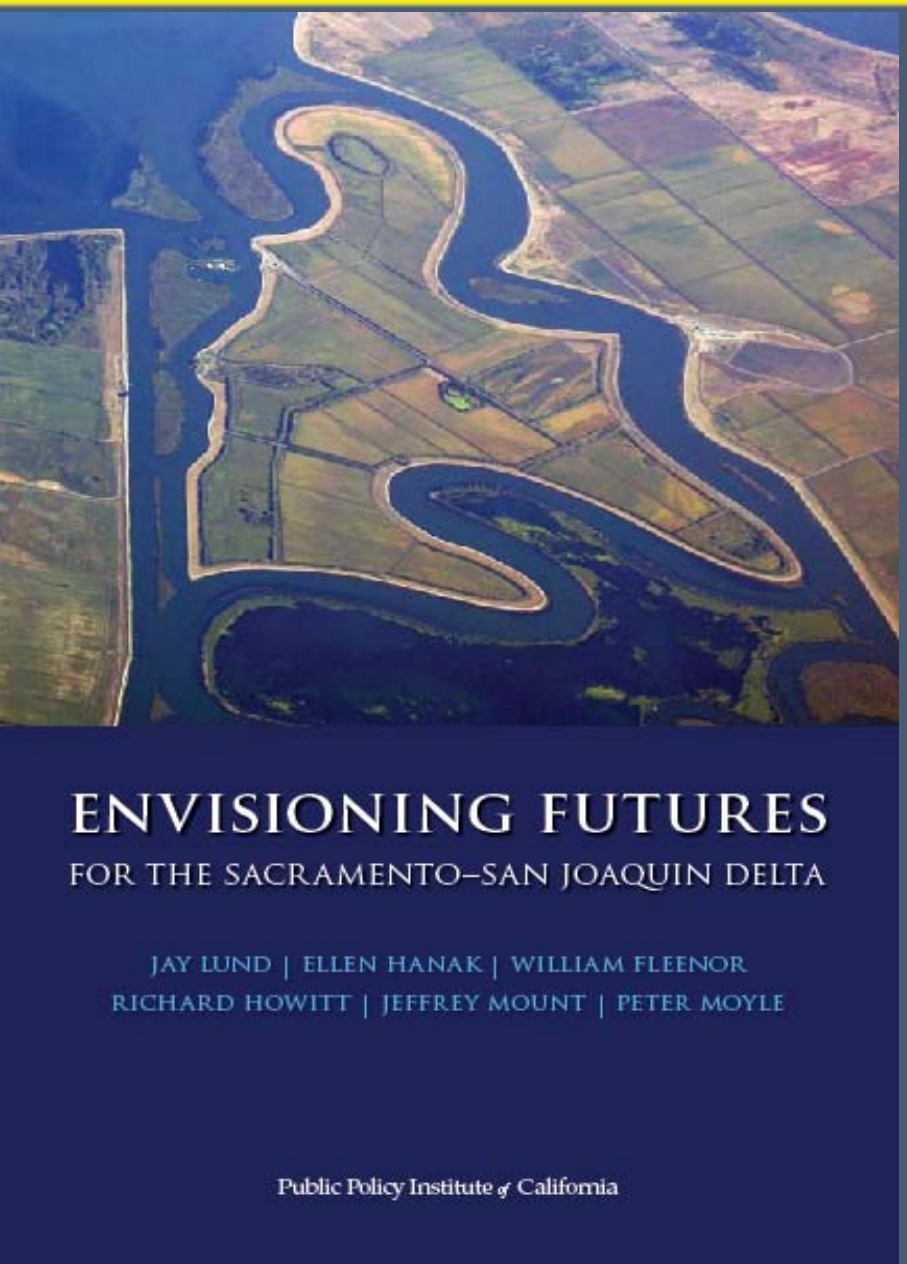
Beyond the Peripheral Canal



Engineers:
Jay Lund, UC Davis*
William Fleenor, UC Davis

Economists:
Ellen Hanak, PPIC*
Richard Howitt, UC Davis

Geologist:
Jeffrey Mount, UC Davis

Biologist:
Peter Moyle, UC Davis

** Lead authors*

Envisioning Futures for the Sacramento-San Joaquin Delta - Report and Project

- Delta possibilities and alternatives through a technical/scientific process
- Non-partisan and non-stakeholder effort
- Content developed in year-long collaboration among authors, with broader discussions
- Initiated and published by the Public Policy Institute of California (PPIC)
- Co-sponsored by UC Davis and PPIC

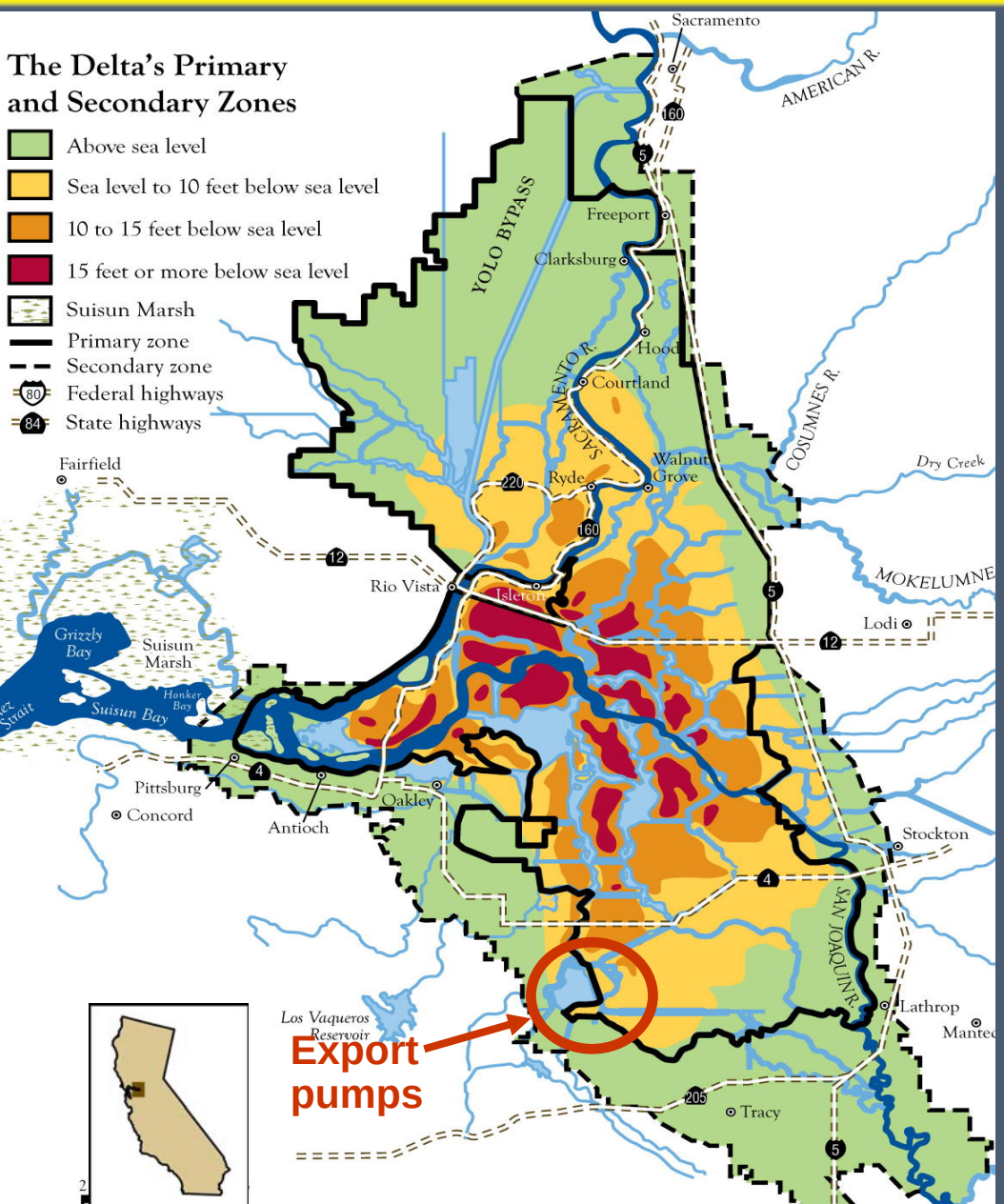
Major Themes

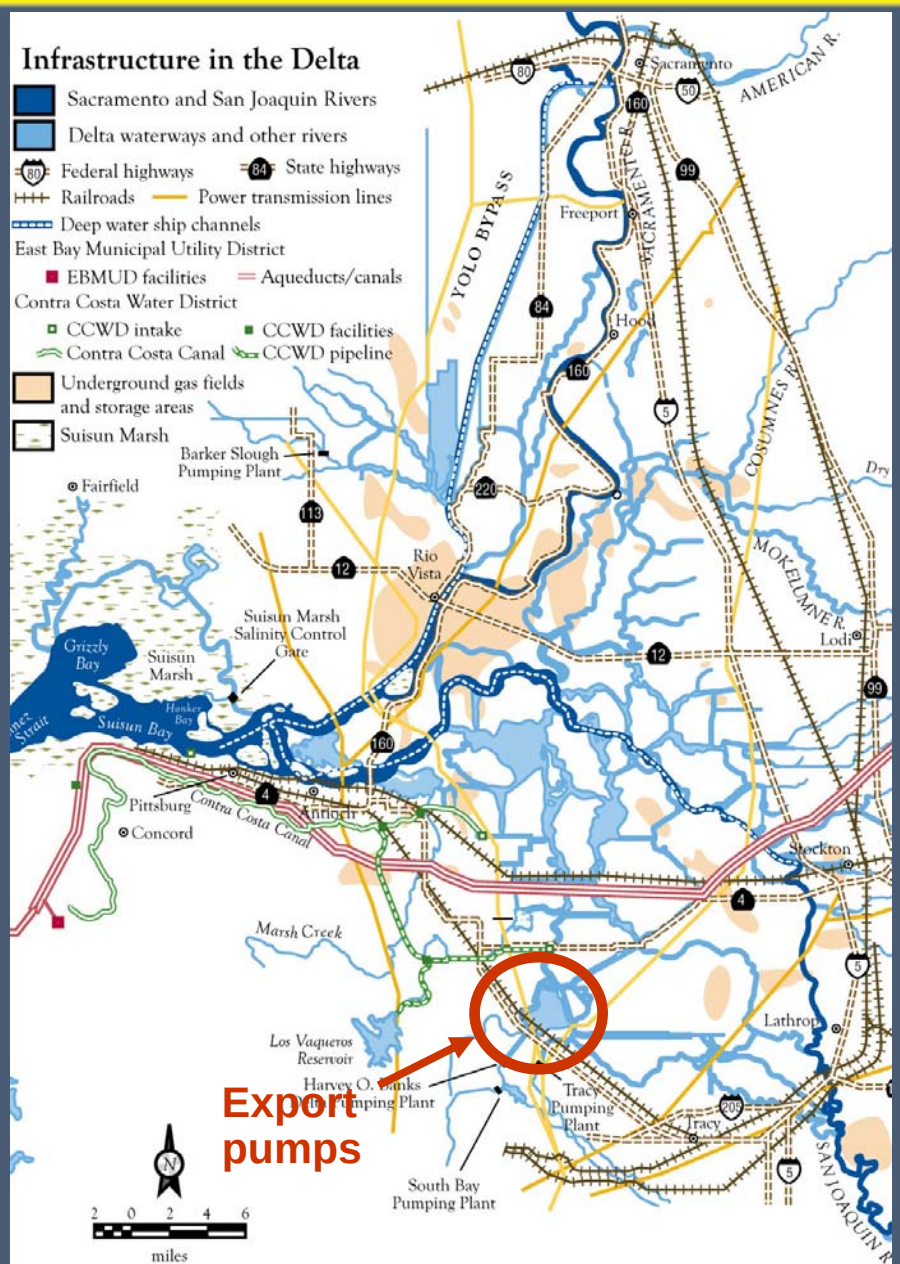
- Current Delta is unsustainable for almost all stakeholders
- Improved understanding of the Delta provides opportunities for new solutions
- Promising alternatives exist
- Most Delta users have ability to adapt
- Promising solutions are unlikely to arise from a stakeholder-only process

