University of California
Agriculture and Natural Resources

Sierra Valley, April 2016

Groundwater in Sierra/Plumas County & Sustainable Groundwater Management

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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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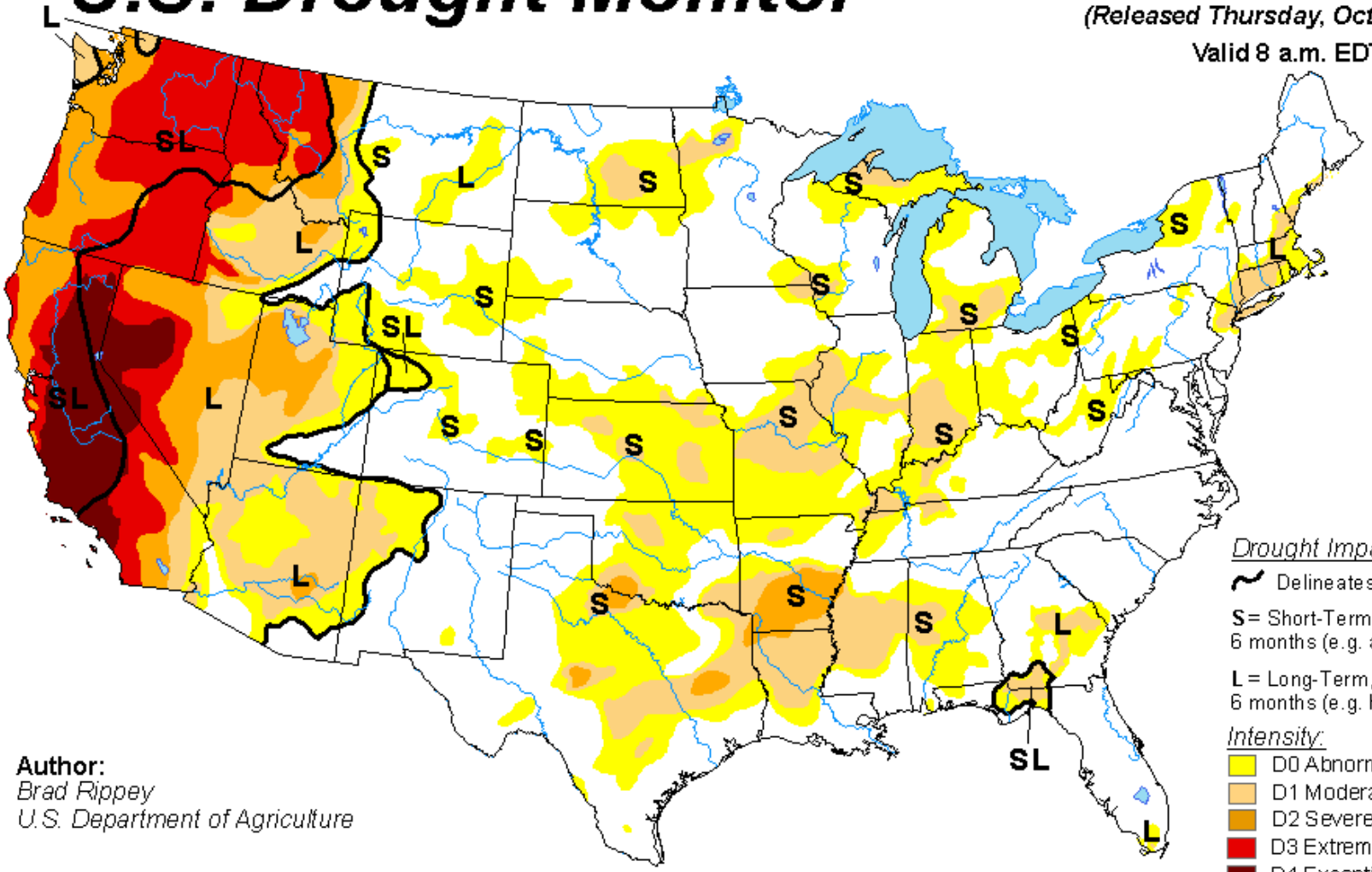
U.S. Drought Monitor

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

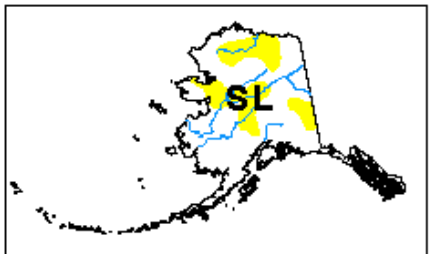
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

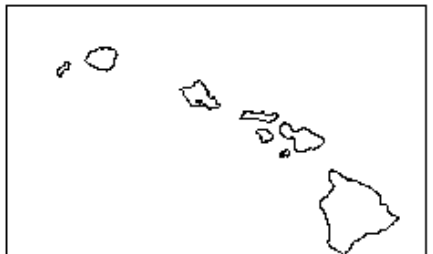
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

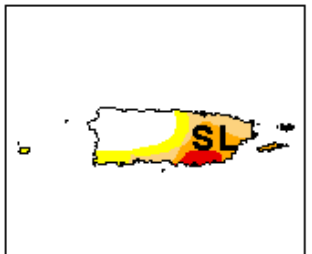
Intensity:

- 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

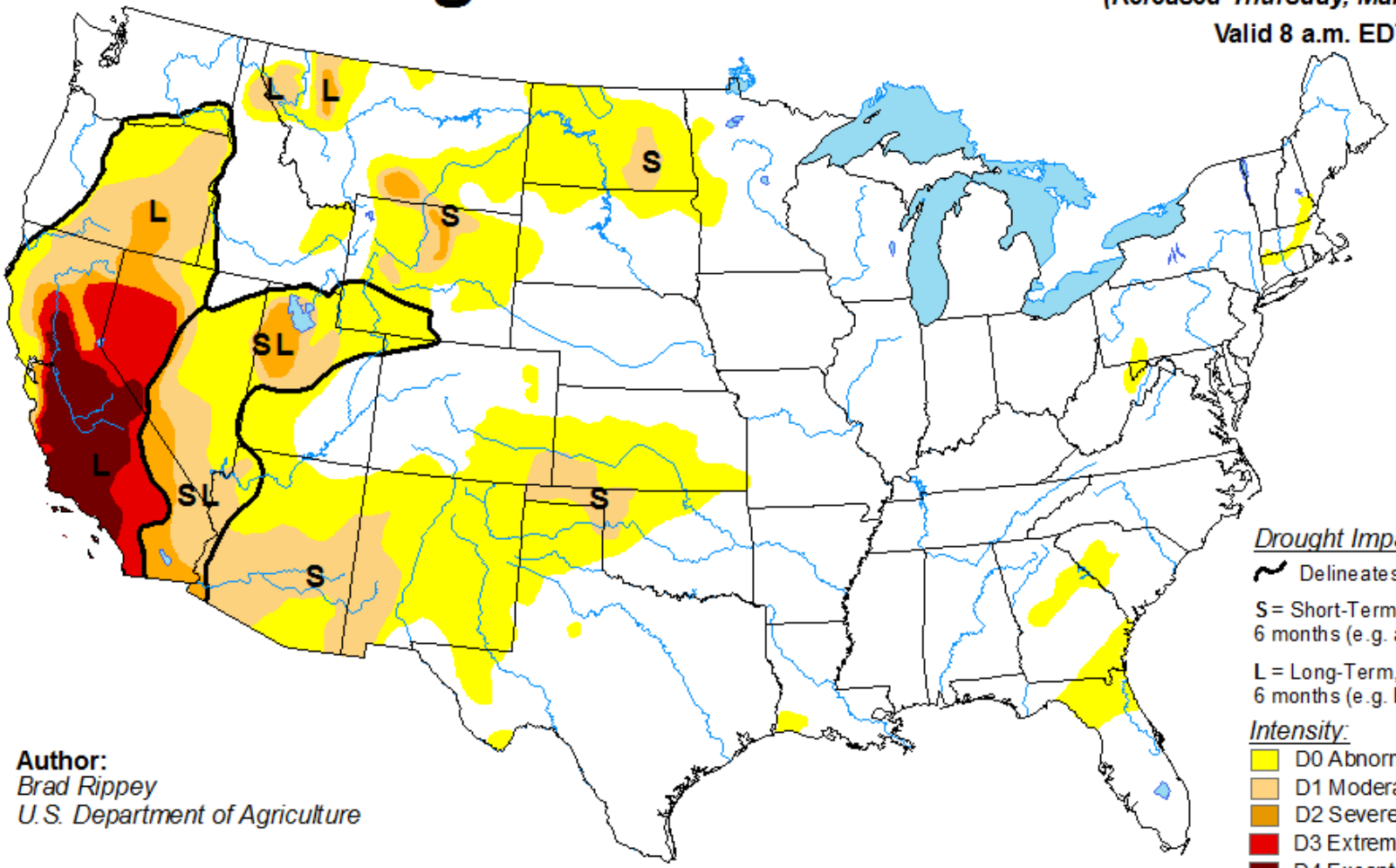
http://droughtmonitor.unl.edu/

U.S. Drought Monitor

March 22, 2016

(Released Thursday, Mar. 24, 2016)

Valid 8 a.m. EDT



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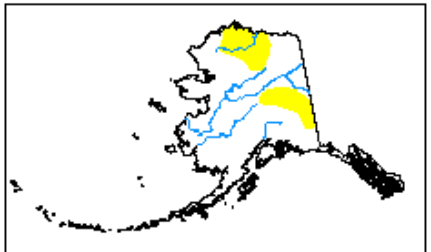

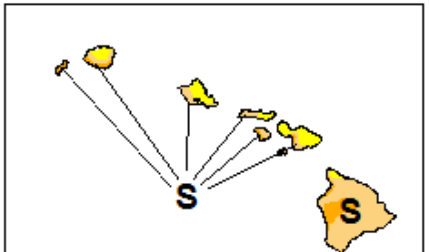

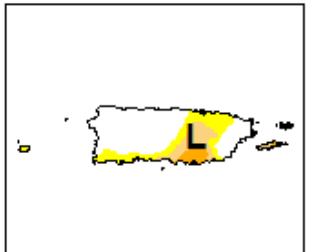

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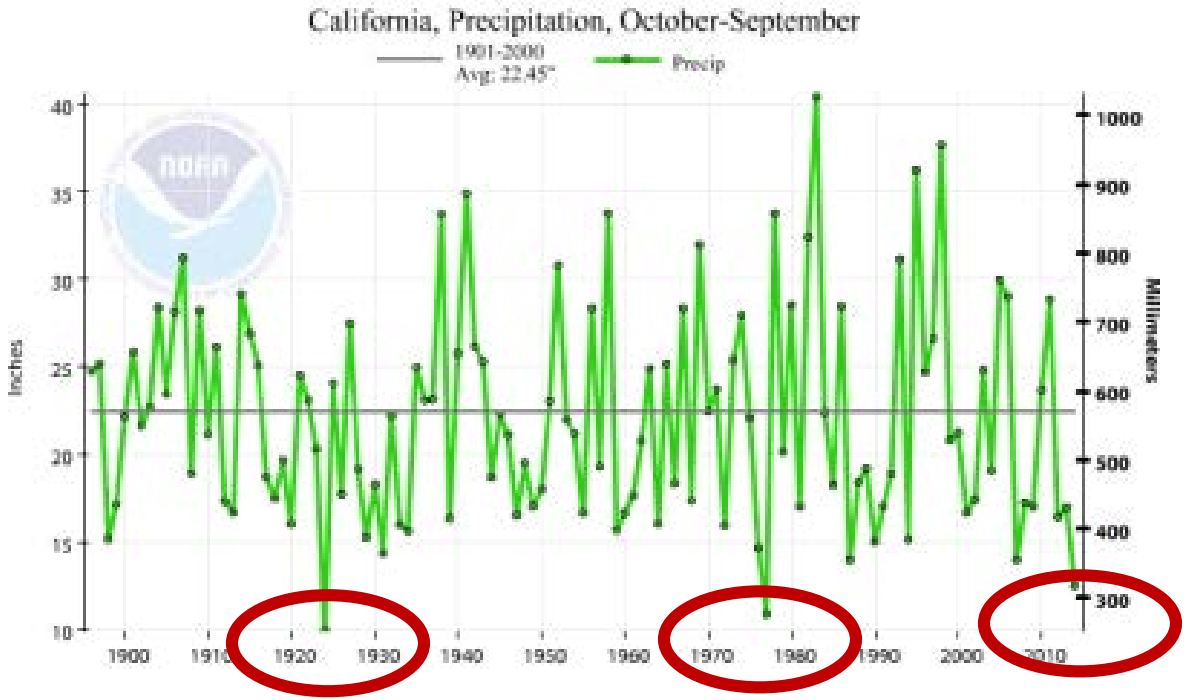
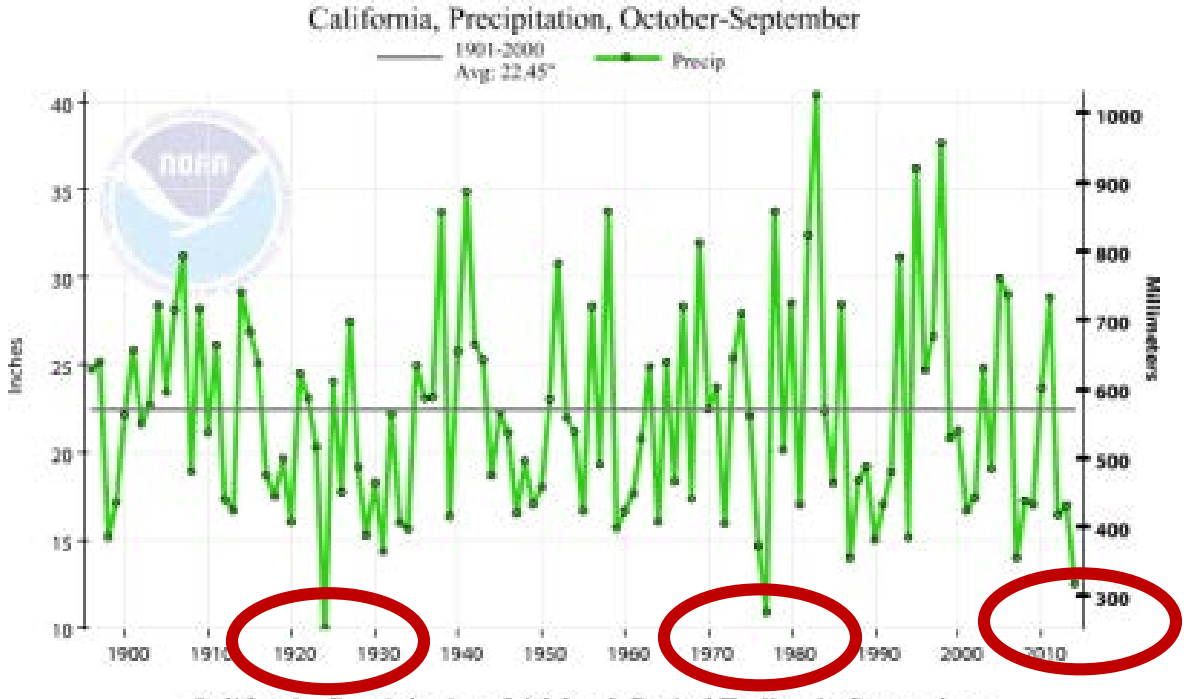
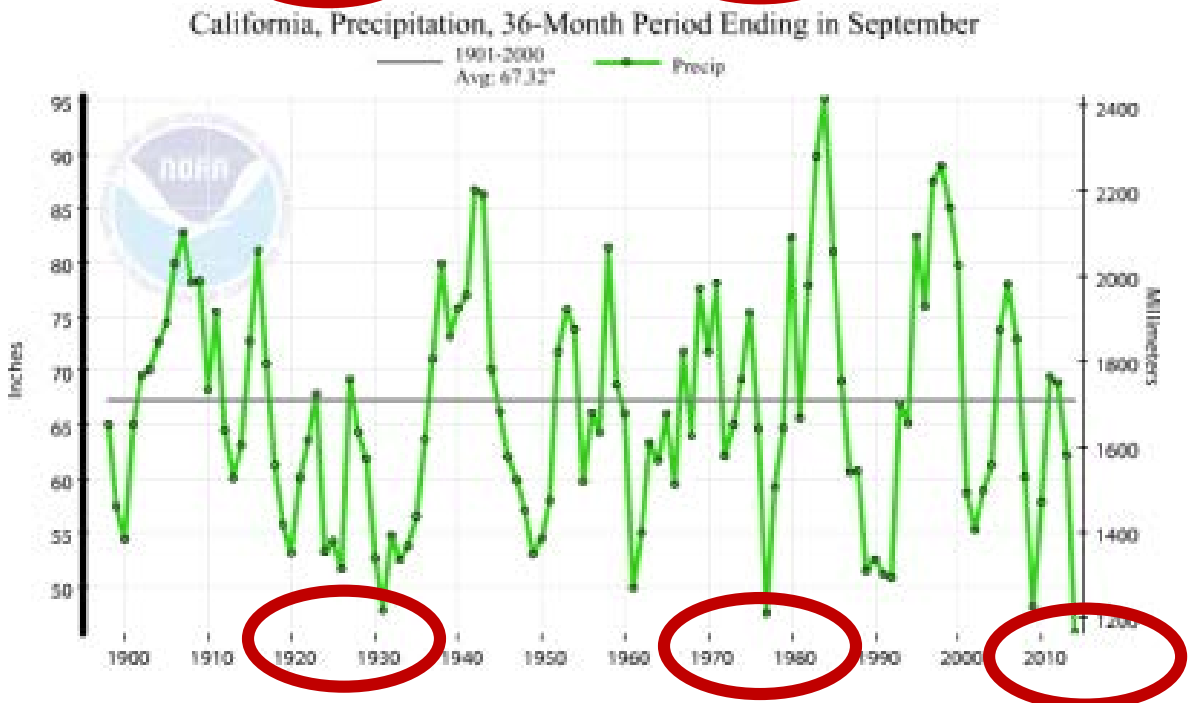
Annual P [inches]



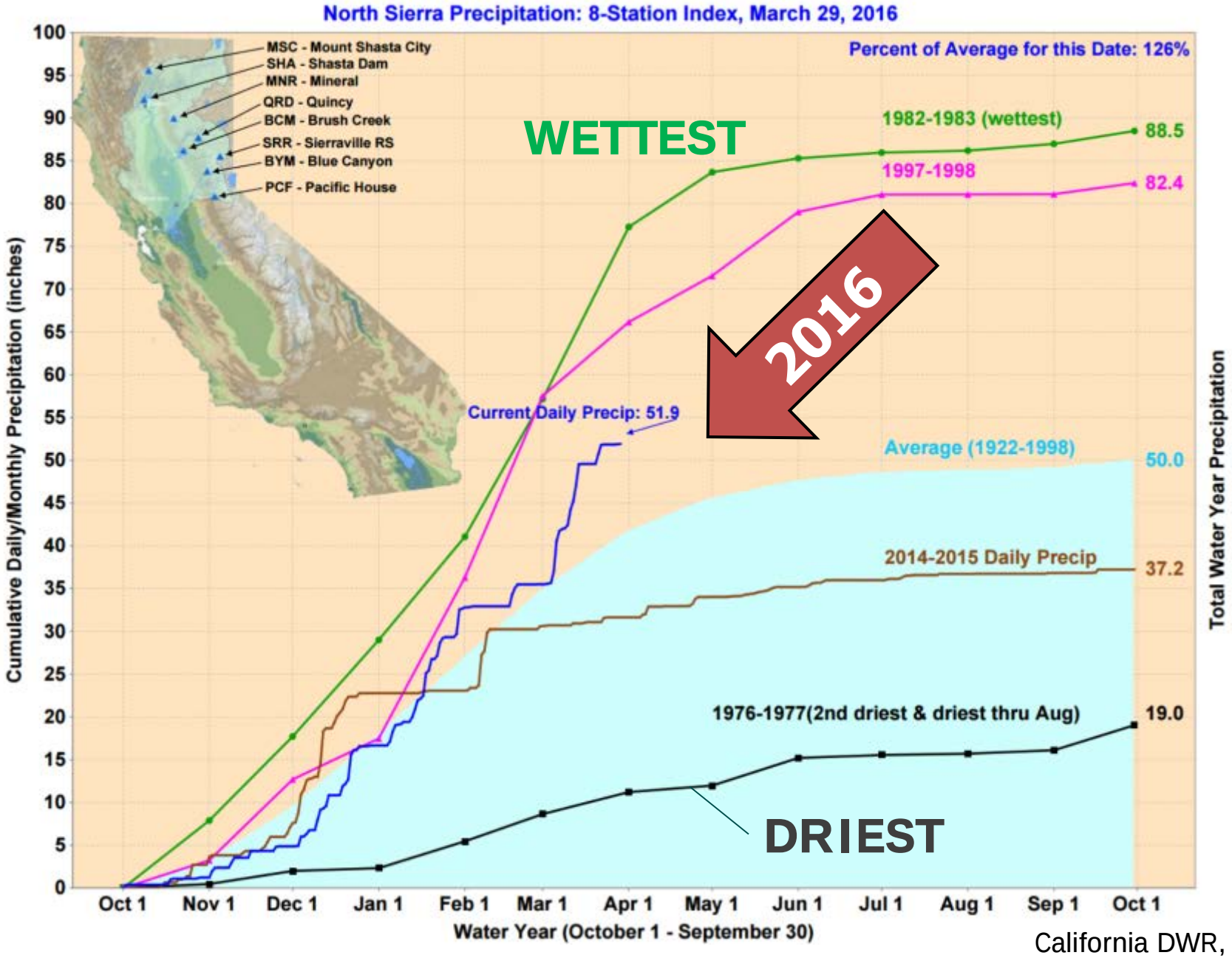
Annual P [inches]



Tri-annual P [inches]

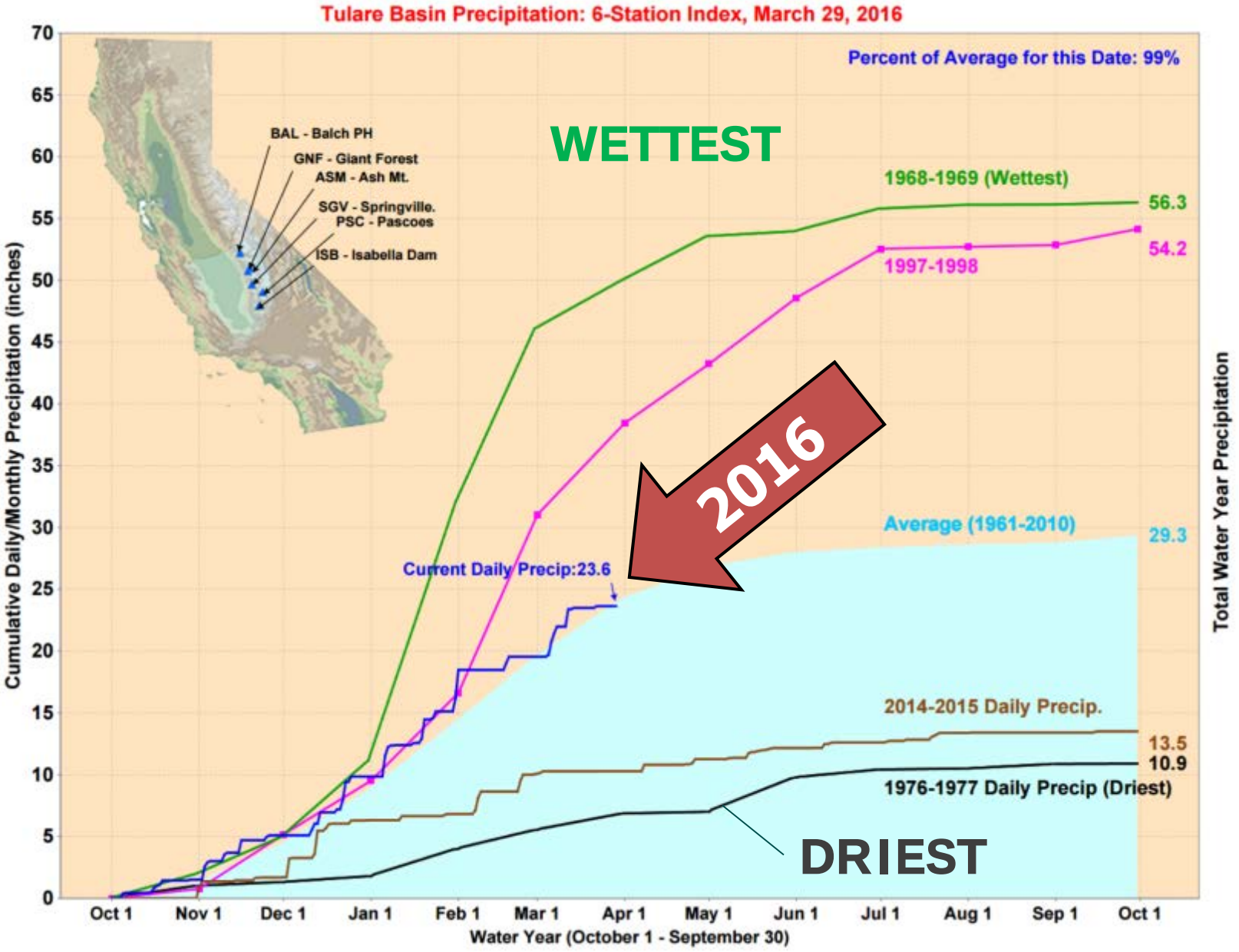


Cumulative Precipitation October - September



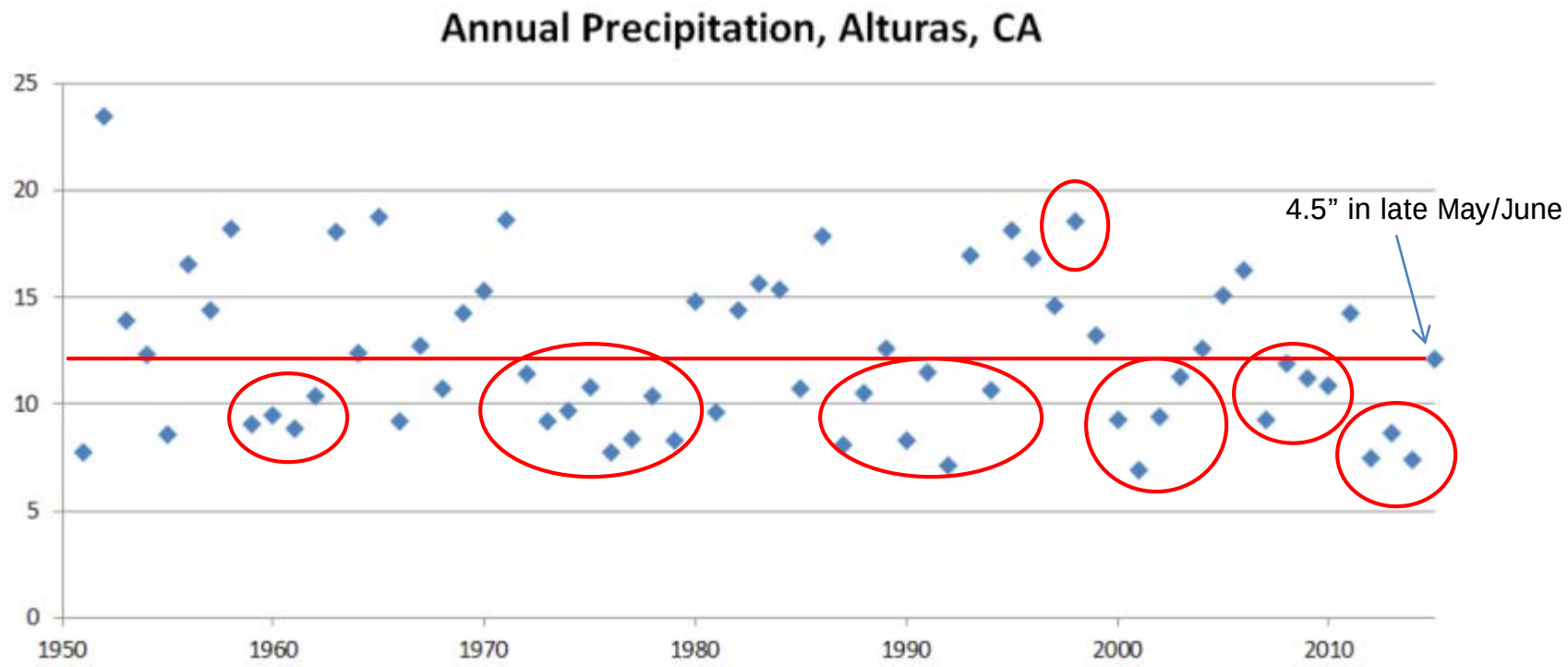
California DWR, 2015

Cumulative Precipitation October - September



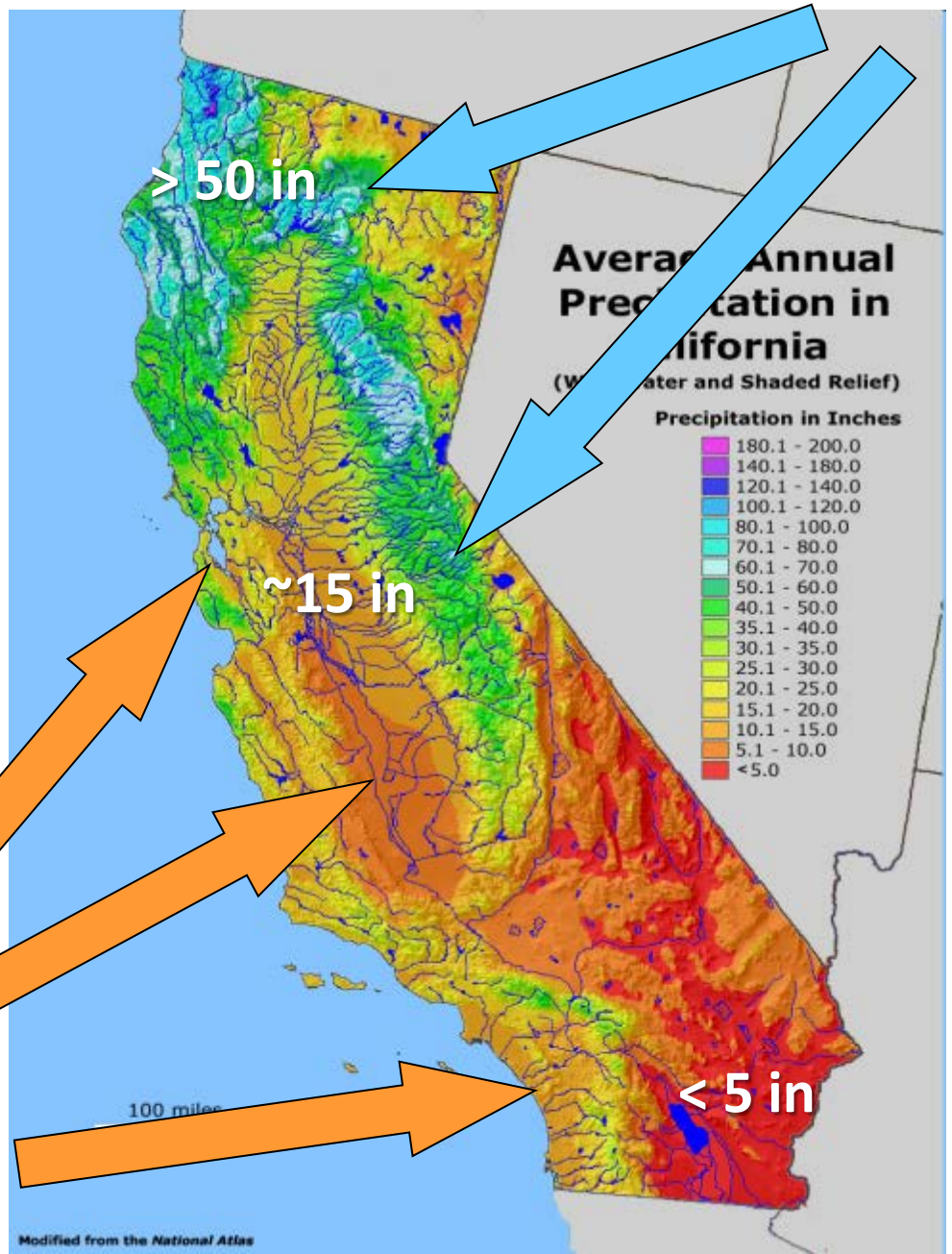
California DWR, 2015

Modoc County Precipitation (CIMIS)



RAIN

Space and Time Disconnect between Water Supply and Water Use

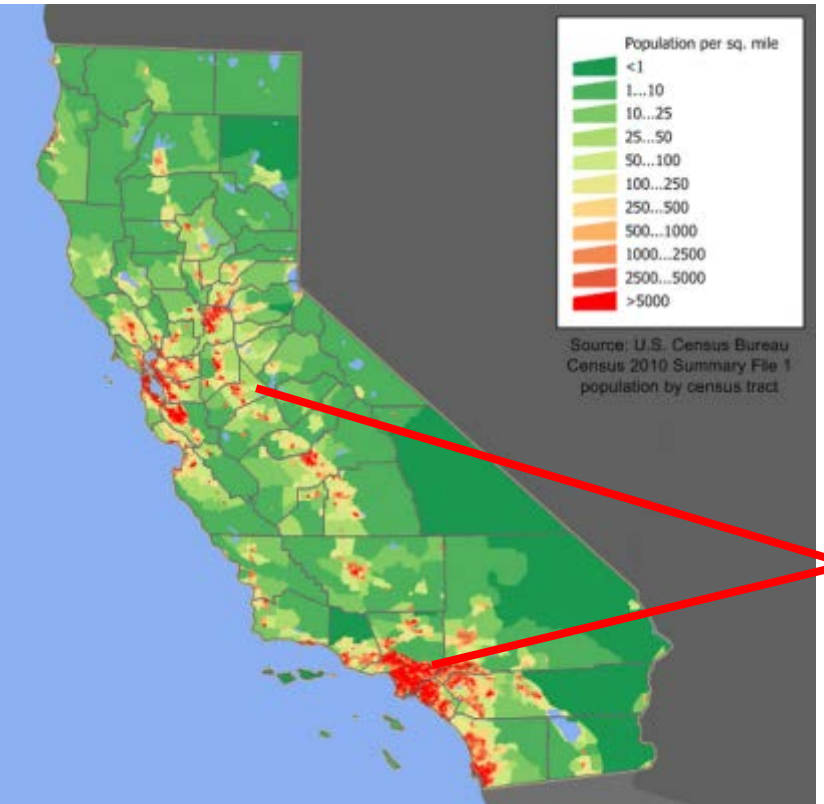


WATER USERS

California's Water Users

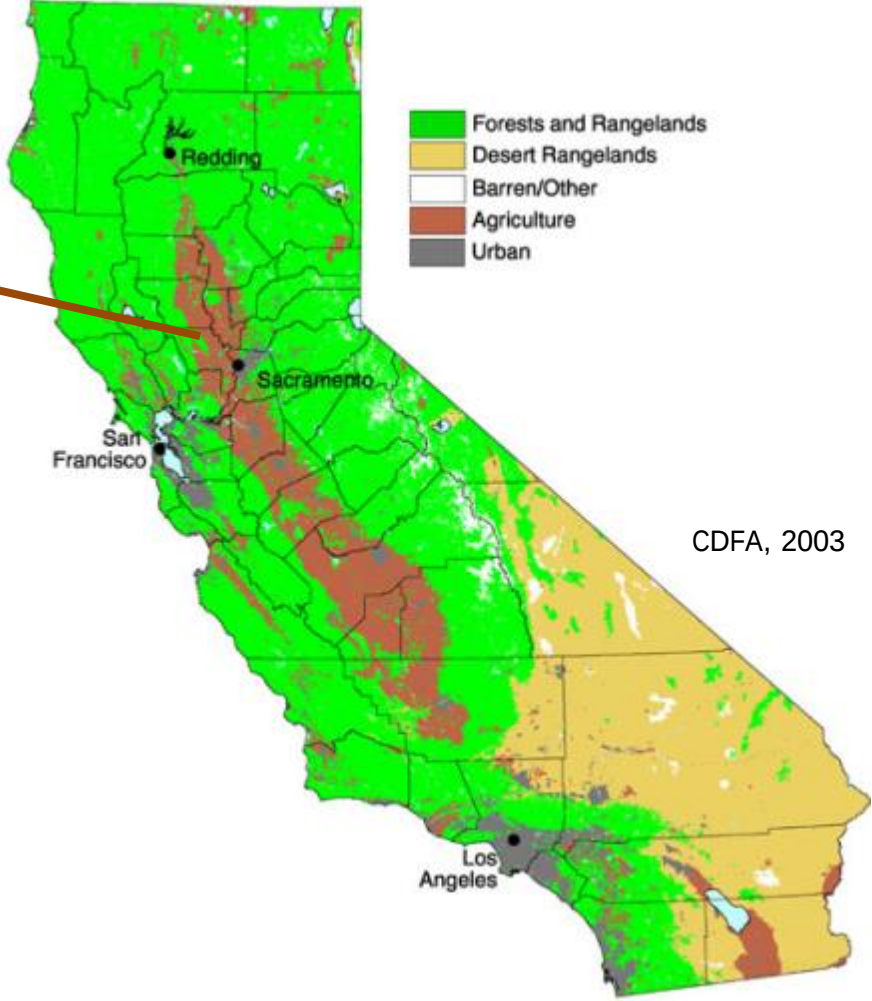
Irrigated Agriculture
9.5 million acres
(4 million ha)

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



Population
38 million people

water use:
8 MAF (10 km^3)



