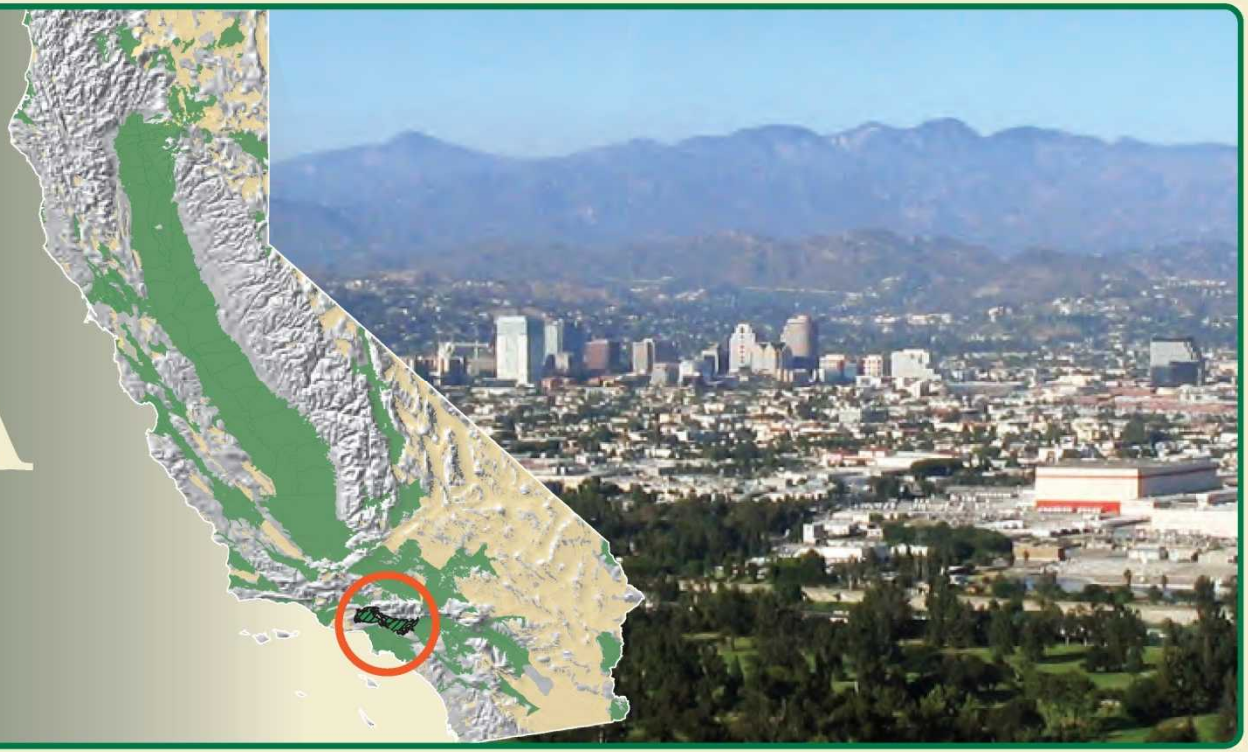
CALIFORNIA
GAMA
PROGRAM



Groundwater Quality in the San Fernando-San Gabriel valleys: Results from the California GAMA Priority Basins Project

Justin Kulongoski, Michael Land, and Kenneth Belitz
U.S. Geological Survey
San Diego, California

USGS
science for a changing world

California Water Boards

Comprehensive Groundwater Assessment: Spatially Distributed Randomized Sampling Approach

- **Equal area grids**

  Divide a groundwater basin into “cells” of equal area

- **Spatially distributed sampling**

  Obtain one sample per cell

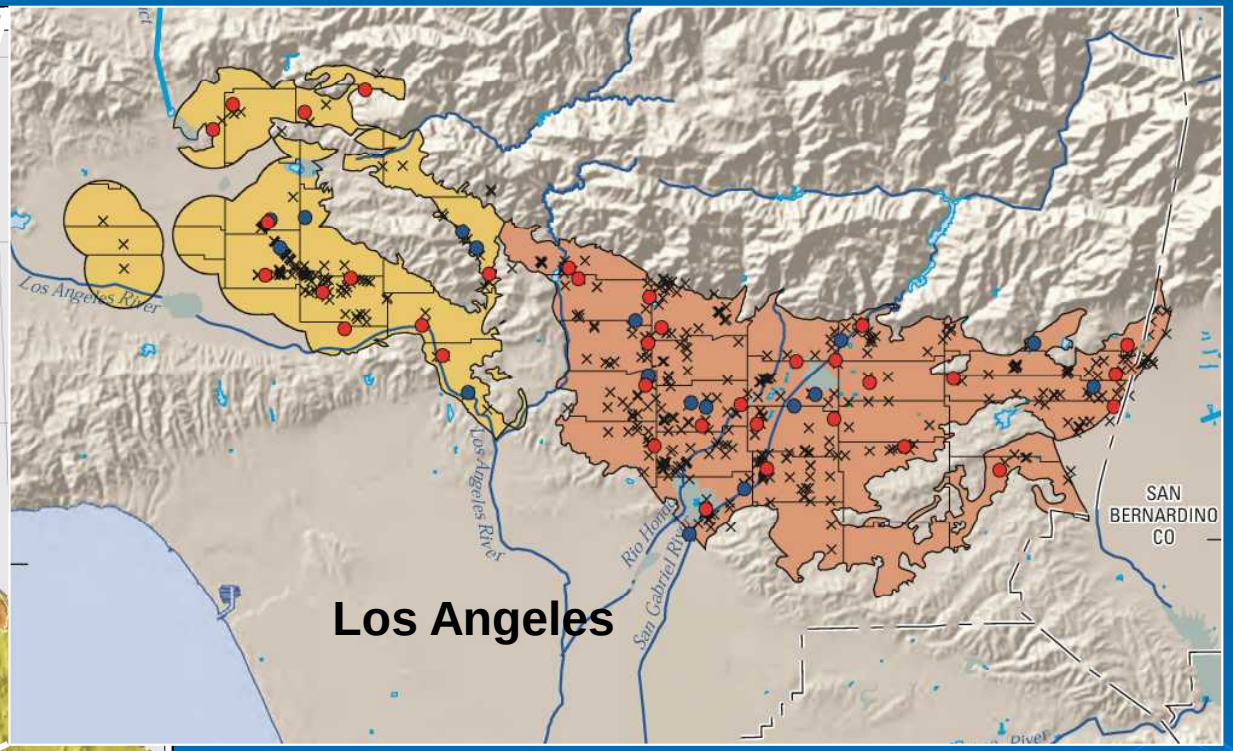
- **Spatially unbiased assessment**

  Utilize one or many values power cell to assess groundwater quality at the basin scale

USGS science for a changing world

California Water Boards

San Fernando-San Gabriel GAMA Study Unit: Spatially distributed randomized network



- 35 grid cells sampled
- Density of 1 well per grid cell: 25 km^2

USGS science for a changing world

California Water Boards

Constituent Sampling Schedules

Fast schedule (227)	Slow schedule (292)
88 Volatile organic compounds	***Fast schedule +***
122 Pesticides and degredates	pH, DO, alkalinity, turbidity
Stable isotopes of water	Major ions
Tritium and noble gases	Coliform and coliphage
Conductance and temperature	Nutrients and DOC
NDMA, TCP, perchlorate, 1,4-dioxane	Trace elements
As, Cr, and Fe speciation	Gross alpha and beta radioactivity
	Carbon isotopes
	Radium 226/228, Radon-222

USGS science for a changing world

California Water Boards

GAMA Priority Basin Project Products

USGS
science for a changing world

In cooperation with the California State Water Resources Control Board

Ground-Water Quality Data in the San Fernando-San Gabriel Study Unit, 2005: Results from the California GAMA Program

Data Series xxx

U.S. Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

California Water Boards

Prepared in cooperation with the California State Water Resources Control Board
A product of the California Groundwater Ambient Monitoring and Assessment (GAMA) Program

Status of Groundwater Quality in the San Fernando–San Gabriel Study Unit, 2005: California GAMA Priority Basin Project

Scientific Investigations Report 2011–5206

U.S. Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

California Water Boards

U.S. Geological Survey and the California State Water Resources Control Board

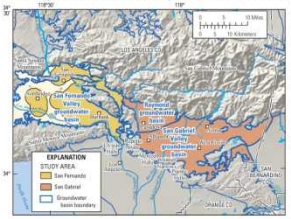
Groundwater Quality in the San Fernando–San Gabriel Groundwater Basins, California

Groundwater provides more than 40 percent of California's drinking water. To protect this vital resource, the State of California created the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The Priority Basin Project of the GAMA Program provides a comprehensive assessment of the State's groundwater quality and increases public access to groundwater-quality information. The San Fernando and San Gabriel groundwater basins constitute one of the study units being evaluated.

