University of California
Agriculture and Natural Resources

Mariposa, April 2016

Groundwater in Madera/Mariposa County & Sustainable Groundwater Management

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http://groundwater.ucdavis.edu

UCDAVIS
UNIVERSITY OF CALIFORNIA


Photo: Justin Sullivan / Getty Images

Veronica Rocha / Los Angeles Times


Lake Mendocino, 12/2013
Jay Jasperse / SCWA

Brad Zweerink for Earth Justice

Jim Wilson/ The New York Times

Jim Wilson/ The New York Times

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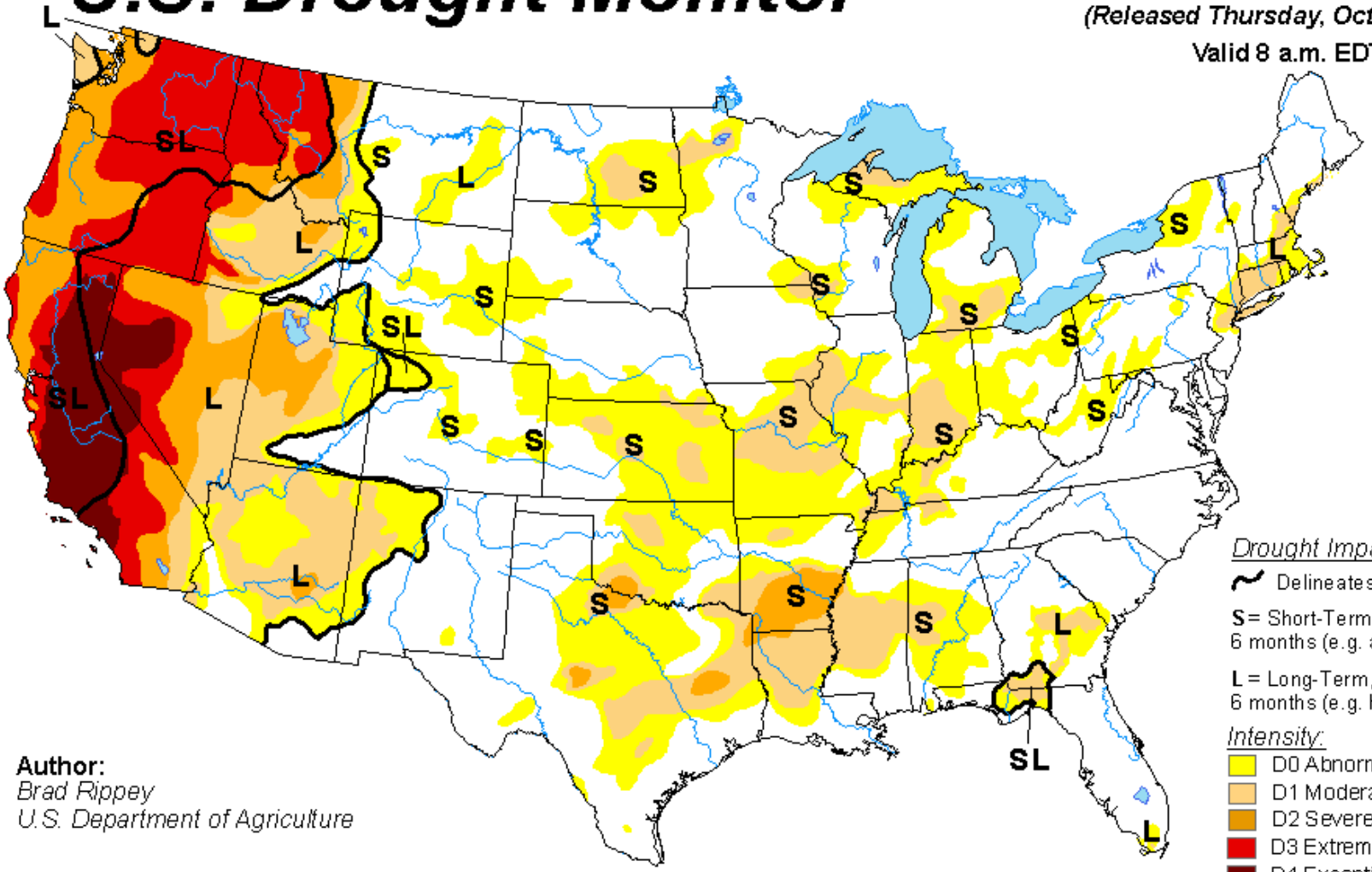
U.S. Drought Monitor

October 27, 2015

(Released Thursday, Oct. 29, 2015)

Valid 8 a.m. EDT



Author:
Brad Rippey
U.S. Department of Agriculture

Drought Impact Types:

Delineates dominant impacts

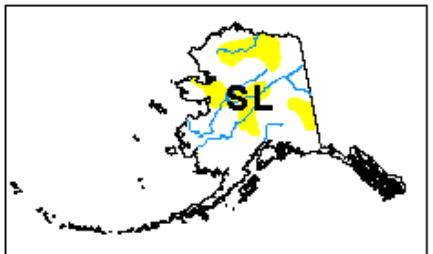
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

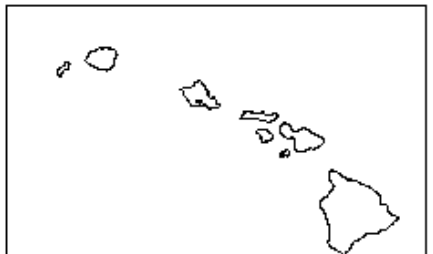
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

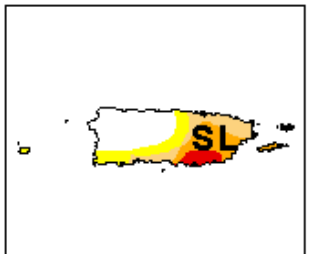
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.







USDA National Drought Mitigation Center

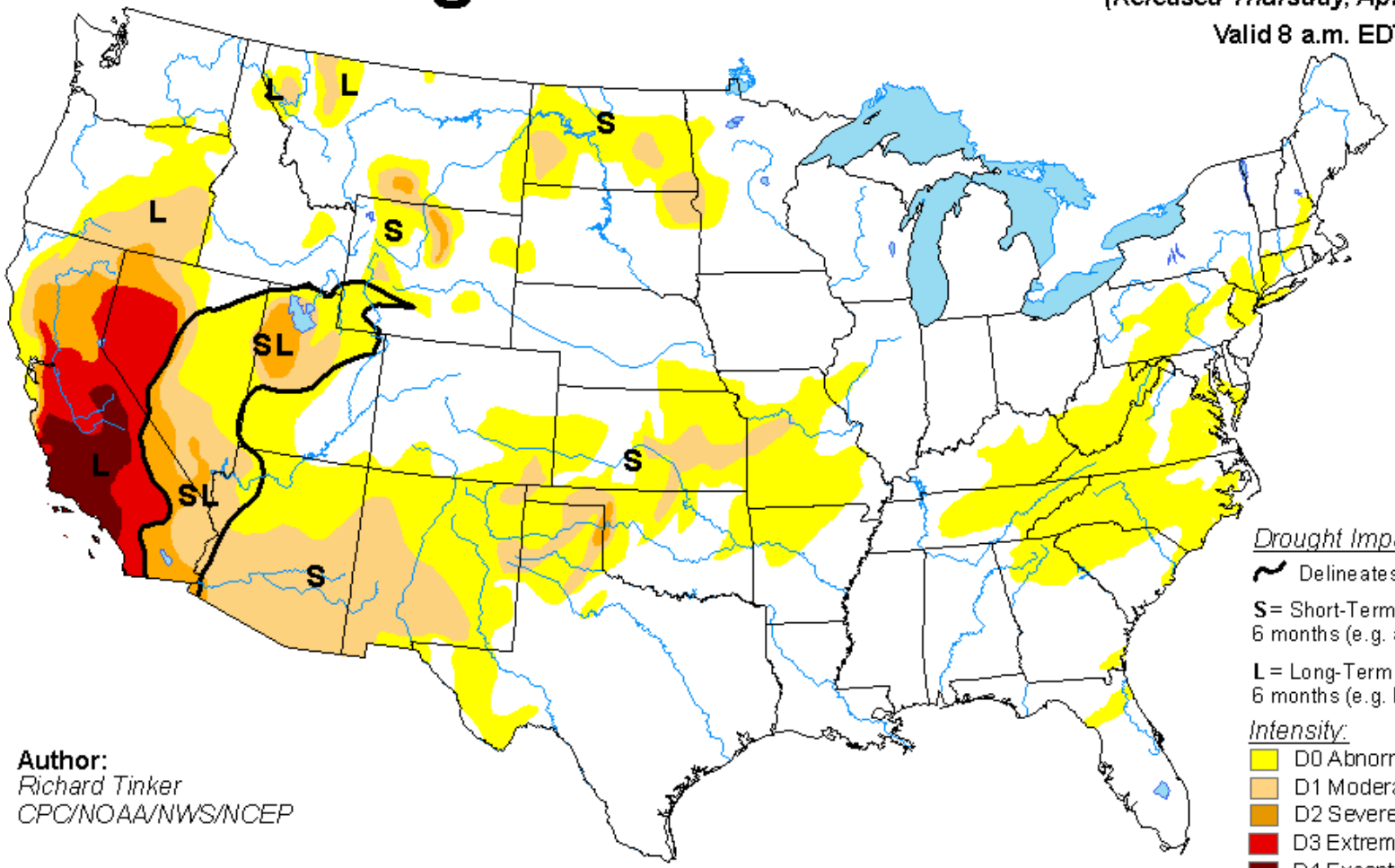
http://droughtmonitor.unl.edu/

U.S. Drought Monitor

April 19, 2016

(Released Thursday, Apr. 21, 2016)

Valid 8 a.m. EDT



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

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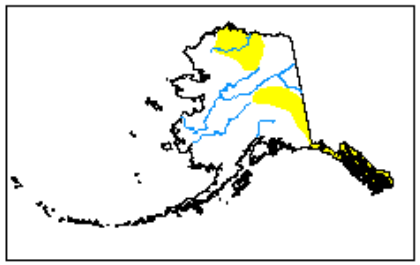

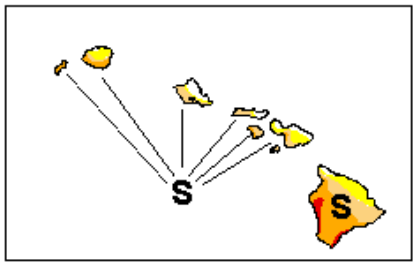

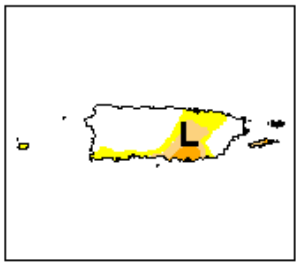

USDA National Drought Mitigation Center

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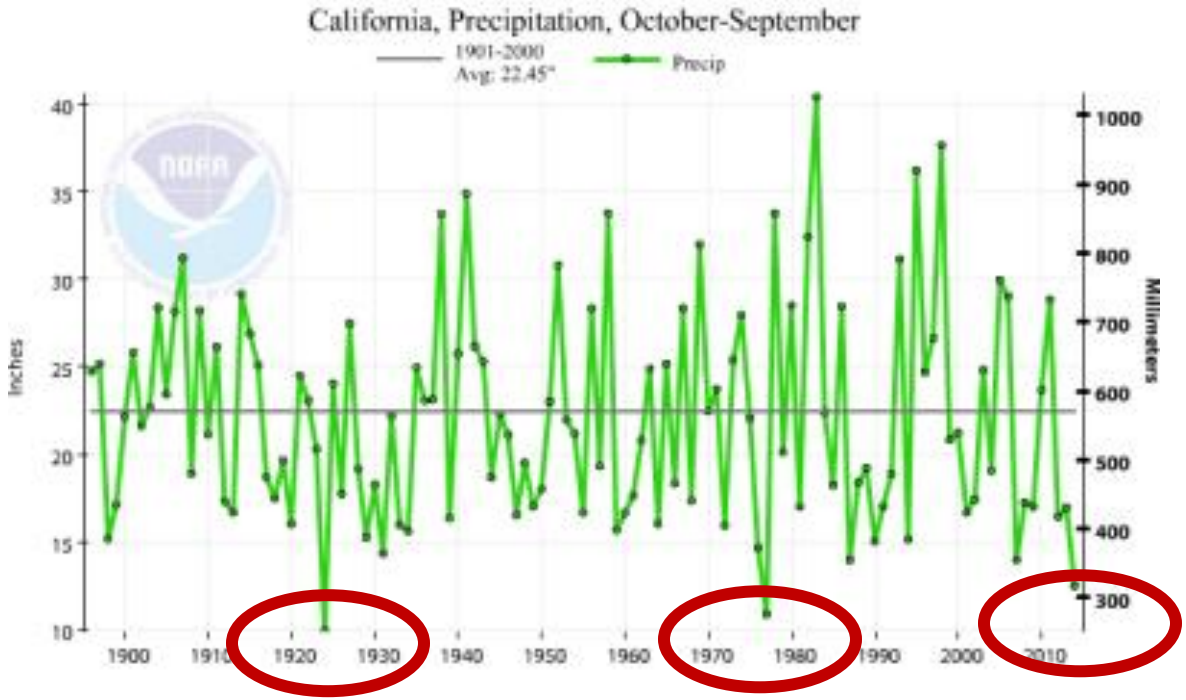
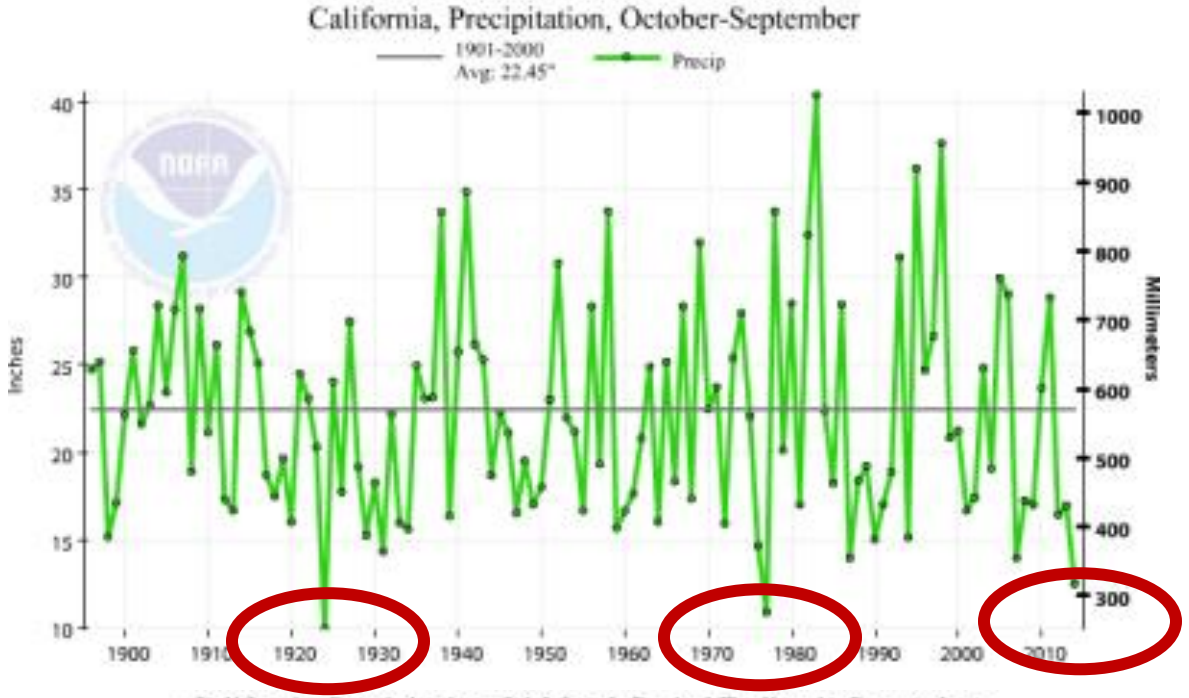
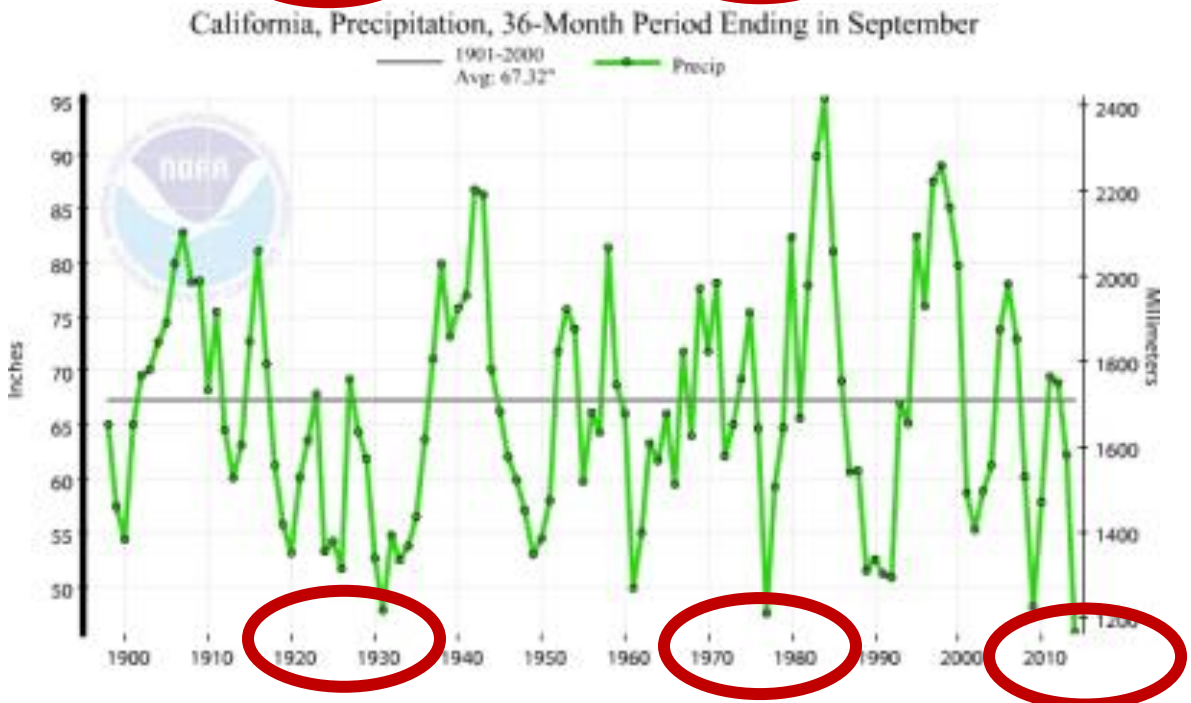
Annual P [inches]



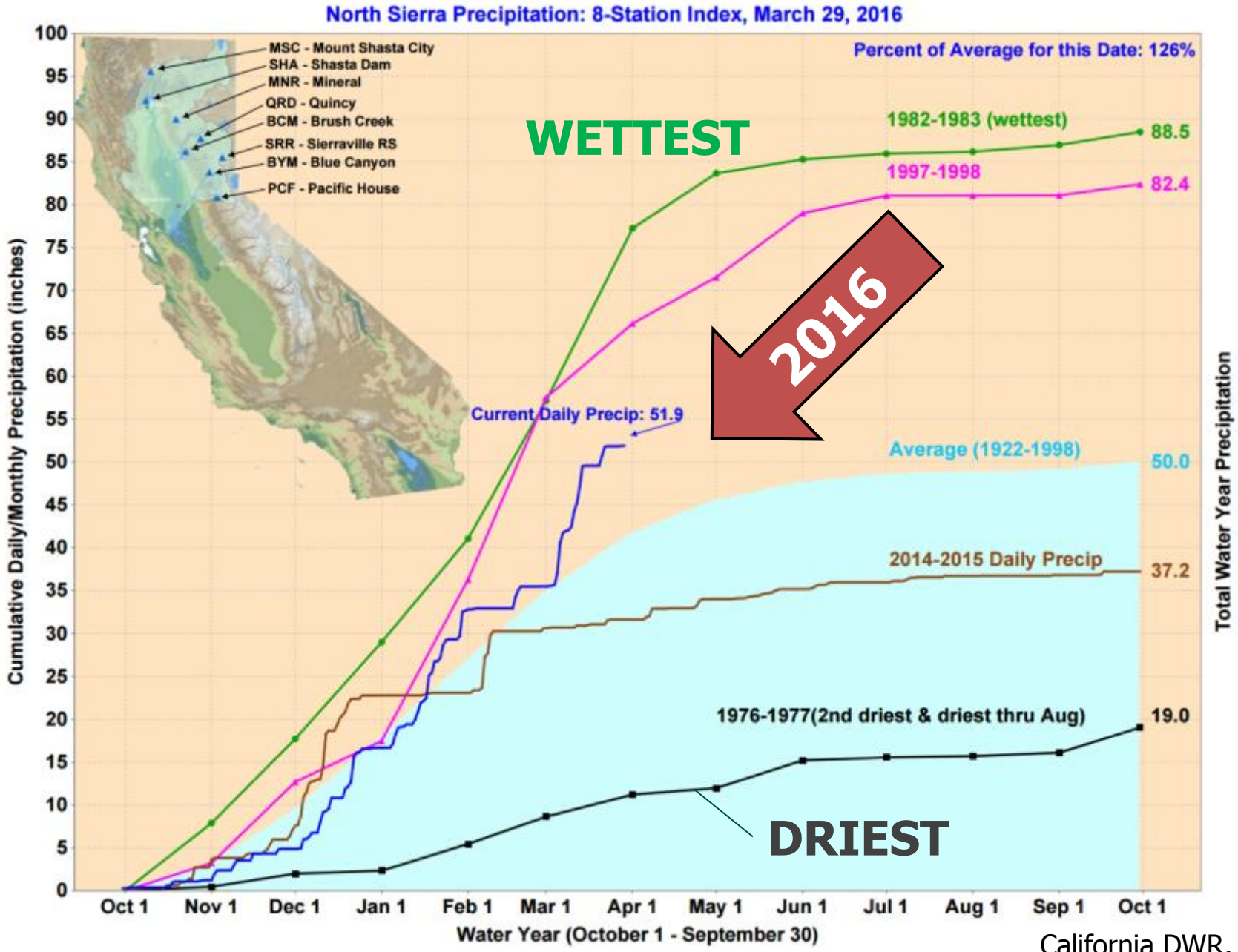
Annual P [inches]



Tri-annual P [inches]

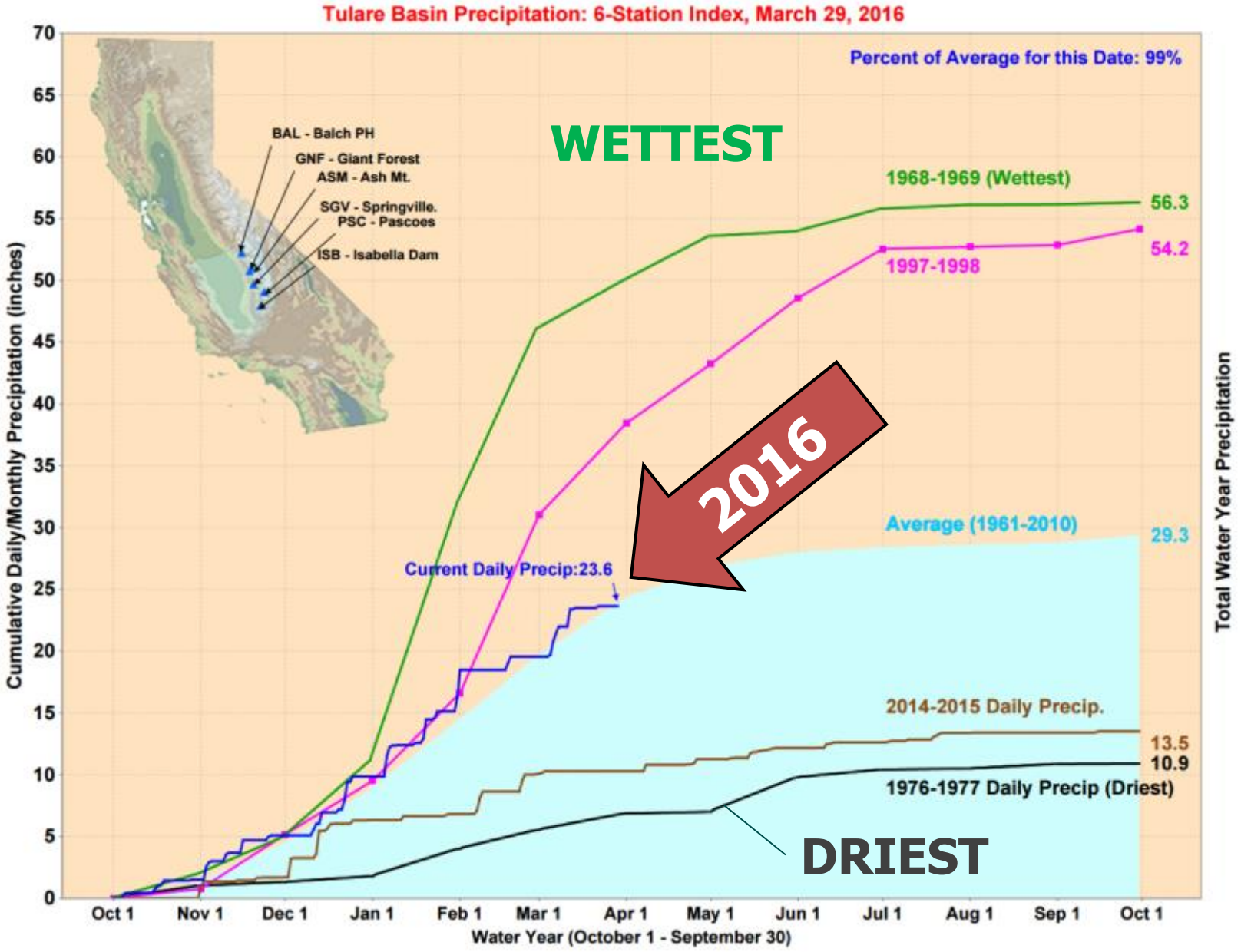


Cumulative Precipitation October - September



California DWR, 2015

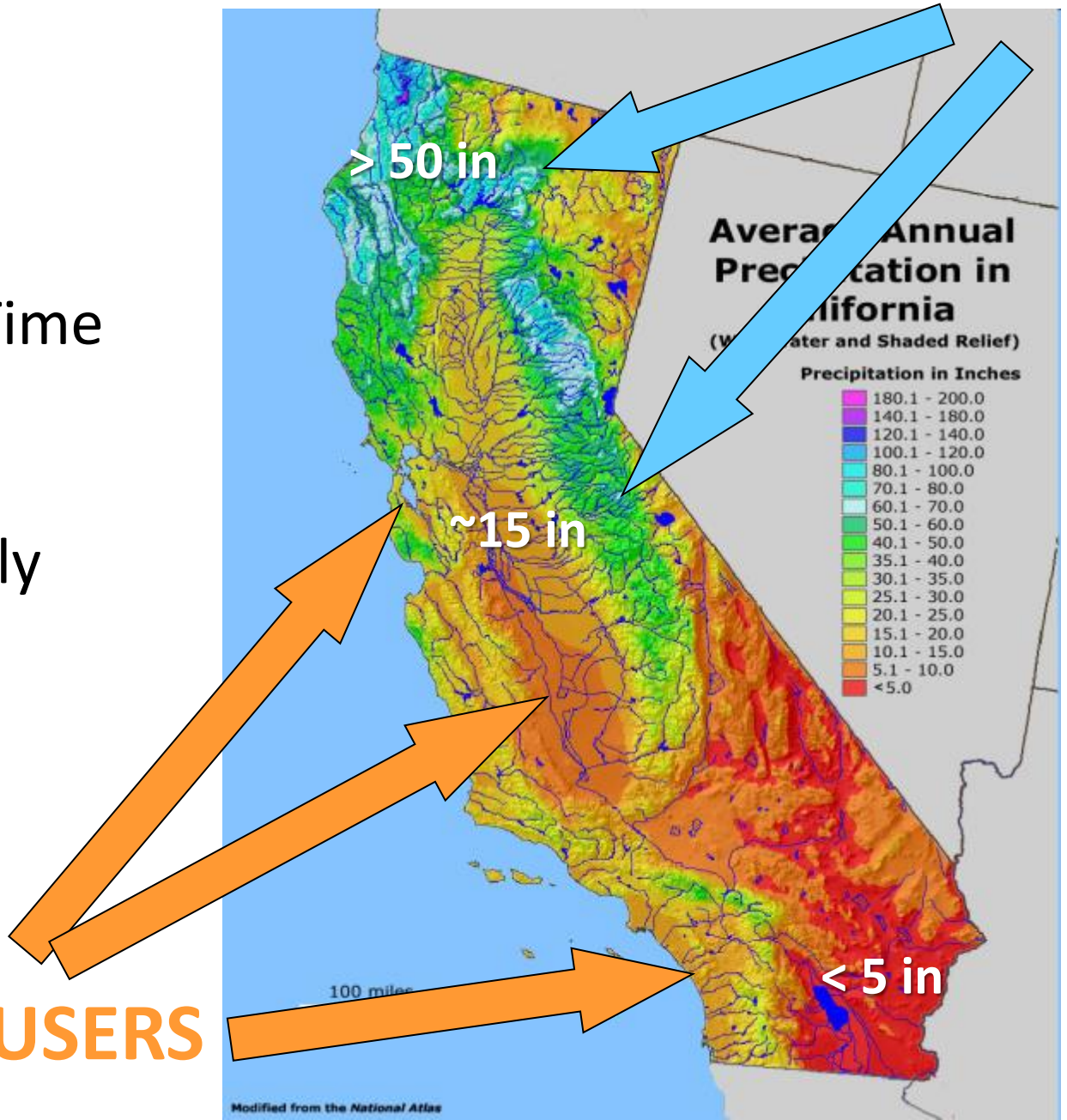
Cumulative Precipitation October - September



