State Summary for Wisconsin

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 Wisconsin is shown in figures WI1–WI16. 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 that included Wisconsin and had at least 10 samples is given in table WI1. The areal extent of some NAWQA major-aquifer studies goes beyond the State boundary (fig. WI4). All data associated with a major-aquifer study are provided and are used in contaminant summaries even if the sampled well was located outside the State boundary. The "Selected References" section at the end of this summary lists previous Wisconsin studies that are relevant to the 11 contaminants.

In Wisconsin, the largest area with the highest population density is located in the southeastern part of the State (fig. WI1). About 60 percent of the combined domestic (private) and public drinking-water supply is obtained from ground water. The population (by census-block group for 1990) using a domestic-water supply from ground water was widespread throughout the State, with the exception of most of the northeastern part of the State where less than 250 people per census block group were using ground water as a domestic-water supply (fig. WI2). In general, the population density in Wisconsin is low except in urban centers (fig. WI1). Most of the land use in Wisconsin is agricultural and forest lands (fig. WI3).

Five major-aquifer studies in two principal aquifers (Cambrian-Ordovician aquifer system and glacial aquifers) were conducted in Wisconsin (fig. WI4). The Cambrian-Ordovician aquifer system occurs in the southern two-thirds of Wisconsin and is a complex multiaquifer system with individual aquifers separated by leaky confining units. The aquifers in Wisconsin primarily occur in sandstone units that are overlain by the Maquoketa confining unit (Olcott, 1992).

Table WI1. Percentage of samples with concentrations greater than U.S. Environmental Protection Agency human-health benchmarks for National Water-Quality Assessment (NAWQA) Program major-aquifer studies that included Wisconsin and had at least 10 samples.

Study-Unit code for NAWQA major-aquifer study	Principal aquifer	Contaminant	Number of samples	Percentage of samples with concentrations greater than human-health benchmark
umissus3	Cambrian-Ordovician aquifer system	Radon	24	[1]71/0.0
wmicsus1	Cambrian-Ordovician aquifer system	Radon	21	[1]62/0.0
umissus4	Cambrian-Ordovician aquifer system	Radon	23	[1]61/0.0
wmicsus2	Glacial aquifers	Radon	25	[1]36/0.0
uirbsus1	Glacial aquifers	Radon	27	[1]30/0.0
wmicsus1	Cambrian-Ordovician aquifer system	Nitrite plus nitrate	21	14
umissus3	Cambrian-Ordovician aquifer system	Nitrite plus nitrate	25	8.0
wmicsus1	Cambrian-Ordovician aquifer system	Strontium	18	11
wmicsus2	Glacial aquifers	Arsenic	25	8.0
umissus3	Cambrian-Ordovician aquifer system	Manganese	25	8.0
umissus4	Cambrian-Ordovician aquifer system	Manganese	25	8.0
wmicsus2	Glacial aquifers	Manganese	25	8.0
uirbsus1	Glacial aquifers	Manganese	27	3.7

[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).

Several glacial aquifers occur near the land surface in the northern and eastern parts of Wisconsin and are contained in unconsolidated sand and gravel deposits of Quaternary age. Most of the individual aquifers that compose the system were formed mostly from sediments deposited by continental glaciers or by meltwater from glaciers and the aquifers readily receive, store, transmit, and discharge water (Olcott, 1992). Well yields are quite variable in the glacial systems because of variable thicknesses, coarseness of material, and the extent of the deposits. The most productive glacial aquifers in Wisconsin are in outwash deposits and can yield from 500 to 1,000 gallons per minute (Olcott, 1992).

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. WI5) 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, nitrate, strontium, arsenic, and manganese had concentrations greater than USEPA human-health benchmarks (table WI1). Radon had the greatest potential human-health concern because it had the largest percentage of samples with concentrations greater than the human-health benchmark of 300 picocuries per liter (pCi/L). Radon concentrations were largest in three major-aquifer studies (umissus3, wmicsus1, and umissus4) in the Cambrian-Ordovician aquifer system, with concentrations greater than the proposed Maximum Contaminant Level (MCL) of 300 pCi/L in more than 60 percent of the samples (table WI1). Median radon concentrations ranged from about 300 to 500 pCi/L in the three major-aquifer studies (fig. WI5). Radon concentrations also were greater than the proposed MCL of 300 pCi/L in two major-aquifer studies in the glacial aquifers principal aquifer (about 36 percent of the samples in wmicsus2 and about 30 percent in uribsus1), with median concentrations ranging from 200 to 250 pCi/L (fig. WI5). None of the radon concentrations were greater than the alternative proposed MCL of 4,000 pCi/L. U.S. Geological Survey (USGS) State data from the NWIS database also showed radon concentrations greater than 300 pCi/L in many of the samples collected and in the same general areas as the NAWQA samples (fig. WI13). USGS State data from the NWIS database also showed some concentrations in northeastern Wisconsin that were greater than 4,000 pCi/L. Radon-222 is a decay product of radium-226, and radon concentrations are widespread and can be attributed to natural sources in the soil and rock material in Wisconsin.

