

**Restoring Streams Before and After Fires –
*the benefits, water rights issues, and how to
manage risks***

AFTER THE FLAMES CONFERENCE April 15 2024

Jackie Corday, Corday Natural Resources Consulting

Abby Burk, Audubon Senior Mgr, Western Rivers Program



Colorado Healthy Headwaters Working Group | Audubon Rockies – working to support watershed restoration

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Colorado Healthy Headwaters Working Group

Working together to increase the pace, scale, and value of process-based restoration throughout Colorado.

Founders & Tri-Chairs:

- Jackie Corday
- Abby Burk (Audubon Rockies)
- Fay Hartman (American Rivers)

HHWG members – Academic *researchers* (CSU, CMU, & MSI), *state agencies* (CPW, CDOT, CWCB), *federal agencies* (NRCS, USFS, BLM), **Tribes**, local govt, watershed and conservation *nonprofits*, and river/wetland restoration *practitioners*



Part 1 **What** is LTPBR Restoration?
What are the **BENEFITS** to public and private lands and waters?

Degraded incised streams – unfortunately, very common in all Western States



Most common causes:

- Riparian veg removal
- Historic mining & timber harvest practices
- Altered flows, dams
- Moved & channelized for ag or development
- Unmanaged grazing
- Removal of beaver

Why are incised streams a problem?

Physical effects of disconnected floodplains include:

- **Lowered groundwater tables**
- **Lower summer base flows** – streams can even transition from perennial to intermittent
- **Higher sedimentation = lower water quality** and often leads to reduced reservoir capacity costing \$100s of millions every year in the West.
- **Loss of riparian and wetlands and forage** for livestock and wildlife

What is the scale of the problem? River stats

- Colorado has over 105,000 miles of rivers.
- ~61% of smaller streams and ~97% of major rivers have experienced **floodplain alteration**, rendering their floodplains partially or wholly nonfunctional.
- **Climate change impacts** of drought, less snowpack, & fires are exacerbating/magnifying the problems incised streams cause.

Rivers modified by floodplain alteration

STATE	SHARE OF HEADWATERS THAT HAVE BEEN MODIFIED	SHARE OF SMALLER RIVERS AND STREAMS THAT HAVE BEEN MODIFIED	SHARE OF MAJOR RIVERS THAT HAVE BEEN MODIFIED	SHARE OF ALL RIVERS THAT HAVE BEEN MODIFIED
Arizona	32%	56%	96%	63%
California	36%	41%	80%	45%
Colorado	51%	61%	97%	63%

Chart from [Disappearing West](#), Center for American Progress website.

The degree of floodplain alteration differs substantially



All photos by
Jackie Corday

How have we restored altered/degraded streams in the past? What is process-based restoration (PBR) – Why is it different?



Classic Form Based project in Central Oregon



But the Oregon stream use to occupy the entire valley like this one in Utah

Process-based restoration (PBR) begins with an analysis of **what *caused*** the stream degradation - **approaches then focus on addressing the cause(s).**

Examples include:

- **Road BMPs** to reduce erosion/sediment loading of streams adjacent to roads
- **Removing fish barriers/dams/undersized culverts** to restore connectivity/habitat
- **Restoring wood recruitment** by restoring riparian forests – can include placement of large wood in rivers/floodplain, grazing mgt, and riparian plantings
- **Removing levees/dikes** in floodplains to restore floodplain footprint and functions
- **Low-tech PBR (LTPBR) is a sub-set of PBR** typically used to reconnect small incised streams to their floodplain by various hand-built structures made of natural materials



LTPBR methods can generally be categorized into **where** you're working

Perennial and intermittent streams

In-stream methods:

- ❖ Beaver mimicry structures, BDAs
- ❖ Post-assisted log structures, PALS
- ❖ Large woody debris, LWD
- ❖ Rock detention structures, RDSs
- ❖ Native sod speed bumps

Stream corridor methods:

- ❖ Grazing management – BMPs
- ❖ Replacing undersized culverts
- ❖ Riparian plantings

Ephemeral streams/wet meadows

Erosion gully/ headcut methods

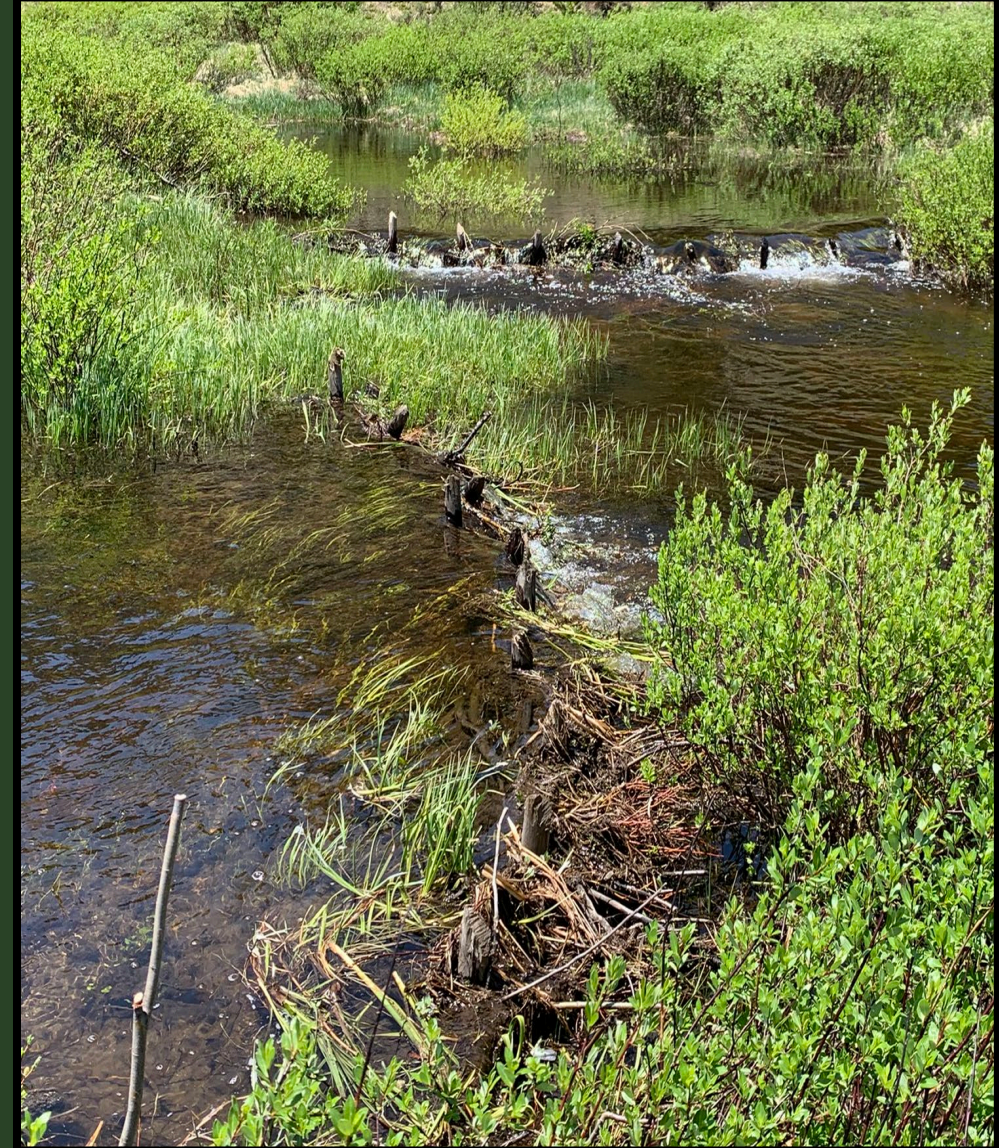
- ❖ Zeedyk rock structures
- ❖ Wicker weirs
- ❖ Grazing management



LTPBR methods in **Perennial streams**

Beaver Mimicry Structures (BMS or BDAs)

