

Drought and the Delta, as of 2016

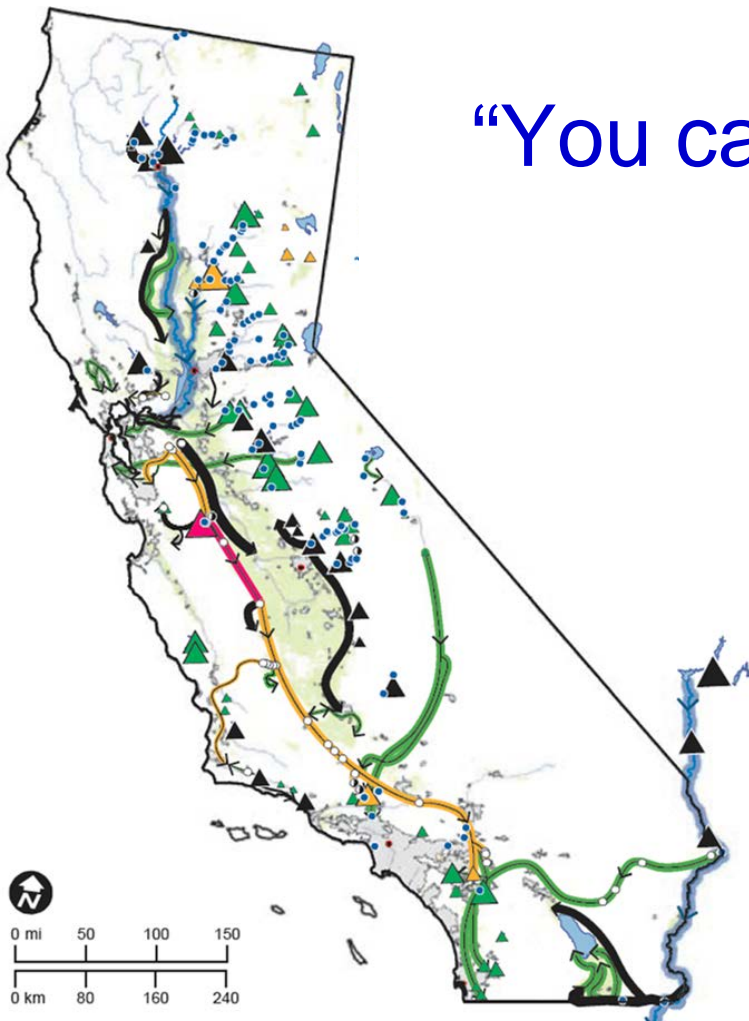
“You can never step in the same
river twice” Heraclitus

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CaliforniaWaterBlog.com



Tired of Drought?



Outline

- 1) Droughts, management, and history
- 2) This drought so far
- 3) Drought impacts for Delta
- 4) Other drought fall-out
- 5) Preparing for drought
- 6) Lessons so far



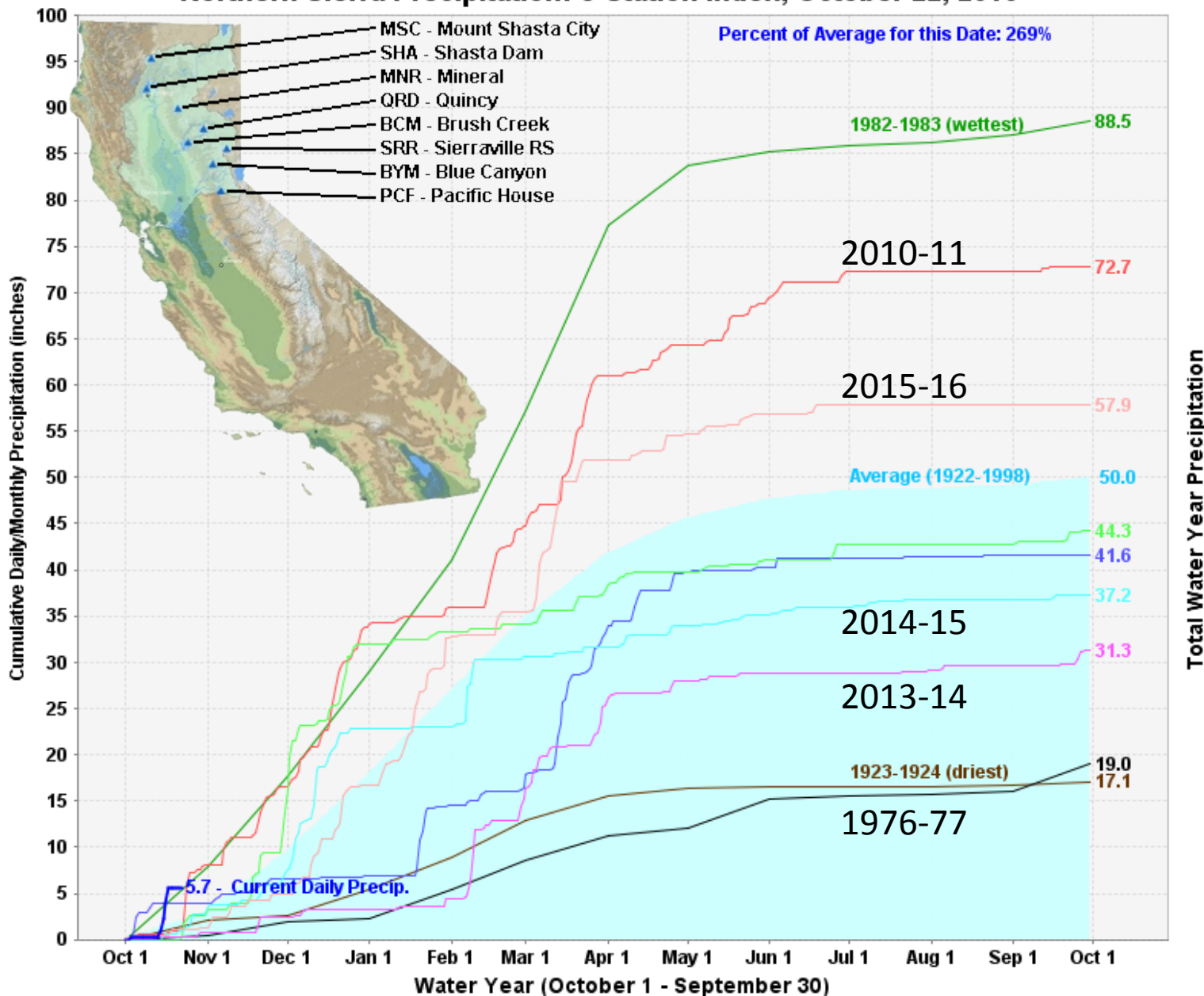
Droughts test water systems!

1. Water systems and the societies they serve are always changing
2. Droughts bring attention to needs for change
3. This drought is helping improve groundwater
4. Ecosystem and accounting problems
5. Every generation needs at least a threatening drought, and a threatening flood
6. Learn from test! Don't panic.
Pay attention.



