BUILDING ECOSYSTEM RESILIENCY WITH LOW-TECH PROCESS-BASED RESTORATION

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MONTANA LAKES CONFERENCE
EMERGING ISSUES IN LAKE SCIENCE AND MANAGEMENT

MONTANA LAKES CONFERENCE
OCTOBER 19-20, 2023

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ROADMAP

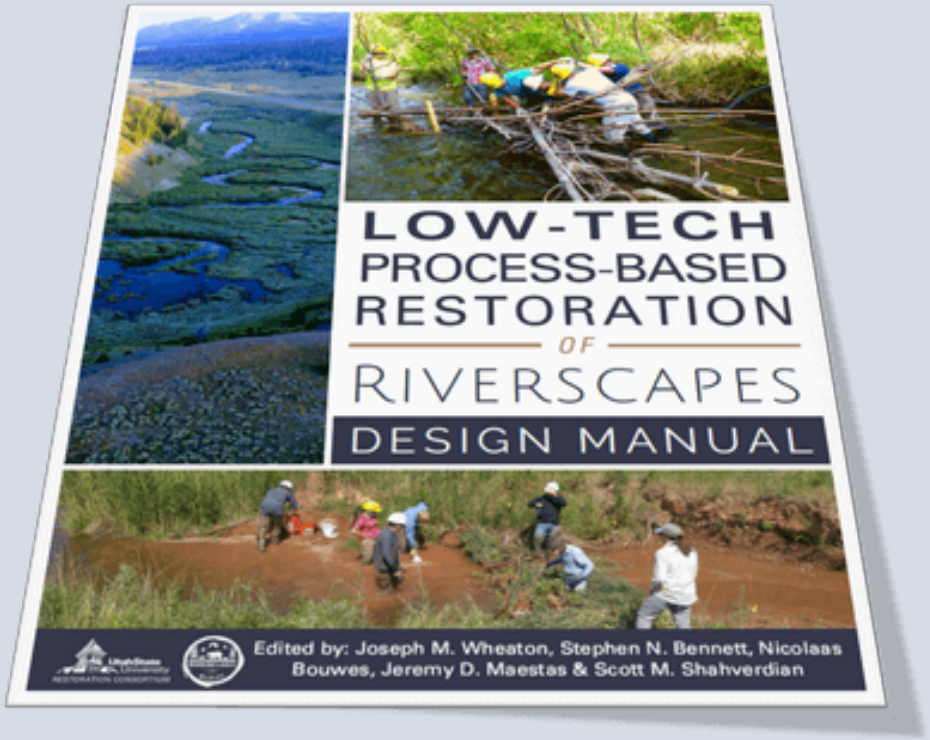
- WHAT IS LTPBR?
- WHY EMULATE BEAVERS?
- MONTANA CASE STUDY
- DESIGN PROCESS
- WIDESPREAD APPLICATIONS
- WATERSHED BENEFITS

SOURCE: BOX 2020

WHAT IS LTPBR?

Low-Tech Process-Based Restoration

- **Low-tech** = cost-effective, minimal engineering, hand-built, and sometimes short design life-span.
- **Process-based** = Utilize hydrologic, geomorphic, and biological processes to repair ecosystems and encourage potential to **self-sustain**.
- LTPBR excellent for systems that lack **structural complexity,** historically, this was achieved in many systems through beaver dam complexes.