- **Goal is to reconnect the floodplain** by using natural materials to build *temporary* structures that will **slow the flow and catch sediment** such as:
 - willows, cobble, native sod
- **Designed to aggrade the stream** slowly via trapped sediment.
- **Most suitable for 1st to 4th order streams (wadable) in locations where the riverscape can be restored without constraints from infrastructure.**



Example of a Western Colorado LTPBR project that used both PALS and BMS



PALS installed July 2019



Left pic – June 2021

Right pic – June 2023

Examples of bank attached PALS

Photo courtesy of Eagle County Open Space

Photo from BioLogic



Anabranch Solutions

Channel spanning PALS in central Oregon



LWD/PALS project in Central Oregon
Anabranch Solutions



The Oregon stream use to occupy the entire valley like this one in Utah

Examples of LTPBR methods
in dryer locations –
intermittent streams where
beaver cannot survive



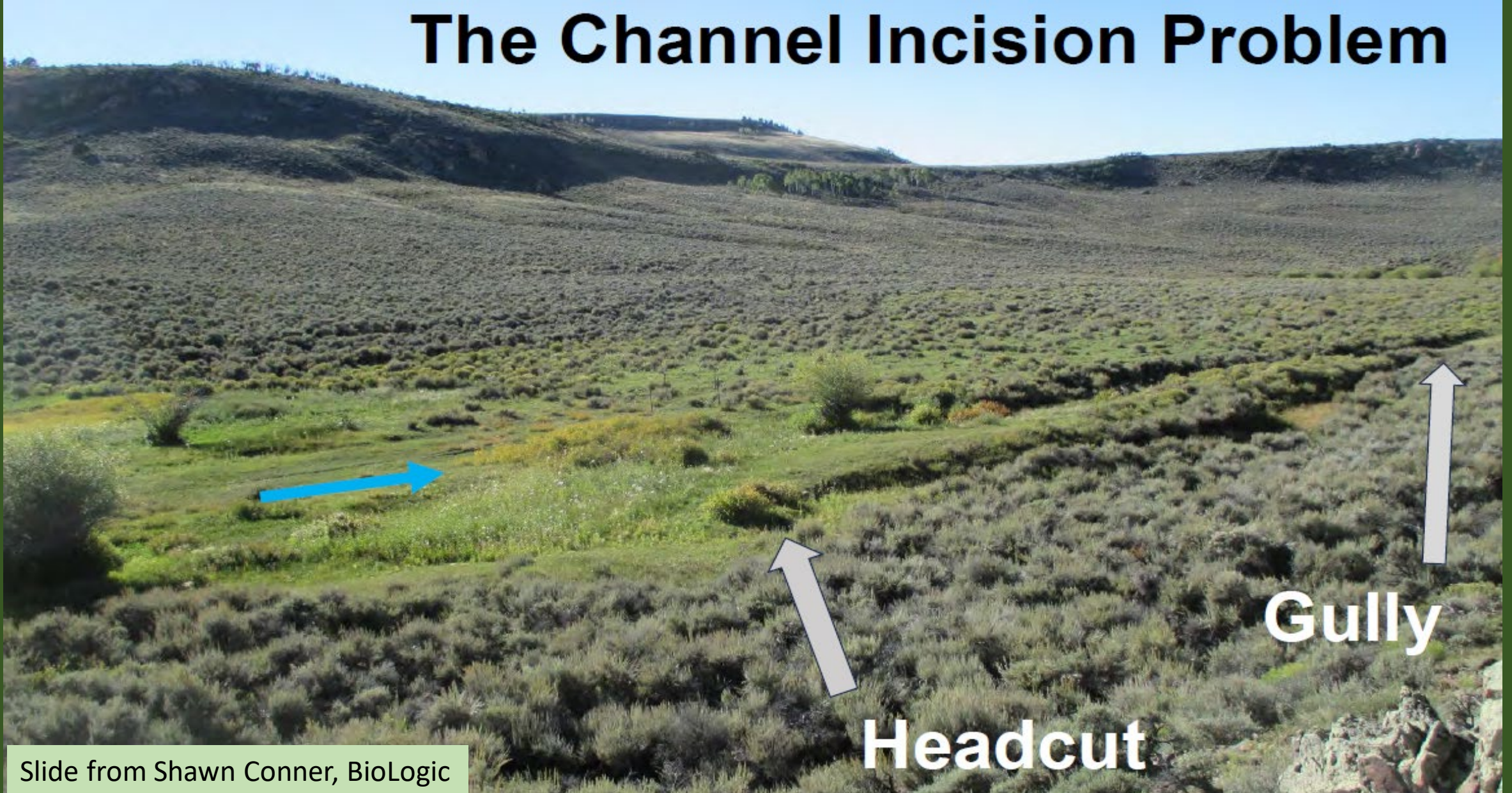
PALS in an intermittent stream



Rock Detention Structures on an
intermittent stream in SE Arizona – Photo
from USGS Research Physical Scientist Dr. Laura Norman

Ephemeral drainages/wet meadows

The Channel Incision Problem



Slide from Shawn Conner, BioLogic

Examples of Zeedyk rock work in **ephemeral streams** – stabilizing the **erosional headcuts** to keep it from destroying the critical meadow habitat



➤ **Assess the causes of the stream degradation**

➤ Sometimes both **high-tech** and **low-tech** approaches are needed.

➤ Example, stressors in this project:

- **undersized culverts** on ranch roads
- **Unmanaged grazing** eliminated riparian vegetation
- **Massive post-fire debris flows**



What are the **benefits** of restoring streams via LTPBR?

Big reason why LTPBR is catching on so fast around the west . . .

The science – numerous case studies show how effective it is for restoring *ecological* and *ecosystem services*.



Comprehensive LTPBR “state of the science” report by Jackie Corday

- ❖ LTPBR state of the science review was a deliverable for an American Rivers CWCB grant called:

