GROUNDWATER INFORMATION SHEET

Boron (B)

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information, compiled by staff of the Groundwater Ambient Monitoring and Assessment (GAMA) Program, is pulled from a variety of sources and the data relates mainly to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	Boron (B)
Aliases	None
Chemical Formula	B
CAS No.	7440-42-8
Storet No.	01020 (dissolved); 01022 (total)
Summary	The California Department of Public Health (CDPH) regulates boron as a drinking water contaminant. The current State Notification Level (NL) for boron, set by CDPH, is 1,000 µg/L (1 mg/L). The most prevalent sources of boron in drinking water are from the leaching of rocks and soils, wastewater, and fertilizers/pesticides. As of June 2010, 286 drinking water wells (of 7,583 sampled) have had concentrations of boron above the NL. Most boron detections above the NL have occurred in Yolo, San Joaquin, and Kern counties.

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal	US EPA	NA[2]
State Notification Level (NL) [3]	CDPH	1,000 µg/L
Detection Limit for Purposes of Reporting (DLR)	CDPH	100 µg/L

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see *A Compilation of Water Quality Goals* (Marshack, 2008).

[2]There is no Federal regulatory standard for boron in drinking water.

[3] Notification levels are non-regulatory health-based advisory levels established by CDPH for chemicals for which maximum contaminant levels have not been established.

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[4,5]	
Detection Type	**Number of Groundwater Sources**
Number of active and standby public drinking water wells that have had boron concentrations > 1,000 µg/L.	286 of 7,583 sampled
Top 3 counties with active and standby public drinking water wells that have had boron concentrations >1,000 µg/L.	Yolo (33), San Joaquin (29), and Kern (26)

[4]Based on CDPH database query dated June 2010 using GeoTracker GAMA

[5]In general, drinking water from active and standby wells is treated or blended so consumers are not exposed to water exceeding MCLs. Individual domestic wells and wells for small water systems not regulated by CDPH are not included in these figures.

ANALYTICAL INFORMATION		
Method	**Detection Limit (Quantitation Limit)**	**Note**
EPA 200.7	3 µg/L	CDPH approved for public drinking water systems
Analytical Notes	Boron samples can be contaminated by borosilicate (pyrex) glass. Only plastic or polytetrafluoroethylene (PTFE) materials should be used when collecting, storing, or handling water samples for boron analysis.	
Public Drinking Water Testing Requirements	Public water systems are required to test for boron on a schedule established by CDPH. When boron is detected at levels greater than the NL, the utility or responsible agency must report that detection to relevant public agencies.	

BORON OCCURRENCE	
Anthropogenic Sources	Borate compounds are used in the manufacture of many different commercial products including:. insulation and textile-grade fiberglass, borosilicate glass, fire retardants, enamels, ceramic glazes, , laundry bleach, agricultural fertilizers and herbicides. Major anthropogenic sources of boron to groundwater include: industrial wastewater discharges, municipal wastewater discharges, and agricultural activities. Power plants can also release boron to the atmosphere.
Natural Sources	Boron does not naturally occur in elemental form. Boron has a high affinity for forming very stable bonds with electronegative atoms (atoms that donate electrons), and as a result often exists in compounds bound to oxygen atoms. Boron-containing minerals are common in nature as Na and Ca-borates, borosilicate minerals, and boric acid. Examples of natural borate minerals include borax, borax pentahydrate, ulexite, and inyoite. Boron concentrations in groundwater are derived from leaching of rocks and soils that contain borate and borosilicate minerals. Boron is found in seawater, and can be found in evaporite deposits and other sedimentary rocks. Boron deposits are found in the desert areas of California. The world's largest boron mine, and California's largest open-pit mine, is located near the town of Boron, California.
History of Occurrence	According to the US Geological Survey, the United States was the world's leading producer of refined boron compounds in 2004 and 2005, producing over 1,210,000 metric tons. The use of boron in some cleaning agents is beginning to decrease due to environmental concerns. However, boron compounds are among the most widely used whitening agents used today.
Contaminant Transport Characteristics	While elemental boron is insoluble in water, borate minerals including borax, borax pentahydrate, and anhydrous borax are extremely soluble. Once boron compounds dissolve, they generally act as a salt (dissolved ion) and are difficult to remove from water.

REMEDIATION & TREATMENT TECHNOLOGIES

Reverse osmosis or distillation units are effective boron treatment methods. Distillation involves producing, collecting, and condensing steam; boron and other impurities do not travel with the steam and are left out of the condensate. Reverse osmosis places water under pressure and forces the water through a fine membrane that keeps boron and other minerals out. Both distillation and reverse osmosis are costly, require significant time and energy to operate efficiently, and require approximately three times the amount of water to use. Both methods are low-yield systems, and storage space is needed for the treated water. Blow-down or reject water must be safely disposed of, as well. Ion exchange with a boron-specific exchange resin has also proven to be effective.

Boiling, over-the-counter water filters (pitcher filters or faucet-attachment filters), and water softeners are not effective at removing boron from water. Boiling water does not reduce boron concentrations but will actually increase boron concentrations.

