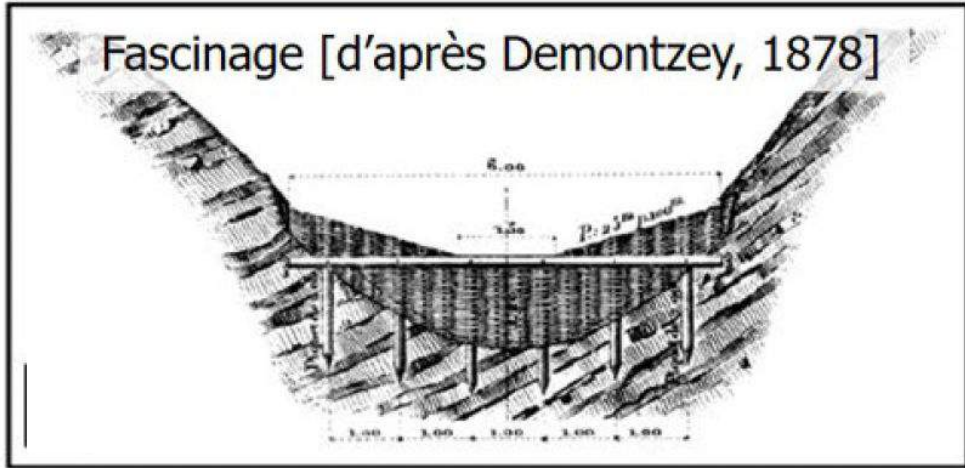


Evolving Low-Tech Restoration Tools for Modified Landscapes



**“Low-Tech Process-Based Restoration:
Mimicking nature isn’t rocket science, its
way more dynamic than that!”**

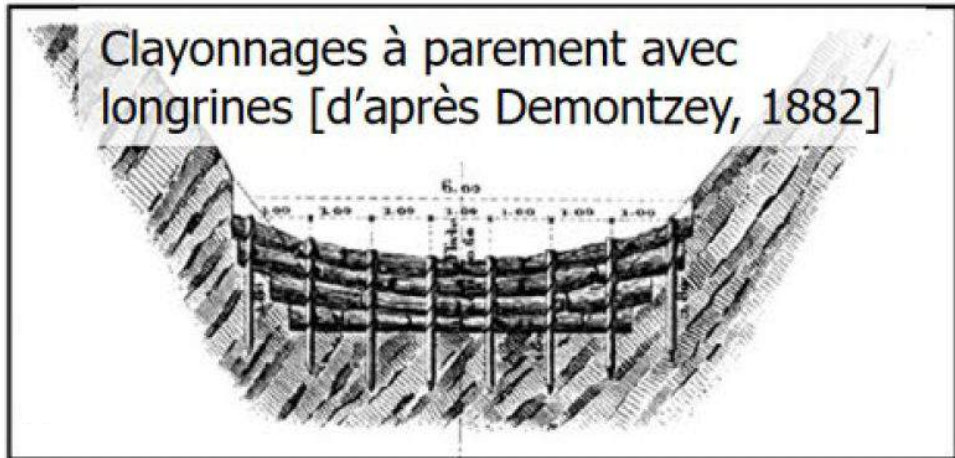




“Exemples de correction hydraulique torrentielle”

Figure 66 from Frédéric Liébault (2003)

Applied in France, especially in the 1870's to 1890's



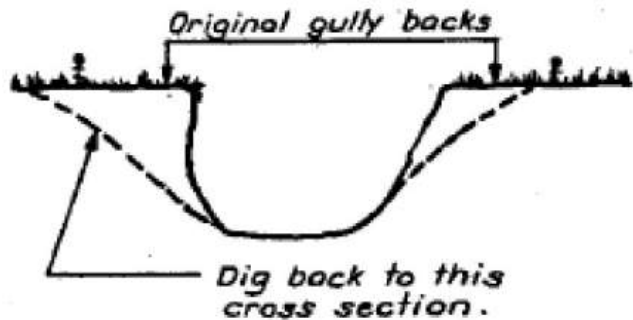


Figure 25

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

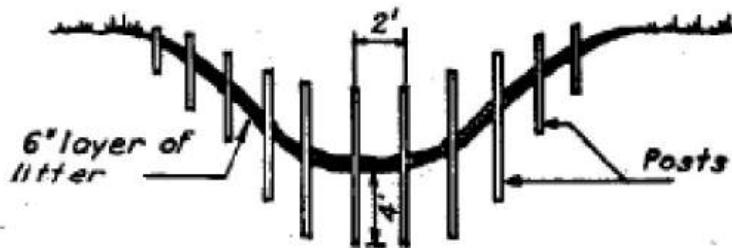


Figure 26

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

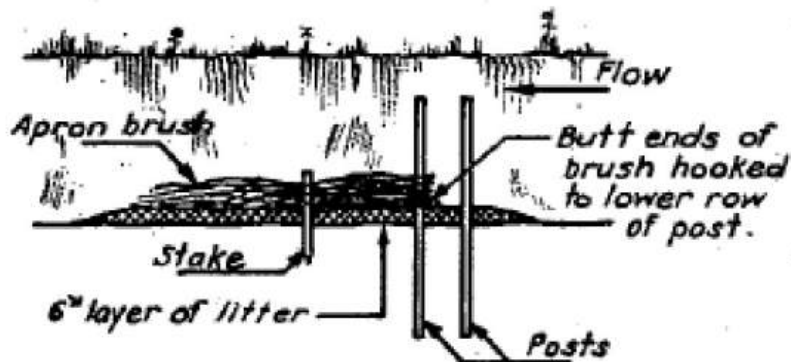


Figure 27

Side section of dam after apron brush has been placed.