California DWR, 2015

RAIN

Space and Time
Disconnect
between
Water Supply
and
Water Use

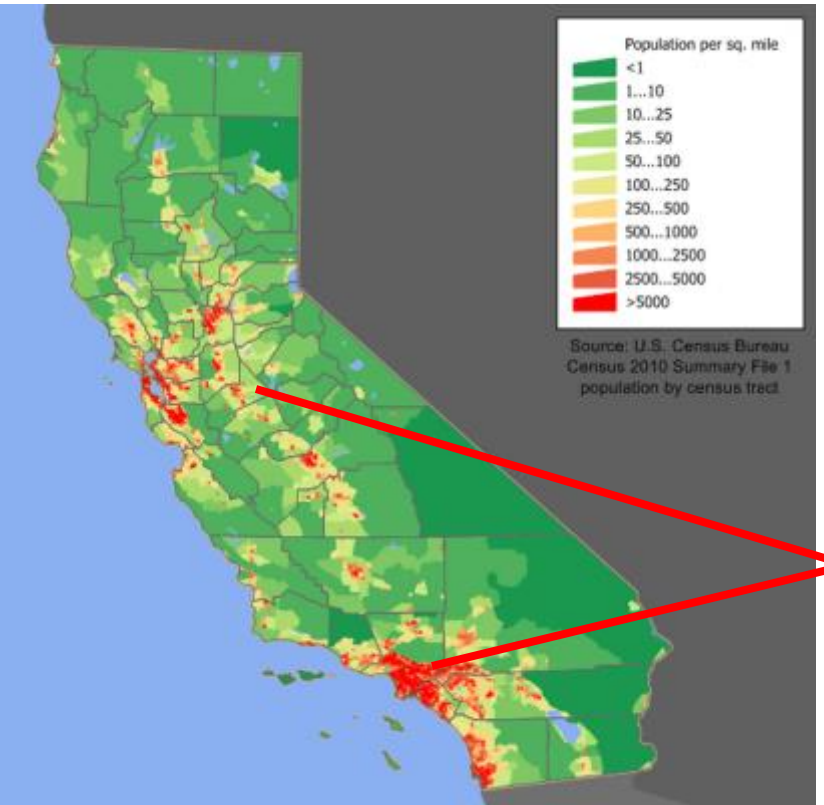


WATER USERS

California's Water Users

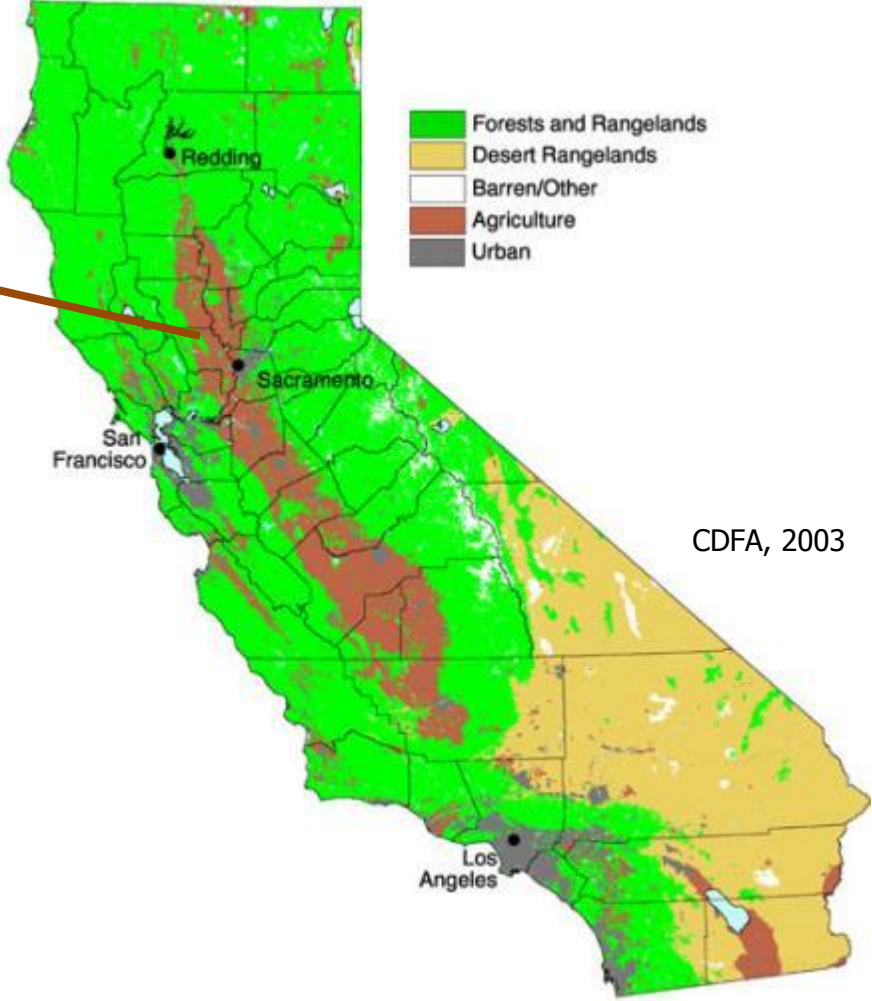
Irrigated Agriculture
9.5 million acres
(4 million ha)

applied water use:
27 – 35 MAF
(35 – 45 km^3)



Population
38 million people

water use:
8 MAF (10 km^3)



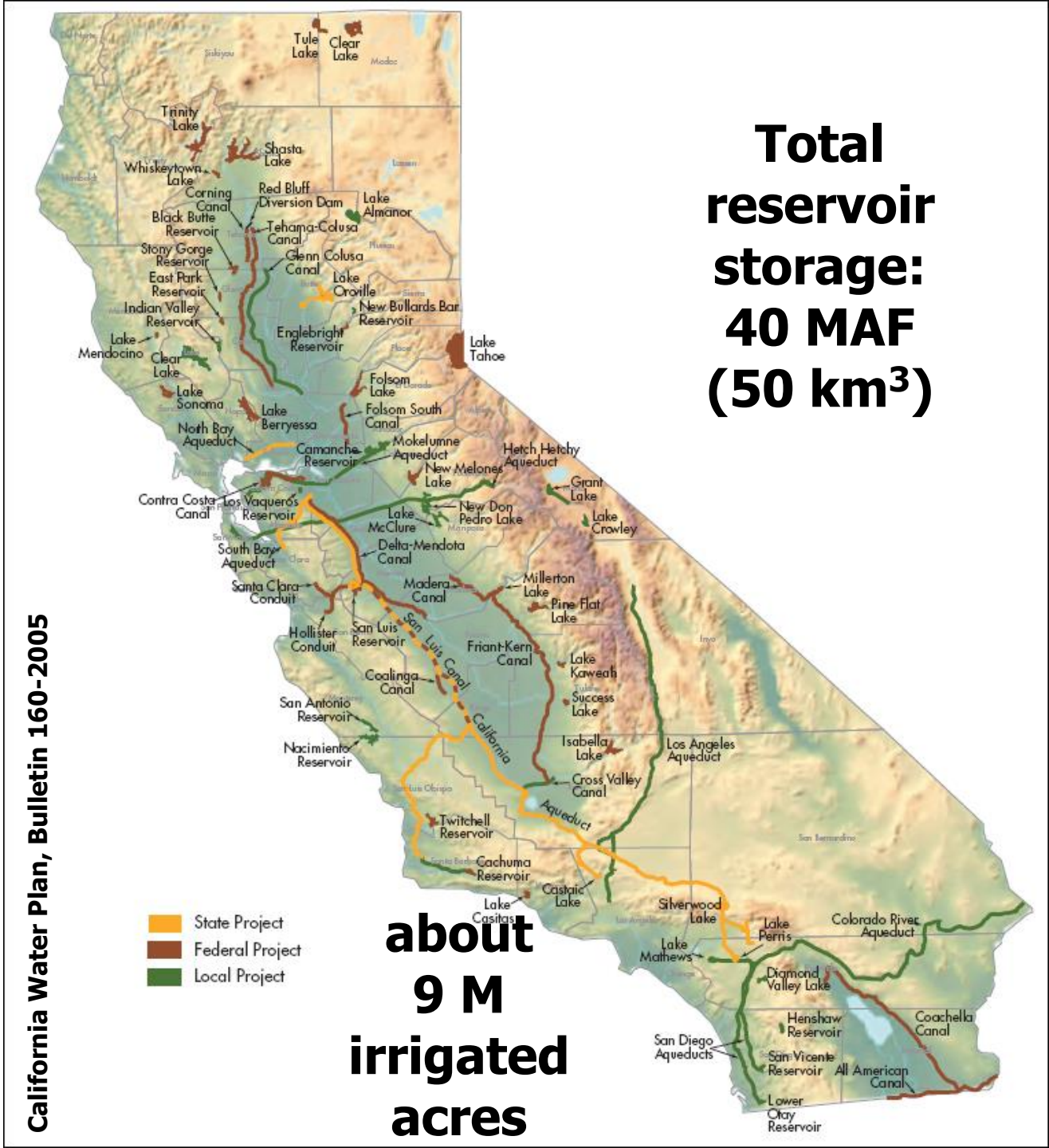
CDFA, 2003

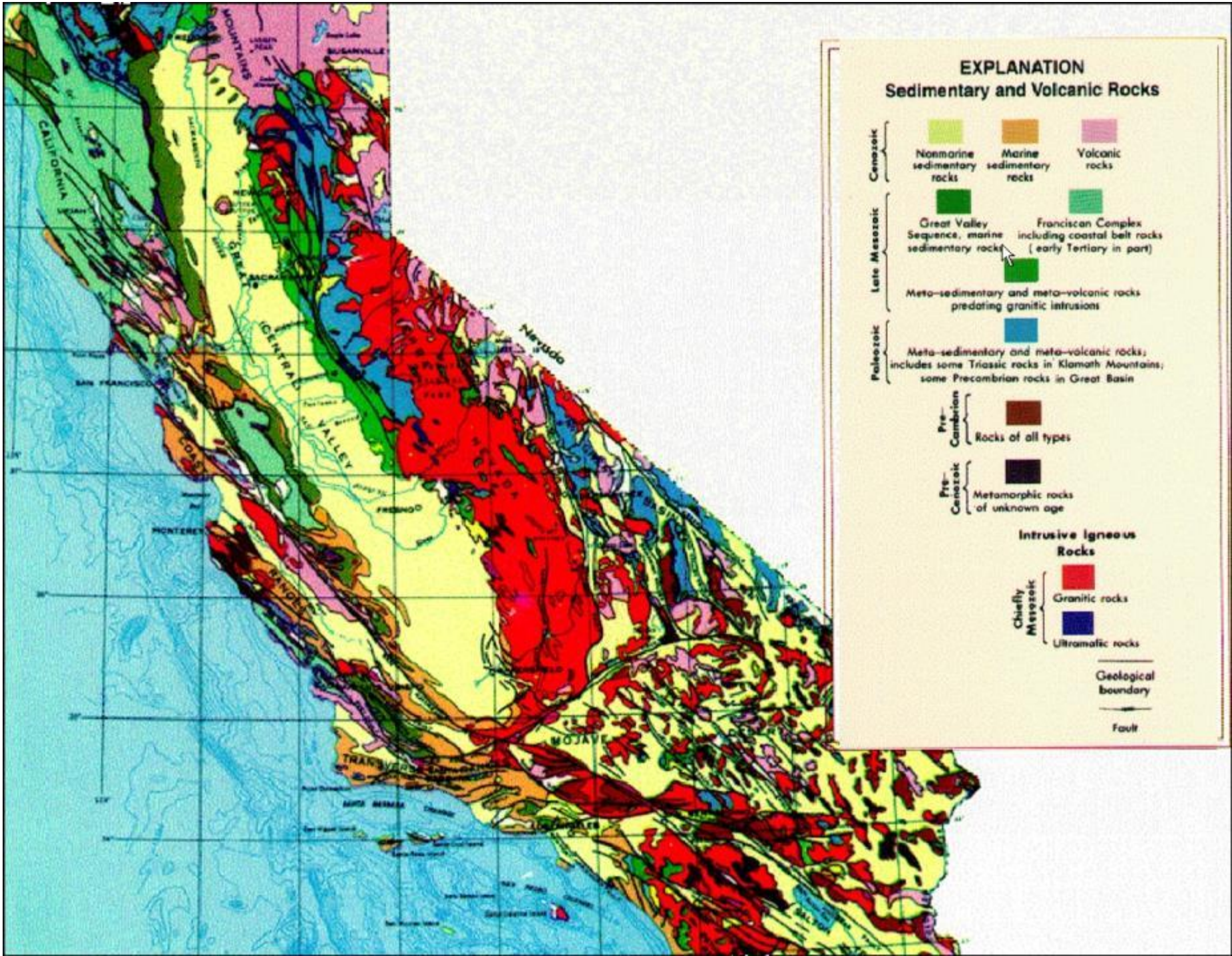
Environment
&
protected streams, wetlands:
45 MAF (55 km^3)

MAF = million acre-feet

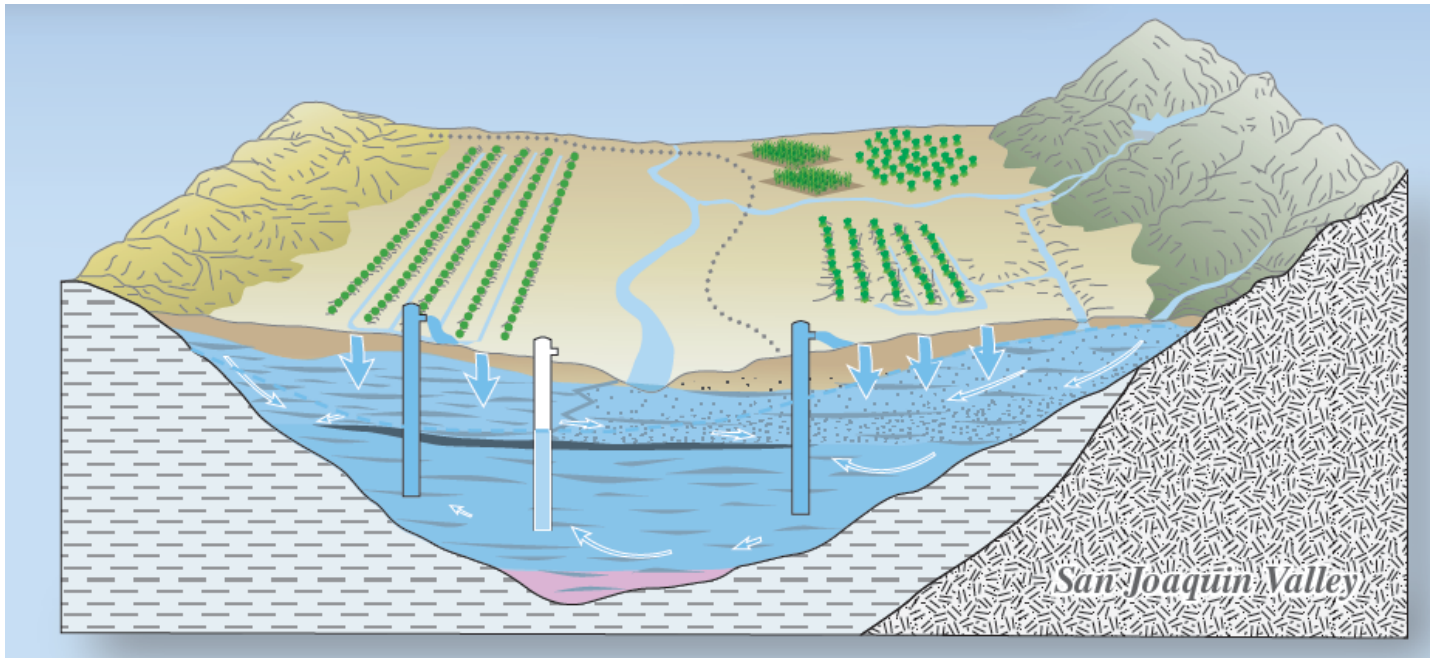
California Water Infra-structure:

Bridging the Spatial and Temporal Disconnect between SUPPLY and USE

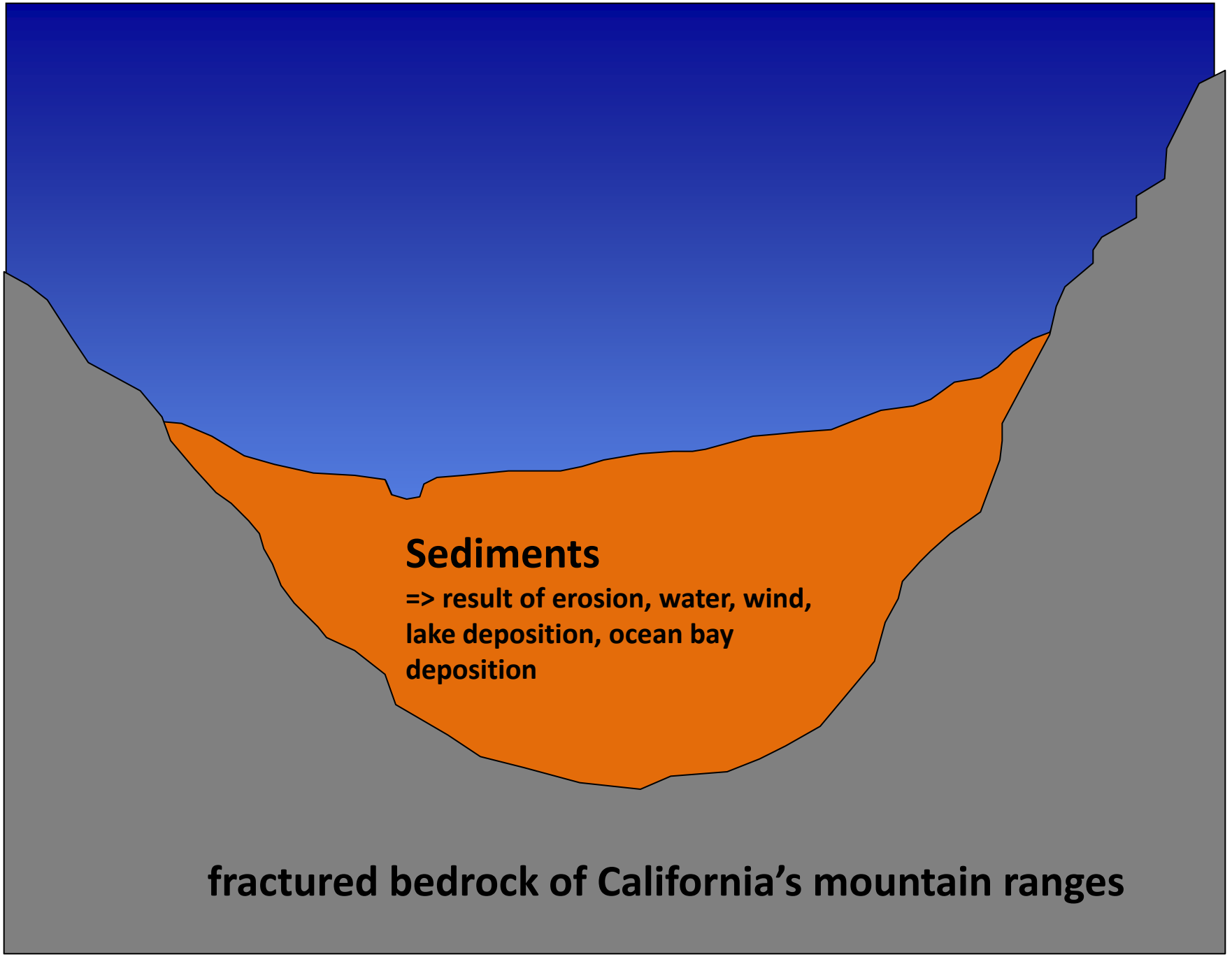


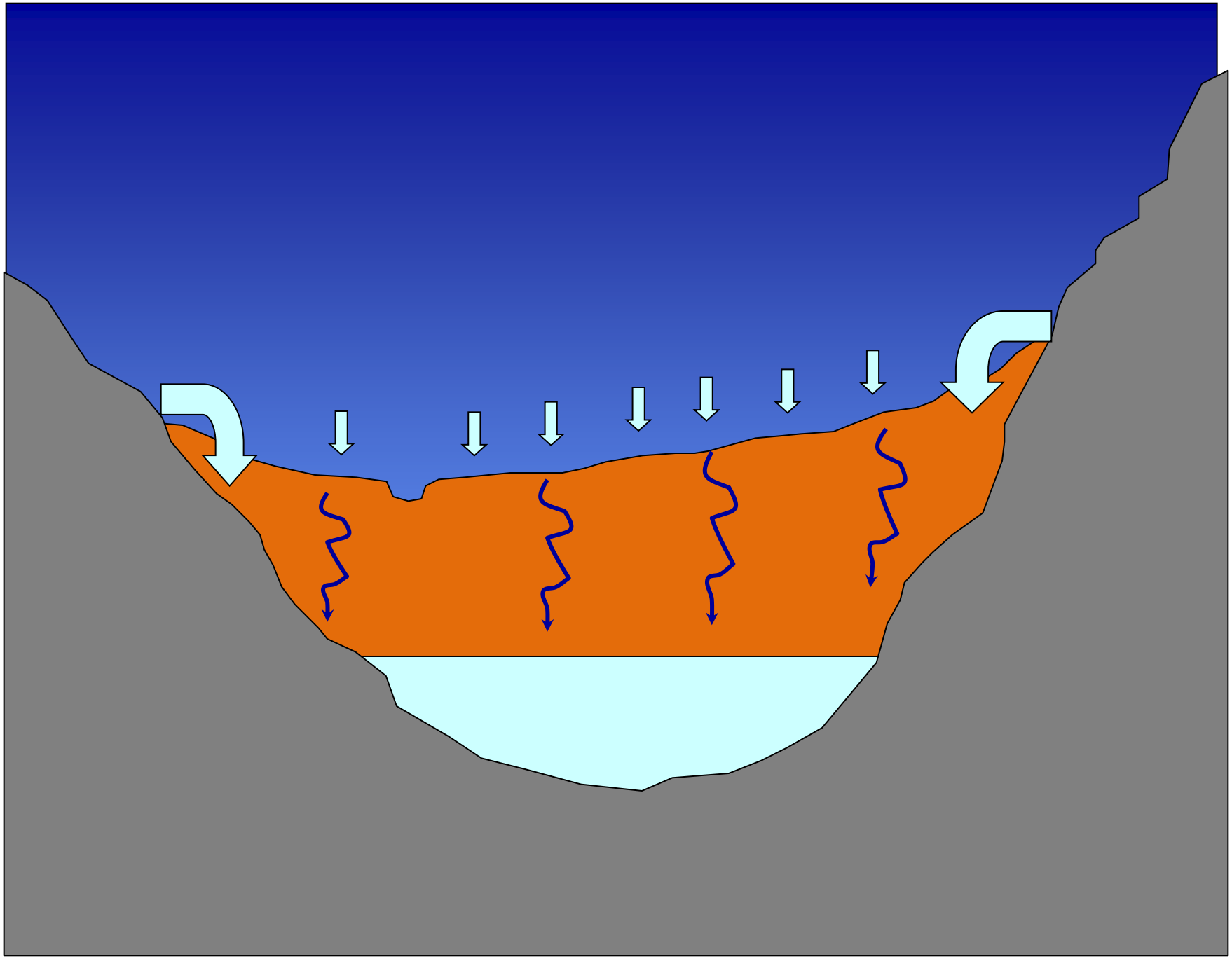

EXPLANATION
Sedimentary and Volcanic Rocks
Cenozoic
Nonmarine sedimentary rocks
Marine sedimentary rocks
Volcanic rocks
Late Mesozoic
Great Valley Sequence, marine sedimentary rocks
Franciscan Complex including coastal belt rocks (early Tertiary in part)
Meta-sedimentary and meta-volcanic rocks predating granitic intrusions
Paleozoic
Meta-sedimentary and meta-volcanic rocks; includes some Triassic rocks in Klamath Mountains; some Precambrian rocks in Great Basin
Pre-Cambrian
Rocks of all types
Pre-Cenozoic
Metamorphic rocks of unknown age
Intrusive Igneous Rocks
Chiefly Mesozoic
Granitic rocks
Ultramafic rocks
Geological boundary
Fault
CALIFORNIA
SACRAMENTO
SAN FRANCISCO
FRESNO
MONTEREY
MOJAVE
SANTA BARBARA
LOS ANGELES
SALTON SEA
Nevada