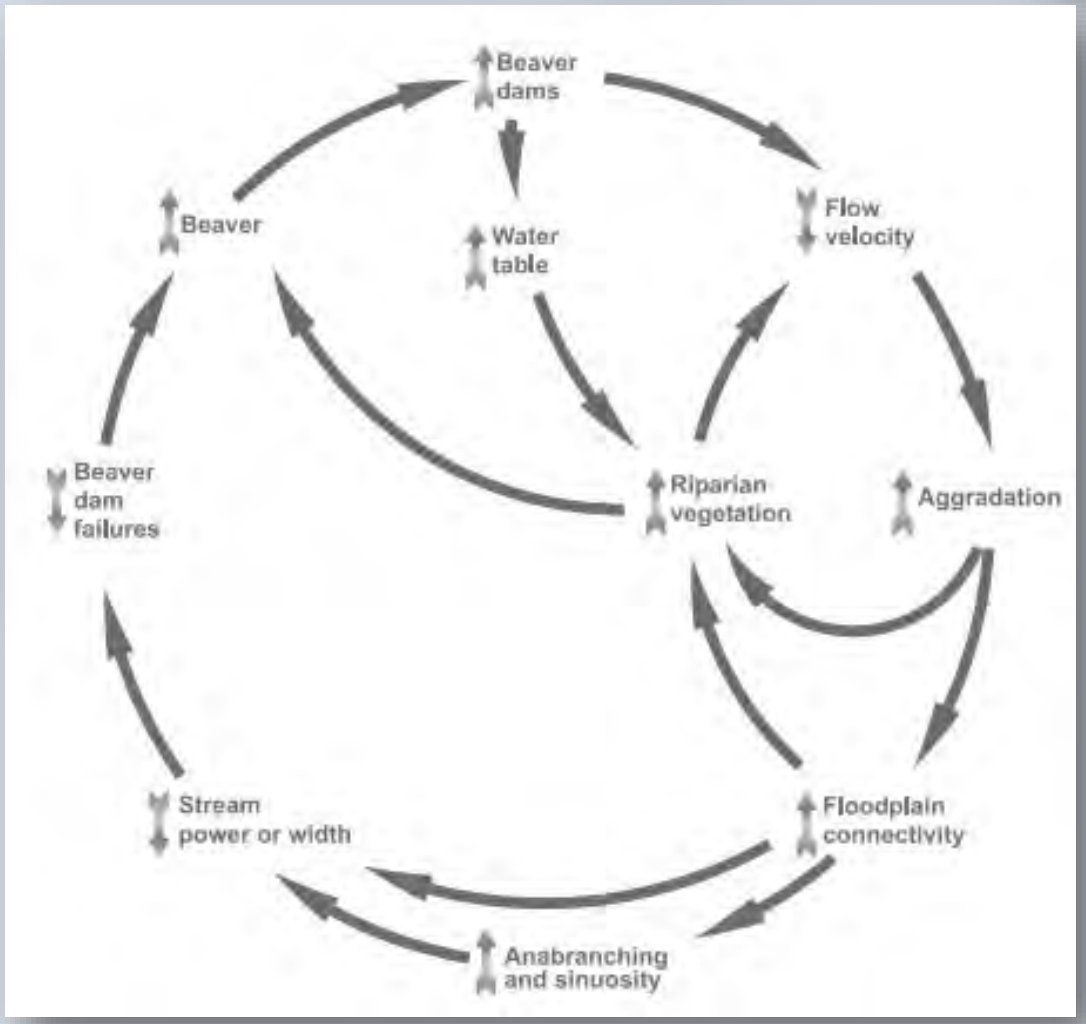


"Structural-starvation of wood and beaver dams in riverscapes is one of the most common impairments affecting riverscape health." (Wheaton et al 2019).

BEAVER FEEDBACK LOOP

WHY EMULATE BEAVERS?

