

Stream Processes and Riparian Function

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Warm thanks and appreciation to

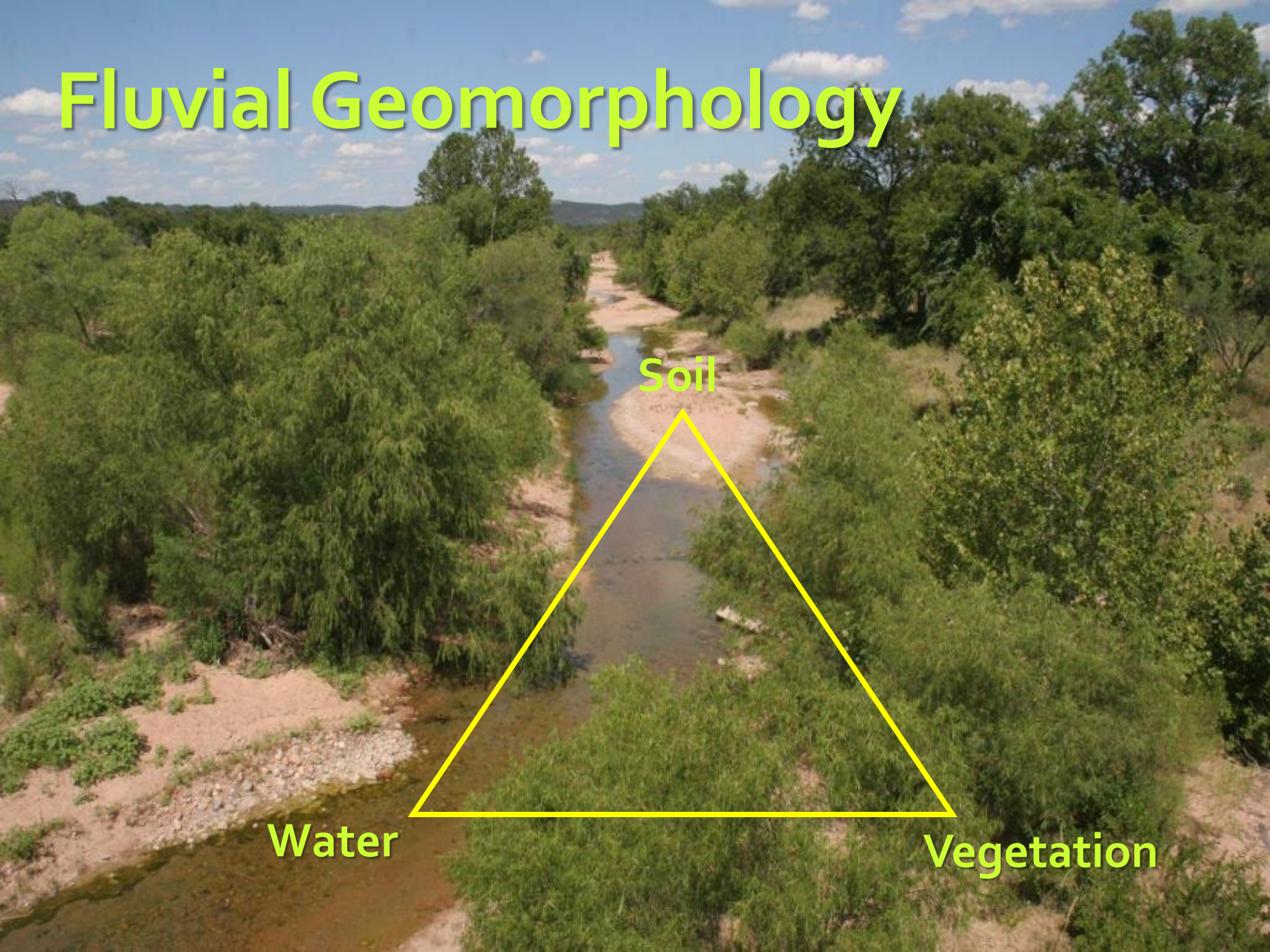
Steve Nelle



Kenneth Mayben



Fluvial Geomorphology



Soil

Water

Vegetation

Objectives

- What are the functions of a stream?
- What are some myths about streams?
- How do streams shape and maintain themselves?
- How are streams altered?
- Can streams be repaired?

What do creeks and rivers want to do?

Functions of a Stream

- Transport water
- Transport and deposit sediment
- Transport and replenish nutrients
- Biological functions (food, shelter, shading, movement, etc.)



Stream, Floodplain, and Riparian Areas are One

Functions -> Values

- Erosion Control
- Water Quality
- Wildlife Habitat
- Aquatic Habitat
- Recreation
- Water Storage
- Flood Protection





Dispelling Myths

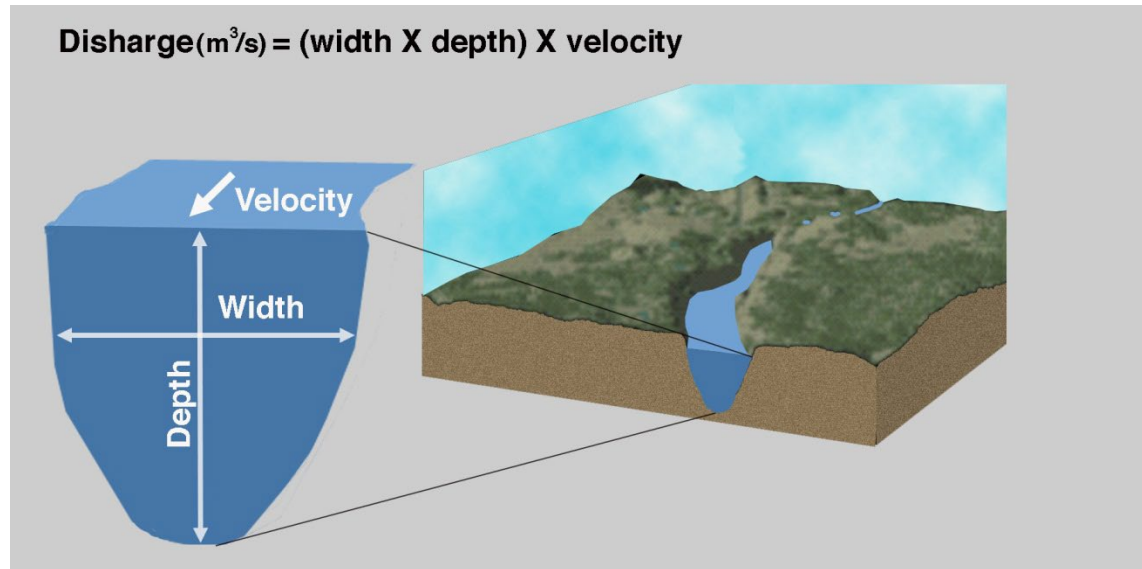
- Streambank and watershed erosion are natural processes
- Streams should change over time. A dynamic equilibrium exists in stable stream channels
- Floods and drought have some beneficial functions

Stable Stream

- A stable stream has a consistent shape (dimension, pattern, and profile) such that, over time, channel features are maintained and the stream system neither
 - aggrades (deposits excess sediment), nor
 - degrades (erodes excess sediment).
- Lateral migration and erosion do not necessarily indicate instability. Stable streams are also dynamic.

How Do Streams Shape Themselves?

- Channel Width
- Channel Depth
- Velocity
- Discharge
- Channel Slope
- Channel Material & Roughness
- Sediment Load
- Sediment Size