Sacramento Valley Precipitation

Northern Sierra Precipitation: 8-Station Index, October 22, 2016

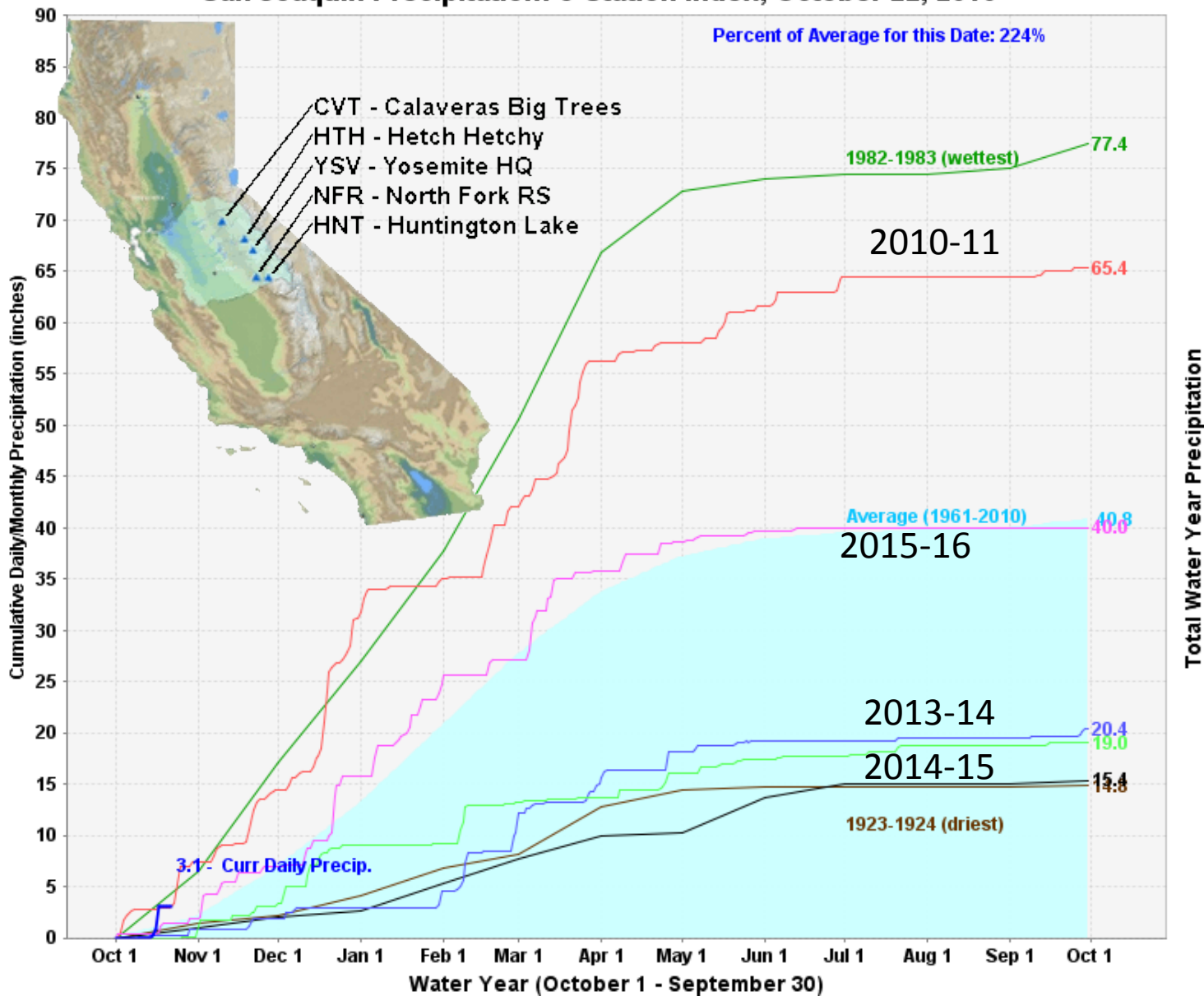


Total Water Year Precipitation

2014:
8th driest
in 106
years,
4th driest
in runoff

San Joaquin Valley Precipitation

San Joaquin Precipitation: 5-Station Index, October 22, 2016



2015:
3rd driest in
106 years

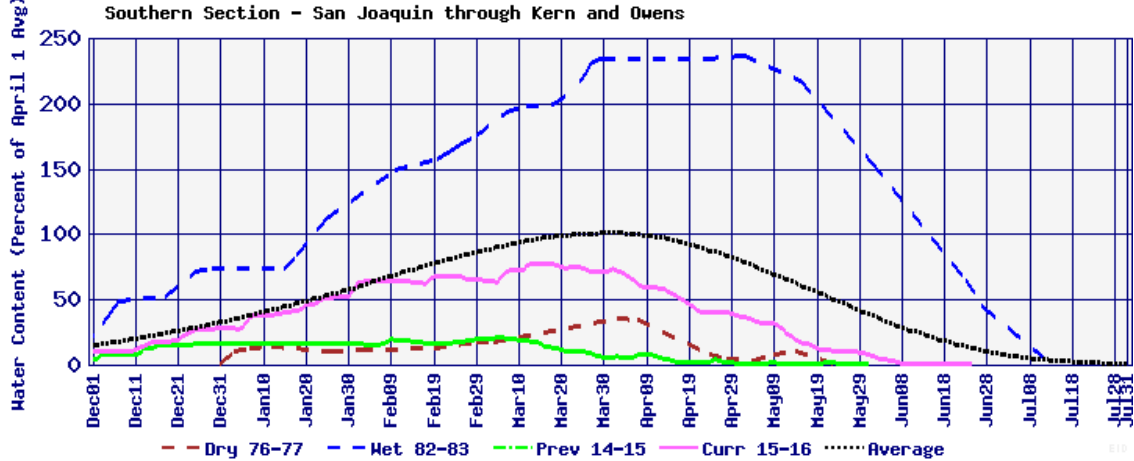
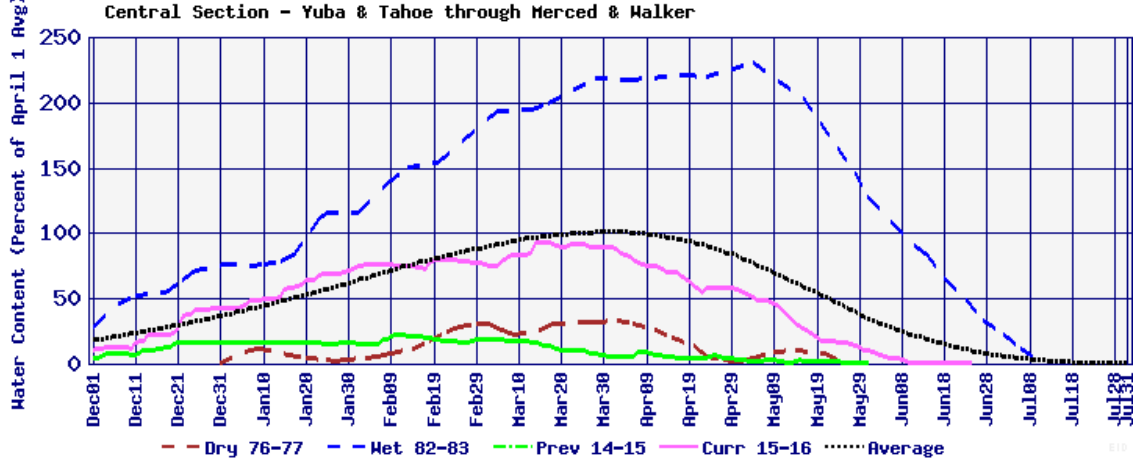
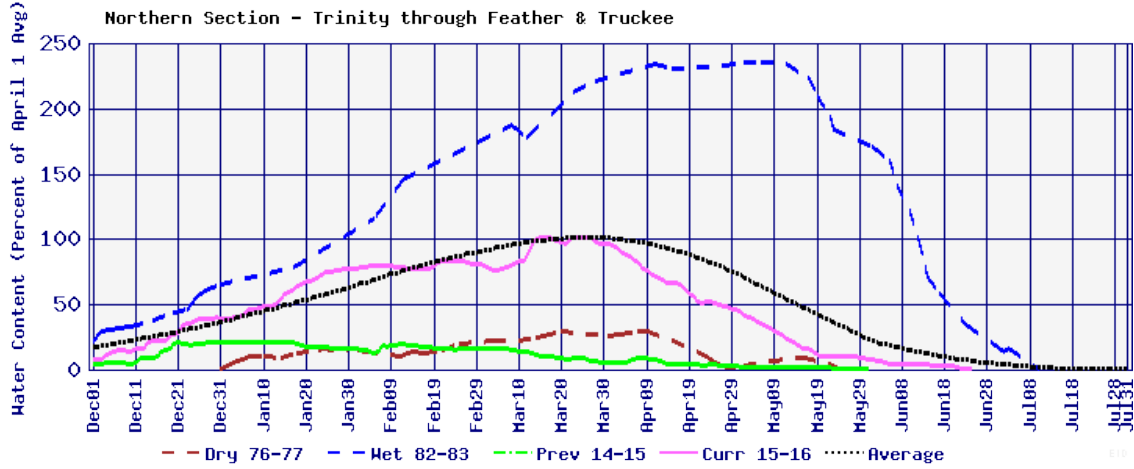
Sierra Snowpack