Nitrate had the next largest potential concern to human health. About 14 percent of the samples from the wmicsus1 major-aquifer study and 8 percent of the samples from the umissus3 major-aquifer study, both in the Cambrian-Ordovician aquifer system, had concentrations greater than the human-health benchmark (MCL of 10 milligrams per liter (mg/L) as N) (table WI1). USGS State data also showed this principal aquifer along with the glacial aquifers in central Wisconsin to have nitrate concentrations greater than the human-health benchmark, but the geographic extent of the concentrations is better defined using USGS State data than NAWQA data (fig. WI11). These nitrate concentrations appear coincident with agricultural land use, and many people could be using domestic-water supplies in this area based on water-use data.

Strontium concentrations were larger than the human-health benchmark (Lifetime Health Advisory (HA) of 4,000 micrograms per liter (µg/L)) in two samples (about 11 percent) from the wmicsus1 major-aquifer study in the Cambrian-Ordovician aquifer system; however, only one of the samples was collected in the State of Wisconsin (fig. WI14). USGS State data showed a much larger geographic extent of strontium concentrations greater than the human-health benchmark in this same principal aquifer (fig. WI14).

Arsenic concentrations were greater than the human-health benchmark (MCL of 10 µg/L) in two samples (8 percent) in northeastern Wisconsin from the wmicsus2 major-aquifer study in the glacial aquifers (fig. WI6). USGS State data also showed this area to have arsenic concentrations greater than the human-health benchmark in addition to one sample in southeastern Wisconsin (fig. WI6).

Manganese concentrations were greater than the human-health benchmark (HA of 300 µg/L) in two major-aquifer studies in the Cambrian-Ordovician aquifer system (two samples each (8 percent) from the umissus3 and umissus4 major-aquifer studies) and in two major-aquifer studies in the glacial aquifers (1 sample (about 4 percent) and 2 samples (8 percent) from the uirbsus1 and wmicsus2 major-aquifer studies, respectively) (table WI1). Median manganese concentrations for the umissus4, umissus3, and uirbsus1 major-aquifer studies were within an order of magnitude of the human-health benchmark (fig. WI5). USGS State data contained more samples than the NAWQA data set, and USGS State data better defined the geographical extent of the manganese concentrations greater than the human-health benchmark (fig. WI10).

For the entire Wisconsin data set, no concentrations of atrazine (fig. WI7), benzene (fig. WI8), CIAT (fig. WI9), PCE (fig. WI12), TCE (fig. WI15), and uranium (fig. WI16) were greater 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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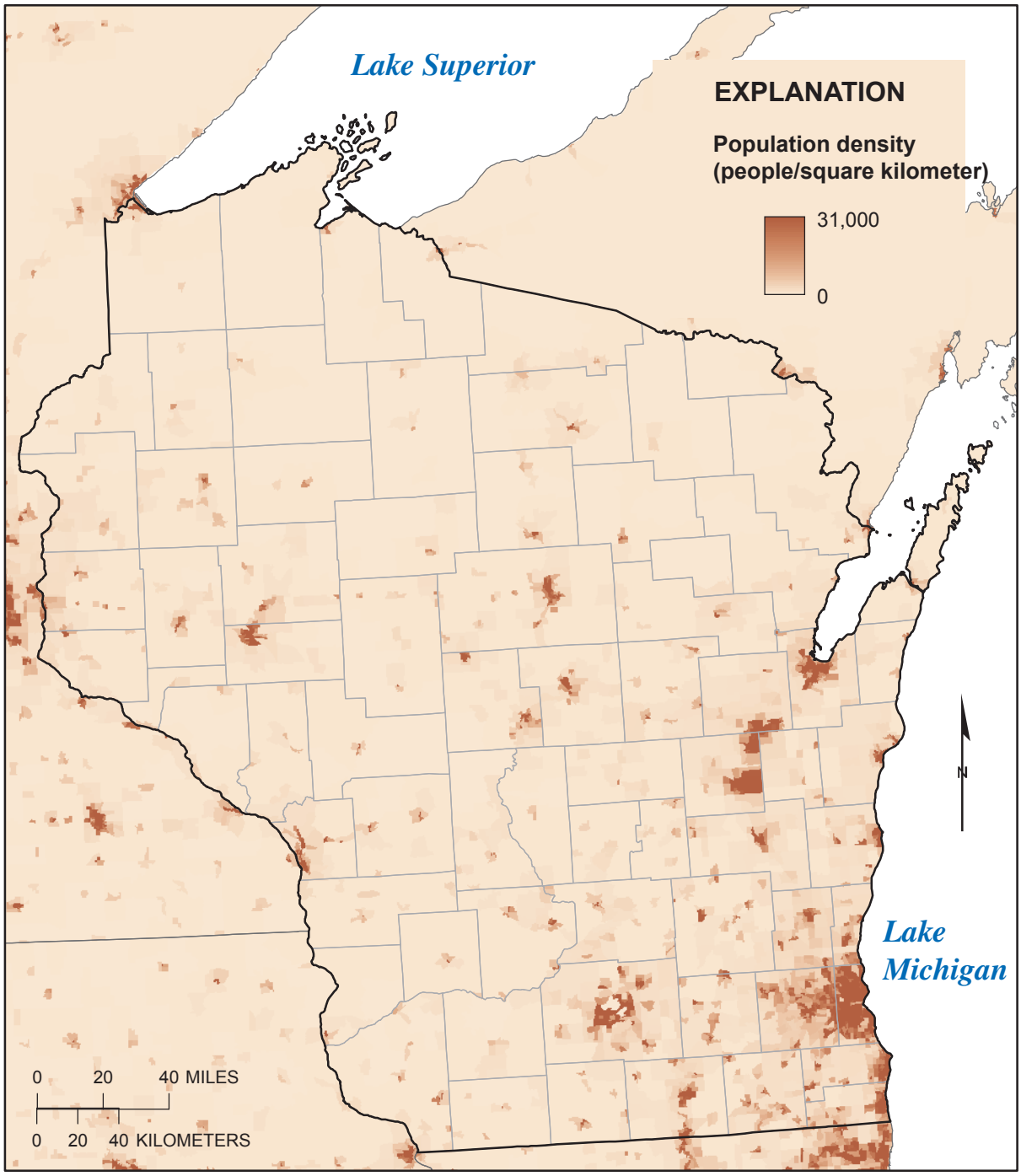

