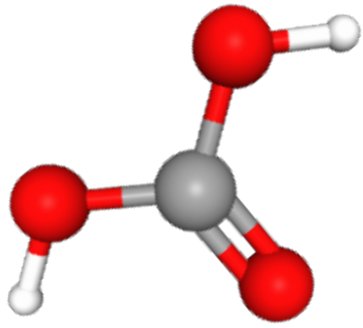
Groundwater Fact Sheet
Lead (Pb)



Constituent of Concern
Lead

Synonym
Plumbum (obsolete)

Chemical Formula
Pb

CAS Number
7439-92-1

Storet Number
01049 (dissolved), 01051 (total)

Summary
The United States Environmental Protection Agency (EPA) has defined an Action Level (AL) of 15 g/L for lead. With the passage of the EPA regulation AL on 12/11/95, California's Maximum Contaminant Level (MCL) for lead was rescinded. Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. The most common sources of lead in drinking water are corrosion of household plumbing systems and erosion of natural deposits. Historically, lead has been used in household paints, as a gasoline additive, in soldering compounds, and in metal piping.

Based on State Water Resources Control Board (SWRCB) data from 2007 to 2017, 134 active and standby public supply water wells (of 8,089 wells sampled, 1,509 detections) had at least one detection of lead above the AL. Most of these detections were measured only once and possibly were the result of lead leaching from pipes. Most lead detections above the AL occurred in Kern (12 wells), San Bernardino (10 wells), San Joaquin (9 wells), and Monterey (9 wells) counties

REGULATORY WATER QUALITY LEVELS[1]

LEAD (Pb)

Type	Agency	Concentration
Federal Action Level (AL)[2]	EPA[3]	15 µg/L
State MCL (rescinded)[2]	SWRCB[4]	15 µg/L
Detection Limit for Purposes of Reporting (DLR)	SWRCB[4]	5 µg/L
Public Health Goal (PHG)	OEHHA[5]	0.2 µg/L
Cancer Potency Factor (1/10^6 cancer risk)	OEHHA[5]	4.1 µg/L

[1]Other water quality levels may exist. For further information, see "A Compilation of Water Quality Goals", 17th Edition (SWRCB).
[2]The Action Level (AL) functions similarly to a maximum contaminant level (MCL), but with additional testing requirements. If more than 10% of samples collected at the point of delivery exceed the AL, the water distributor must take steps to reduce the corrosivity and/or lead concentrations of the delivered water. The MCL for lead in California was rescinded with the adoption of the regulatory Action Level effective 12/11/95.
[3]EPA – United States Environmental Protection Agency
[4]SWRCB - State Water Resources Control Board

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[5]OEHHA – Office of Environmental Health Hazard Assessment

LEAD DETECTIONS IN PUBLIC WATER WELL SOURCES[6]	
Number of active and standby public water wells with lead concentrations > 15 µg/L [7]	134 of 8,089 wells tested with 1,509 detections
Top 3 counties with lead detection in public wells above the Action Limit	Kern (12), San Bernardino (10), San Joaquin (9), and Monterey (9)

[6]Based on 2007-2017 public standby and active well (groundwater sources) data collected by the SWRCB.
[7]Water from active and standby wells is treated to prevent exposure to chemical concentrations above the MCL or other health-based benchmarks. Data from private domestic wells and wells with less than 15 service connections are not available.

ANALYTICAL INFORMATION		
Approved EPA methods	200.8	200.9
Detection Limit (µg/L)	0.015	0.7
Notes	Determination of trace elements in waters and wastes by Inductively Coupled Plasma - Mass Spectrometry (ICP/MS)	Determination of trace elements by stabilized temperature Graphite Furnace Atomic Absorption (GFAA)
Known Limitations to Analytical Methods	Few laboratories are equipped to conduct ICP/MS analysis necessary for low detection limit quantification and speciation. Sample handling and preservation methods differ for different analytical methods. No single method is appropriate for all sample matrices, but preservation is very important due to speciation concerns. Sulfide interference may occur in field-testing methods (colorimetric). Sample filtration may be done but is not required.	
Public Drinking Water Testing Requirements	Public water systems are required to test for lead on a schedule established by SWRCB-DDW. Public supply systems must also periodically sample water at the point of delivery (generally, in household taps); if more than 10% of the taps exceed the Action Level, the supplier must begin efforts to reduce lead concentrations at the point of delivery.	

Lead Occurrence

Anthropogenic Sources

There are several significant anthropogenic sources of lead in drinking water, including pipes, solder, brass fixtures and faucets, and other types of plumbing fittings. Prior to 1978, leaded gasoline was a major source of lead to the environment. Exhaust and lead particulates from this gasoline were transported to the atmosphere, surface water, and groundwater. Other sources of lead to water include fishing equipment (sinkers), car batteries, and some food cans. Dust – both indoor and outdoor – can contain significant amounts of lead from both natural and anthropogenic sources.

