DRAFT
GROUNDWATER INFORMATION SHEET

Tetrachloroethylene (PCE)

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The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of sources and 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	Tetrachloroethylene (PCE)
Aliases	Tetrachloroethene, Perchloroethylene, Carbon Dichloride, Perchlor, Antisol, Ankilostin
Chemical Formula	C_2Cl_4
CAS No.	127-18-4
Storet No.	34475
Summary	The California Department of Health Services (DHS) regulates PCE as a drinking water contaminant. The current State Maximum Contaminant Level (MCL) for PCE, set by DHS, is 5 µg/L. Common anthropogenic sources of PCE include discharges related to drycleaning operations and metal degreasing processes. Based on DHS data through 2000, 252 of approximately 16,000 public drinking water wells (active and standby status) have had concentrations of PCE ≥ 5 µg/L, with most detections occurring in Los Angeles, San Bernardino and Kern Counties.

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal MCL	US EPA, Region 9	5 µg/L
State MCL	DHS	5 µg/L
Action Level	DHS	4 µg/L
Detection Limit for Purposes of Reporting (DLR)	DHS	0.5µg/L
Others: Public Health Goal (PHG) Preliminary Remediation Goal (PRG)	 OEHHA US EPA, Region 9	 0.06 µg/L 1.1 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, 2000).

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[2]	
Detection Type	**Number of Groundwater Sources**
Number of active and standby public drinking water wells[3] with PCE concentration ≥ 5 µg/L.	252 of approximately 16,000
Top 3 counties having public drinking water wells with PCE concentration ≥ 5 µg/L.	Los Angeles, San Bernardino, Kern

[2]Based on DHS data collected from 1984-2000 (Geotracker). See Figures 1 and 2.

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

ANALYTICAL INFORMATION	
Analytical Test Methods	US EPA Methods 502.2, 524.2, 551.1, 8260B
Detection Limit	0.5 µg/L
Known Limitations to Analytical Methods	Sample must be cooled to 4 °C upon collection and analyzed within 14 days. Sample must be free of air bubbles.
Public Drinking Water Testing Requirements	According to DHS regulations for public drinking water systems, groundwater sources must be initially monitored for PCE during four consecutive quarterly sampling events. If no detections are found in the initial samples, the groundwater system must take annual samples for a minimum of three consecutive years. The groundwater system may then reduce monitoring to one sample per each compliance period. The compliance period is established by DHS, and in the case of no detections, may be up to six years.

PCE OCCURRENCE	
Anthropogenic Sources	PCE originates in the environment from discharges to soil, air and water as a result of dry cleaning, textile operations, and metal degreasing processes. It was also widely used in the production of CFC-113 (Freon-113) and other fluorocarbons. In smaller quantities the chemical is used in rubber coatings, solvent soaps, printing inks, adhesives and glues, sealants, polishes, lubricants and pesticides.
Natural Sources	PCE is a manufactured chemical and does not occur naturally in the environment.
History of Occurrence	PCE has been used as a metal degreaser by military services and industry since the 1940s. Later, PCE was also used in drycleaning processes. Due to poor handling and disposal practices, solvents such as PCE and trichloroethylene (TCE) entered the environment through evaporation, leaks and improper disposal. It is estimated that there are more than 400,000 sites in the US where soil and ground water are contaminated by chlorinated solvents. In California, numerous solvent plumes have originated from drycleaning facilities in the Central Valley, Southern California and San Francisco Bay area. Between the years of 1984 and 2000, 14,909 drinking water sources were sampled for PCE and data were provided to DHS. As of January 2001, PCE was reported at concentrations above the State MCL (5 μg/L) in 252 public drinking water wells (active or standby status) listed in the DHS database.
Contaminant Transport Characteristics	Mobility of PCE is described as moderate (Fetter 1988) with an average solubility in groundwater of 200 mg/L, and a soil-water partition coefficient (K_{oc}) of 152. The half-life degradation rate in groundwater is estimated to be between 1 to 2 years, based on aqueous aerobic biodegradation (Howard et al 1991) but may be considerably longer under certain conditions.

