

Restored & Constructed Wetlands for Phosphorus & Sediment Removal



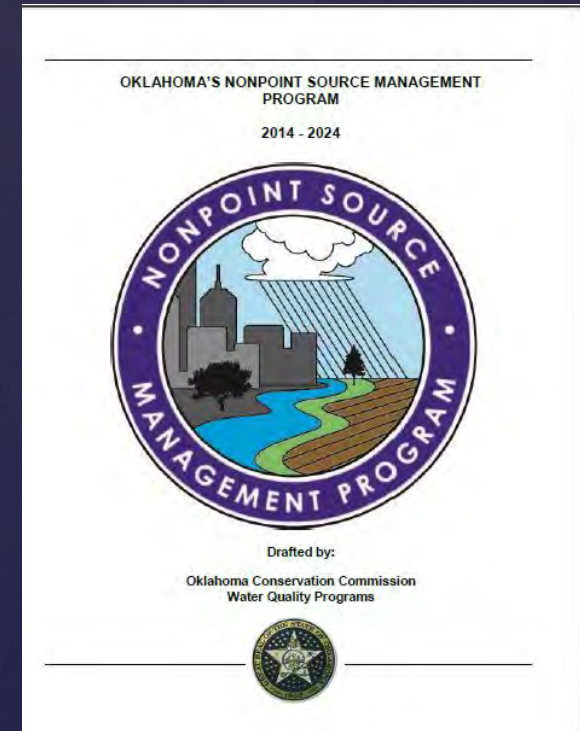
STEVE PATTERSON

BIO X DESIGN

OCLWA 2015 - STILLWATER, OK - APRIL 8-9, 2015

Oklahoma's Nonpoint Source Management Program (2014-2024):

“Wetland restoration, construction, and/or protection for water quality treatment or improvement...are appropriate in nearly all types of land uses or sources, and to address multiple types of causes.”



