State Summary for California

Information on population density, use of domestic-water supply, land use, and distribution of the 11 selected contaminants (arsenic, atrazine, benzene, deethylatrazine (CIAT), manganese, nitrate (data for nitrate consists of analyses for nitrite plus nitrate, as N, by the laboratory), perchloroethene (PCE), radon, strontium, trichloroethene (TCE), and uranium) for domestic well data for California is shown in figures CA1–CA16. The percentage of samples with concentrations greater than U.S. Environmental Protection Agency (USEPA) human-health benchmarks for National Water-Quality Assessment (NAWQA) Program major-aquifer studies in California is given in table CA1. The "Selected References" section at the end of this summary lists previous California studies that are relevant to the 11 contaminants.

In California, the largest areas with the highest population density are located along the west central and southwestern parts of the State (fig. CA1). Almost 50 percent of the domestic (private) and public drinking-water supply is obtained from ground water. The population (by census-block group for 1990) using domestic-water supplies was greatest in the central part of the State (fig. CA2). Although California is a heavily populated State, most land use is agricultural, rangeland, and forest lands. Most of the agricultural areas are located in the central part of California, whereas most of the rangeland is in the southern part of the State (fig. CA3).

Two major-aquifer studies were conducted in one principal aquifer (Central Valley aquifer system) for which samples were collected from domestic wells in California (fig. CA4). The Central Valley aquifer system is a basin-fill aquifer system composed of sand and gravel beds about 400 miles long and from 20 to 70 miles wide in central California (fig. CA4; Planert and Williams, 1995). Several beds and lenses of fine-grained material of silt and clay also make up a large percentage of the aquifer system. These beds do not readily transmit water under natural conditions and act as barriers to vertical flow and cause differences in hydraulic head with depth. Water is under unconfined conditions in the upper few hundred feet of the aquifer and grades to confined conditions with depth due to numerous overlapping lens-shaped clay beds (Planert and Williams, 1995). Well yields of more than 1,000 gallons per minute are commonly obtained throughout the aquifer system, and much of the water is used for irrigation.

Water-quality data for 11 selected contaminants (table 2) in samples from domestic-water supplies were compiled and summarized. The concentrations relative to USEPA human-health benchmarks (table 2, fig. CA5) and the number of major-aquifer studies with concentrations greater than human-health benchmarks were both considered in evaluating the potential concern to human health. This analysis assumes that current USEPA benchmarks (U.S. Environmental Protection Agency, 2006) are the most relevant and accurate measure of human-health risk.

Radon, arsenic, nitrate, manganese, and uranium had concentrations greater than USEPA human-health benchmarks (table CA1, fig. CA5). Radon had the greatest potential human-health concern because it had the largest percentage of samples with concentrations greater than a human-health benchmark. Radon concentrations were large in both major-aquifer studies (sacrsus1 and sanjsus1) in the Central Valley

Table CA1. Percentage of samples with concentrations greater than U.S. Environmental Protection Agency human-health benchmarks in domestic wells for National Water-Quality Assessment (NAWQA) Program major-aquifer studies in California.

Study-Unit code for NAWQA major-aquifer study	Principal aquifer	Contaminant	Number of samples	Percentage of samples with concentrations greater than human-health benchmark
sanjsus1	Central Valley aquifer system	Radon	31	[1]97/0.0
sacrsus1	Central Valley aquifer system	Radon	27	[1]93/0.0
sacrsus1	Central Valley aquifer system	Arsenic	27	26
sanjsus1	Central Valley aquifer system	Uranium	32	16
sanjsus1	Central Valley aquifer system	Nitrite plus nitrate	31	13
sacrsus1	Central Valley aquifer system	Nitrite plus nitrate	27	3.7
sacrsus1	Central Valley aquifer system	Manganese	27	3.7
sanjsus1	Central Valley aquifer system	Manganese	32	3.1

[1]First number is the percentage greater than 300 picocuries per liter (proposed Maximum Contaminant Level), and second number is the percentage greater than 4,000 picocuries per liter (alternate proposed Maximum Contaminant Level).

aquifer system. About 93 and 97 percent of samples from the sacrsus1 and sanjsus1 major-aquifer studies had radon concentrations greater than the human-health benchmark of 300 picocuries per liter (pCi/L) (table CA1), which is the proposed Maximum Contaminant Level (MCL). Median radon concentrations for the two studies ranged from about 500 to 700 pCi/L (fig. CA5), and none of the radon concentrations were greater than the alternative proposed MCL of 4,000 pCi/L (table CA1). Radon-222 is a decay product of radium-226, and radon concentrations greater than the human-health benchmark are widespread and probably can be attributed to natural sources in the soil and rock material in California.

Arsenic had the next largest potential concern to human health. About 26 percent of the samples in one major-aquifer study (sacrsus1) had arsenic concentrations greater than the human-health benchmark, which is the MCL of 10 micrograms per liter (µg/L) (table CA1). Median arsenic concentrations of samples from both studies (sacrsus1 and sanjsus1) were within an order of magnitude of the human-health benchmark (fig. CA5). U.S. Geological Survey (USGS) State data also showed arsenic concentrations to be greater than the human-health benchmark in the same general area as the NAWQA samples (fig. CA6). USGS State data also showed an area in the southern part of the State with arsenic concentrations greater than the human-health benchmark (fig. CA6). These arsenic concentrations appear coincident with two primary areas in the State, and land use or geologic setting may be factors for the concentrations.

Uranium concentrations were greater than the human-health benchmark (MCL of 30 µg/L) in about 16 percent of the samples from the sanjsus1 major-aquifer study (table CA1). Median uranium concentrations were within an order of magnitude of the human-health benchmark (fig. CA5). USGS State data showed uranium concentrations to be greater than the human-health benchmarks in the same area as the NAWQA samples, with several additional sample locations (fig. CA16).

About 13 percent (sanjsus1) and 4 percent (sacrsus1) of the samples from the two major-aquifer studies from the Central Valley aquifer system had nitrate concentrations greater than the human-health benchmark, which is the MCL of 10 milligrams per liter (mg/L) (table CA1). Median concentrations of both studies (sacrsus1 and sanjsus1) were within an order of magnitude of the human-health benchmark (fig. CA5). USGS State data also showed that these same areas, along with areas along the west coast and in the southern part of the State, have nitrate concentrations greater than the human-health benchmarks, but the geographic extent is better defined using USGS State data than NAWQA data (fig. CA11). These elevated nitrate concentrations occur in almost all the areas that have a large number of samples available, and many people could be using domestic-water supplies in these areas.

Manganese concentrations were greater than the USEPA human-health benchmark (Lifetime Health Advisory (HA) of 300 µg/L) in one sample each (about 3 to 4 percent) from the two major-aquifer studies (table CA1). USGS State data also showed manganese concentrations to be greater than the human-health benchmark in the same general areas that the NAWQA samples were collected, and also in areas along the west coast and in the southern part of the State (fig. CA10).

Strontium did not have any concentrations larger than the human-health benchmark (HA of 4,000 µg/L) for the NAWQA samples collected. However, strontium concentrations in 4 of the 393 samples available from USGS State data in the NWIS database were greater than the human-health benchmark (fig. CA14).

For the entire California data set, atrazine(fig. CA7), benzene (fig. CA8), CIAT (fig. CA9), PCE (fig. CA12), and TCE (fig. CA15) did not have concentrations larger than USEPA human-health benchmarks for either NAWQA or USGS State data. CIAT is a degradation product of atrazine and does not have a human-health benchmark; however, for this report, the MCL for atrazine is used as a benchmark for CIAT because their toxicities are considered equivalent.

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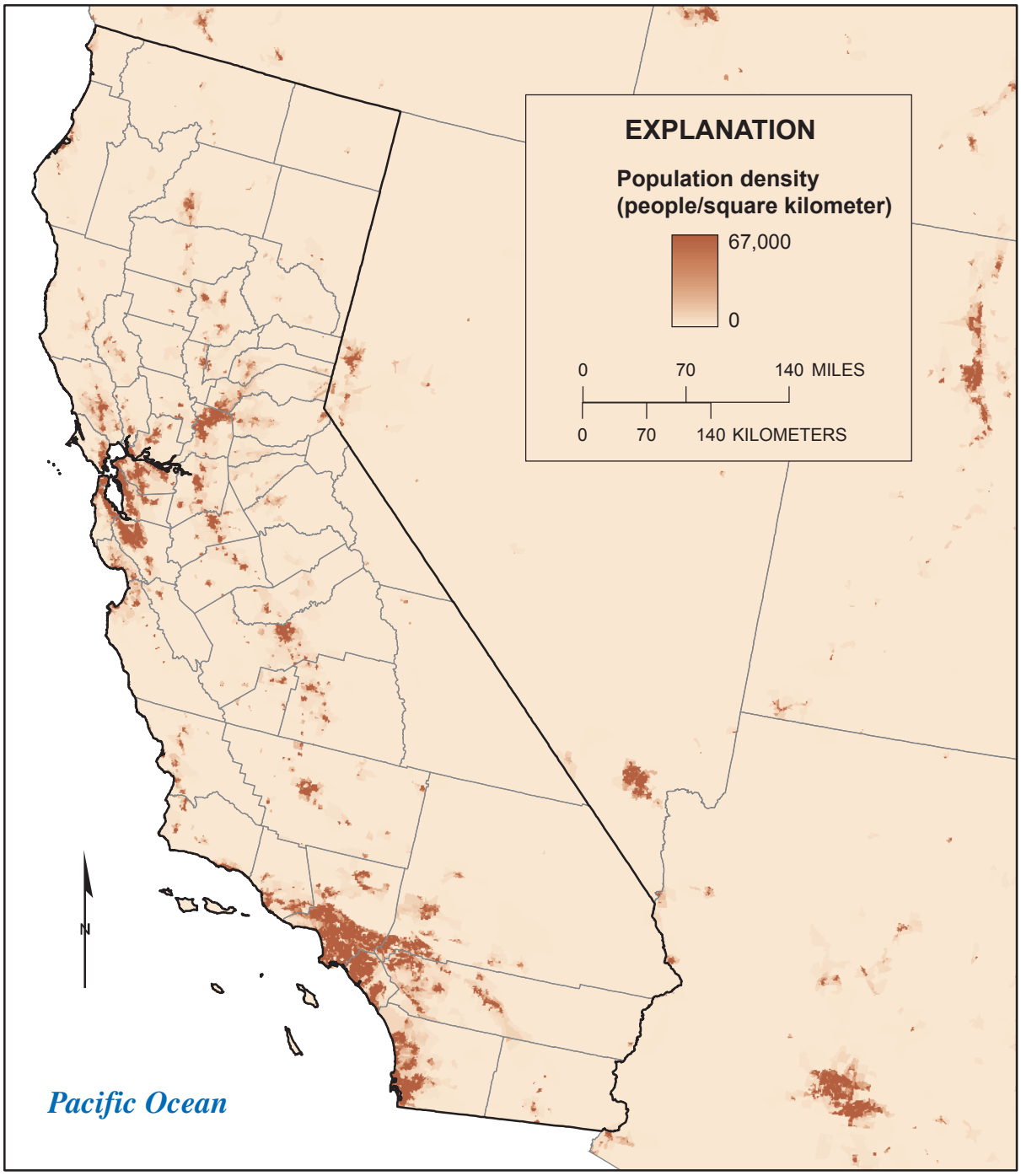

Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Figure CA1. Population density for California and nearby States. (Data from Hitt, 2003.)