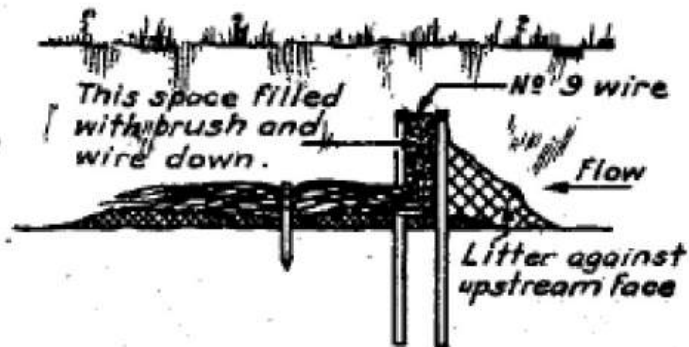
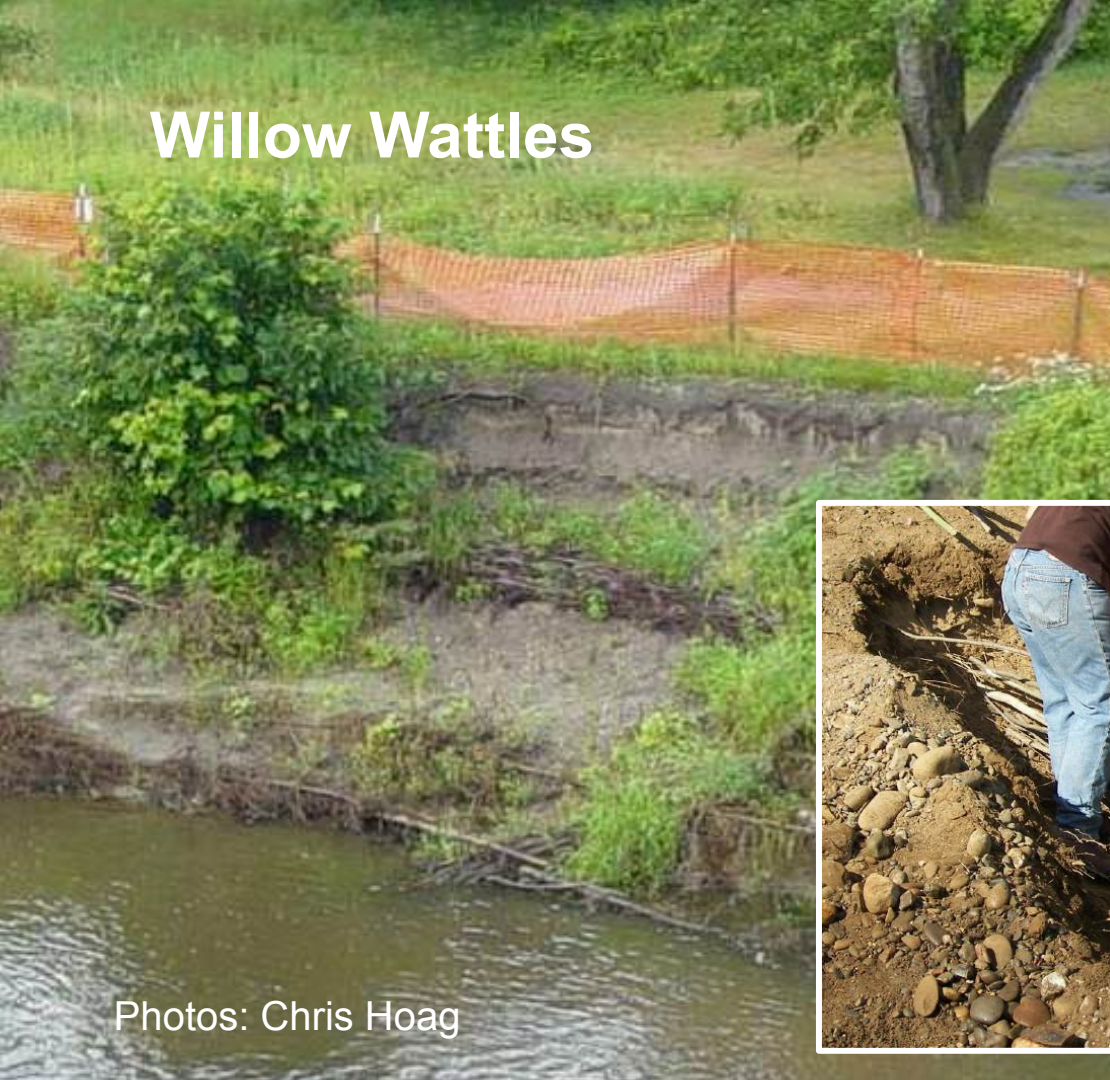


Figure 28

Side section of completed dam.

Willow Wattles



Photos: Chris Hoag



Using Beaver Dams to Restore Incised Stream Ecosystems

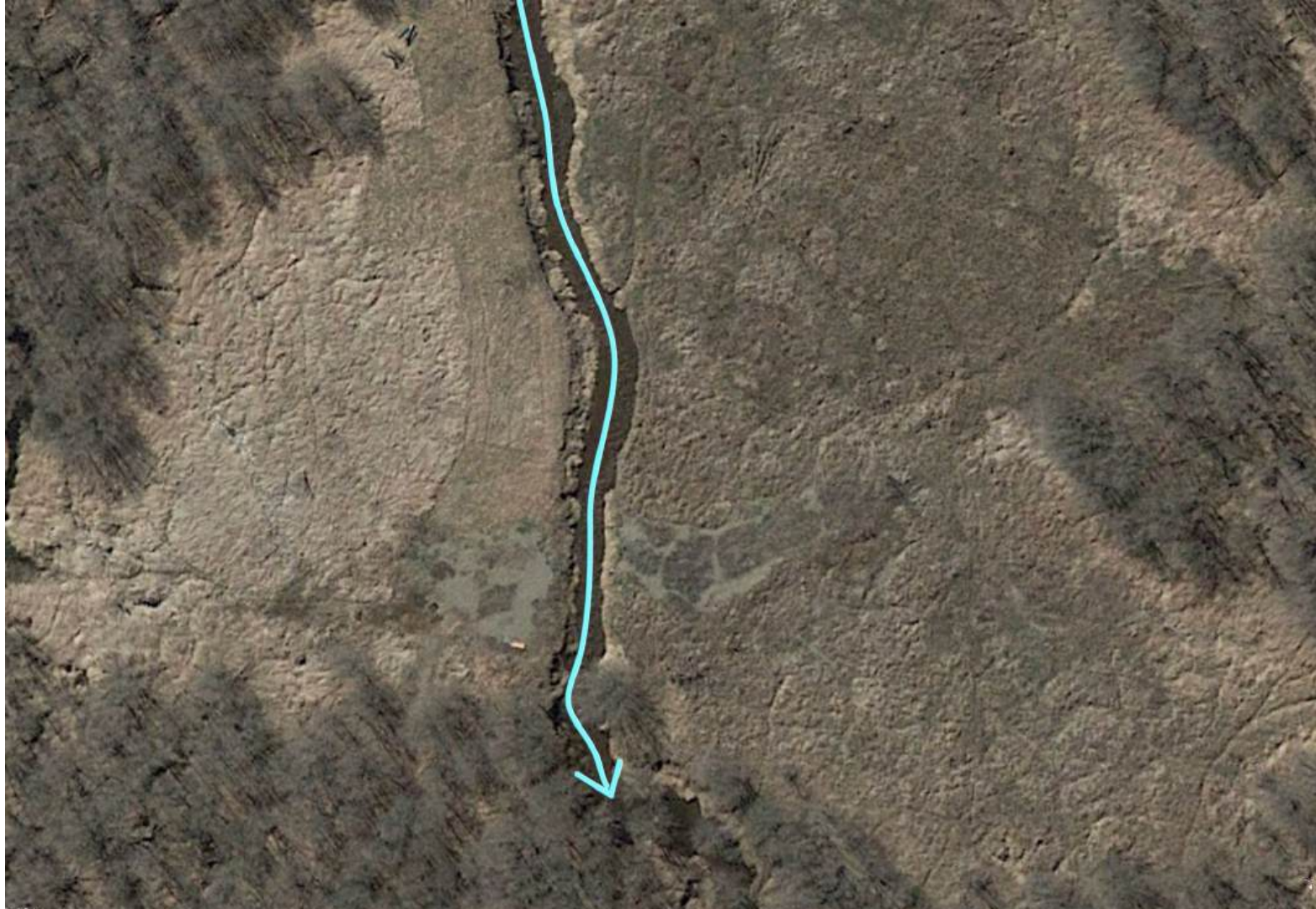
MICHAEL M. POLLOCK, TIMOTHY J. BEECHIE, JOSEPH M. WHEATON, CHRIS E. JORDAN, NICK BOUWES, NICHOLAS WEBER, AND CAROL VOLK