BEAVERS ARE ECOSYSTEM ENGINEERS – CREATE AND MAINTAIN MICROHABITATS



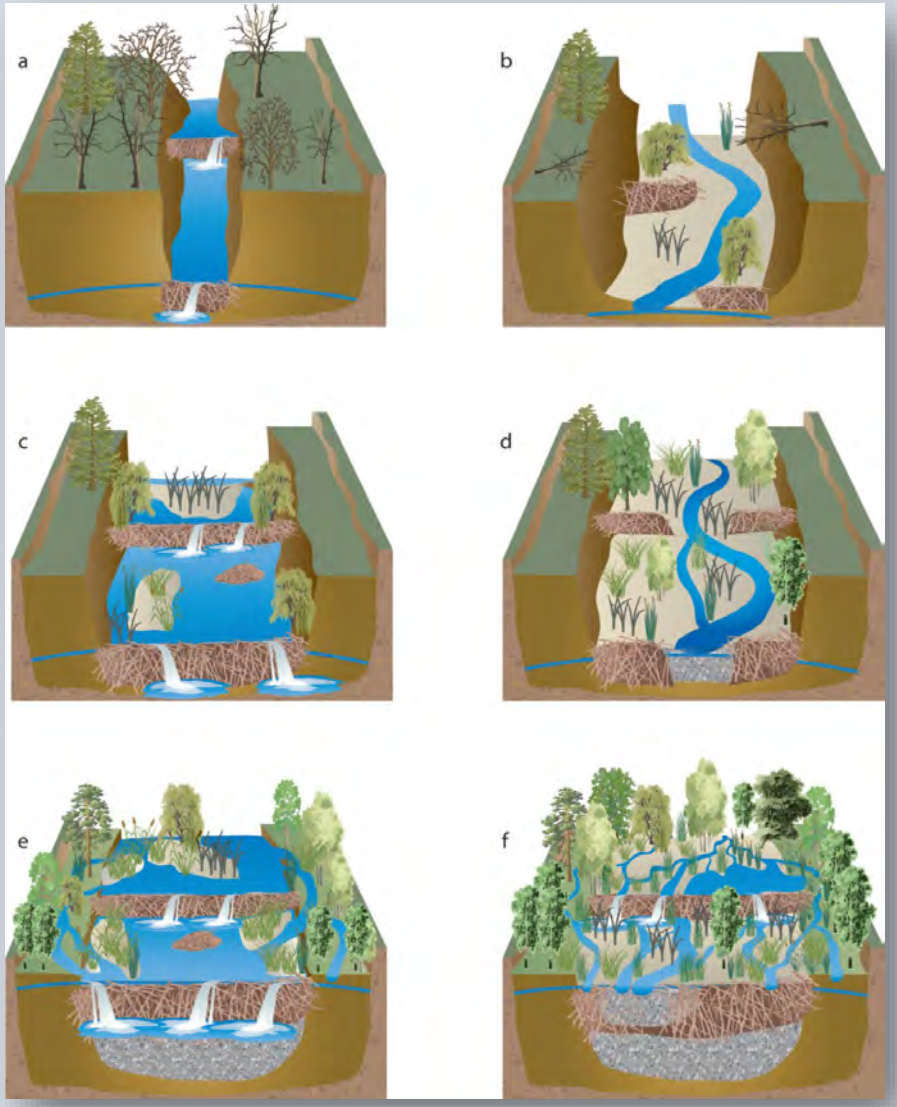
SOURCE: POLLOCK ET AL. 2014

PROCESS IN ACTION

a) Dams constructed in incised channel→ **backwater**

b) Altered hydraulics impacts geomorphic processes → **aggradation**

c) Vegetation establishes, water disperses over floodplain



SOURCE: POLLOCK ET AL. 2014

d) More vegetation is established, new flow paths form → **anabranching**

e) Water table is raised and river is reconnected to historic floodplain

f) Never-ending feedback loop → **dynamic equilibrium** is restored!