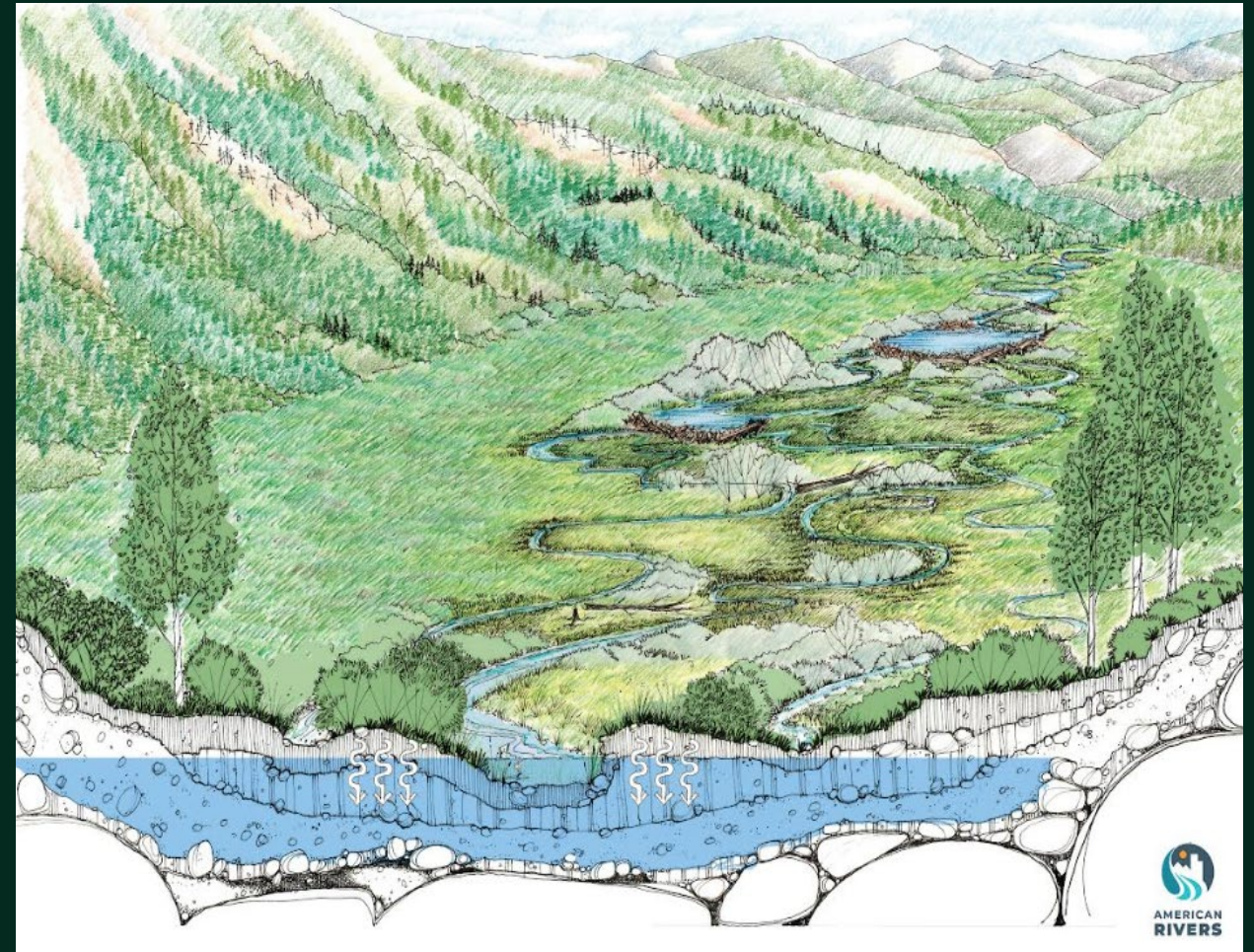
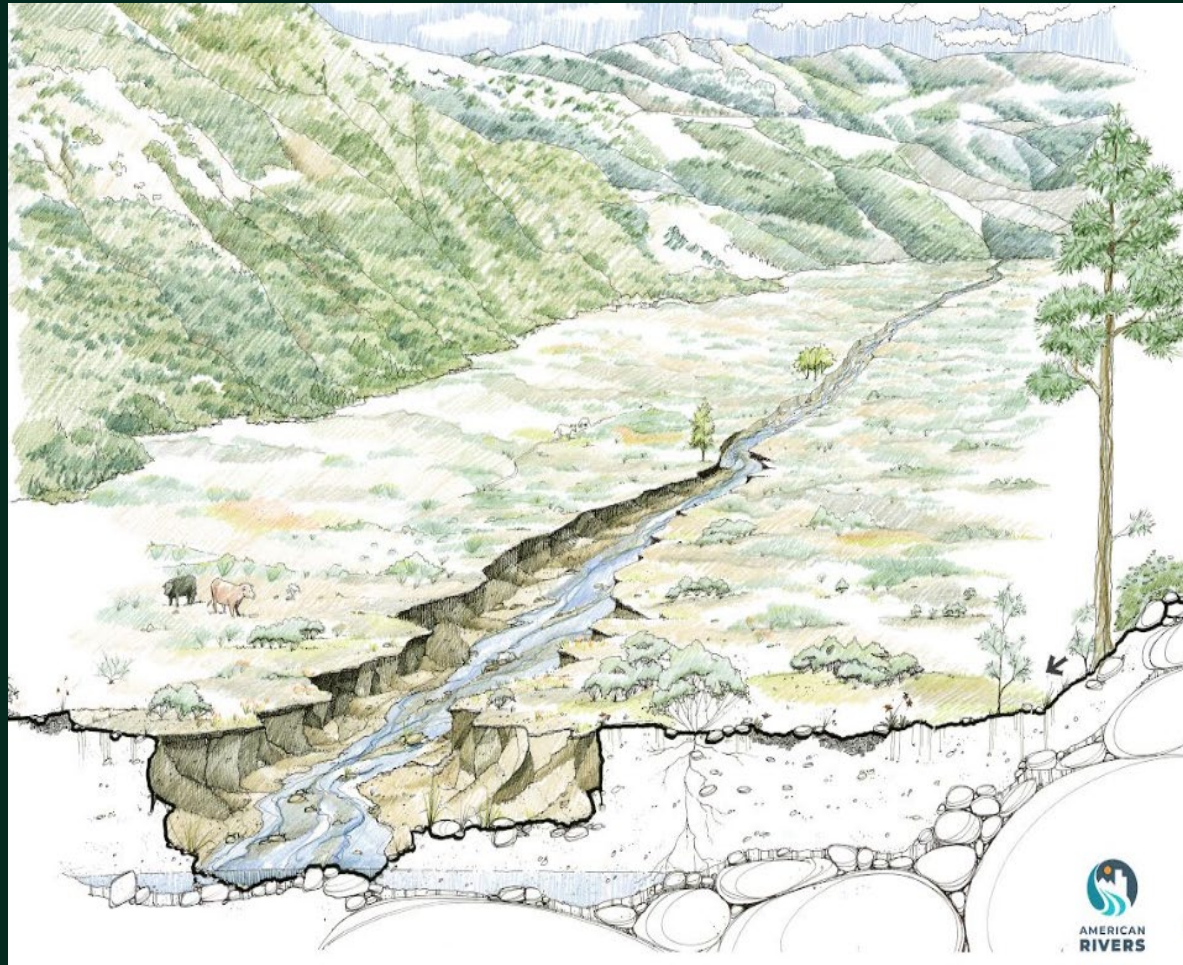
Engaging West Slope Agriculture in Headwaters Restoration to Improve Water Security

- ❖ **American Rivers website link for the paper:**
[State of the Science on Restoring Western Headwater Mountain Streams](https://www.americanrivers.org/state-of-the-science-on-restoring-western-headwater-mountain-streams)
([americanrivers.org](https://www.americanrivers.org))
- ❖ **Version 2.0** of the report is now available

Restoring Western Headwater Streams with Low-Tech Process-Based Methods: A Review of the Science and Case Study Results, Challenges, and Opportunities

Version 2.0, January 2024





The research focused on what are hydrologic, biologic, and ecosystem services effects of restoring a degraded incised stream to a healthy functioning riverscape

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Benefits of healthy headwater riverscapes with connected functioning floodplains

Ecosystem services for people and improved habitat for wildlife:

- **Increased resilience to wildfire and drought** by rewetting the soils and providing fire breaks
- **Improved water quality by reducing sedimentation** and filtering out other pollutants
- **Improved river habitat** and ecologic functioning
- **Improved availability of water and forage** for livestock and wildlife

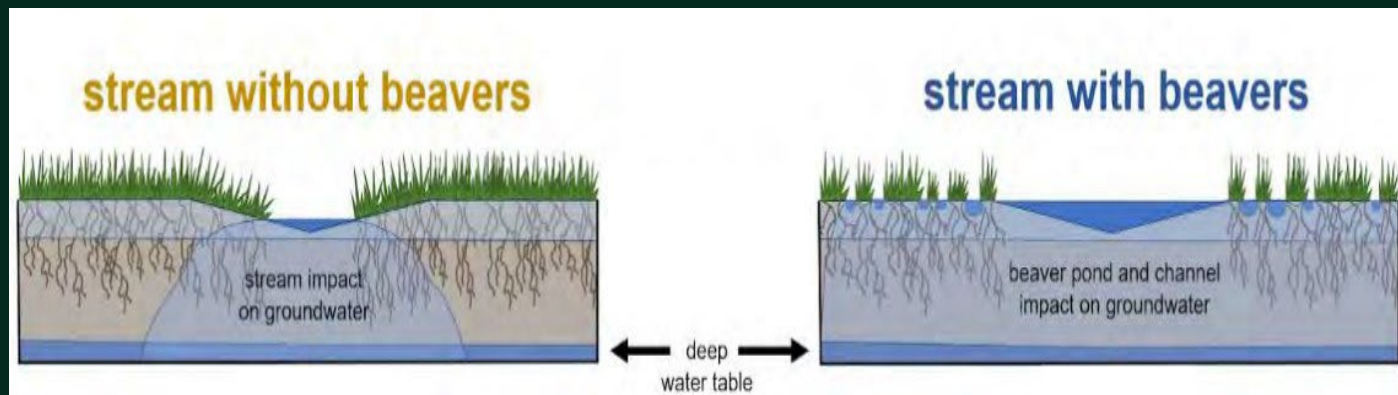


Hydrologic Effects

- **Increased surface water** – attenuation behind LTPBR structures or beaver dams and connected side channels
- **Aquifer recharge** - Attenuation of peak flows from snowpack & storms result in **higher ground water table** & greater Hyporheic exchange
- **Increased later season flows** - combo of increased surface and groundwater can result in flows lasting longer into the summer months - restoring the former natural hydrograph



Before and after photos of a LTPBR project that installed BDAs to facilitate the return of beaver to this reach of Bridge Creek in eastern Oregon, [Weber et al. \(2017\)](#).