The San Fernando–San Gabriel Study Unit

The San Fernando–San Gabriel study unit is approximately 460 square miles and consists of the San Fernando Valley, Raymond, and San Gabriel Valley groundwater basins (California Department of Water Resources, 2003). The study unit has hot, dry summers and cool, moist winters. Average annual rainfall ranges from 17 to 21 inches over the three basins. The study areas are drained by the Los Angeles, San Gabriel, and Rio Hondo rivers and their tributaries (Land and Belitz, 2008).

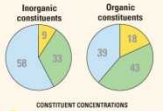
The San Fernando and San Gabriel Valleys are sedimentologically diverse basins situated within the Transverse Ranges of southern California. These structurally complex basins formed as a result of the dextral slip of the San Andreas Fault system in the late Tertiary–Quaternary (Tinsley, 2001). The valleys have been filled, up to 6,400 feet, with marine and terrestrial sediments of Pleistocene through Holocene age that overlie crystaline basement. The alluvium and underlying marine deposits contain freshwater used for supply. The primary aquifers in the study unit are defined as those parts of the aquifers corresponding to the perforated intervals of wells listed in the California Department of Public Health (CDPH) database. Public-supply wells are typically drilled to depths of 400 to 785 feet, consist of solid casing from the land surface to a depth of about 157 to 300 feet, and are perforated below the solid casing. Water quality in the primary aquifers may differ from that in the shallower and deeper parts of the aquifer system. Groundwater movement is generally from the northern parts of the valleys south towards the Pacific Ocean.



Land use in the study unit is approximately 83 percent (%) urban, 16% natural, and 1% agricultural. The urban landscape consists of residential, commercial, and industrial areas. Natural lands are mostly shrublands and grasslands. The largest urban areas are Los Angeles, San Fernando, Northridge, Burbank, Pasadena, Alhambra, Azusa, and West Covina.

Recharge to the groundwater basins occurs from the infiltration of runoff and imported water at spreading basins, infiltration of precipitation and irrigation, and infiltration of streamflow from the major rivers and their tributaries. Streamflow is a combination of runoff from the surrounding mountains, imported water, industrial discharges, and treated wastewater effluent. The primary sources of discharge are water pumped for municipal supply and for irrigation.

Overview of Water Quality



Values are a percentage of the area of the primary aquifers with concentrations in the three specified categories. Values on piechart may not equal 100 due to rounding of percentages.

GAMA's Priority Basin Project evaluates the quality of untreated groundwater. However, for context, benchmarks established for drinking-water quality are used for comparison. Benchmarks and definitions of *high*, *moderate*, and *low* concentrations are discussed in the inset box on page 3.

Many inorganic constituents occur naturally in groundwater. The concentrations of the inorganic constituents can be affected by natural processes as well as by human activities. In the San Fernando–San Gabriel study unit, one or more inorganic constituents were present at high concentrations in about 9% of the primary aquifers and at moderate concentrations in about 33%.

Man-made organic constituents are found in products used in the home, business, industry, and agriculture. Organic constituents can enter the environment through normal usage, spills, or improper disposal. In this study unit, one or more organic constituents were present at high concentrations in 18% of the primary aquifers and at moderate concentrations in about 43%

U.S. Department of the Interior
U.S. Geological Survey

Printed on recycled paper

Fact Sheet 2011–3139
March 2012

STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

USGS
science for a changing world

Relative concentration: concentration/benchmark

AQUIFER-SCALE PROPORTION

The primary metric for assessing groundwater quality at the basin scale

HIGH relative concentration > 1

MODERATE

0.1 < rel. conc. < 1 for organic
0.5 < rel. conc. < 1 for inorganic

LOW

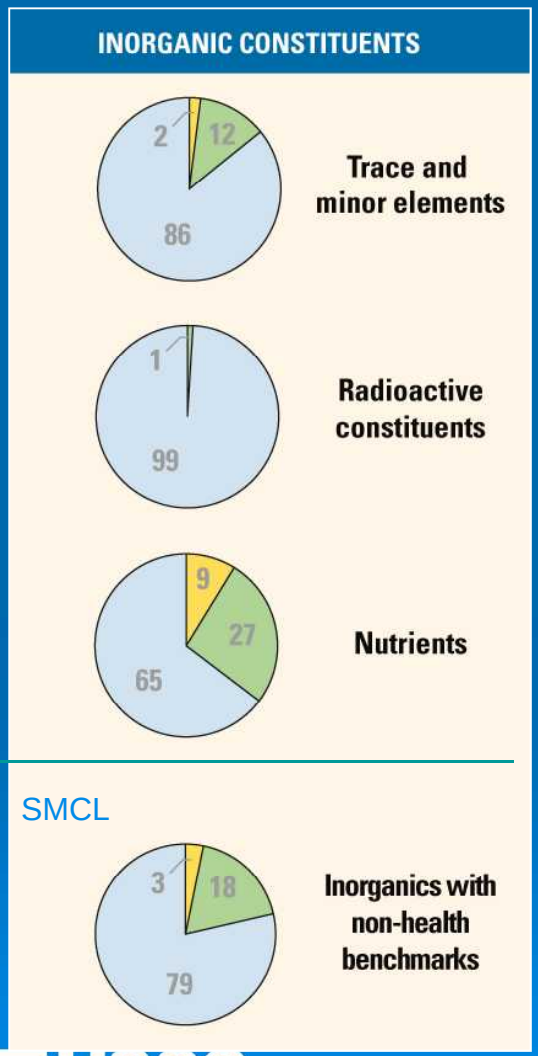
rel. conc. < 0.1 for organic
rel. conc. < 0.5 for inorganic

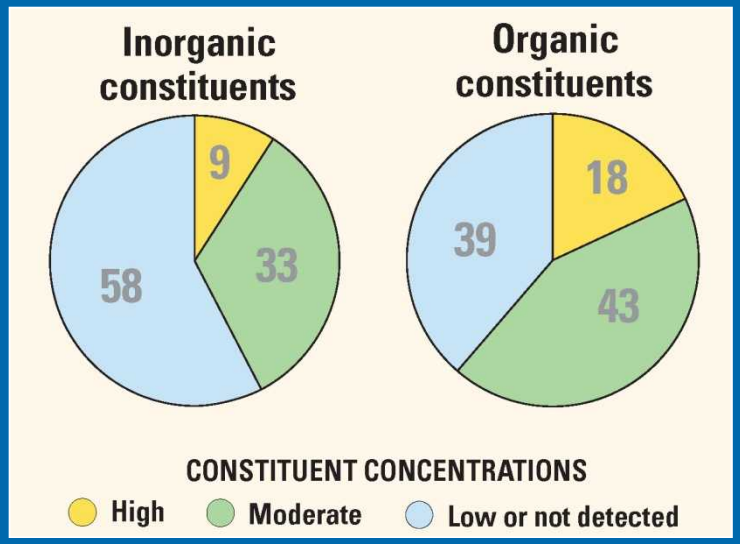
Organic constituents are generally introduced by people
Inorganic constituents occur naturally or can be introduced by people