- Wetland restoration
- Constructed wetlands
 - Treatment wetlands

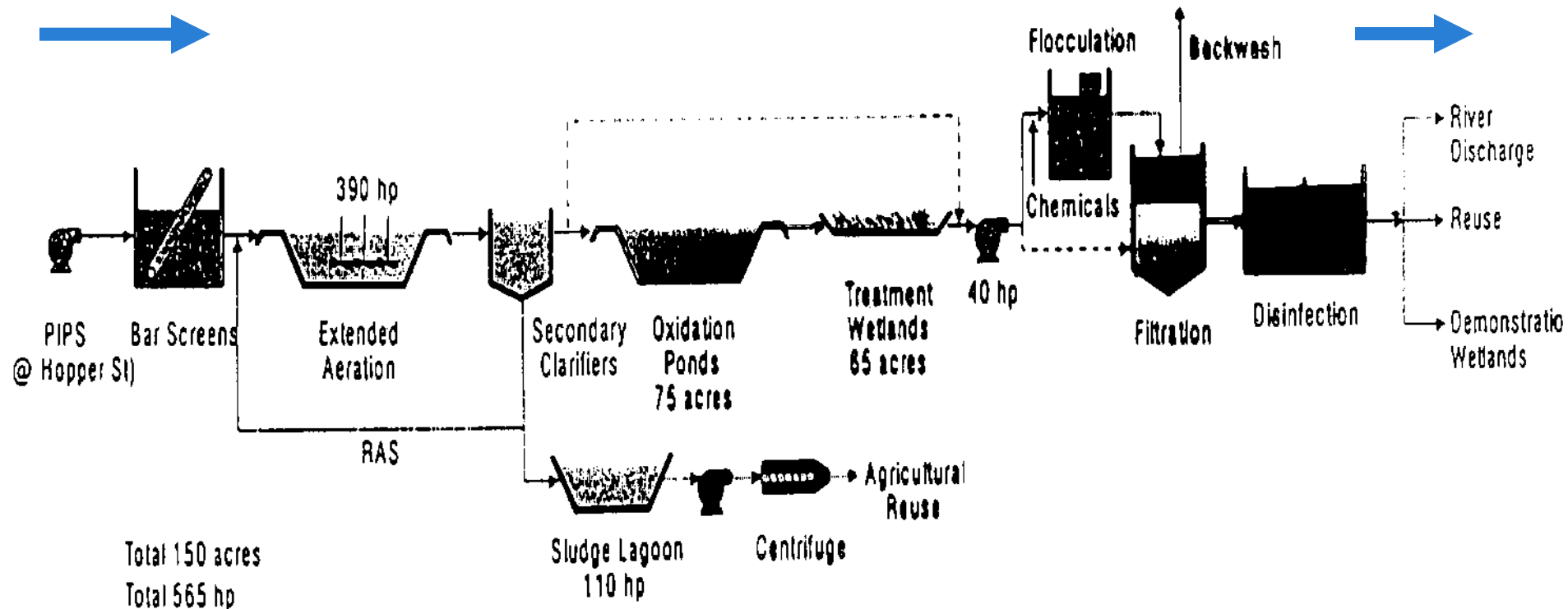


- Processes-based
 - Restoration--what are the ecological & physical processes that create & maintain the wetland you want to restore?
 - Treatment wetlands—what are the processes that you want to use?

- 6 basic wetland types:
 - Swamp
 - Marsh
 - Shallow water
 - Wet meadow
 - Fen
 - Bog