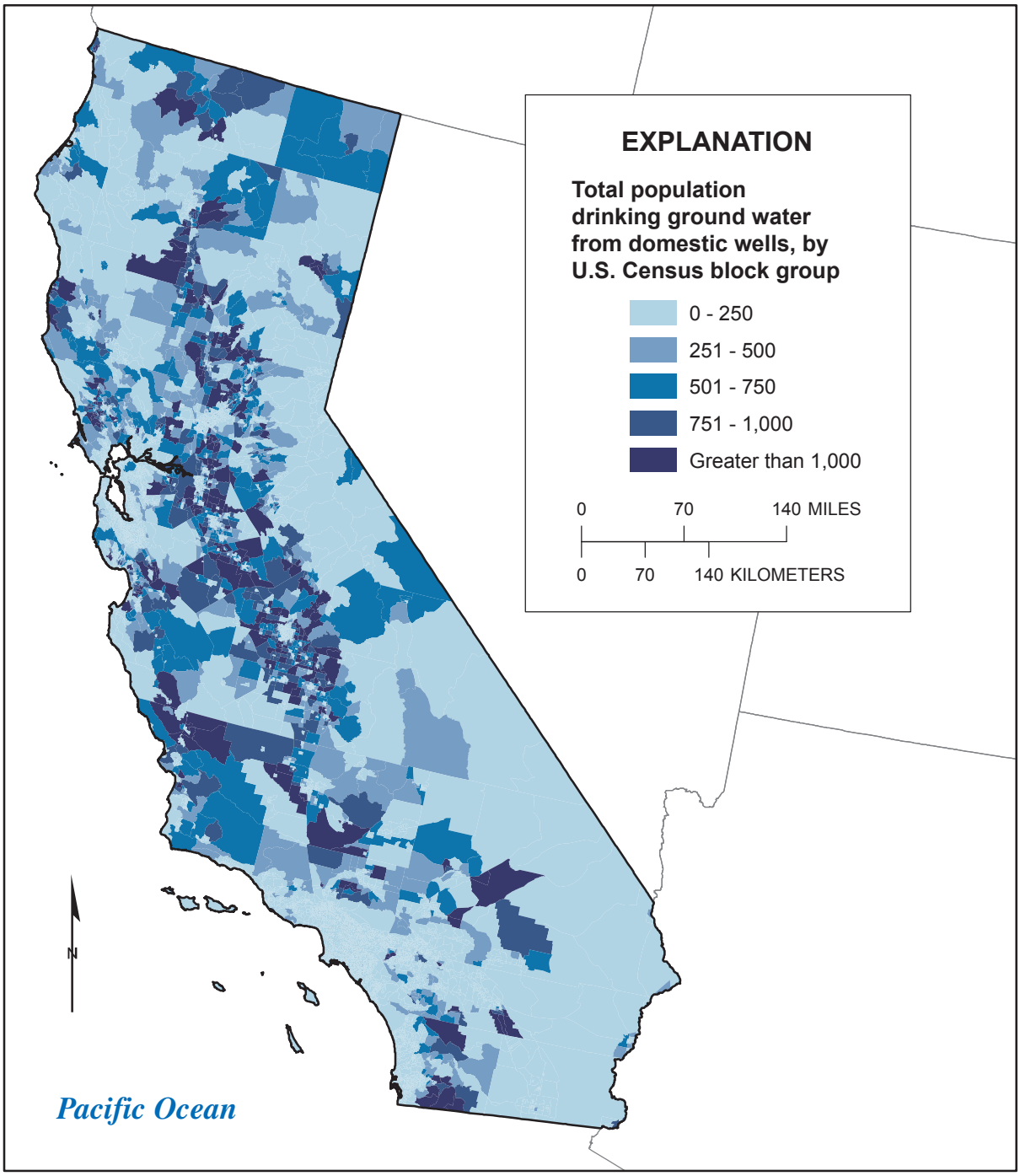

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Figure CA2. Population using domestic-water supply (from ground water) for California. (Data from 1990 U.S. Census block group, Kerie Hitt, U.S. Geological Survey, written commun., 1997.)

