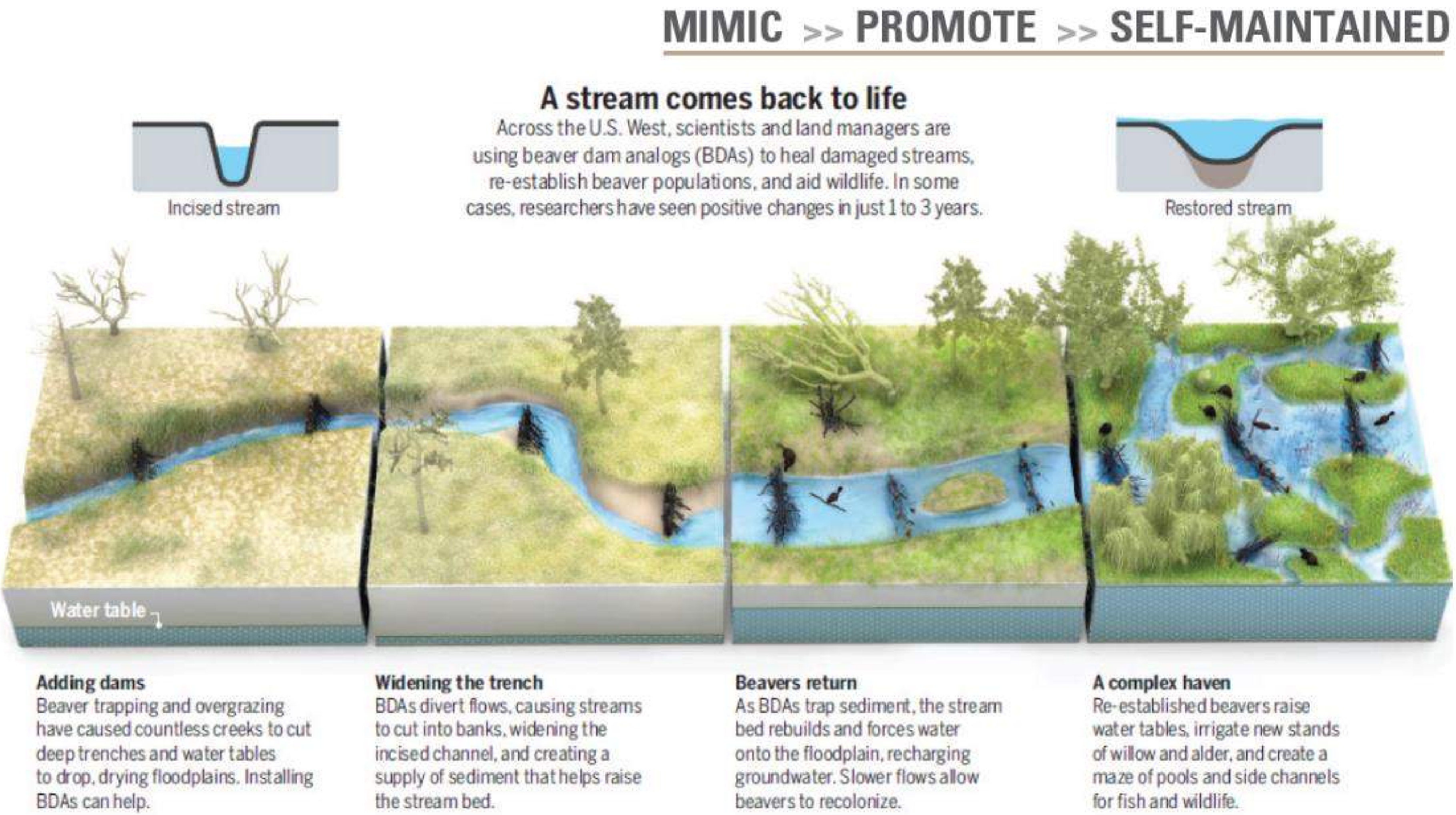
Low-Tech Process-Based Stream Restoration

Is it suitable for the Broad Basin?

