Valuing Water

Learning from the past to add resilience to our future

Presentation Outline

- History
- Reference Condition
- Hydrology of Low Gradient Streams
- Evolution of Restoration Techniques
- Changing Conditions

What we know about our past…

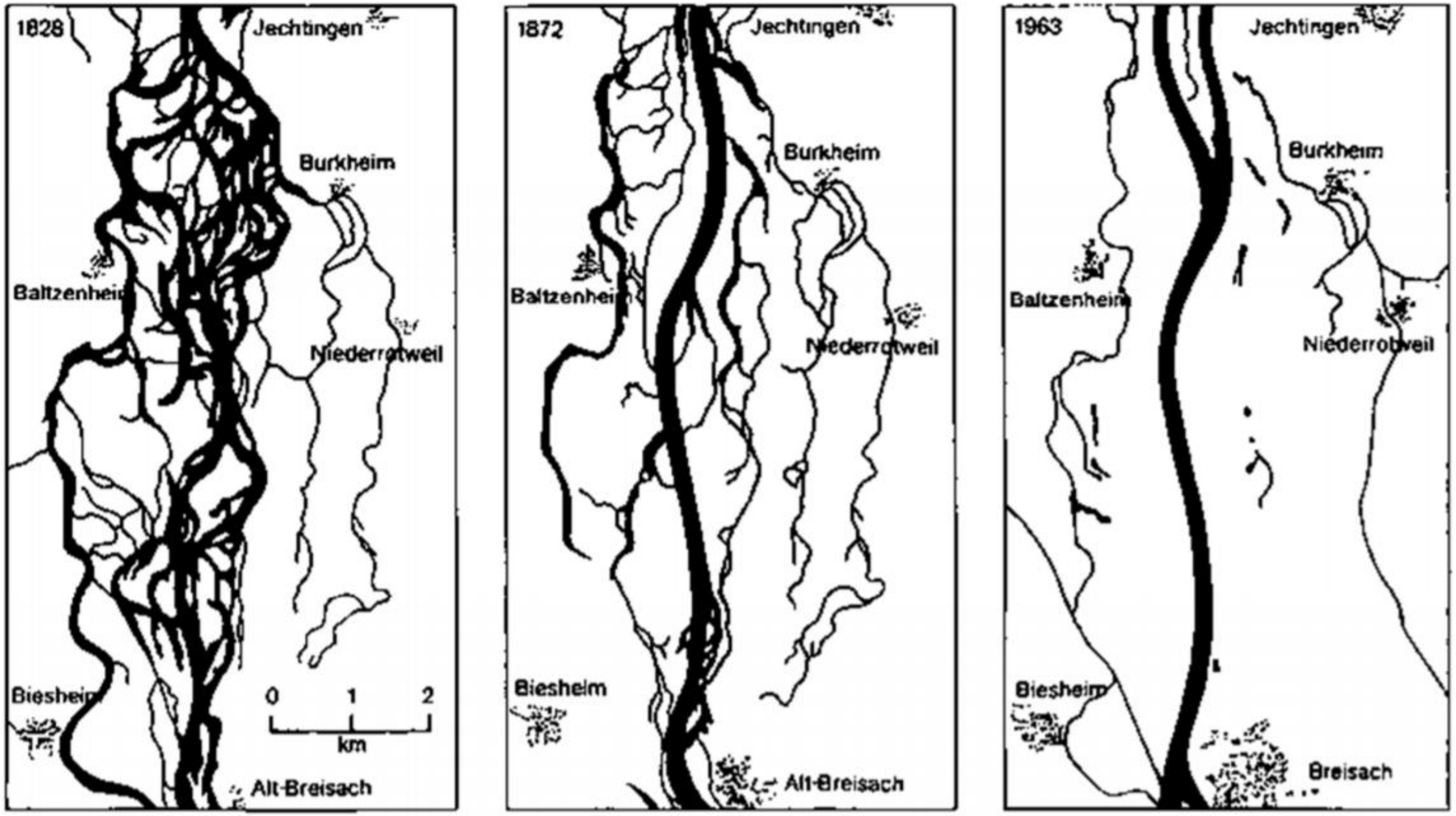
What are we trying to achieve?

