CWEMF
Annual Meeting

2023

Greg Gartrell, PhD PE

Some history

1987-1993 Contentious, repetitive disputes on fisheries, water quality, water supplies while the SWRCB struggled to update the Water Quality Control Plan under Court mandate

1994: year that BDMF was started and the year of the Bay-Delta Accord

BDMF was started in part to move arguments out of the Board hearings and into a collaborative forum for discussion and resolution.

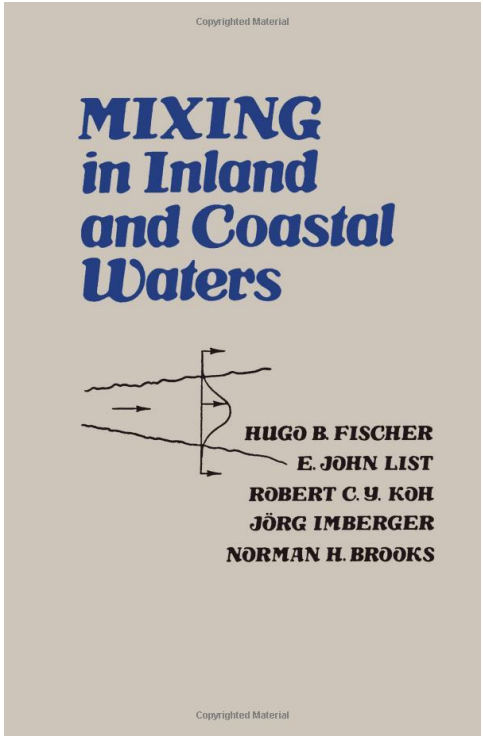
Whence Forum in the name and Convener rather than Chair.

Some Thanks

- Lyle Hoag
- BJ Miller
- George Barnes
- Francis Chung
- Margaret Johnston
- Richard Denton
- SFEI
- IEP

Hugo B. Fischer

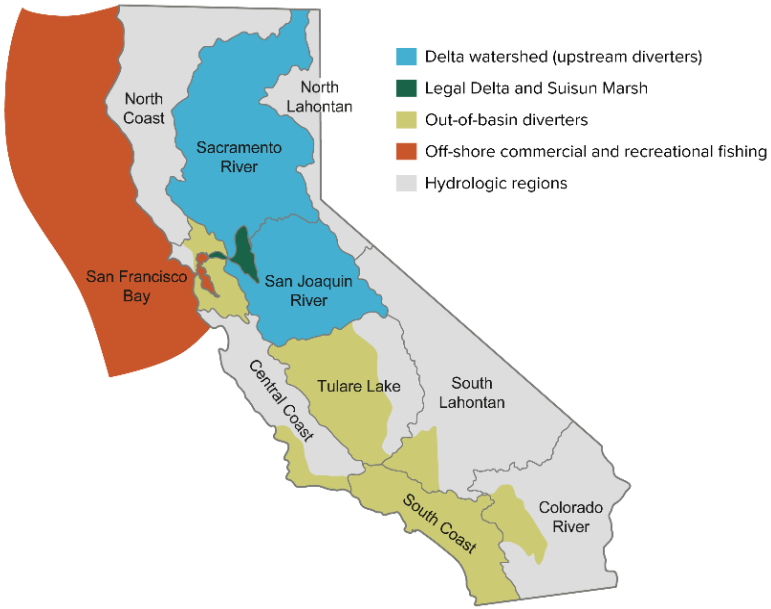
- 4 seminal papers on dispersion
  - GI Taylor (2), Rex Elder: 2D
  - Hugo's doctoral thesis (3D, theoretical, laboratory and field)—first Straub Award
- Continued with new work at Berkeley on tidal flows (Bolinas Lagoon, Suisun Marsh, Delta)
- Shifted from the era of physical models to numerical
- Use of Lagrangian formulation



Where water went: PPIC reports: 2017 and 2022 update

- **42 years of watershed flows** from runoff to Delta outflow
- **Evolution of water quality standards:** effects on water uses and Delta outflow
- **Upstream use**: estimates runoff, depletions upstream of Delta
- **Shifting trends**: climatic, regulatory effects
- **Recommend improvements**: for accounting, management

