Using Beaver to Restore Streams-

The State of the Art and the Science

Beta Version 2.12.15

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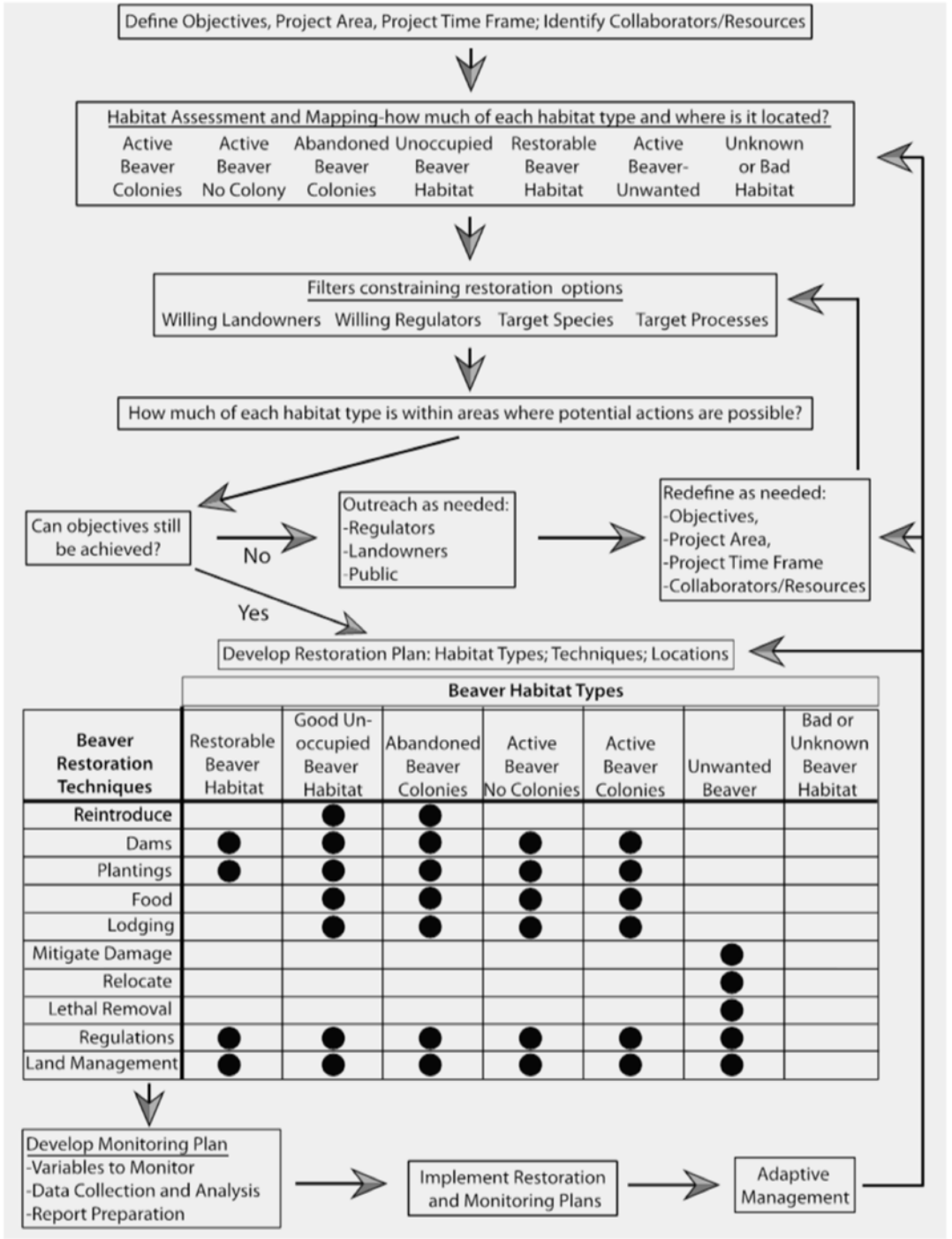
Overview of Steps in Beaver Restoration Projects

1. Define project goals, time frame, spatial extent, resources, collaborators
2. Beaver habitat restoration assessment-watershed level
3. Identify constraints on potential restoration sites
4. Determine if objectives can be met based on available sites, constraints and available resources
5. Redefine goals, expand resources, etc. as needed
6. Develop appropriate beaver restoration techniques
7. Develop restoration and monitoring plans
8. Implement restoration and monitoring plans
9. Adaptive management

Beaver Restoration and Management Techniques Flowchart



Beaver Restoration Techniques	Beaver Habitat Types: Restorable Beaver Habitat	Good Un-occupied Beaver Habitat	Abandoned Beaver Colonies	Active Beaver No Colonies	Active Beaver Colonies	Unwanted Beaver	Bad or Unknown Beaver Habitat
Reintroduce		●	●				
Dams	●	●	●	●	●		
Plantings	●	●	●	●	●		
Food		●	●	●	●		
Lodging		●	●	●	●		
Mitigate Damage						●	
Relocate						●	
Lethal Removal						●	
Regulations	●	●	●	●	●	●	
Land Management	●	●	●	●	●	●	

Step 1. Define goals, time, space, and resources

a) Goals-what are you doing?

b) How many years is your organization committed to the project?

c) What is the size of your project area (beaver tend to move)?

d) What resources do you need to for your project, what resources available (e.g. GIS, permit facilitation, etc.)?

e) Who are your collaborators and what resources can they bring to the table?

   i. Landowners

   ii. Regulatory agencies

   iii. Non-governmental organizations

   iv. Indian tribes

   v. Non-regulatory agencies

   vi. Funding agencies and organizations

Time and Space: Beaver dams are ephemeral and dynamic (Adapted from Demmer and Beschta 2008)

1989,
9 dams

1992,
51 dams

1998,
8 dams

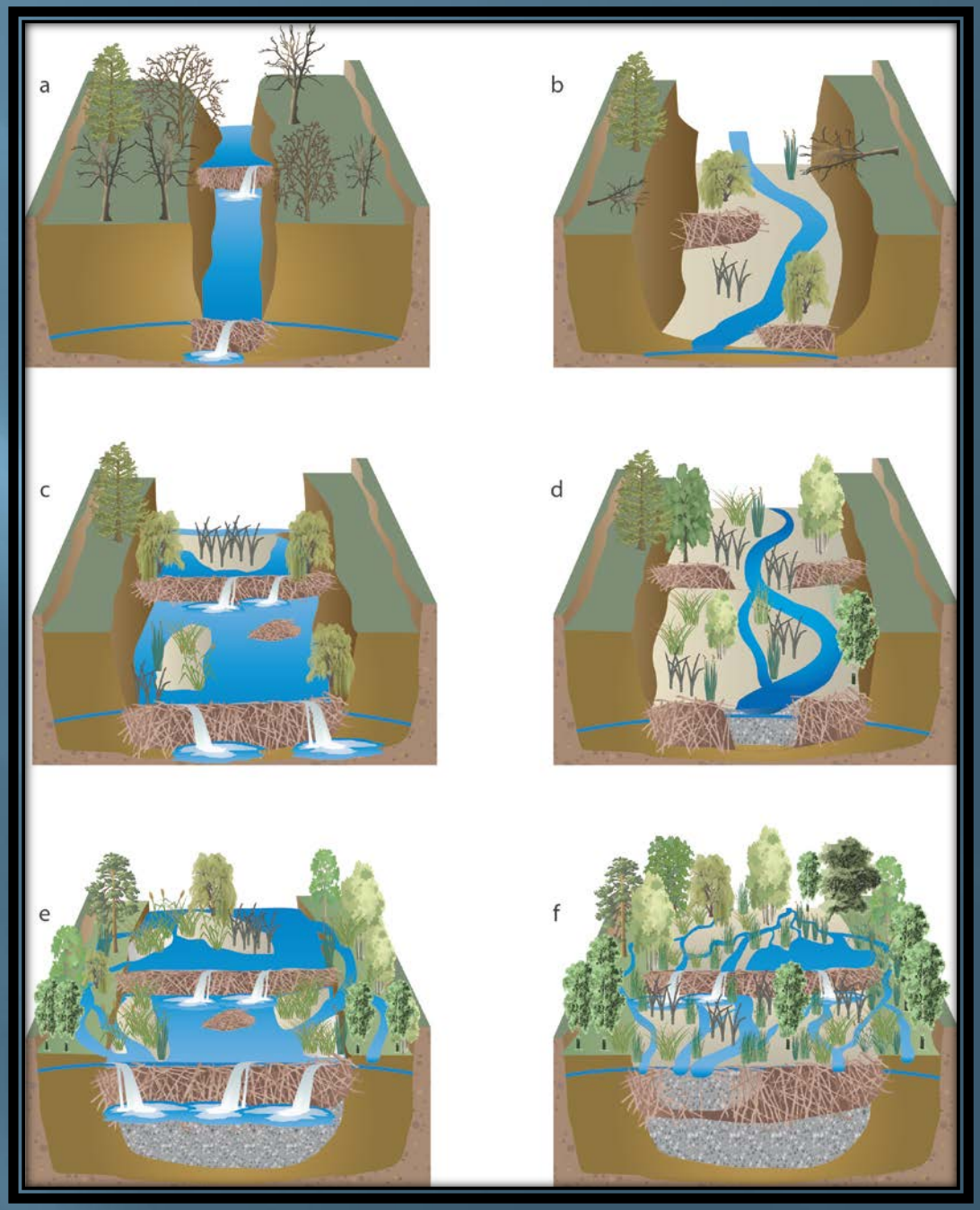
Each beaver dam represented by small red dot on map