Warm drought

Less snowpack accumulation

Melts more quickly

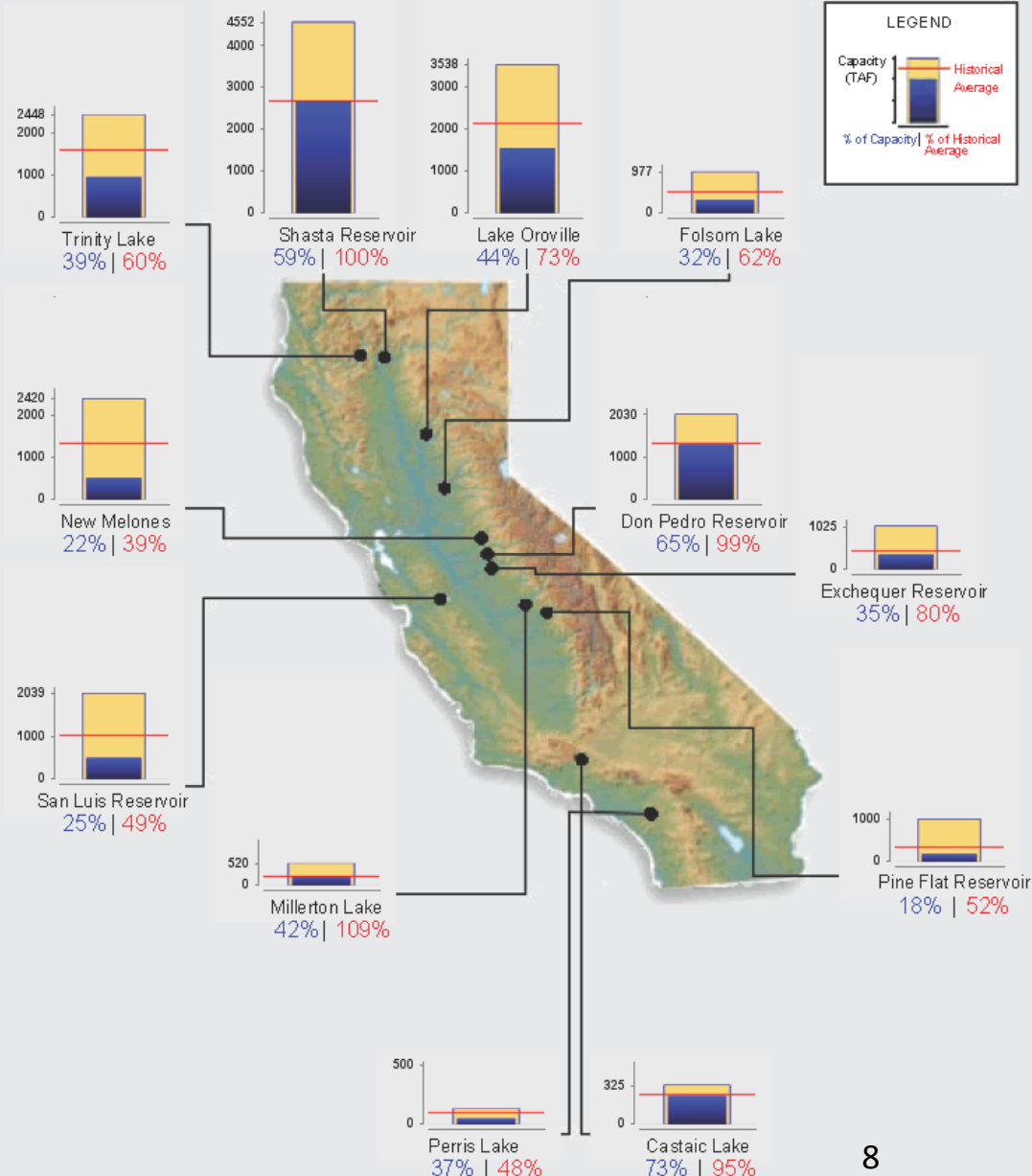
Implications for future



Reservoir Storage

Ending At Midnight - October 21, 2016

CURRENT RESERVOIR CONDITIONS



Much better than 2015

3.5 maf below historical reservoir average

Shasta cold water?

Getting water across Delta?

Groundwater down 10+ maf from before drought

Drought's Delta Impacts

1) Ecosystems

- Waterfowl, fish (native, recreational)

2) Water Quality

- Salinity, algae, aquatic vegetation

3) Delta Operations and Infrastructure

- Water operations, barriers, levees

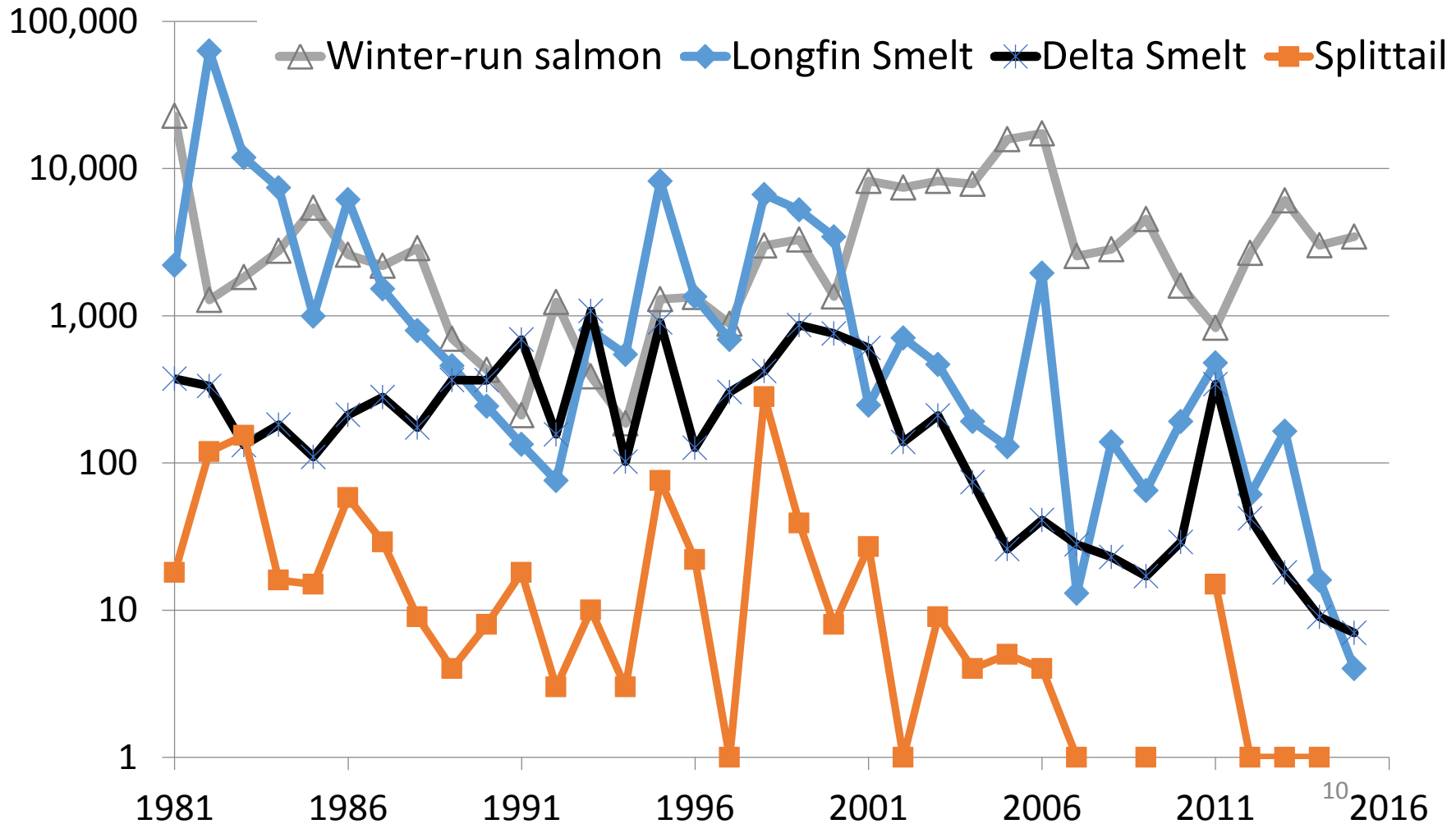
4) Delta agriculture

- Fallowing programs, salinity

5) Policy and Science Implications

Fish

- Current state of native fish is horrible, and worsening
- Will more fish become listed and extend the “drought”?