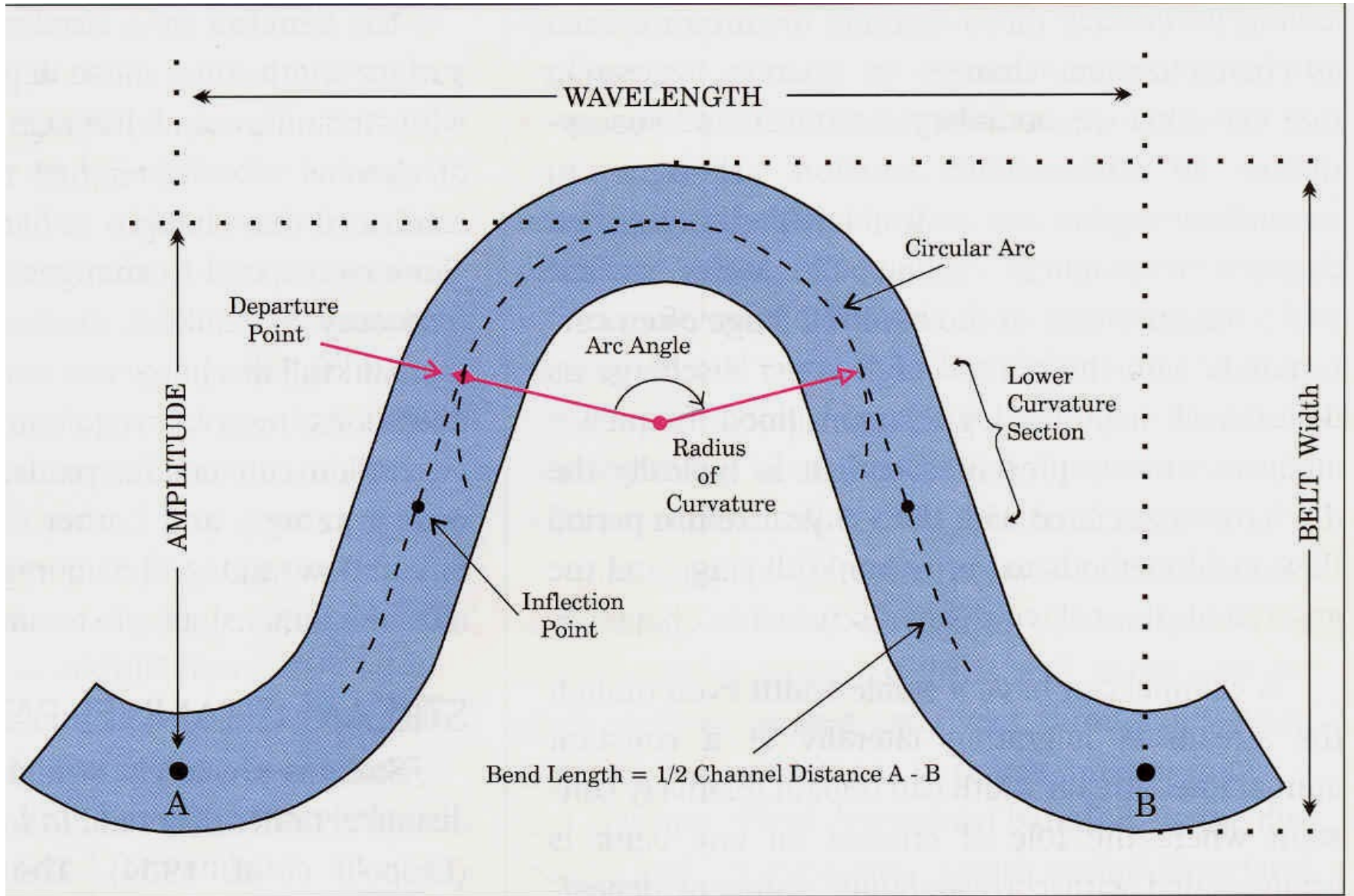


Change one variable and others will adjust in response

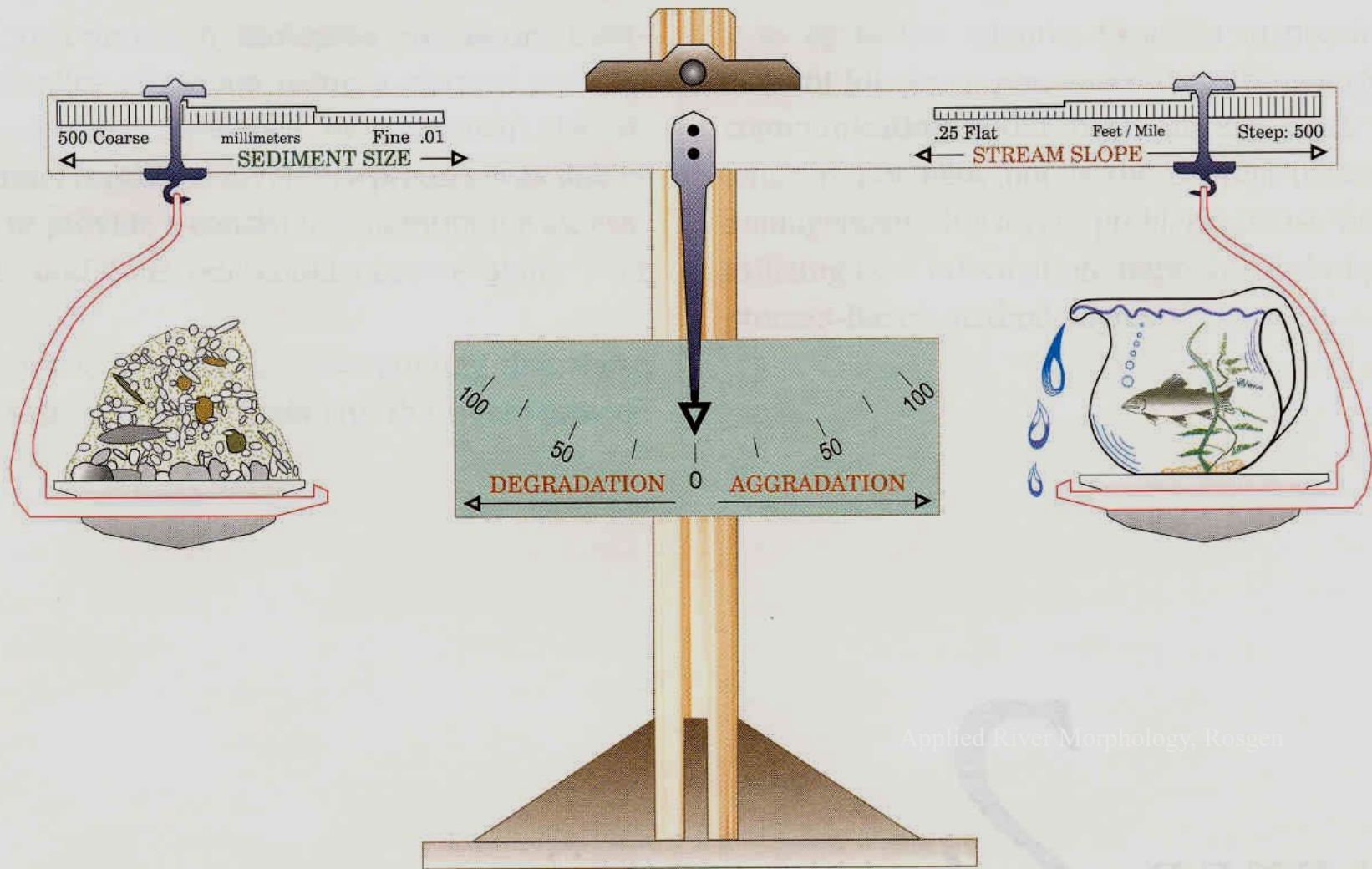
Many Universal Similarities



Channel Geometry



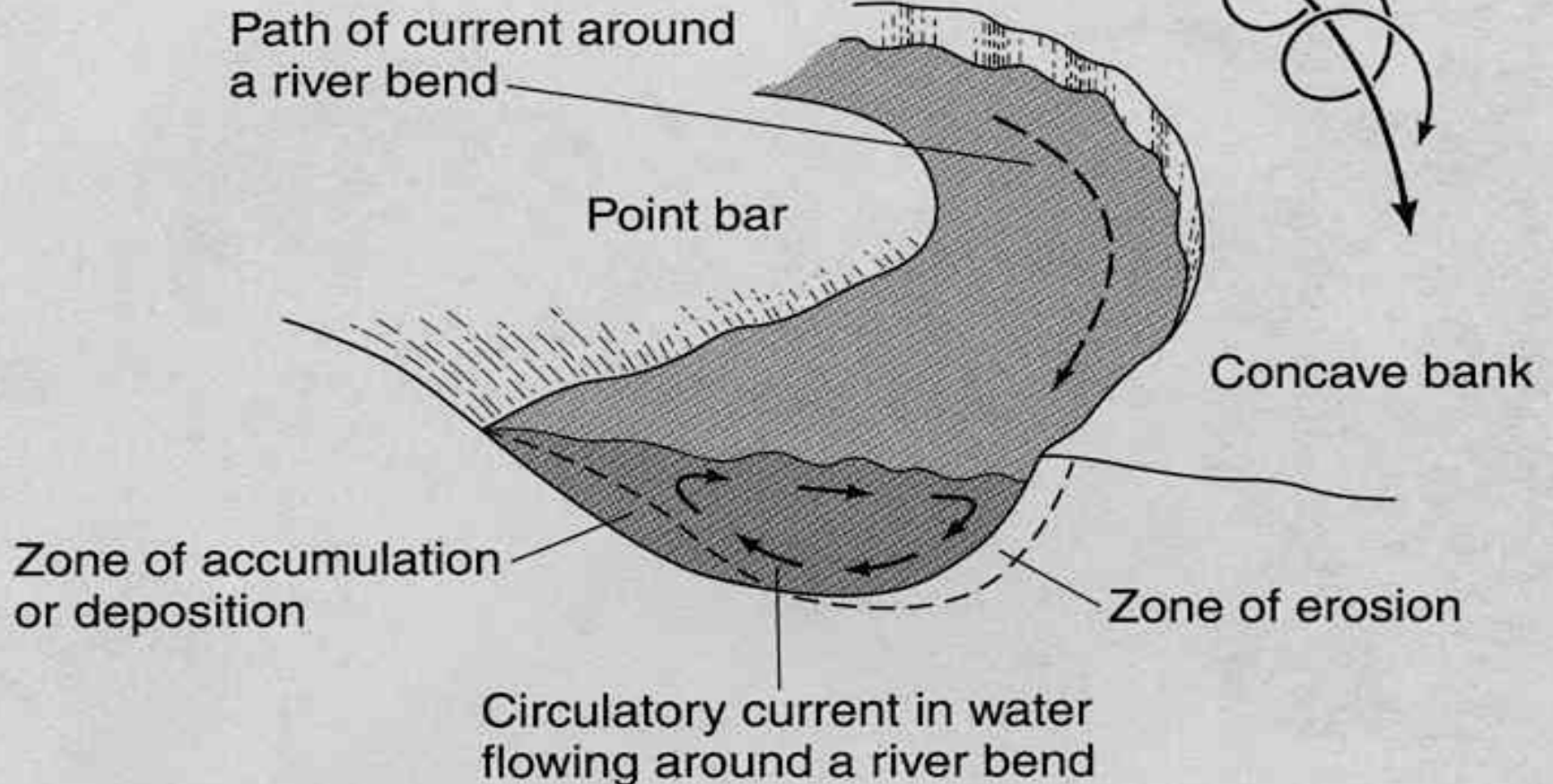
Lane's Relationship (1955)



Applied River Morphology, Rosgen

How Water Flows

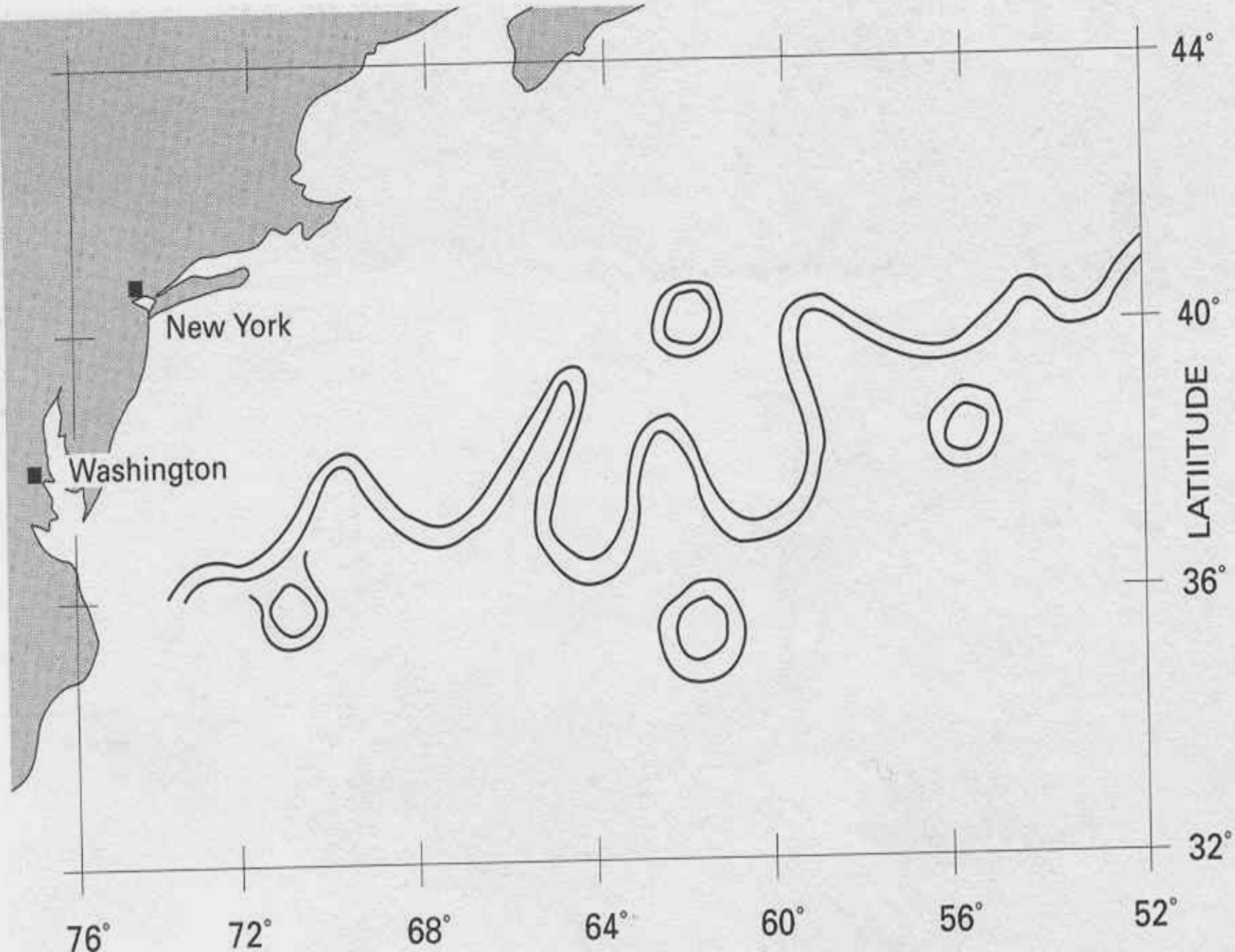
Exaggerated sketch of the screwlike path of a particle of water around a river bend