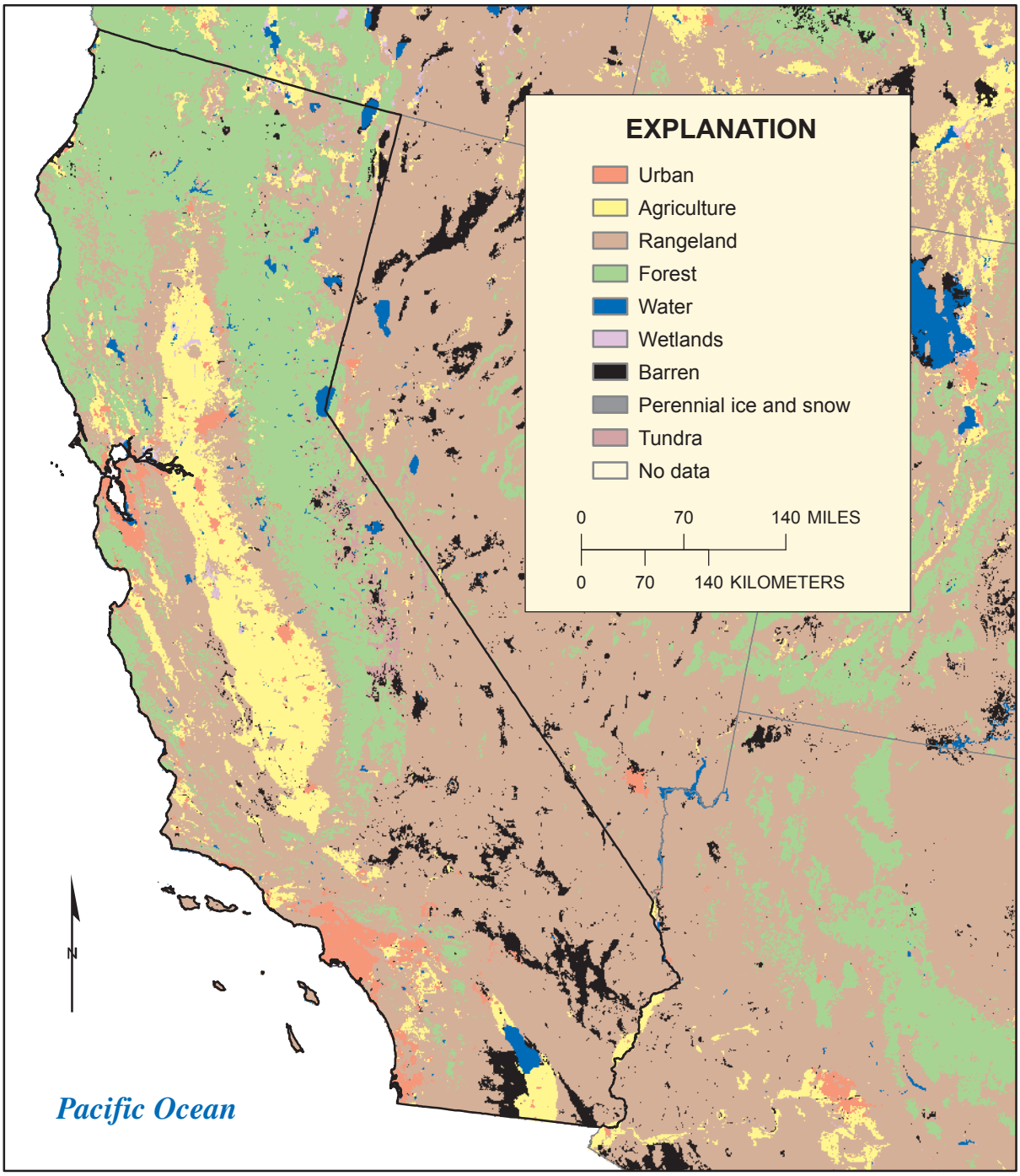

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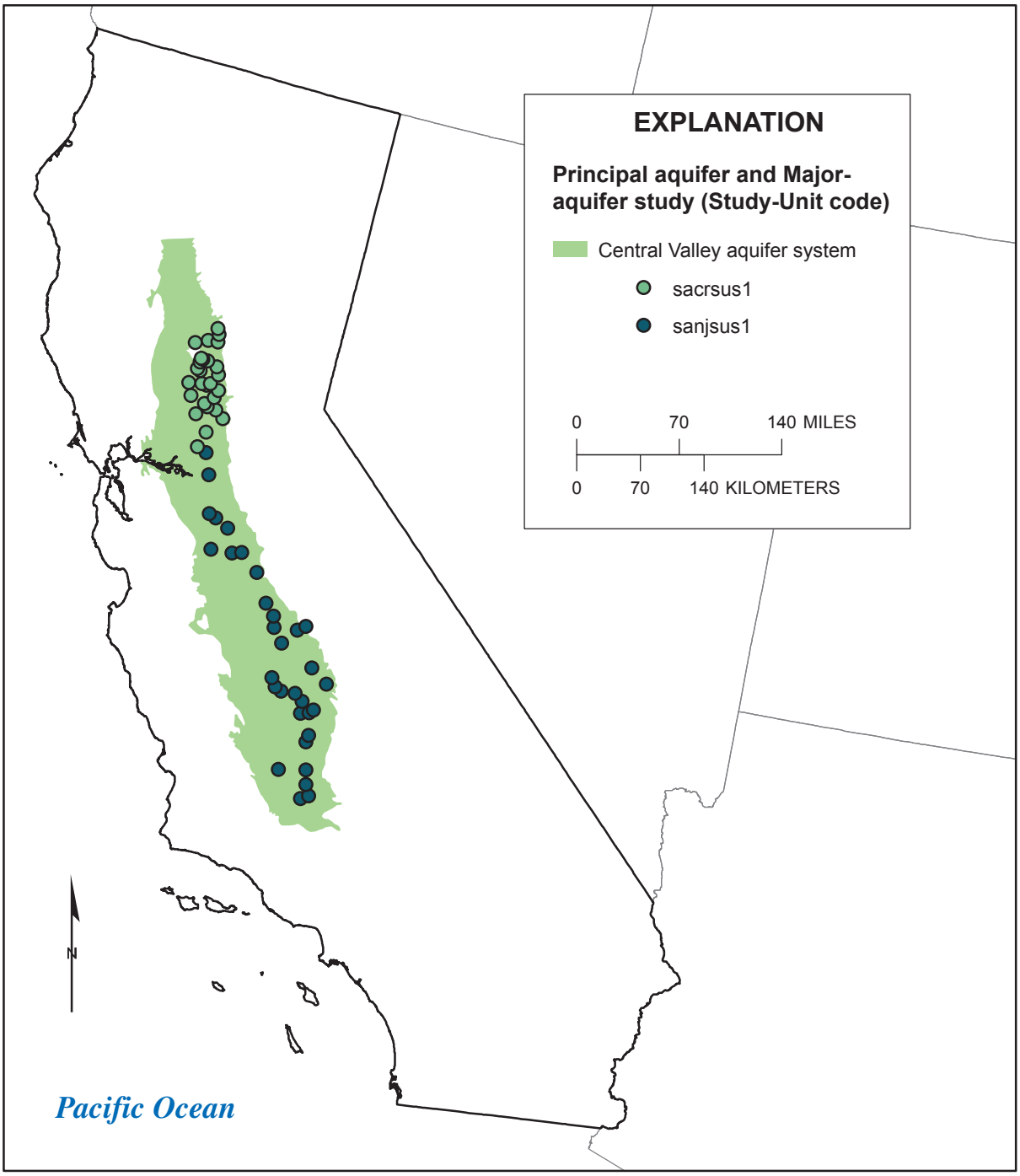
Figure CA3. Land use/land cover for California and nearby States. (Data from Naomi Nakagaki, U.S. Geological Survey, written commun., 2005.)



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Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

Figure CA4. Location of domestic wells sampled for National Water-Quality Assessment (NAWQA) major-aquifer studies that included California.

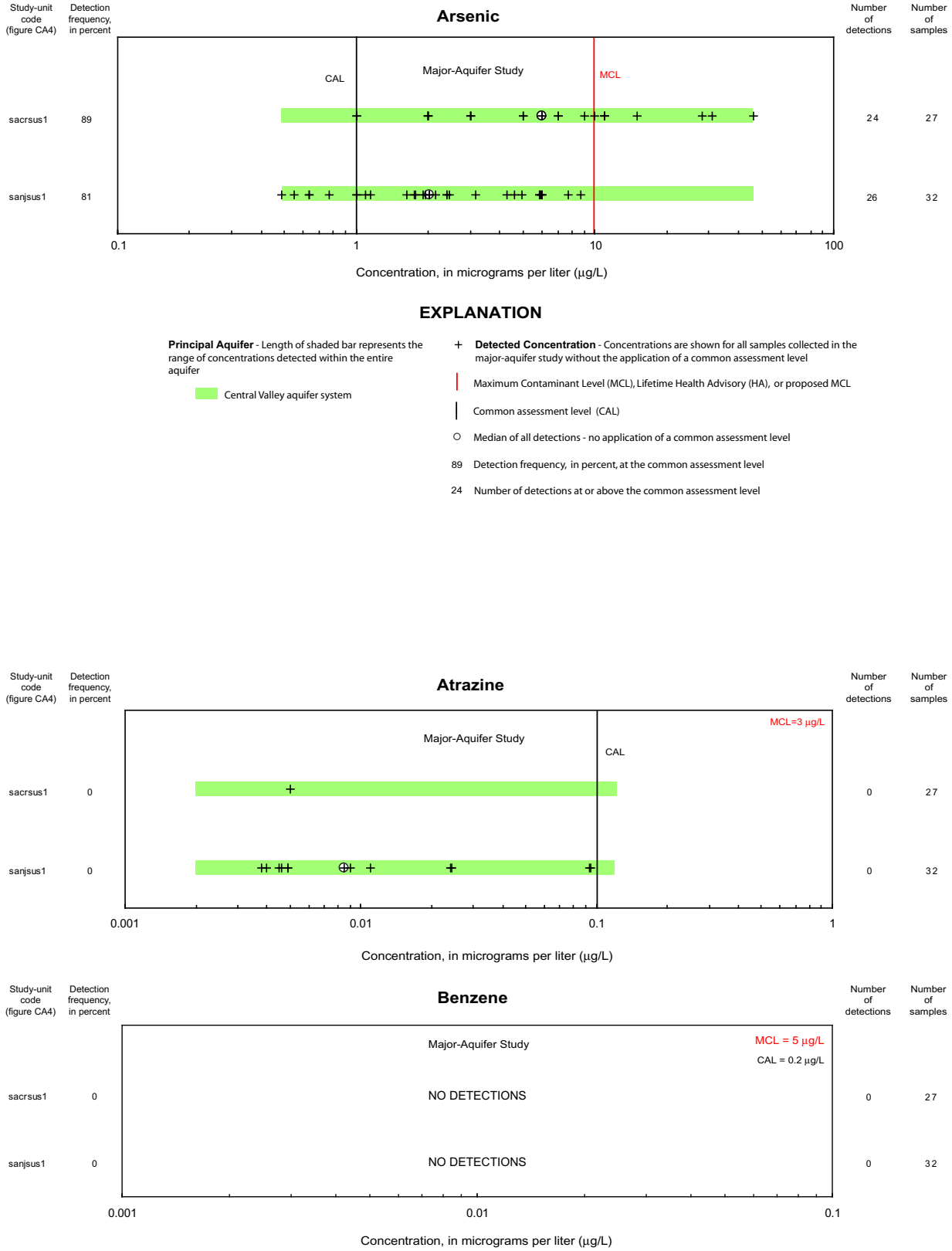


Figure CA5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for California (includes studies for which at least 10 analyses were available).