2016 Water Project Deliveries

North of Delta:

100% for both CVP and SWP

South of Delta:

CVP: 100% for Exchange contractors, refuges, CCWD

50% for Friant contracts

5% for other S. of Delta contracts

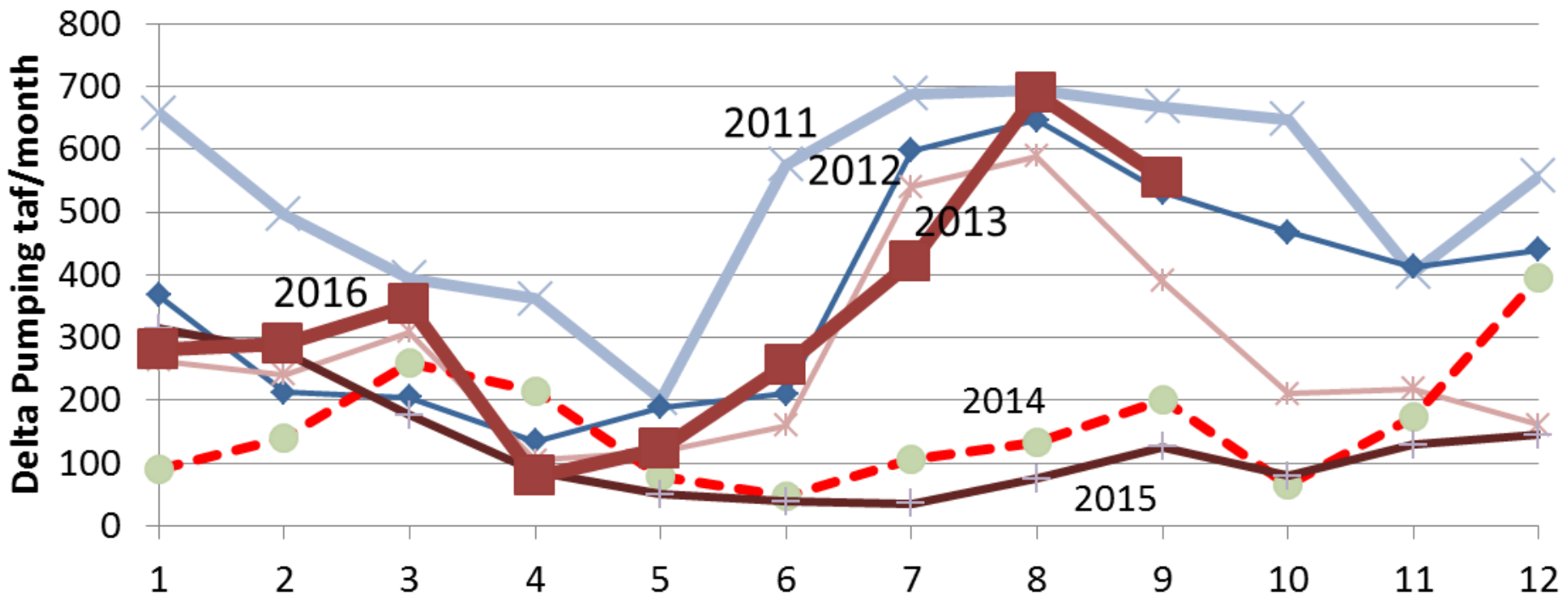
SWP: 60% of full contract

Problems getting water across the Delta

Delta Project Diversions

Diminished exports with each drought year.

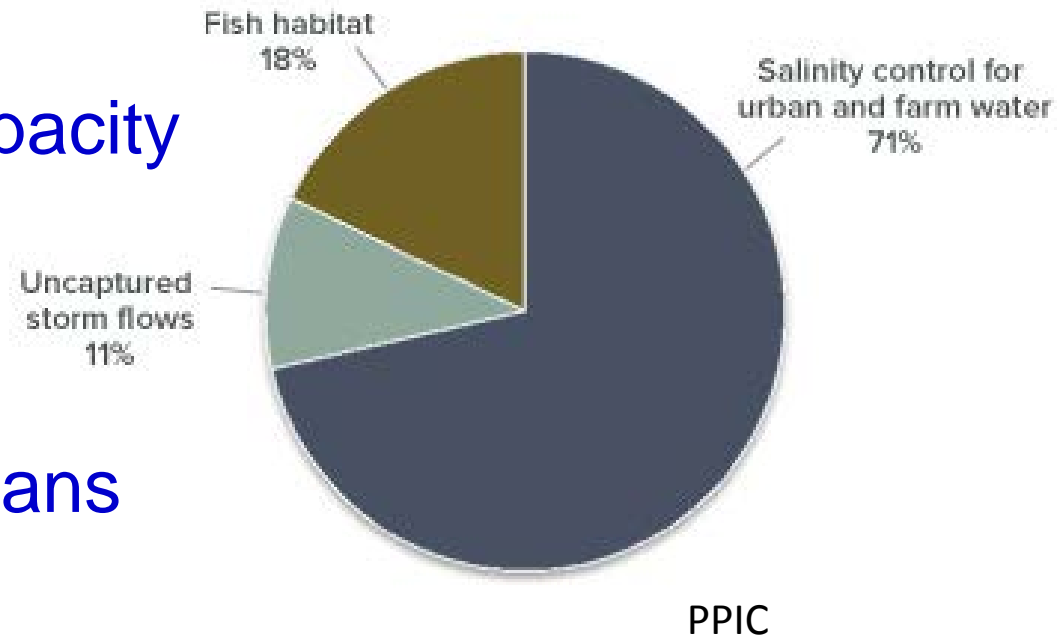
Some 2016 recovery, but it's not 2011



Causes of reduced diversions?

- Reduced water availability – drought
- Inadequate storage capacity
- Inadequate diversion capacity/location
- Salinity control for humans
- Flow control for fish

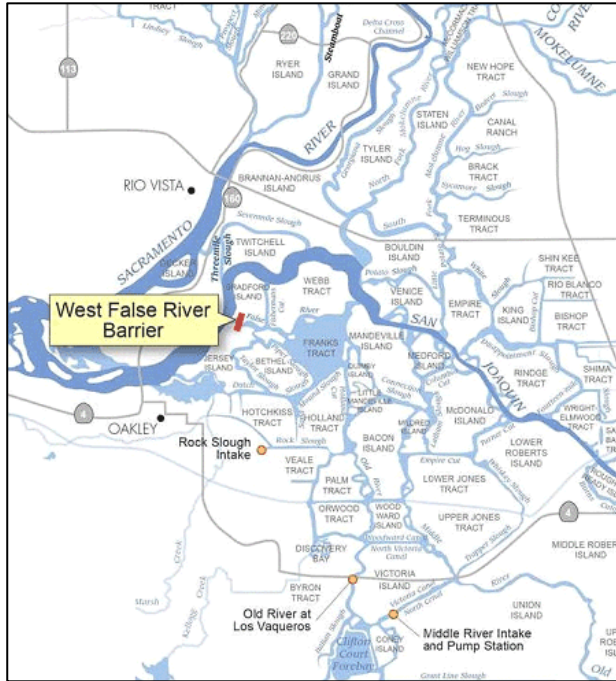
2014 DELTA OUTFLOWS
(4.2 MILLION ACRE-FEET)



Would be useful to figure this out.

Delta Flows and Drought Barrier

Future barriers?



DWR



- Better salinity
- Saved outflow
- Algae, fish?

Levee Failure from Drought?

Failure of a peat dike in Wilnis, the Netherlands in 2003 due to dryness and loss of stability.



Interesting, but not in California yet.

