APPROACHES TO DESIGNING AND CONSTRUCTING WOOD JAMS IN MANAGED TIMBERLAND SETTINGS IN NORTHERN CALIFORNIA

2018 Large Wood Technical Field School
Salmonid Restoration Federation
Trout Unlimited
Ask yourself, why are you doing what you're doing?

What are your specific reach scale goals?

How did you choose where to implement your project?

Consider all the tools and techniques that are available to you...in other words, don't get stuck on one technique and employ it everywhere you happen to have access....

Base your project on an analysis of the watersheds immediate and long term needs, informed by past, current, and future expected watershed disturbances...

Keep in mind that the fundamental cause of many dysfunctional streams is that the system of wood recruitment and retention is broken, simply adding wood for habitat is not solving that problem, it's treating a symptom.
Define your restoration approach, and hence your performance objectives, by examining past landscape disturbances and their impacts.

- What landscape disturbances has the stream been subjected to?
- How have those disturbances impacted the watershed?
- Are the disturbances ongoing, slowing down, or relicts from the past?
- How or can you mitigate the watershed impacts by installing wood jams?
- Define your objectives and recognize the associated risks....
- Defining your objectives will assure that you are implementing the best plan in the best location....
- What tools, loading, and anchoring techniques do you have at your disposal?
What functions does wood perform in northern California stream channels?

- Provides habitat
- Provides roughness
- Provides grade control
- Provides bank protection
- Provides durability for apex bar jams
- Sorts bedload
FUNDAMENTAL DISTURBANCES IMPACTING FORESTED WATERSHEDS

- Road Construction
  - Alters surface and ground water hydrology
  - Primary source of accelerated fine sediment delivery
  - Drains groundwater

- Stream Disturbance
  - Tractor logging
  - Stream clearing
  - Riparian disturbance/conversion

- Forest age and composition change
CUMULATIVE IMPACTS...AKA
(THE TRAGEDY OF THE COMMONS)
(DEATH BY A THOUSAND CUTS)
(MAULED BY A PACK OF CHIHUAHUA)

- Individuals acting independently and quasi-rationally according to each's self-interest behave contrary to the best interests of the whole group by depleting some common resource such as water volume, water quality, and fisheries resources.
ROAD AND SKID TRAIL CONSTRUCTION
The watershed is subjected to 7’ (84”) of rain per year

Assume a watershed has 120 miles (633,600’) of road

The average road width is 12’

The road system as a whole exhibits 50% hydrologic connectivity

Calculate amount of rainfall that lands on the road

- \( (633,600' \times 12') \times 7' = 53,222,400 \text{ cu. ft. of water} \)

Calculate runoff

- \( 53,222,400 \text{ cu. ft.} \times 0.5 = 26,611,200 \text{ cu. ft. of water runoff from road} \)

Convert to gallons

- \( 26,611,200 \text{ cu. ft.} \times 7.48 \text{ gal./cu. ft.} = 199,051,776 \text{ gallons per year} \)
STREAM DISTURBANCE, ROAD CONSTRUCTION, AND FOREST AGE AND COMPOSITION CHANGE
Initially you get one of two responses from watershed scale disturbances

- Channel Aggradation
- Channel Scour

It's what follows the initial channel response that often drives the most appropriate restoration actions.

Let's look at a couple of scenarios.
Two unique scenarios that result in an incised stream channel

Pre-disturbance conditions

- Stream hydrology, sediment supply, and natural wood recruitment system in balance
- Typical channel reach characteristics
  - Floodplain frequently connected to stream
  - Wide variety of vertical channel structure (i.e. inset terraces, etc.)
  - Channel sinuous within the valley corridor
  - Riparian vegetation mature, flourishing, and conifer dominant
  - Riparian vegetation naturally recruiting mature conifers to stream

Post-disturbance conditions

- Channel incision from a combination of increased peak runoff and stream clearing
- Typical channel reach characteristics
  - Floodplain totally disconnected from channel
  - Lack of vertical channel structure
  - Channel totally confined
  - Lack of velocity refuge for fish
  - Riparian vegetation mature and hardwood dominant
  - Riparian vegetation recruiting young hardwoods to stream
  - Channel substrate coarse and angular

Post-disturbance adjustments

- Channel aggradation from watershed disturbance
- Typical channel reach characteristics
  - Floodplain totally disconnected from channel
  - Lack of vertical channel structure
  - Channel totally confined
  - Lack of velocity refuge for fish
  - Riparian vegetation mature and hardwood dominant
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TWO CHANNEL EVOLUTION SCENARIOS
AN INCISED STREAM CHANNEL THAT DEVELOPED AS A RESULT OF AGGRADATION AND SUBSEQUENT INCISION
Some Wood Loading Objectives