HEALTH EFFECT INFORMATION

Most human exposure to boron comes from either boric acid or borax. Boric acid is the form of boron most likely to be encountered in drinking water, and can be lethal at high concentrations. Other symptoms of boric acid ingestion include gastrointestinal tract distress, vomiting, abdominal pain, diarrhea, and nausea. Animal studies have observed reproductive and developmental effects when boron was ingested at high levels.

Boron may also be a trace micronutrient that appears to affect utilization and metabolism of other important substances including calcium, copper, magnesium, nitrogen, glucose, trigliceryides, reactive oxygen, and estrogen.

KEY REFERENCES

1. State Water Resources Control Board. GeoTracker GAMA (Groundwater Ambient Monitoring and Assessment) Database http://www.waterboards.ca.gov/water_issues/programs/gama/geotracker_gama.shtml

2. United States Environmental Protection Agency. 2008. Drinking Water Health Advisory for Boron

3. World Health Organization. 1998. Guidelines for drinking-water quality: Boron in Drinking-water. Addendum to Vol. 2 *Health criteria and other supporting information.*

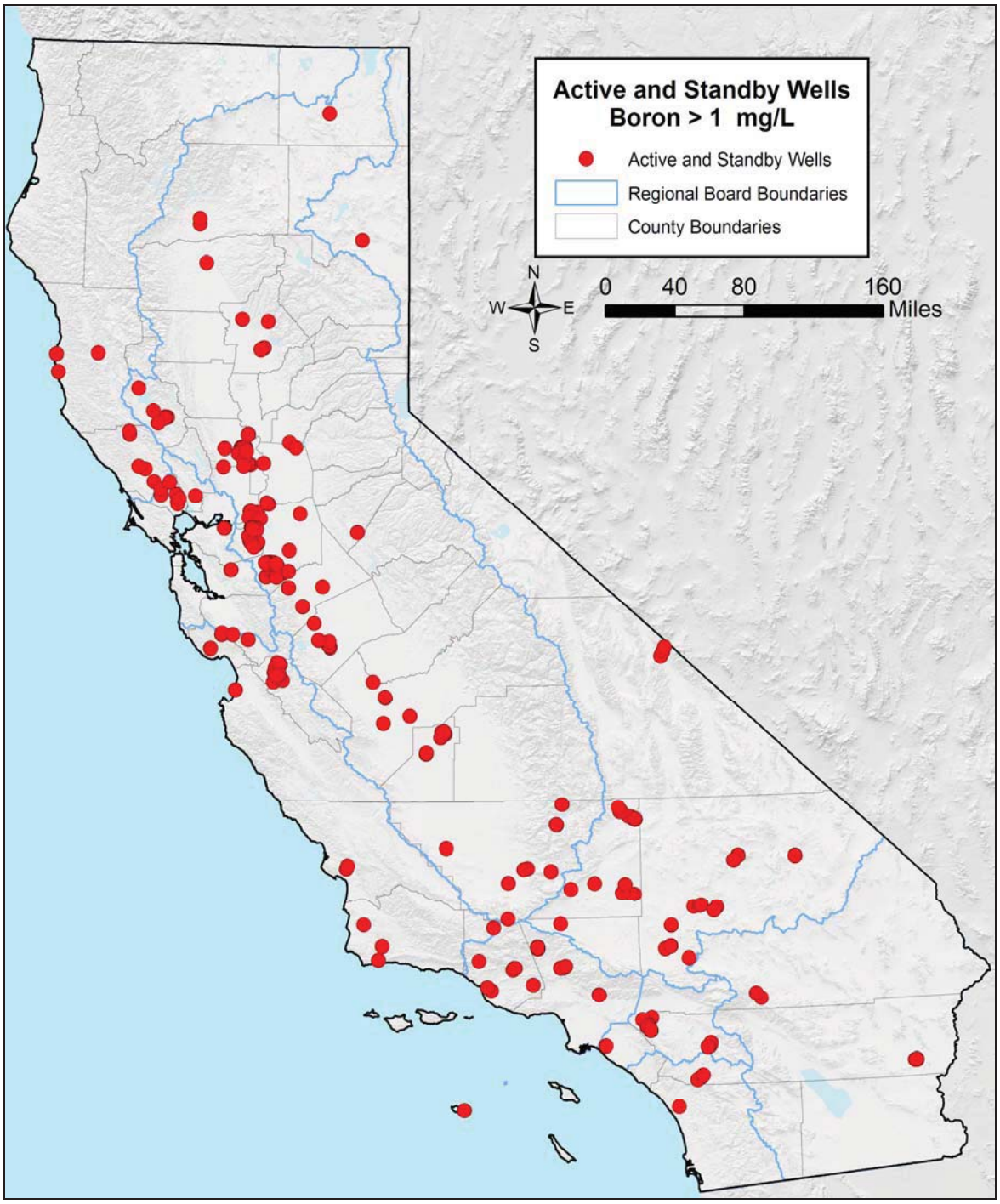
4. Minnesota Pollution Control Agency. 1998. Boron in Minnesota's Ground Water.

