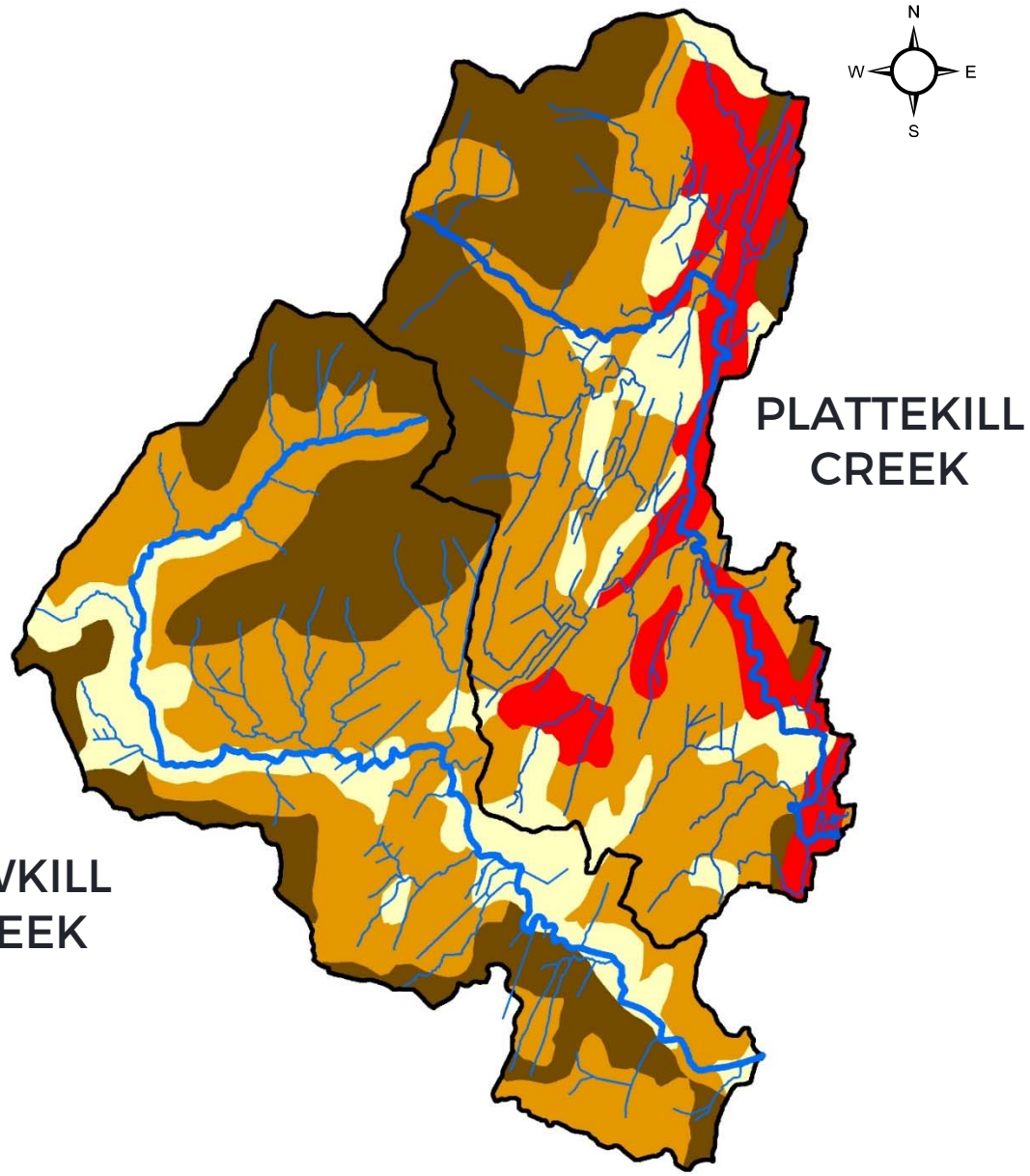


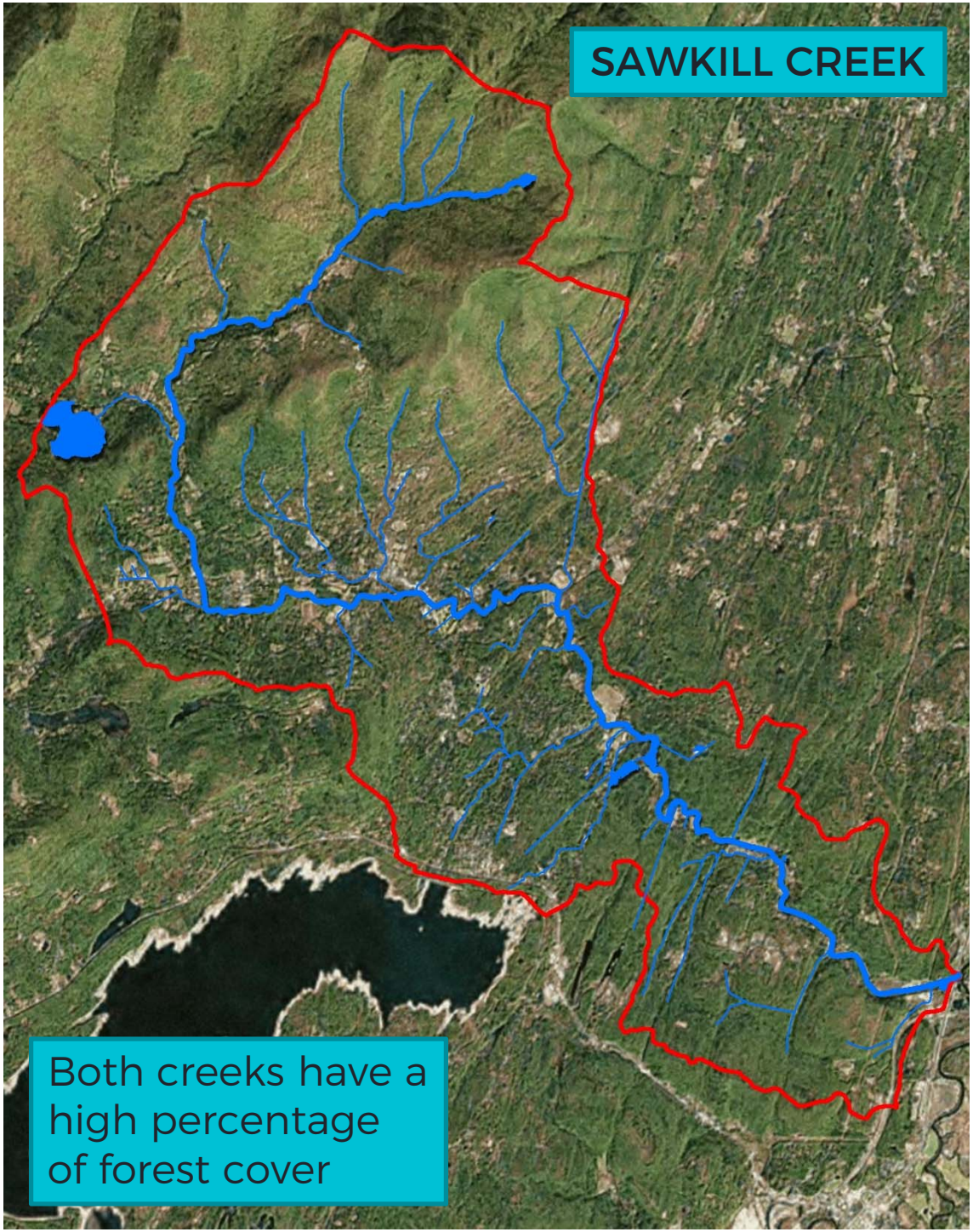
WATERSHED GEOLOGY

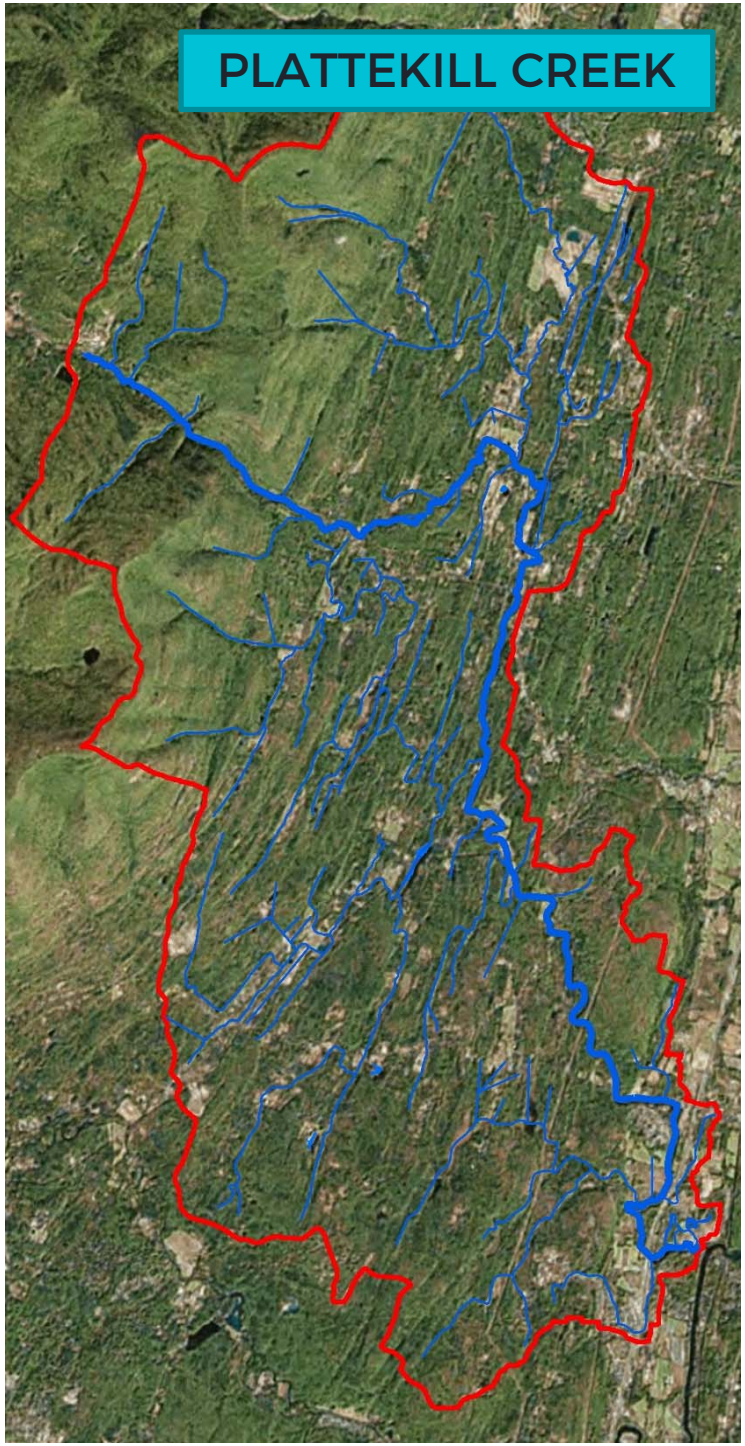
Bedrock: shale, sandstone

Surficial Materials:

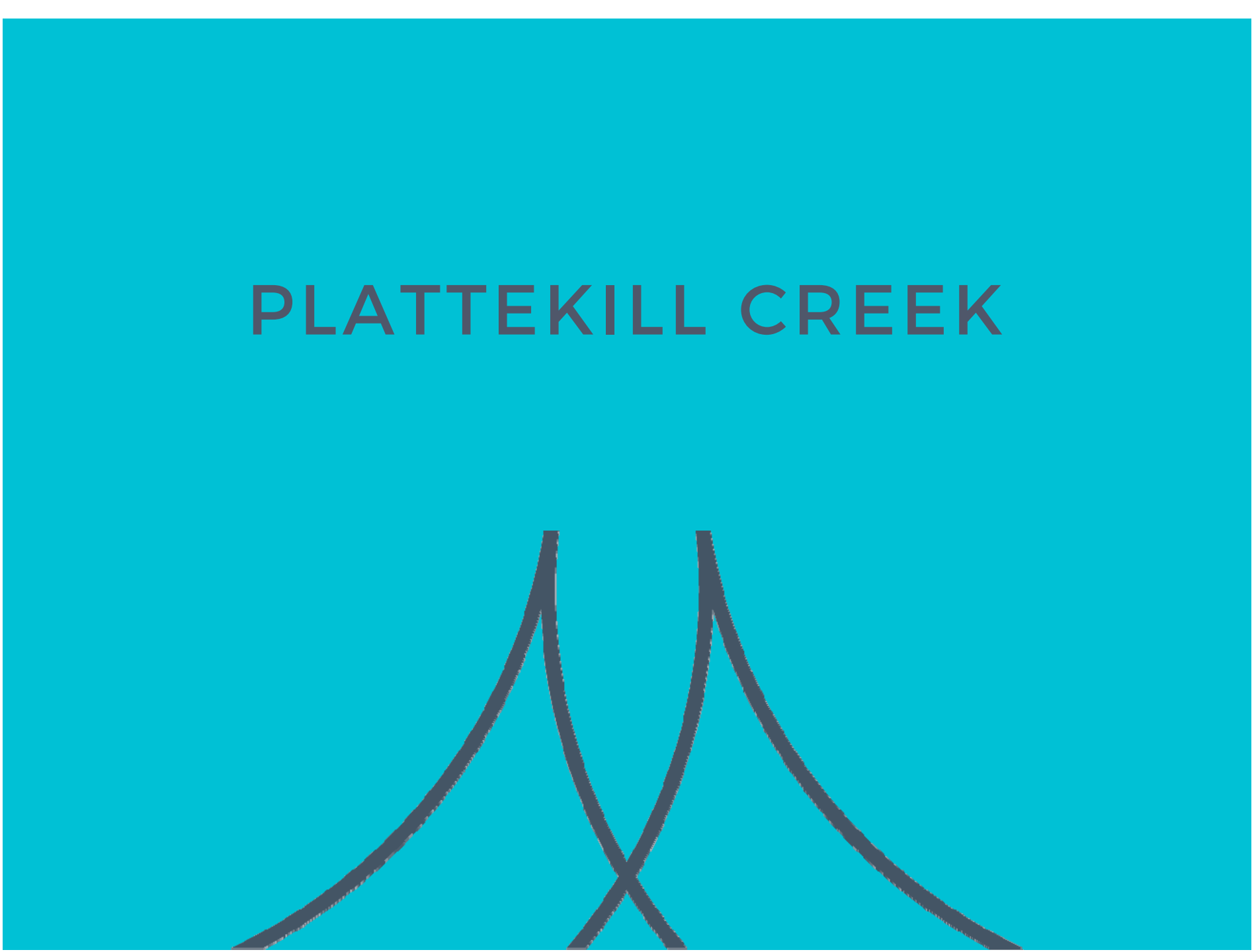
- glacial till
- bedrock at or close to surface
- sand and gravel
- lacustrine clay



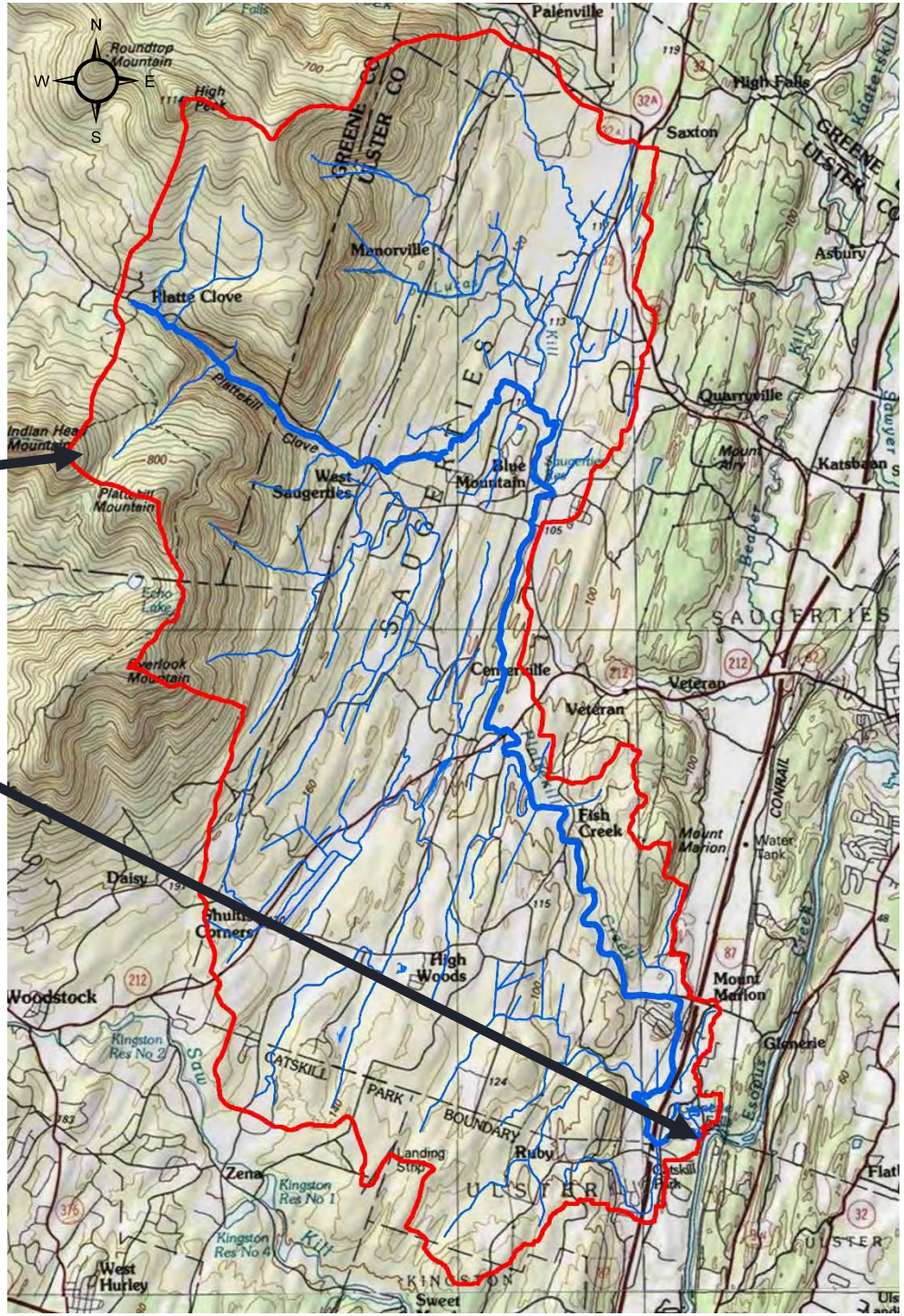

SAWKILL CREEK
Both creeks have a high percentage of forest cover


PLATTEKILL CREEK

PLATTEKILL CREEK



- Flows a distance of 17 miles
- Headwaters at ~3,360 feet above sea level on Indian Head Mountain
- Outlets to Esopus Creek at ~120 feet above sea level
- Vertical drop of ~3,240 feet
- Average channel slope of 3.6 percent

