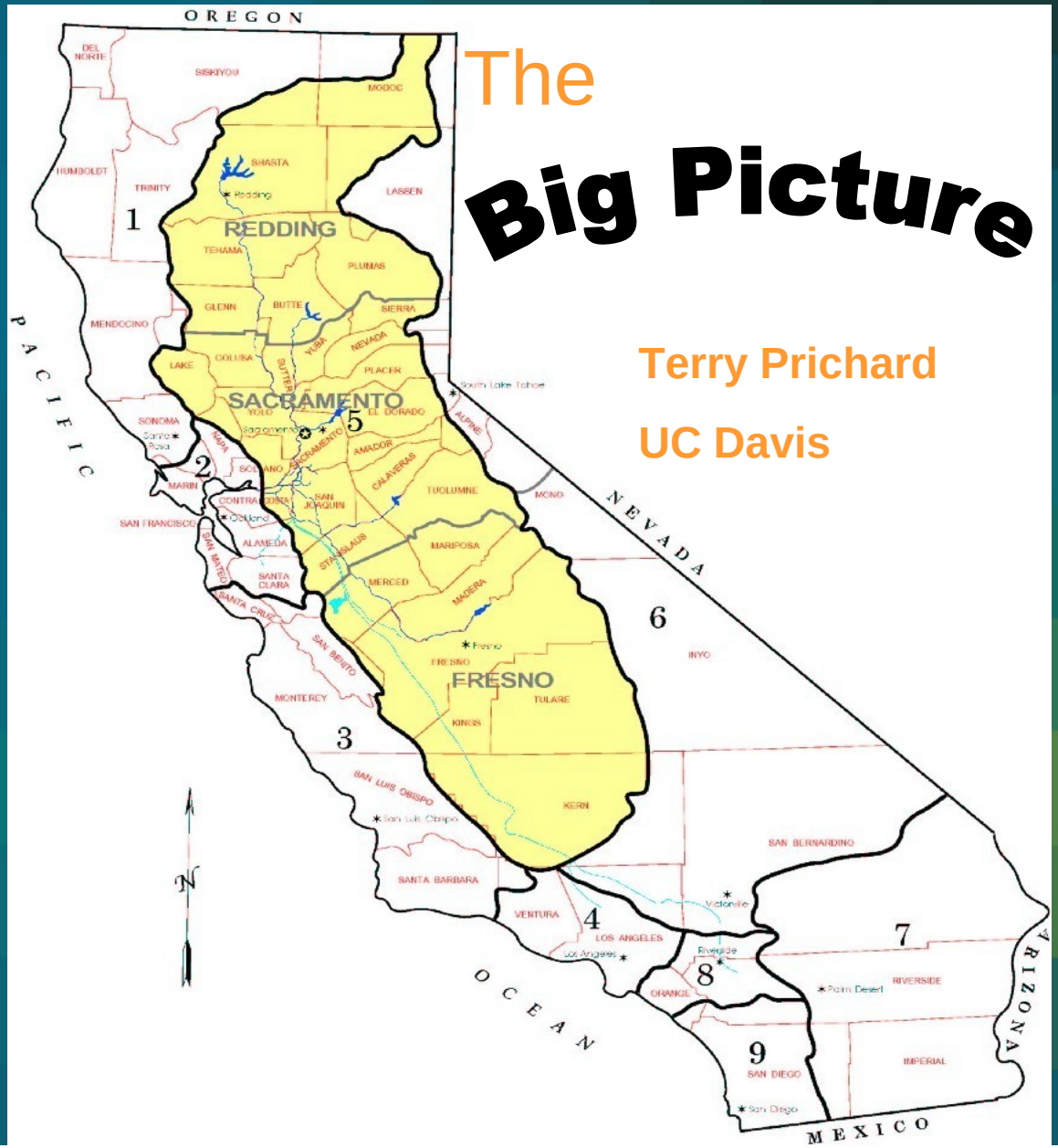
Water's of California



The

Big Picture

Terry Prichard

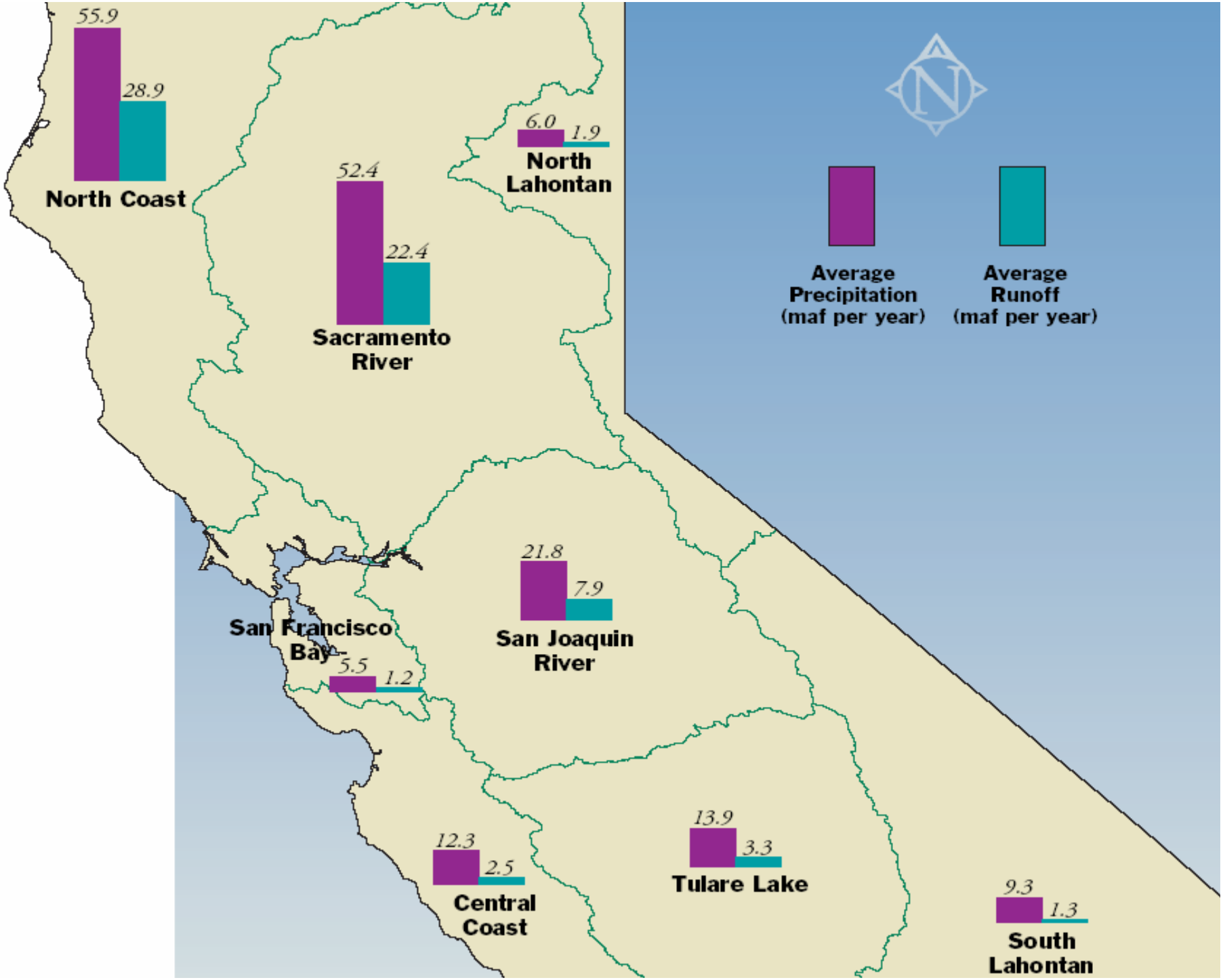
UC Davis

California's Waters

- Water Sources
  Surface water
  Ground water
- Uses
  – Agriculture
  – Municipal and Industrial (urban)
  – Environmental
- Ag Use limitations