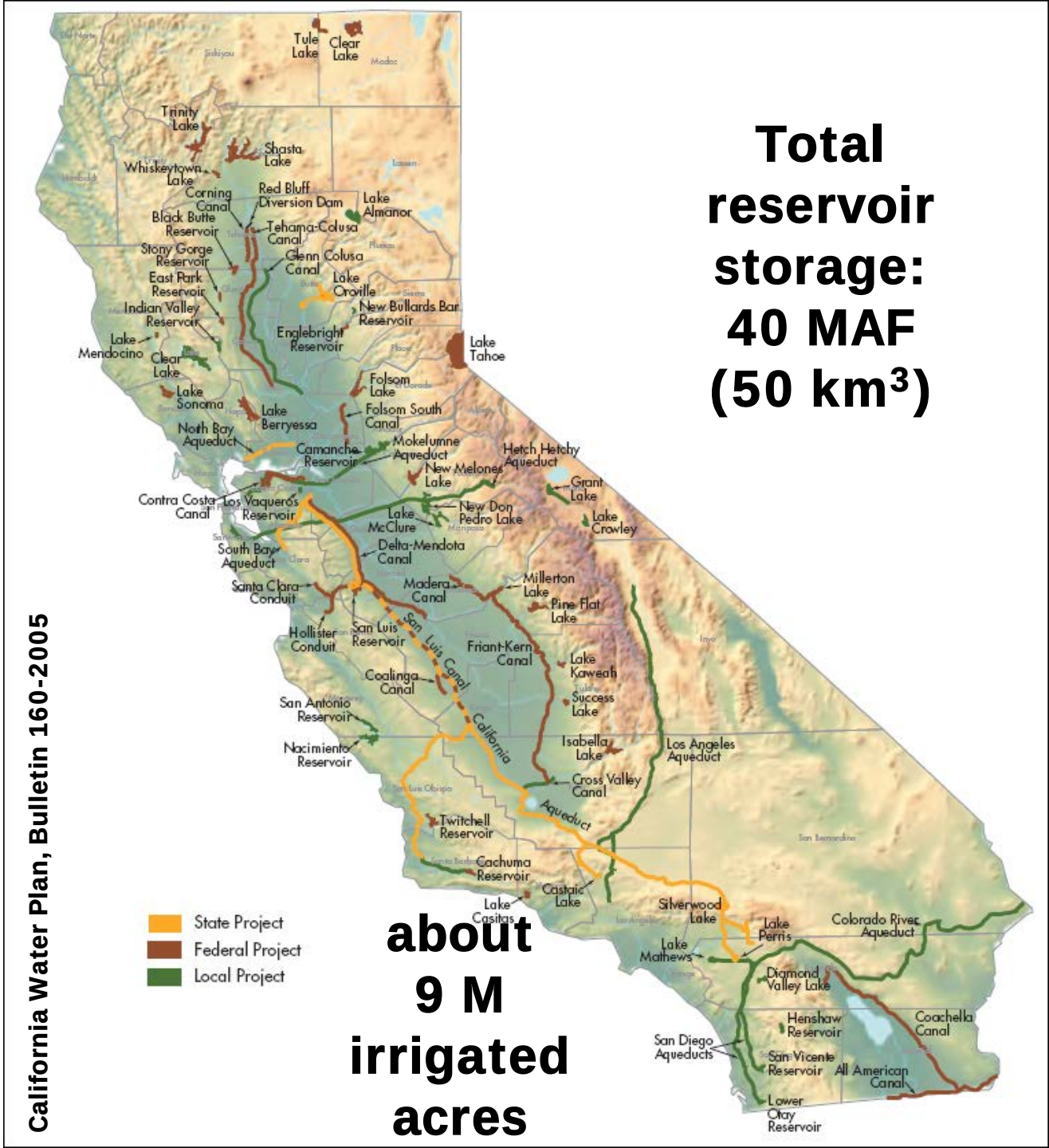
CDFA, 2003

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

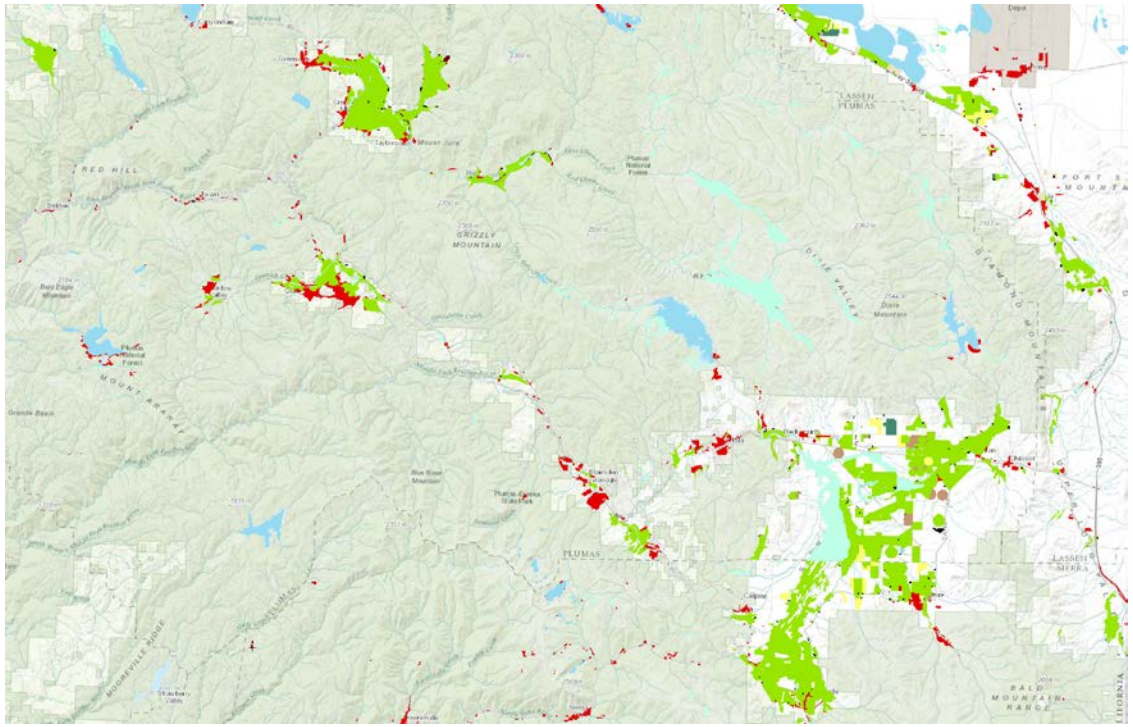


Plumas and Sierra County Landuse & Water Infra-structure:

Bridging the Spatial and Temporal Disconnect between SUPPLY and USE

about 42,000 irrigated acres

About 23,000 people



$ 1,000

$1,000

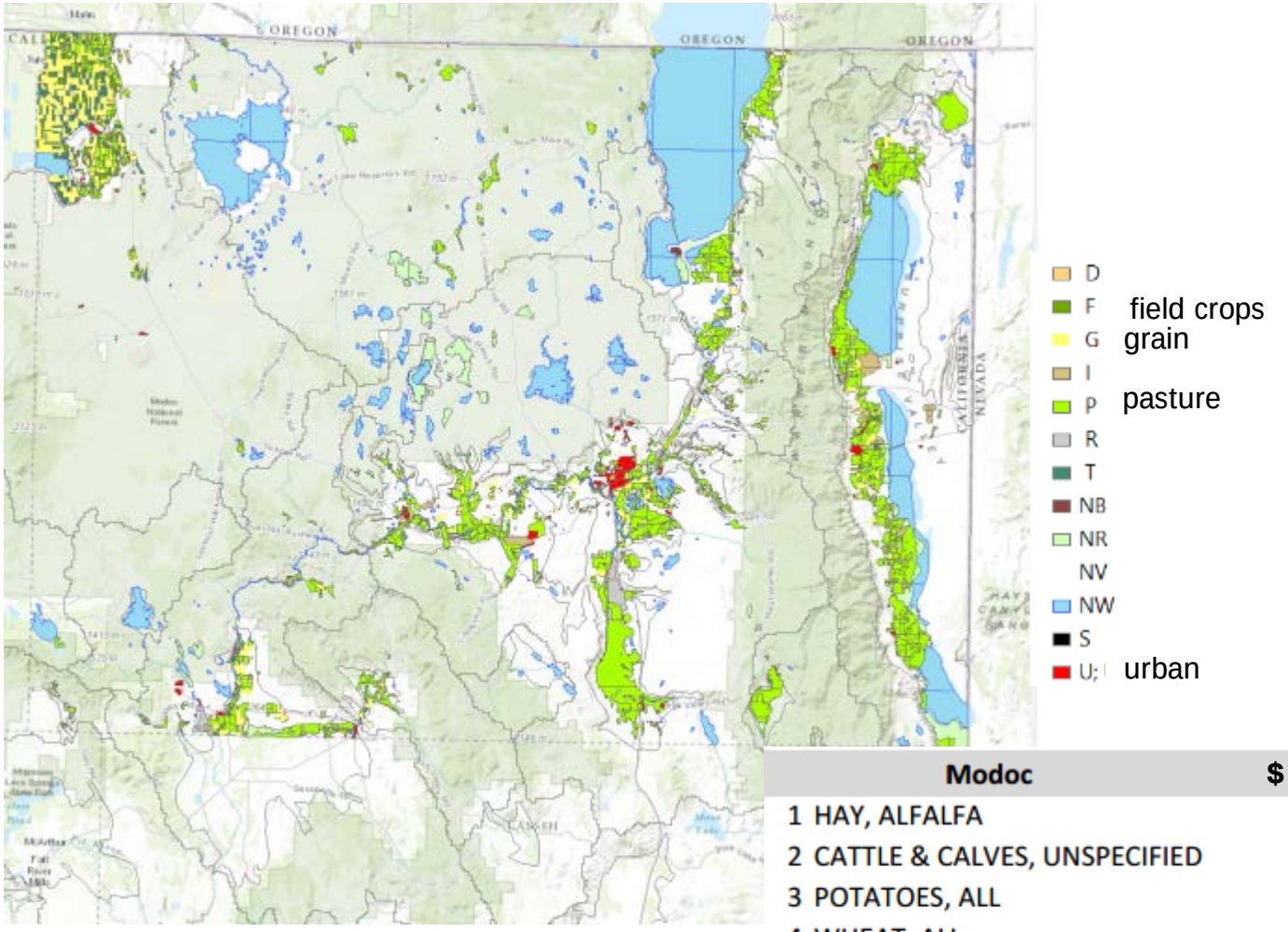
Plumas			Sierra	
1	CATTLE, STOCKERS, FEEDERS	11,975	CATTLE, STOCKERS, FEEDERS	3,590
2	PASTURE, IRRIGATED	2,310	PASTURE, IRRIGATED	756
3	HAY, ALFALFA	2,160	HAY, ALFALFA	548
4	HAY, WILD	1,170	HAY, WILD	454
5	PASTURE, FORAGE, MISC.	1,040	PASTURE, FORAGE, MISC.	400
6	CATTLE, BEEF COWS, CULL	542	HAY, GRAIN	161
7	HAY, GRAIN	252	CATTLE, BEEF COWS, CULL	149
8	FRUITS & NUTS, UNSPECIFIED	250	PASTURE, RANGE	72
9	PASTURE, RANGE	195	FRUITS & NUTS, UNSPECIFIED	35
10	LIVESTOCK, UNSPECIFIED	125	LIVESTOCK, UNSPECIFIED	35

Modoc County Landuse & Water Infra-structure:

Bridging the Spatial and Temporal Disconnect between SUPPLY and USE

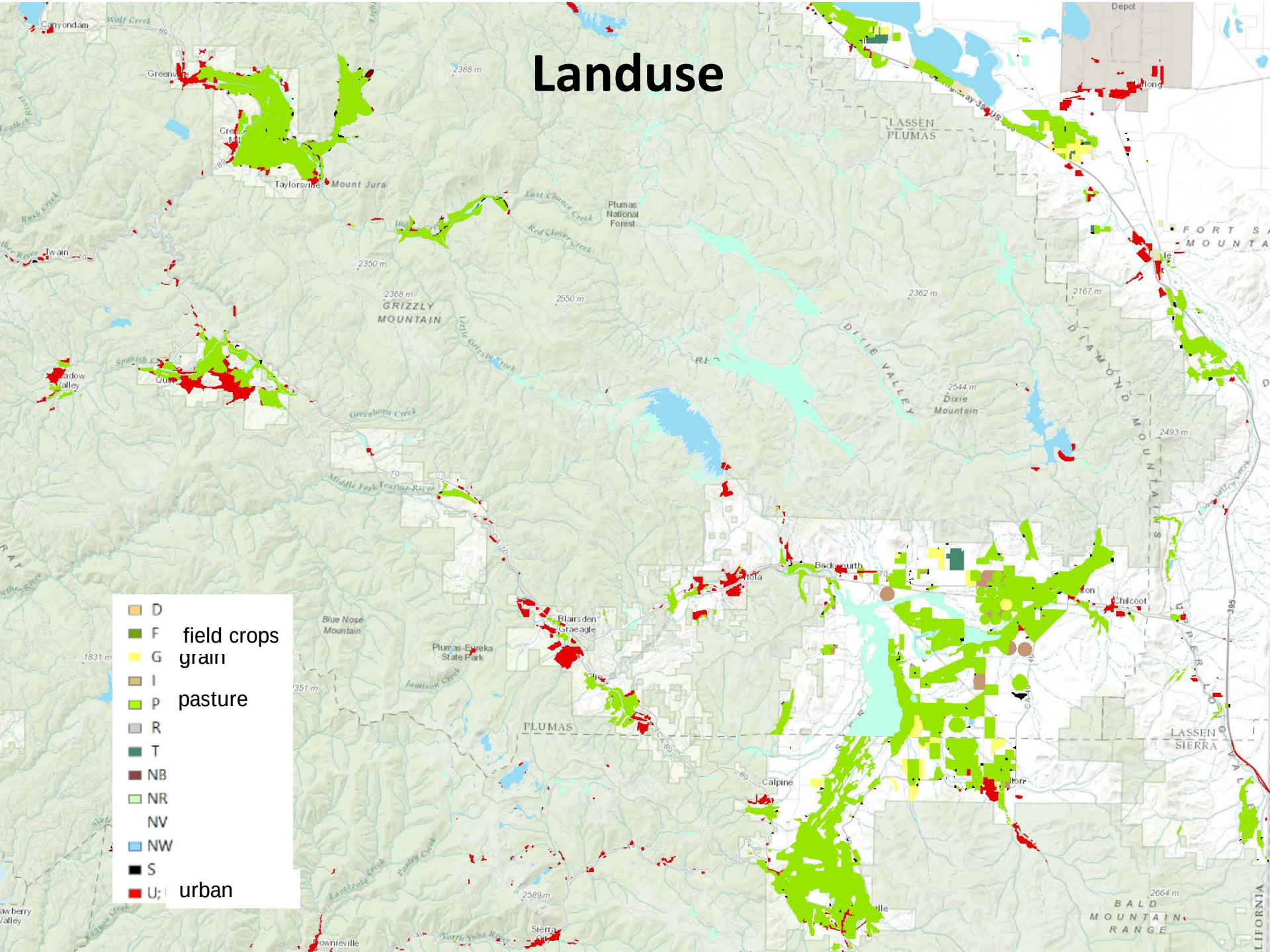
about 170,000 irrigated acres

about 10,000 people

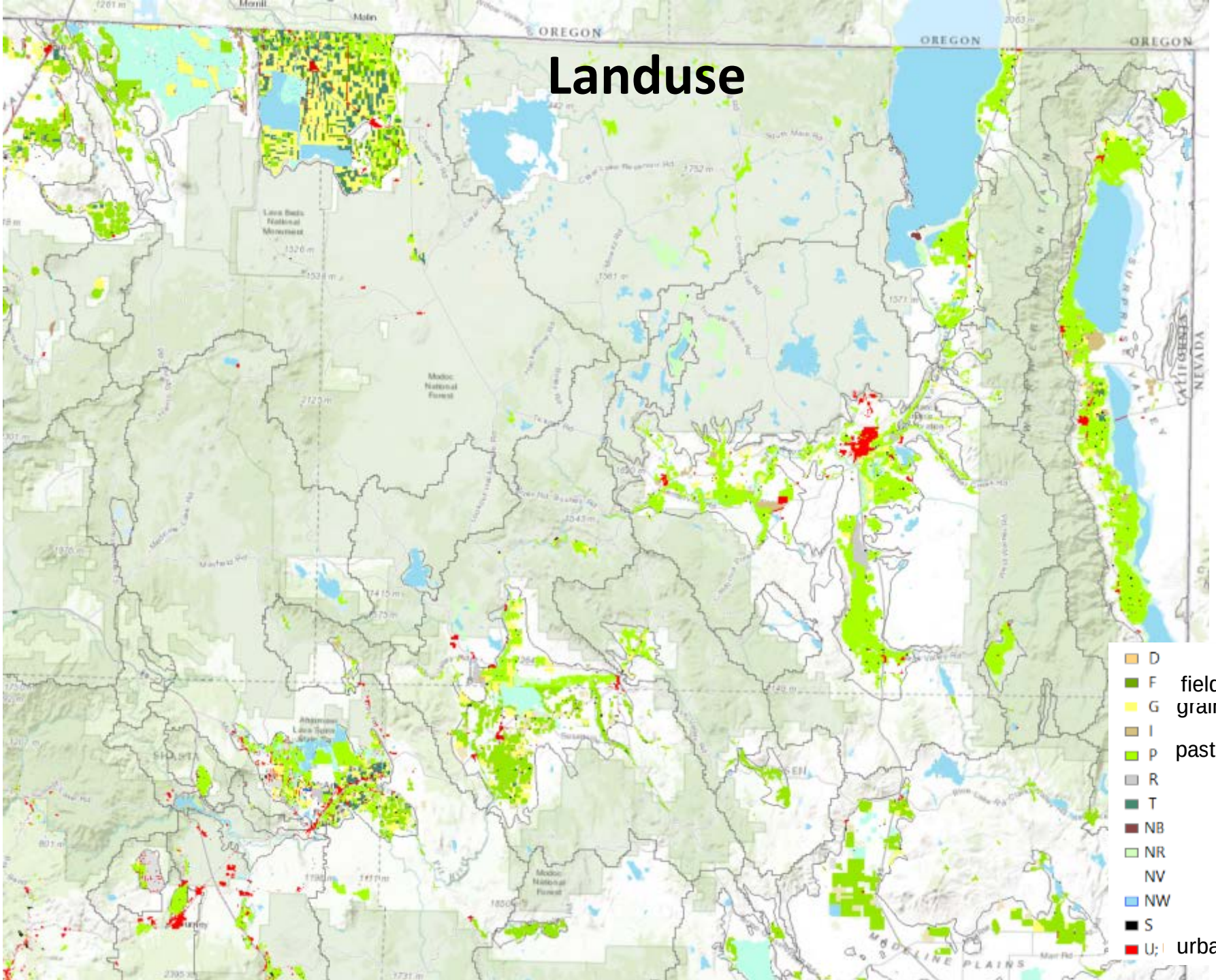


	Modoc	$ 1,000
1	HAY, ALFALFA	36,464
2	CATTLE & CALVES, UNSPECIFIED	18,894
3	POTATOES, ALL	14,743
4	WHEAT, ALL	6,091
5	VEGETABLES, UNSPECIFIED	5,836
6	PASTURE, IRRIGATED	5,500
7	HAY, GRAIN	4,523
8	PASTURE, RANGE	4,032
9	HAY, WILD	3,850
10	ONIONS	3,077

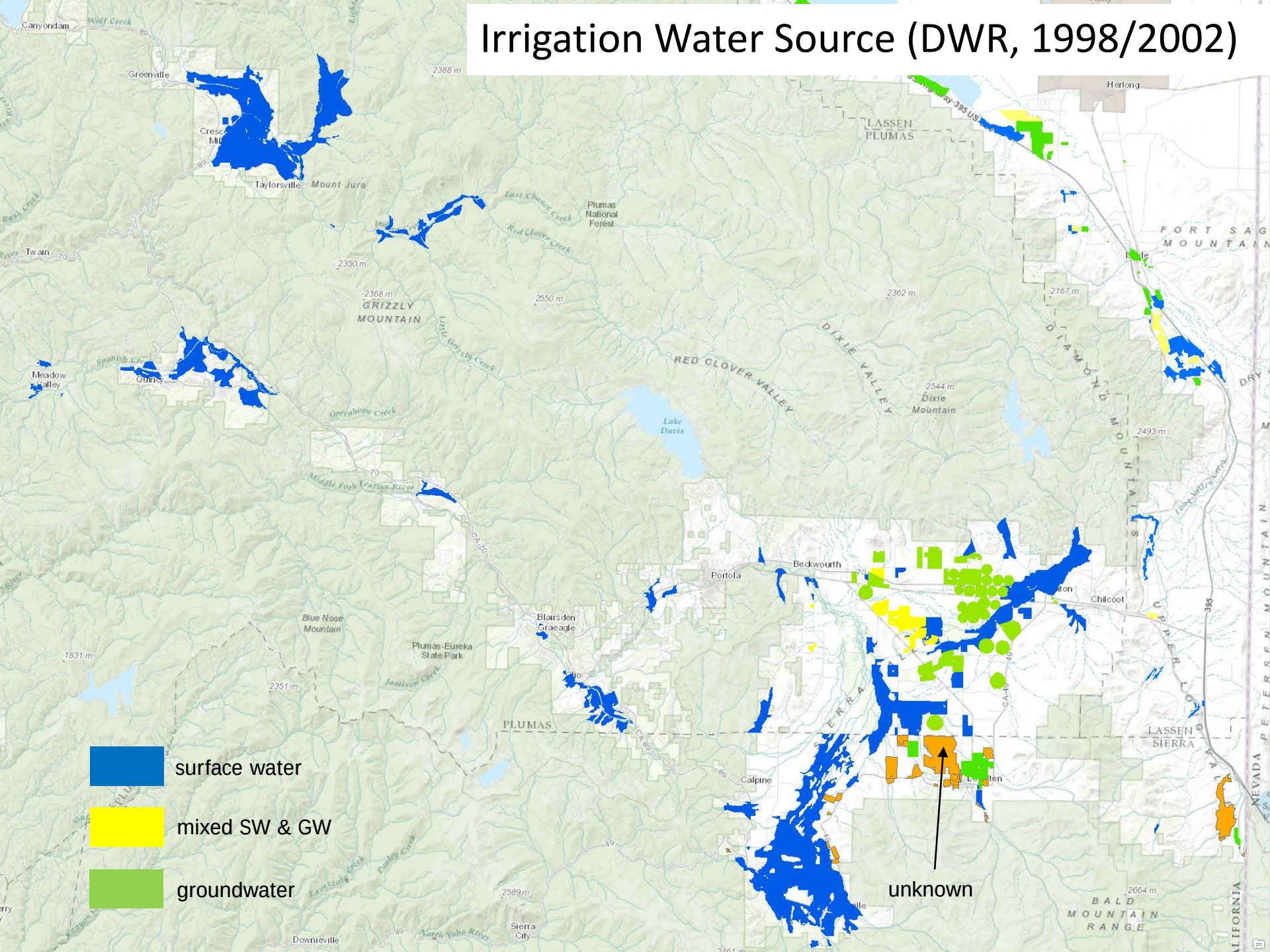
Landuse


D
F
field crops
G
grain
I
P
pasture
R
T
NB
NR
NV
NW
S
U;
urban
Canyondam
Taylorsville
Mount Jura
Plumas National Forest
Twain
GRIZZLY MOUNTAIN
Dixie Mountain
DIXIE VALLEY
DIAMOND MOUNTAINS
Blue Nose Mountain
Plumas-Eureka State Park
Blairsden-Graeagle
Chilcoot
Calpine
PLUMAS
LASSEN
SIERRA
BALD MOUNTAIN RANGE
Downieville
Depot

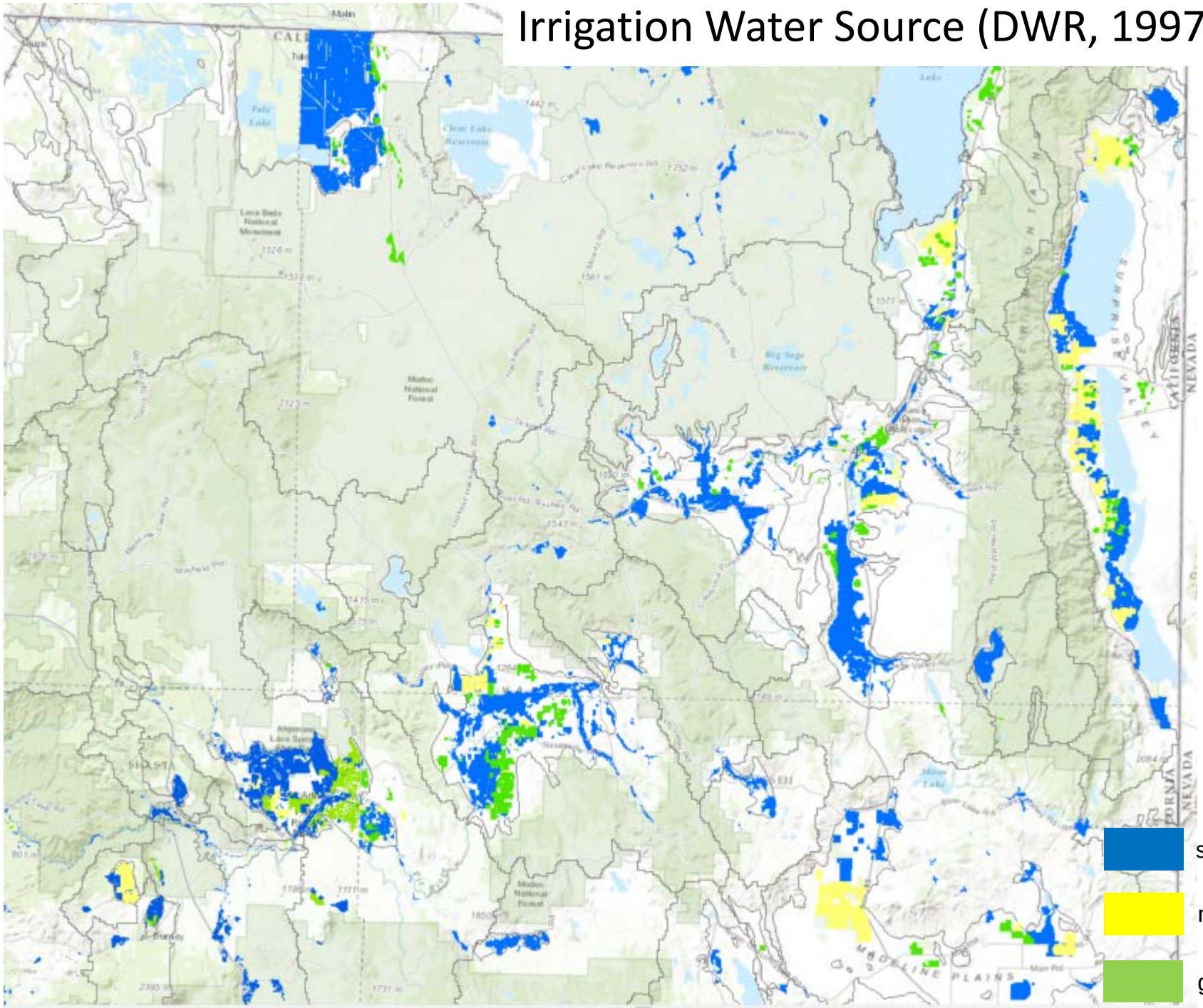
Landuse

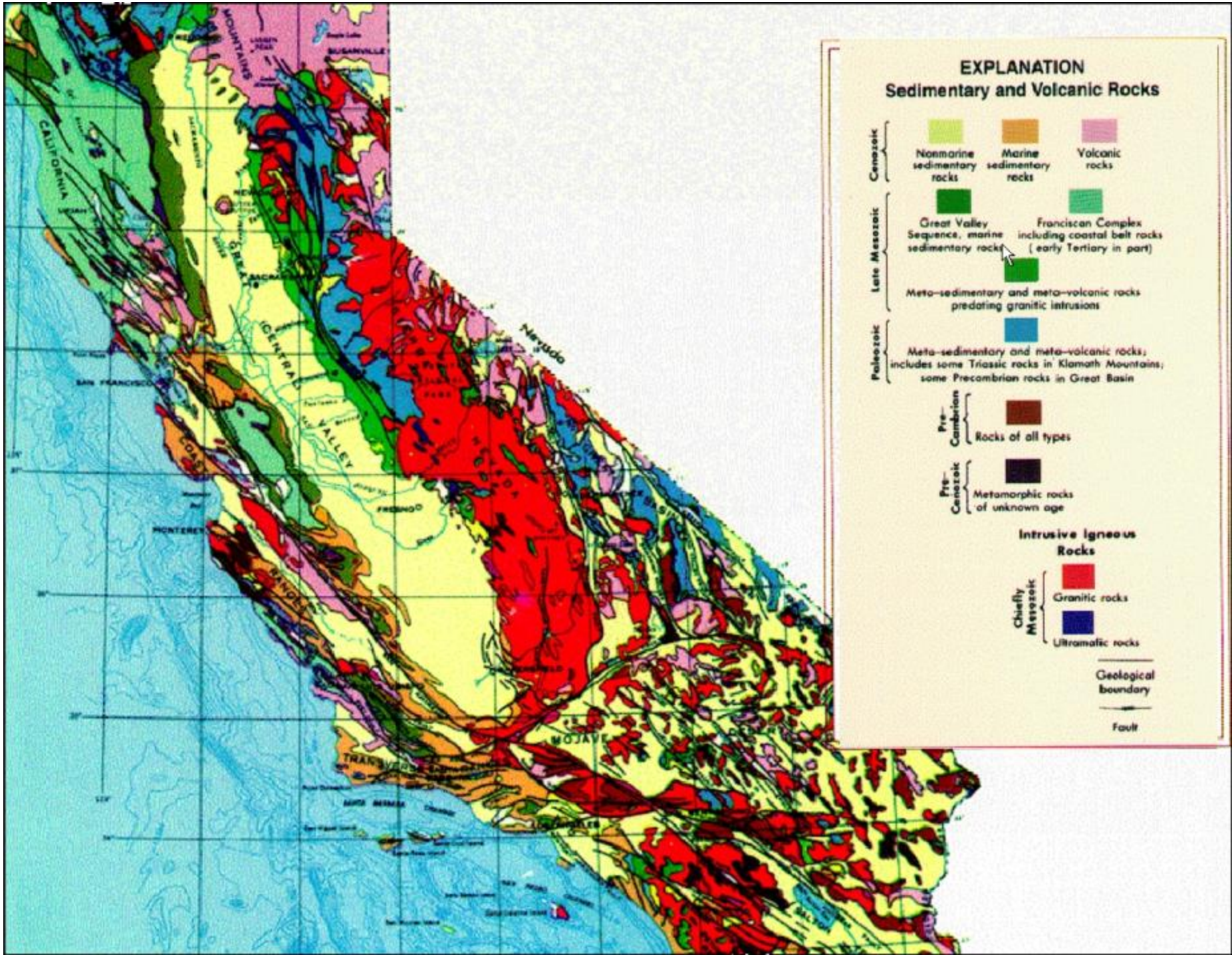

OREGON
OREGON
OREGON
NEVADA
D
F
G
I
P
R
T
NB
NR
NV
NW
S
U;
field crops
grain
pasture
urban

Irrigation Water Source (DWR, 1998/2002)



Irrigation Water Source (DWR, 1997)



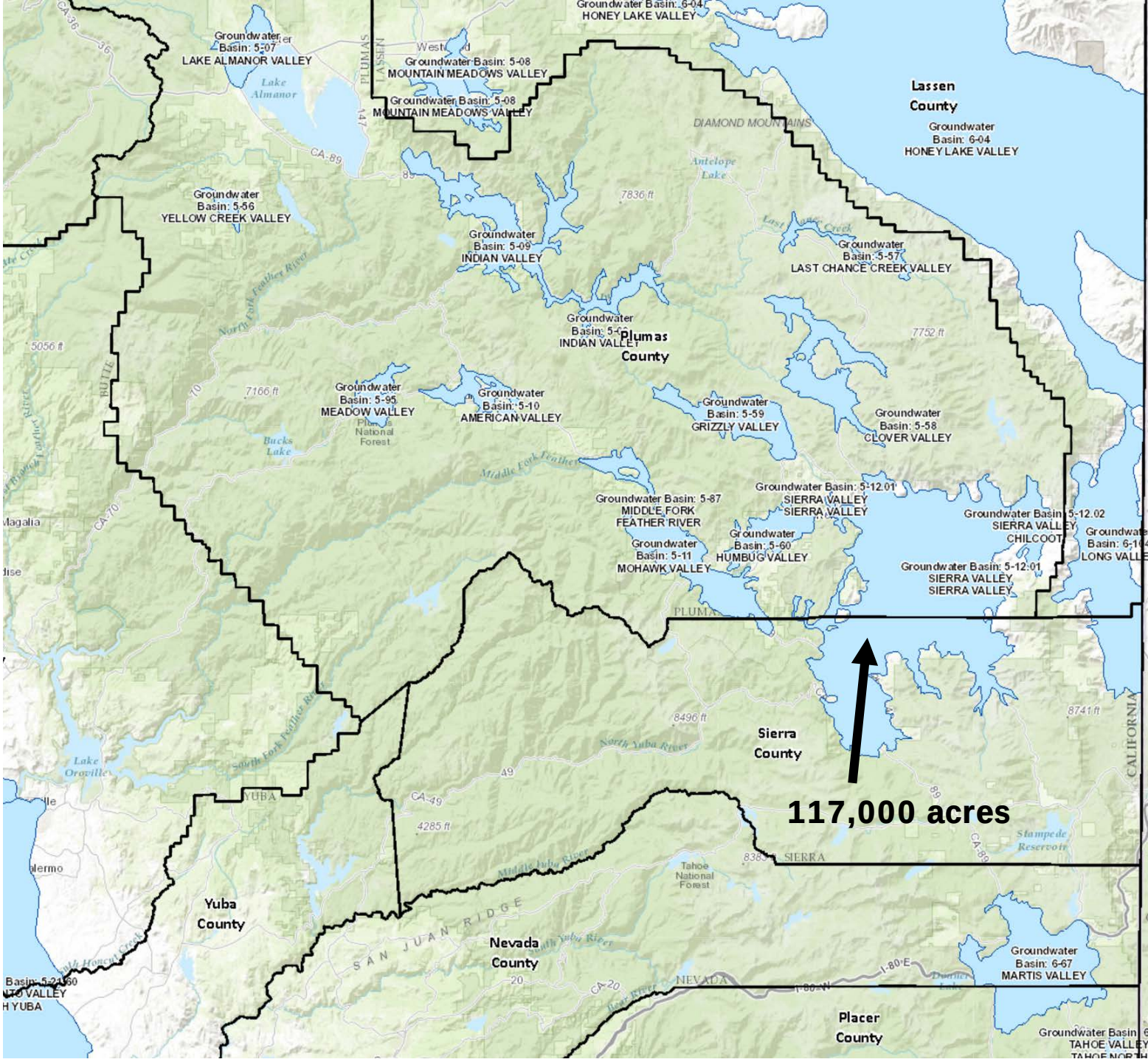

EXPLANATION
Sedimentary and Volcanic Rocks
Cenozoic
Nonmarine sedimentary rocks
Marine sedimentary rocks
Volcanic rocks
Late Mesozoic
Great Valley Sequence, marine sedimentary rocks
Franciscan Complex including coastal belt rocks (early Tertiary in part)
Meta-sedimentary and meta-volcanic rocks predating 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
SAN FRANCISCO
MONTEREY
FRESNO
MOJAVE
SANTA MONICA
Nevada

Alluvial Groundwater Basins –

Sacramento River Watershed

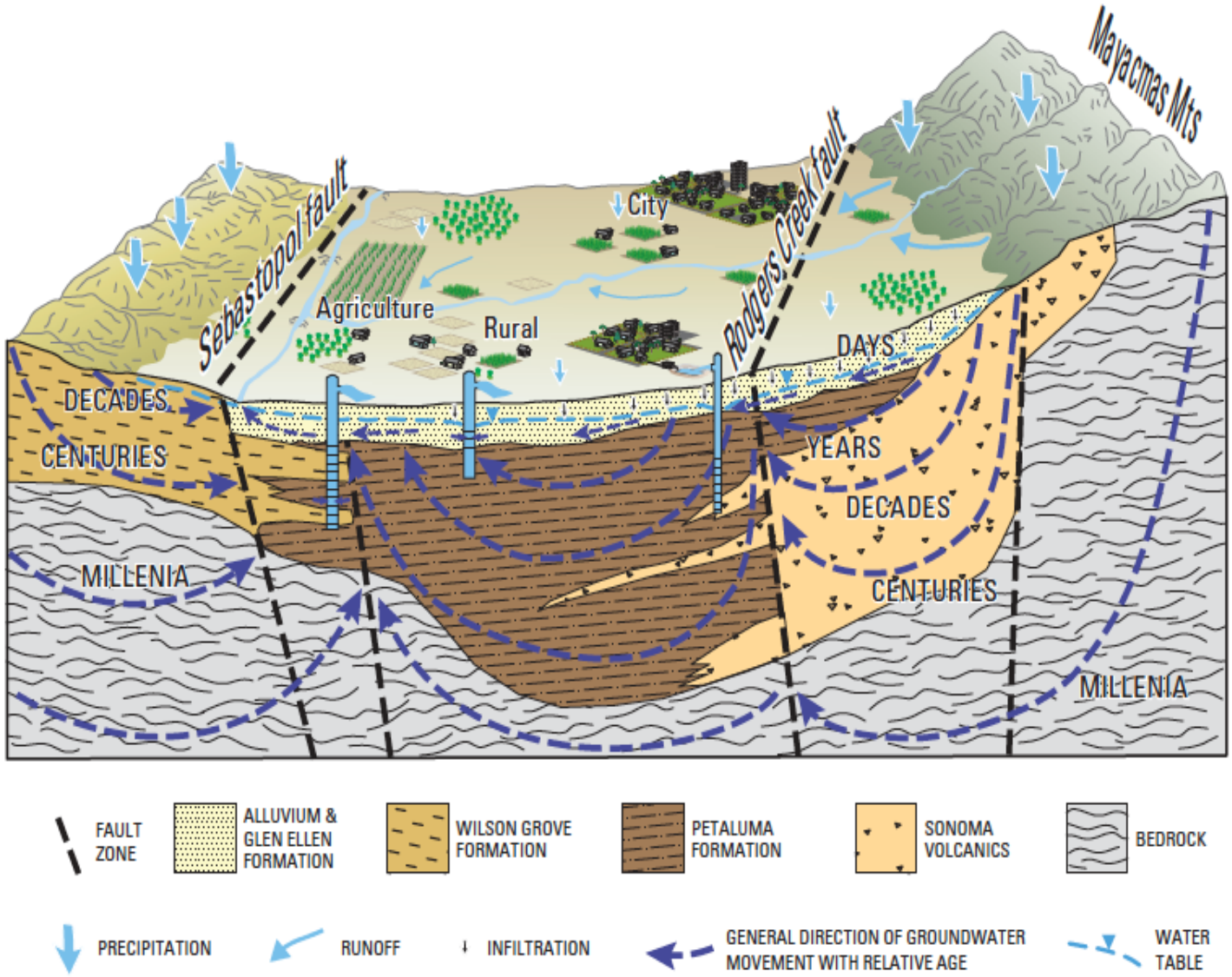
CA DWR Bulletin 118

Alluvial Groundwater Basins



Conceptual Model: Santa Rosa Plain

- Groundwater occurs in all four primary formations
- Precipitation and streambed infiltration primary source of recharge
- Primary discharge:
  - Pumping
  - ET
  - Baseflow
- Dominantly flows east to west
- Creeks gain water
- Groundwater levels declined due to pumping and have partially recovered



COURTESY - Marcus Trotta, Sonoma County Water Agency, 2015

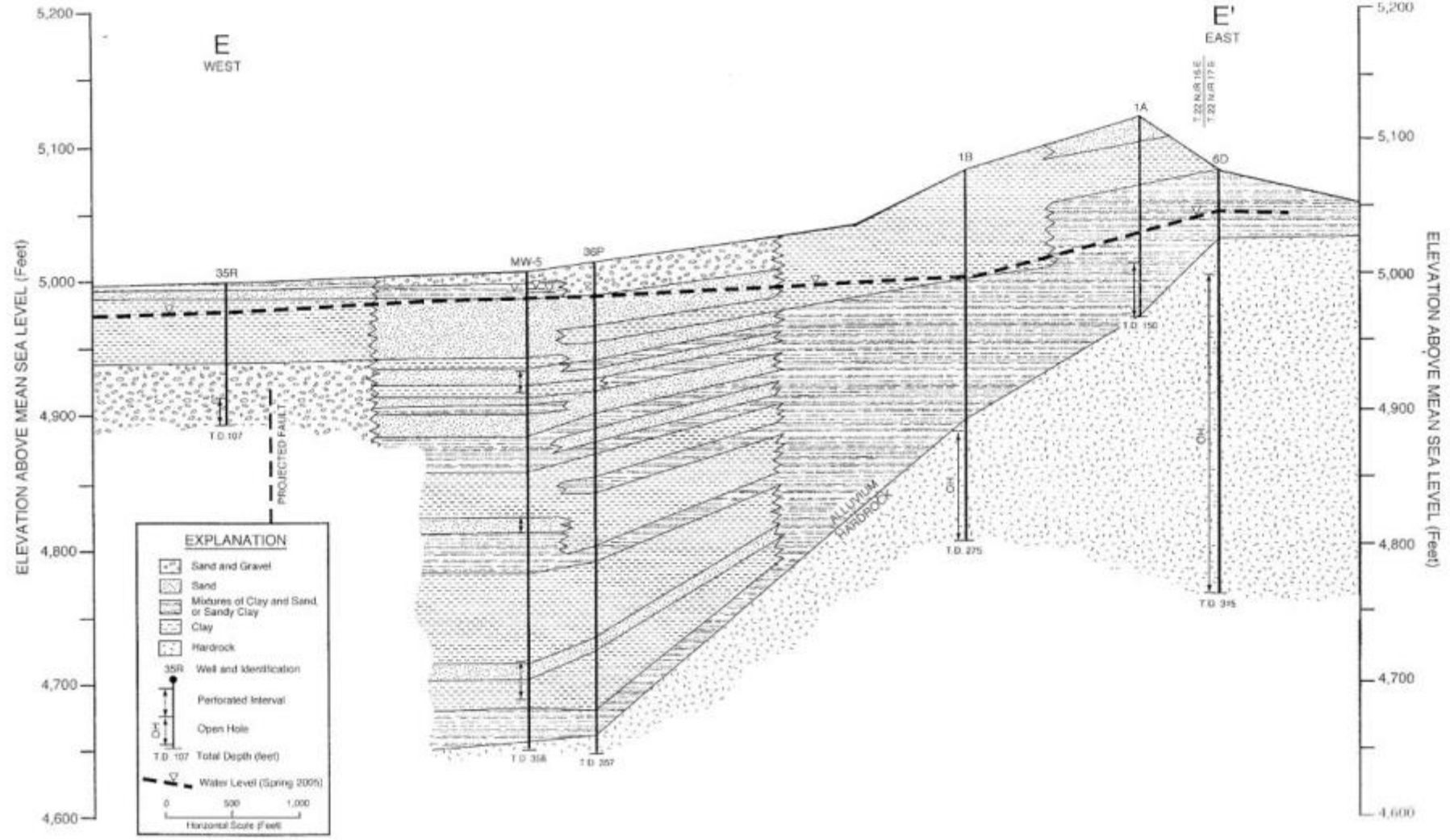


FIGURE 3 - SUBSURFACE GEOLOGIC CROSS SECTION E - E'