Most Californians rely on the Delta and its watershed



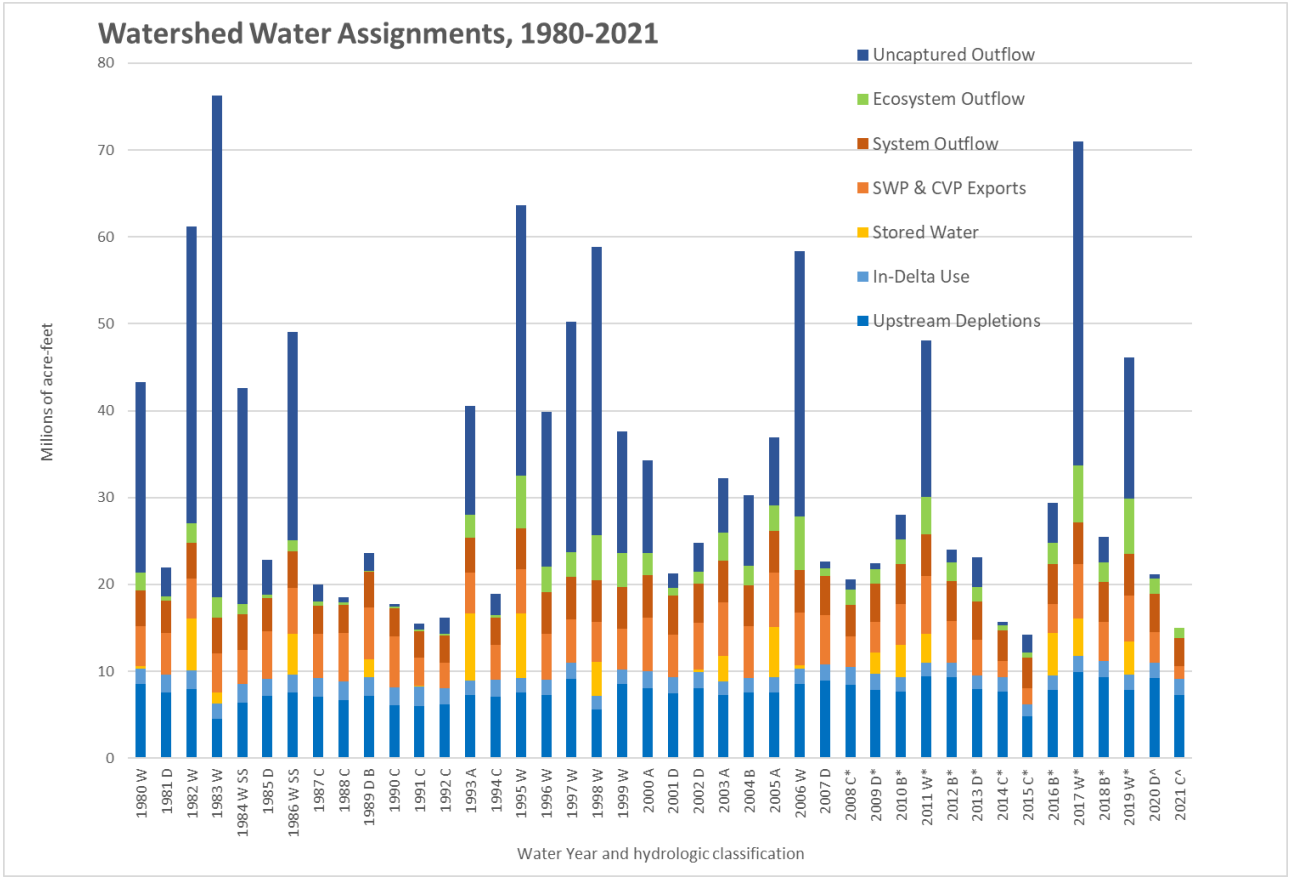
1980–2021 water accounts: sources, uses, outflow

- **Sources**
  - Runoff
  - Reservoir storage/releases
  - Delta inflow
  - Delta precipitation
- **Uses**
  - Upstream depletions (*annual, calculated by difference*)
  - In-Delta uses (farms, cities, nature)
  - Exports (SWP, CVP)

- **Delta outflow** (building block approach)*
  - "System" outflow for salinity
    - Export water quality
    - Delta M&I, ag standards
  - Ecosystem outflow (net increment)
    - Flows (D1641, CVPIA, VAMP, ESA)
    - Water quality (spring, fall X2)
    - Export pumping limits (various)
  - Uncaptured outflow

*Although system outflow also supports habitat, *it would be needed even if there were no ecosystem objectives for the Delta*.

1980-1921 Where did Watershed Runoff Go?