Graphics courtesy of Nick Weber, EcoLogical Research

Beaver Habitat is Dynamic

-Value to species or even life history stages for one species Δ/τ

-Physical benefits (e.g. groundwater recharge) Δ/τ

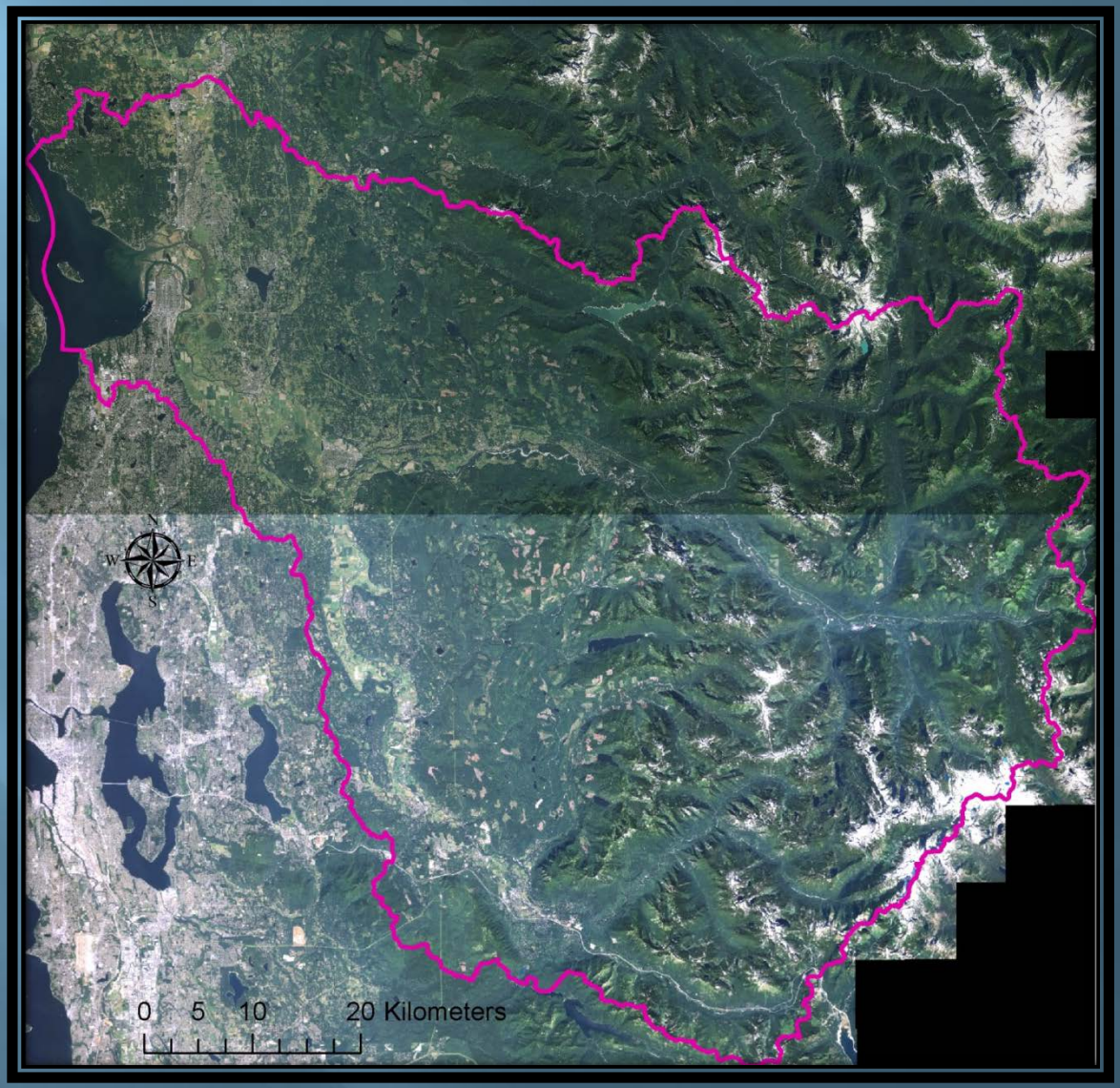


From Pollock et al. 2014

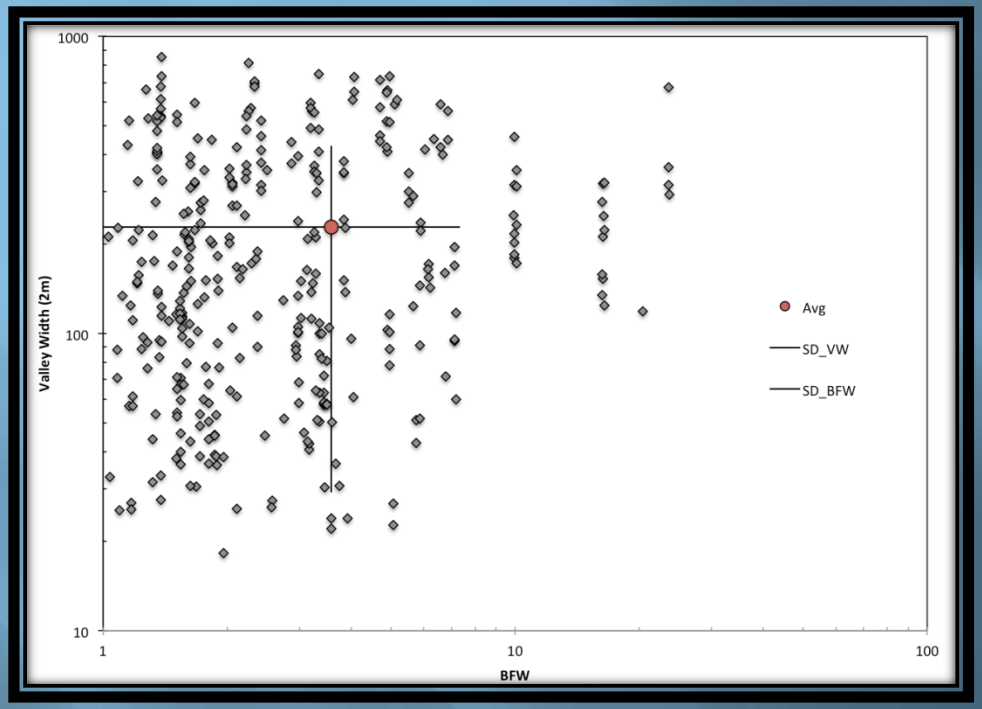
Δ/τ. 20 yr sequence, Nevada:

a) Standard grazing
b) Conservation grazing
c) Conservation grazing with beaver

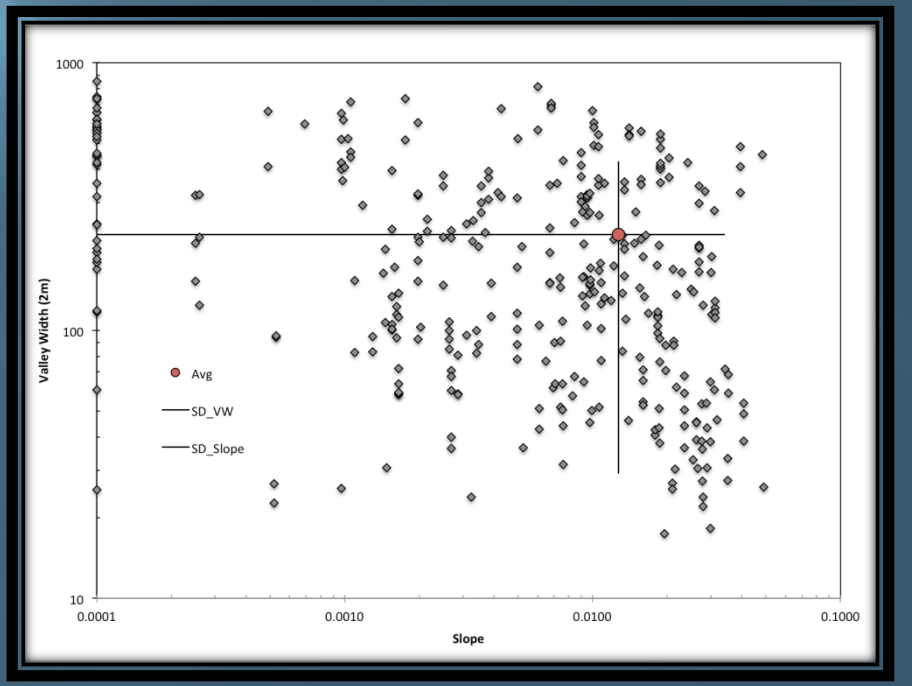
Step 2. Beaver Habitat Restoration Assessment



Beaver Reach Characteristics- Snohomish Basin, WA



- < 8 m BFW
- > 30 m VW
- < 4% Slope



Pollock et al., in prep.

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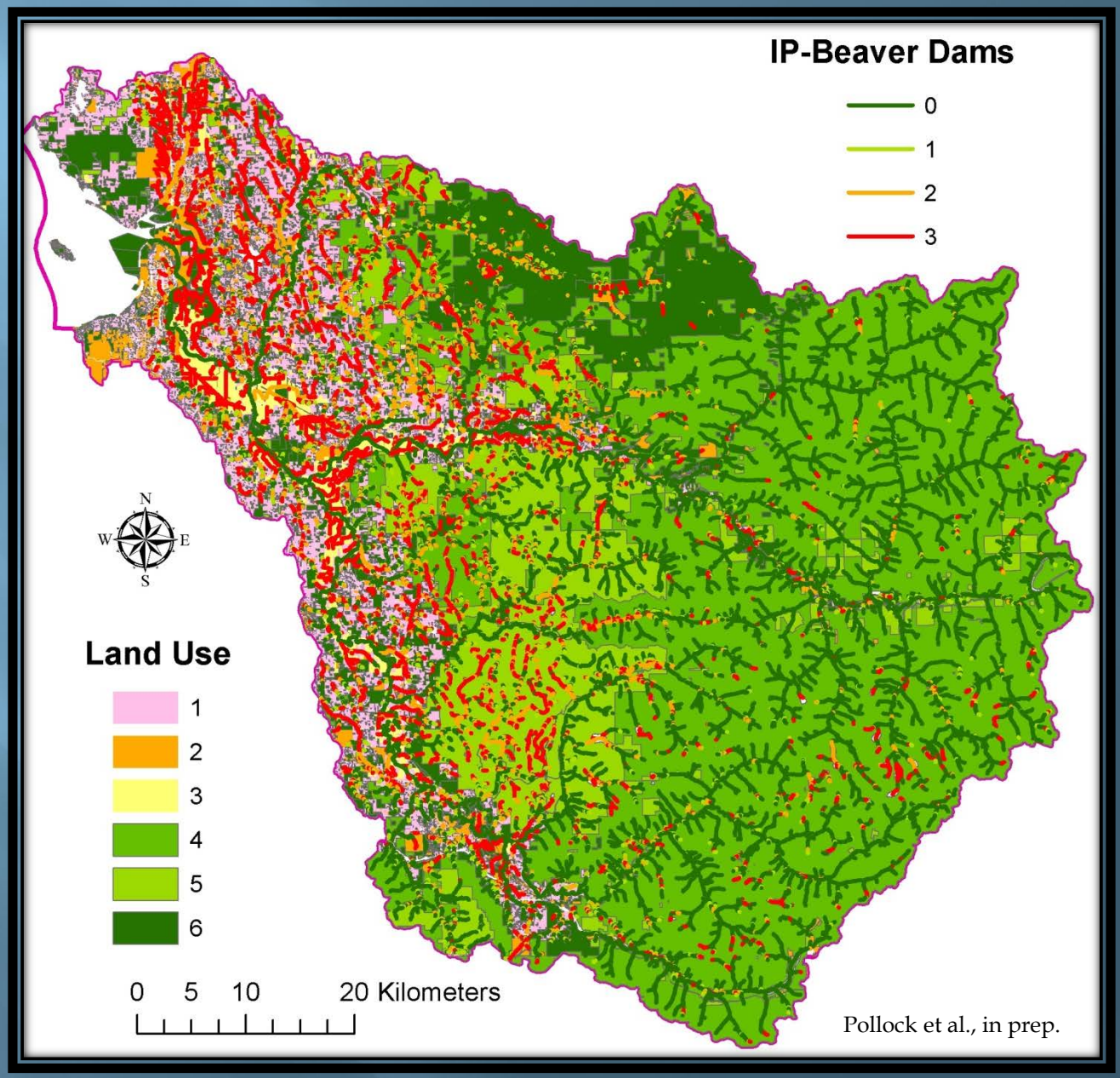
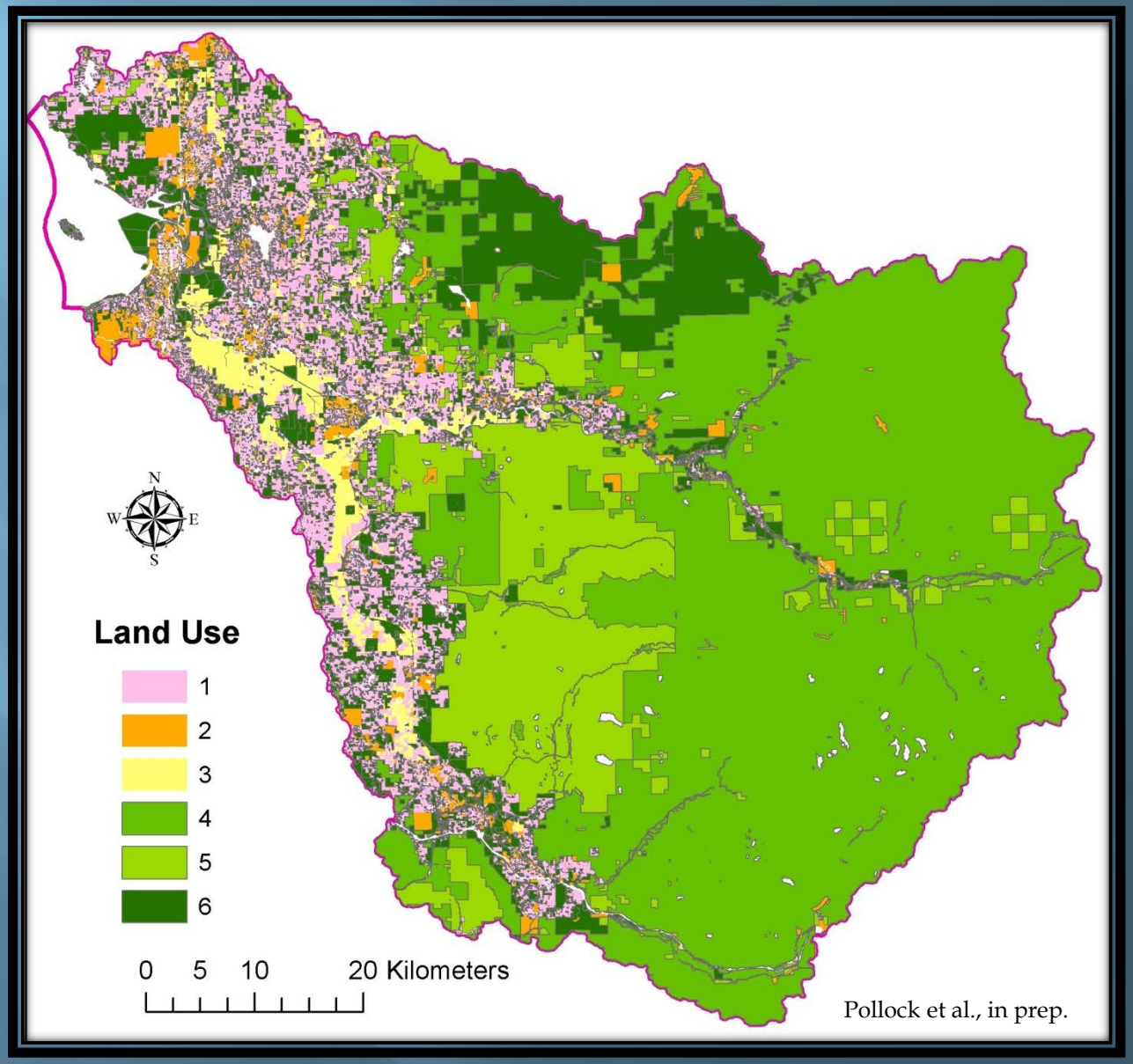
Beaver Intrinsic Potential Map