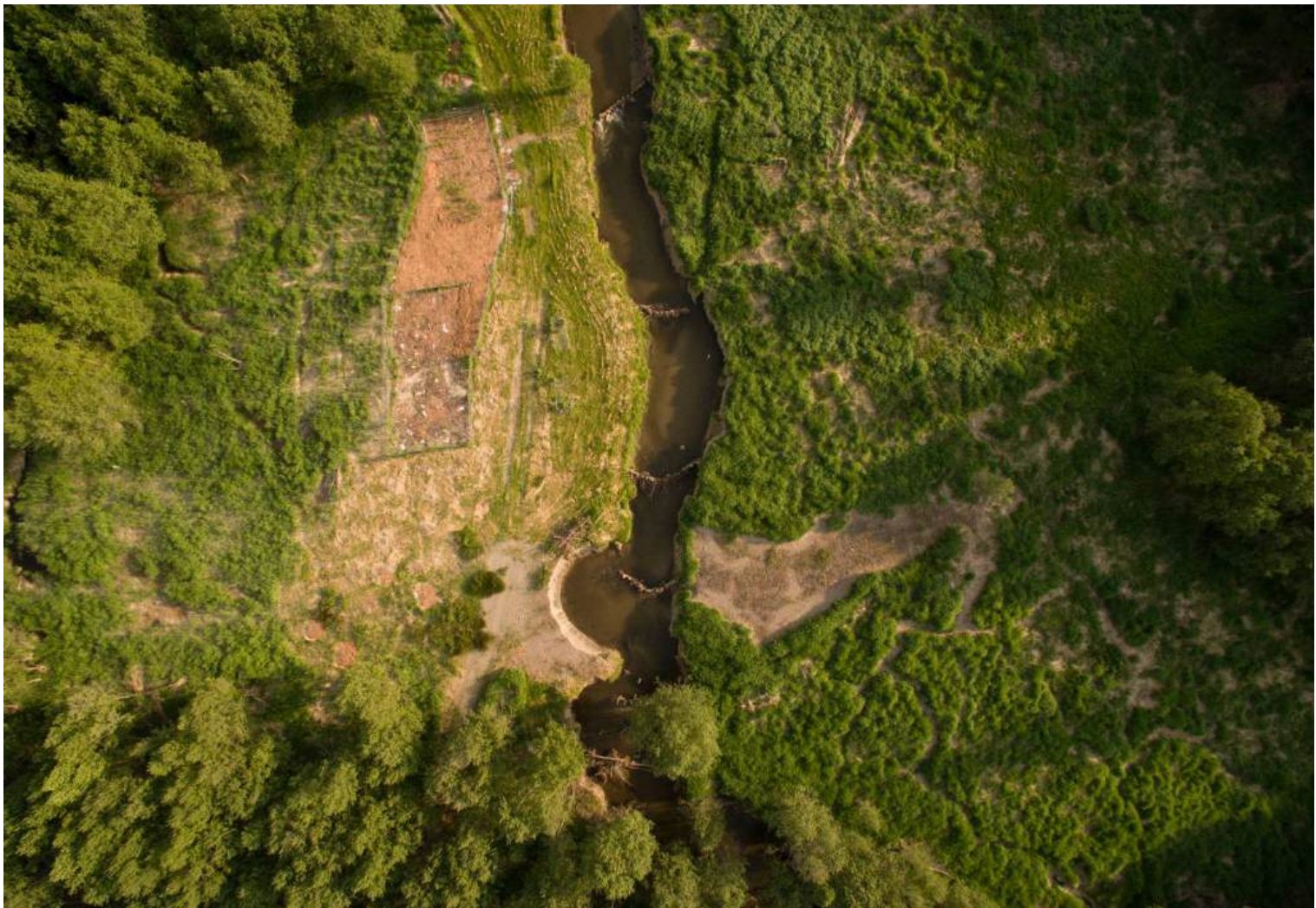


Michael Pollock's "Post-line wicker weave"

Beaver Dam Analog Technique Evolution









More info: okanoganhighlands.org

**Changes:
2015 - 2018**

**Channel Length > 25%
increase (+486 ft.)**

**Reach-scale slope reduction
over -20%**



Post-Line
Wicker Weave
style BDA

















Photo by Julie Vanderwal
More: okanoganhighlands.org







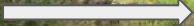






Photo by Julie Vanderwal
More: okanogahighlands.org





August 2016



June 2020

Beaver Dam Analog Technique Evolution



Original Post Line
Wicker Weave



Next Gen Conifer
Brush Mattress



Best-of-Both
Worlds Hybrid

D

Most recent:
“Lasagne” style
structures
(variations)



D

Most recent:
“Lasagne” style
structures
(variations)



D



Most recent:
“Lasagne” style
structures
(variations)

D



Most recent:
“Lasagne” style
structures
(variations)

D

Most recent:
“Lasagne” style
structures
(variations)



Beaver Dam Analog Fish Passage

The science is based on:



Post-line wicker weave style BDAs, such as those described and researched by Pollock et al.



Natural beaver dams

Guiding Principle:

As designs diverge from those studied, the research becomes less applicable.



