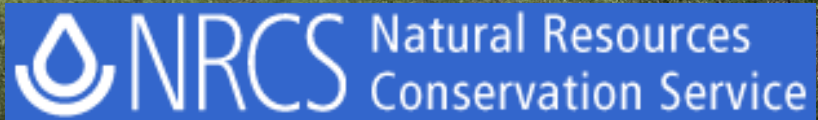


California's Central Valley

Hydrology, the key to understanding ecosystem service delivery



Background

- USDA-NRCS (CEAP) funded research
- Ecosystem services of California's Central Valley and Oregon's Upper Klamath River Basin wetlands
- Partners: Point Blue, USGS-Water Research Center, NRCS (Davis), Sonoma State University, USFWS-NWR



Hydrology – changes in time

1 = Sacramento River

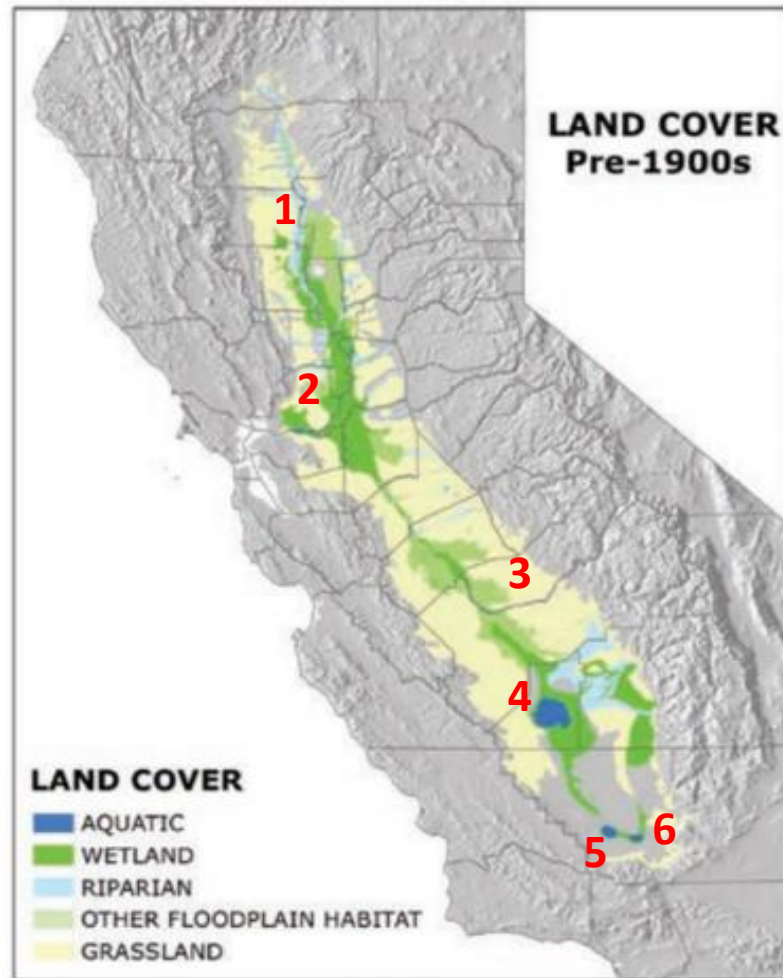
2= Bay/ Delta

3=San Joaquin River

4= Tulare Lake

5=Buena Vista Lake

6= Kern Lake



Disappearance of Central Valley wetlands © Central Valley Historical Information Center, 2003



Tulare Lake and the southern San Joaquin Valley in the early 1870s. At the onset of American settlement in the area in the late 1840s, the lake was the largest body of fresh water west of the Great Lakes. Its destruction by the late 1800s because of diking and water diversion for irrigation was one of the most dramatic signs of a major theme in the state's history: the rapid transformation of the wild California landscape into one dominated almost completely by human action. From *Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California* (Washington: Government Printing Office, 1874). Courtesy Huntington Library.

1 = Sacramento River – channelized/dammed

2= Bay/ Delta – drained/channelized

3=San Joaquin River - channelized

4= Tulare Lake

5=Buena Vista Lake

6= Kern Lake

Wetland Restoration

- USDA programs
- Restored 24,000 hectares since inception
- Ecosystems services
 - **Provisioning** e.g., biodiversity, habitat
 - **Regulating** e.g., carbon storage, water quality, groundwater recharge
 - Cultural
 - Supporting

The screenshot shows the USDA Natural Resources Conservation Service website. The header includes the USDA logo, the text "Natural Resources Conservation Service", and the "United States Department of Agriculture". Navigation links for "Topics", "Programs", "Newsroom", "Blog", and "Contact Us" are present. A search bar and social media icons are also visible.

The main content area is titled "Agricultural Conservation Easement Program". It features a large image of two people in a field with the ACEP logo overlaid. Below the image, a paragraph describes the program's purpose: "The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands."

On the left side, there is a "Programs" sidebar with a tree structure listing various programs, including "Farm Bill", "Financial Assistance", "Technical Assistance", and "Easements".

