National Large Wood Manual

Assessment, Planning, Desi
Wood in Fluvial Ecosystems
and Structure

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U.S. Department of the Interior
Bureau of Reclamation

US Army
of Engin

Chapter 4

GEOMORPHOLOGY AND HYDROLOGY CONSIDERATIONS

Point Bar Structure, Salmon River, Near Welches, Oregon. Photo credit: Brian Bair.

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Geomorphology and hydrology considerations for placing and managing large wood in streams

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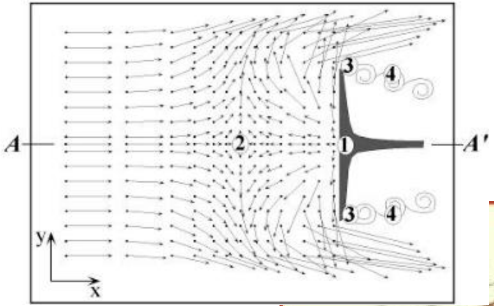
Natural Systems Design

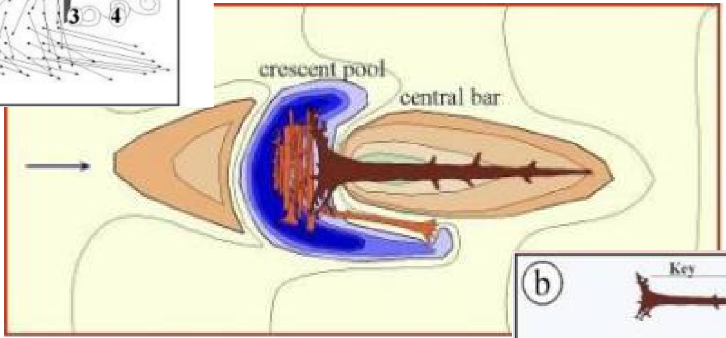
Natural Systems Design, www.naturaldes.com

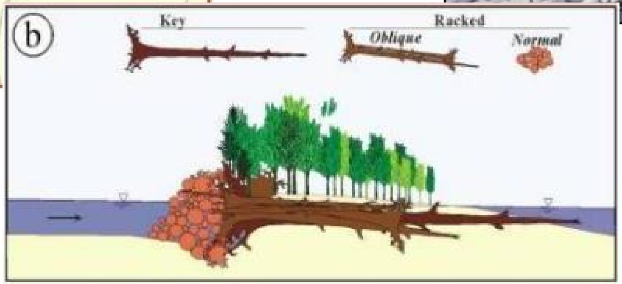
Seattle, WA; Bellingham, WA; Port Angeles, WA

Wood once was common in streams across the United States and isolated examples can still can be found in many.

Wood → Obstructs Flow → Alters Hydraulics → Local Scour/deposition (pools/bars) → Reach Scale Inundation & Sedimentation → More Complex Channel Morphology