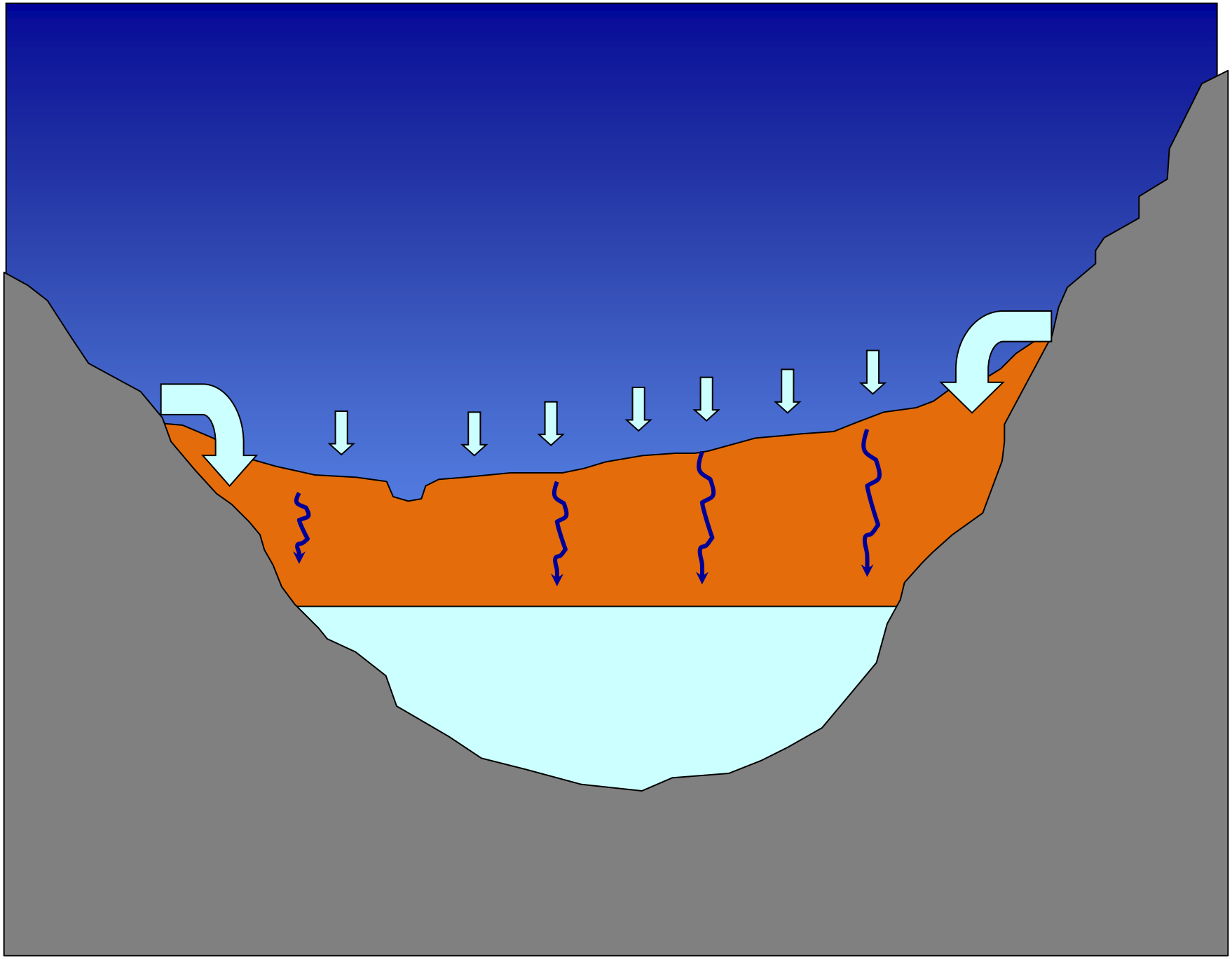
Conceptual Model: Central Valley

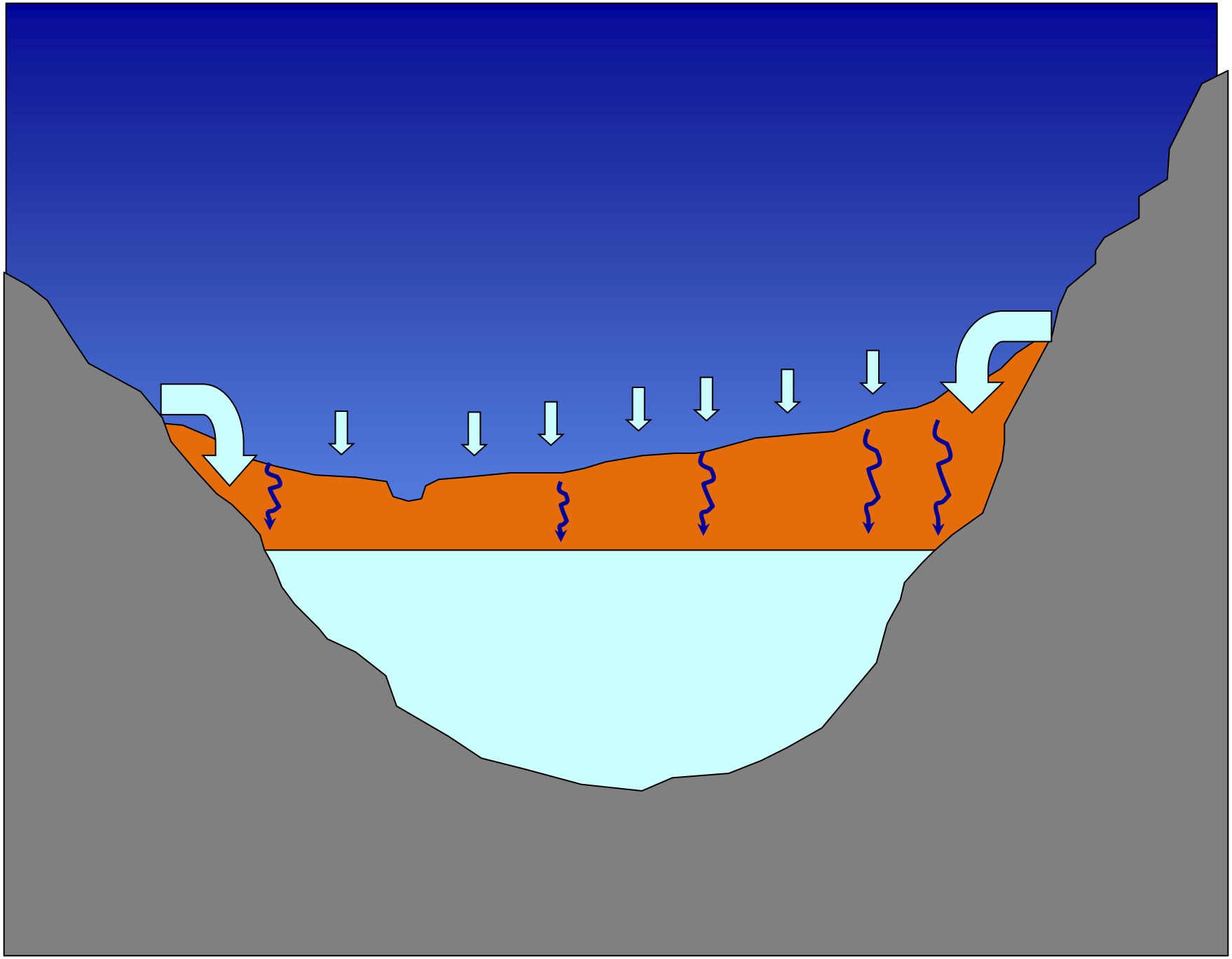


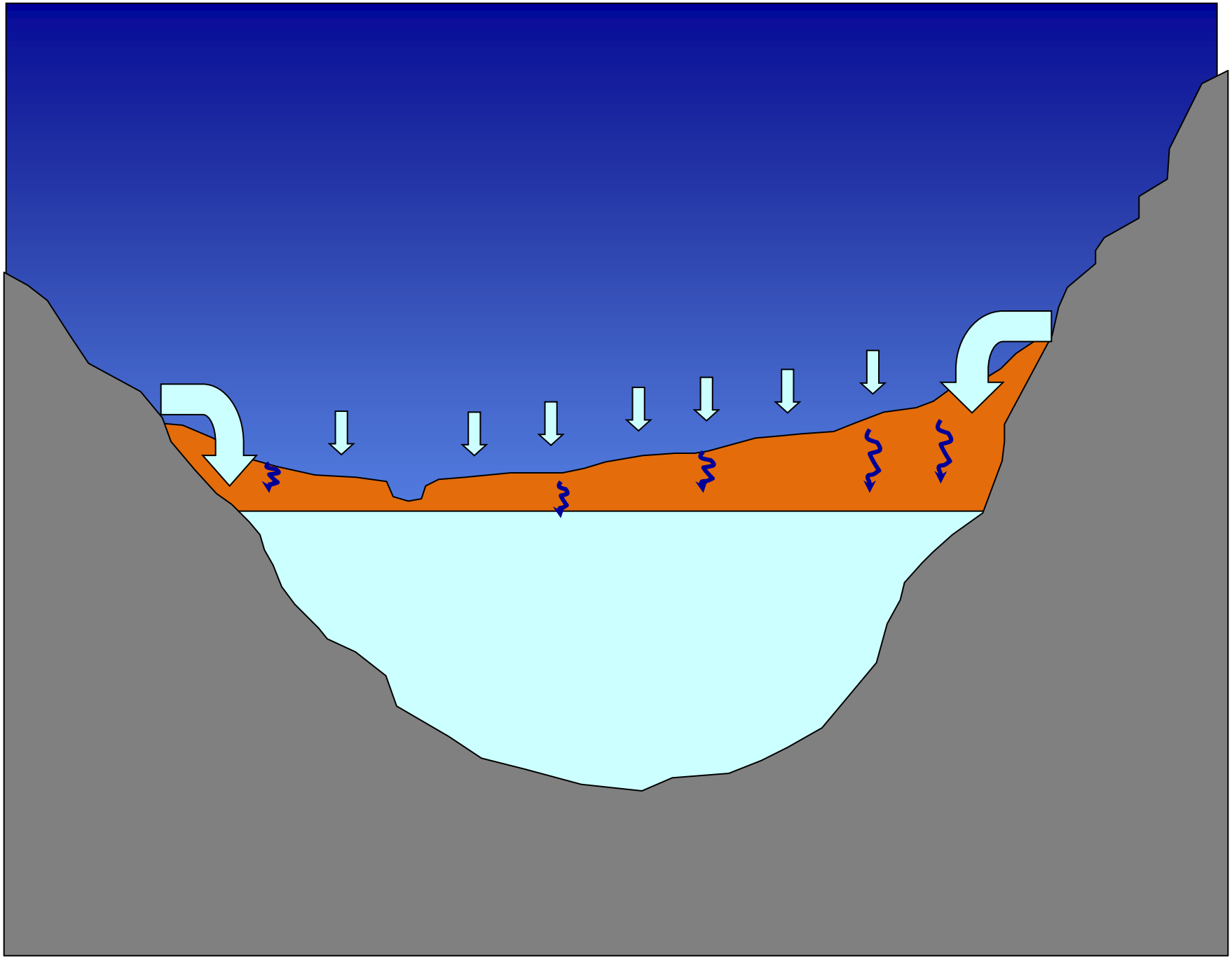
- Precipitation and streambed infiltration primary source of recharge
- Primary discharge:
  - Pumping
  - ET
  - Baseflow
- Dominantly flows mountain front toward San Joaquin River
- Streams gain water in their lower portion near San Joaquin River
- Groundwater levels declined due to pumping

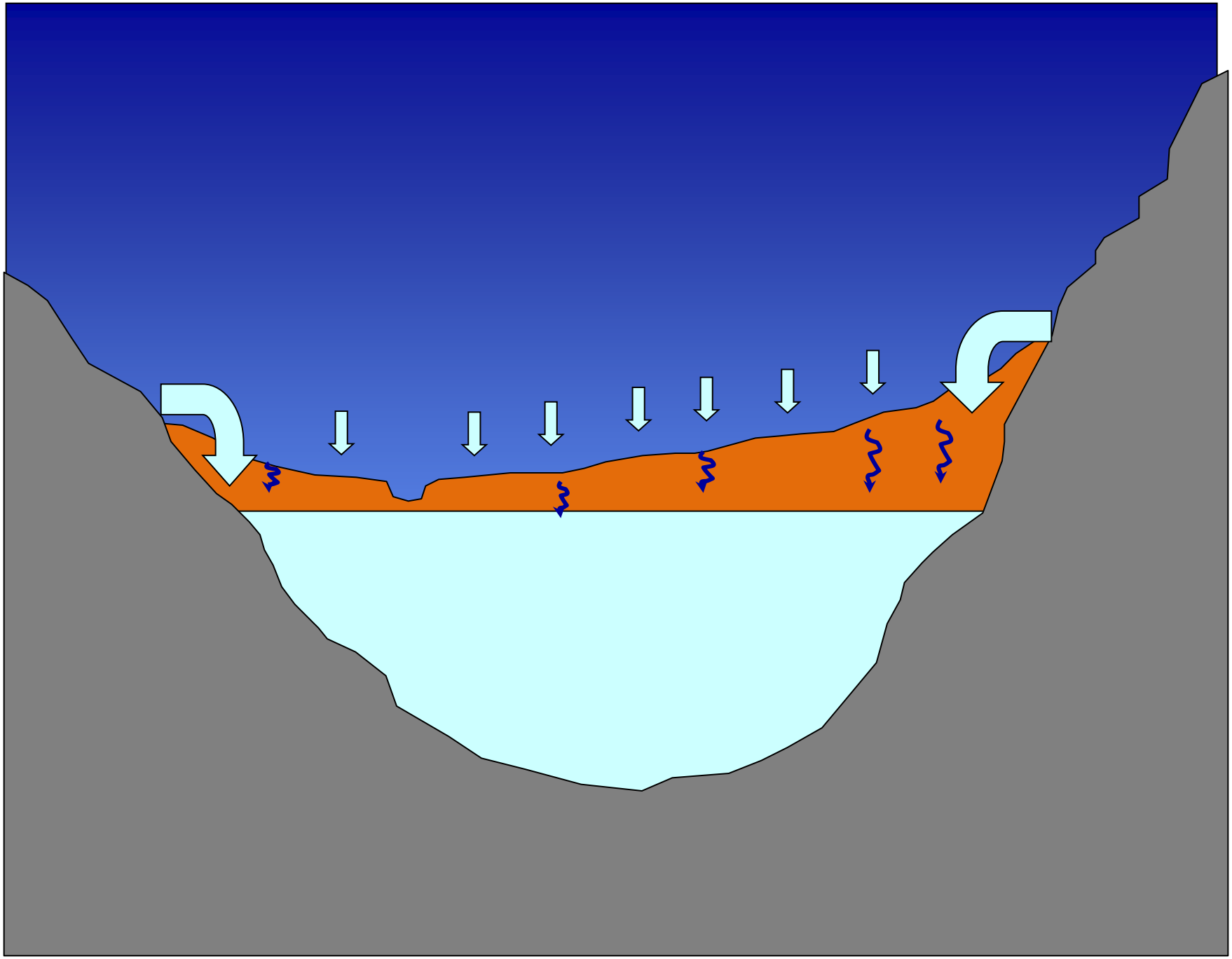

Sediments
=> result of erosion, water, wind, lake deposition, ocean bay deposition
fractured bedrock of California's mountain ranges