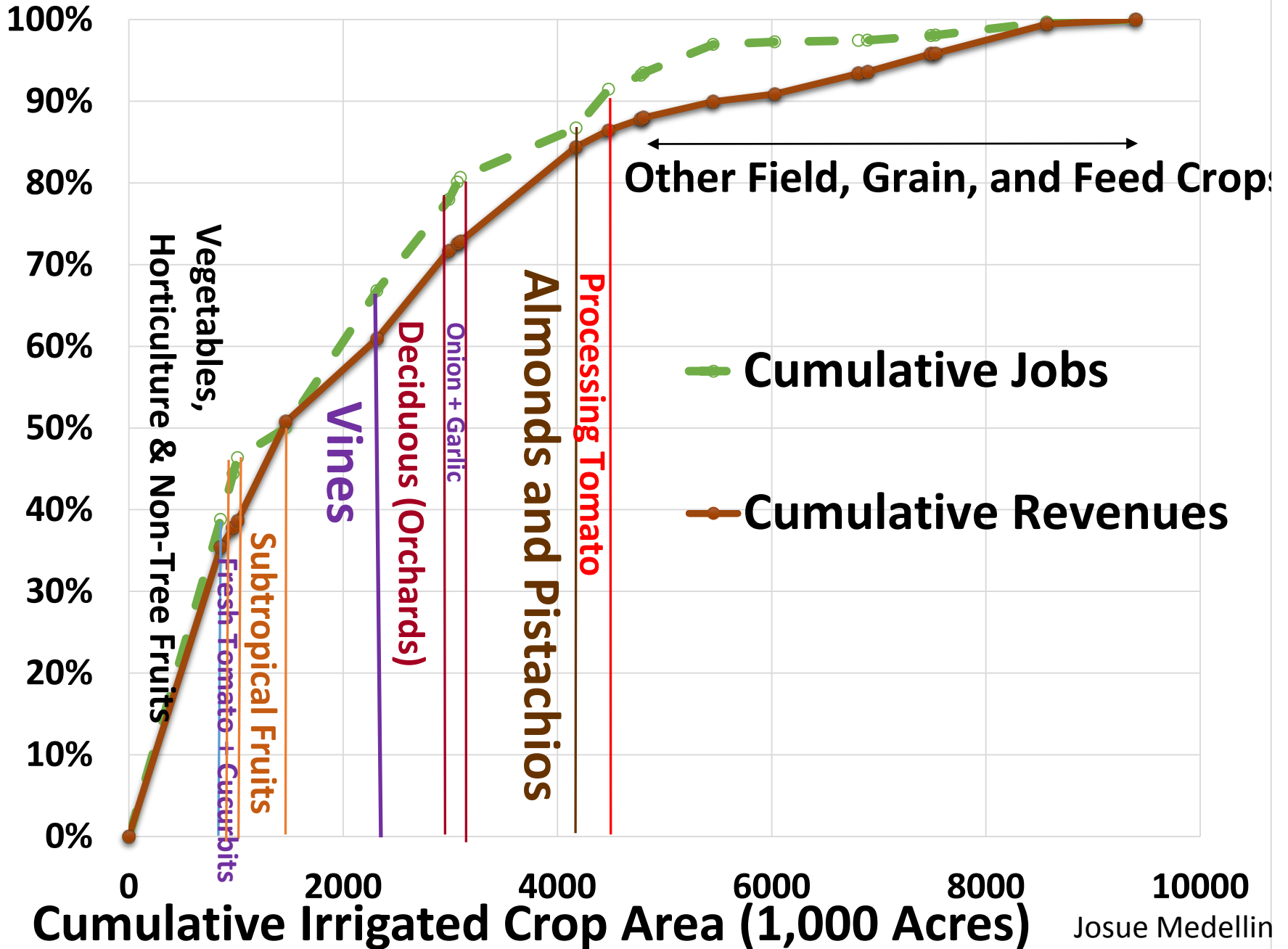
2015 Estimated Agricultural Drought Impacts

Description	Impact	Base year	Percent
Drought water shortage (million acre-ft)	8.7	26.4	33%
Groundwater replacement (million ac-ft)	6.0	8.4	72%
Net water shortage (million acre-ft)	2.7	26.4	10%
Drought-related idle land (acres)	540,000	9 million*	6%
Crop revenue losses (\$)	\$900 million	\$40 billion	2.3%
Dairy and livestock revenue losses (\$)	\$350 million	\$13 billion	2.7%
Costs of additional pumping (\$)	\$590 million	\$780 million	75.5%
Net revenue losses (\$)	\$1.8 billion	54 billion rev.	3.3%
Total economic impact (\$)	\$2.7 billion	NA	NA
Direct job losses (farm seasonal)	10,100	200,000 [#]	5.1%
Total job losses	21,000	NA	NA

* NASA-ARC estimate of normal Central Valley idle land is 1.2 million acres.

[#] Total agriculture employment is about 412,000, of which 200,000 is farm production.

Cumulative Jobs and Revenues



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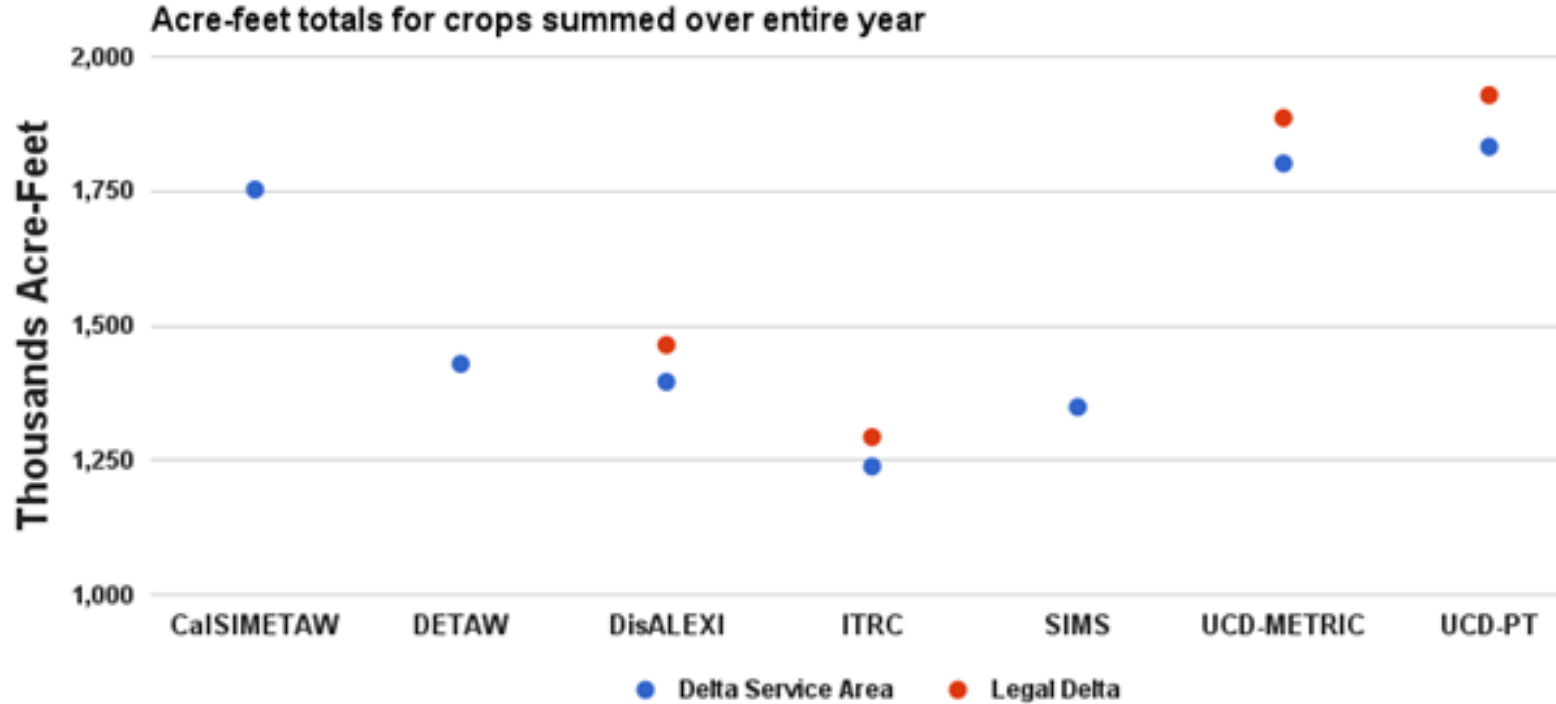
5) Policy and Science Implications

Other drought fall-out

- 1) Tighter water accounting
- 2) Ending groundwater overdraft
- 3) El Nino and drought prediction?
- 4) Temperature operations for Shasta



