

Diversifying Central Valley's  
Water Supply: Can  
Produced Water have a  
Role for Agriculture?

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Almond Board of California  
8/10/16

# California's Water Supply is Changing....

- Increased Population in the State
- Water Availability
  - Sustainable Groundwater Management Act (SGMA)
  - Endangered Species Act
  - Delta restoration/ SJ River restoration
  - Dam relicensing
  - Climate Change
  - Colorado River
- Water Quality
  - Porter Cologne Act
    - Irrigated Lands Regulatory Program
    - CV-SALTs
  - Clean Water Act (TMDLs)



# Basics of Water in California

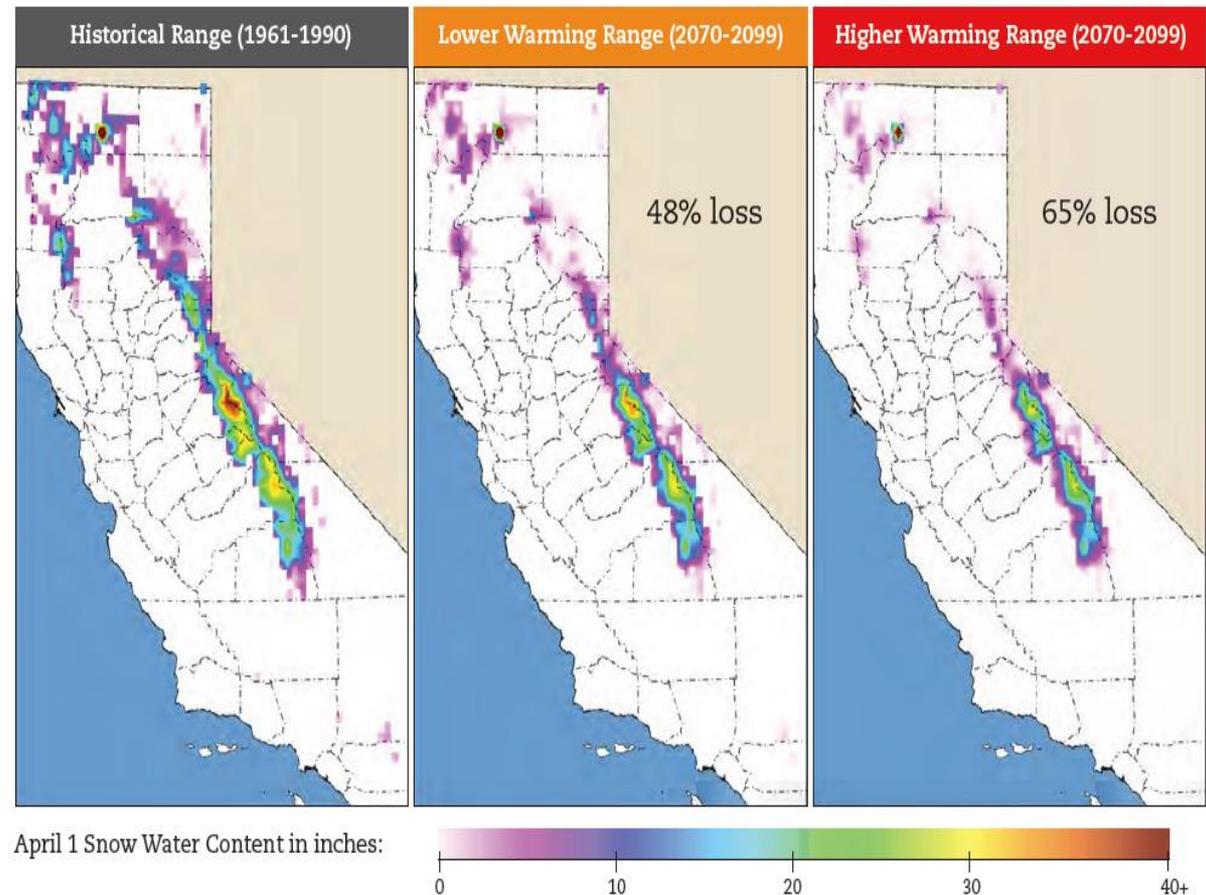


- It rains/snows in winter and doesn't rain in summer (Mediterranean climate)
- System moves water from north to south and from winter to summer (snow pack)
- 75% of available water (water, snow) originates north of the Delta – California's "water hub"
- 80% of the water is used south of the Delta
- 65% of the water relies on snow pack in the mountains
- Current system set up for 2/3 current population
- Continued debate and efforts to diversify the water supply
- Droughts recur in Mediterranean Climates