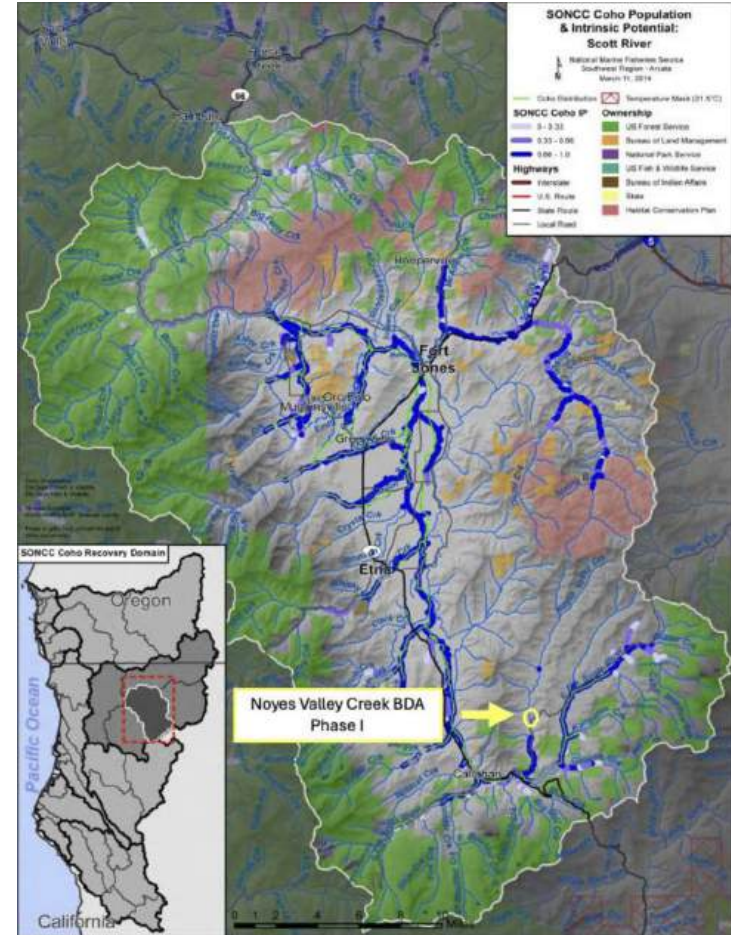
Case Study: Noyes Valley Creek, Scott River Watershed, California



Lasagne-style BDAs installed Summer 2025 *Project reach appeared non-anadromous*

Intent: To “provide context and detail to support ongoing monitoring, adaptive management efforts, and the future application of these structures.”

Source: Upper Noyes Valley Creek Process-Based Restoration Field Note from Implementation of Beaver Dam Analogs (BDAs) - July 7, 2025 (Debrief)
All photos and graphics provided by the Scott River Watershed Council.



Case Study: Structure Design



Case Study: Mortality of Coho Salmon

Construction
Days 1 and 2:
No fish observed

Day 3:
Two coho salmon
observed
(one alive, one
deceased)

Day 4:
Live fish observed;
very low DO; turbidity
stopped construction



Case Study: Mortality of Coho Salmon

Lasagne-style BDAs at Noyes Valley Creek, Summer 2025
Scott River Watershed, California

In total, 50 coho salmon were found dead because of the implementation of BDA structures.

Day 5:
39 coho died



Case Study: Mortality of Coho Salmon

**Lasagne-style BDAs at Noyes Valley Creek, Summer 2025
Scott River Watershed, California**

Day 10:
Thunderstorm

Day 11:
10 dead coho salmon and
several dead rainbow trout,
entangled on/in
structures



Beaver Dam Analog (BDA) structure design concerns



Unintended
entrapment
zones



Adaptive management aimed to:

- *eliminate access for fish to the top of the dam*
- *create an active fish passage channel*

Adaptive Management:

Adaptive management aimed to:

- Eliminate access for fish to the top of the dam
- Create an active fish passage channel

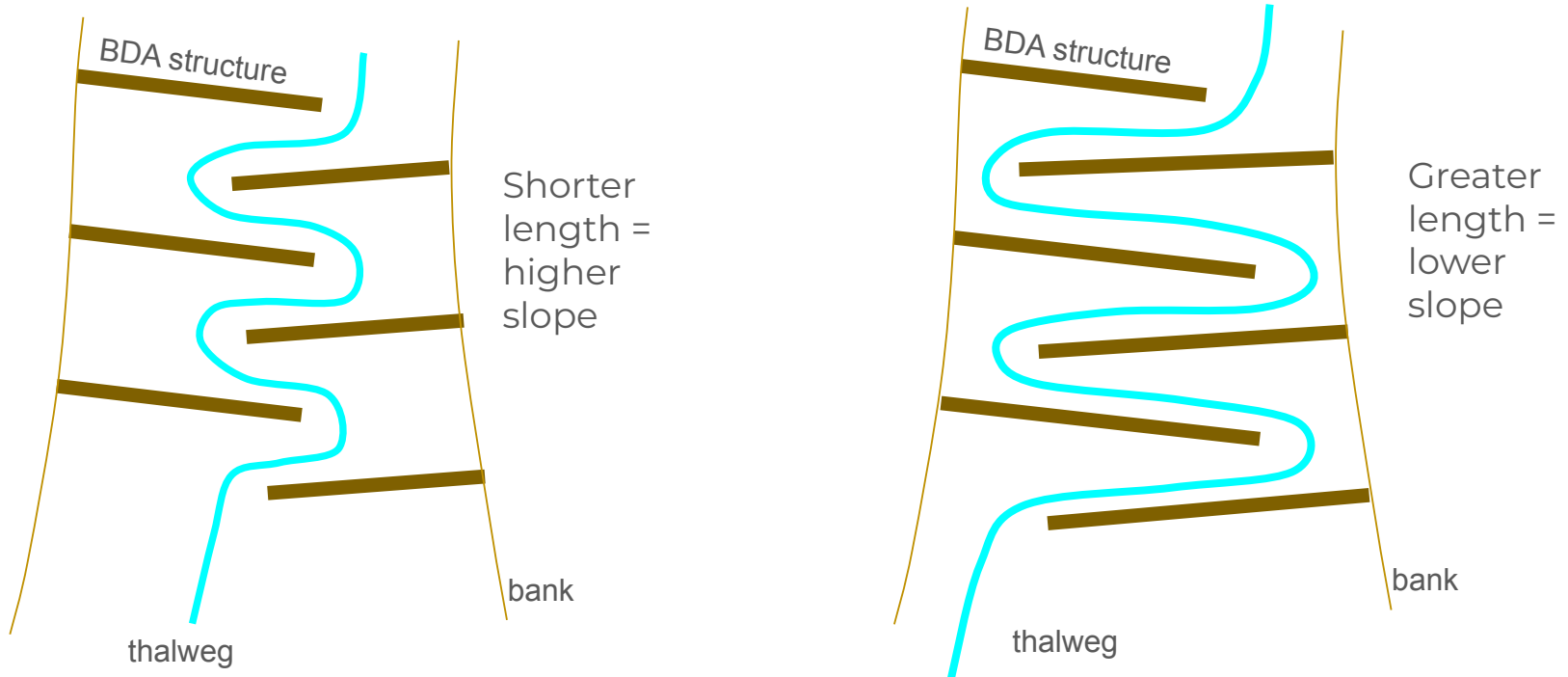




7/8/25, 1:07 PM
NVPP19a

Adaptive Management:

1. Preventing access to the apron (implemented right away)
2. Creating notches for fish passage (implemented right away)
3. Building partially-channel spanning structures with a passage channel running in between (below, implemented in December)