Below the sidebar, there is a "Conservation Compliance" section with a graphic and a link to "Conservation Compliance Home".

At the bottom, there is a "Benefits" section titled "USDA Seeks Partner Proposals to Protect and Restore Critical Wetlands". It states: "NRCS is making \$15 million in financial and technical assistance available to help eligible conservation partners leverage local resources to voluntarily protect, restore and enhance critical wetlands on private and tribal agricultural land nationwide. The funding is provided through the Wetland Reserve Enhancement Partnership, a special enrollment option under the Agricultural Conservation Easement Program. **Proposals are due to NRCS State Offices by May 16, 2016.**"

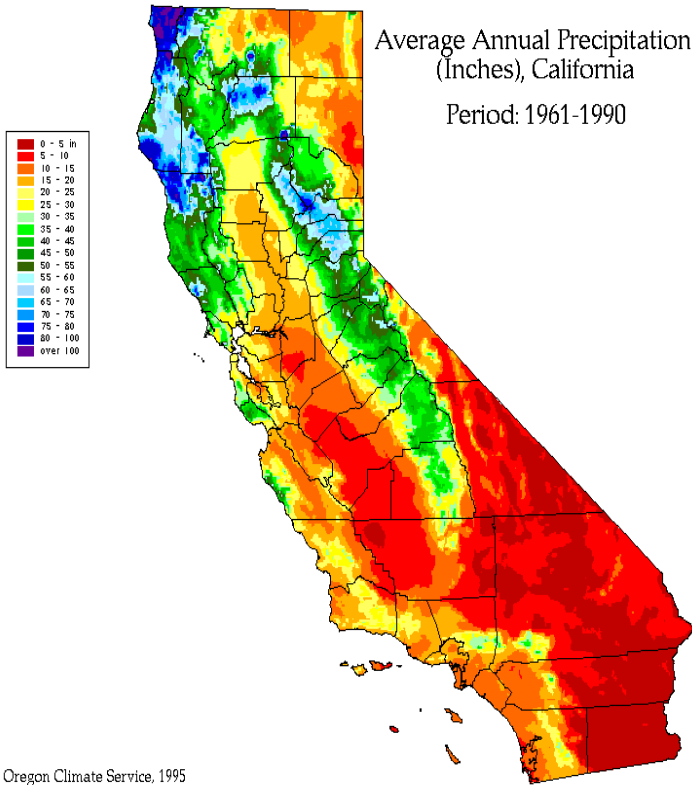
On the right side, there is a "What's New in ACEP?" section. It mentions: "NRCS is now accepting project proposals from eligible conservation partners to restore, protect and enhance critical wetlands. **WREP proposals are due to NRCS State Offices by May 16, 2016.**" It also includes a link to a YouTube webinar: "Transition to ACEP Webinar on YouTube (opens in new window)" with the URL <https://youtu.be/9gDYYJ01zIQ>.