Outline

- <u>Why the Delta matters</u>
- California's Delta crisis
- New thinking: ecosystem and adaptation
- Some long-term alternatives
- Screening of alternatives
- Recommendations

The Sacramento-San Joaquin Delta





Why the Delta Matters to Californians

Water Supply

Agriculture

Ecosystem

Infrastructure

Recreation

Housing

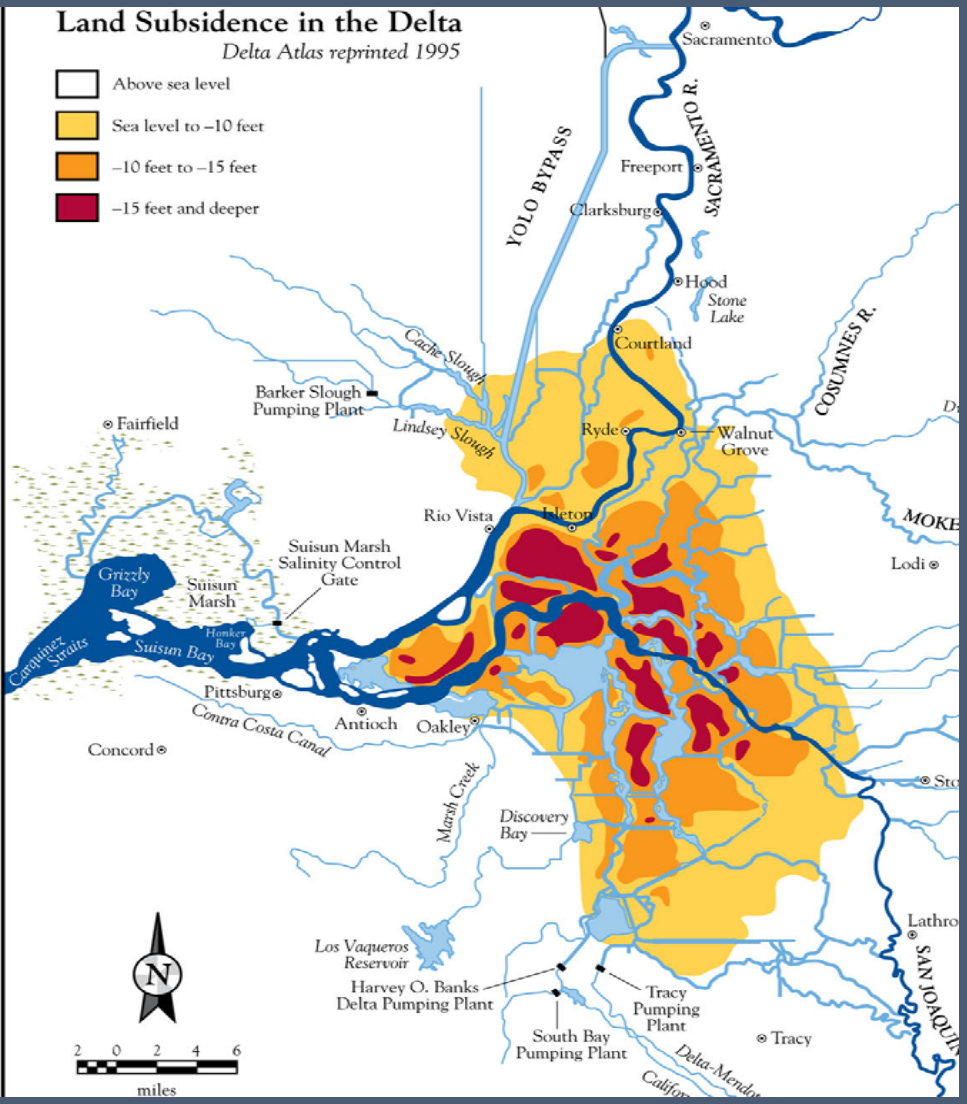
Outline

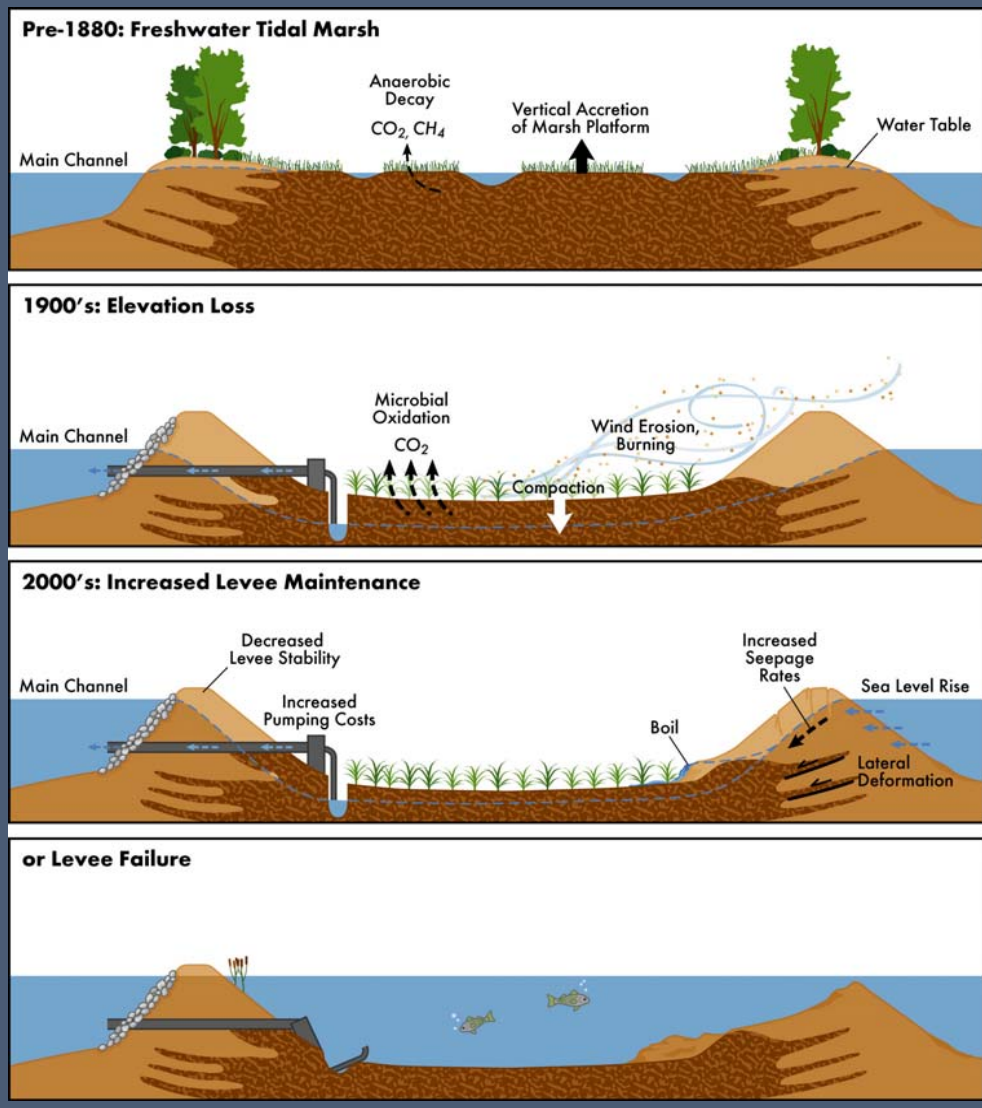
- Why the Delta matters
- California's Delta crisis
- New thinking: ecosystem and adaptation
- Some long-term alternatives
- Screening of alternatives
- Conclusions and recommendations

A Three-pronged Crisis

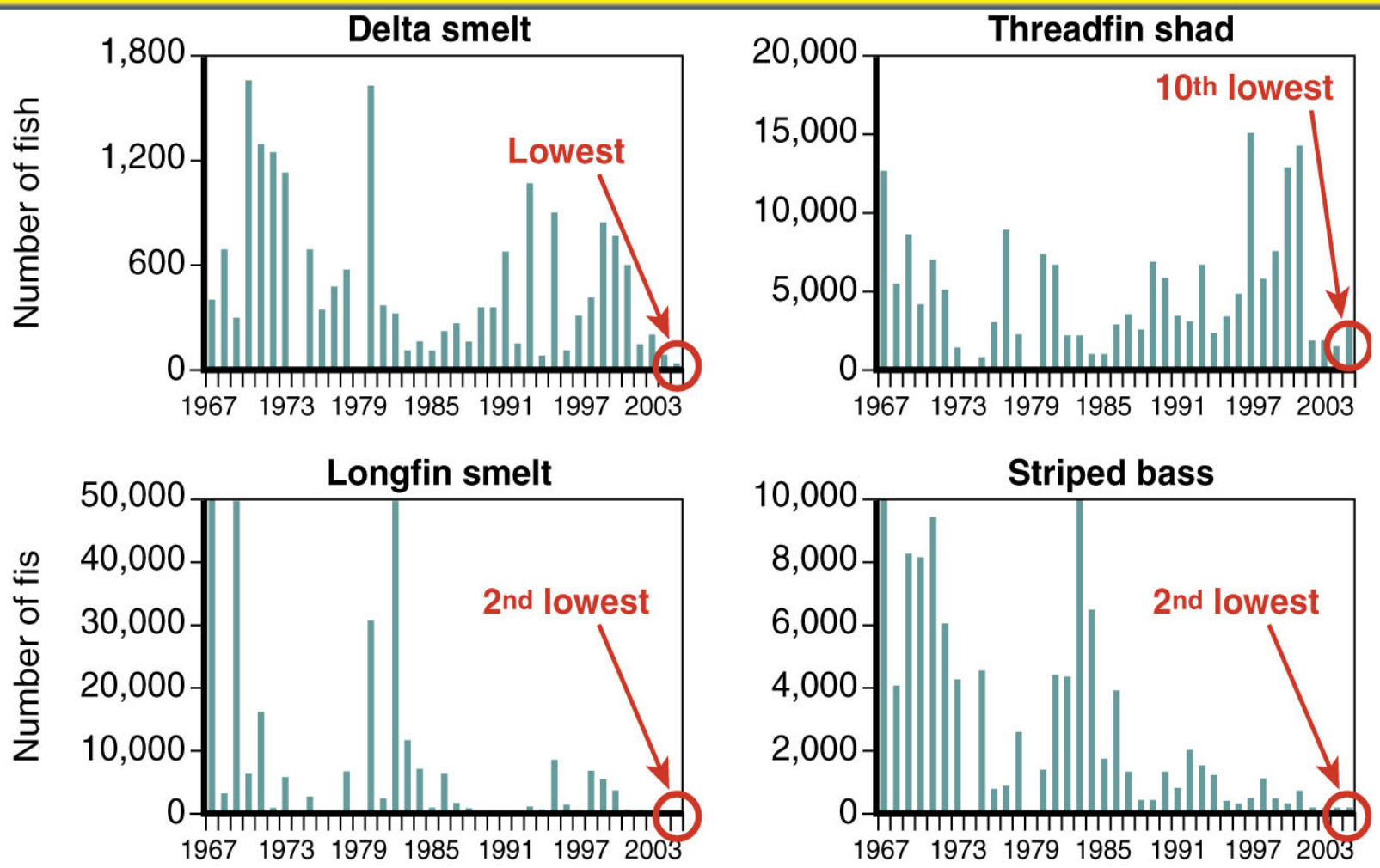
- Levees at increasing risk
  - Sea level rise and sinking land
  - Floods and earthquakes
- Steep declines in many fish species
  - Many are “listed”
  - Culprits: invasive species, habitat loss, pumps
- Governing institutions lacking
  - Resurgence of legal actions

Subsidence and Sea Level Rise





An Ecosystem in Crisis



SOURCE: California Department of Fish and Game.