Unit processes in a conventional wastewater treatment plant



Primary wetland processes: that provide water quality improvement:

Sedimentation & trapping:

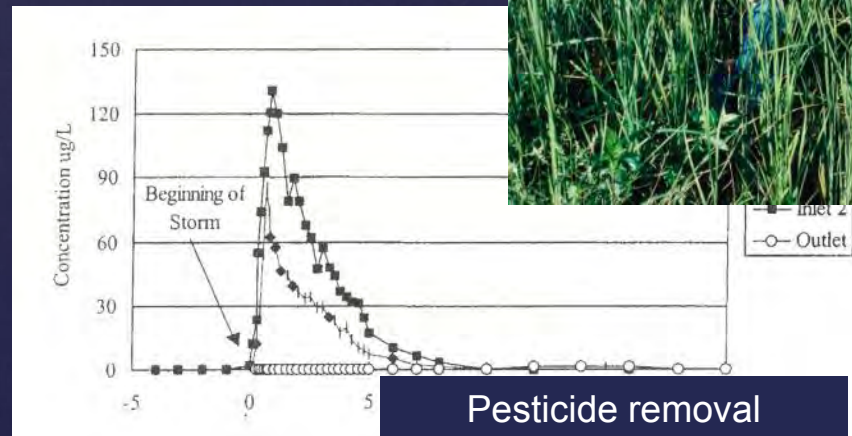
- of particles & sediment;
shallow quiescent water +
biofilm capture &
flocculation
 - **no carbon**

Metabolization:

- of pollutants (eg, nitrate,
some pesticides)
 - **labile carbon**

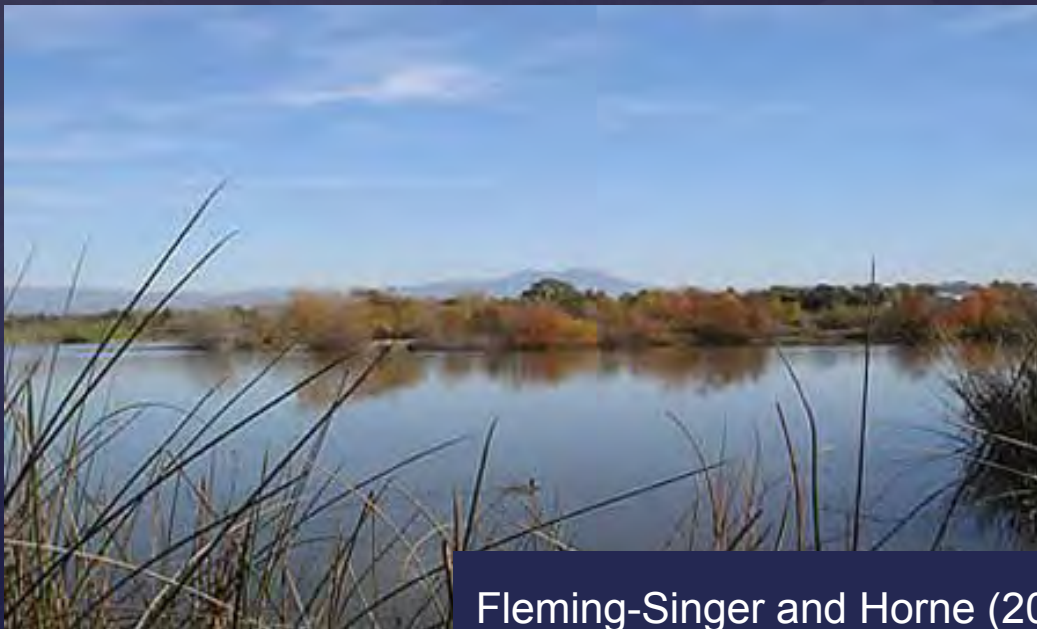
Immobilization:

- Of pollutants (eg, heavy
metals & some pesticides)
 - **refractory carbon**



San Joaquin Wildlife Sanctuary

- › Both treatment and habitat goals
- › Maximize nitrate ($\text{NO}_3\text{-N}$) removal rates
- › Maintain 90% open water and episodically exposed shoreline for avian habitat
- › 80% removal efficiency for total inorganic nitrogen (TIN) and 60% for total nitrogen (TN)
- › Avian species richness 65 to 76 (& up 200) species of shorebirds and waterfowl



Fleming-Singer and Horne (2006)



Upper Truckee River & Wetland Restoration Project South Lake Tahoe, CA

The Project Team:

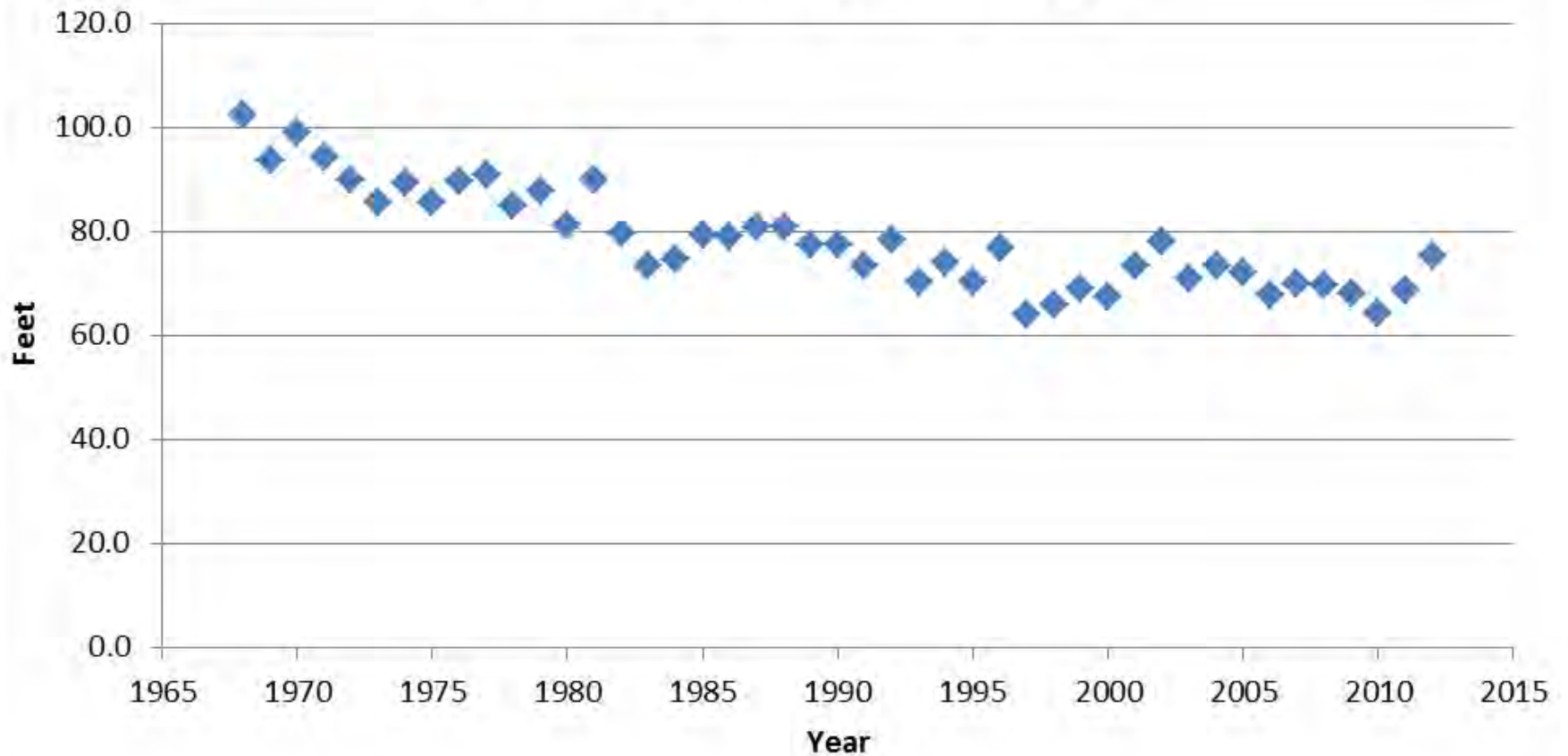
- California Tahoe Conservancy
- California Department of General Services
- EDAW, Inc.
- ENTRIX, Inc.