Significant challenges – Invaluable learning opportunity



Case Study: Key Takeaways and Lessons Learned

Lasagne-style BDAs at Noyes Valley Creek, Summer 2025
Scott River Watershed, California

Structure installation:

1. Build structures that closely resemble those studied.



Case Study: Key Takeaways and Lessons Learned

Lasagne-style BDAs at Noyes Valley Creek, Summer 2025 Scott River Watershed, California

Structure installation:

1. Build structures that closely resemble those studied.
2. Diversity is key:
 - a. Vary structure length, height, width, and design
 - b. Build both channel-spanning and non-channel spanning structures, depending on the site
 - c. Consider overlapping, non-channel spanning structures if fish passage is a significant concern
 - d. Aim for heterogeneity



Case Study: Key Takeaways and Lessons Learned

Lasagne-style BDAs at Noyes Valley Creek, Summer 2025 Scott River Watershed, California

Structure installation:

1. Build structures that closely resemble those studied.
2. Diversity is key:
 - a. Vary structure length, height, width, and design
 - b. Build both channel-spanning and non-channel spanning structures, depending on the site
 - c. Consider overlapping, non-channel spanning structures if fish passage is a significant concern
 - d. Aim for heterogeneity
3. Include notching and/or lower weave at center to facilitate fish passage during low flows



Case Study: Key Takeaways and Lessons Learned

Lasagne-style BDAs at Noyes Valley Creek, Summer 2025 Scott River Watershed, California

Structure installation:

1. Build structures that closely resemble those studied.
2. Diversity is key:
 - a. Vary structure length, height, width, and design
 - b. Build both channel-spanning and non-channel spanning structures, depending on the site
 - c. Consider overlapping, non-channel spanning structures if fish passage is a significant concern
 - d. Aim for heterogeneity
3. Include notching and/or lower weave at center to facilitate fish passage during low flows



Low-Tech Process-Based Restoration centers on:

- the stream needing space to move
- deferring to the stream to decide how it will interact with structure



**Example: A
straightened channel
can be made sinuous
again by adding woody
structure**



Triple Creek, Okanogan County, WA - Okanogan Highlands Alliance; more about project: okanoganhighlands.org

LTPBR meets a modified landscape

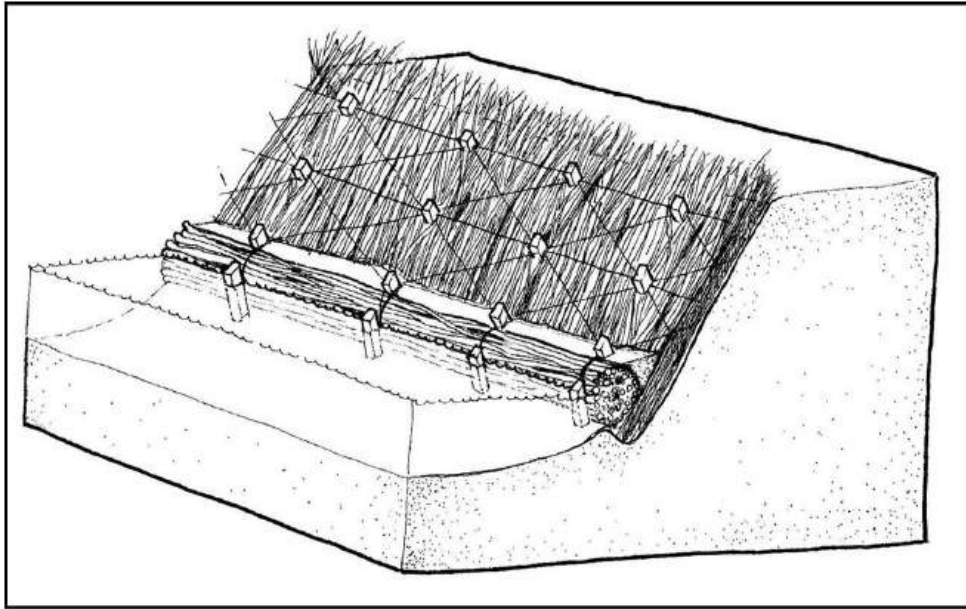
What do you do when there's infrastructure involved?

- Homes
- Agricultural fields
- Bridges
- Culverts
- Roads
- Property boundaries and surveyed corners
- Other human-built structures



Your Toolbox May Need:

Native plant based streambank techniques that can allow LTPBR to occur on sites where constraints are present



Your Toolbox May Need:

Native plant based streambank techniques that can allow LTPBR to occur on sites where constraints are present

Traditionally called:

Streambank Soil Bioengineering

Evolving into LTPBR:

Nature-Based Streambank Solutions





What do you do when the stream doesn't have room to move?



Nature-Based Streambank Solutions

There may be places within a project area where you need to stabilize a bank.



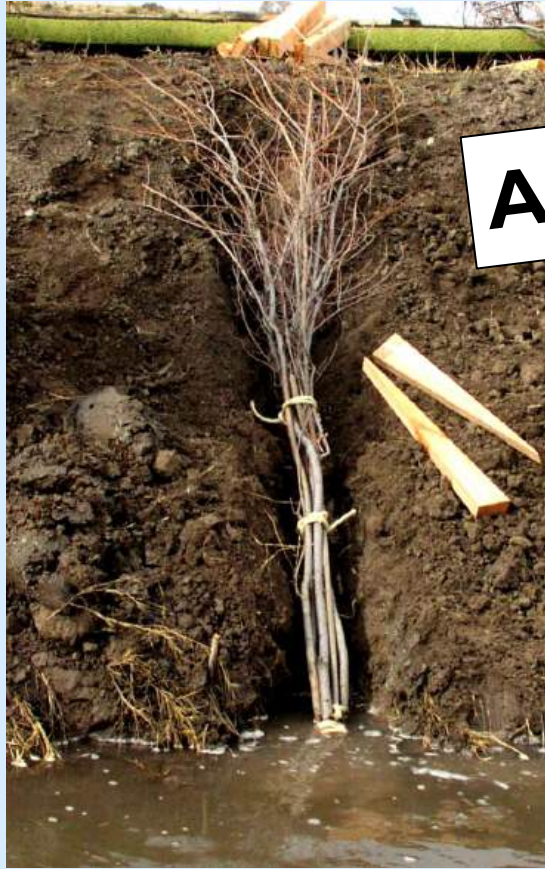


Dormant Unrooted Cuttings

- Induces deposition
- Lowers velocities
- Mechanically pins the streambank



What else can you do with dormant cuttings?



A lot!