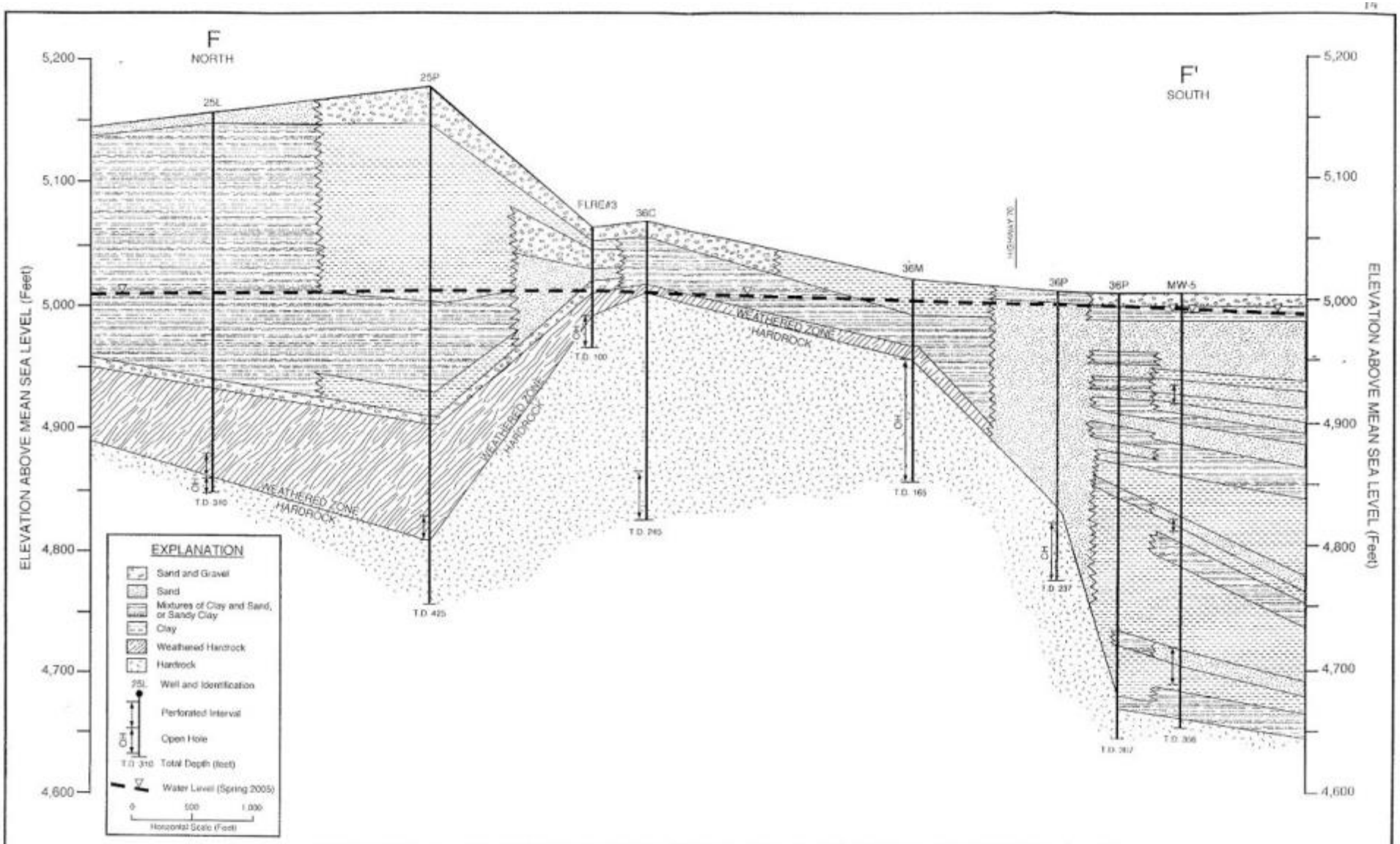


FIGURE 4 - SUBSURFACE GEOLOGIC CROSS SECTION F - F'

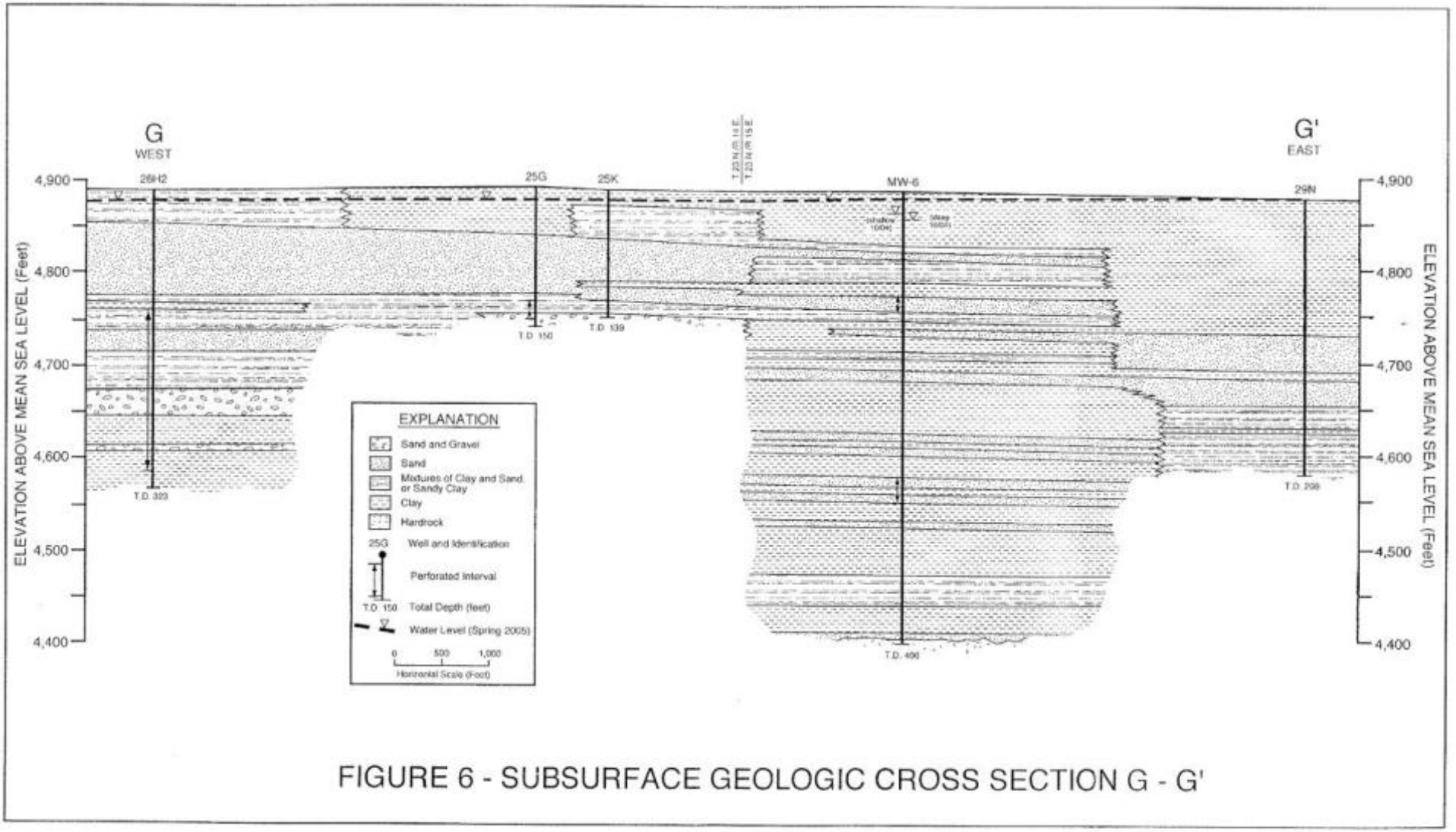
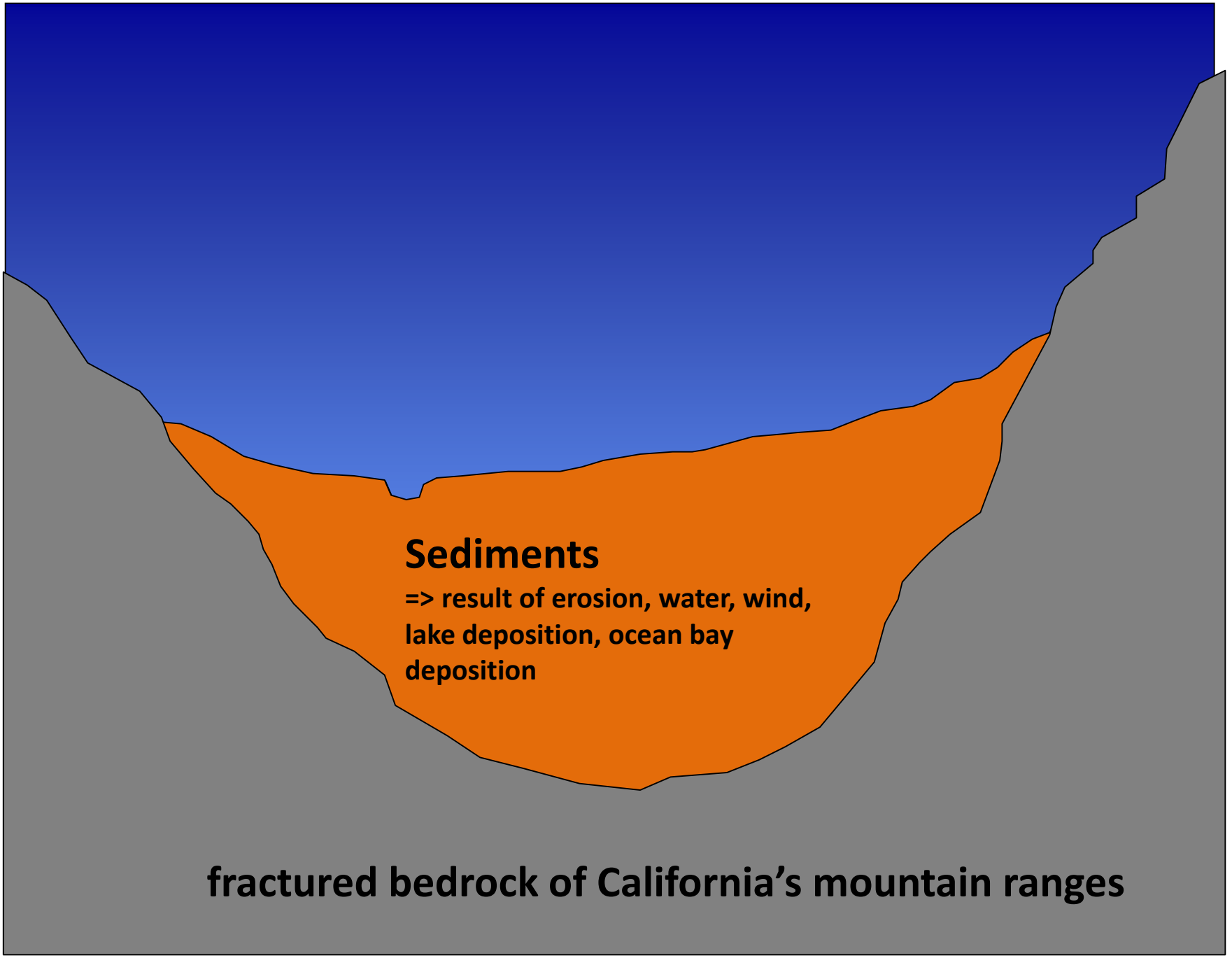
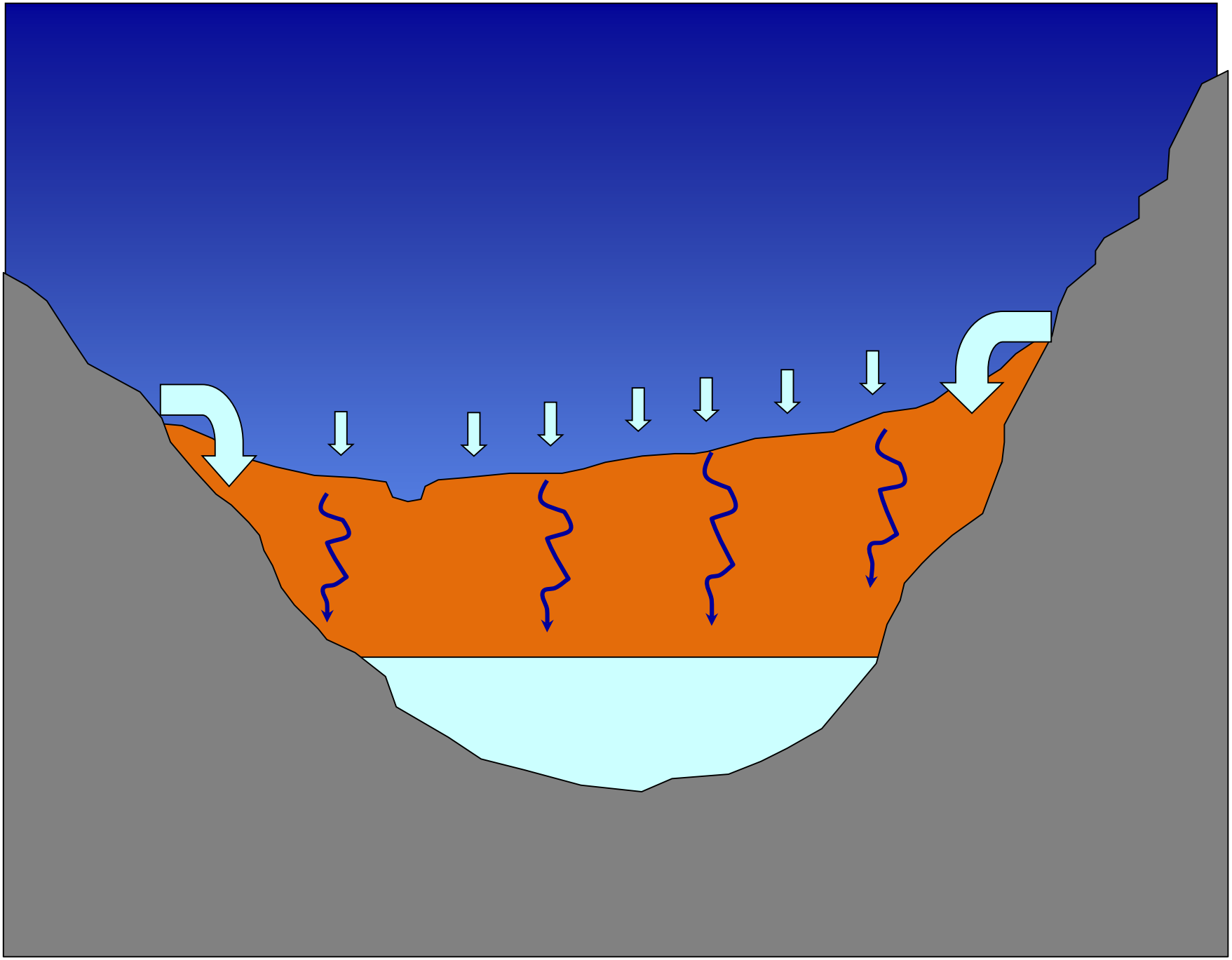
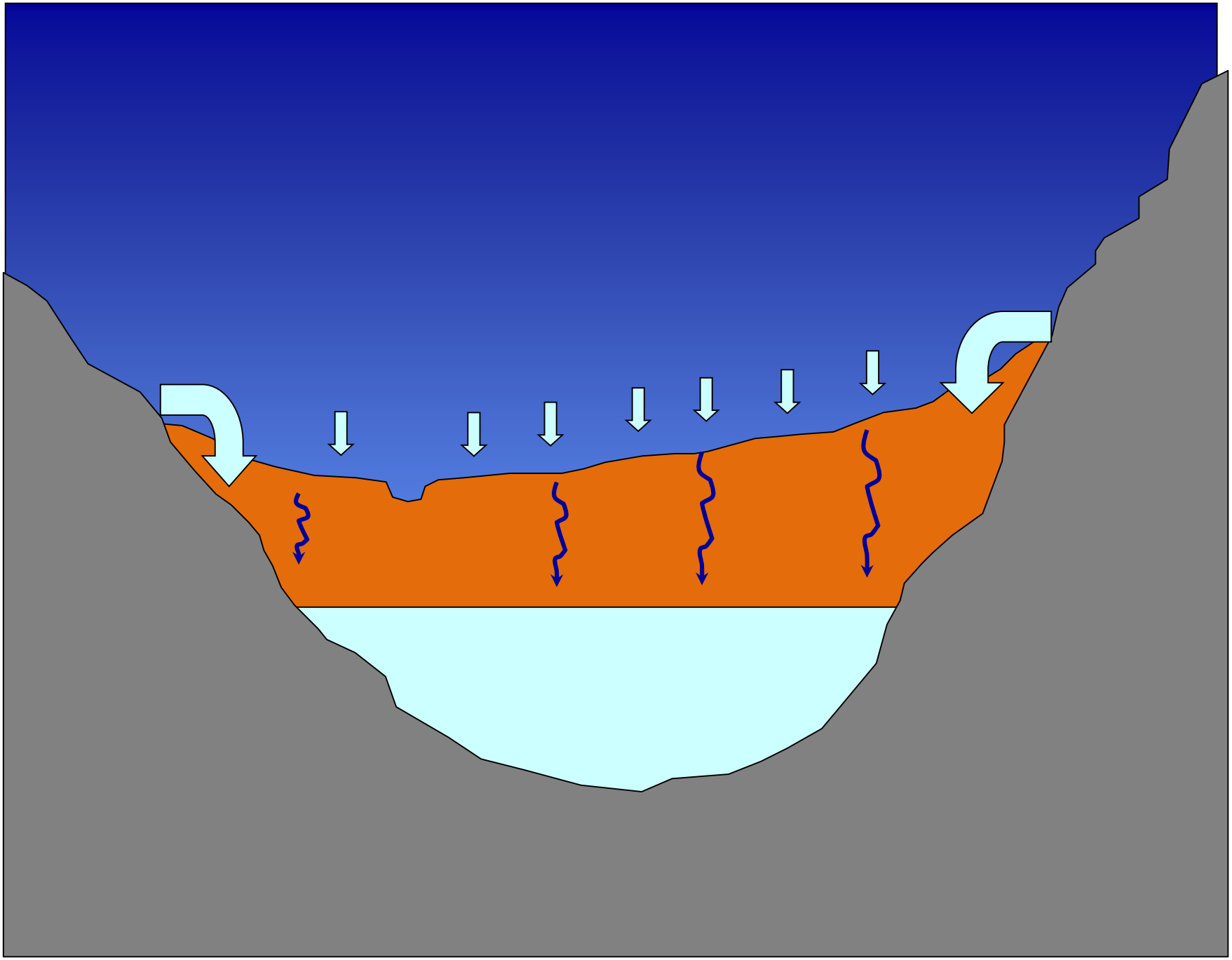
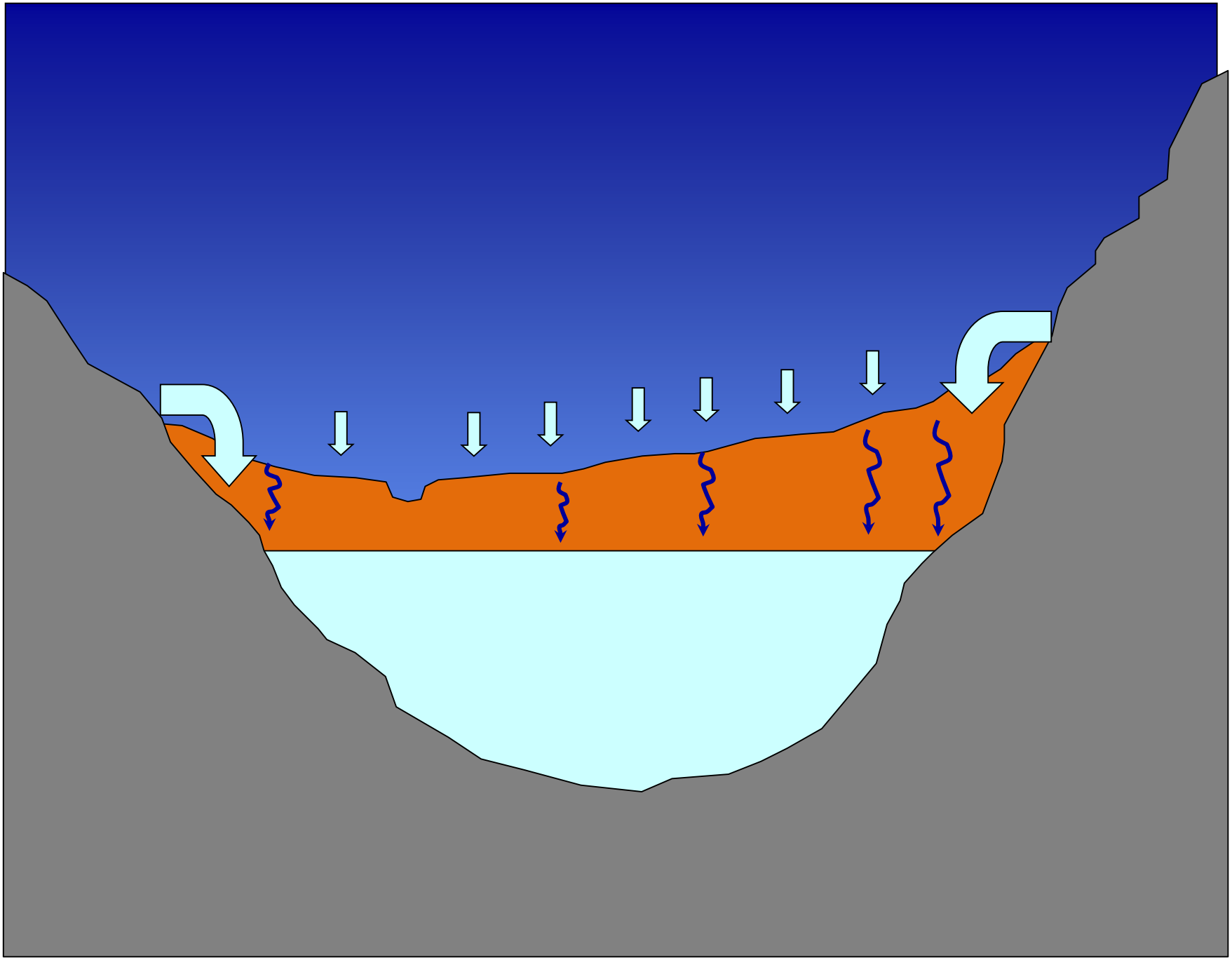


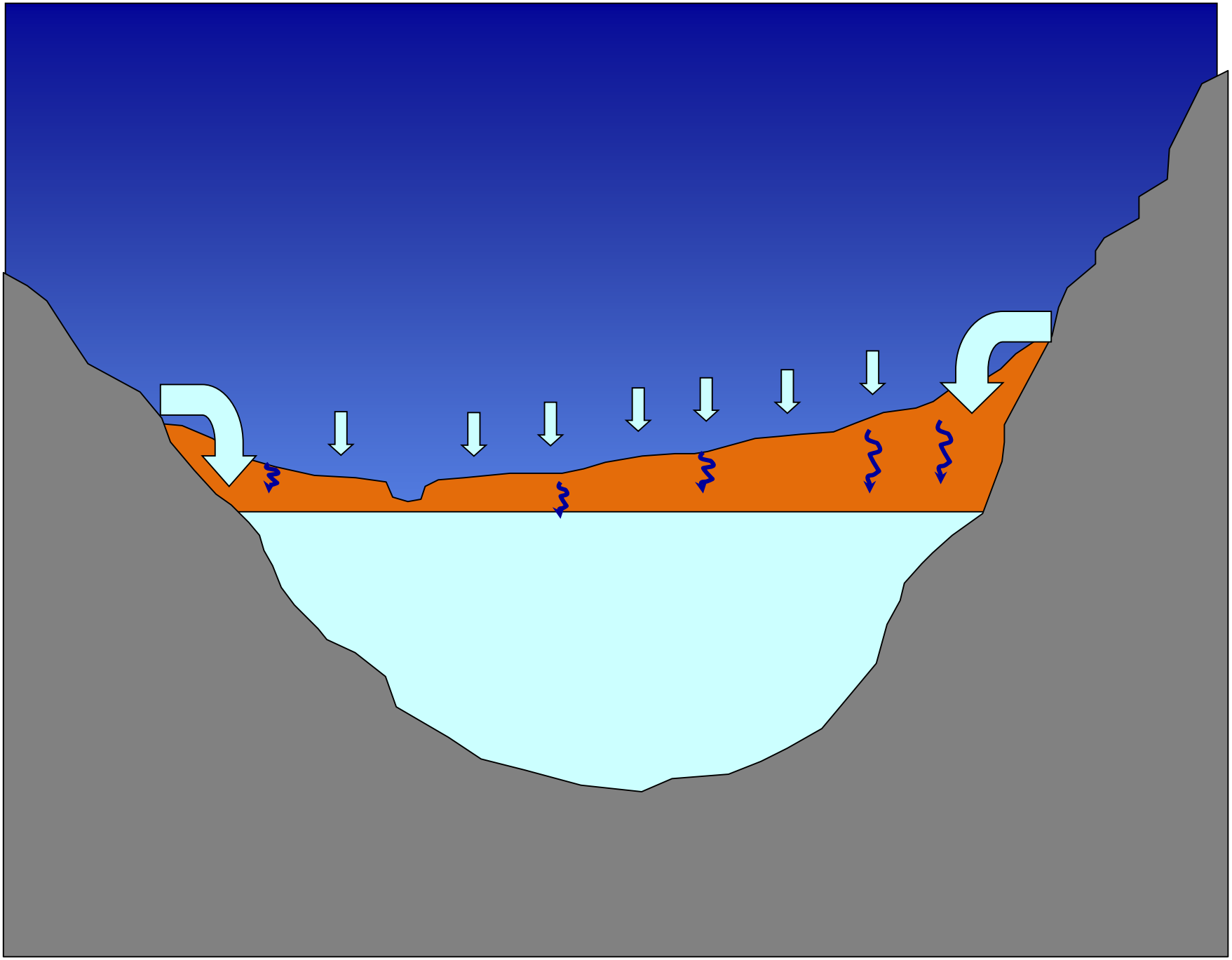
FIGURE 6 - SUBSURFACE GEOLOGIC CROSS SECTION G - G'

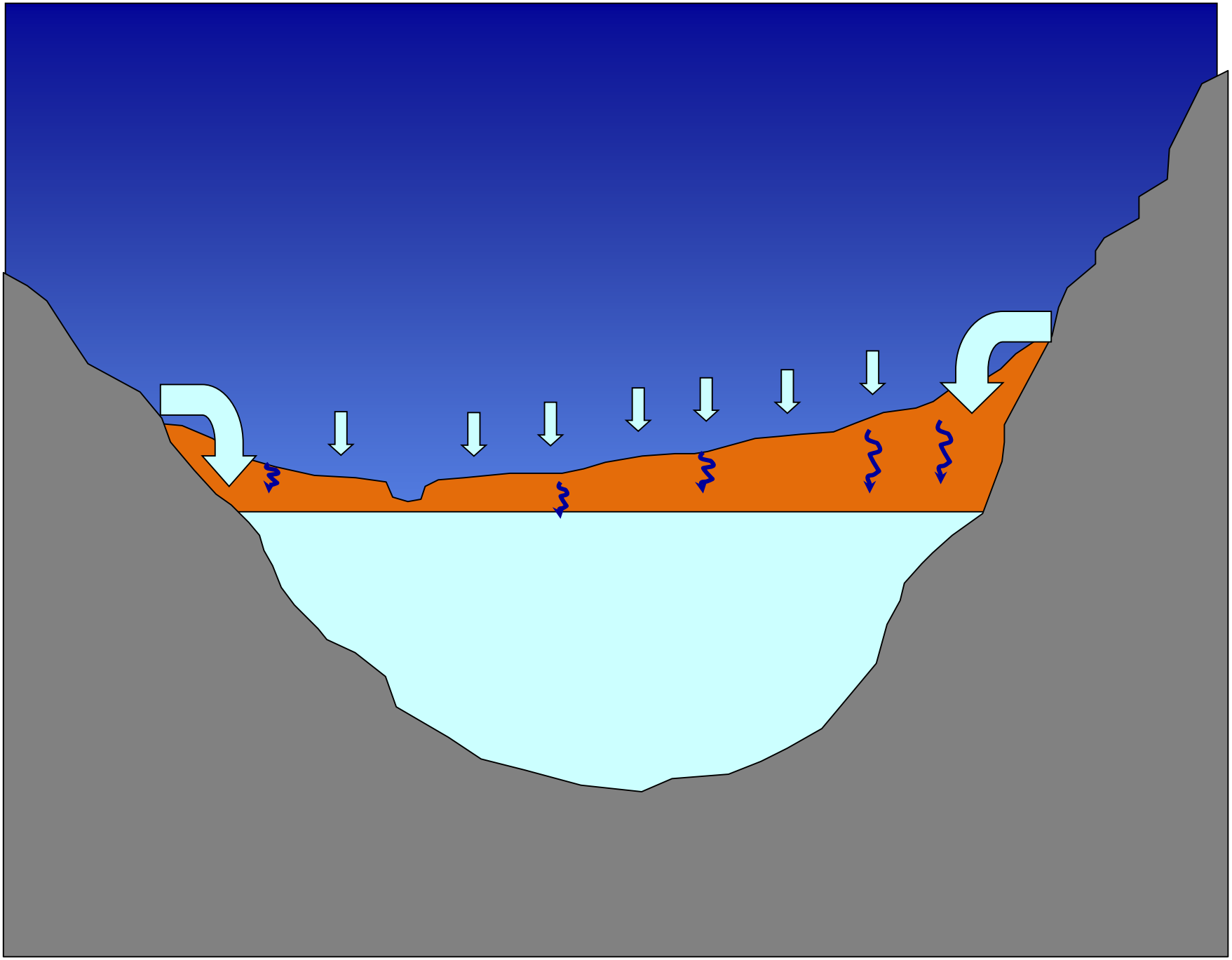

Sediments
=> result of erosion, water, wind, lake deposition, ocean bay deposition
fractured bedrock of California's mountain ranges

