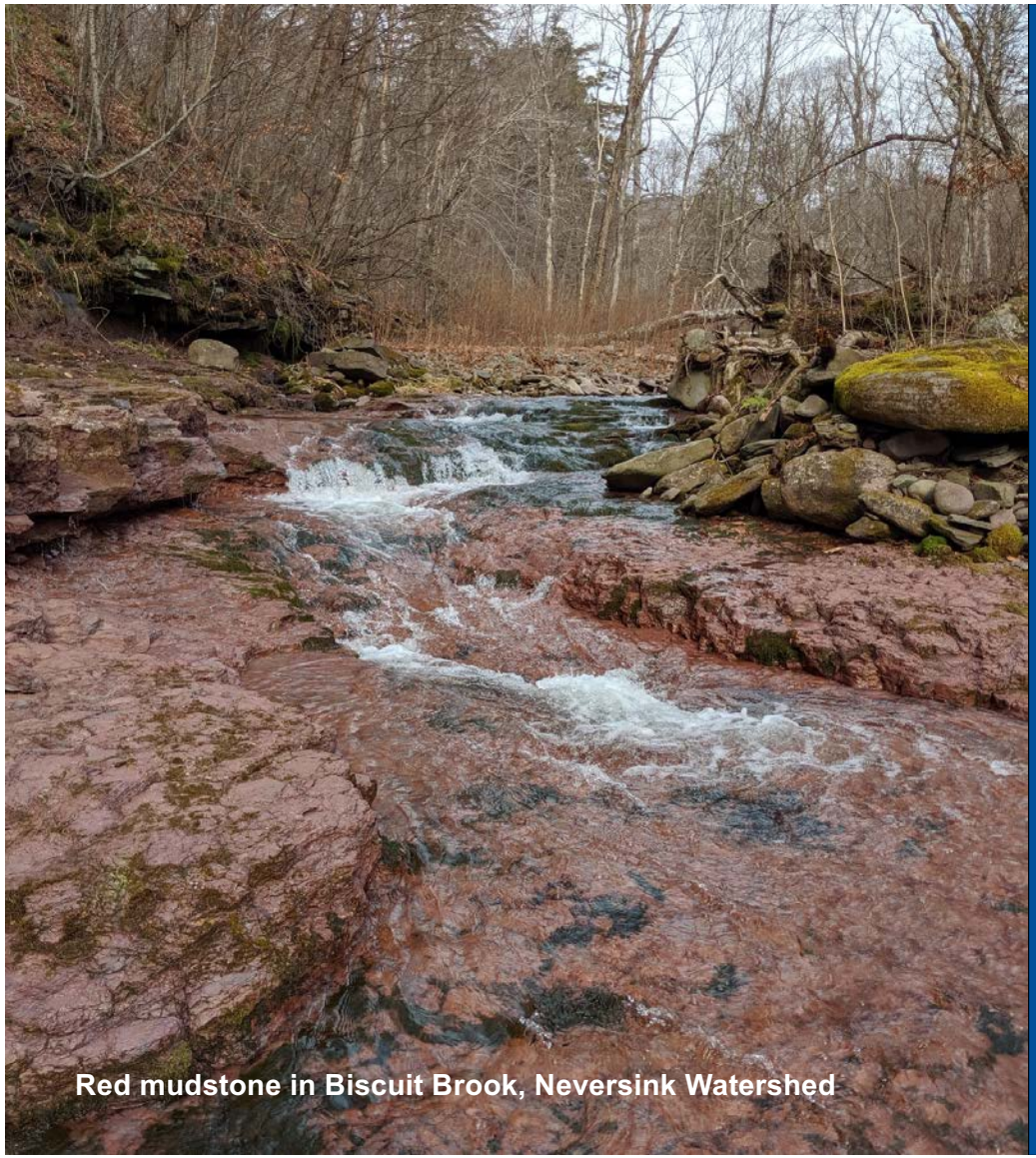


Red mudstone in Biscuit Brook, Neversink Watershed

A Streamside Guide to Catskill Mountain Geology

Dany Davis

BUREAU OF WATER SUPPLY, STREAM MANAGEMENT PROGRAM

NYC Environmental Protection

Black Chasm Falls in Platte Clove, Plattekill Watershed

Eroding terraces on Stony Clove Creek, Esopus Creek Watershed

Streams are great geologic story tellers,
if we know how to listen.


What we are going to do
A little quiz
Reading
The landscape
A stream walk

Let's get started: What can you tell me about the geology you can see in this photo?

- **What are these landforms?**
- **Can we see what they are composed of?**
- **What formed them?**

Geology and the discipline of geomorphology can help guide us to answers.

Let's get started: What can you tell me about the geology you can see in this photo?

- **What is this feature?**
- **How would you describe these rocks?**
- **What do these rocks tell us?**

Geology and the discipline of geomorphology can help guide us to answers.

Let's get started: What can you tell me about the geology you can see in this photo?

- **What is this?**
- **How would you describe this feature?**
- **What story could this be telling us?**

Geology and the discipline of geomorphology can help guide us to answers.