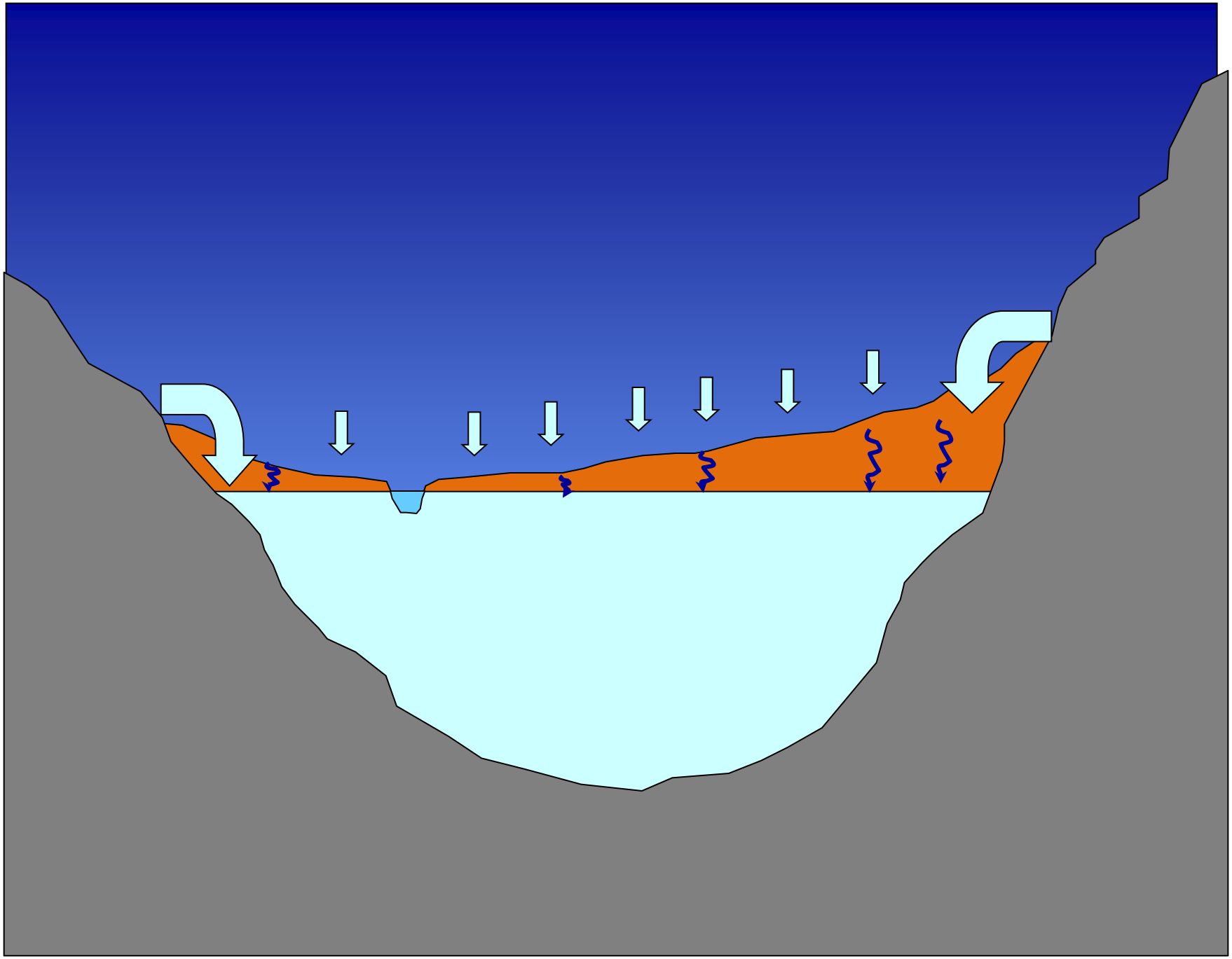


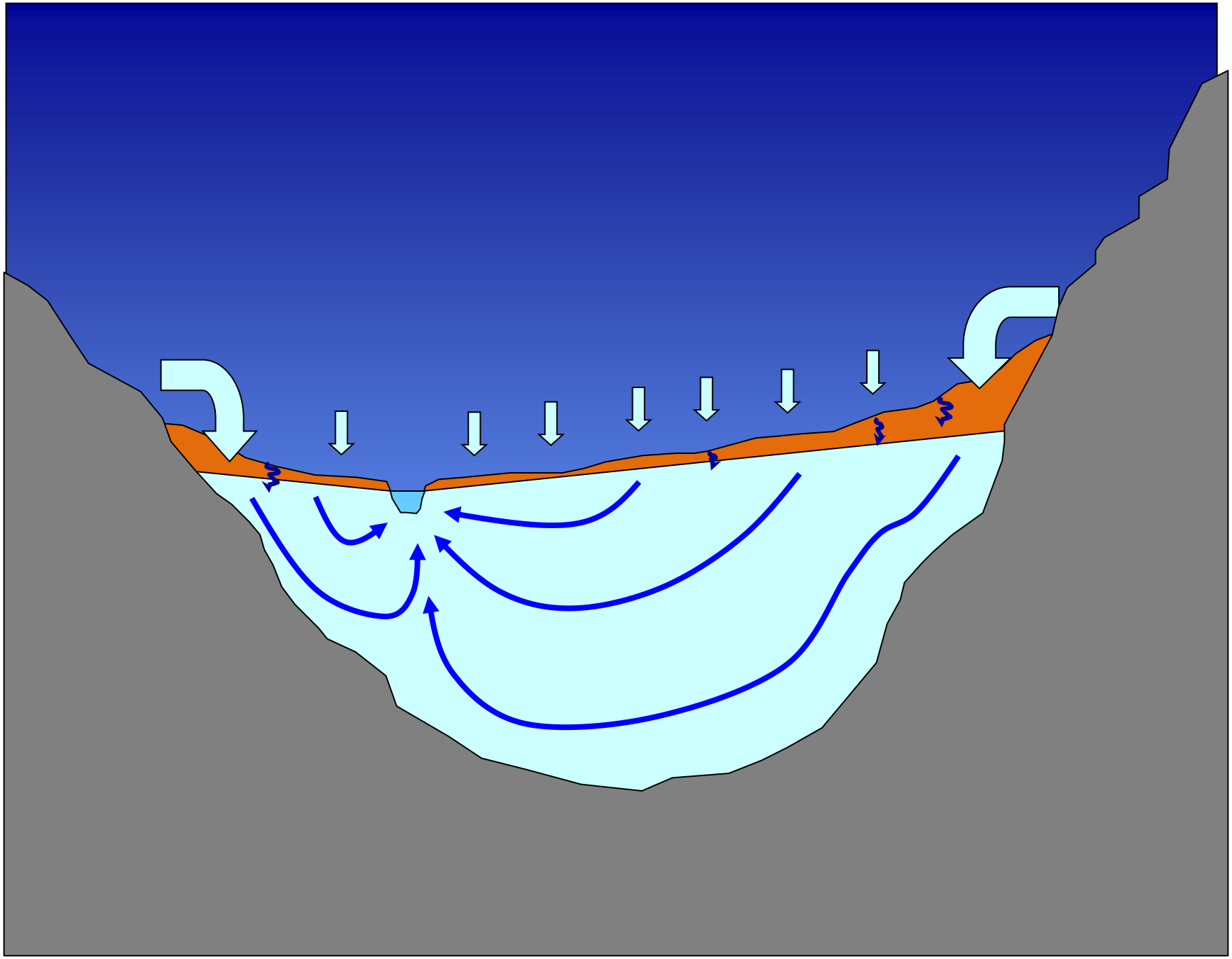


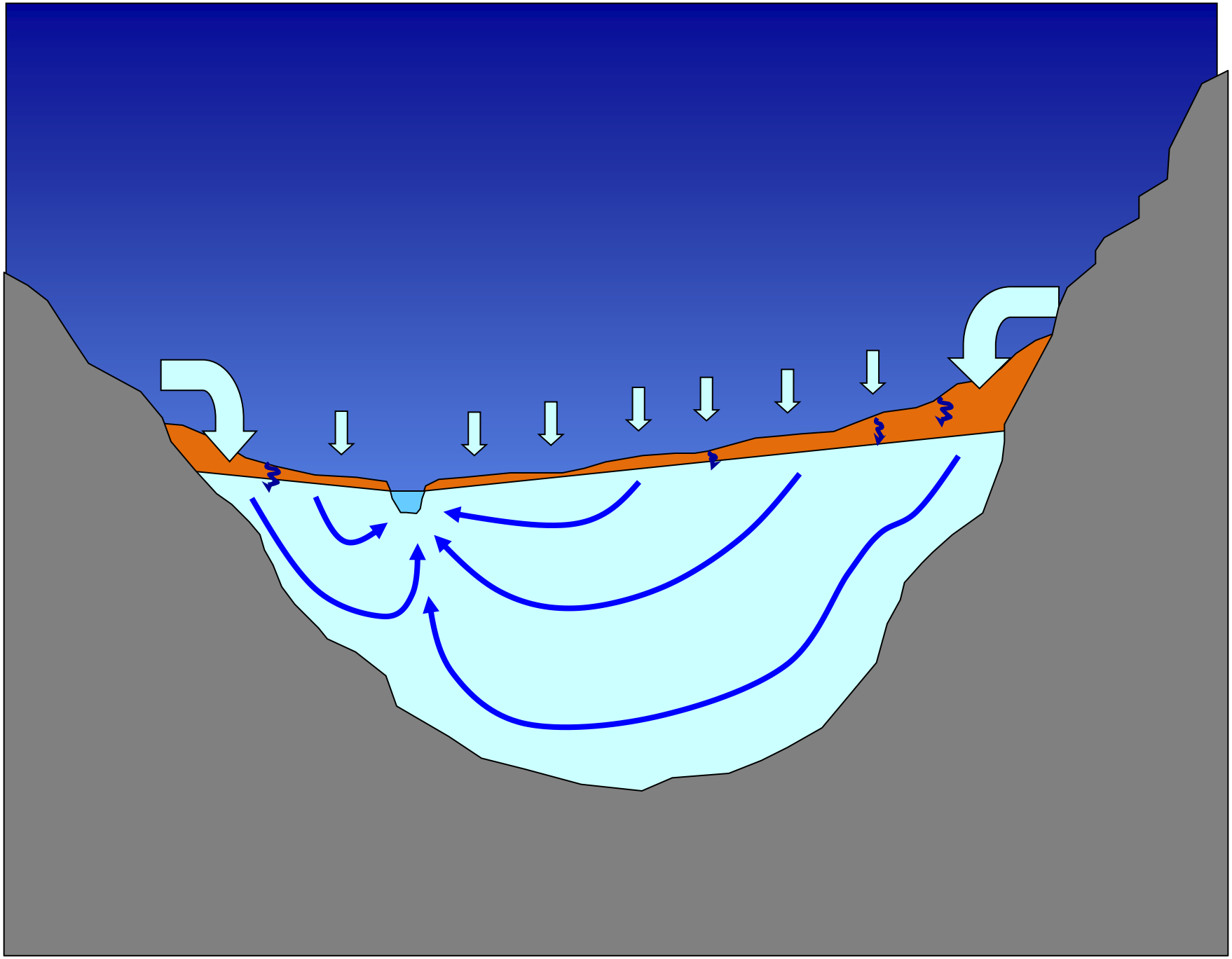


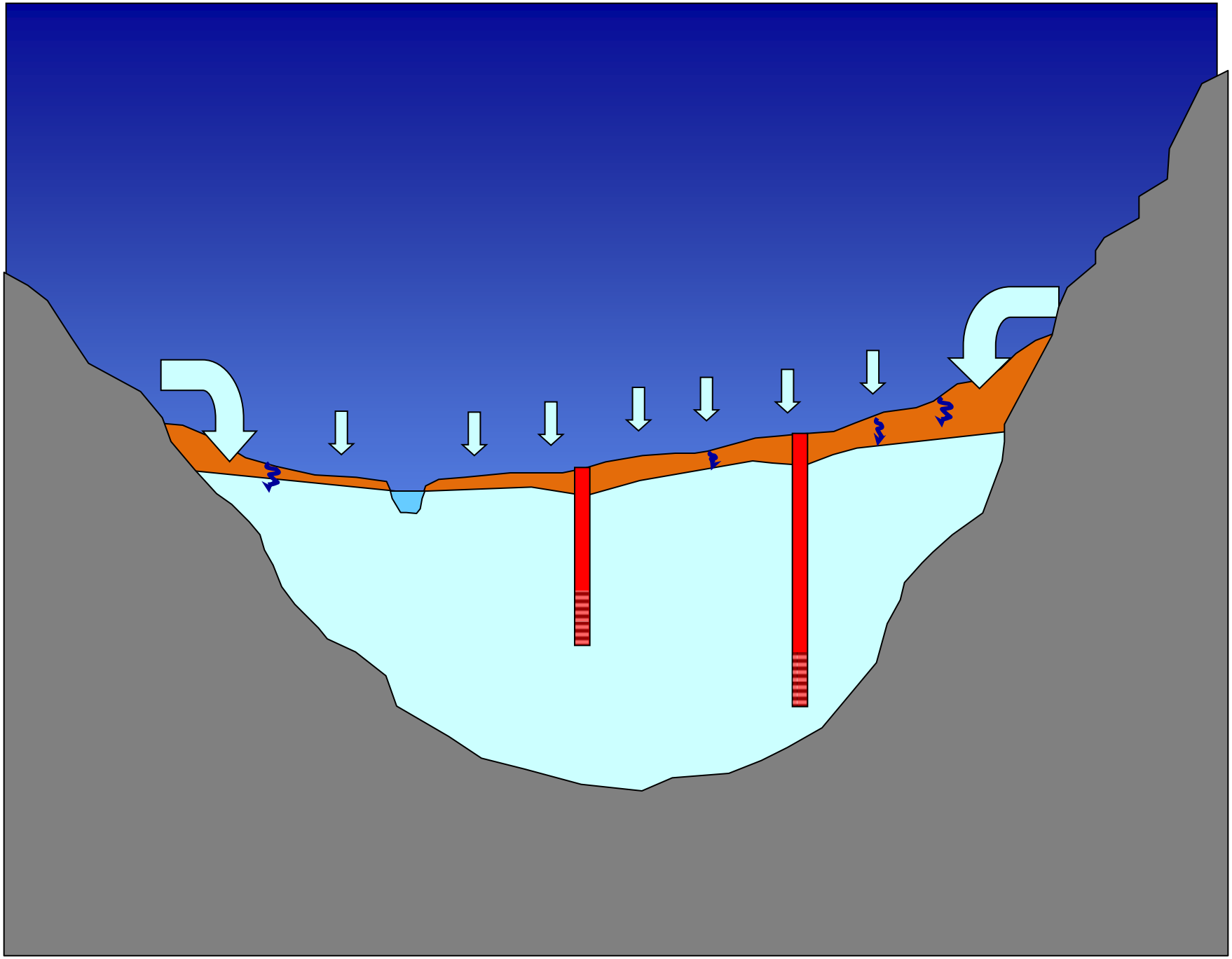


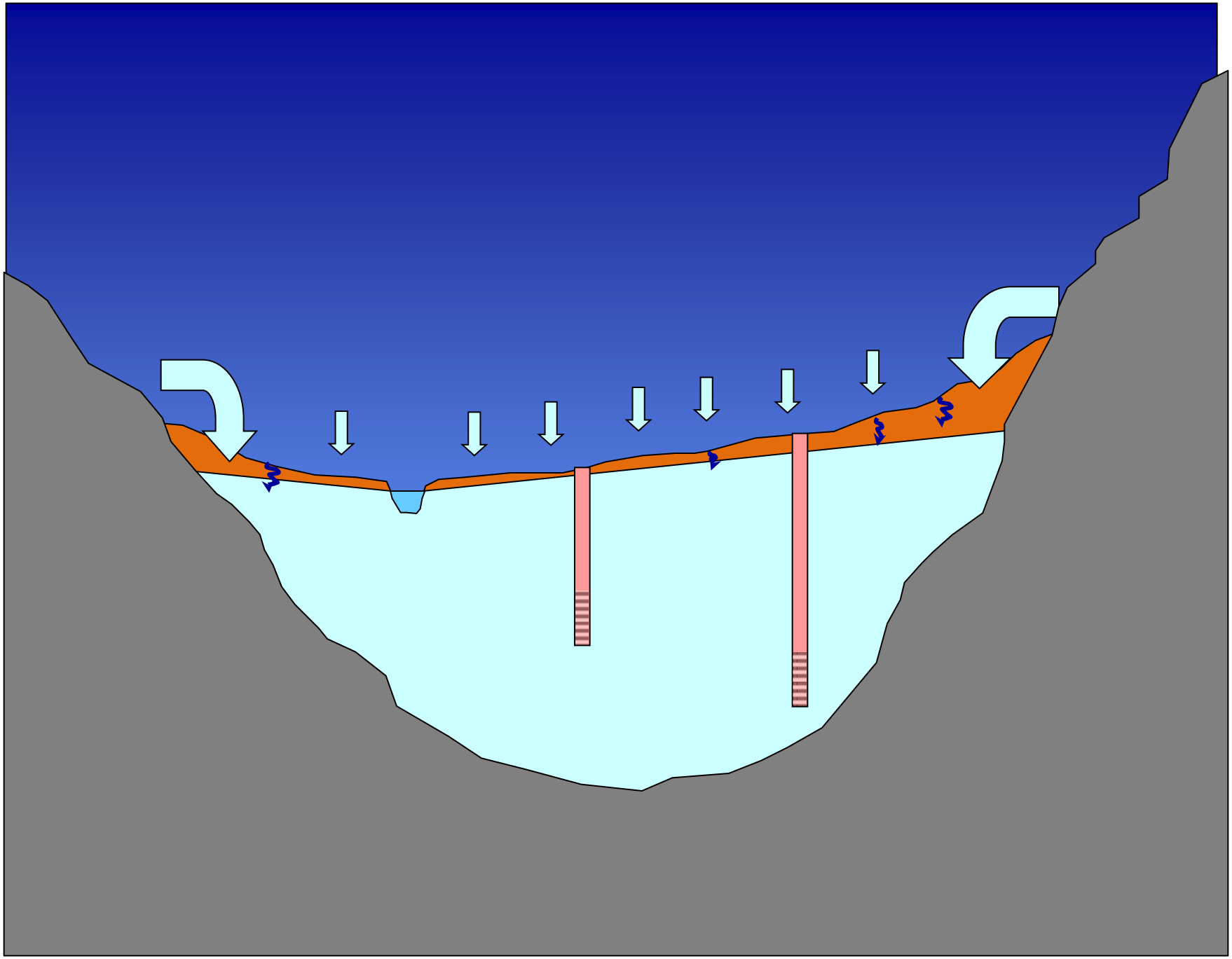


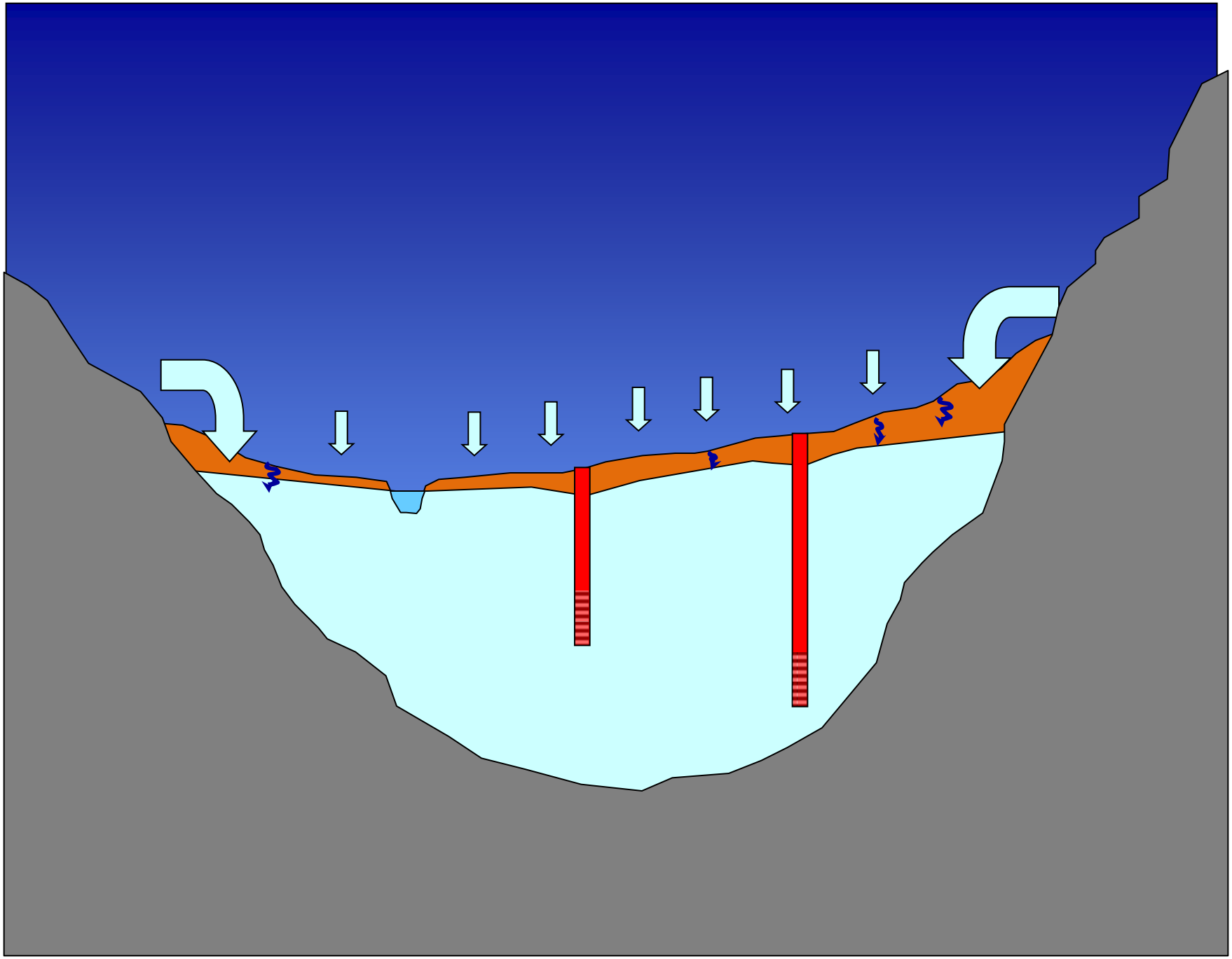


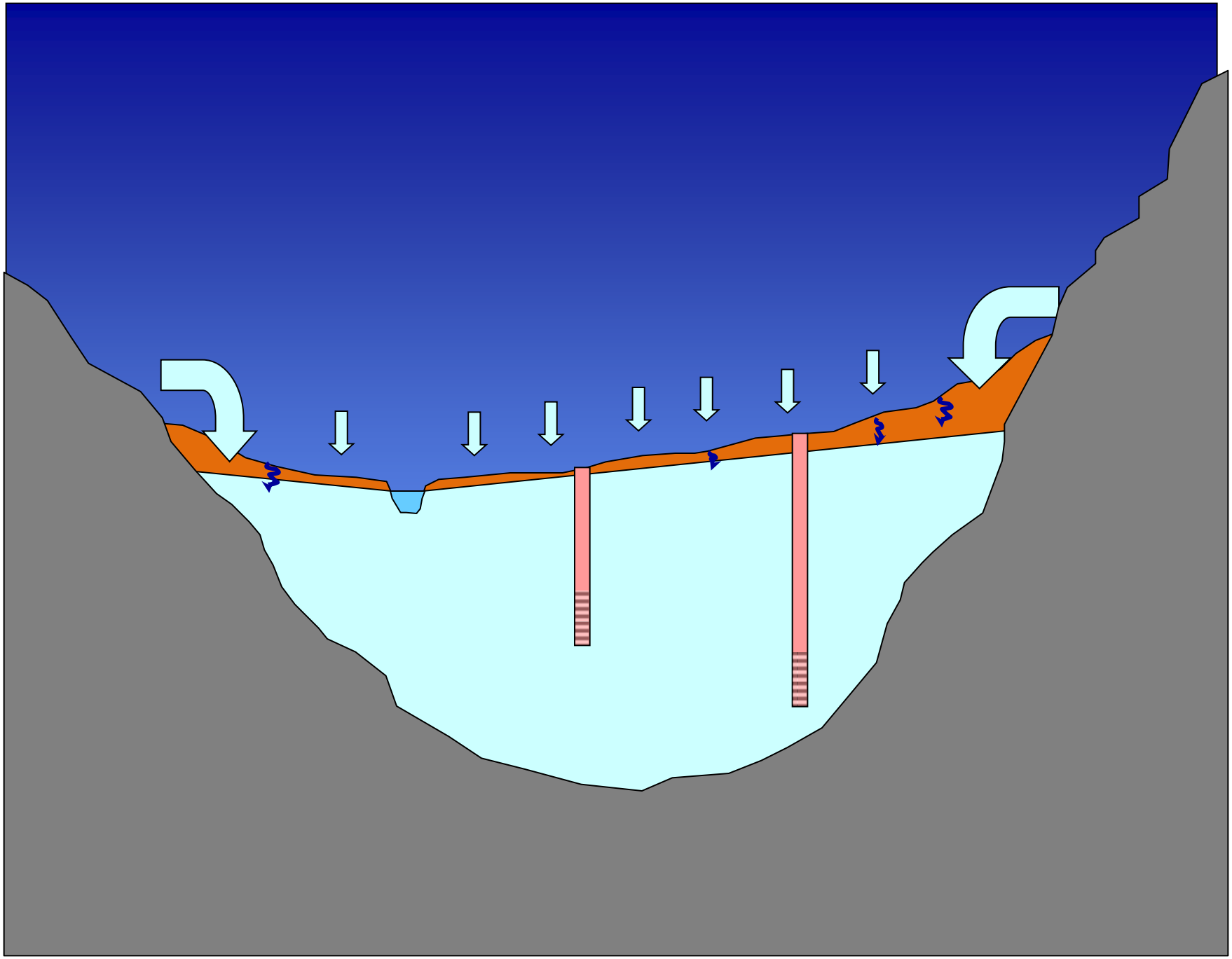


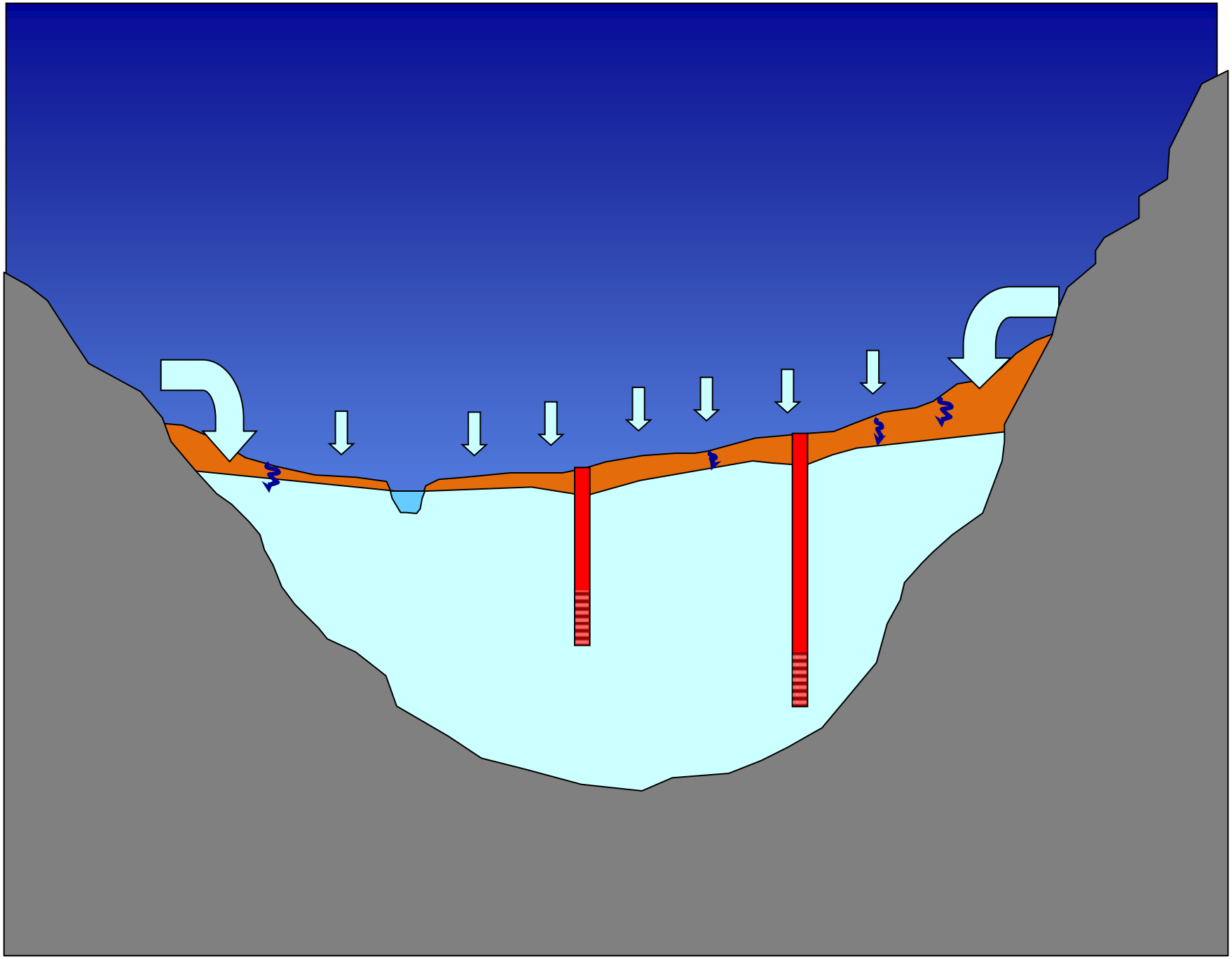


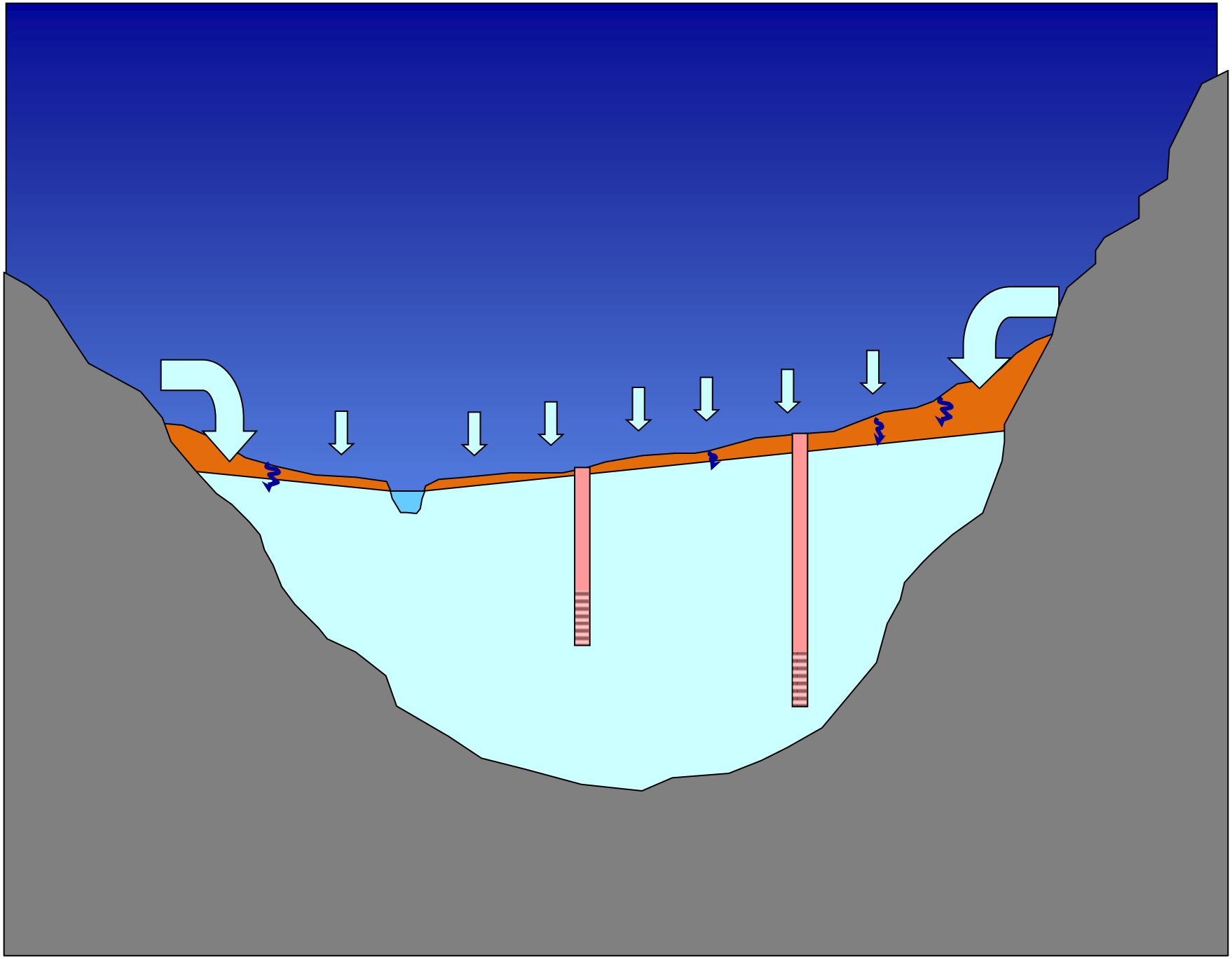


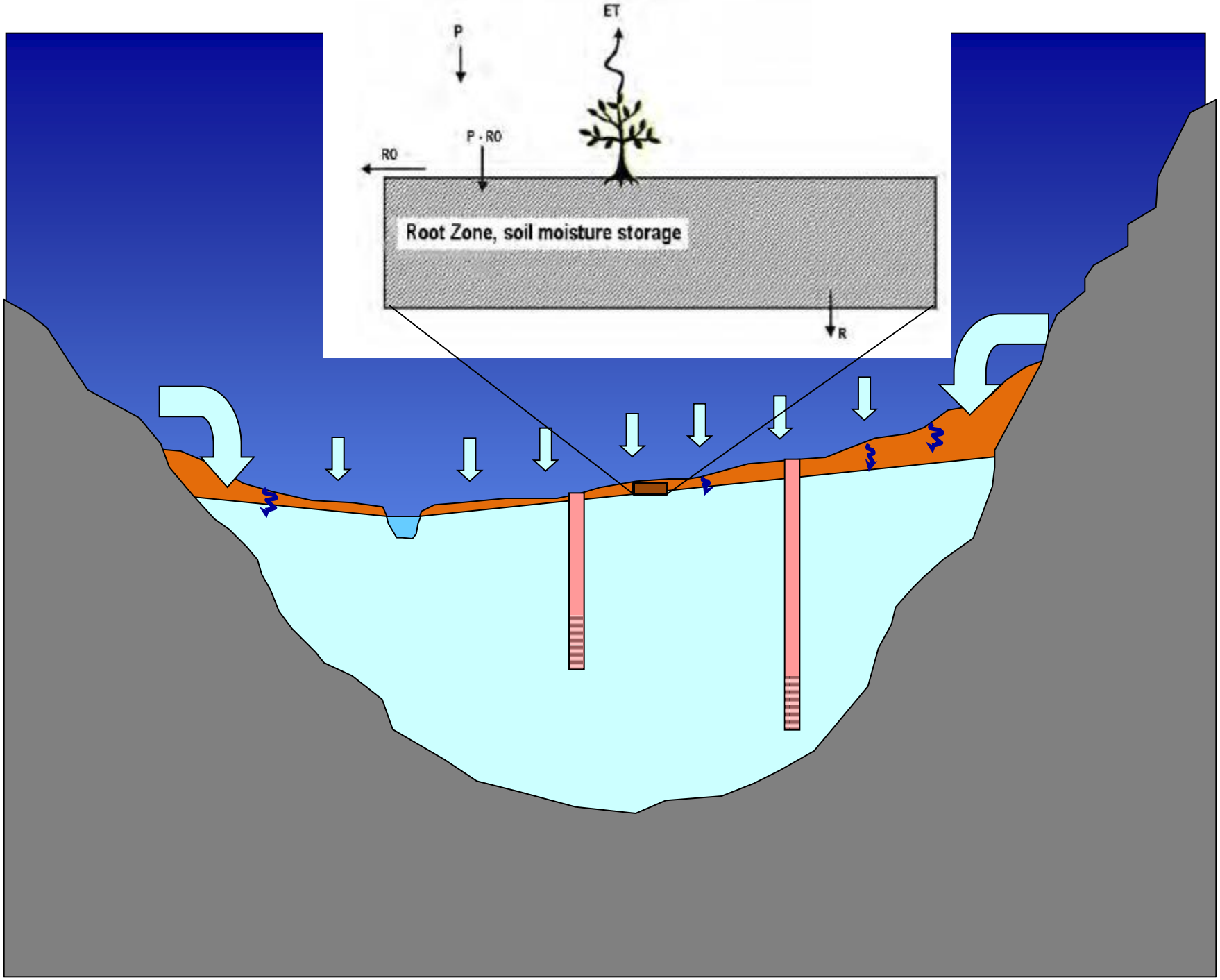




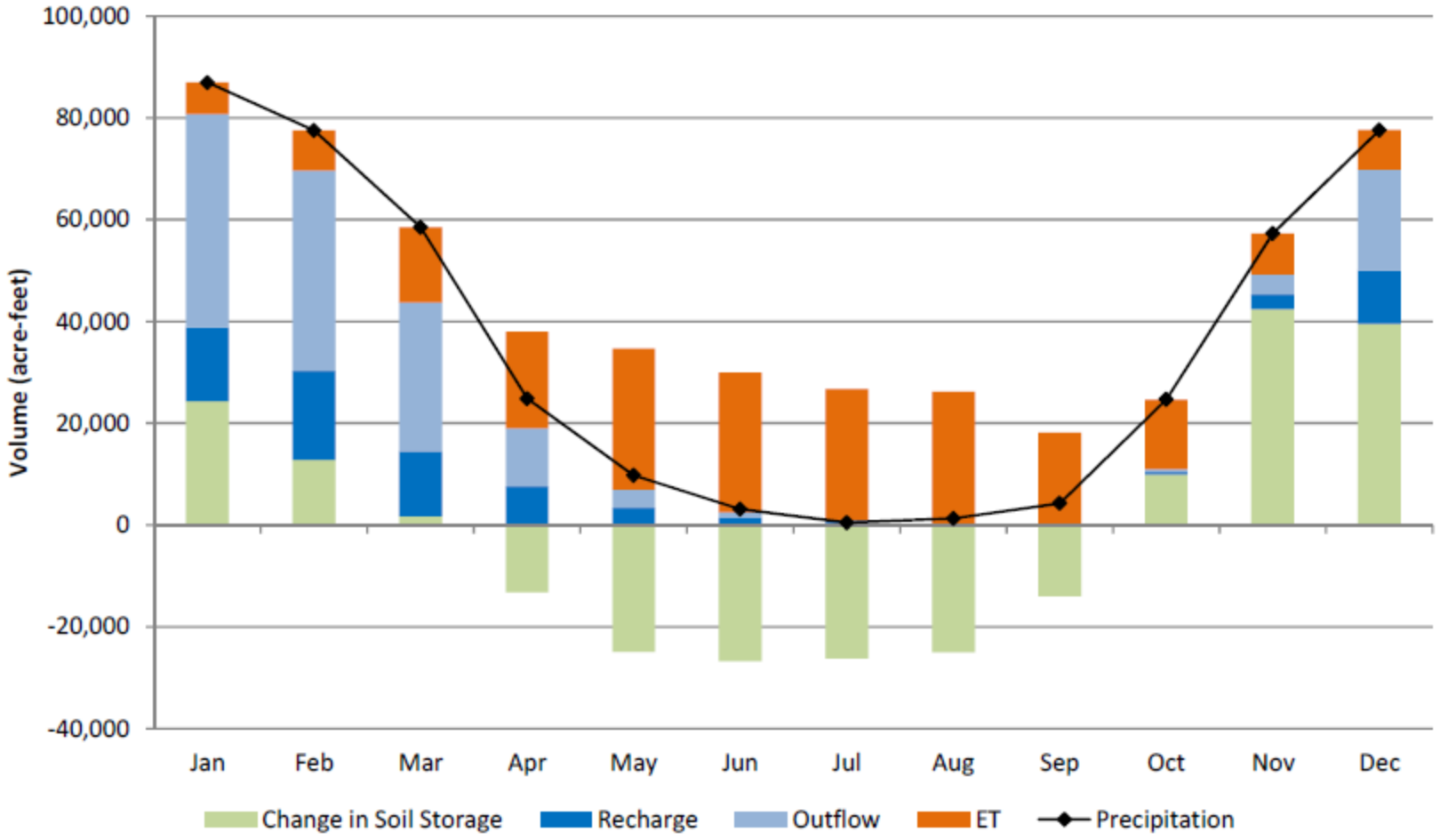







P
ET
P - RO
RO
Root Zone, soil moisture storage
R

Dynamics of the Soil Root Zone Water Budget: Napa River Watershed



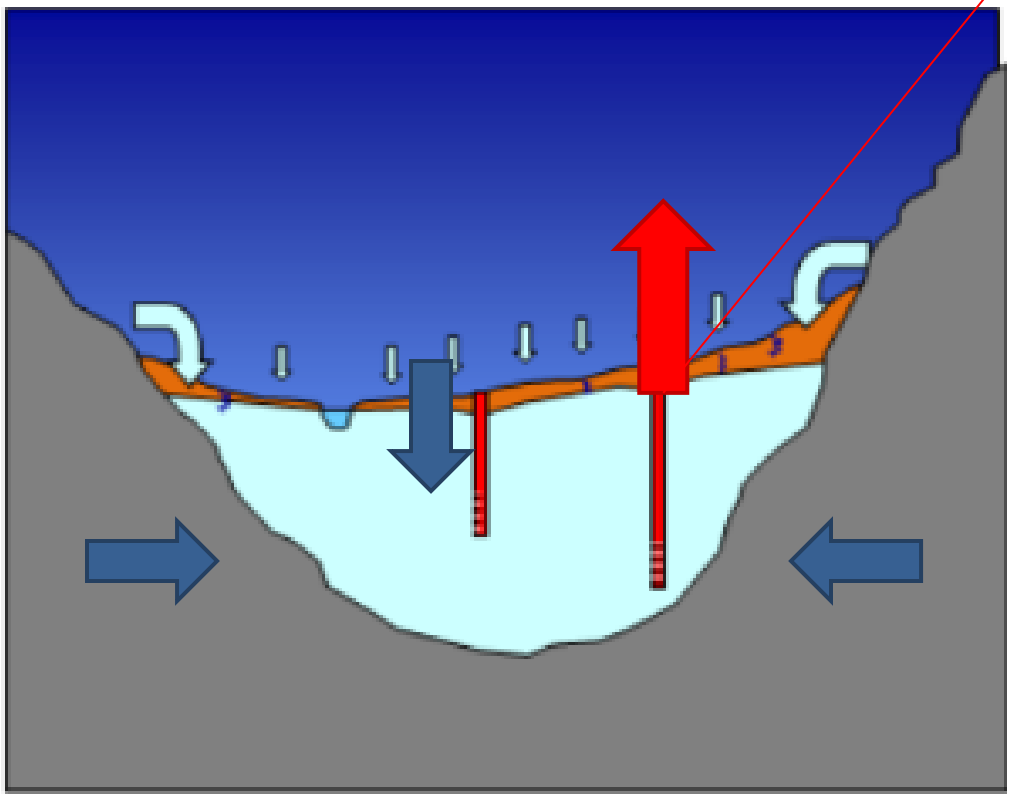
LSCE and MBK, Napa Hydrogeologic Characterization, 2013