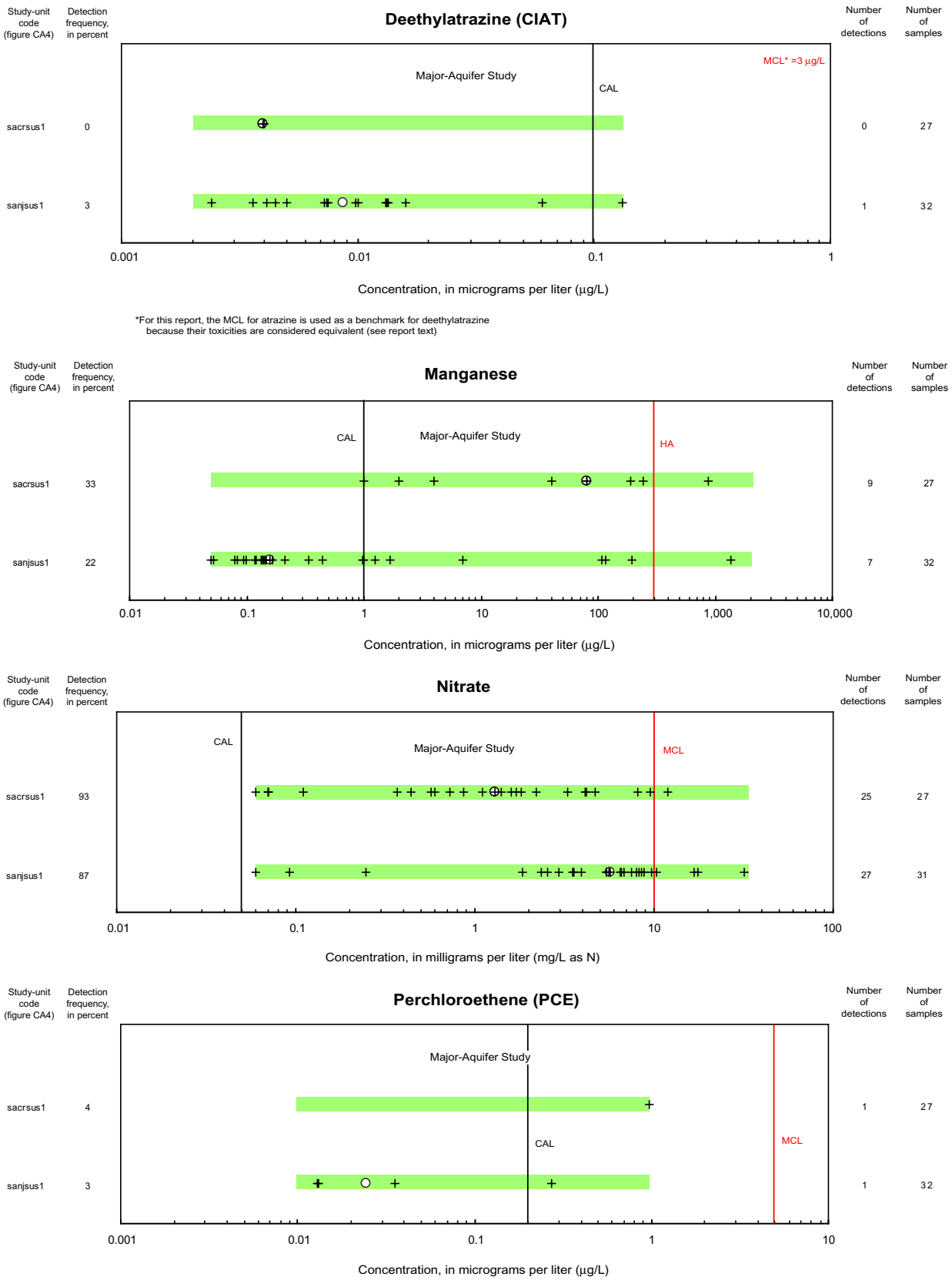
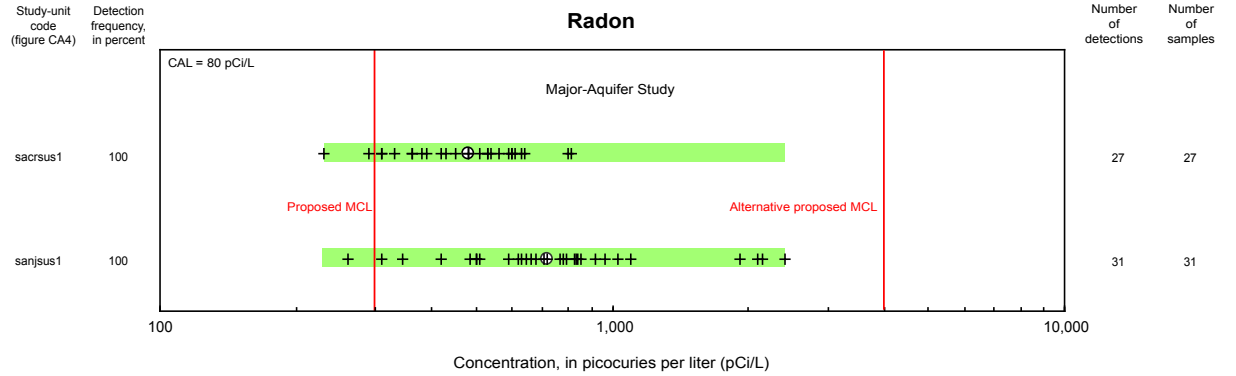
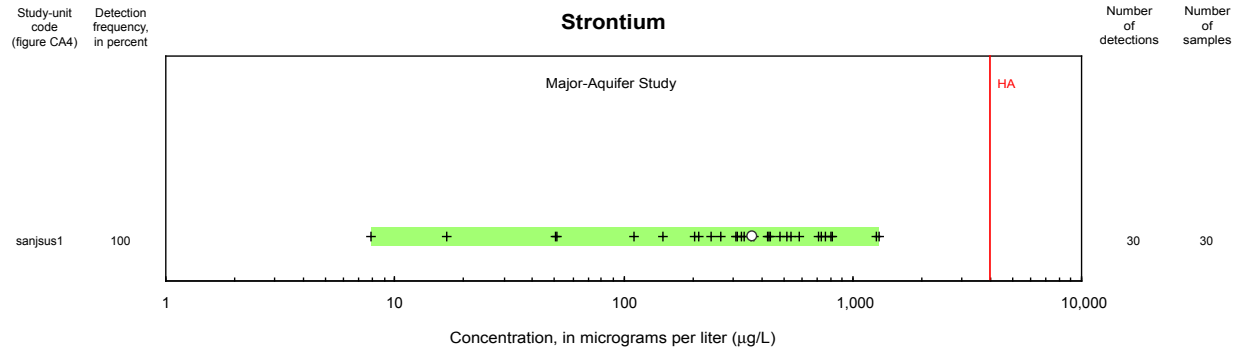
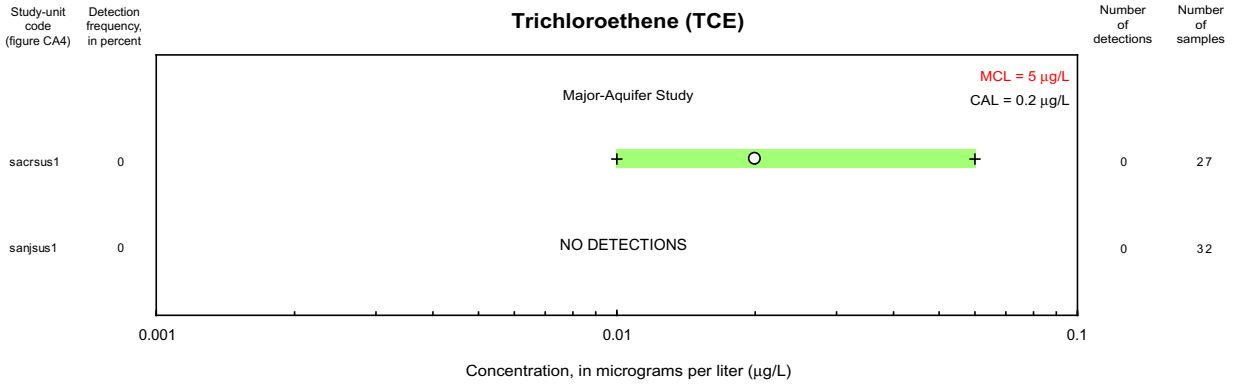


Figure CA5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for California (includes studies for which at least 10 analyses were available). —Continued







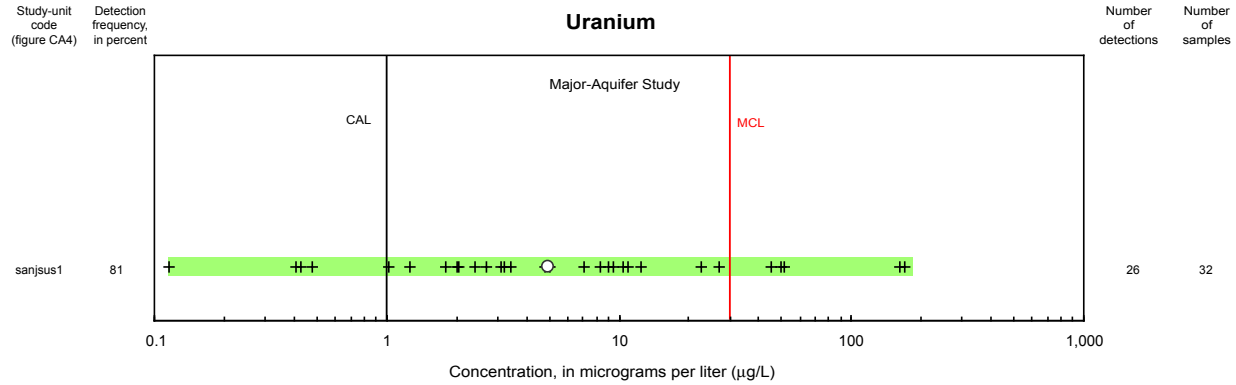
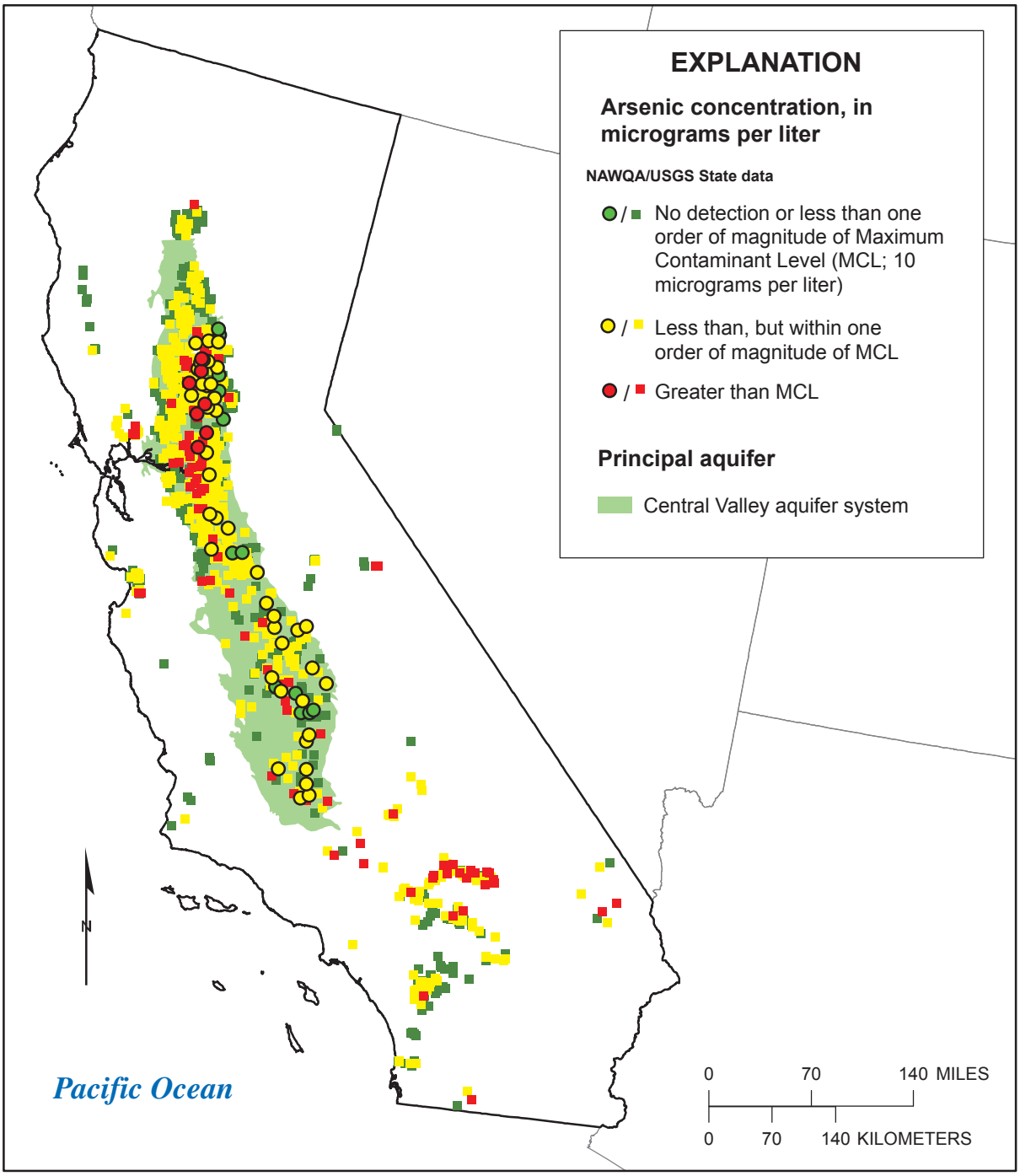


