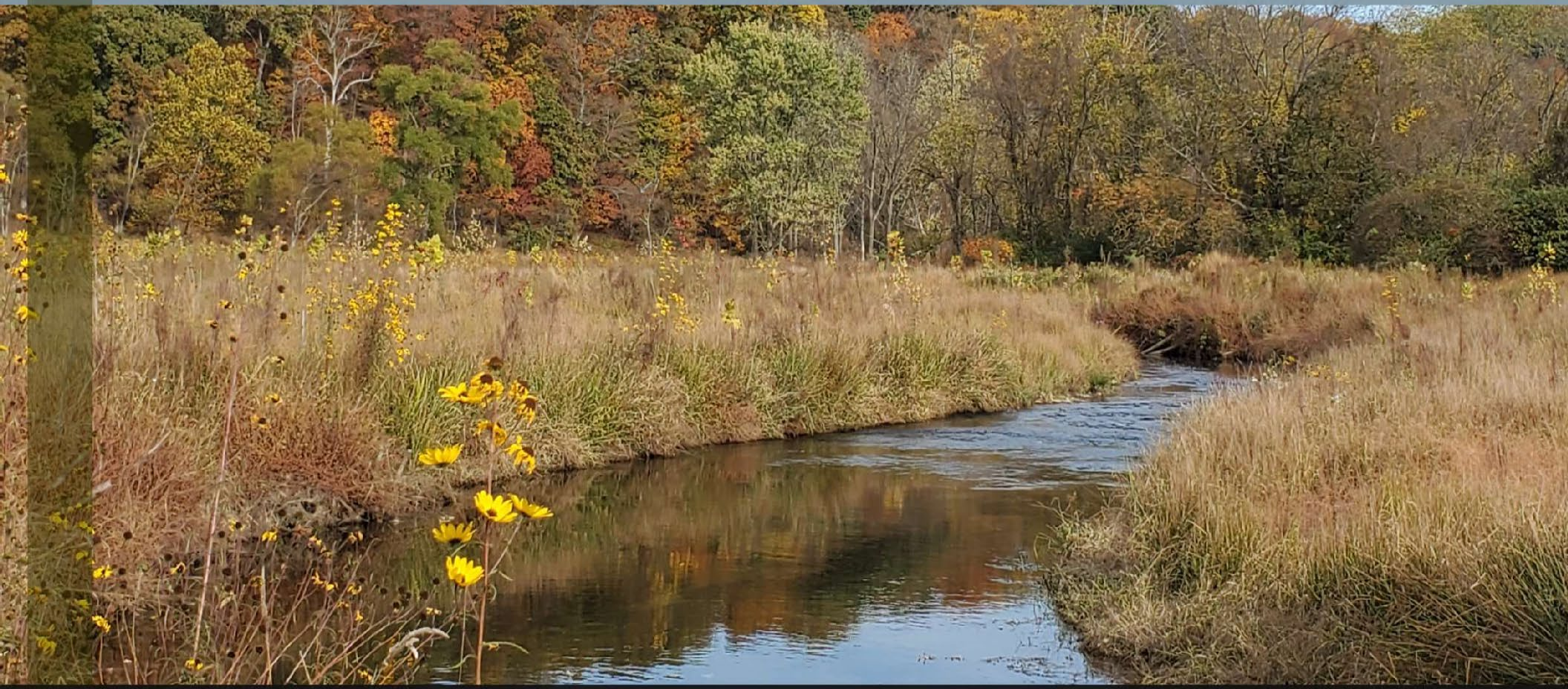
Stream Restoration Webinar Series: Finding Common Ground – Stream Restoration Through the Years