Precipitation

- Average in CA 23 inches
- 75 % November to March
- 50 % December and January


55.9
28.9
North Coast
52.4
22.4
Sacramento River
6.0
1.9
North Lahontan
Average Precipitation (maf per year)
Average Runoff (maf per year)
21.8
7.9
San Joaquin River
San Francisco Bay
5.5
1.2
12.3
2.5
Central Coast
13.9
3.3
Tulare Lake
9.3
1.3
South Lahontan

Annual precipitation in CA 200 maf (input)

- Rain and Snow
- 2/3 in North
- 1/3 in South

Depletion of the input 200 maf

- Return to atmosphere 76%
- Storage and use 0.5%
  - reserve supply, discharge to saline waters or sink
- Runoff 23%
- USE?

Return to Atmosphere
76%

- 65% of the total 200 maf lost to
  - Evaporation and Transpiration
    - forest
    - rangeland
    - un-irrigated agriculture and native vegetation
    - evaporation of precipitation on irrigated lands

leaving 71 maf for possible runoff in streams

33 maf Ag water applied 70% Evapotranspiration

Runoff

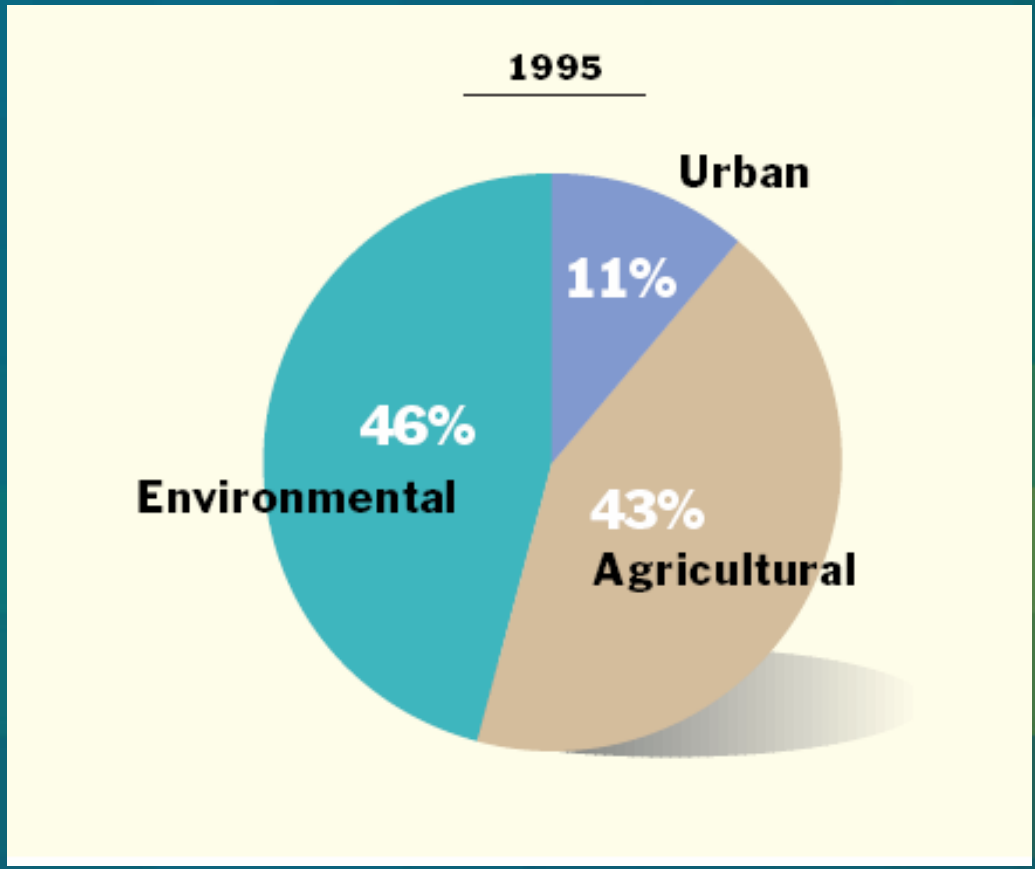
- Starts out from streams after evaporation loses at 71 maf or 35 % of total
- End flow once Ag and M & I is removed = 23%
- Only 27maf unencumbered
  - wild and scenic rivers 18 maf (of the 45 maf)