5. Minnesota Department of Health. Drinking Water Protection Section. Boron in Drinking Water; Information for Users of Pathfinder Village Public Water Supply.

6. United States Environmental Protection Agency. 2008. Summary Document from the Health Advisory for Boron and Compounds.

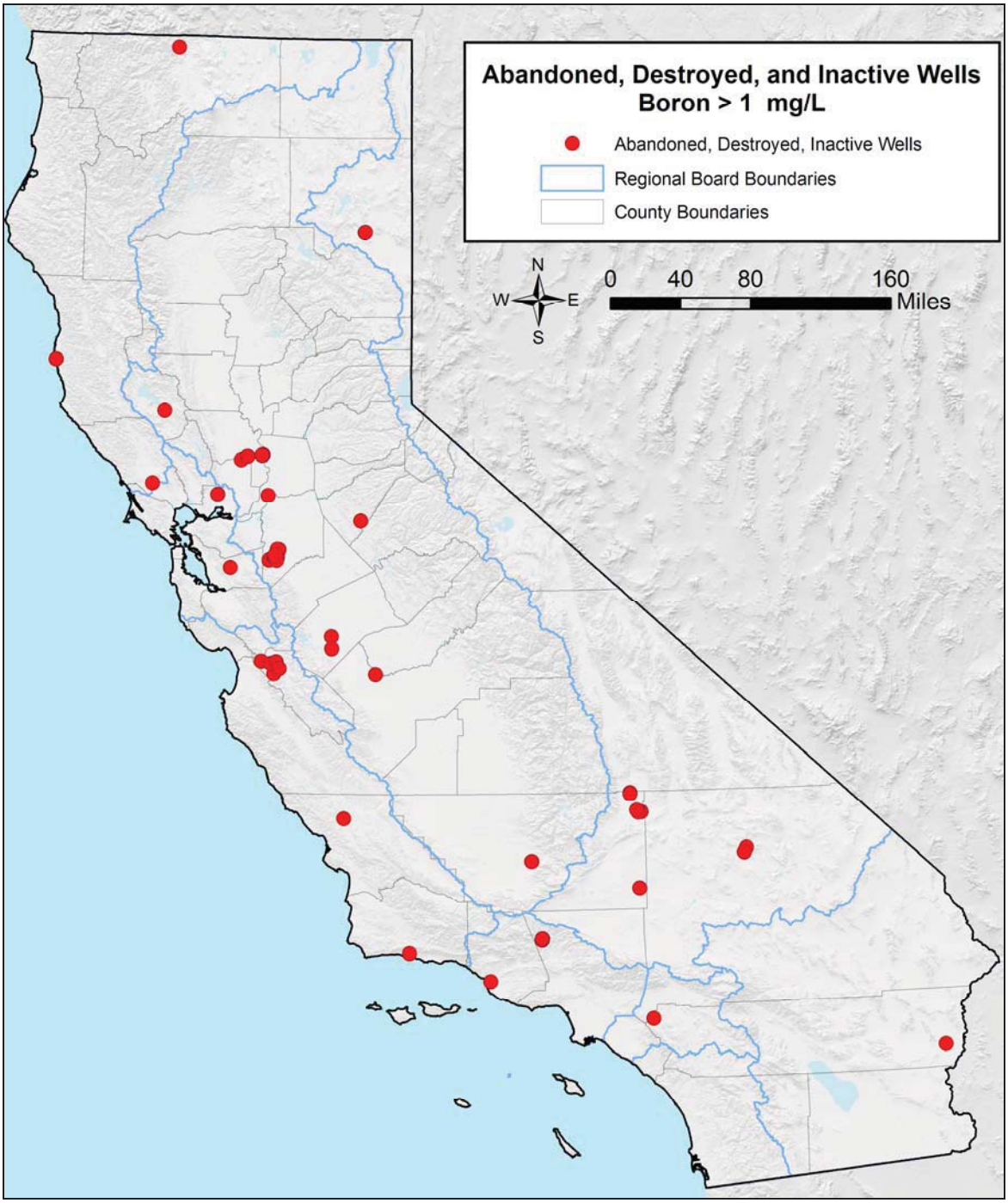
7. California Environmental Protection Agency / Regional Water Quality Control Board, Central Valley Region. Updated July 2008. *Water Quality Goals*. Prepared by Jon B. Marshack. http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/index.html

FOR MORE INFORMATION, CONTACT: John Borkovich, SWRCB (916) 341-5779



Active and Standby CDPH Regulated Public Drinking Water Wells with at Least One Detection of Boron above the NL (286).

Source: June 2010 well query of CDPH data using GeoTracker GAMA



Abandoned, Destroyed and Inactive CDPH Regulated Public Drinking Water Wells with at Least One Detection of Boron above the NL (48).

Source: June 2010 well query of CDPH data using GeoTracker GAMA