NOTES: Graphs report the indices for the fall midwater trawl. Circles indicate the rank of indices in 2005. For delta smelt, longfin smelt, and striped bass, the recent indices represent low points in long-term declines of their populations.

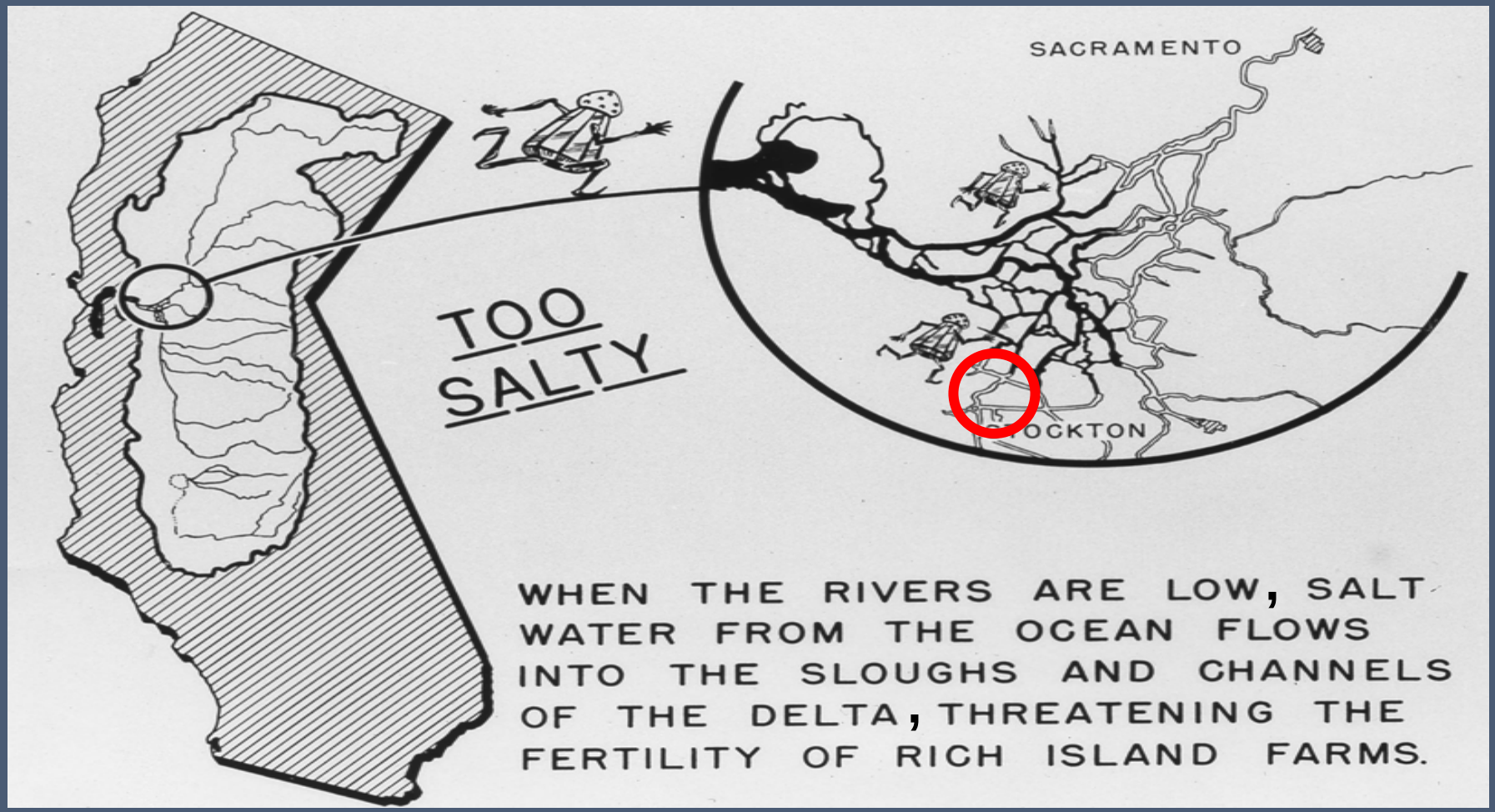
Emerging Policy Responses

- New studies on fish declines and levee risks
- Emergency funds for levee repairs
- "Delta Vision" process and Blue Ribbon Panel
- Bay-Delta Conservation Plan
- Stakeholders promoting several approaches
  - Shoring up levees, peripheral canal, reduced water exports

Outline

- Why the Delta matters
- California's Delta crisis
- <u>New thinking: ecosystem and adaptation</u>
- Some long-term alternatives
- Screening of alternatives
- Recommendations

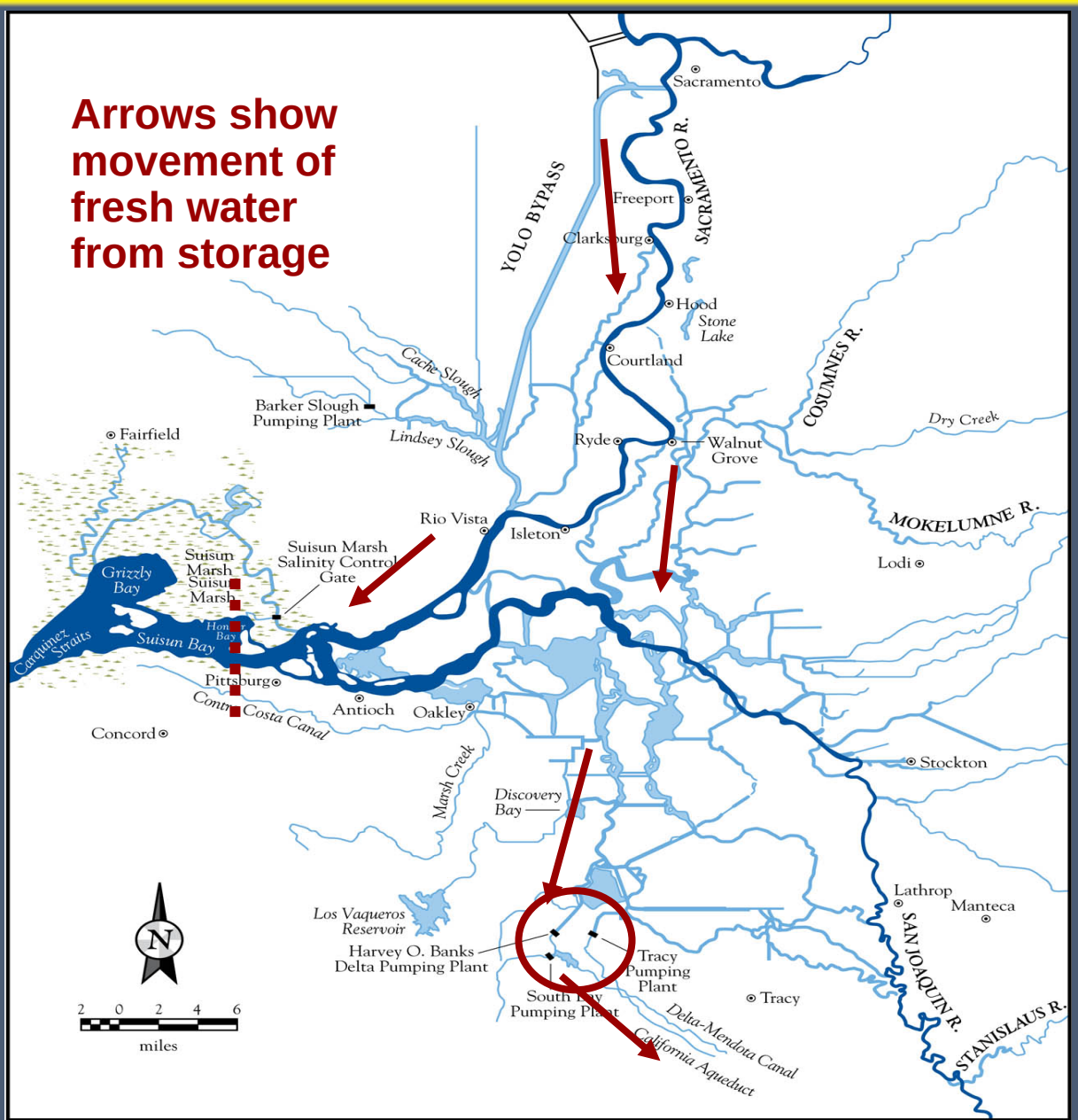
Since 1920s, California Policy Has Aimed to Keep the Delta Fresh