REMEDIATION & TREATMENT TECHNOLOGIES	
Groundwater Remediation	Treatment of groundwater containing PCE includes traditional pump-and-treat technology (using air stripping or activated carbon filtration), *in situ* chemical oxidation with peroxide or ozone, dechlorination by Hydrogen-Releasing Compound (HRC) and emerging biodegradation techniques. A recently discovered bacteria strain (coccoid 195, Cornell University)

	preferentially uses PCE as a source of energy. Slow natural biodegradation of PCE may occur under anaerobic conditions when microorganisms are acclimated. However, the biodegradation process degrades PCE to TCE and eventually to vinyl chloride, which are also considered to be human carcinogens.
Drinking Water and Wastewater Treatment	Drinking water can be treated by various in-line processes. Traditionally, air stripping and activated carbon filters are used to remove PCE and other volatile organic carbons (VOCs) from water. Ultra-violet radiation is also used for low-flow systems. Wastewater treatment plants use chemical oxidation and are increasingly using biodegradation processes to remove VOCs from water.

HEALTH EFFECT INFORMATION

Acute: Acute exposures at levels above 200 mg/L may cause eye irritation and light-headedness; 400 mg/L, eye and nasal irritation, lack of coordination within 2 hours; 600 mg/L, dizziness within 10 minutes; 1500 mg/L, extreme irritation to eyes and respiratory tract, dizziness within 2 minutes, unconsciousness within 30 minutes. These effects are related to PCE contaminated air.

Chronic: Long-term exposures to PCE at levels above the MCL (5 µg/L) can cause adverse effects to liver, kidneys, and central nervous system. Prolonged dermal exposure can cause irritation, dryness, and dermatitis.

Carcinogen. There is scientific evidence that PCE may cause cancer from prolonged exposure even at levels below the MCL. The US EPA classifies PCE as a probable human carcinogen. The California PHG (0.06 µg/L) for PCE is calculated to represent a negligible risk of contracting cancer from the use of drinking water containing PCE in the household environment over a lifetime.

KEY REFERENCES

1. California Environmental Protection Agency / Regional Water Quality Control Board, Central Valley Region. August 2000. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marshack. http://www.swrcb.ca.gov/rwqcb5/available_documents/wq_goals/wq_goals.pdf

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3. Howard, H. Philip, et.al., Environmental Degradation Rates. 1991. Lewis Publisher.

4. National Safety Council. Chemical Backgrounders. *Tetrachloroethylene.* http://www.nsc.org/ehc/chemical/Tetrachl.htm (Oct. 23, 2002)

5. Page, Douglas. *Perc-Eating Sewer Bacteria Could Cleanup Cleaners* www.hightechcareers.com/doc498a/perc498a.html (Oct. 23, 2002)

6. Siegrist, Robert L. In-Situ Chemical Oxidation for Remediation of Contaminated Soil and Ground Water, Ground Water Currents No. 37. September 2000. http://clu-in.com/Products/Newsltrs/GWC/gwc0900.htm

7. U.S. Environmental Protection Agency, Technology Innovation Office. Bioremediation of Chlorinated Solvent Contaminated Groundwater. August 1998. Prepared by Megan Grindstaff. http://207.86.51.66/products/intern/bioremed.htm

8. U.S. Environmental Protection Agency. Chemical Summary for Perchloroethylene. August 1994. EPA 749-F-94-020a. http://epa.gov/opptintr/chemfact/s_perchl.txt

9. U.S. Environmental Protection Agency. Office of Water. *Technical Fact Sheet: Tetrachloroethylene*. http://www.epa.gov/ODWDW/dwh/t-voc/tetrachl.html (Sept. 2002)