Reference Condition

- Based on what time in history?
  - Pre-European Settlement
  - 1950 Hydrology & Geomorphology Data

Cluer et al., 2013

Example from Europe - Upper River Rhine at Breisach Germany



Anastomosed
1828 – Prior to river training

Anabranched
1872 – after re-alignment by Johann Gottfried Tulla

Meandering
1963 – fully canalised single-thread

Prior to European colonization beaver populations were estimated to number 60–400 million in North America (Naiman, Johnston, & Kelley, 1988). Beaver were intensively trapped for their pelts through the 1800s and eradicated from developed areas where they were often considered a nuisance. Beaver populations became isolated, and their numbers were dramatically reduced in urban and rural areas, with only about 10% of historical populations remaining (Wilson & Reeder, 2005).

Bailey et al., 2019

Example 1: Upper Mississippi and Missouri River Basins (Hey and Phillip 1995).

Researchers estimate that beaver ponds covered 51,100,000 acres in 1600 compared to 511,000 acres in 1990. They estimated wetlands at 44,700,000 acres in 1780 versus 18,900,000 acres in 1980. This reduction in ponds (surface water stored) and wetlands (groundwater stored) has resulted in a huge loss of flood control, and system stability during droughts and years with high precipitation.

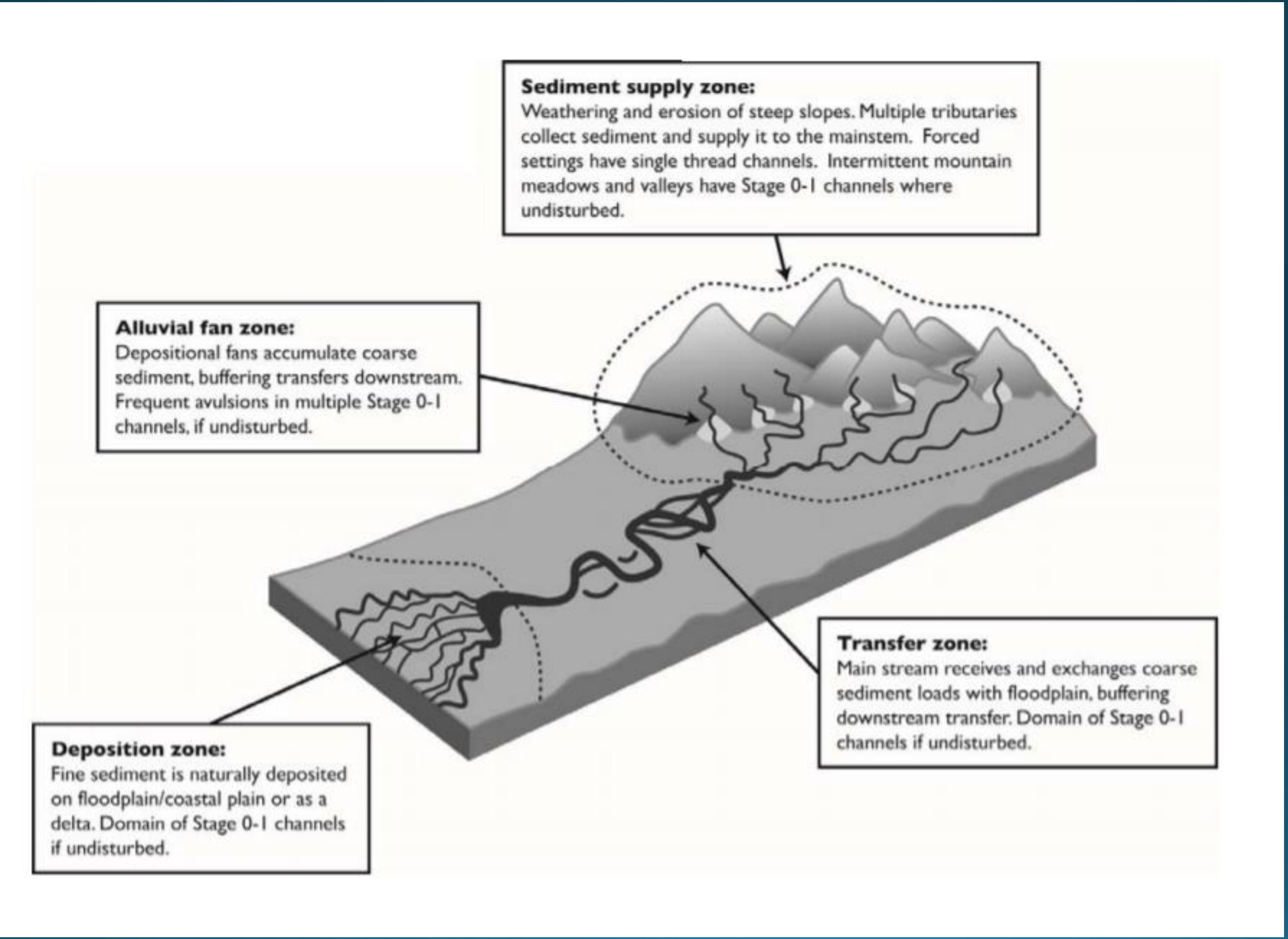
Example 2: Elk Island National Park in east-central Alberta, Canada (Hood and Bayley 2008).