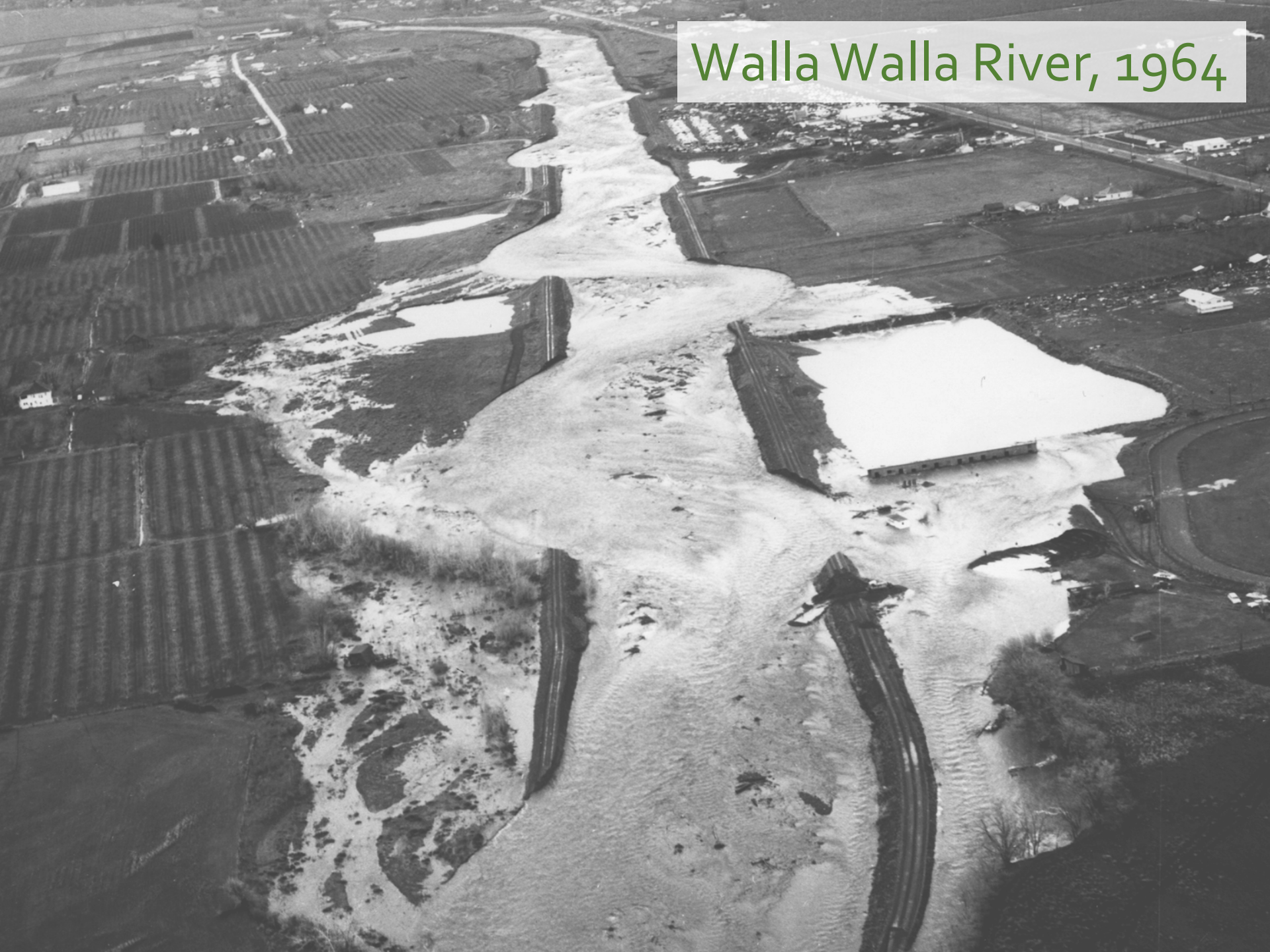
Lesson 1:

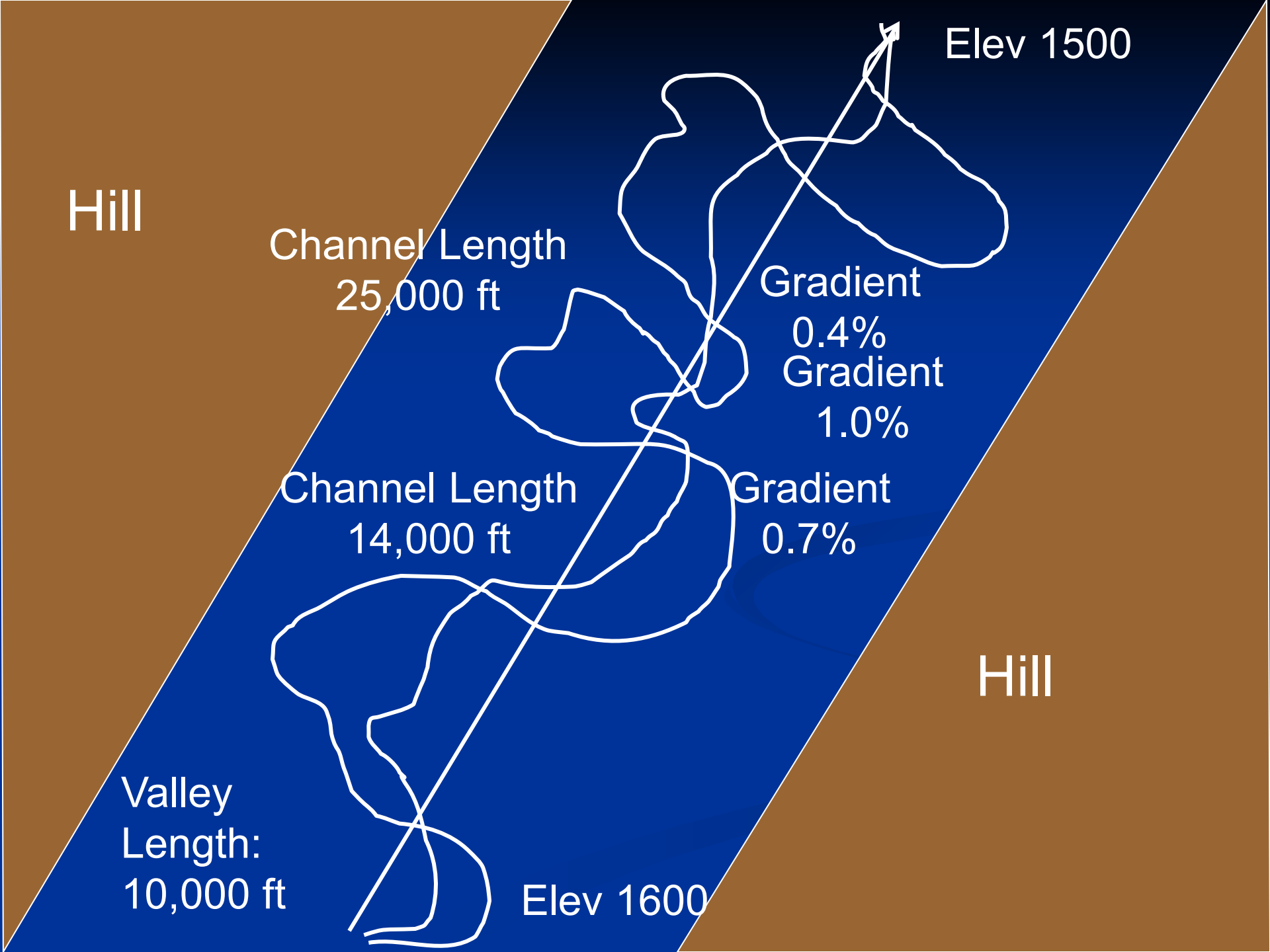
Most streams do not want to be wide and straight