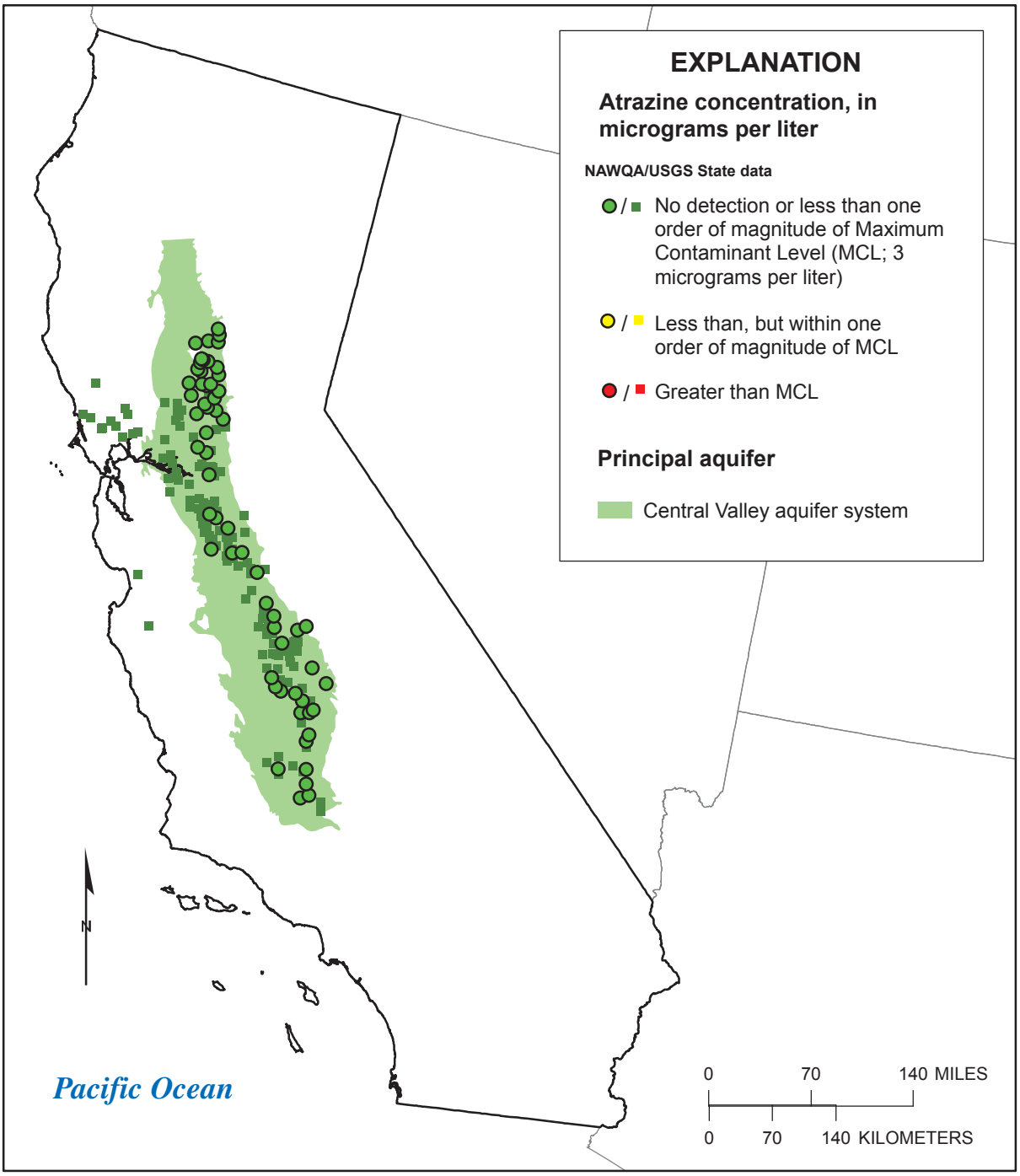
Figure CA5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for California (includes studies for which at least 10 analyses were available). —Continued



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

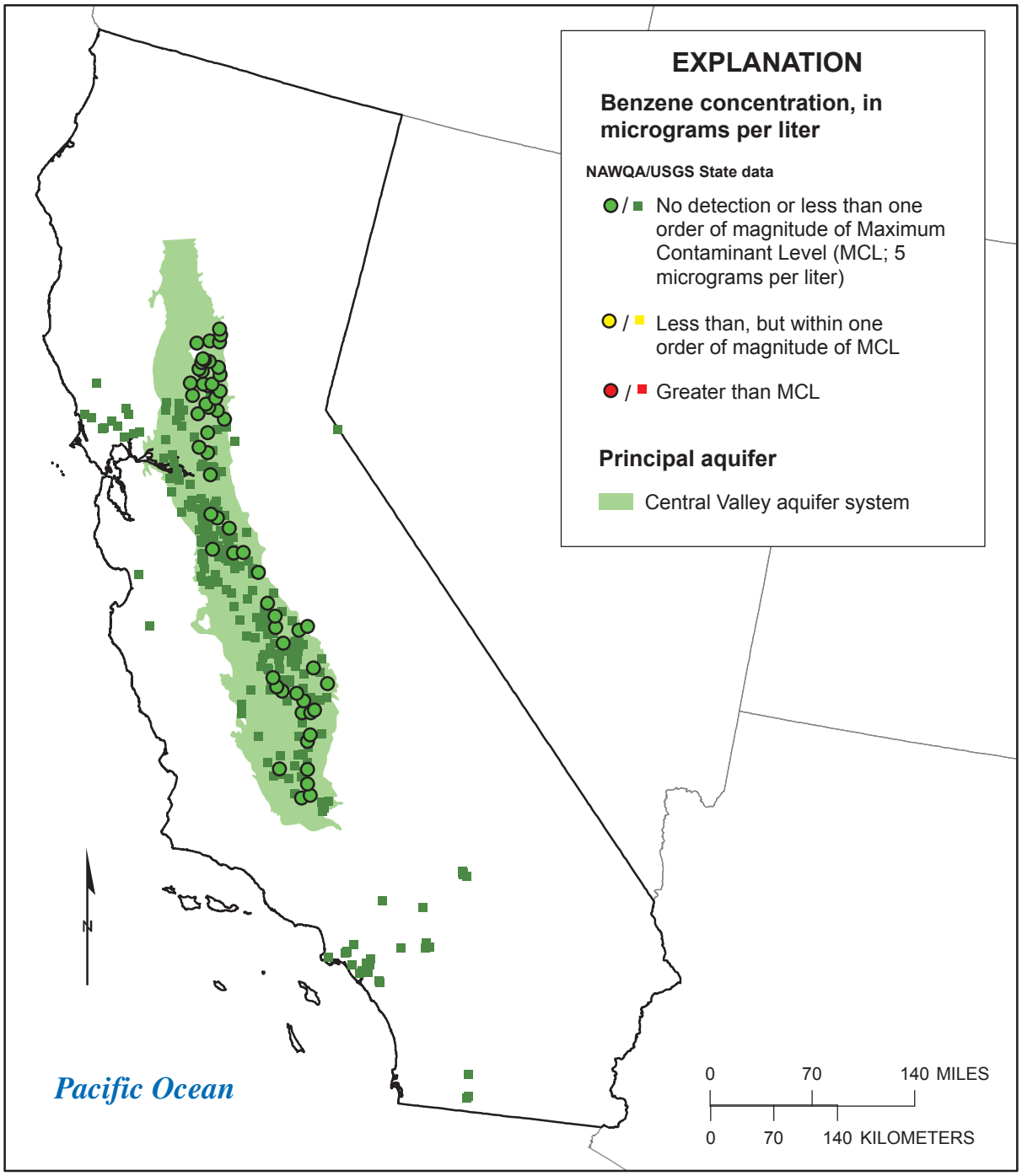
Figure CA6. Concentration of arsenic in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