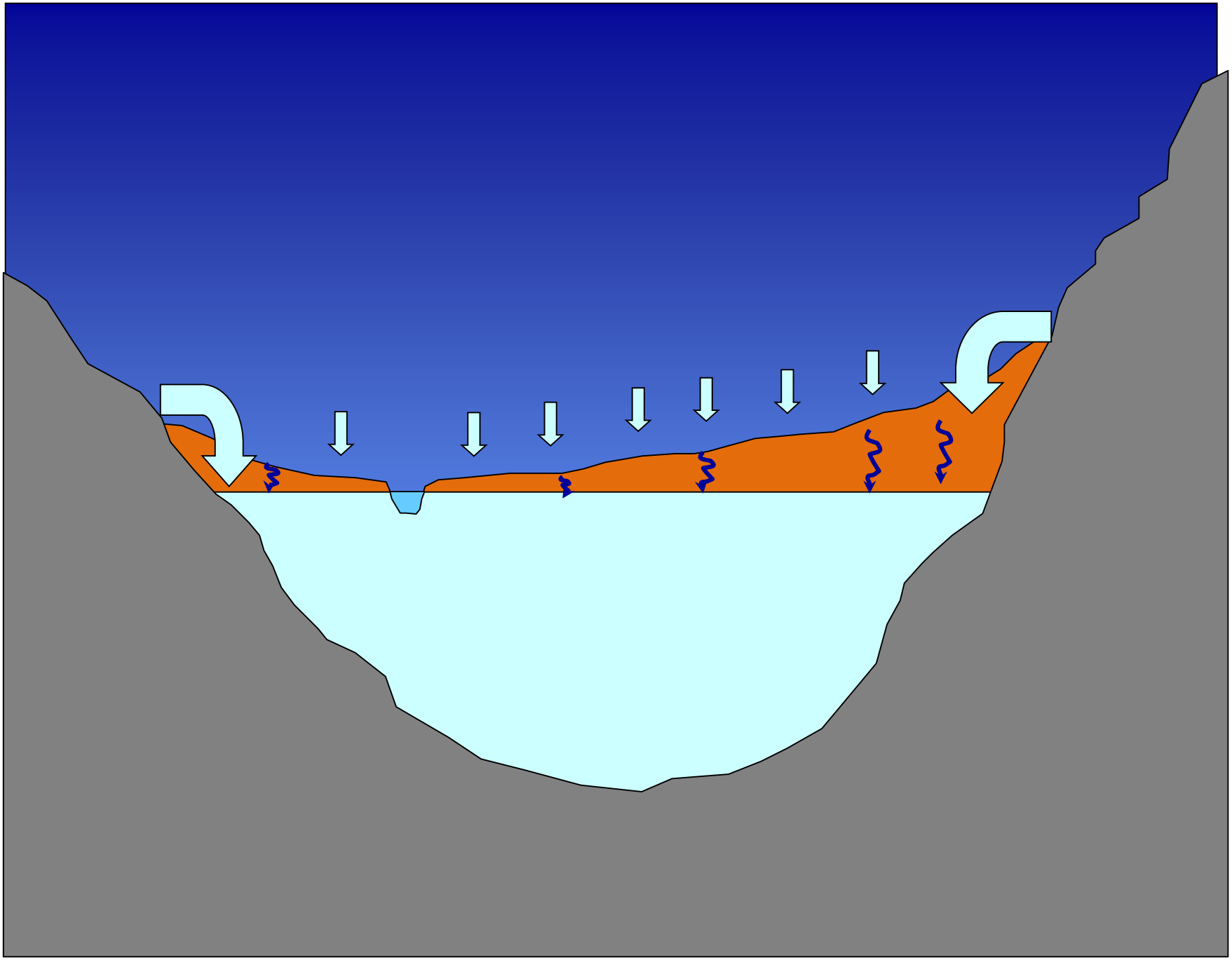


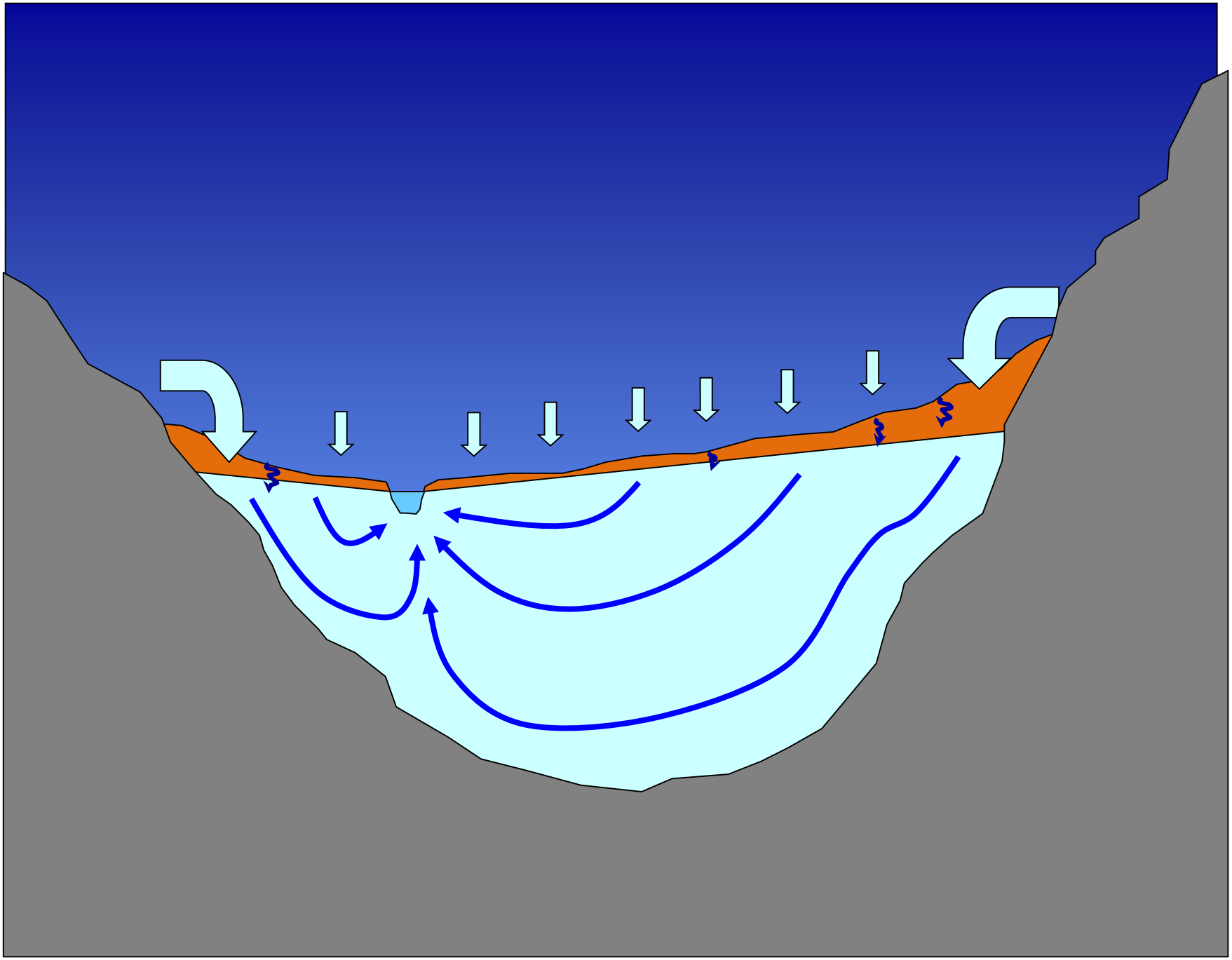


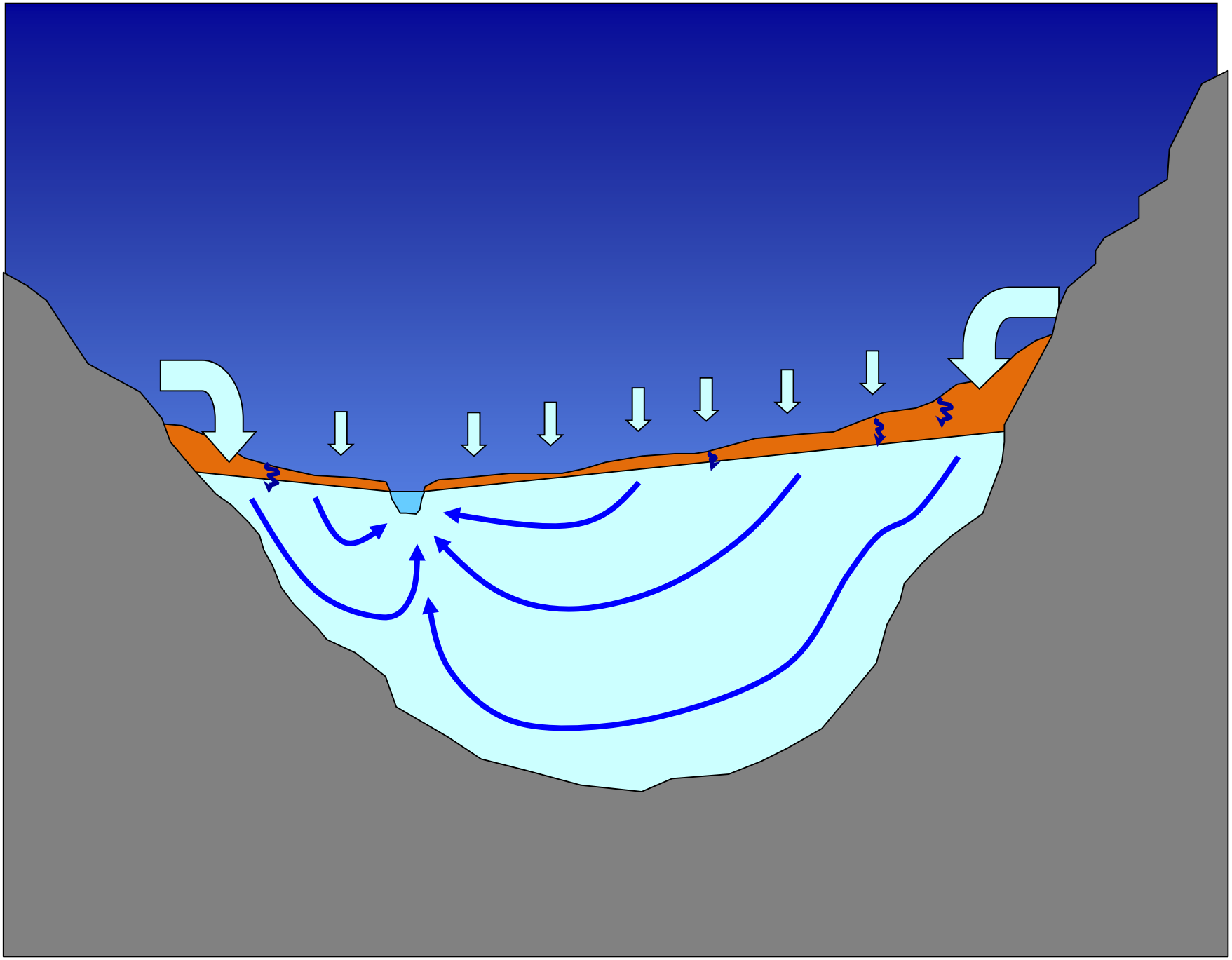


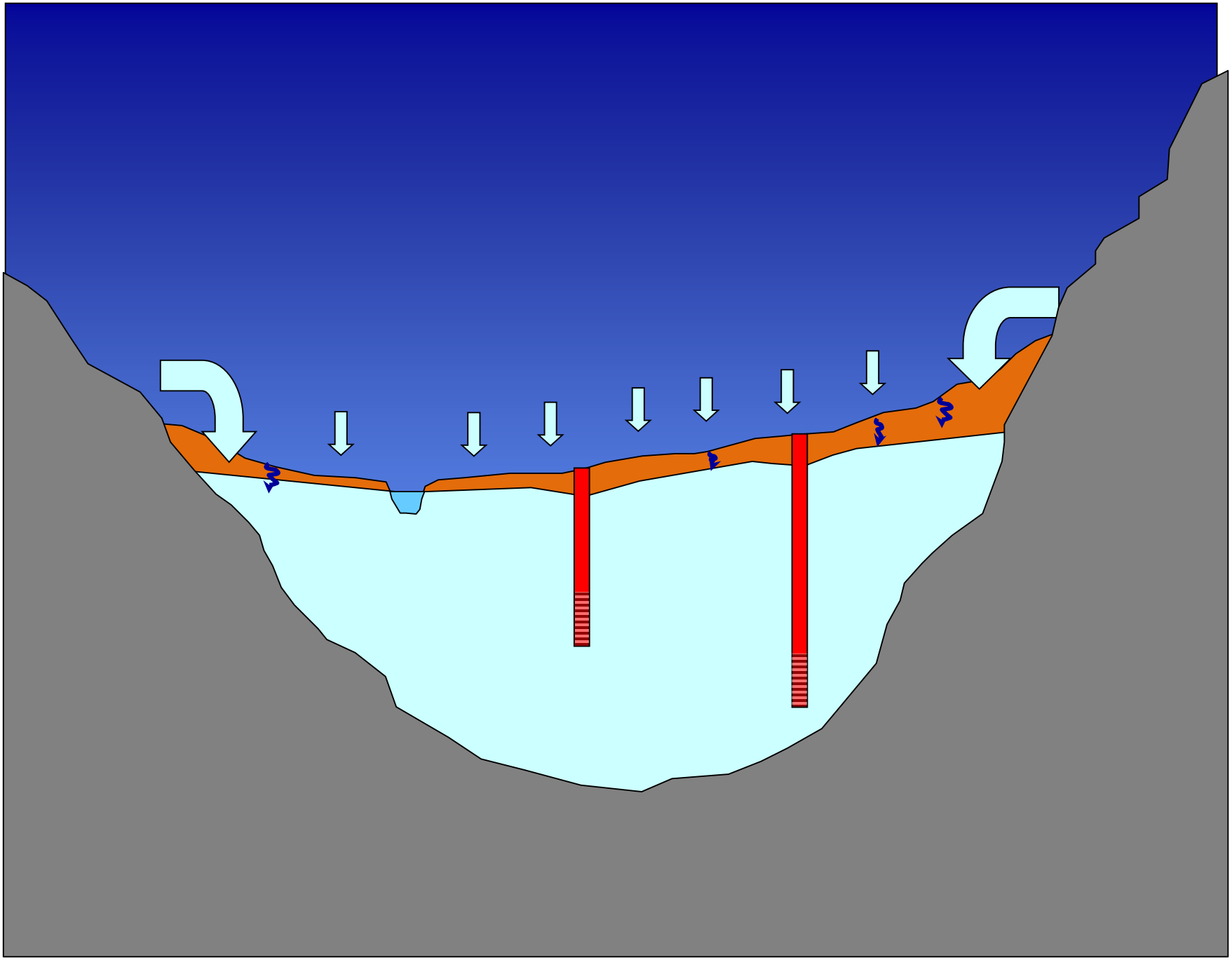


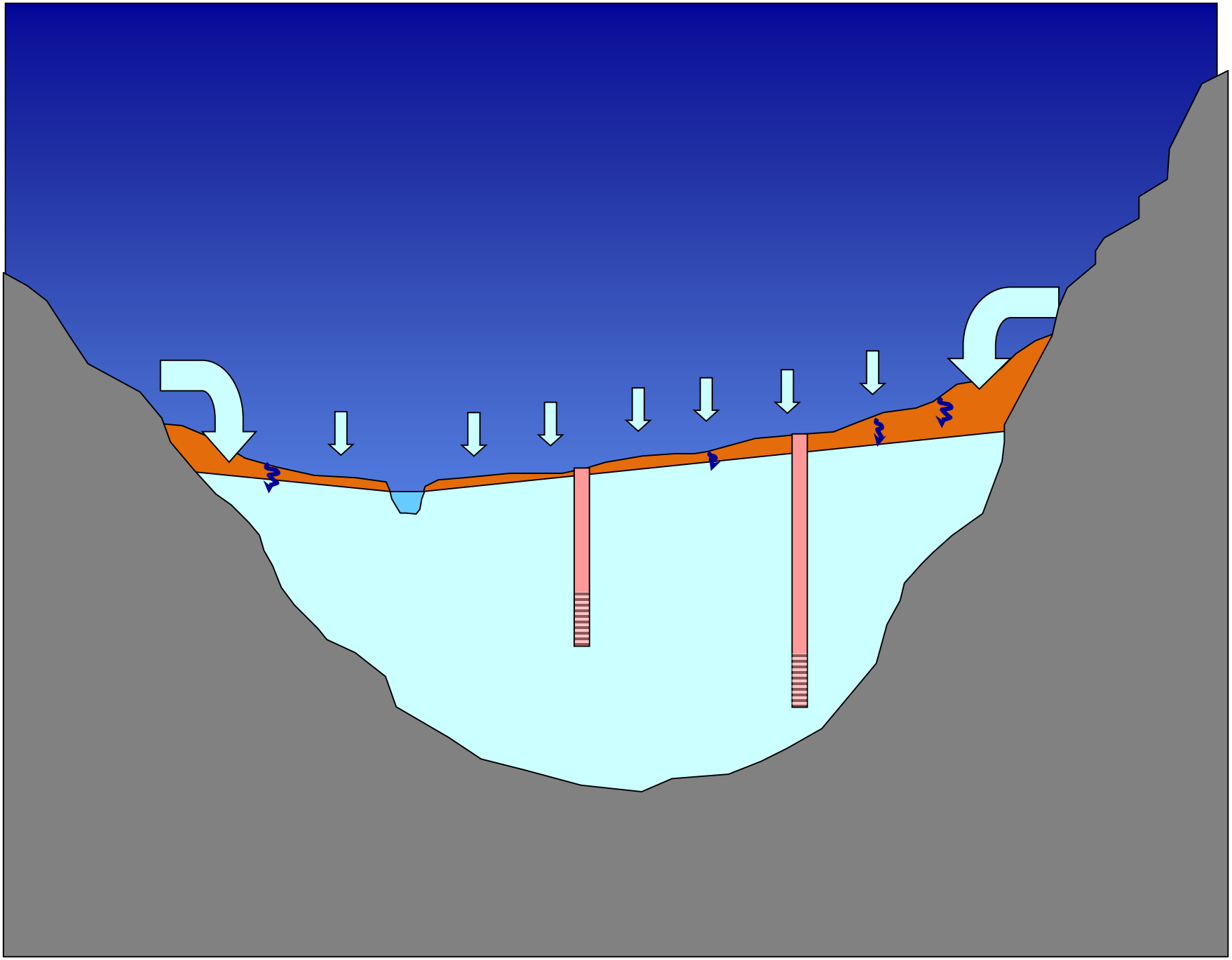


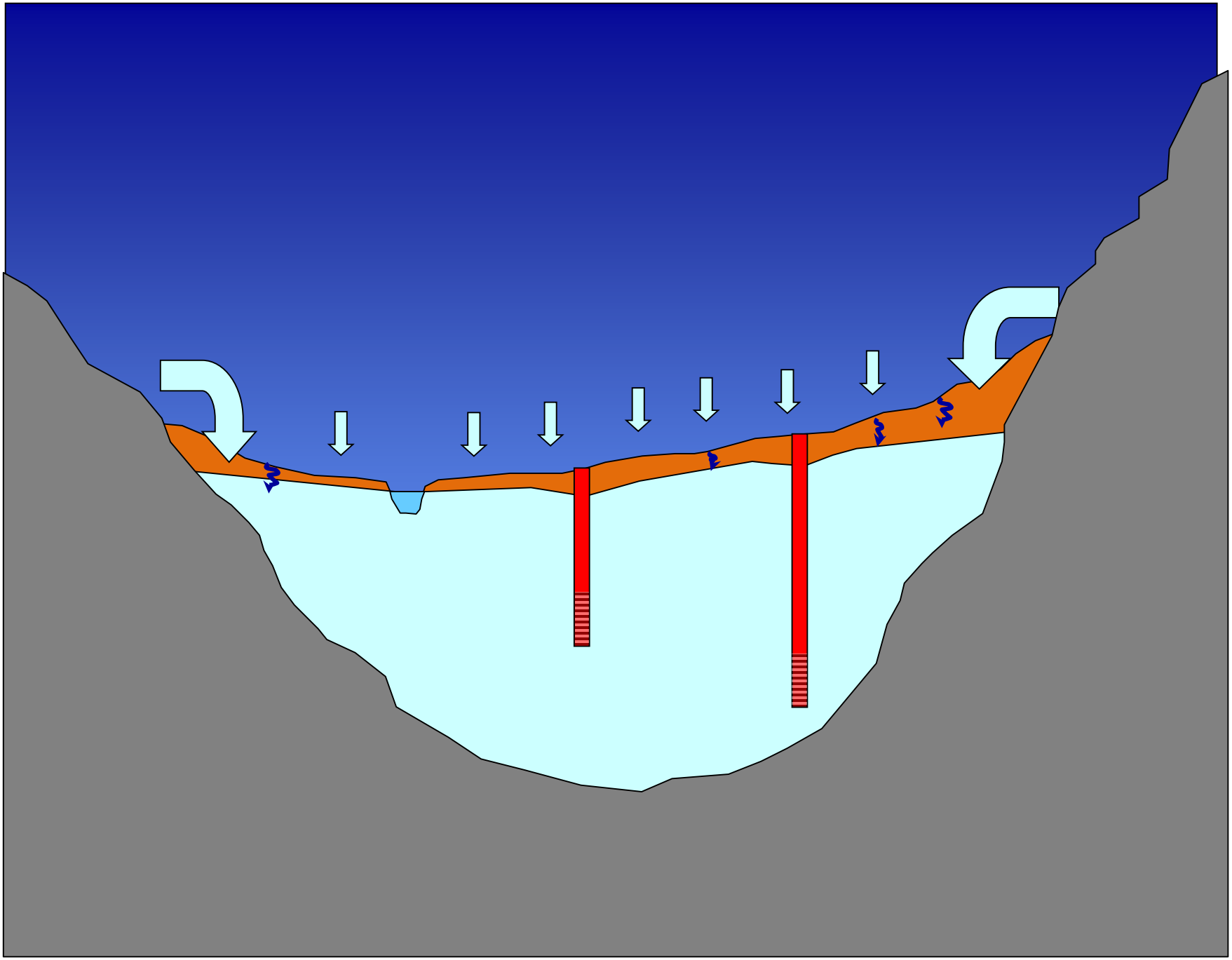


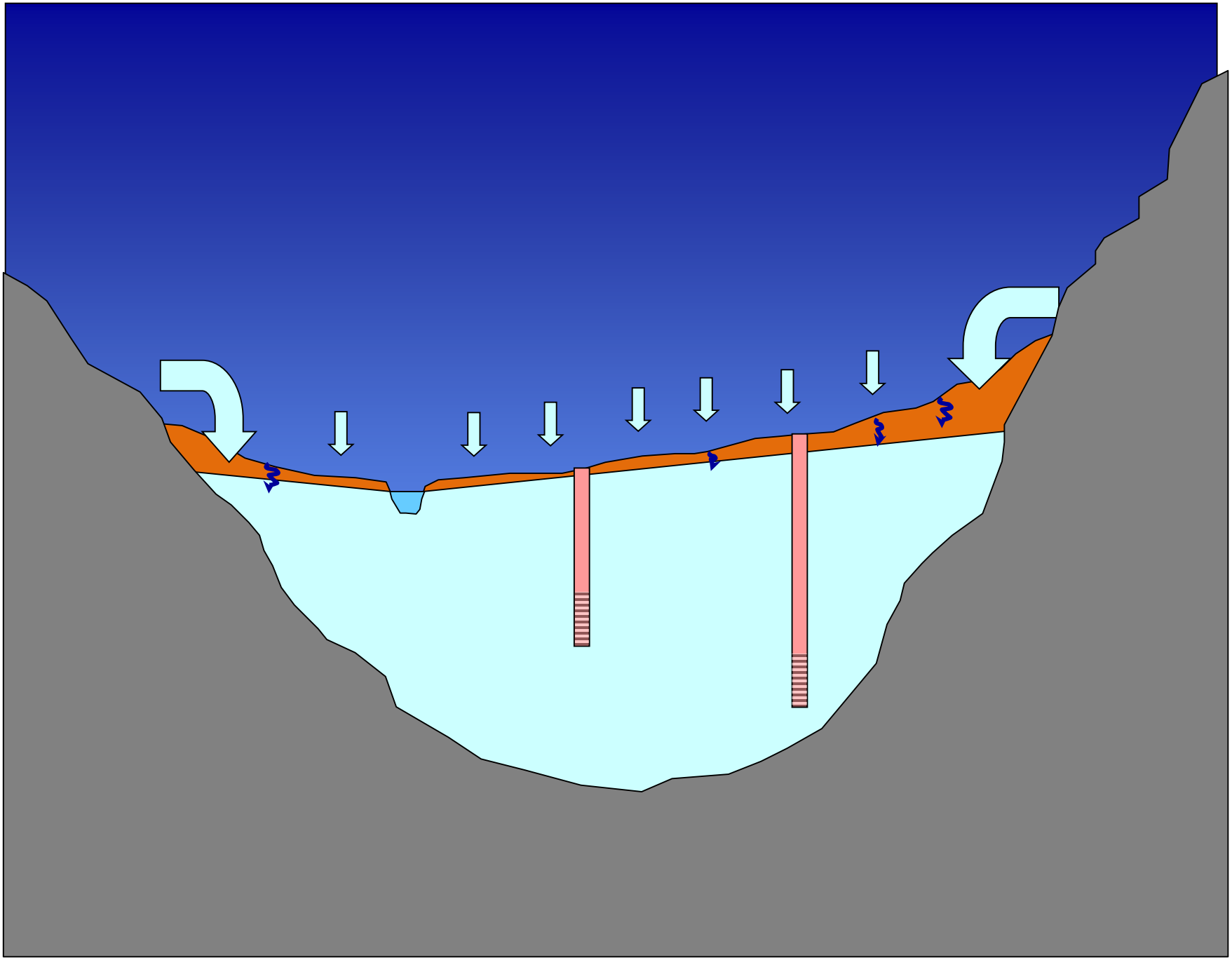


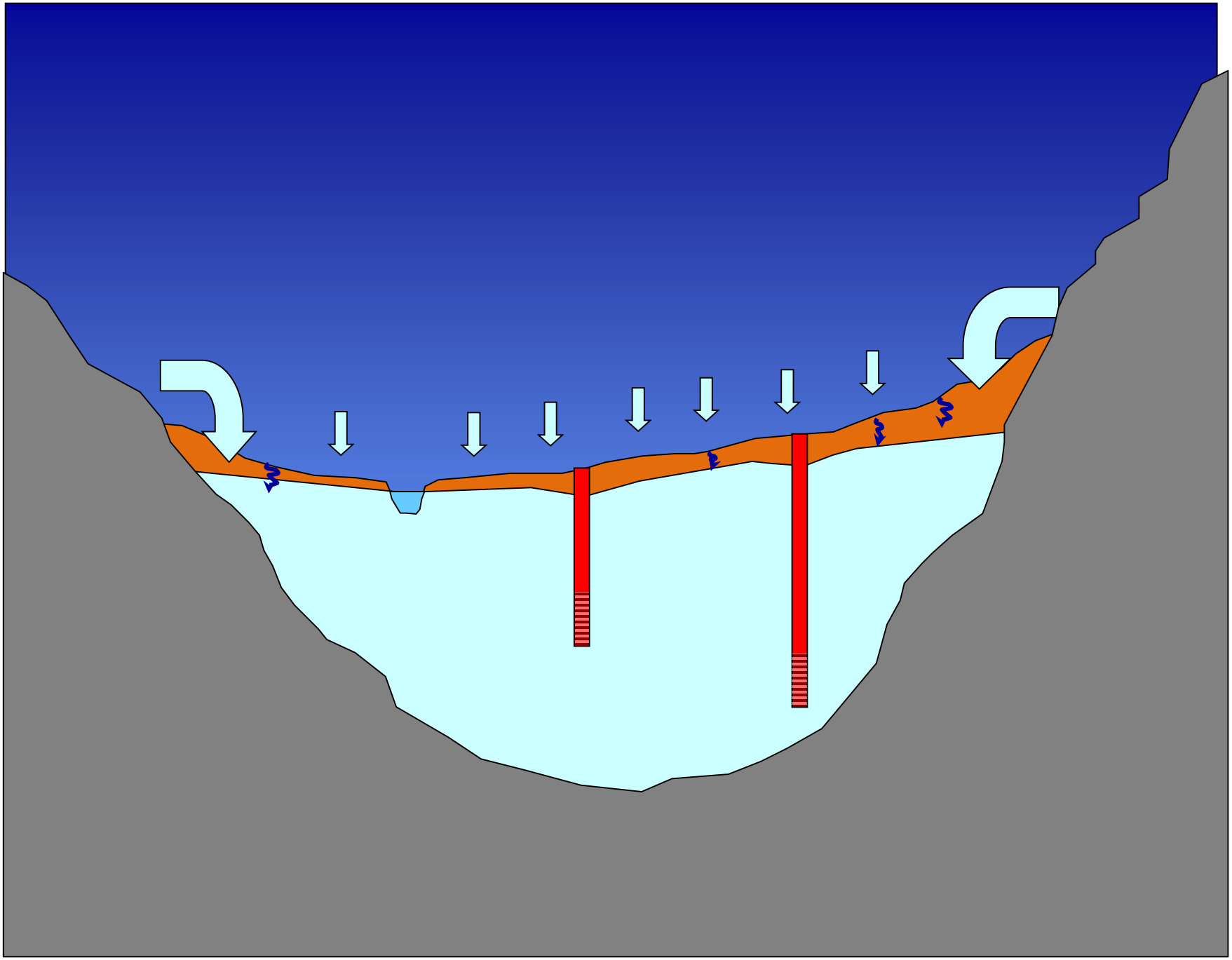


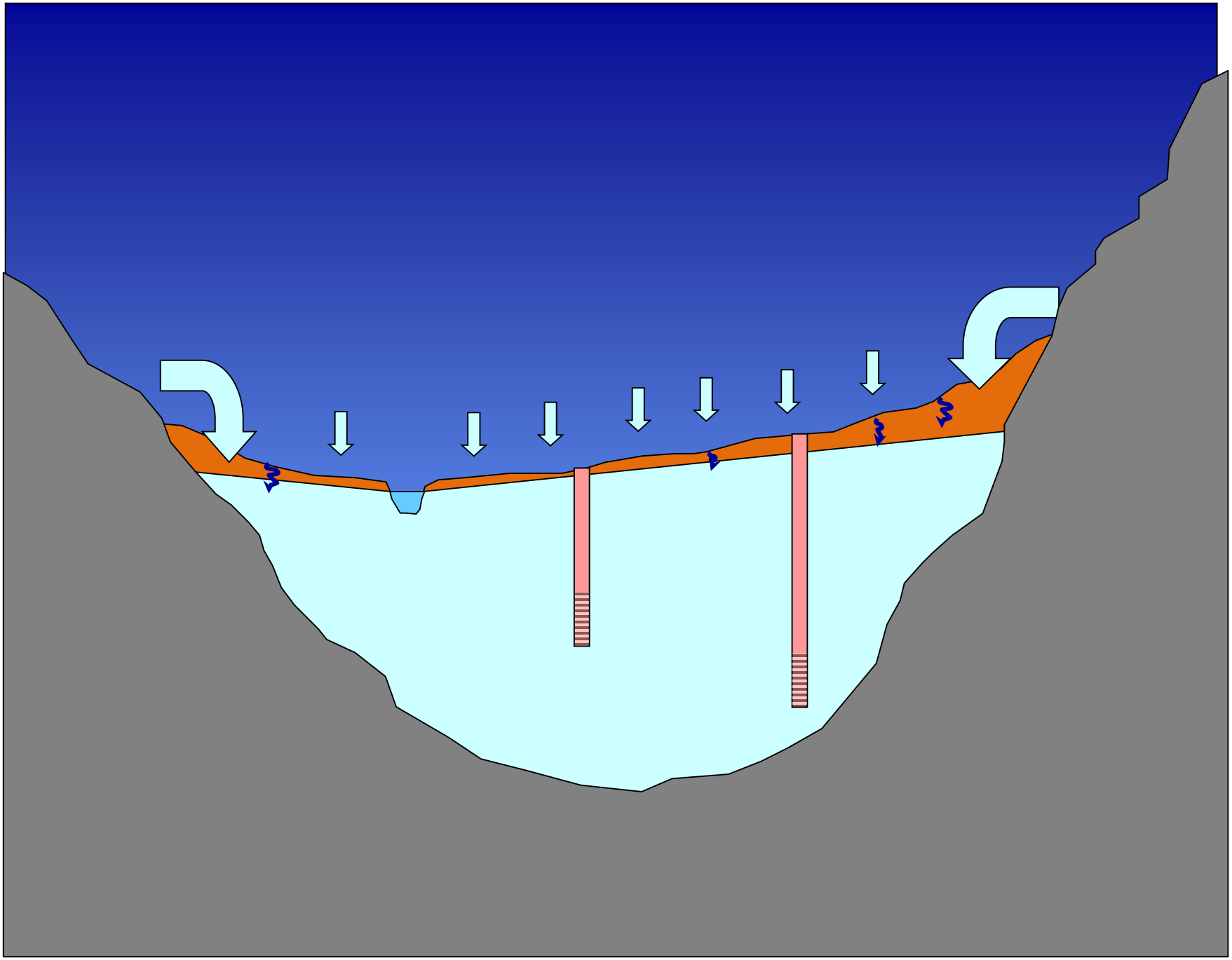


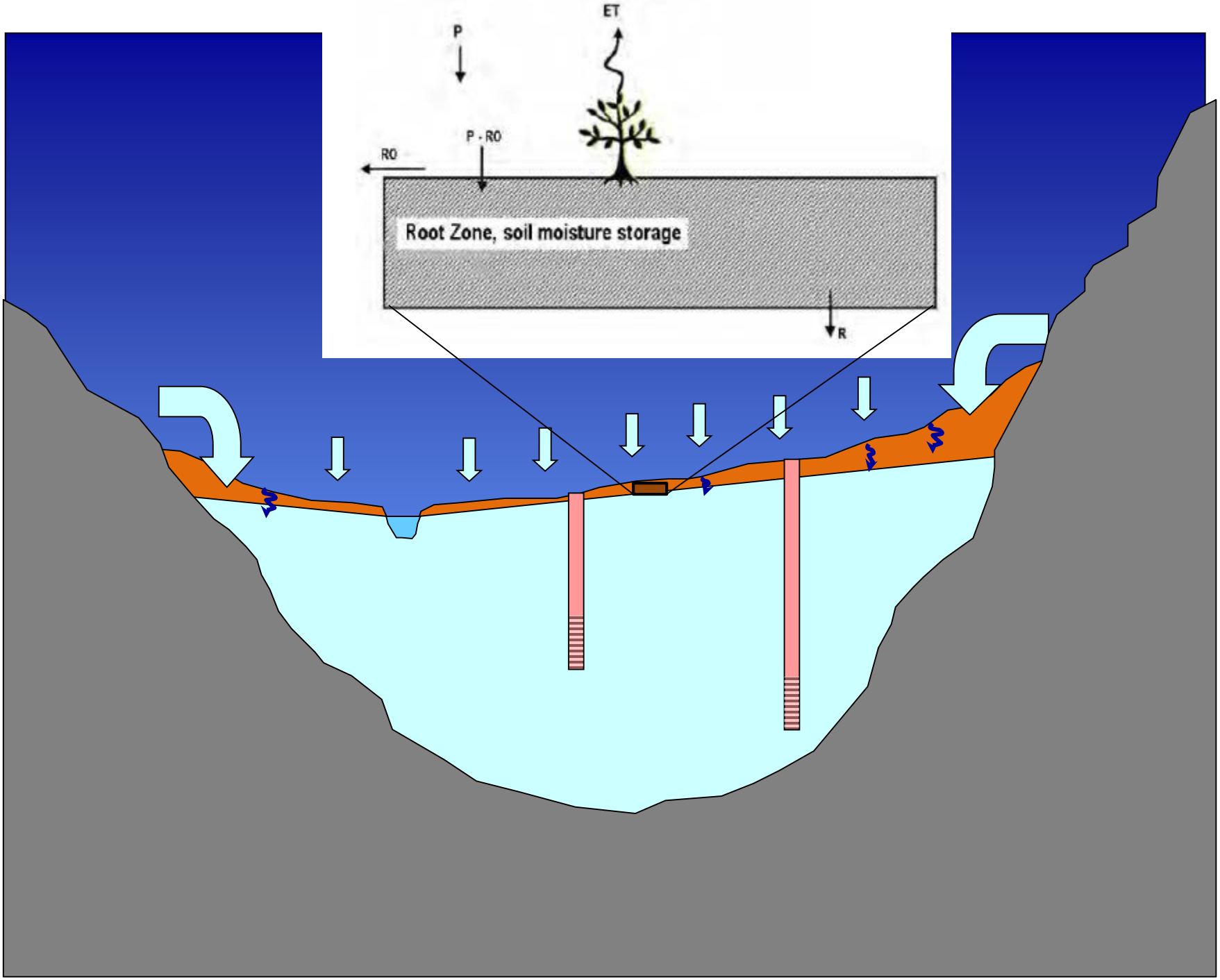




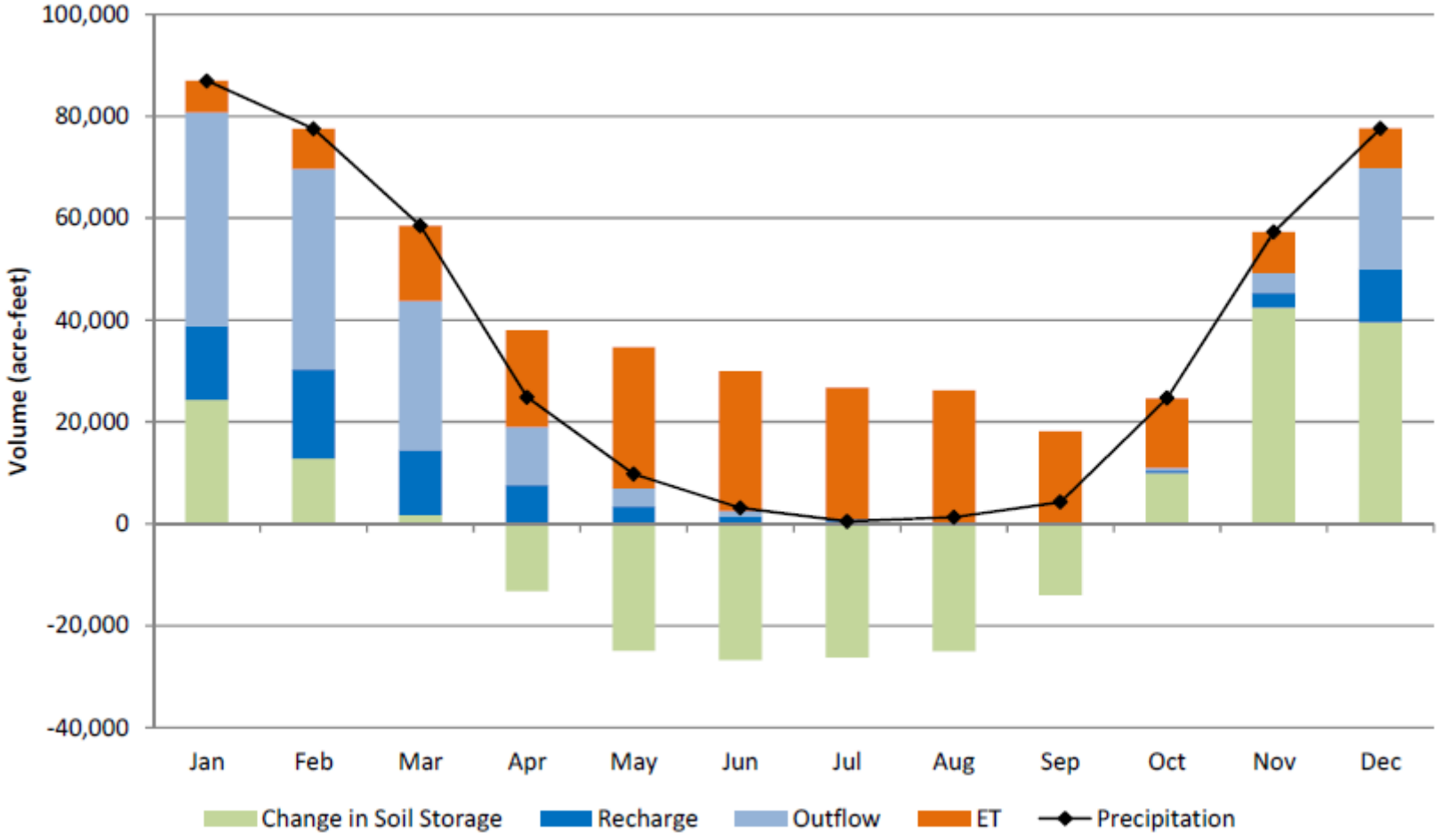







P
ET
P - RO
RO
Root Zone, soil moisture storage
R

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



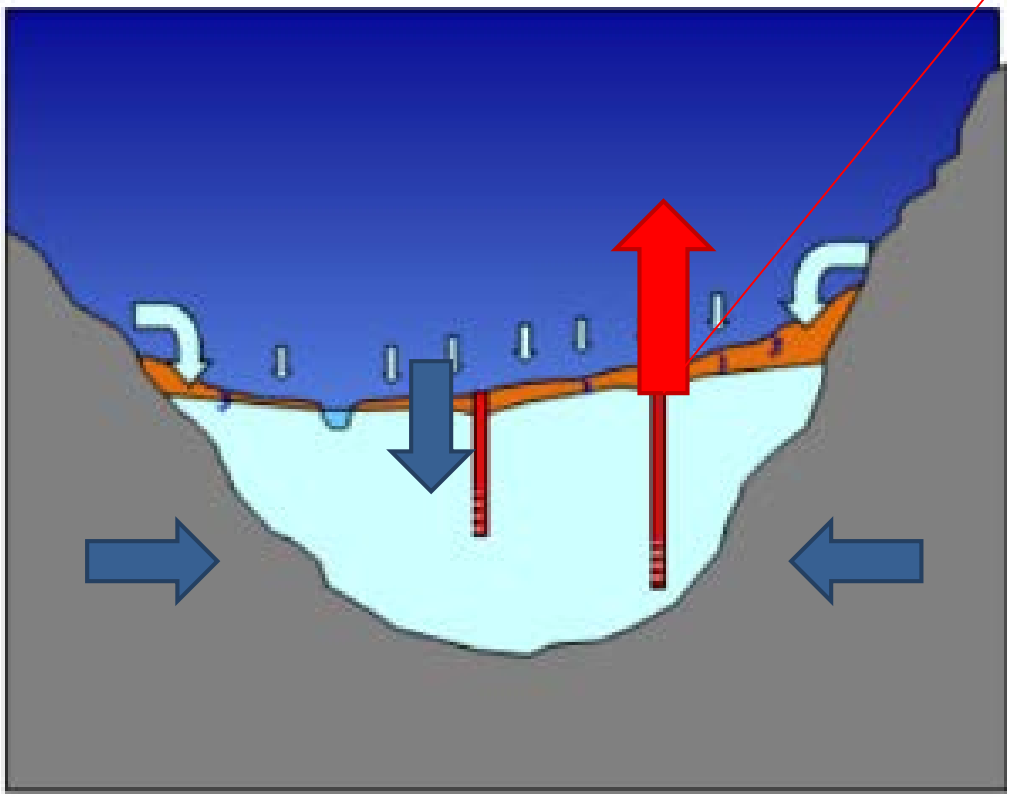
LSCE and MBK, Napa Hydrogeologic Characterization, 2013

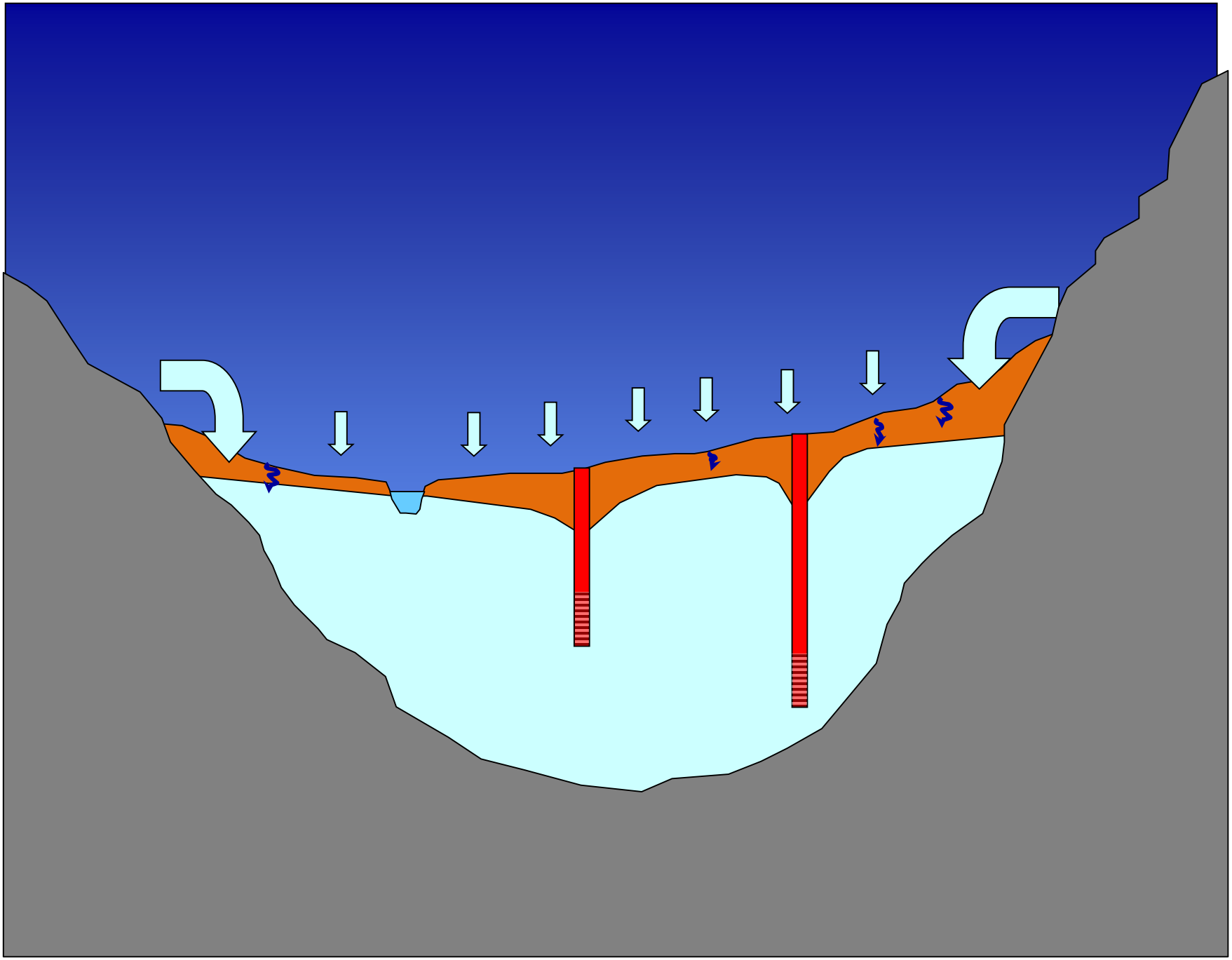
Watershed Water Budget: Sierra Valley

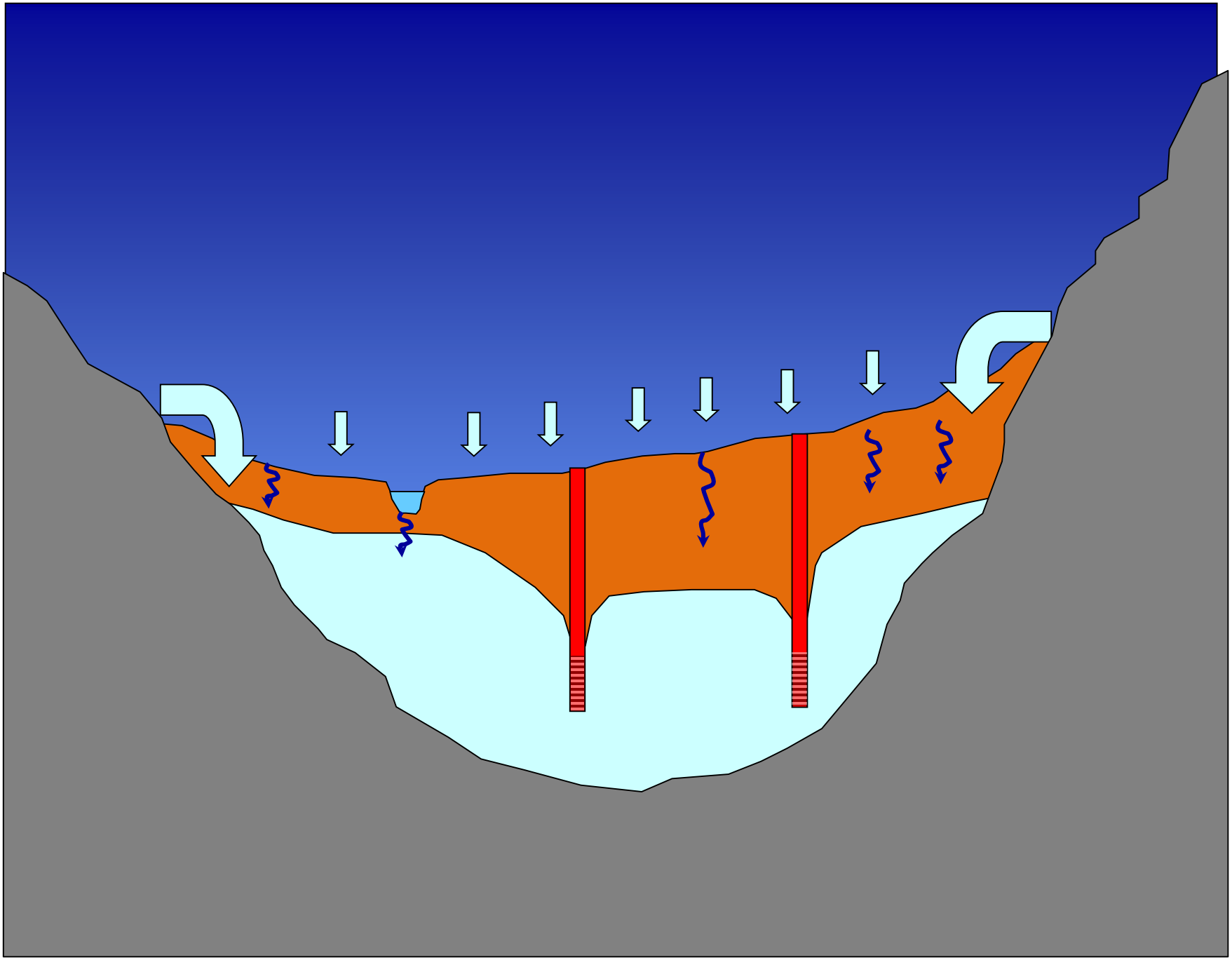
Estimated Groundwater Pumping:

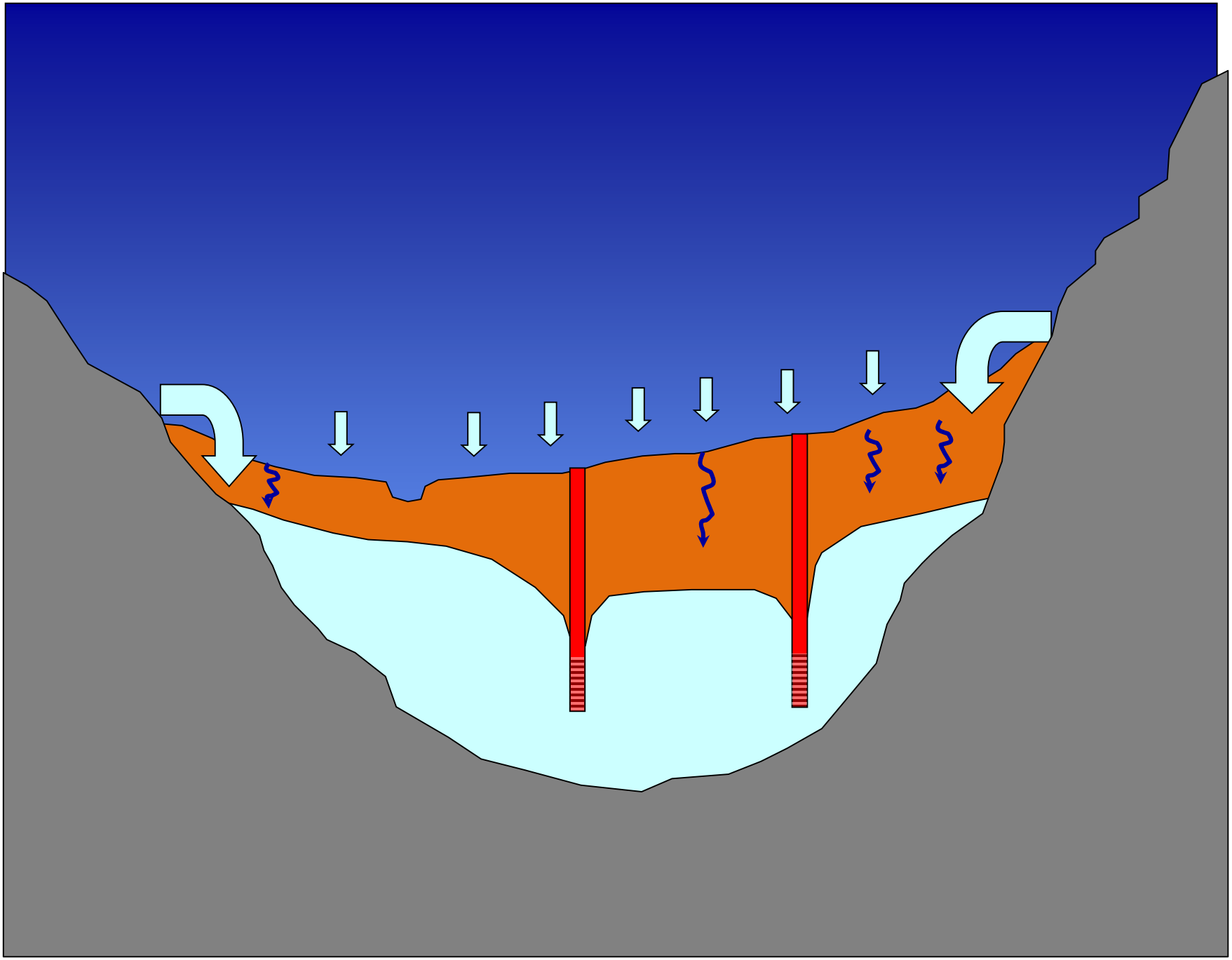
3,500 acre-feet

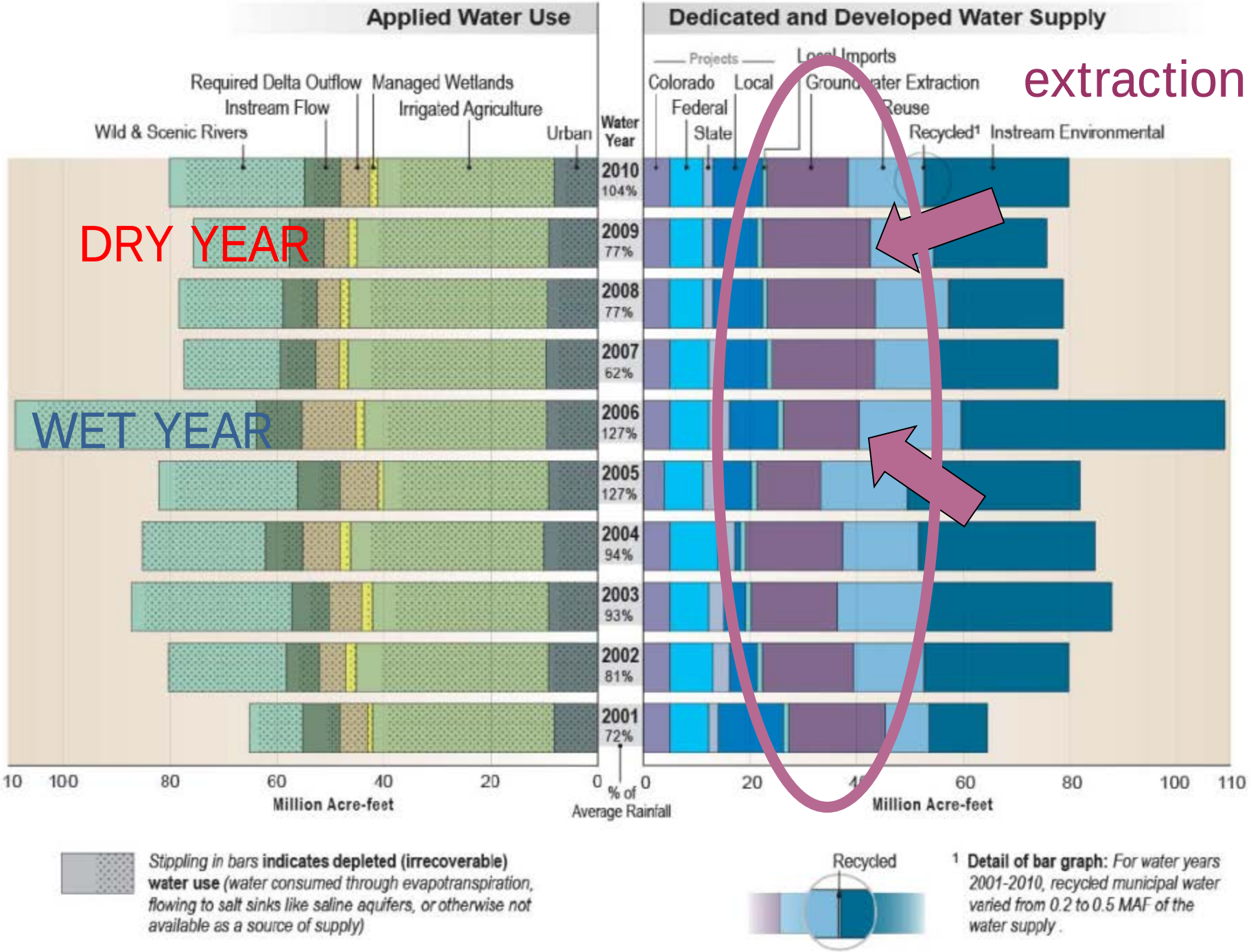
(DWR 2015)





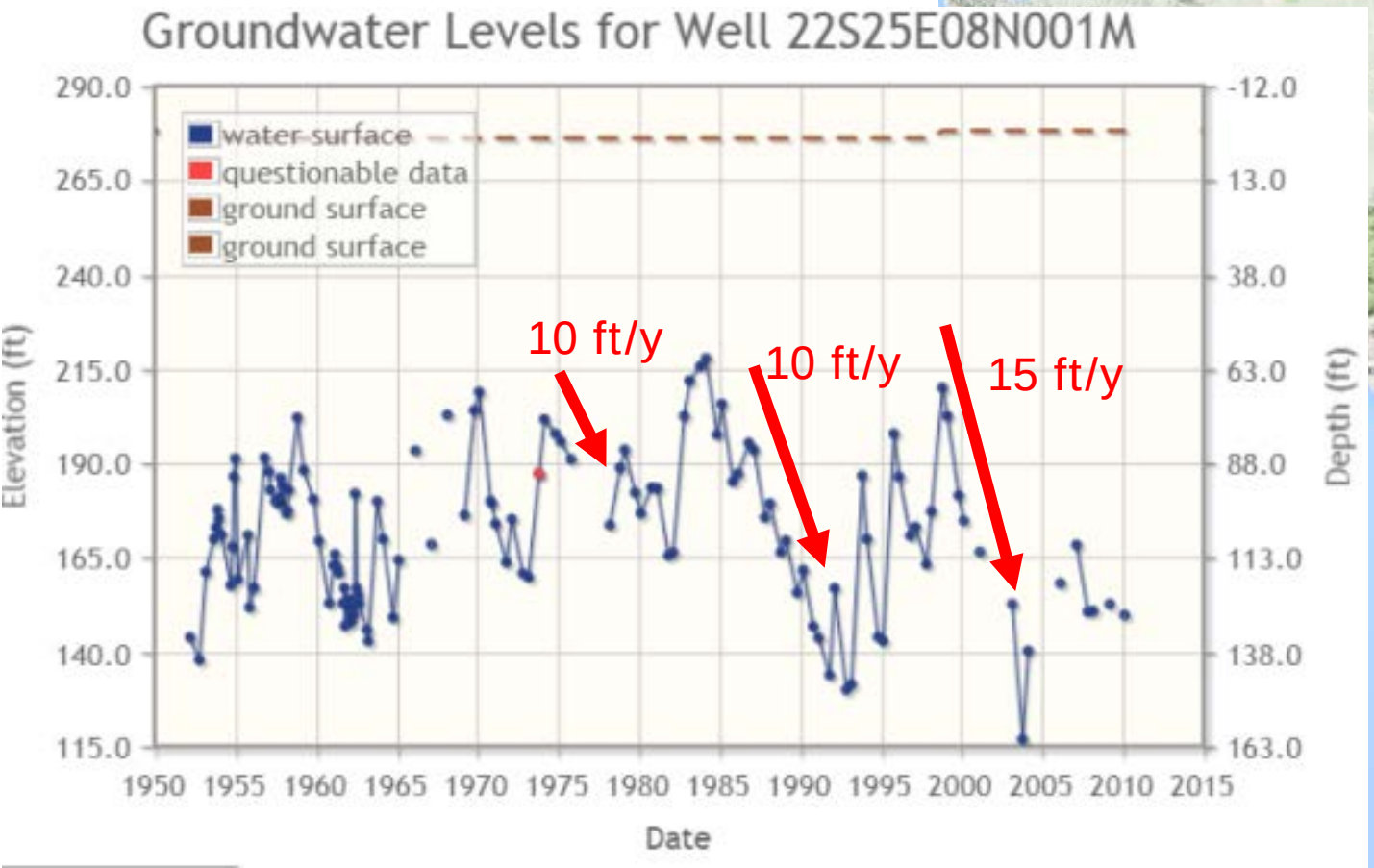


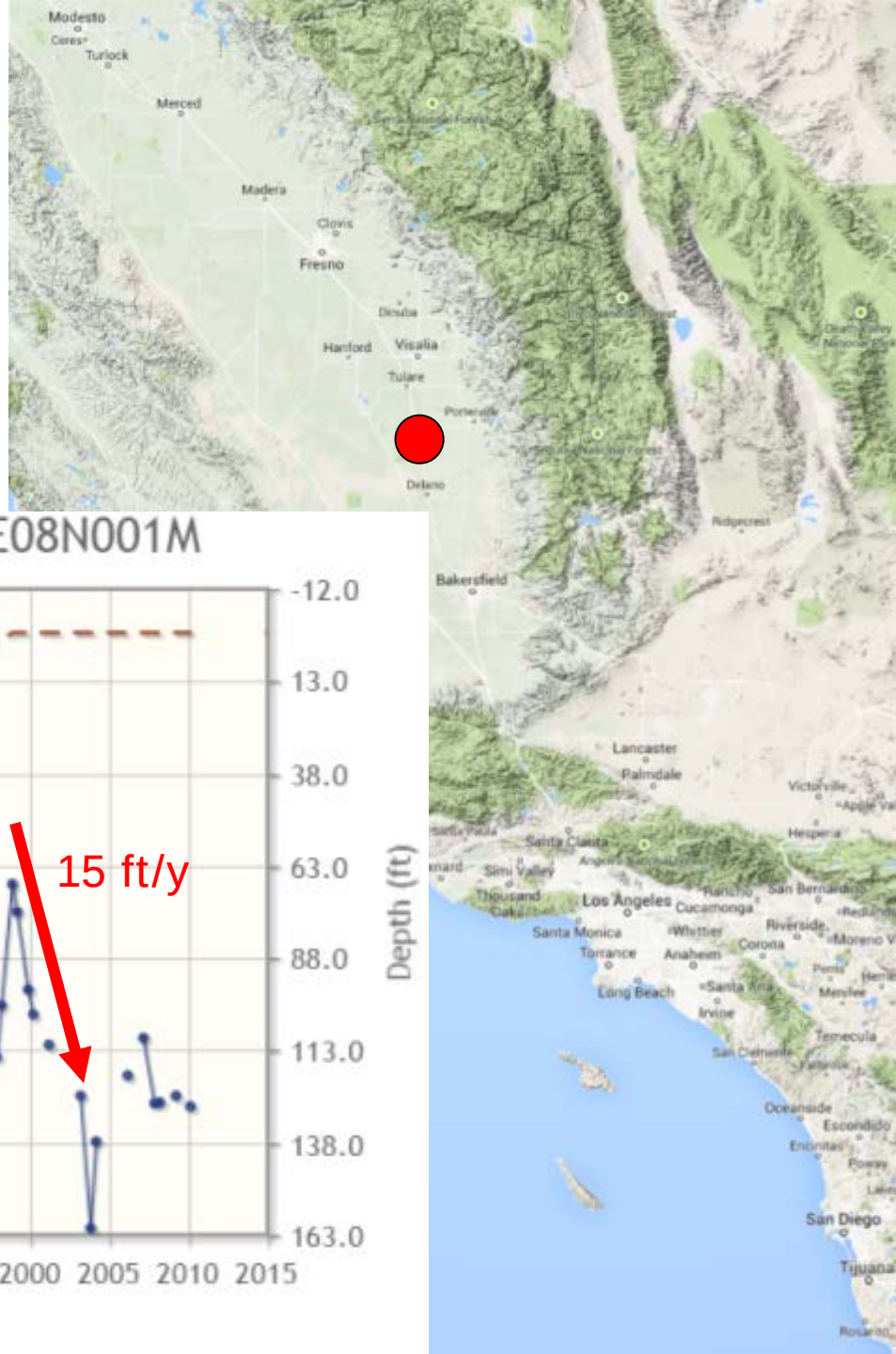




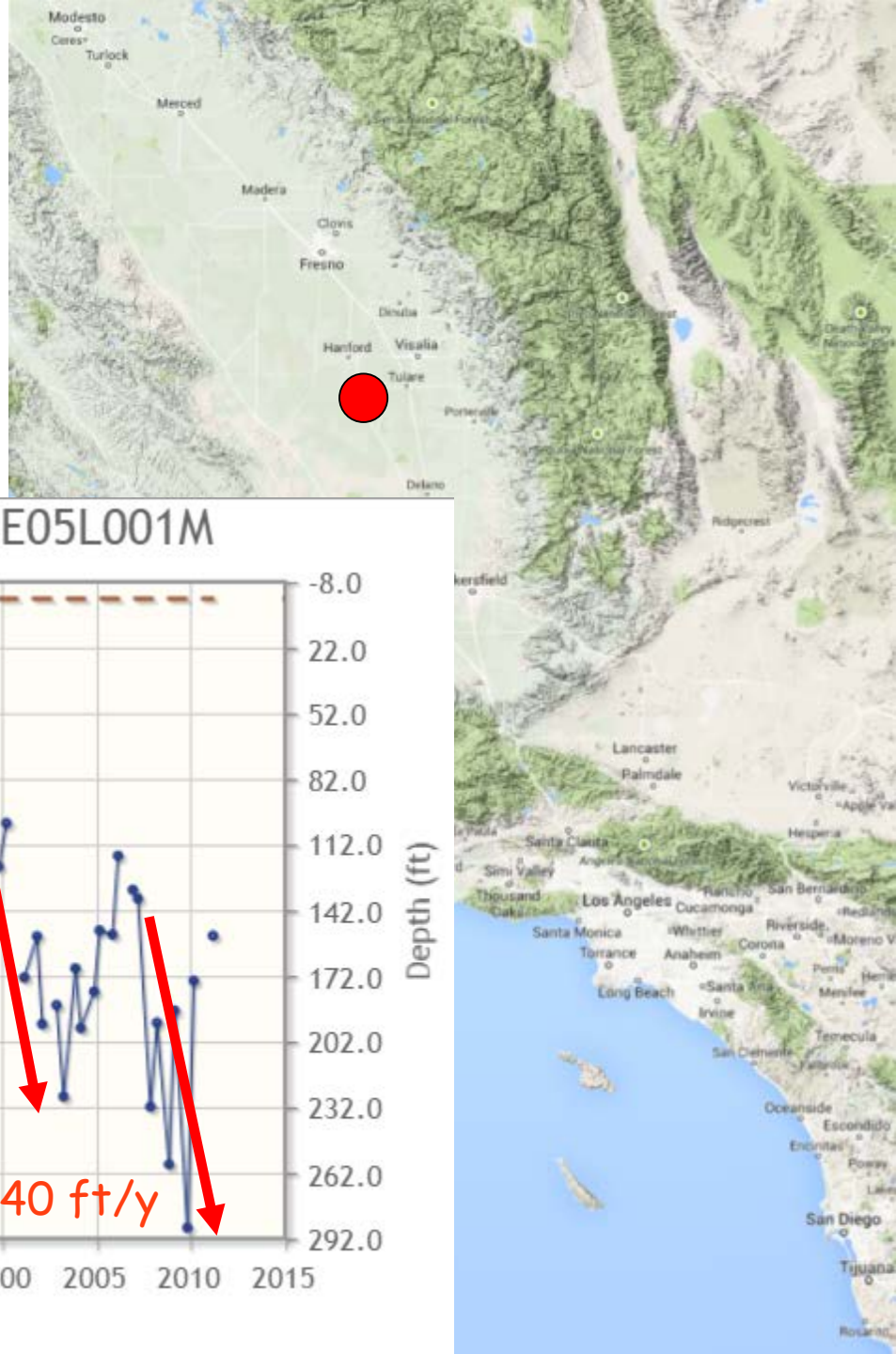
From: DWR California Water Plan 2013 - Draft (Bulletin 160-2013)

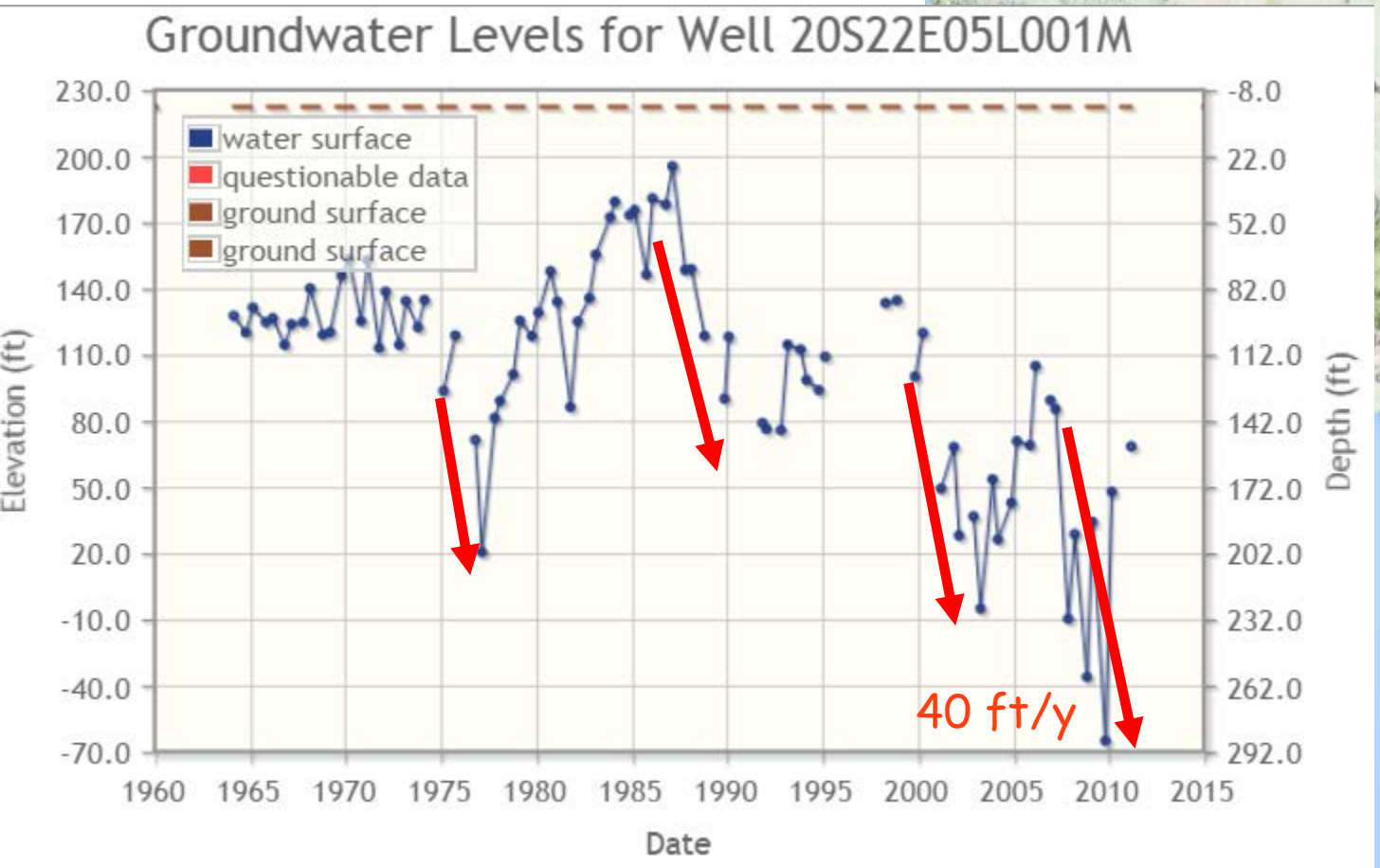
Groundwater Levels during Drought

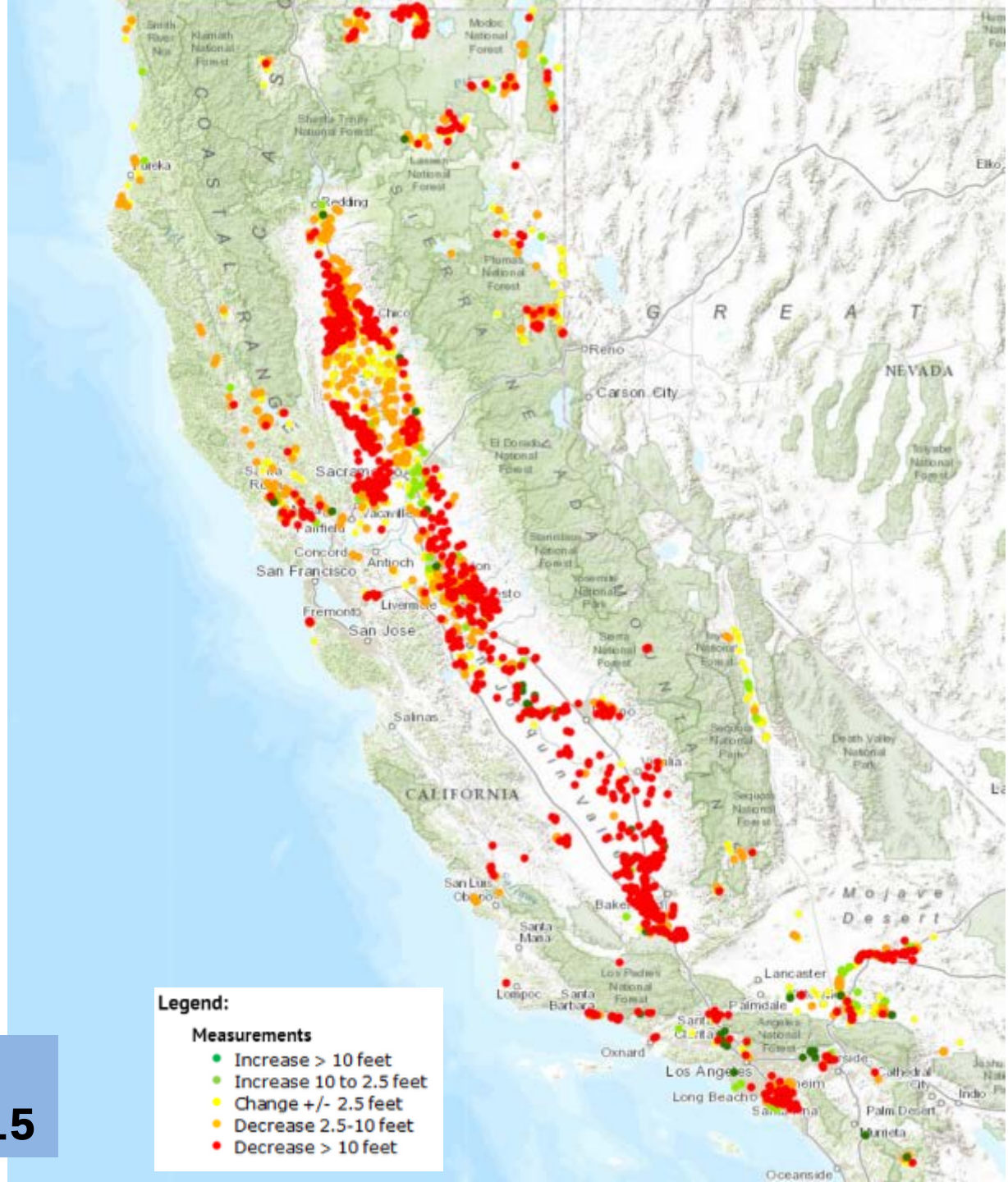




Groundwater Levels during Drought



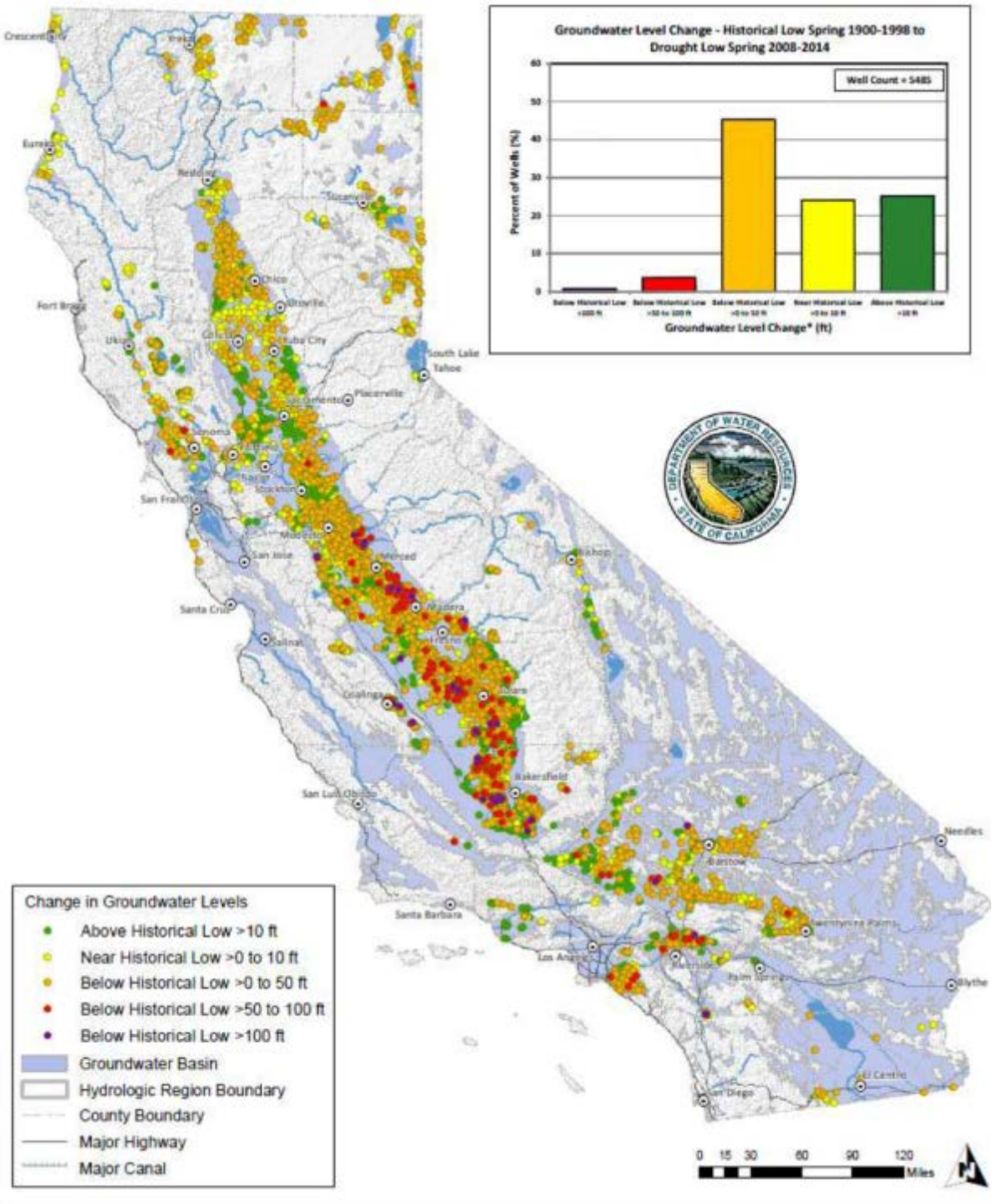




Water Level Change
Spring 2005 – Spring 2015

Change in Groundwater Level

Record Low 20th Century to Drought 2008-2014



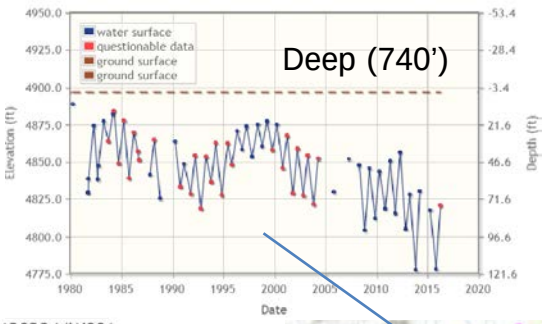
http://www.water.ca.gov/waterconditions/docs/Drought_Response-Groundwater_Basins_April30_Final_BC.pdf

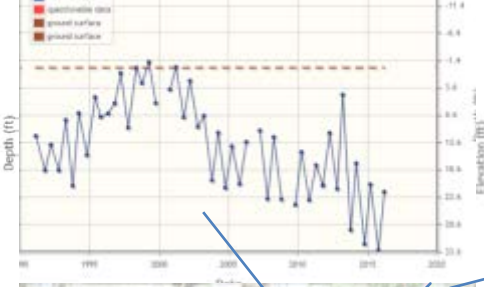
Consequences of Groundwater Overdraft…

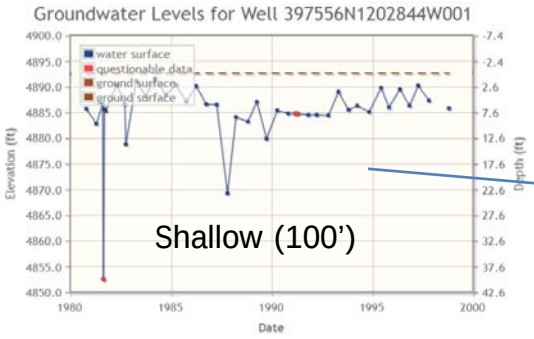
- New well construction cost
- Increased pumping cost / lost pump efficiency
- Land subsidence
- Water quality degradation
- Seawater intrusion
- Surface water depletion
- Impact to groundwater dependent ecosystems

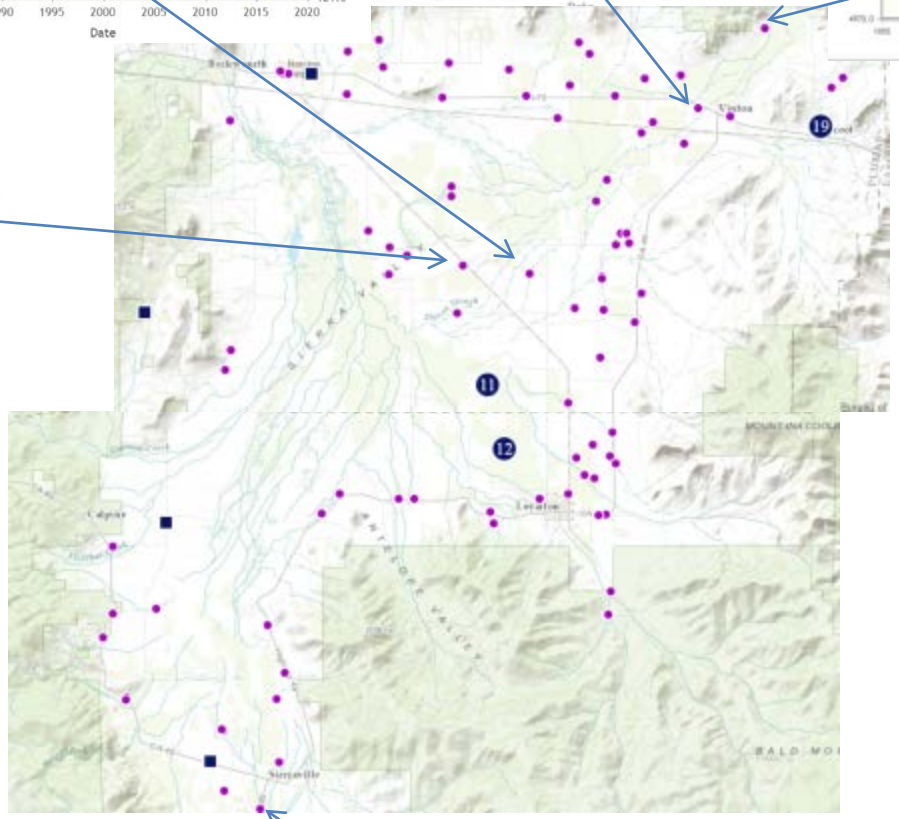
…Long Before Running Out of Groundwater!