Step 3. Identify Constraints on Potential Restoration Sites

a) Landowner constraints
b) Regulatory constraints (to be discussed later)
    a) State
    b) Federal
    c) Tribal
    d) Regulations vary by landowner type (private, federal, tribal) and activity (e.g. instream work, riparian work, beaver relocation)
c) Target species distribution
    a) Salmonids
    b) Cascade frog
    c) Willow flycatcher
d) Target habitat type (e.g. Incised streams)
e) Funding constraints

Land Use is Biggest External Constraint



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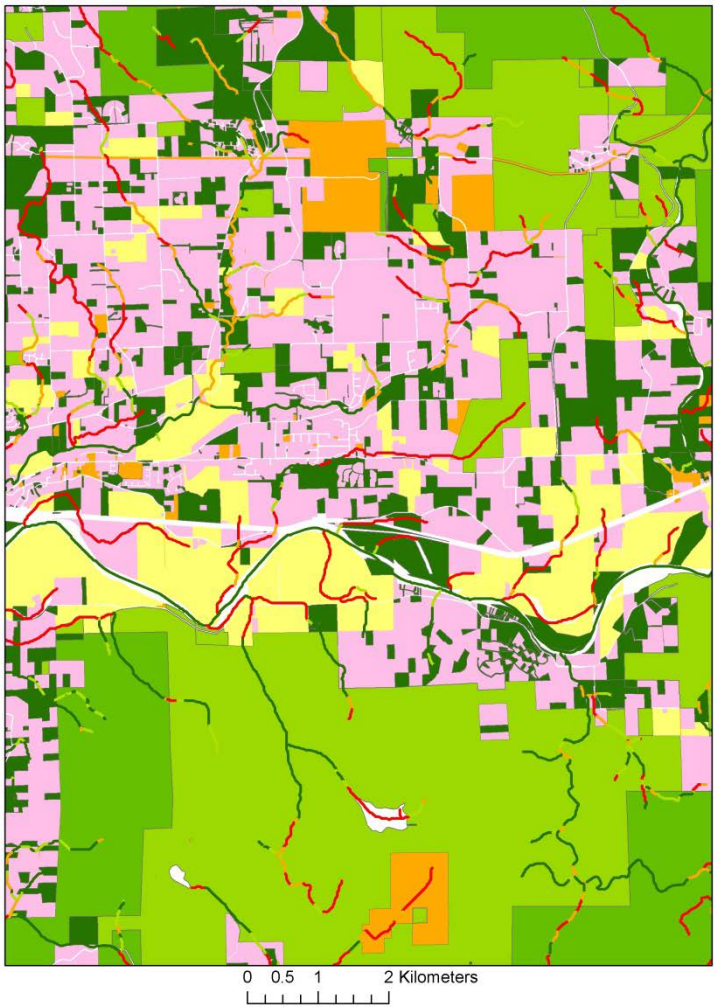
BIP in Fragmented v. Unfragmented Landscapes



- On-the-ground data are essential
- -Beaver (past and present)
- Infrastructure
- Property Boundaries
- -Vegetation
- -Competitors
- -Ground truthing

Methow Beaver Project Beaver Habitat Score Card (compliments of Kent Woodruff)

Methow Beaver Project

Release Site Score Card Date_____

Site ID_____ Observer_____

GPS Coordinates_UTM (NAD 83)_____ Subwatershed_____

Lat Long_____ Location Description _____

Stream Gradient of the defined habitat unit
5. ≤3% 3. 4-6% 1. 7-9% 0. ≥9%

Stream Flow

_____ Max (spring) / Min (fall)

	garden hose	fire hose	30"culvert	un-wadeable
garden hose	1			
fire hose	3	4		
30"culvert	4	5	5	
un-wadeable	1	2	1	0

Habitat Unit Size (stream length)
_____ 5. Extensive stretch of the stream 1. Small isolated pocket

Woody Food
a. 3. Aspen, willow 2. Alder 1. Other hardwoods

b. 3. Within 10 meters 2. Within 30 meters 1. Within 100 meters

c. 3. Large amount (thousands of stems) 2. Some (hundreds of stems) 1. Little (dozens)

_____ **Woody food score = multiply a x b x c**

Herbaceous Food
3.Grass/Forbs Present 0. No Grass/Forbs Present

Floodplain Width
_____ 5. Wide stream bottom 0. Narrow V Channel

Dominant Stream Substrate
5. Silt/Clay/Mud 2.Sand 1. Gravel 0. Cobble -1. Boulders -3. Bedrock

Historic Beaver use
10. Old structures present 0. No indication of previous occupancy

Lodge and dam building materials
_____ 5. variety of 1-6" diameter woody vegetation avail. -10. no building material present

Browsing / Grazing impacts
5. No Impact or obvious presence of browsers / grazers (-10). Heavy browsing / grazing impact.

_____ Bonus: (5 points each) 1. Easy Access. 2. Recent fire. 3. No conflict with human values. 4. Existing aquatic escape cover. 5. Landowner / user enthusiastic

Total Score

Narrative description of site and notes/ Photo ID# / sketch on back:

Beaver Habitat Types

Beaver Restoration Techniques	Beaver Habitat Types						
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Plantings	●	●	●	●	●		
Food		●	●	●	●		
Lodging		●	●	●	●		
Mitigate Damage						●	
Relocate						●	
Lethal Removal						●	
Regulations	●	●	●	●	●	●	
Land Management	●	●	●	●	●	●	

Summary-Where can beaver thrive?

- BIP or similar models help guide where to look (and where not to look) for beaver habitat. They are an indicator, but not necessarily a good predictor at the reach level
- Land ownership and land cover are important filters
- Need a favorable regulatory environment
- On-the-ground surveys are needed to evaluate:
  - Current and historic beaver usage
  - Substrate (bank and bed) conditions
  - Competition
  - Verification of remotely sensed parameters
    - Stream slope
    - Stream width
    - Valley width
    - Vegetation

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6. Developing Appropriate Beaver Restoration Techniques (By Habitat Type)

	Beaver Habitat Types						
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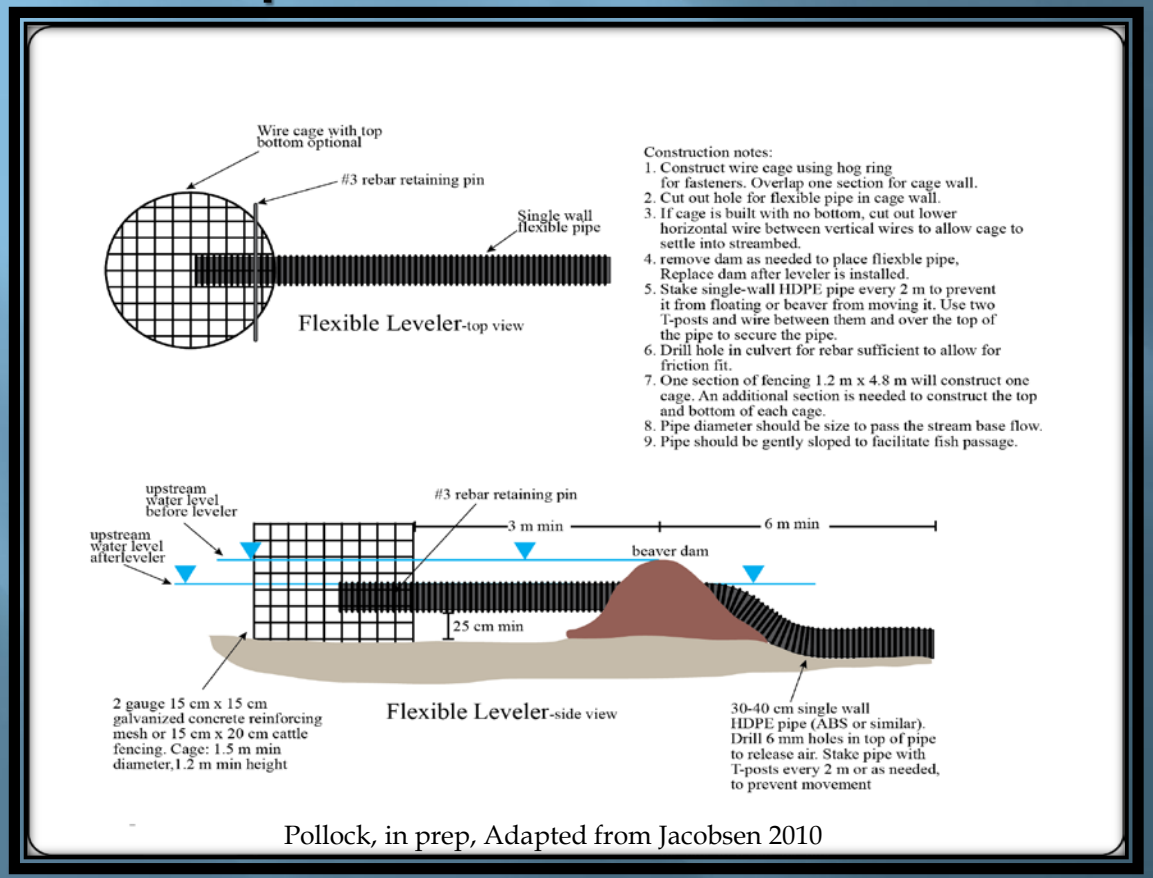
Land Management	●	●	●	●	●	●	