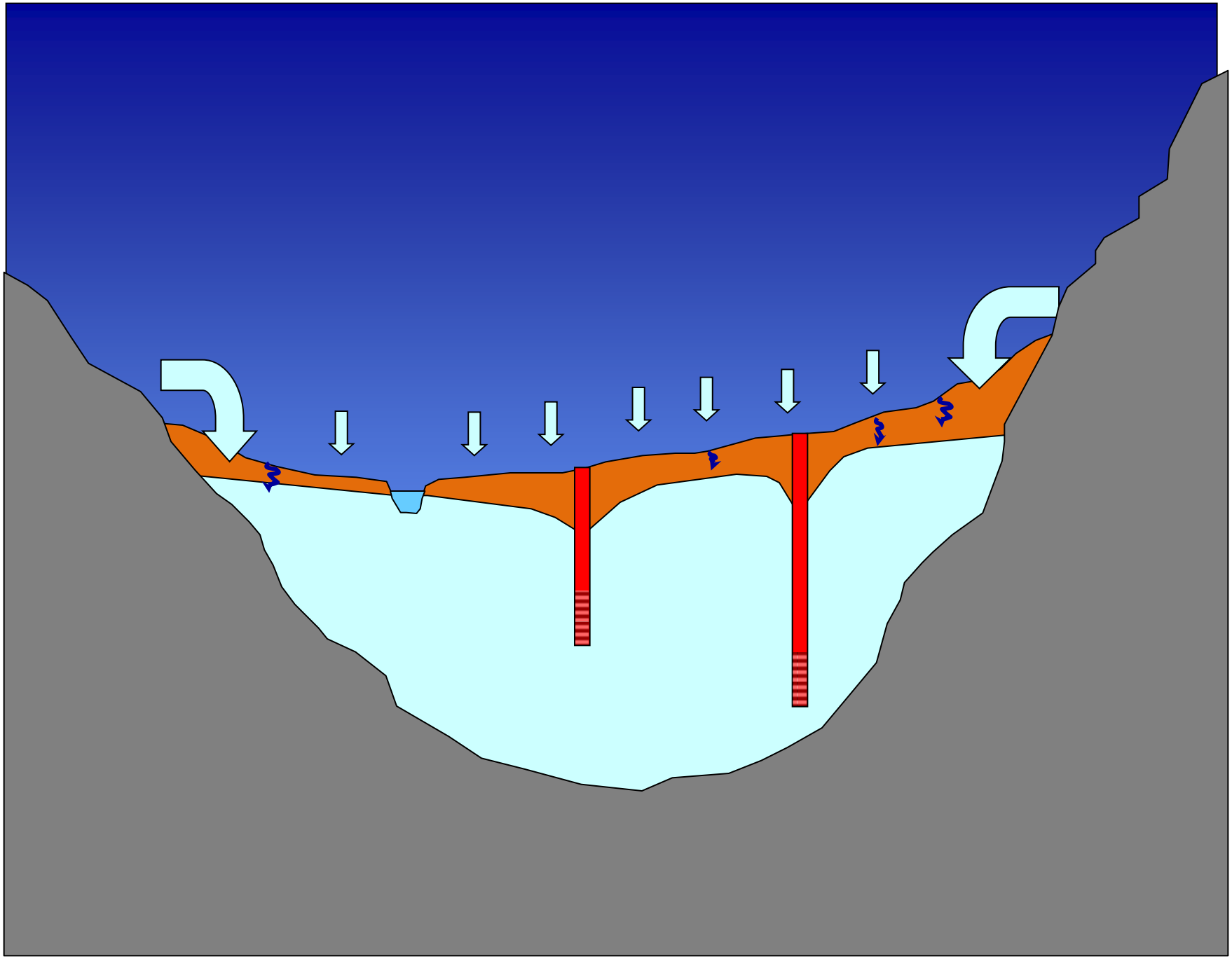
Watershed Water Budget: Sierra Valley

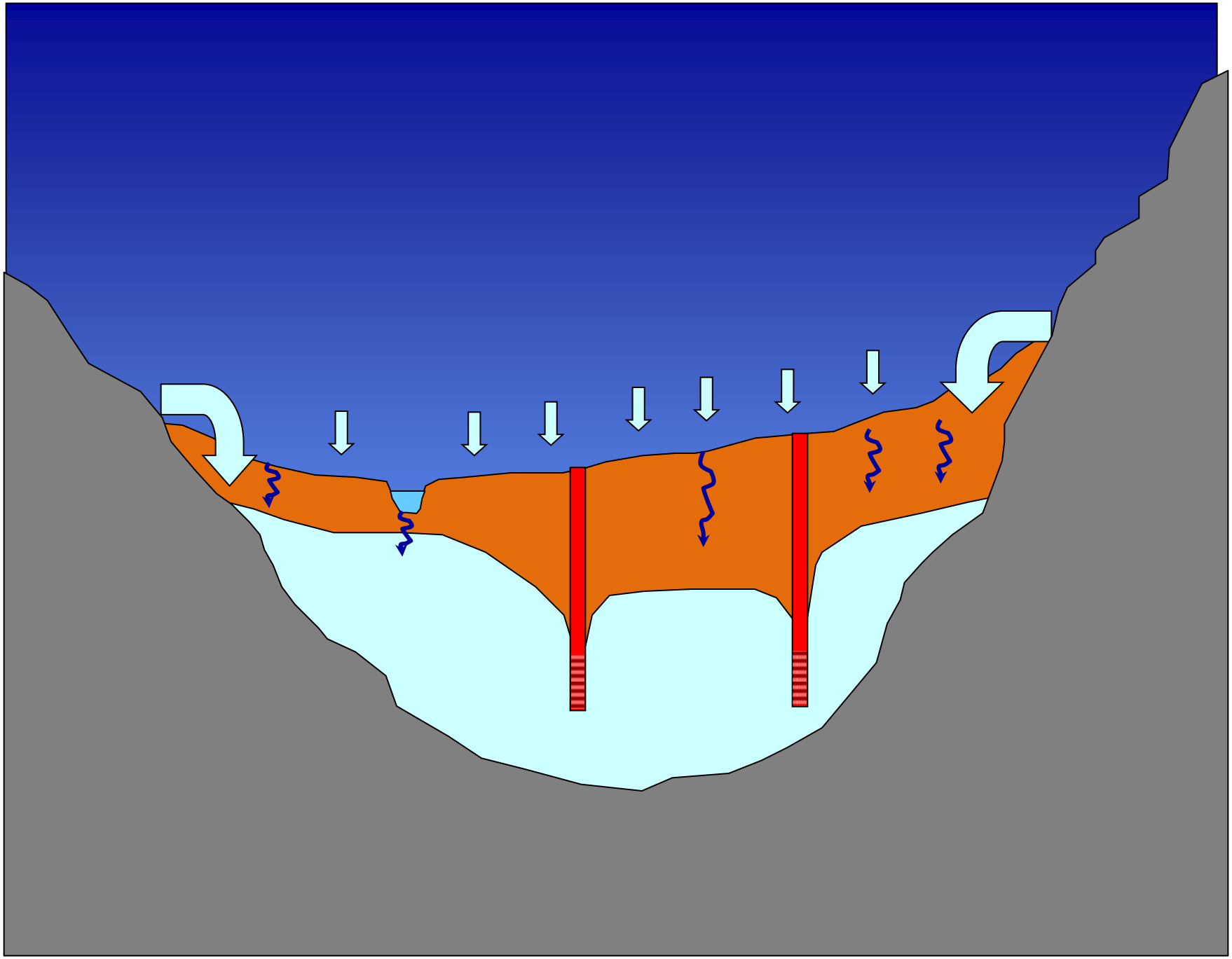
Estimated Groundwater Pumping:

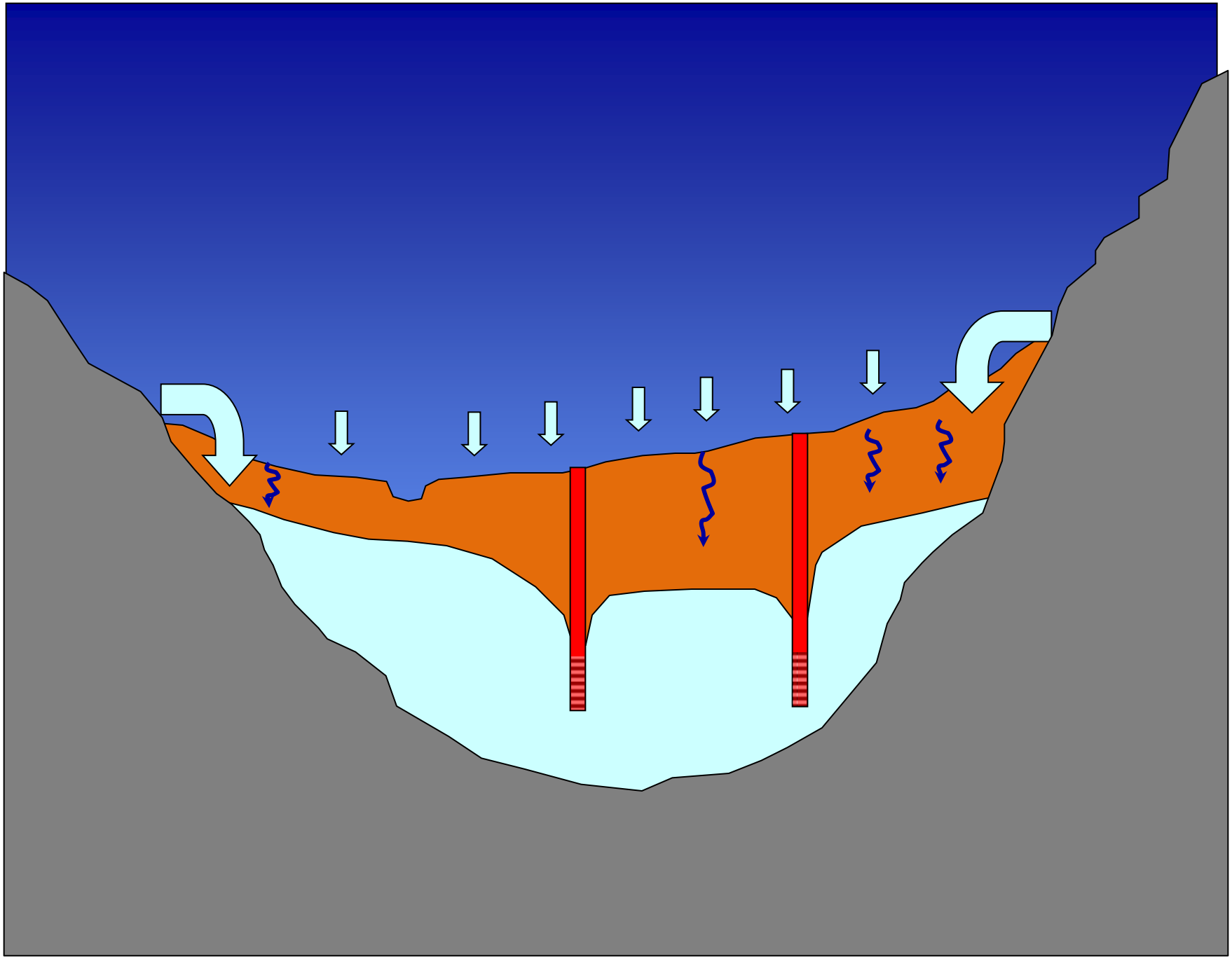
3,500 acre-feet

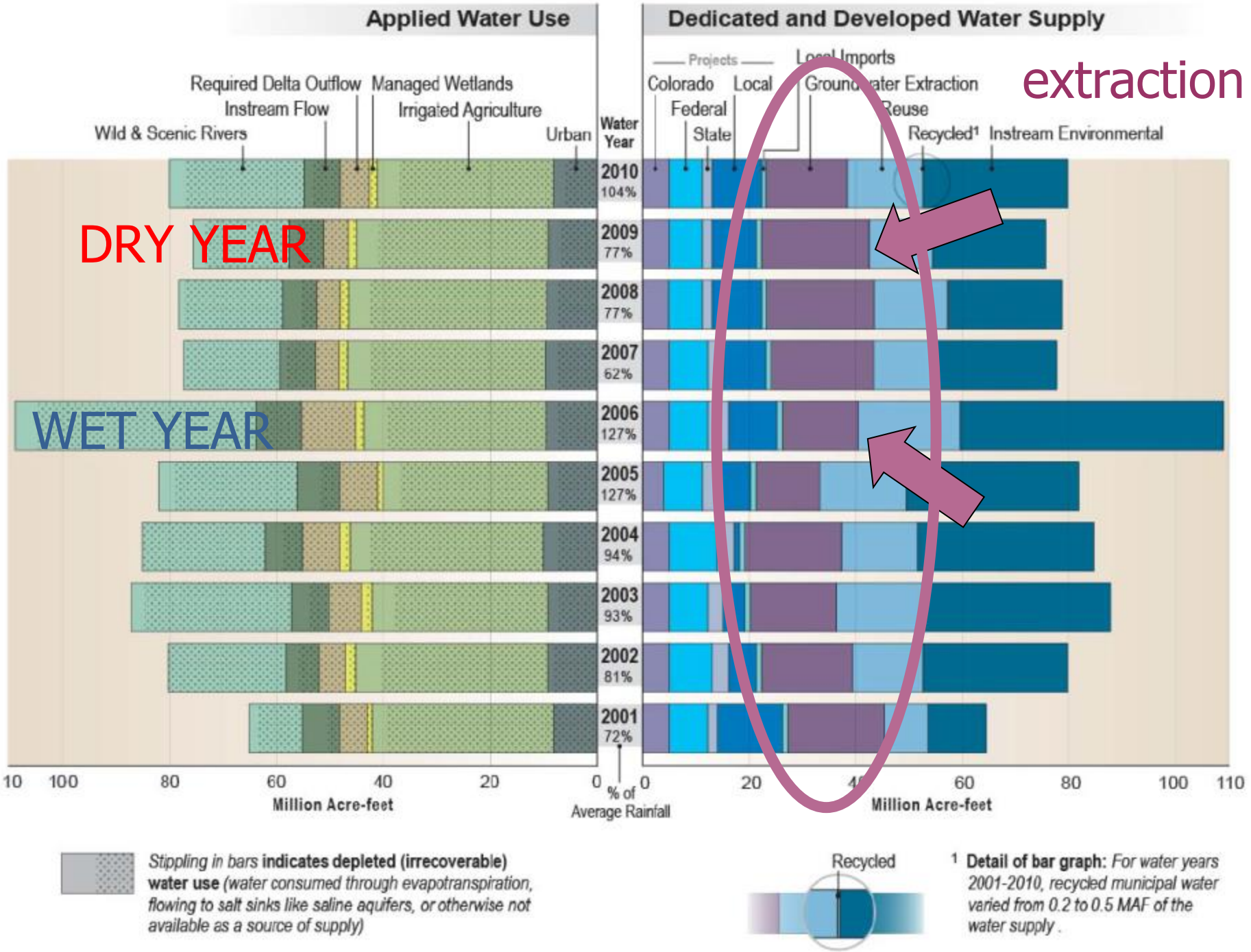
(DWR 2015)





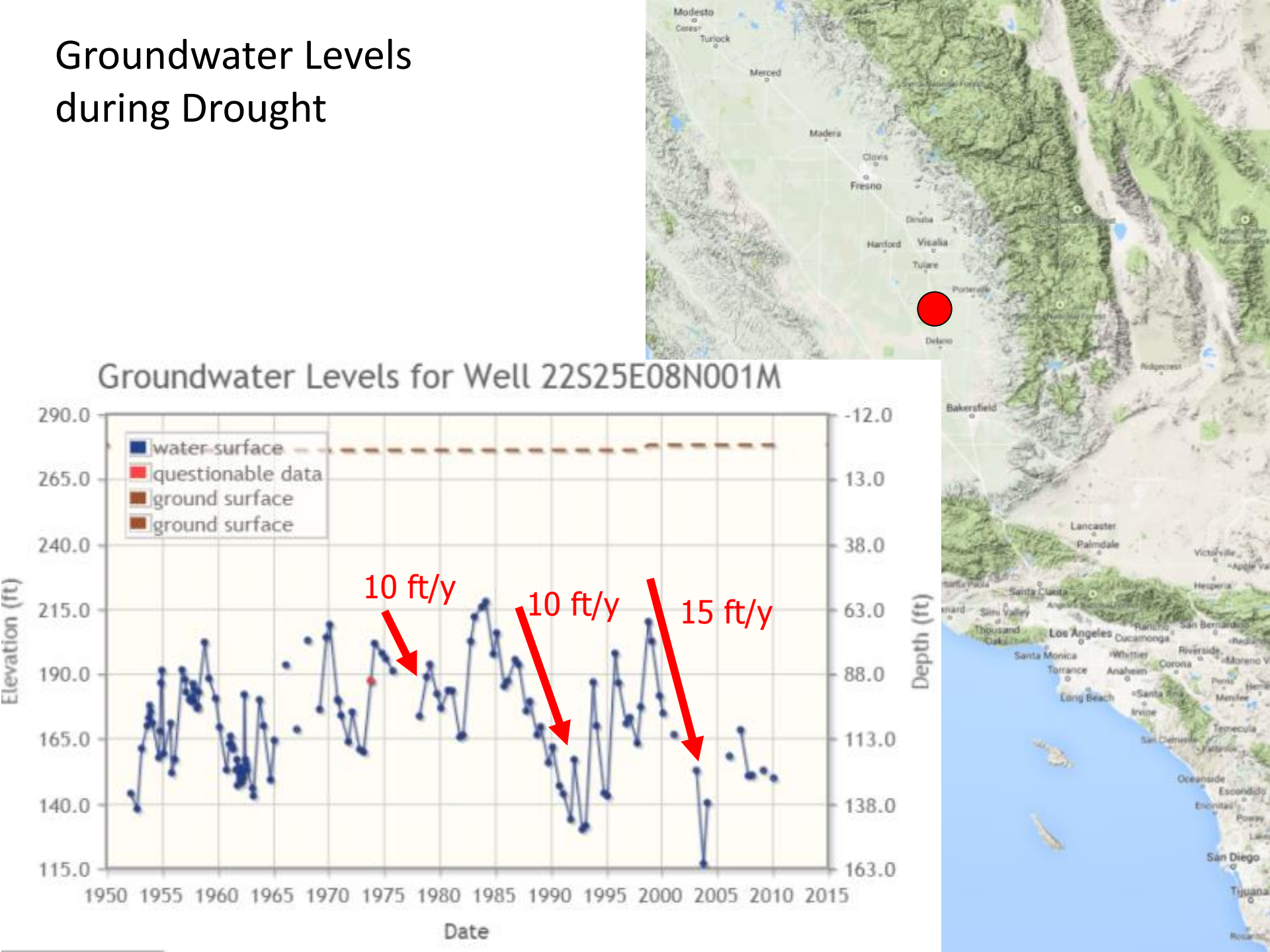




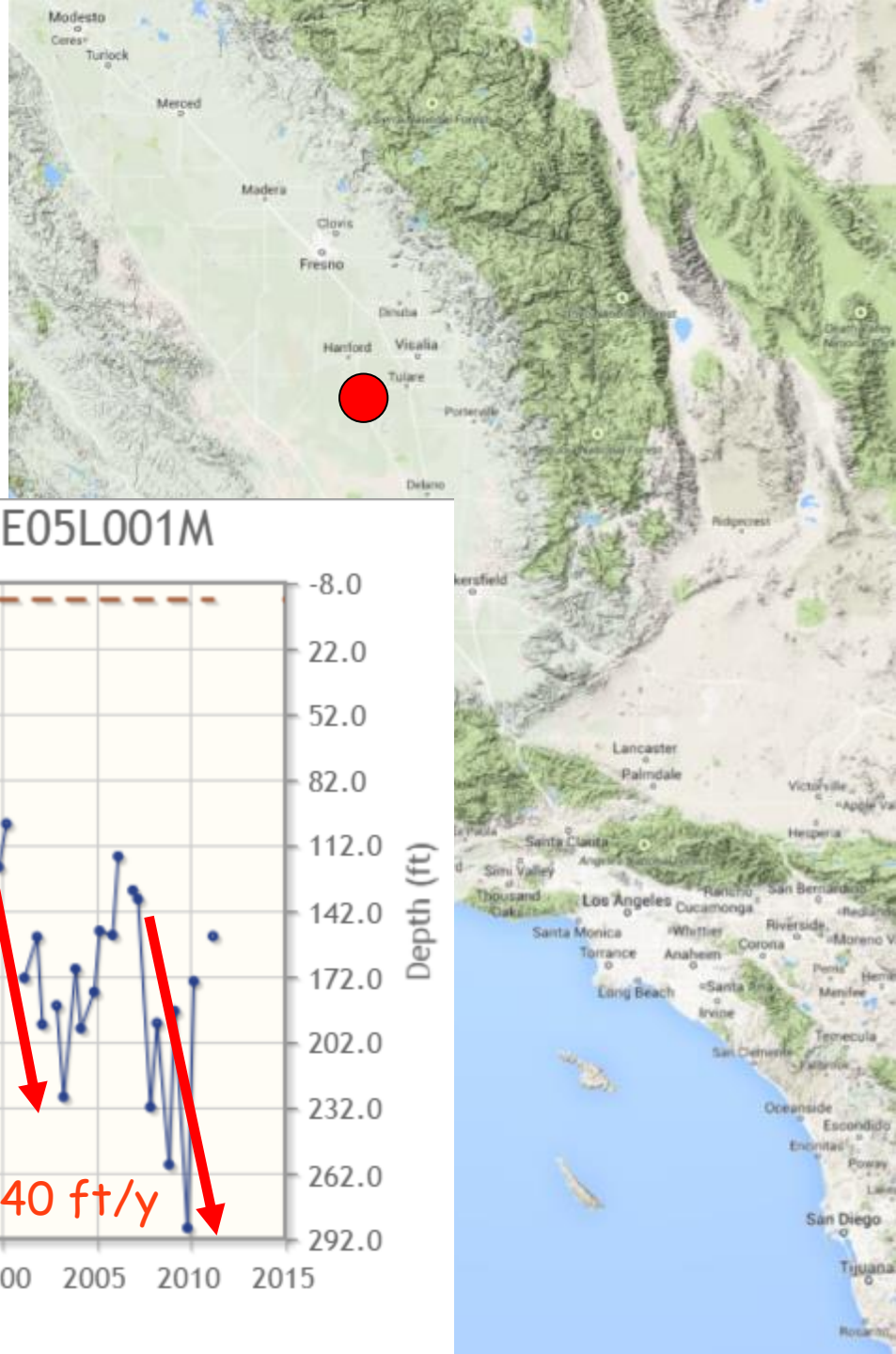


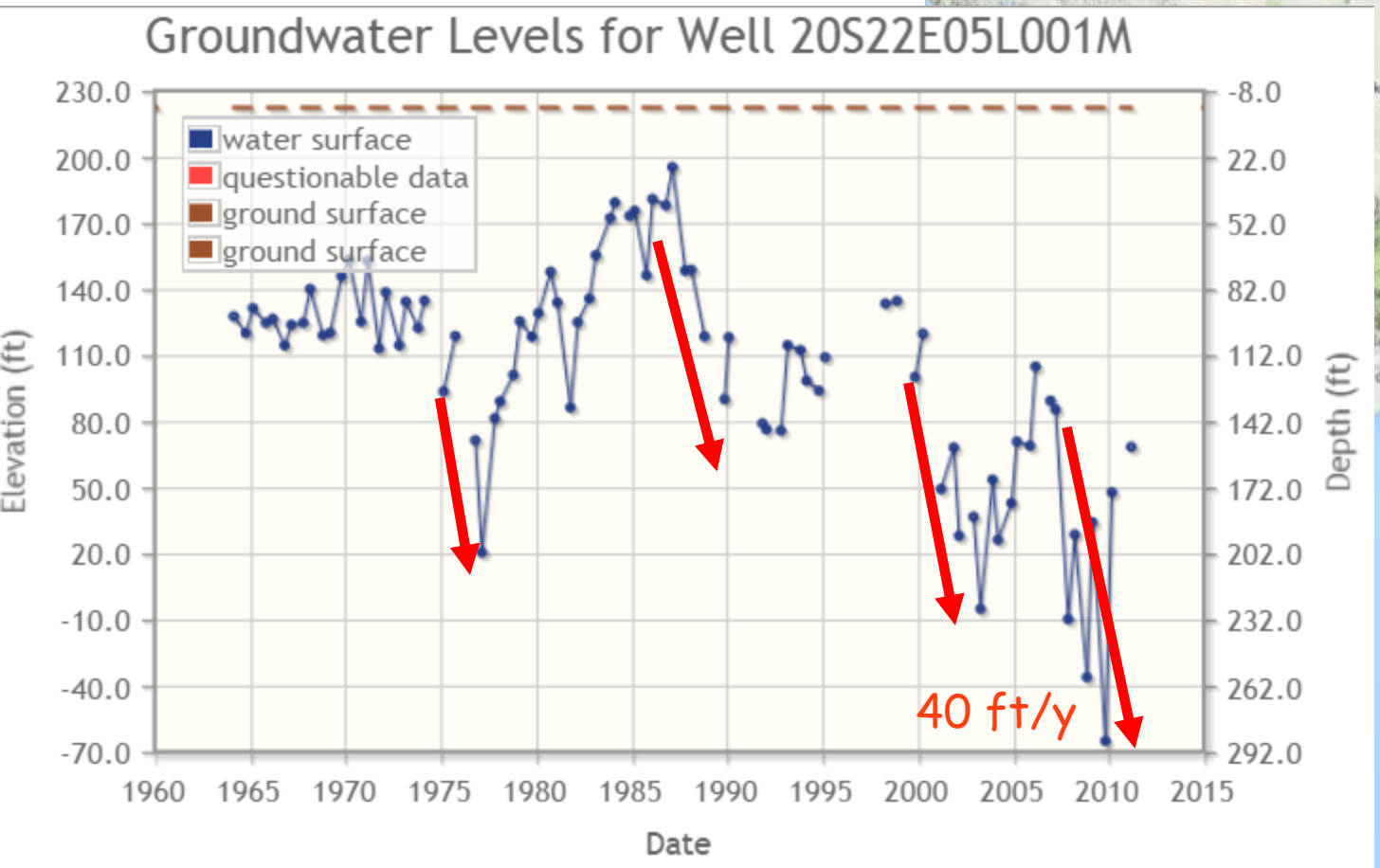
From: DWR California Water Plan 2013 - Draft (Bulletin 160-2013)