# Water Availability Changing: California Snowpack

- Based on modeling research at Scripps Institution on Oceanography, by the end of the century, the Sierra snowpack may experience a 48-65% loss from the 1961-1990 average.
- Due to climate change, warmer temperatures are expected to change streamflow patterns. Since early 20<sup>th</sup> Century, there has been a decline of 5-13% in spring runoff (April to July) for major rivers in Northern California.

Historical and Projected California Snowpack



Historical and projected April 1 Snow Water content for the Sierra for lower and higher warming scenarios depicting the effect of human generated greenhouse gases and aerosols on climate. By the end of this century, the Sierra snowpack is projected to experience a 48 to 65 percent loss from its average at the end of the previous century.

# Water Availability Changing: Regulatory



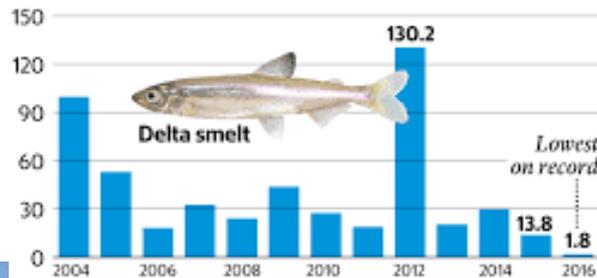
## Endangered Species Act:

- Pumping limited due to Delta Smelt
  - Flows for water temperature for listed salmon species
- ➔ Less water been able to move from north to south

### Delta smelt abundance

Scientists use trawl nets to survey smelt populations at many Delta locations. They report the results as an index of the number fish relative to the volume of water sampled.

#### Spring adult index



Sources: California Department of Fish and Wildlife

The Sacramento Bee



## Restoration/ SJ River Restoration

- Maintain temperatures or flows for endangered fish in Sacramento River
- Flows to prevent salt water intrusion in Delta
- SWB expected to require 50% unimpaired flows for Stanislaus, Tuolumne, Merced Rivers

## Dam Relicensing

- Every 50 years the dam operations need to be reviewed and relicensed by FERC
- A number of key dams are at that point
- Opportunity for current operations to be revised to account for wildlife or habitat issues

San Luis Reservoir 8/4/16

# Recent History of Surface Water Allocations to Central Valley Project and State Water Project

Changes due to both drought and regulatory limits on pumping  
Pumping restrictions due to smelt started in 2007

Year	Central Valley Project	State Water Project
2016	5%	60%
2015	0	20
2014	0	20
2013	20	35
2012	40	60
2011	80	80
2010	45	50
2009	10	30
2008	40	35
2007	50	60
2006	100%	100%

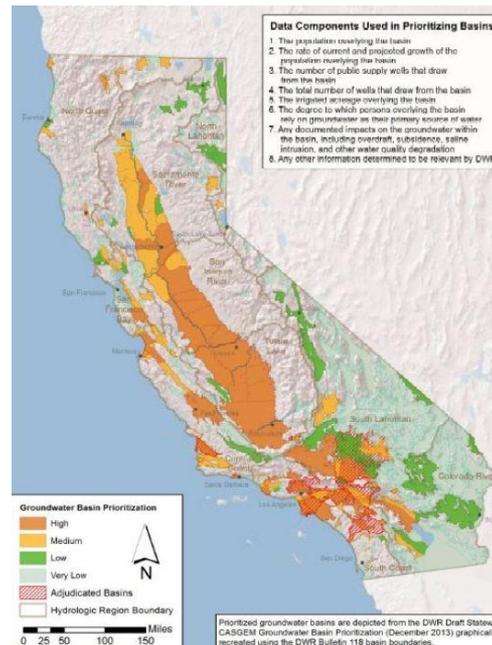
# Water Availability Changing: Regulatory

## Sustainable Groundwater Management Act (SGMA)

- Groundwater needs to be managed such that it is not being consistently depleted.
- ➔ Will not be able to rely on groundwater (~ 40% of almond growers rely exclusively on groundwater)
- Groundwater use that affects surface water (common near streams and rivers) will be restricted
- Groundwater recharge will help to manage it more sustainably