Walla Walla River, 1964





Elev 1500

Hill

Channel Length
25,000 ft

Gradient
0.4%
Gradient
1.0%

Channel Length
14,000 ft

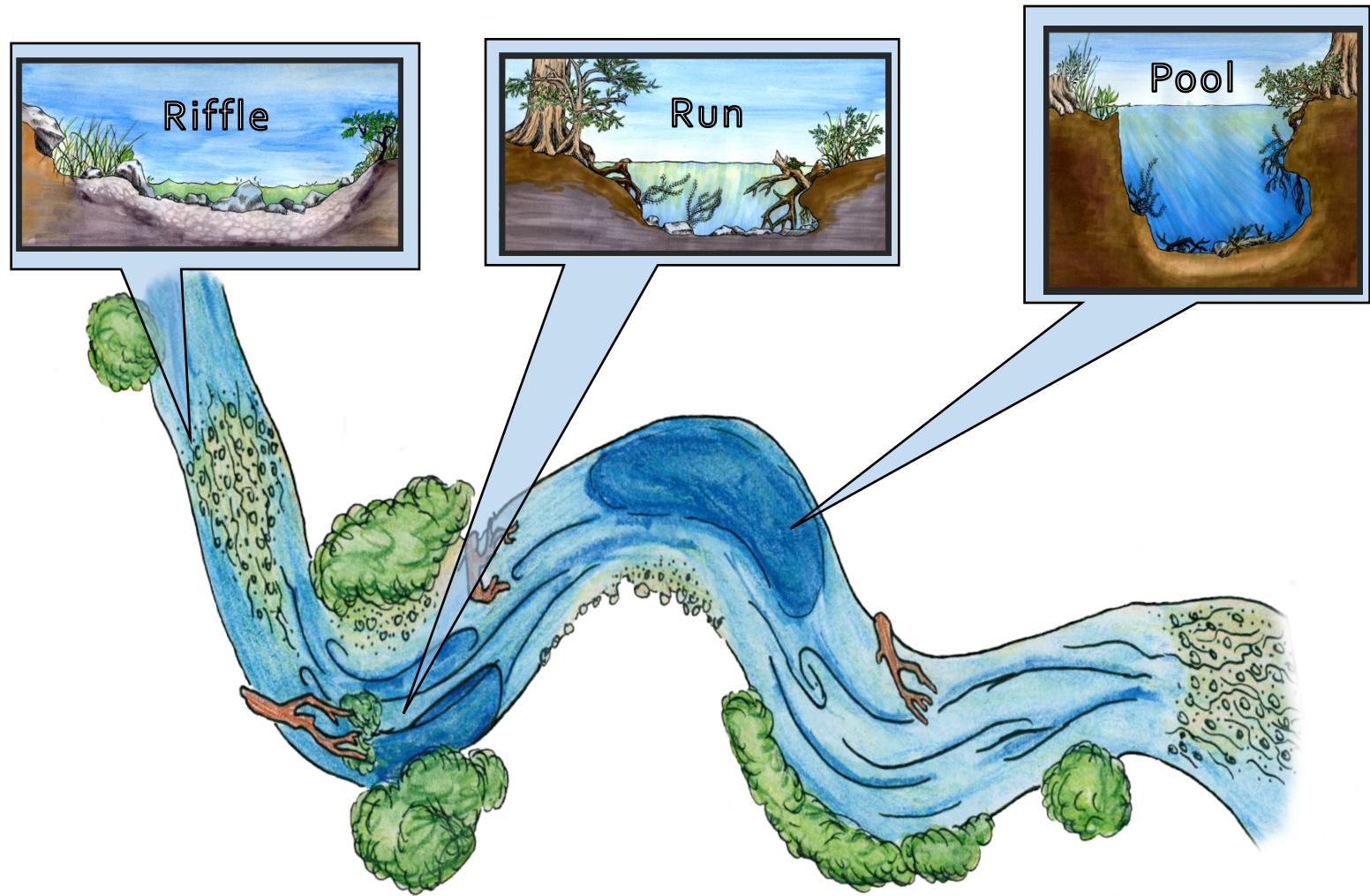
Gradient
0.7%

Hill

Valley
Length:
10,000 ft

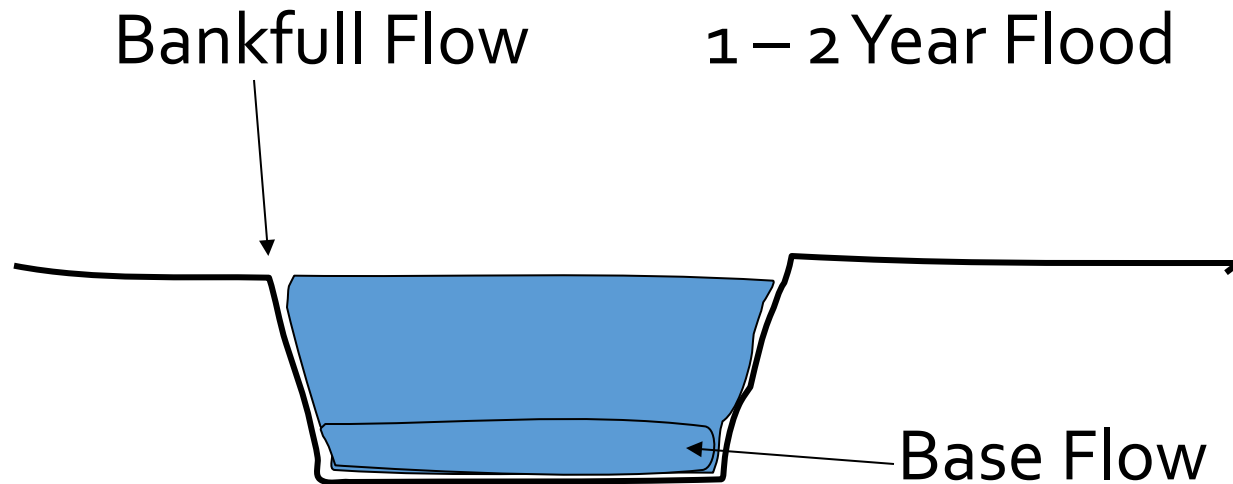
Elev 1600

Patterns of rivers are naturally developed to *dissipate the energy* of the moving water and to transport sediment.



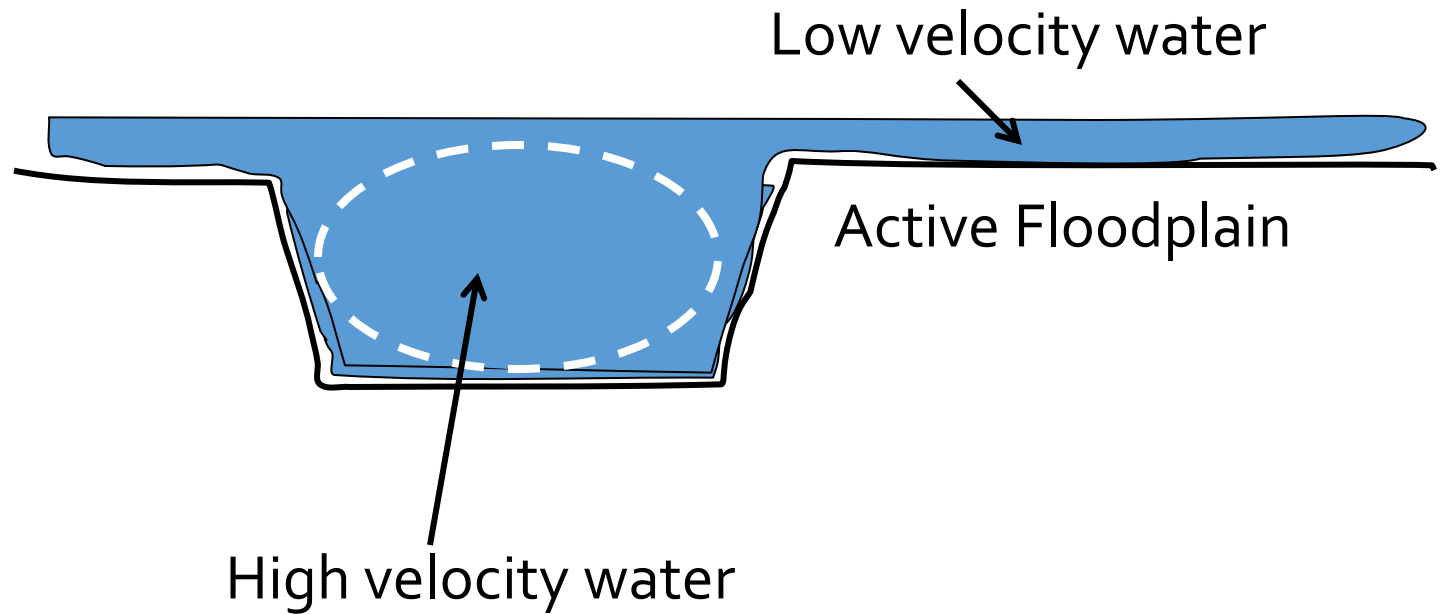
Meander geometry and associated riffles and pools adjust to keep the system operating efficiently





Lesson 2:

Floodplains Dissipate Energy and Trap Sediment



Lesson 2:

Floodplains Dissipate Energy and Trap Sediment



Floodplain

Bankfull



Large Wood Dissipates Energy





Wood Catches Sediment





Large Wood Helps to Build Floodplains and Channels

4 1,540 years

3 2,270 years

2
9,450 years

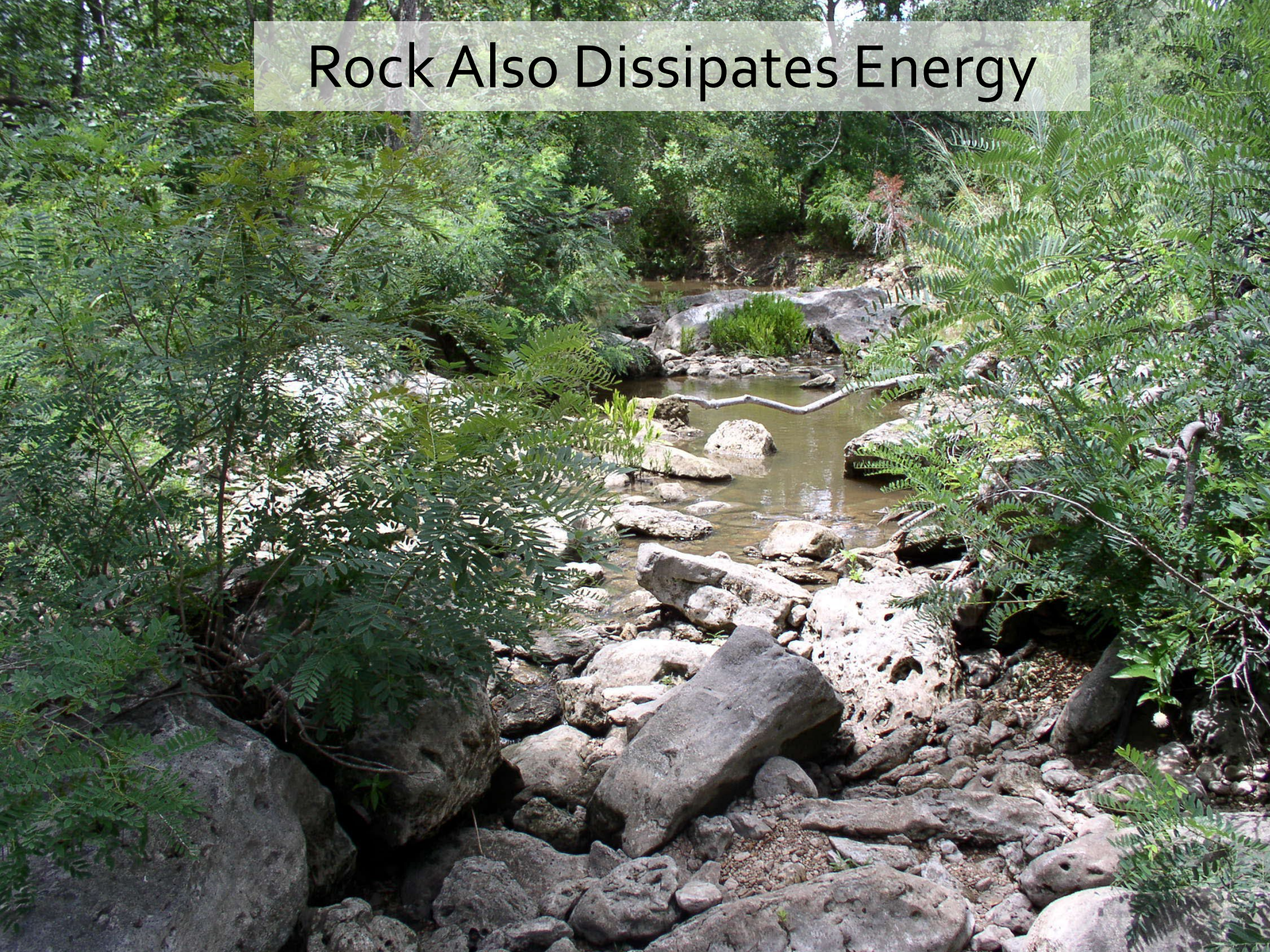
1 2,476 years*

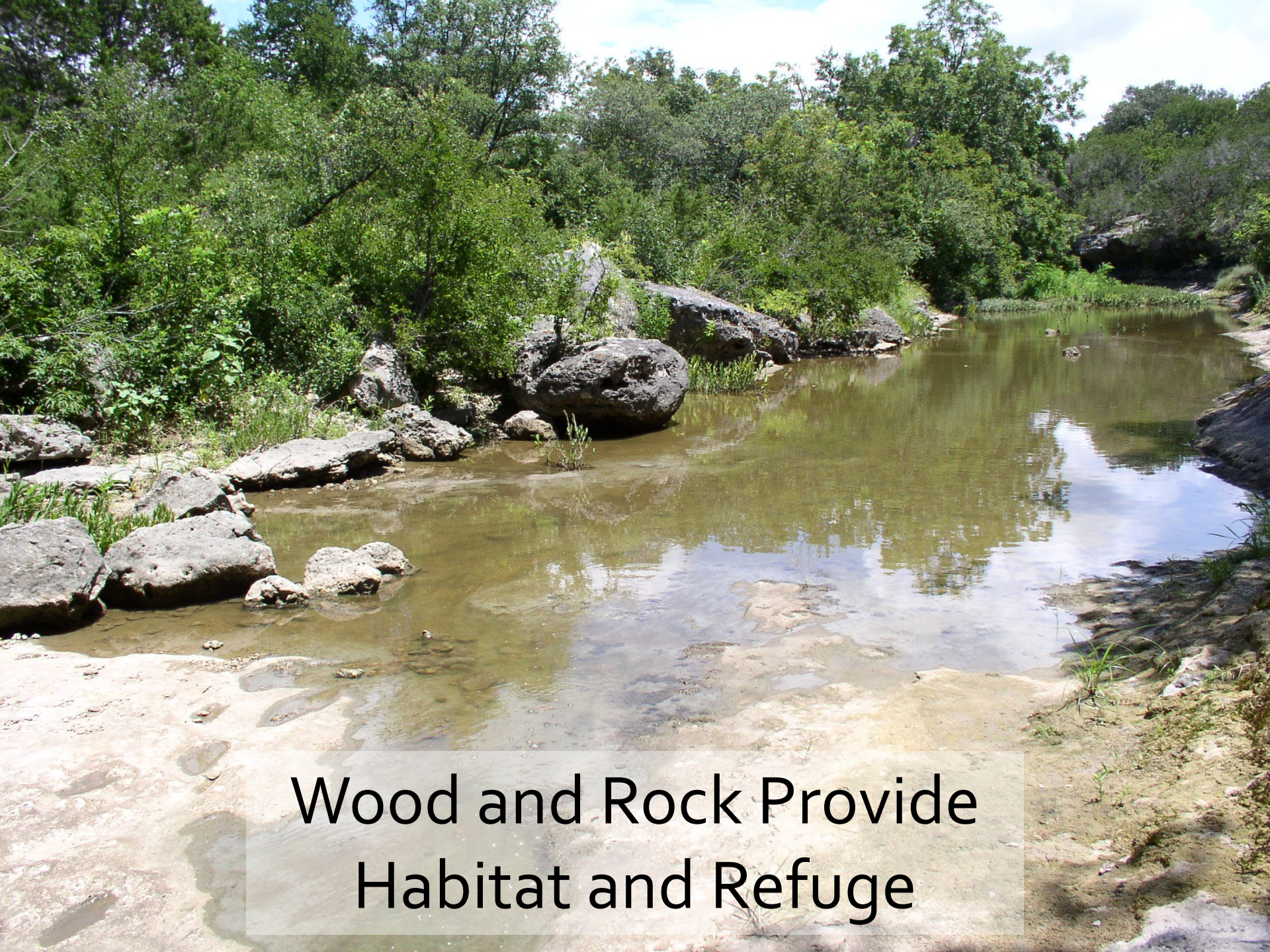
***The Temporal Distribution
and Carbon Storage of
Large Oak Wood in Streams
and Floodplain Deposits***

Richard P. Guyette, Daniel C.
Dey, and Michael C.
Stambaugh



Rock Also Dissipates Energy

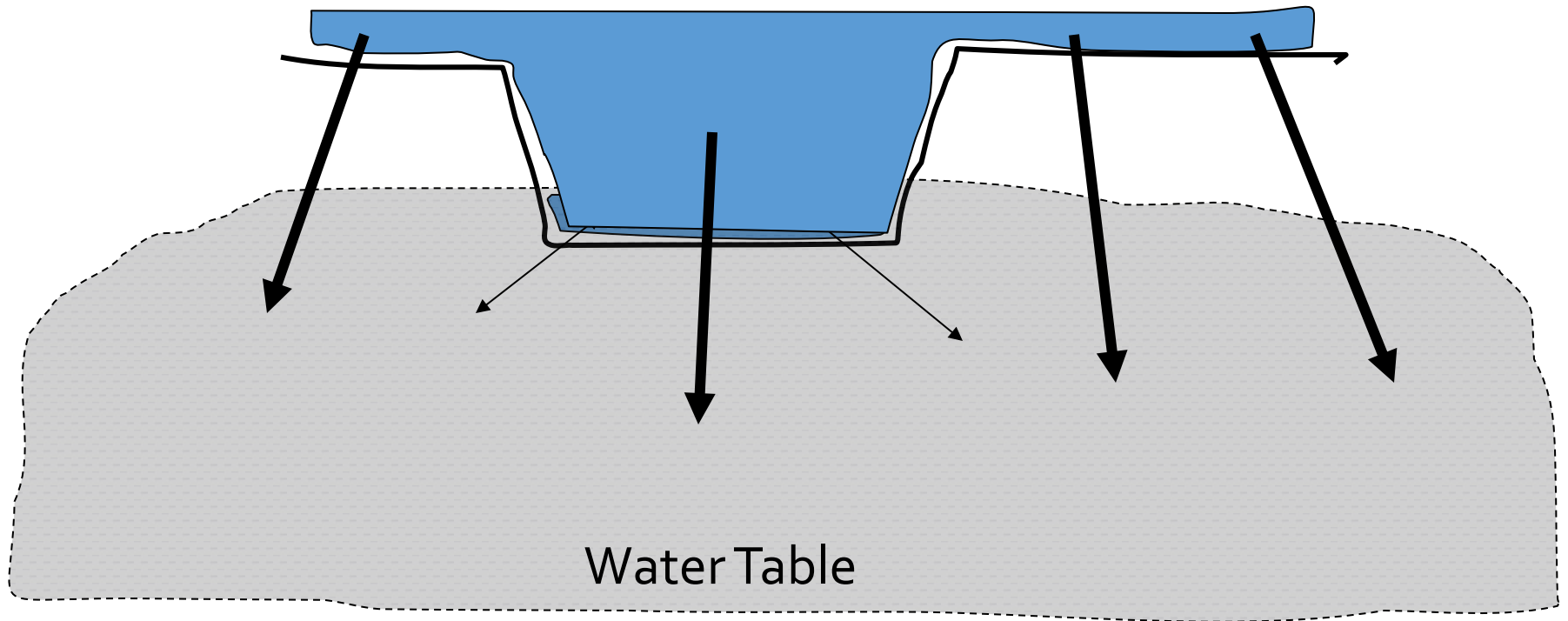




Wood and Rock Provide
Habitat and Refuge

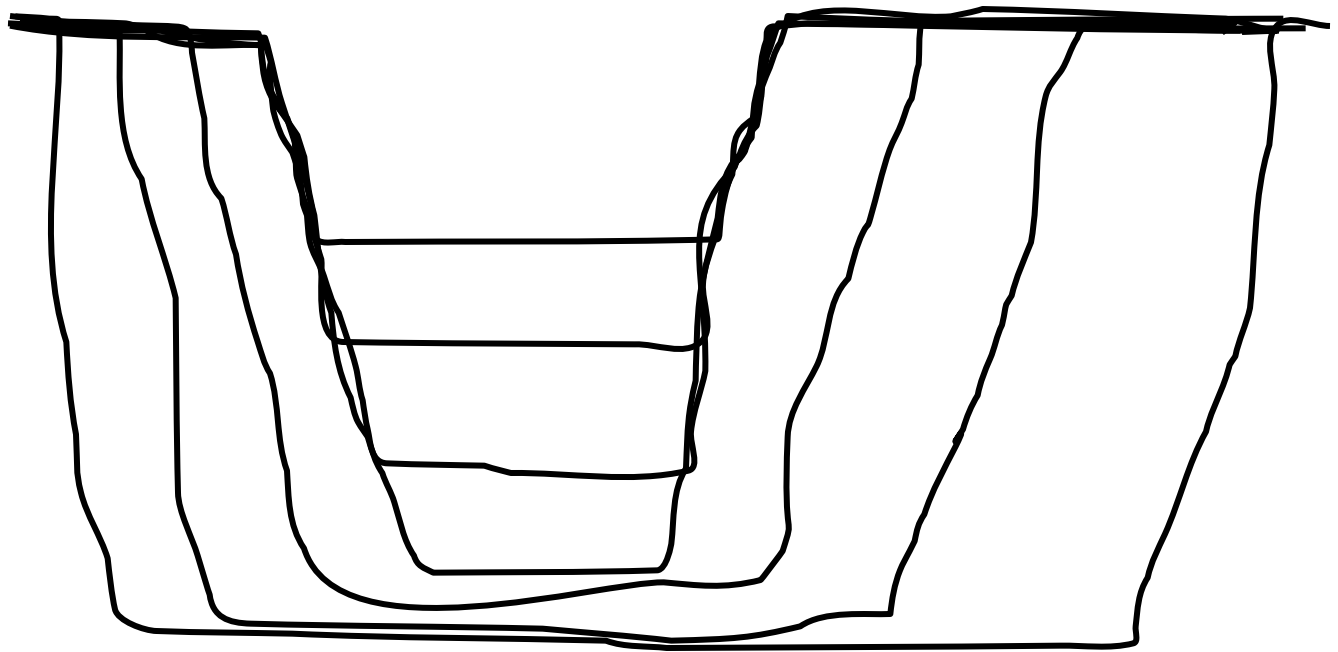
Lesson 3:

Flooding Recharges Water Tables



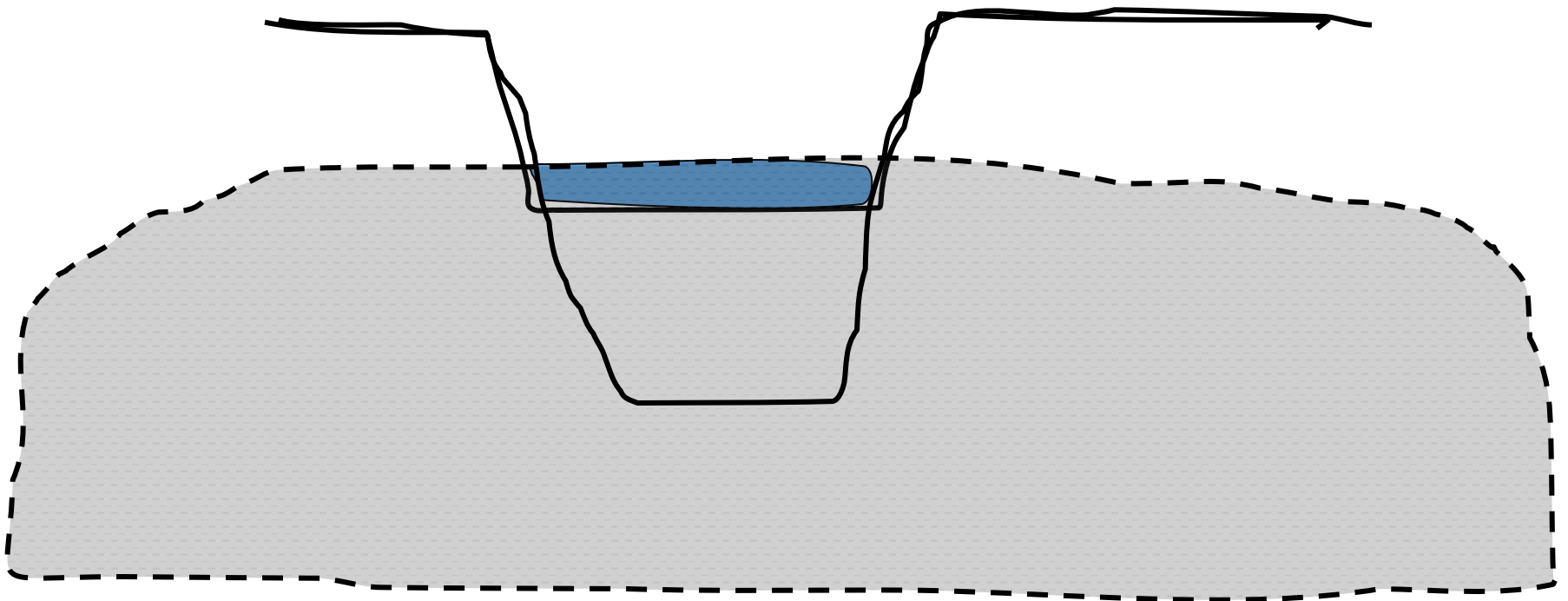
Lesson 4:

Excessive Erosion Enlarges the Channel



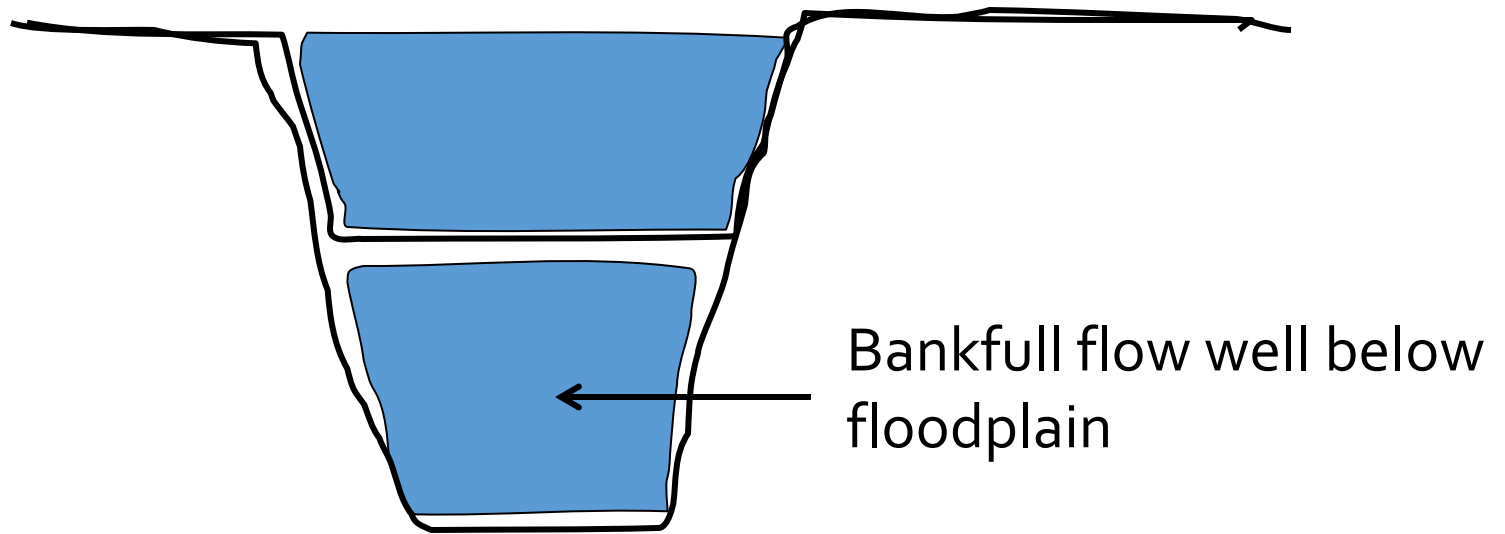


Lesson 5: Down-cutting Drains the Water Table

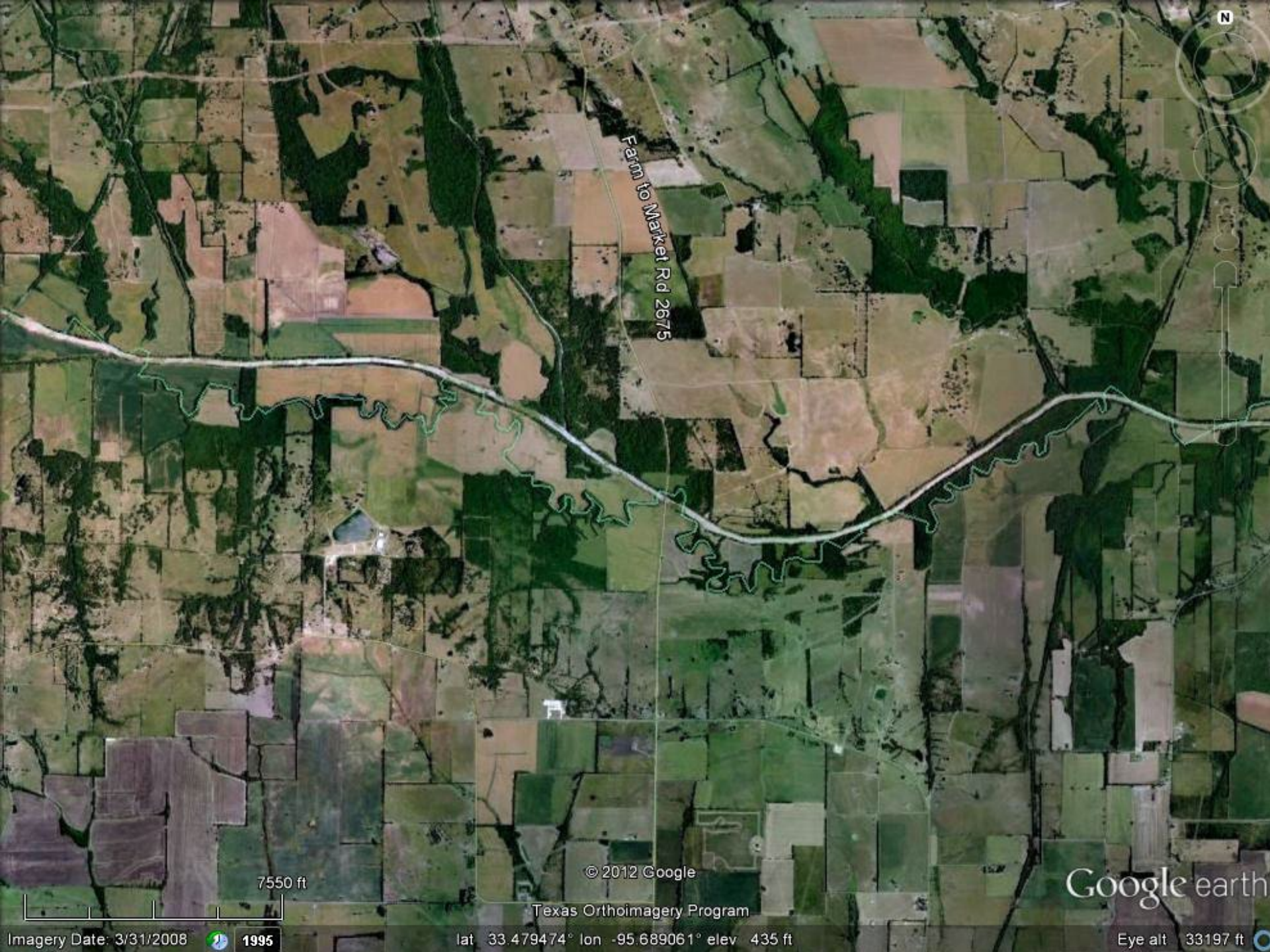


Lesson 6:

Down-cutting: Lose Access to Floodplain







Farm to Market Rd 2675

7550 ft

© 2012 Google

Texas Orthoimagery Program

Google earth

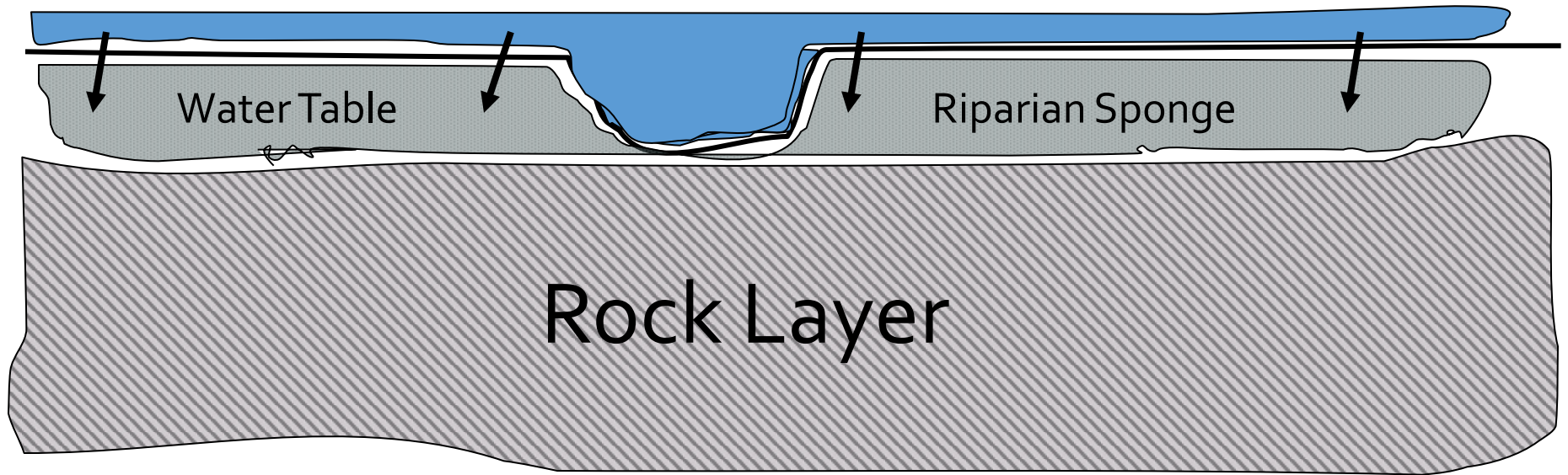
Imagery Date: 3/31/2008

1995

lat 33.479474° lon -95.689061° elev 435 ft

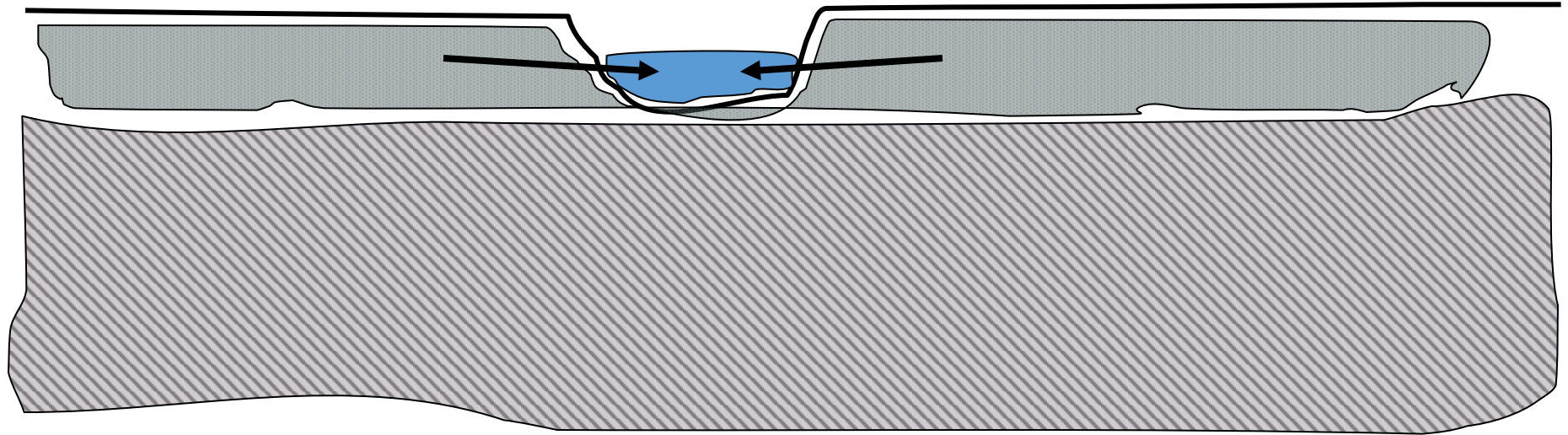
Eye alt 33197 ft





Lesson 7:

The Water Table Sustains Base Flow

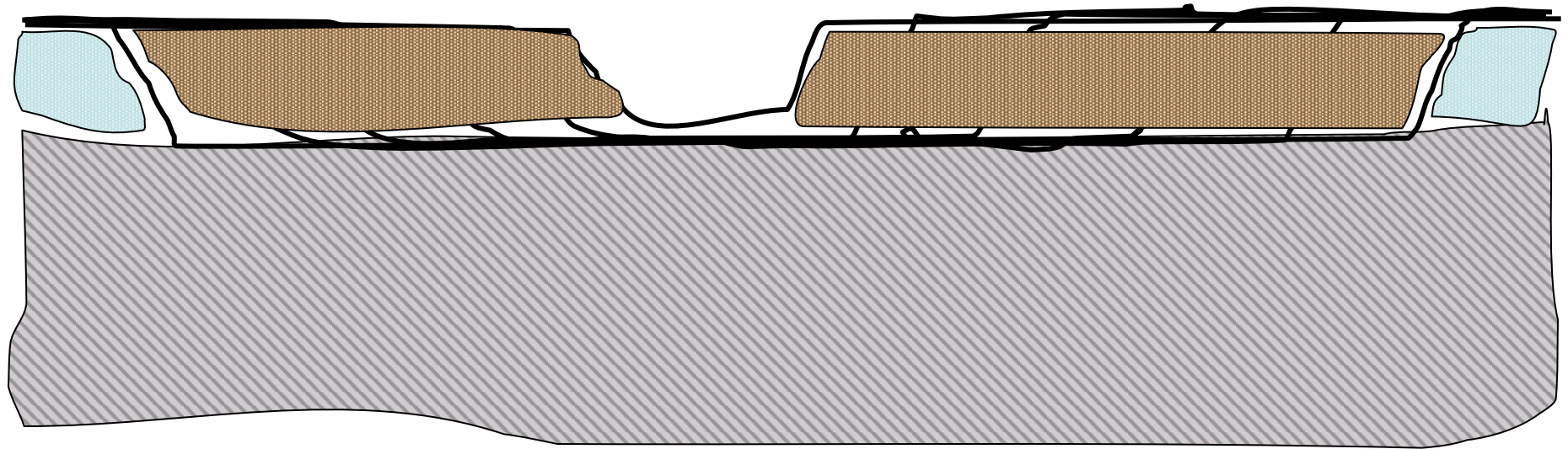




Riparian Sponge

Lesson 8:

Channel Widening Reduces the Riparian Sponge





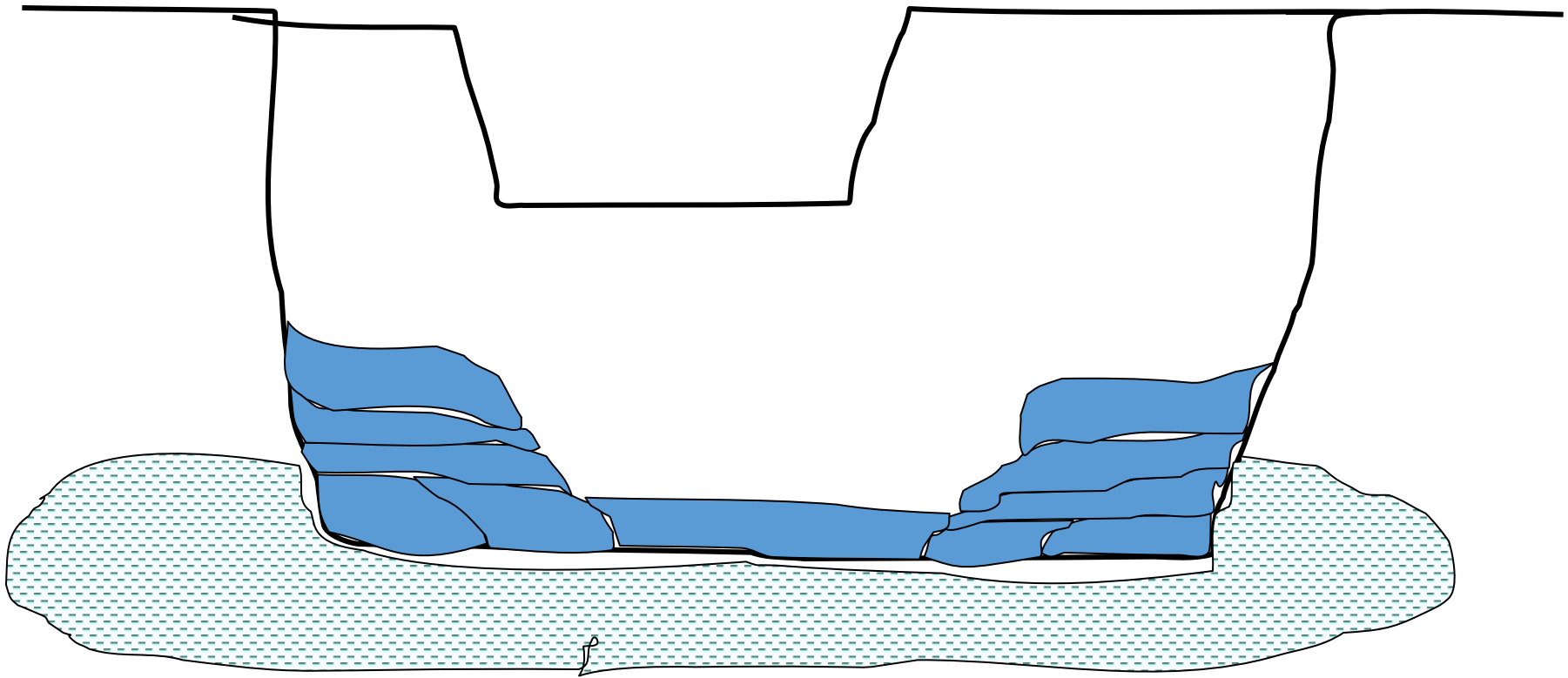
Lesson 9: Unnaturally wide, shallow streams cannot properly transport sediment



Results in excessive temperatures and low oxygen levels

Lesson 10:

Degraded and eroded channels can be restored



Channel Evolution











Blanco River
April 2016



Blanco River
September 2016



Blanco River
May 2017



Blanco River
May 2017

From water shedding...