Wittenberg, Catskill Mountains, New York

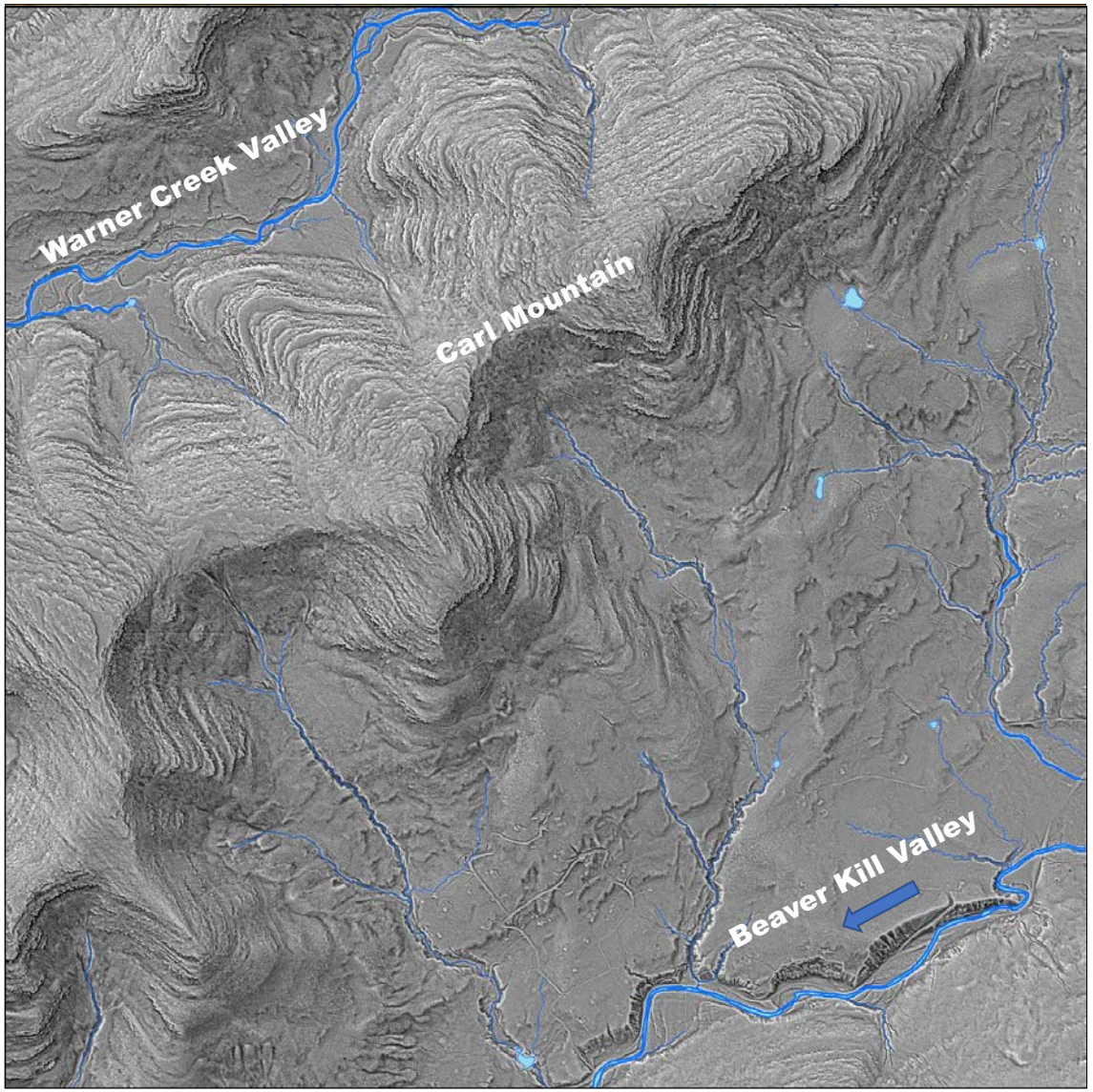
Bear Mountain, Kenai Mountains, Alaska

Reading the Landscape: Mountains

- There are many ways to make a mountain and a mountain range.
- In all cases there are driving forces that uplift the terrain and there are the driving forces that work to lower the terrain.
- All mountains are a topographic expression of the balance or imbalance of these forces, the nature of the bedrock and time.