Developed water supply and uses

- Interstate imports 5 maf
- Surface 22
- Ground water 15
- Reclaimed 0.2

- Total 42 maf

	MAF
Urban	8.8
Agricultural	33.8
Environmental	36.9



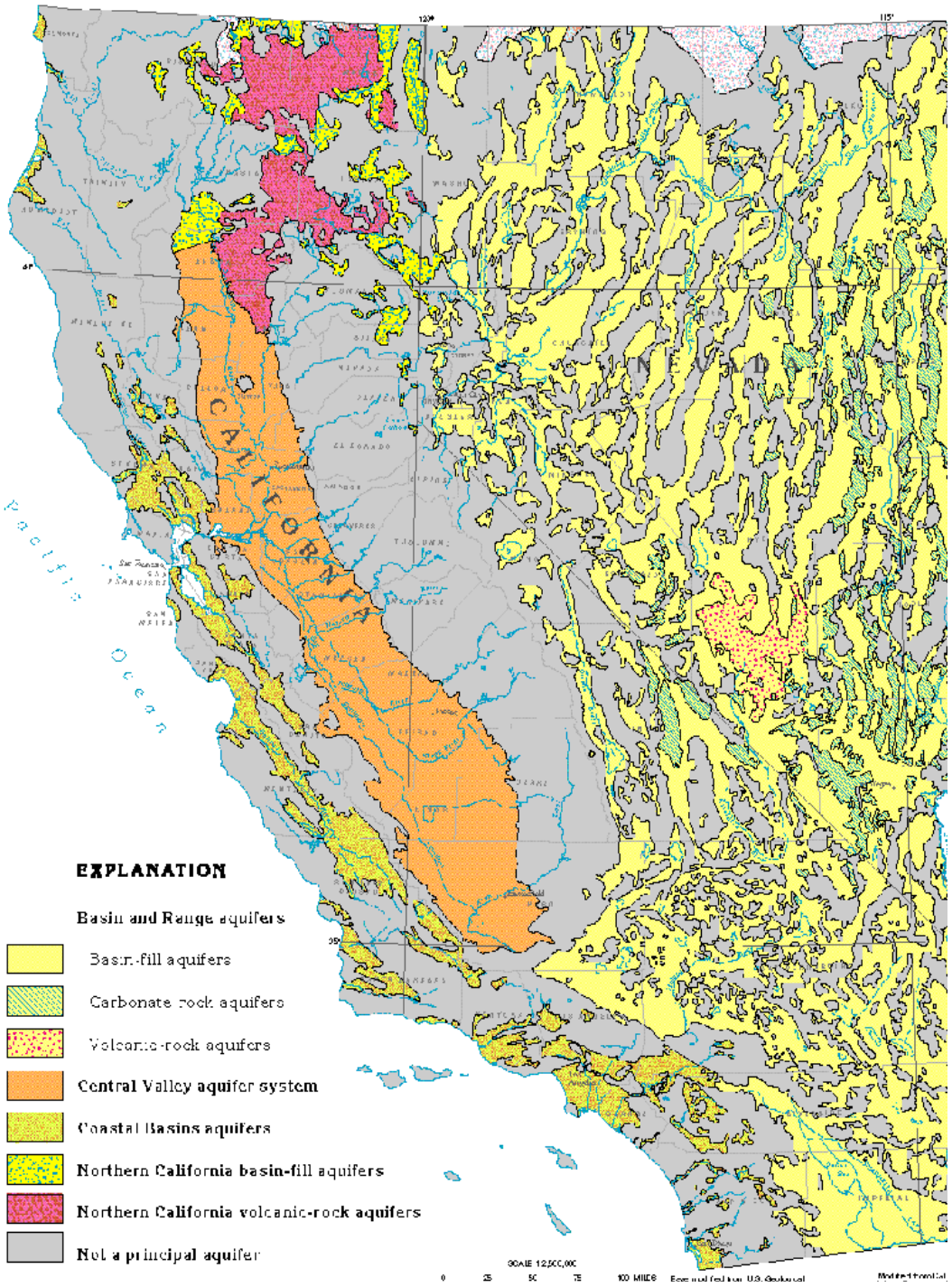
Distribution of surface water resources in CA