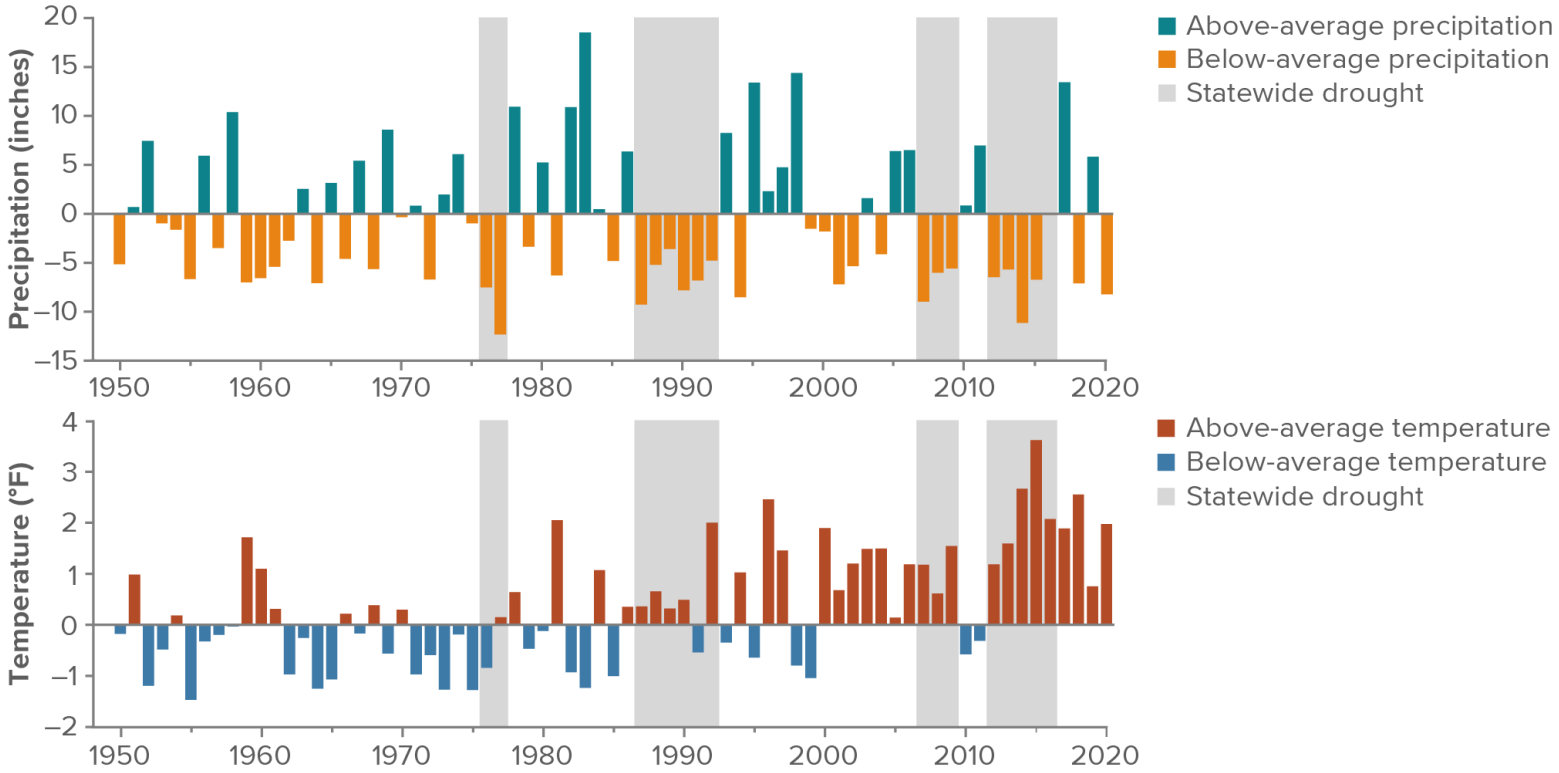


Compare: Upstream depletions and Delta Use with Exports

Compare: wet year with dry year Upstream and Delta Use

Compare: Pre-2000 Upstream use with Post-2000

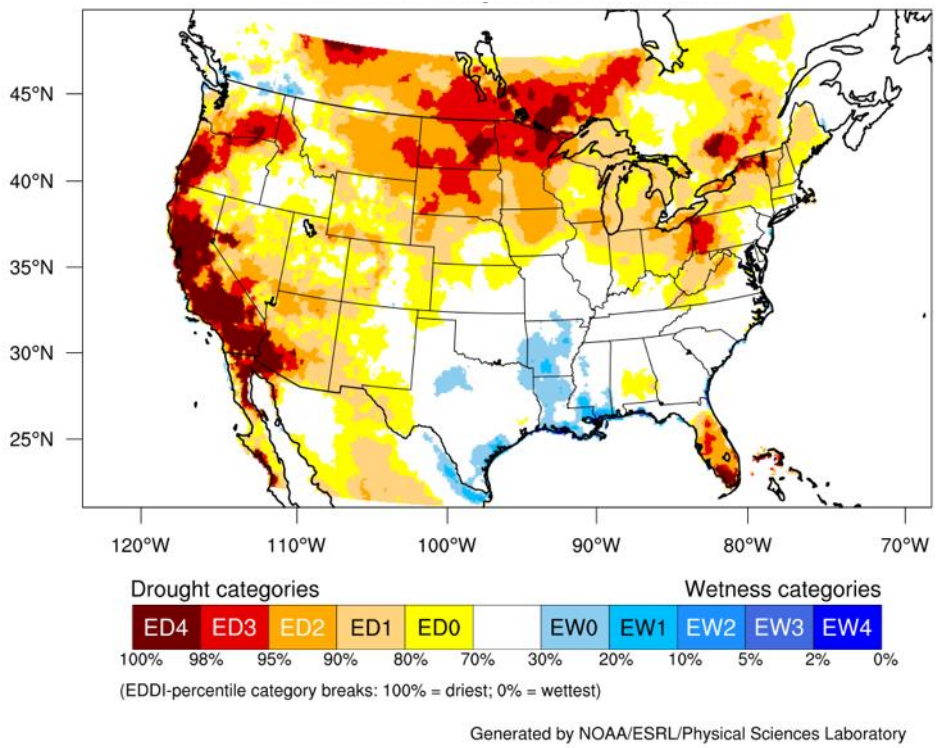
We are in the era of the hot drought



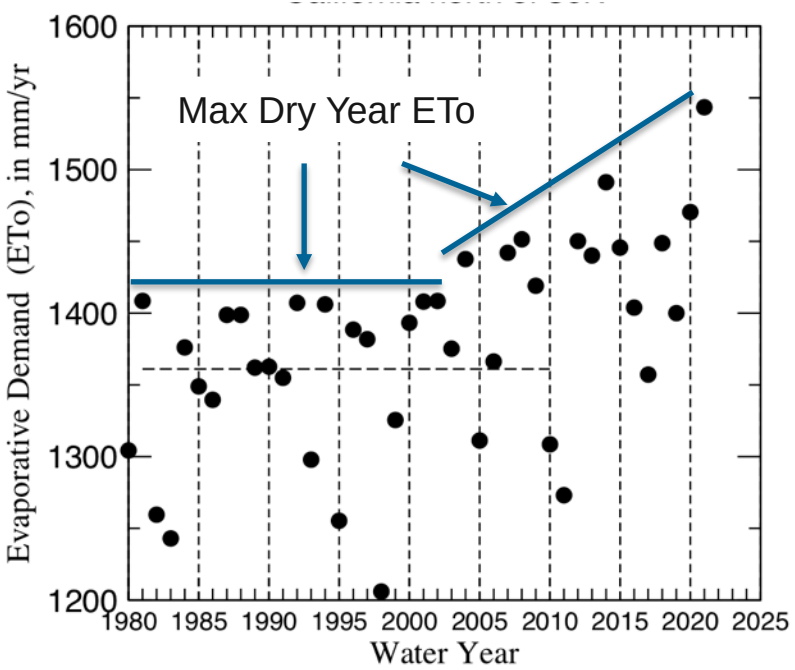