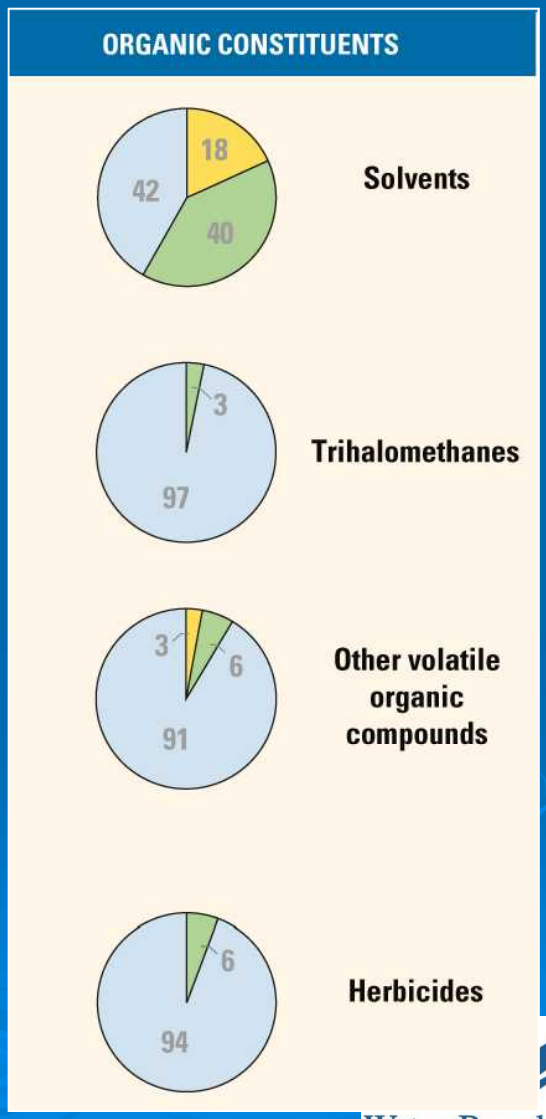
Water Boards

USGS science for a changing world

Assessment of Groundwater Quality: Aquifer Scale Proportions



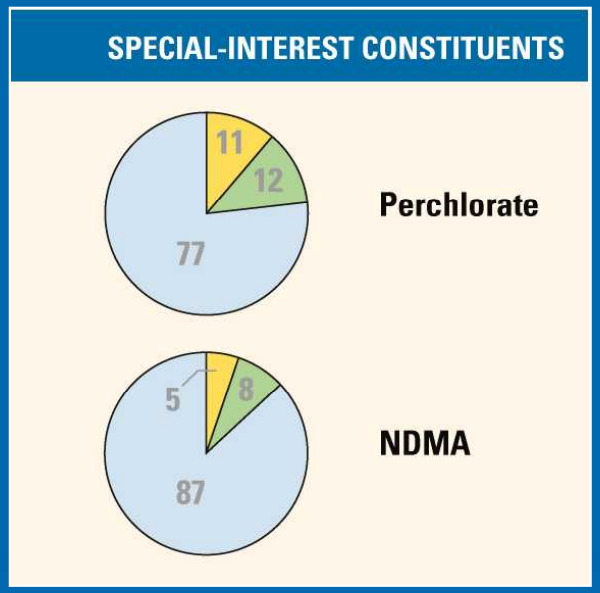




USGS science for a changing world

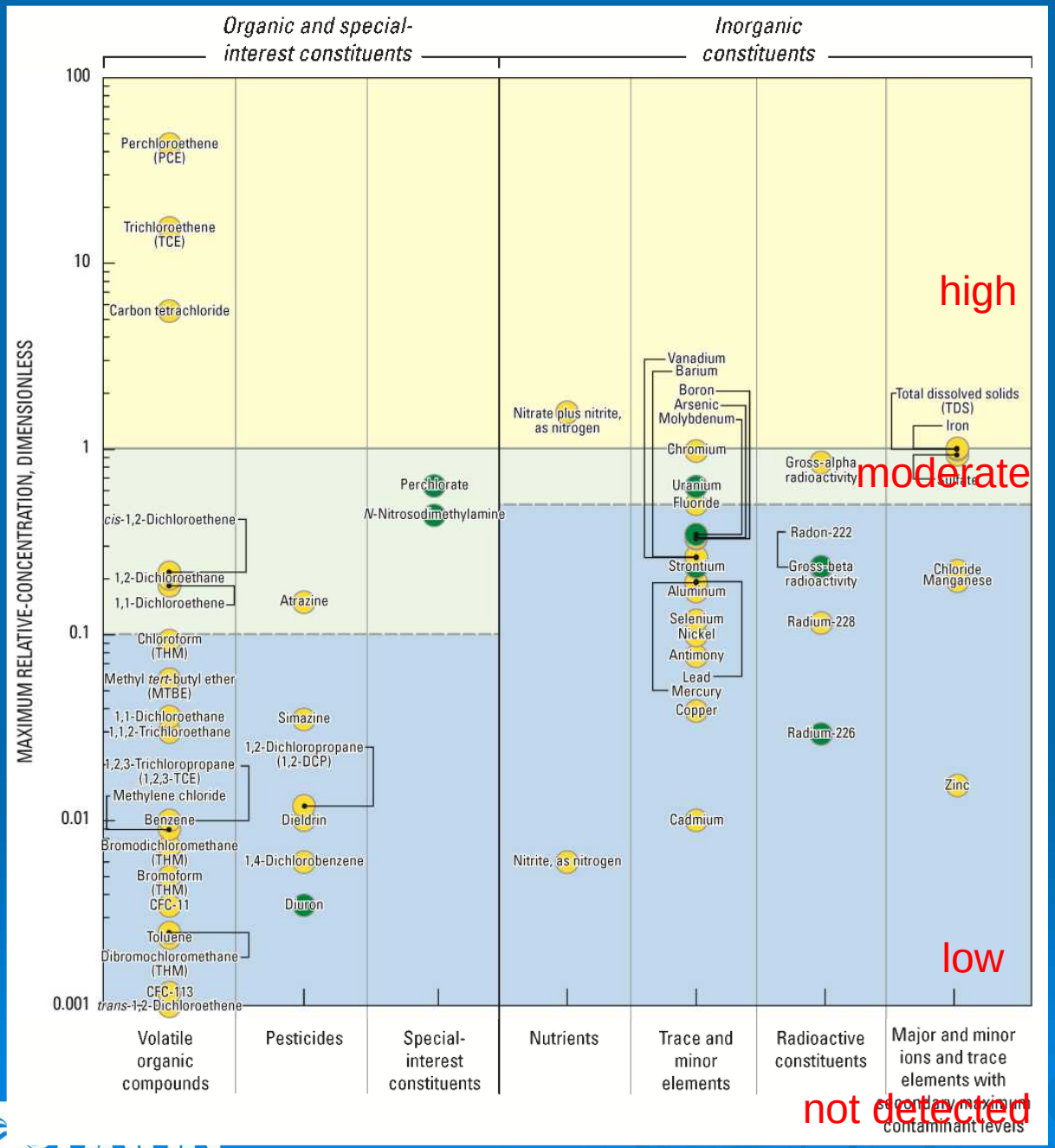
Water Boards

Assessment of Groundwater Quality: Aquifer Scale Proportions