- 71 maf for possible runoff in streams
  - 32 % in Sac river sys.
  - 9% in SJ system.
  - 40% north coast,
  - 20% rest of state
- Use 75 % use south of Sacramento

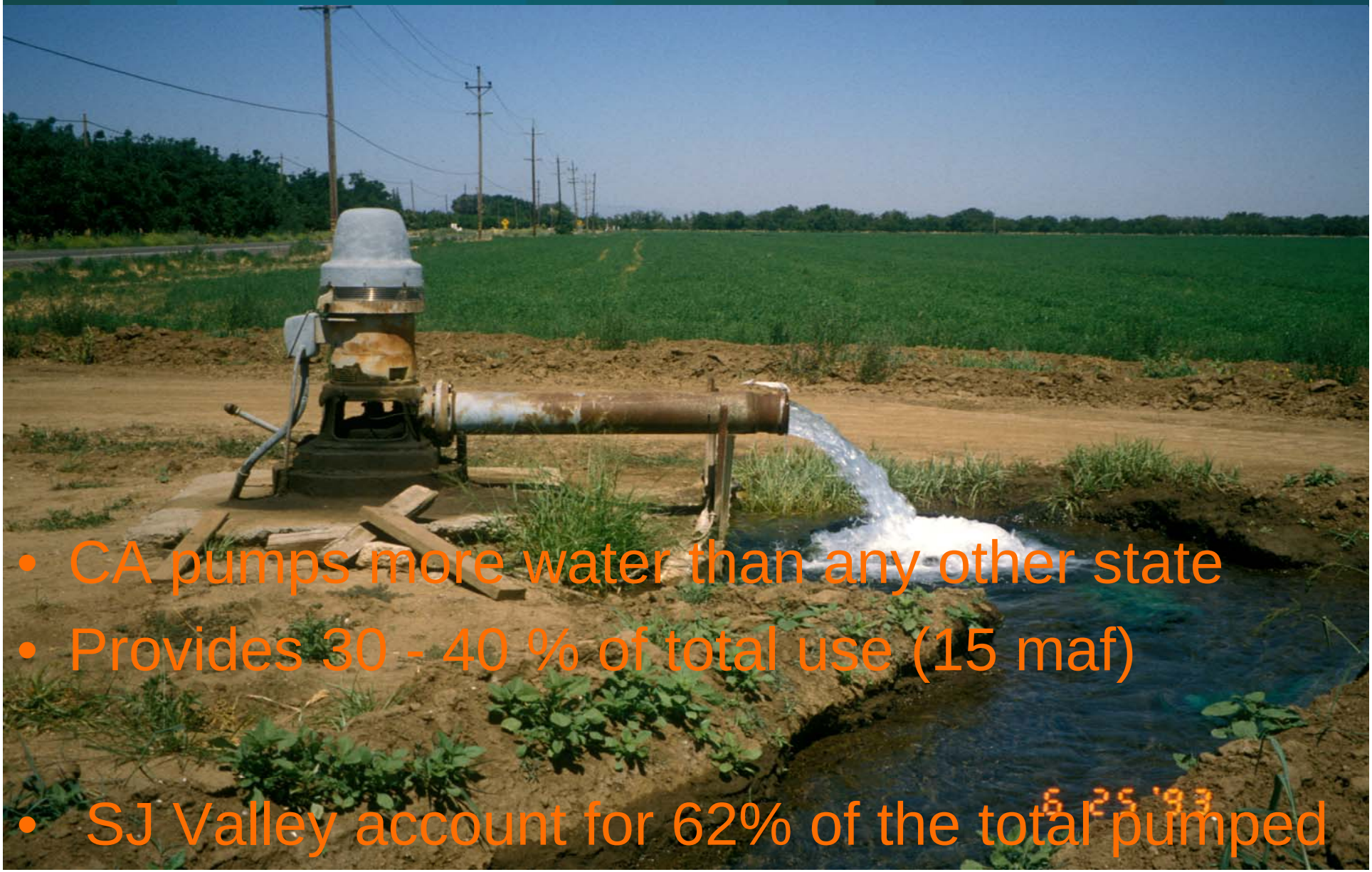
Ground Water

- Original steady state
  - Artesian wells common < 1900
  - Recharge at fringe of aquifer
  - Water surfaced at river basin depression (marsh)
  - Flow to bay

Ground water aquifers



Ground Water Today



- CA pumps more water than any other state
- Provides 30 - 40 % of total use (15 maf)
- SJ Valley account for 62% of the total pumped

Ground Water Today

- Typical well yields 1000 – 2000 gpm
- Lift 60-800 ft with 100 – 200 most common
- Deeper in SJ Valley

Ground Water Overdraft

Annual extraction vs. annual yield 1995

- Sac River region 0.03 maf
- SJ River 0.239
- Tulare Lake 0.820

- Total 1.1 maf

Water transfer. Aqueducts

The lack of **quantity** or **quality** lead to the transfer of water from areas of high supply to those of need. This occurred in both the Sac Valley and SJ Valley.

On average year 11 maf in all service areas

Water quality (Ag)

- Water quality varies in both surface and ground water sources
- Rate waters by suitability for use
  - Total Dissolved Solids (TDS)
  - Specific Ion toxicities
  - Infiltration Problems

Water quality (Ag)

Surface water quality are a consequence of:

- Travel through the area of origin
- The level of use/reuse

Eastern Sierra	20 to 50 ppm
Sacramento River	98 ppm
San Joaquin River	236 ppm

Water Quality (Ag)

Inflows from the west side of the valley tend to be higher in:

- Sodium
- Chloride
- Boron

due to the parent material

Groundwater Quality (Ag)

- Direct relation to the sediments in which it is stored
- Variable but tends to increase in TDS with deeper depths

Agricultural and Municipal Operations

- Deep percolation losses can move other contaminants into pumped groundwater
- Nitrates, pesticides and solvents are of concern