Source: Climate Tracker, Western Regional Climate Center 1980-2001 baseline

The big change: evaporative demand

Evaporative Demand Water Year 2021



Water Year Evaporative Demand
California North of 36N

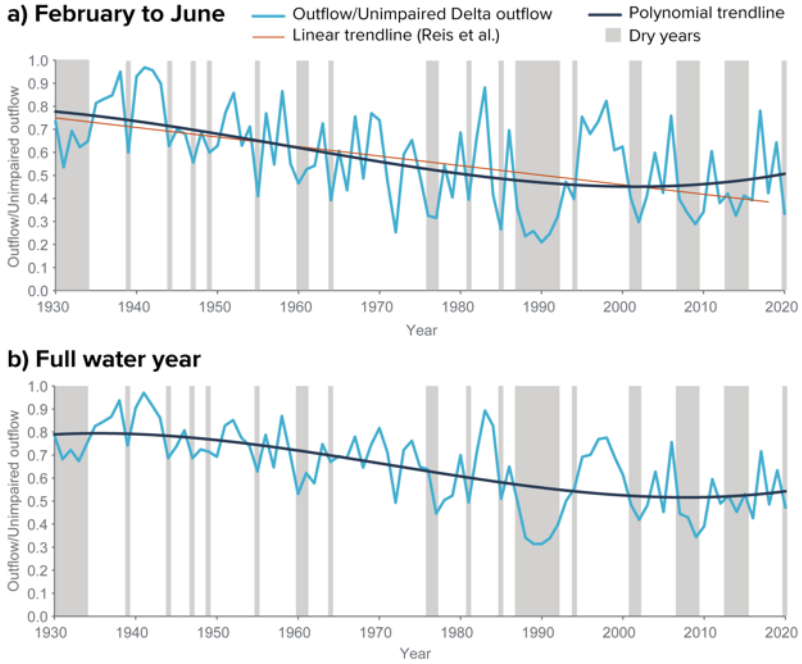


Source: Mike Dettinger, using data from Albano et al. (2022)