August 2015



to water catching

May 2018



April 2020

Bear Creek Riparian Restoration

Central Oregon
3500', 12" Rainfall



Wayne Elmore,
National Riparian Service Team
Full Stream Consulting





1977

Intermittent flow – No fish
Accelerated erosion - Sediment loss
Poor vegetation
Wet riparian area (sponge) = 4 acres / mile
Water storage = 1.5 ac ft / mile
Bank erosion = 12,500 feet



A Change in Grazing Management

- 1977 – 1984: No grazing / Reduced grazing to jump-start recovery
- 1985 – Present: Short term grazing during late winter to improve riparian vegetation



1983



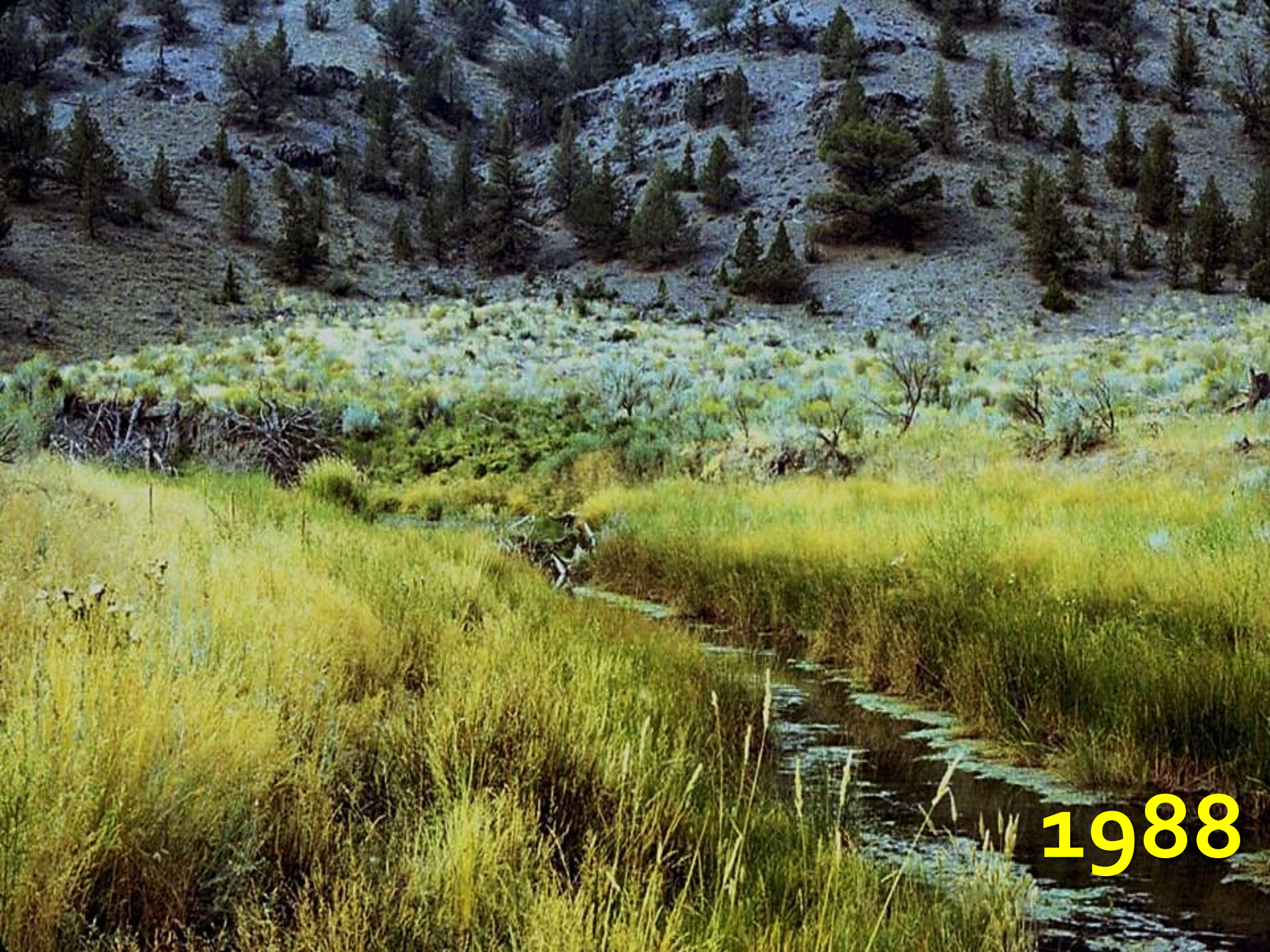
1986



June 1987



Aug 1987



1988



1993



Feb 1996



April 1996



Oct 1996

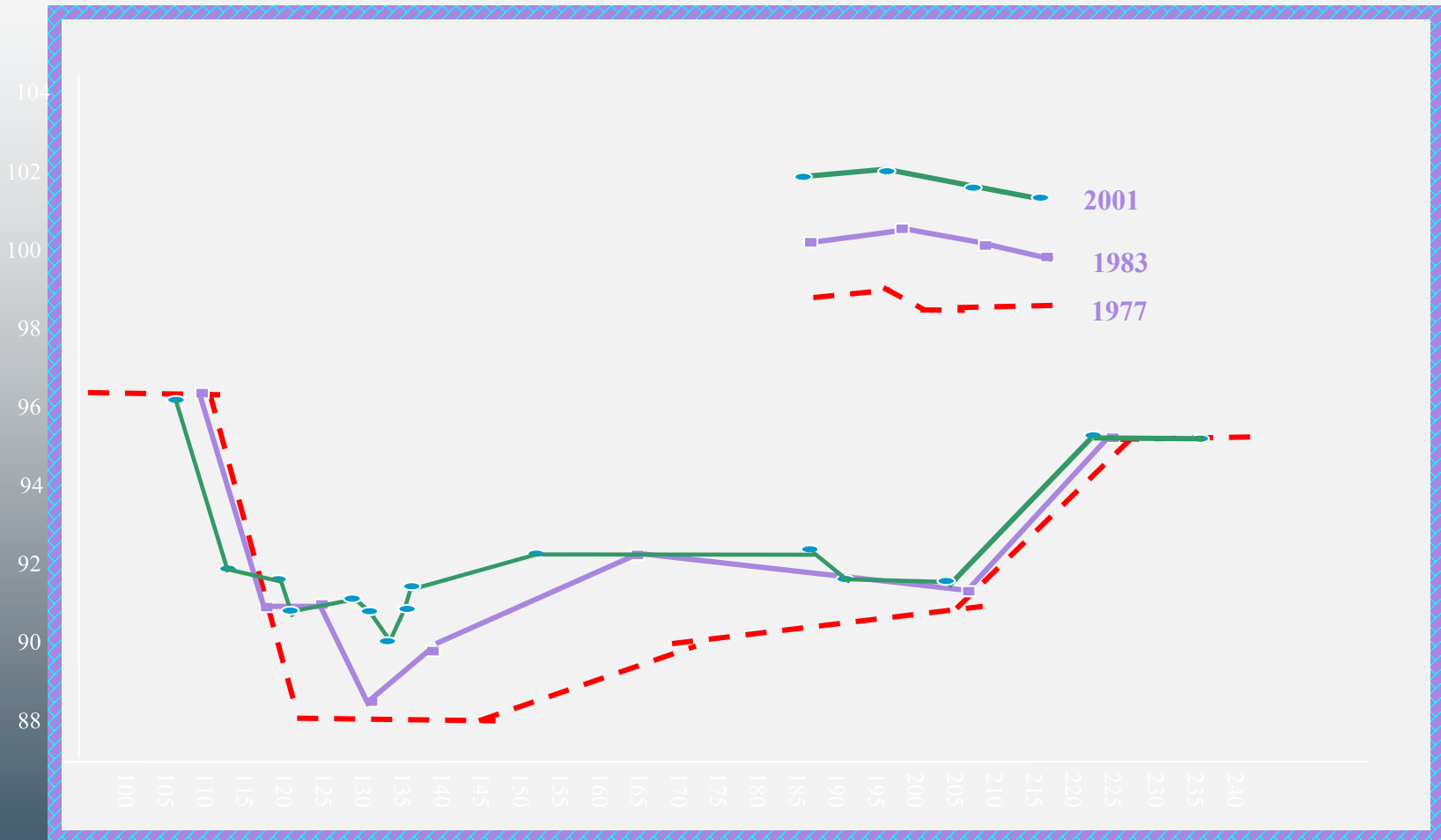


2001

7 10 01

Bear Creek : Change In Channel Profile (1977 – 2001)

1983



- Sediment Captured = 7400 CY/Mile
- Riparian “Sponge” Increased to 12 Ac/Mile
- Water Storage : Net gain of 4.9 ac ft /mile
- Perennial flow; prime fish habitat
- 10x Increase in livestock forage
- Bank erosion reduced to 100 feet



Instream Structures and Stream Restoration

- J-hooks, x-vanes, sloping banks, weirs, bioengineering, etc.
- These may be expensive and unnecessary where improved riparian management is adequate.



Summary

- Streams are dynamic and function to transport water, sediment, and nutrients
- A stream's shape is predictable and measurable. A change in one variable will cause an adjustment in another.
- The stream, floodplain, and riparian area are one system (think watershed!).
- Floods and drought have some beneficial functions.
- Good riparian management helps maintain stability, base flow, the water table, and the "riparian sponge."
- Streams can often repair themselves with a change in management



A scenic photograph of a river flowing through a lush forest. The river is calm in the background, reflecting the surrounding greenery. In the foreground, the water flows over rocks and fallen logs, creating small rapids. The banks are covered in dense vegetation, including tall grasses and large trees with thick trunks. The lighting suggests a warm, golden hour, with sunlight filtering through the leaves.

Thank you!

**Melissa Parker and Ryan McGillicuddy
Texas Parks and Wildlife Department**