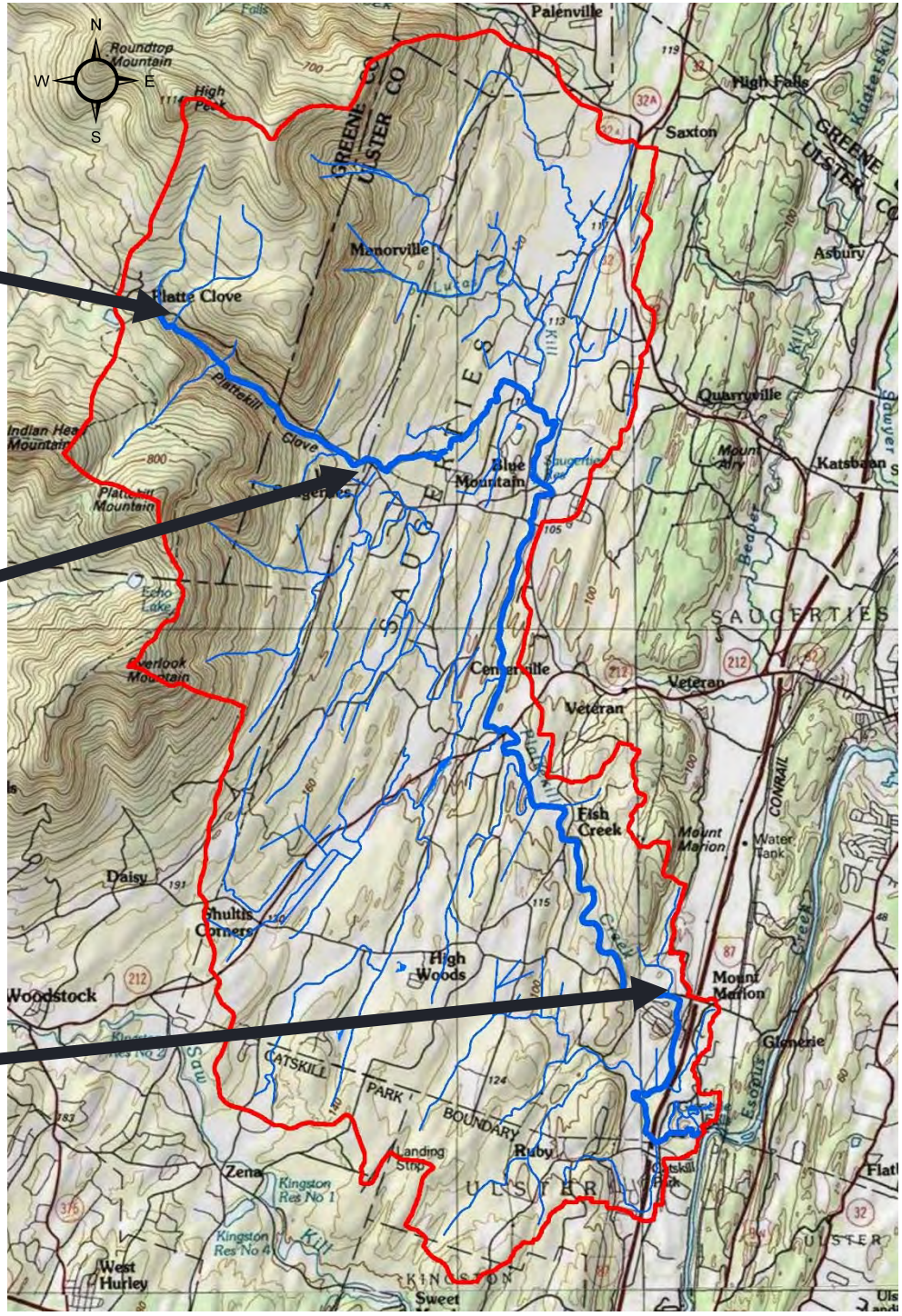


PLATTE CLOVE PRESERVE, HUNTER

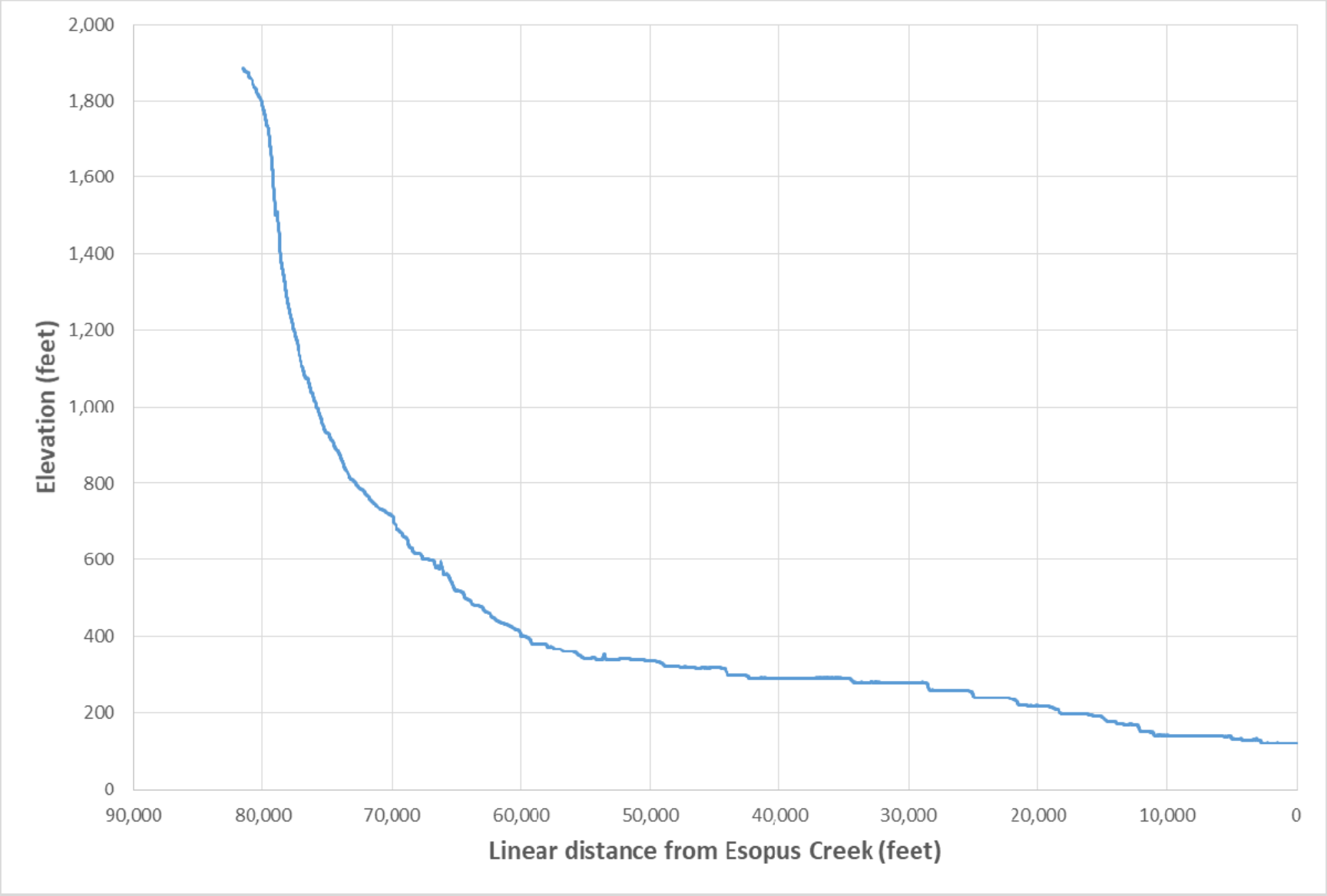
FALLS, WEST SAUGERTIES

MOUNT MARION

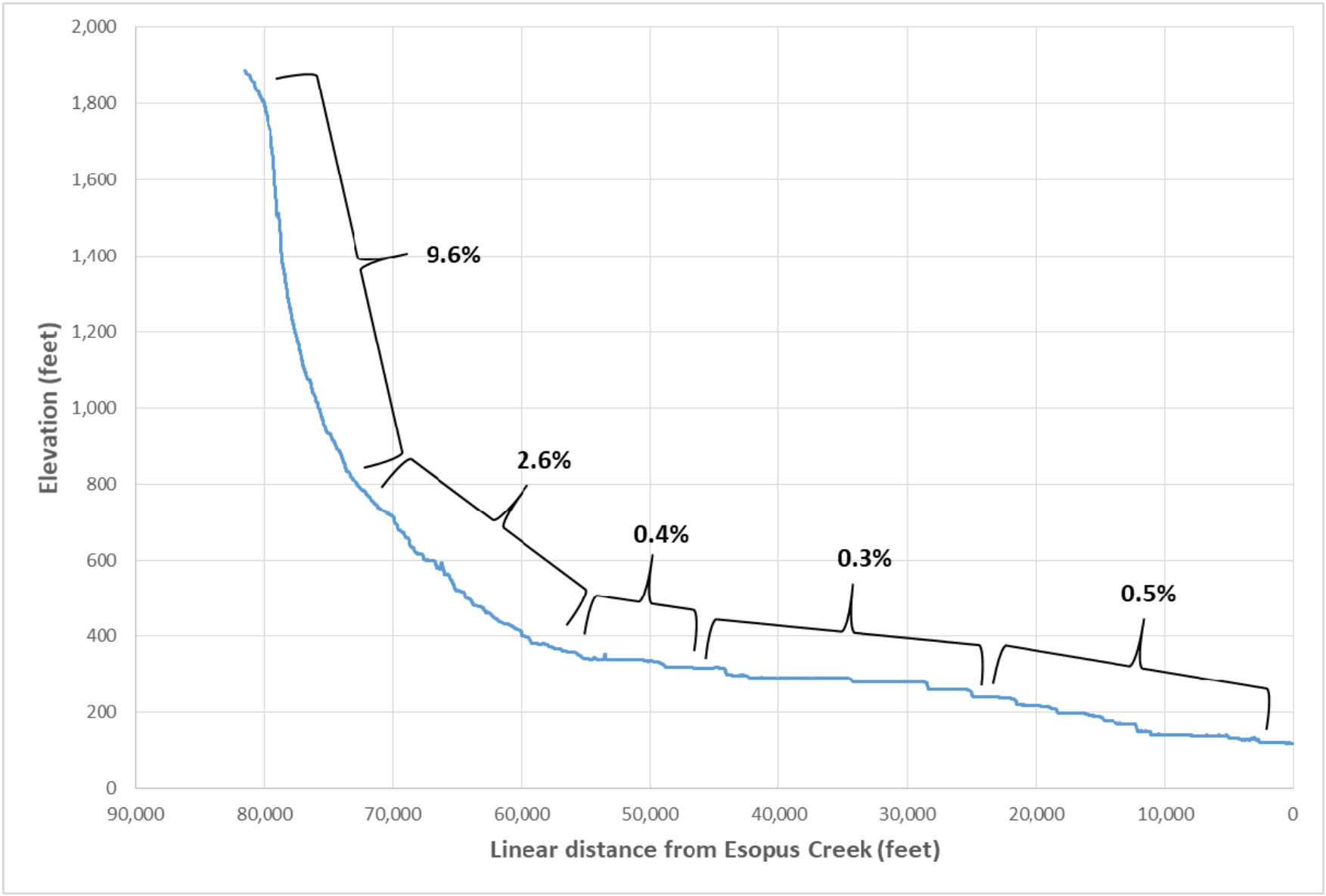
(Photos: M. Carabetta)



A *longitudinal profile* of a river depicts the change in elevation of the channel from its headwaters to its mouth, thereby showing the rate of change of slope (or gradient) with distance downstream (Fryirs and Brierley, 2013)