Lake Tahoe

Annual Average Secchi Depth



“What people want is to be able to see their toes when they are standing in about 3 or 4 feet of water.”

--Ed Fite, Oklahoma Scenic River Commission
Administrator



Pre-development Conditions

December 1930





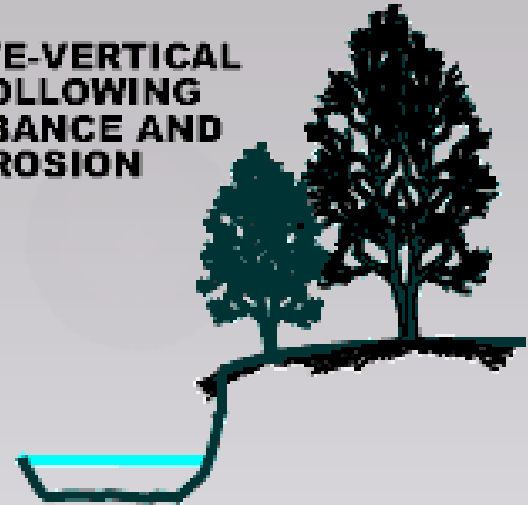


Ozarks Streams

'NATURAL' CONVEX-UPWARD BANK AND CHANNEL



CONCAVE-VERTICAL BANK FOLLOWING DISTURBANCE AND BANK EROSION

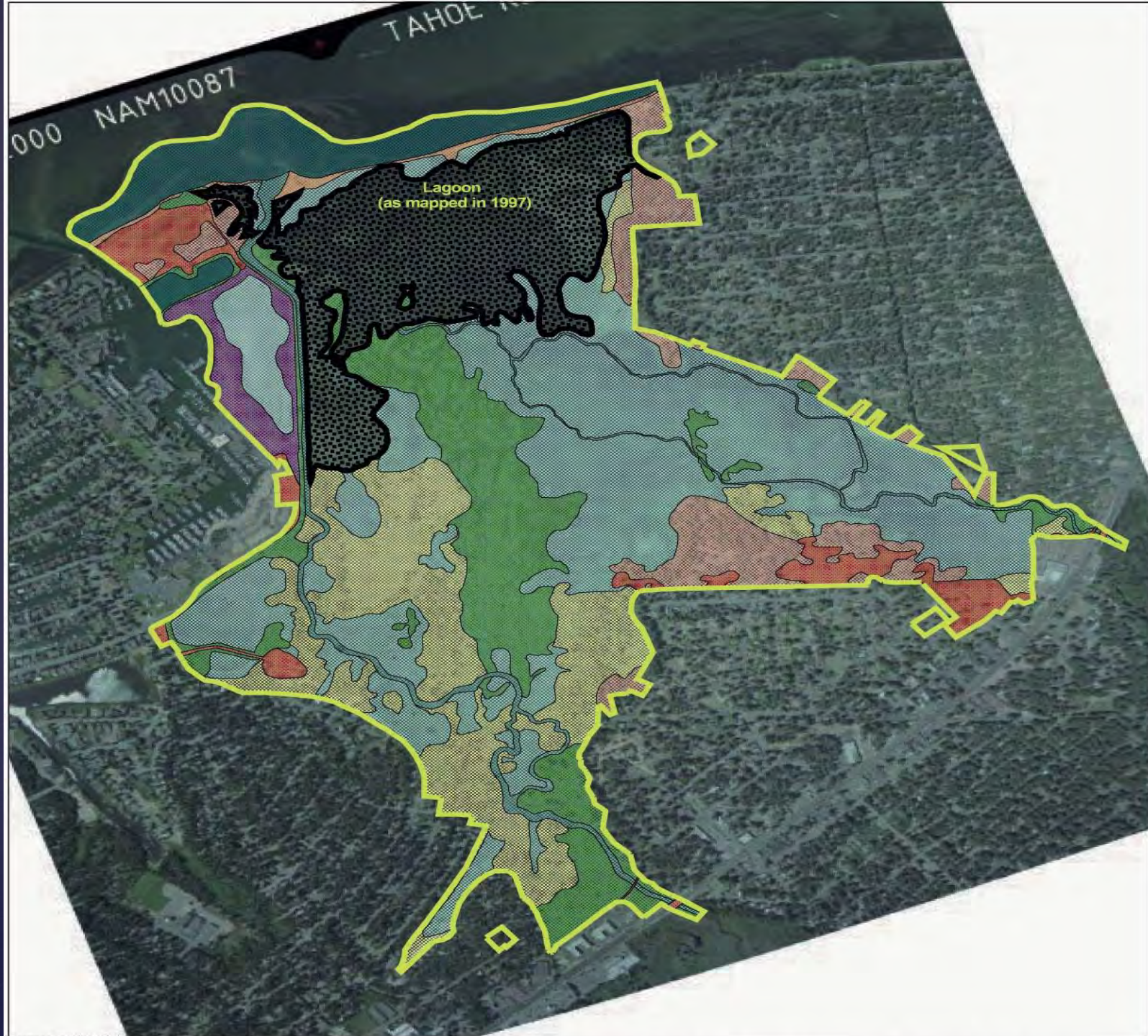


Over the last 100 years, Ozarks streams have become wider and shallower...

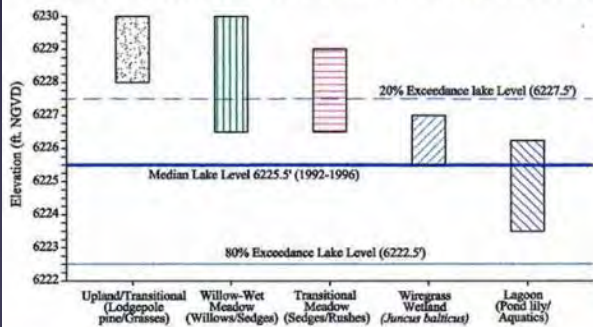
Source: USGS Ozarks Stream Geomorphology Project
<http://www.cerc.usgs.gov/rss/osgp/projecttour.htm>







OBSERVED ELEVATION RANGES FOR VEGETATION TYPES EAST OF PARCEL 4*.



Plant Communities

* Based on September 1998 review (V. Mahabick, S. Patterson, and J. Etra) of WBSW 1995 and 1998 plant community observations. Bar graphs indicate elevations of highest and lowest observations for each plant community.