Documenting changes in the amount of open water during dry and wet years between 1948 and 2002 due to the presence, or absence, of beavers. The beaver dam building and maintenance made the area much less sensitive to drought and helped decrease downstream flood peaks by increasing the river's rapid access to its floodplain during high flows.

Example 3: Crane Creek, Oregon (Schaffer 1941).

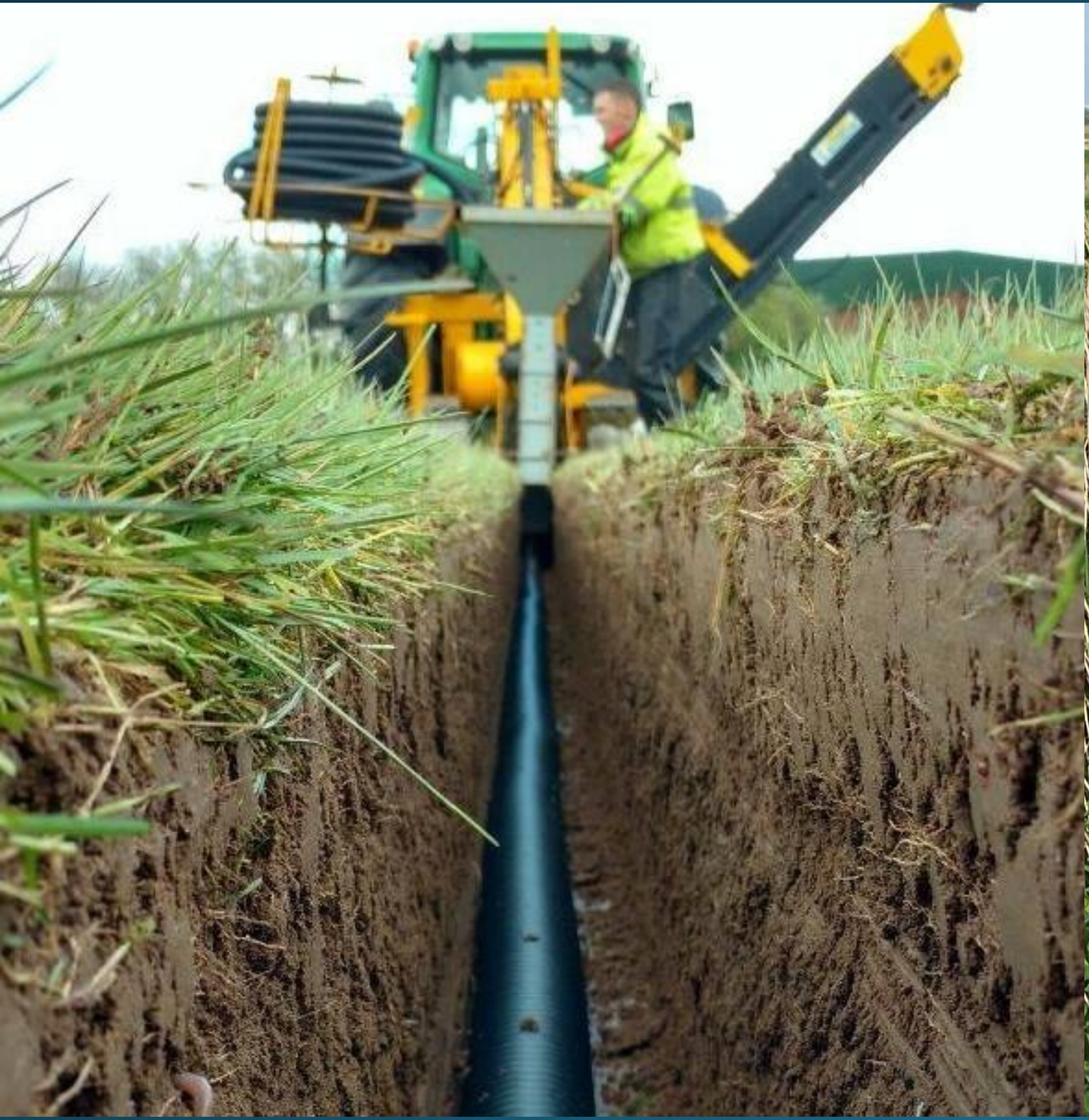
Prior to 1924 beavers were present in Crane Creek and the meadows had stirrup-high native grasses. The grasses were sub-irrigated by beaver ponds. In 1924 the beavers were trapped out. In 1925 the channel began to incise and by 1935 the channel had deepened 25 feet. In 1936 beavers were reintroduced, and by 1938 the water table had risen and the hay meadow production had improved. 1939 was a drought year, yet water was abundant on the ranch with beaver ponds, while absent downstream on the ranch without beaver ponds.