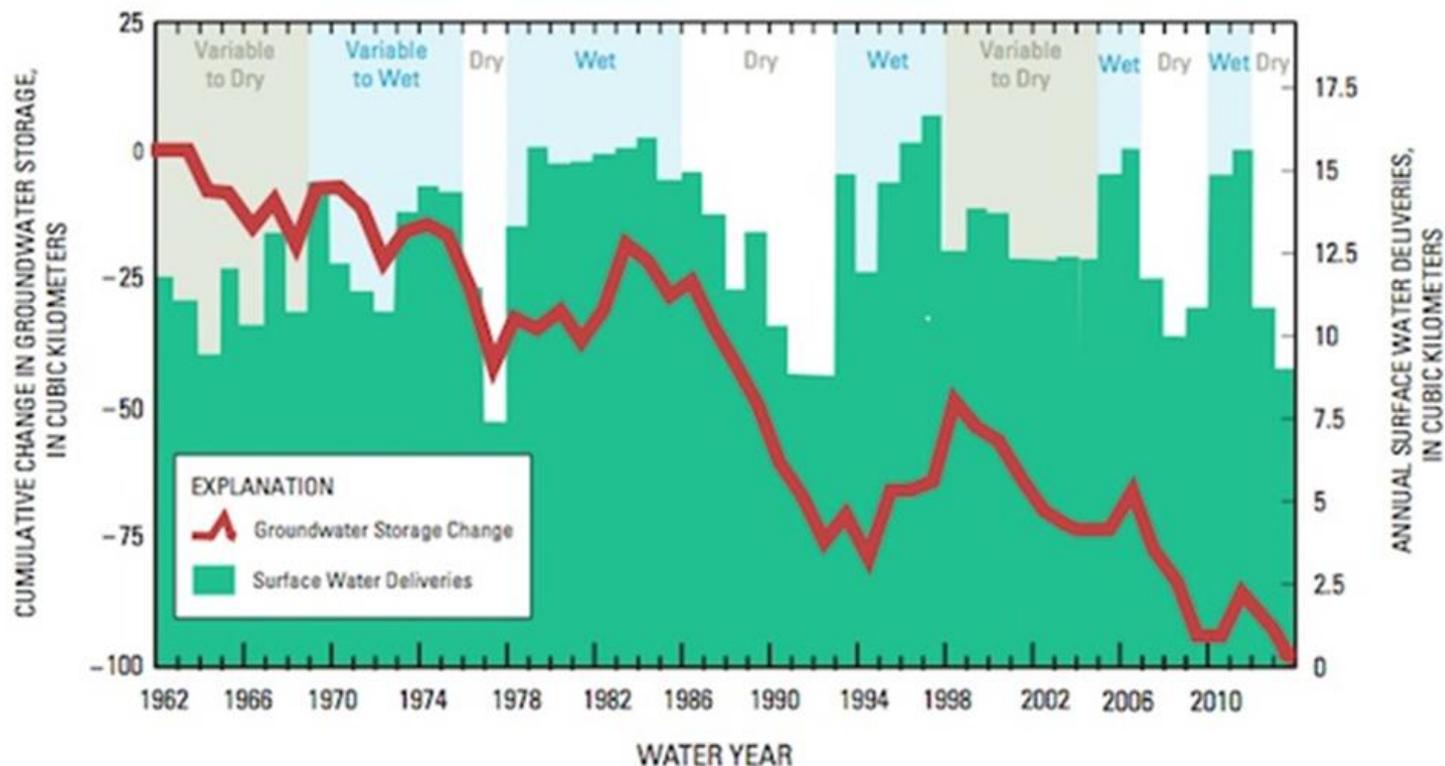
## SGMA Timeline (excerpts)

- Sept 2014 – Legislation passed
- Jan 2015 - DWR define GW Basin priorities
- Dec 2016 –DWR estimates water available for GW replenishment
- Jan 2017 – DWR defines BMPs for sustainable management
- June 2017 – deadline for formation of Groundwater Sustainability Agencies (GSA)
- Jan 2020 – GW Sustainability Plans (GSP) due for critically overdrafted basins
- Jan 2022 – GSP due for other basins
- Jan 2040-2042 – basins must be sustainably managed



# Interaction of Surface Water and Ground Water Supply

- With less surface water available there is a greater reliance on groundwater
- Groundwater access will be cut back by SGMA requiring alternative sources of ag water



**Figure 3** Graph showing surface water deliveries and cumulative storage changes simulated by the Central Valley Hydrologic Model. One cubic kilometer is about 811,000 acre-feet.