USGS science for a changing world

California Water Boards

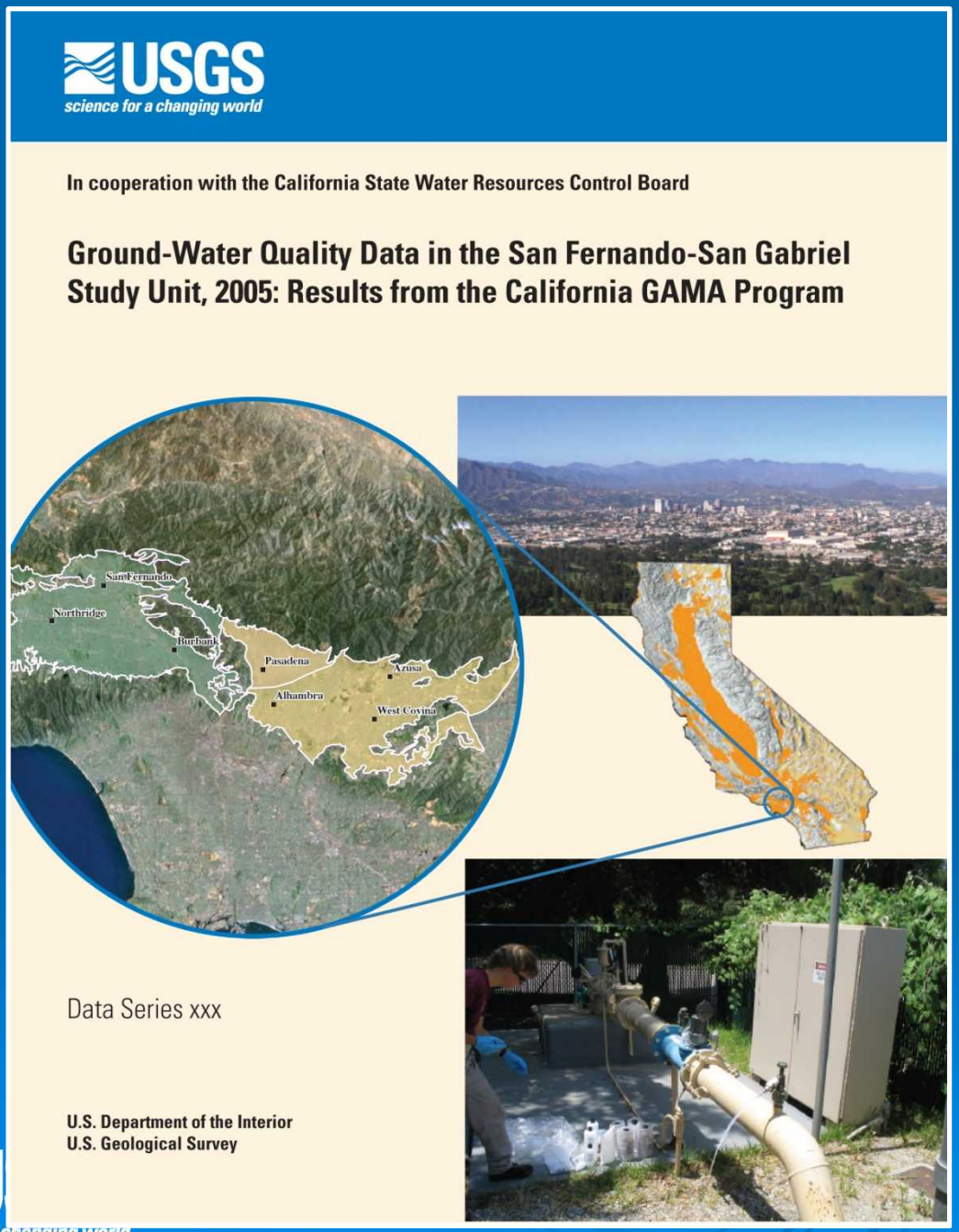


Relative Concentration Plot

- Presents status assessment
- Used to evaluate which constituents are considered for further assessment in the report

science for a changing world

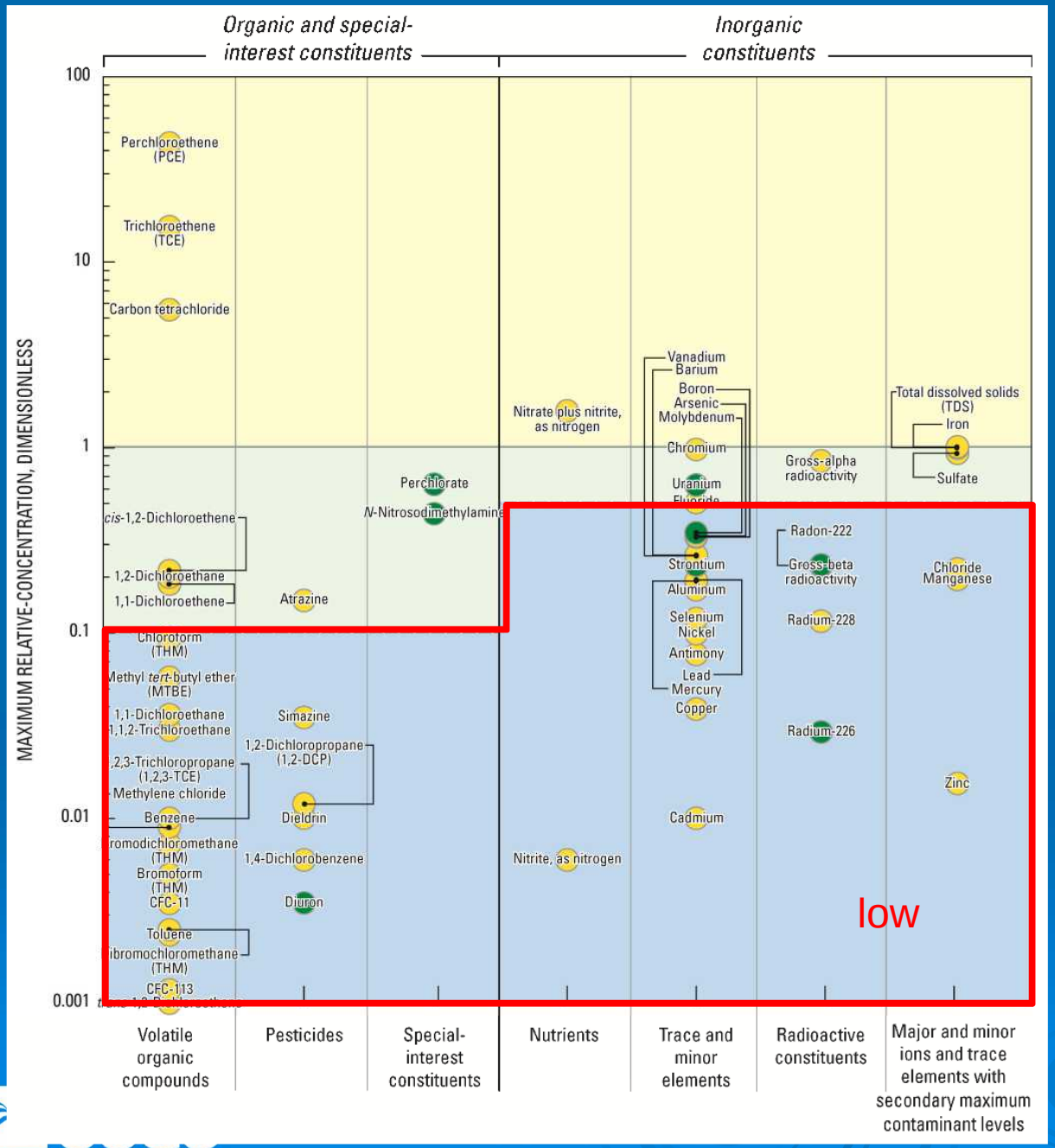
California Water Boards



Constituents not detected:

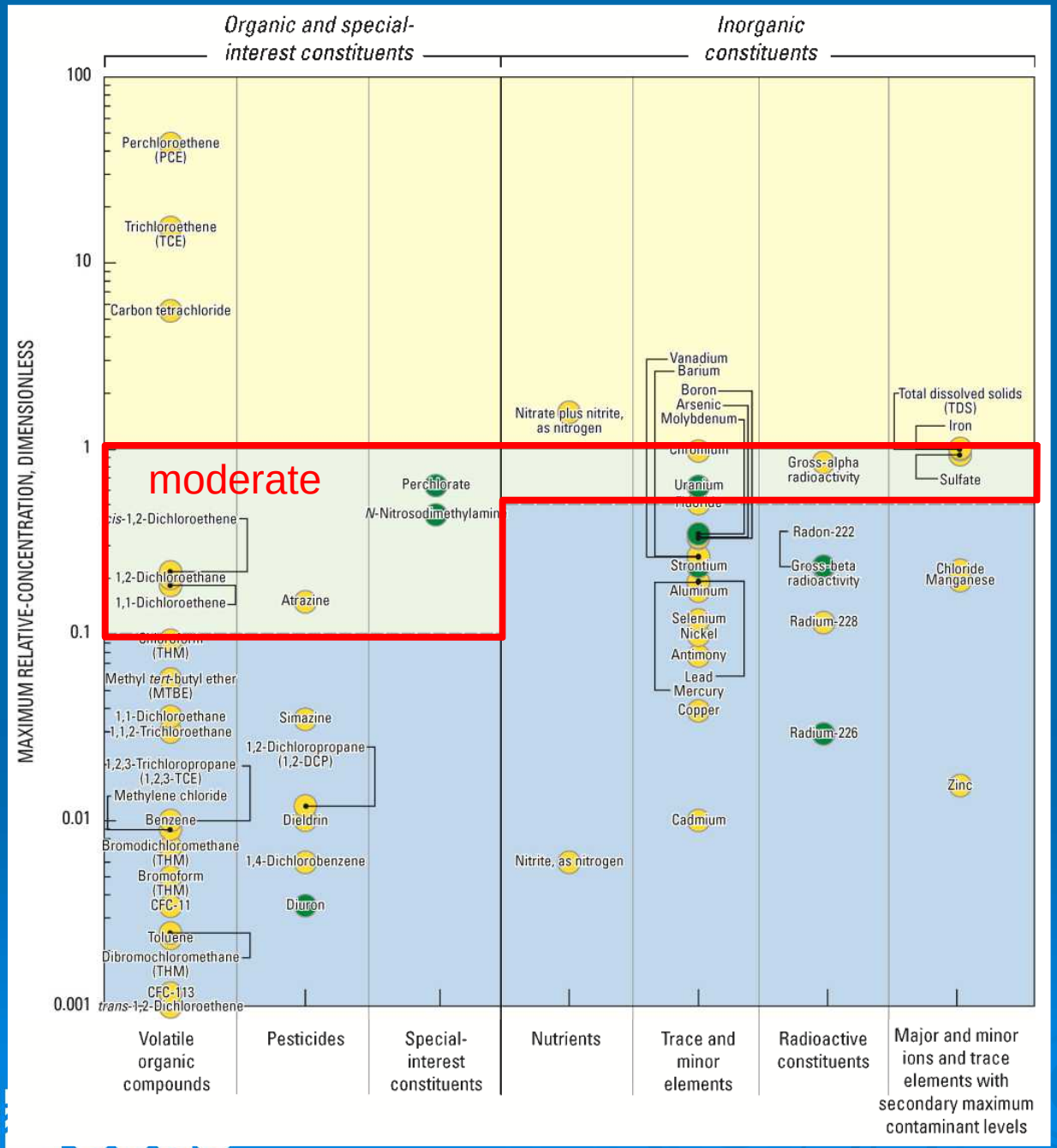
- Tabulated in Data Series Report

Relative Concentration Plot



Constituents with low relative-concentrations:

- Presented in this plot with their maximum relative concentration
- Tabulated in Data Series Report



Relative Concentration Plot

Constituents with moderate relative-concentrations:

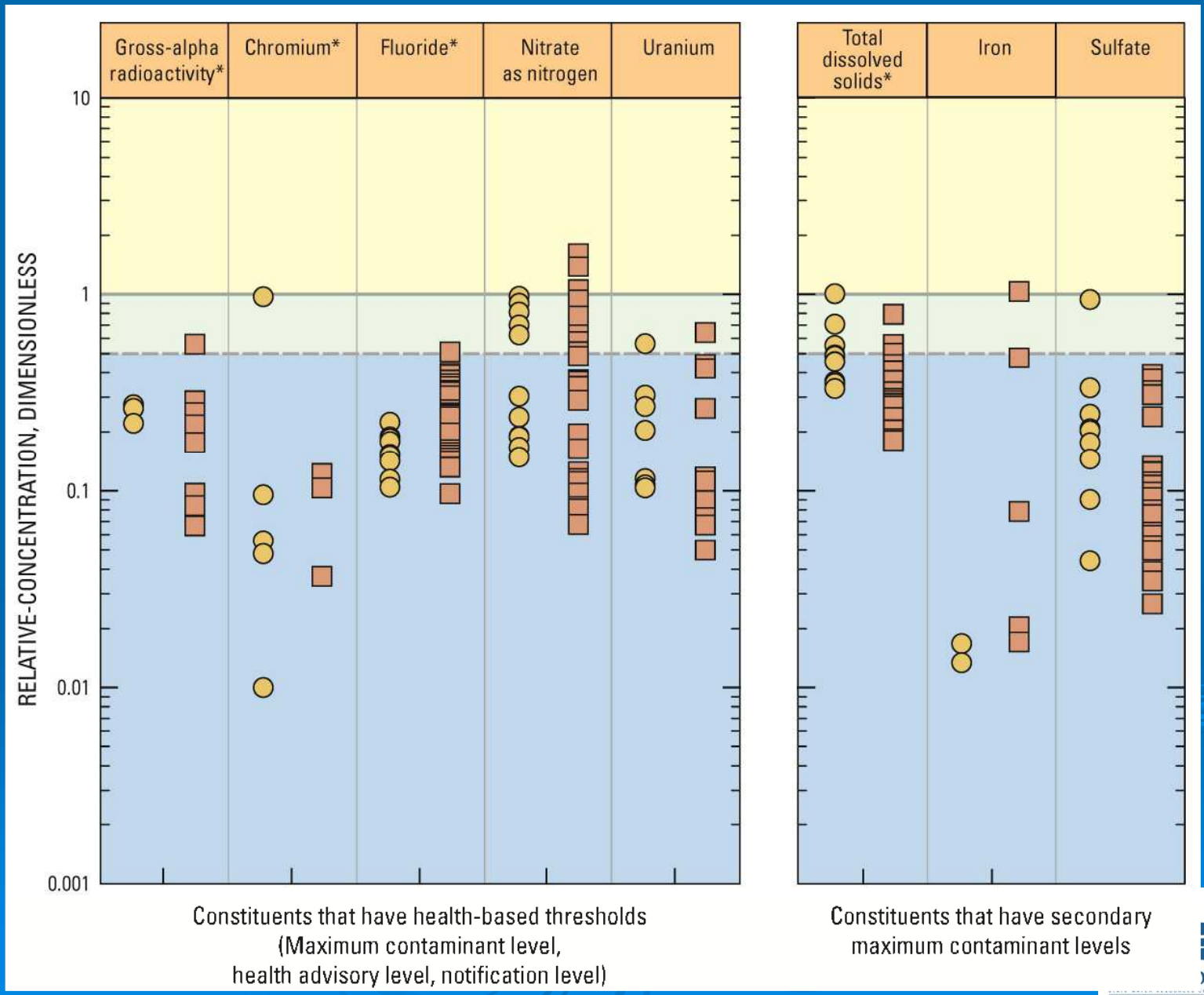
- Presented in this plot with their maximum relative concentration
- Also presented in dot plots
- Discussed in text