FOR MORE INFORMATION, CONTACT:
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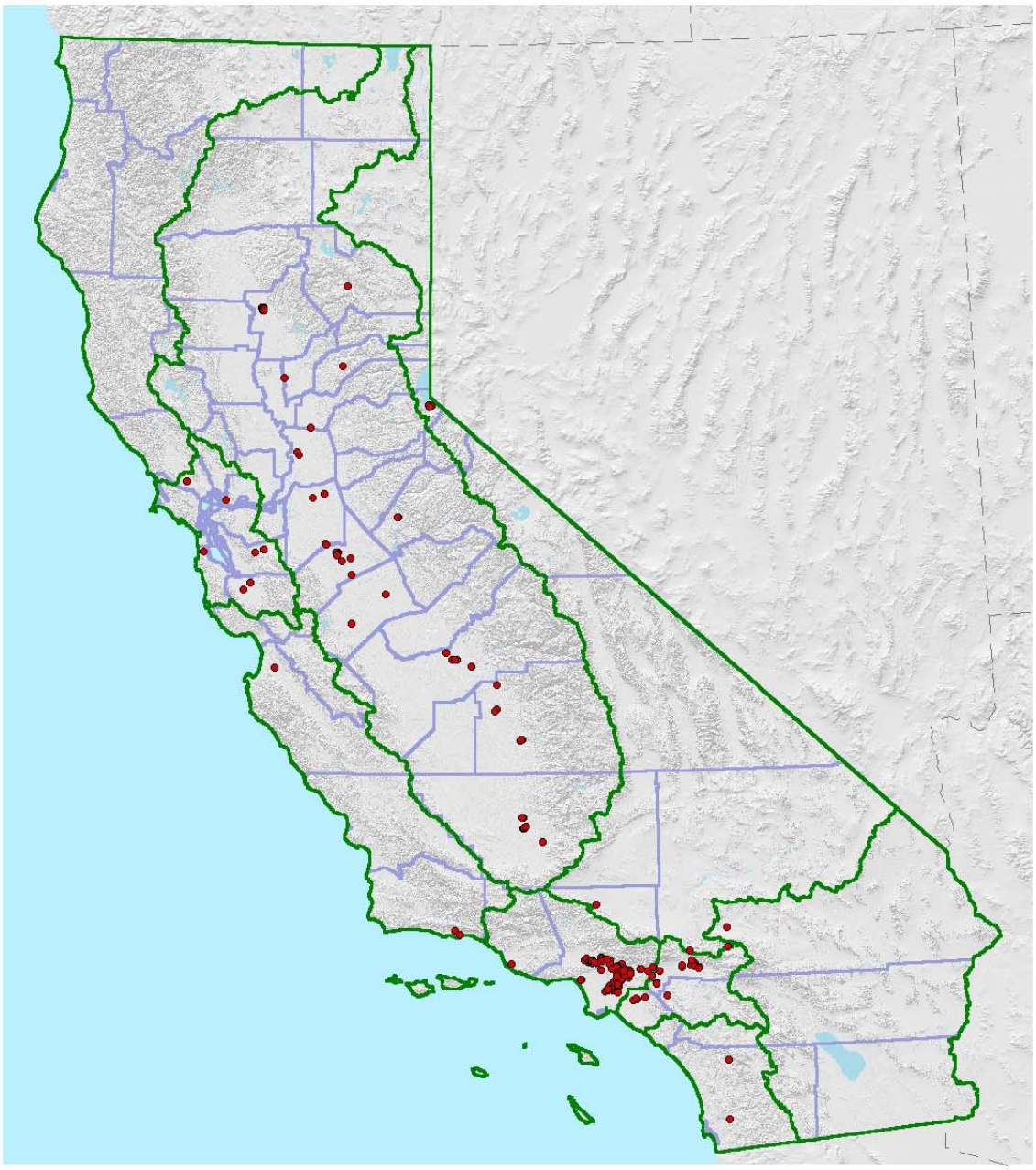
Groundwater Information Sheet: PCE
Figure 1



Active and Standby DHS Wells (252 Total) with at Least One Detection of PCE >= 5 PPB MCL

Source: 1984 - 2000 DHS Data (Map Revised 10/02/02)