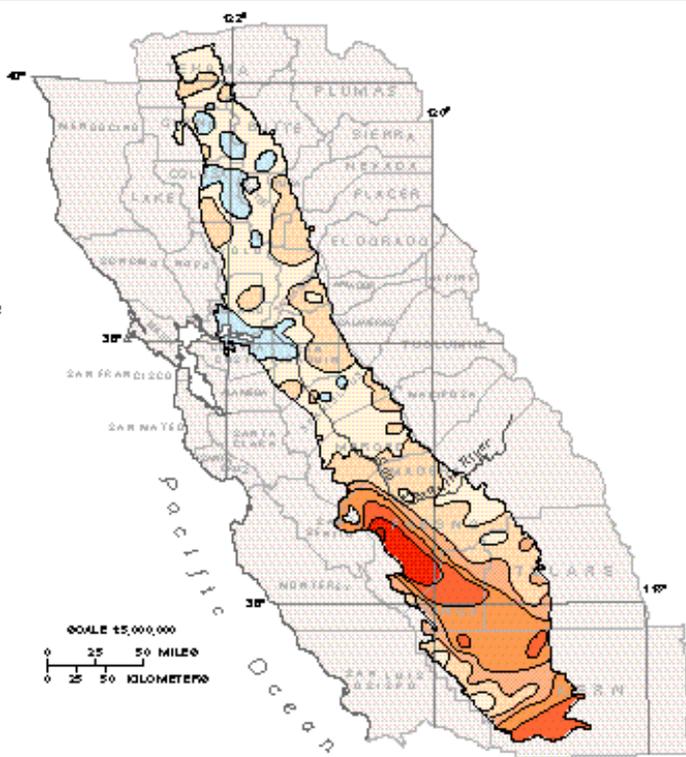
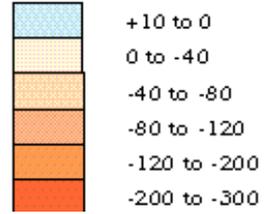
[ca.water.usgs.gov](http://ca.water.usgs.gov)

# Interaction of Surface Water Supply with Ground Water Usage

Figure 82. Ground-water withdrawals from 1860 to the 1960's caused water levels in the confined part of the aquifer system to decline over most of the Central Valley, in some areas more than 400 feet.

### EXPLANATION

Hydraulic-head change in the lower confined aquifer (1860-1961), in feet. +, rise; -, decline



I Swain, L.A., 1969, Ground-water flow in the Central Survey Professional Paper 1401-D, 127 p.   
 Data modified from U.S. Geological Survey digital data, 1:2,000,000, 1972.   
 Modified from Williamson and others, 1959.



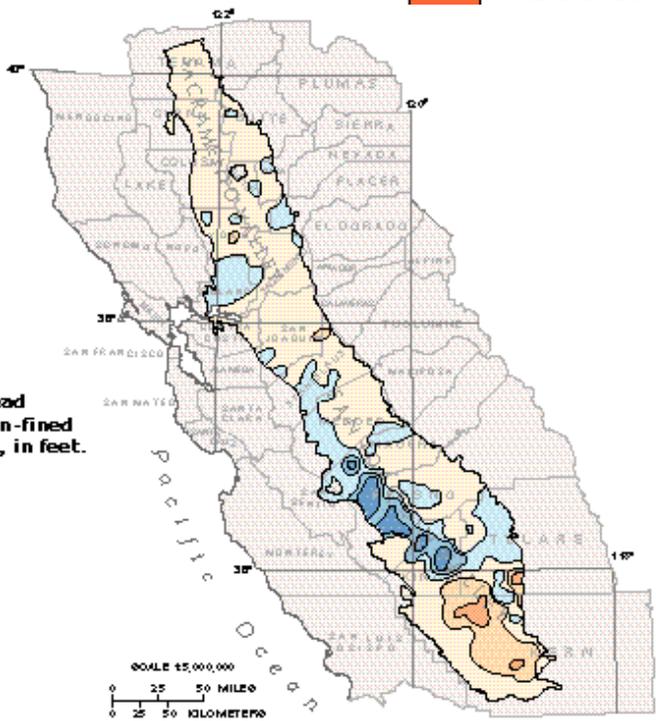
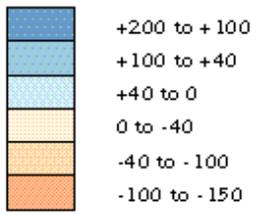
**GROUND WATER ATLAS of the UNITED STATES**  
 California, Nevada  
 HA 730-B