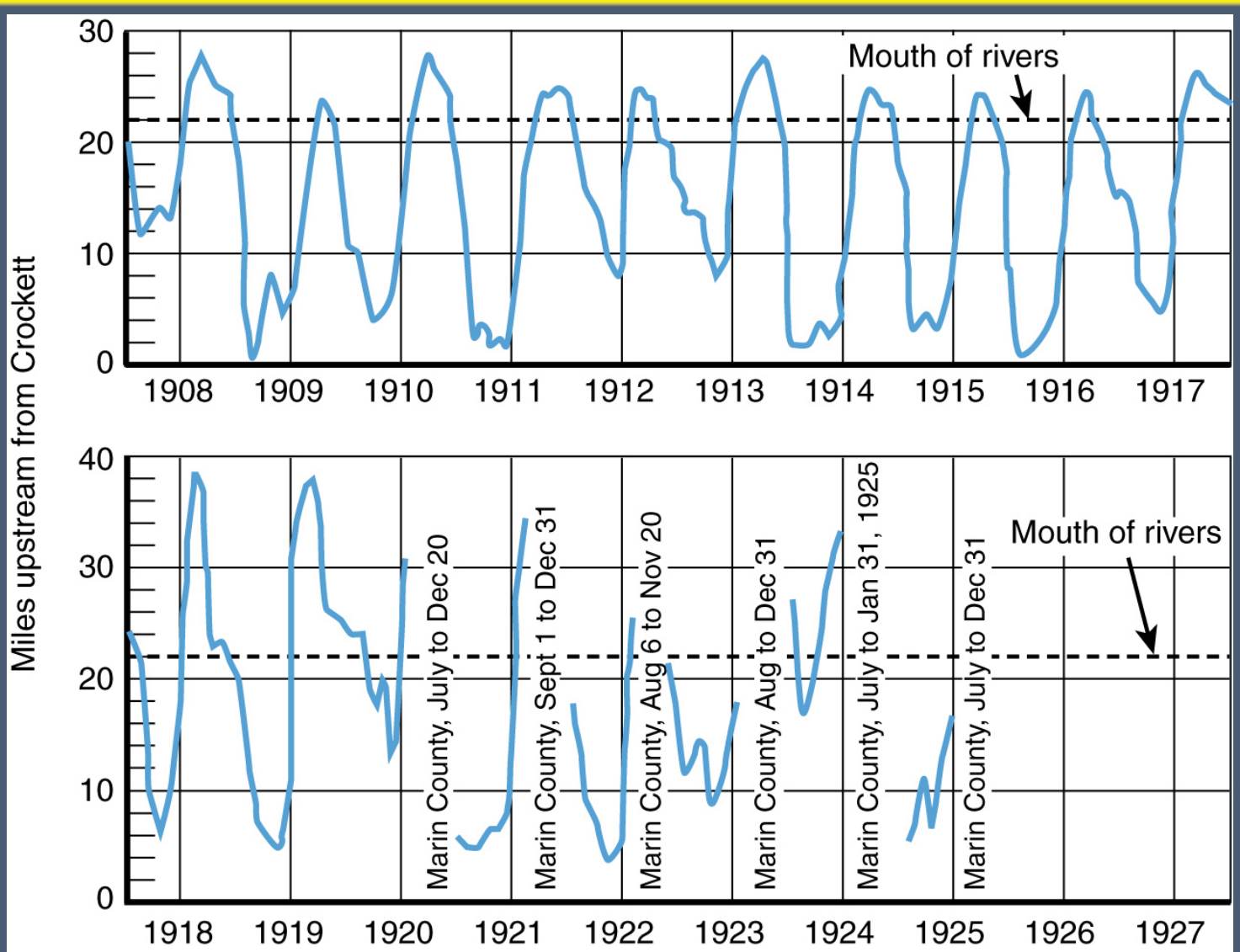
1945 USBR report

- Delta farmers and water exporters benefit from low salinity

In 1940s, Central Valley Project Created "Hydraulic Barrier" for Water Exports

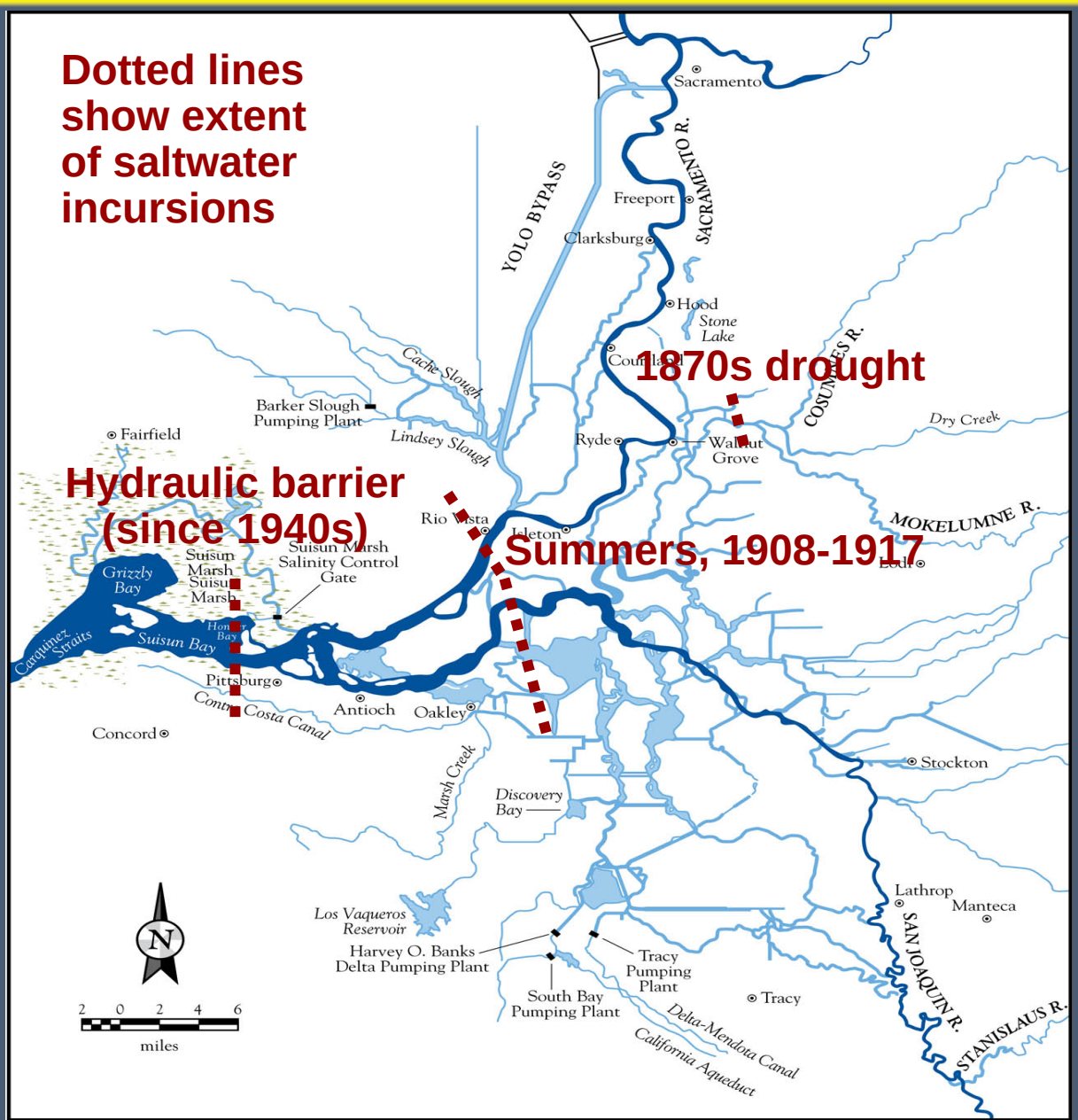


Historically, Delta Salinity Fluctuated

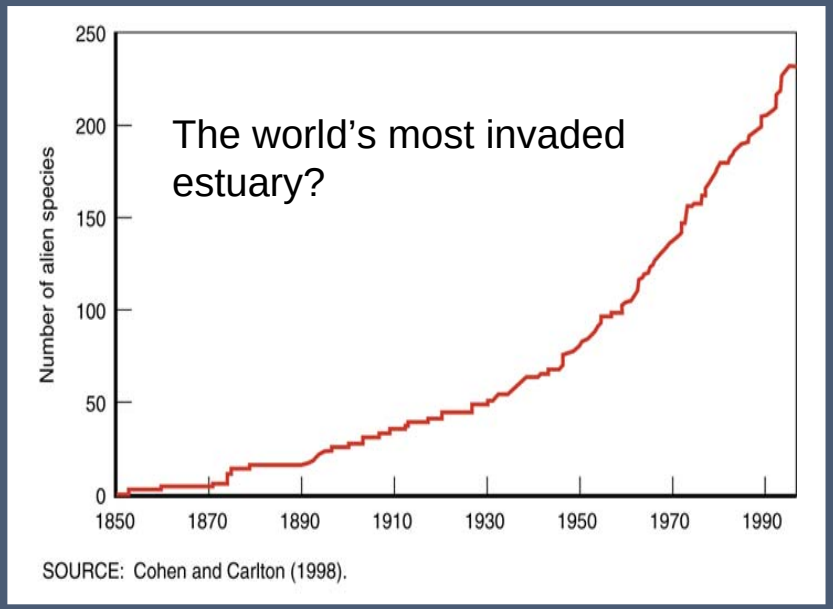


SOURCE: Young (1929), Plate 9-1.

“Hydraulic Barrier” Prevents Seasonal and Dry-year Salinity Incursions

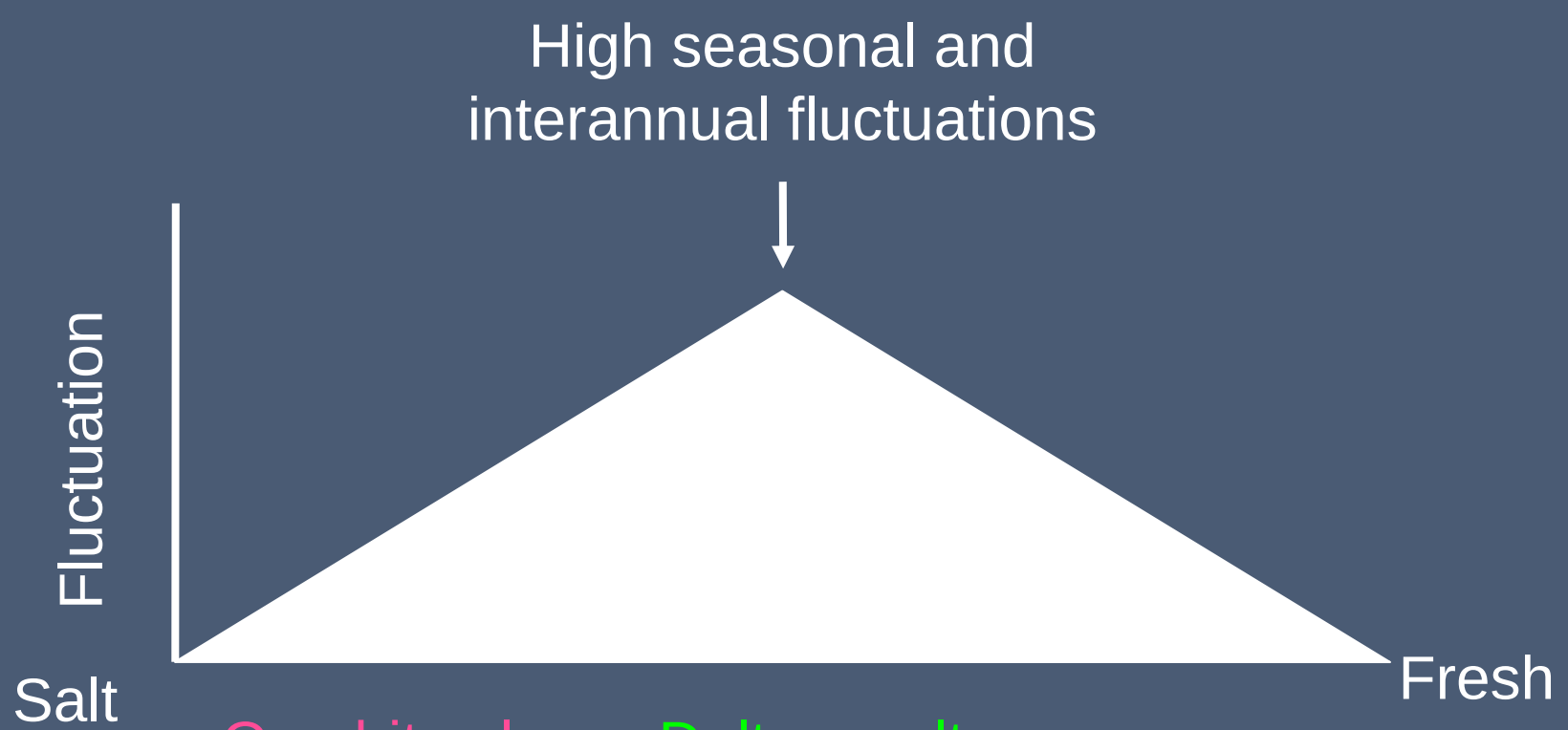


Conceptual Ecosystem Model



- Incorporates recent thinking about estuary
- Includes new understanding of:
  - hydrodynamics
  - invasive species
  - interdependence
  - landscape change
  - export pumping

Desirable and Undesirable Species In A Salinity Gradient With Seasonal and Annual Fluctuations



Anchovy
Surf perches
Marine fish

Overbite clam
Siberian prawn
Jellyfish

Delta smelt
Striped bass
Longfin smelt
Splittail
Mysid shrimp
Tule perch

Largemouth bass
Bluegill
Brazil waterweed
Water hyacinth
Asian clam

Static, Freshwater Delta Not Good for Native Species

- Native species evolved in a fluctuating Delta
- Alien species have taken hold and harm native species
- Alien species do best with constant salinity (fresh or saline)
- Restoring fluctuating conditions may be key to native species' survival