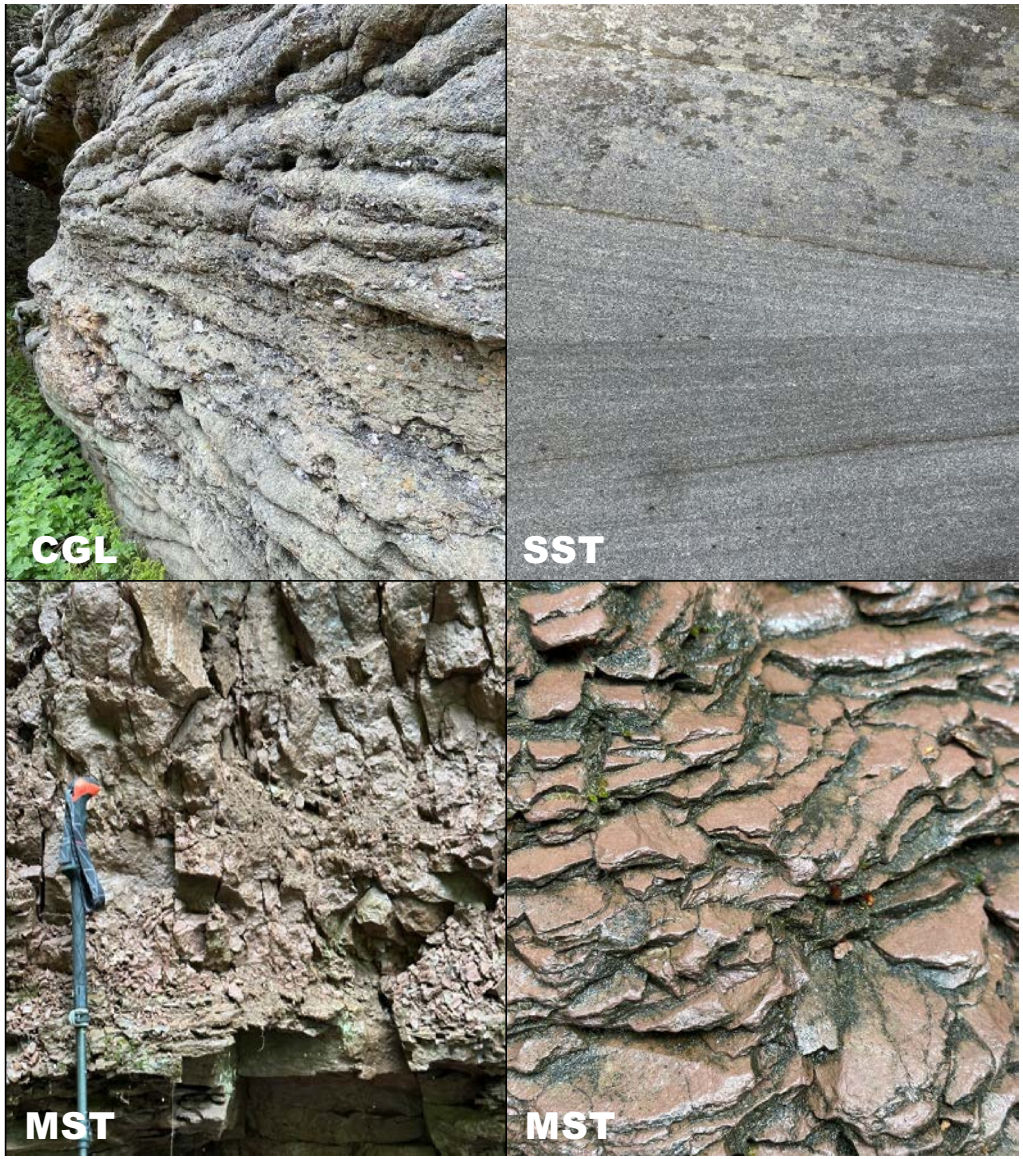
Reading the Landscape: Topographic Maps

- Topographic maps can reveal much about the geologic story.
- We can see how streams have helped define this mountain landscape.
- We also see an important feature of the bedrock: it is layered forming a step-like profile. What might account for that?

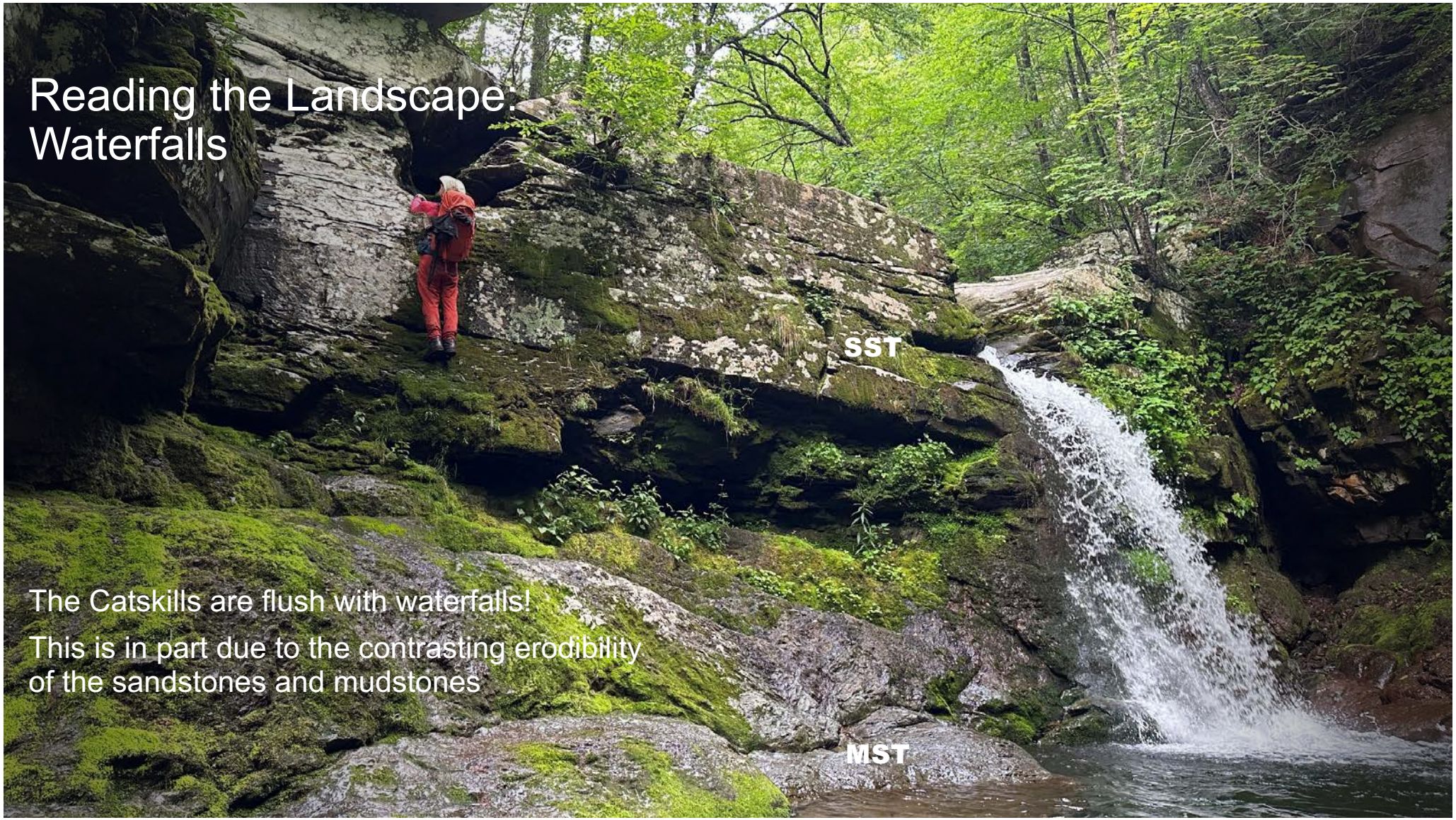


Reading the Landscape: Bedrock

- Catskill Mountain bedrock is a repeating sequence of
  - Erosion resistant **sandstones (SST)** and **conglomerates (CGL** **“**sand and gravel stones”),
  - Erosion prone **mudstones (MST)** comprising a wide variety of fine-grained silt and clay rocks like **shale** and **paleosols.**
- The stair-step profile of the Catskill Mountains is the result of this alternating sequence of erosion resistant and erosion prone bedrock layers.