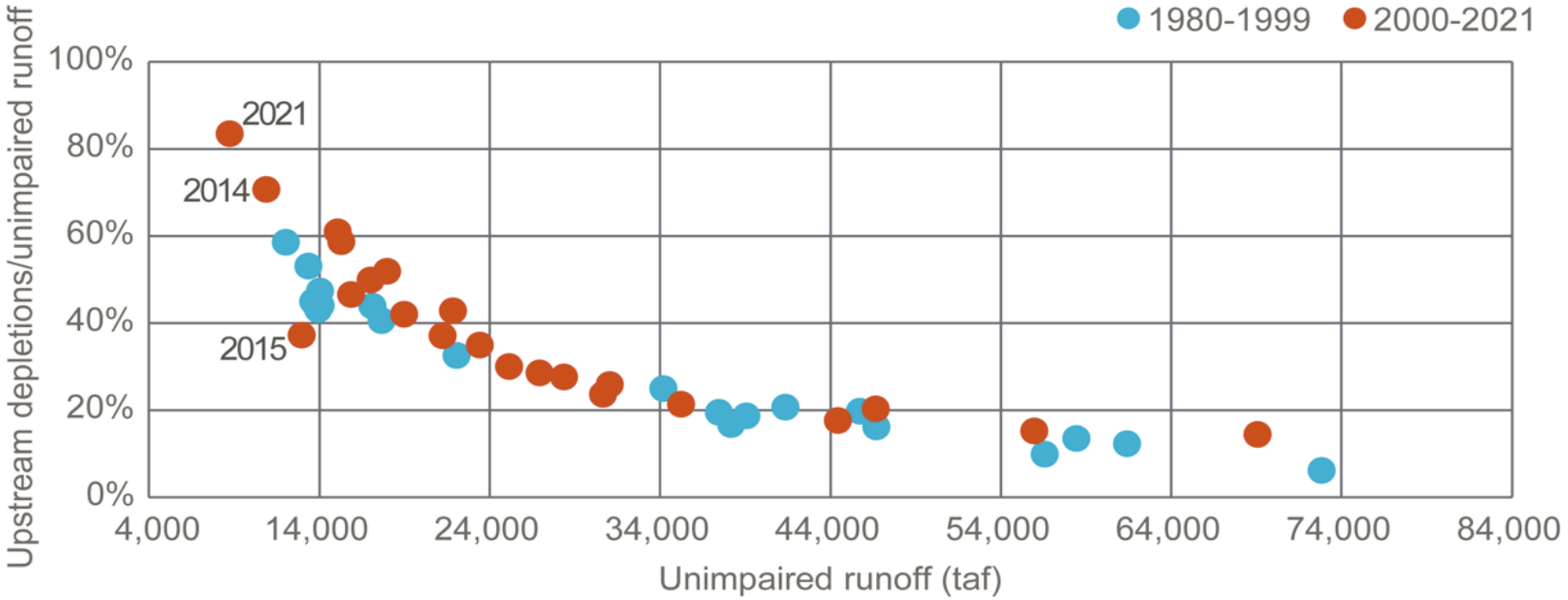
Outflow trends have changed

- Since early 1990s, more outflow is needed to meet salinity standards
- Ecosystem regulations post 1995, 2008 also increased outflow share; species declines continue
- Both trends—plus increases in upstream use—are increasing pressure on CVP, SWP reservoirs
- Uncaptured outflow makes up the bulk of outflow during wet years