Adapted from Abbe and Montgomery 1996

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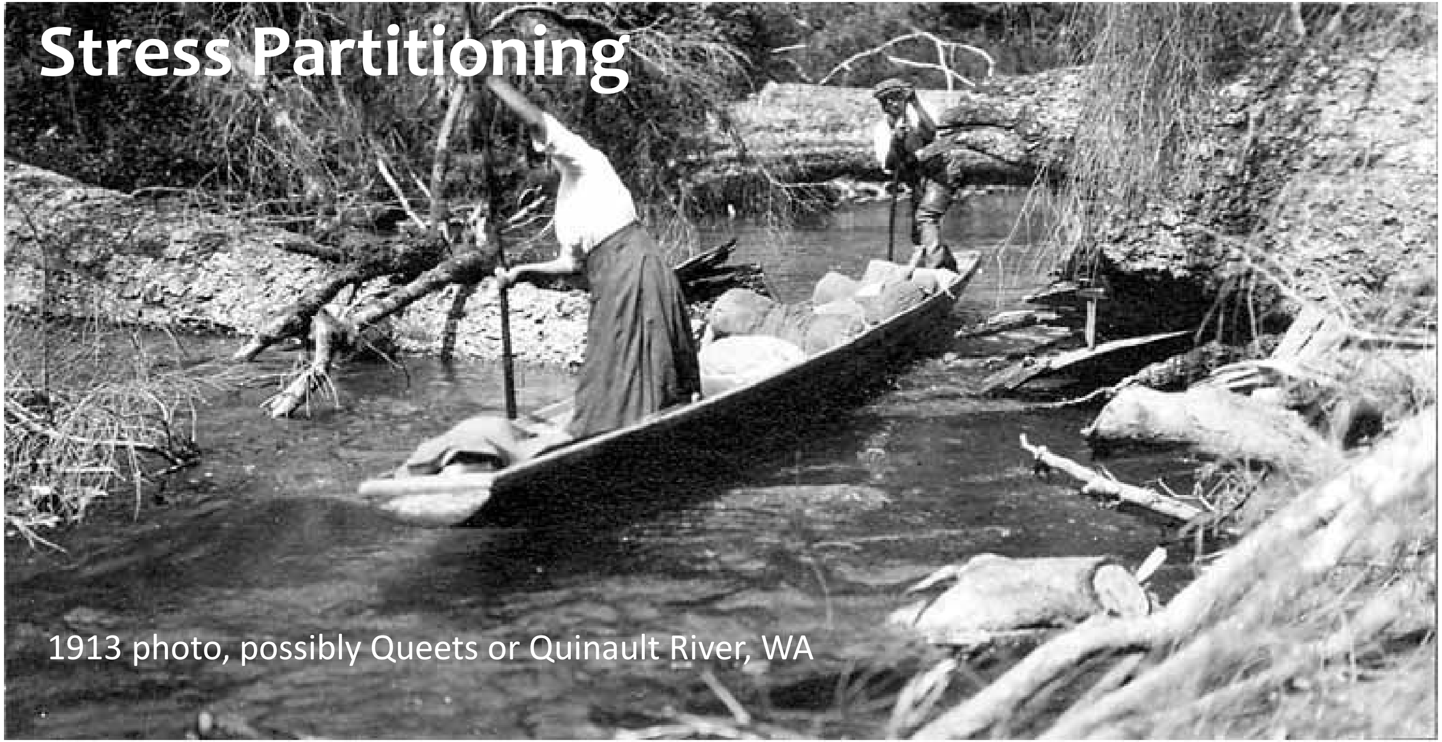
Stress Partitioning



1913 photo, possibly Queets or Quinault River, WA

$$\tau_0 = \tau_{grains} + \tau_{bed} + \tau_{banks} + \tau_{wood}$$

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Stress partitioning considering only LWD and grain roughness

energy acting on substrate		energy acting on wood		total energy available
$\rho C_B U^2$	+	$\rho C_{DA}(H/2L)\, U^2$	=	$\rho g h s$
τ_{GS}		τ_{LWD}		τ_o

C_B = drag coefficient for the bed
C_{DA} = wood drag coefficient = $C_D/(1-B)^2$
U = flow velocity
h = water depth

S = energy slope
B = blockage coefficient = H/h
H = diameter of LWD
L = spacing of LWD