Climate and Management linked



Unmanaged



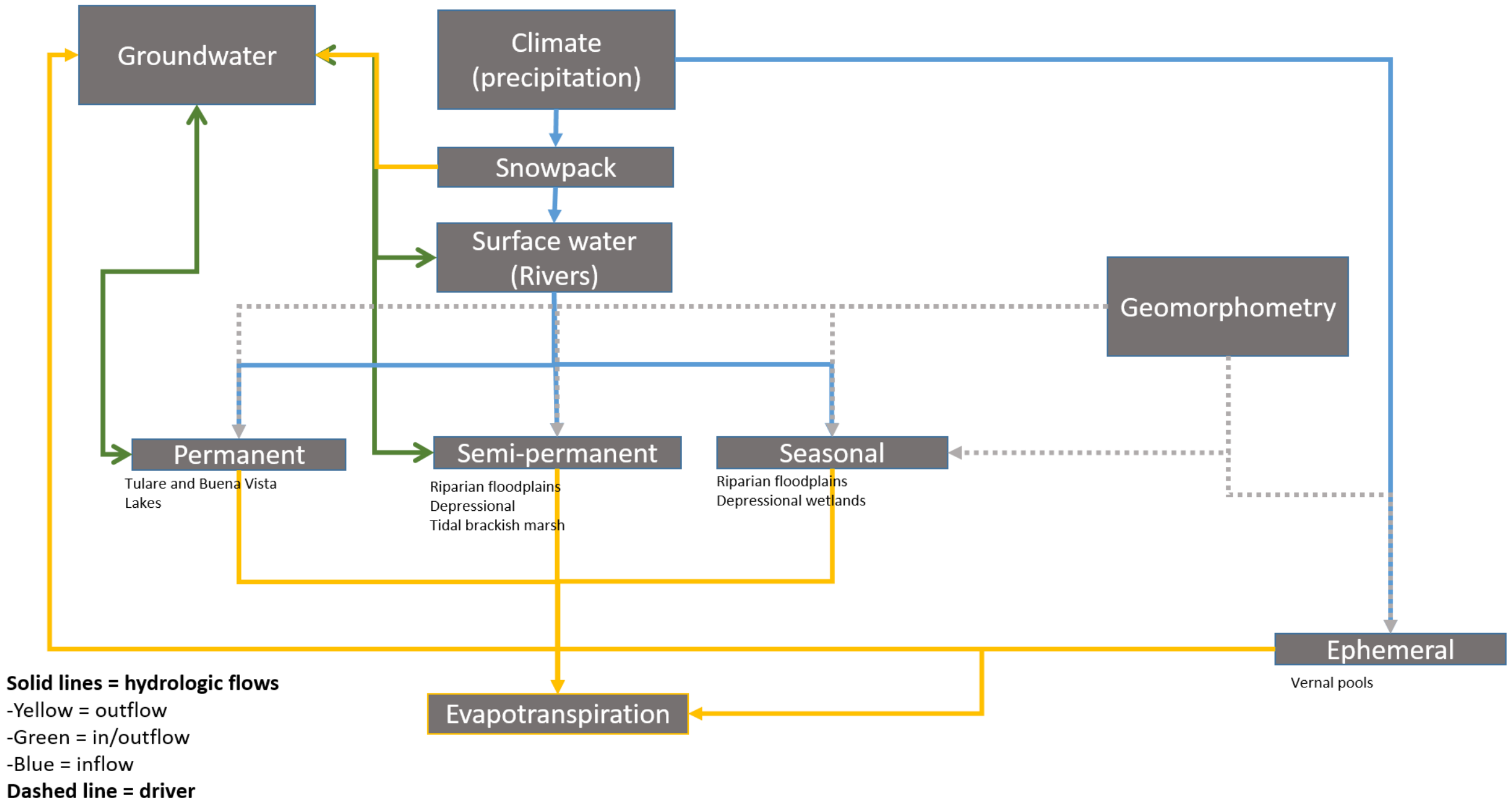
Intermediate



Intensive

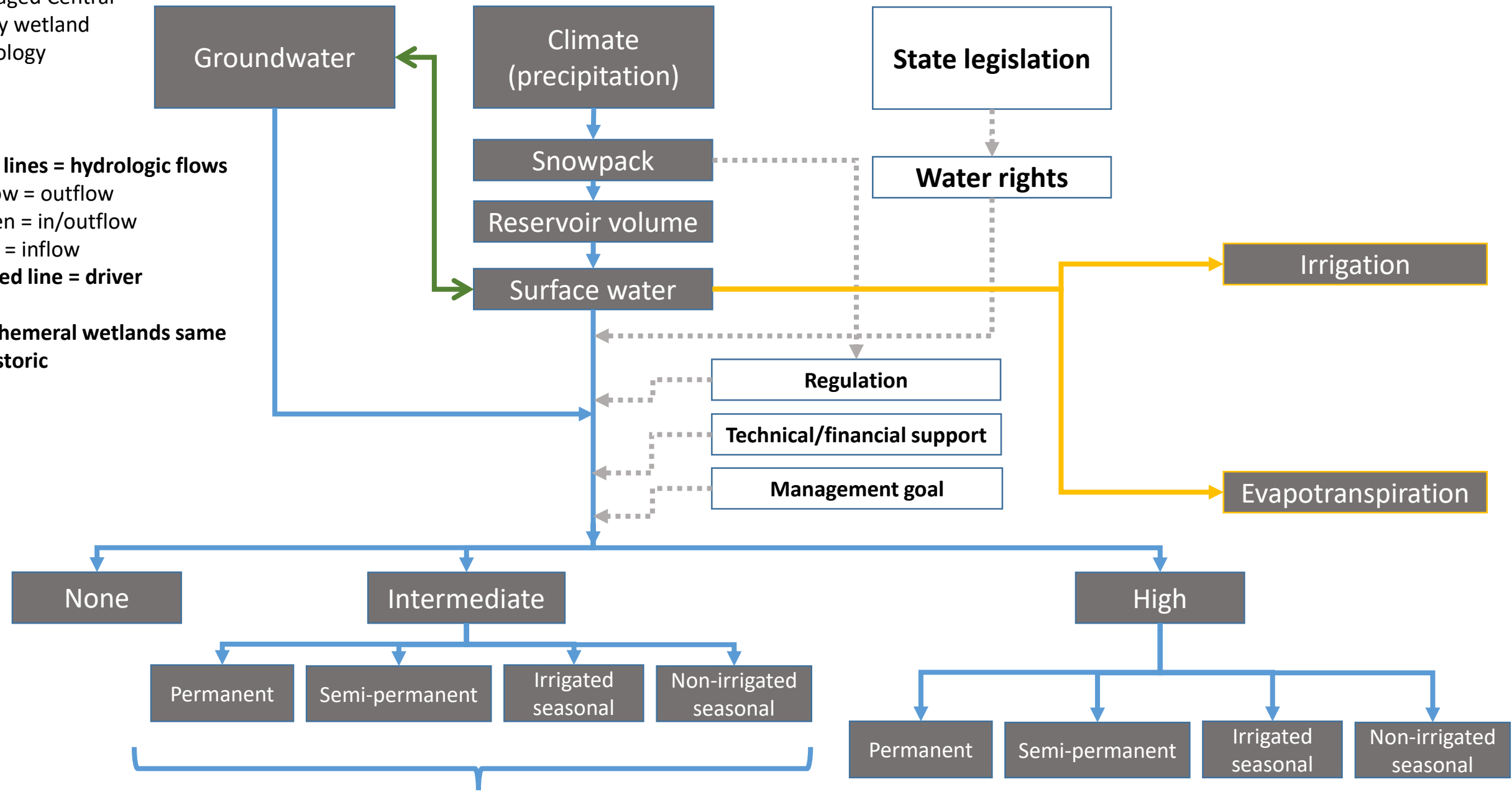
No active management following restoration or less than 50% of time since restoration	Flooded annually for more than 50% of time since restoration	Flooded, Drawn-down, Mowed, disked, burned, grazed, chemical weed control, moist soil management, emergent cover management