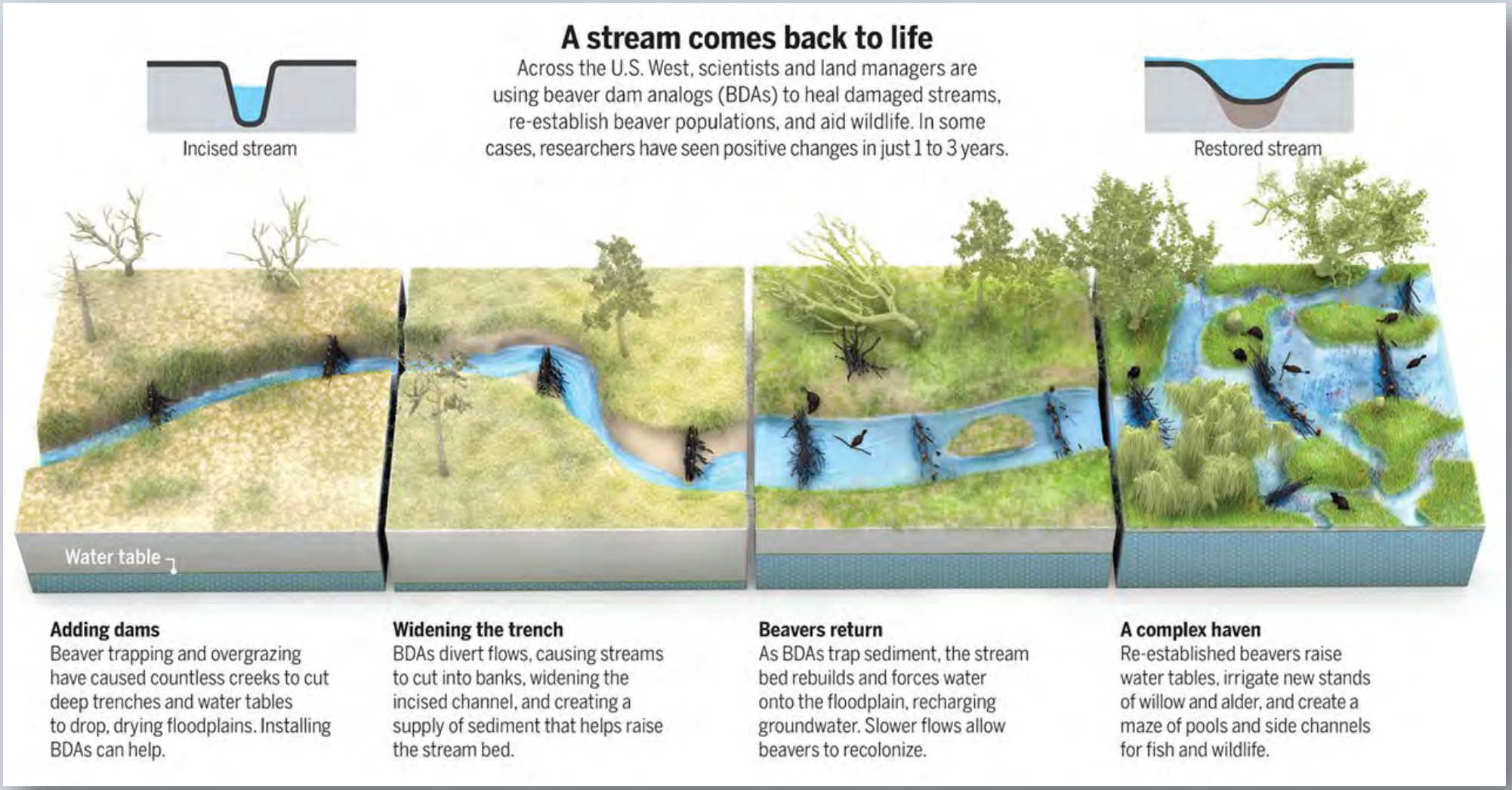
PROCESS IN ACTION

"Our cultural ideal of the stream as a thin blue line is so different from the streams where beavers live: wide and sinuous, with irregular emergent zones."

SOURCE: PASSMORE, 2019.

FIRE RESILIENCE

THE BDA EFFECT



SOURCE: GOLDFARB 2018B

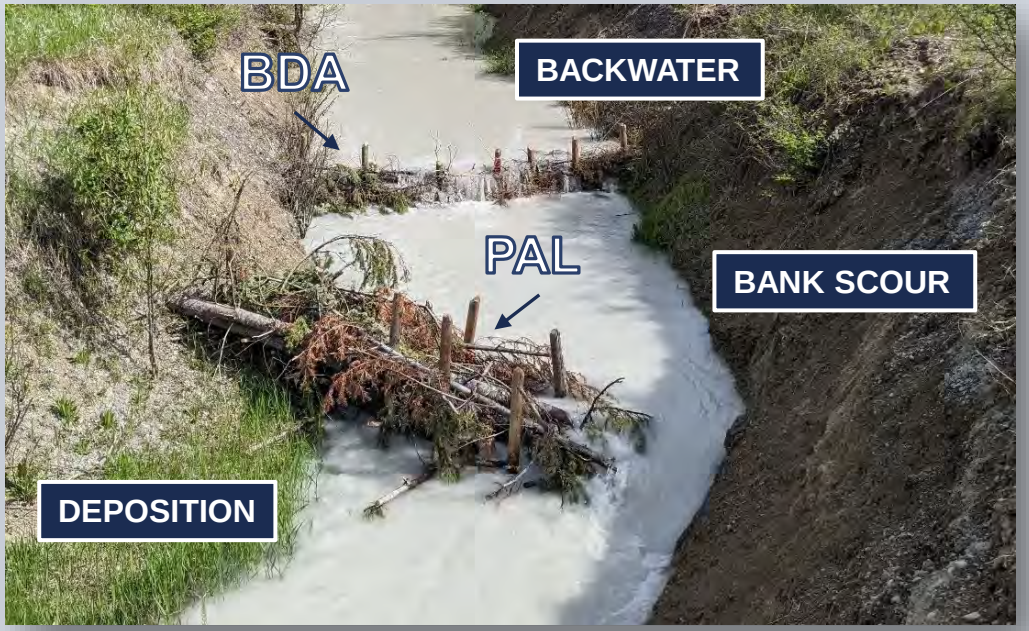
LTPBR STRUCTURES

- **PALS (POST-ASSISTED LOG STRUCTURES)**

  → Mimic natural wood accumulation
  → Alternative to large wood structures

- **BDAS (BEAVER DAM ANALOGUES)**

  → Mimic beaver activity
  → Alternative to traditional grade control structures



KRAUSE CREEK, SOURCE: RICHARDSON 2022

APPLICATION: TETON SPRING CREEK

MONTANA FRESHWATER PARTNERS

- **PROJECT LOCATION:** 737-acre ranch outside of Choteau, Montana
- **PARTNER:** Montana Freshwater Partners
- **IMPAIRMENTS:** Vegetative cover, flow, temperature, and water quality
- **FUNDING SOURCE(S):** Section 319
- **SOURCE OF DEGRADATION:** Cattle and other anthropogenic influences → incision, widening, and loss of vegetation