Cluster Planting



install



3 years later

Clump Plantings



April

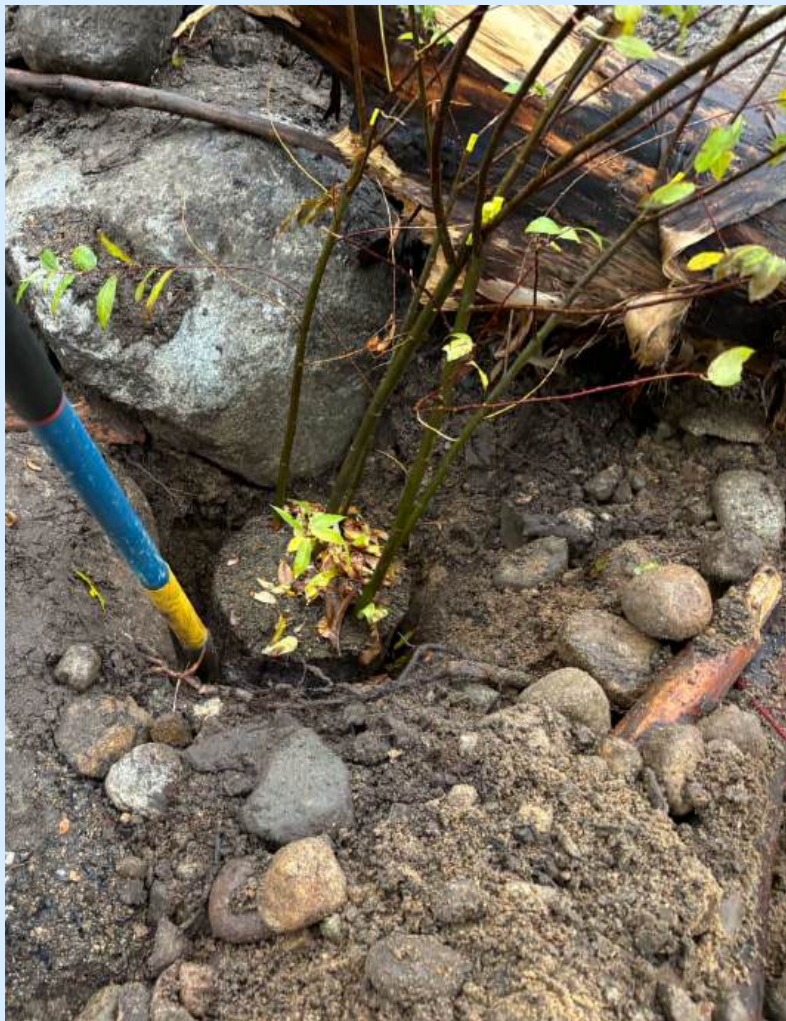
Nursery Sourced Clump Plantings

October (same year)



**Beaver Food
Forest Nursery**
@beaverfoodforest

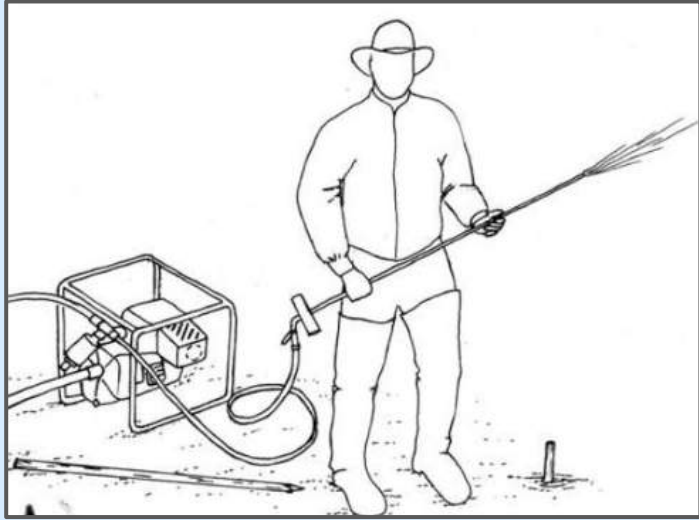




**Skyline Project, Methow Salmon Recovery Foundation;
plants from Beaver Food Forest Nursery**

- **Great for rocky sites**
- **Quick to provide significant function**

Planting with the Waterjet Stinger



Planting with the Waterjet Stinger





What if you could strategically stabilize the bank in a way that also adds roughness - and uses native plants instead of rock?



What if you could strategically stabilize the bank in a way that also adds roughness - and uses native plants instead of rock?



California



Fascine

Brush Mattress

Cluster planting

Vertical bundle

California



About one year after installation





4 years after install

What do you do when the stream doesn't have room to move?



Weather station

Corner survey marker

What if you could strategically stabilize the bank in a way that also adds roughness – and uses native plants?

Nature-Based Streambank Solutions





Here, the vertical bundle creates an anchor point at the upstream end of the brush mattress. However, vertical bundles can also be installed on their own for bank stabilization.