[Preview and d](#)

Figure 86. As a result of increased surface-water importation during the 1960's and 1970's, ground-water withdrawals were reduced and water levels rose in the deep confined aquifer in many areas from 1961 to 1976. However, declines continued in the southern part of the San Joaquin Valley.

### EXPLANATION

Observed hydraulic head change in lower confined aquifer (1961-76), in feet. +, rise; -, decline



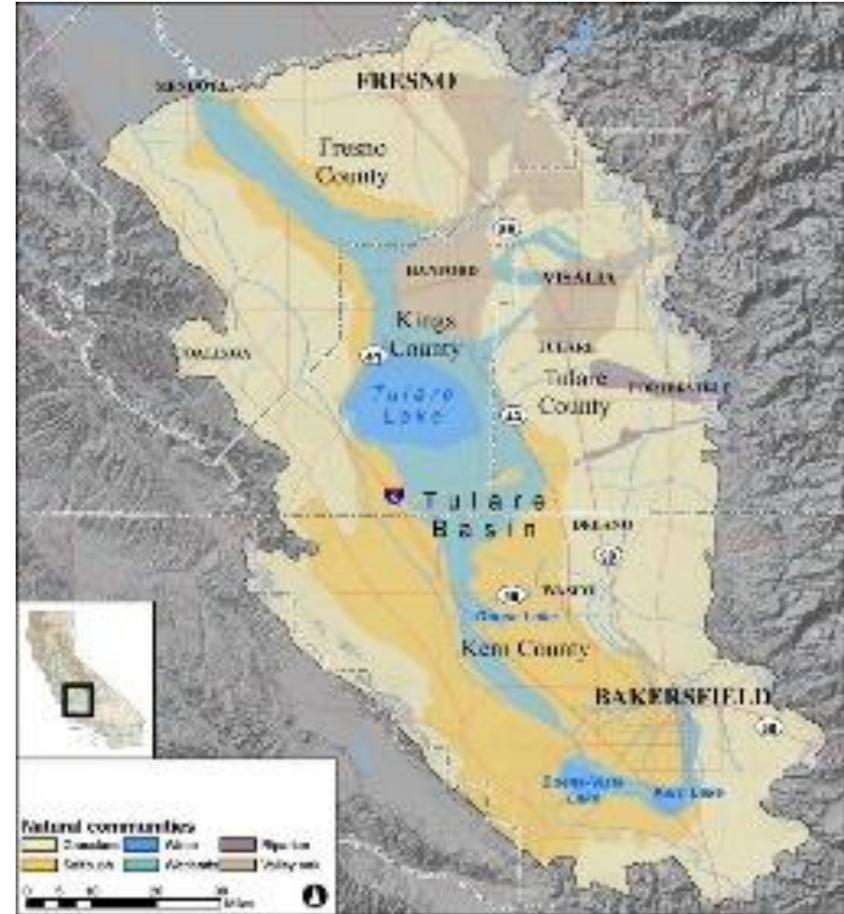
Williamson, A.K., Prudic, D.E., and Swain, L.A., 1969, Ground-water flow in the Central Valley, California: U.S. Geological Survey Professional Paper 1401-D, 127 p.