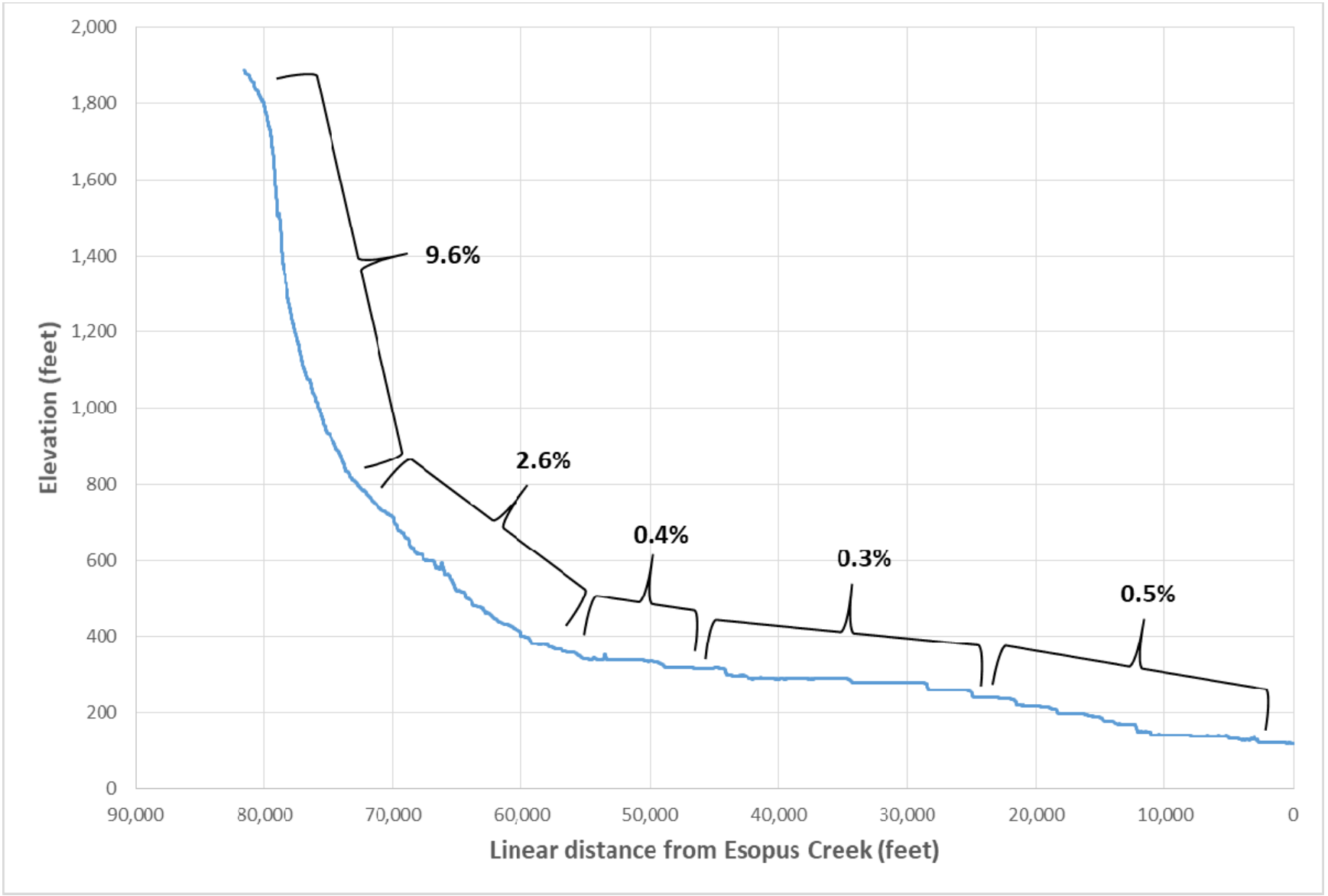


DIRECTION OF FLOW



STREAM DISCHARGE

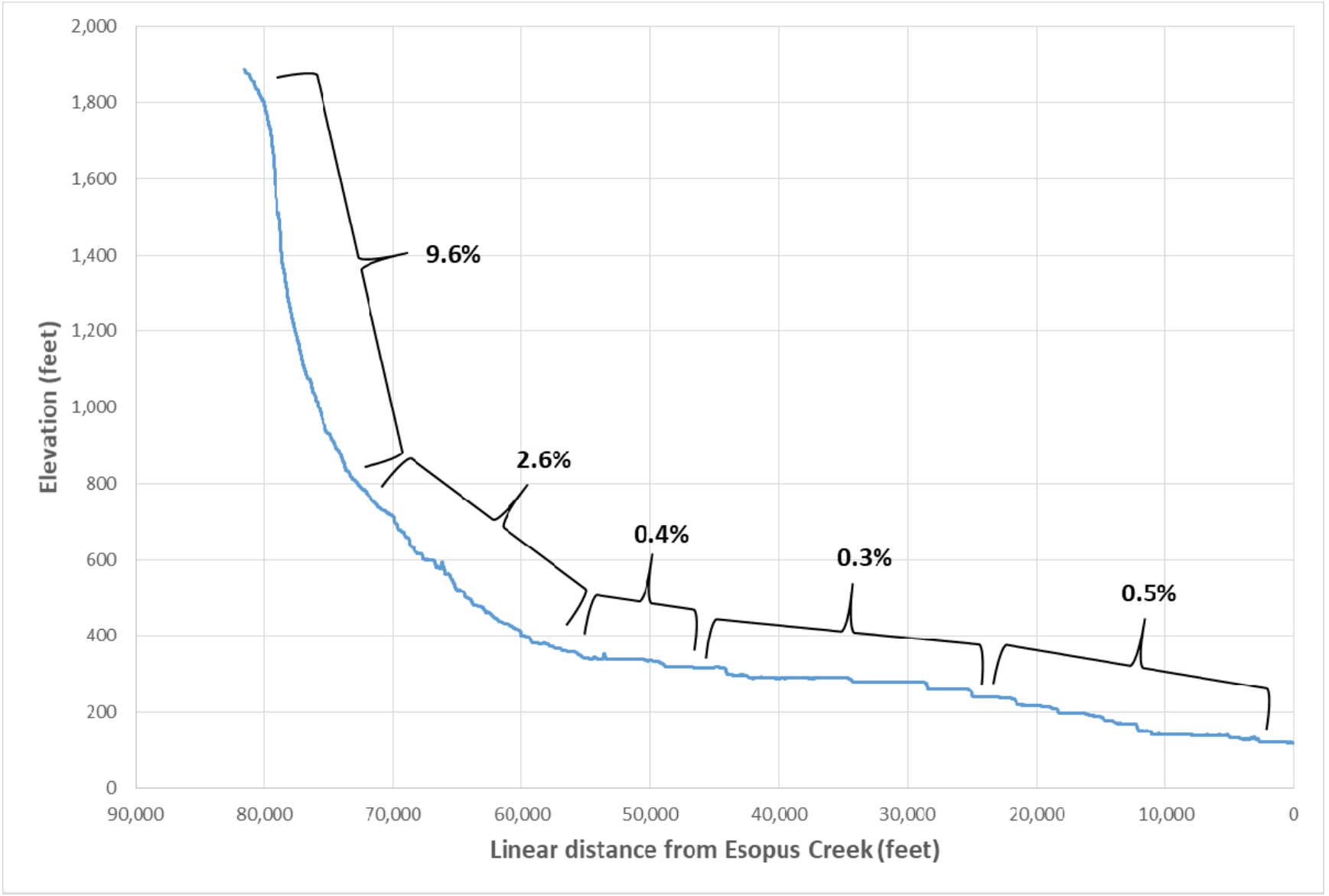
lower higher



CHANNEL WIDTH & DEPTH

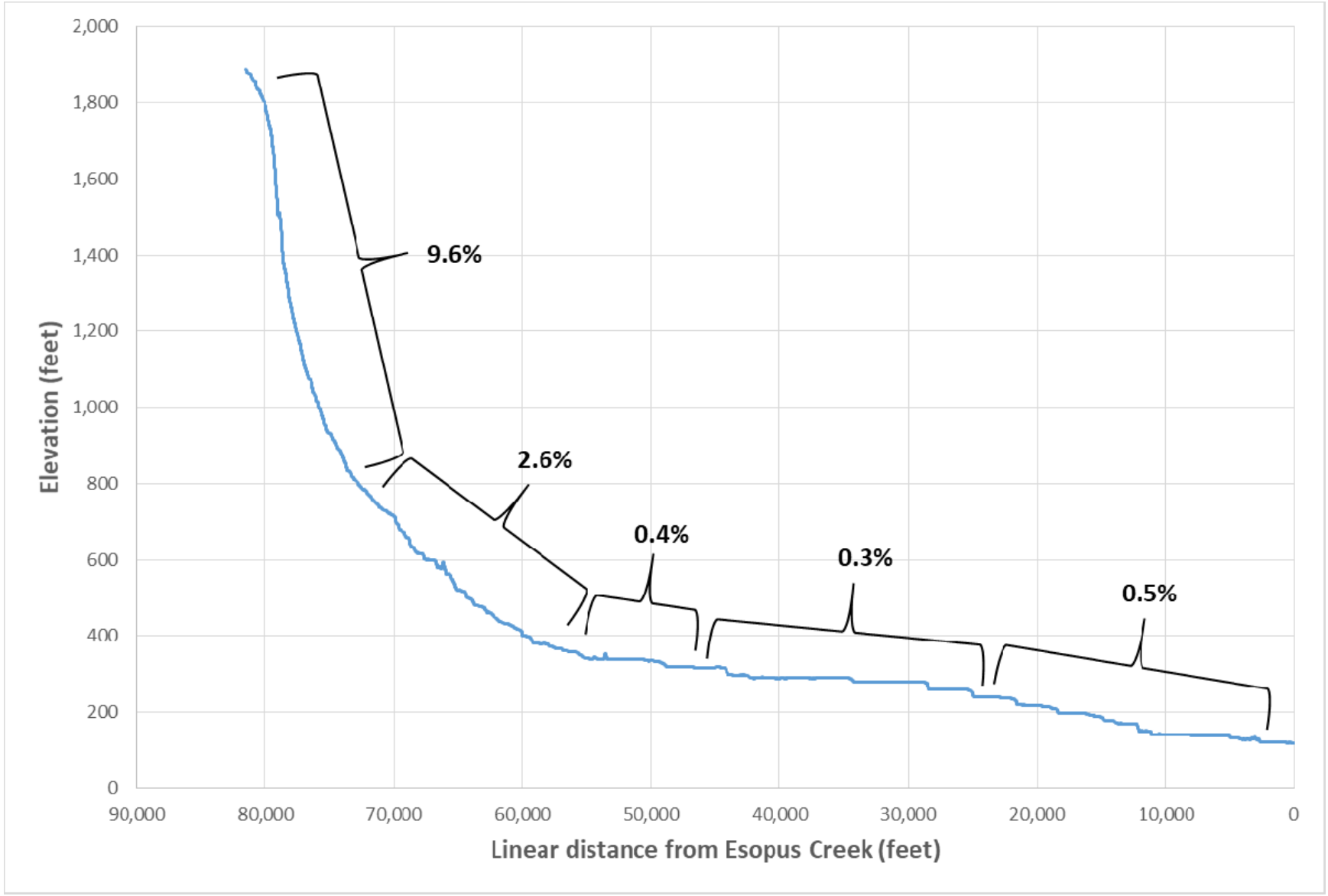
more narrow & shallow

wider & deeper



BED MATERIAL TEXTURE

coarser finer



VALLEY CONFINEMENT

- more confined
- less accommodation space
- few floodplains

- less confined
- more accommodation space
- well developed floodplains

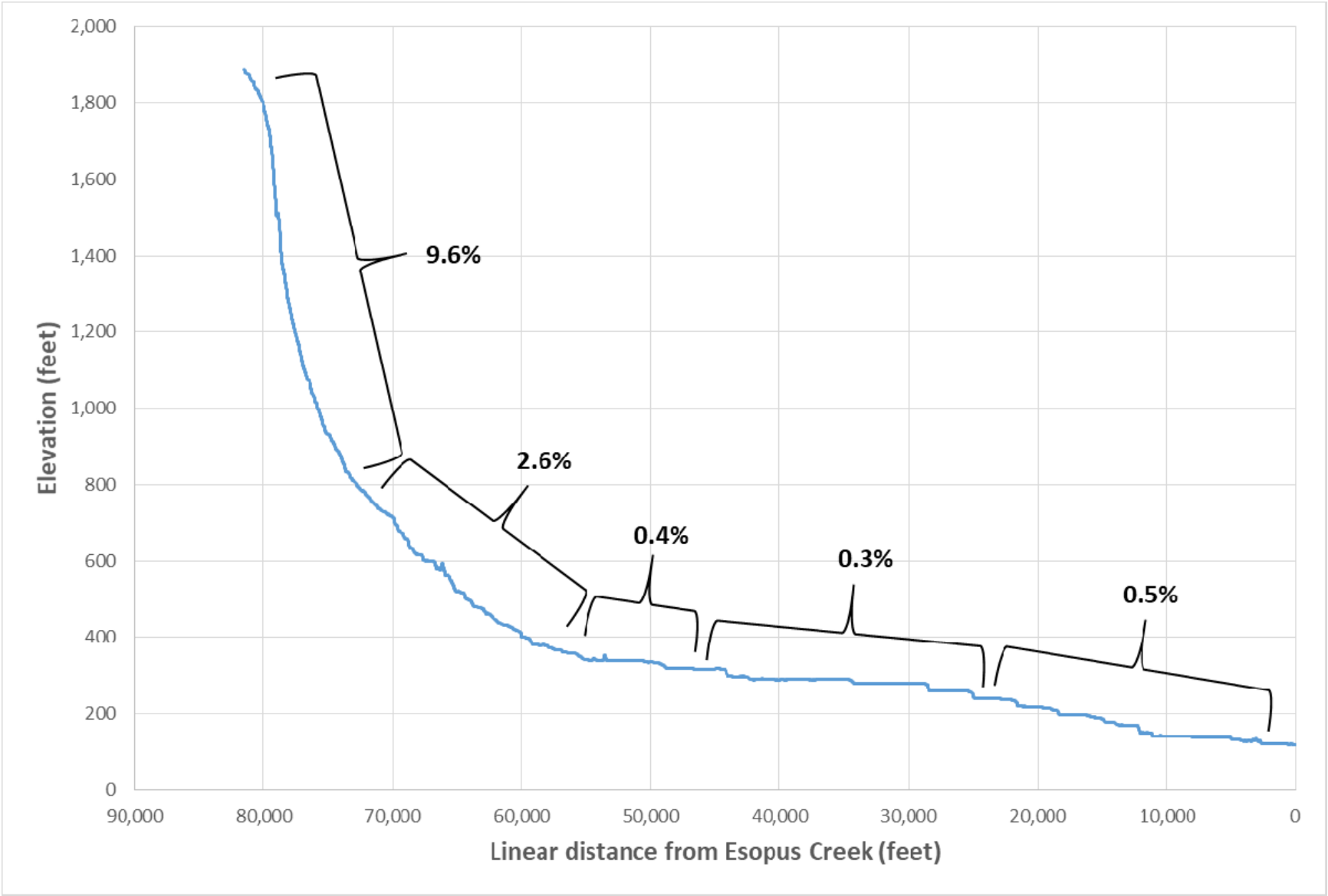
Upper Catskill Creek near Franklinton Vlaie

Sawkill Creek at Thorn Preserve

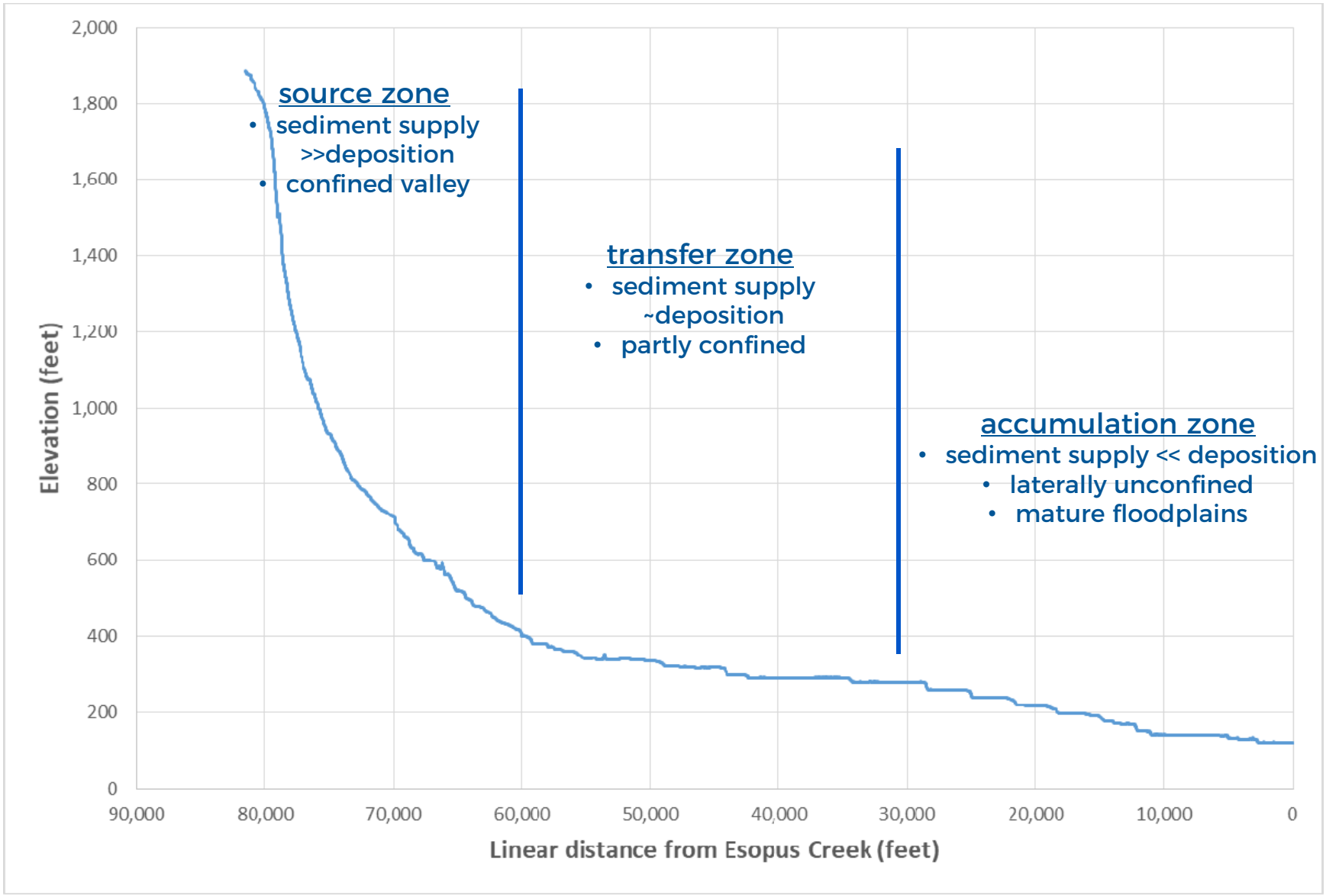
(Photos: M. Carabetta)