Adapted from Manga and Kirchner 2000

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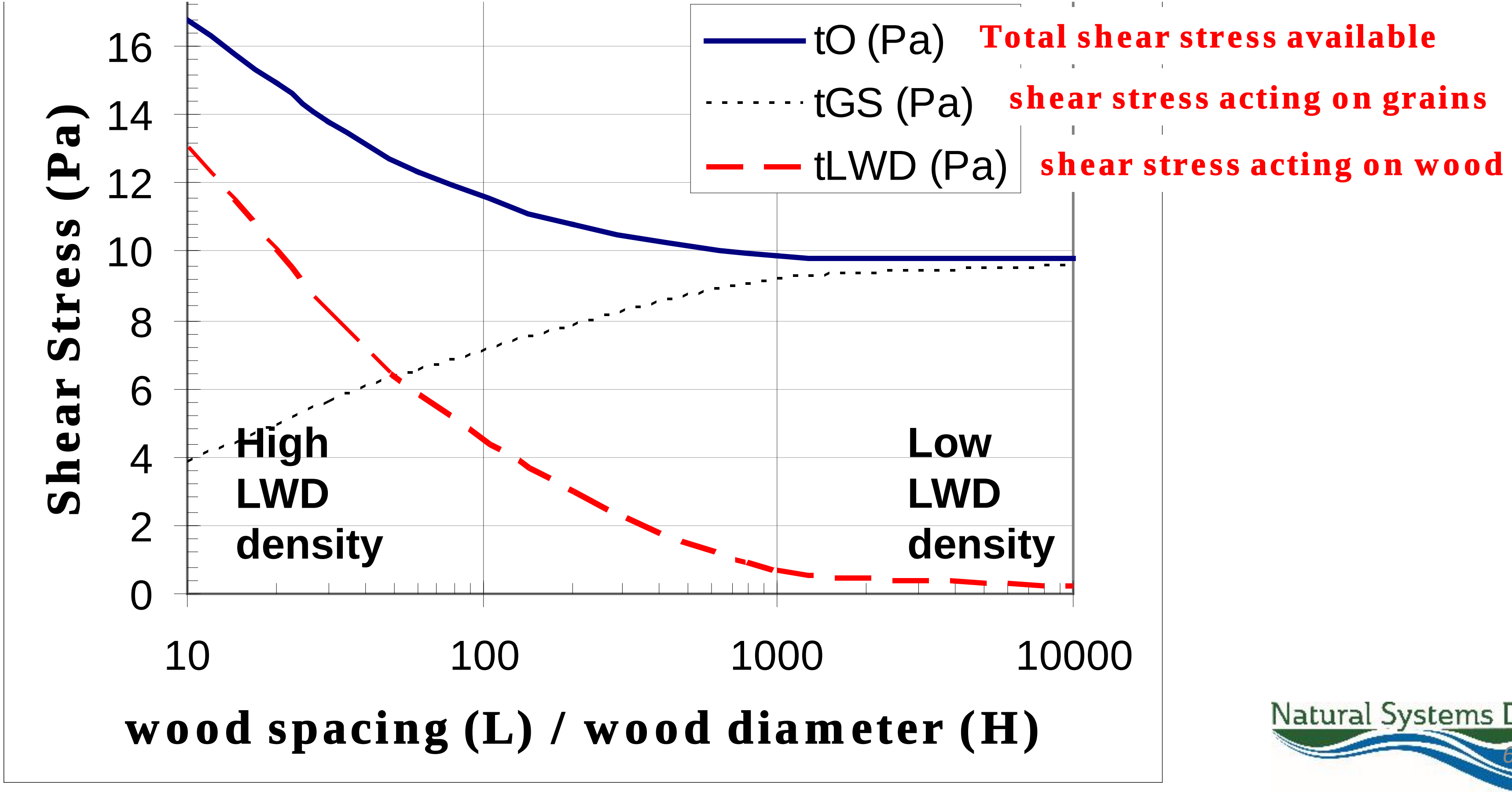
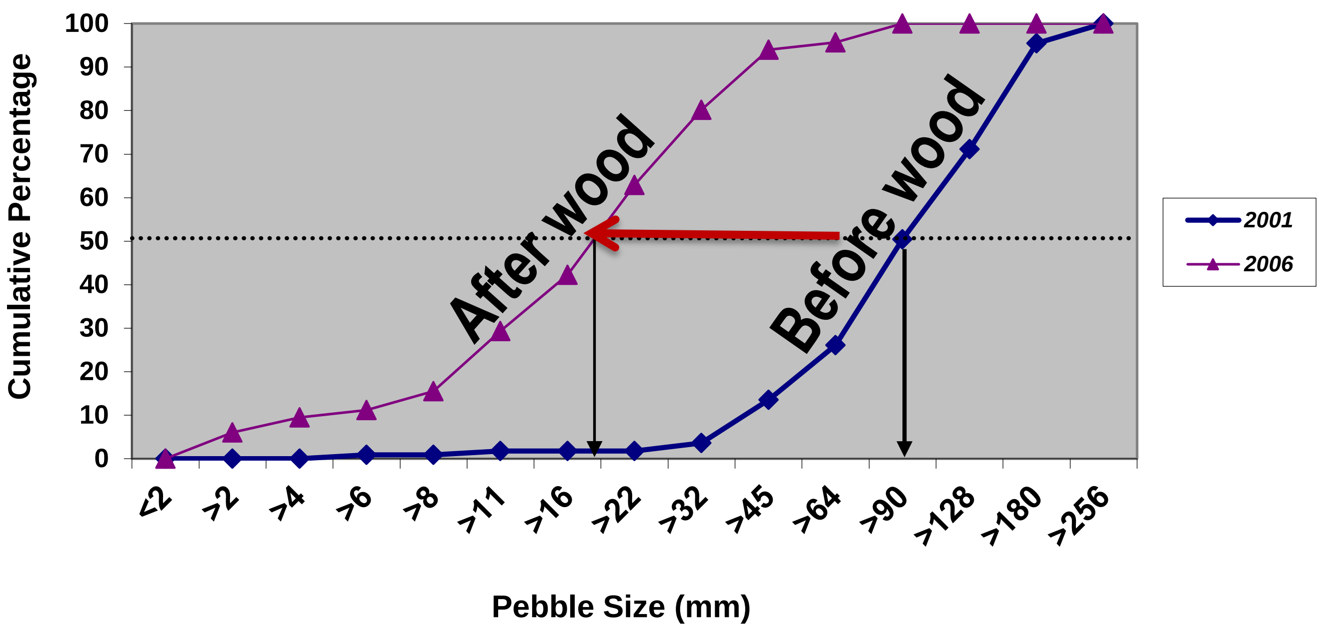
τ_{LWD} increases exponentially with increasing LWD density