Figure CA7. Concentration of atrazine in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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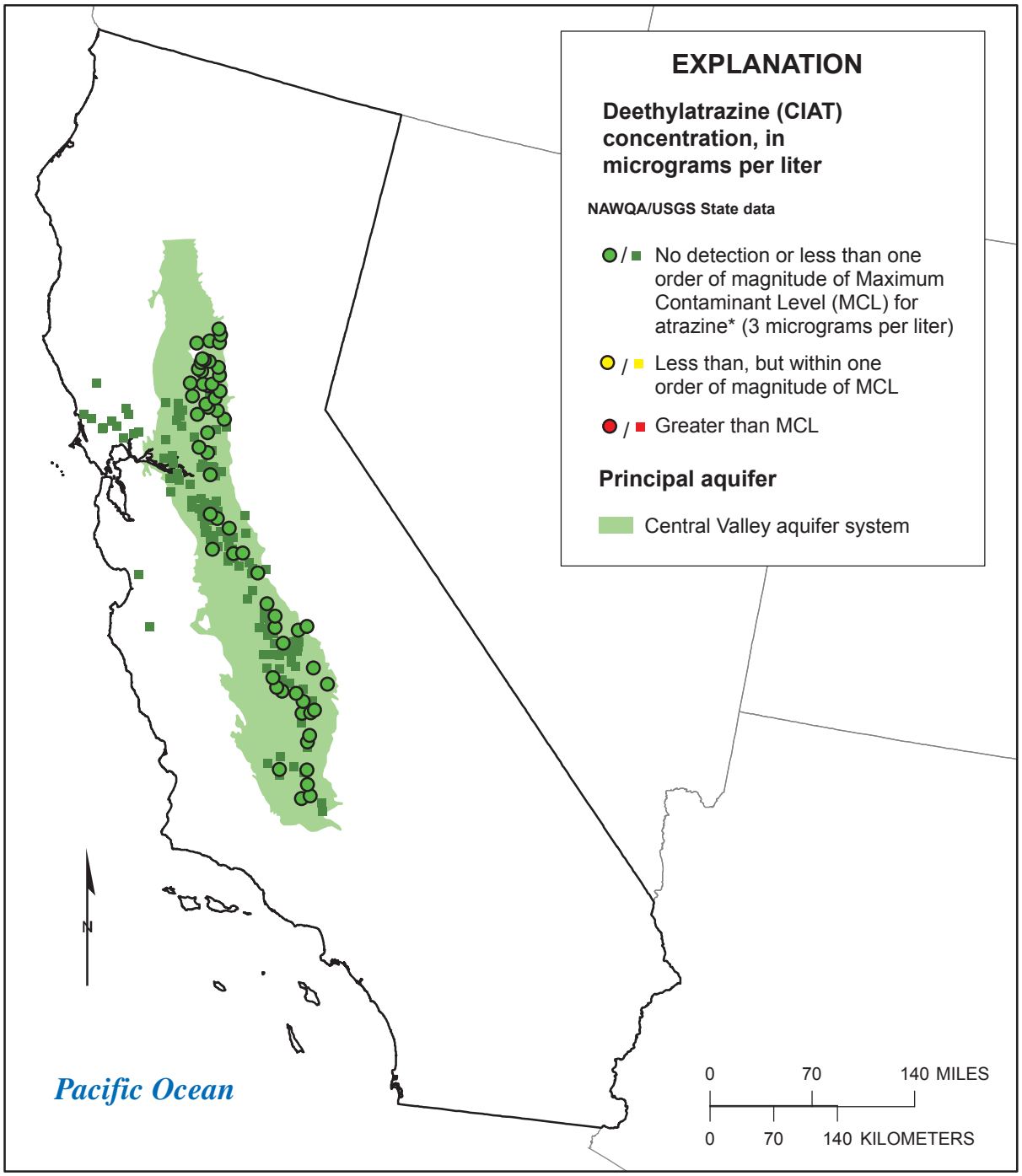
Principal aquifer data from U.S. Geological Survey, 2003

Figure CA8. Concentration of benzene in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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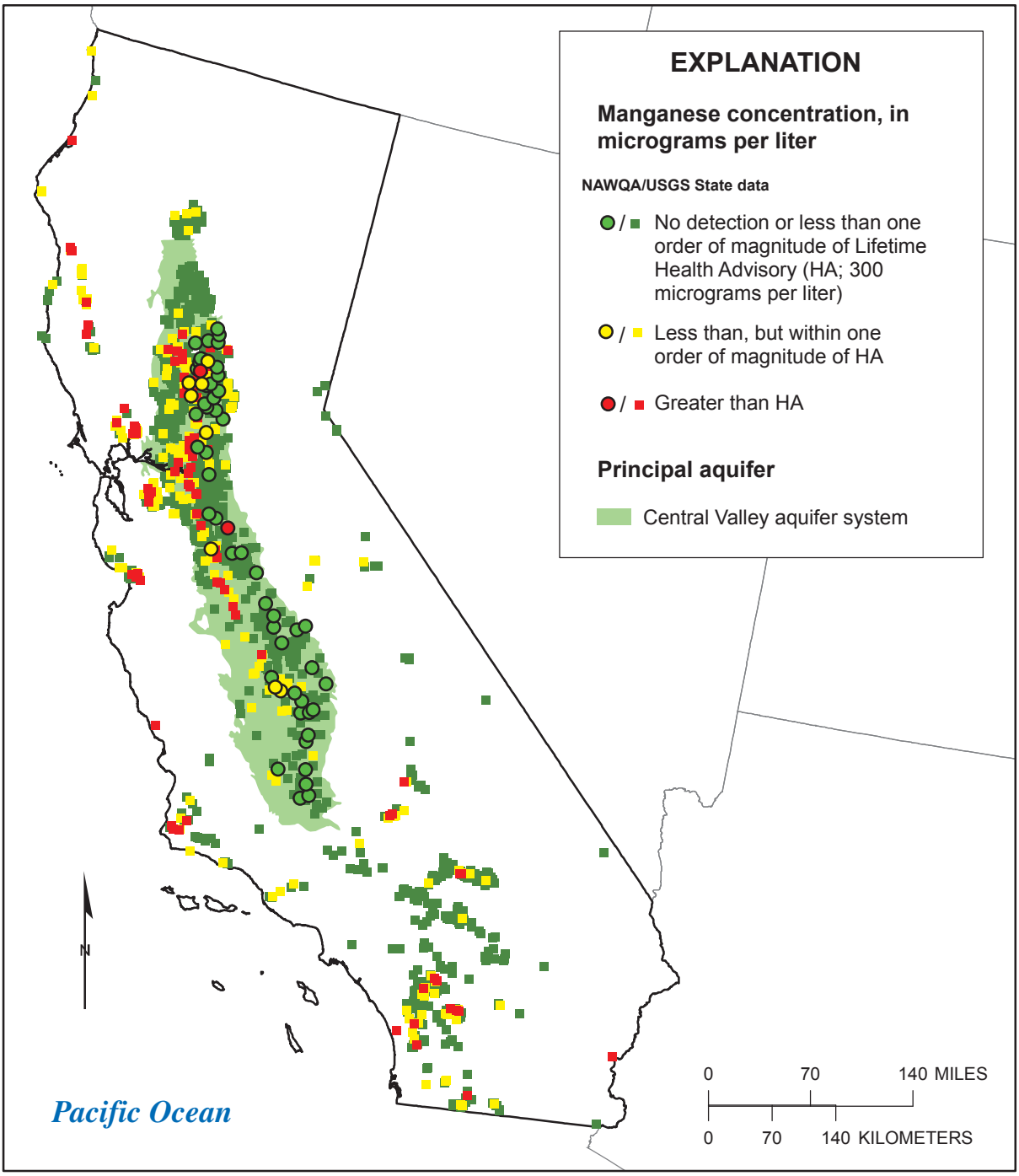
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

* For this report, the MCL for atrazine is used as benchmark for deethylatrazine because their toxicities are considered equivalent (see report text).

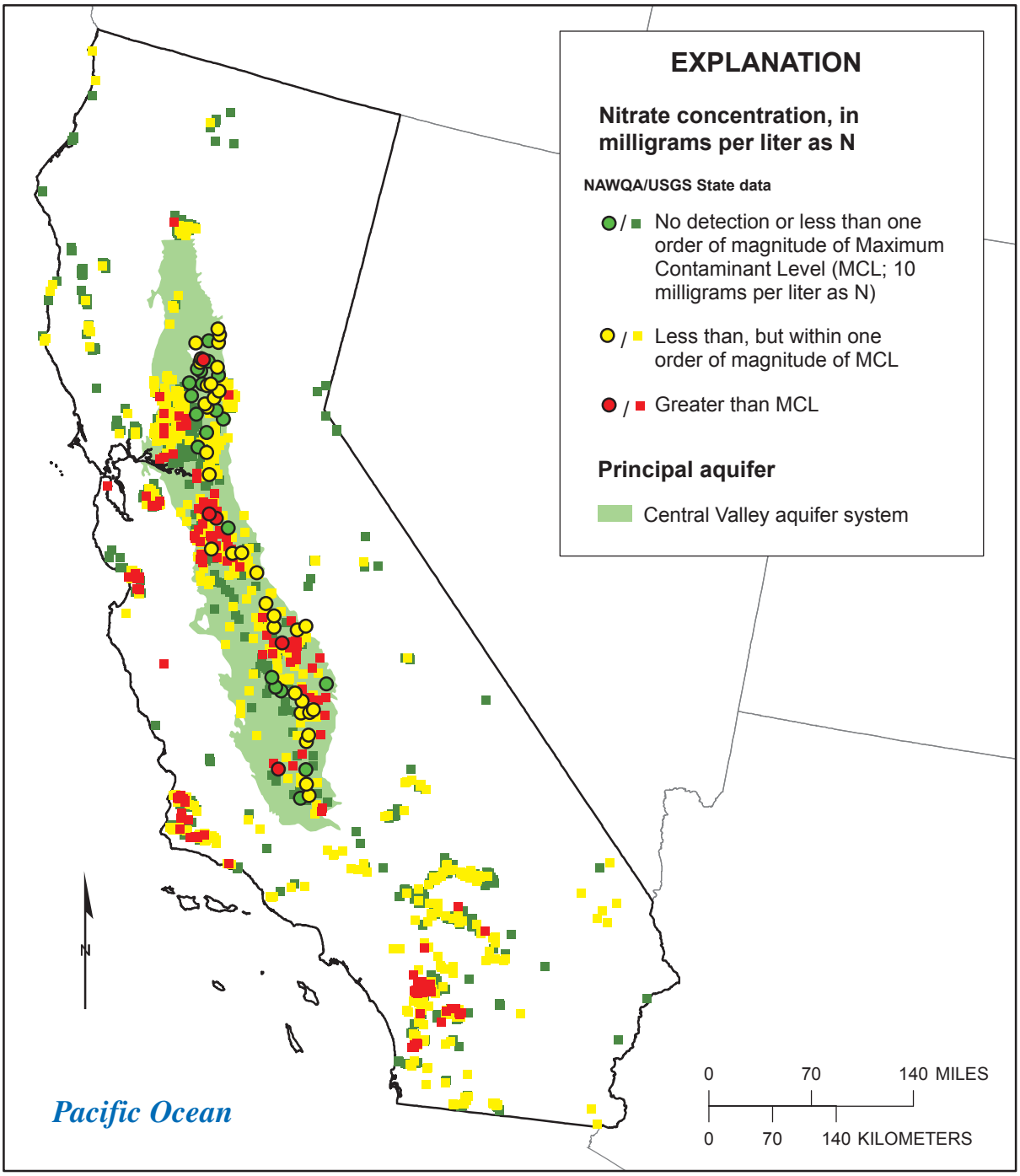
Figure CA9. Concentration of deethylatrazine (CIAT) in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