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Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Figure WI1. Population density for Wisconsin and nearby States. (Data from Hitt, 2003.)

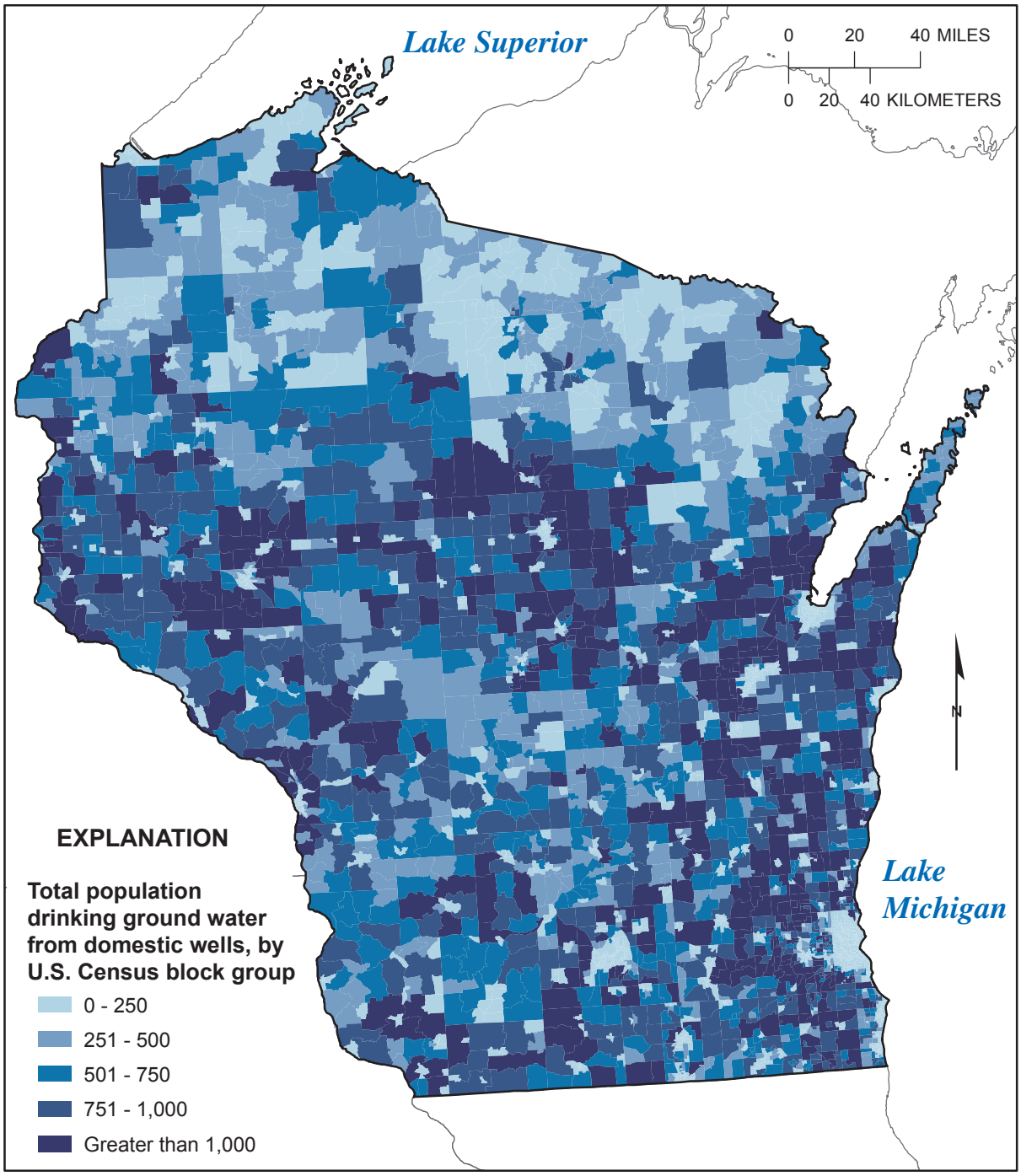

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Figure WI2. Population using domestic-water supply (from ground water) for Wisconsin. (Data from 1990 U.S. Census block group, Kerie Hitt, U.S. Geological Survey, written commun., 1997.)