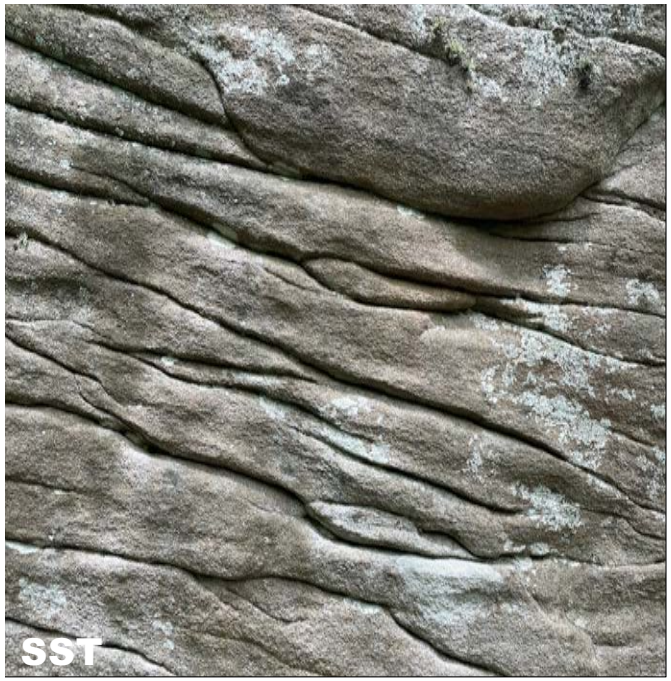


Reading the Landscape: Waterfalls



The Catskills are flush with waterfalls!

This is in part due to the contrasting erodibility of the sandstones and mudstones

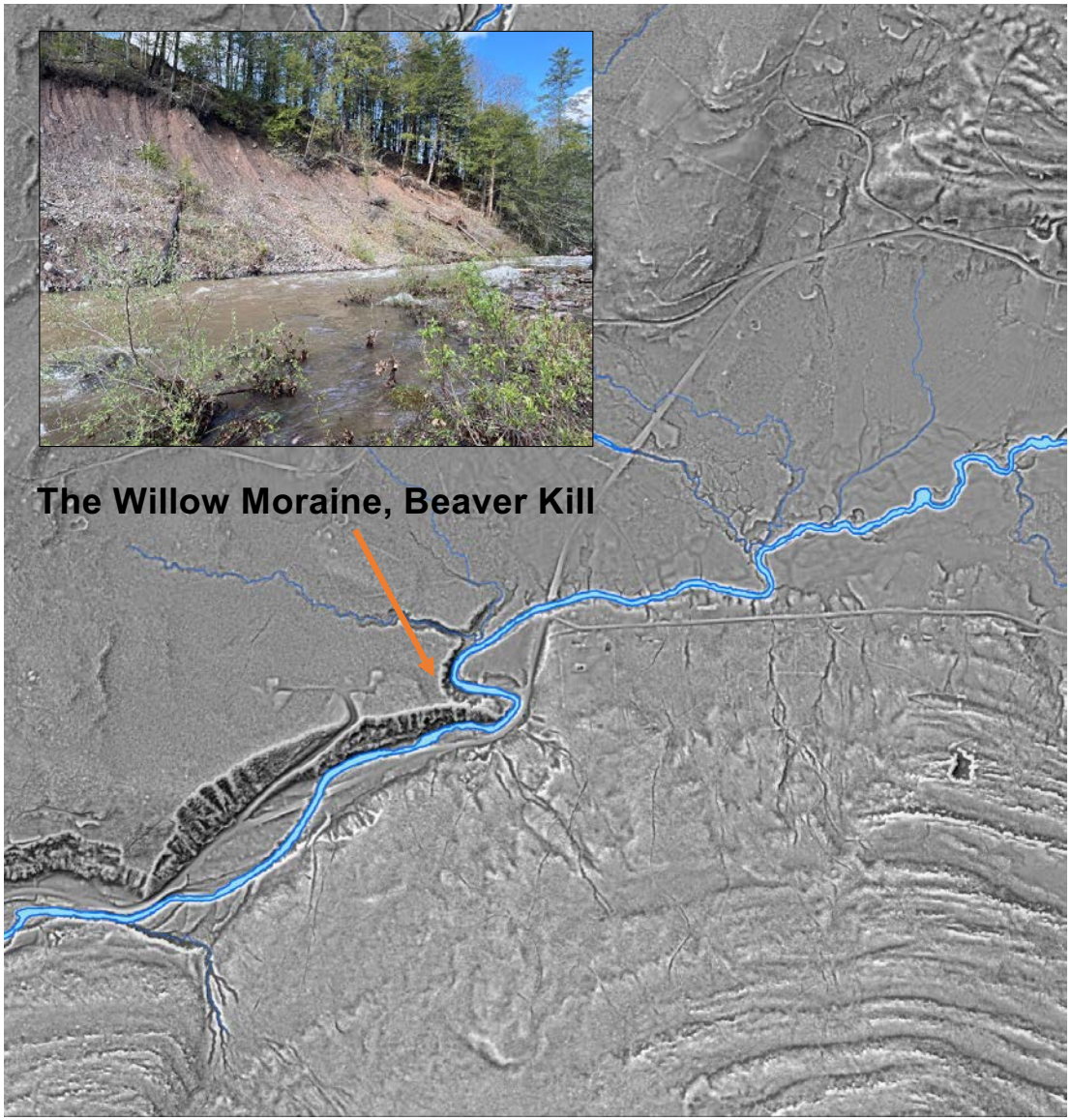


Bedrock Foundations: The Late Devonian Era

- The story the rocks tell is of 375- to 380-million-year-old rivers hauling the eroded terrain of ancient ancestors of the Appalachian Mountains in the east to an expansive shallow inland sea to the west.
- The sandstones/conglomerates are the river channel sediment.
- The mudstones (shales, paleosols, siltstones) represent the riparian floodplains.
- If you look, you will find the fossil remains of riparian forest fragments incorporated into the river system sediment.