Mitigating Beaver Damage

- Pond levelers
- Culvert guards
- Tree protection

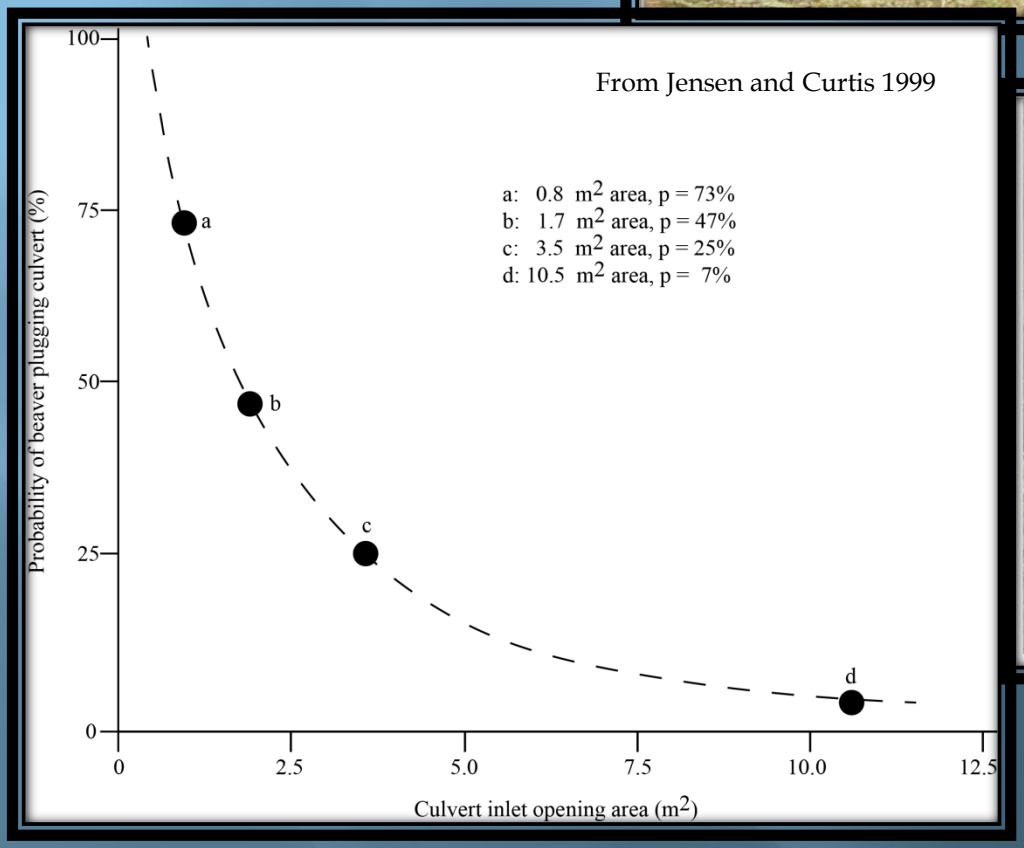


Pollock, in prep, Adapted from Jacobsen 2010

Pond leveler photographs from Boyle 2006

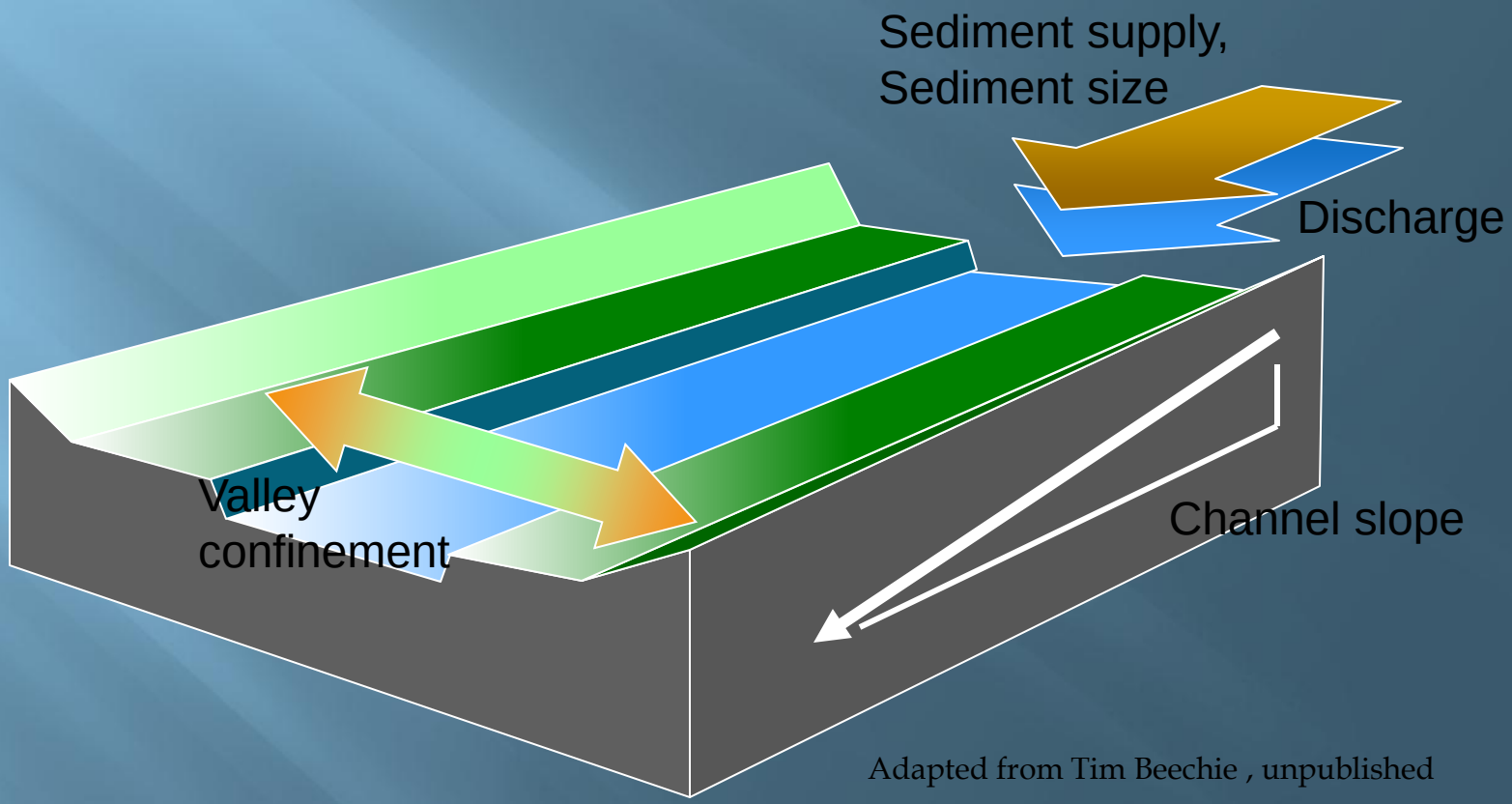
Mitigation Techniques

Culvert guard photographs from Boyle 2006



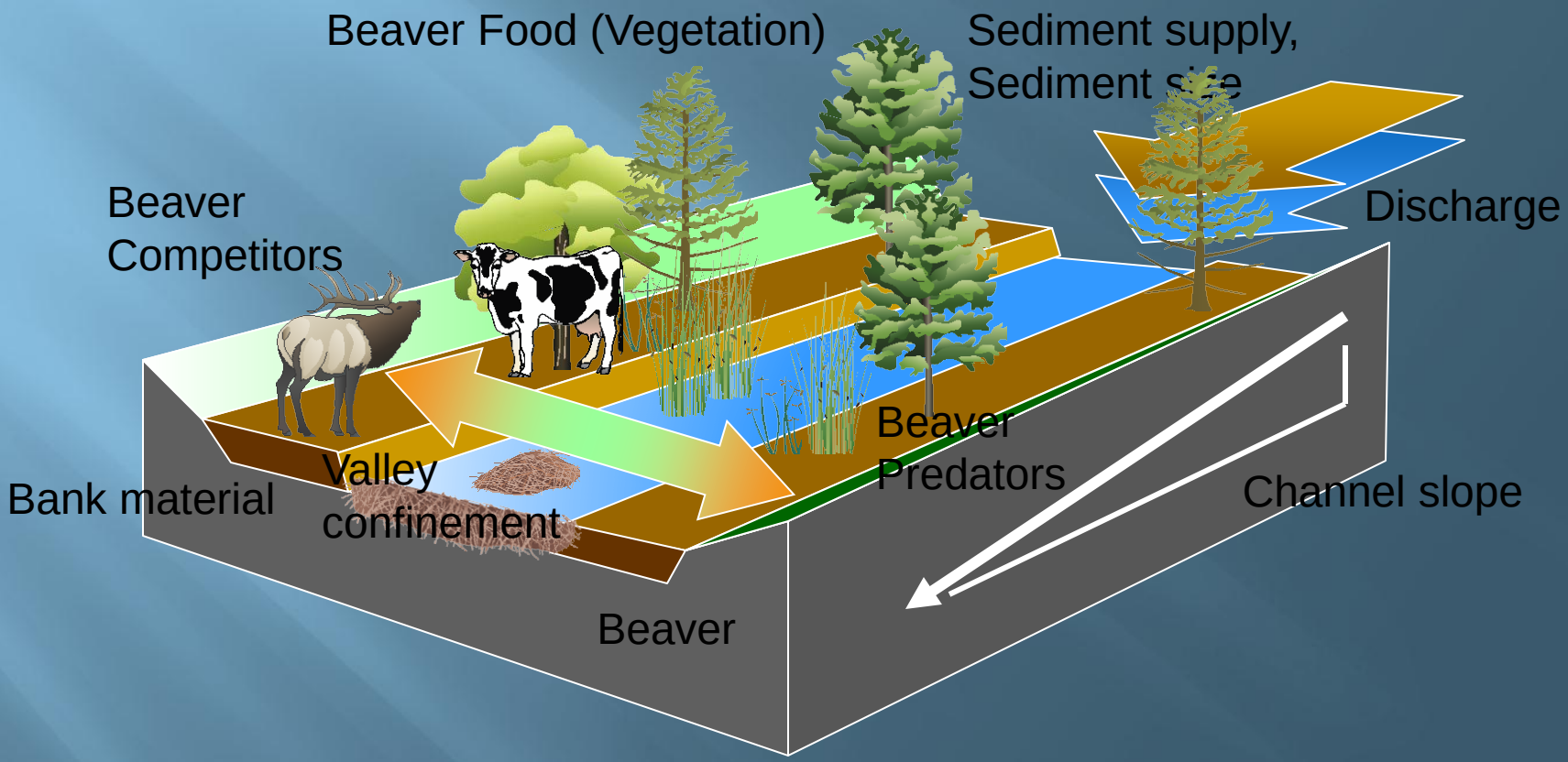
Beaver Dam Analogues-Design

BDA Placement-Local controls on beaver restoration potential

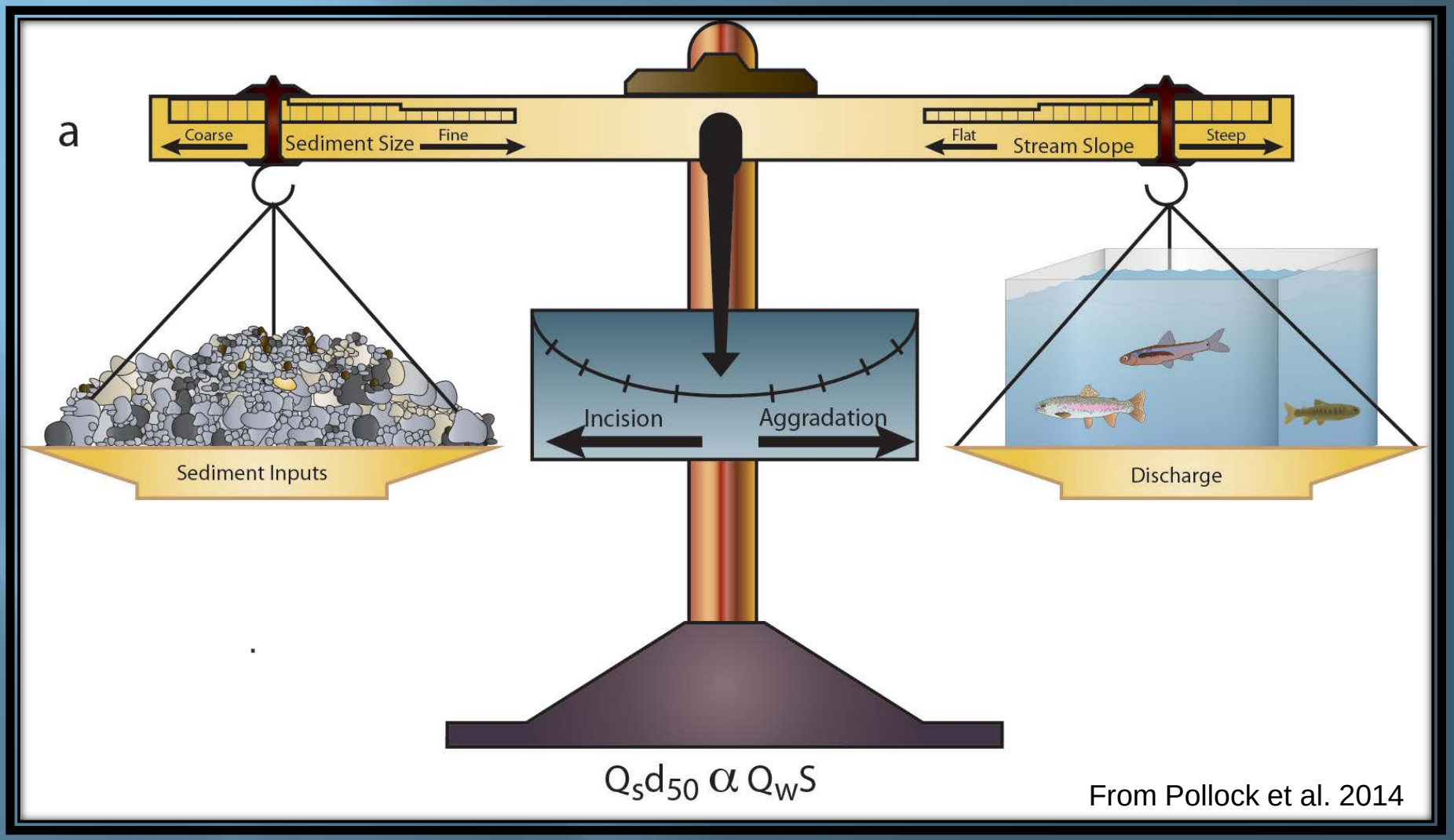


Adapted from Tim Beechie , unpublished

BDA Placement-Local controls on beaver restoration potential

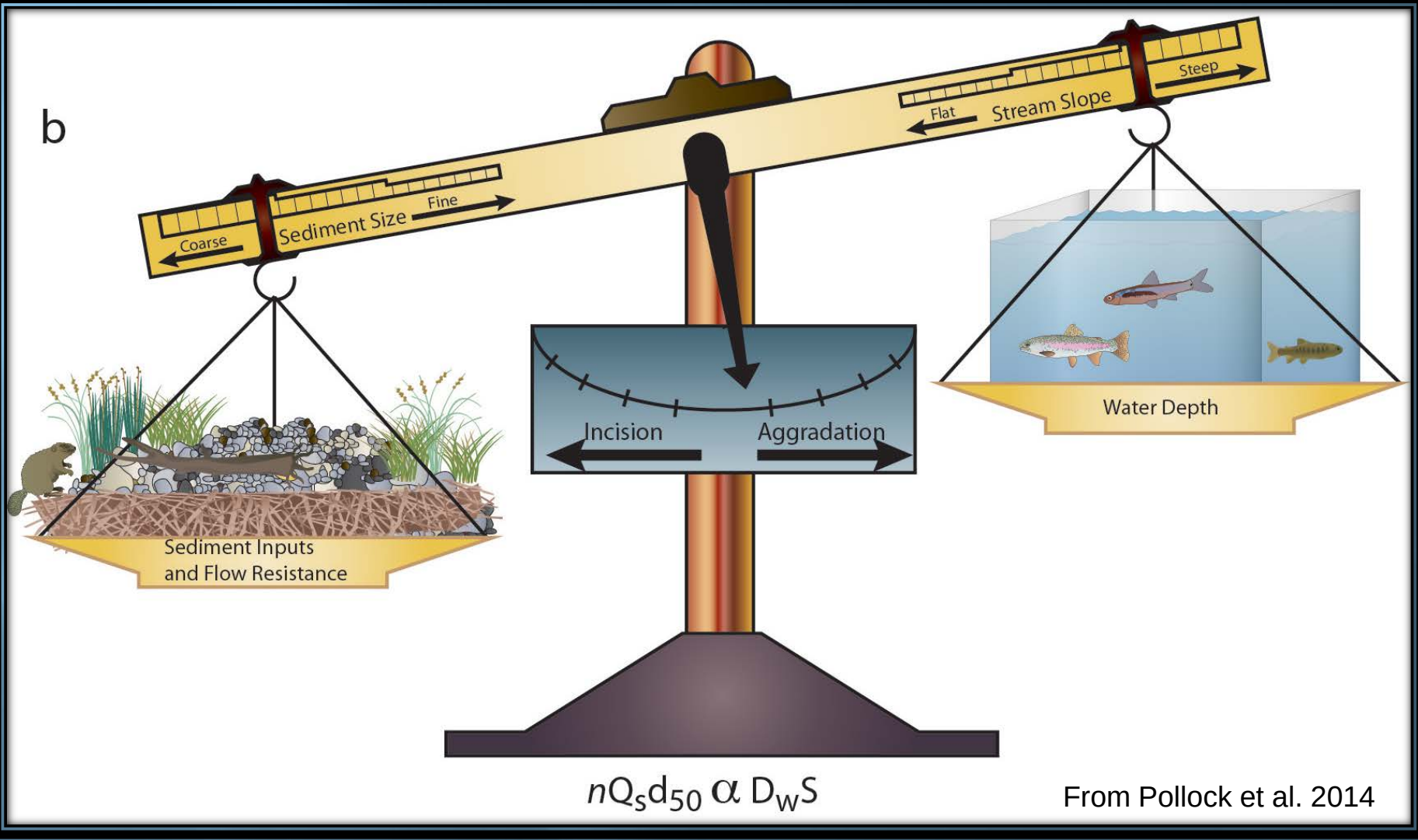


Physical Models Focus on the Relationship Between Hydrology and Sediment



From Pollock et al. 2014

Biology (e.g. beaver dams and vegetation), Significantly affects sediment-discharge relationships



From Pollock et al. 2014

Beaver Dam Analogues

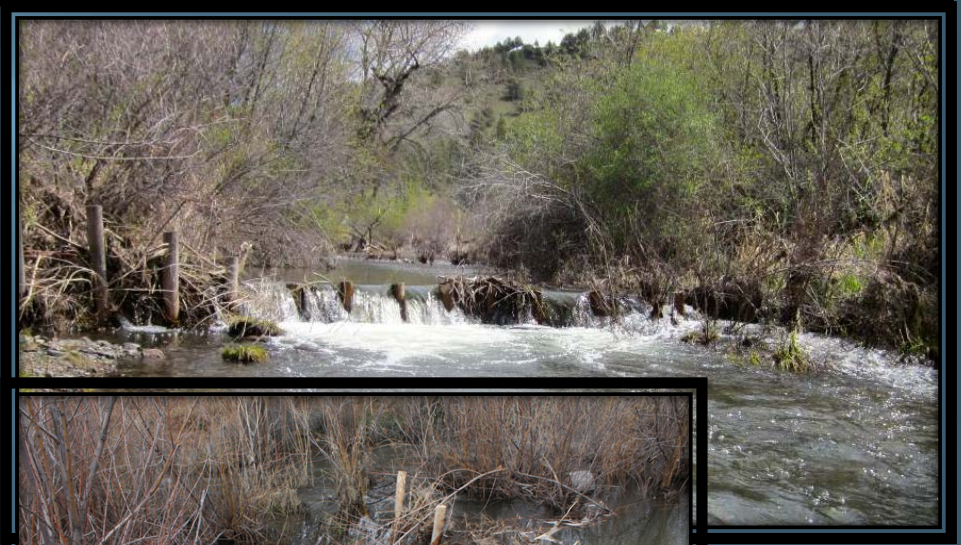
- **What are BDAs and what do they do?**
  - **Working Definition: "*Structures completely or partially built by humans that mimic many of the functions of natural beaver dams*"**
  - **Characteristics**
    - **Reduce velocities**
    - **Reduce bedload and washload transport**
    - **Disperse flow**
    - **Create ponds, pools and wetlands**
    - **Create riparian habitat**
    - **Passable to fish**
    - **100% Organic**
    - **Ephemeral**
    - **Dynamic**
    - **Porous**
    - **Often used by beaver**
    - **Require multiple treatments**

BDAs-Materials and Equipment

- **Materials-similar to beaver dams**
  - Willow branches
  - Herbaceous vegetation
  - Rocks
  - Mud
  - Wood posts*
- **Equipment needed**
  - Chainsaw-to cut and sharpen posts
  - Hand saws to cut willow
  - Post pounder/power source (hydraulic or pneumatic)
- **Material cost and labor = $500-$5000/structure**
  - Size of structure (length)
  - Size of stream (depth of posts)
  - Source distance of building materials
  - Labor costs
  - Efficiency