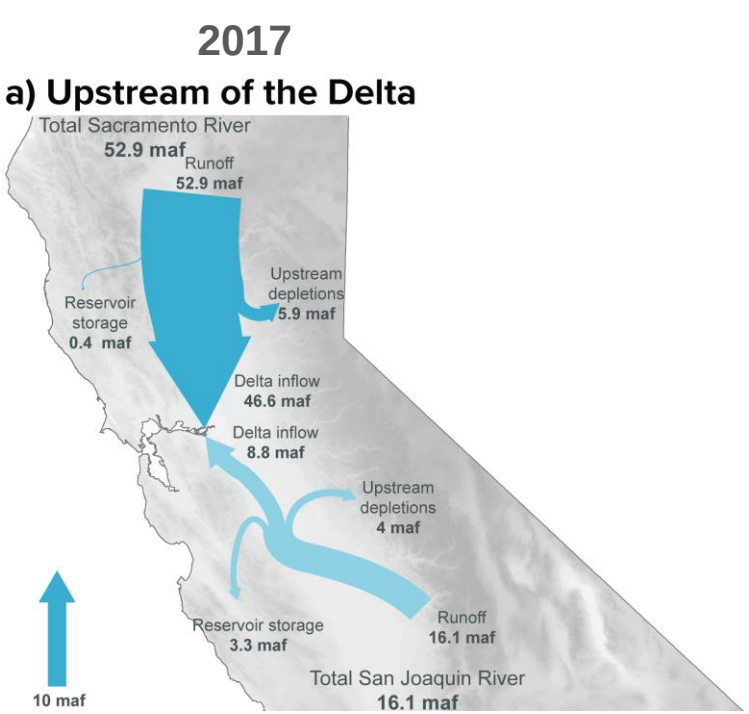
Delta Outflow/Unimpaired Outflow

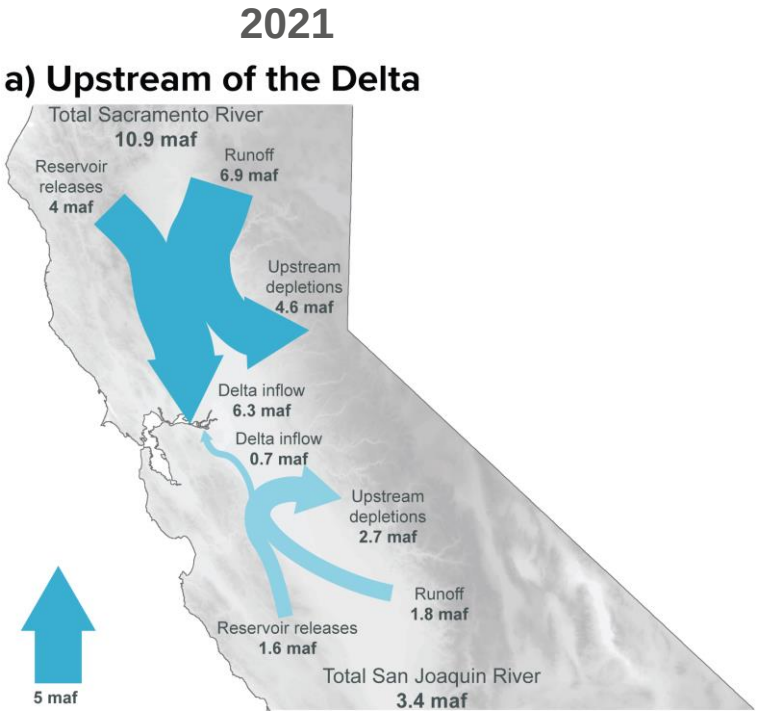


Upstream depletions are increasing in dry years, reducing inflow to the Delta



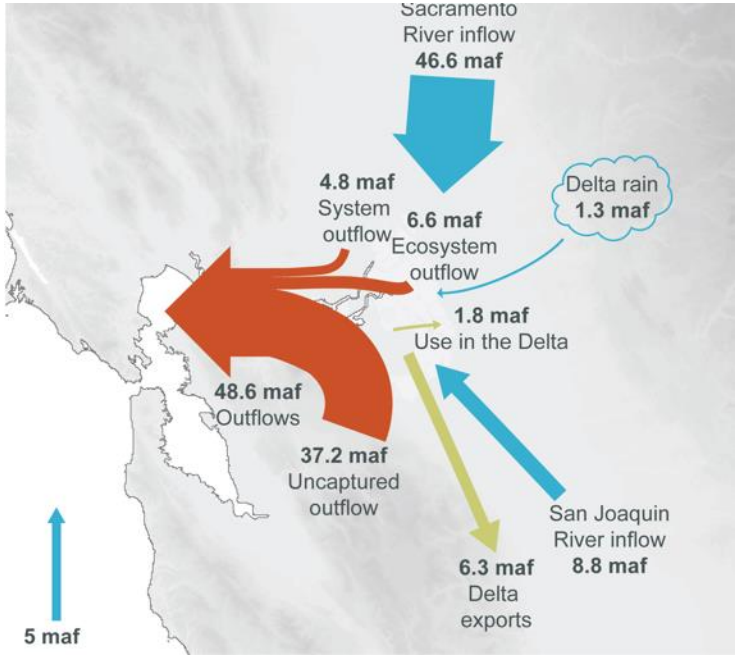
Comparing Delta flows in recent wet and dry years





Wet year sources and uses: 2017

- Just over a quarter of runoff went to uses: upstream (15%), in-Delta (3%), exports (10%)
- Less than a fifth went to regulatory outflow: ecosystem (10%), system (7%)
- More than half (55%) became uncaptured outflow
- Lack of storage south of Delta limited export pumping by > 400,000 af