The amount of lead in your tap water will depend on several factors, including the age and material of your pipes, concentrations delivered by the public utility (or, if you are a private domestic well owner, the concentrations in the raw groundwater), and corrosivity (acidity, temperature, and the concentration of other mineral components) of the water. More corrosive water can cause greater leaching from pipes. According to the EPA, newer homes will typically have higher lead concentrations. As a home and pipes age, mineral deposits will form a coating on the inside of the pipes and protect against further corrosion. However, older homes with lead pipes can still have significant concentrations of lead in their tap water.

Paint is an additional source of household lead. Lead was used extensively in paint pigments prior to 1960. After 1960, use of lead paints decreased significantly. Lead paint was banned in 1978. Dust and paint chips from lead paints can be a significant source of lead to children; however, the contribution of lead to groundwater and drinking water from paint is not believed to be significant.

Natural Sources

Lead naturally occurs in rocks and mineral deposits that have varying degrees of solubility. Leaching of those rocks and minerals can cause elevated lead concentrations in groundwater.

Groundwater contamination from "natural" lead sources is thought to be rare in California. Most detections of lead above the AL are very likely the result of leaching from pipes and plumbing. Lead detected in public water supply wells may likely come from materials used in the construction of the well (for example, casing, solder, and pump machinery), and may not reflect ambient (natural) background water quality.

History of Occurrence

Historically, lead was used extensively in piping, as a component of solder, in brass fittings, and in some types of faucets and fixtures. Plumbing installed prior to 1930 typically contained some lead. Copper pipes have replaced lead pipes in most residential buildings – however, lead solder was often used with copper pipes. The EPA regards lead solder as a major cause of lead contamination in household water. Recognition that lead from pipes and solders could contribute to childhood developmental delays resulted in laws limiting the amount of lead in household plumbing. The EPA required lead-free plumbing in 1988. In 1991, the EPA established the 15 µg/L Federal Action Level. California followed in 1995 with its Action Level (functioning as MCL) of 15 µg/L. In January 2010, California updated laws mandating "lead-free" piping and soldering materials for use in households.

Contaminant Transport Characteristics

Elementary lead does not dissolve in water under normal conditions. However, it may occur dissolved in water as lead carbonate. Lead also frequently binds to sulphur in sulfide form, or to phosphor in phosphate form. In these forms lead is extremely insoluble and is present as immobile compounds in the environment. Lead compounds are generally soluble in soft, slightly acidic water, like acid mine drainage waters.

Remediation and Treatment Technologies

Lead remediation is usually not practicable in groundwater, since most lead in drinking water usually comes from household sources (pipes, fittings, solder). However, there are several methods and actions that are effective in reducing the lead concentration in drinking water:

Filters
Some household faucets or pitcher filters will remove lead from drinking water. The label on the filter should be checked to ensure that it is certified for lead removal.

Run the Water
One of the most effective techniques to reduce lead concentrations in your tap water is to let the faucet run for 30 seconds to two minutes before using the water for drinking, cooking, or brushing your teeth. If the water has sat in your house's plumbing or piping for more than about six hours, the water run will help to flush out lead that has leached from household pipes. Usually, the water will change temperature once the pipes have flushed.

Boiling WILL NOT Remove Lead
Boiling water with lead in it will not remove the lead – in fact, boiling water will slightly increase lead concentrations.

Use Cold Water for Cooking and Drinking
Use only cold water for cooking or consumption. Hot water can more easily leach lead from pipes. If hot water is required for cooking, use cold water and heat that water on a stovetop or in a microwave. Do not use hot tap water to make instant drinks, tea, coffee, or baby formula.

Test Your Water
If you are concerned, the only way to confirm the presence of lead is to test your drinking water. Most public utility systems are required to test for lead and cannot deliver water with lead concentrations greater than the AL (15 µg/L). However, this testing does not reflect lead conditions at the point of delivery (at your tap). Additional corrosion or leaching can occur within your household plumbing. A list of California-certified laboratories is available at the SWRCB-GAMA Program Website at: http://www.waterboards.ca.gov/gama/domestic_wells_testing.shtml. Some over-the-counter testing kits are also available that provide a relative picture of the lead concentration in your tap water.

Health Effect Information
Health effects of lead poisoning are most significant for infants and children and exposure can result in physical and mental developmental delays. Children under the age of six are most sensitive to lead in drinking water. Pregnant women should also limit lead consumption due to possible fetal developmental effects. The EPA estimates that 10 to 20 percent of the total lead exposure for young children comes from drinking water. In infants whose diet consists mainly of liquids, as much as 40 to 60 percent of their lead exposure can come from drinking water.
For adults, high lead concentrations in drinking water can result in high blood pressure or kidney problems. Lead is also classified as a probable human carcinogen.