Water Level Hydrographs, Sierra Valley









Water Level Map, 2004

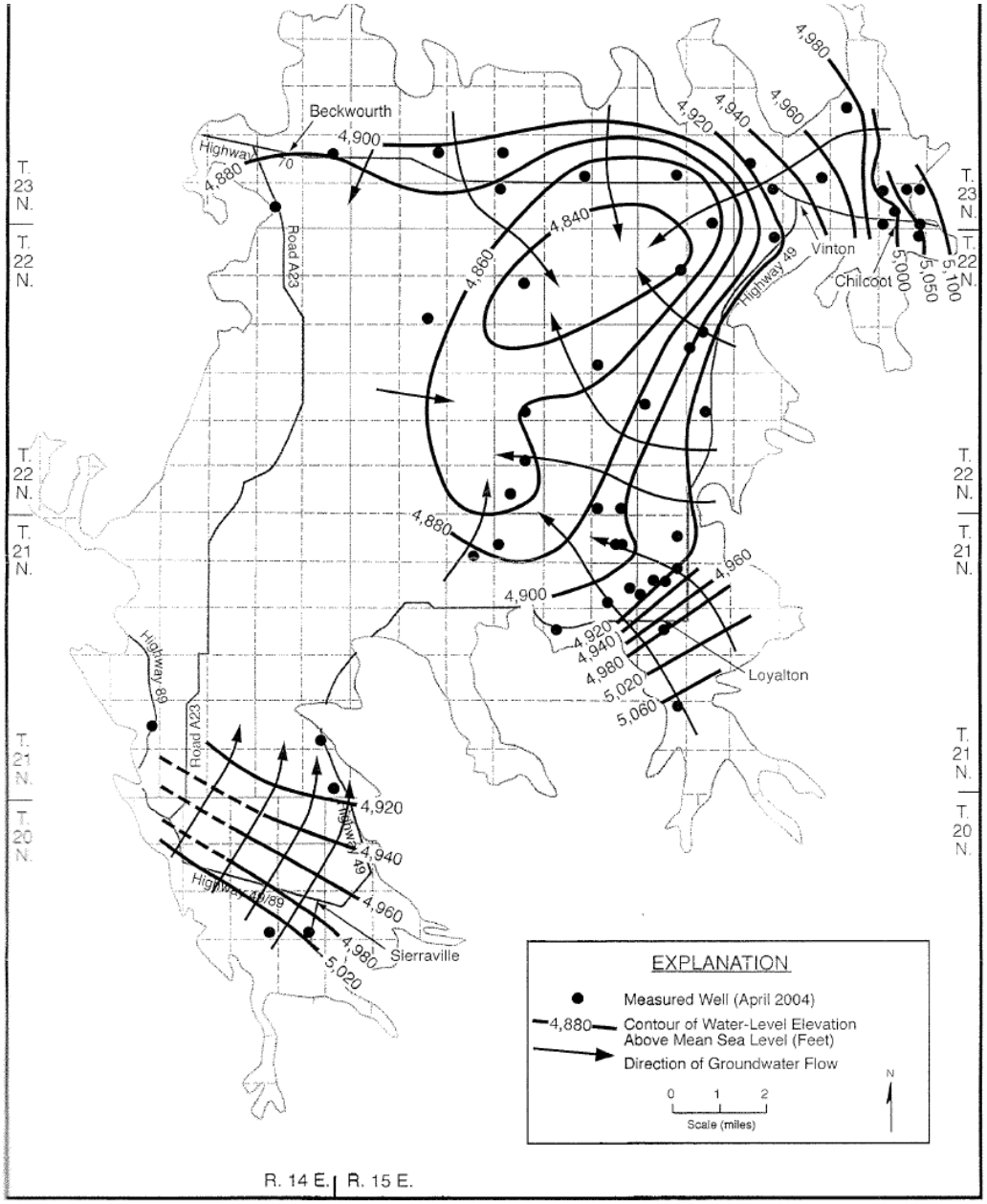
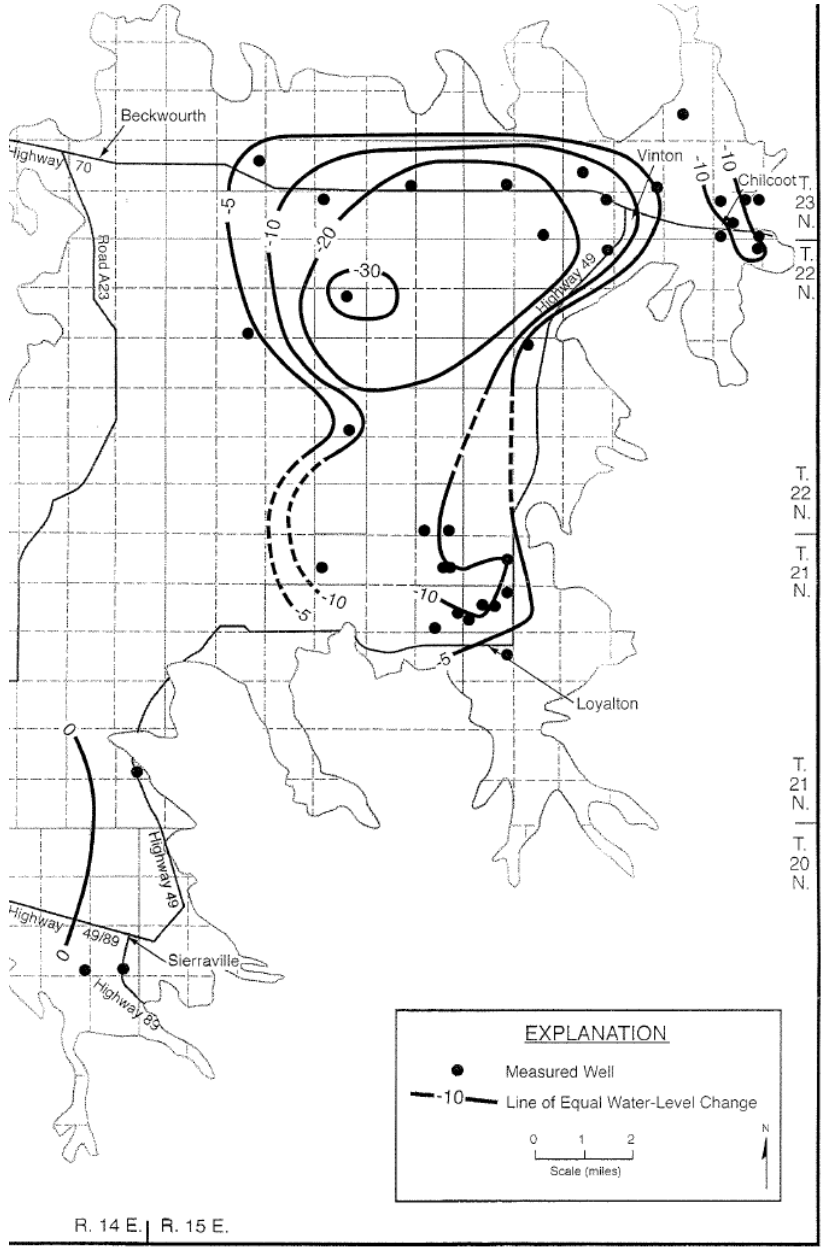


FIGURE 8 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW IN SPRING 2004

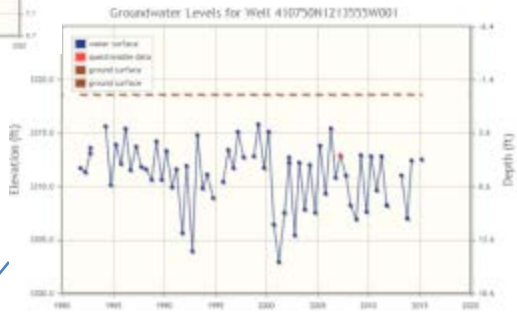
Water Level Change 1998-2005

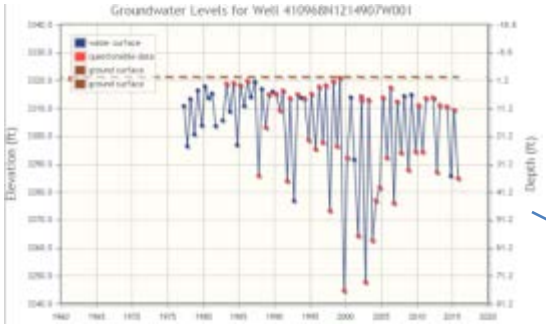


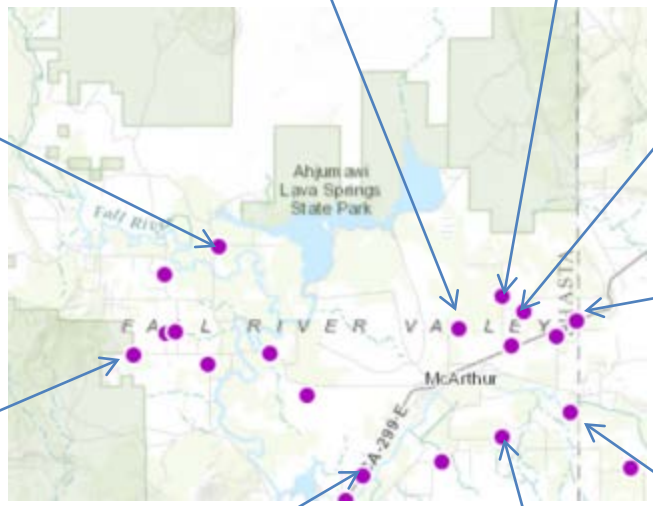
WATER-LEVEL CHANGES FOR SPRING 1998 - SPRING 2005

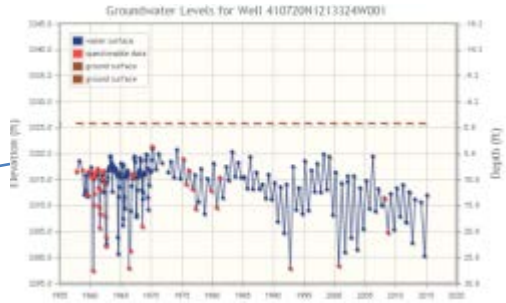
Source: K. Schmidt, 2005

Water Level Hydrographs, Fall River Valley

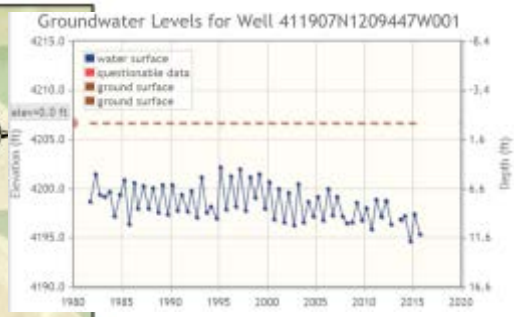


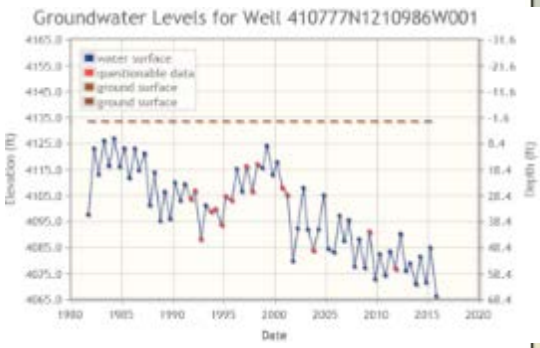


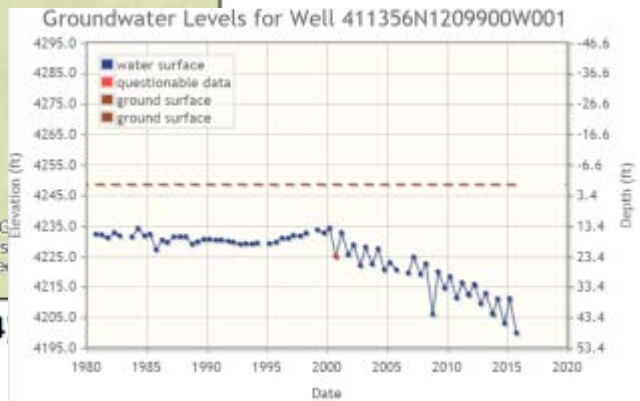




Water Level Hydrographs, Big Valley



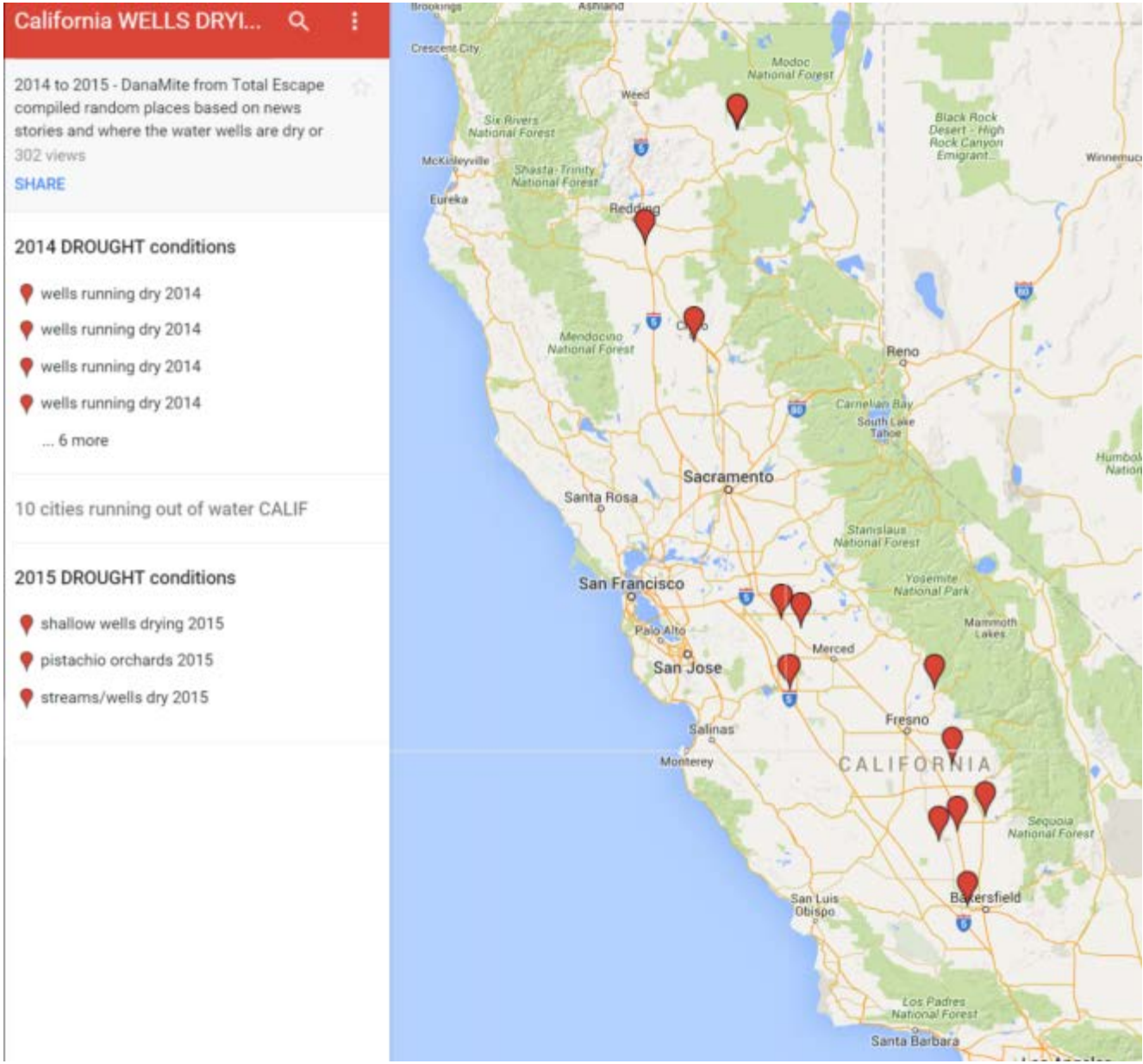




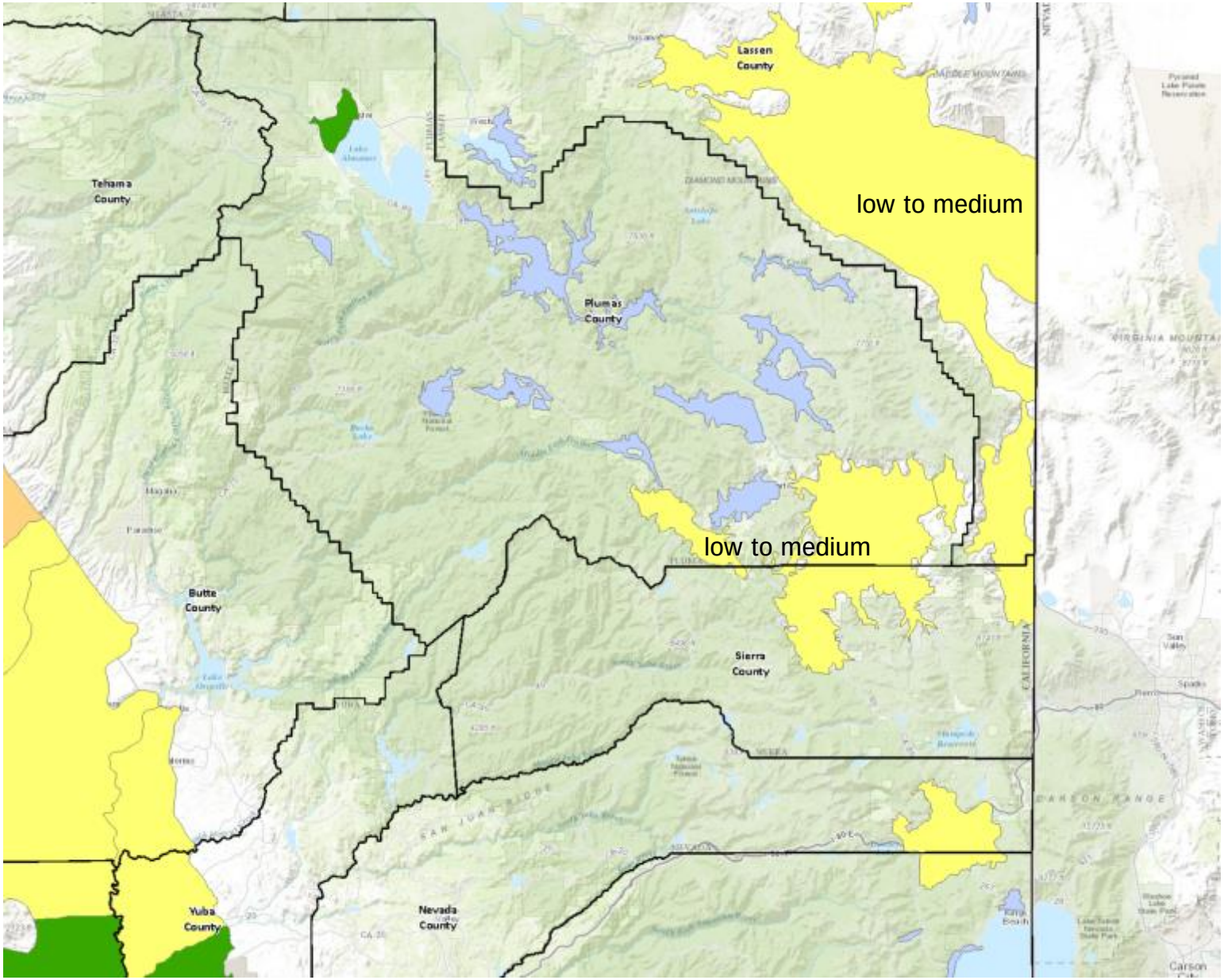
Monitoring Wells: Big Valley (subbasin 5-4

Scale 1:130,000

Wells Drying Up



Subsidence Risk, Modoc County



modified from CA DWR, 2014

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:
    - Right of water users to negotiate physical "equitable, practical" solution, regardless of water rights
    - Individual water rights holders cannot be forced into a voluntary agreement

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    - Right of water users to negotiate physical "equitable, practical" solution, regardless of water rights
    - Individual water rights holders cannot be forced into a voluntary agreement
- State groundwater management:
  - Voluntary local groundwater management plans: AB 3030 (1992)
  - 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**.

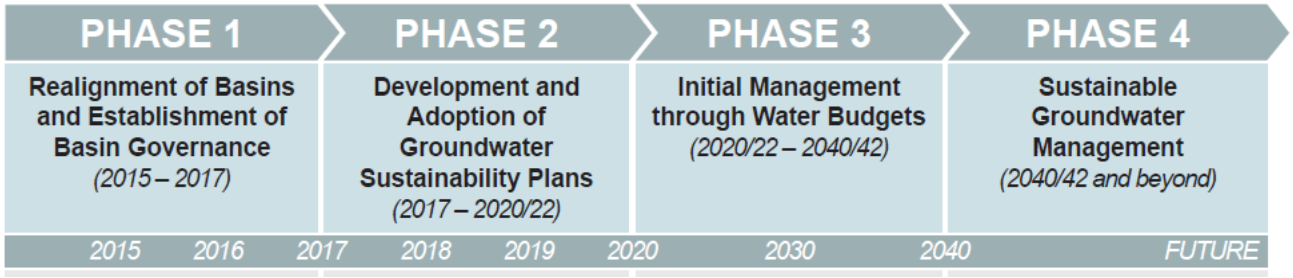
(4) Significant and unreasonable **degraded water quality**, including the migration of contaminant plumes that impair water supplies.

(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?



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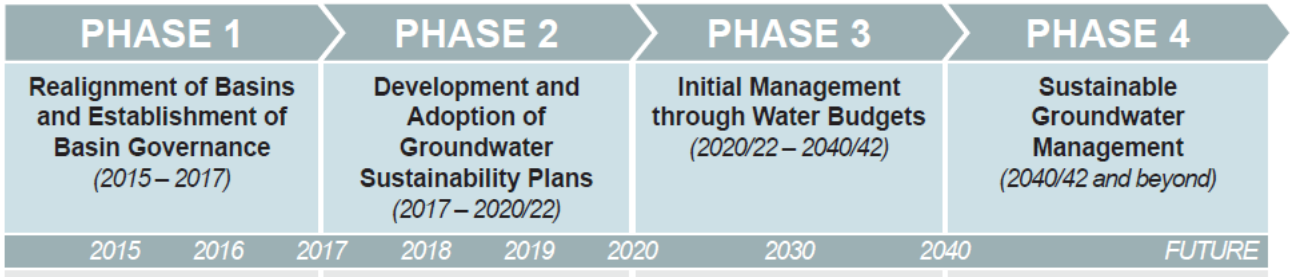
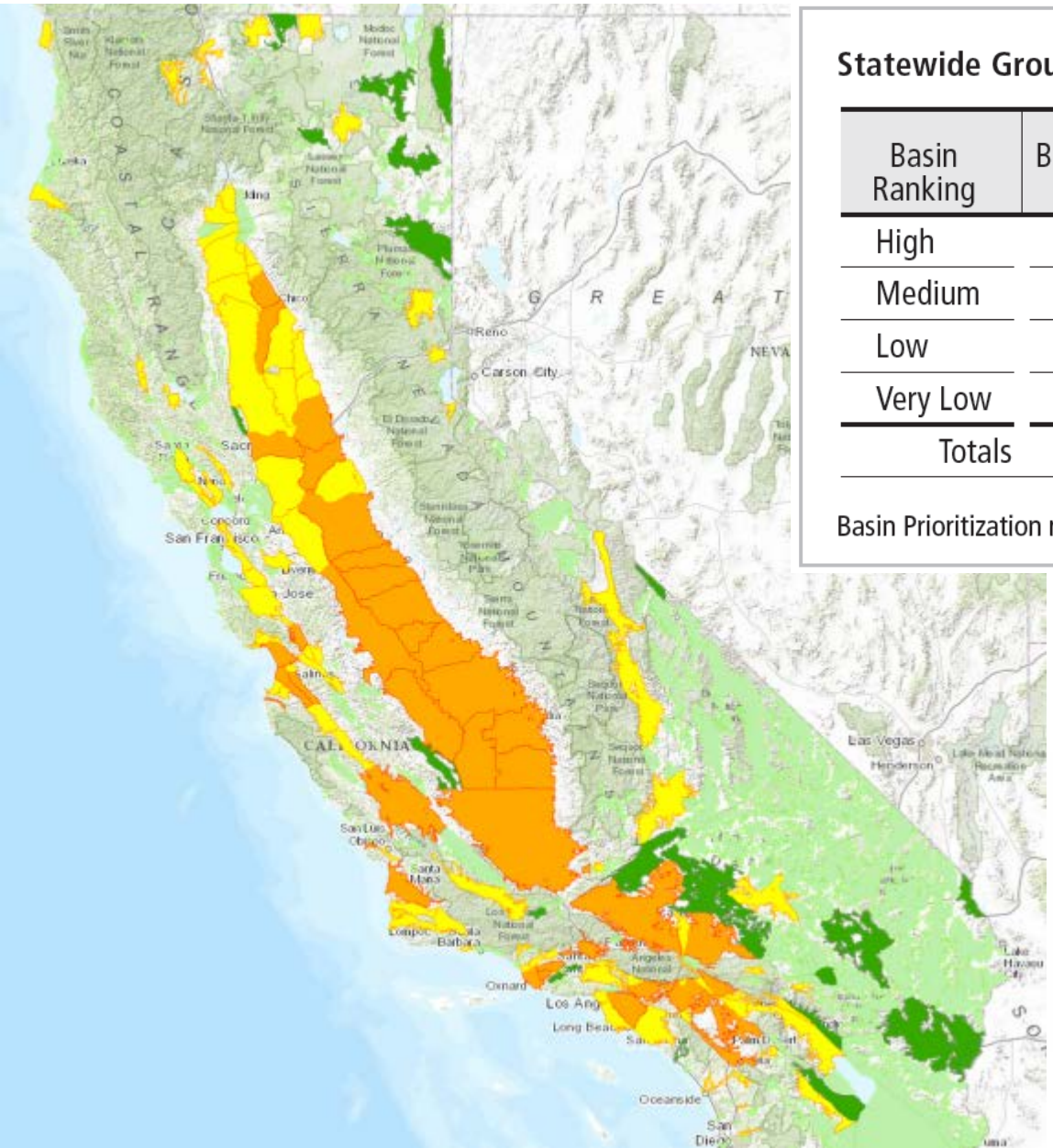


- **First Step: forming a Groundwater Sustainability Agency (GSA)**
  - By June 2017

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%

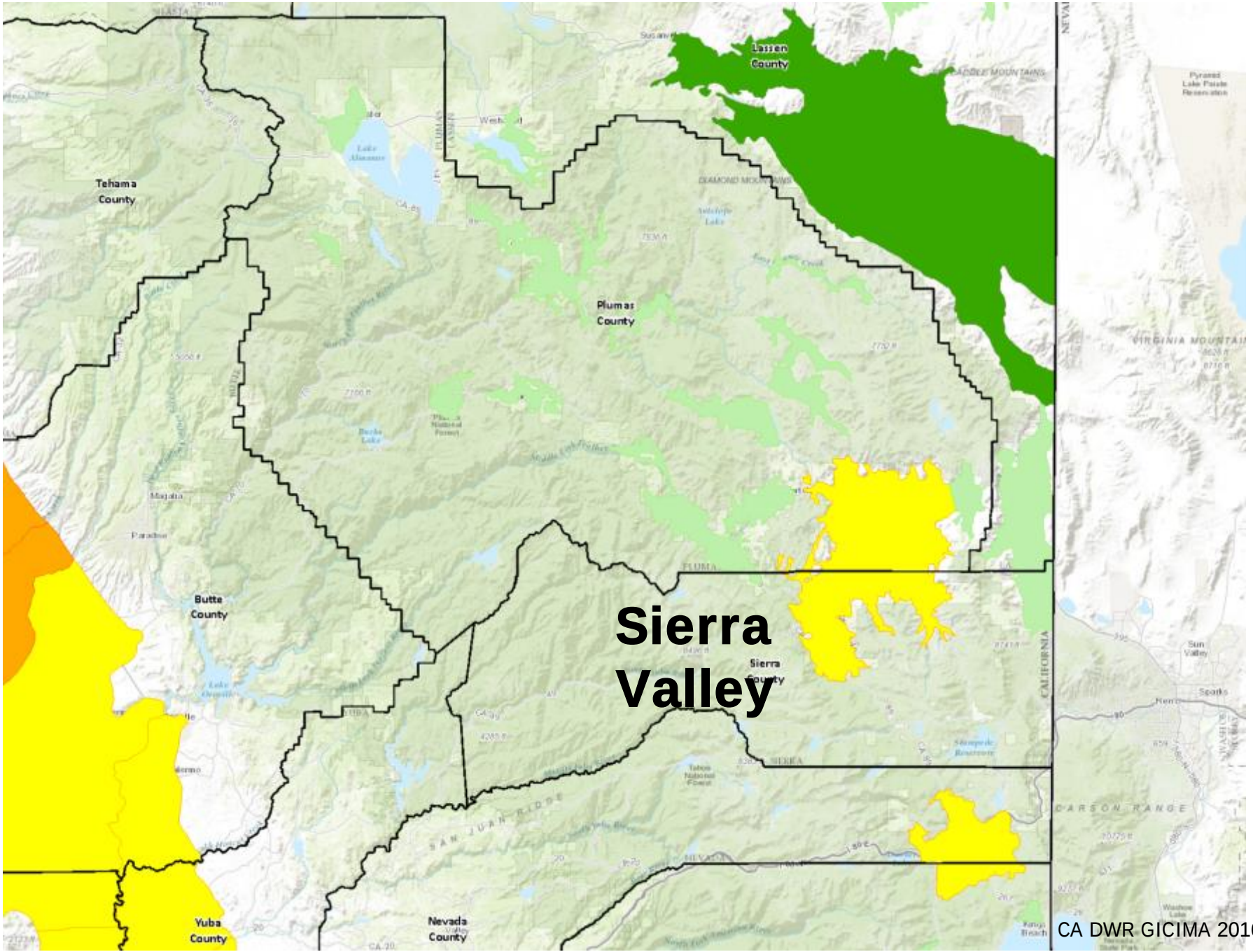
Basin Prioritization results – June 2, 2014

CASGEM Groundwater Basin Prioritization

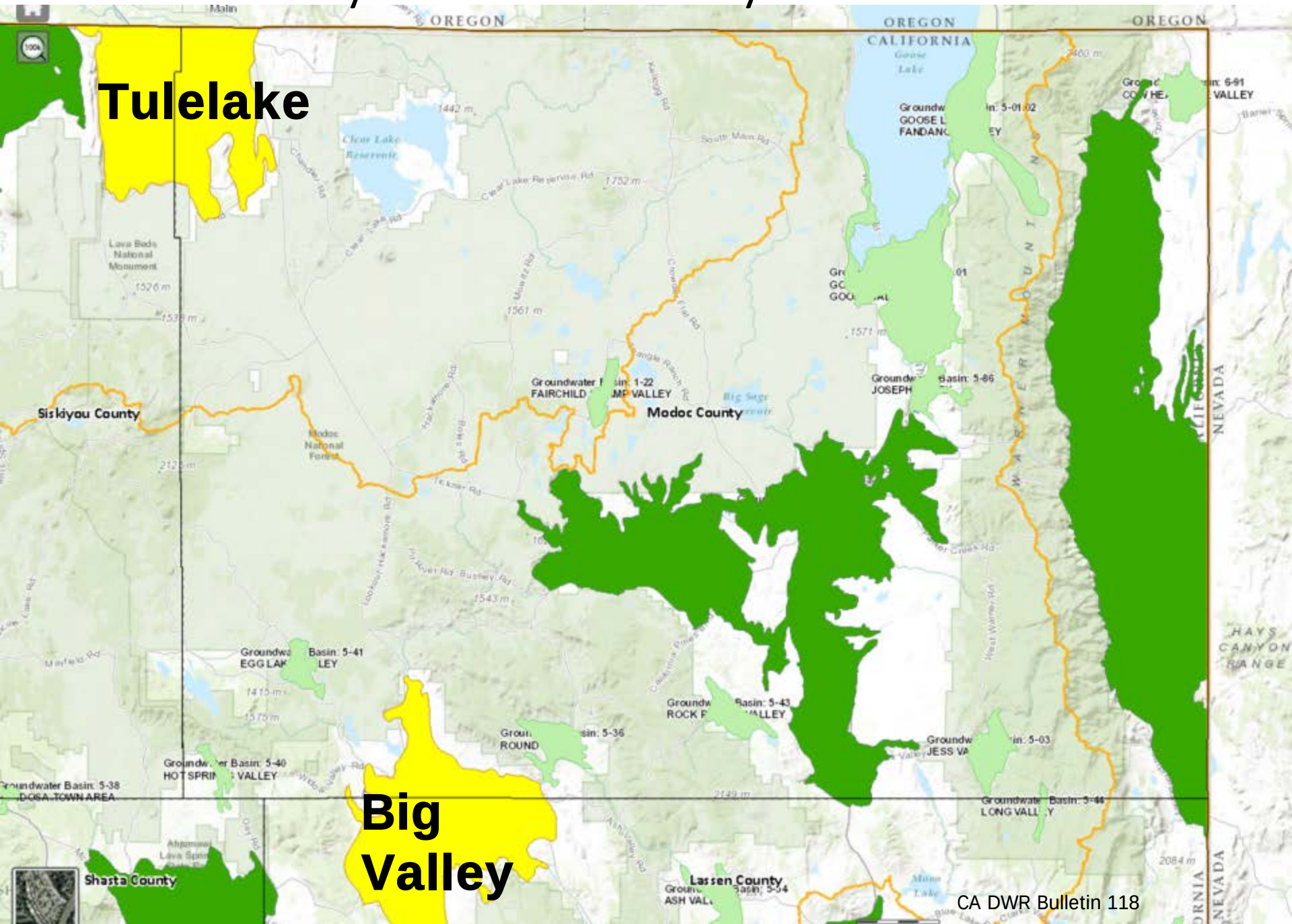
- High
- Medium
- Low
- Very Low

California Department of Water Resources, 2015

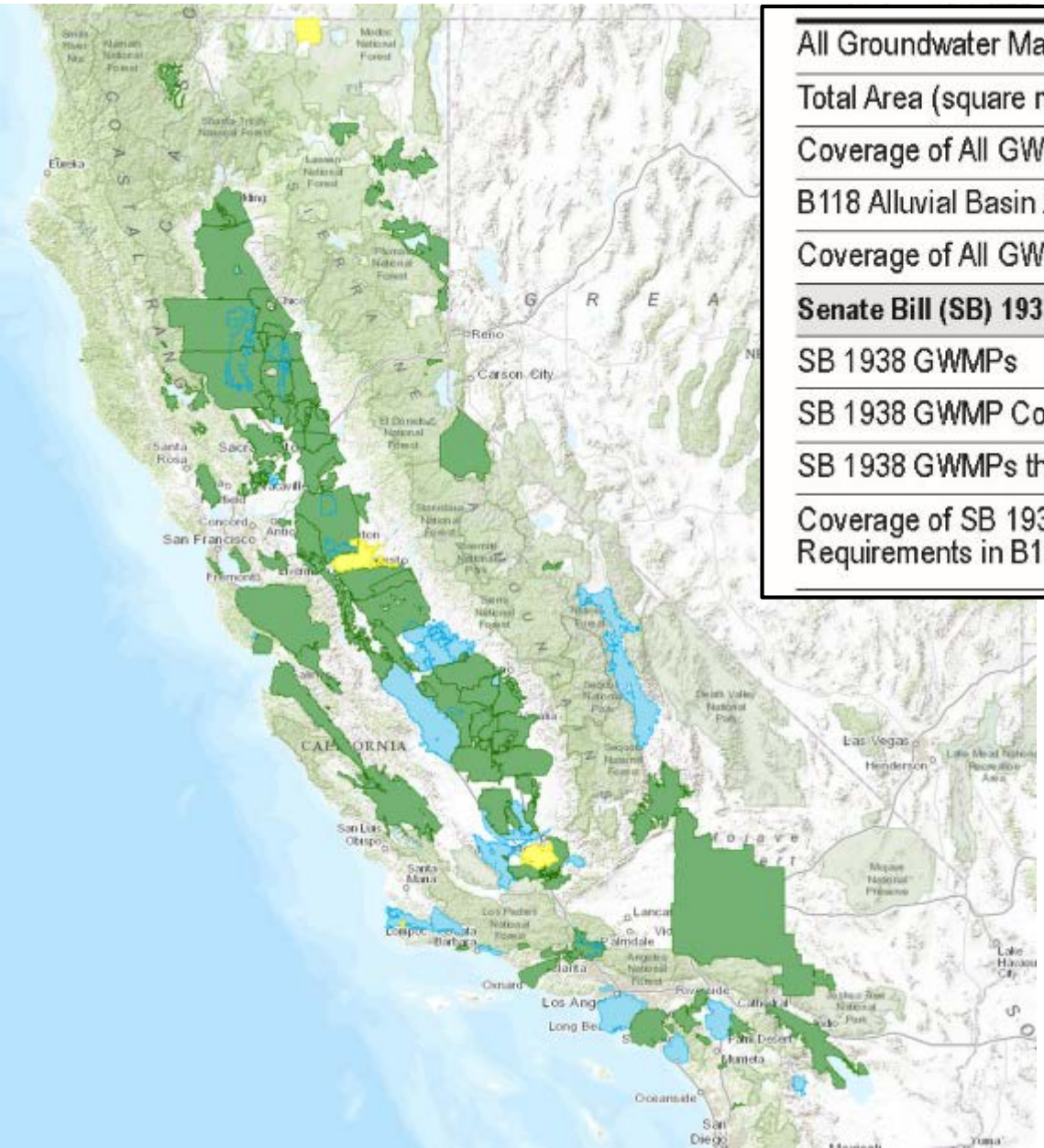
Plumas and Sierra County: 1 Medium Priority Groundwater Basin



Modoc County: 2 Medium Priority Groundwater Basins



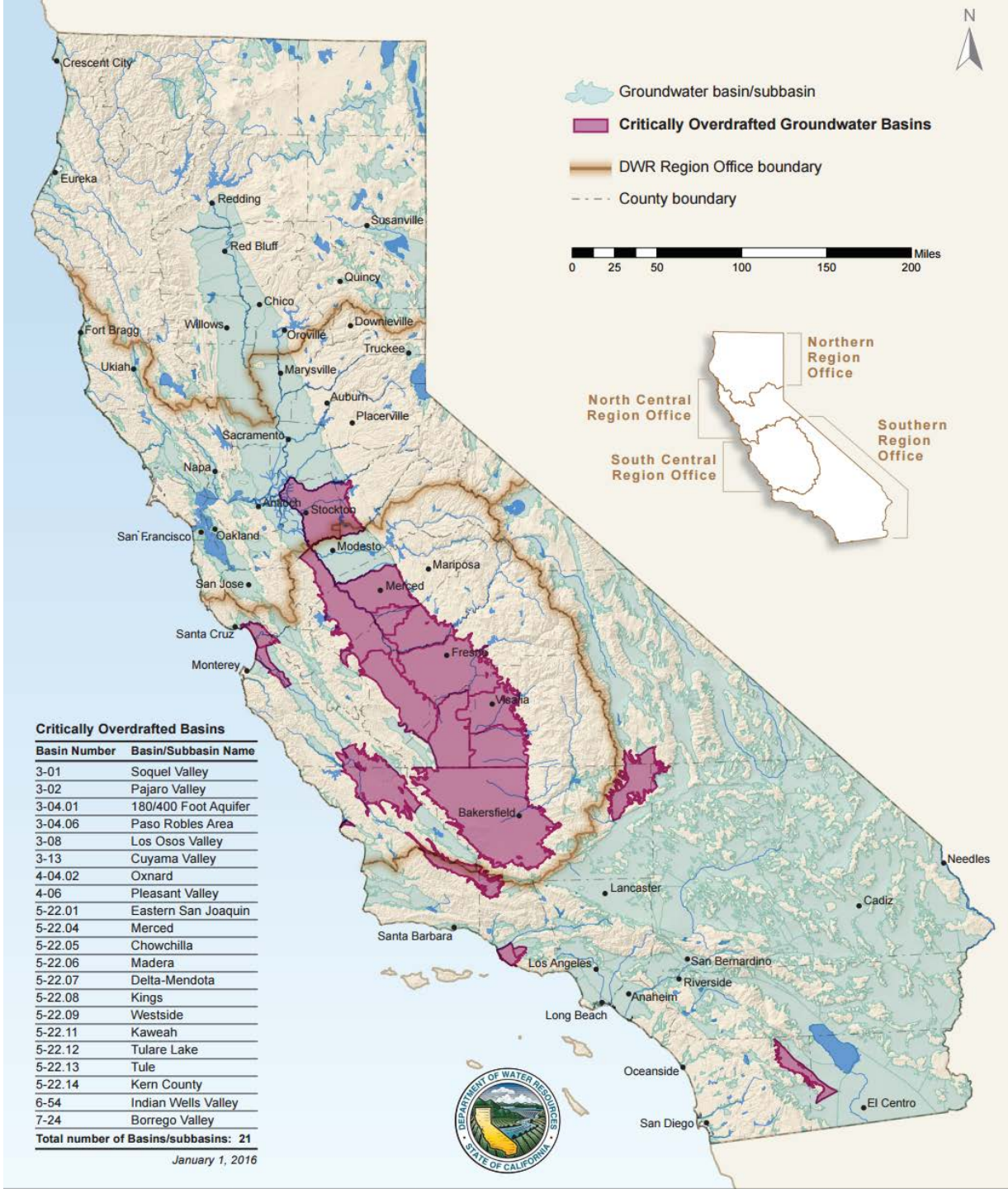
Existing Groundwater Management Plans: Inventory and Assessment (No or Limited Implementation)



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%

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

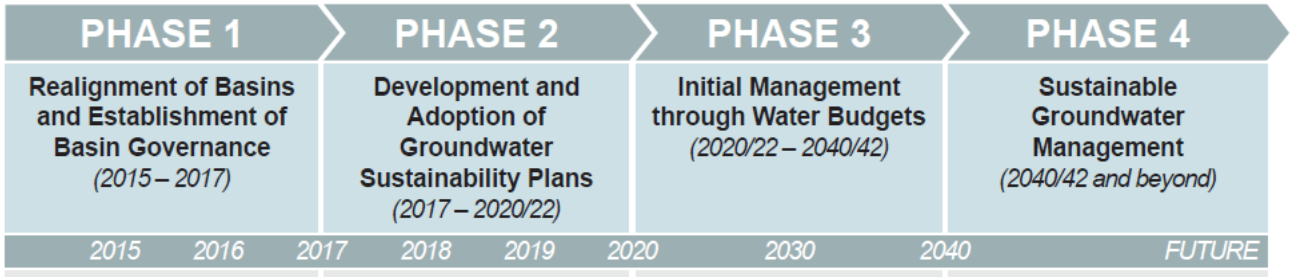
Who can be a GSA?