- Provide Habitat
  - Scour pools
  - Store gravel
  - Sort gravel
  - Velocity refuge
  - Provide cover

- Engineering
  - Provide grade control
  - Protect channel banks
  - Provide apex for mid-channel jams

- Reach scale fluvial geomorphology
  - Force lateral scour
  - Reach scale aggradation
  - Raise water surface elevations
  - Increase sinuosity
  - Slow channel reach velocities
SOME INSTALLATION TECHNIQUES AND A FEW THOUGHTS

- Excavator with log tongs
  - Most versatile of all the techniques

- Grapple cat
  - Allows some directional log installs, good for moving trees

- Skidder
  - Allows some directional log installs, good for moving trees

- Chop and drop (accelerated recruitment)
  - Fast and cheap, outcomes less predictable, typically uses trees from riparian, can be employed where heavy equipment cannot get to

- Helicopter
  - Expensive, can move big trees, can be employed where heavy equipment cannot get to

- Hand crews (CCC style)
  - Can integrate with other installation techniques well, can be employed where heavy equipment cannot get to

- Yoder
  - Relatively slow and expensive, can minimize riparian disturbance
- Wedging
- Trenching
- Bolting
- 1.5-2.0 x Bankfull width
- Bank injection
- Pile driving
- Ballasting
DON'T FORGET REVETMENTS!
LETS LOOK AT A FEW CASE STUDIES...

ANDERSON CREEK
Watershed Impacts

- Heavily logged repeatedly between 1900 and 1990
- Significant road construction
- Tractor logging in stream corridors
- Stream clearing between 1970 and 1980s
- Riparian converted from old growth redwood and fir to alder dominant
- Several significant logs jams exist within the stream corridor

Unique Conditions

- Pleistocene/Holocene fluvial terrace transitions from 40’ above the current channel to 0’ above the channel over a distance of 3.5 miles
LOWER ANDERSON CREEK PRE IMPLEMENTATION CONDITIONS
UPPER ANDERSON CREEK PRE IMPLEMENTATION CONDITIONS
ANDERSON CREEK SITE A1

Feature A1 before looking UPS facing South

Feature A1 After looking UPS at right bank
ANDERSON CREEK SITE A2-3  (MIDDLE STREAM REACH)

Feature 2-3 before looking upstream

Feature 2-3 after looking upstream
ANDERSON CREEK PRE-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)
ANDERSON CREEK PRE-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)
ANDERSON CREEK POST-IMPLEMENTATION CONDITIONS (UPPER STREAM REACH)
LITTLE NORTH FORK NOYO PRE-IMPLEMENTATION CONDITIONS

**Watershed Impacts**
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- Stream corridor almost completely filled with anthropogenic sedimentation

**Unique Conditions**
- Upper stream reach heavily aggraded, lower stream reach heavily incised, reaches separated by a migrating headcut
LITTLE NORTH FORK NOYO PRE-IMPLEMENTATION CONDITIONS

Upper reach

Lower reach
The headcut separating the upper and lower stream reaches
LITTLE NORTH FORK NOYO POST-IMPLEMENTATION CONDITIONS
CONCLUSIONS AND TIDBITS OF UNSOLICITED ADVISE

- Use all the tools and techniques available to you, don’t just apply one technique you’re comfortable with where you can procure access (If a hammer is your only tool, every problem looks like a nail)…..

- Define your project objectives based on the watershed conditions and construct your jams to meet those objectives, it might be a mistake to simply say “I’m creating fish habitat”. Think about both feature specific and reach specific objectives…. 

- Only procure existing conifers from the riparian corridor (that would otherwise fall in the stream naturally at a later date) if you really need to. Remember your overarching goal should be to fix the broken system of wood recruitment and retention)…..

- Fir logs are a better choice than redwood for key logs…. 

- Keep the root wads on your trees, it makes them heavier and creates more roughness and complexity in the stream…. 

- An excavator with a thumb and log tongs allows you to create effective wood jams on both sides of the stream channel and allows for trench anchoring…. 
Construct jams at the base of riffles to maximize stream power, adding wood to existing pools may cause sedimentation...

Construct jams using existing stable wood where possible....

Mimic wood size, orientation, and function for your watershed and stream reach.....

Determine why you are observing channel incision, and construct jams accordingly....

Understand all of your projects associated risks and mitigate for them appropriately...

Wear a hardhat, don’t be stupid.....Trees branches can fall hours after harvesting....

Try to anchor without hardware if possible, its really just more garbage in the stream....

Construct jams to adjust vertically