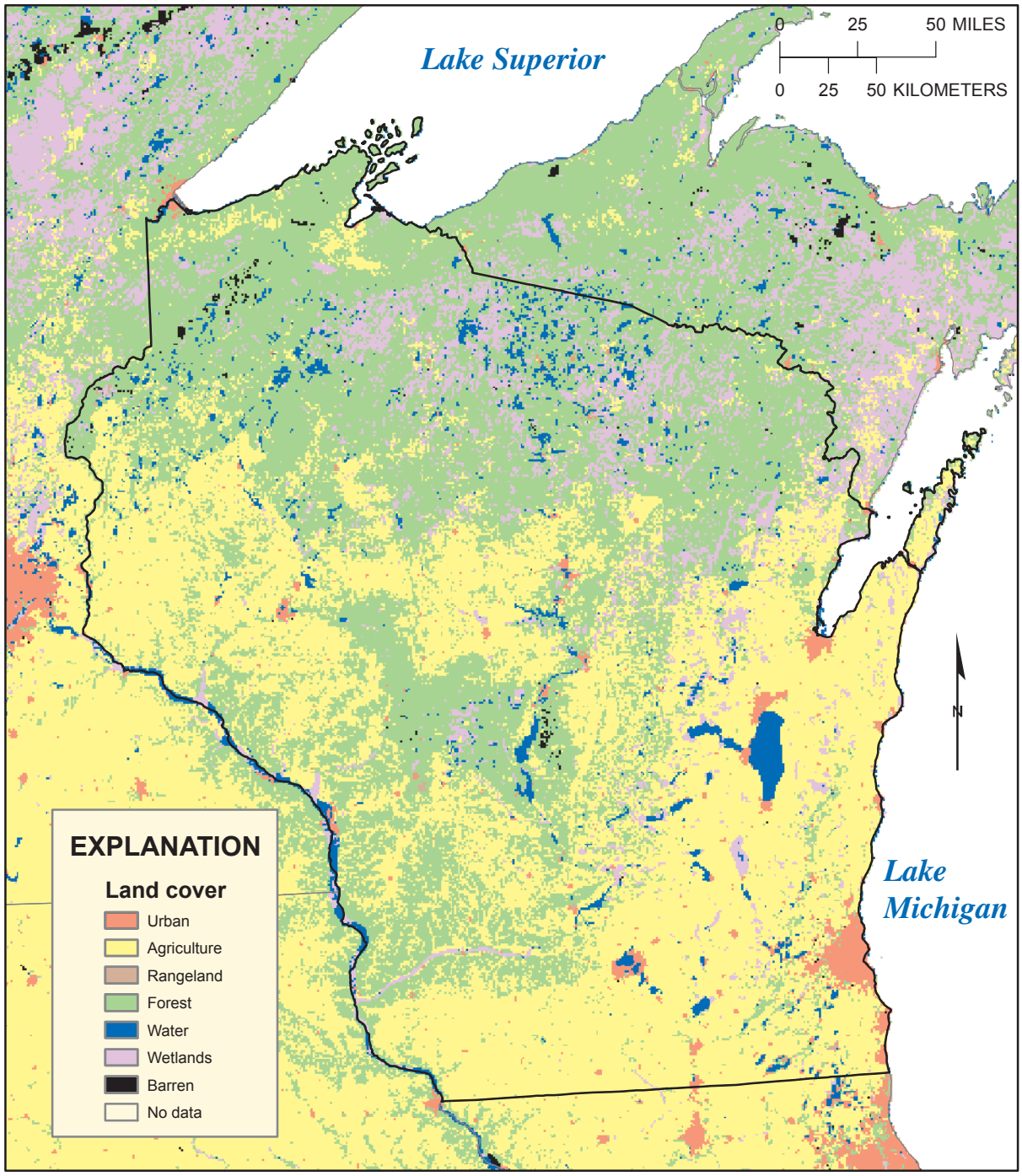

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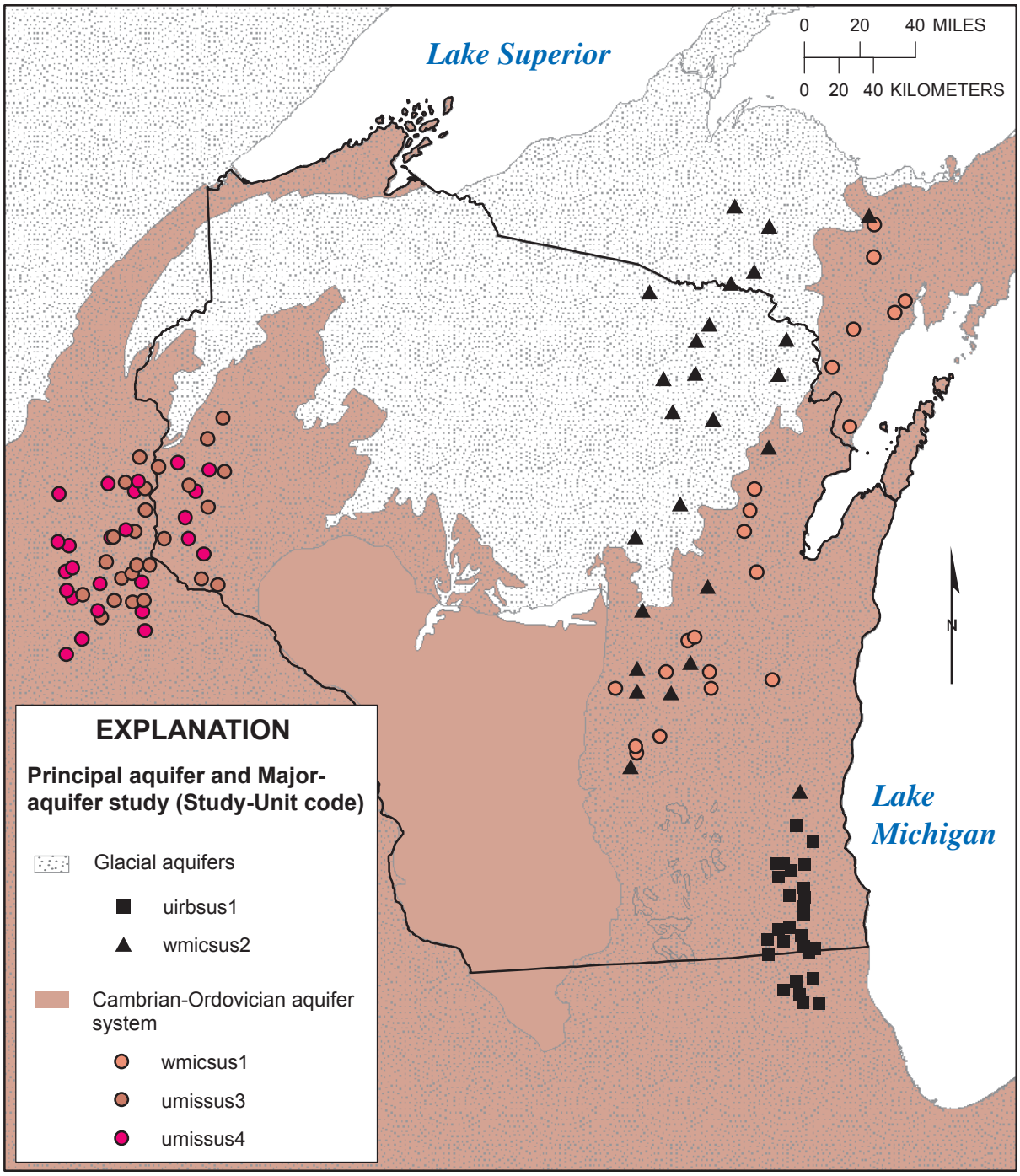
Figure WI3. Land use/land cover for Wisconsin and nearby States. (Data from Naomi Nakagaki, U.S. Geological