Delta Crop ET 2015












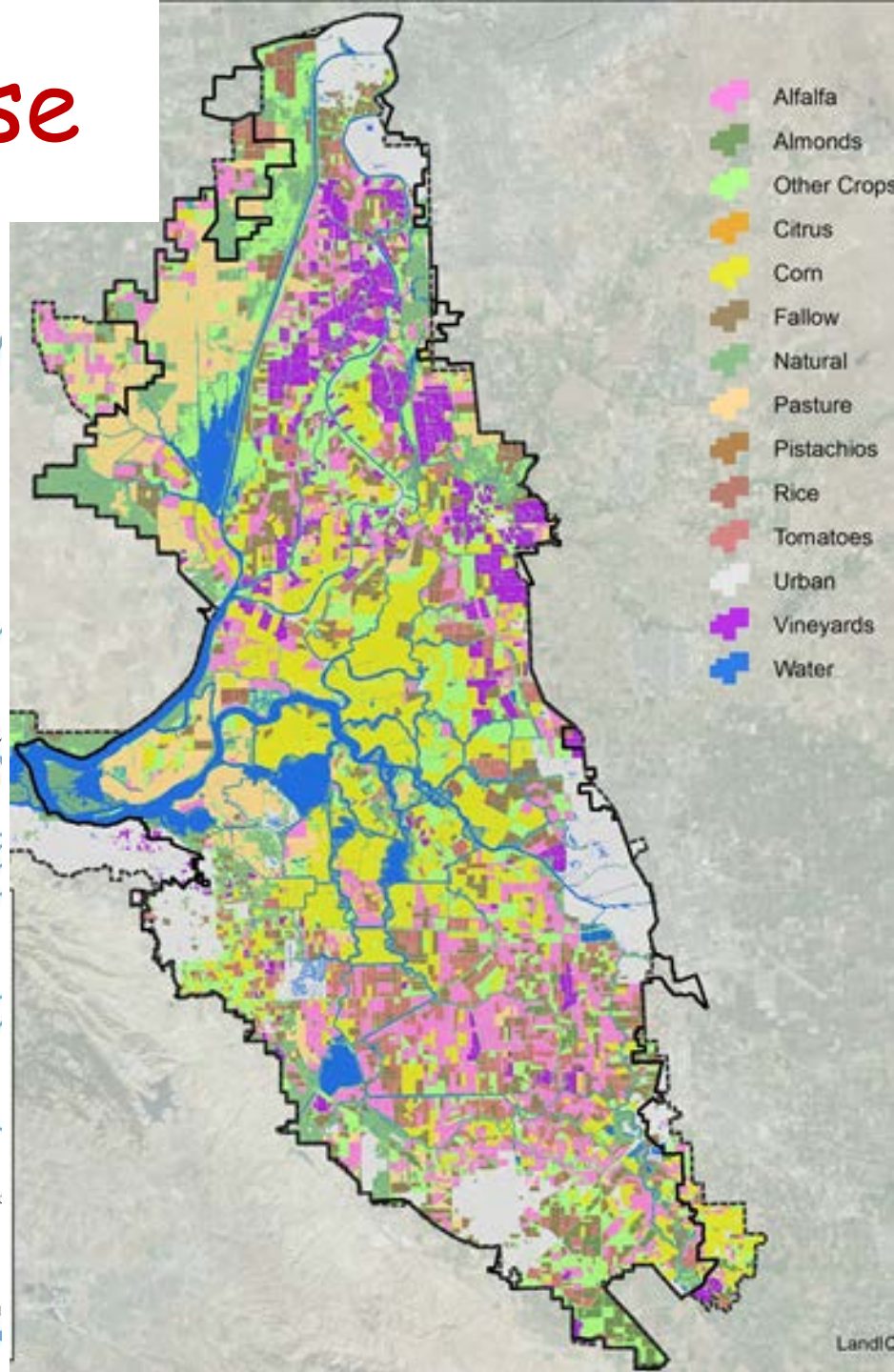
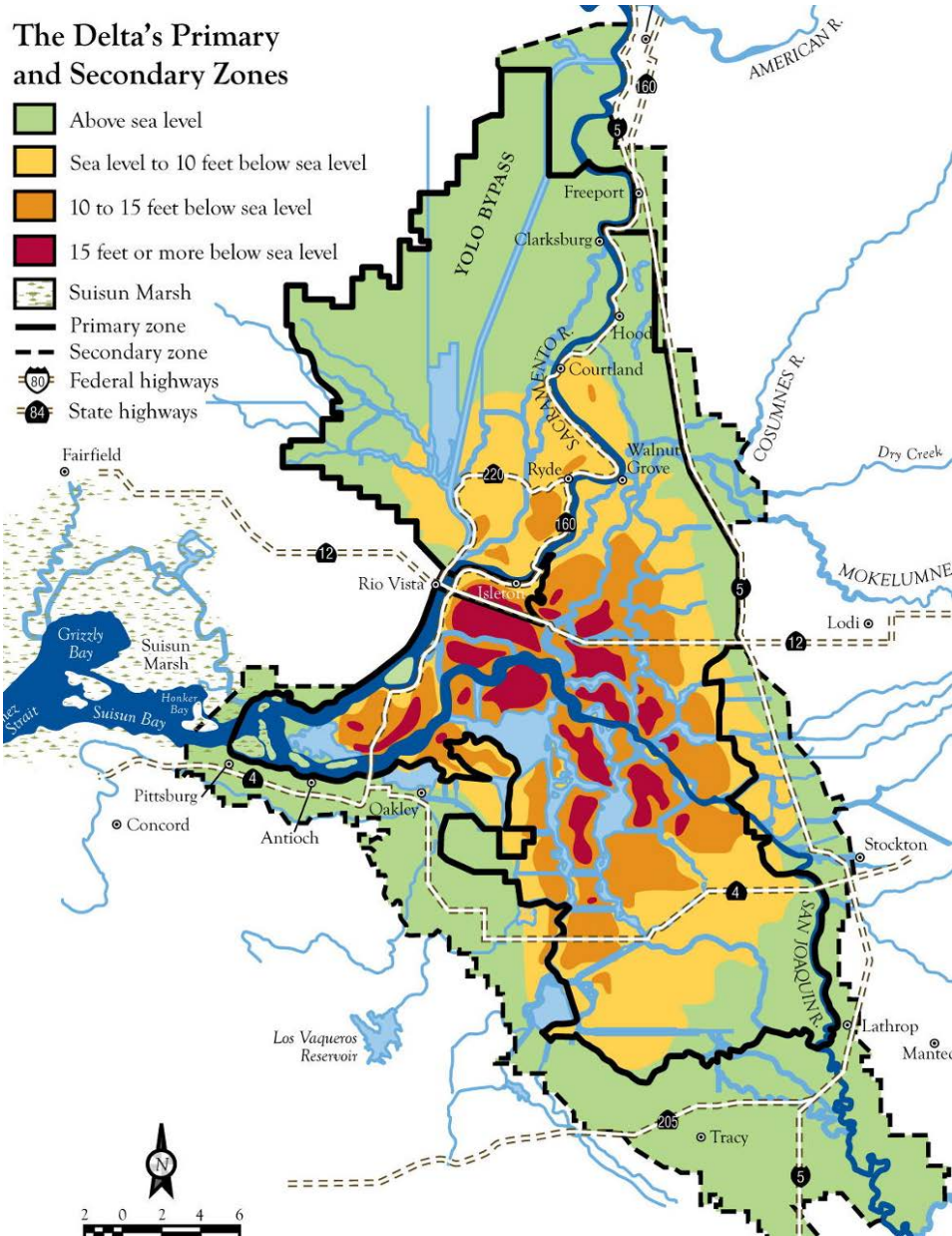
- Recent collaborative study (SWRCB, UC Davis, et al.)
- 7 different methods, independent estimates
- More to come, better estimates + field data