Hydrologic effects improve Drought Resilience

Two recent PhD studies focused on **determining if restoring historic beaver populations in upper watersheds could act as a 2nd snowpack.**

Both studies concluded **beaver have the potential to increase summer water availability**, especially in rain-dominated basins.



Slide by the
Roaring
Fork
Watershed
Biodiversity
Initiative

Wildfire Resilience

Water doesn't burn. Beaver complexes are

Without Beavers

With Beavers



Photos by Dr. Joe Wheaton, Utah State University, of the 2019 Sharps Fire in Idaho

Wildfire Resilience

Oregon, Summer 2021
413,000 acres



Extensive research on this topic from Dr. Emily Fairfax

Large beaver complex survived Colorado's -2020 Cameron Peak fire

Photo: Evan Barrientos/Audubon Rockies



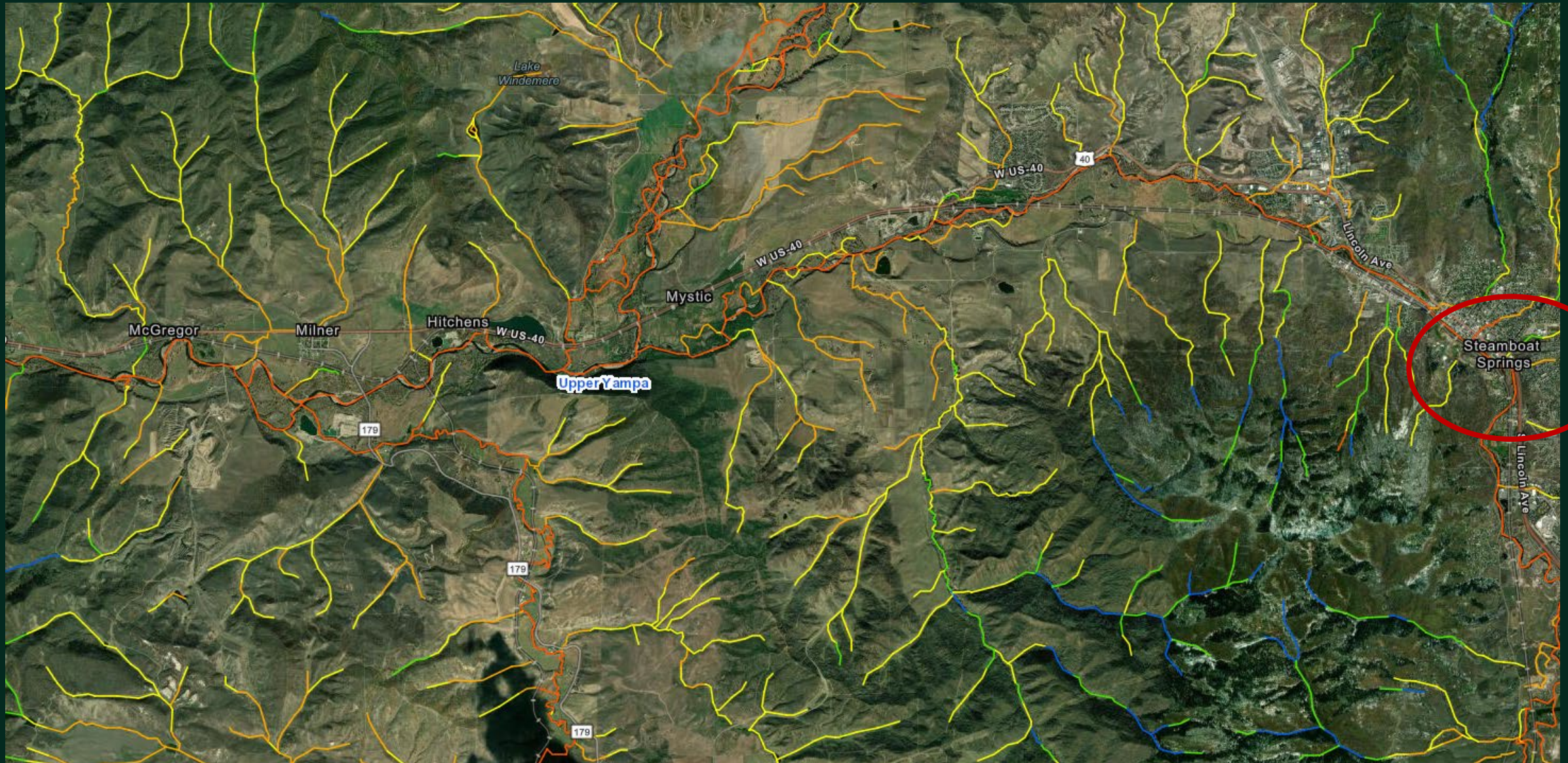
Little Beaver
Creek
after 2020
Cameron
Peak Fire
Ellen Wohl
Photo



Beaver wetland complexes used to occupy this whole valley – bottom pic shows what happened after many years of their absence.



Colorado Beaver Restoration Assessment Tool (BRAT) – CNHP Watershed Toolbox - Colorado Wetland Information Center (colostate.edu)



3rd reason “Why LTPBR” — The Economics

Large scale problems need cost effective scalable solutions

LTPBR typically costs about 1/10th the cost of traditional heavy equipment approaches per mile of restoration.

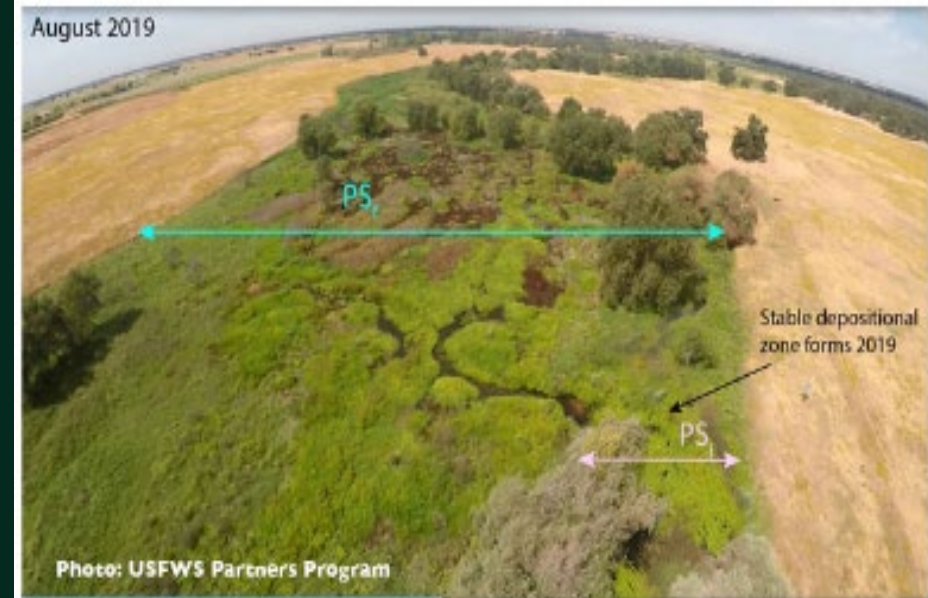


A screenshot of the Wyoming Game & Fish Department website. The header includes the department's logo, the name "WYOMING GAME & FISH DEPARTMENT", a "Sign in" button, and a search bar. Below the header are four main navigation buttons: "APPLY OR BUY" (red), "HUNTING IN WYOMING" (orange), "FISHING & BOATING" (blue), and "PUBLIC ACCESS" (green). A secondary navigation bar contains links for "NEWS", "REGIONAL OFFICES", "HABITAT", "REGULATIONS", "PERMITS", "EDUCATION", "GET INVOLVED", and "LAW ENFORCEMENT". The main content area features a large photograph of a beaver in a stream, surrounded by fallen trees and brush. Below the photo is a breadcrumb trail: "Regional Offices > Lander Region > Lander Region News > Beaver Relocations Help Everyone". At the bottom of the page, the article title "Beaver Relocations Help Everyone" is displayed in a large, bold font.