Survey, written commun., 2005.)



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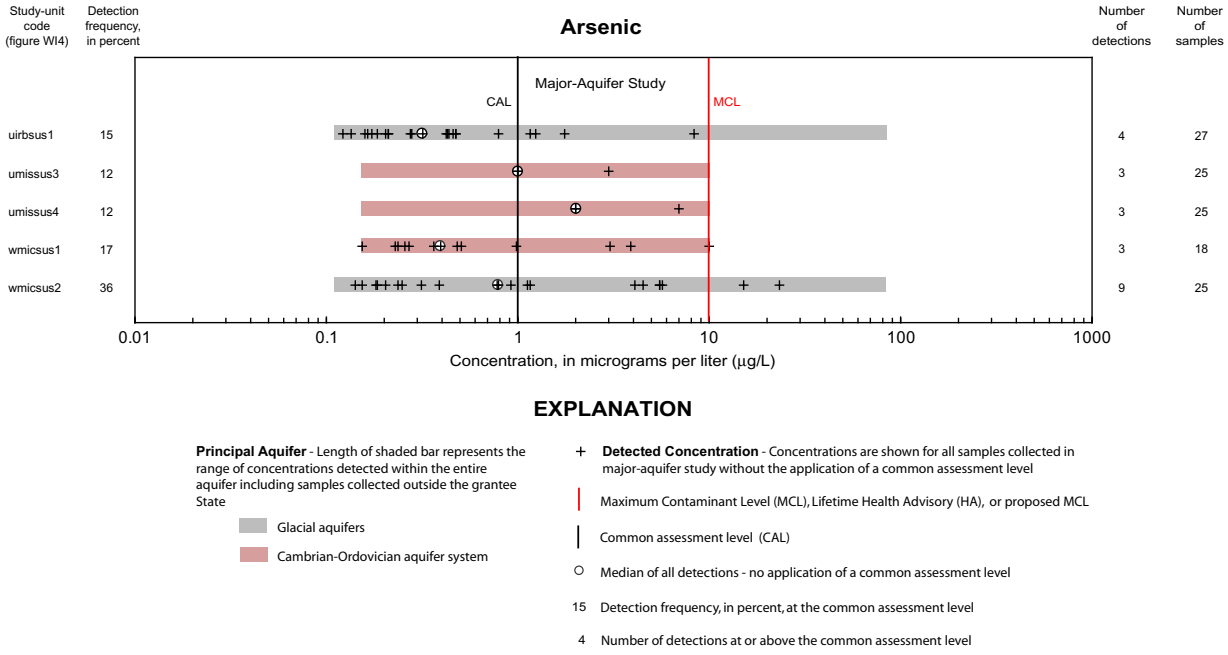
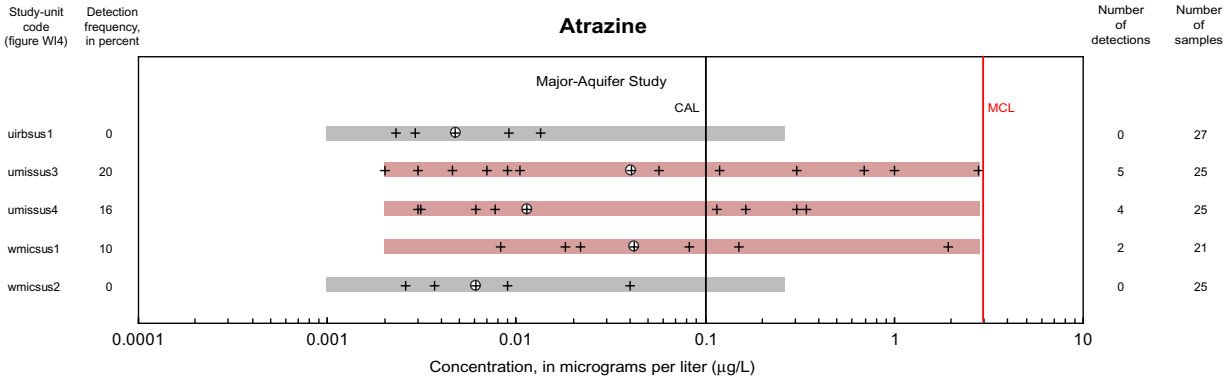
Standard Parallels 29°30' and 45°30', central meridian -96°