South of Jackpot, NV

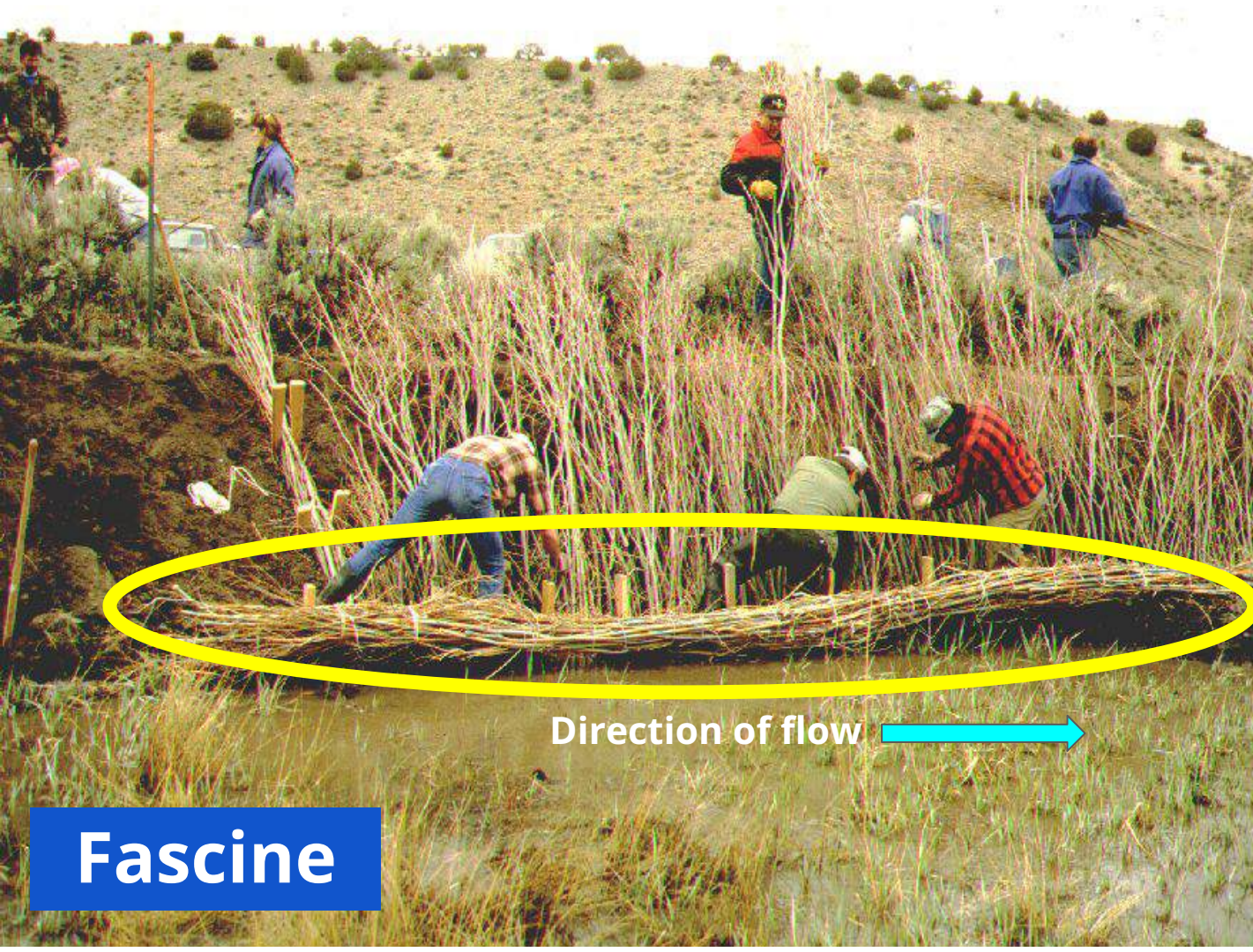


Laying willow stems on the vertical cutbank provides for soil-to-stem contact. Willows can then grow roots into the bank and put out shoots for a living bank treatment.

Direction of flow 

Brush Mattress

South of Jackpot, NV



The fascine protects the toe of the bank and the bottoms of the vertical willows

Fascine

South of Jackpot, NV

One Year Later

Corner
survey
marker

*South of
Jackpot,
NV*



Five Years Later

**Weather
station**



12 Years Later



Vertical Bundles

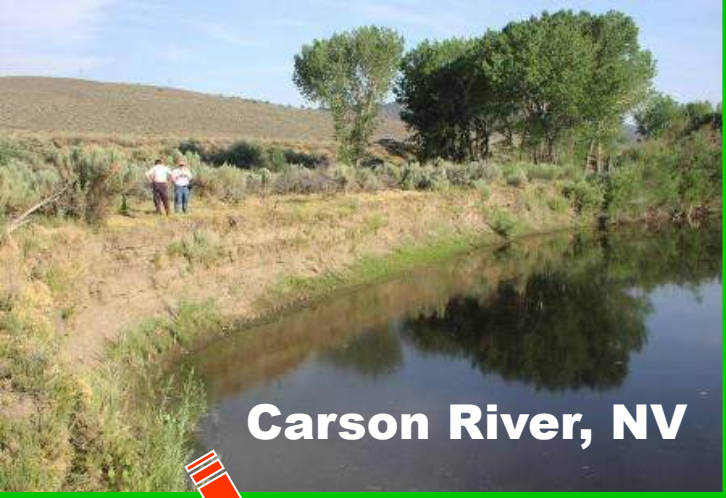


Yuma River just outside of the Yuma, AZ city limits



**Typical growth
of vertical
bundles after
1-2 years**

Brush Spurs



angled upstream





**1/3 of
bundle
in the
bank**

Willow Wattle



- Acts as a wall
- Addresses surface erosion
- Traps sediment
- Offers immediate protection
- Spurs / deflectors

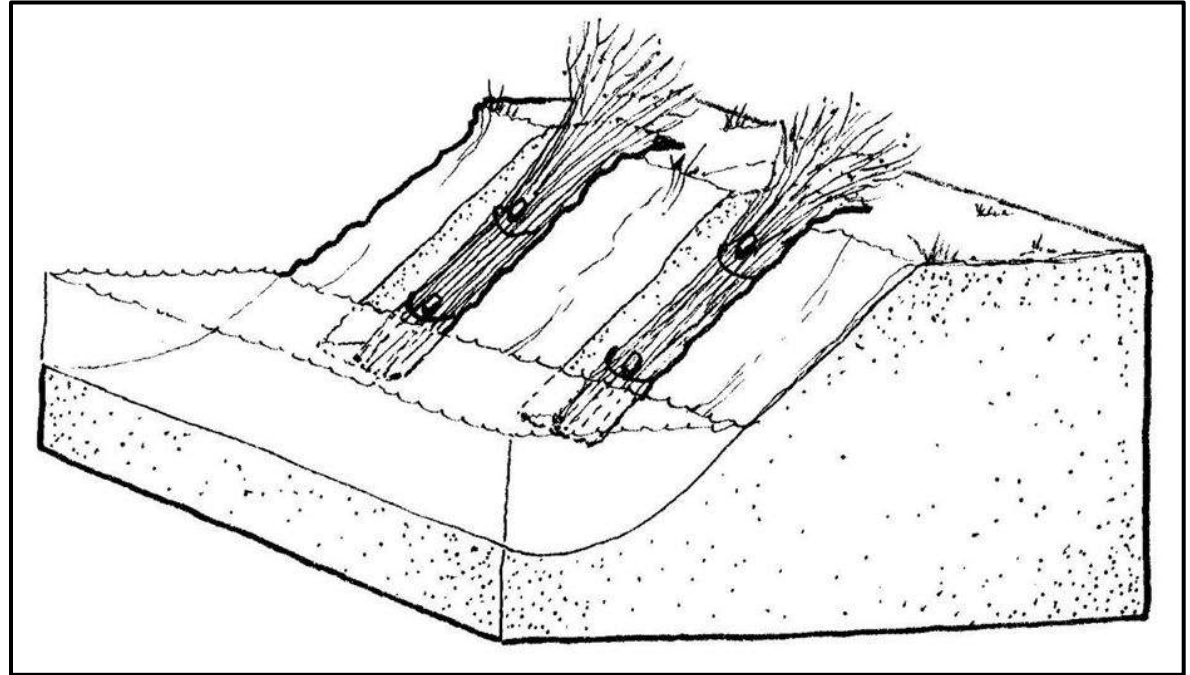
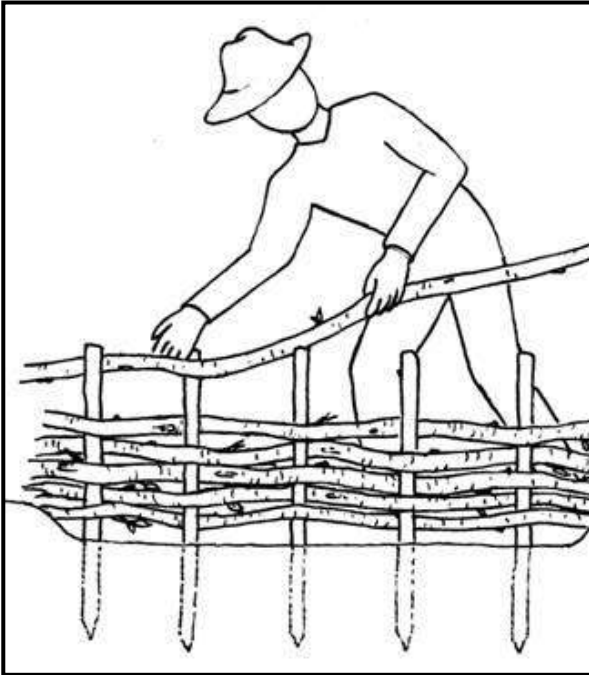
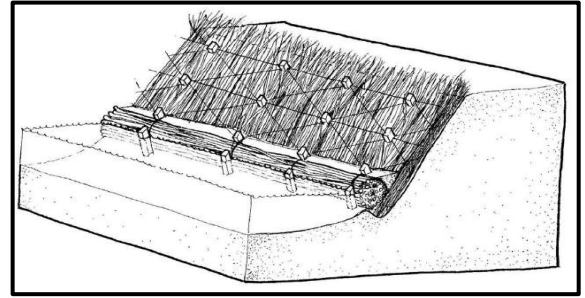