- 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

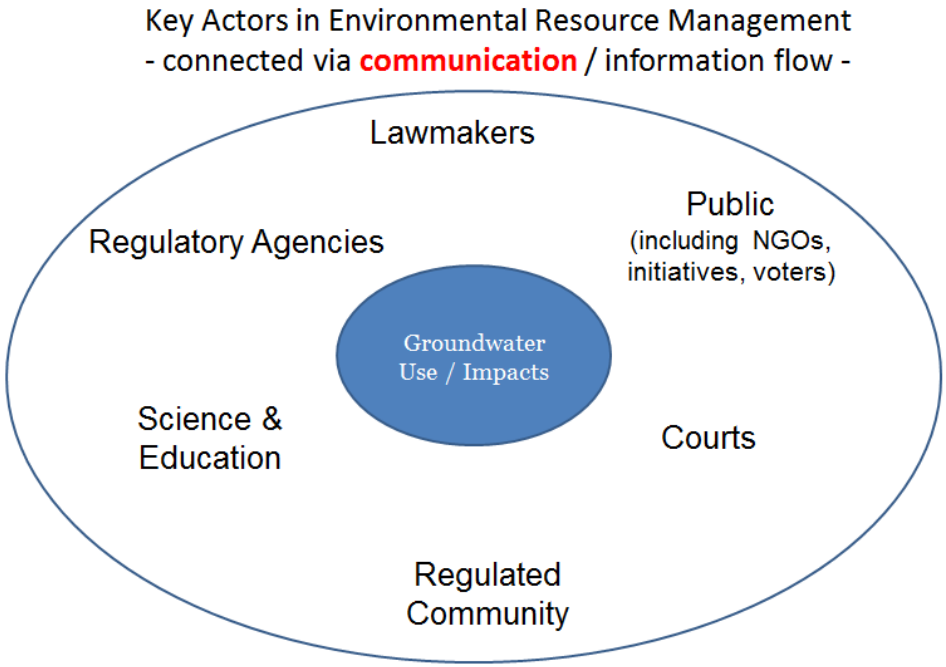
So What Exactly Will Happen?



- 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 -

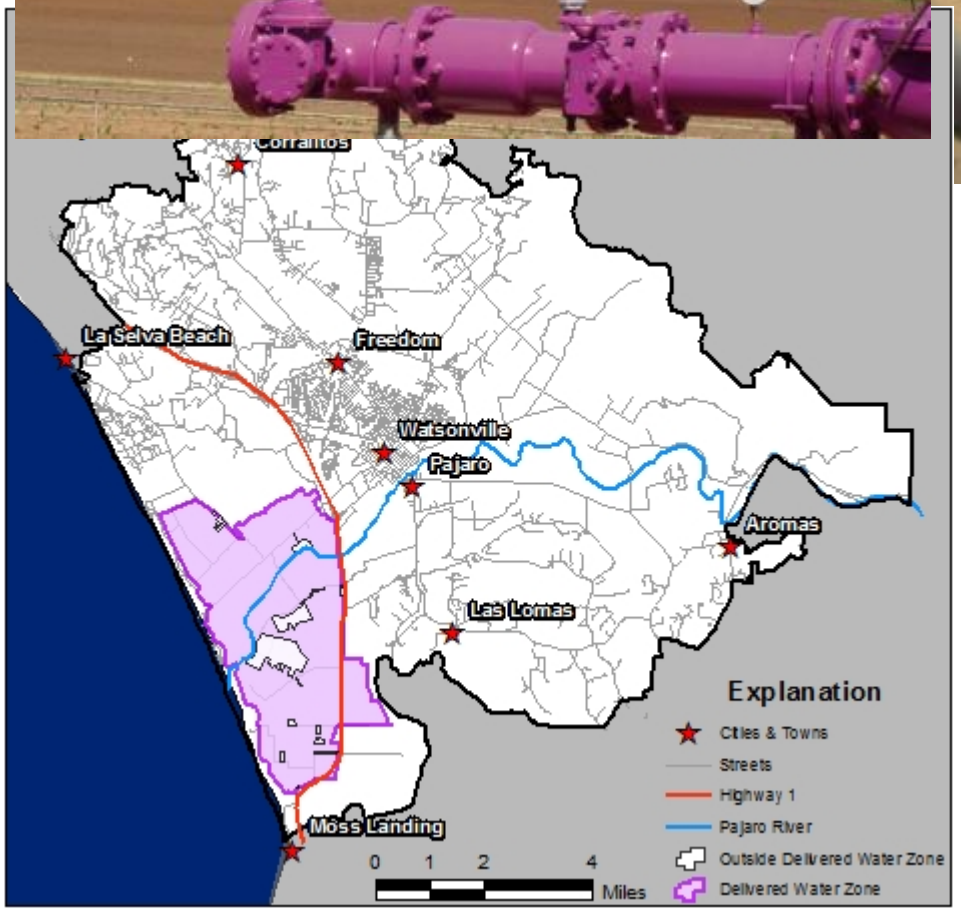
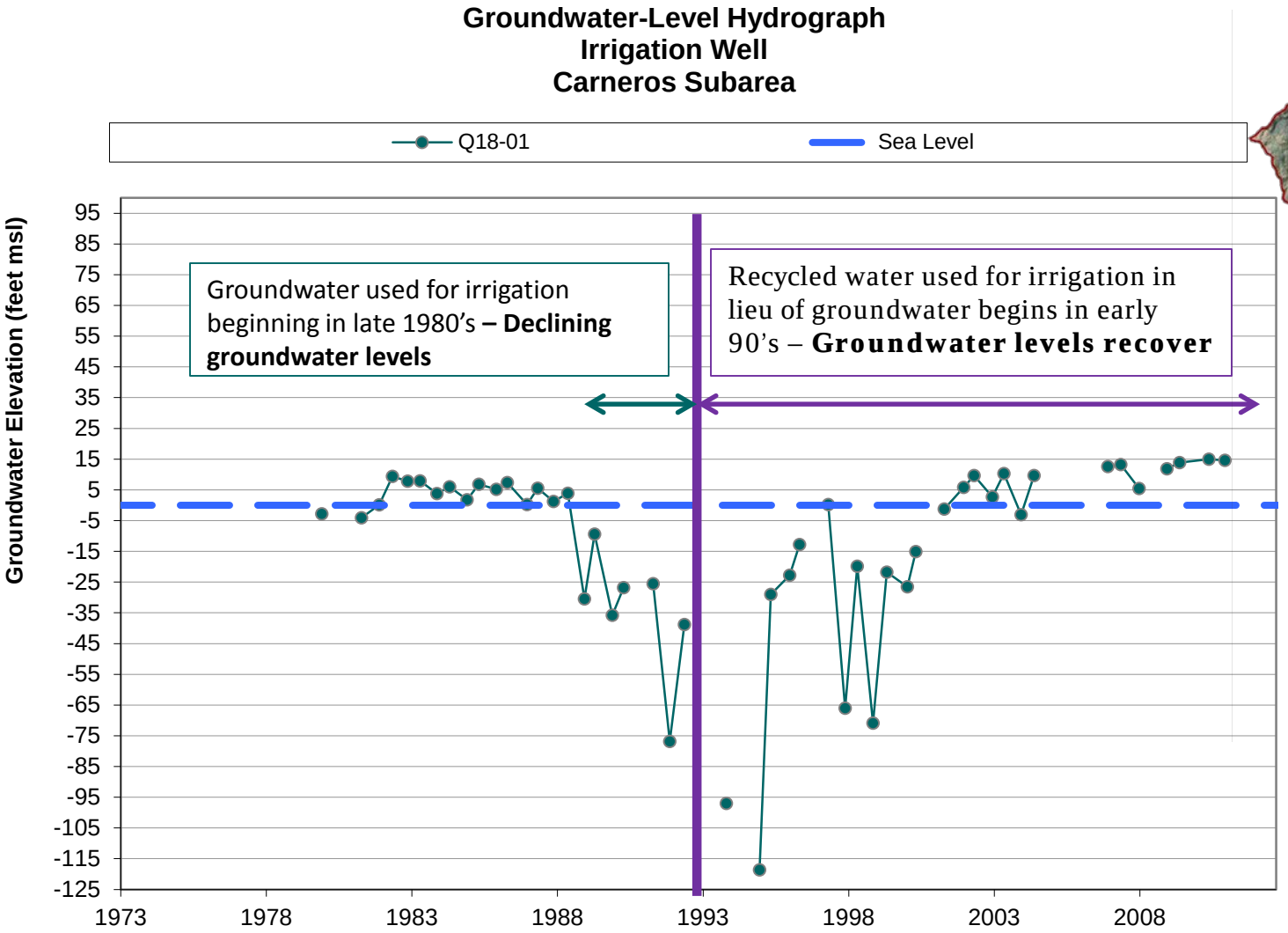
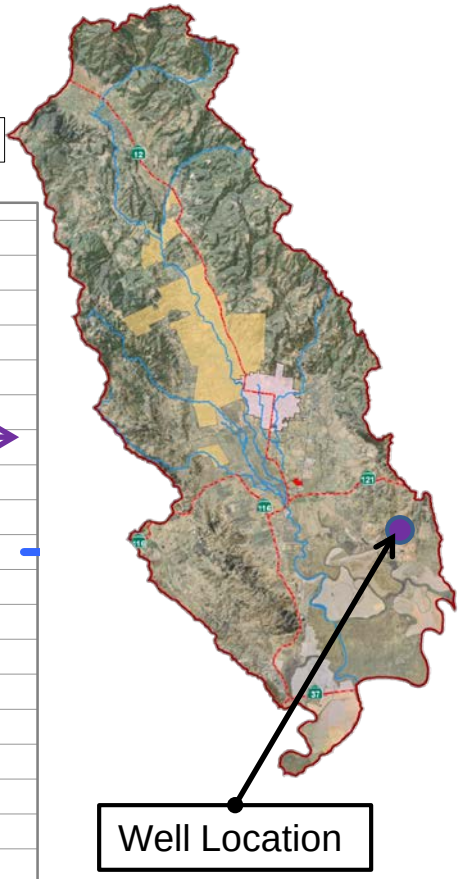


Photo: Californian Salinas

Photo: J.D. Hillard

Irrigation with Recycled Water to Offset Groundwater Pumping





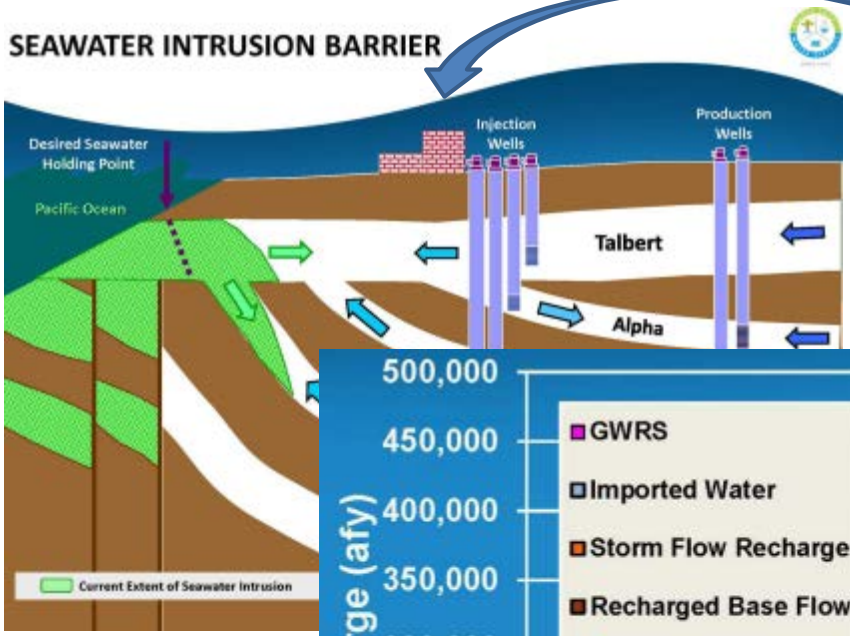
COURTESY - Marcus Trotta, Sonoma County Water Agency, 2015

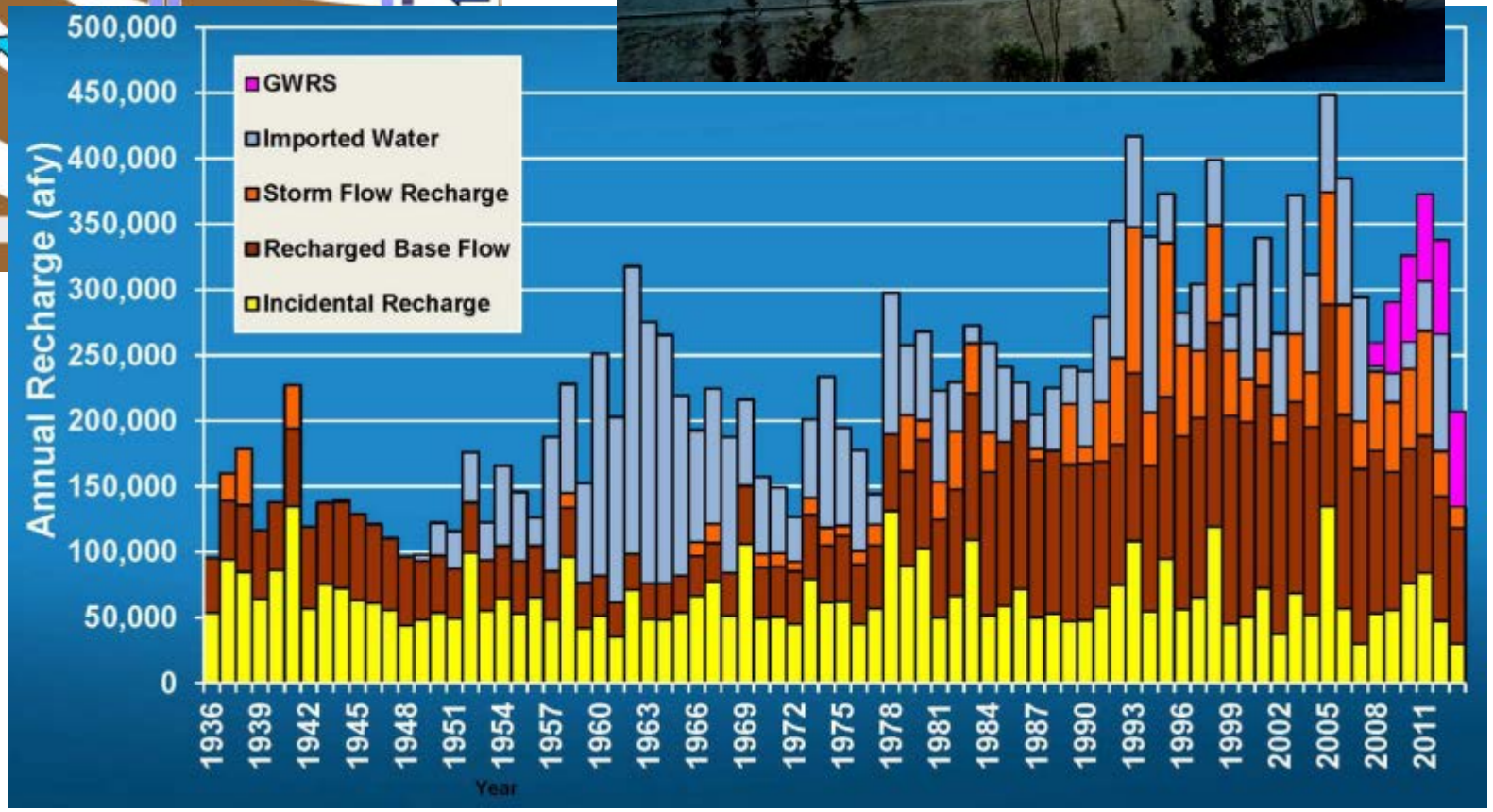
Water Banking

From: Ted Johnson, WRD 2013

DWR, California Water Plan Update 2013

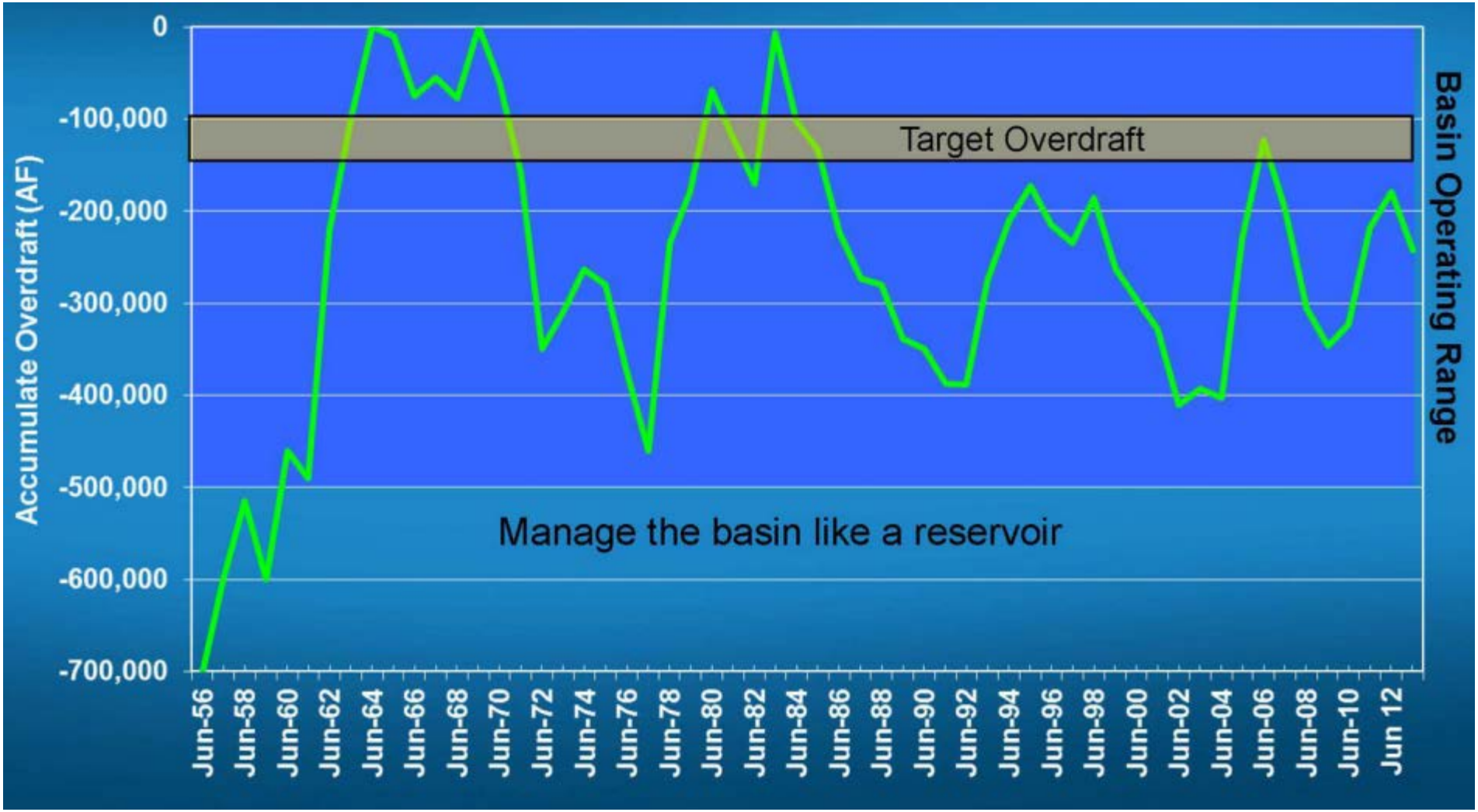
Orange County:
Groundwater Recharge Portfolio



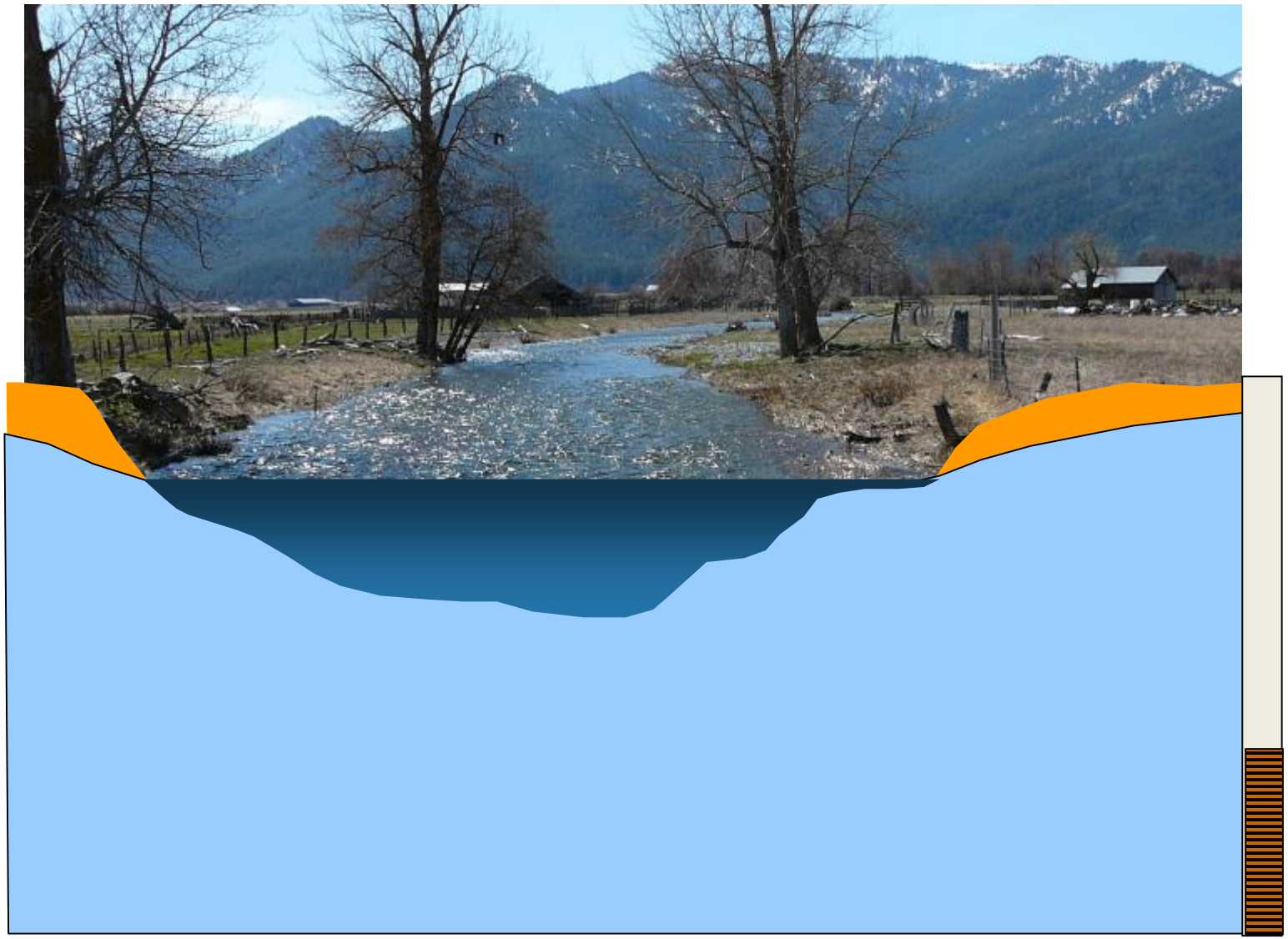


Orange County Water District, 2014

Seawater Intrusion



Well Near a Stream



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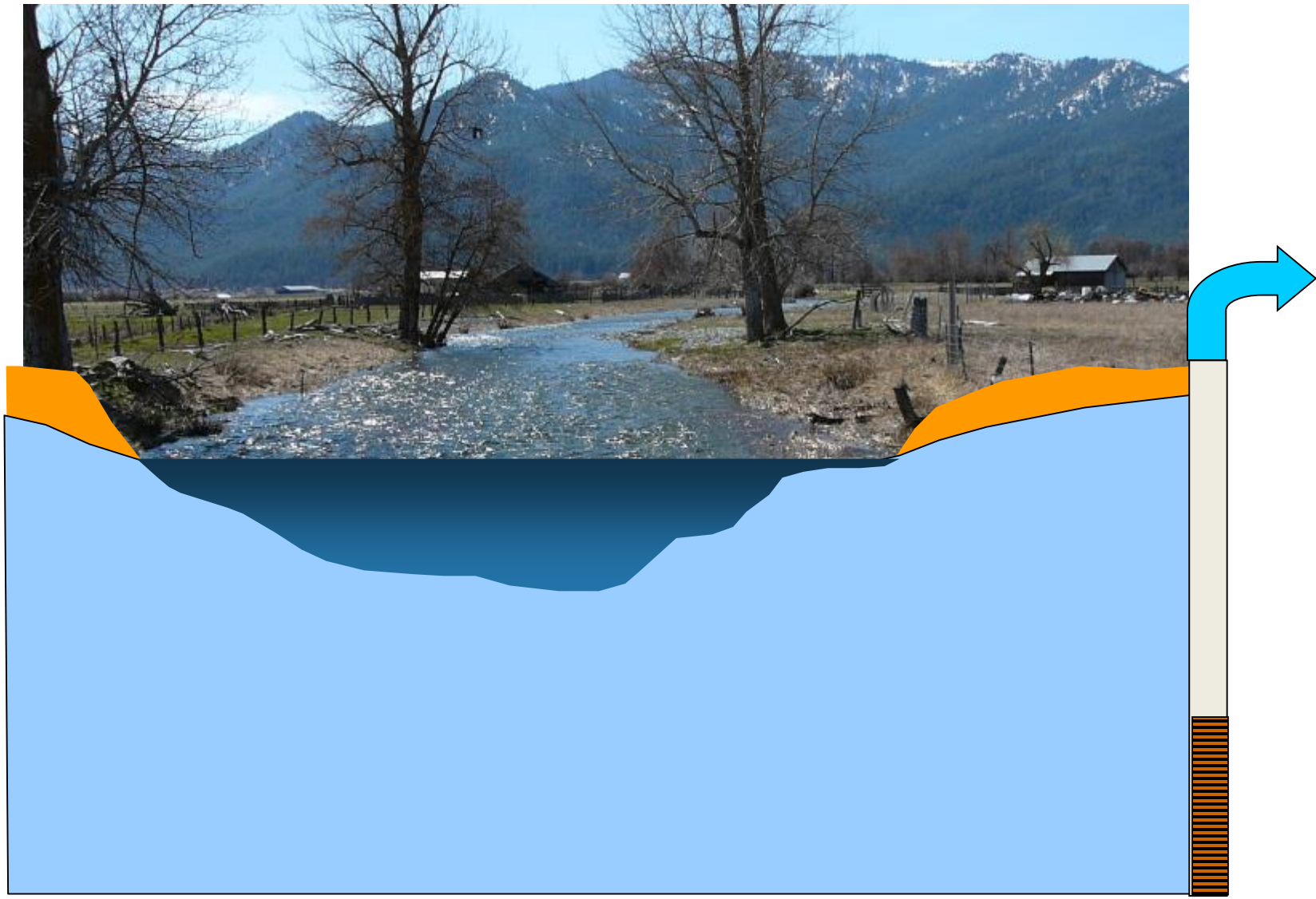

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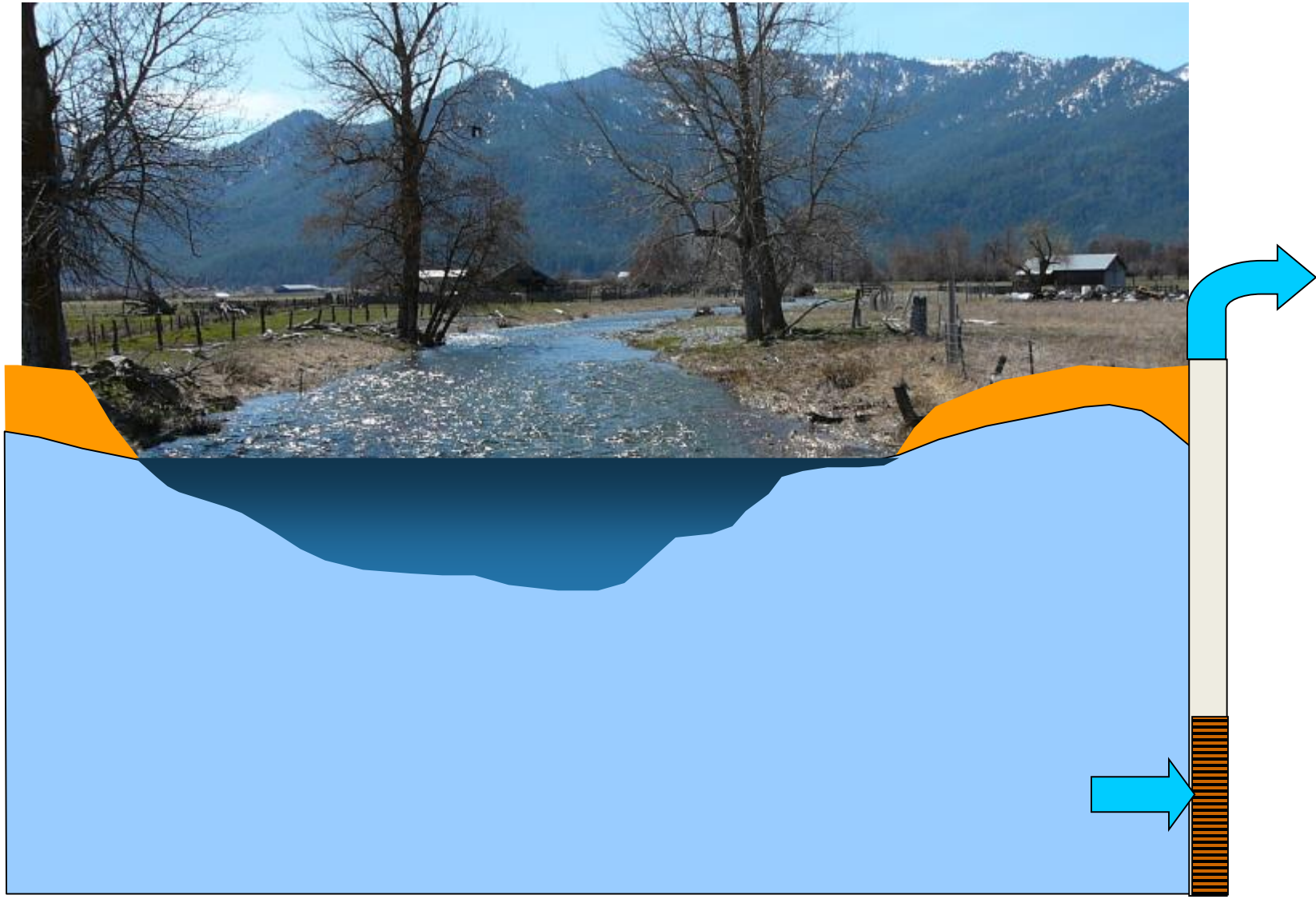

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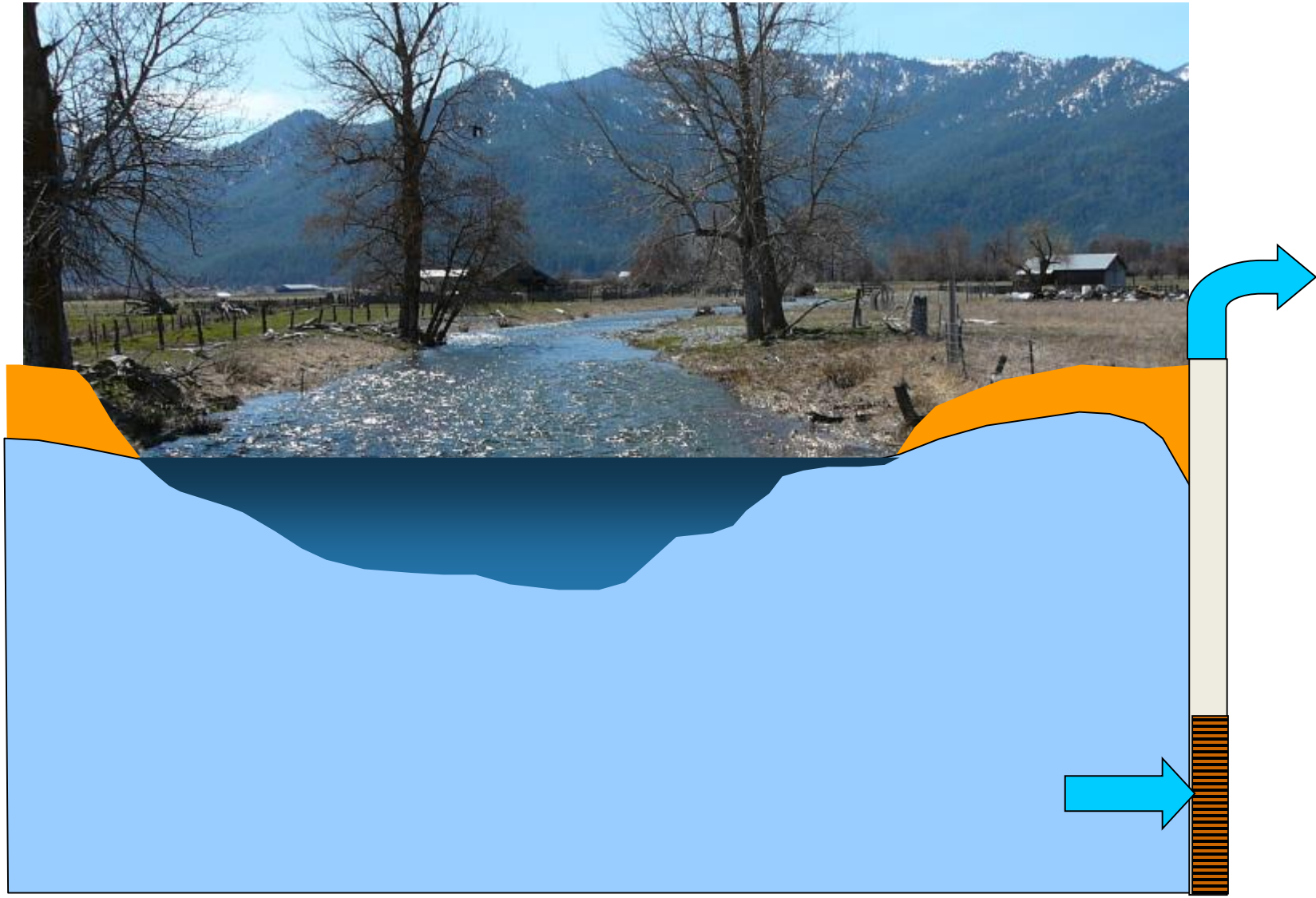

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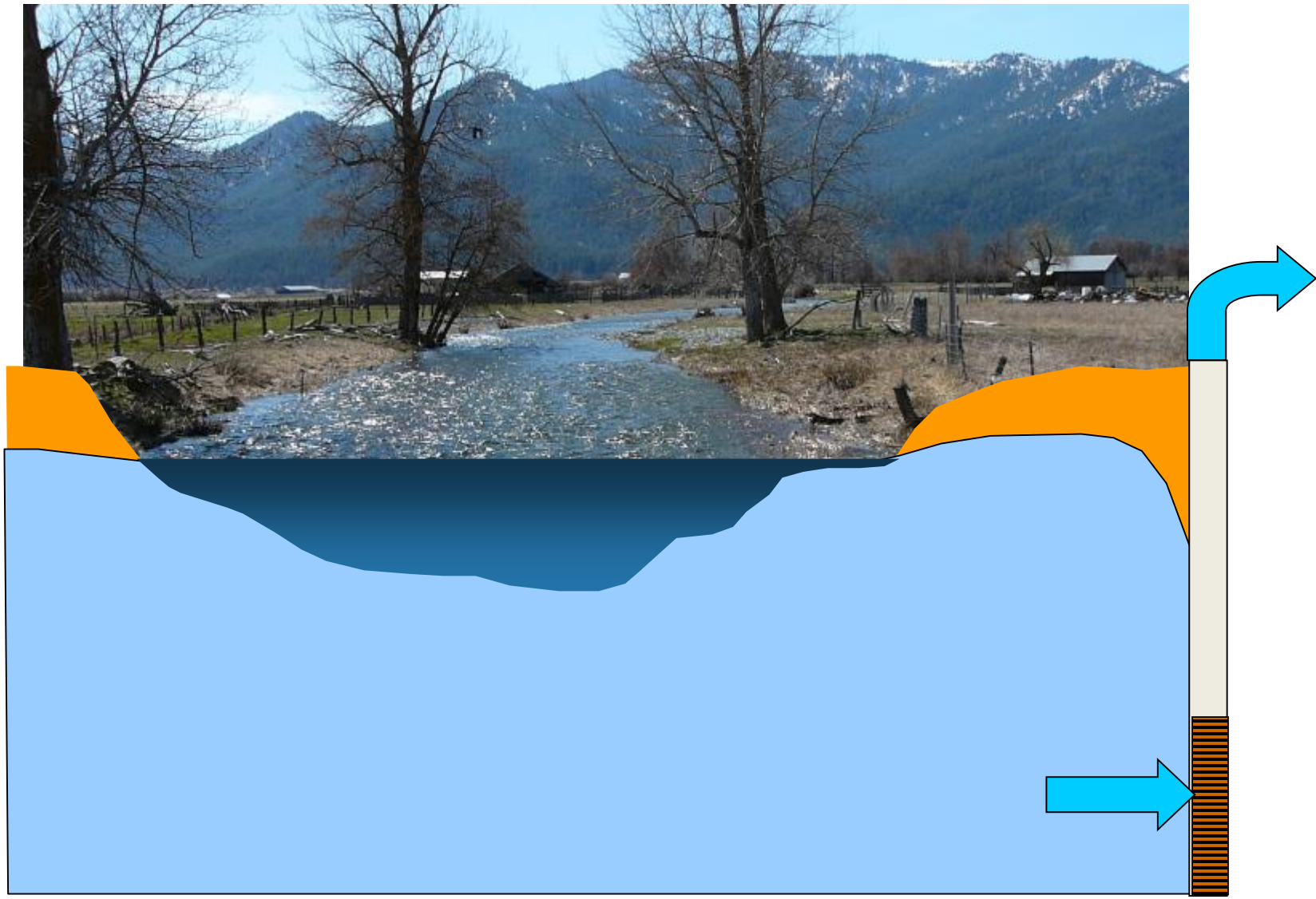