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

Figure WI4. Location of domestic wells sampled for National Water-Quality Assessment (NAWQA) major-aquifer studies that included Wisconsin.





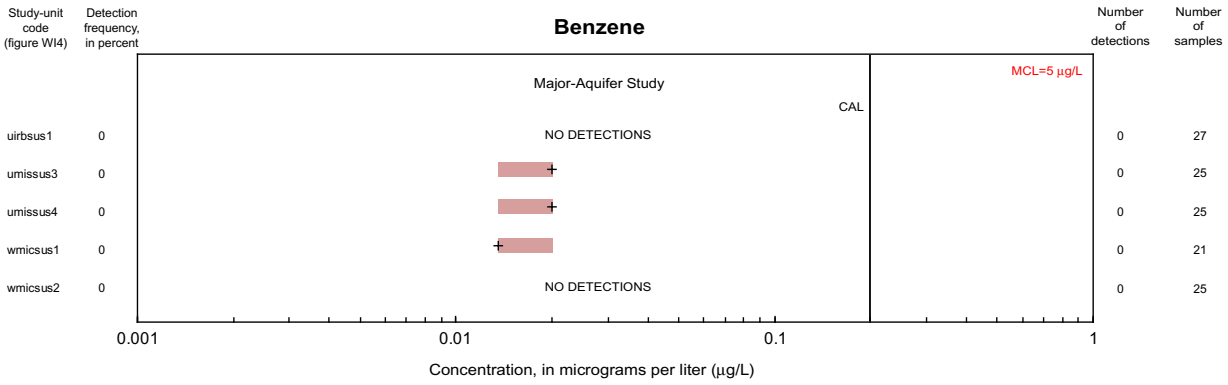


Figure WI5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for Wisconsin (includes studies for which at least 10 analyses were available).