Important Water Supply Issues

- Quantity
- Quality
- Timing
- Assured supply
- Cost

Walnut Crop Water Use

San Joaquin Valley

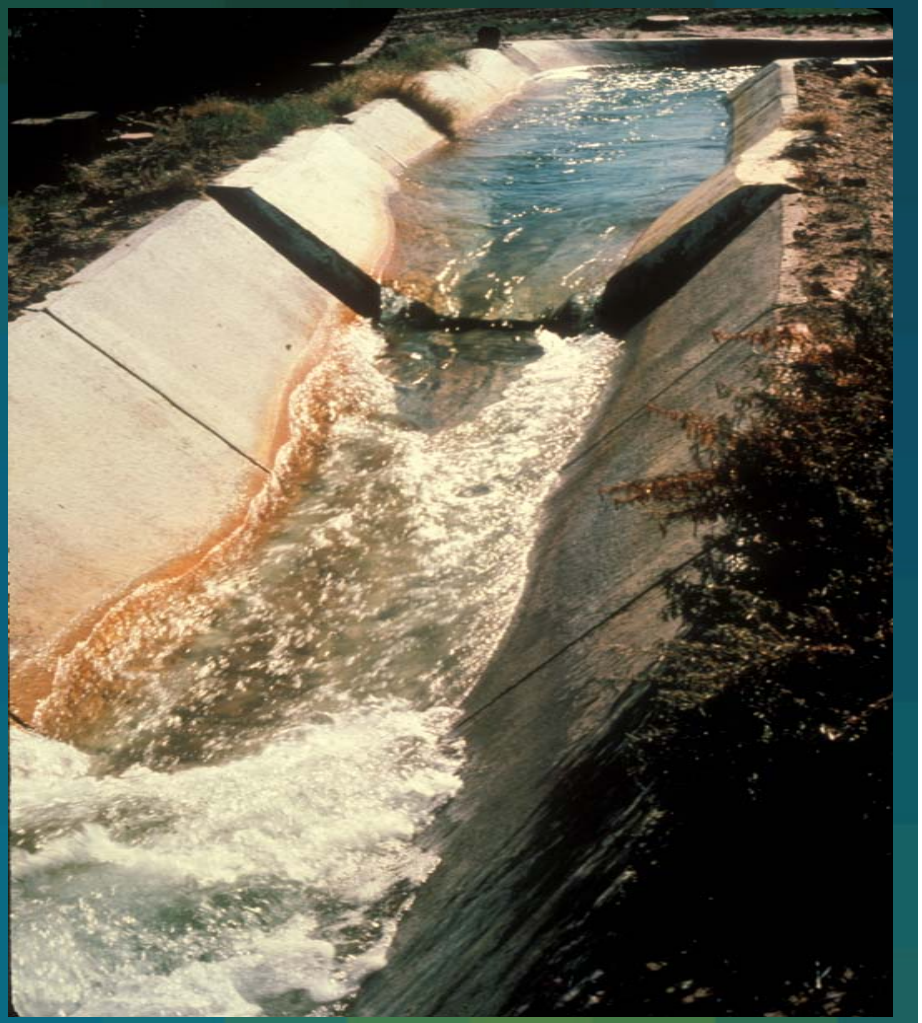
Month	Inches	Month	Inches
Mar	0.3	July	9.4
April	3.0	Aug	8.1
May	5.8	Sept	5.4
June	7.4	Oct	2.3
		Nov	0.6

TOTAL: 42.0 Inches

Water Quality

- Increased irrigation water salinity required a higher leaching fraction to sustain yield
- Increases costs and risk

Crop Water Use



- Non- crop use
  - Germination
  - Frost Control
- Surface ID vs. Pumped water

Flexibility

- During times of reduced surface supply ground water preferred as an assured source.
- Mix surface with groundwater of lower quality

Assured Supply

Delivery Timing

- Surface: large head, Infrequent

Delivery Timing

- Low Volume: Small Head, Frequent Automation

Water costs

Surface water costs weighted avg 1996

	$/af
• Sac River	12
• SJ River	22
• Tulare Lake	42

Water costs

Groundwater: Variable

Lift, power plant type

Table 7-10. Typical Agricultural Ground Water Production Costs in 1992 by Hydrologic Region

Region	*Ground Water Costs ($/acre-foot)†*
North Coast	10-70
San Francisco Bay	60-130
Central Coast	80
South Coast	80-120
Sacramento River	30-60
San Joaquin	30-40
Tulare Lake	40-80
North Lahontan	60
South Lahontan	20
Colorado River	90

† The range represents the average cost at specific locations within a region, and includes capital, operation, maintenance, and replacement costs.

Water costs: Groundwater

From:
Costs of Pressurized Irrigation Systems ANR 21585 2000

- Total annualized costs based on:
- 40 ac Trees
- 3 ft of water delivered per acre
- 100 foot lift + pressure head
- Initial + operating costs
- Total = $442/ac or $147 /af


Fuel cost $57 af
Capital cost 50,000
Lift head= 100 ft
Pressure head = 88 ft
Drawdown= 3 ft
Friction loss= 3 ft
TDH 194 ft
Flow 1000 gpm

	1995	*2020 Forecast*	*Change*
Population (million)	32.1	47.5	+15.4
Irrigated crops (million acres)	9.5	9.2	-0.3
Urban water use (maf)	8.8	12.0	+3.2
Agricultural water use (maf)	33.8	31.5	-2.3
Environmental water use (maf)	36.9	37.0	+0.1