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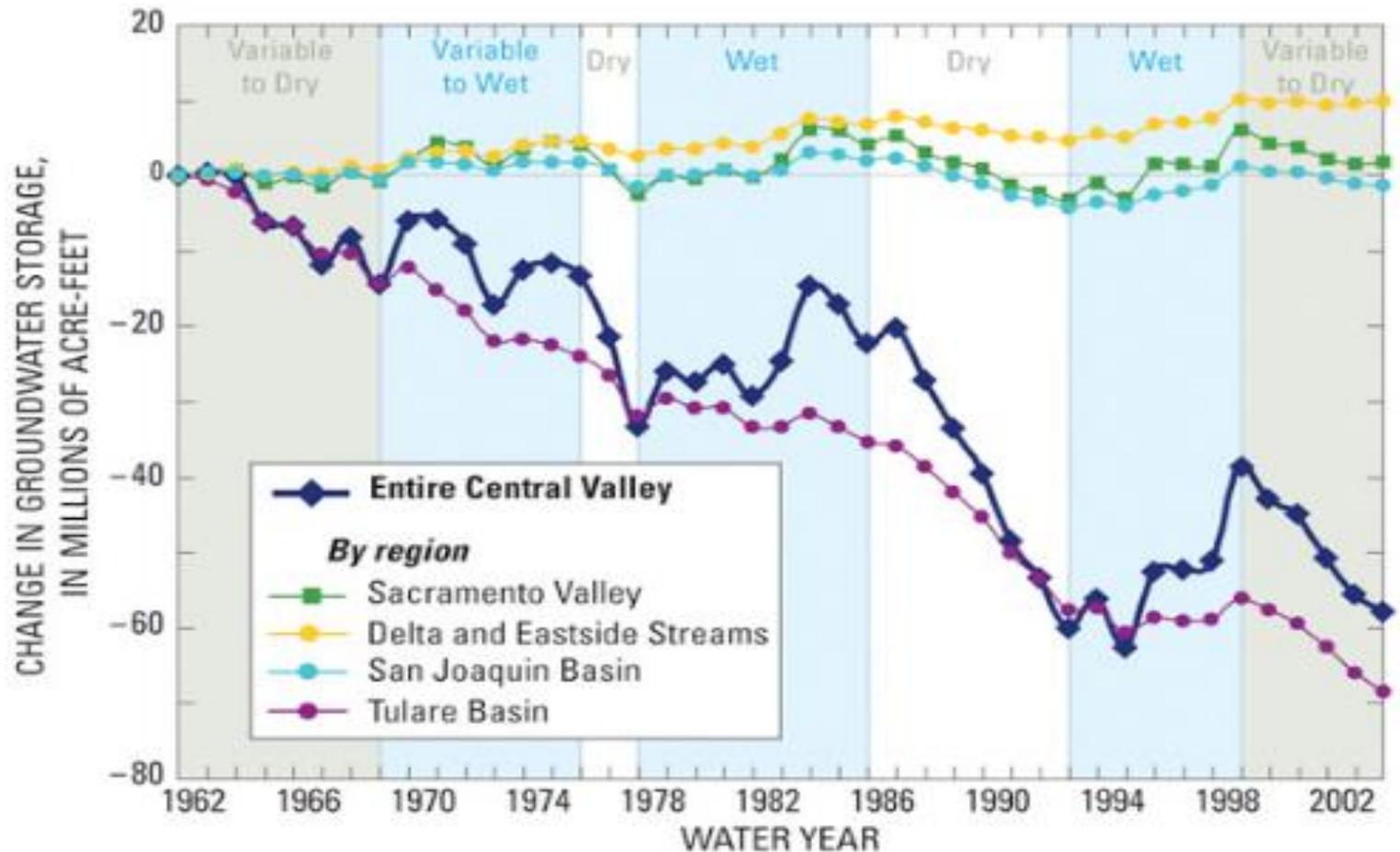
# Tulare Lake Basin – Agriculture Value – Highest Value in US

- Fresno County (2014)
  - Total Agriculture value \$7 Billion
    - Top 5 crops – almonds, grapes, poultry, milk, cattle and calves total \$4.07 Billion, 58% of total
- Kern County
  - Total Agriculture value \$7.5 Billion
    - Top 5 crops – grapes, almonds, milk, citrus, cattle and calves total \$5 Billion, 66% of total
- Kings County
  - Total Agriculture value \$2.47 Billion
    - Top 5 crops – milk, cotton, cattle and calves, almonds, tomatoes total \$1.56 Billion, 63% of total
- Tulare County
  - Total Agriculture value \$8.08 Billion
    - Top 5 crops – milk, cattle and calves, oranges, grapes, almonds total \$5.6 Billion, 69% of total