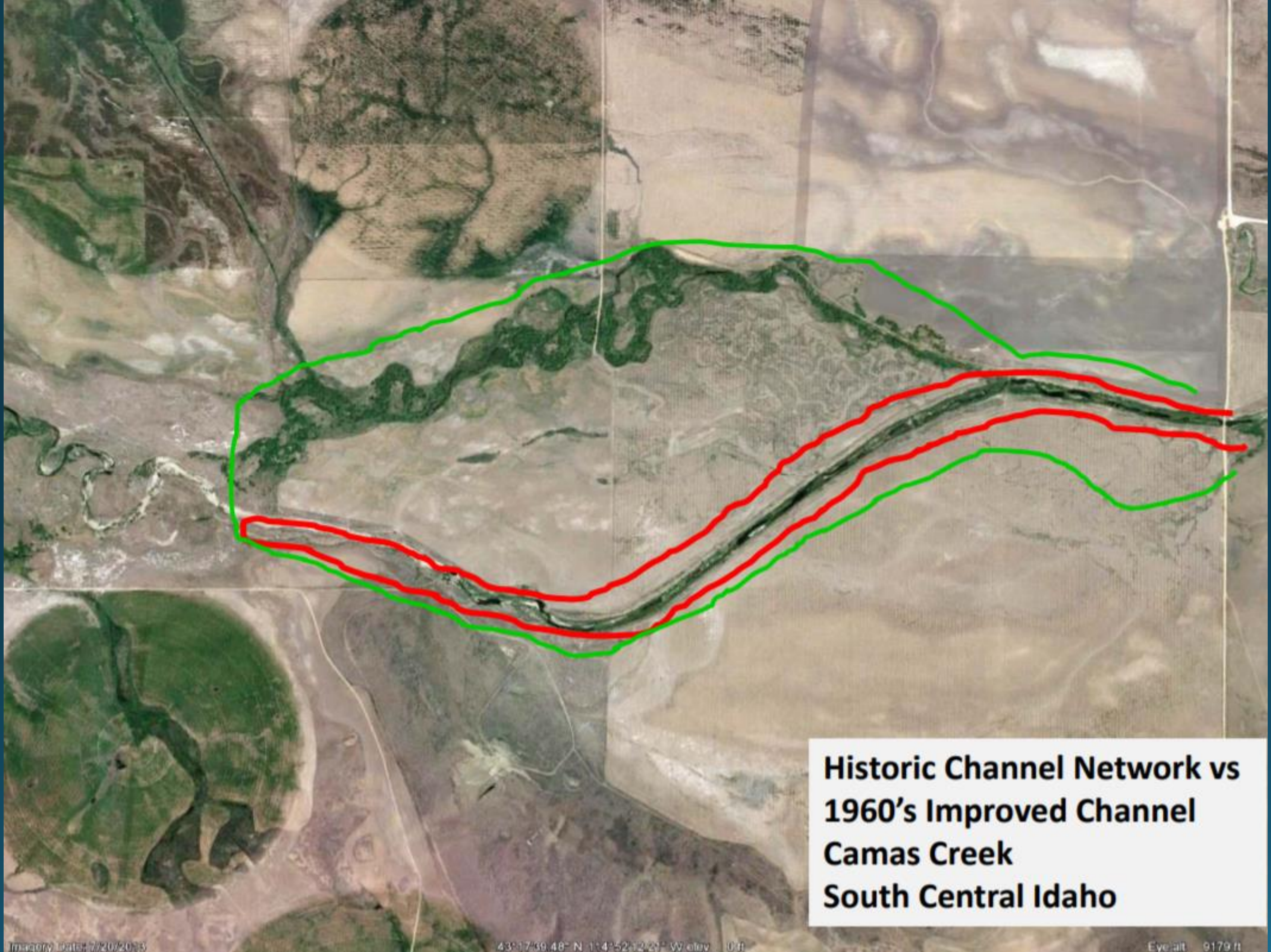
Fouty, 2008



Cluer et al., 2013

For 100's of years we have actively converted depositional stream reaches into transport stream reaches.





Historic Channel Network vs
1960's Improved Channel
Camas Creek
South Central Idaho