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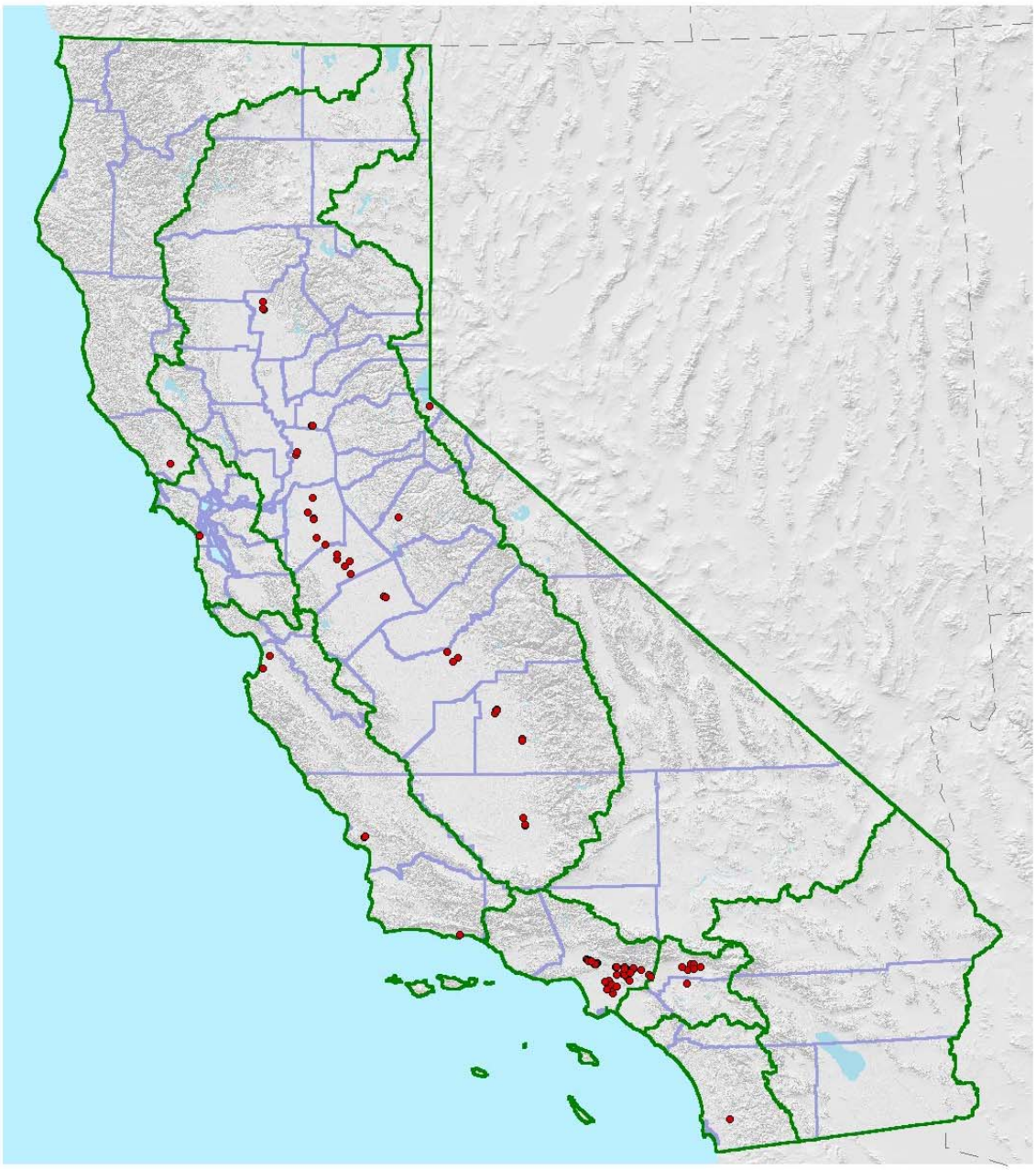
GEOTRACKER

Groundwater Information Sheet: PCE
Figure 2



Abandoned, Destroyed, and Inactive DHS Wells (103 Total) with at Least One Detection of PCE >= 5 PPB MCL

Source: 1984 - 2000 DHS Data (Map Revised 10/02/02)

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