Reading The Landscape: The Legacy of the Ice Ages

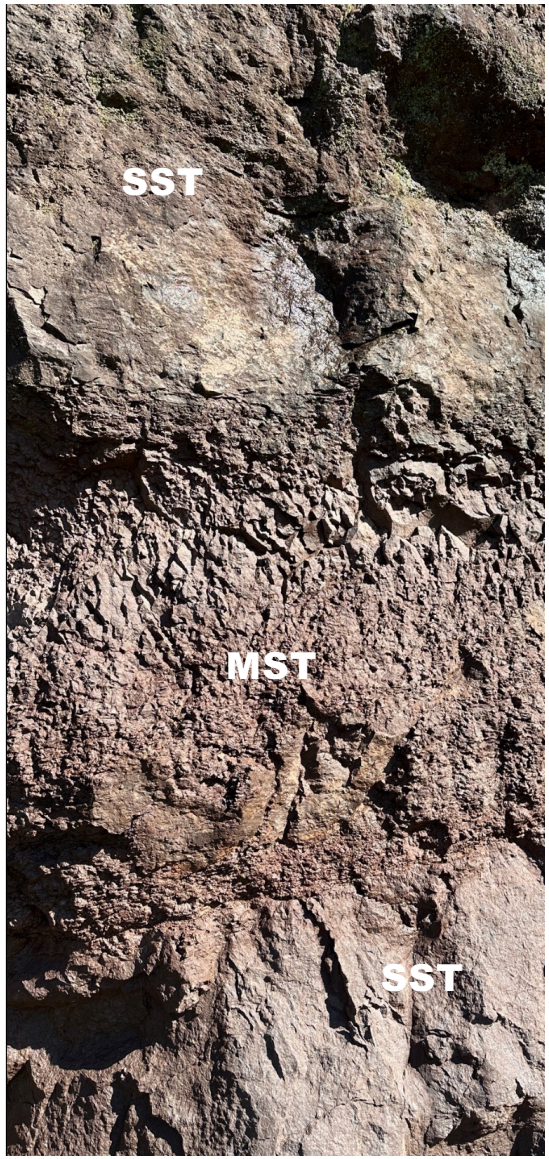
- Digital terrain maps reveal the most recent geologic forces to shape this landscape:
  - Glaciers and continental ice sheets of the Pleistocene epoch left an erosional and depositional imprint.
  - Streams and landslides continue to shape the landscape today.




Let’s step into the stream...

Reading Streams: Cobble Bar Stories

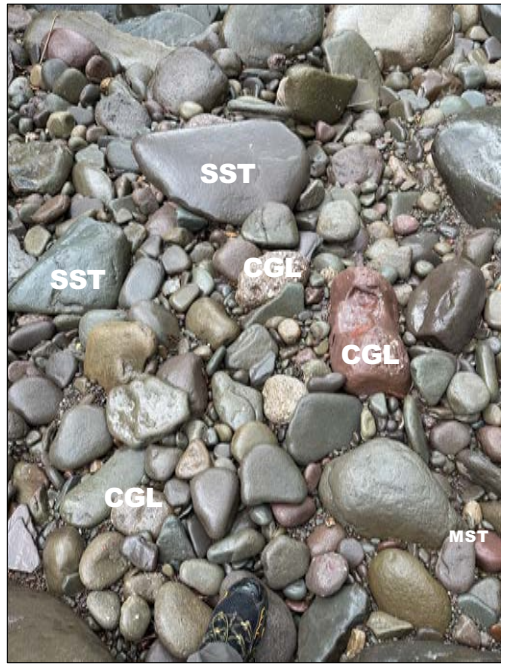
- There are many stories to find in a single stream cobble bar.
- Visit any Catskill stream sediment bar and almost every rock is either
  - Sandstone
  - Mudstone
  - Conglomerate
- These are the rocks we see that make up the Catskill mountains.
- Streams are conveyor belts of the sampled terrain.



Plattekill

Stony Clove Creek

Esopus Creek



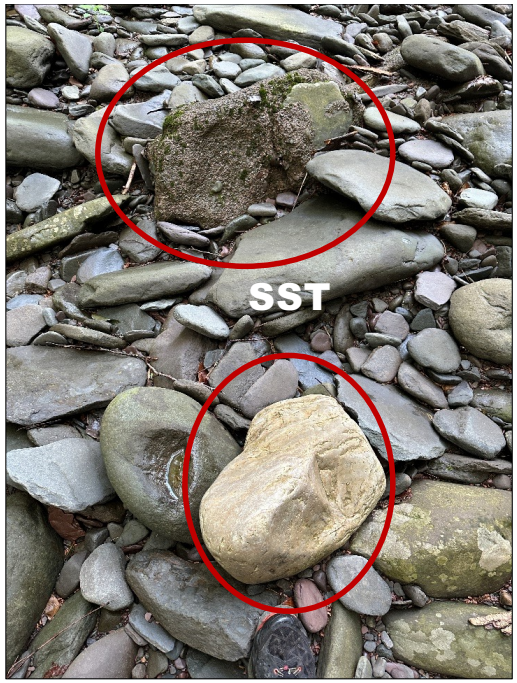
Woodland Creek

Catskill Stream Cobble Bars

Each of these cobble bars is on different Catskill streams, yet the sampled geology is very similar.

There are differences though in each bar: different proportions of rock types, different shapes, revealing some of the diversity in the relative uniformity of Catskill mountain bedrock and geologic history.