Doty Ravine Preserve, Lincoln, CA

- The Placer Land Trust needed to reduce wildfire risk of the dried out riparian corridor in the Doty Ravine Preserve.
- Options offered were to spend over \$1,000,000 with a heavy equipment approach or try LTPBR for less than \$60,000.
- The Land Trust built a series of BMSs that beaver took over, which sped up the restoration of over 60 acres with tremendous results according to USFWS biologist Damion Ciotti.
- He initially thought it would take up to 10 years to reconnect the floodplain, but it only took three with the assistance of beaver.

"It was insane, it was awesome," said Lynnette Batt, the conservation director of the Placer Land Trust. It went from dry grassland. .. to totally revegetated, trees popping up, willows, wetland plants of all types, different meandering stream channels across about 60 acres of floodplain." This California Creek Bed Was A Wildfire Risk, Then The Beavers Went To Work; <https://www.sacbee.com/news/local/article252187473.html>



Before and after: Doty Ravine Preserve in 2017 and 2019

(courtesy of USFWS)



Pause for questions

Part 2 – Water rights issues

Water Rights Law in the US – differs state by state, but strong similarities among Western States (Prior Appropriation Doctrine) and in Eastern States (Riparian Doctrine)

Today's talk focuses on the Western States



What's the Issue with PBR stream restoration & Water Rights in the Western States?

- **Process-based Restoration looks different** – it IS different than the past 30+ years of keeping streams confined to a single channel.
- This has led water users to question if such restoration can harm water rights.
- It's important to acknowledge these things, but the **science thus far shows there should not be an *assumption* of harm**. If done properly, case studies are showing LTPBR benefits people and nature.



LTPBR project on Beaver Creek west of Gunnison, CO

How are Western States approaching LTPBR and water rights issues?

States with written policy:

- **Utah** – DWR policy adopted for BDAs in Dec. 2018 – requires Division Engineer to review detailed design plans to determine if the project may harm water rights. If so, a temporary permit is needed.
- **Idaho** – DWR policy adopted for BDAs/PALS in Dec. 2019 – In short, requires project leads to contact downstream water rights holders to determine if they support the project and/or have concerns.
- **Wyoming** - DWR policy adopted for BDAs in Dec. 2018 requires a temporary permit to create up to 10 BDA “reservoirs” not to exceed a total of 20 AF.
- **Montana** – DNRC guidelines adopted in 2016 state that a water right “may” be needed if a BDA ponds more than 0.1 AF.

States with DWR letters issued:

- **California** – Cal DWR concluded that “a degraded incised stream is not natural” when faced with a complaint from a water rights holder about a PBR stream restoration project. “The Project is intended to restore a natural flow regime, and **appropriators are only entitled to divert from the natural stream flow.**”
- **Colorado** – Legislation passed in **May 2023 – SB270**, that created 6 types of Minor Stream Restoration Activities that are exempted from having to obtain a water right if all criteria are met. The [CO Healthy Headwaters Working Group](#) is offering training on how to apply the new law to projects.



GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director


Division of Water Rights

KENT L. JONES
State Engineer/Division Director

Internal Correspondence

Division of Water Rights


To: Water Rights Division Staff

From: Kent L. Jones, P.E. 
State Engineer
Director – Utah Division of Water Rights

Date: December 28, 2018

Subject: **POLICY FOR BEAVER DAM ANALOGUE (BDA) CONSTRUCTION**

With increased activity in constructing man-made, small impoundments on natural streams, often referred to as Beaver Dam Analogues (BDA), it has come to the attention of the Division of Water Rights that there is a significant concern as to the effect these BDAs are having on existing water rights. Downstream users are concerned that by impounding water with a BDA, water that flowed naturally down the stream to the water right holders is now stopped from flowing to them. Even though it is a small amount of water, it is still taking water away from the downstream users. Usually BDA projects proposes to do several of these small impoundments on the same stream which collectively add to the amount of water lost to the system. In addition, they assert that the impoundments allow water to seep into the surrounding riparian area providing water for additional vegetative growth and increased evapotranspiration. It is asserted that this would diminish the amount of water flowing to satisfy downstream water right holders and impair their water rights.

An aerial photograph of a mountain valley. A winding stream flows through a lush green meadow in the center. The surrounding hillsides are covered in a dense forest of charred, blackened trees, indicating a recent wildfire. The mountains in the background are rugged and rocky, with some green vegetation on the lower slopes.

SB23-270

Projects To Restore Natural Stream Systems - Concerning activities that restore the environmental health of natural stream systems without administration.

SPONSORS:

Sen. Roberts & Sen. Simpson
Rep. McCormick & Rep. Catlin

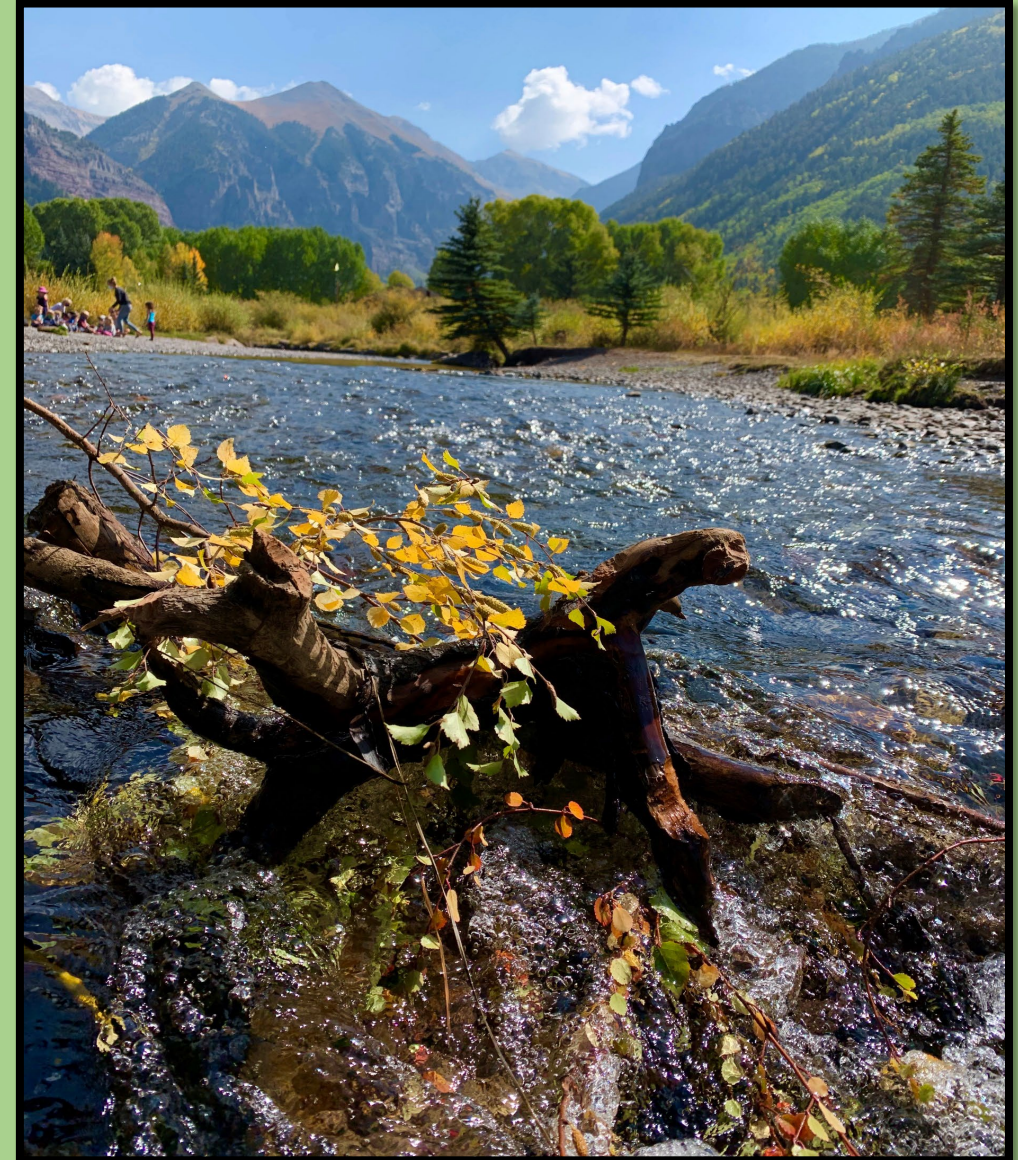
SESSION: 2023 Regular Session

<https://rockies.audubon.org/rivers/articles/beavers-offer-help-western-waters>

Photo: Evan Barrientos/Audubon Rockies

What did the bill say was the purpose/need?

- “Functioning natural streams are beneficial to all Coloradans because they **provide clean water** for farms and cities as well as broad-based public safety and **ecological services**, including:
 - Forest and watershed health;
 - Wildfire mitigation and recovery;
 - Flood safety;
 - Water Quality;
 - Recreation, and
 - Riparian and aquatic habitats”
- “The general assembly therefore declares that, because of the vast amount of benefits that natural streams provide the state's communities and environment,
the state should facilitate and encourage the commencement of projects that restore the environmental health of natural stream systems.”



The SIX MINOR STREAM RESTORATION ACTIVITIES UNDER SB270 that can proceed without being subject to water rights administration

1	Stabilizing the banks or substrate	“Natural stream” – perennial streams	allow water flow downstream	<u>don't</u> cause the water level to exceed the OHWM	incidental increase of surface area
2	Mechanical grading along	“ Natural stream system ”	no ground water exposure	no diversion of surface water	no collection of storm water
3	Stabilizing banks and substrate	Ephemeral or intermittent stream	deformable porous structures	may incidentally and temporarily	increase surface area or infiltration
4	Daylighting	Natural Stream	that has been piped or buried		
5	Reducing the surface area	Natural stream	to address reductions in historical flow amounts		
6	Installing structures or reconstructing a channel	Natural stream system	Recovery from impacts of fire or flood	emergency	

What is OHWM? Under Section 404 of the Clean Water Act, the OHWM defines the lateral limits of Federal jurisdiction over non-tidal Waters of the US (WOTUS), in the absence of adjacent wetlands.

- “that **line on the shore established by the fluctuations of water** and
- indicated by **physical characteristics** such as:
 - [a] clear, natural line impressed on the bank, shelving,
 - changes in the character of soil,
 - destruction of terrestrial **vegetation**,
 - the presence of litter and debris, or
- other appropriate means that consider the characteristics of the surrounding areas.”

A common description of the OHWM equates it to “the mark left by **average peak flow over multiple years.**”



US Army Corps
of Engineers®
Engineer Research and
Development Center



Wetlands Regulatory Assistance Program (WRAP)

National Ordinary High Water Mark Field Delineation Manual for Rivers and Streams

Interim Version

Gabrielle C. L. David, Ken M. Fritz, Tracie-Lynn Nadeau, Brian
J. Topping, Aaron O. Allen, Patrick H. Trier, Steven L.
Kichefski, L. Allan James, Ellen Wohl, and Daniel Hamill

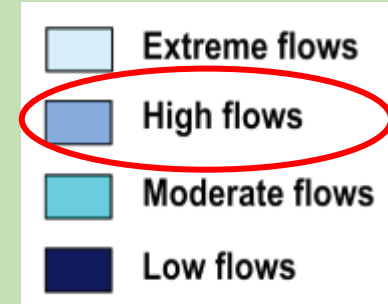
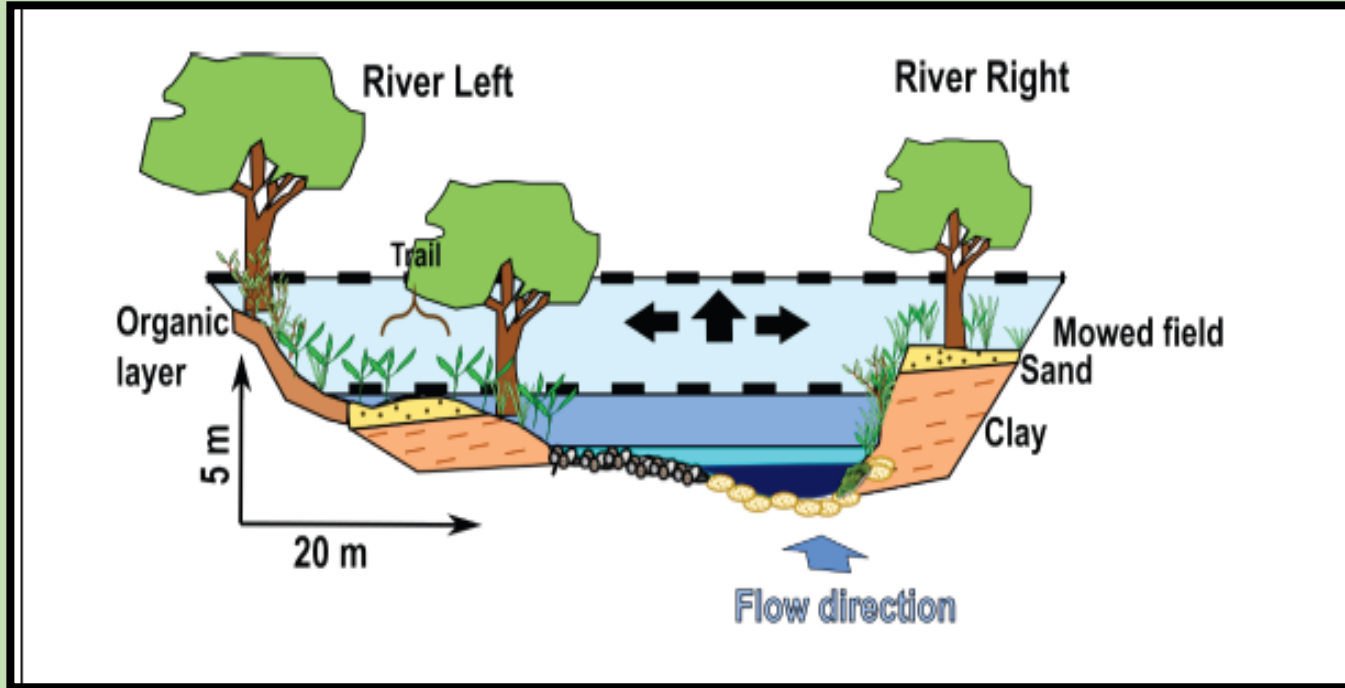
November 2022