RESTORATION APPROACH

OBJECTIVES:

- Improve floodplain connection
- Enhance riparian function
- Promote geomorphic “stability” (reduce incision)
- Increase habitat diversity
- Improve water quality

RESTORATION ACTIONS:

- Construct beaver dam analog structures (BDAs)
- Remove small berm located within floodplain
- Install Cottonwood browse protectors

DESIGN PROCESS

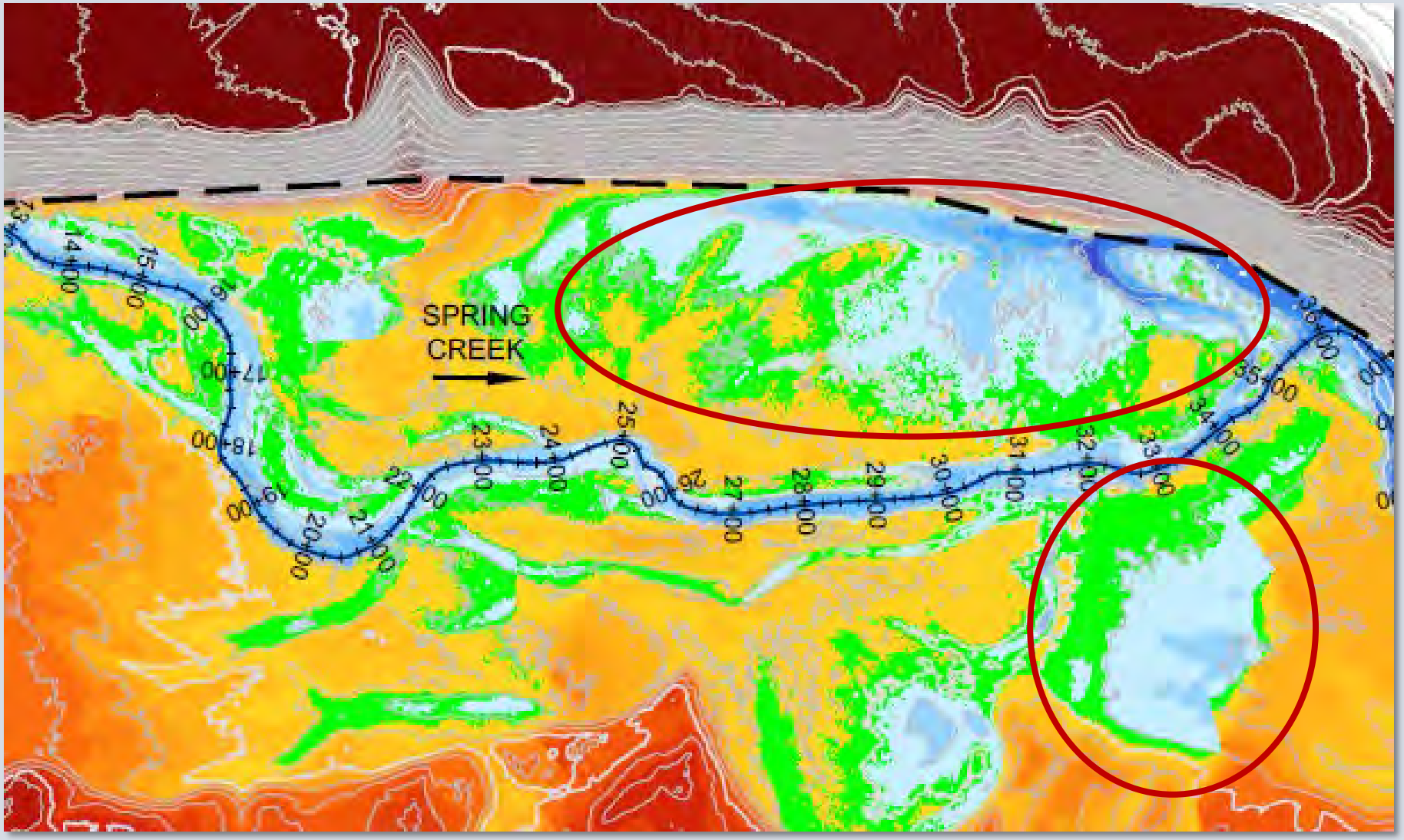
1) Assess floodplain connectivity

2) BDA structure placement based on slope and topography

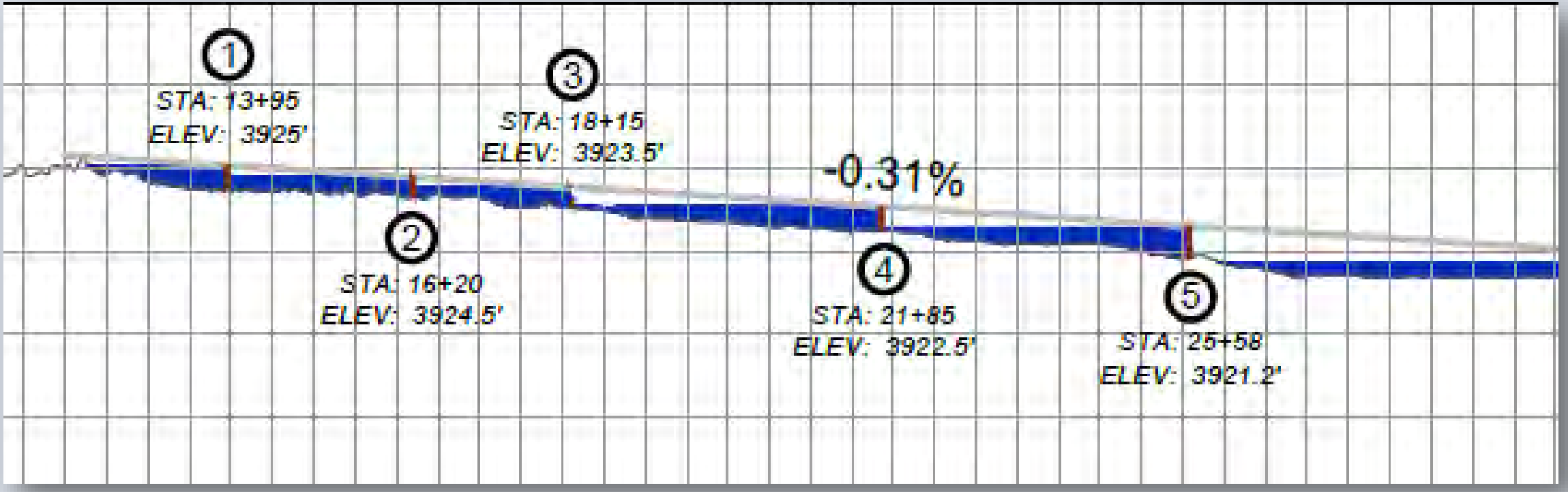
3) Establish height of structure

4) Examine resulting hydrology (i.e. area of influence and inundation) and iterate