Plattekill



Plattekill

Plattekill

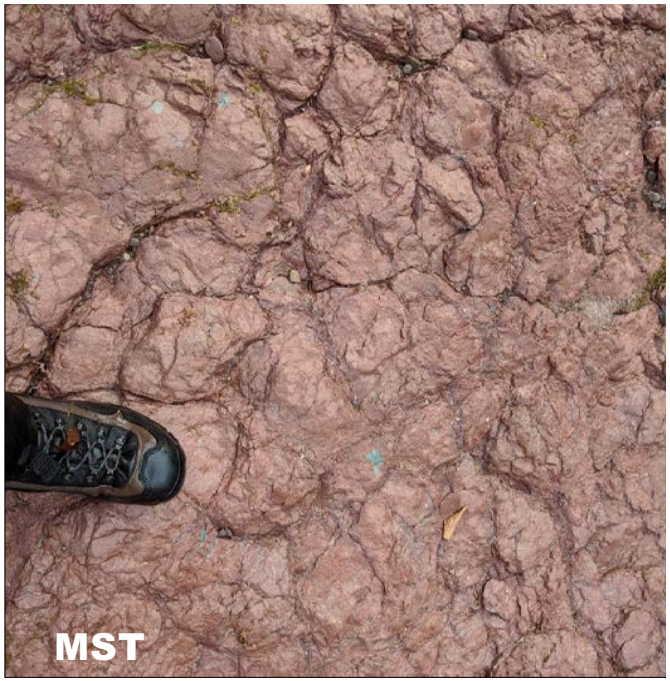
Plattekill

Catskill Stream Cobble Bars

These cobble bars on the Plattekill include unique (1) glacial visitors, (2) a “false’ rock; (3) potential evidence of a Devonian flood, and (4) a mysterious puzzle.

Plattekill

Biscuit Brook

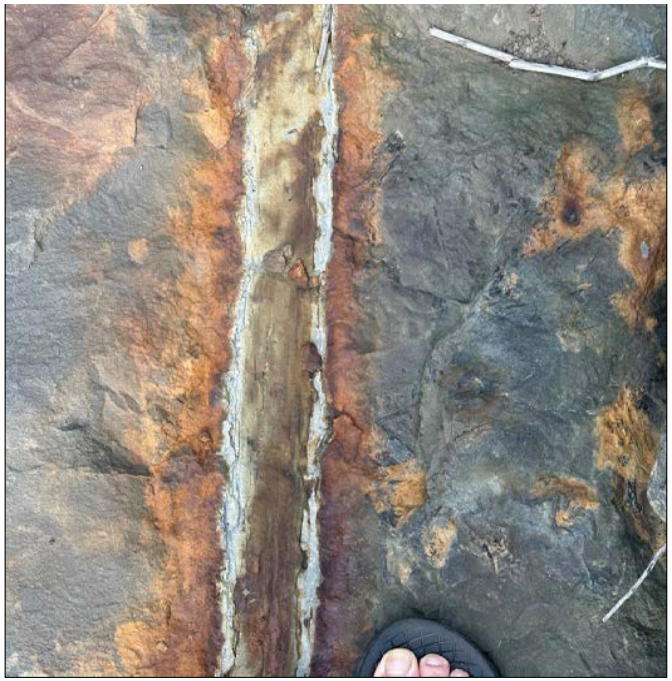


Biscuit Brook

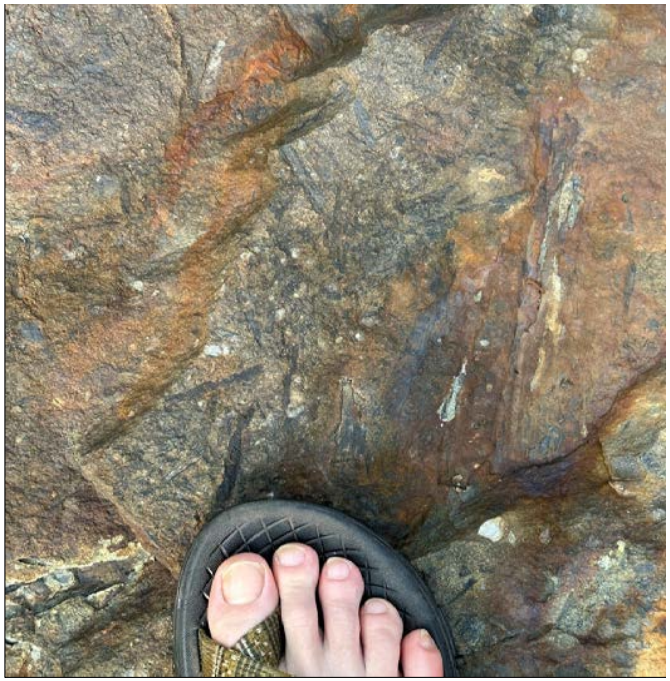
Devonian River Fluvial Forms

These are photos of fluvial forms observed in Devonian river sandstones that show “fossil” ripples and migrating sand dunes in planform and cross-section; and a photo of a “fossil” muddy flood plain with desiccation cracks and root traces.

Esopus Creek



Stony Clove Creek

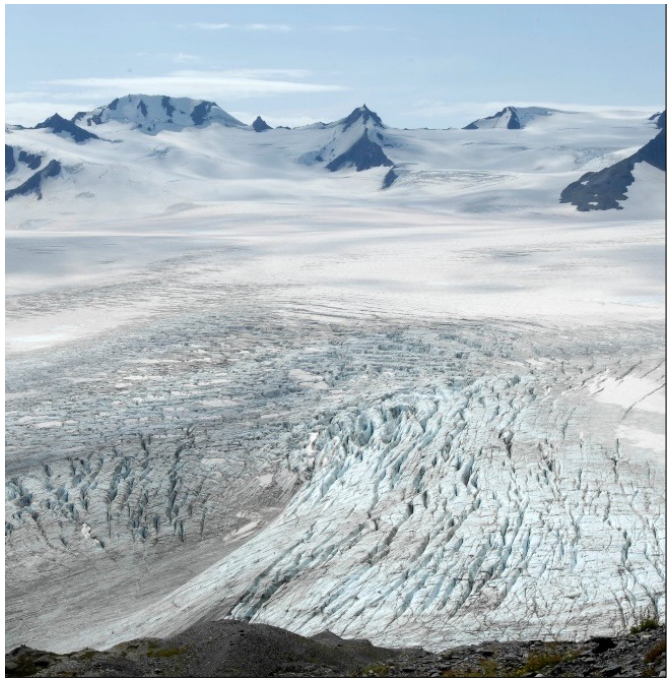


Plattekill

Devonian “Woody Debris”

These are photos of plant fragments that were entrained into the ancient Devonian rivers and deposited as part of the material these streams conveyed.