(right to left on plot)



Engineered logjams lower shear stress available for sediment transport, reducing grain size of bed material



D50 of bed decreased almost 5 fold after ELJs were installed.
D50(before) = 90 mm, D50 (after) = 19 mm

Elwha River, WA
Abbe et al. 2004

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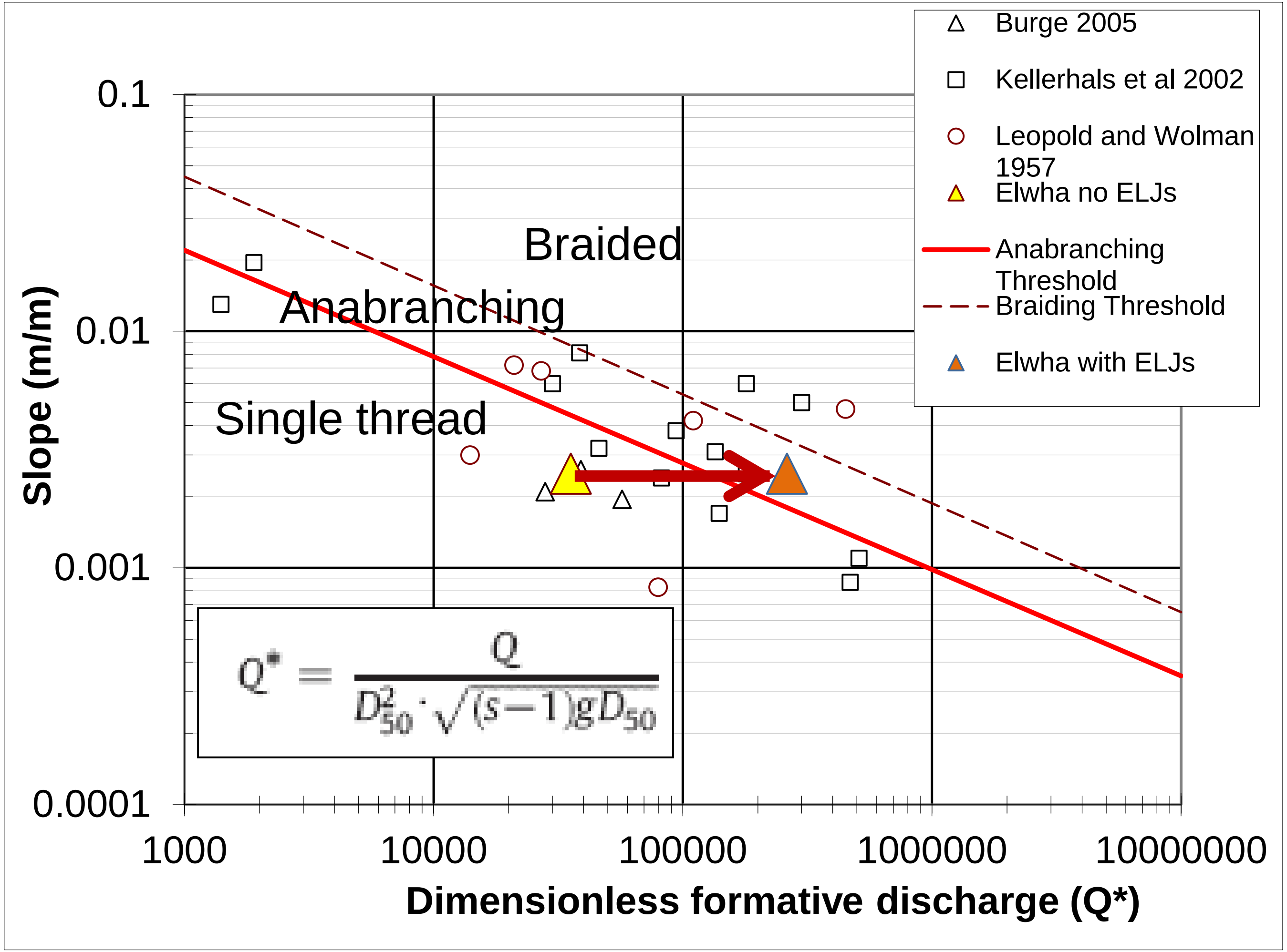