Presentation by C. Alex Pellett

9/14/2023



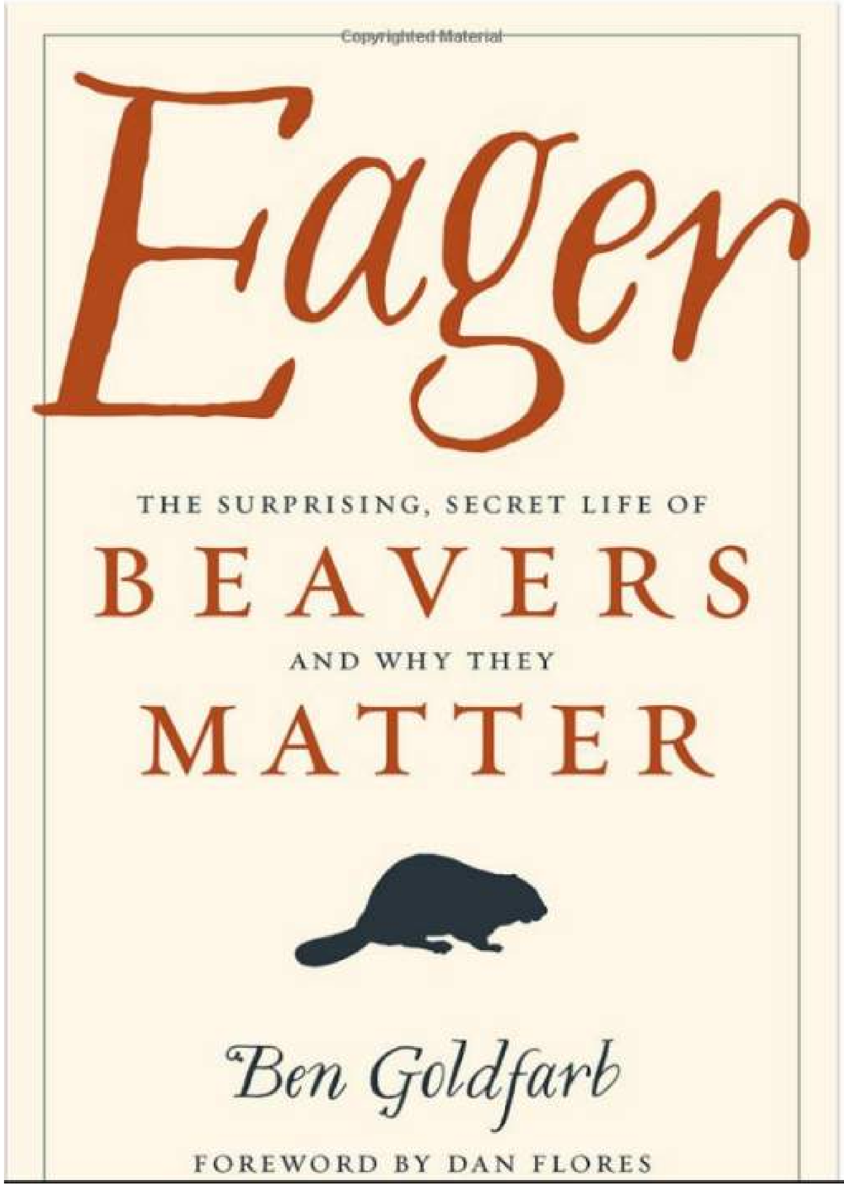
An example from Goldfarb (2018) of achieving a self-sustaining condition where meals of beaver dam analogues (BDAs) mimic beaver dam activity, and then the maintenance and expansion of beaver dam activity is taken over by actual beaver and they maintain a complex system state. Figure © Science by V. Altounian

How I heard about it:

2022 SC Water Resources Conference presentations by Joshua Robinson, Robinson Design Engineers

- Nature-Based Solutions for Eroding Stream Banks and Shorelines
- Uncertainty Analysis of SC Piedmont Regional Hydraulic Geometry Curves

"Eager" was recommended in a discussion after the presentations.