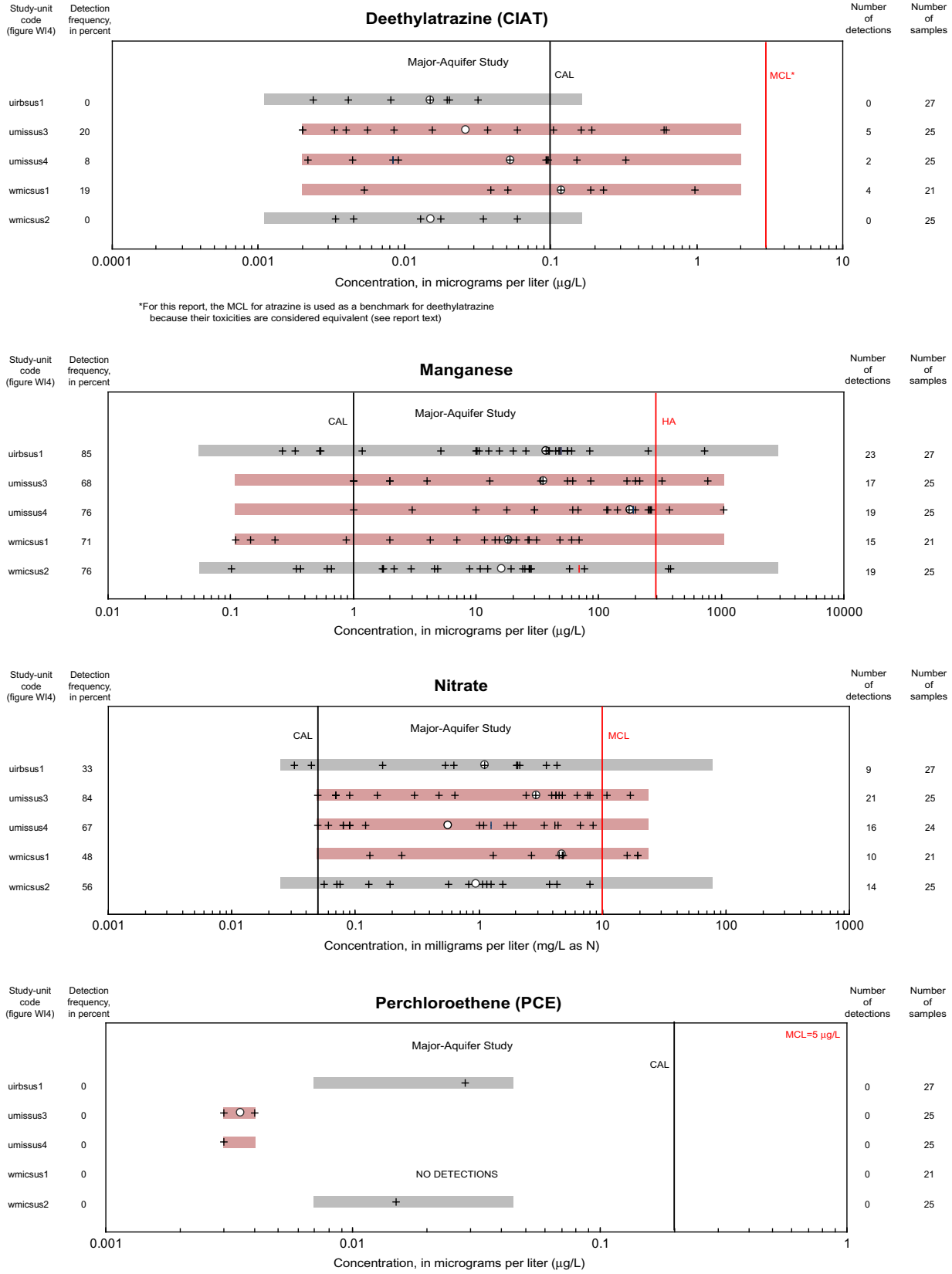


Figure WI5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for Wisconsin (includes studies for which at least 10 analyses were available).—Continued