Did this wood support Devonian aquatic ecosytems?



Harding Icefield, Kenai Peninsula, AK

Glacial till, Stony Clove Creek

Glacial lake clay, Warner Creek

Connecting to the Ice Ages

Catskill streams are still processing the glacial legacy sediment left behind ~15,000 to ~25,000 years ago.

East Kill

East Kill

Stony Clove Creek

Glacial Tills of the Catskills

The glacial legacy of the ice ages includes thick deposits of consolidated glacial till that was entrained at the base of thousands of feet of flowing ice. Much of the sediment we see in today's streams originated from this glacial source.

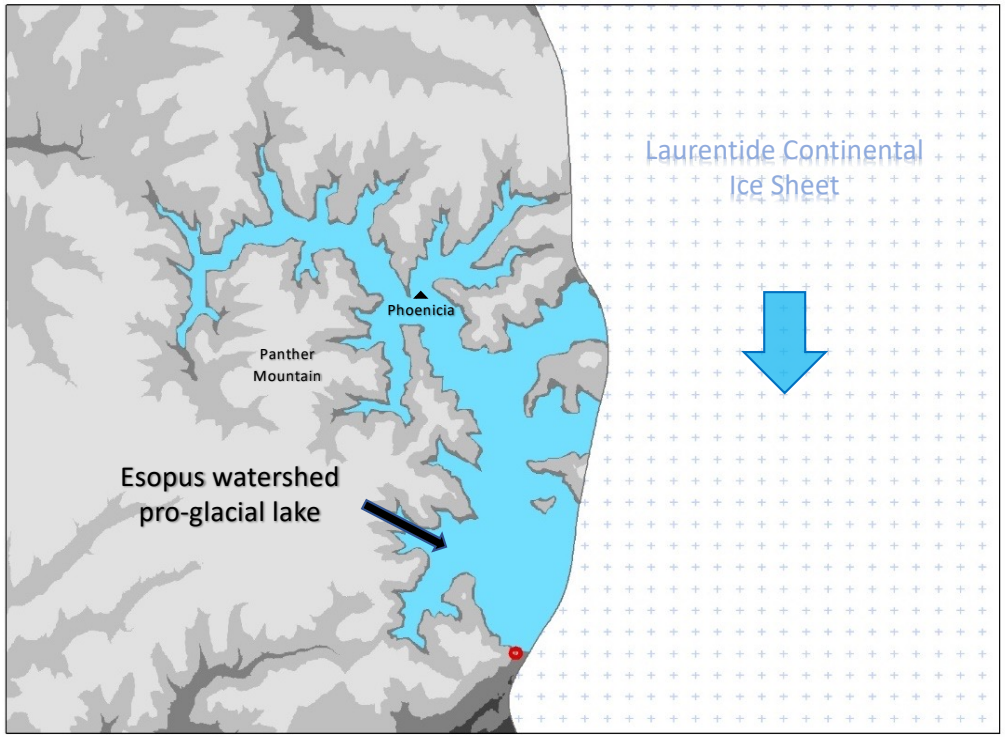
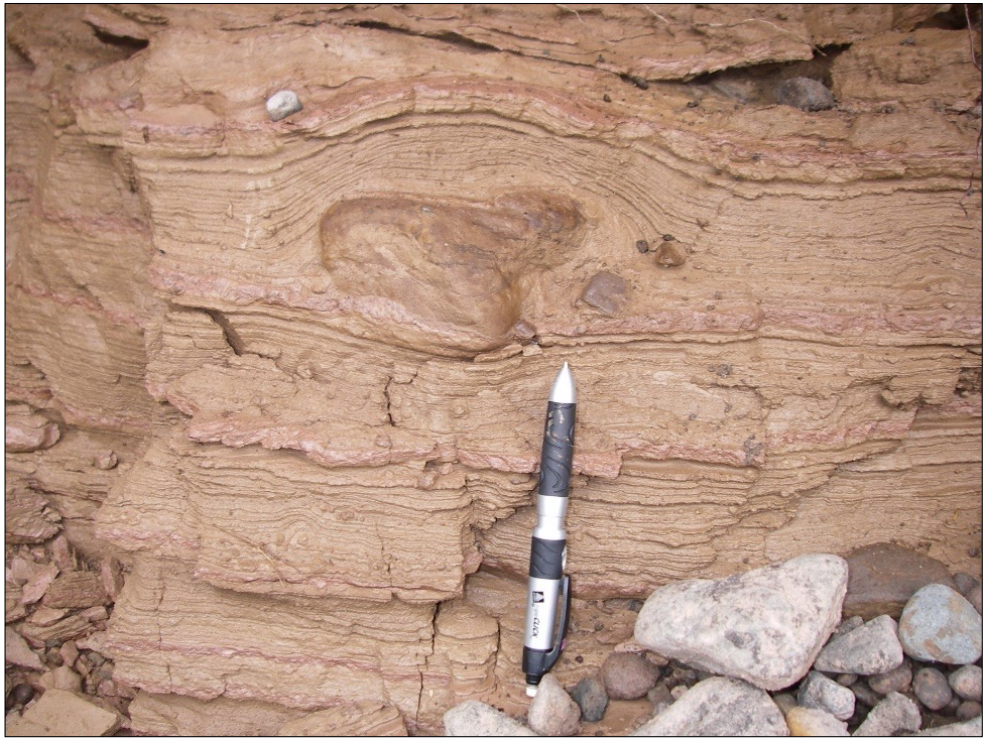