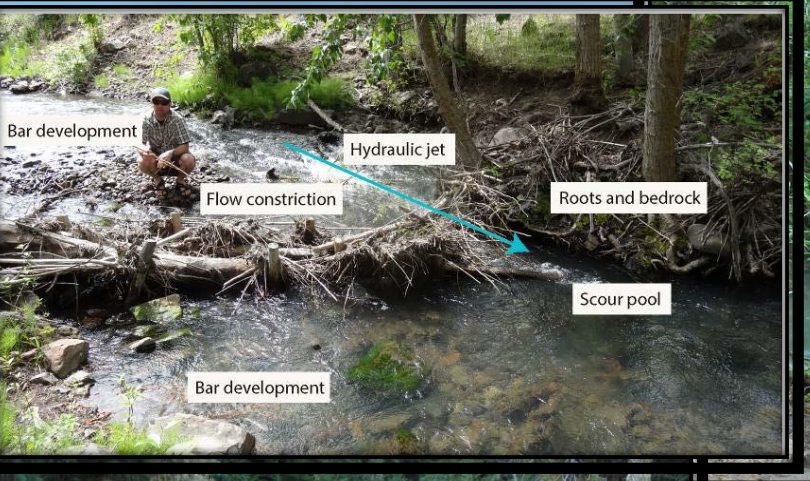
BDA Variants

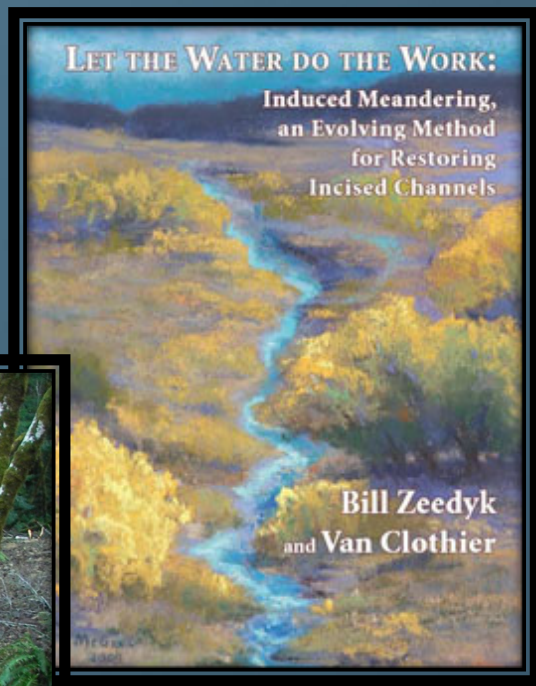
- Post Line
- Post Line with Willow Weave
- Starter Dam(=sealed PLWW)
  - Upstream berm
  - Downstream berm
  - No berm
- Reinforced Existing or Abandoned Dams

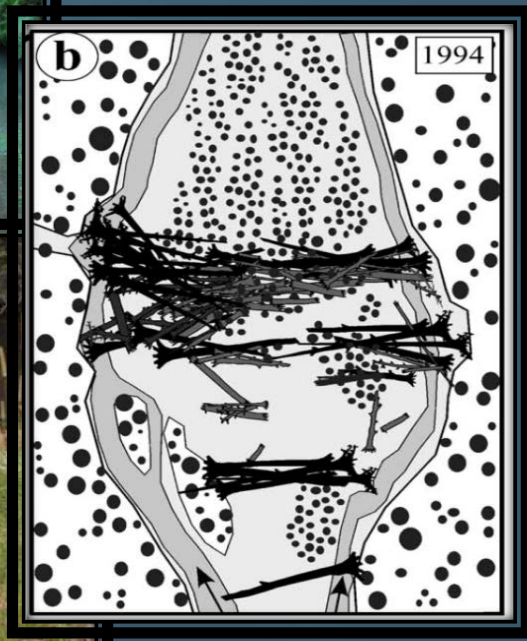


BDA Analogues?

Log Steps (USFS-many locales, T. McKee-Mattole R., CA)
Gravel Dams (Campbell Rnch-Silvies R., OR, CDA Tr., ID)
Meander Dams (Quivira Coalition, NM)?
Constriction Dams (N. Weber-Asotin R., WA)?
Choke Dams (P. Devries-Idaho)?
Wood jams?



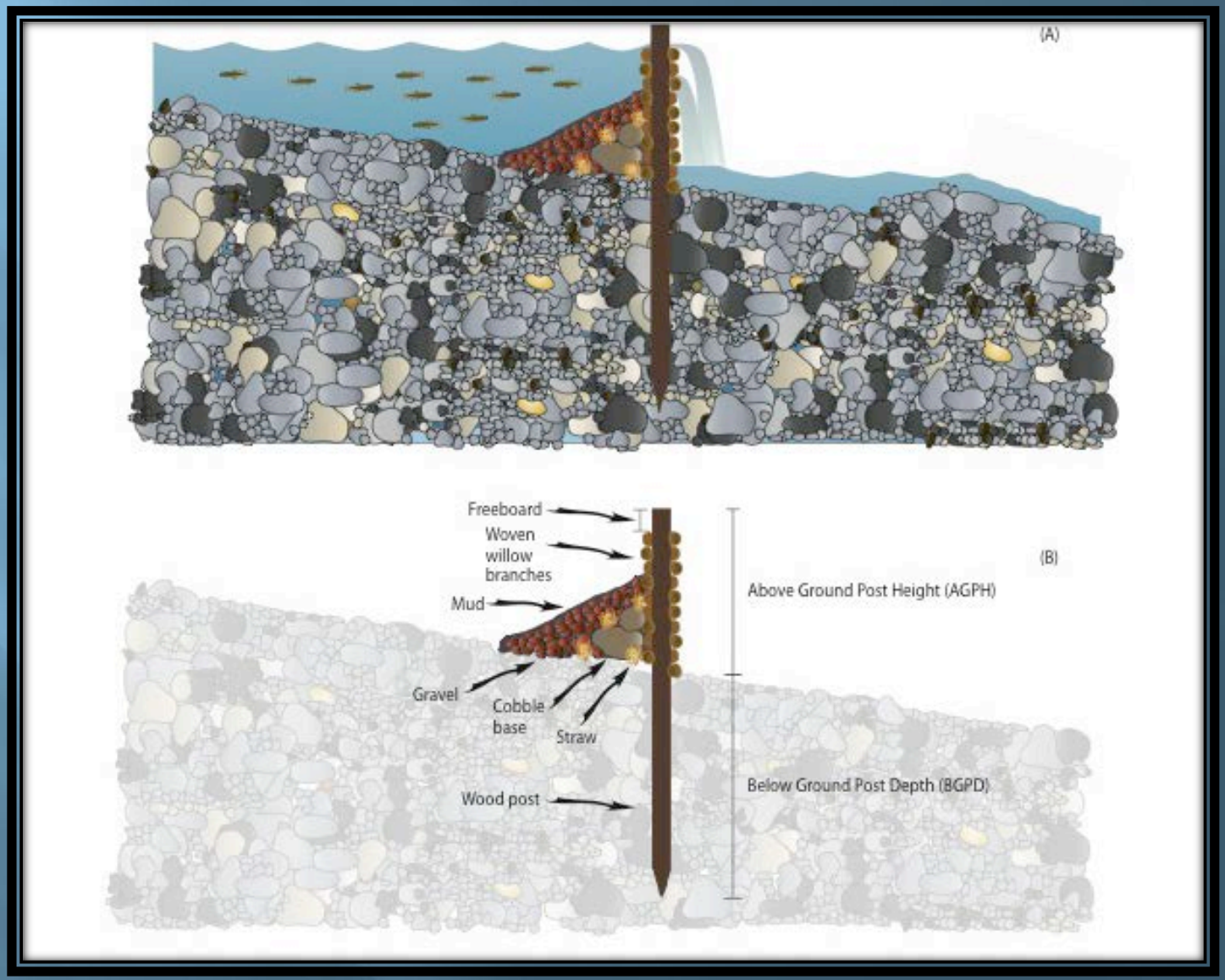




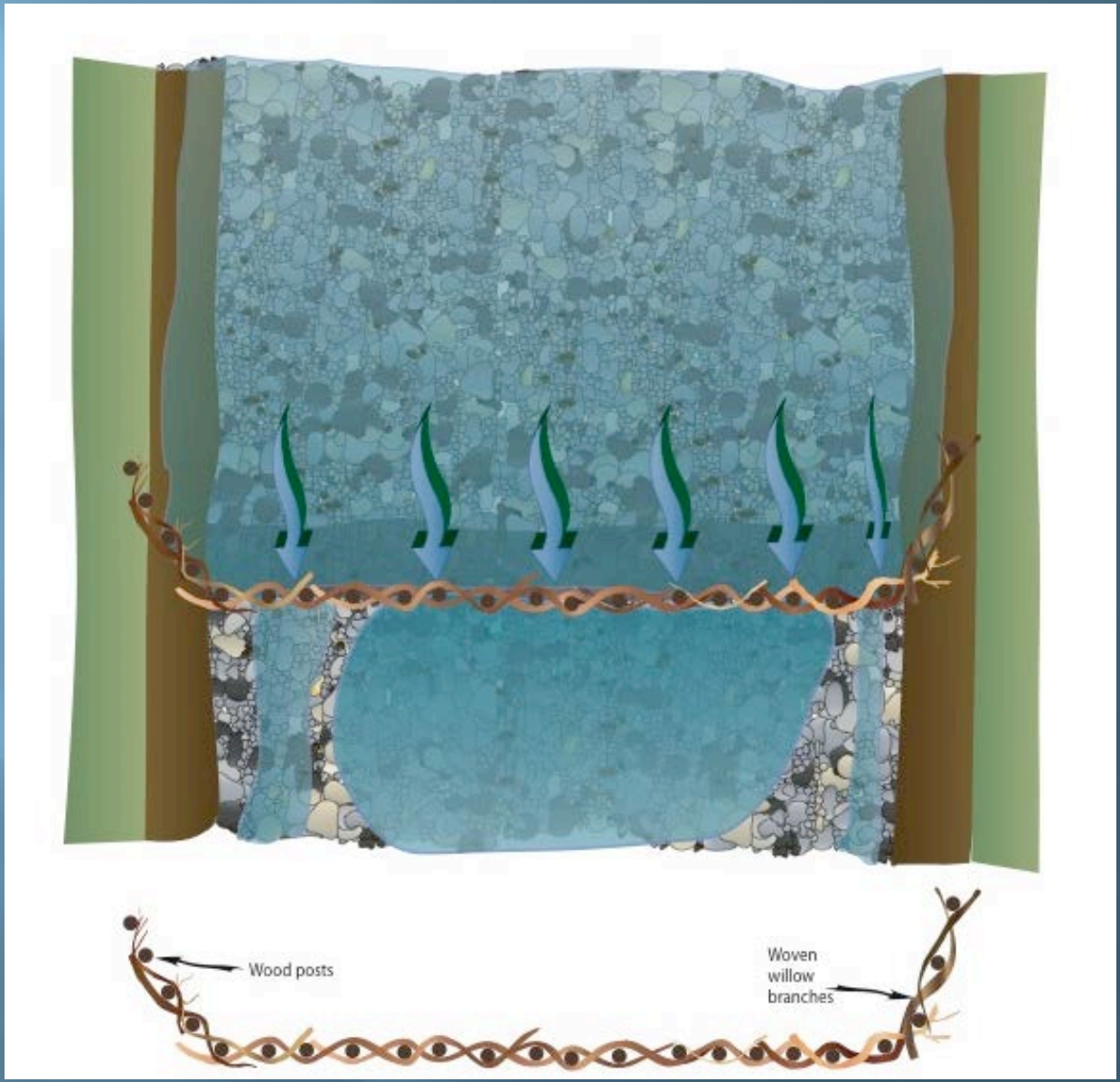
Beaver Dam Analogues-Placement

- **Where are BDAs placed?**
  - In reaches that can or could support beaver
  - Site-specific considerations include:
    - Habitat unit (e.g. glide, pool, riffle)-Riffle crests preferred
    - Degree of incision
    - Floodplain width
    - Terrace width
    - Stream planform
    - Stream slope
    - Bank material
    - Bed material
    - Beaver presence/absence
    - Proximity to infrastructure
    - Competitors and predators
    - Vegetation
- **Most technically challenging aspect of BDAs**