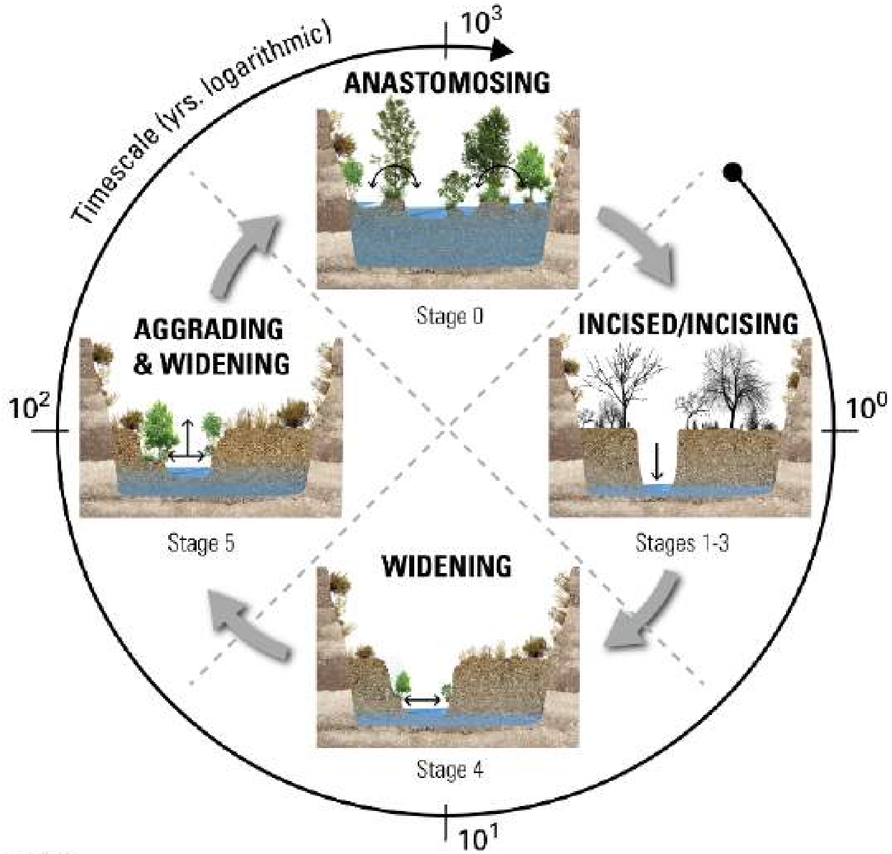
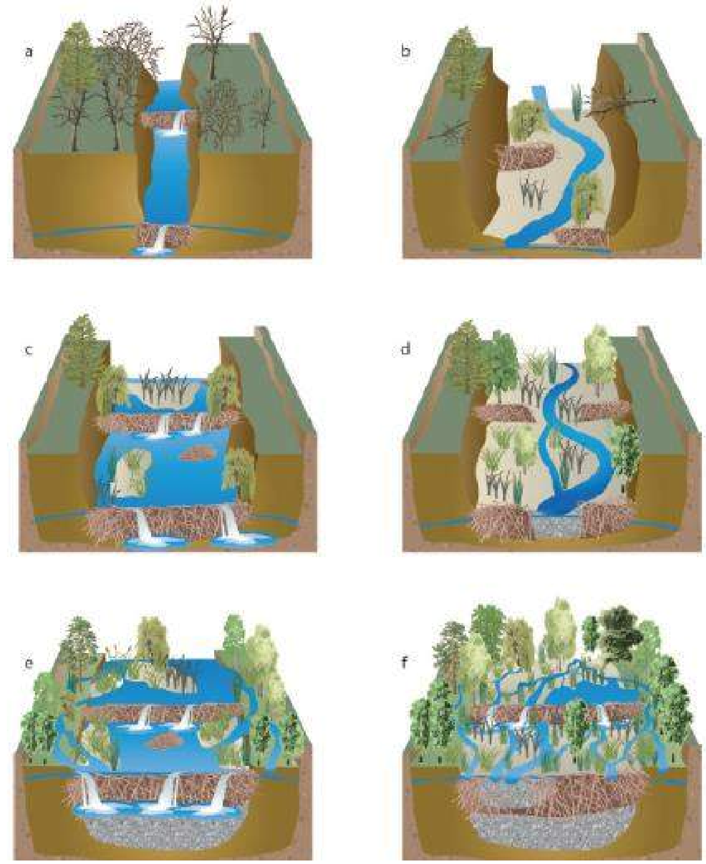


Figure 5 – A riverscapes evolution model simplification and adaptation of Cluer and Thorne (2014) stream evolution model.