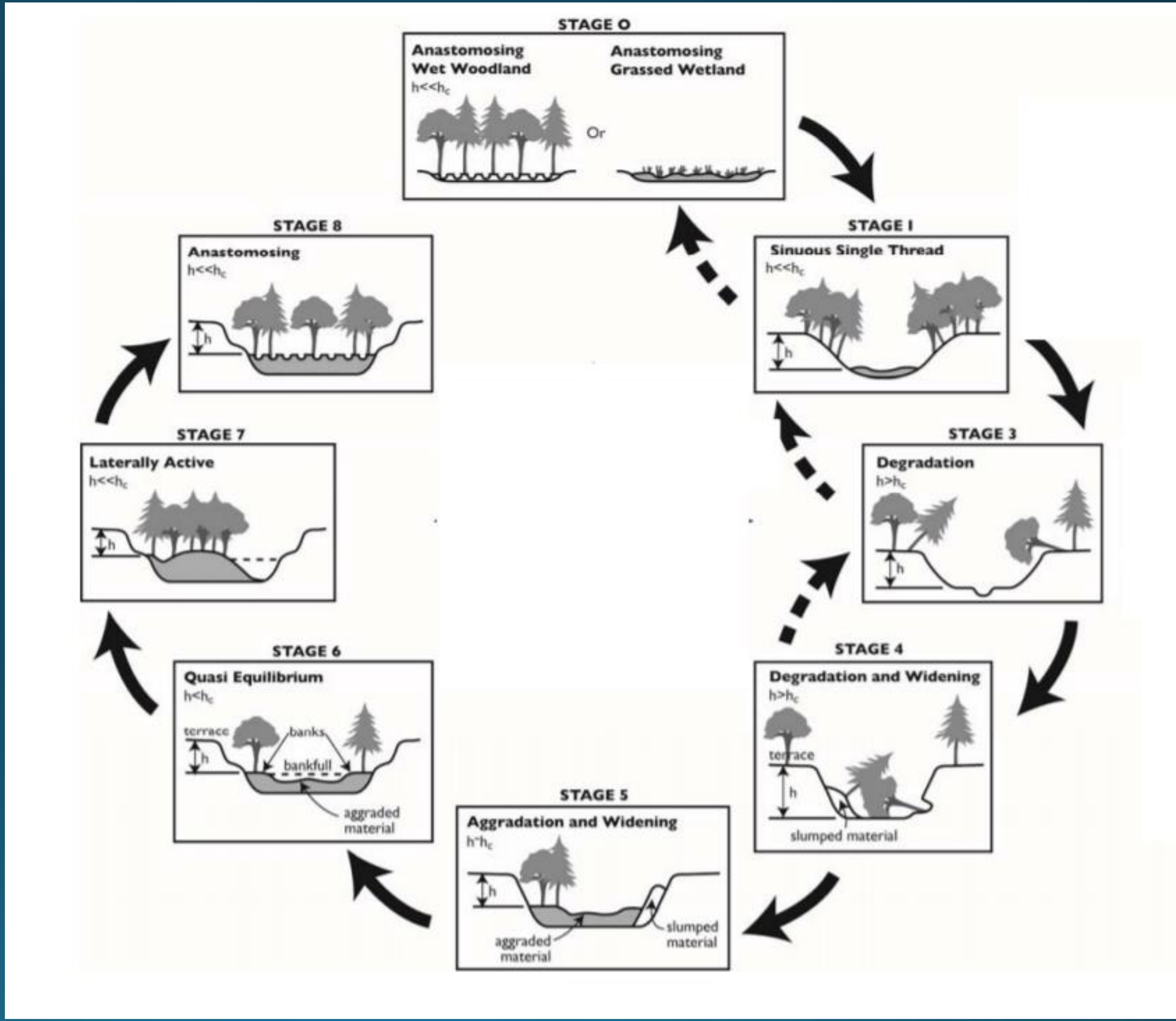
Cluer, 2018

It is now generally accepted that river engineering and management that works with rather than against natural processes is more likely to attain and sustain the multi-functional goals (e.g. land drainage, flood risk management, fisheries conservation, biodiversity, and recreation) demanded by local stakeholders and society more widely.