Illustration of a hypothetical glacial lake (adapted from A. Kozlowski)

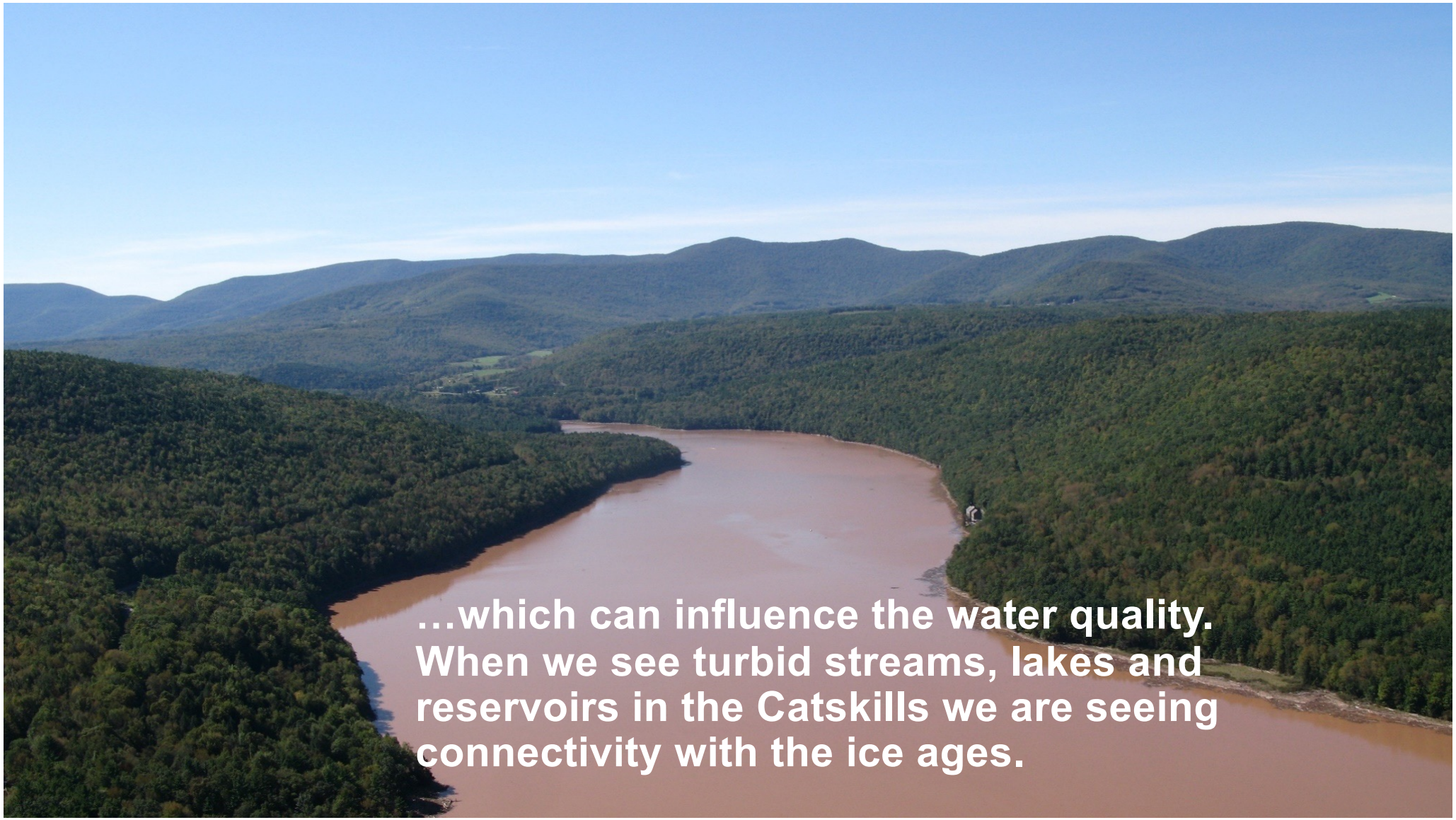


Glacial lake sediment in Beaver Kill

Glacial Lakes of the Catskills

The glacial legacy of the ice ages also includes variably thick deposits of lake sediment from valley-filling glacial lakes and smaller lakes during the messy process of the advance and retreat of the ice sheets in and out of the Catskills.


These layers of ice age silt and clay are becoming this eras stream transported sediment…


…which can influence the water quality.
When we see turbid streams, lakes and
reservoirs in the Catskills we are seeing
connectivity with the ice ages.

Diamond Notch Falls, West Kill, Schoharie Creek Watershed

TS Irene Flood headcut, Warner Creek, Esopus Creek Watershed

Valley Evolution: Knickpoints

Valley evolution in the Catskills happens across the spans of thousands to millions of years through the persistent and episodic application of stream power creating an incised landscape.

This process can also happen in the course of one flood!

Woodland Creek headwaters

Beaver Kill

Bushnellsville Creek

Valley Evolution: Landslides

Valley evolution in the Catskills also happens through the persistent and episodic application of mass wasting or landslides in an incised landscape.

This process is driven by climate and weather as well as by streams cutting into the base of steep slopes.

This is key to how **new** sediment gets into streams!

Let's wrap up: What can you tell me about the geology you can see in this photo?

- **What is this feature?**
- **How would you describe these rocks?**
- **What do these rocks tell us?**

Geology and the discipline of geomorphology can help guide us to answers

Let's wrap up: What can you tell me about the geology you can see in this photo?

- **What are we looking at?**
- **What is going on in the middle layer?**
- **What story could this be telling us?**

Geology and the discipline of geomorphology can help guide us to answers


Thank You