2015 Delta Land Use

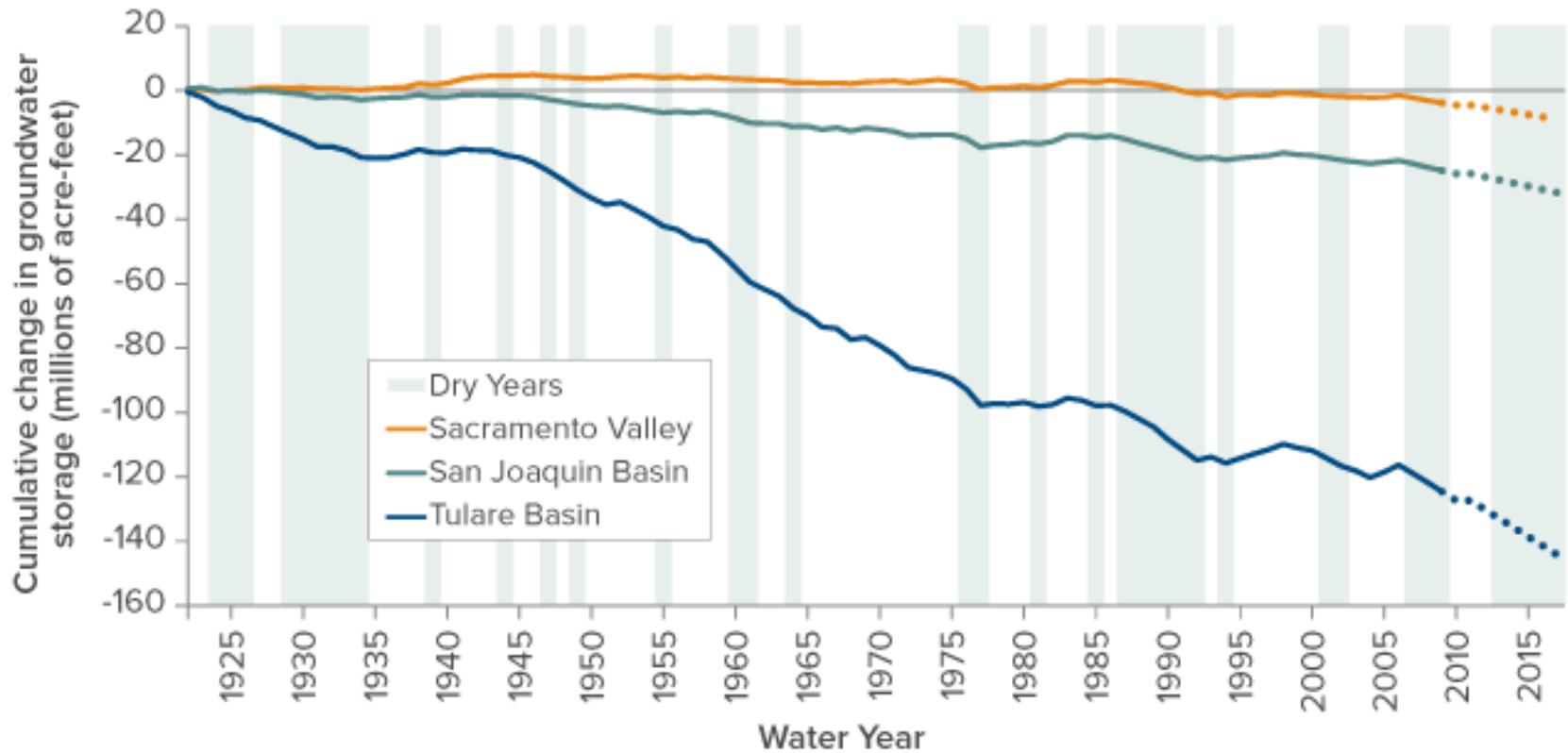
The Delta's Primary and Secondary Zones

-  Above sea level
-  Sea level to 10 feet below sea level
-  10 to 15 feet below sea level
-  15 feet or more below sea level
-  Suisun Marsh
-  Primary zone
-  Secondary zone
-  Federal highways
-  State highways



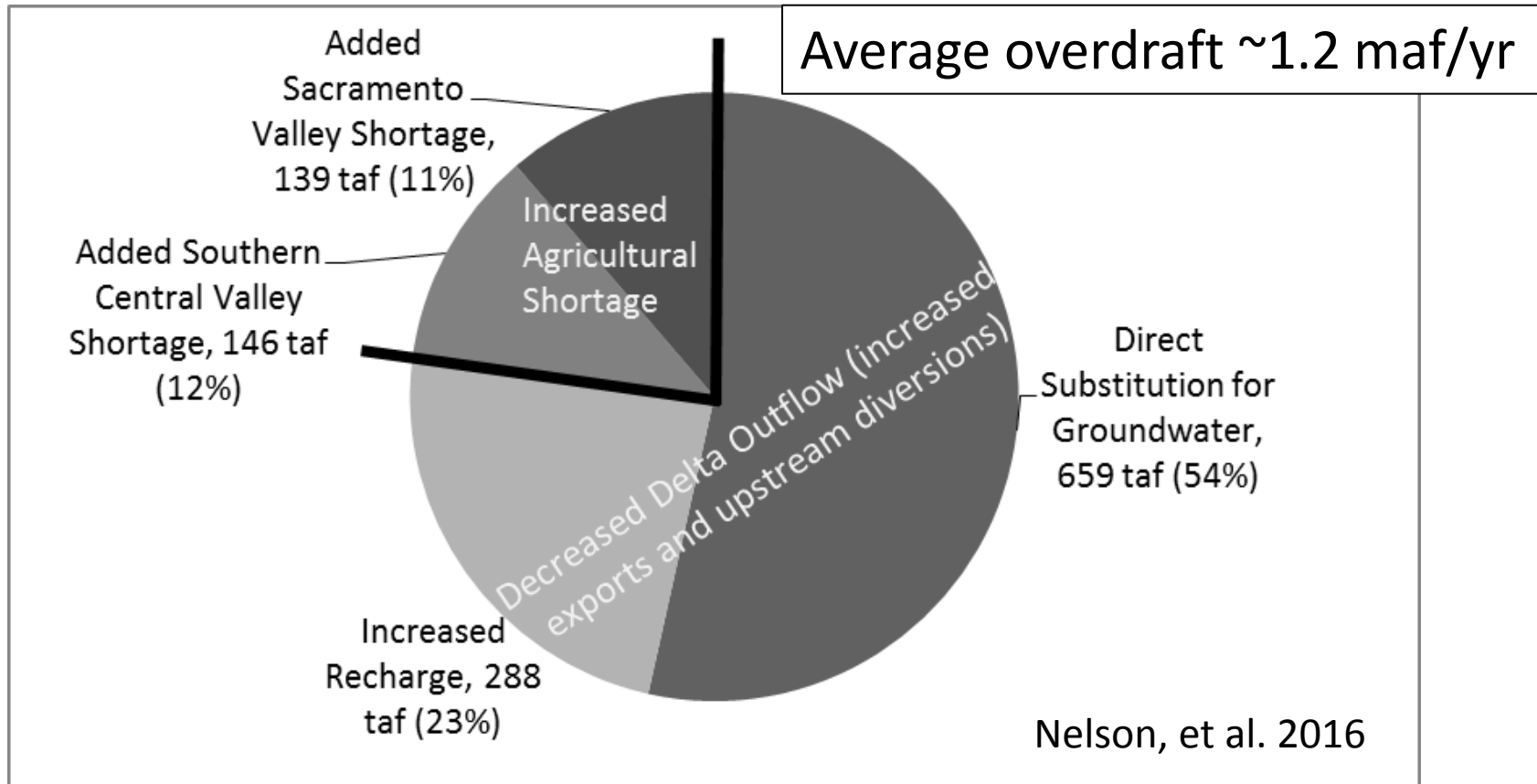
-  Alfalfa
-  Almonds
-  Other Crops
-  Citrus
-  Corn
-  Fallow
-  Natural
-  Pasture
-  Pistachios
-  Rice
-  Tomatoes
-  Urban
-  Vineyards
-  Water