VOLUME OF STORED ALLUVIUM

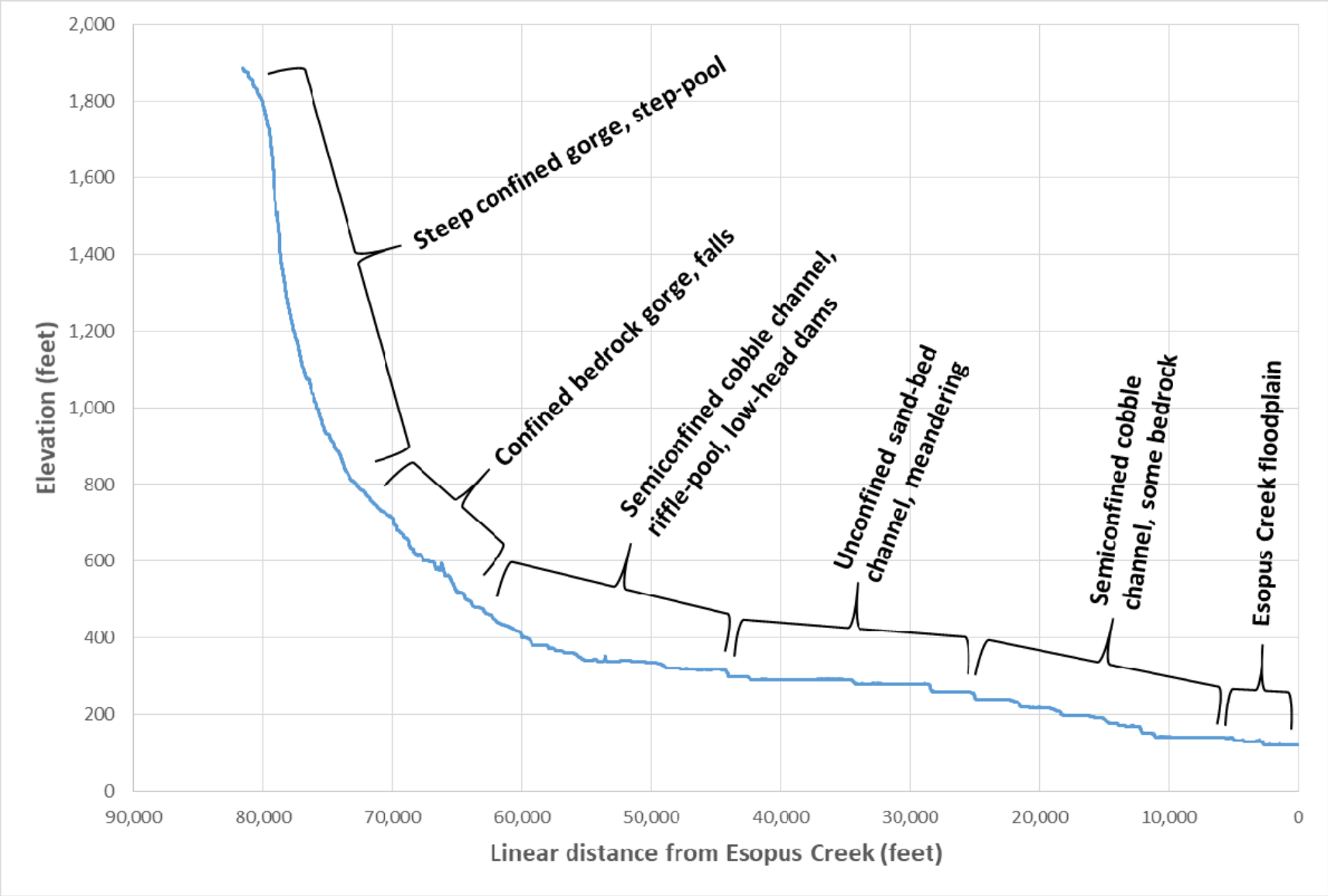
low high



GEOMORPHIC TRANSITIONS

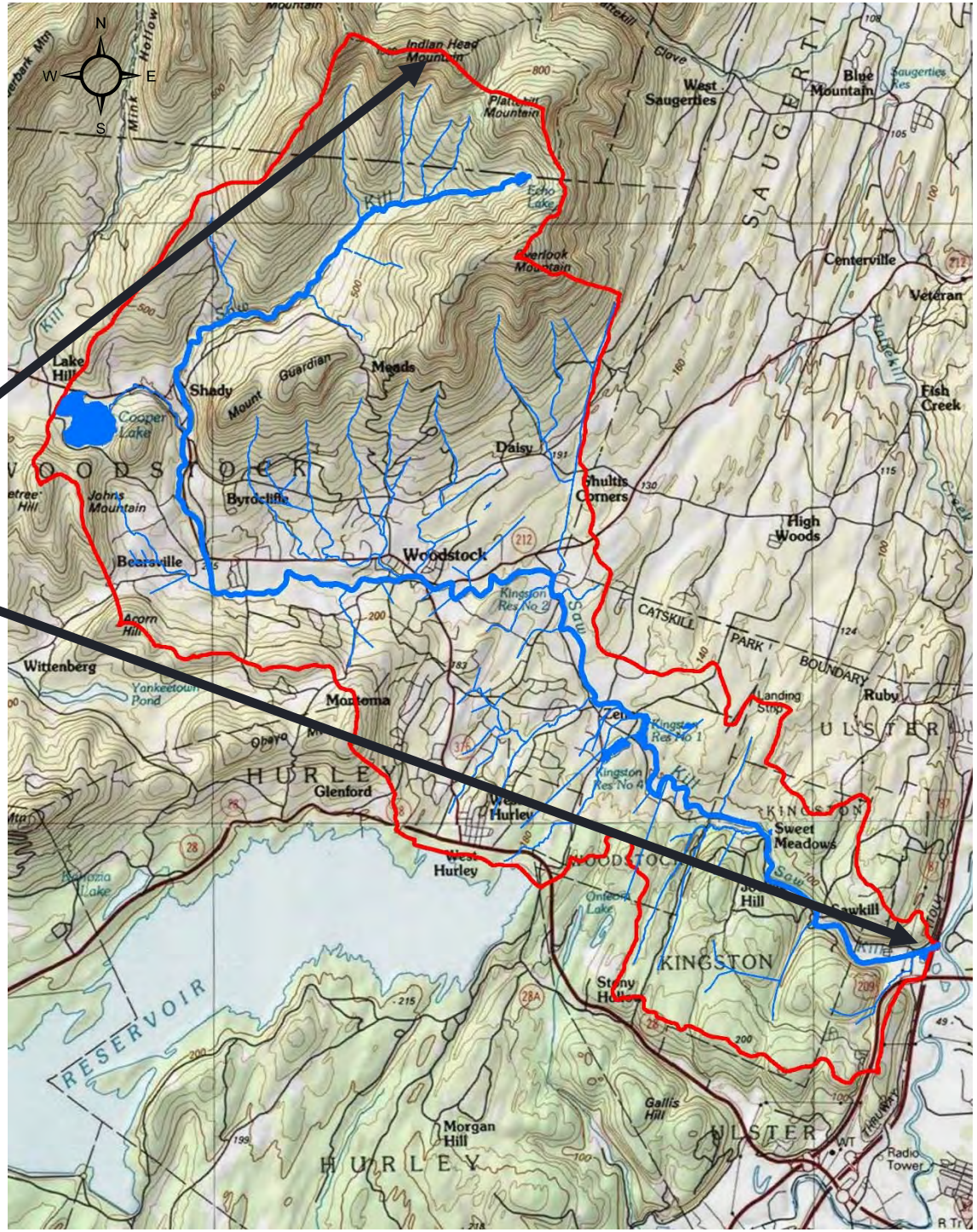


GENERALIZED CHANNEL CHARACTERIZATION



SAWKILL CREEK

- Flows a distance of 19.5 miles
- Headwaters at ~3,570 feet above sea level on Indian Head Mountain
- Outlets to Esopus Creek at ~140 feet above sea level
- Vertical drop of ~3,240 feet
- Average channel slope of 3.3 percent

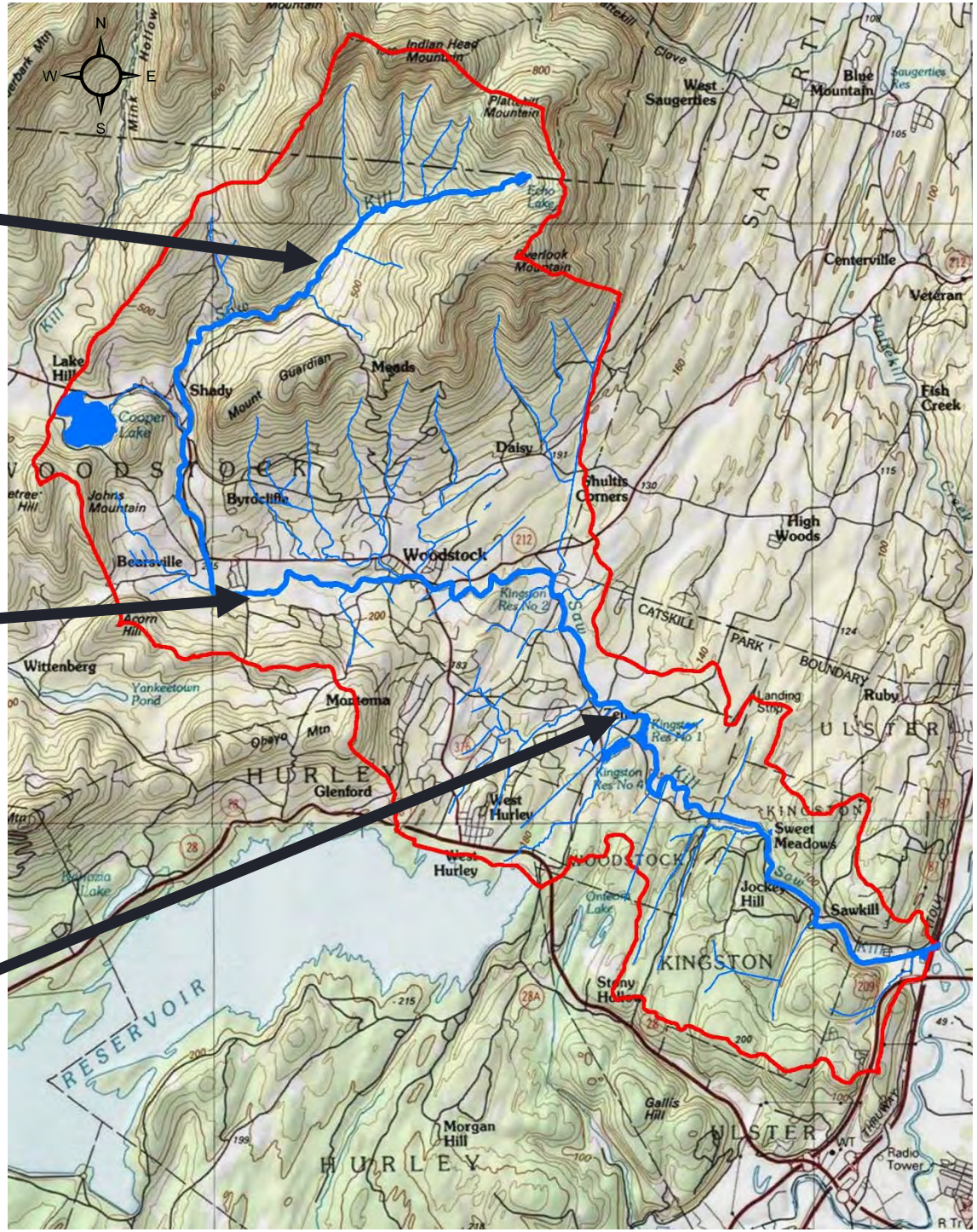


Keefe Hollow Road, Woodstock

Yeery Hill Road, Woodstock

Thorn Preserve, Woodstock

(Photos: M. Carabetta)