Beaver can accelerate stream evolution



See Figure 4 from **Pollock et al. (2014)**: *DOI: 10.1093/biosci/biu036*

Healthy streams should moderate extreme flows and reduce sediment transport(?)

Low-cost techniques seem necessary in order to address stream degradation at scale.

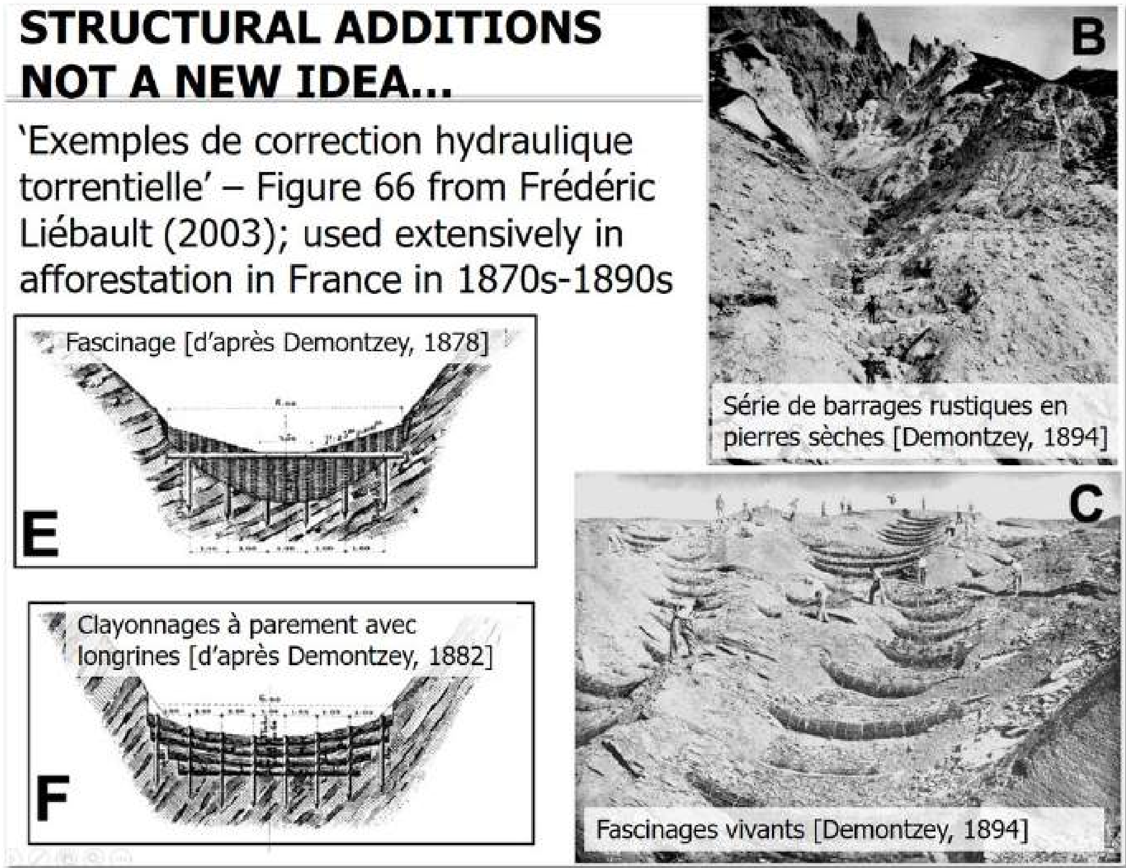


Figure 10 – An example from the Drome Catchment in France in the 1800s where large numbers of simple hand-built structures were added to degraded streams ('hydraulique torrentielle') to restore (correct) the problem. This figure highlights just how long some of these concepts have been around (even if forgotten). The pen and ink drawings of Demontzey in E & F show the use of posts, wicker weaves, and log cribs in what later became known as 'check dams' and are similar to techniques we use with post-assisted log structures. Adaptation of figure from figure 66 of Liébault (2003) PhD thesis. Slide from Wheaton (2018).