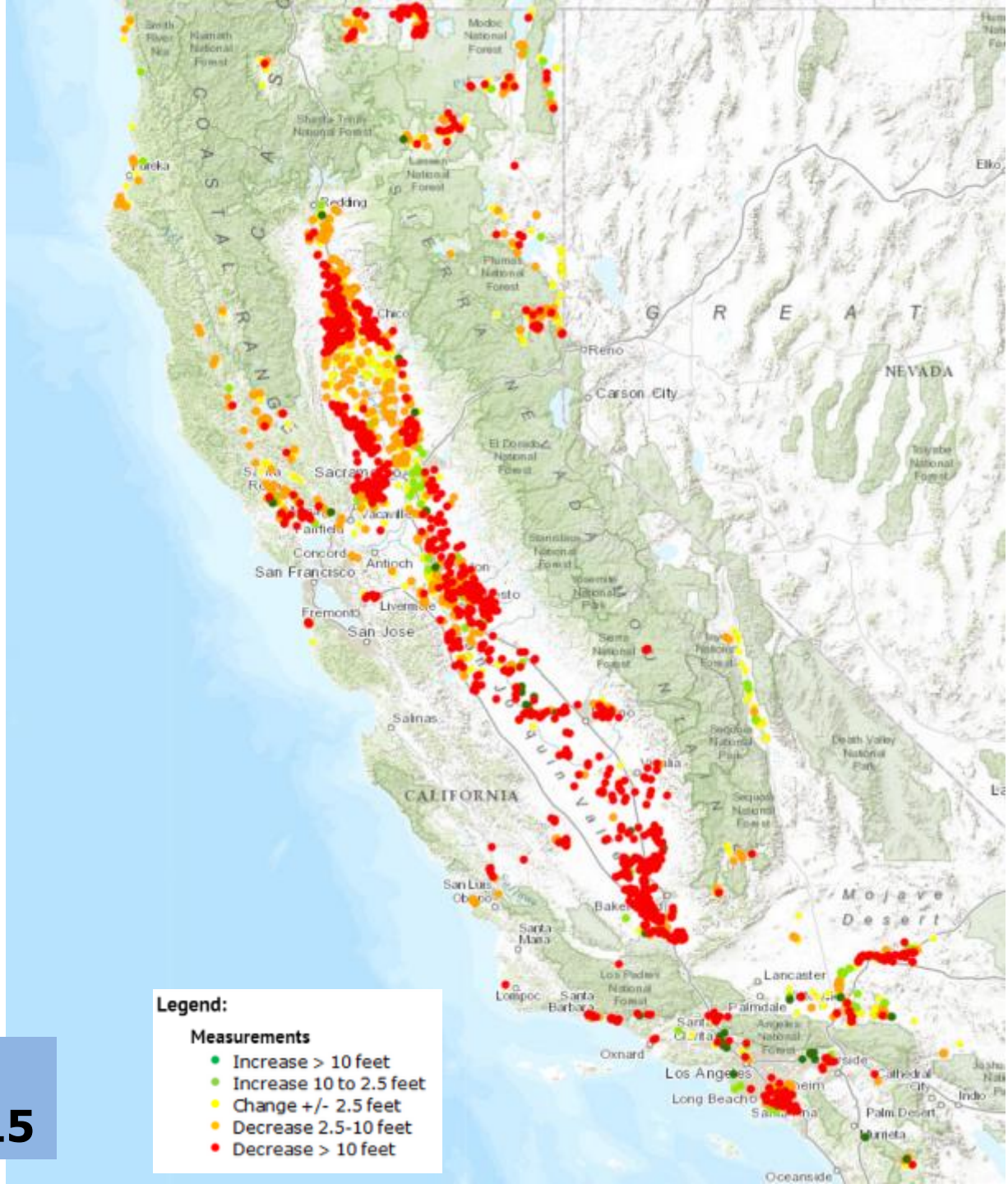
Groundwater Levels during Drought



Groundwater Levels during Drought



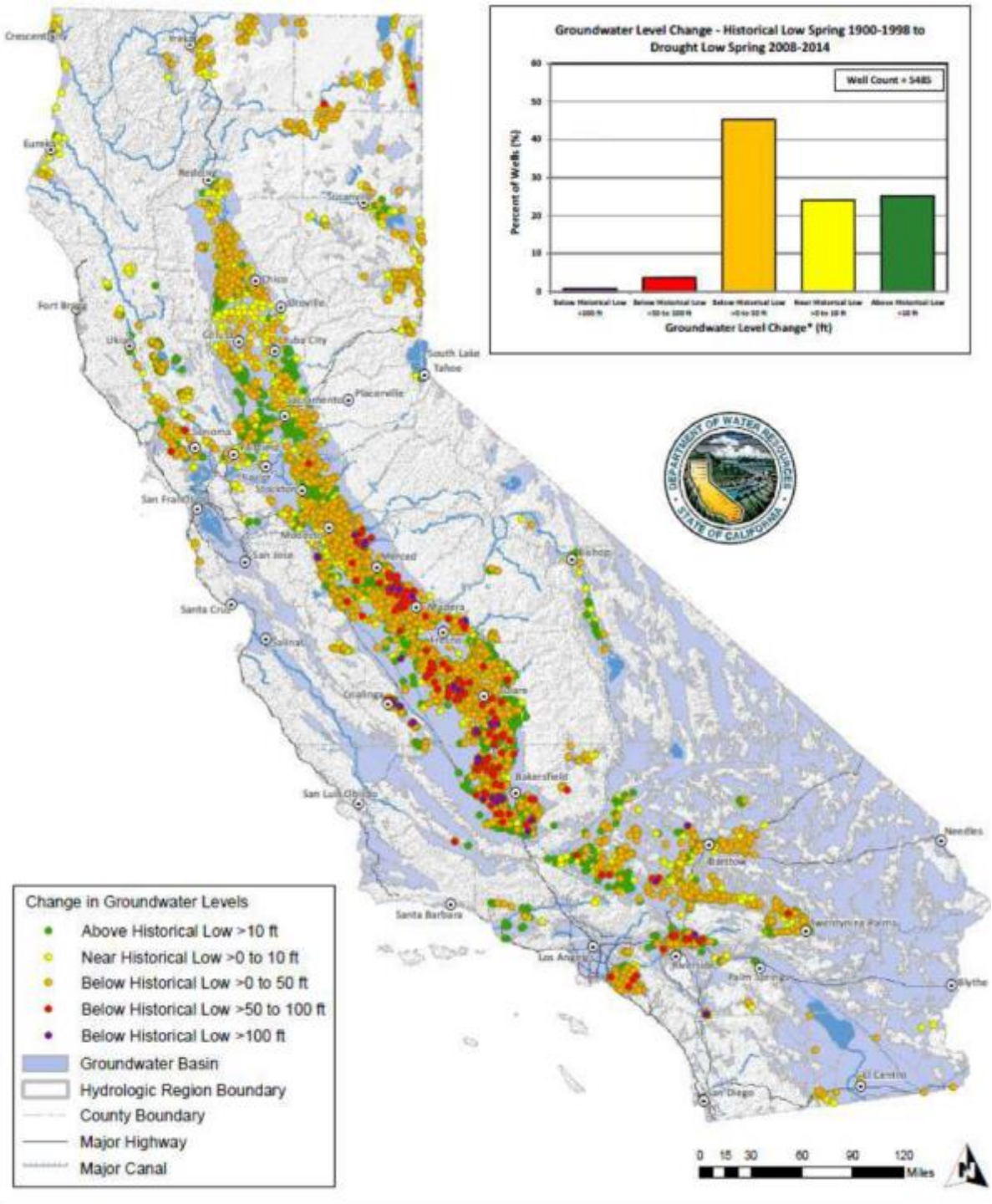




Water Level Change
Spring 2005 – Spring 2015

Change in Groundwater Level

Record Low 20th Century to Drought 2008-2014



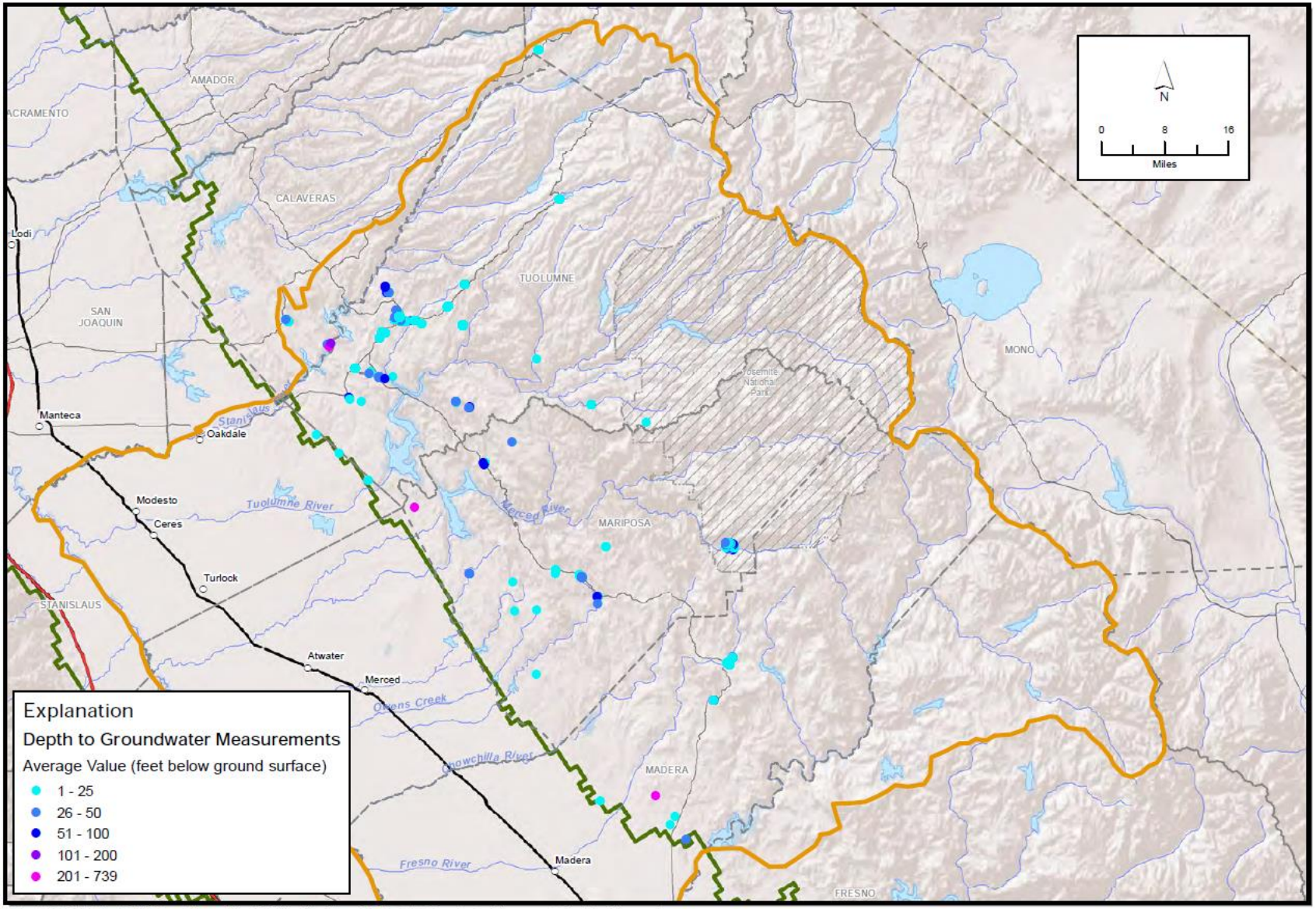
http://www.water.ca.gov/waterconditions/docs/Drought_Response-Groundwater_Basins_April30_Final_BC.pdf

Consequences of Groundwater Overdraft…

- New well construction cost
- Increased pumping cost / lost pump efficiency
- Land subsidence
- Water quality degradation
- Seawater intrusion
- Surface water depletion
- Impact to groundwater dependent ecosystems

…Long Before Running Out of Groundwater!

Depth to Groundwater in the Sierra Nevada

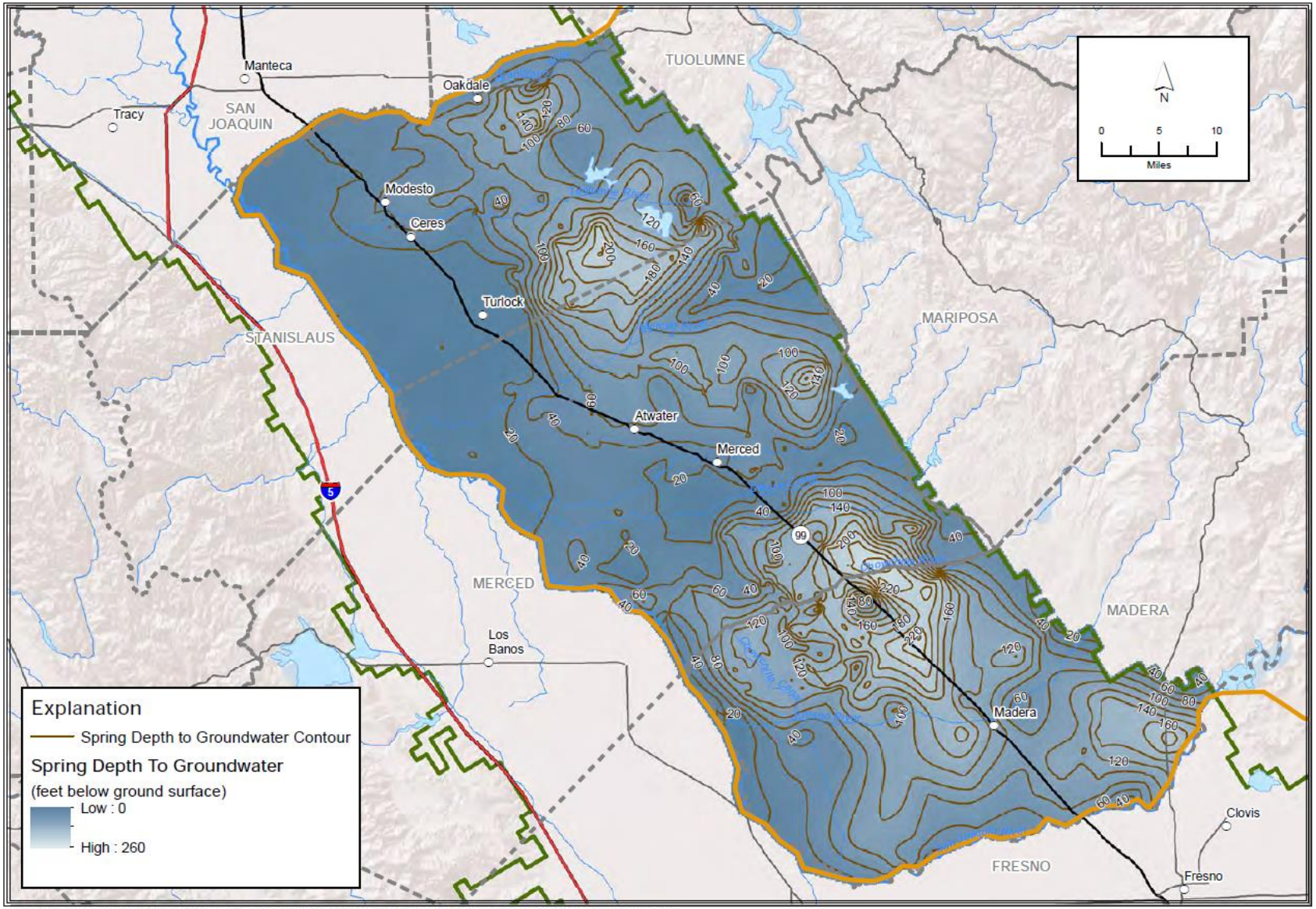


Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure 3-15 Depth to Groundwater Measurements Peripheral Area.mxd

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-15
Depth to Groundwater Measurements: Peripheral Area

Depth to Groundwater (in Spring)



Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure 3-11 Spring Depth to Groundwater Contour Central Valley Floor.mxd

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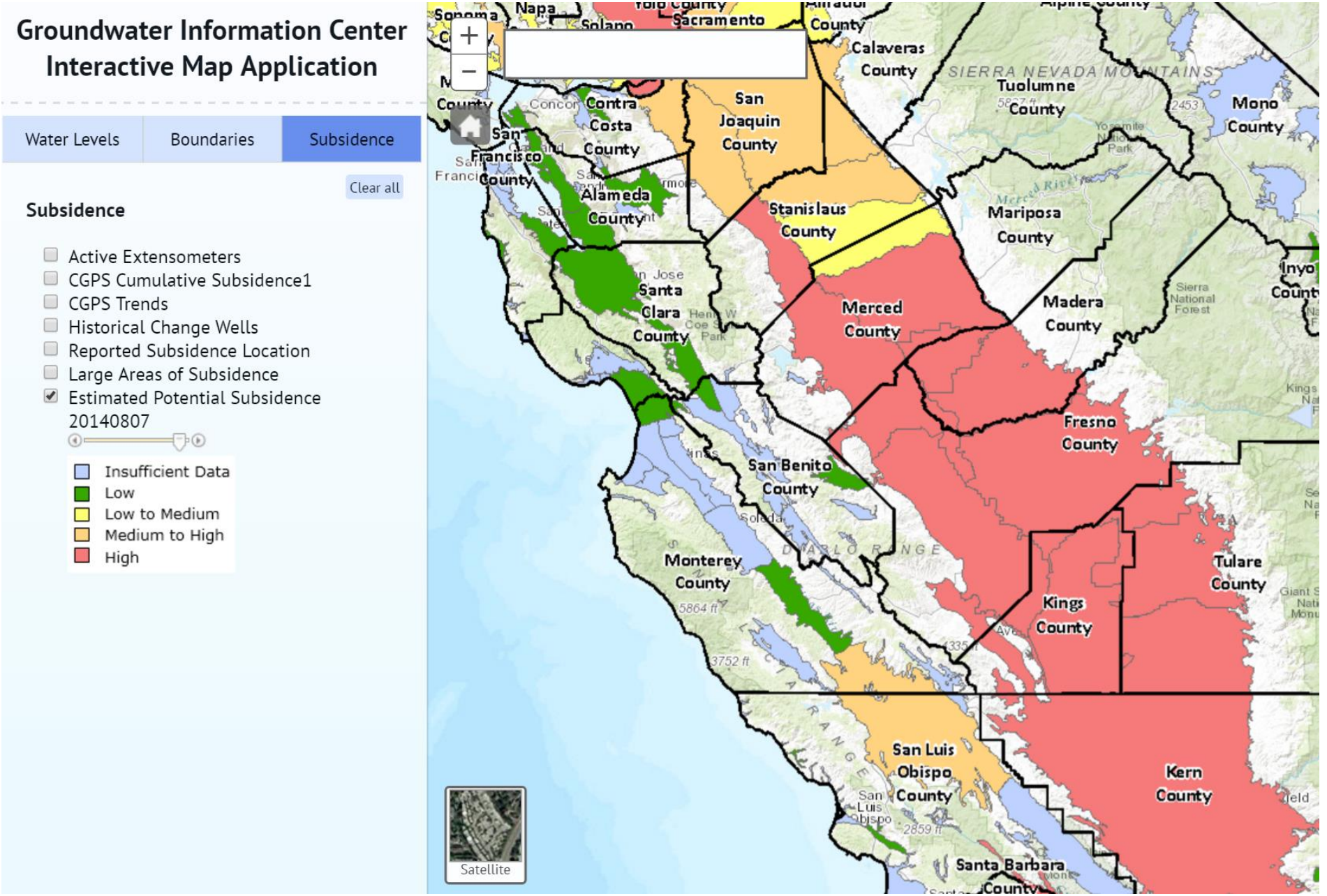
Figure 3-11
Spring Depth to Groundwater Contours: Central Valley Floor

Subsidence Risk, Central California



modified from CA DWR, 2016

California Groundwater Rights: Background

- Correlative Rights Doctrine – safe yield of groundwater basin shared by overlying users
  - Katz v. Wilkinshaw, 1908
- California constitutional mandate for beneficial use (1928)
- Special districts (20 different types, about 2,300 districts)
  - Water districts, irrigation districts, private water companies, reclamation districts, water conservation districts, water replenishment districts, water storage districts, etc.
- County police power – controls groundwater exports
  - Baldwin vs. Tehama County, 1994
- The Courts: basin adjudication / "physical solution" – controls extraction
  - Many Southern California (sub)basins, mid 20th century
  - City of Barstow vs. Mojave Water Agency, 2000:
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California Groundwater Rights: Background

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  - Financial incentives for local groundwater management: SB 1938 (2002)
  - **Sustainable Groundwater Management Act of 2014: mandatory & expanded local control**

Sustainable Groundwater Management Act of 2014

SEC. 2.

Section 113 is added to the Water Code, to read:

113.

It is the policy of the state that **groundwater resources be managed sustainably for long-term reliability and multiple economic, social, and environmental benefits** for current and future beneficial uses.

Sustainable groundwater **management is best achieved locally** through the development, implementation, and updating of plans and programs based on the best available science.

[emphasis added]

Sustainability = No “Undesirable Results”

10721. Unless the context otherwise requires, the following definitions govern the construction of this part:

(u) “Sustainable groundwater management” means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) **“Undesirable result” means one or more of the following** effects caused by groundwater conditions occurring throughout the basin (Section 10721 (w)):

(1) **Chronic lowering of groundwater levels** indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable **reduction of groundwater storage**.

(3) Significant and unreasonable **seawater intrusion**.

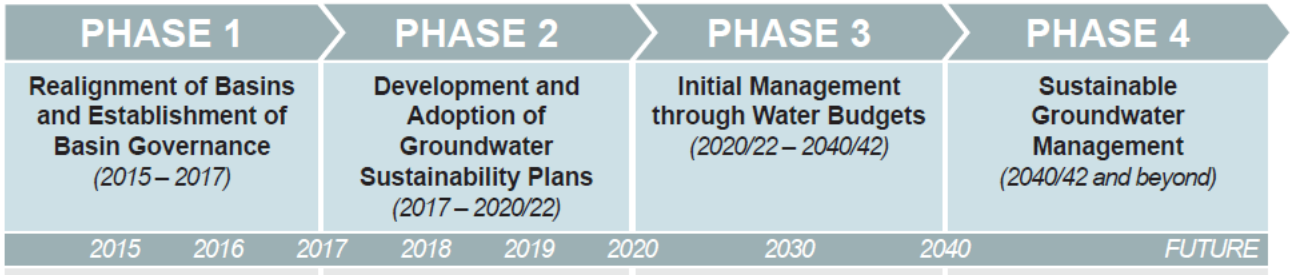
(4) Significant and unreasonable **degraded water quality**, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable **land subsidence** that substantially interferes with surface land uses.

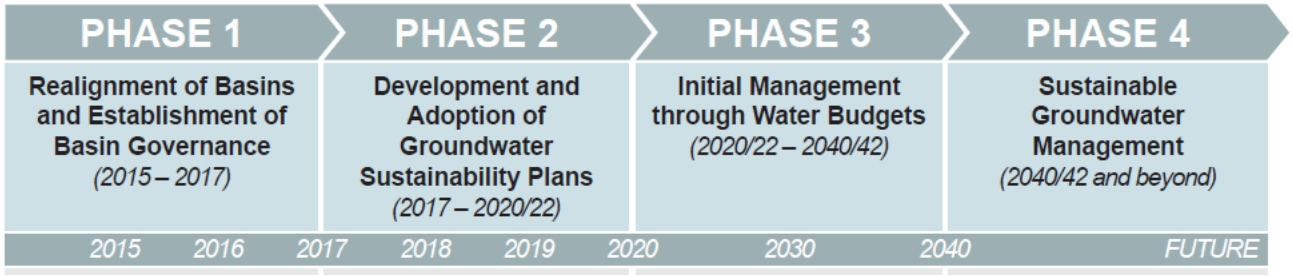
(6) **Surface water depletions** that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

[emphasis added]

So What Exactly Will Happen?

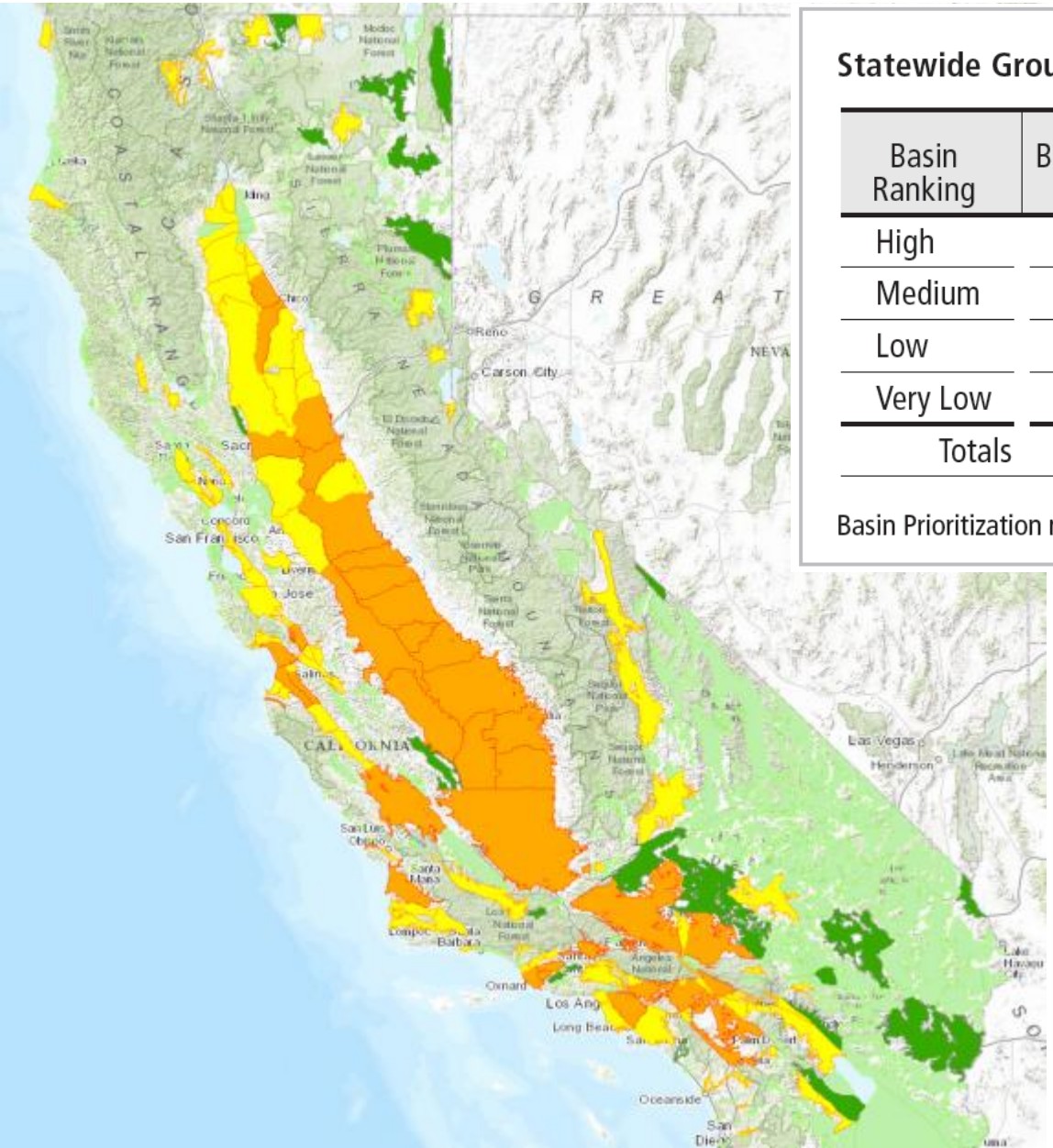


So What Exactly Will Happen?