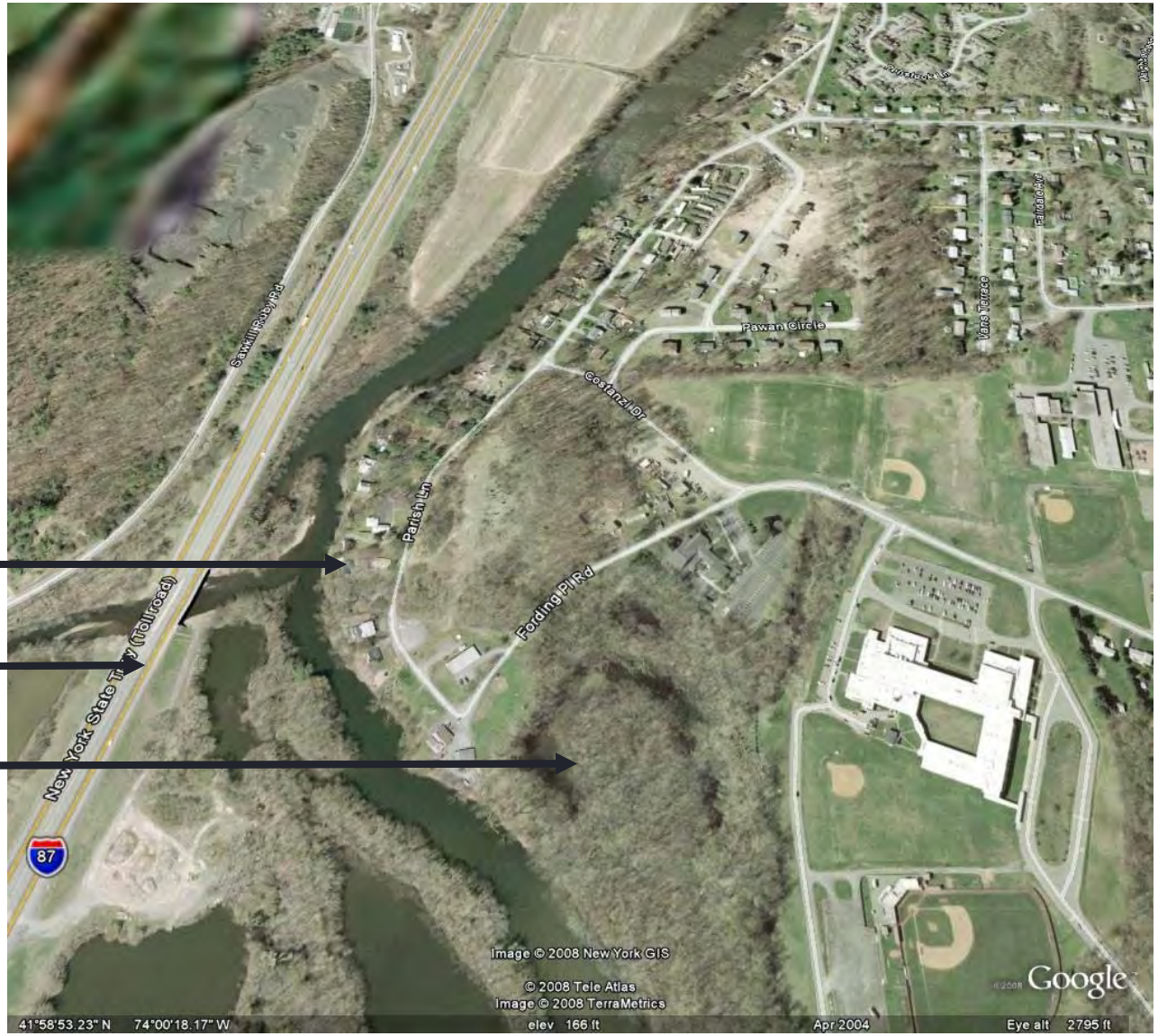


OUTLET OF SAWKILL AT ESOPUS CREEK

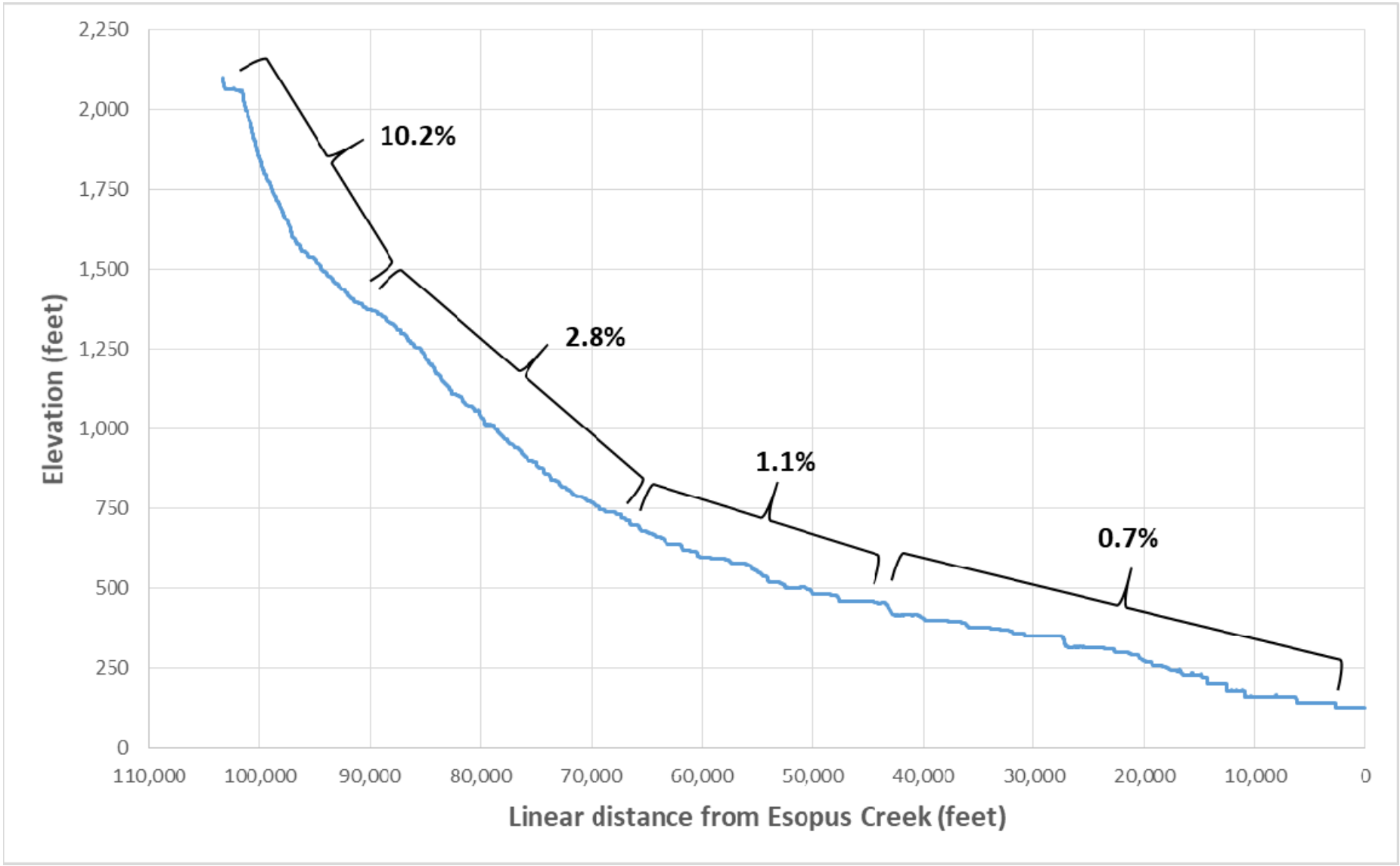
CONFLUENCE BAR

SAWKILL CREEK

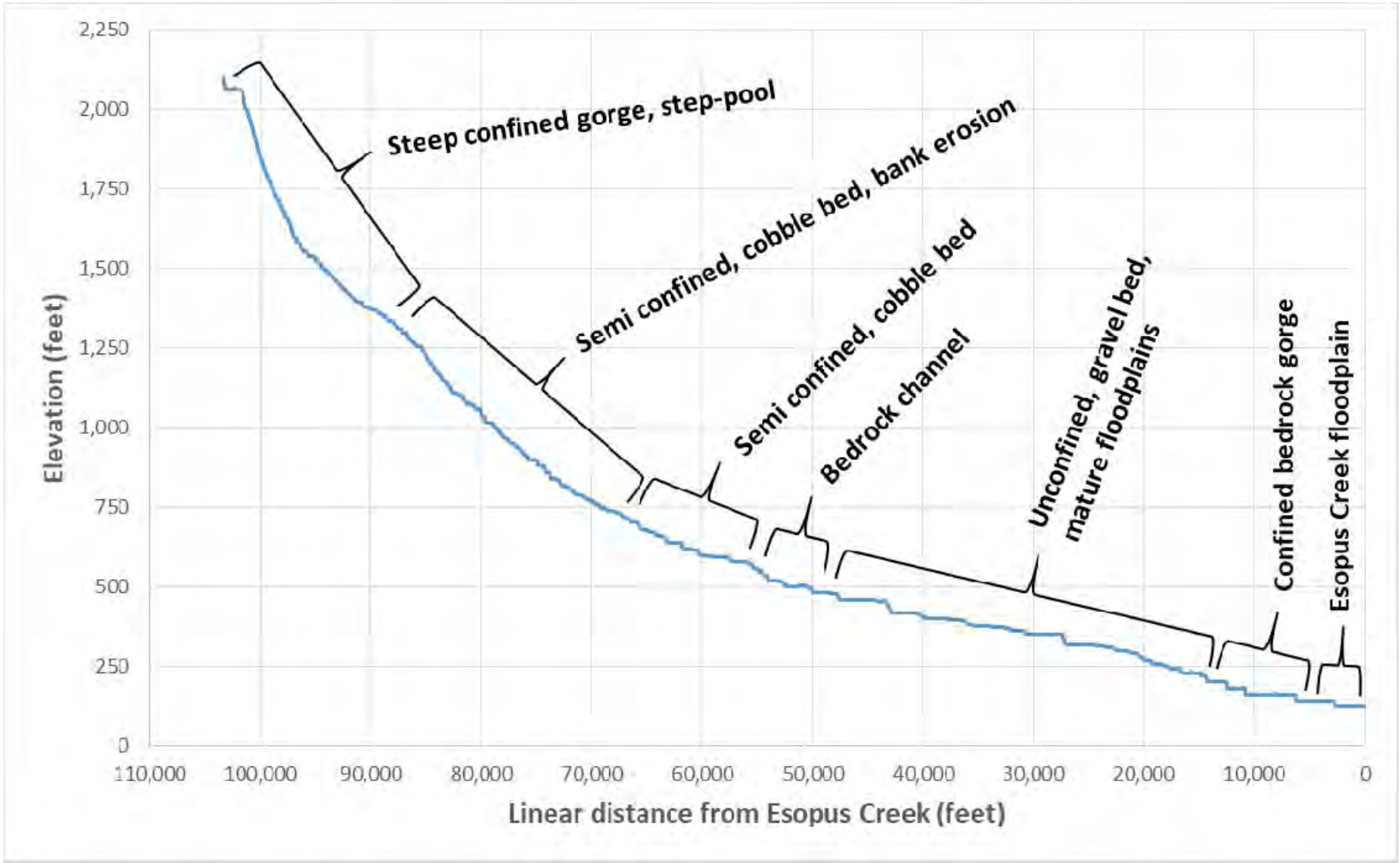
OX-BOW LAKE



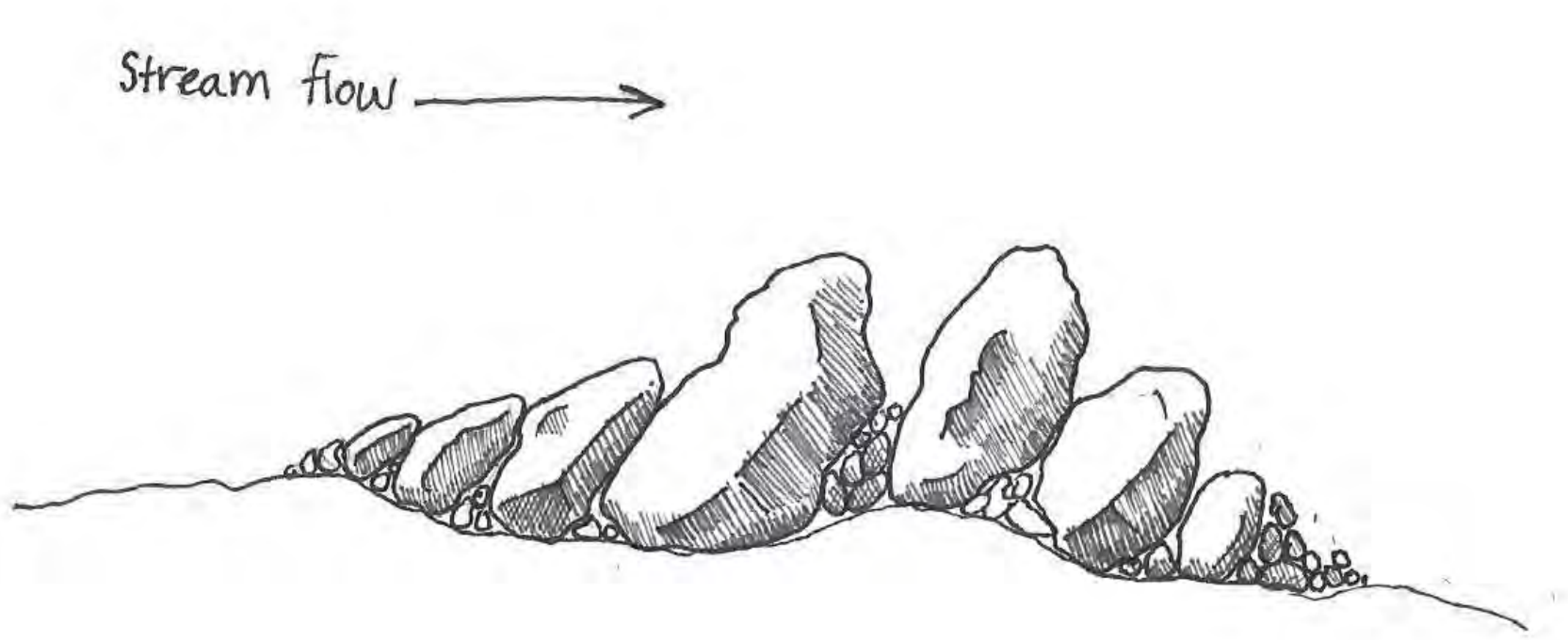
DIRECTION OF FLOW

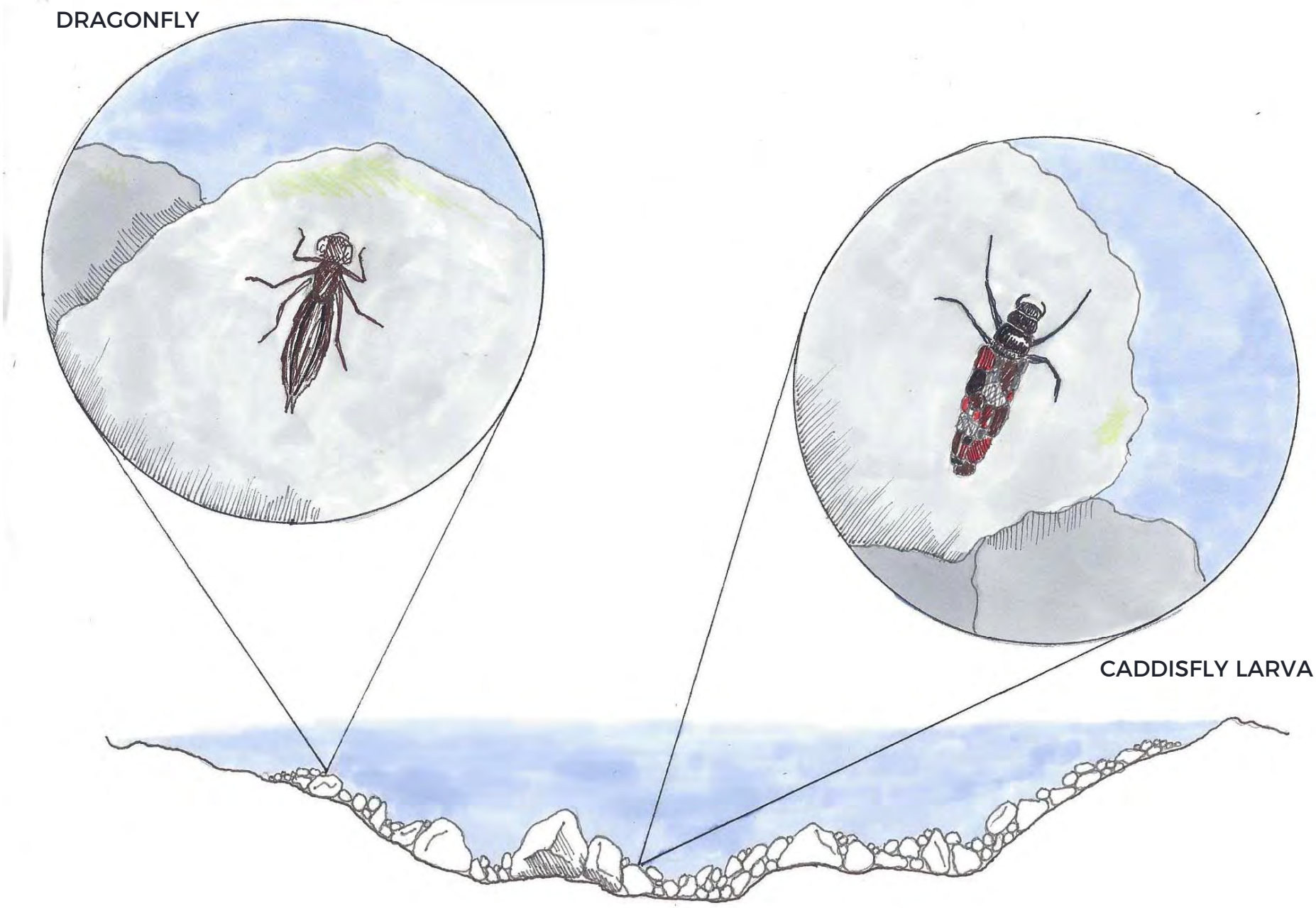


GENERALIZED CHANNEL CHARACTERIZATION



Imbrication is the stacking or overlapping of individual grains in the direction of the current, resulting in a tightly-packed channel bed.




DRAGONFLY
CADDISFLY LARVA

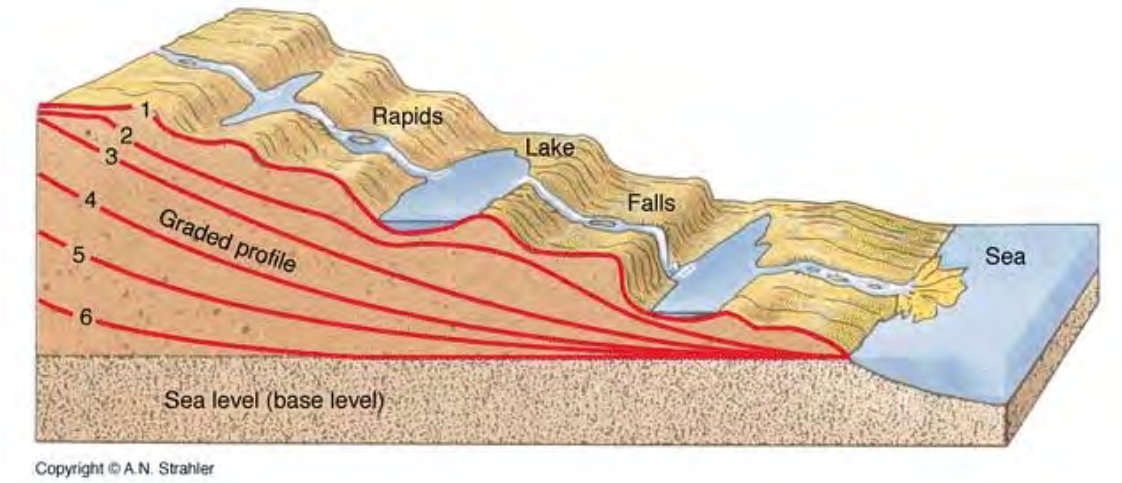
EQUILIBRIUM

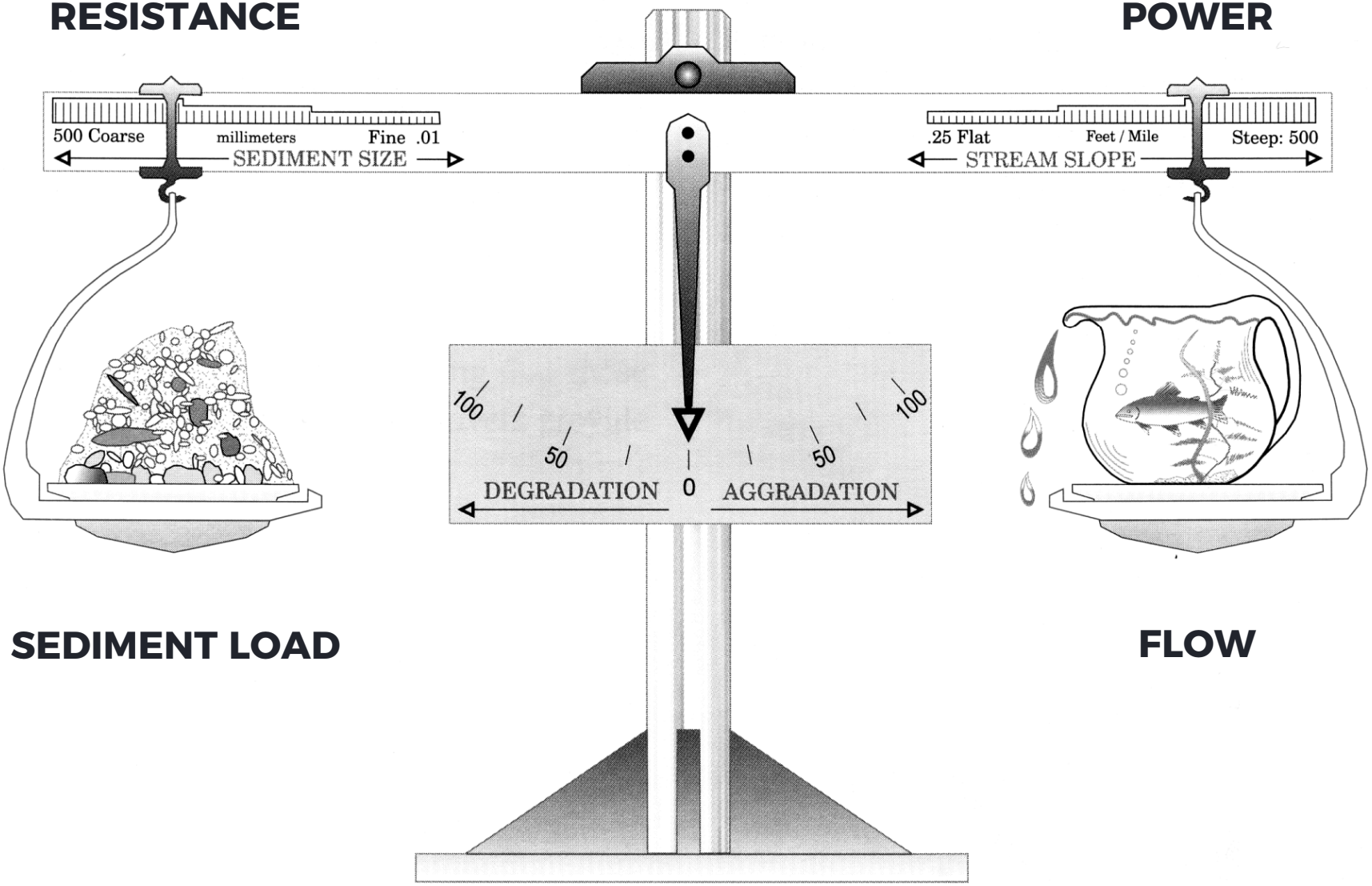
“Where the stream bed slope has adjusted to prevailing water and sediment loads such that the channel neither aggrades nor degrades, and slope remains constant thro time.”

Gilbert,1877

“One in which, over a period of years, slope is delicately adjusted to provide, with prevailing discharge and channel characteristics, just the velocity required for transportation of the load supplied by the drainage basin.”