June 4, 2024

Richard Starr

Ecosystem Planning and Restoration

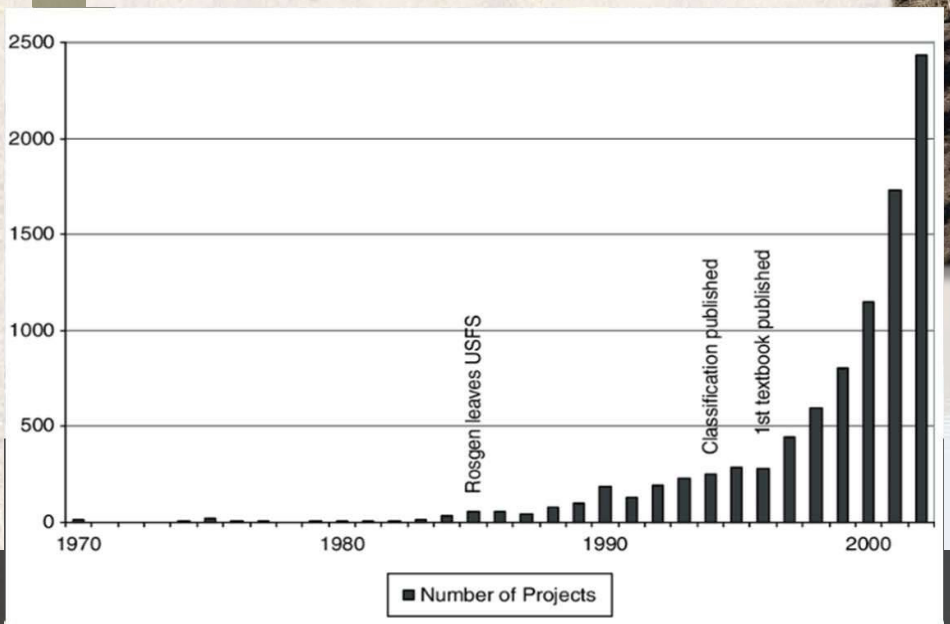
1970's – 1990's

- **1972 CWA – Protect Nation's Drinking Water**
  - Focused on water quality
- **1980's**
  - Flood control
  - Infrastructure protection
  - Mineral source
  - Waste deposal
  - Agricultural/Irrigation
  - Transportation
  - Recreation
  - **Low ecological uplift**

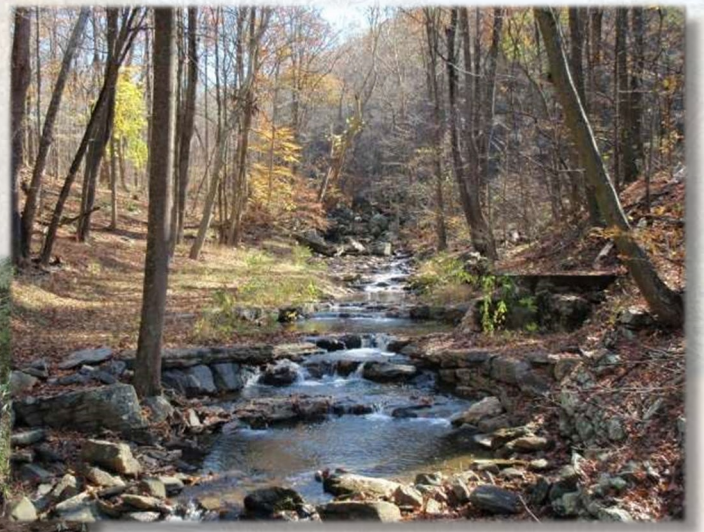
- **1990's**
  - Shift in perspective of stream values
  - Required (mitigation) and Voluntary restoration
  - Natural Channel Design
  - Primarily stream channel restoration focus
  - **Improved instream ecological uplift**

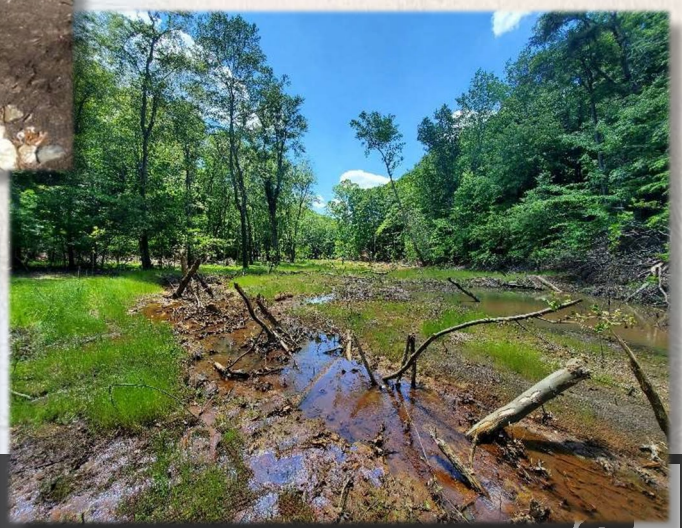
2000's – 2020's

- EPA 2008 Mitigation Rule: Function Focused
- Chesapeake Bay TMDL Established - 2010
- Designs consider/focus on floodplain processes
- Development of varying design objectives and approaches
- **Instream and floodplain ecological uplift**



Number of stream restoration projects in the US per year, as reported by the National River Restoration Science Synthesis project (Bernhardt et al. 2005)





EPR

Design Approaches

1. Natural Channel Design
2. Dynamic Valley Restoration Design
3. Legacy Sediment Removal
4. Step Pool Storm Conveyance Systems Design
5. Beaver Analog







Natural Channel Design

- **Developed by:** Dave Rosgen, *P.H., Ph.D*
- **Design Goal:** Self-sustaining stream over time
- **Typical Approach:** Channel design based on bankfull discharge and floodplain based on entrenchment ratio
- **Energy Dissipation:** Channel plan form and/or profile and floodplain access
- **Primary design criteria:** Reference reach data and design criteria based on bankfull discharge
- **Typical Methods:**
  - Priorities 1 – 3 Floodplain Connection
  - Lateral and vertical stability structures (rock and/or wood)
- Should verify **design stability with 1D hydraulic** modeling