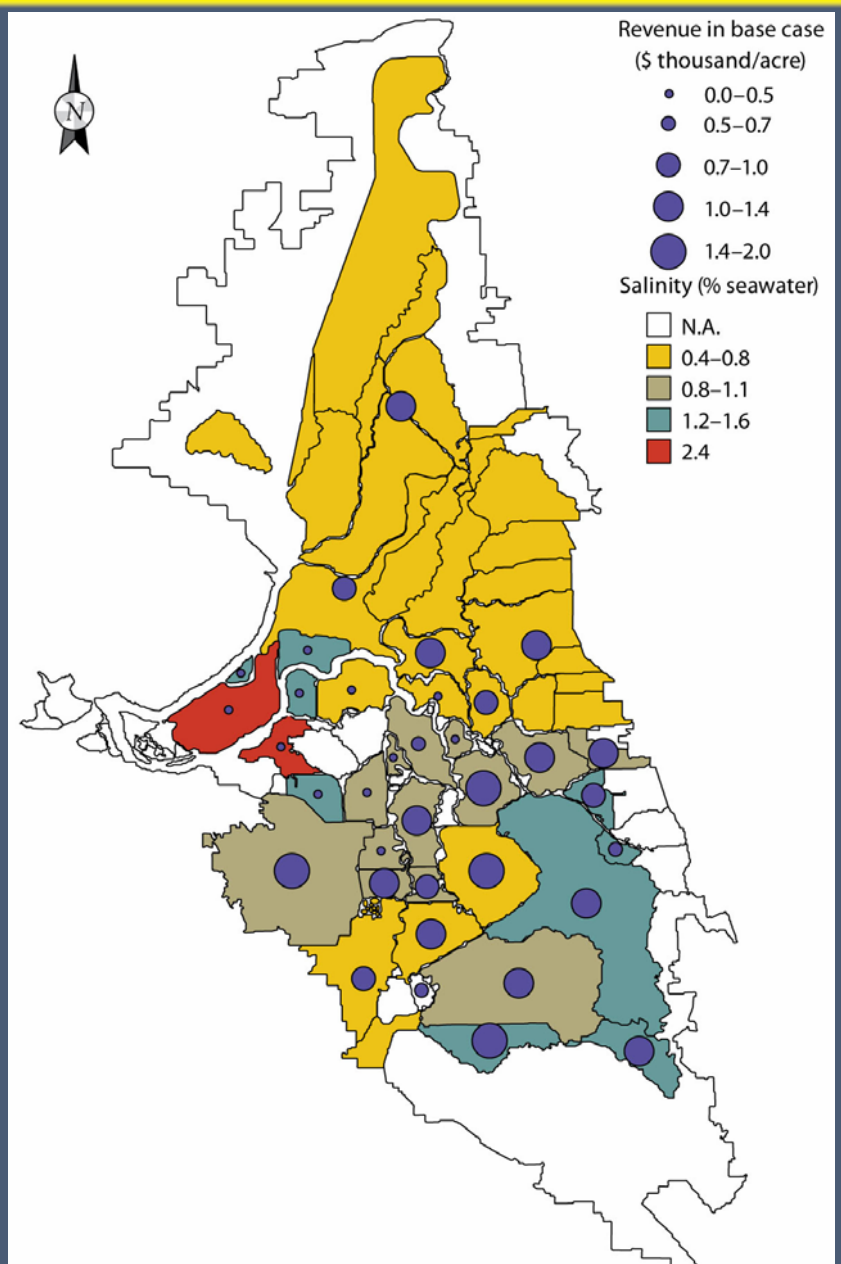
Asiatic clam

Brazilian waterweed

Overbite clam

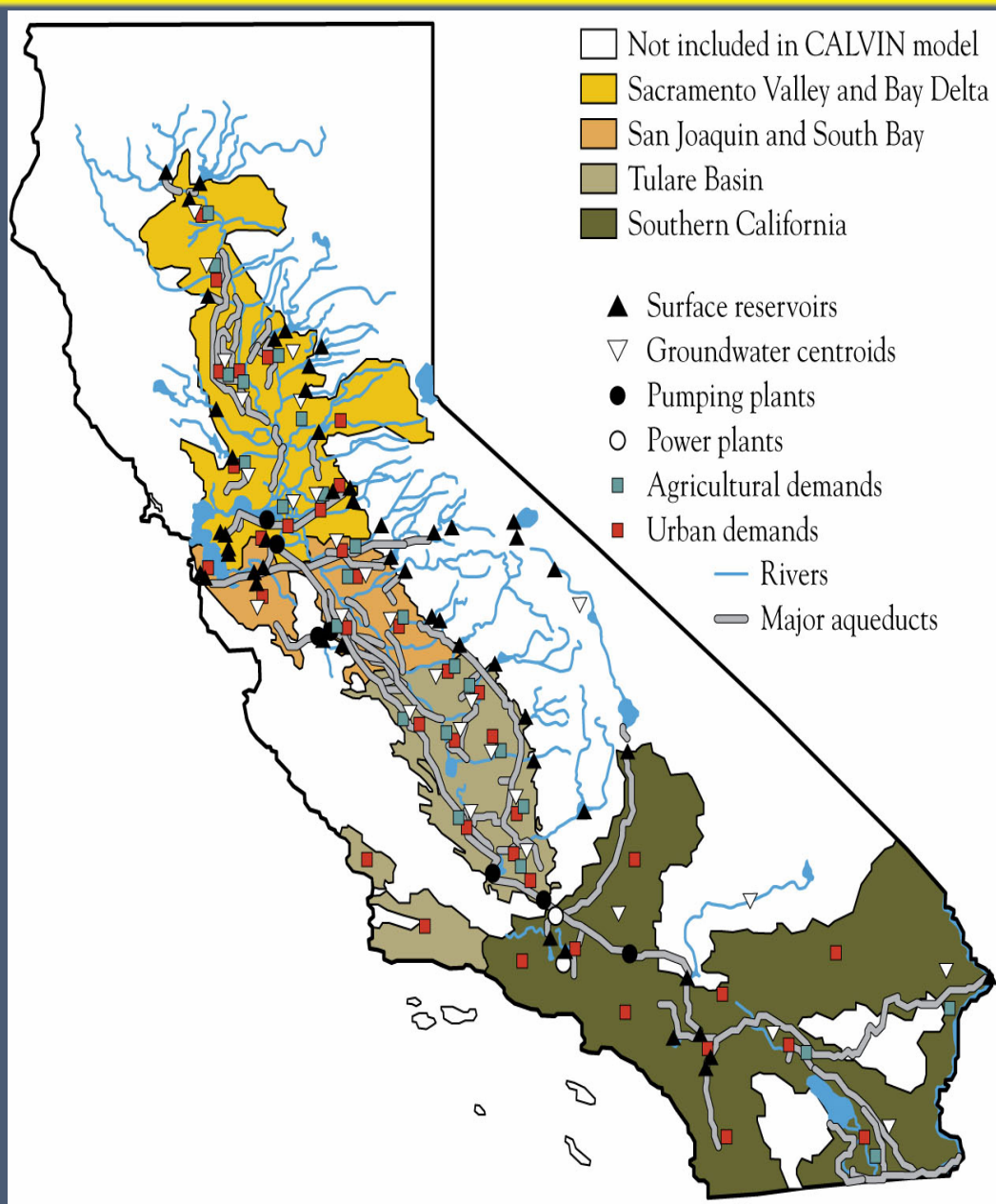
Delta Agricultural Costs – DAP

- Delta agricultural production and economics model
- Salinity's economic effects by island
- Costs and local adaptations for major Delta islands