Mackin, 1948





(Sediment LOAD) x (Sediment SIZE) ∝ (Stream SLOPE) x (Stream DISCHARGE)

Source: Lane, 1955;
Rosgen and Silvey, 1996

NON-ALLUVIAL CHANNELS

- Glacial Till
- Bedrock
- Artificial Linings
- Fixed Alignment
- No Floodplain
- Rigid Boundaries
- Many Degrading / Incised Channels

Moyer Creek, Frankfort NY

Bellinger Brook, Herkimer NY

(Photos: M. Carabetta)

ALLUVIAL CHANNELS

- Located In Or On Sediment Deposits
- Sedimentary Floodplain
- Modern Sediment Loads
- Mobile Bed
- Prone To Varying Alignment

CHANNELS OUT OF EQUILIBRIUM

- Degrading
- Aggrading
- Braided
- Alluvial Fans
- Deltas
- Modified Hydrology
- Modified Sediment Loads

Roaring Branch, Bennington, VT, June, 2010

HYDROLOGY, HYDRAULICS, SEDIMENT

- HYDROLOGY-river flow rates, hydrographs, peak flood discharges, low flow rates
- HYDRAULICS-how water moves; surface elevations, depths, flow velocities
- SEDIMENT-Soils eroded and transported by water

RIVER STRESSORS

- Natural- (climate, uplift, erosion)
- Human – Direct (dredge, dike, divert, discharges, drainage)
- Human – Indirect (watershed changes)

PREDICTED RUNOFF CHANGES

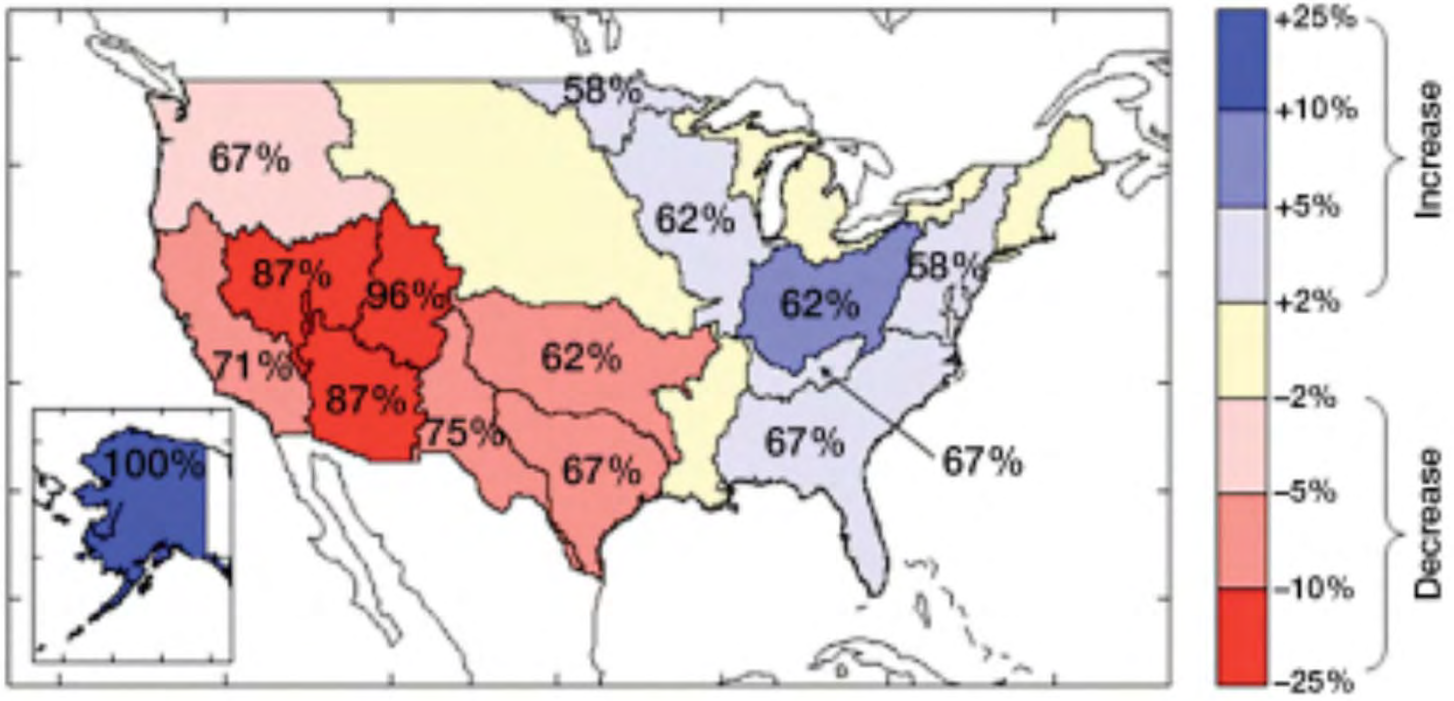


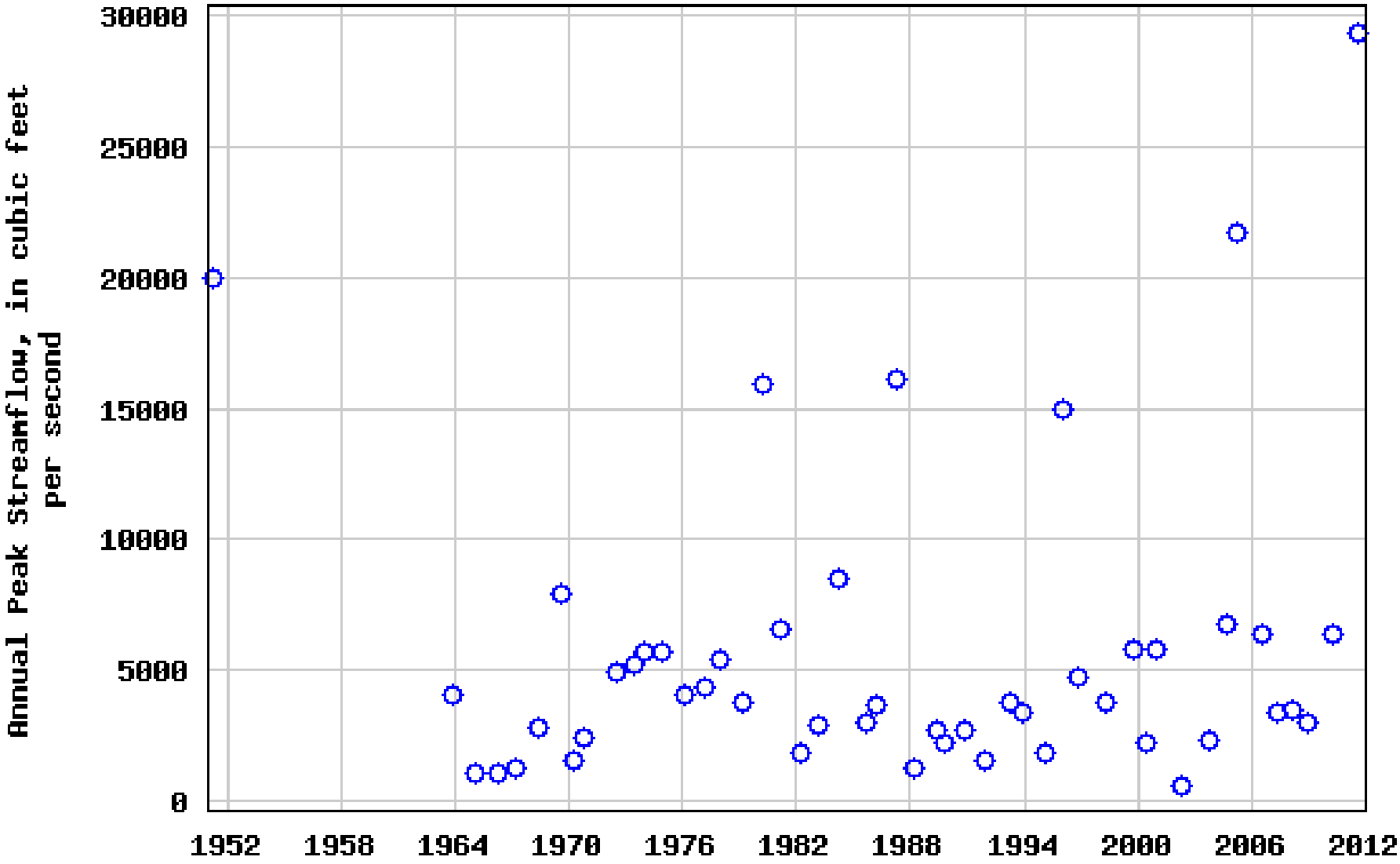
Figure 4.10 *Median changes in runoff interpolated to USGS water resources regions from Milly et al. (2005) from 24 pairs of GCM simulations for 2041-2060 relative to 1901-1970. Percentages are fraction of 24 runs for which differences had same sign as the 24-run median. Results replotted from Milly et al. (2005) by Dr. P.C.D. Milly, USGS.*

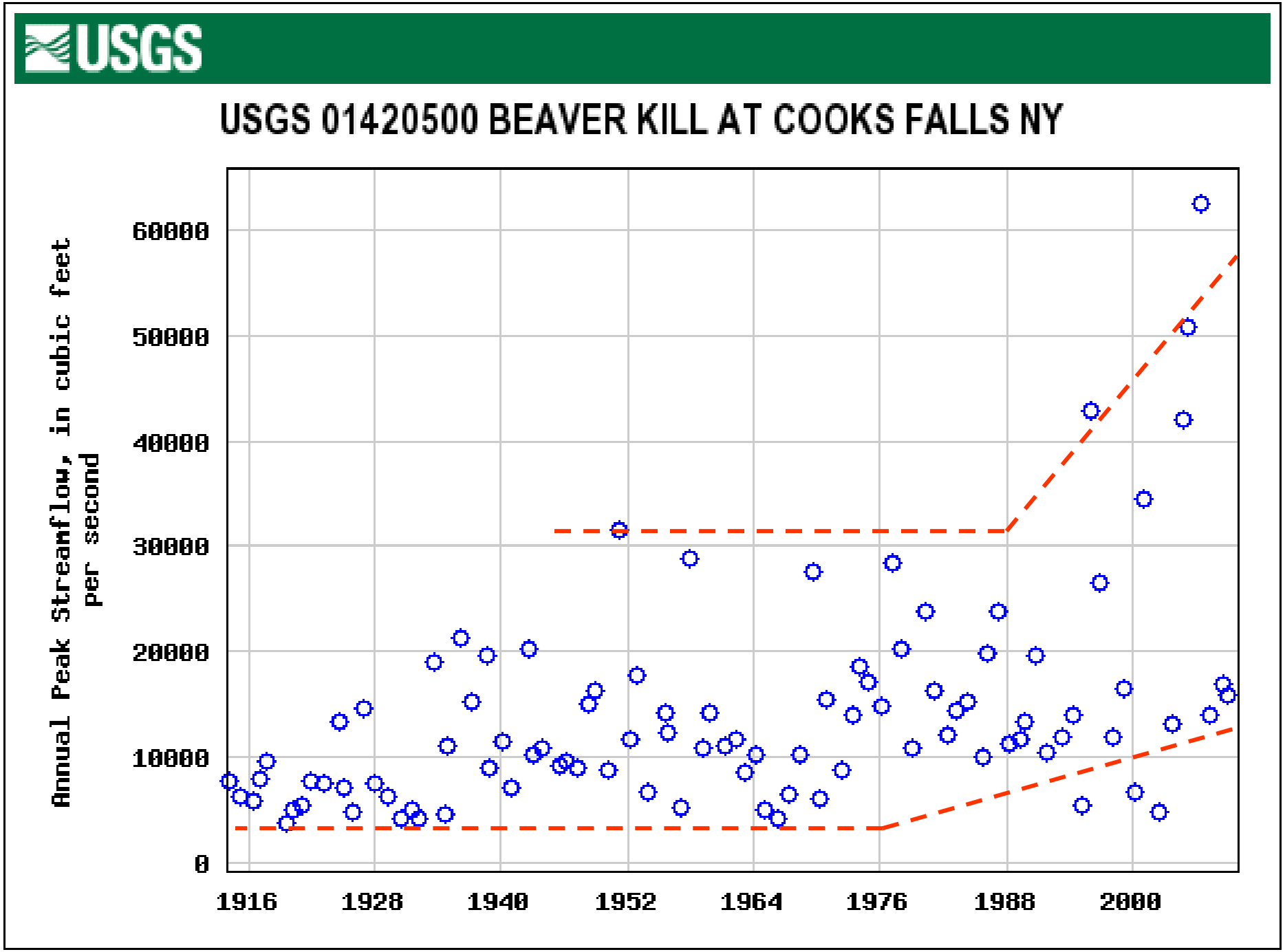
PREDICTED RIVER TRENDS

- Higher Annual Runoff
- Increased Variation
- Wetter Winter, Spring
- Drier Summer, Fall
- More Thunder Storms
- Increased Flood Risks

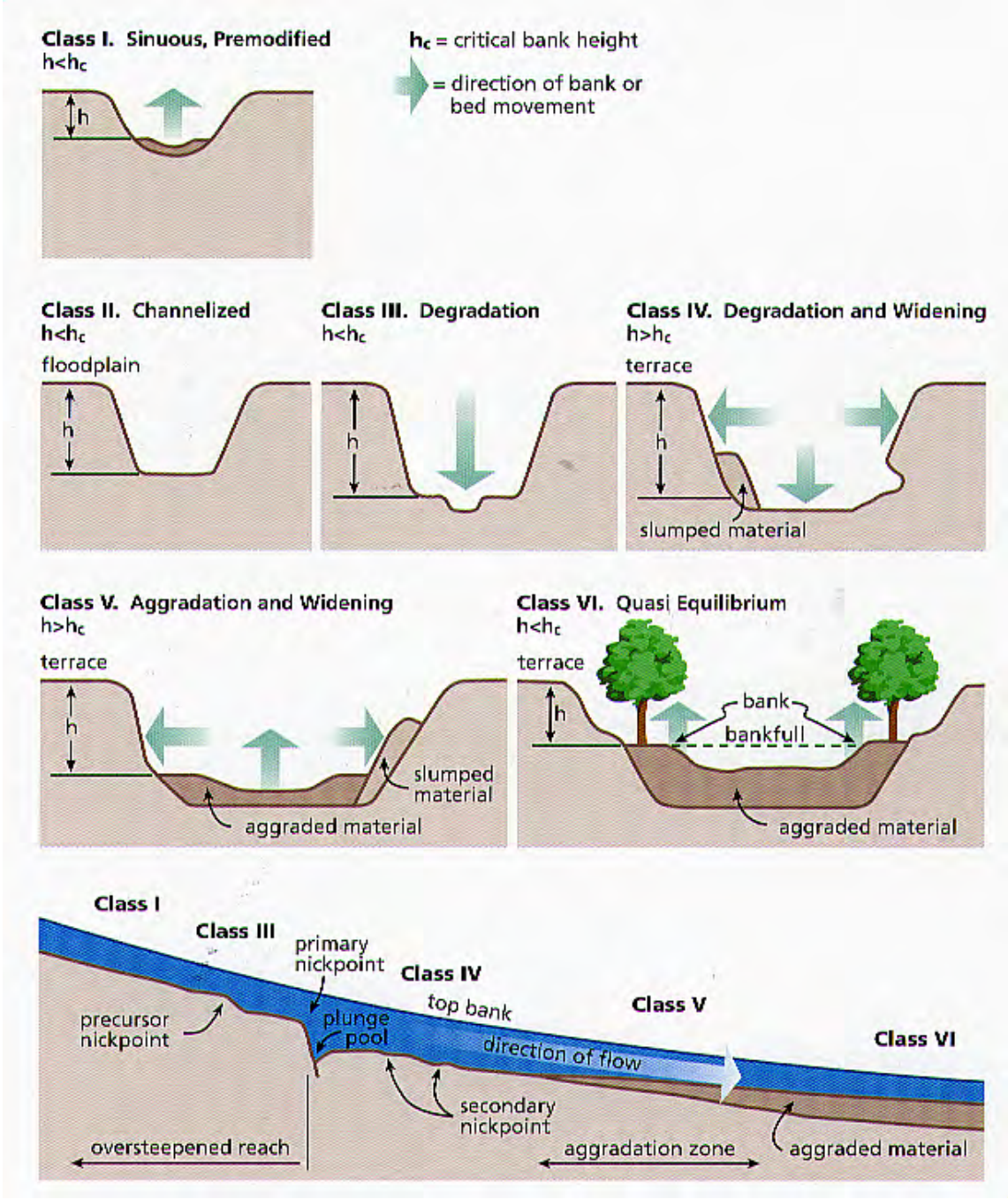
USGS

USGS 01362200 ESOPUS CREEK AT ALLABEN NY




USGS
USGS 01420500 BEAVER KILL AT COOKS FALLS NY
Annual Peak Streamflow, in cubic feet per second
60000
50000
40000
30000
20000
10000
0
1916
1928
1940
1952
1964
1976
1988
2000

CHANNEL EVOLUTION MODEL



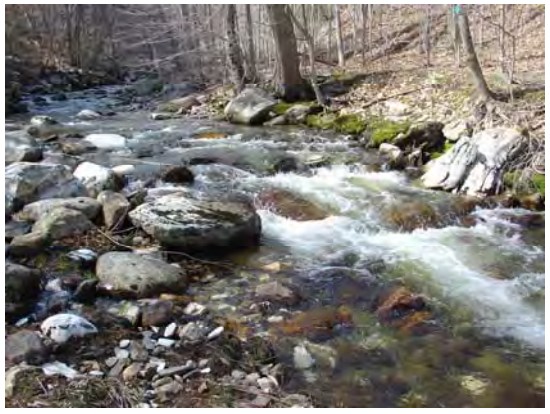
Simon, 1989

RIVER VULNERABILITY ANALYSIS

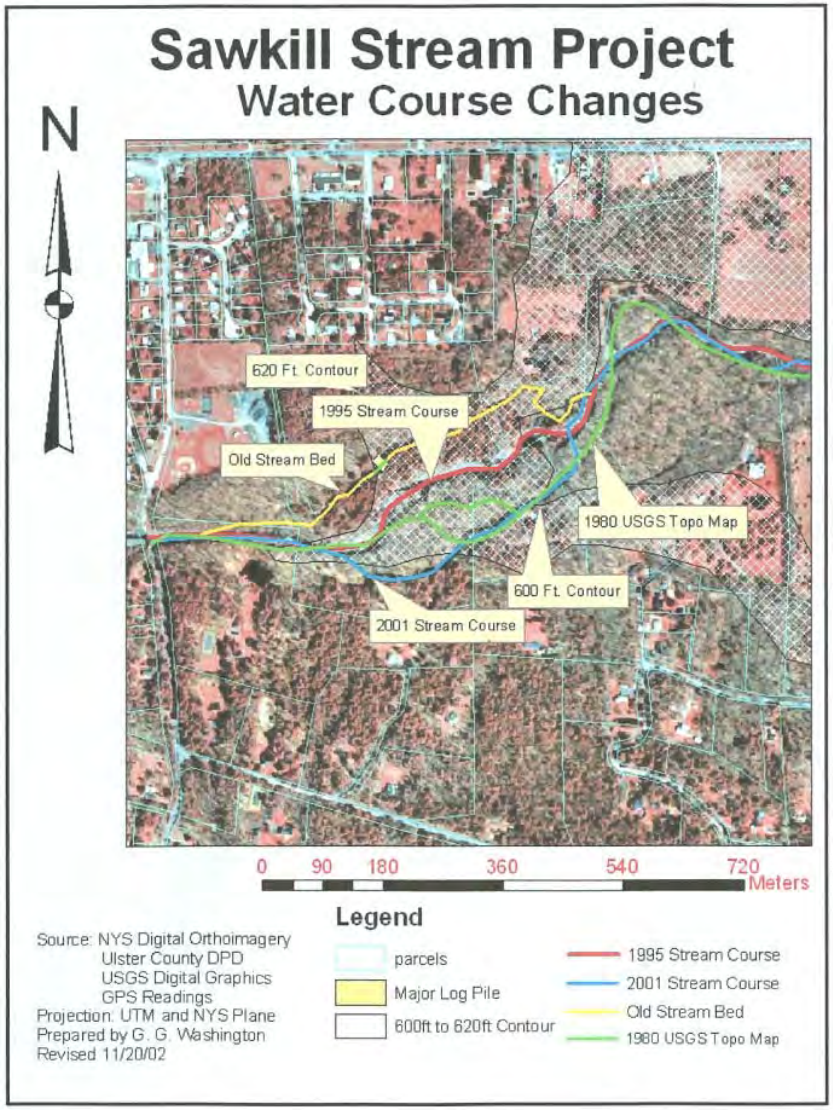
- River Classification
- Channel and Valley Confinement
- Potential Stresses
- Threshold Conditions
- Susceptibility to Stress
- Potential Attribute Changes
- Potential River Types
- Temporal Aspects