Historic Central Valley wetland hydrology





Solid lines = hydrologic flows
-Yellow = outflow
-Green = in/outflow
-Blue = inflow
Dashed line = driver

****Ephemeral wetlands same as historic**

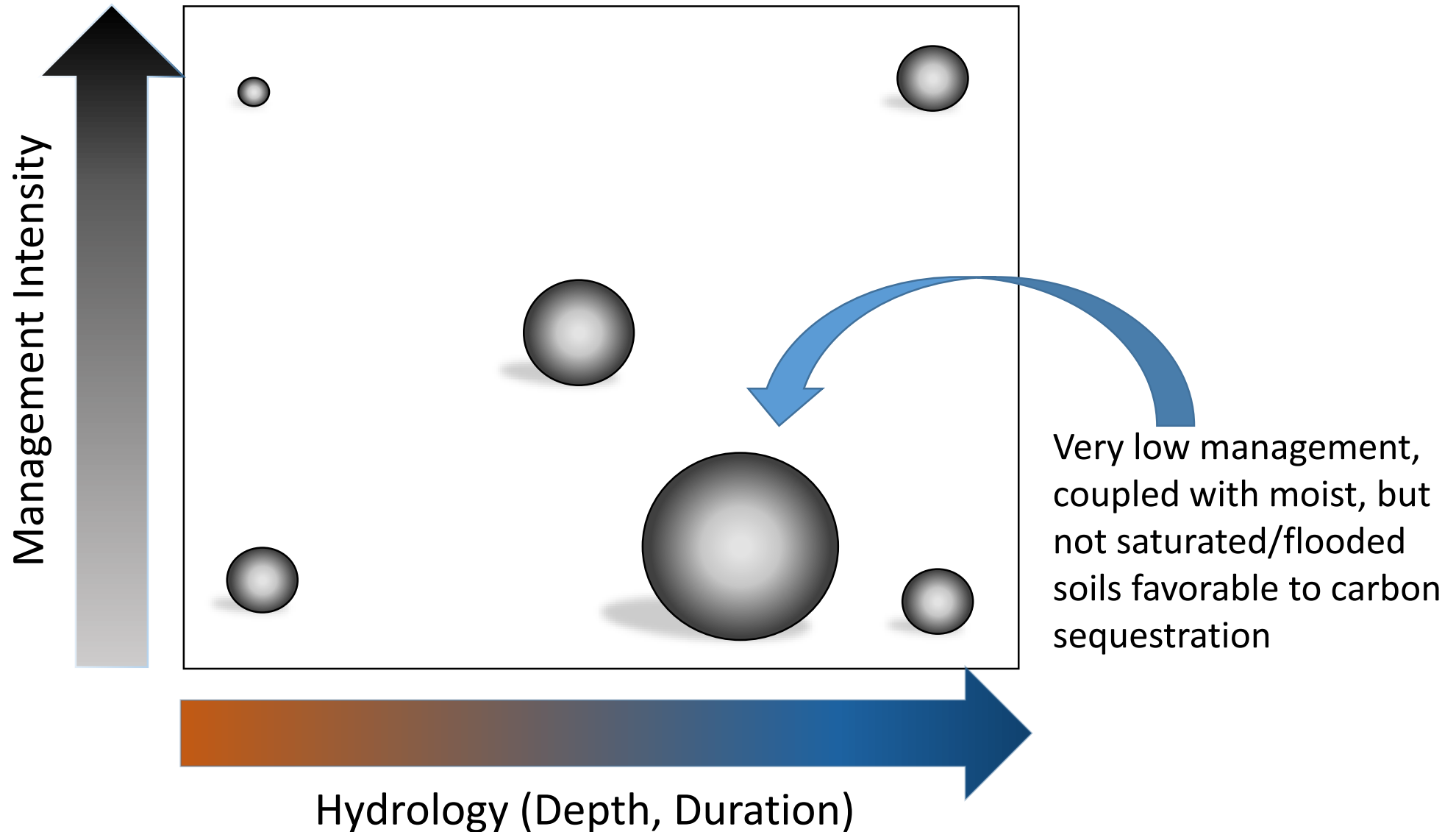


As in Intensively managed sites, but unmanaged ~50% of time since restoration

Assessment summary-climate and management

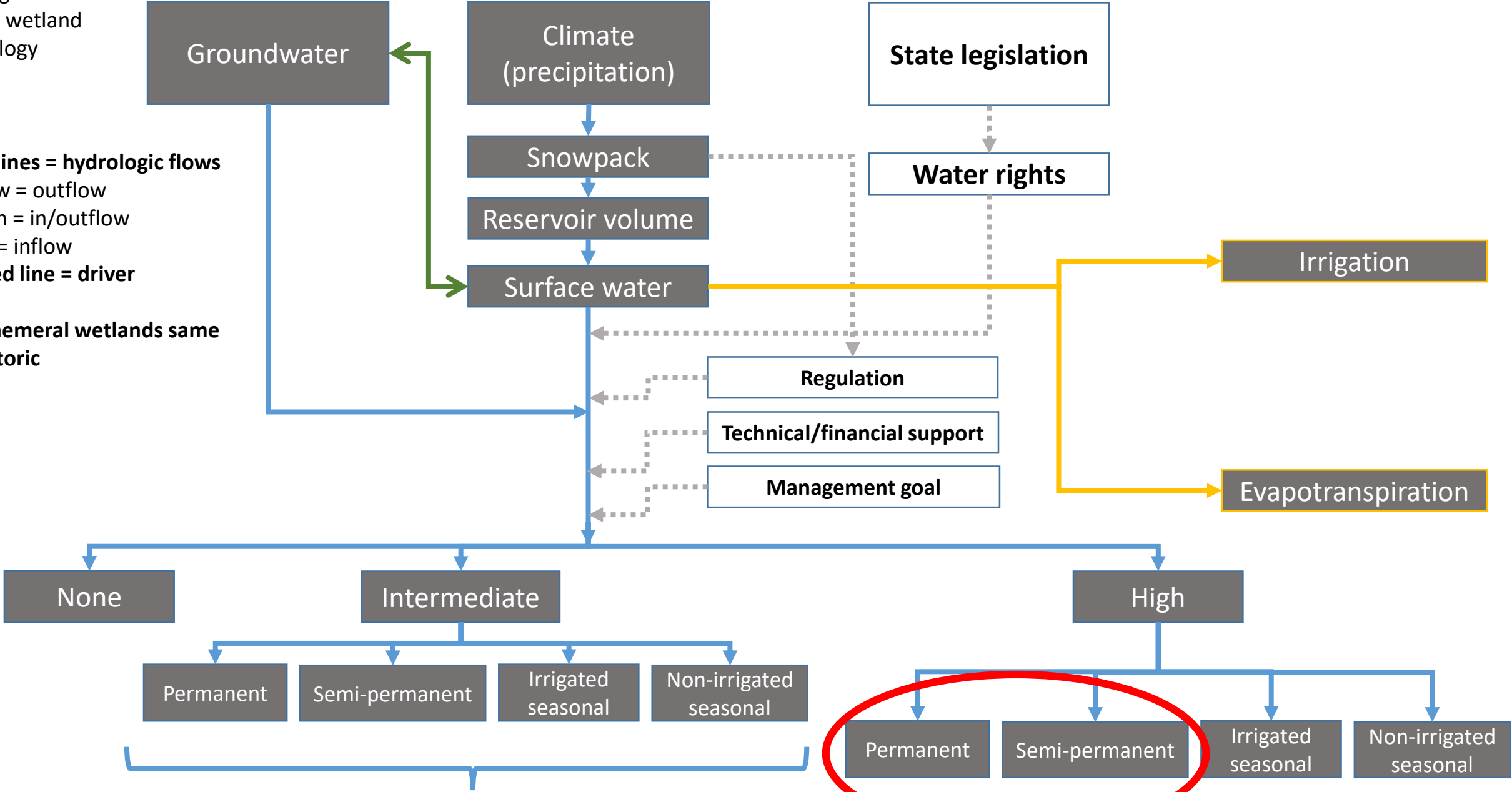
Unmanaged, Low management		Intensive management	
			
Upland plants (biodiversity/carbon)		Soil carbon (carbon/climate stabilization)	Wintering waterfowl (biodiversity/recreation)
Upland birds (biodiversity/recreation)		Shorebirds (biodiversity/recreation)	Breeding waterfowl (biodiversity/recreation)
Pollinators		Amphibians (biodiversity/recreation)	Water quality (clean water)
		Wetland plants (biodiversity/carbon/nutrient uptake)	

Hydrology and management – Carbon



Solid lines = hydrologic flows
-Yellow = outflow
-Green = in/outflow
-Blue = inflow
Dashed line = driver