Groundwater depletion, especially in California's Tulare Lake Basin



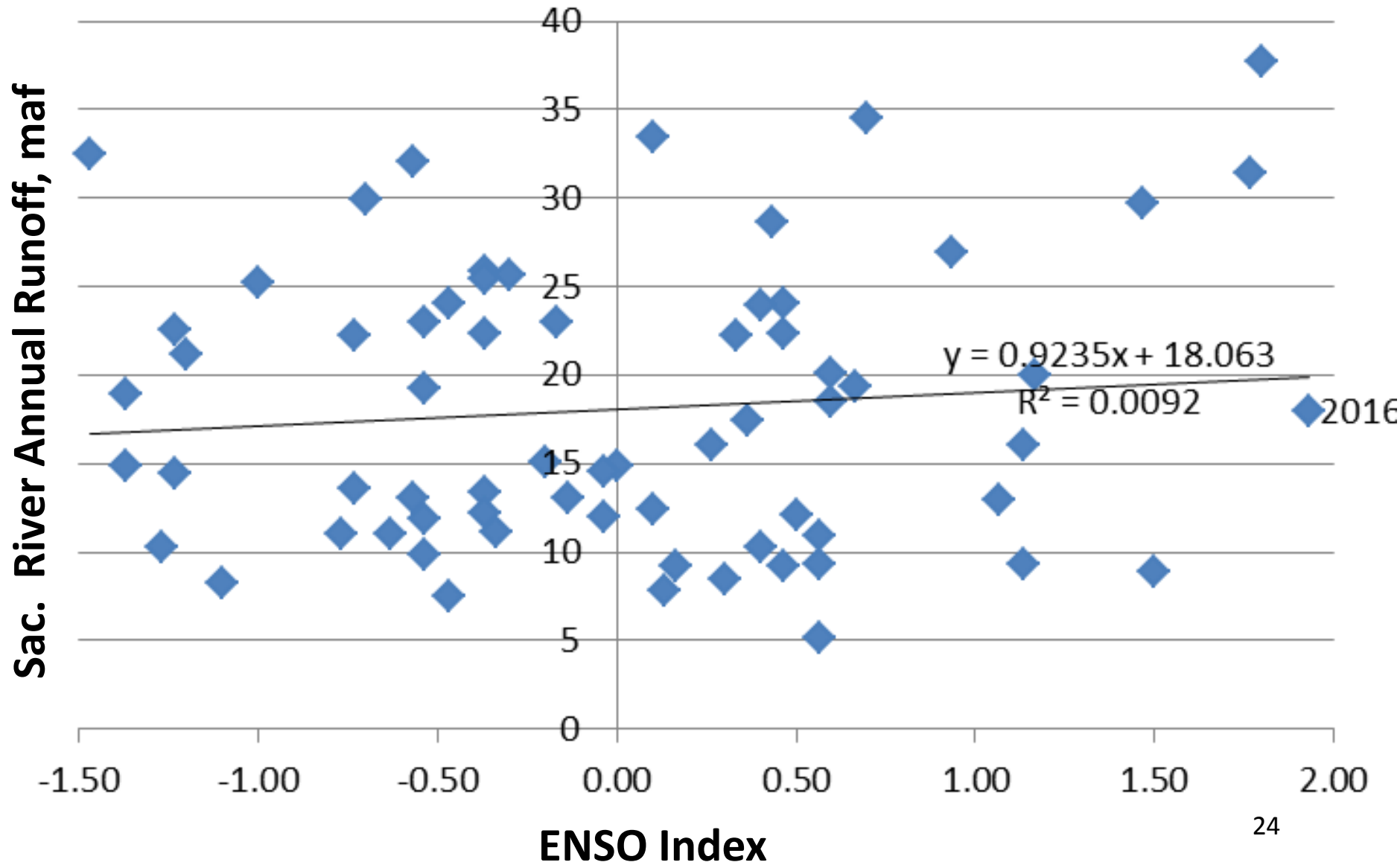
SOURCE: *What If California's Drought Continues?* (PPIC, 2015), Figure 3. Data through 2009 from DWR; author estimates after 2009. Projections since 2009 may underestimate depletions since the onset of the latest drought (2012+).

Ending Groundwater Overdraft and The Delta

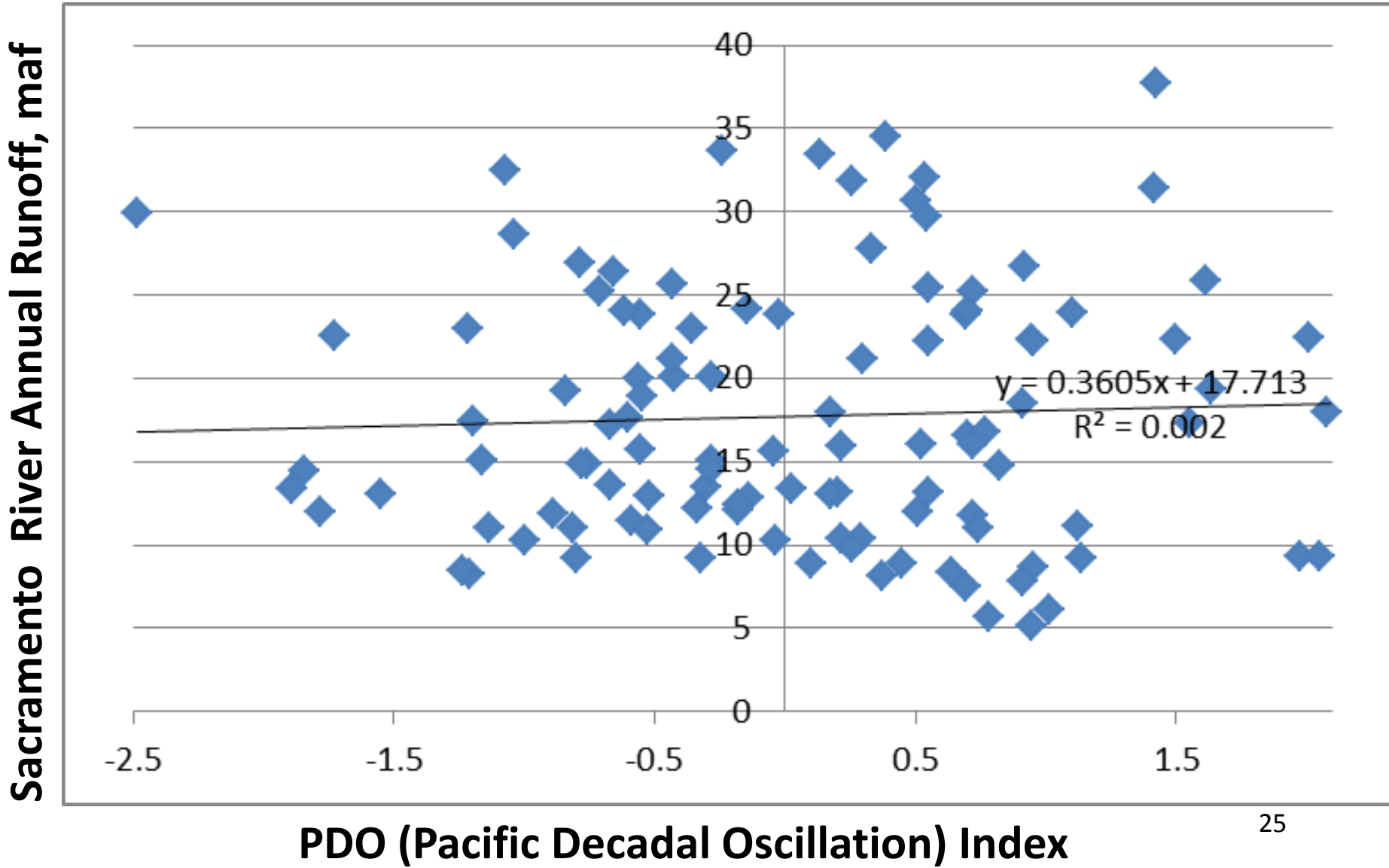


- Ending overdraft will increase Delta water demands
- Solving groundwater will make solving Delta problems more interesting

Streamflow and El Nino



California Streamflow and PDO



Preparing for Drought in the Delta

1) In-Delta water users:

- Urban areas – conserve, store, inter-tie
- Agriculture – re-operate, sell/buy water

2) Recreation – SAV

3) Water exporters

4) Environmental regulators – habitat and population development; selling environmental water, rather than giving it away?

5) Project agencies –Barrier & operations plan exploration and preparation, compensation



Lessons from Drought, so far

- 1) Climate is warming
- 2) Small economic impact
- 3) Native fish hit hardest
- 4) Challenge managing for the Delta and for the water system hub
- 5) Future barriers, tunnels, ecosystems?
- 6) Cautious optimism is possible.
Fighting over water is a losing battle.