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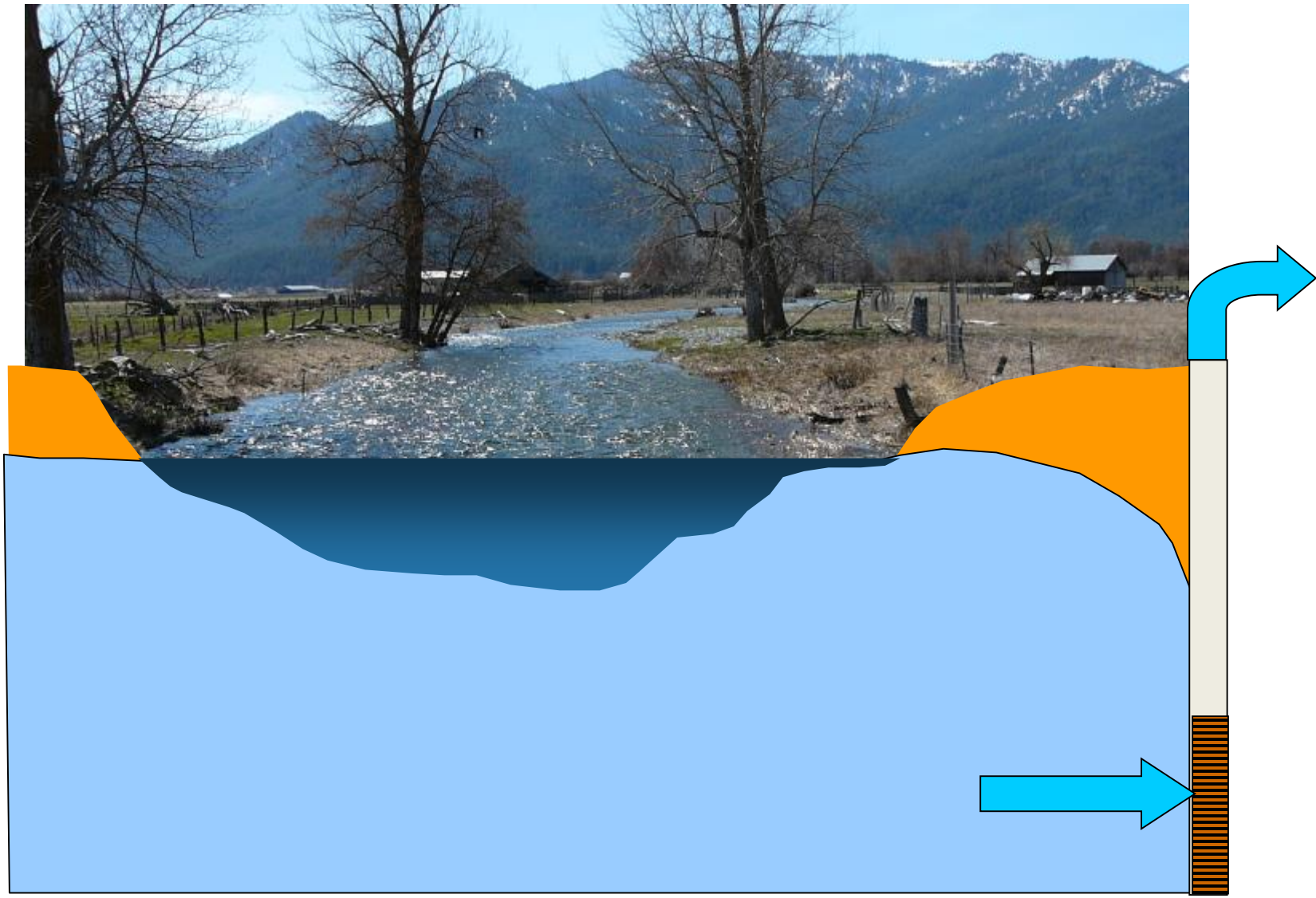

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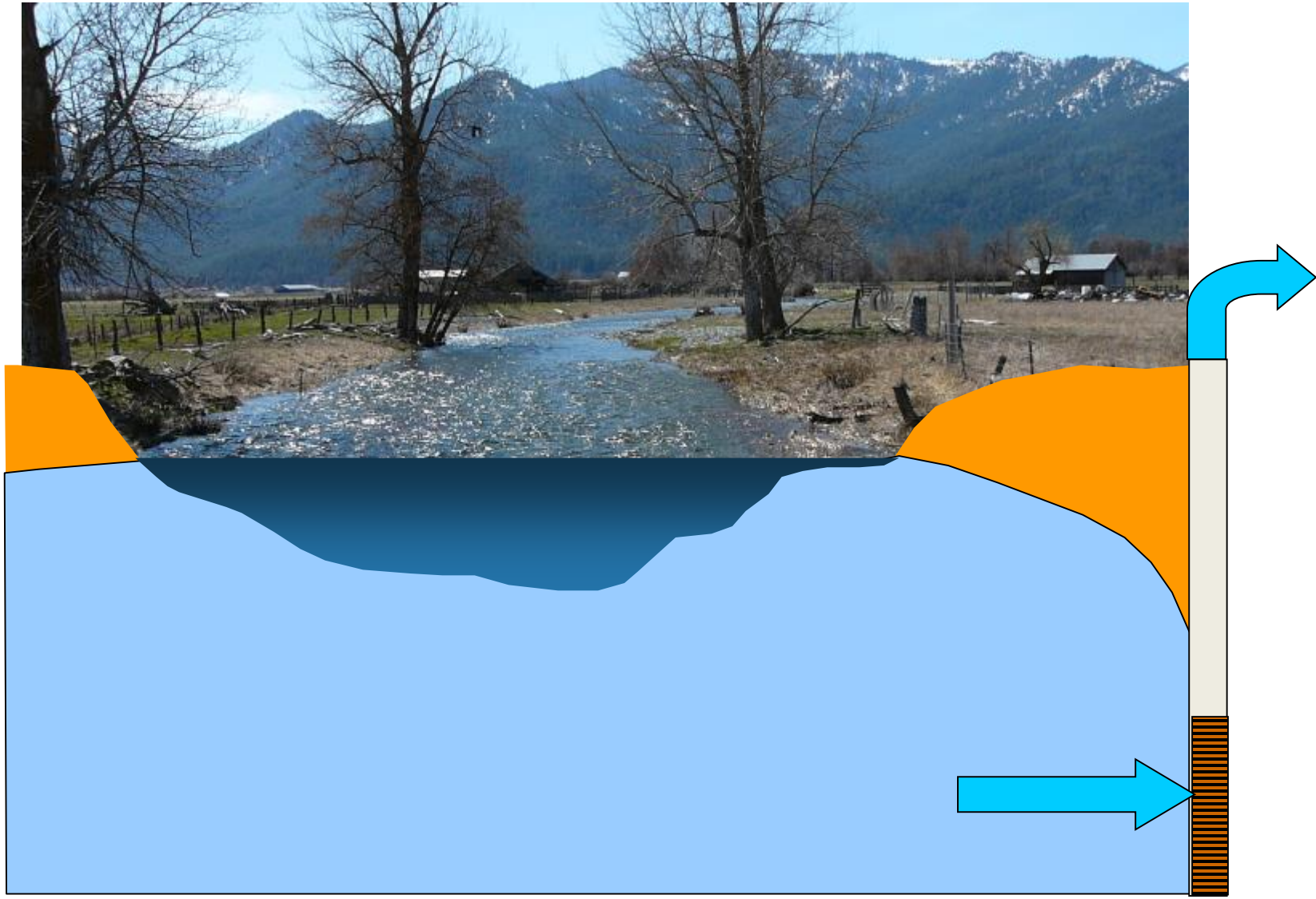

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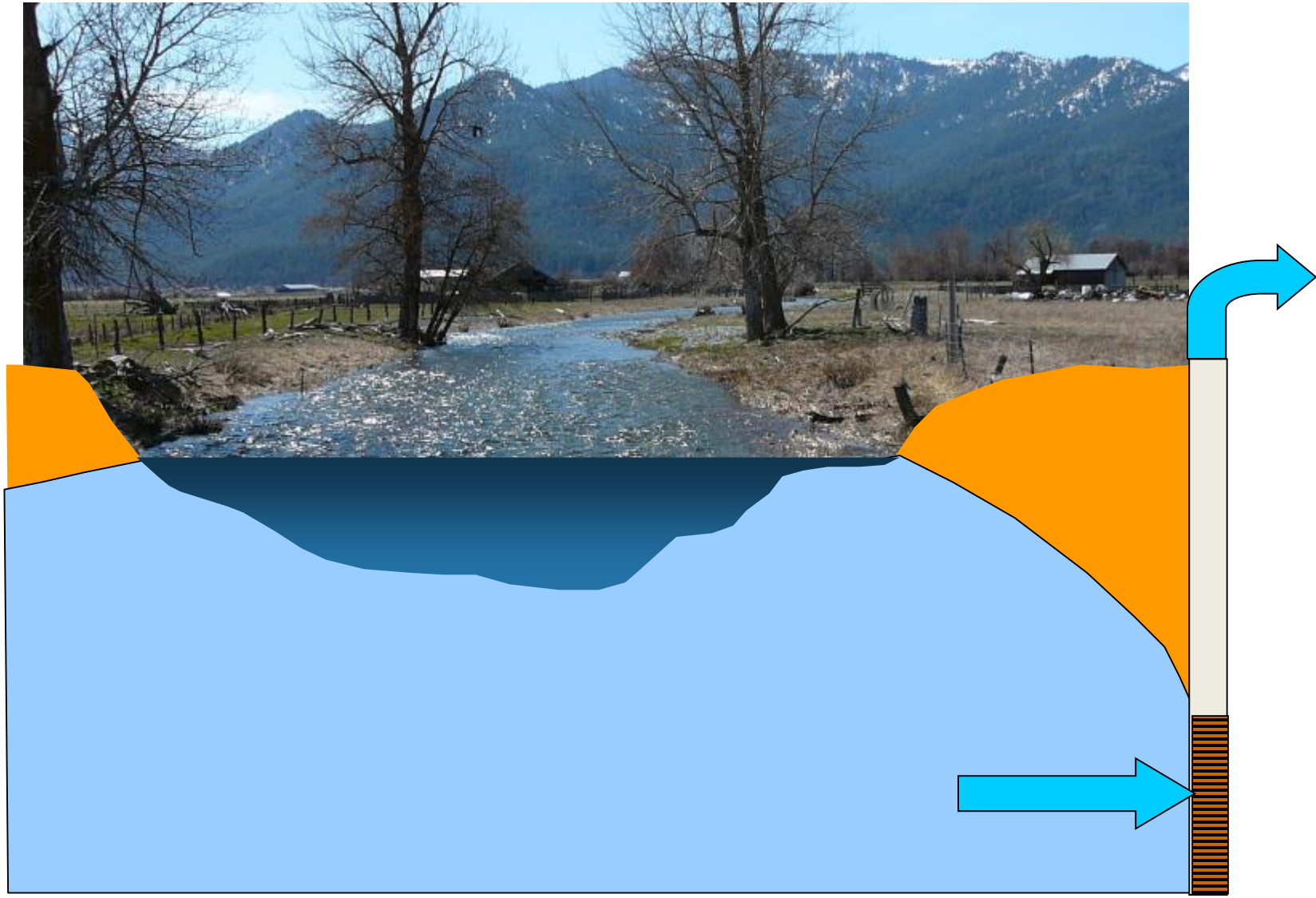

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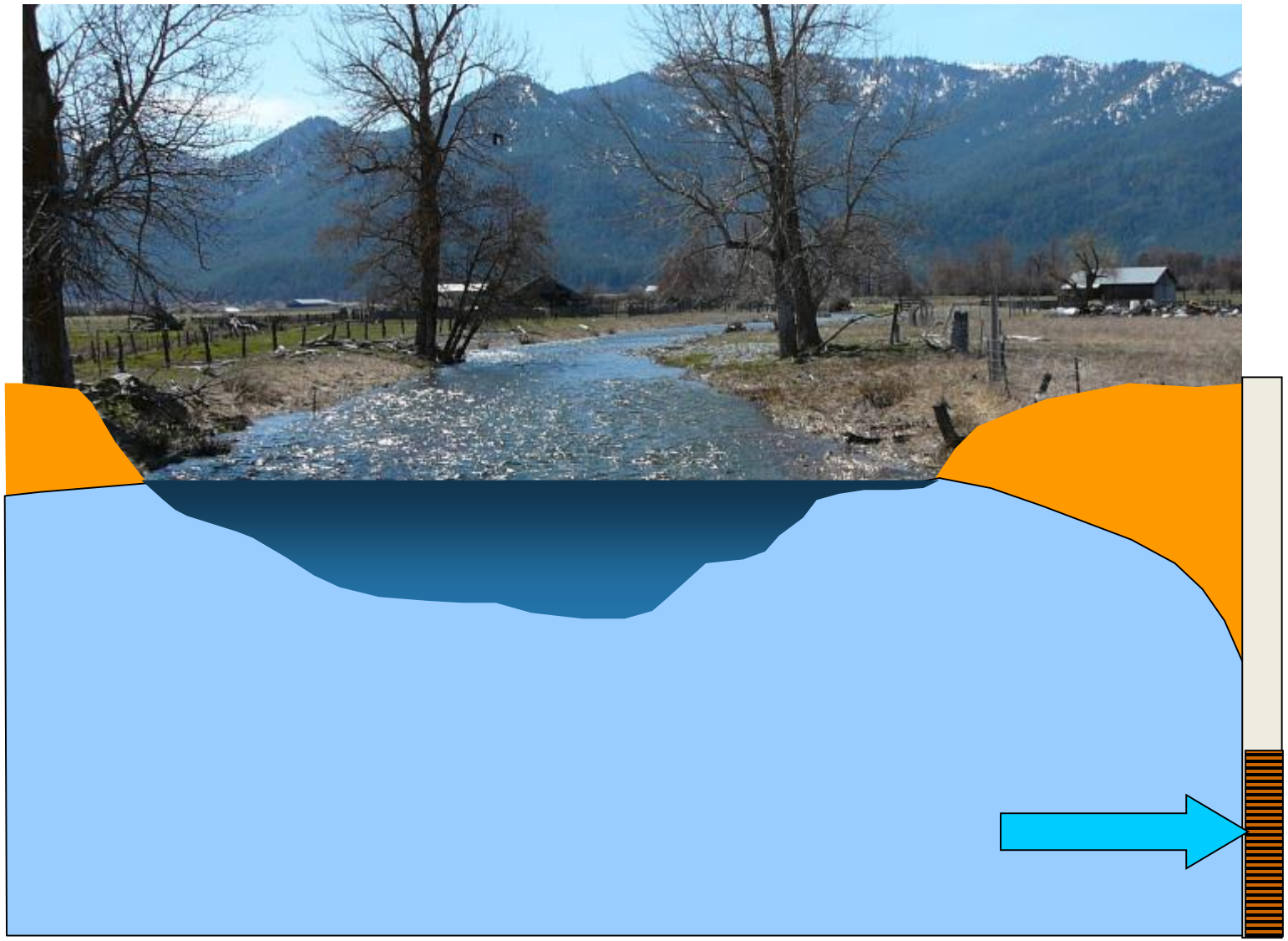

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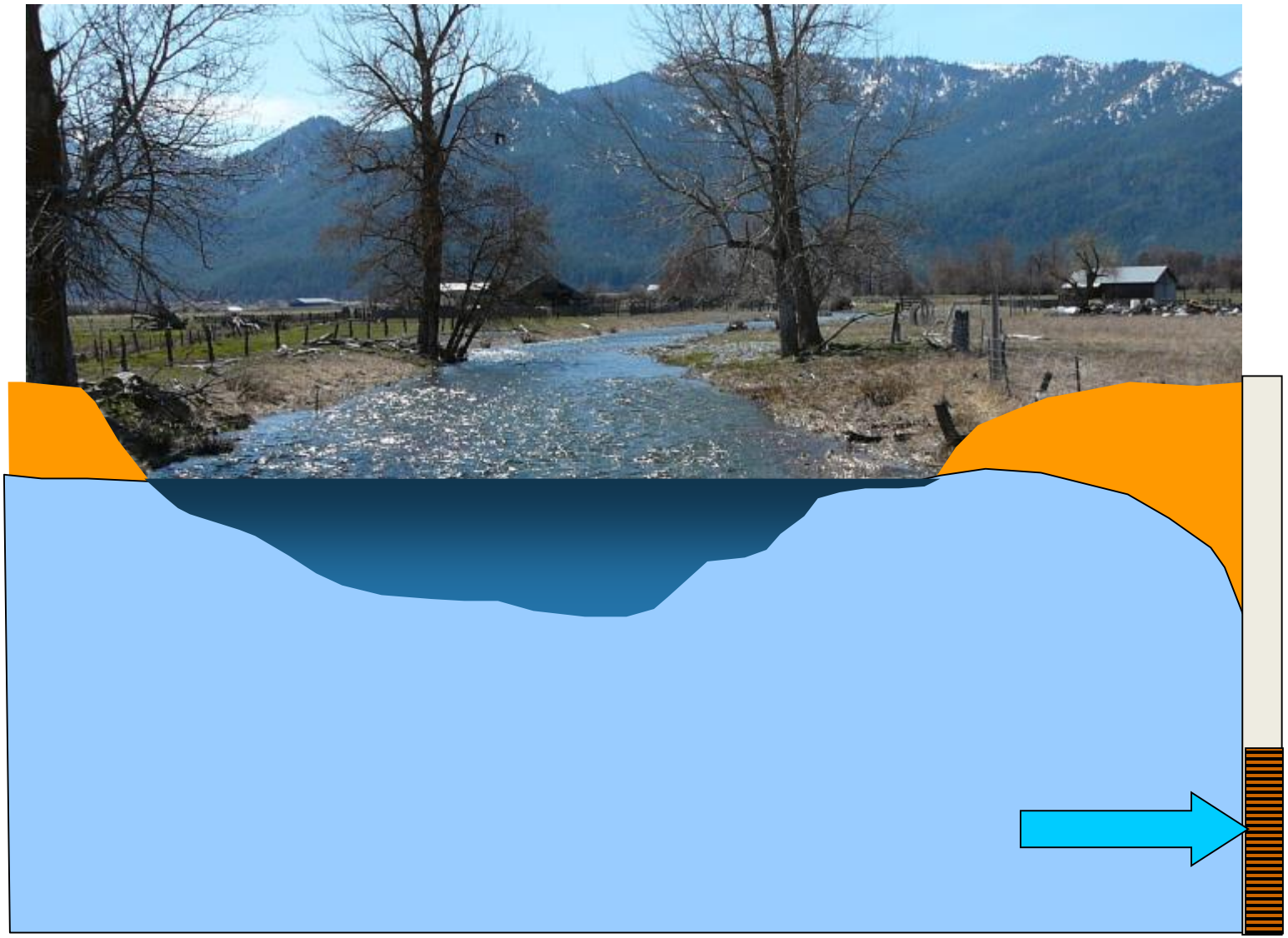

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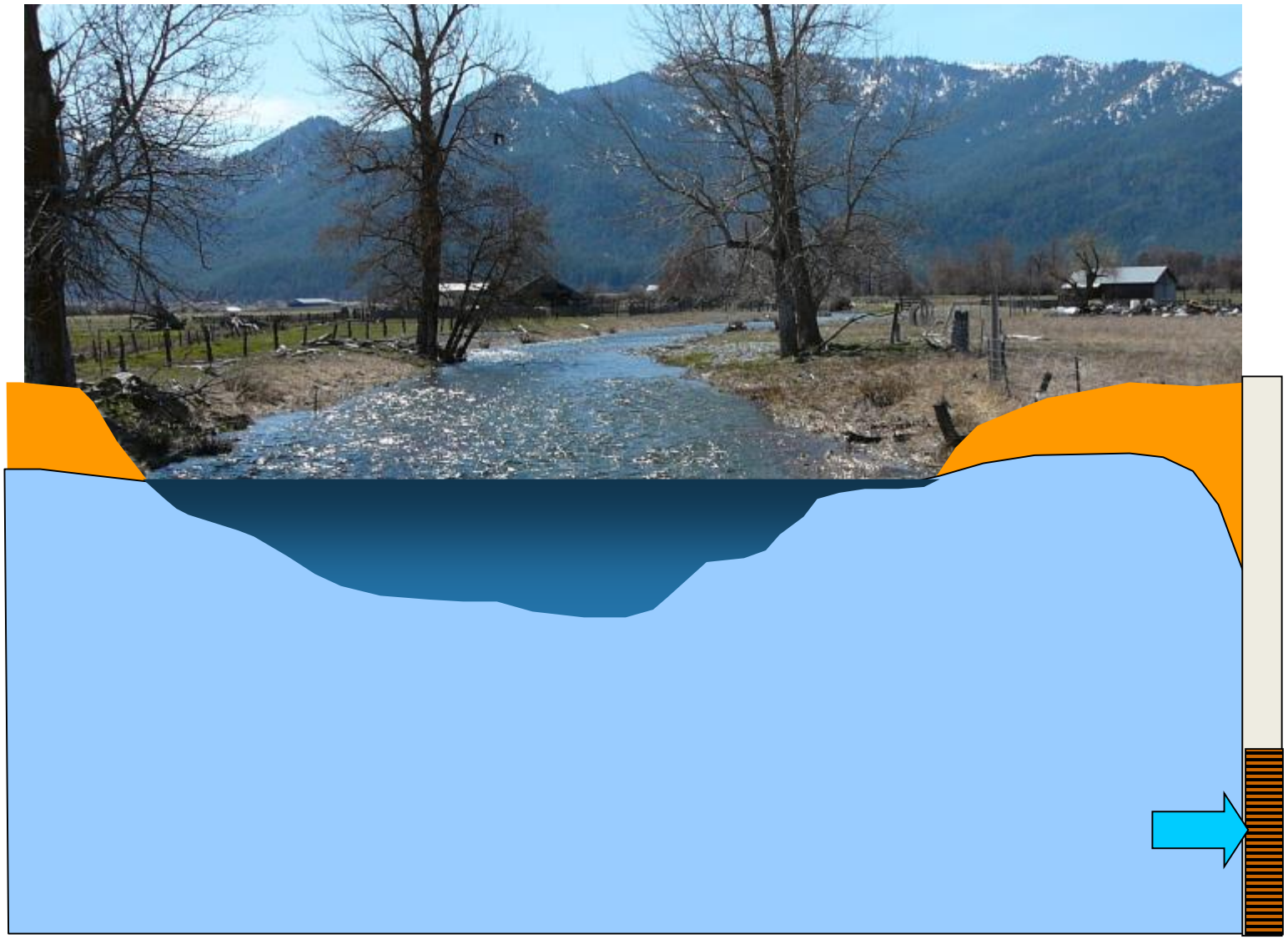

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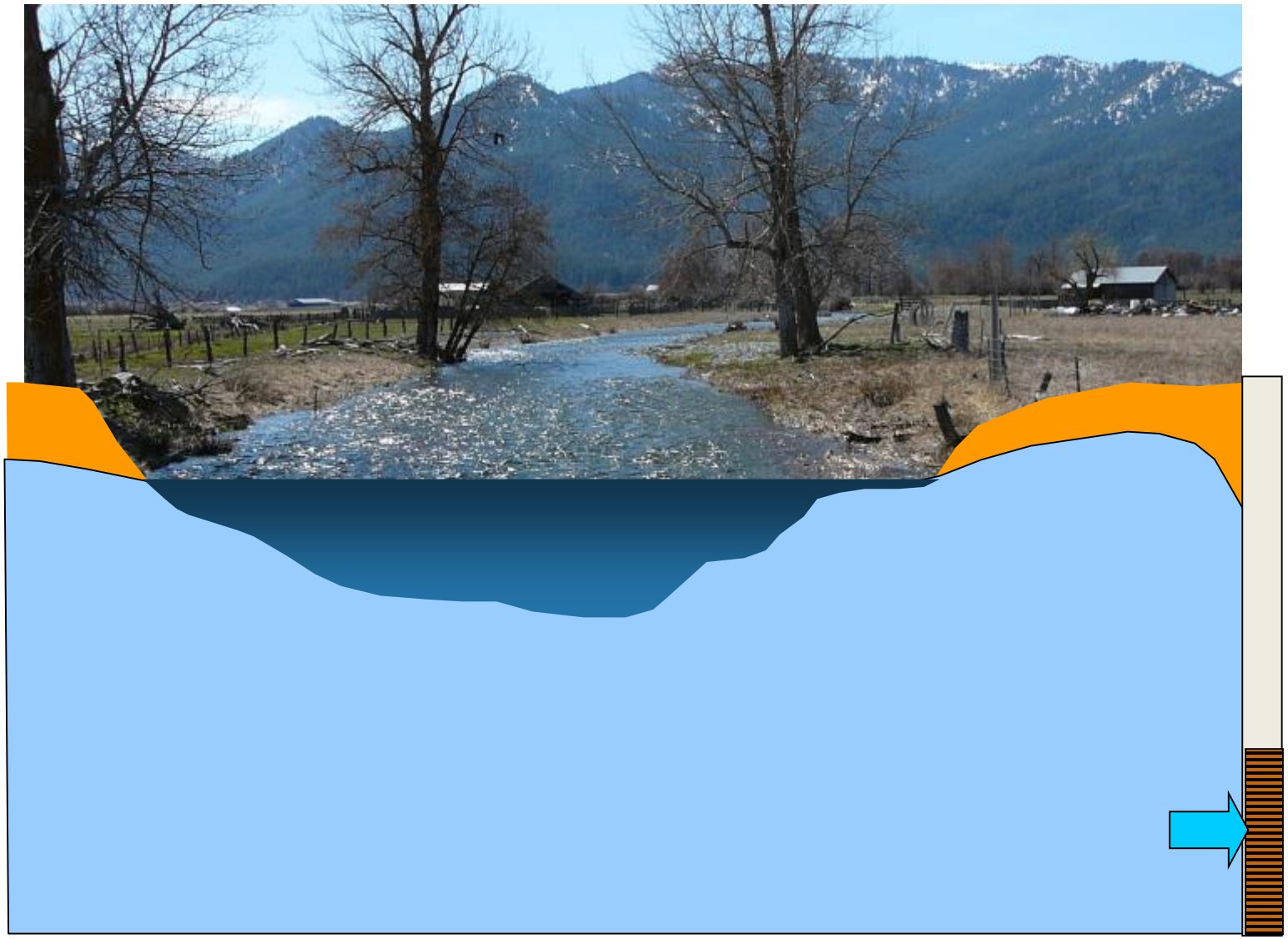

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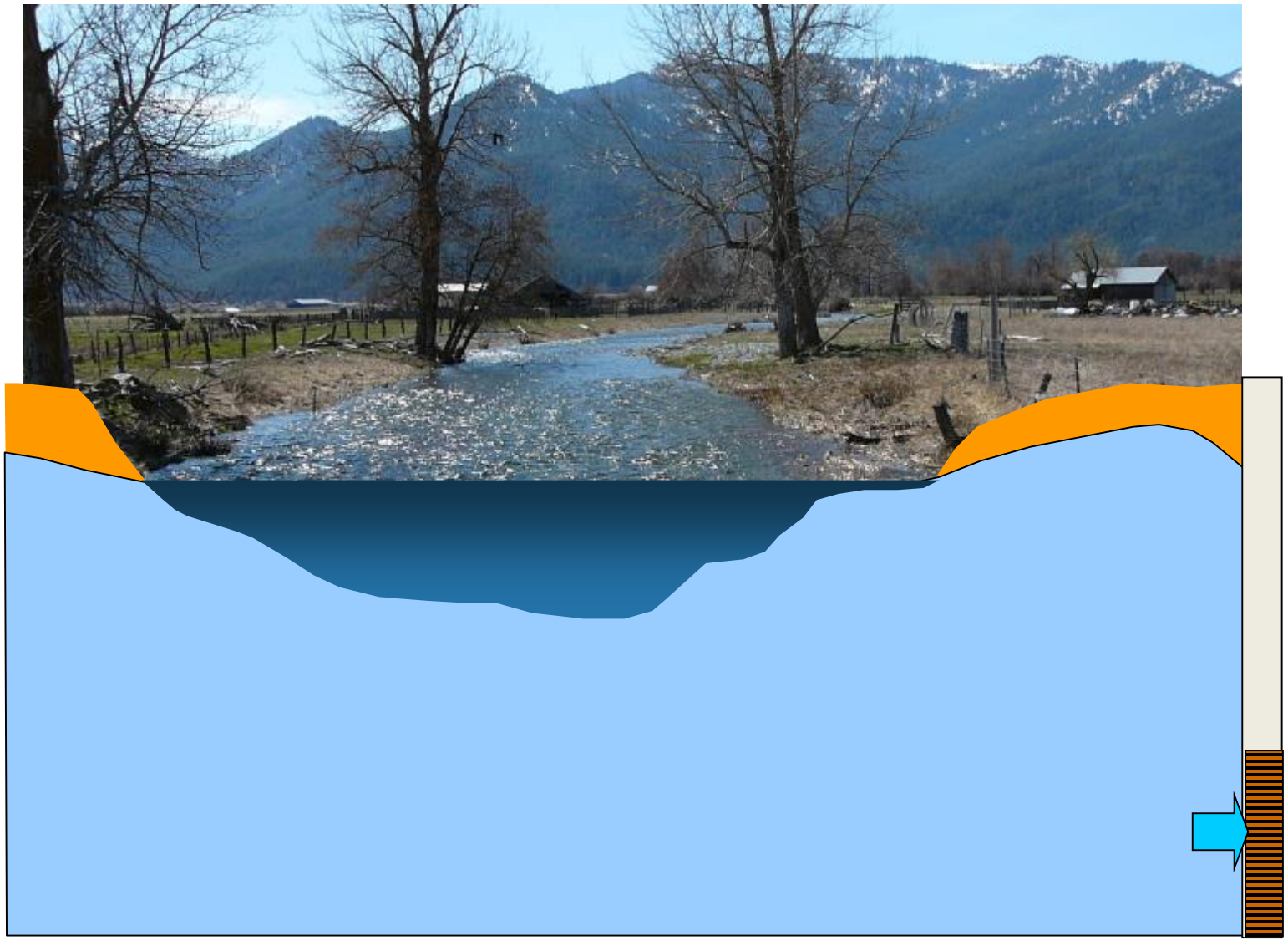

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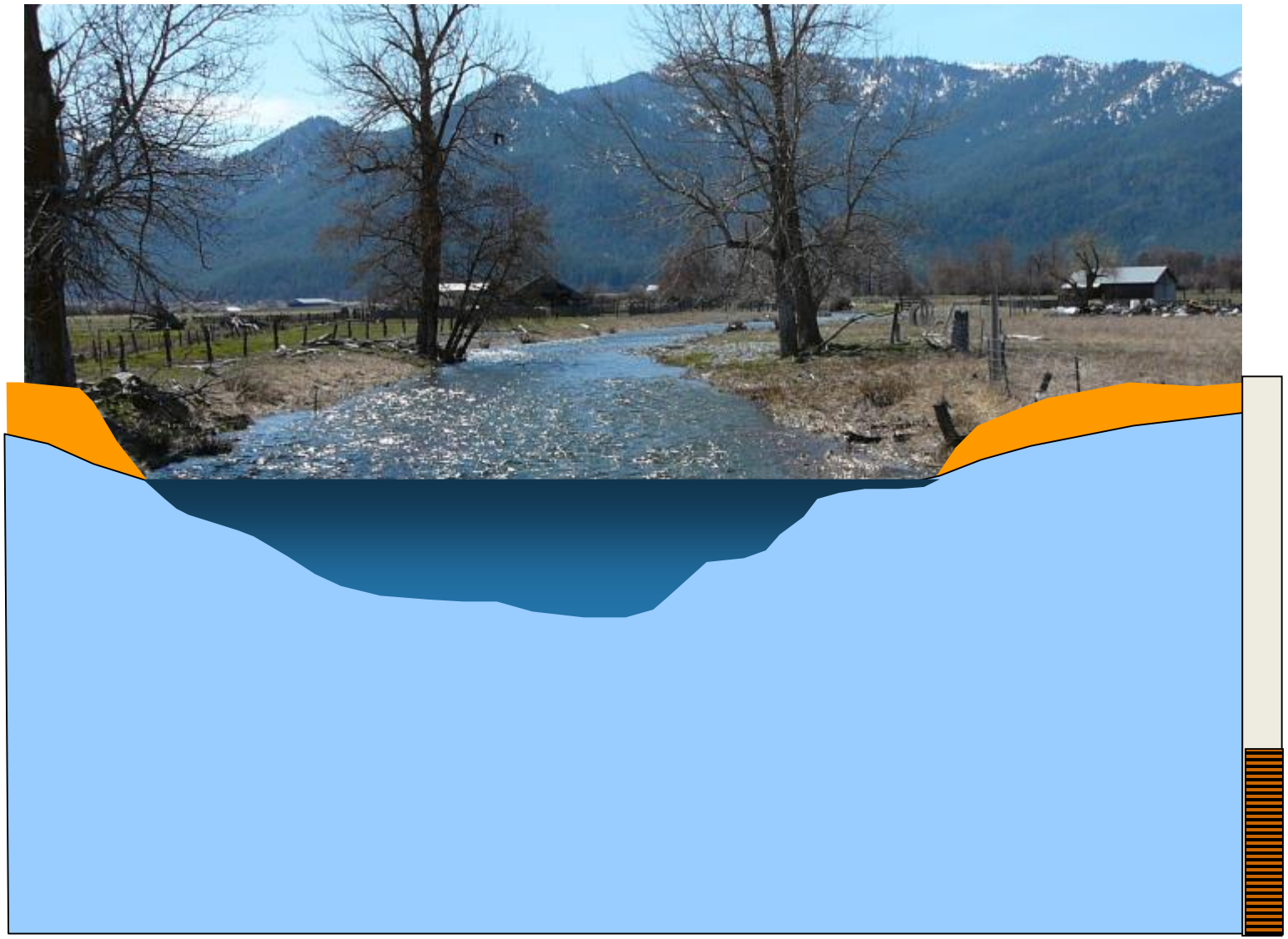
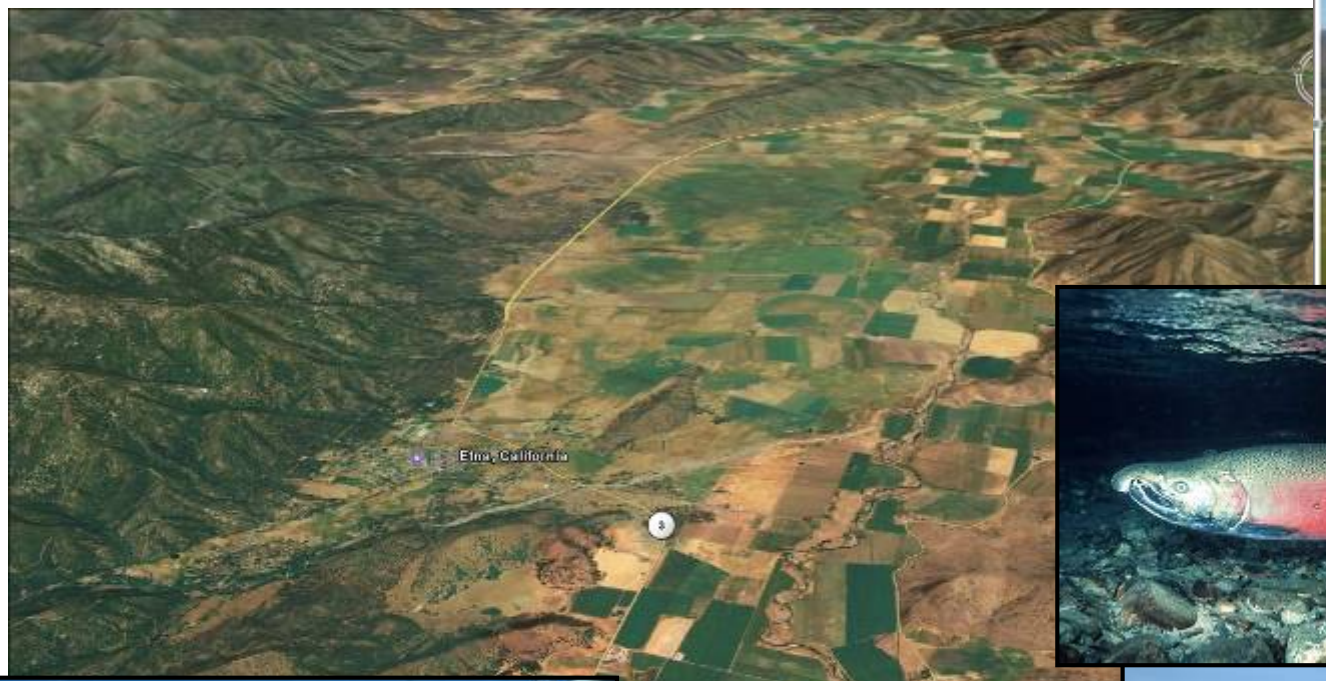


Groundwater Banking for Environmental Flows: Scott Valley, Siskiyou County



Foglia et al., WRR 2013

Groundwater Management Tools for GSAs (Groundwater Sustainability Agencies)

- Communication and networking measures
  - Facilitate stakeholder participation
  - Education
  - Data analysis and reporting
  - Secure funding (grants, project applications,….)
  - Inform landuse decisions by county or cities
- Infrastructure measures:
  - Water efficiency projects
  - Wastewater treatment and recycling
  - Importing water
  - Conjunctive use of surface water and groundwater
  - Groundwater banking
  - Monitoring networks, data collection, and data analysis/modeling
- Limiting Groundwater Use / Mandates:
  - Limit extraction
  - Mandate reductions in current pumping
  - Limit construction of new wells
  - Requiring water conservation measures
  - Fees to support management/infrastructure/communication efforts

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

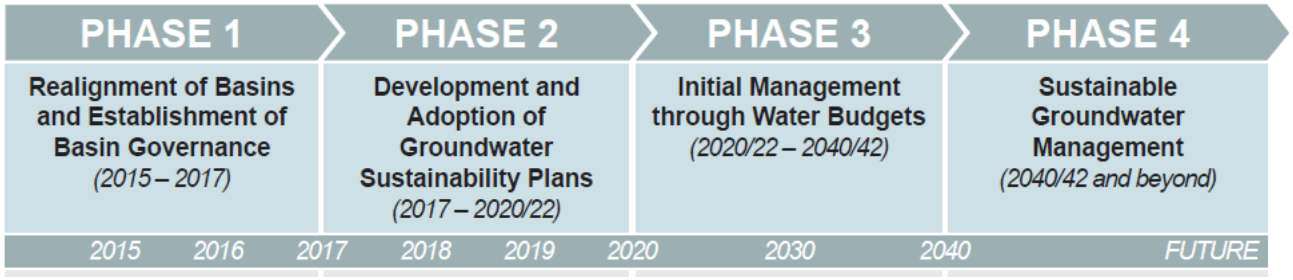
Role of the State: Carrot **& Stick**

- 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

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:
    - Right of water users to negotiate physical "equitable, practical" solution, regardless of water rights
    - Individual water rights holders cannot be forced into a voluntary agreement
- State groundwater management:
  - Voluntary local groundwater management plans: AB 3030 (1992)
  - 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?)**

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
- **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

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://groundwater.ucdavis.edu/links_California/ (miscellaneous groundwater information sources)
- Contact Dr. Thomas Harter at ThHarter@ucdavis.edu

Maralyn Miller: Stream in Modoc County