Growth after one growing season



Growth after two growing seasons
North Dakota

If you want to install these treatments, you will need training on how to implement – which is outside of the scope of this talk.



Streambank Soil Bioengineering Field Guide for Low Precipitation Areas



Prepared by

Chris Hoag, Wetland Plant Ecologist, USDA-NRCS, Plant Materials
Center, P.O. Box 296, Aberdeen ID 83210

And

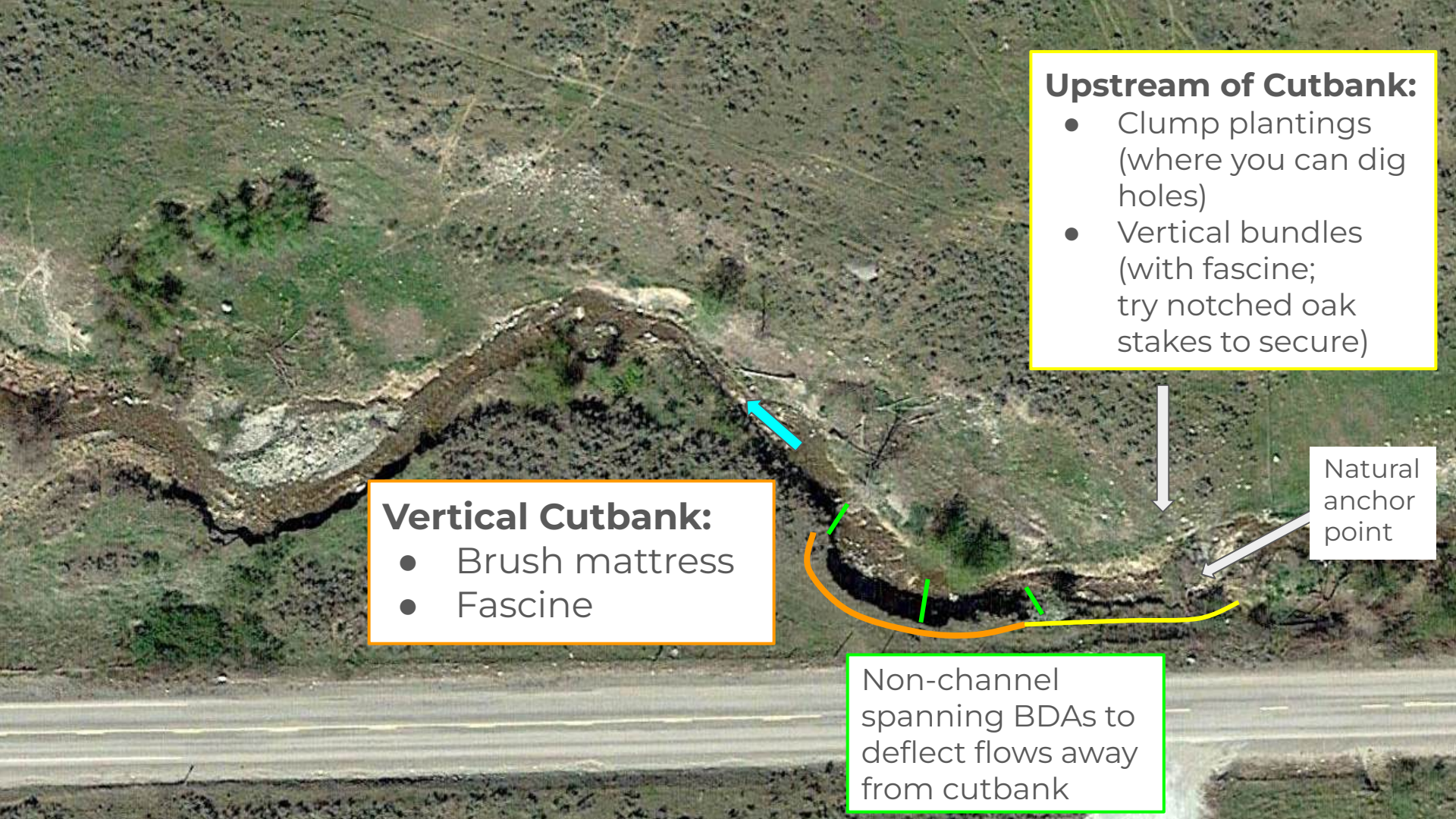
Jon Fripp, Stream Mechanics Civil Engineer, USDA-NRCS, National
Design, Construction, and Soil Mechanics Center, P.O. Box 6567, Fort
Worth TX, 76115

December 2002



Nature-Based Streambank Solutions





Upstream of Cutbank:

- Clump plantings (where you can dig holes)
- Vertical bundles (with fascine; try notched oak stakes to secure)

Vertical Cutbank:

- Brush mattress
- Fascine

Natural anchor point

Non-channel spanning BDAs to deflect flows away from cutbank

Evolving Low-Tech Restoration Tools for Modified Landscapes



Several treatments in combination



Julie Vanderwal

Certified Ecological Restoration Practitioner

Sparrow Song Consulting

Twisp, WA

sparrowsongjulie@gmail.com

509-476-2432

Chris Hoag

Riparian Plant Ecologist

Hoag Riparian & Wetland Restoration, LLC

American Falls, Idaho

jchris.hoag@gmail.com

208-221-0944