Key Resources

1. Agency for Toxic Substances and Disease Registry, http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=22
2. California State Water Resources Control Board. A Compilation of Water Quality Goals, 17th Edition, (SWRCB, 2016). http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/index.shtml
3. California State Water Resources Control Board-Division of Drinking Water, http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.shtml
4. Centers for Disease Control and Prevention (CDC), Lead and Drinking Water from Private Wells, http://www.cdc.gov/healthywater/drinking/private/wells/disease/lead.html
5. Office of Environmental Health Hazard Assessment (OEHHA), Public Health Goals for Chemicals in Drinking Water-Lead, http://oehha.ca.gov/media/downloads/pesticides/public-health-goal/leadfinalphg042409.pdf
6. US Environmental Protection Agency (EPA), Lead, http://www.epa.gov/lead/

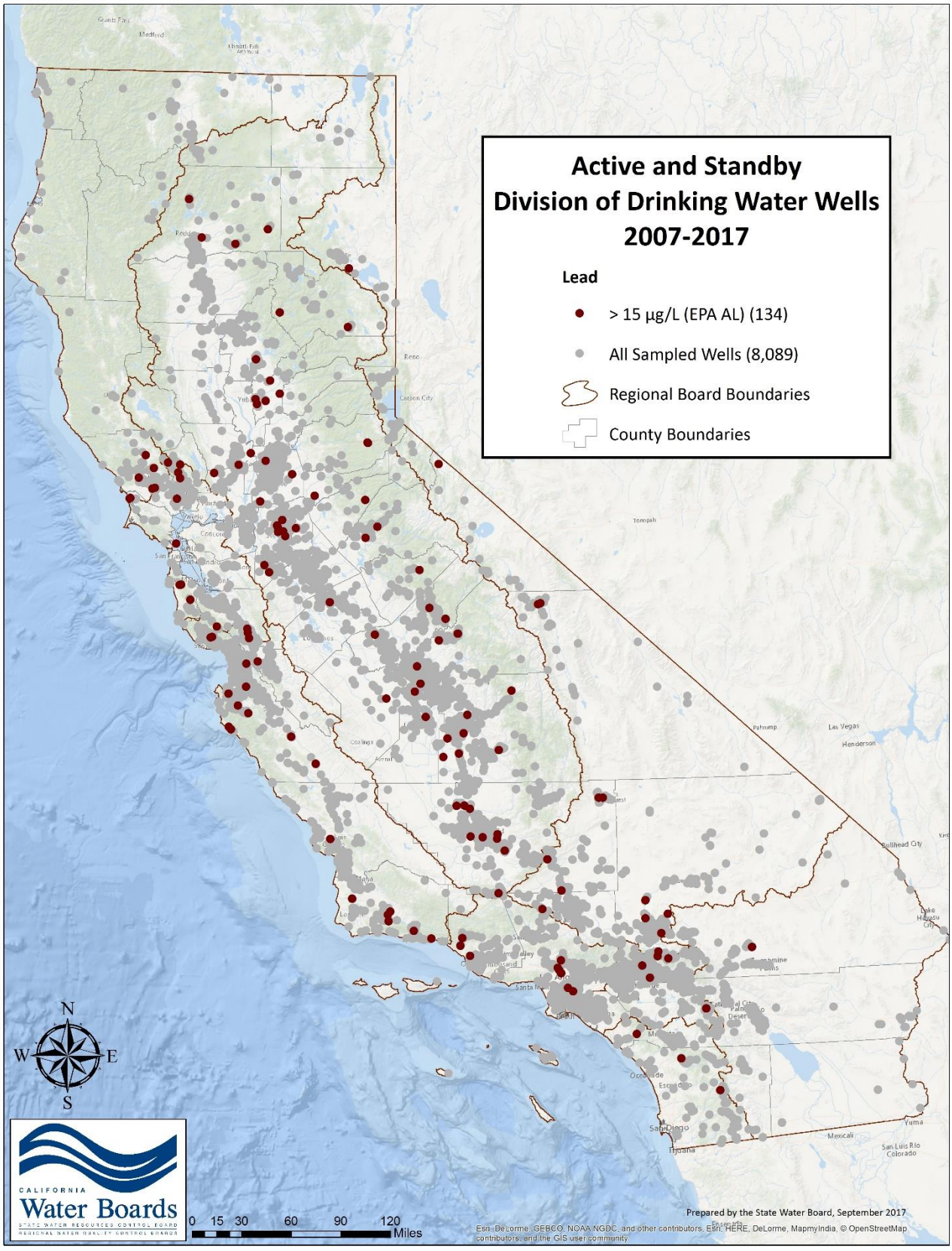

Figure 1. Active and standby public drinking water wells that had at least one detection of lead above the EPA AL, 2007-2017, 134 wells. (*Source: Public supply well data in GAMA GIS*).