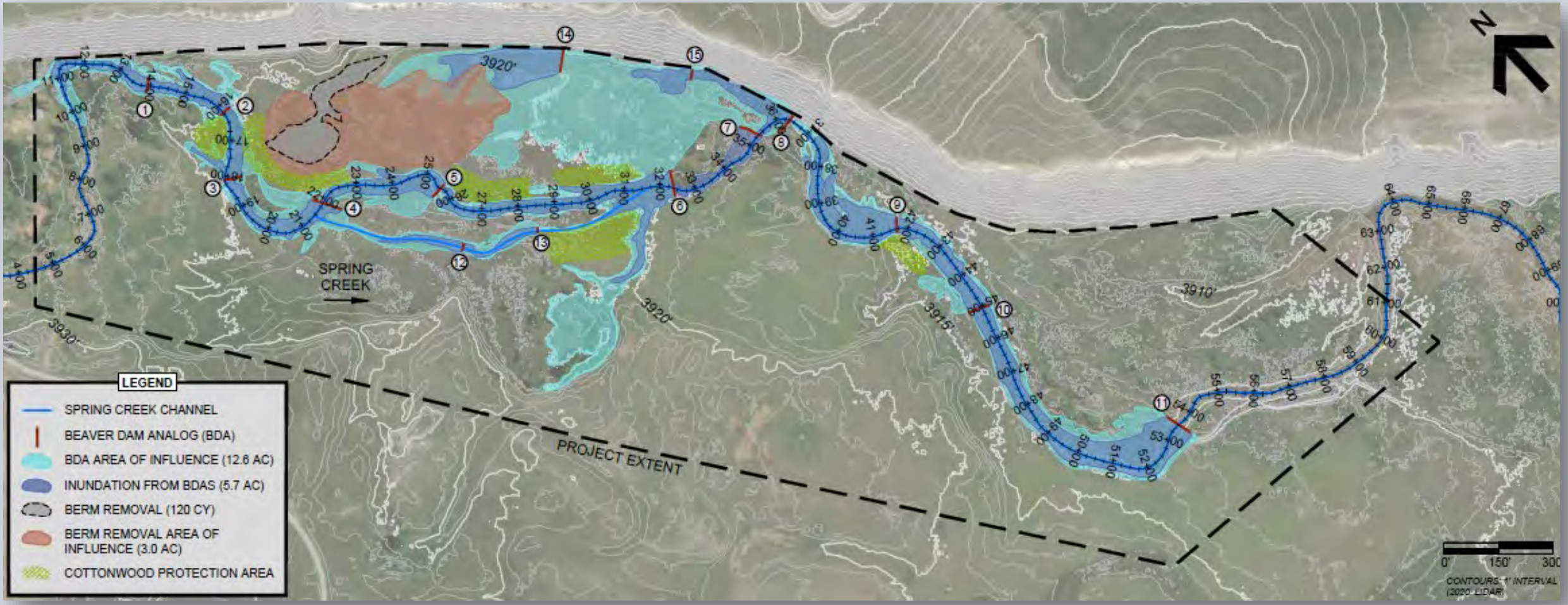
RELATIVE ELEVATION MAP



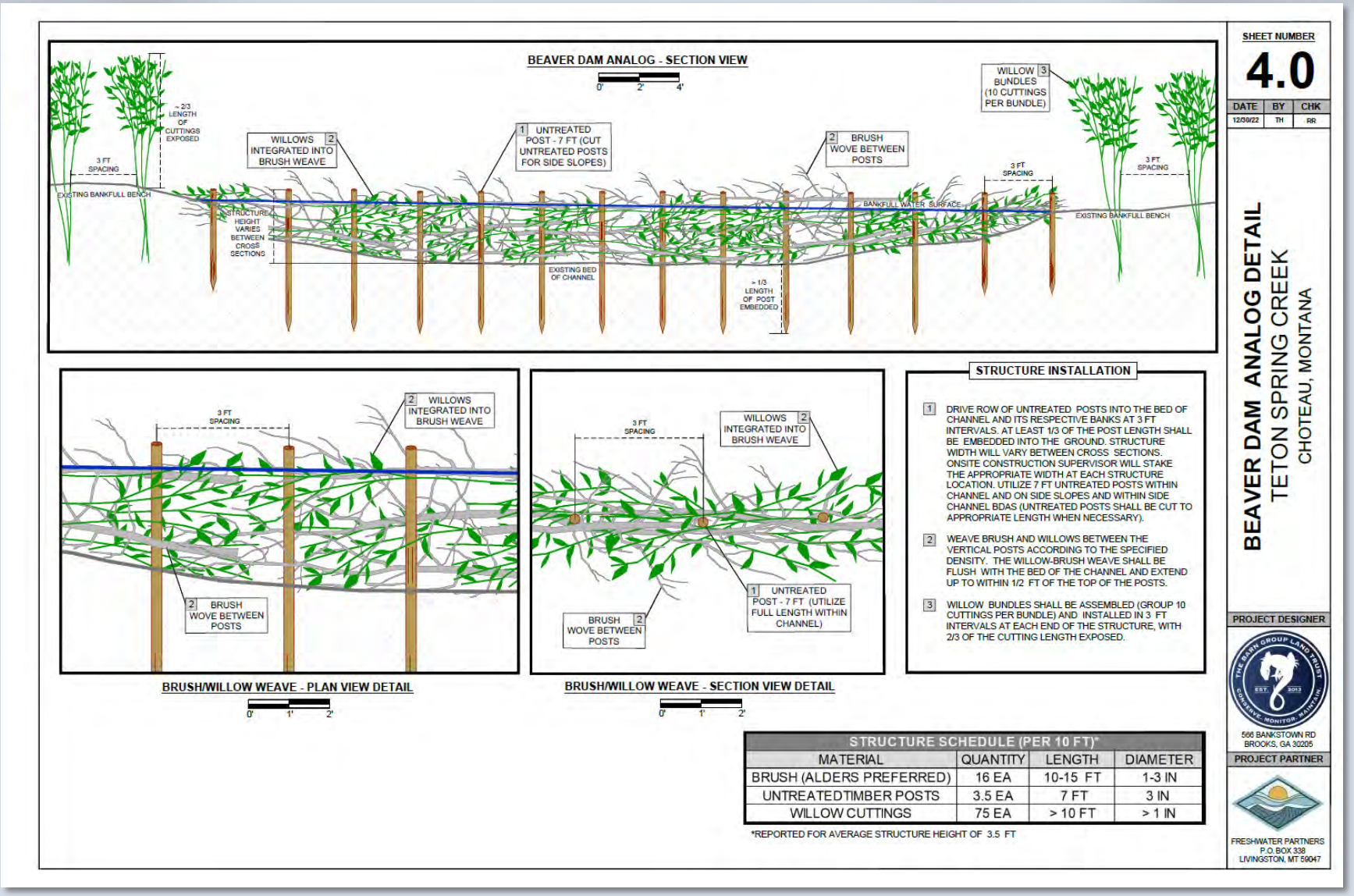
STRUCTURE PLACEMENT



ESTIMATING HYDROLOGY



STRUCTURE DETAIL



STRUCTURE INSTALLATION

1. DRIVE ROW OF UNTREATED POSTS INTO THE BED OF CHANNEL AND ITS RESPECTIVE BANKS AT 3 FT INTERVALS. AT LEAST 1/3 OF THE POST LENGTH SHALL BE EMBEDDED INTO THE GROUND. STRUCTURE WIDTH WILL VARY BETWEEN CROSS SECTIONS. ONSITE CONSTRUCTION SUPERVISOR WILL STAKE THE APPROPRIATE WIDTH AT EACH STRUCTURE LOCATION. UTILIZE 7 FT UNTREATED POSTS WITHIN CHANNEL AND ON SIDE SLOPES AND WITHIN SIDE CHANNEL BDAS (UNTREATED POSTS SHALL BE CUT TO APPROPRIATE LENGTH WHEN NECESSARY).
2. WEAVE BRUSH AND WILLOWS BETWEEN THE VERTICAL POSTS ACCORDING TO THE SPECIFIED DENSITY. THE WILLOW-BRUSH WEAVE SHALL BE FLUSH WITH THE BED OF THE CHANNEL AND EXTEND UP TO WITHIN 1/2 FT OF THE TOP OF THE POSTS.
3. WILLOW BUNDLES SHALL BE ASSEMBLED (GROUP 10 CUTTINGS PER BUNDLE) AND INSTALLED IN 3 FT INTERVALS AT EACH END OF THE STRUCTURE, WITH 2/3 OF THE CUTTING LENGTH EXPOSED.

STRUCTURE SCHEDULE (PER 10 FT)*

MATERIAL	QUANTITY	LENGTH	DIAMETER