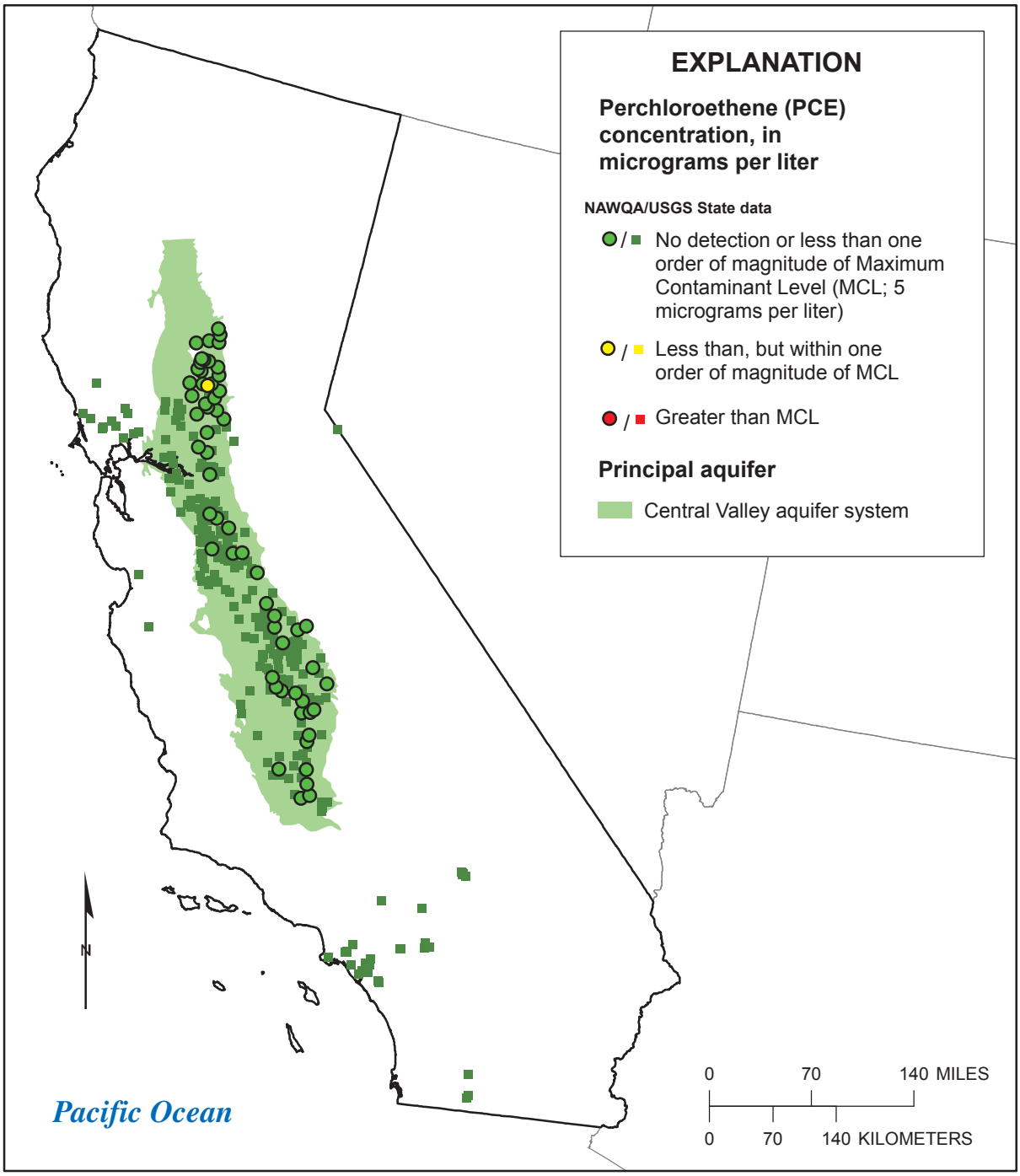
Figure CA10. Concentration of manganese in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

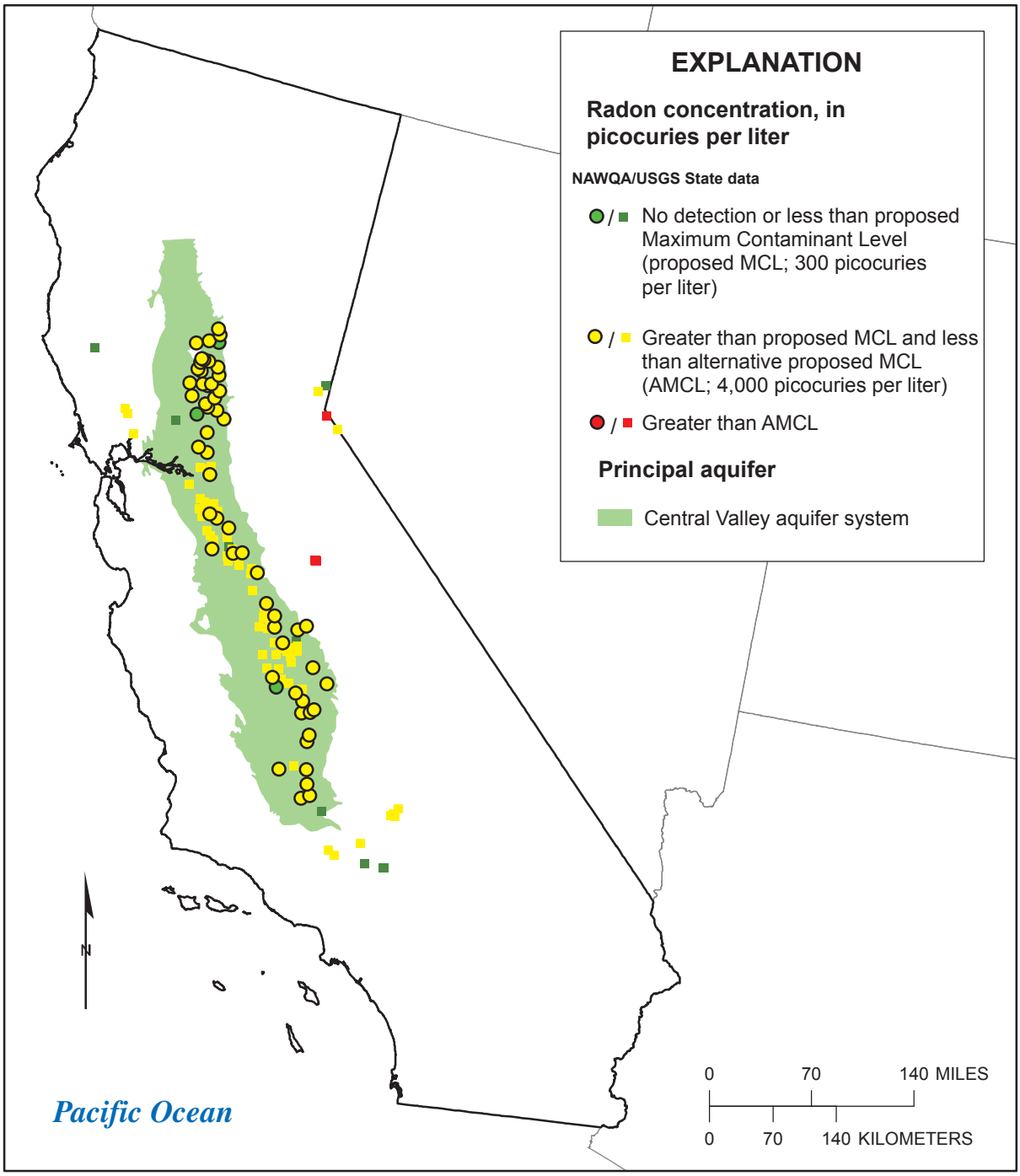
Figure CA11. Concentration of nitrate in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