Dynamic Valley Restoration Design

- **Developed by:** Art Parola, *P.E., Ph.D*
- **Design Goal:** Create stream/wetland mosaic
- **Typical Approach:** Design baseflow channel or no channel at all
- **Energy Dissipation:** Reduce stage increases by spreading runoff over entire floodplain
- **Primary design criteria:**
  - Keep floodplain shear stresses below 2 lb/sf
  - Storm event flows access floodplain flow frequently (less than 1-yr event)
- **Typical Methods:**
  - Lower floodplain and build base flow channel
  - Install grade control structures to reconnect to floodplain
  - Most designs require valley grade control structures
  - Legacy Sediment Removal – lower floodplain to historic floodplain and gravel basal layer (*typically associated prior to colonial settlement*)
- **Requires 2D modeling**

EPR

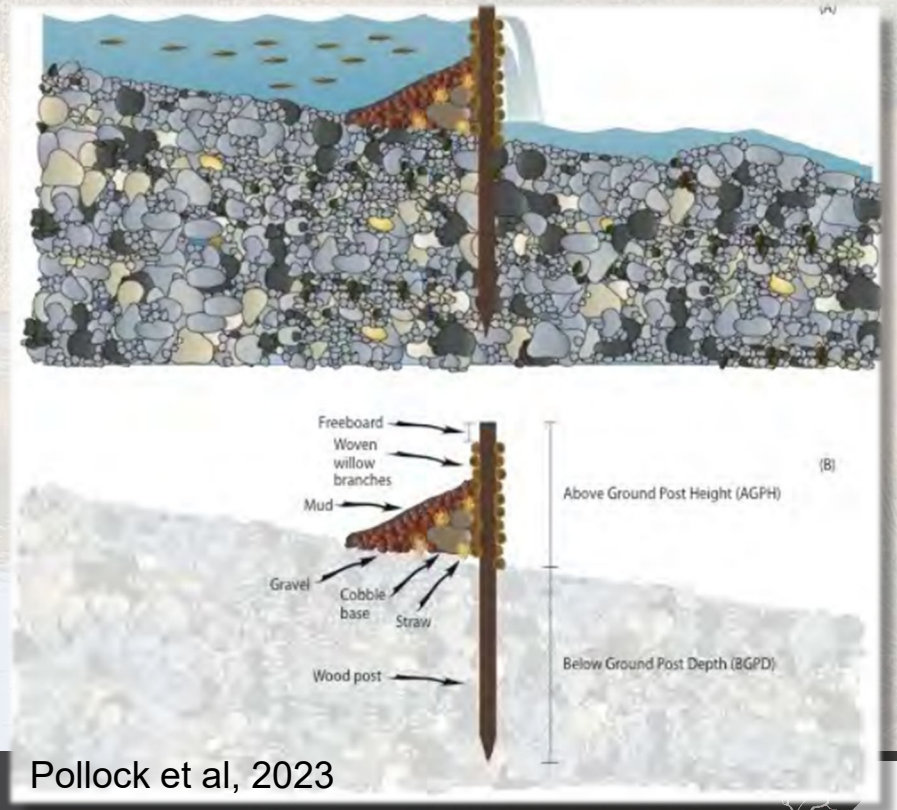
Step Pool Storm Conveyance Systems

- **Developed by**: Keith Underwood
- **Design Goal:** Storm flow storage and attenuation to foster filtration and infiltration
- **Typical Approach:** Cobble weirs, step-pools, and sand seepage berms
- **Energy Dissipation:** Drop over cobble weirs and large pools
- **Primary Design Criteria:**
  - Design weirs to a 100-yr storm event
  - 0.5 to 1.0 ft drop between weirs
- **Typical Methods:**
  - Fill channel to top of existing banks
  - Partially fill channel and grade back banks to stable slope.
- Design Guidelines for Step Pool Storm Conveyance Systems (AACO 2023)

Beaver Analog

- **Reference:** The Beaver Restoration Guidebook (Pollock et al, 2023)
- **Design Goal:** Mimic or reinforce natural beaver dams
- **Typical Approach:** Combination of multiple dams within a broader dam complex
- **Energy Dissipation:** Utilize entire floodplain and add floodplain roughness structures/dams
- **Primary Design Criteria:**
  - BDA's connect with existing floodplain elevation or higher
- **Typical Methods:**
  - Wood posts interwoven with branches and backfilled with straw, cobble, gravel, and mud
  - Wood installed downstream of dam to reduce scour
  - Plantings for stability and beaver food source
- May require maintenance, especially if beavers don't colonize site

Pollock et al, 2023



Pollock et al, 2023

Best Design Approach

Design a stream system that will be self-sustaining over time, given existing and likely future conditions of the watershed, floodplain, and stream that maximizes ecological uplift while minimizing impacts to existing natural resources.

Ridge/Valley Confined Valley NCD


Piedmont Unconfined NCD/LCR


Coastal Plain Headwater RSC


Coastal Plain Unconfined Valley
Dynamic Valley/Base Flow Channel