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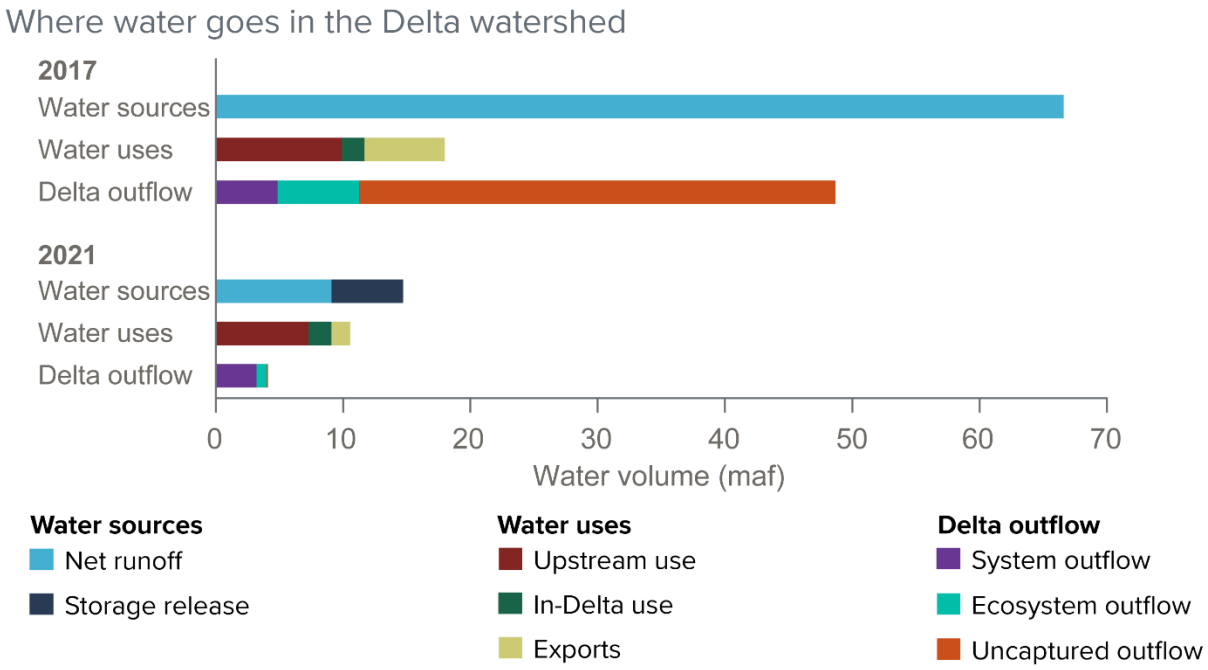
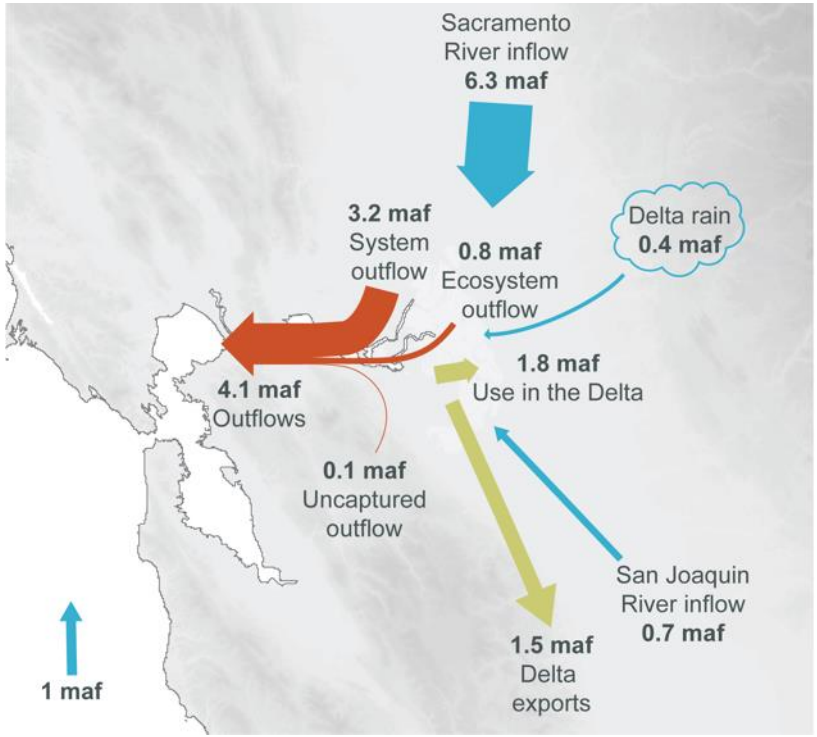
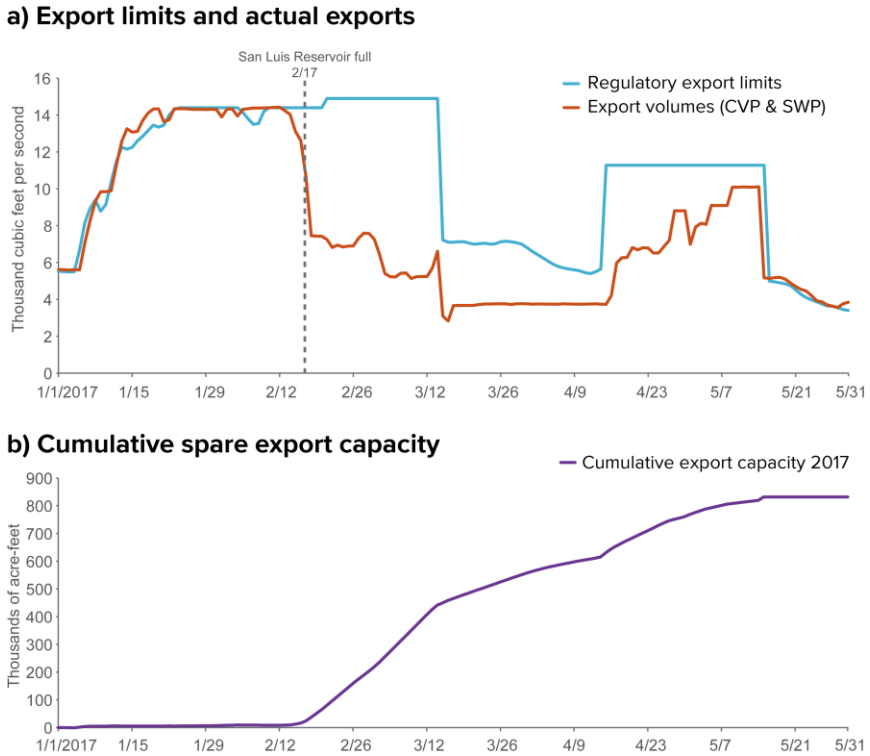