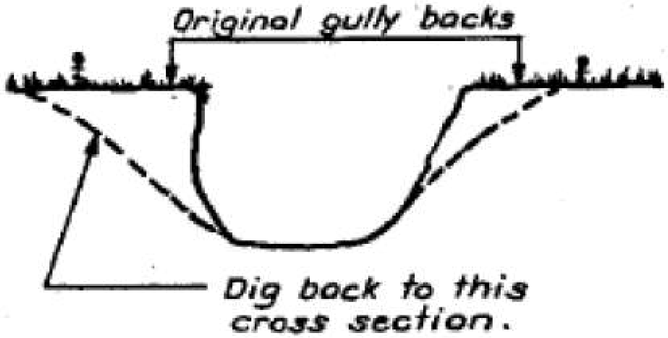


Figure 25
Sectional elevation of gully showing how banks should be sloped back.

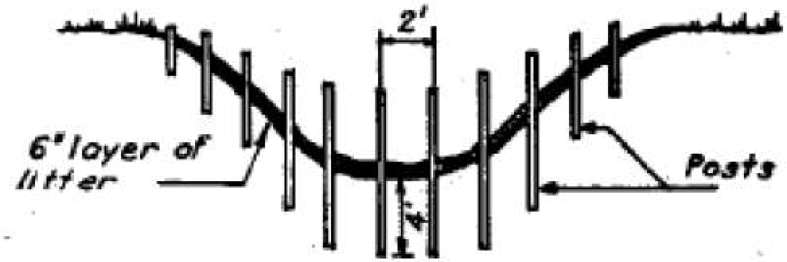


Figure 26
Sectional elevation of gully showing posts and litter in place for dam. Note that the posts are lower in the center.

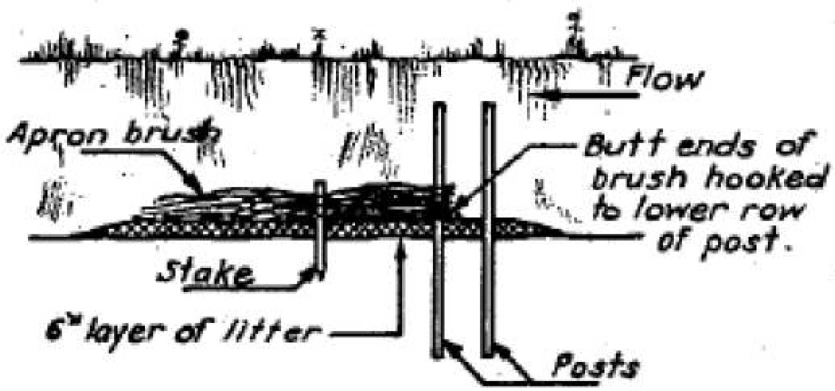


Figure 27
Side section of dam after apron brush has been placed.

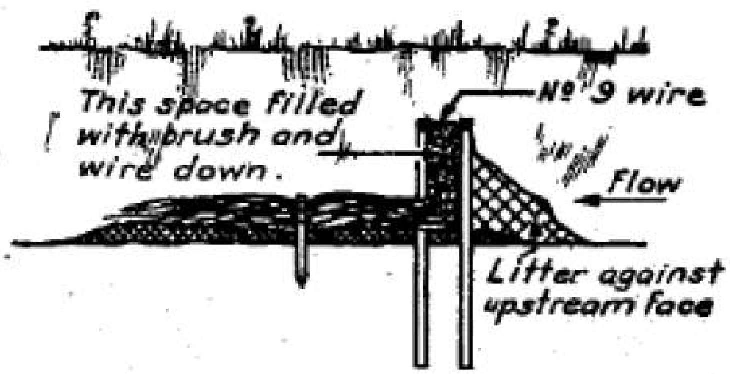


Figure 28
Side section of completed dam.

Figure 8 –Figures from Handbook of Erosion Control in Mountain Meadows (Kraebel and Pillsbury, 1934). The approach to restoration and many of the specific techniques are similar to the approaches outlined in this manual, though tending to focus on ephemeral channels.