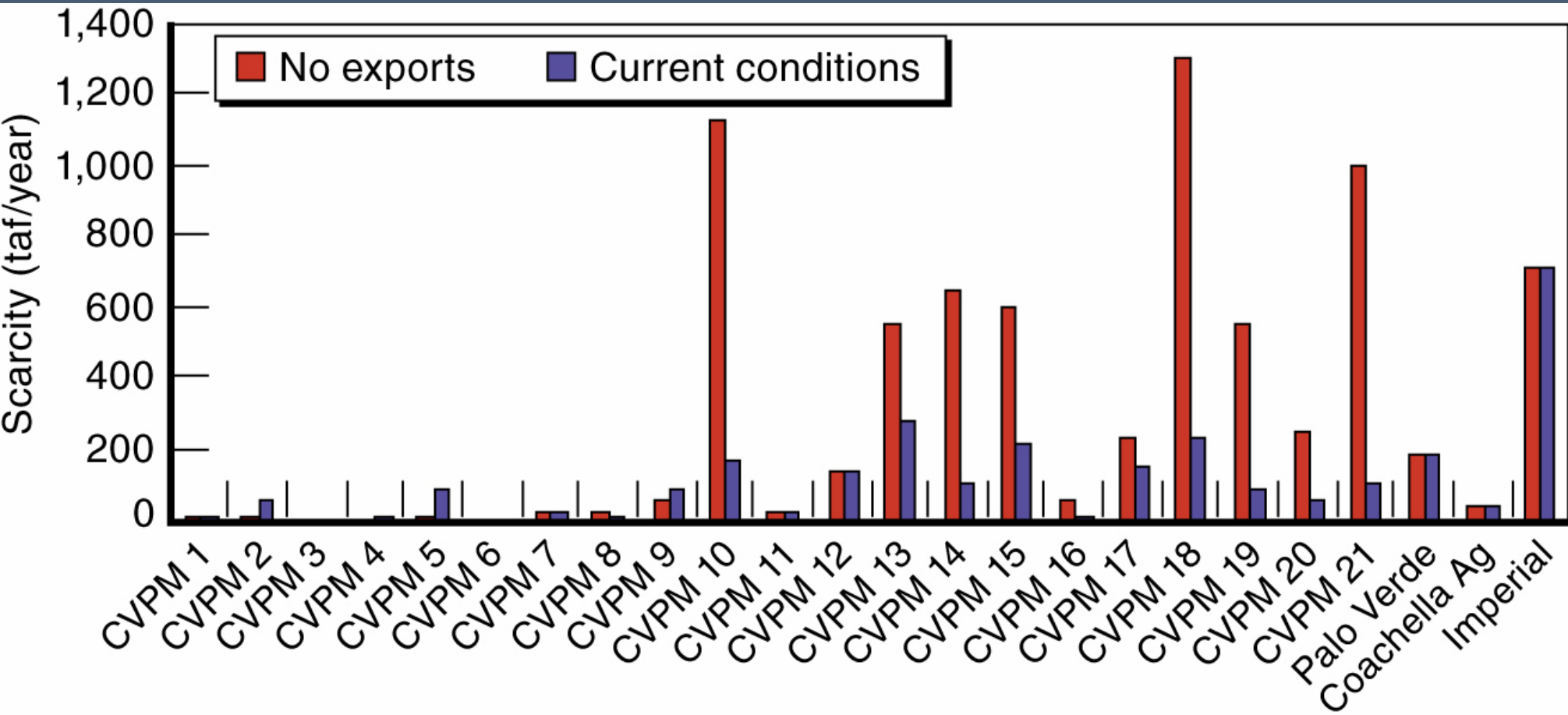


Statewide Water Costs – CALVIN

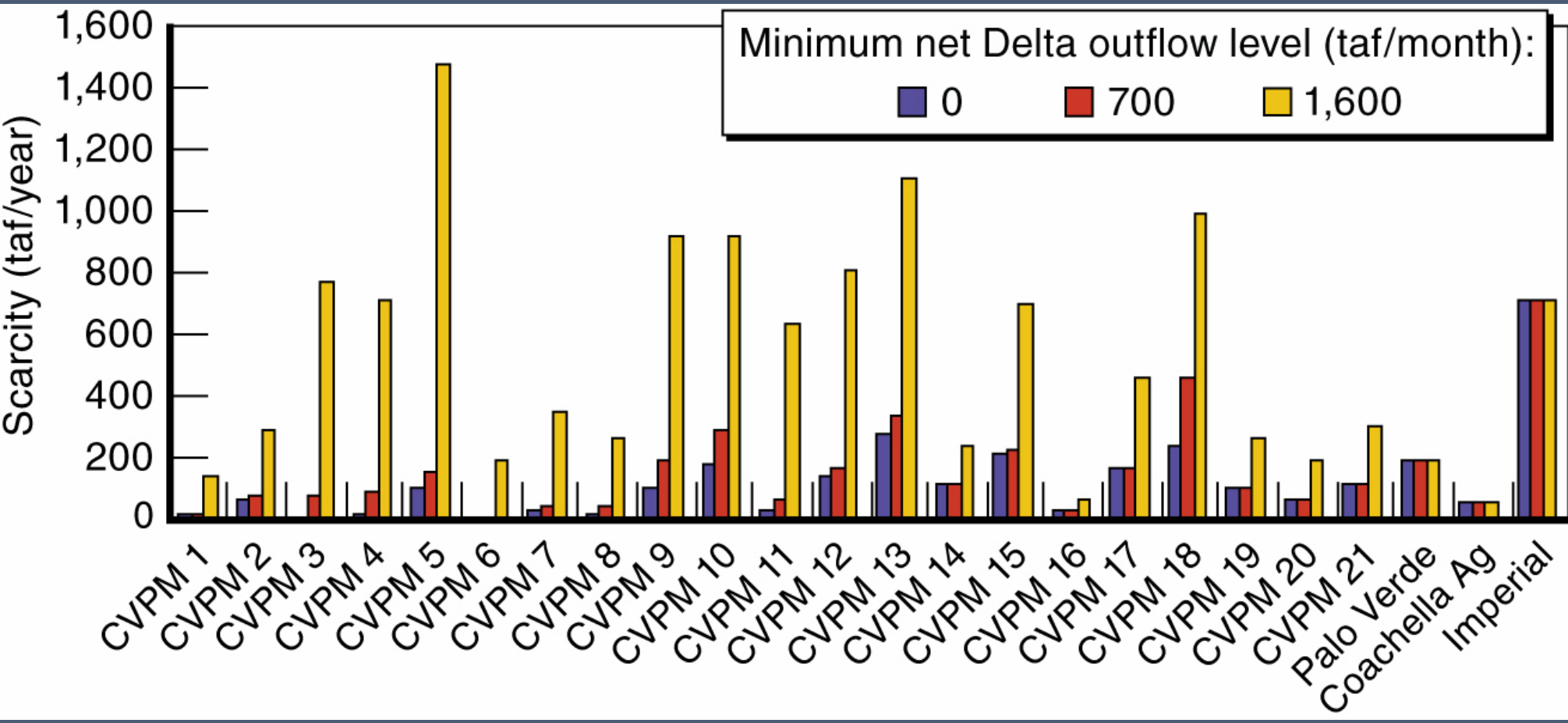
- Statewide integrated engineering-optimization model
- Integrates hydrology, infrastructure, operations, economic performance, and environmental flows
- Economical adaptations to significantly changed conditions



Agricultural Water Scarcity – No Exports



Agricultural Water Scarcity – Greater Minimum Delta Outflows



Model Result Implications

- Adaptations exist to changes in Delta policies
  - Export water users
  - Upstream water users
  - Delta agriculture
- Economic costs are finite, but can be large

Outline

- Why the Delta matters
- California's Delta crisis
- New thinking: ecosystem and adaptation
- <u>Some long-term alternatives</u>
- Screening of alternatives
- Recommendations

Nine Delta Alternatives

- Freshwater Delta
  - Two levee-based alternatives
  - Physical salinity barrier
- Fluctuating Delta
  - Two peripheral canal alternatives
  - Armored-island aqueduct
- Reduced-exports Delta (*also fluctuating)
  - Opportunistic Delta*
  - Eco-Delta*
  - Abandoned Delta

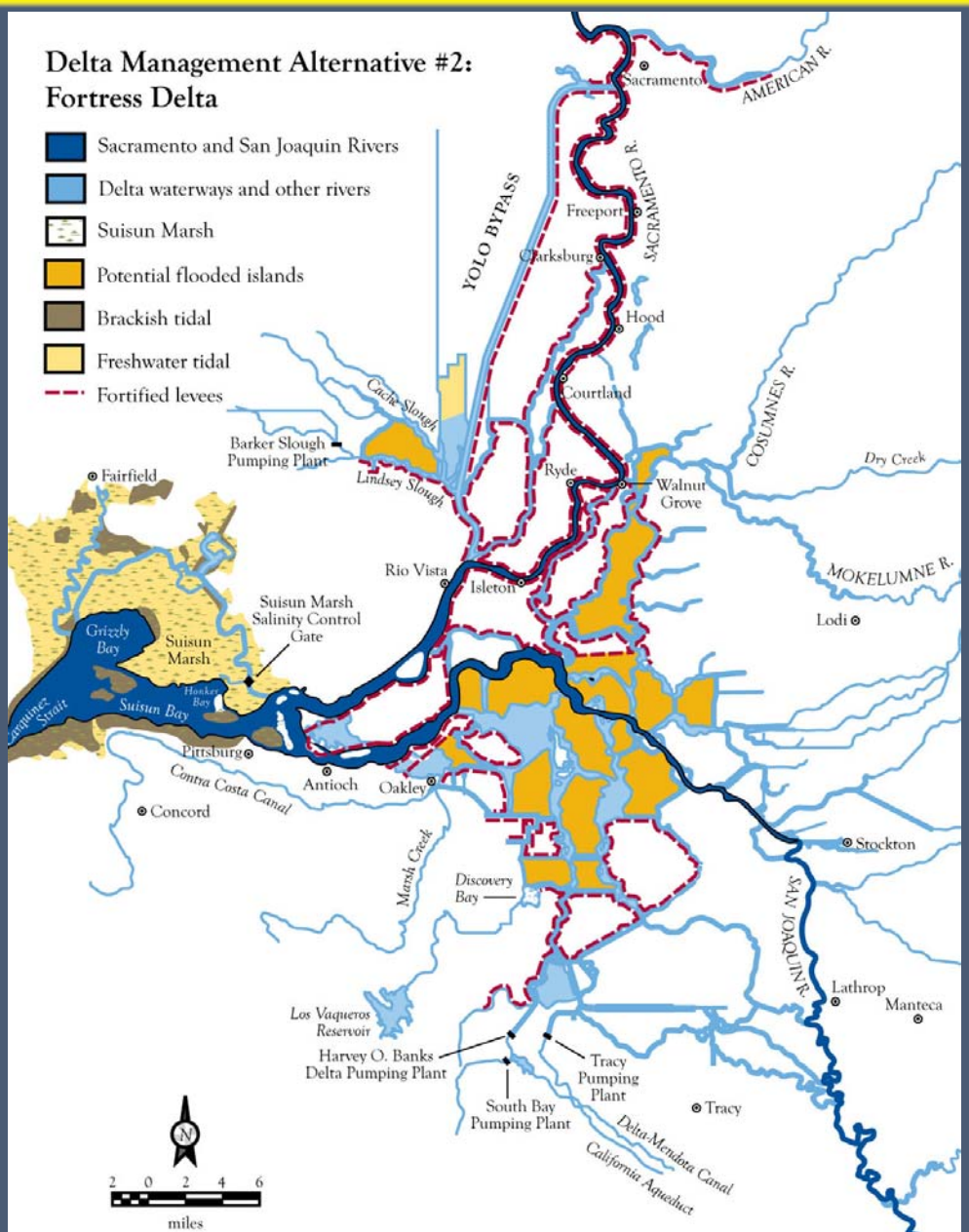
1) Levees as Usual: Enhancing Current Levee System, Keeping Delta Fresh

- Status quo, with improvements
- Maintains current land uses
- Increasing risks of failure

Sacramento River levee

2) Fortress Delta: Dutch Standards of Flood Protection – A Big Jump

- Keeps Delta fresh
- Strategic levees become much more reliable…
- Aids urbanization
- …but many islands lose protection



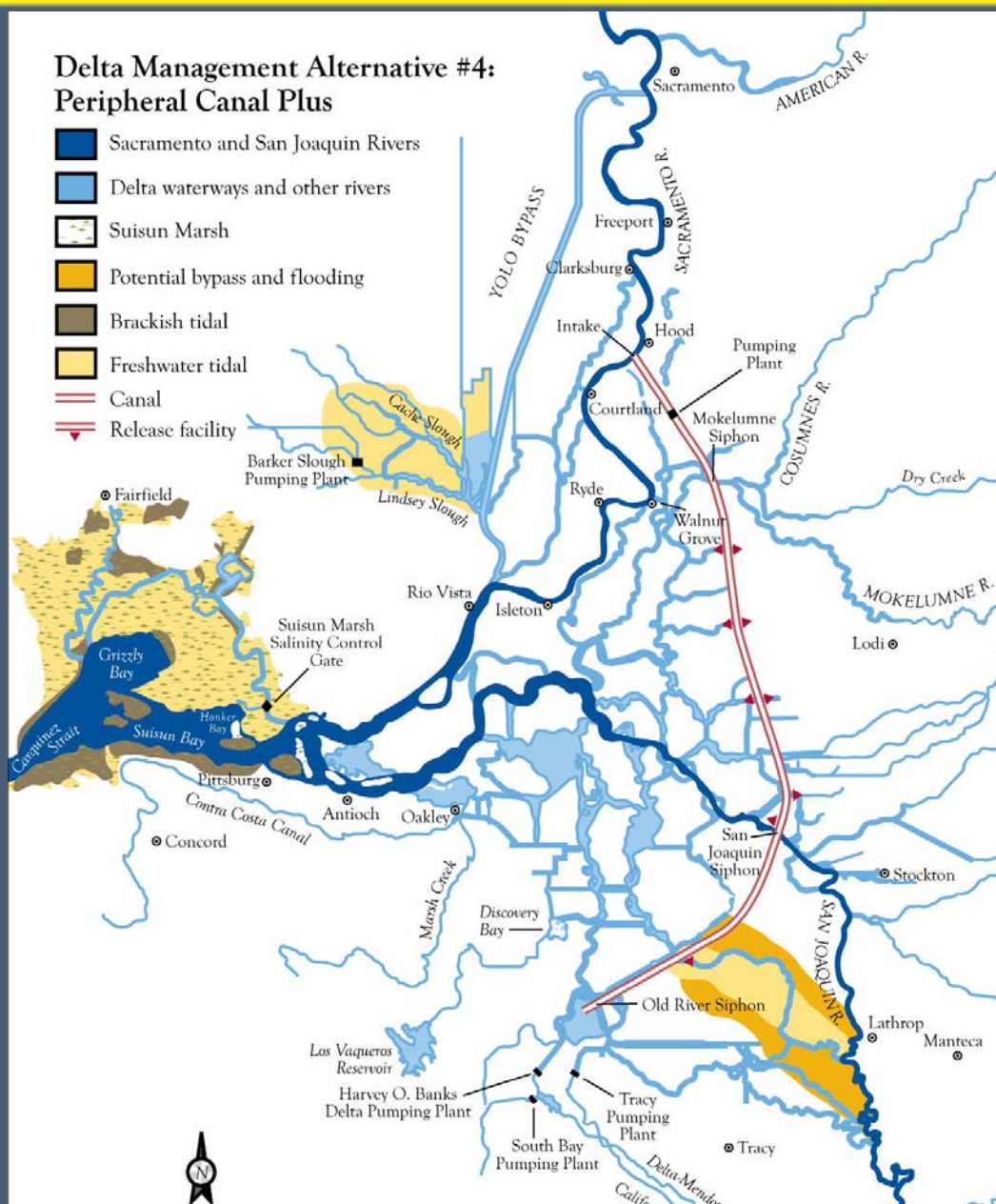
3) Seawater Barrier: Dutch Engineers Have Recently Revived This Solution