Wohl et al., 2005; Thorne et al., 2010

Cluer et al., 2013

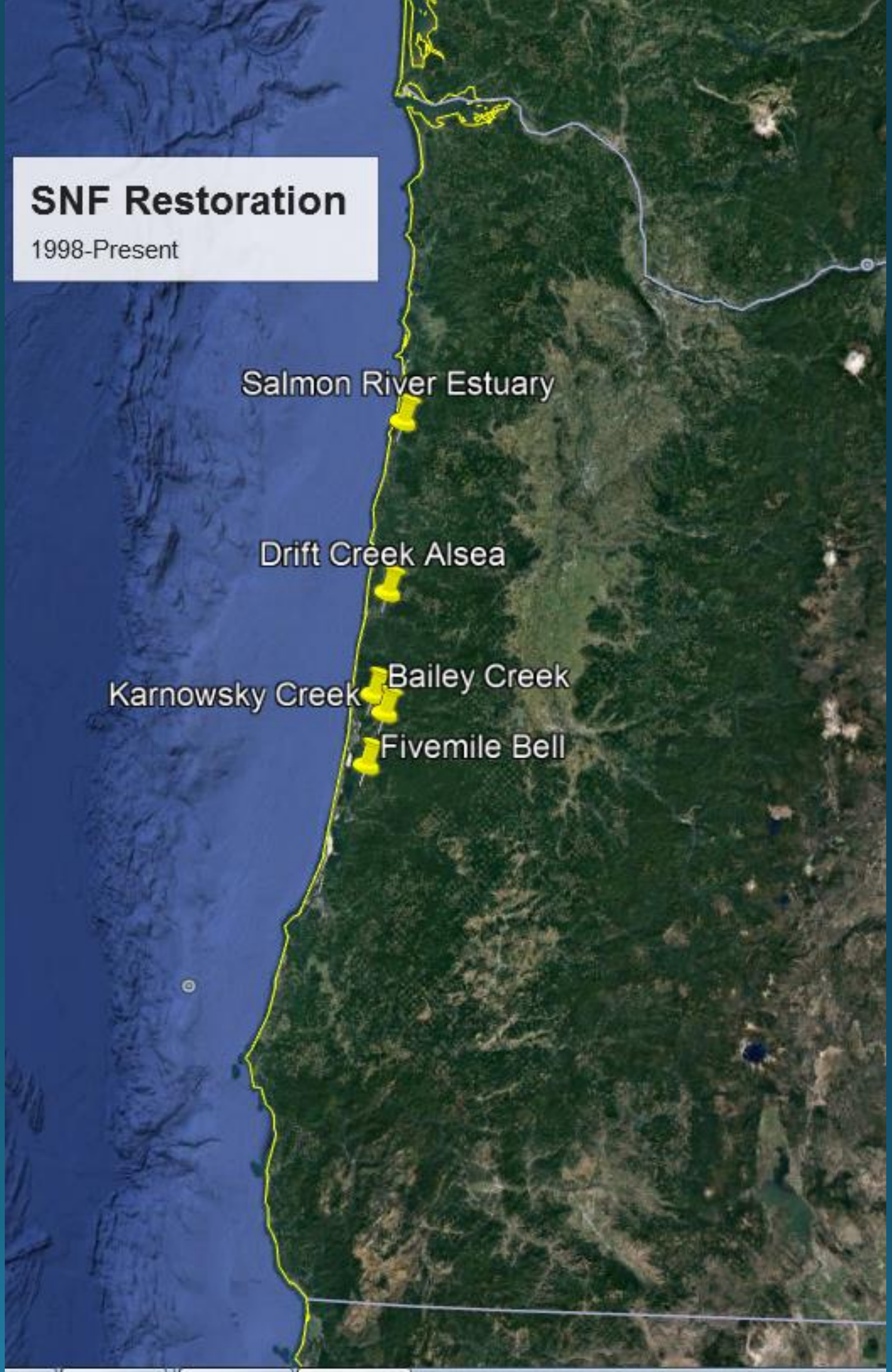
The Evolution of Restoration in Low Gradient Depositional Streams



Cluer et al., 2013

Siuslaw National Forest Aquatic Restoration

- 1999 Bailey Creek- Enchanted Valley
- 2003 Karnowsky Creek
- 2006 Drift Creek-Alsea
- 2007-2017 Salmon River Estuary
- 2012-present Fivemile & Bell Creeks