- **First Step: forming a Groundwater Sustainability Agency (GSA)**
  - By June 2017

Medium and High Priority Groundwater Basins



Statewide Groundwater Basin Prioritization Summary

Basin Ranking	Basin Count per Rank	Percent of Total for State	
		GW Use	Overlying Population
High	43	69%	47%
Medium	84	27%	41%
Low	27	3%	1%
Very Low	361	1%	11%
Totals	515	100%	100%

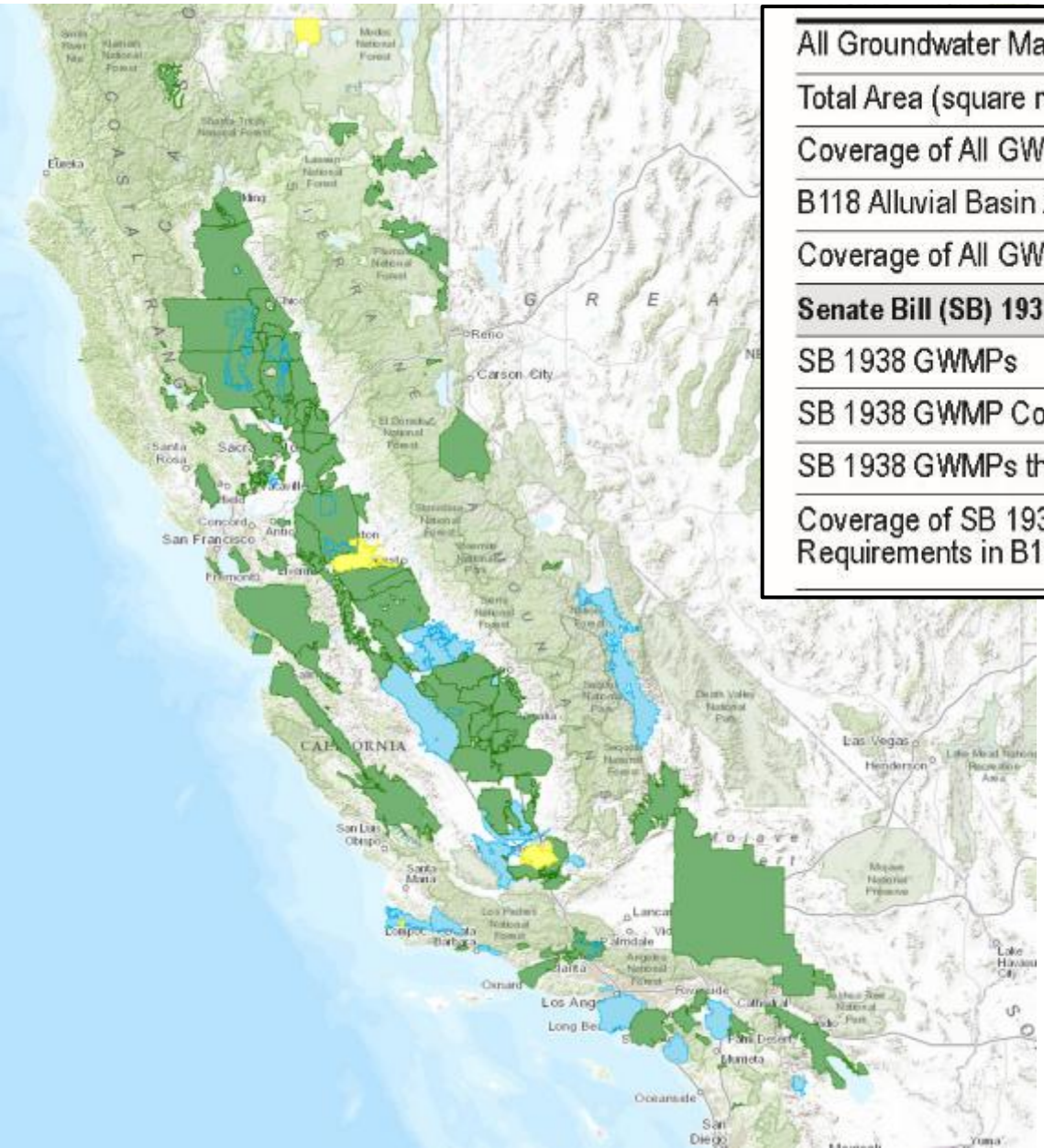
Basin Prioritization results – June 2, 2014

CASGEM Groundwater Basin Prioritization

- High
- Medium
- Low
- Very Low

California Department of Water Resources, 2015

Existing Groundwater Management Plans: Inventory and Assessment (No or Limited Implementation)



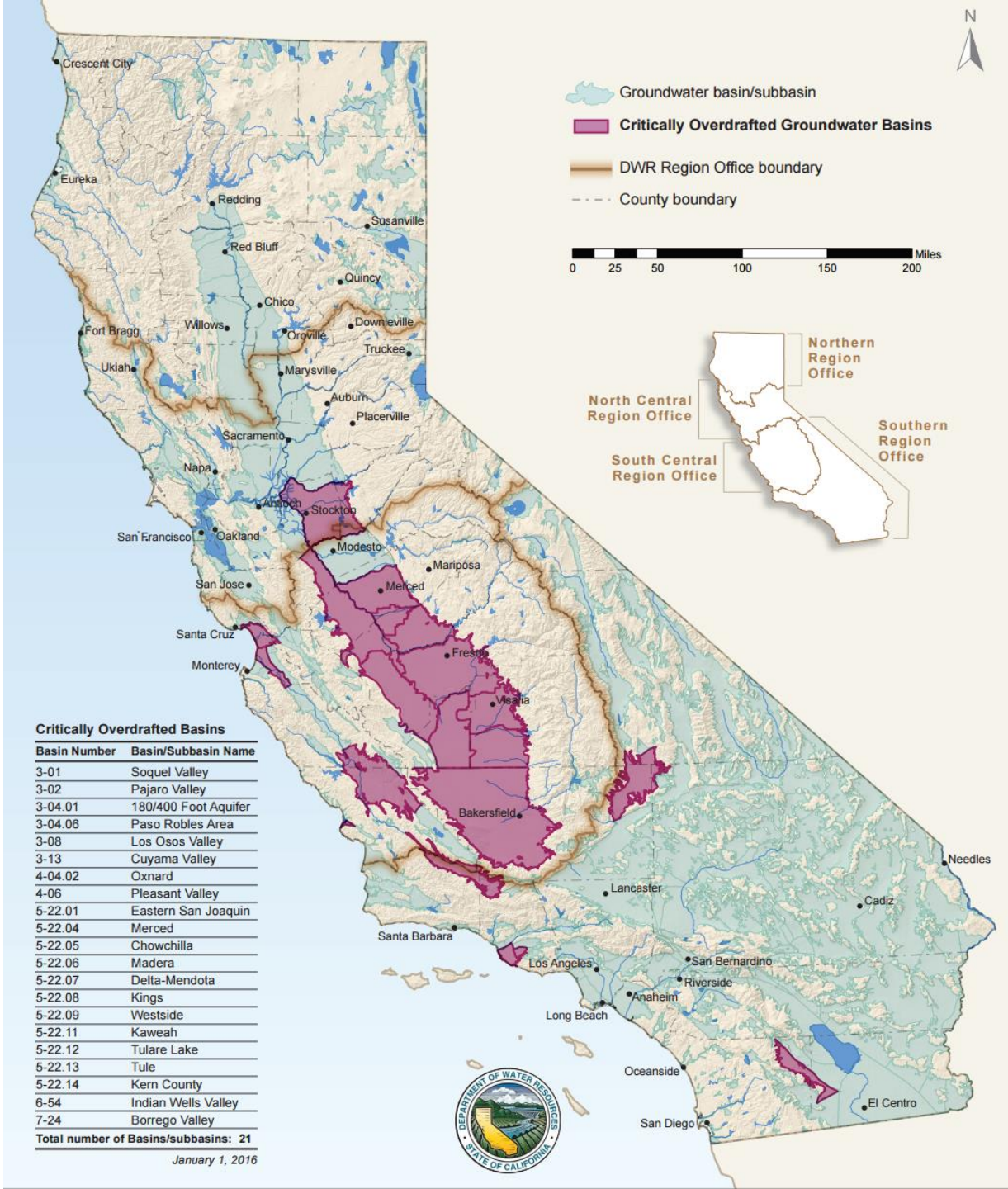
All Groundwater Management Plans (GWMP)	119
Total Area (square miles)	158,600
Coverage of All GWMPs (%)	20%
B118 Alluvial Basin Area (square miles)	61,900
Coverage of All GWMPs in B118 Basins Area (%)	42%
Senate Bill (SB) 1938 GWMPs Overlying B118 Alluvial Basins	
SB 1938 GWMPs	83
SB 1938 GWMP Coverage in B118 Basin Area (%)	32%
SB 1938 GWMPs that include all CA Water Code Requirements	35
Coverage of SB 1938 GWMPs that include all CA Water Code Requirements in B118 Basin Area (%)	17%

Groundwater Management Plans

- AB 359
- SB 1938
- AB 3030

California Department of Water Resources, 2015

Critically Overdrafted Basins – Plans Due in 2020



Critically Overdrafted Basins

Basin Number	Basin/Subbasin Name
3-01	Soquel Valley
3-02	Pajaro Valley
3-04.01	180/400 Foot Aquifer
3-04.06	Paso Robles Area
3-08	Los Osos Valley
3-13	Cuyama Valley
4-04.02	Oxnard
4-06	Pleasant Valley
5-22.01	Eastern San Joaquin
5-22.04	Merced
5-22.05	Chowchilla
5-22.06	Madera
5-22.07	Delta-Mendota
5-22.08	Kings
5-22.09	Westside
5-22.11	Kaweah
5-22.12	Tulare Lake
5-22.13	Tule
5-22.14	Kern County
6-54	Indian Wells Valley
7-24	Borrego Valley
Total number of Basins/subbasins: 21	

January 1, 2016

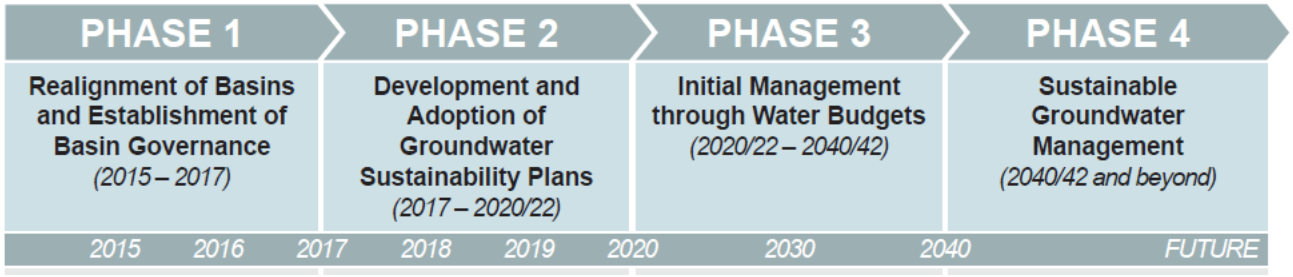
Who can be a GSA?

- Exempt:
  - Adjudicated basins (mostly in southern CA)
  - Functional equivalent of a GSA, adjudicated basin
- Any local public agency
  - Cities
  - Counties
  - Water / irrigation districts
  - Other public agencies with responsibility for:
    - water supply,
    - water management, or
    - land use
  - NEW special acts districts (created by legislature, then CEQA, LAFCO, public vote) => Paso Robles

GSA Formation: Next Steps

- County: Groundwater Advisory Committee
- Stimulate dialogue / communication among local agencies, key stakeholders (e.g., Farm Bureau)
- Engage broad range of interested parties
- Gather information about the basin / find out where the information is / what is available
- Understand what Groundwater Sustainability Planning entails
- Look over the fence and see what's happening elsewhere
- Transparency, transparency, transparency
- DEADLINE: June 30, 2017

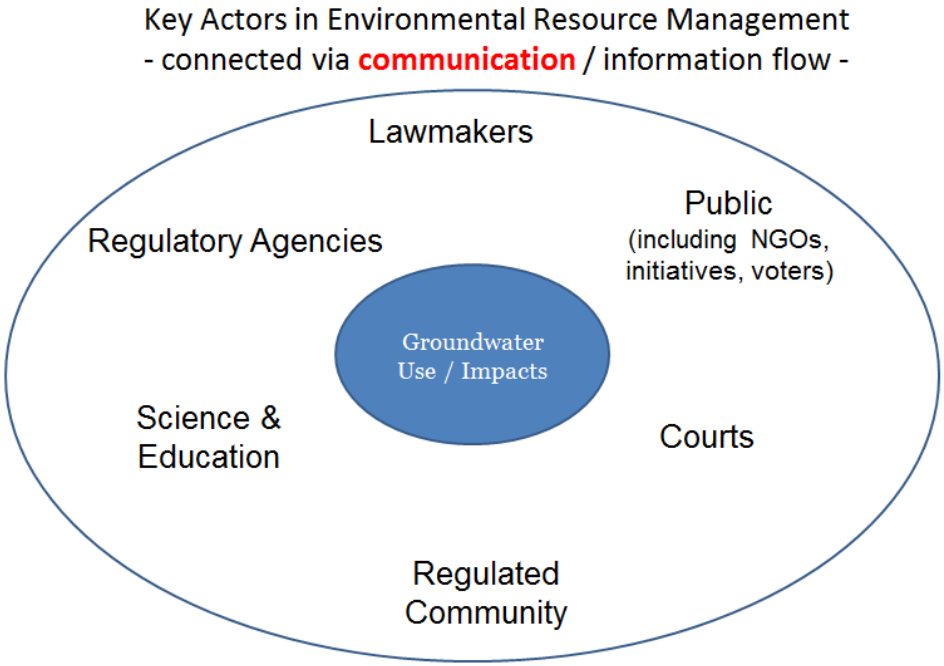
So What Exactly Will Happen?



- First Step: forming a Groundwater Sustainability Agency (GSA)
  - By June 2017
- **Second Step: developing a Groundwater Sustainability Plan (GSP)**
  - Within 5 years of GSA formation

Key Elements of (Local/regional) California Groundwater Management Plans

- Context / Basin Description
- Public and agency involvement
- Basin management objectives
- Monitoring
- Accountability and review



Sustainable Groundwater Mgmt Act:

- Enforcement mandate
- Empowerment for demand management (in addition to supply management)
- Integration with surface water management
- Integration with water quality management (source control, remediation, containment)
- Integration with landuse planning
- Local control / enforcement, with state oversight / enforcement

Groundwater Management Portfolio: Overview

- Data collection, monitoring, modeling, assessment
- Supply management
- Demand management
- Stakeholder engagement and management

Monitoring and Assessment

Groundwater Sustainability Agencies have *discretionary* authority to:

- Conduct studies
- Register & monitor wells
- Set well spacing requirements
- Require extraction reporting
- Regulate extractions
- Implement capital projects
- Assess fees to cover costs

Some exemptions for smaller private well owners

COURTESY - Marcus Trotta, Sonoma County Water Agency, 2015

Recycled Water Reuse
- Pajaro Valley -

Photo: Californian Salinas

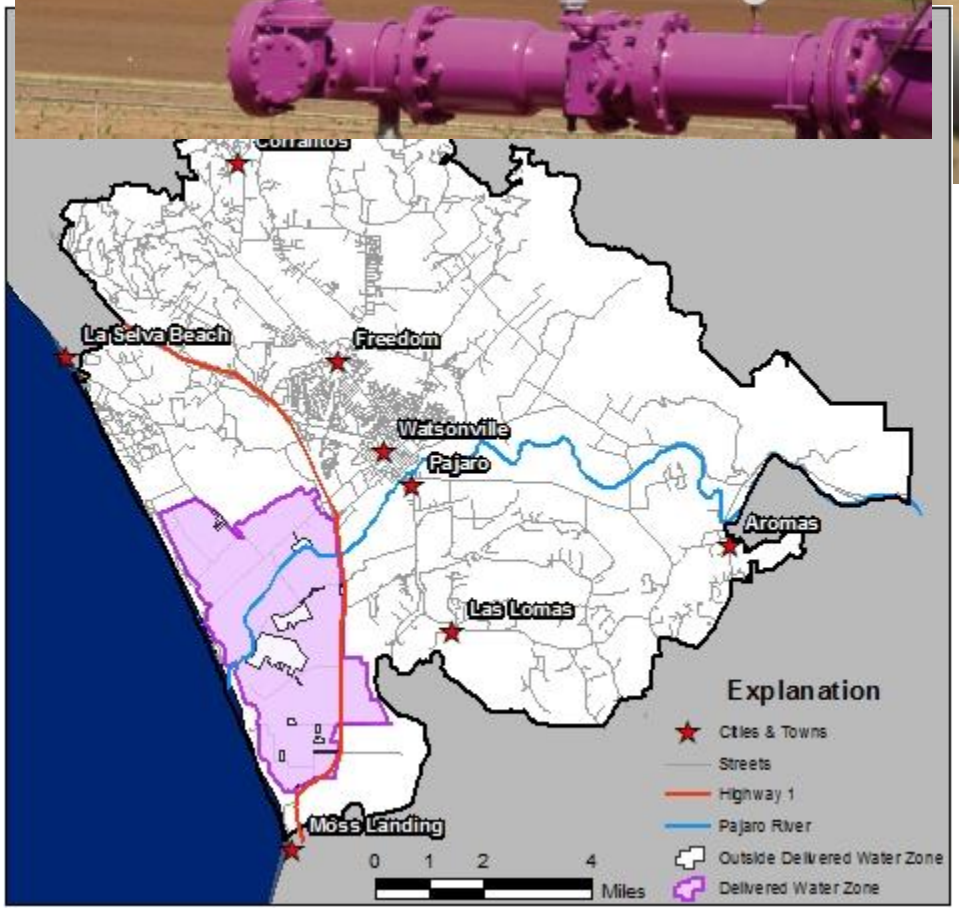
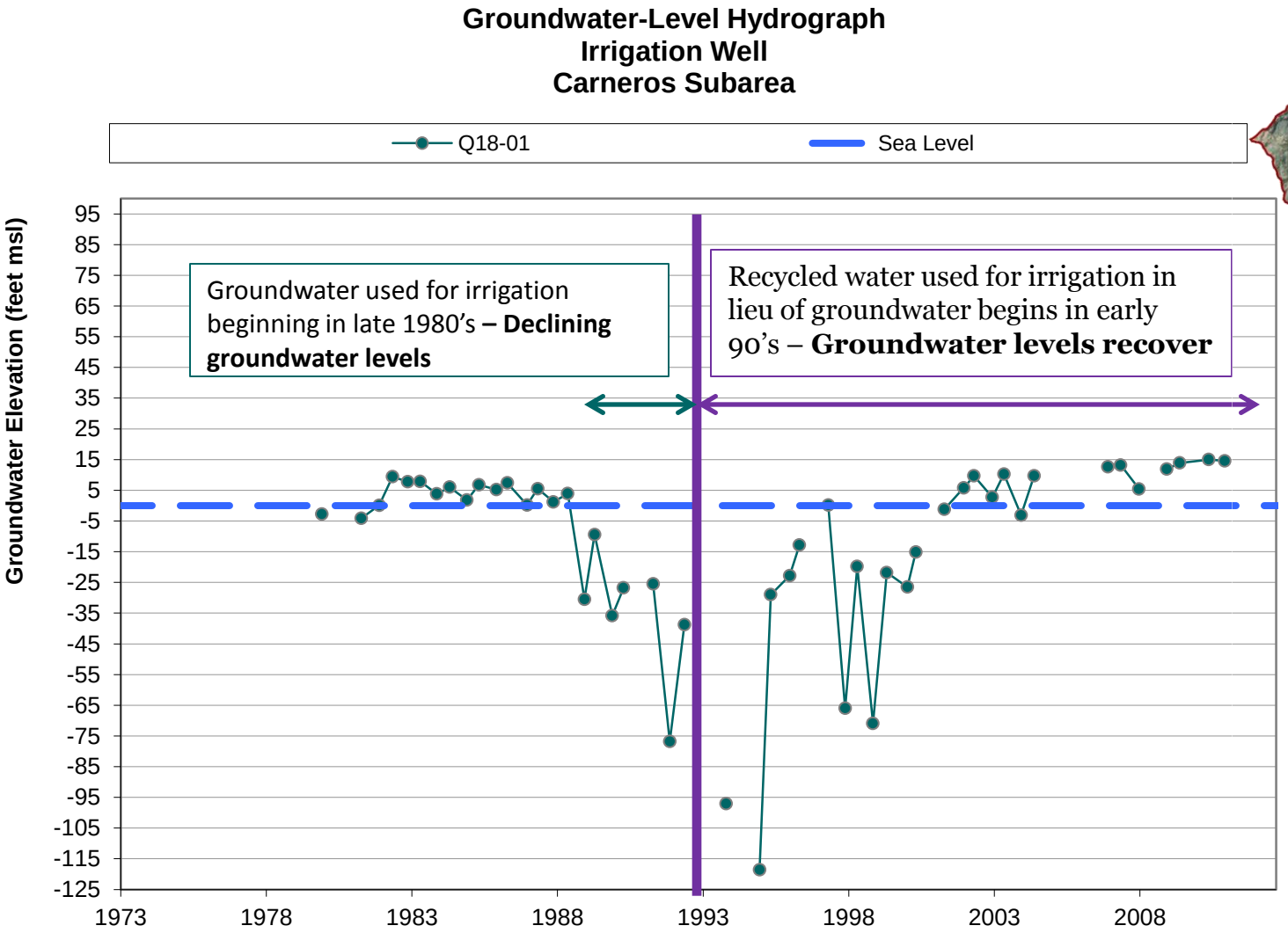
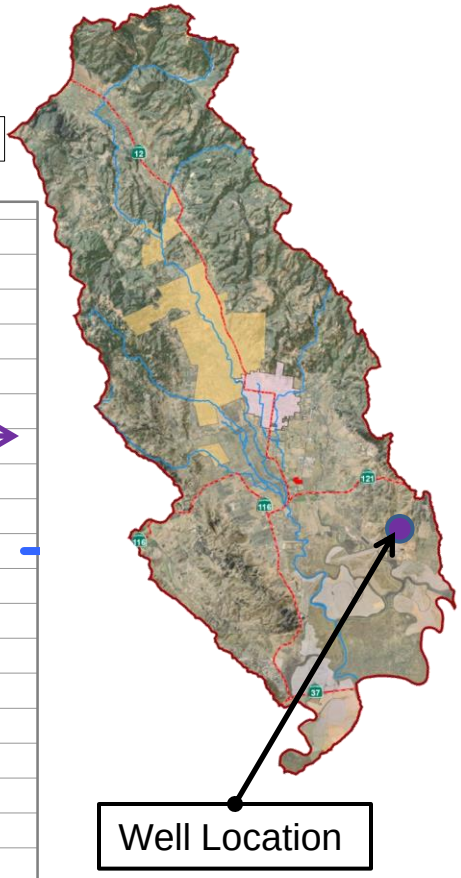


Photo: J.D. Hillard

Irrigation with Recycled Water to Offset Groundwater Pumping





COURTESY - Marcus Trotta, Sonoma County Water Agency, 2015

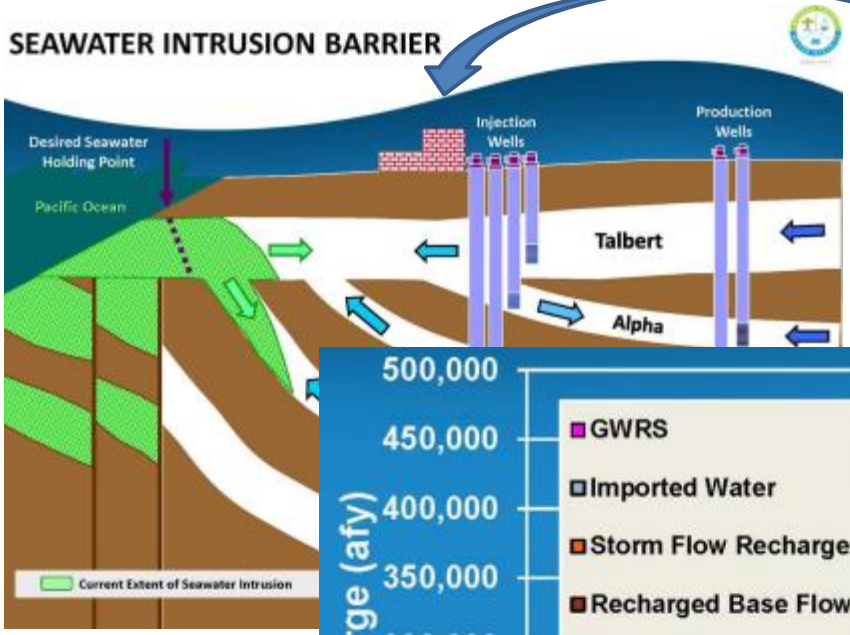
Water Banking

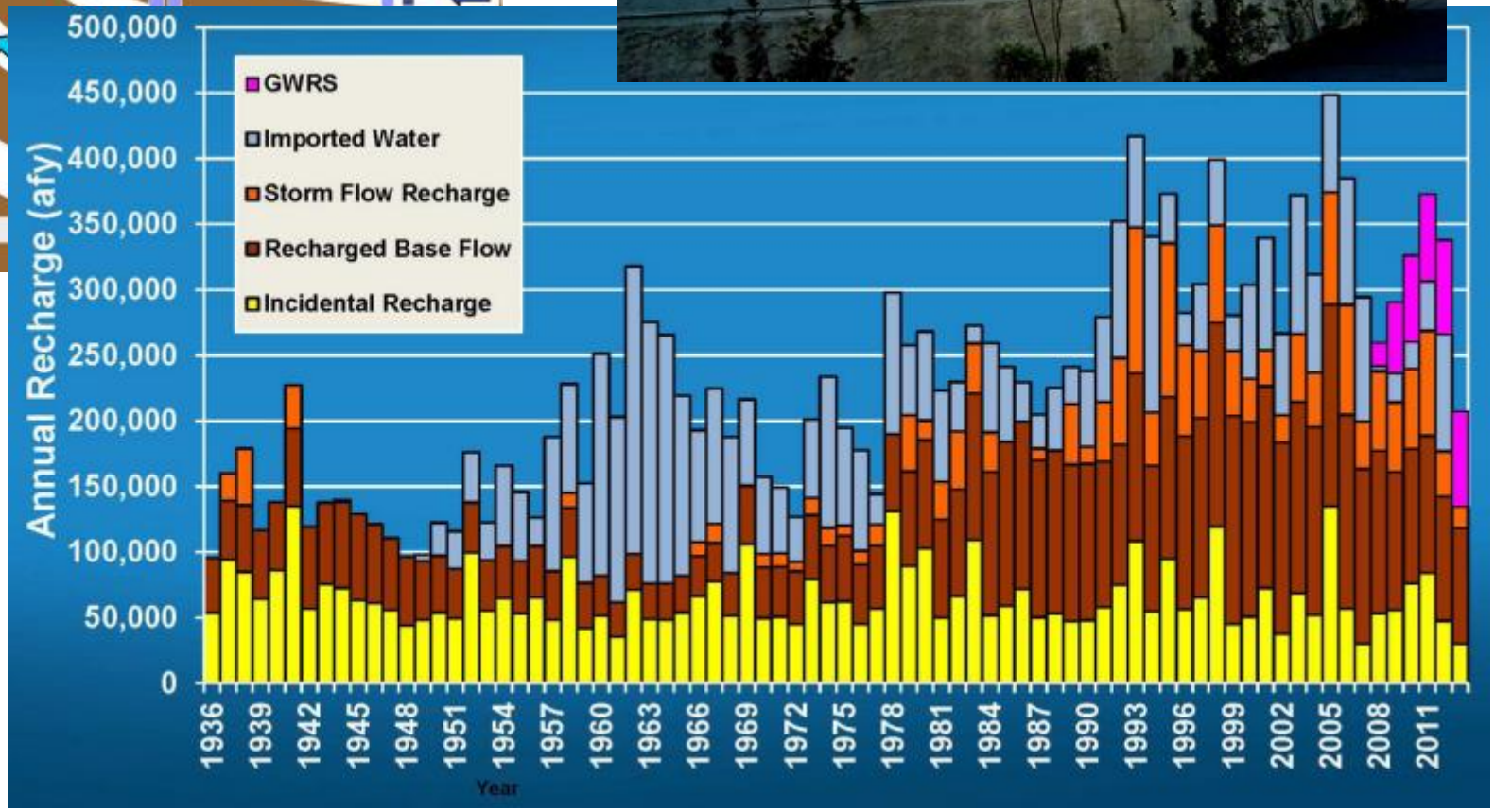
From: Ted Johnson, WRD 2013

Yuba River: Infrastructure, such as this water discharge pipe, allow water districts and agencies to manage surface water and groundwater within the same hydrologic area as a single resource, using one source to balance the other when surface water or groundwater levels are low. This can reduce water diversions and groundwater pumping, enhance local supply, and increase the amount of water available for transfer.