Reducing substrate grain size can change channel planform

(adapted from Eaton et al. 2010)

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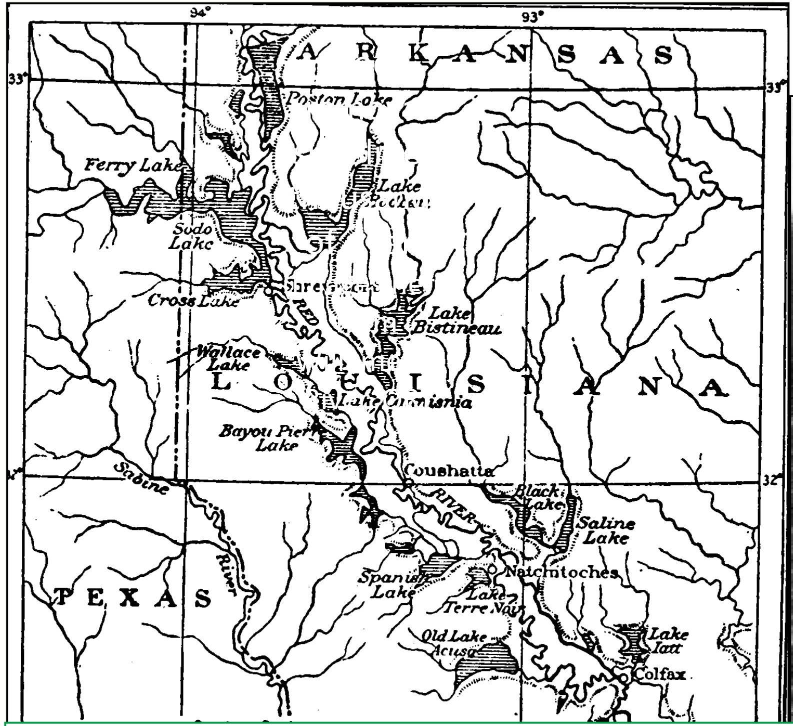
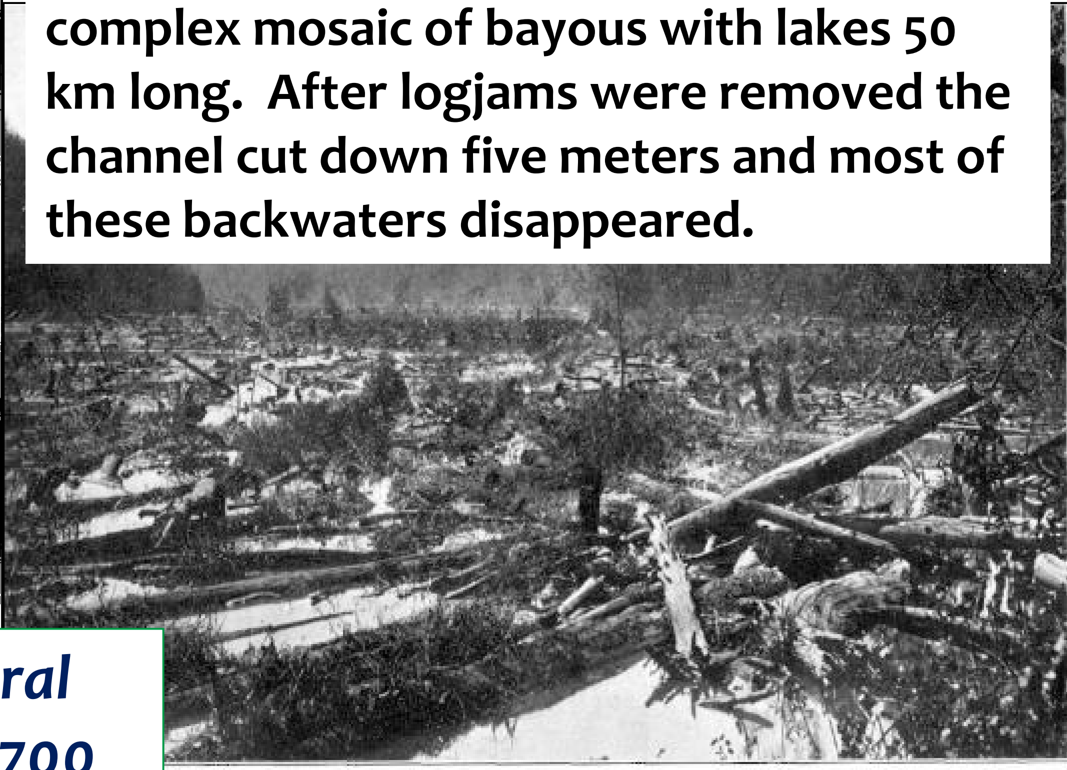
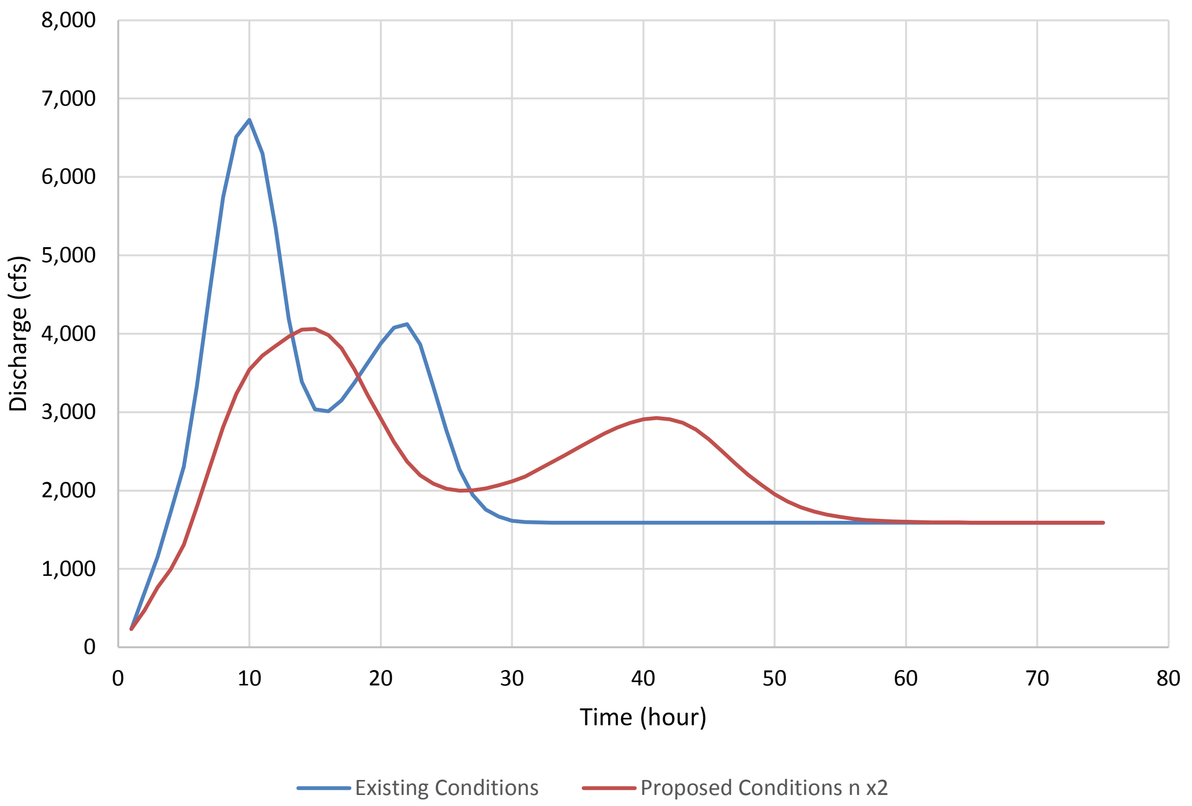