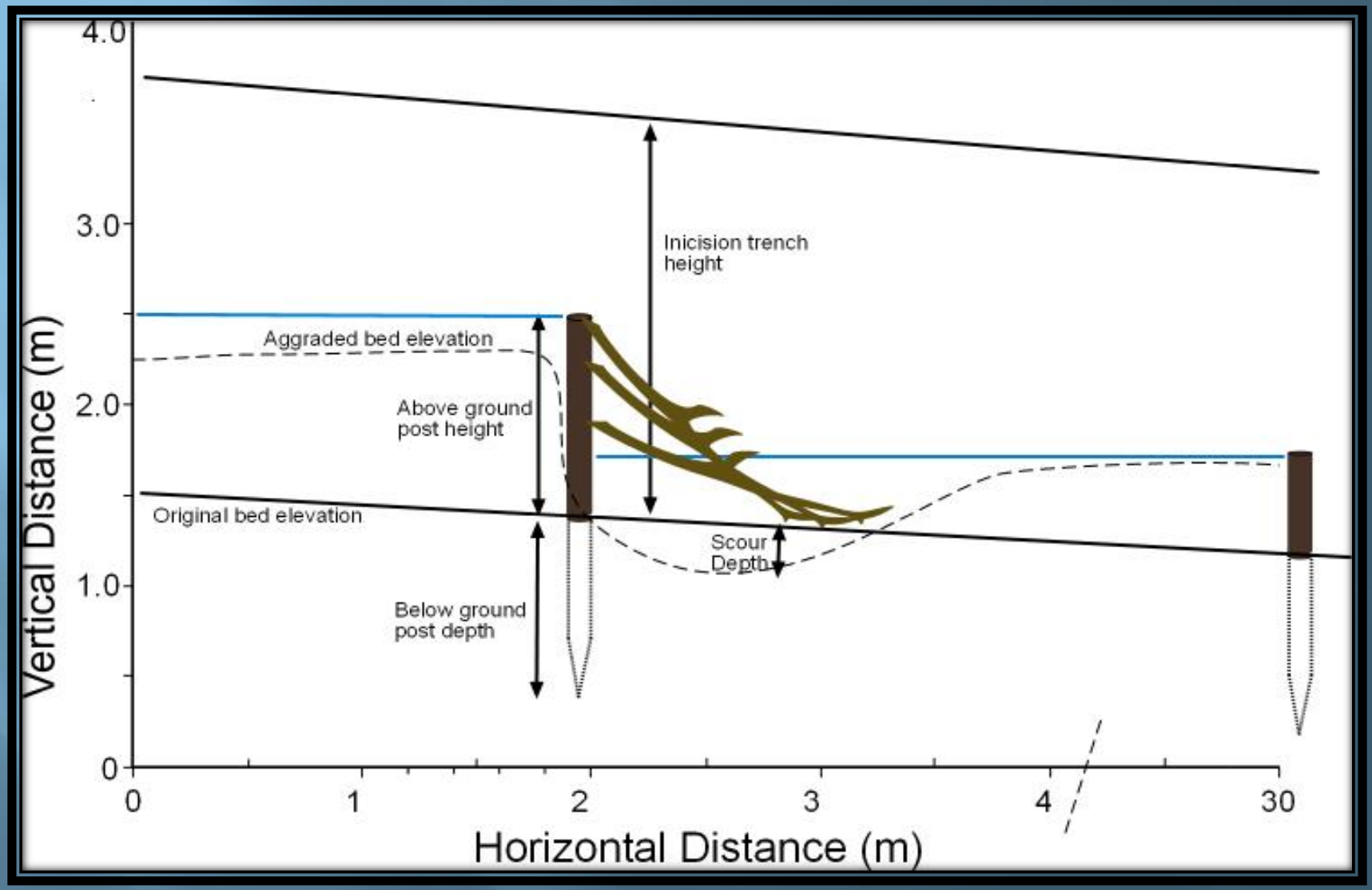
Beaver Dam Analogue-Side View



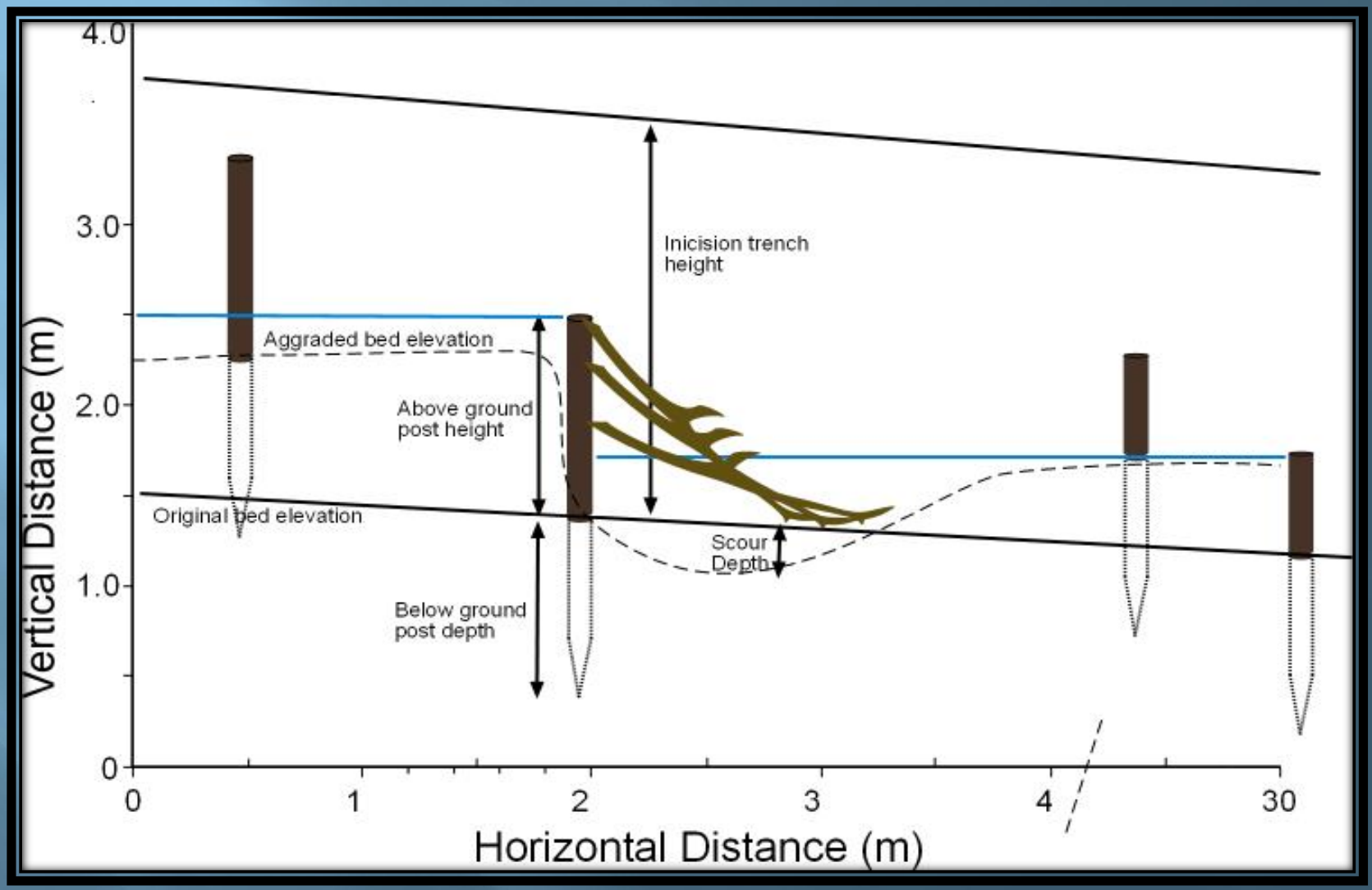
Beaver Dam Analogue-Plan View



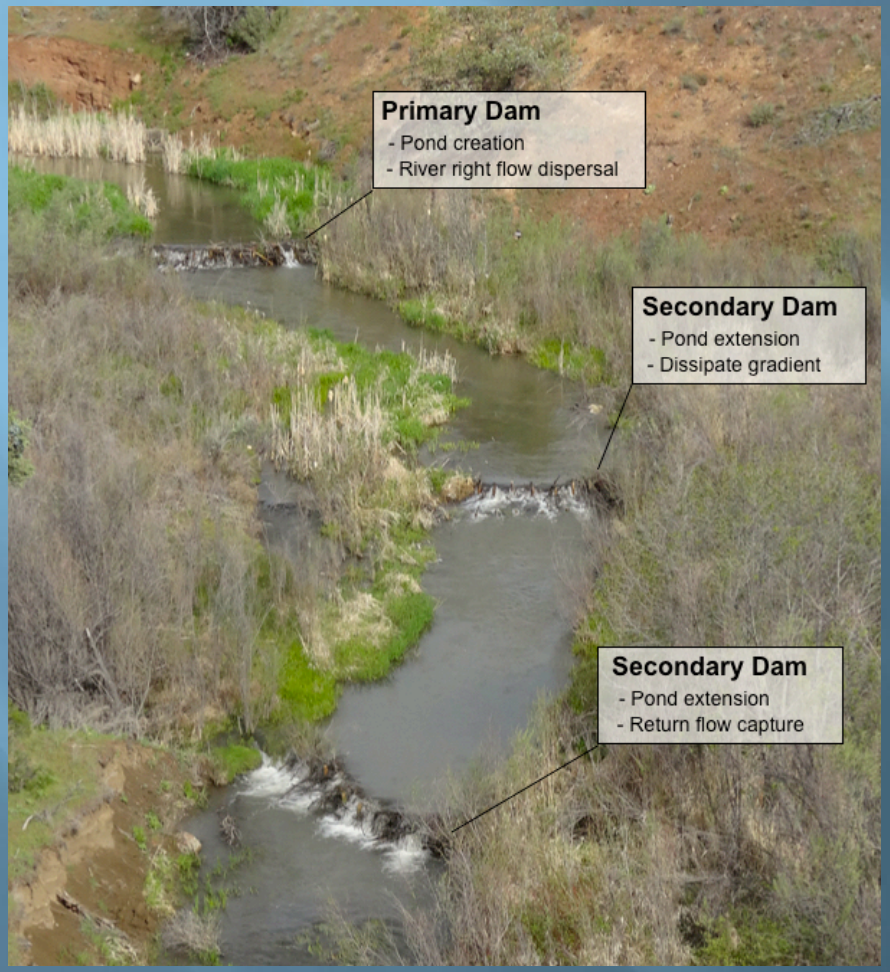
BDA-Sideview in Incision Trench

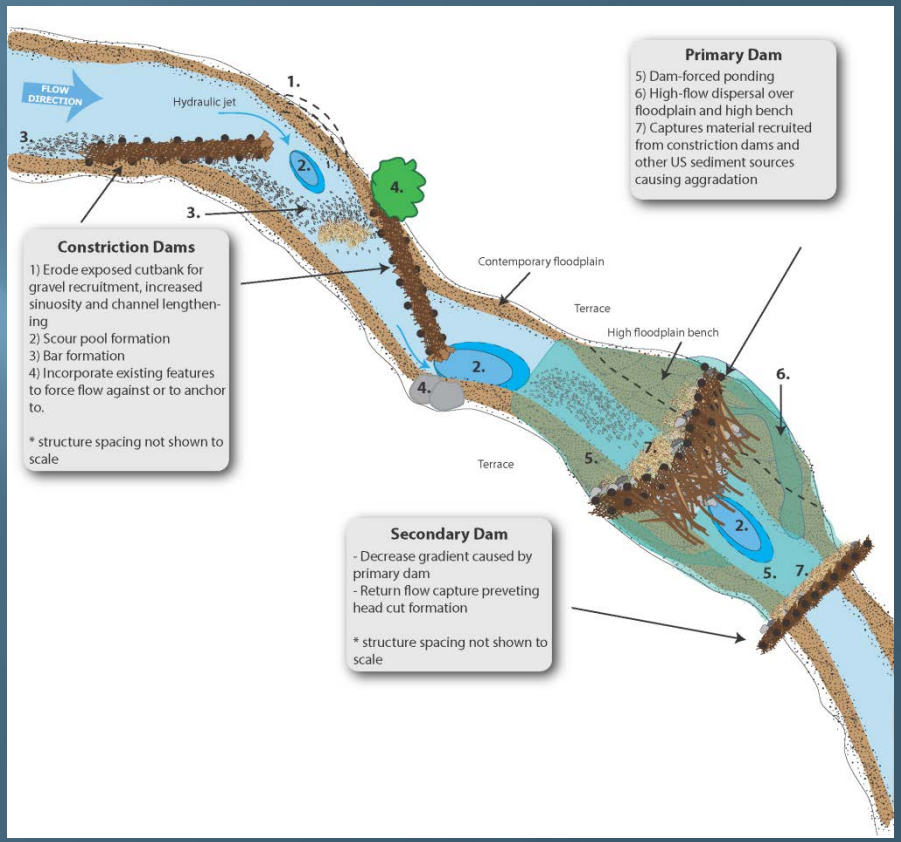


BDA-Round 2 after aggradation occurs



BDAs work together





Beaver Dam Analogues-Reach Scale Treatment

Figure courtesy of Carol Volk, South Fork Research

Beaver Dam Analogues-Reach Scale Effects

Joe Wheaton (USU), Unpublished

Since 2009, a combination of BDAs and beaver turned a narrow single thread channel with an infrequently inundated floodplain into a multi-threaded channel with water levels close to the floodplain surface most of the year