DWR, California Water Plan Update 2013

Orange County: Groundwater Recharge Portfolio





Orange County Water District, 2014

Seawater Intrusion

Role of the State: **Carrot**

- Department of Water Resources has a key role:
  - Technical assistance and funding (Prop 1: $100 million for SGMA)
  - Regulation
    - Groundwater basin boundary adjustments
    - Minimum guidelines for appropriate GSP
  - Control
    - Review and approve GSPs
    - Review implementation

Role of the State: Carrot **& Stick**

- Department of Water Resources has a key role:
  - Technical assistance and funding (Prop 1: $100 million for SGMA)
  - Regulation
    - Groundwater basin boundary adjustments
    - Minimum guidelines for appropriate GSP
  - Control
    - Review and approve GSPs
    - Review implementation
- State Water Resources Control Board:
  - Enforcement where local control fails (after 2017)
    - "probabationary status"
    - Public hearing and 180 days to fix the problem
  - After 180 days: SWRCB poses as interim GSA
    - Groundwater extraction reporting mandatory
    - Possibly temporary control of groundwater extraction
    - Development and implementation of interim GSP
  - When locals are ready: get authority back from state

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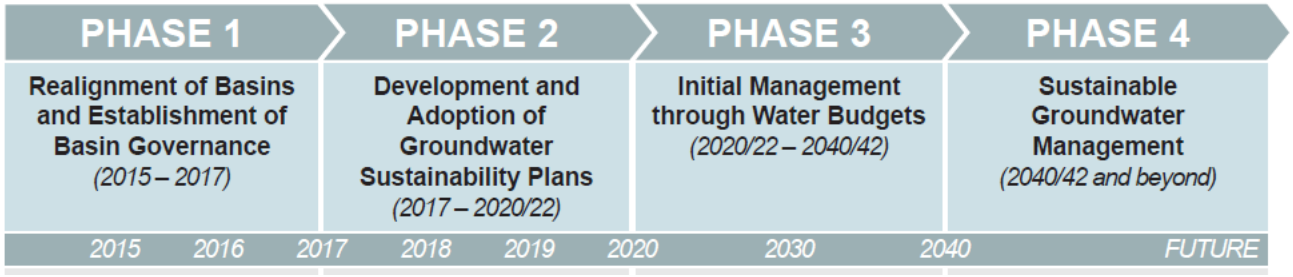
  - Financial incentives for local groundwater management: SB 1938 (2002)
  - Sustainable Groundwater Management Act of 2014: mandatory & expanded local control
- => if local/regional control fails: State Water Resources Control Board
- **The Courts**
  - **Streamlined adjudication (legislation in 2015) => consistent with SGMA**

So What Exactly Will Happen?



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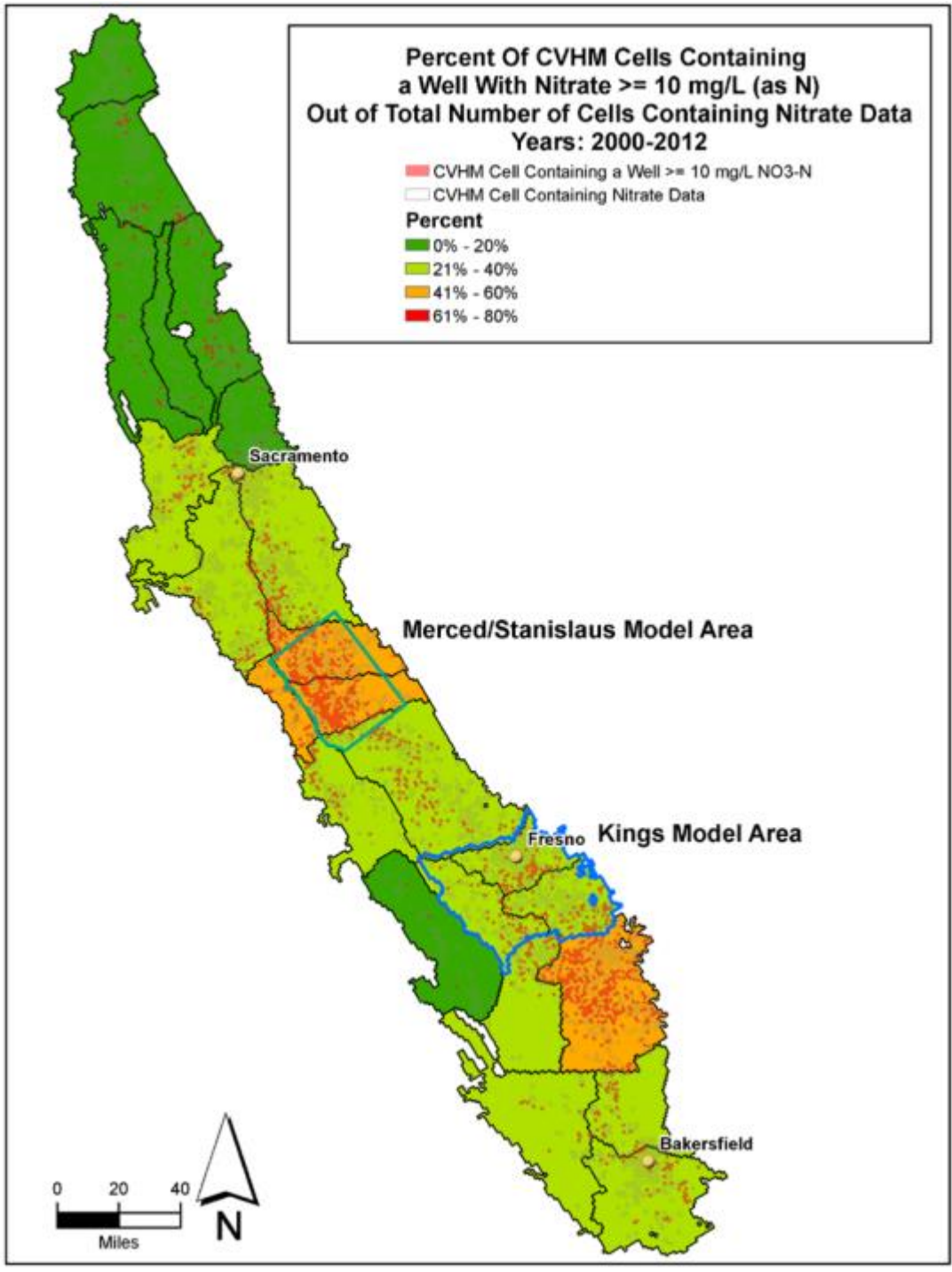
  - By June 2017
- Second Step: developing a Groundwater Sustainability Plan (GSP)
  - Within 5 years of GSA formation
- **Third Step: implementing Groundwater Sustainability Plan**
  - **achieve sustainable management no later than 2042**
  - DWR may grant up to two 5-year extensions upon showing of good cause and progress

Nitrate: Impacted regions within the Central Valley

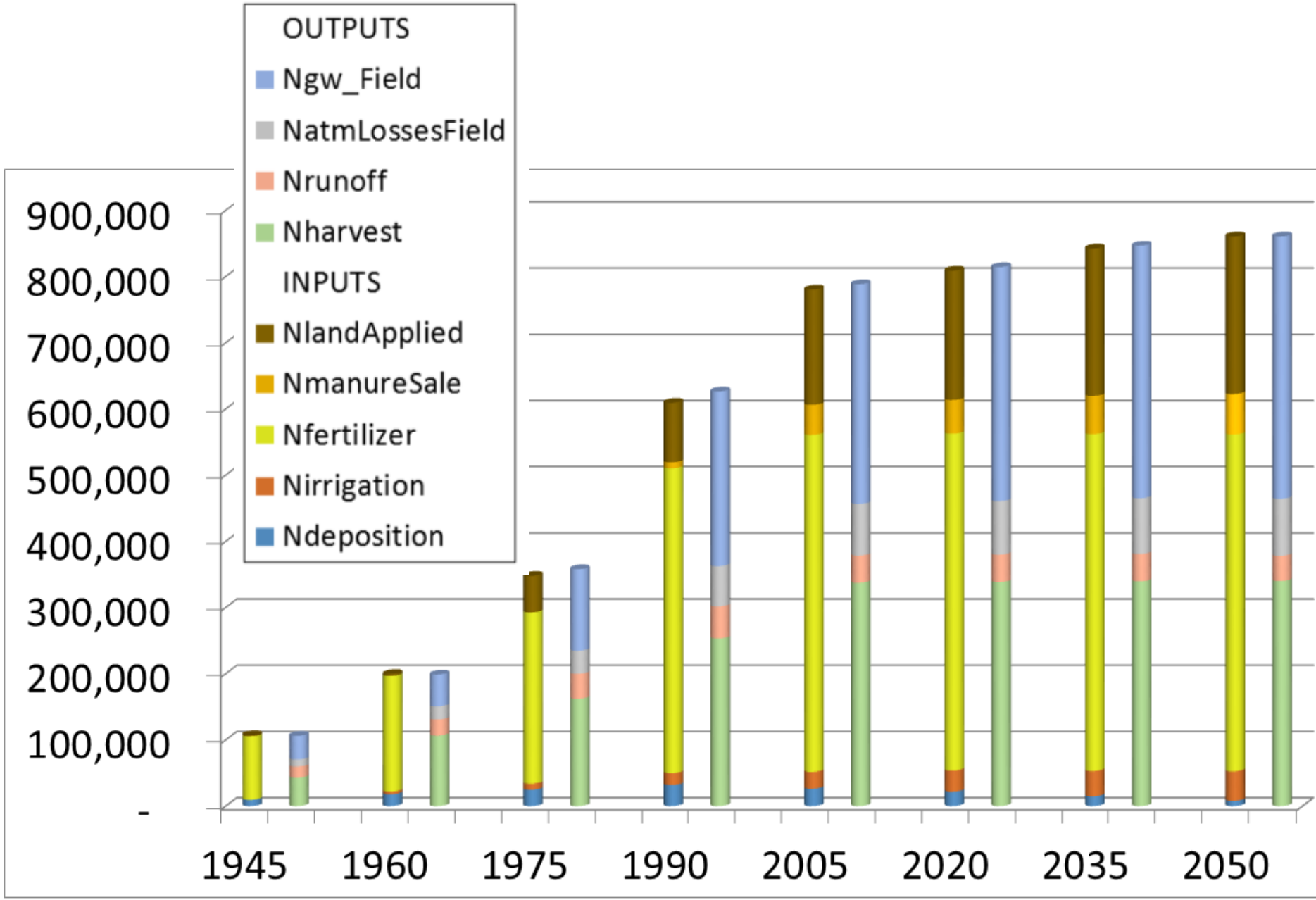
red dots: wells above MCL for nitrate

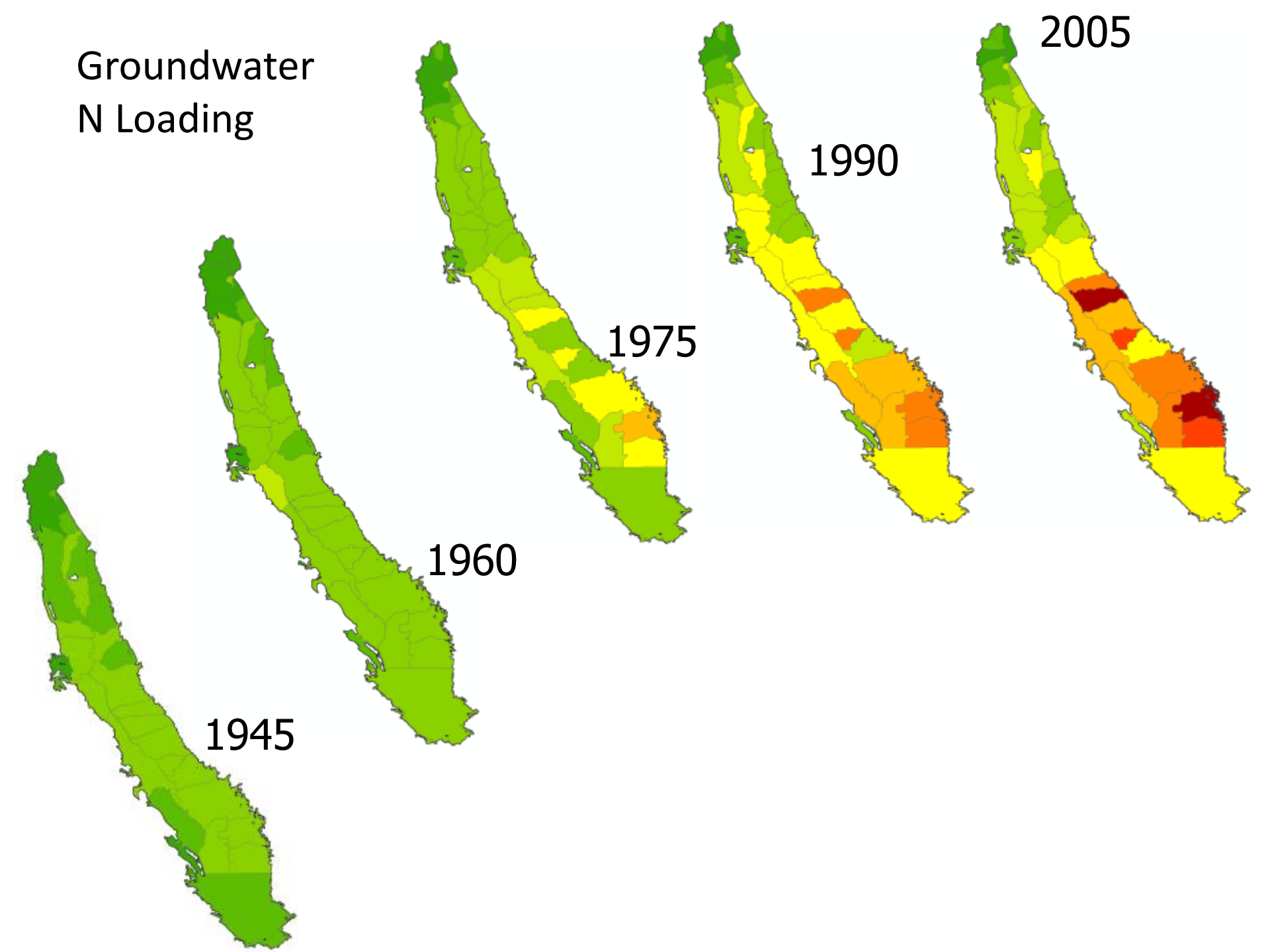


CVSALTS, Tasks 7 and 8 – Salt and Nitrate Analysis for the Central Valley Floor Final Report, December 2013

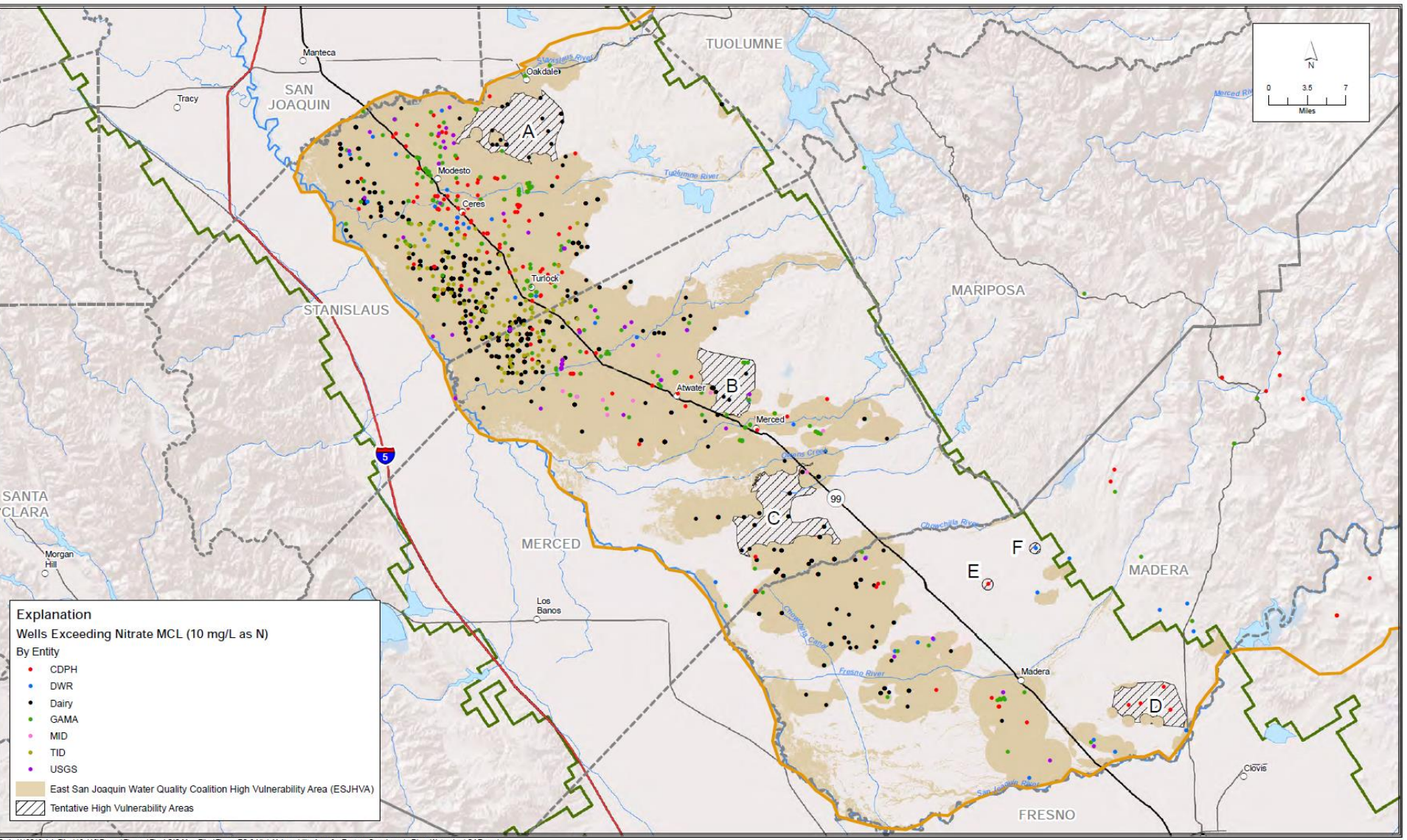
Figure 7-14

Central Valley Cropland N Mass Balance 1945 - 2050




Groundwater
N Loading
1945
1960
1975
1990
2005

Nitrate Contaminated Wells in the San Joaquin Valley



Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure ES-3 High Vulnerability Area for Eastern San Joaquin River Watershed GAR.mxd

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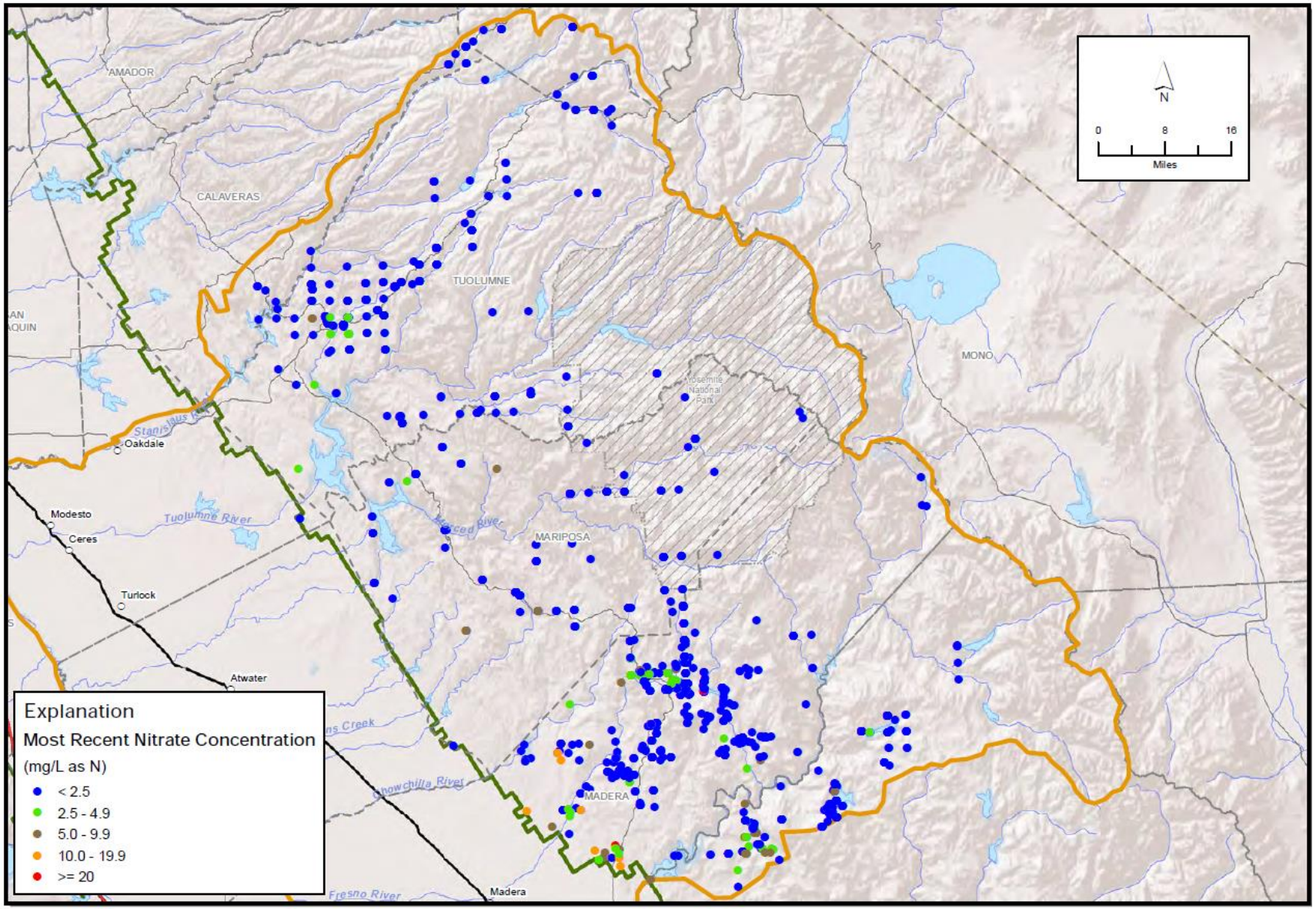
Figure ES-3
High Vulnerability Area for the East San Joaquin Water Quality Coalition

Nitrate in Sierra Nevada Groundwater

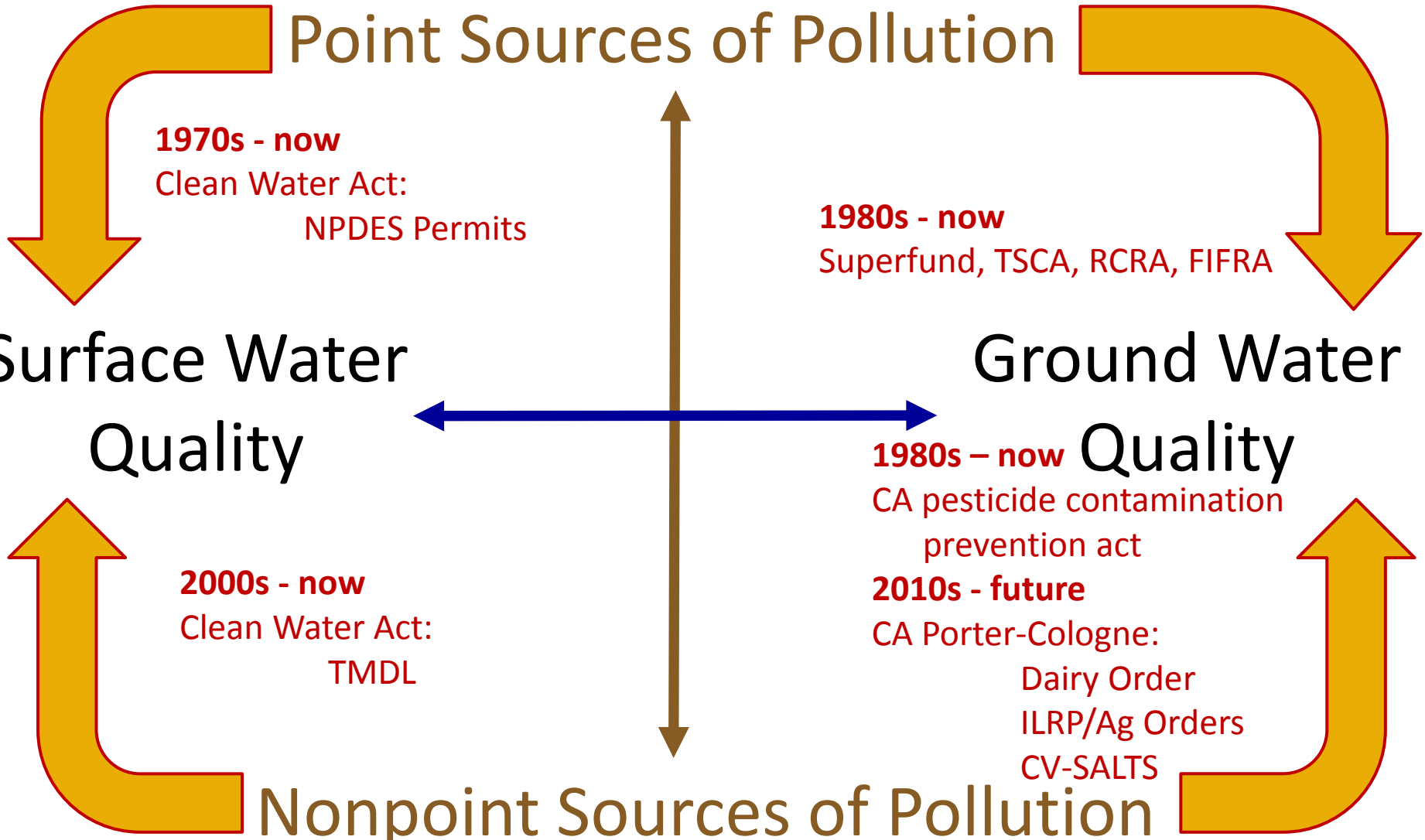


Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure 5-6 Nitrate Concentrations in Peripheral Area.mxd

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 5-6
Nitrate Concentrations in the Peripheral Area

Regulating Water Pollution Sources



Focus: Enforcement Monitoring

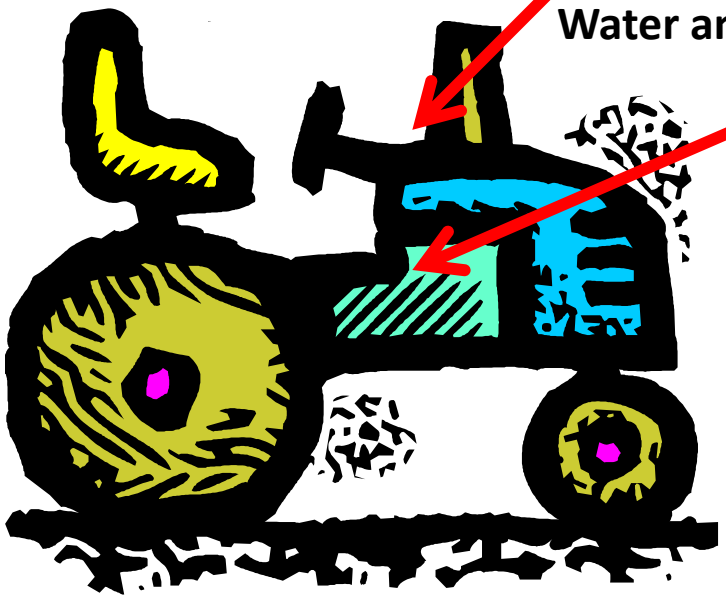
Alternative Monitoring Approach to Nonpoint Source:

Responsible Party:
Landowner

Feedback:
Nutrient/Water Monitoring & Assessment

Management Tool:
Water and Nutrient Management

Enforcement:
Annual Nitrogen Budget
+
Management Practice Assessment
+
Regional Trend Monitoring



Harter, California Agriculture 69(3), 2015

Online Resources

- http://groundwater.ucdavis.edu/sgma
- http://groundwater.ucdavis.edu/calendar
- http://www.water.ca.gov/groundwater/casgem/ (California DWR groundwater level monitoring program
- http://www.water.ca.gov/waterconditions/drought/# (California DWR drought information)
- http://www.waterboards.ca.gov/gama/geotracker_gama.shtml (California groundwater quality information)
- http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/
- http://groundwater.ucdavis.edu/links_California/ (miscellaneous groundwater information sources)
- Contact Dr. Thomas Harter at ThHarter@ucdavis.edu

Maralyn Miller: Stream in Modoc County