BRUSH (ALDERS PREFERRED)	16 EA	10-15 FT	1-3 IN
UNTREATEDTIMBER POSTS	3.5 EA	7 FT	3 IN
WILLOW CUTTINGS	75 EA	> 10 FT	> 1 IN

*REPORTED FOR AVERAGE STRUCTURE HEIGHT OF 3.5 FT

SHEET NUMBER
4.0

DATE	BY	CHK
12/30/22	TH	RR

BEAVER DAM ANALOG DETAIL
TETON SPRING CREEK
CHOTEAU, MONTANA

PROJECT DESIGNER

566 BANKSTOWN RD
BROOKS, GA 30205

PROJECT PARTNER

FRESHWATER PARTNERS
P.O. BOX 338
LIVINGSTON, MT 59047

WIDESPREAD APPLICATIONS

- **Pacific Northwest** (*Methow River*)
- **Northern Rockies** - Ditched and Heavily Grazed Streams (*Teton Spring Creek*)
- **Sagebrush Steppe / Arid Riverscapes** (*Wyoming/Utah*)

SOURCE: PASSMORE 2019

WATERSHED BENEFITS

Through reestablishment of natural processes, ecological function is restored → bolstering ecosystem resiliency through:

- **Increased water storage**
- **Improvements in water quality (i.e., reduction in erosion, drop in temperatures, sediment and nutrient retention)**
- **Floodplain reconnection**
- **Increased biodiversity / habitat complexity**
- **Fire Resiliency**


QUESTIONS?
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