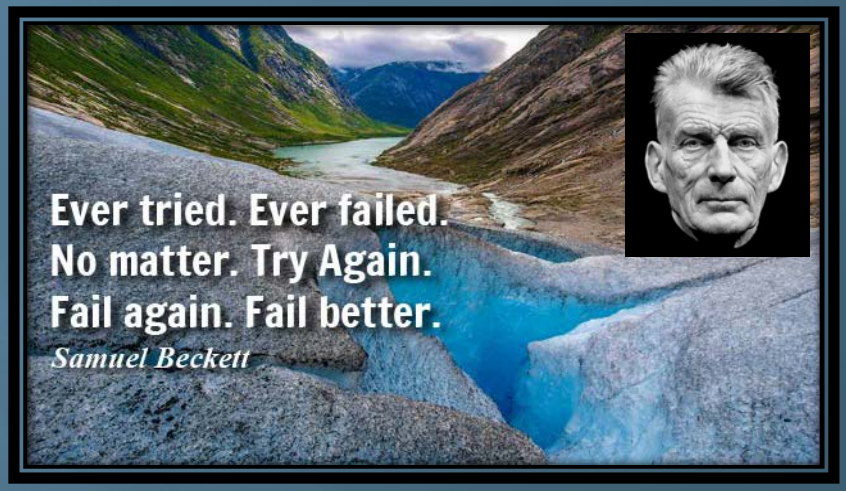
ent

2012 Water extent

2013 Water extent

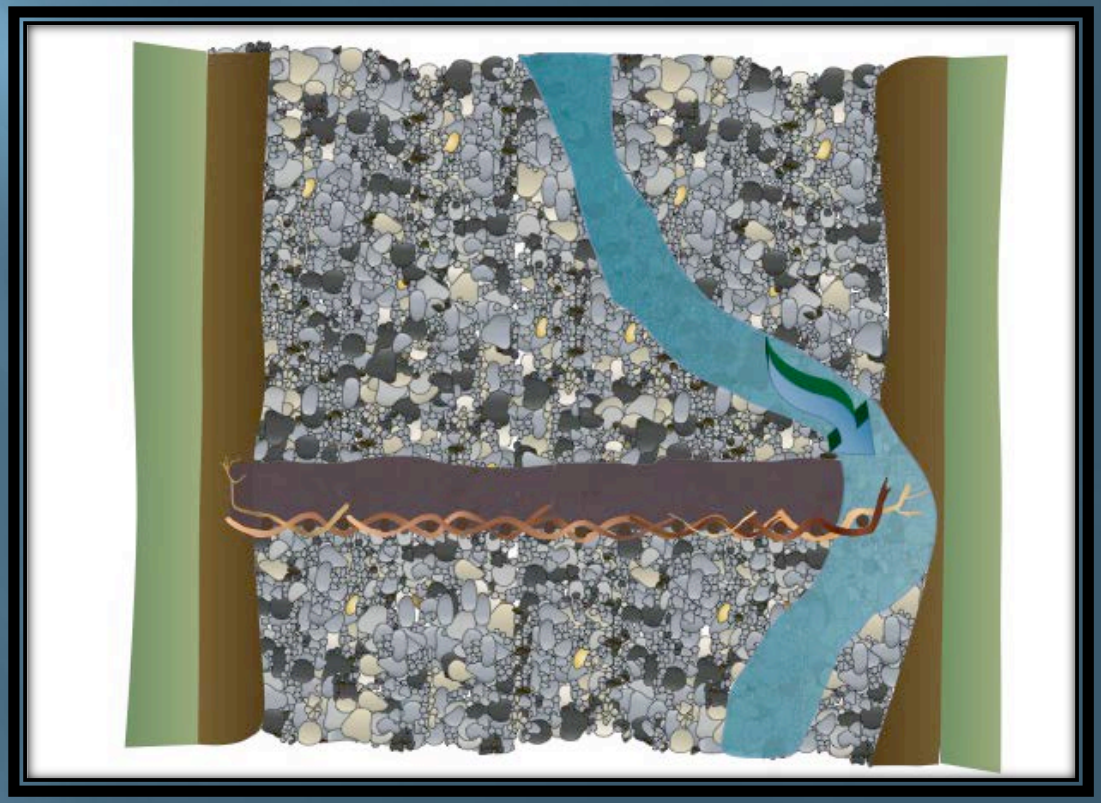
2014 Water extent

BDA "failure"

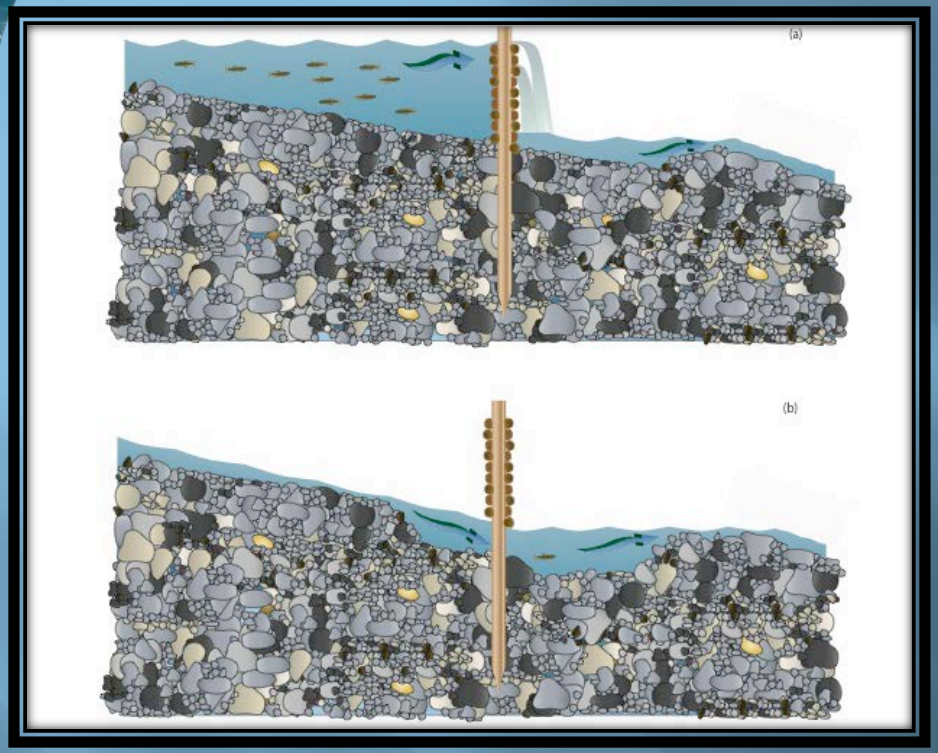


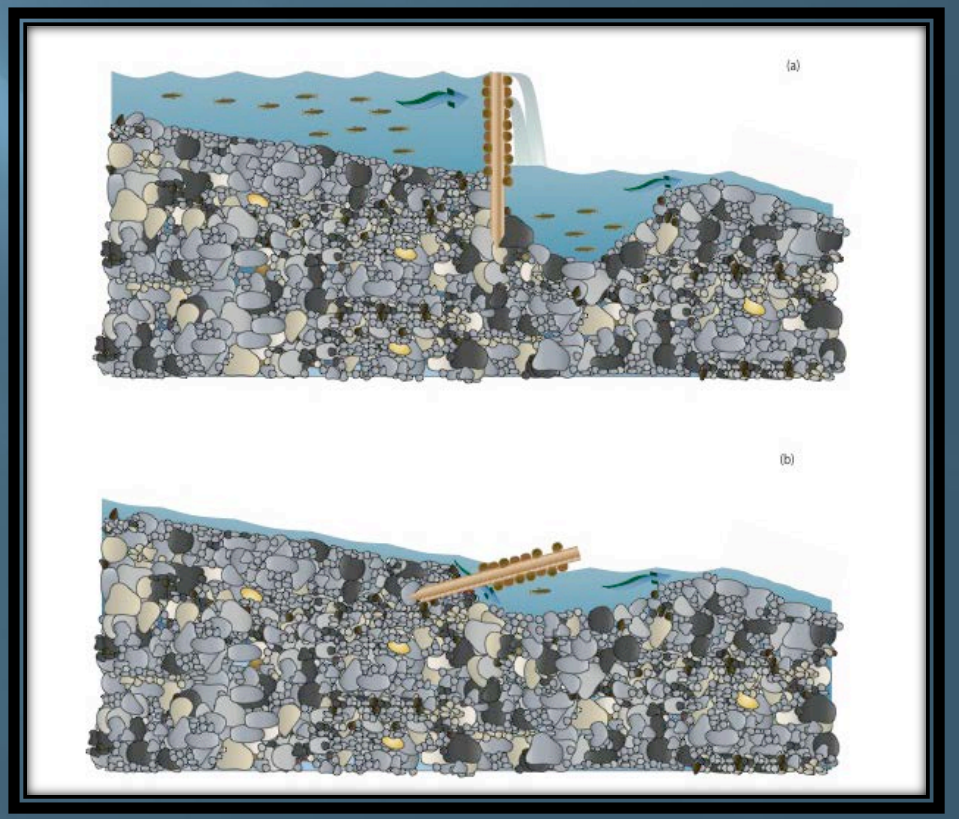
1. "Fail" Definitions not applicable-
   - -To not succeed
   - -To stop functioning normally
   - -To be unsuccessful in achieving ones goal
   - -To prove deficient or lacking
   - -To perform ineffectively or inadequately

2. Spatial and temporal scales of fail
3. Comparative costs of incr. fail v. decr. fail
4. You will fail
5. If you don't fail, that is in itself, failure



BDA Failure mechanisms, continued





THINK BIG
THINK LONG-TERM

"Success" or "failure" is a function of

-time

-space

-goals