- Prevents seawater intrusion…
- …but not island flooding or other issues

Rotterdam movable storm surge barrier

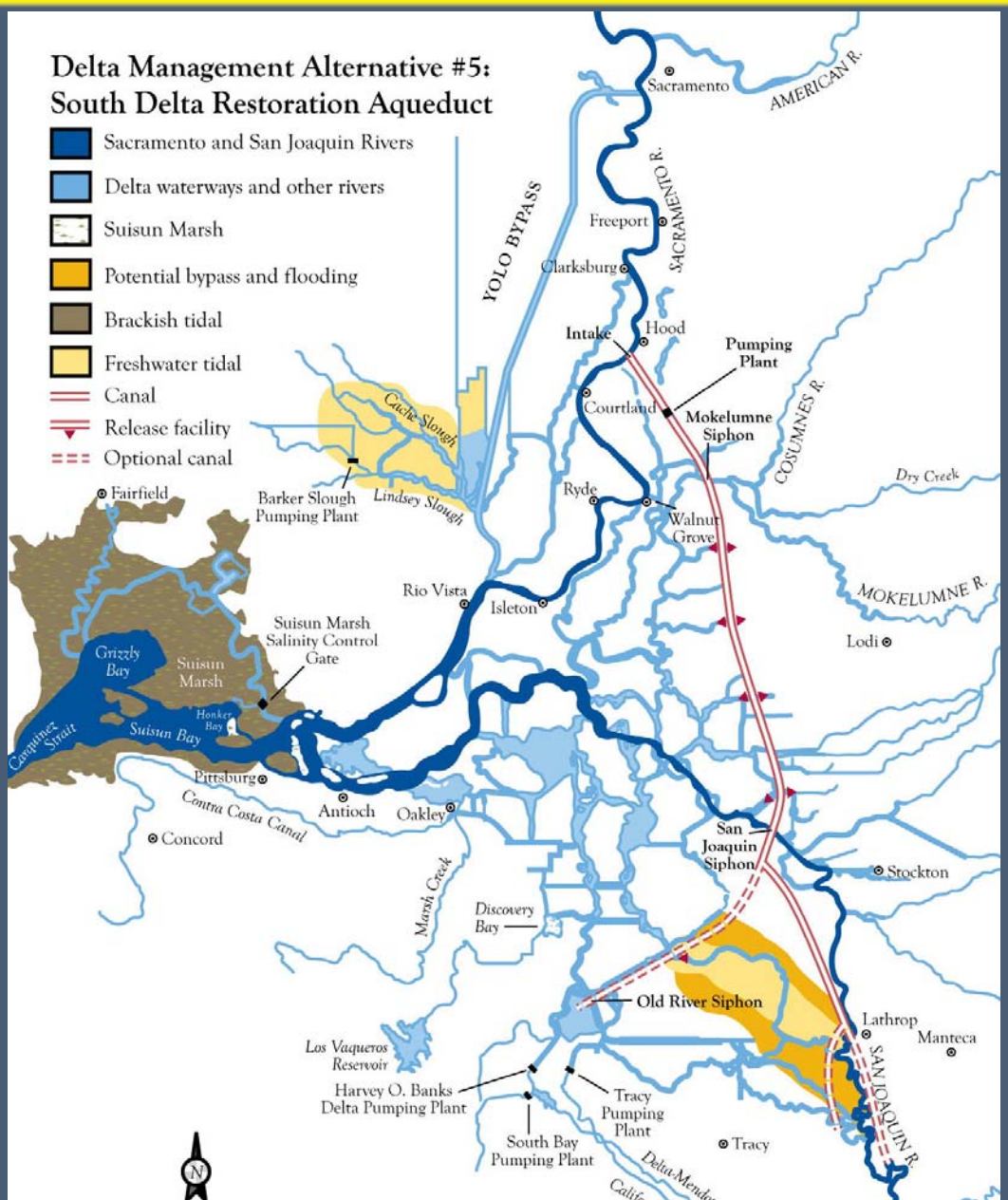
4) Peripheral Canal Plus: Update of a Traditional Idea

- Breaks link between exports and Delta water quality
- Allows Delta to vary
- Adds ecological management actions
- Lower San Joaquin bypass, floodplain/ marsh restoration



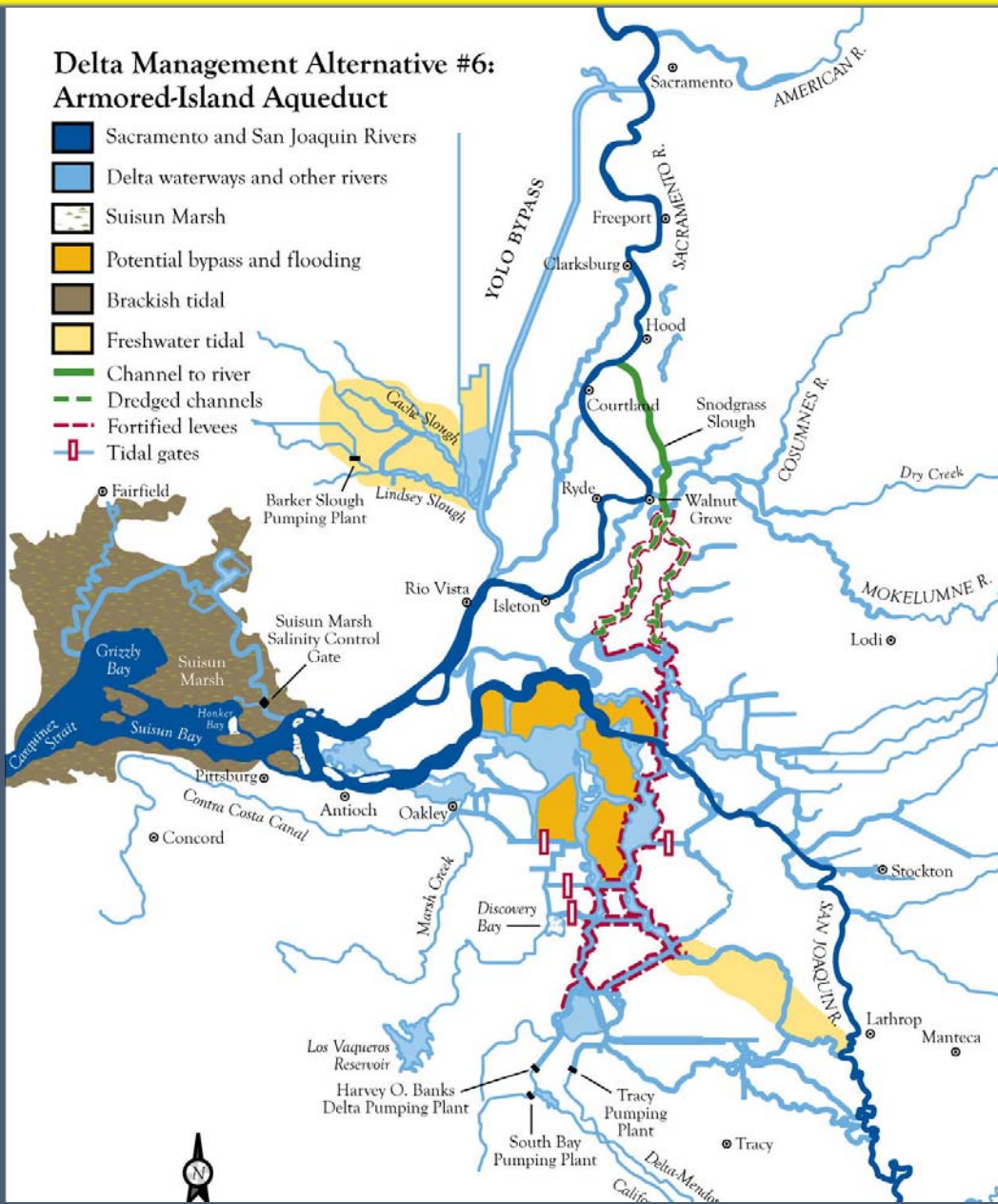
5) South Delta Restoration Aqueduct: A New Peripheral Canal Idea

- Improves S. Delta and lower San Joaquin River water quality
- Ends VAMP, S. Delta Barriers, Stockton Ship Channel programs
- Lower San Joaquin flood bypass for flood control and ecosystem benefits



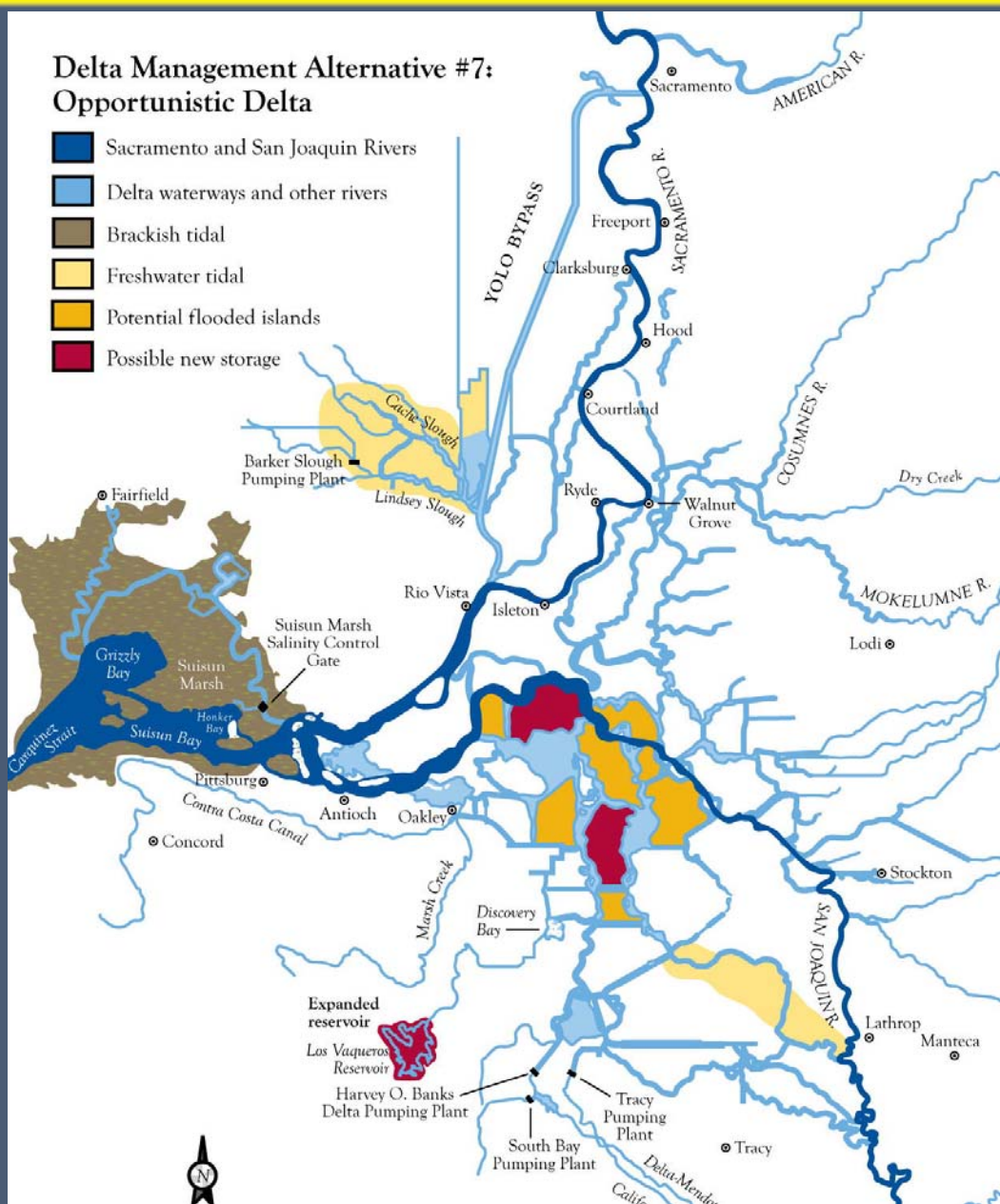
6) Armored-Island Aqueduct: A Through-Delta Solution