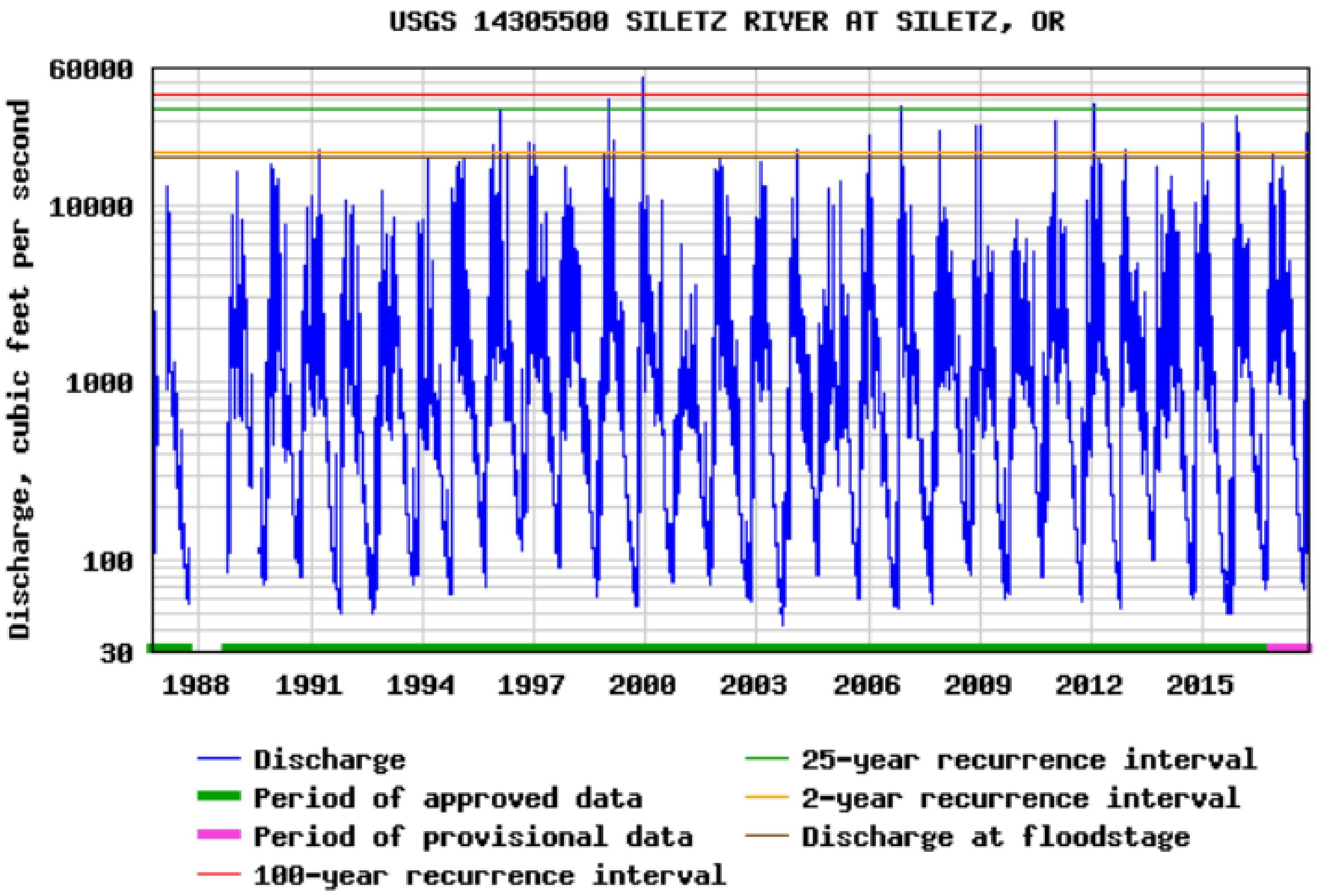
Fivemile & Bell Creeks

Changing Conditions

- Floods
  - Frequency
  - Intensity
- Droughts
  - Frequency
  - Duration
- Fog ?

Discharge, cubic feet per second

Most recent instantaneous value: 1280 11-06-2017 15:30 PST



Willamette River Historic Channels, North of Corvallis, Oregon


Photo Credit—Duncan Berry

Room to React

- Maximal flood attenuation
- Maximal GW recharge
- Maximal sediment pulse attenuation
- Resilient to entire range of watershed processes and pulses

Cluer et al., 2013

Recharge & Connection

- No deep drainage channel
- Stream flow and groundwater connection
- High interaction between flow, sediment, and vegetation
- Small channels easily moderated by vegetation

Cluer et al., 2013