Logjams in the Red River, LA created a complex mosaic of bayous with lakes 50 km long. After logjams were removed the channel cut down five meters and most of these backwaters disappeared.



OF THE SEVERAL TIMBER JAMS COMPOSING THE GREAT RED RIVER RAFT.

Caddo Lake, the largest natural lake in Texas, is formed by a 700 year old logjam

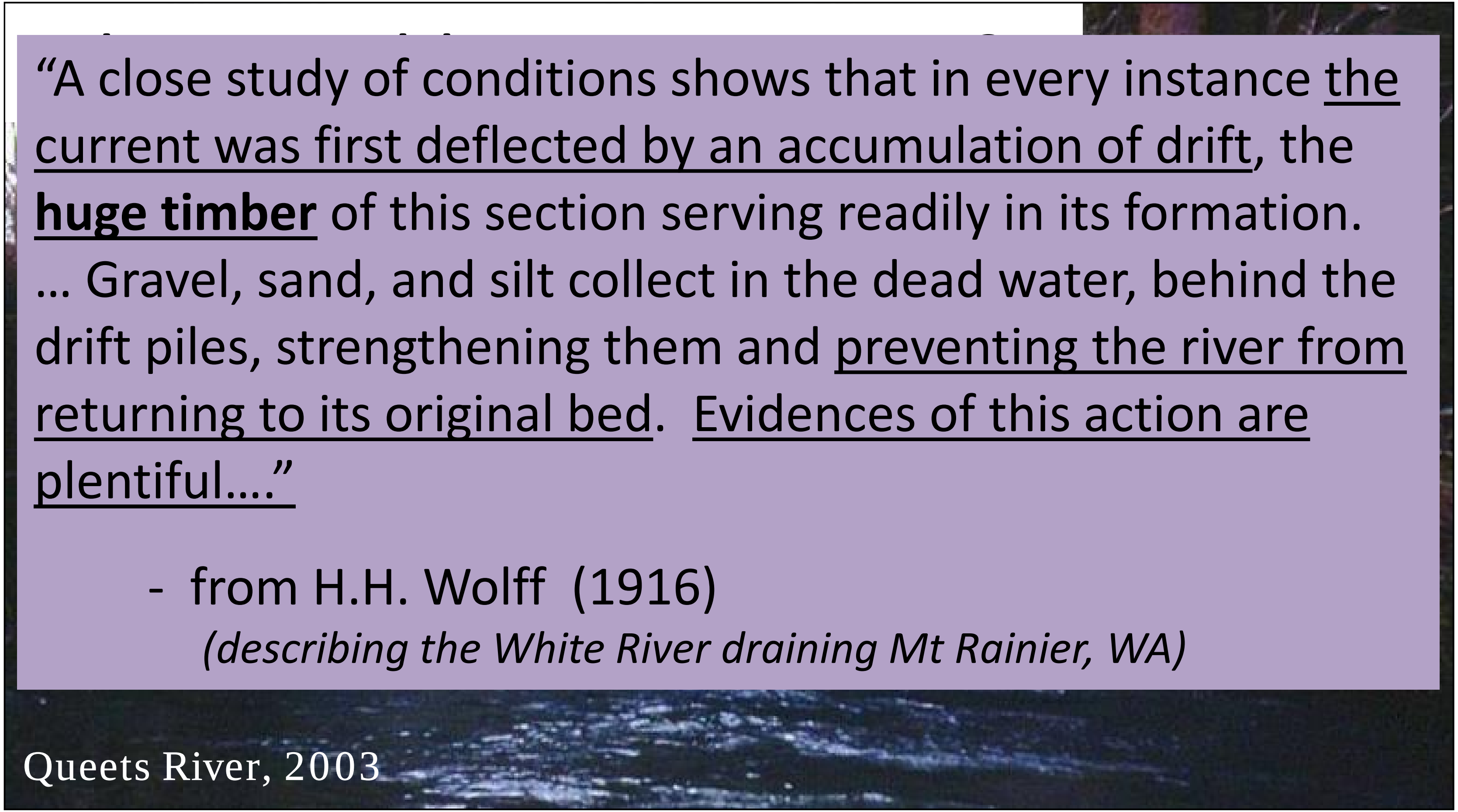


Increasing roughness reduces velocities, raises water elevations and stores more water, increasing habitat in the treatment area and **reducing** downstream flood peaks.

"A close study of conditions shows that in every instance the current was first deflected by an accumulation of drift, the **huge timber** of this section serving readily in its formation. … Gravel, sand, and silt collect in the dead water, behind