LTPBR PRINCIPLES

RIVERSCAPES PRINCIPLES:

1. **Streams need space.** Healthy streams are dynamic, regularly shifting position within their valley bottom, re-working and interacting with their floodplain. Allowing streams to adjust within their valley bottom is essential for maintaining functioning riverscapes.

2. **Structure forces complexity and builds resilience.** Structural elements, such as beaver dams and large woody debris, force changes in flow patterns that produce physically diverse habitats. Physically diverse habitats are more resilient to disturbances than simplified, homogeneous habitats.

3. **The importance of structure varies.** The relative importance and abundance of structural elements varies based on reach type, valley setting, flow regime and watershed context. Recognizing what type of stream you are dealing with (i.e., what other streams it is similar to) helps develop realistic expectations about what that stream should or could look (form) and behave (process) like.

4. **Inefficient conveyance of water is often healthy.** Hydrologic inefficiency is the hallmark of a healthy system. More diverse residence times for water can attenuate potentially damaging floods, fill up valley bottom sponges, and slowly release that water later elevating baseflow and producing critical ecosystem services.

RESTORATION PRINCIPLES:

5 **It's okay to be messy.** When structure is added back to streams, it is meant to mimic and promote the processes of wood accumulation and beaver dam activity. Structures are fed to the system like a meal and should resemble natural structures (log jams, beaver dams, fallen trees) in naturally 'messy' systems. Structures do not have to be perfectly built to yield desirable outcomes. Focus less on the form and more on the processes the structures will promote.

6 **There is strength in numbers.** A large number of smaller structures working in concert with each other can achieve much more than a few isolated, over-built, highly-secured structures. Using a lot of smaller structures provides redundancy and reduces the importance of any one structure. It generally takes many structures, designed in a complex to promote the processes of wood accumulation and beaver dam activity that lead to the desired outcomes.

7 **Use natural building materials.** Natural materials should be used because structures are simply intended to initiate process recovery and go away over time. Locally sourced materials are preferable because they simplify logistics and keep costs down.

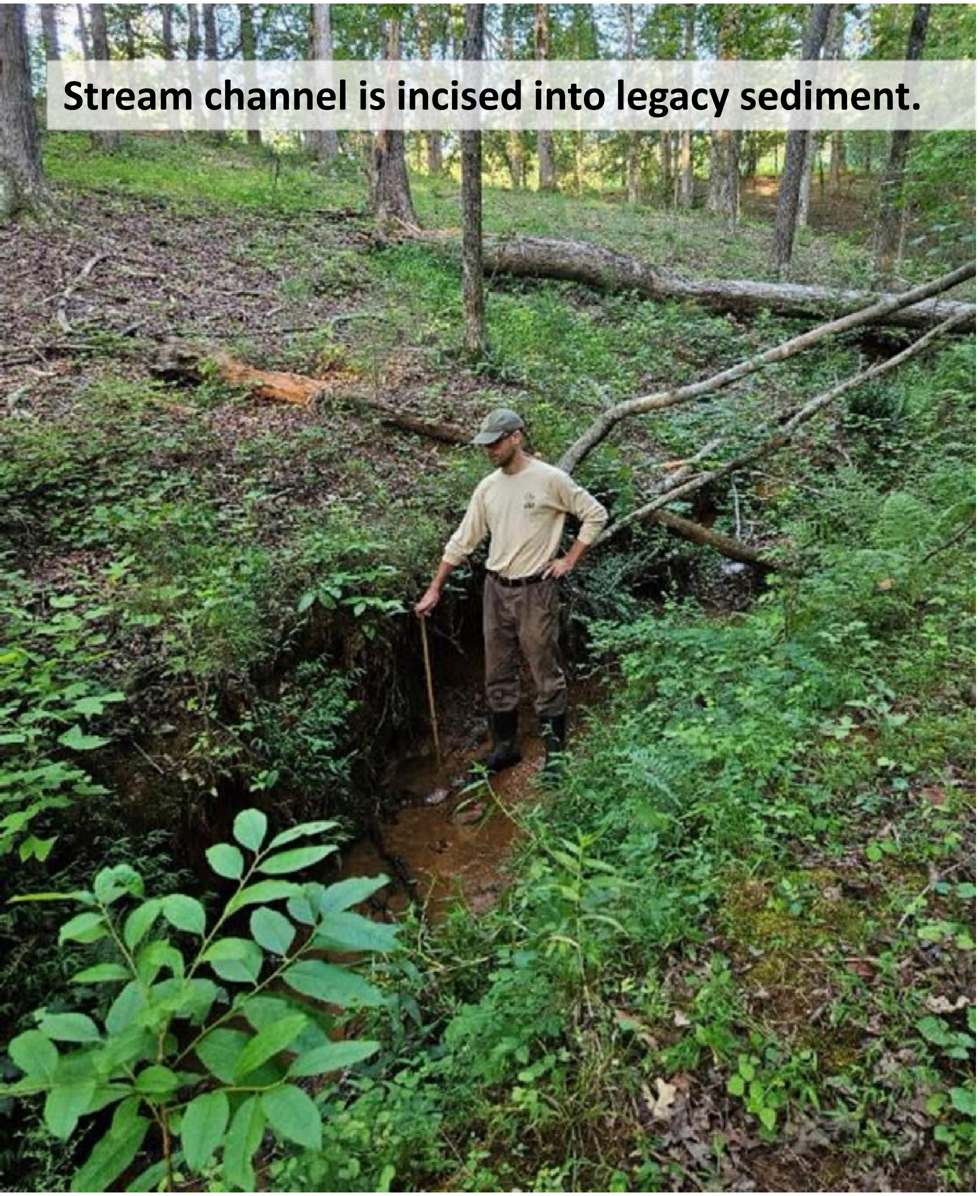
8 **Let the system do the work.** Giving the riverscape and/or beaver the tools (structure) to promote natural processes to heal itself with stream power and ecosystem engineering, as opposed to diesel power, promotes efficiency that allows restoration to scale to the scope of degradation.