➔ \$25 Billion farm gate value without the value of jobs, services, etc. from agriculture



# Tulare Basin – Most Overdrafted Basin in Central Valley



# Water Availability: Opportunities for Central Valley

- ➔ Water from current sources (snowpack, dams, surface water movements and from ground water) will be less regardless of non-drought situations
- ➔ additional dams/ surface water storage will be very limited

## How to increase and diversify water supplies?

- Desalinization?
  - Energy use and air quality implications?
  - Where to put the salts? California Coastal Commission doesn't like salt dumping in to ocean
- Groundwater Recharge?
  - Possible if the right conditions
  - Water quality regulations may affect ability to use in ag lands.
- Recycling of wastewater such as stormwater, municipal waste waters, oil/gas water, etc.?

# ALMOND ORCHARD OF THE FUTURE

AIM Initiatives:  
Where can the almond  
community and ABC  
make a difference?



# AIM: SUSTAINABLE WATER RESOURCES (diversifying water supply)

Municipal Water Recycling

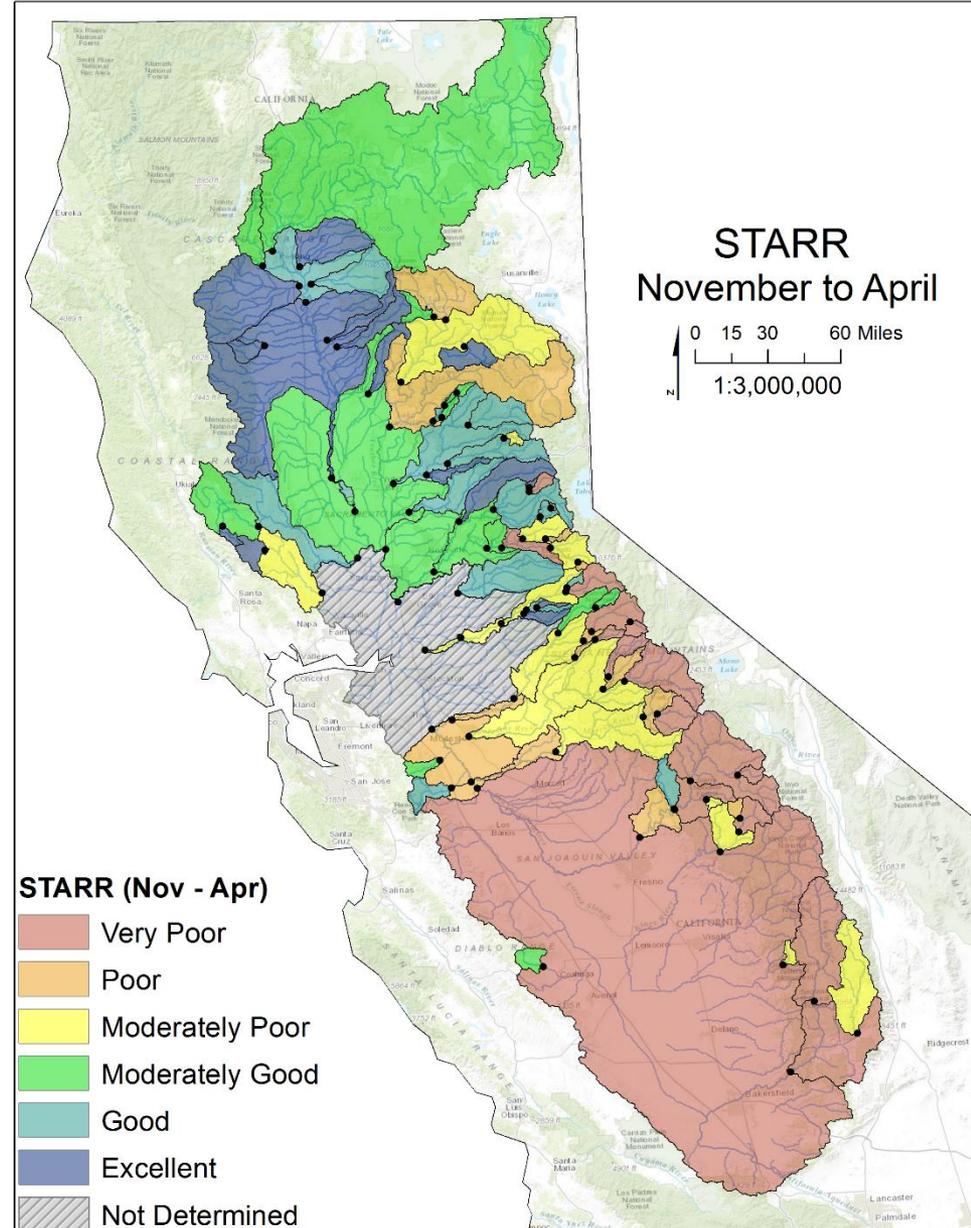


Ground Water Recharge



# STARR

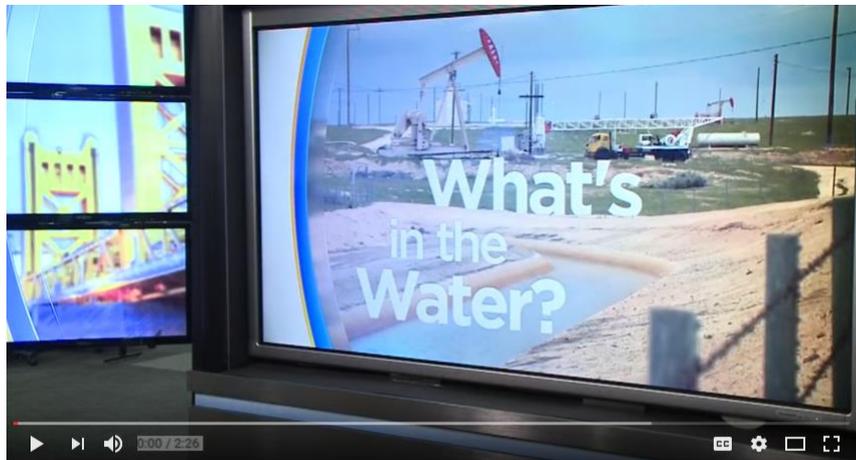
- **STARR index indicates the most suitable watersheds for ag-recharge in terms of water availability**
- **High STARR suggests:**
  - More water physically available
  - for extended periods during the winter months
  - high inter-annual recurrence frequency of flows >90th percentile
- **The STARR results indicate:**
  - High availability in the SRV and high Sierra watersheds
  - Marginal availability in the SJV,
  - Limited *in situ* availability in the Tulare Basin
- **Transport of surface water from the SRV into the SJV could mitigate N-S differences**



However.... Food is currently a pawn in larger battle:

## California water regulators should study food safety

San Francisco Chronicle | January 14, 2016 | Updated: January 14, 2016 5:25pm