the drift piles, strengthening them and preventing the river from returning to its original bed. Evidences of this action are plentiful…."

- from H.H. Wolff (1916)

(describing the White River draining Mt Rainier, WA)



Queets River, 2003

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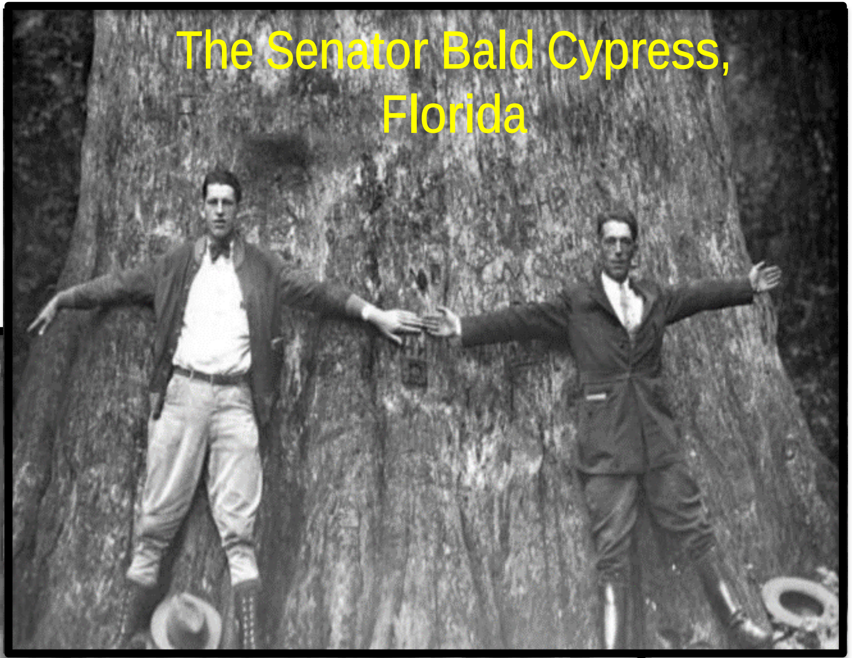
We no longer have the riparian trees we once had



The Problem:

Loss of wood and big trees, channelization, development

The Solution:

Engineered logjams offer means of re-introducing wood to rehabilitate ecosystems, control channel incision, store more water within the channel network, and attenuate flood peaks

Sullivan Creek engineered logjams Pend Orielle County, WA
Natural Systems Design, 2014

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