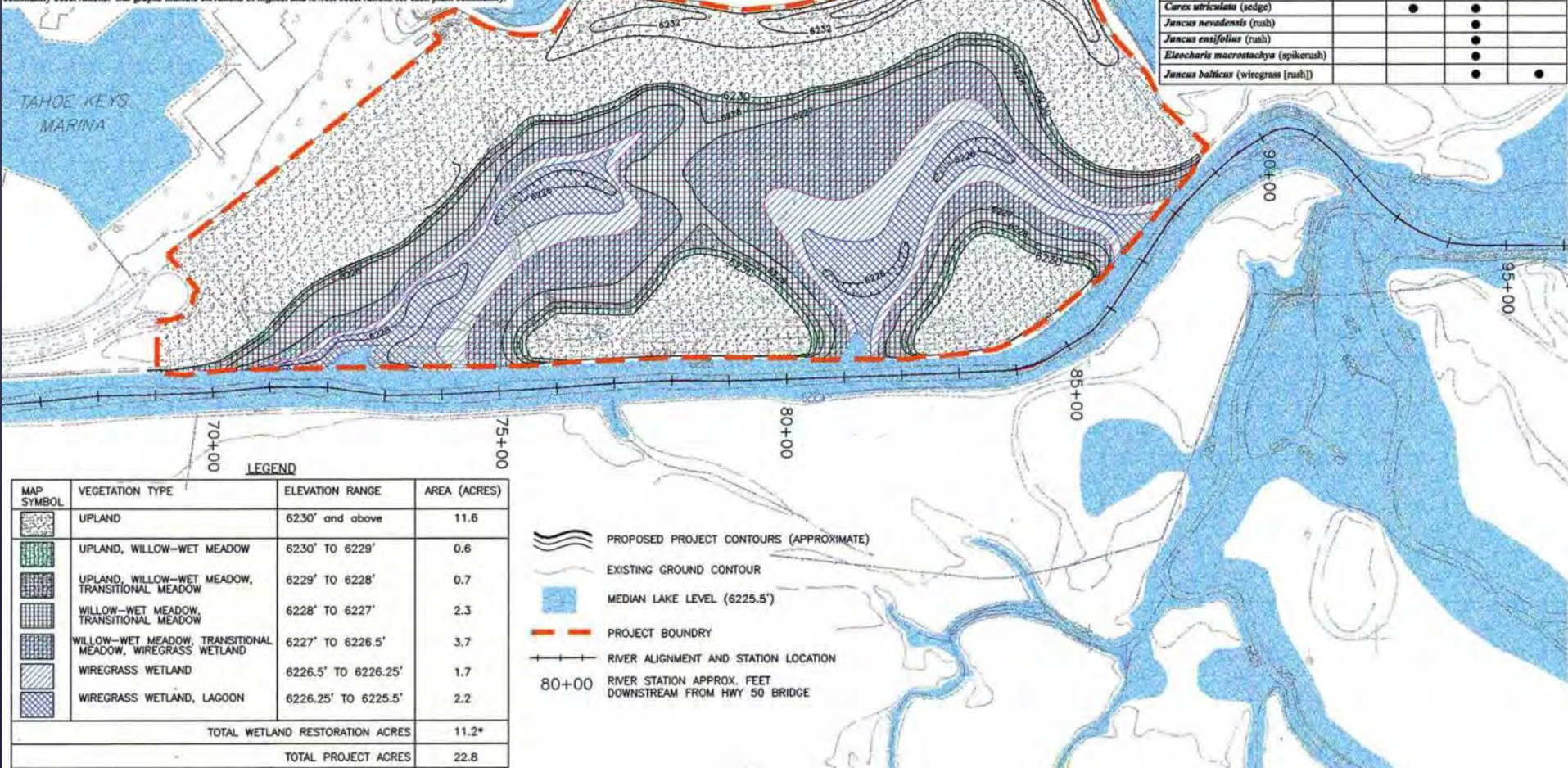


Table 1. Preliminary Restoration Plant Palette, Parcel 4 Full Removal

Species	Target Plant Communities			
	Upland (6230' to 6228')	Willow-Wet Meadow (6228' to 6226.5')	Transitional Meadow (6226.5' to 6225.5')	Wiregrass Wetland (6225' to 6223.5')
<i>Pinus contorta</i> (lodgepole pine)	●			
<i>Ribes lacustre</i> (swamp current)	●			
<i>Bromus carinatus</i> (California brome)	●			
<i>Deschampsia cespitosa</i> (tufted hairgrass)	●			
<i>Horedeum brachyantherum</i> (meadow barley)	●			
<i>Leymus trisetoides</i> (creeping wild rye)	●			
<i>Arnica chamissonis</i>	●			
<i>Potentilla gracilis</i> (cinquefoil)	●			
<i>Salix geyeriana</i> (Geyer's willow)		●		
<i>Salix lemmonii</i> (Lemmon's willow)		●		
<i>Salix lucida</i> var. <i>lasioandra</i> (shining willow)		●		
<i>Carex aquatilis</i> (sedge)		●		
<i>Carex athrestachya</i> (sedge)		●		
<i>Carex praegracilis</i> (sedge)		●		
<i>Carex nebrascensis</i> (sedge)		●	●	
<i>Carex utriculata</i> (sedge)		●	●	
<i>Juncus nevadensis</i> (rush)			●	
<i>Juncus ensifolius</i> (rush)			●	
<i>Eleocharis macrostachya</i> (spikerush)			●	
<i>Juncus balticus</i> (wiregrass [rush])			●	●













Trout Creek floodplain vs Upper Truckee

- Removes 90% of fine particles
- Removes 3-4 times the total P



A landscape photograph showing a field of tall, dry grass in the foreground, with a line of shrubs and trees in the middle ground, and mountains in the background under a cloudy sky.

Questions?