RIVER RESPONSES

STEEP SLOPES	MEDIUM SLOPES	LOW SLOPES
Channel Deepening	Deepens or Widens	Shallows
High Velocity	Modified Sinuosity	Overbank Floods
Bank Failures	Floodplain Scour	Avulsions
Coarser Bed	Log Jams	Wetland Damage



SEDIMENT PROCESS



- Precipitation
- Runoff
- Soil Erosion
- Particle Entrainment
- Sediment Transport
- Deposition
- Consolidation


A15

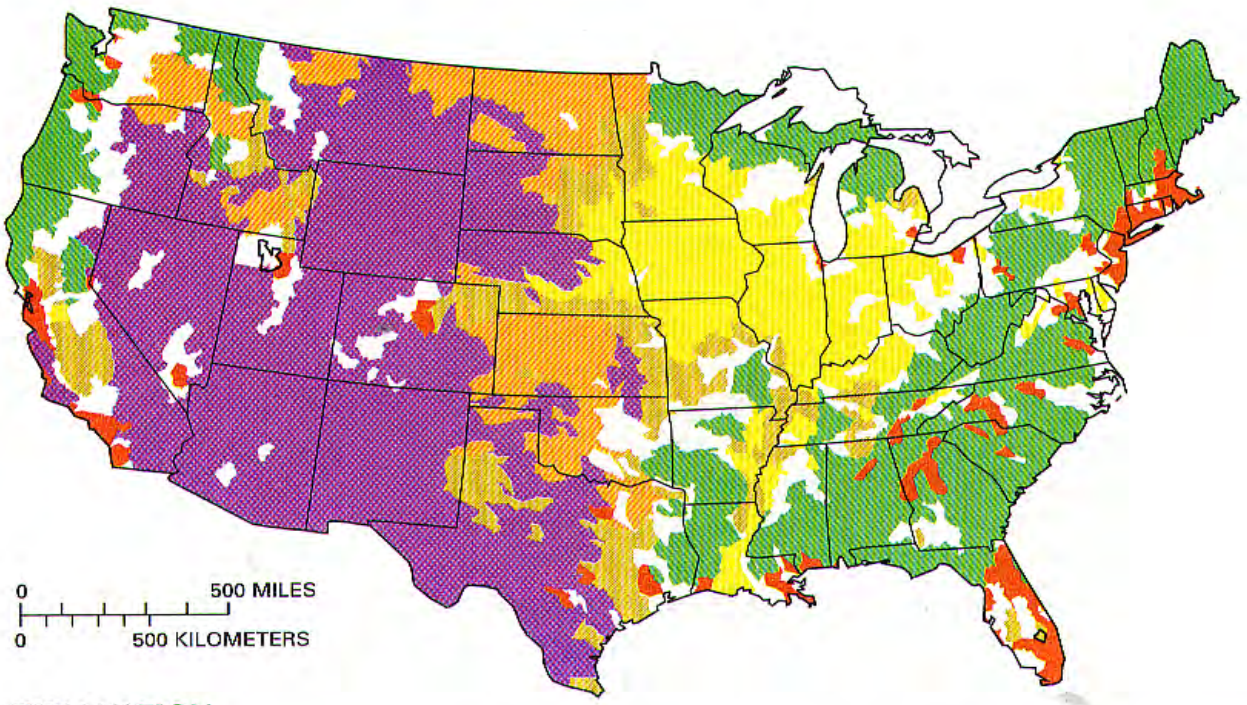

A6
INCHES 1 2 Lufkin 3 RUGGED 4 RED END 5 ENGINEERS


A11
INCHES 1 2 Lufkin 3 RUGGED 4 RED END 5

SEDIMENT SOURCES

- Natural Upland Soil Erosion
- Construction Activity
- Road Sand
- Agriculture
- Trash And Litter
- Upstream Channel Erosion
- Channel Sediment Storage

LAND USE AND SEDIMENT YIELDS



EXPLANATION

LAND USE SHOWN ON MAP	NITRATE 1980–89		TOTAL PHOSPHORUS 1982–89		SUSPENDED SEDIMENT 1980–89	
	Yield, in tons per square mile per year	Percentage change per year	Yield, in tons per square mile per year	Percentage change per year	Yield, in tons per square mile per year	Percentage change per year
AGRICULTURE Wheat	0.032	*	0.010	–2.8	10	+0.8
Corn and soybeans	0.932	*	0.163	–2.1	100	–1.0
Mixed	0.304	*	0.066	–1.6	79	–0.7
URBAN	0.547	+0.2	0.119	–0.6	23	–0.6
FOREST	0.255	*	0.063	–0.8	31	–0.3
RANGE	0.031	*	0.017	–1.9	33	–0.2

* Between –0.1 and +0.1.

SEDIMENT LOADS

- Total Load =
  Bed Material Load & Wash Load
- Bed Material Load =
  Bed Load & Suspended Bed Material
- Wash Load =
  Permanently Suspended Fines
- Floatation

HIGH SEDIMENT CONCENTRATION

LOW SEDIMENT CONCENTRATIONS

SEDIMENT DEPOSITS

RIVER ADJUSTMENTS

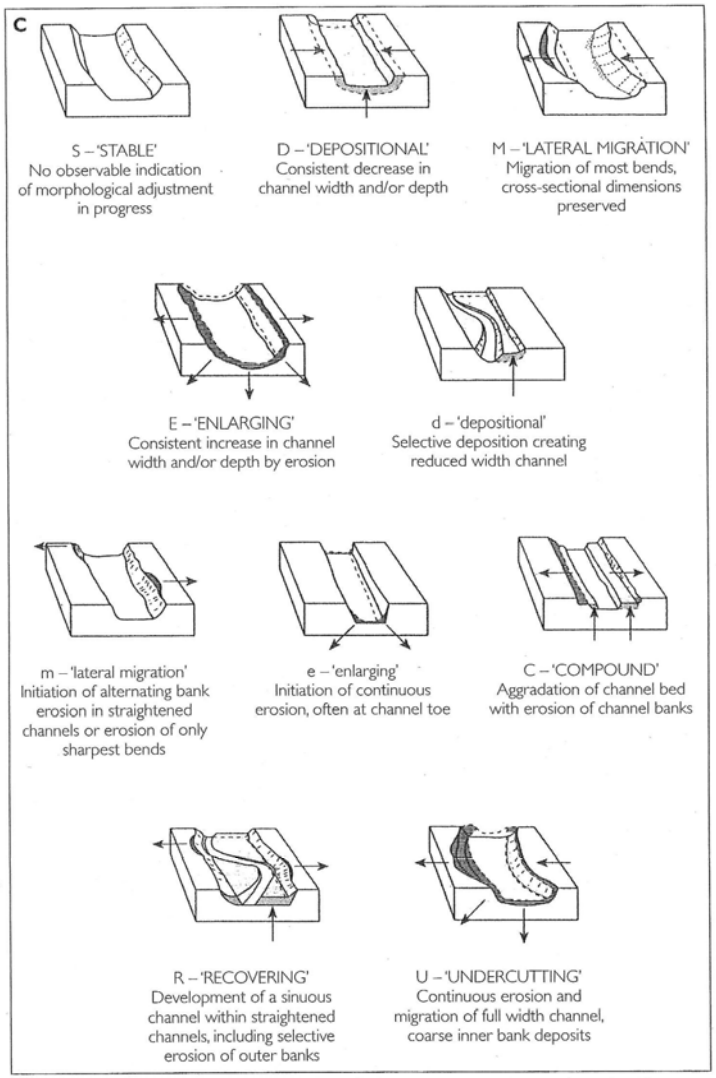
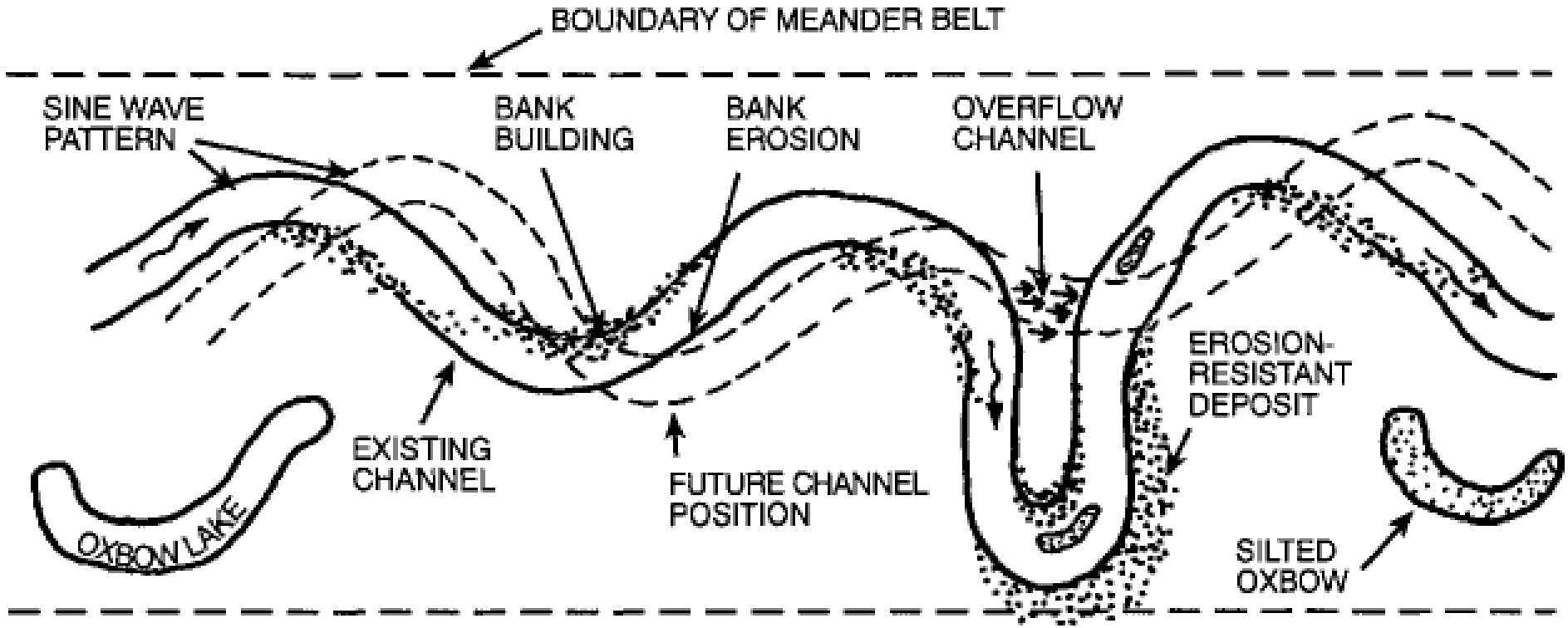


Figure 8.4 *Example classifications of river channel adjustment occurring in river channels subject to human disturbance processes and river engineering* ***A*** *Brice, 1981;* ***B*** *Brookes, 1987a;* ***C*** *Downs, 1992*