- Armor main channels, close others to maintain conveyance
- Keeps eastern Delta fresh
- Allows western and central Delta to fluctuate



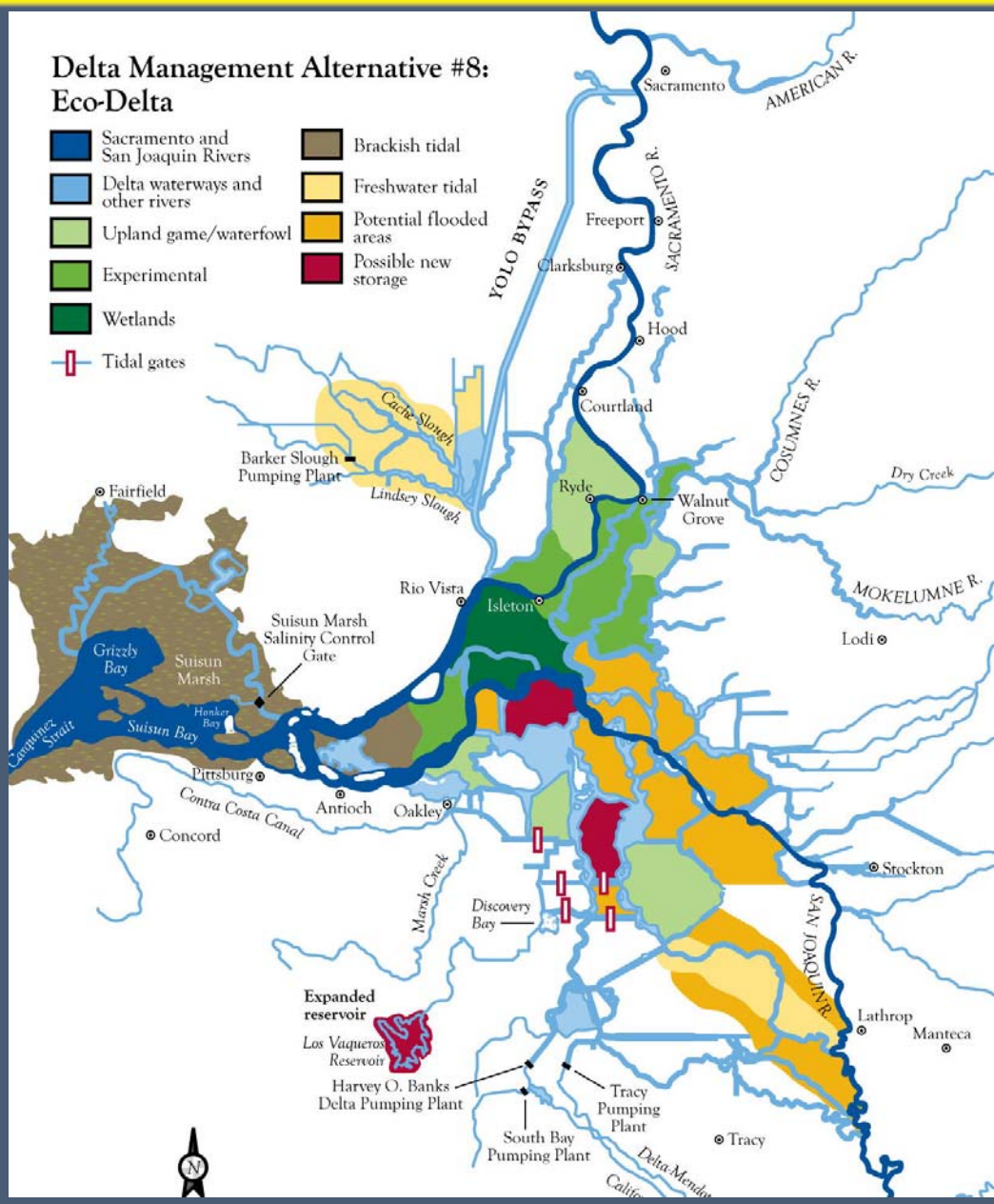
7) Opportunistic Delta: Restores More Natural Fluctuations

- Uses current export locations, pumping is opportunistic
- Western and central Delta salinity fluctuates
- Water exports lower and more variable
- Adds near-pump storage



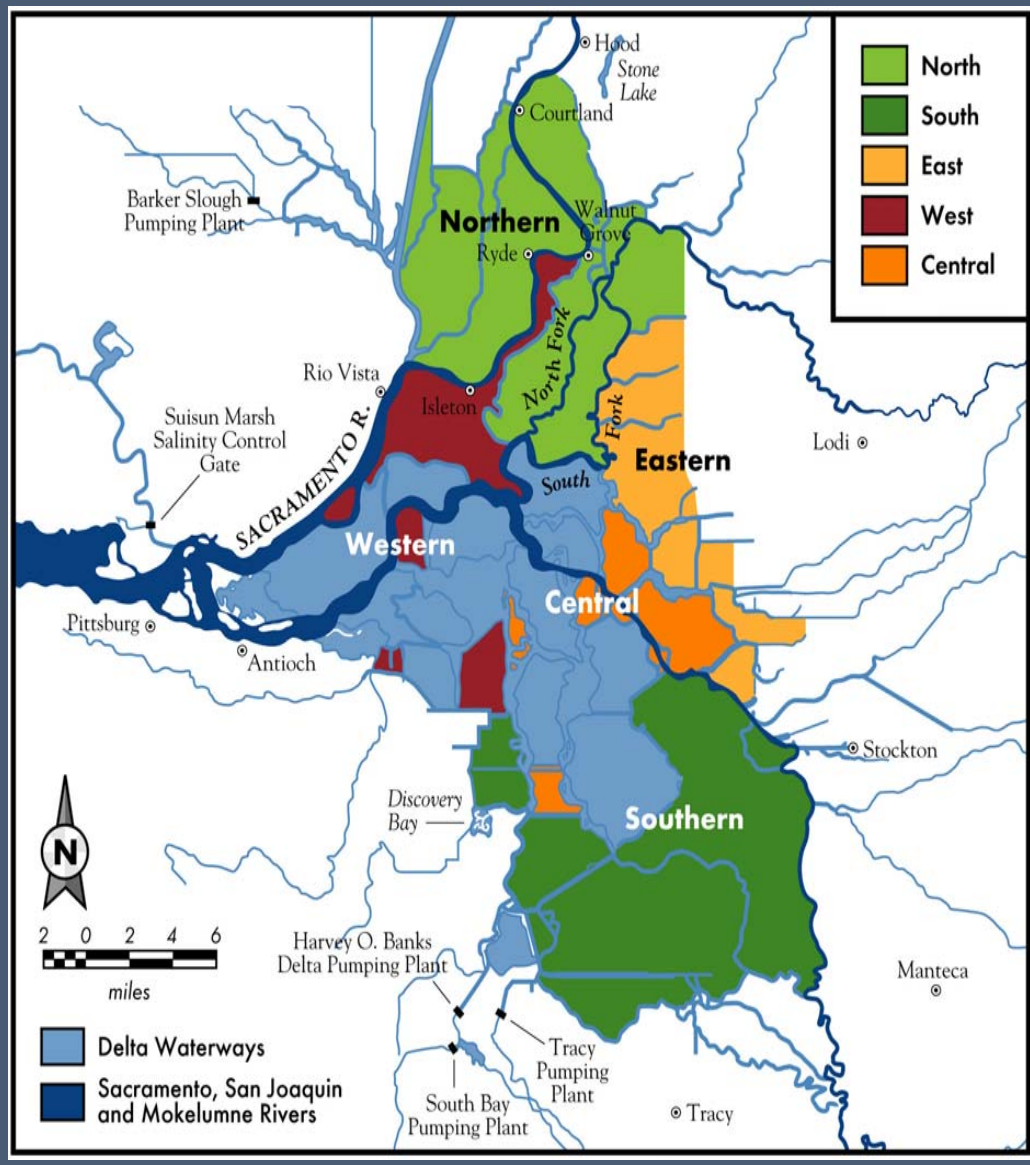
8) Eco-Delta: An Example of Local Specialization

- Allows opportunistic pumping, but at lower levels
- Promotes fluctuating western Delta
- Specialized restoration of islands, bypasses



9) Abandoned Delta: Letting Nature Take its Course

- Abandon an unreliable resource
- 2-in-3 probability of abrupt change from earthquake or flooding
- End of water exports
- Salinity fluctuations in western Delta



Outline

- Why the Delta matters
- California's Delta crisis
- New thinking: ecosystem and adaptation
- Some long-term alternatives
- <u>Screening of alternatives</u>
- Recommendations

Screening Criteria

- Ecosystem performance (conceptual model)
- Water exports (CALVIN)
- Economic and financial costs
  - Delta agriculture and salinity (DAP)
  - Costs of export adaptations (CALVIN)
- Other Delta services (qualitative)

Fluctuating Delta Alternatives Are Most Promising

Alternatives	Environmental Performance	Annual Water Exports	Economic and Financial Costs
1. Levees as Usual	Poor	0 – 6+ maf	~$2 Billion + failures
2. Fortress Delta	Poor	6+ maf	> $4 Billion + lost islands
3. Saltwater Barrier	Poor		$2 – 3 Billion + lost islands
4. Peripheral Canal Plus	Promising - allows Delta to fluctuate		$2 – 3 Billion + < $70 M/year
5. South Delta Aqueduct			$2 – 3 Billion + < $41 M/year
6. Armored-Island Aqueduct	Mixed		$1 – 2 Billion + < $30 M/year
7. Opportunistic Delta	Promising	2 – 8 maf	$0.7 – 2.2 Billion + < $170 M/year
8. Eco-Delta	Best?	1 – 5 maf	Several $ Billion + < $600 M/year
9. Abandoned Delta	Poor	0	$500 Million + ~$1.2 Billion/year

Outline

- Why the Delta matters
- California's Delta crisis
- New thinking: ecosystem and adaptation
- Some long-term alternatives
- Screening of alternatives
- <u>Recommendations</u>

Steps Needed for a Long-term Solution

- Focus on promising alternatives
- Create technical track to explore solutions with problem-solving R&D
- Enhance regional and statewide representation in Delta land use decisions (e.g. SF BCDC)
- Implement “beneficiaries pay” financing
- Establish mitigation mechanisms – everyone will *not* “get better together”

“No Regrets” Short-term Actions

- Emergency preparedness
- “Do not resuscitate” list for some islands
- Delta land use
  - Flood control guidelines for urbanization
  - Habitat protection
- Restoration projects for pelagic fish habitat

Conclusions

- Current Delta is unsustainable for almost all stakeholders
- Improved understanding of the Delta provides opportunities for new solutions
- Promising alternatives exist
- Most Delta users have ability to adapt
- Promising solutions are unlikely to arise from a stakeholder-only process

Science Implications

- Solution-oriented scientific and technical program
  - A planned integrated program
  - Biological studies
  - Hydrodynamic studies
  - Economics and Institutions
  - Operations studies
  - Systems Analysis
- Institutional support - Promising solutions are unlikely to arise from a stakeholder-only process
- Basic Research

Questions?

- **Full report, research brief, and other materials at: www.ppic.org and watershed.ucdavis.edu**

Center for Watershed Sciences
UC DAVIS

Public Policy Institute of California

Questions?

- Full report, research brief, and other materials at: www.ppic.org and watershed.ucdavis.edu