Dry year sources and uses: 2021

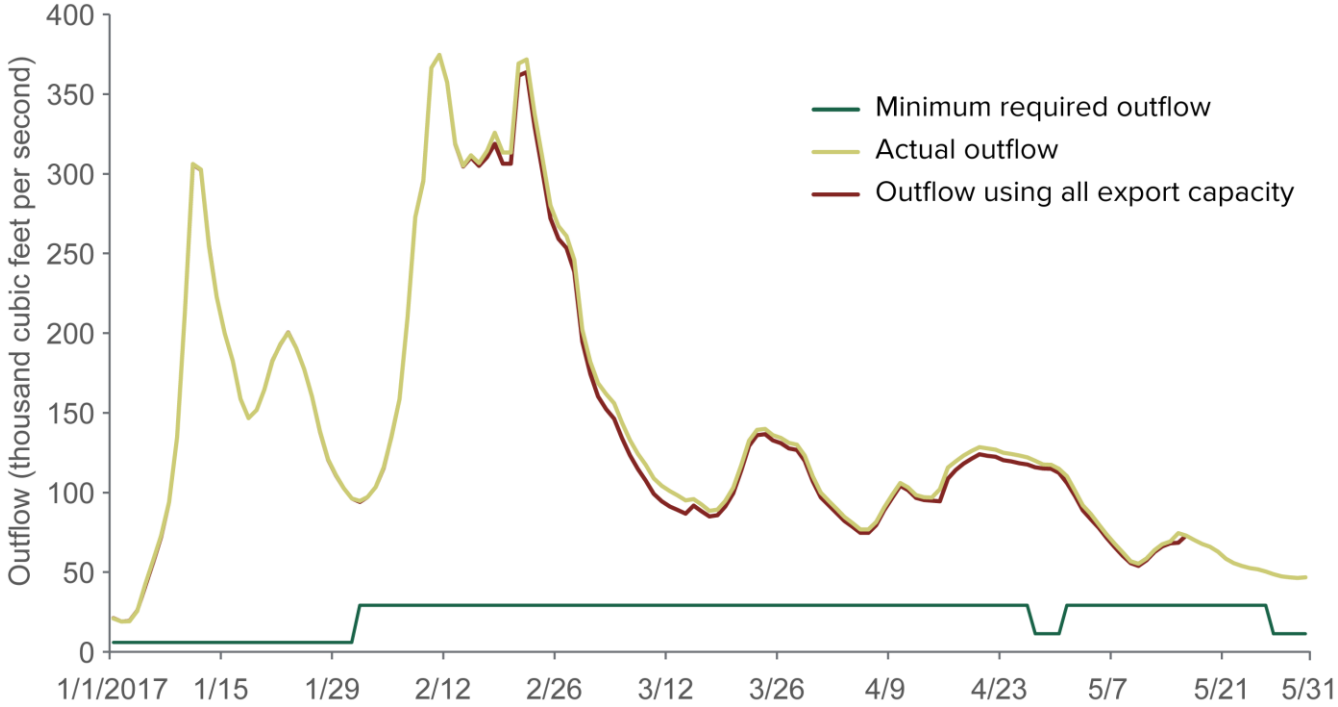
- 84% of unimpaired runoff was used upstream of the Delta
- 16% of unimpaired runoff was used in-Delta
- Ecosystem + system outflow, exports came from CVP, SWP reservoirs
- Salinity barrier and Temporary Urgency Change orders helped (400,000 af)



In 2017, 400–800 taf more exports possible if more storage capacity south of Delta.



This would have barely affected Delta outflow



How can we better manage a warmer, drier Delta watershed?

1. **Improve water accounting**
   - Measure and report all uses upstream of and in the Delta (seepage, riparian uses, diversions, return flows)

2. **Integrate severe droughts into management practices**
   - Model severe droughts, get a plan in place for operations including advance warning on curtailments, revise the WQCP

How can we better manage a warmer, drier Delta watershed?

3. **Modernize and simplify regulations**
   - Simplify rules, and build in flexibility to protect supply *and* environment
   - Coordinate water quality control plan, ESA BiOps/ITP

4. **Prepare for wet years**
   - Capacity to do this both upstream, south of Delta
   - Revisions to how we deal with flood waters

How can modeling help?

Severe drought models

Need plans for dealing with prolonged severe droughts that protect the environment, health and safety, food production

This is something that will require a joint, collaborative effort among DWR, USBR, SWRCB, USFWS, CDFW, NMFS, USGS, and stakeholders

Need for ecological indices

Stop measuring "ecological benefits" with water supply delivery models.

Fortunately, there is a start with ecological-based functional flow model indices. They need to be expanded.

Some things I have learned

- **Checking Model Results**
  - **Everyone checks and double checks when results are odd**
  - **Equally important to check when things seem ok**

- **Greg's First Law**

- **Greg's Second Law**

Thank you!

Photo C. Jeffres

For more information about the PPIC study

- Policy brief (6 pages)
- Technical appendix (detailed analysis--~50 pages)
- Data Set
- Commentary in CalMatters (1-page highlights)

About these slides

These slides were created to accompany a presentation. They do not include full documentation of sources, data samples, methods, and interpretations. To avoid misinterpretations, please contact:

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Thank you for your interest in this work.

Sacramento – San Joaquin Delta

650,000 acres of irrigated agriculture

Delta Outflow

Export pumps at Tracy