MEANDER MIGRATION



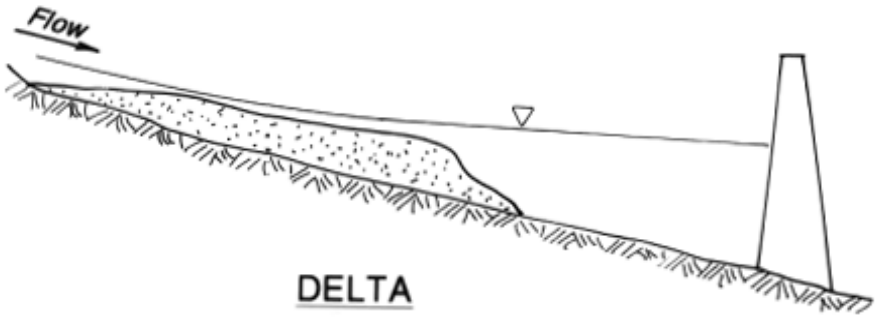
ESOPUS CREEK MEANDERS

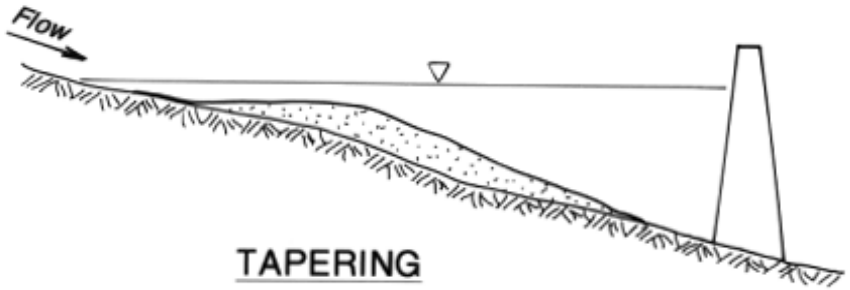
FORMER TRAILER HOMES

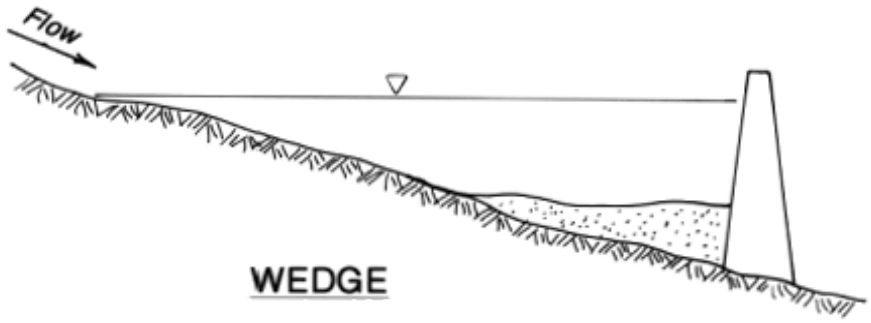
HIGH HAZARD AREAS

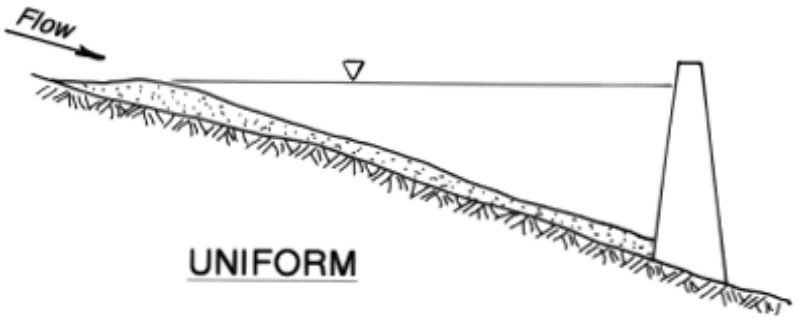
MEANDER SCROLL

SEDIMENT DEPOSITS IN RESERVOIRS







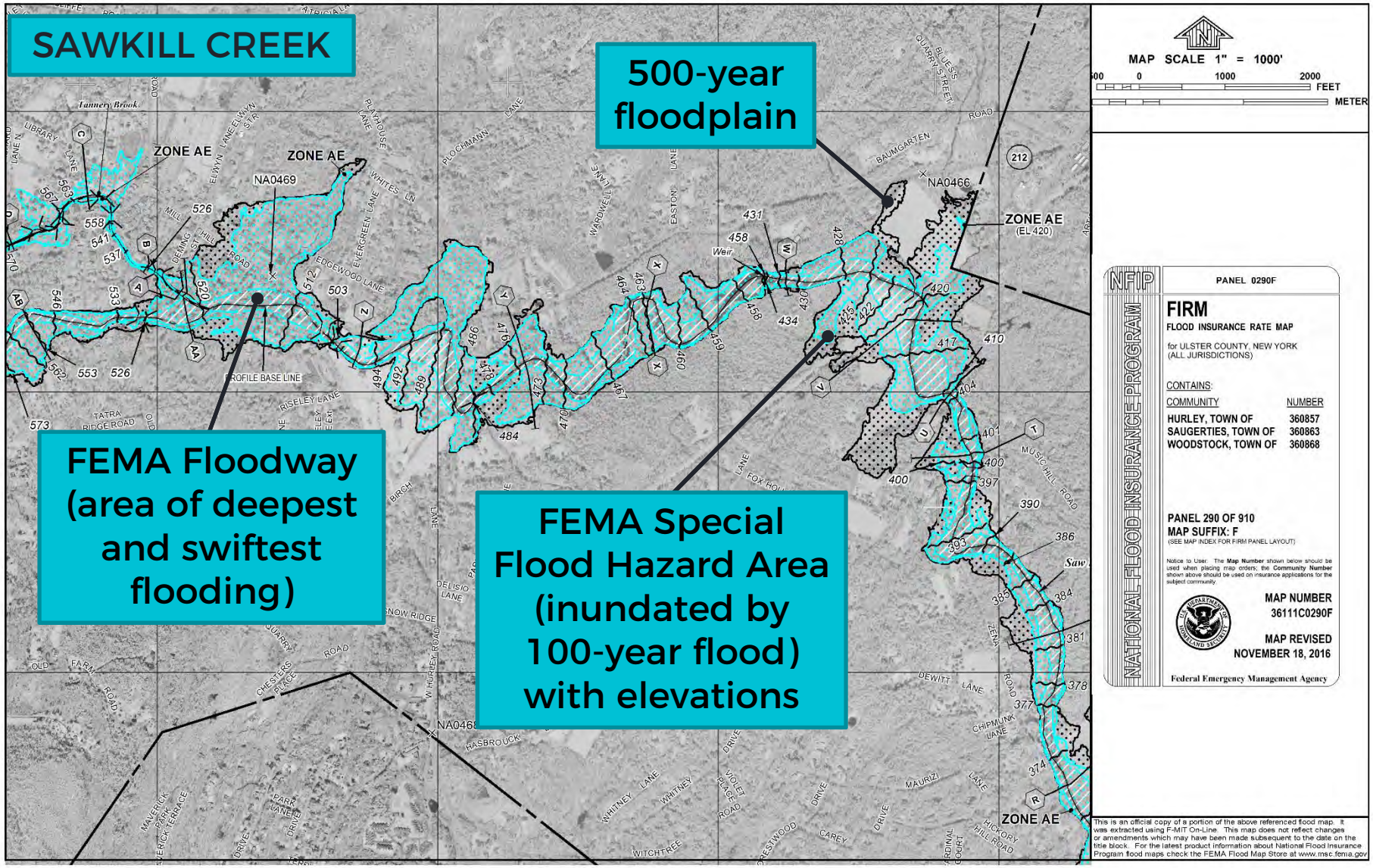


SEDIMENT STORAGE CHARACTERISTICS

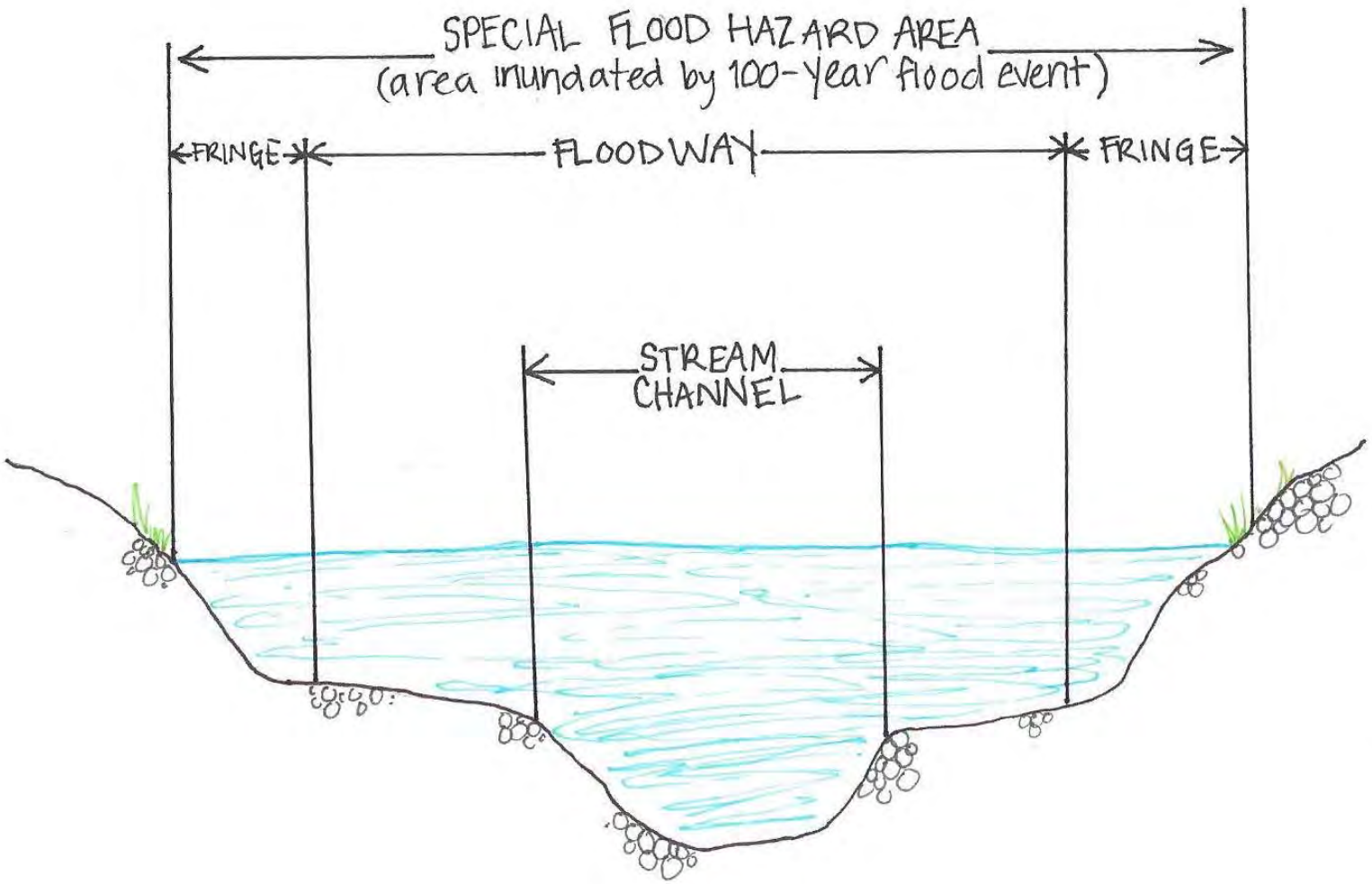
TYPE	NORMAL STAGE	STAGE RANGE	RESIDENCE TIME	TRAP EFFICIENCY
Lake	full	low	long	high
Run of river	full	low	short	low
Water supply	high	moderate	med-long	high
hydropower	high	minor	variable	medium
Flood control	low	large	short	low

SEDIMENT DELTA

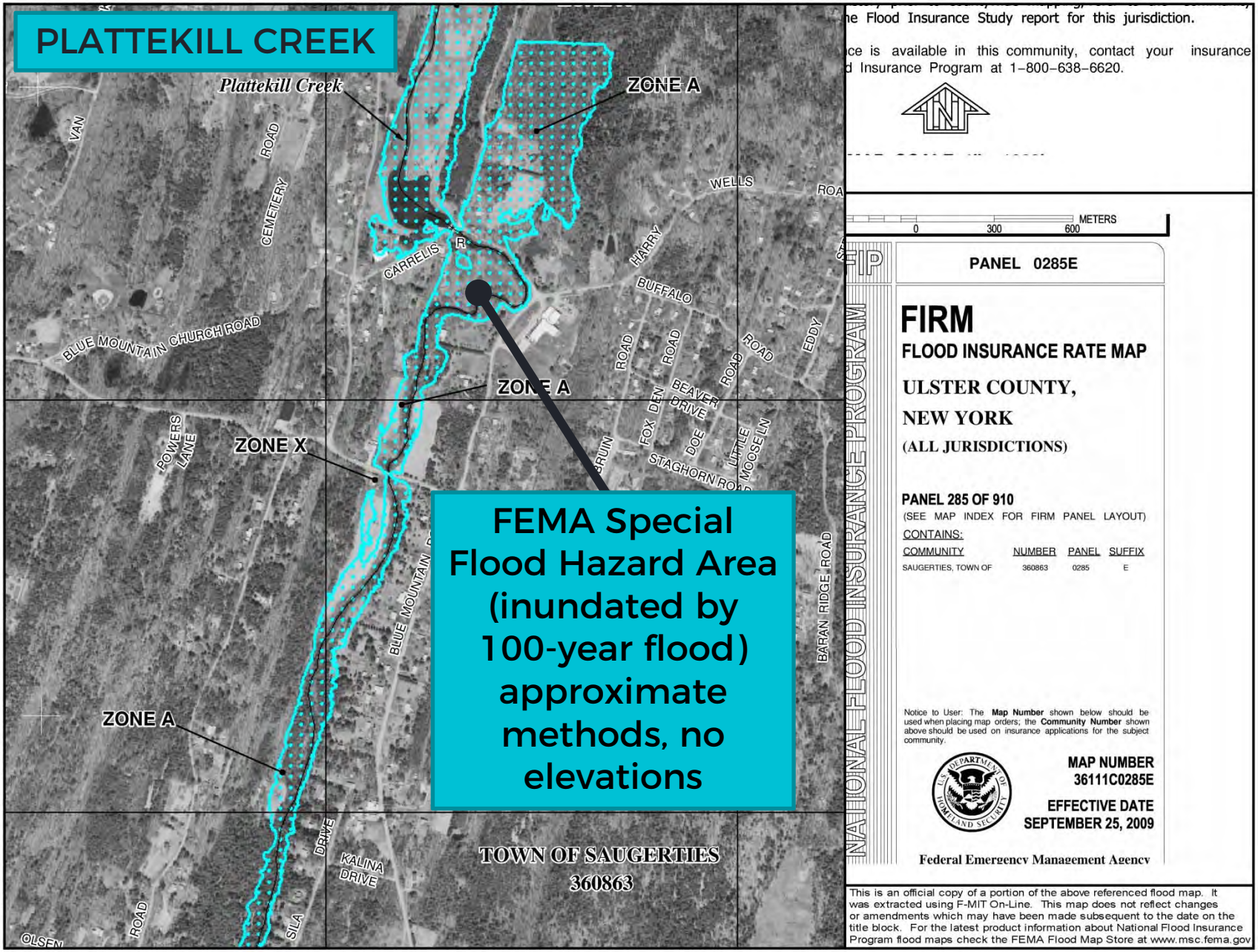
FEMA FLOOD MAPS



FEMA Mapping using Detailed Engineering Methods



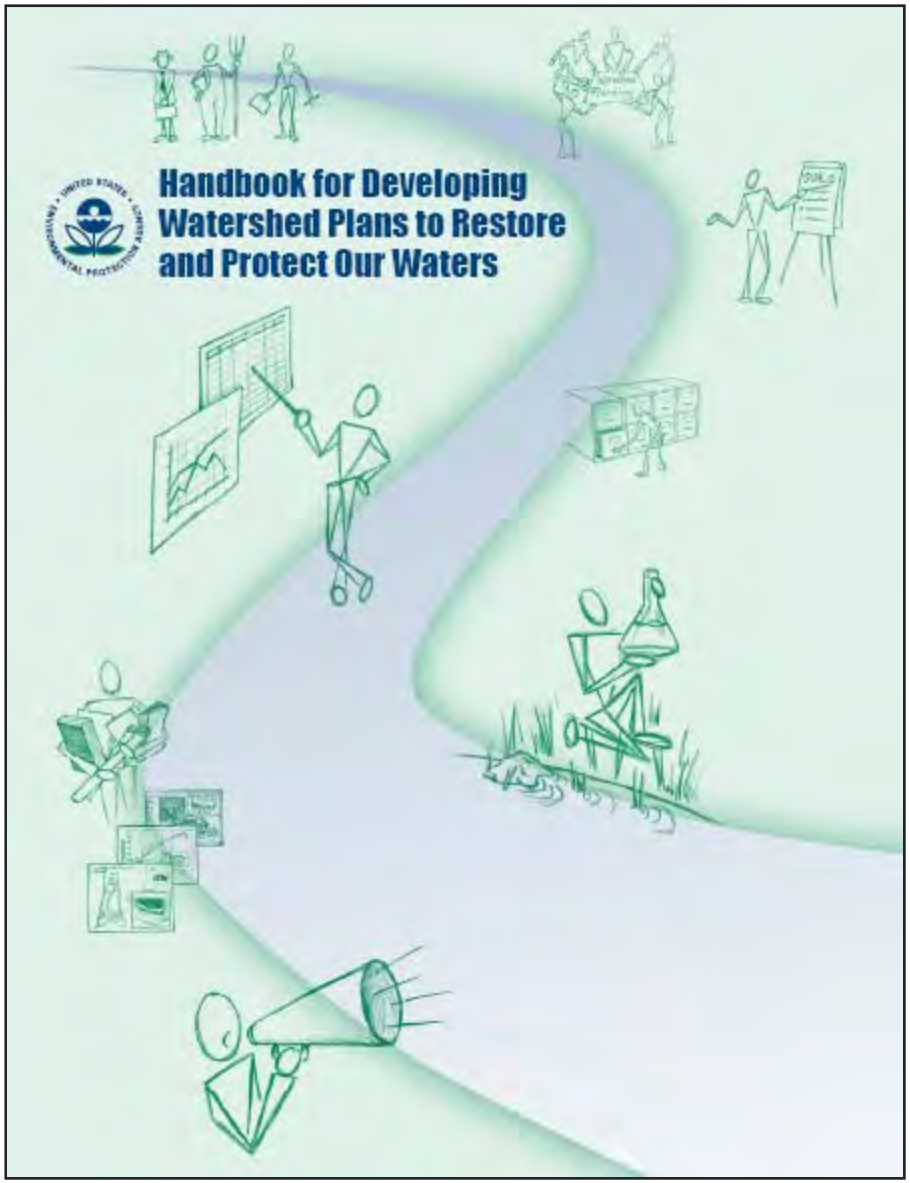
Special Flood Hazard Area, Floodway & Flood Fringe



FEMA Mapping using Approximate Engineering Methods

PLANNING

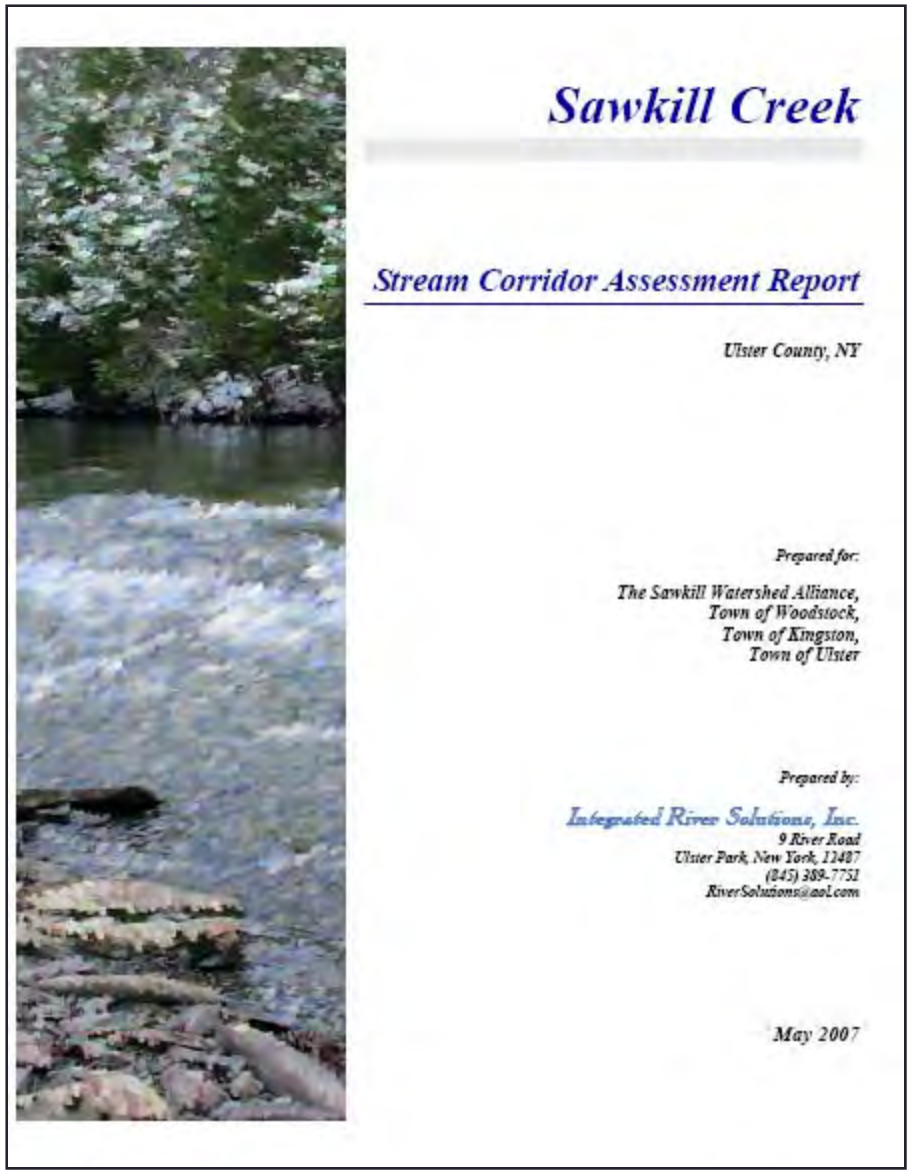
WATERSHED PLANNING PROCESS



WATERSHED PLANNING PROCESS

- Identify & Involve Stakeholders
- Explore Goals & Objectives
- Collect Existing Data
- Document Basin & Corridor Conditions
- Identify Large Scale Problems & Issues
- Develop Future Vision & Specific Objectives
- Assess Site Specific Problems
- Evaluate Alternatives & Strategies
- Prepare Implementation Plan

WATERSHED PLANNING PROCESS



Funded through Hudson River Estuary Program Grant to Town of Woodstock

POTENTIAL FUNDING SOURCES

HUDSON RIVER ESTUARY PROGRAM:

- Tributary Restoration and Resiliency
- Local Stewardship Planning
- River Access and River Education

Sign up to receive **Hudson RiverNet**: Hudson River Estuary Newsletter

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HUDSON RIVER ESTUARY PROGRAM

- Trees for Tribs

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Web Page: http://www.dec.ny.gov/lands/43668.html

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QUESTIONS, COMMENTS, THOUGHTS?