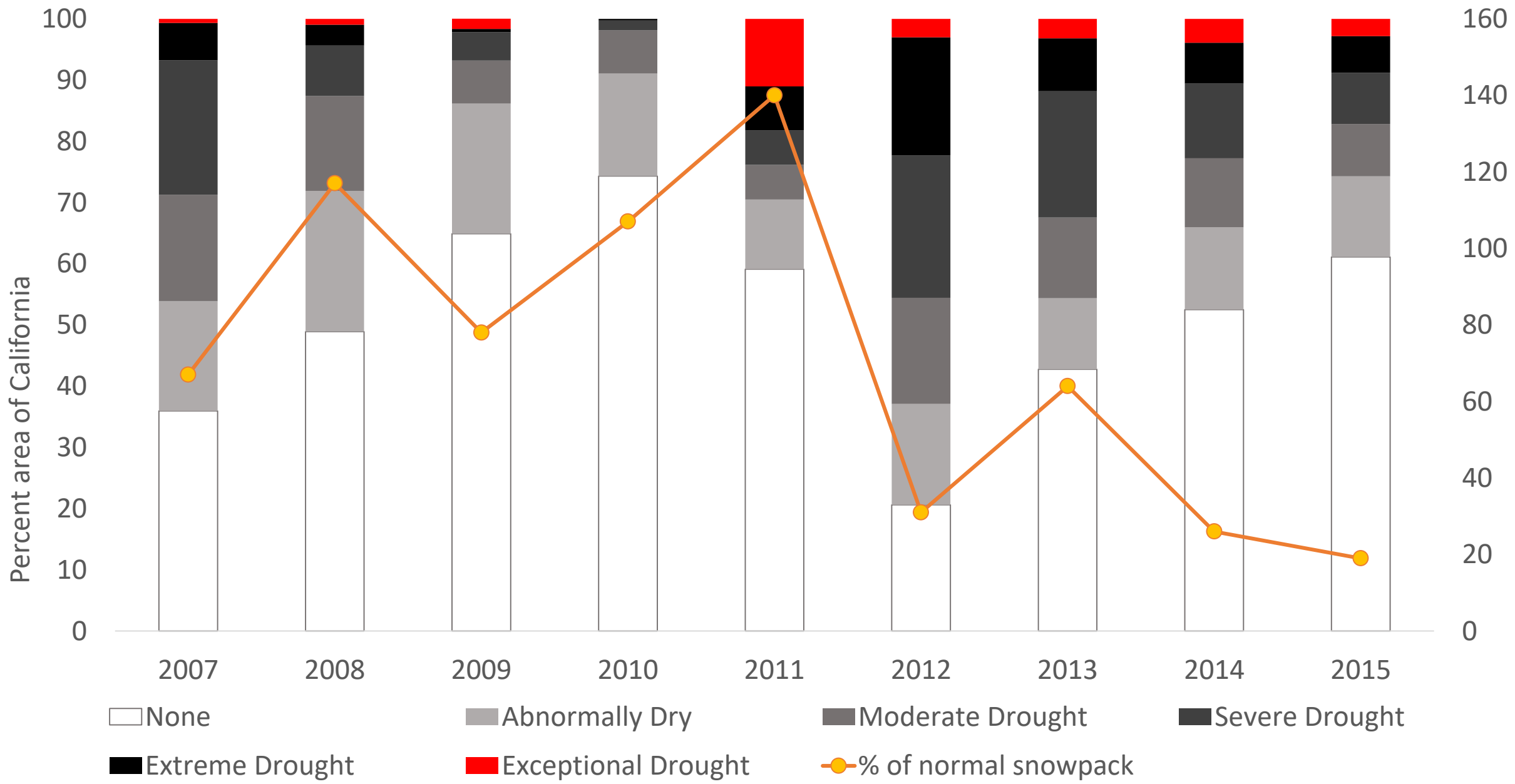
****Ephemeral wetlands same as historic**