9 **Defer decision making to the system.** Wherever possible, let the system make critical design decisions by simply providing the tools and space it needs to adjust. Deferring decision making to the system downplays the significance of uncertainty due to limited knowledge. For example, choosing a floodplain elevation to grade to based on limited hydrology information can be a complex and uncertain endeavor, but deferring to the hydrology of that system to build its own floodplain grade reduces the importance of uncertainty due to limited knowledge.

10 **Self-sustaining systems are the solution.** Low-tech restoration actions in and of themselves are not the solution. Rather they are just intended to initiate processes and nudge the system towards the ultimate goal of building a resilient, self-sustaining riverscape.

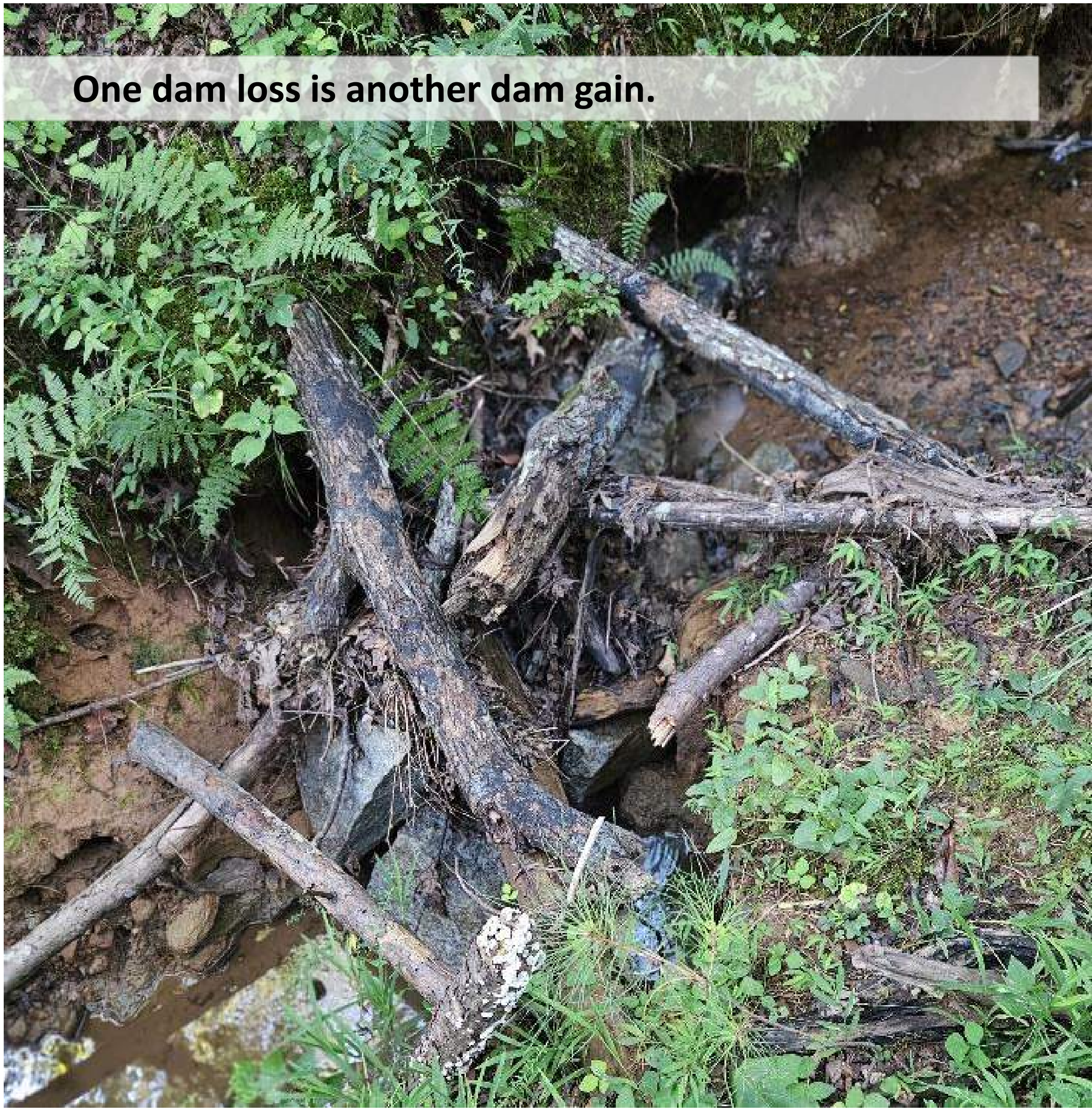
References (available for free online)

- Wheaton JM, Wheaton A, Maestas J, Bennett S, Bouwes N, Shahveridan S, Camp R, Jordan C, Macfarlane W, Portugal E, Weber N. 2019. Low-Tech Process-Based Restoration of Riverscapes: Pocket Field Guide. Utah State University Restoration Consortium. DOI: 10.13140/RG.2.2.28222.13123/1.