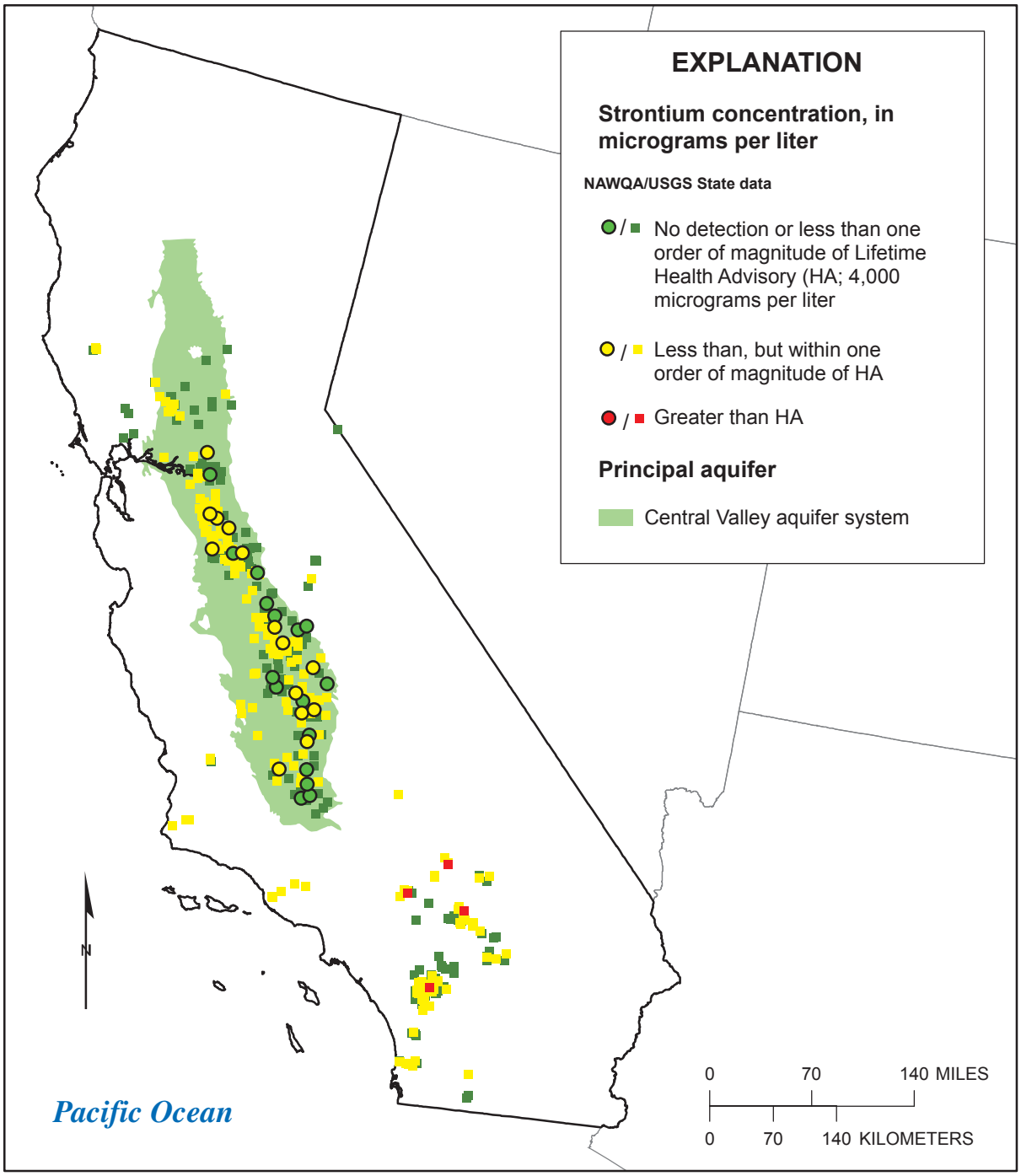
Figure CA12. Concentration of perchloroethene (PCE) in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

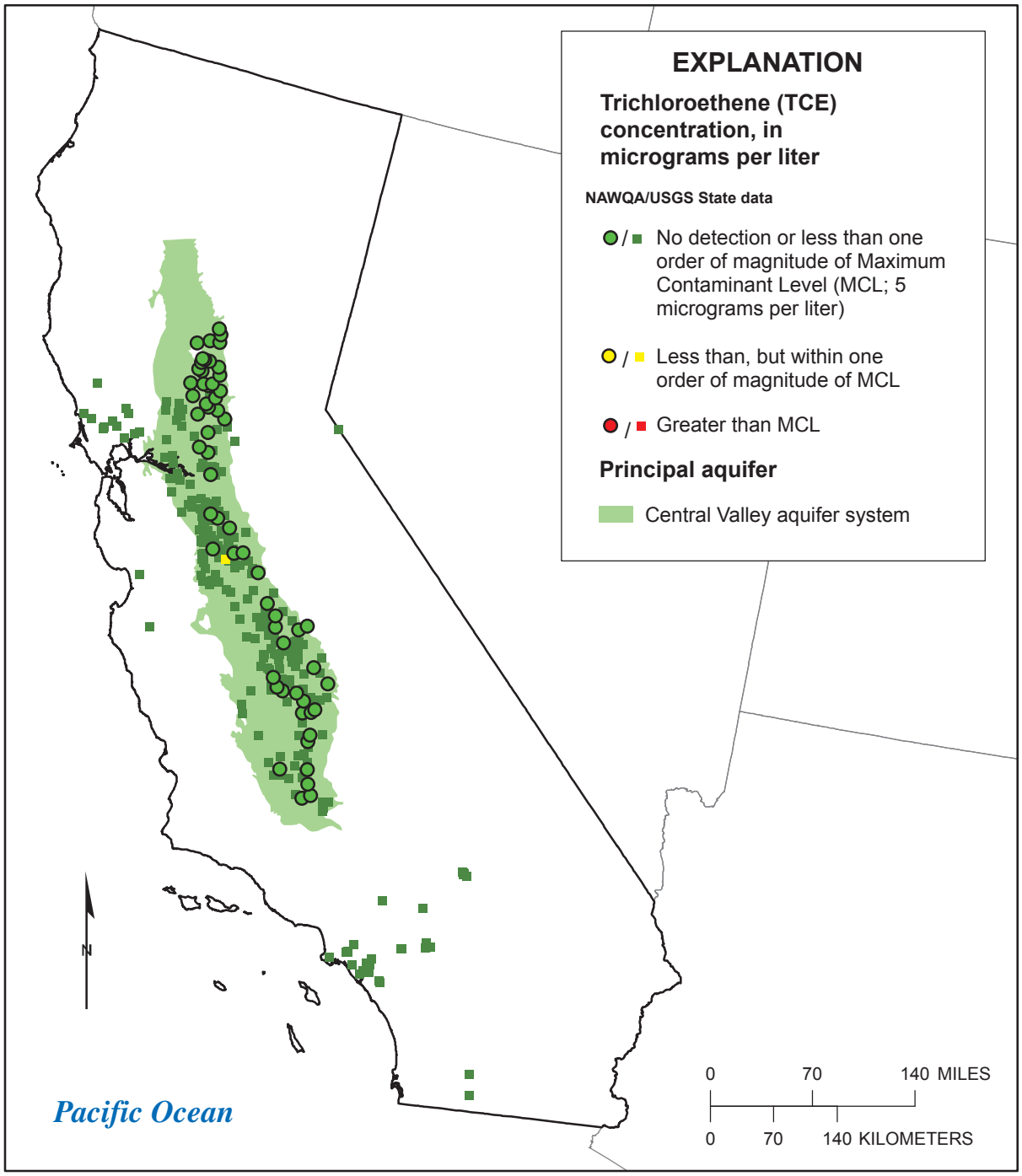
Figure CA13. Concentration of radon in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

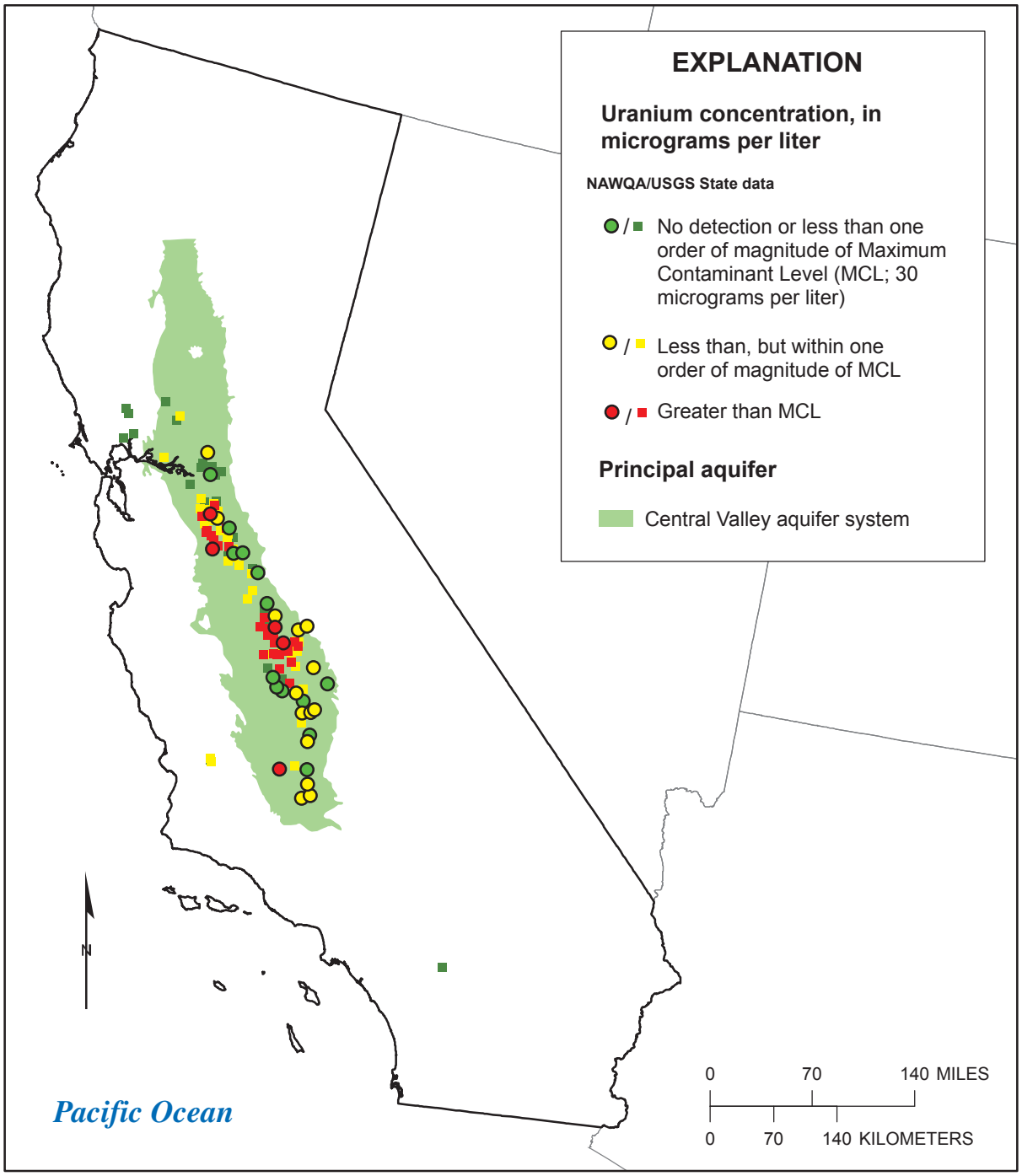
Figure CA14. Concentration of strontium in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

Figure CA15. Concentration of trichloroethene (TCE) in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Principal aquifer data from U.S. Geological Survey, 2003

Figure CA16. Concentration of uranium in samples from domestic wells in California (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological (USGS) Survey State data in the National Water Information System (NWIS)).