science for a changing world

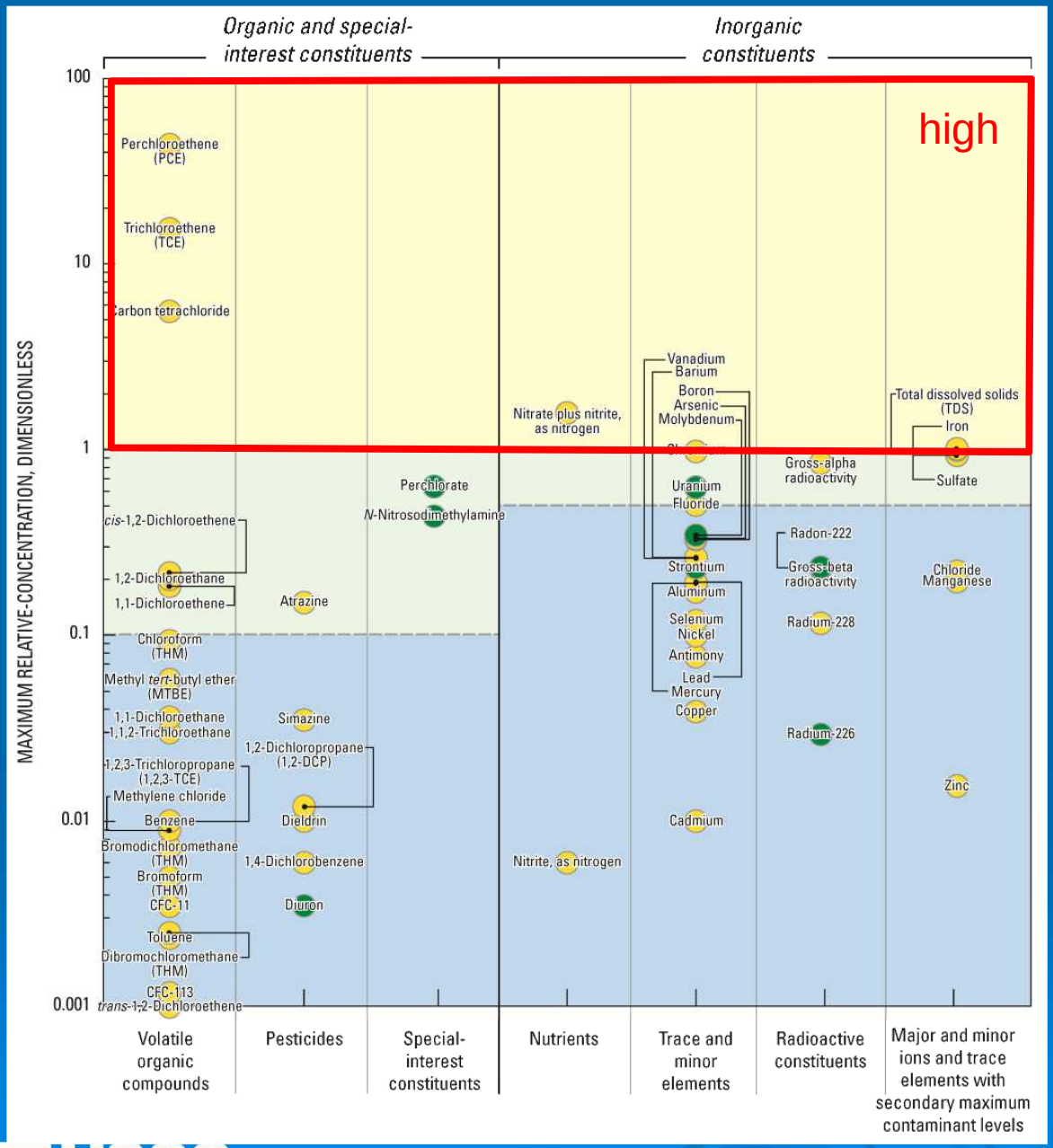
California Water Boards

Inorganic Constituents

Dot plots



USGS science for a changing world



Constituents with high relative-concentrations:

- Presented in this plot with their maximum relative concentration
- Also presented in dot plots
- Discussed in text

For constituents with >2% high or >10% detection frequency:

- Presented in maps;

For constituents with statistically significant correlations:

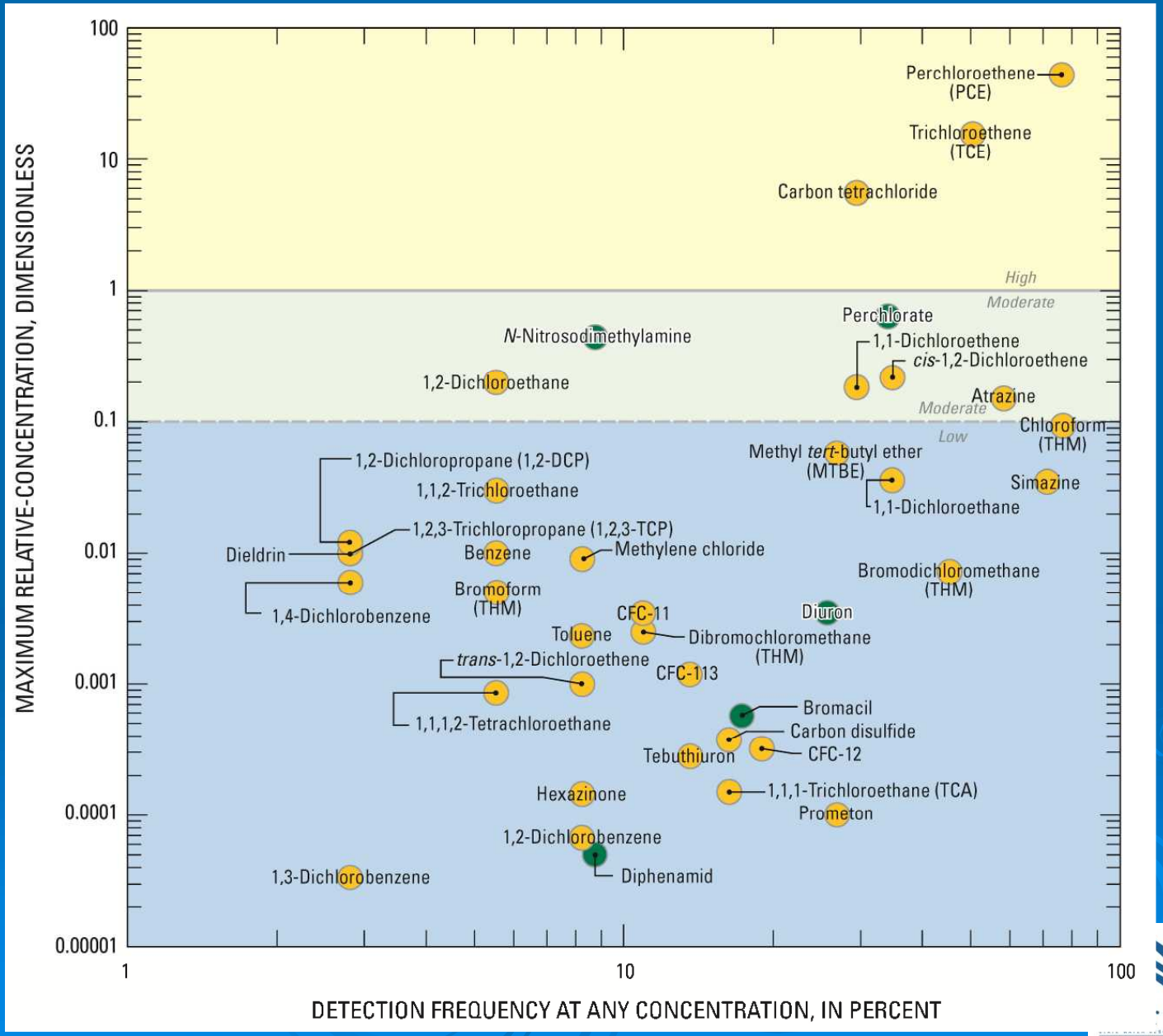
- Presented in additional figures

USGS science for a changing world

California Water Boards

Organic Constituents

Detection Frequency

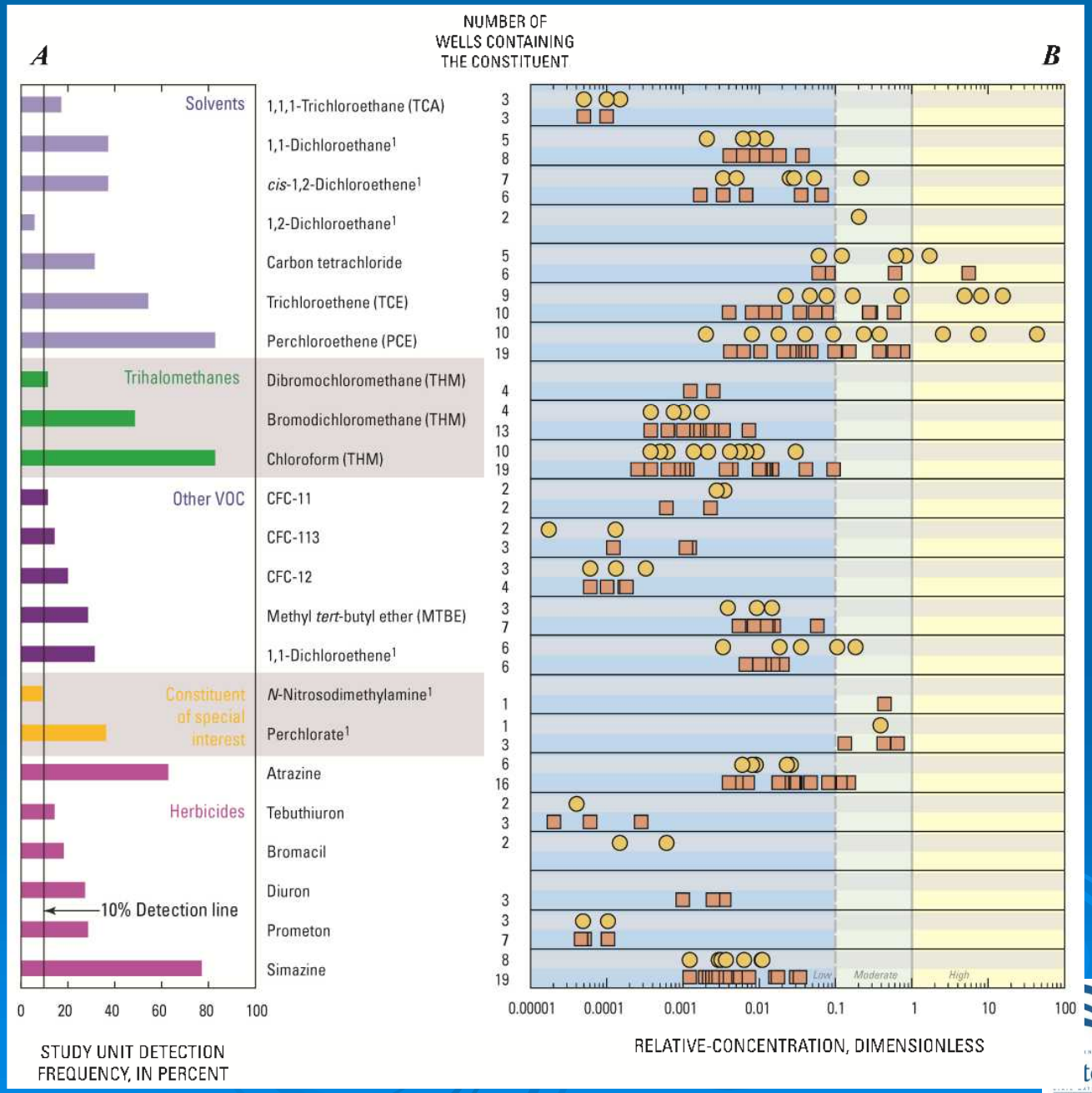


USGS science for a changing world

Boards

Organic Constituents

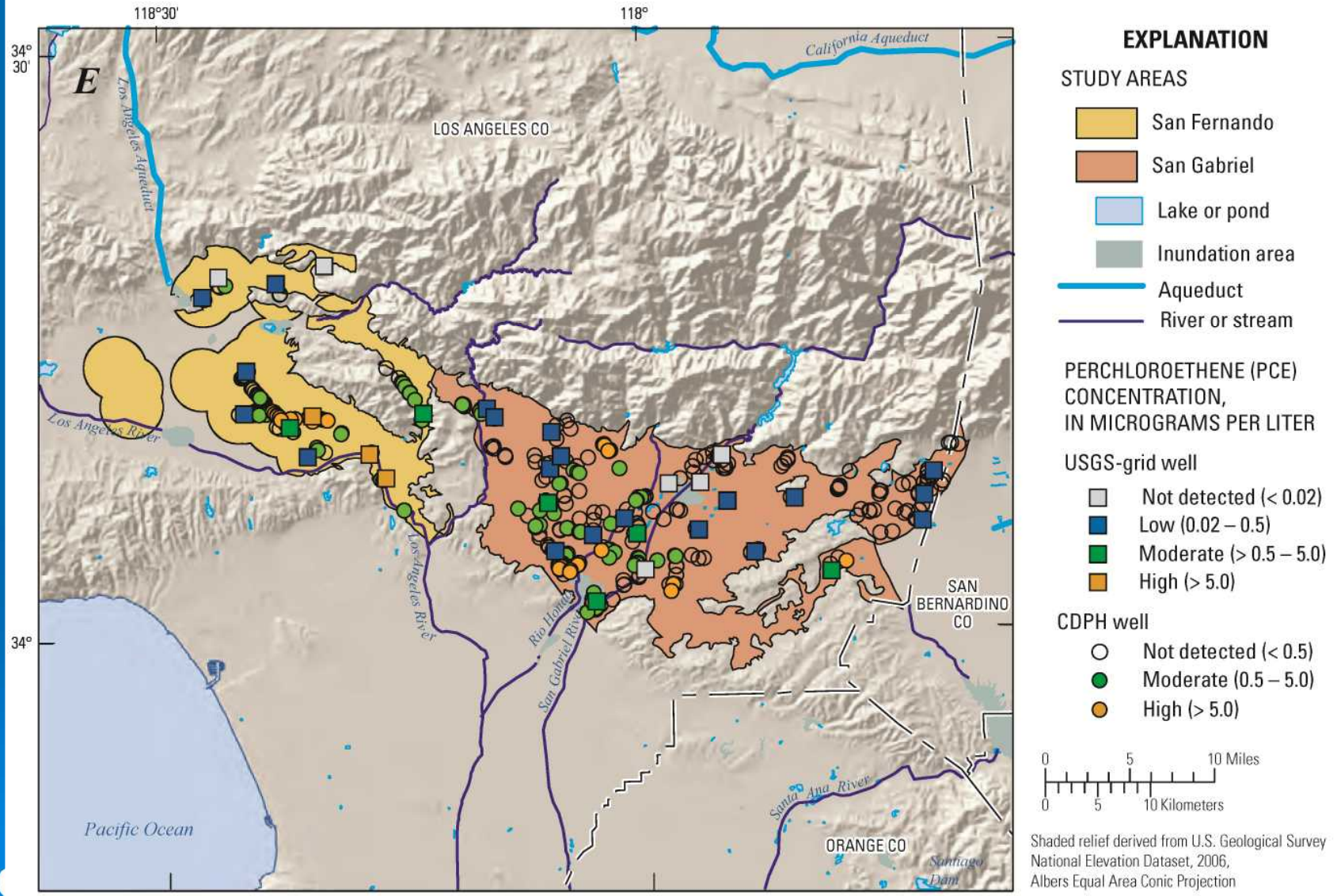
Dot plots



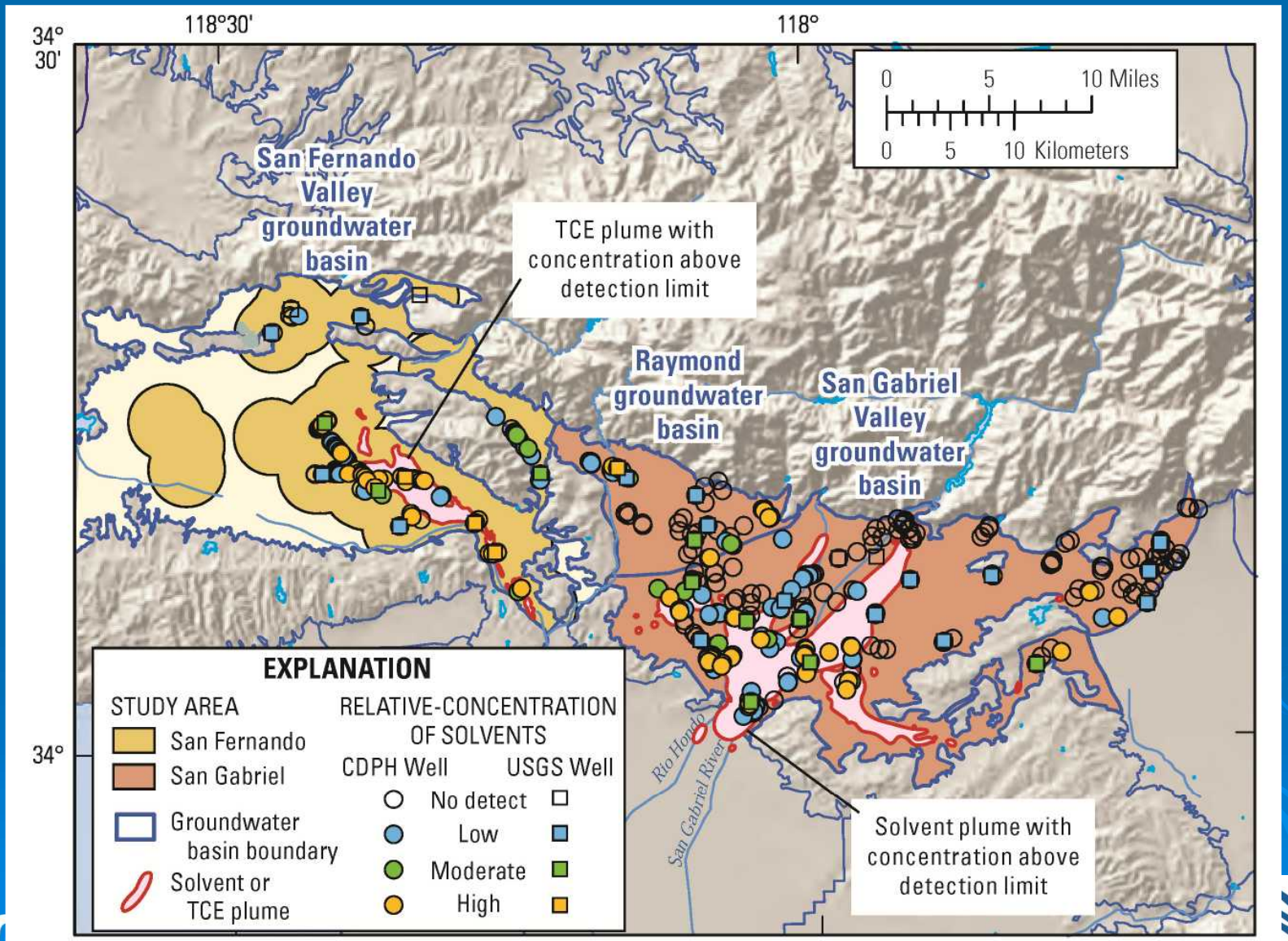
USGS science for a changing world

ter Boards

Constituent Map



Explanatory Figure



GAMA Priority Basin Project: Lessons Learned

- Spatially-distributed design is required for an accurate assessment of the quality of the groundwater resource
- Relative concentrations and aquifer-scale proportions provide context for comparing different constituents and different areas
- A statewide, comprehensive assessment identifies where concentrations are high and where they are not.

USGS science for a changing world

California Water Boards
State Water Resources Control Board
Regional Water Quality Control Boards