- Wheaton J.M., Bennett S.N., Bouwes, N., Maestas J.D. and Shahverdian S.M. (Editors). 2019. Low-Tech Process-Based Restoration of Riverscapes: Design Manual. Version 1.0. Utah State University Restoration Consortium. Logan, UT. 286 pp. DOI: 10.13140/RG.2.2.19590.63049/2.


Stream channel is incised into legacy sediment.


Stream bank and forest floor are undercut.

Plenty of material to build habitat structure.



One dam loss is another dam gain.

- My first dam (fall 2020).
- About 1 foot tall.
- Built up a few inches at a time.
- Just downstream of a “tunnel”
- Holds a small pool and a pile of sediment.
- Added stones to the banks and the apron.
- Concentrates flow, but dissipates energy(?)

Discussion Questions

- Is this likely to cause mosquito problems?
- Clogged culverts?
- Negative habitat impacts?
- Is it better to leave the system alone?
- Are other methods of restoration more appropriate?
- Can we simply throw sticks into creeks?

Discussion with Lake Hartwell Partners

- Cutting trees can provide good habitat.
- Beavers are often problematic.
- Live stakes vs. dead wood
- Widening (land loss) vs. raising (flooding)
- Angle of tree fall.
- We tend towards not changing, but so many things have already been changed.
- Email Heather with reference reach information.