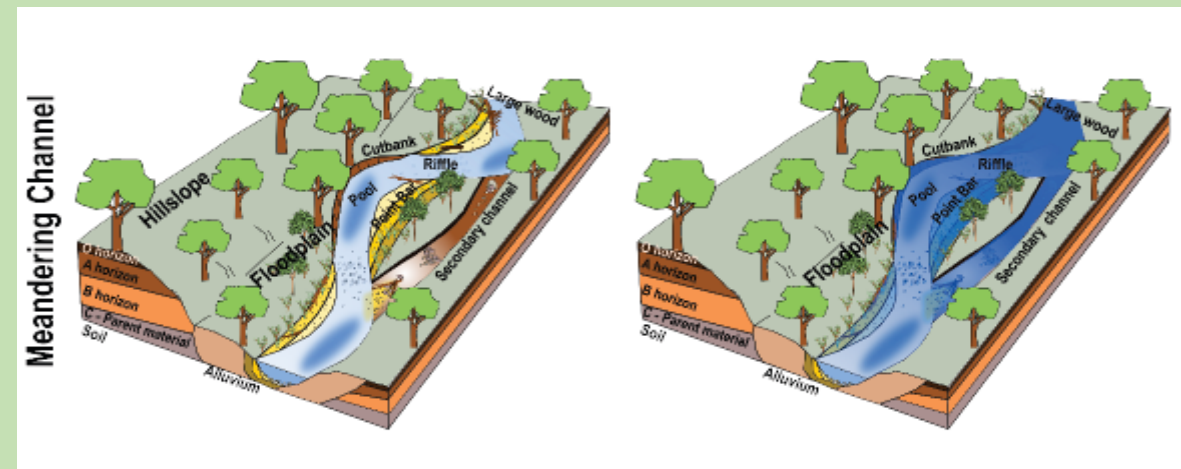
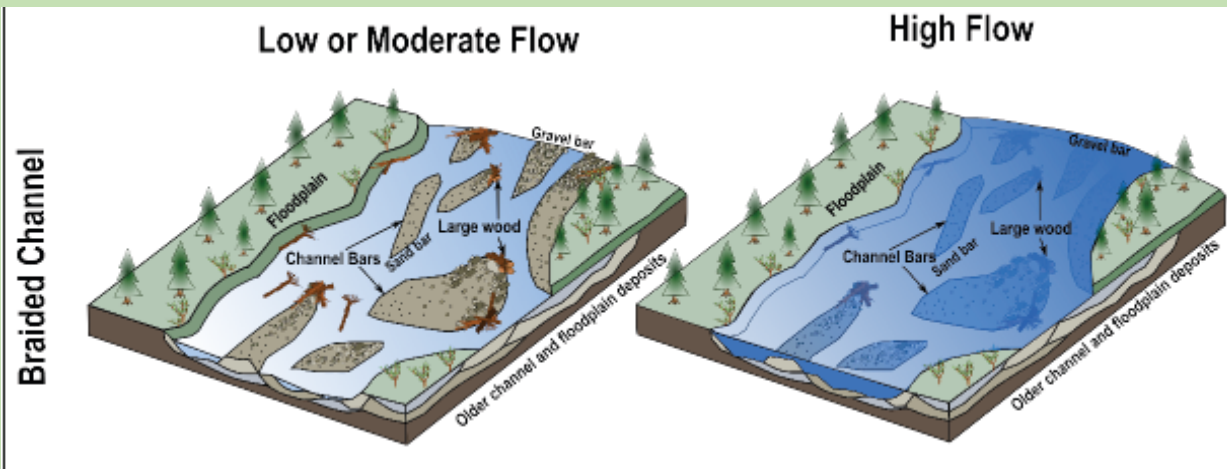
Cold Regions Research
and Engineering Laboratory

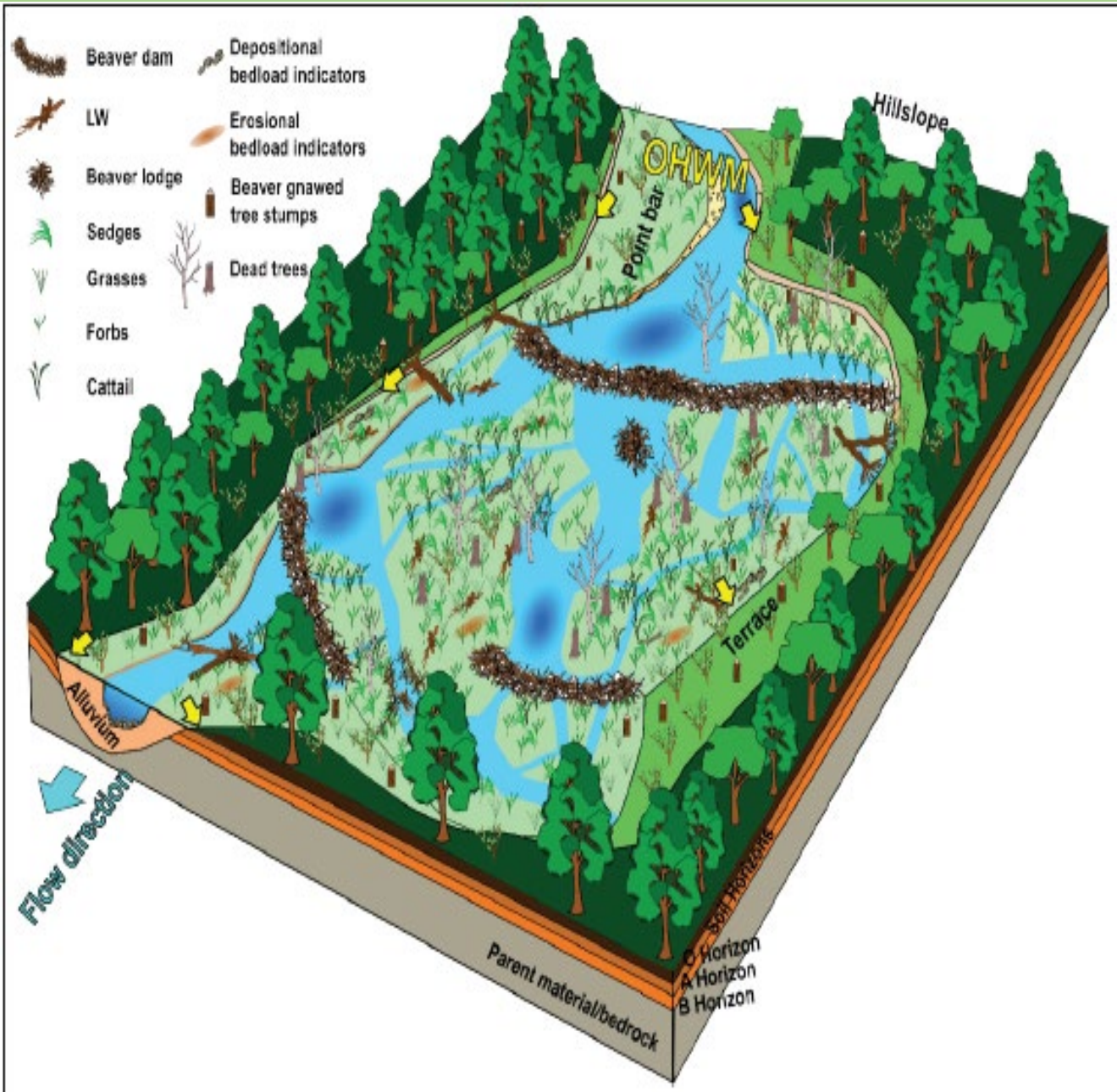
ERDC/CRREL TR-22-26

Graphics & quote from USACE OHWM MANUAL Nov. 2022



“Despite being used as a regulatory boundary for over a century, the federal definition of OHWM does not refer to a specific frequency of high water.”





On-channel beaver complex
"In this schematic, the OHWM would be delineated at the edge of the flood-plain."



Quote & graphic from the USACE OHWM MANUAL Nov. 2022, pg 301

Fish Creek, Wyoming Range, south of Jackson, photo by Chris Hunt [Ward, let's talk about the beaver | Hatch Magazine - Fly Fishing, etc.](#)

Utah restoration project – but this creek is similar to many Western streams



- PALS
- Historic extent of the riverscape
- OHWM? Not easy to tell in the photo

Where is the OHWM in these degraded incised streams?