As in Intensively managed sites, but
unmanaged ~50% of time since
restoration

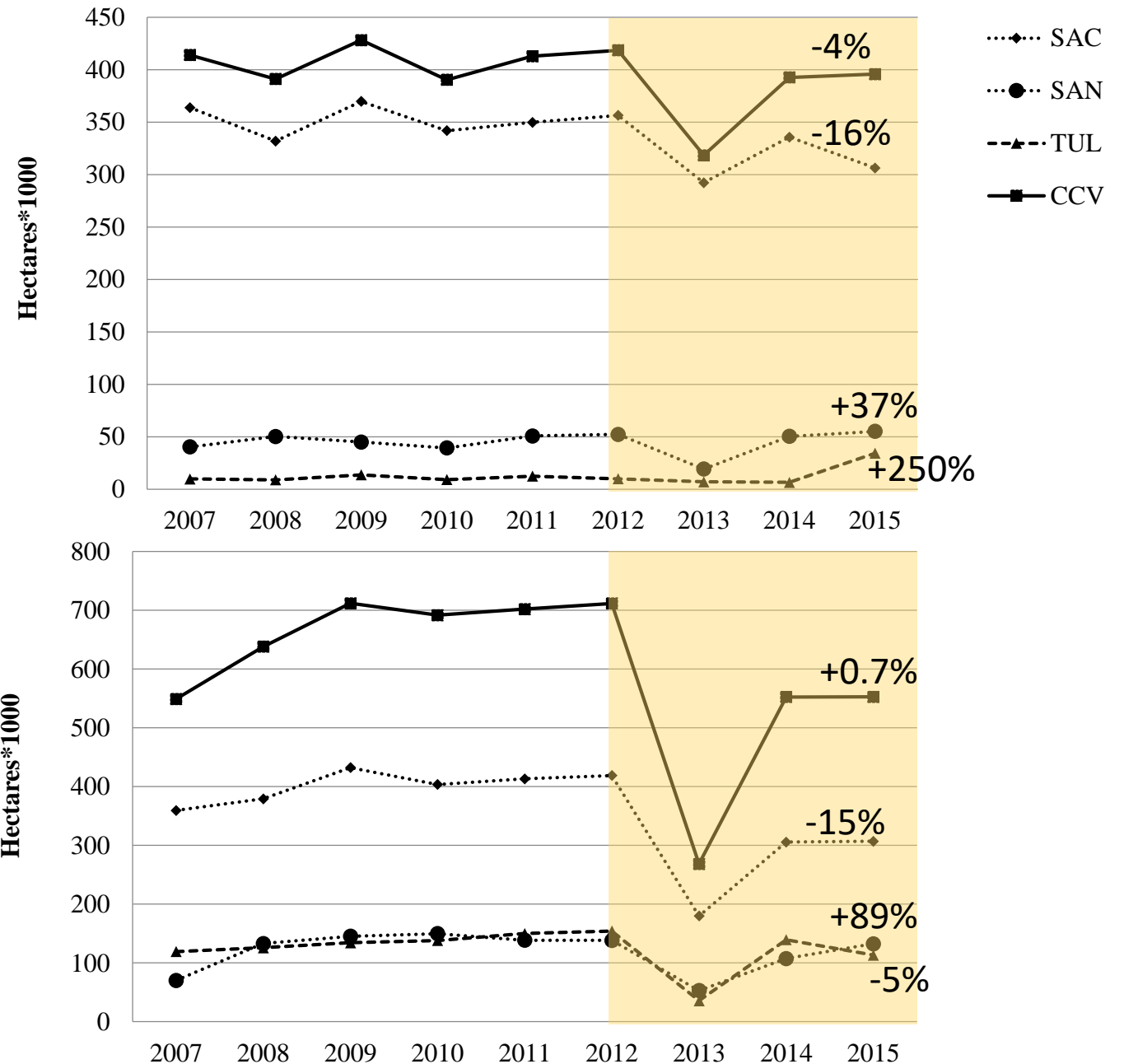
Drought impacts

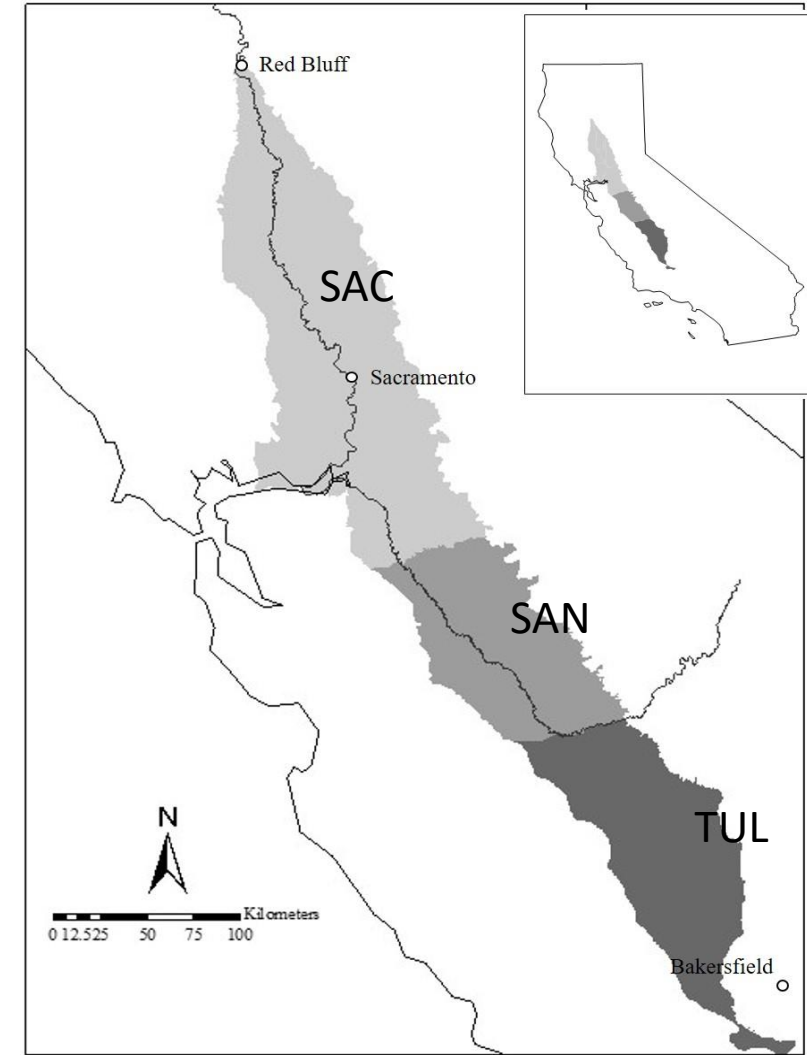
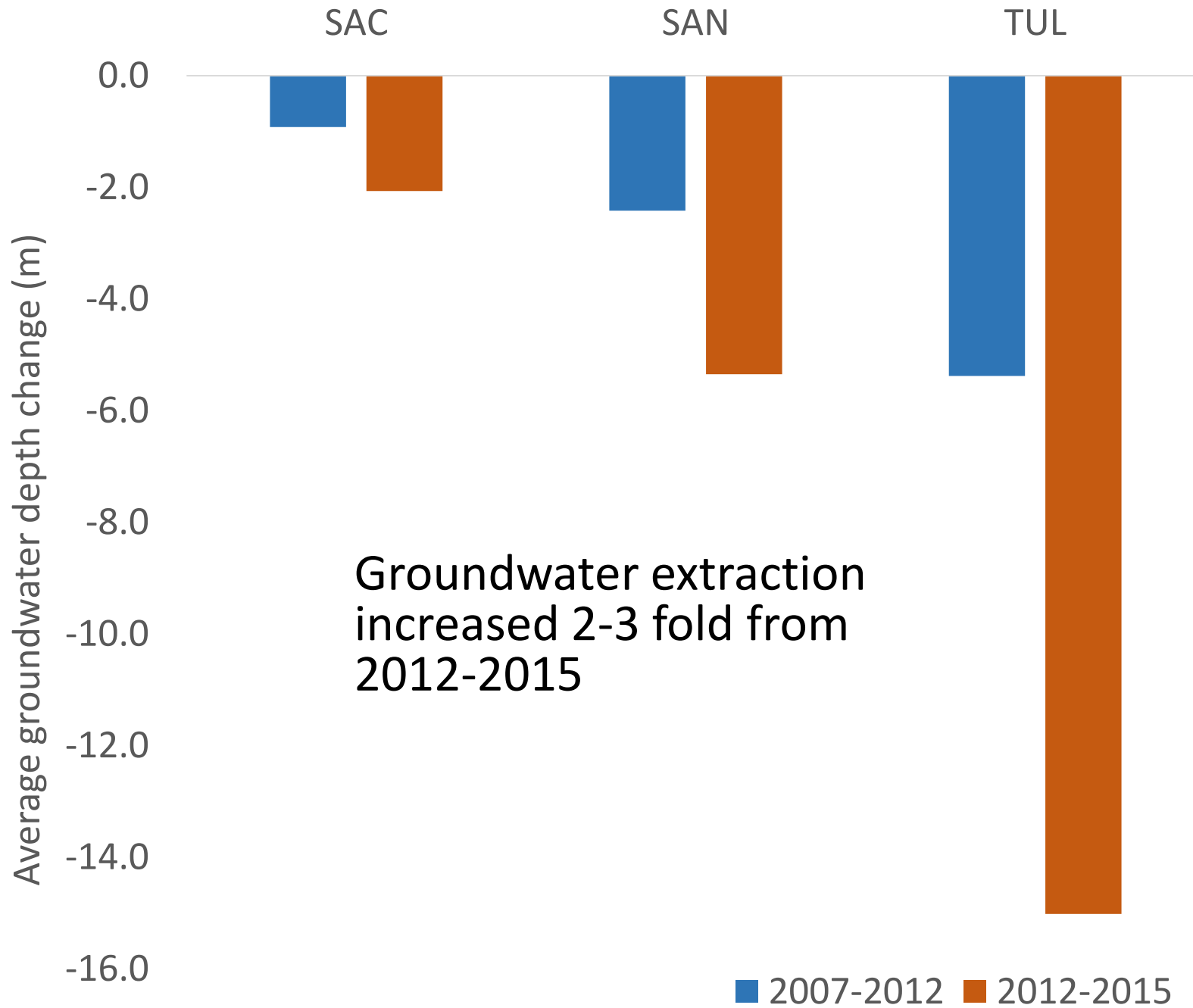




Drought impacts

- InVEST models 2007-2015
- Waterfowl and shorebird habitats declined in northern Central Valley
- But increased substantially in southern Central Valley
 - Similar trends on WRE
 - (~1-2% of waterfowl/shorebird habitat in CCV)
 - Despite worsening drought





Conclusions and recommendations

- Intensive management linked to climate and legislation favors some key functions, but not all.
- Hydrology key, but need to parameterize links between natural and socio-political components in model.
- Recommend that agencies and institutions collect management related information and integrate into analyses.
- Groundwater supplements surface water shortfalls, but unsustainable and negatively impacts infrastructure.
- Investigate degree to which various ecosystem services are dependent on surface vs. groundwater.

Acknowledgements

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- Judy Drexler, USGS California Water Science Center