Summary

Major findings of Study:

- Organic constituents are high in 18% of primary aquifers. Carbon tetrachloride, PCE, and TCE are the most important for water quality
- Inorganic constituents: 9% of public-supply aquifer has high concentrations; nitrate is the most important for water quality
  - 22 organic constituents detected at >10%; 86% of wells had organic detection

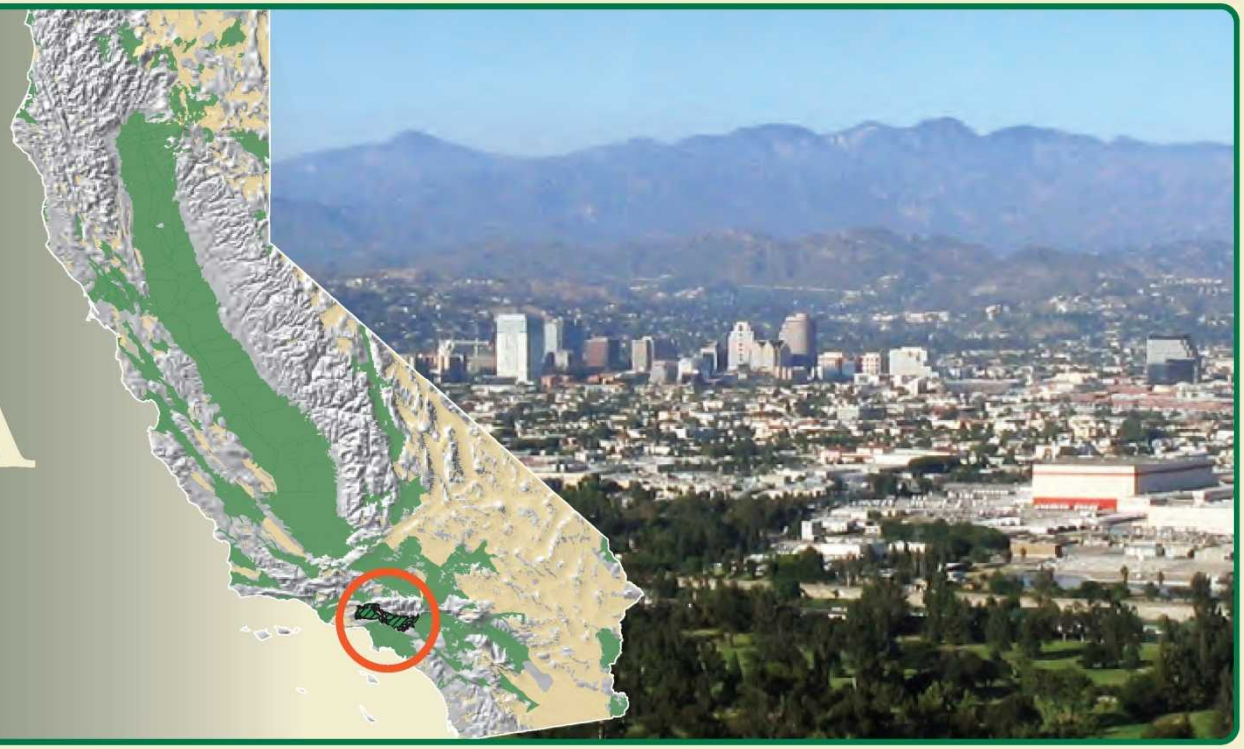
Communication of data is as important as the results

- We developed an effective way of presenting data using:
  - Relative concentrations
  - Aquifer-scale proportions
  - Relative-concentration plot to identify constituents of interest for further discussion
  - Report structure

USGS science for a changing world

California Water Boards

CALIFORNIA GAMA PROGRAM



USGS: http://ca.water.usgs.gov/gama/

Justin Kulongoski

U.S. Geological Survey

619.225.6100

kulongos@usgs.gov

USGS science for a changing world

California Water Boards