Down in the trench, not the natural condition of where it was before the degradation occurred.



“

The OHWM is not a static line and can change over both time and space.

”

The SIX MINOR STREAM RESTORATION ACTIVITIES UNDER SB270 that can proceed without being subject to water rights administration

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(F) INSTALLING STRUCTURES OR RECONSTRUCTING A CHANNEL IN A NATURAL STREAM SYSTEM FOR THE SOLE PURPOSE OF RECOVERY FROM THE IMPACTS OF A WILDLAND FIRE OR FLOOD EMERGENCY.



- This provision provides huge opportunities to do LTPBR work post fire and flooding.
- *Natural stream system* is key here
- NO constraints of OHWM or “incidental increase in surface area”
- “Emergency” is not defined, but lots of examples in CO that substantial wildfire impacts to water supplies last for 5+ years

Wildlands Restoration Volunteers

2023 project in the Cameron Peak burn area

— structures will help capture sediment, reduce the force of high velocity runoff from monsoons and next year's snow melt, which will reduce further erosion/downcutting and improve water quality



Photos from WRV

Coalition for the Poudre River

Cameron Peak Fire Recovery work to improve water quality and riparian health and to reduce flood risk

Methods aimed at reducing erosion and post-fire debris flows:

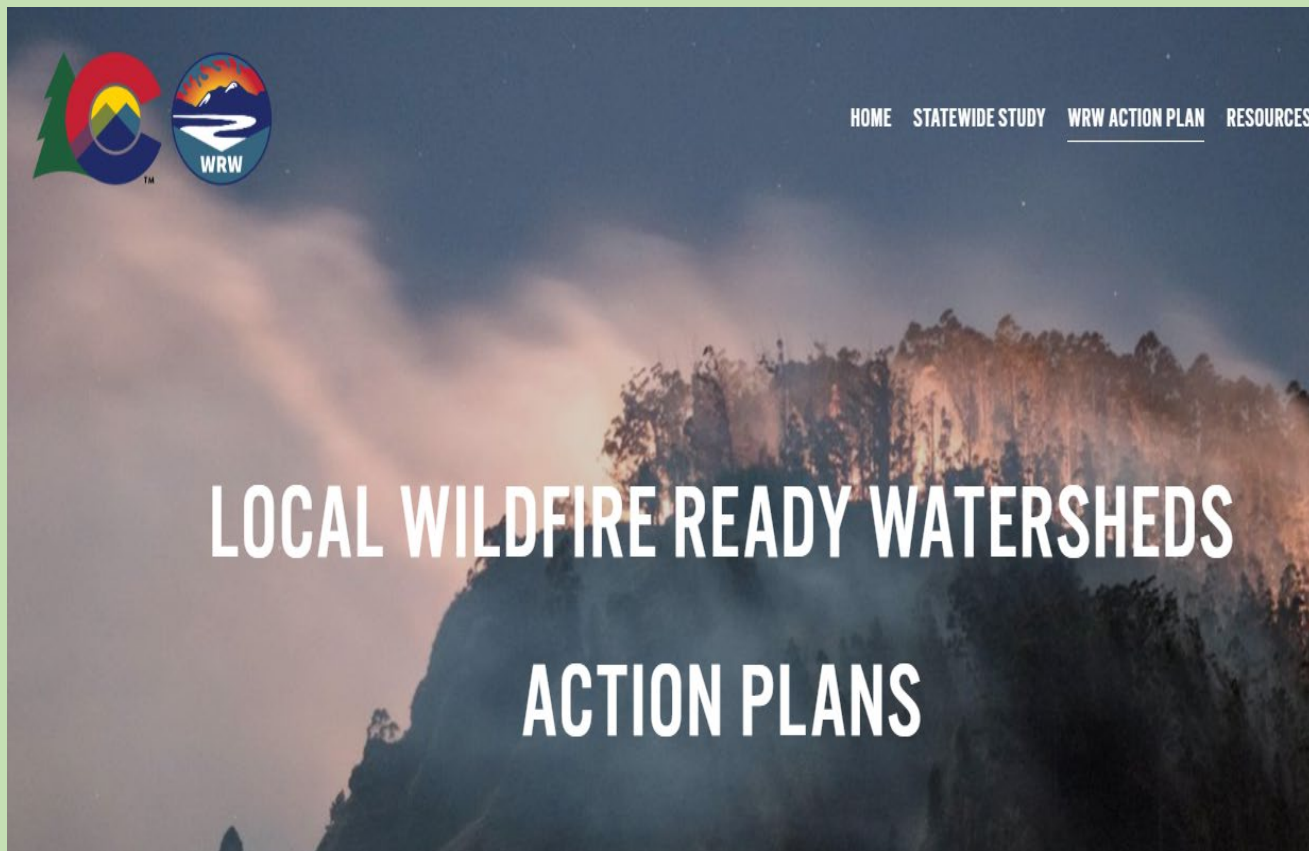
- Creating log jams
- Felling trees into streams and nearby floodplain
- Zeedyk rock structures
- Willow/riparian vegetation staking
- PALS

All of these methods can fit within Minor Restoration Activities (F)



Volunteers work to install a post-assisted log structure (PALS). PALS provide opportunity for sediment storage behind the structures while promoting floodplain connectivity, additional wood recruitment, and riparian health.

What about taking actions **BEFORE** the fire happens that can lessen damaging post-fire debris flows?



- **Wildfire Ready Watersheds Program** created by CWCB to implement the directives in SB21-240
- **Main goal** – “assist communities in **planning** and **implementing mitigation strategies** to minimize these [fire] impacts.”
- **Grants** available from CWCB to prepare and implement WRW Action Plans – reach out to Chris Sturm to learn more

<https://www.wildfirereadywatersheds.com/>



Pause for Questions

Part 3 – How to reduce risks of LTPBR projects
- downstream water rights

Start with very low risk project types –

- rangeland wet meadow gully erosion work
- 1st & 2nd order small streams far from any diversion structures



Our Suggestions for Best Management Practices **under** SB270



- **Early Conversation** - discuss with your partners the project goals – how they can or cannot be met within SB270
 - **Choose the appropriate Minor Stream Restoration Activity** based on where you're working (pre or post fire, perennial, intermittent, ephemeral stream)
- **Document *prior* to project commencement:**
 - Baseline conditions – stream system type, photo points of stream corridor during high and low flows if possible, OHWM, flows if stream gage or other measuring device is available
 - Best estimate of how proposed restoration methods and project design will conform to SB270 criteria
- **Consider consulting with DWR to review your** proposed project for the SB270 criteria ***before*** project installation
- **Document project results after installation** related to the SB270 criteria

Project Planning Considerations to reduce risk of potential water rights concerns (and other potential conflicts):

- **Historical Footprint** – design project to stay within it
- **Choose these factors with care:**
 - **Location** – look for opportunities/places that minimize risk of conflicts with water rights and flooding from beavers –e.g. upper watersheds above reservoirs/diversions, partnering with Sr. water right landowners
 - **LTPBR method/design** – beaver mimicry-type structures should mimic naturally occurring beaver dams that are porous, temporary/deformable, and made of natural materials that allow base flow and fish passage through, under, and around.
 - **Timing of installation** – be careful during low-flow summer months – you don't want your project to reduce flows downstream of your project for any significant time (1 day can be significant)
- **Engagement, transparency, many partners** – who would potentially be concerned? Include them or at least address their concerns; project planning that proactively includes water users and other watershed stakeholders who would potentially be concerned has many benefits.
- **Post project considerations** –
 - **Adaptive mgt** – what worked, what didn't, opportunities to apply lessons learned
 - **Monitoring changes** – hydrology/flows/surface area, vegetation condition, sediment capture, plant and animal species diversity
 - **Assist landowners with beaver coexistence** issues or other post project aspects if needed



Photo from Shawn Conner, BioLogic

Slide from Colorado Healthy Headwaters Working Group