Groups Calling For Ban Of Oil Field Waste Water Being Used In Irrigation



39 views

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Published on Jul 15, 2016

The state does not regulate the process, and it could be more widespread than originally thought.



GIVE \$20 NEXT

## Food & Water Watch and Water Defense Call For Halt to Irrigating Food Crops with Oil Field Wastewater in Nation's Produce Basket

Testing by Water Defense Found Tar Balls and Toxic Industrial Chemicals in Recycled Oil Field Water Sold to Water District in California's Central Valley

➔ Almond buyers are asking questions...

# Questions that Need to be Addressed:

## Depending on quality of water:

- What techniques can clean up water to reduce/remove:
  - Salts (boron, arsenic, sodium, etc)?
  - Any classes of compounds that come from oil/gas productions?
  - Costs of clean up techniques?

Technologies may be relevant to recycling other waters (e.g. brackish waters, storm water, etc)

## Sustainability of Water Supply:

- Impact of changes in oil/gas markets on water supply?
- Interaction of shallower ground water with deeper ground water?

## What levels do contaminants in the water need to attain?

Irrigation water quality standards are not equal to drinking water standards

- For salts – what levels are ok for the crops, avoid salt build up in the soil?
  - May have issues with leaching
- For other constituents the question is whether there any human health risk concerns

## Complex question:

- What levels leave the oil facility?
- What levels are in the irrigation water?
  - Seasonal variation?
- Does the soil/ soil microbial community have an impact?
- Is it taken up by the plant?
  - root vegetables may be different from tree fruit
- Are the levels in the food consequential (risk assessment)?

Any Questions?

Thanks you