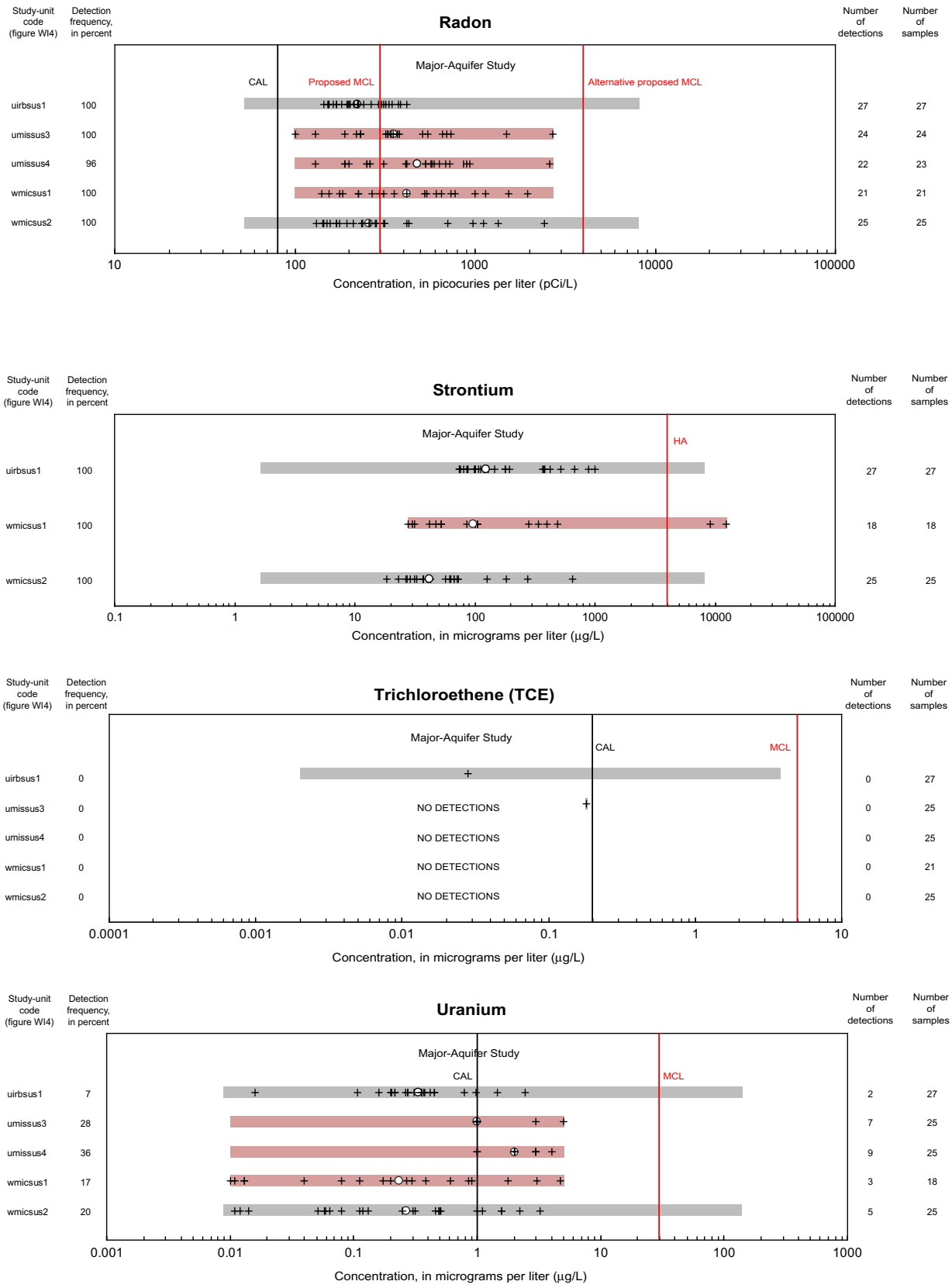
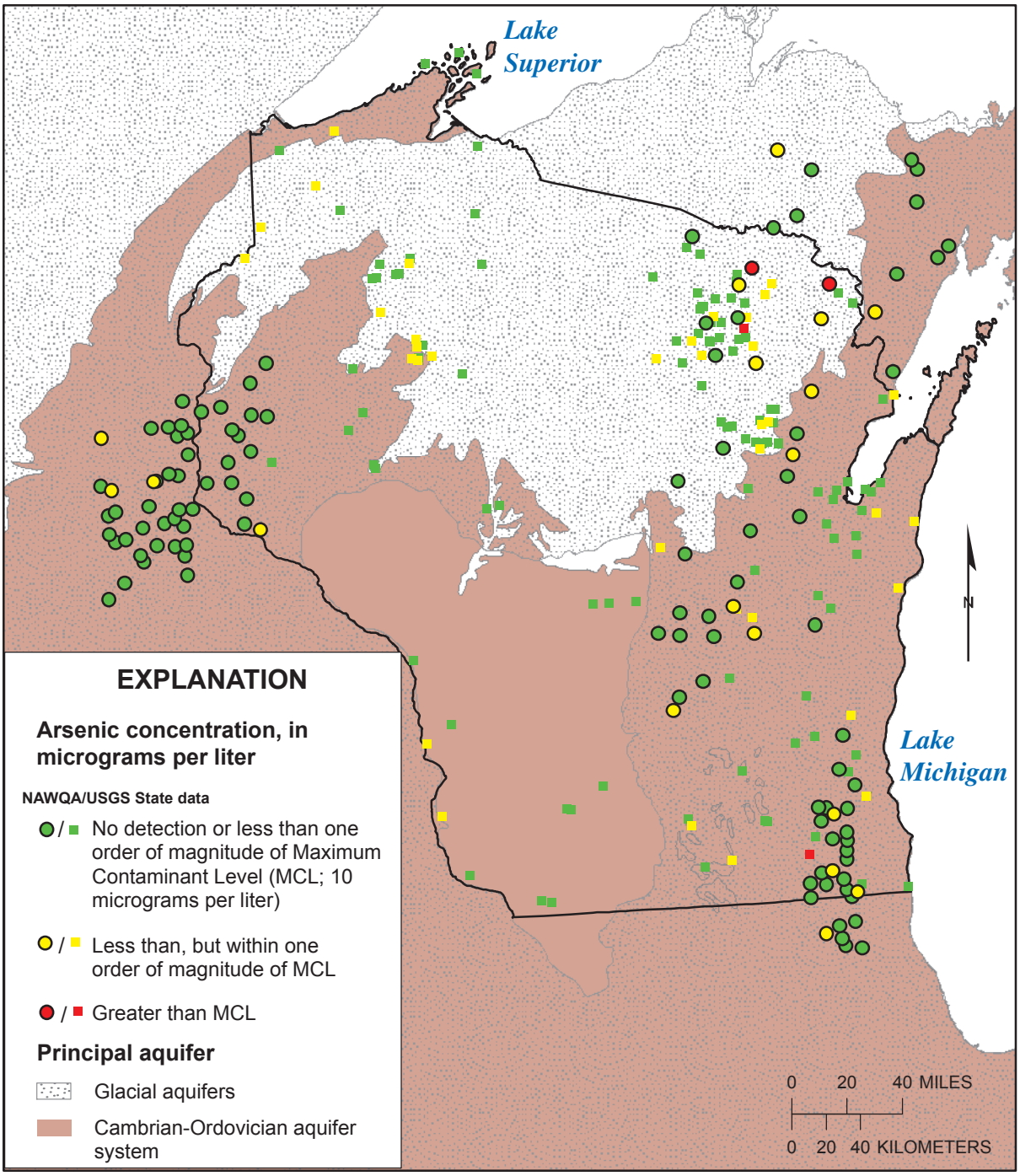


Figure WI5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for Wisconsin (includes studies for which at least 10 analyses were available).—Continued



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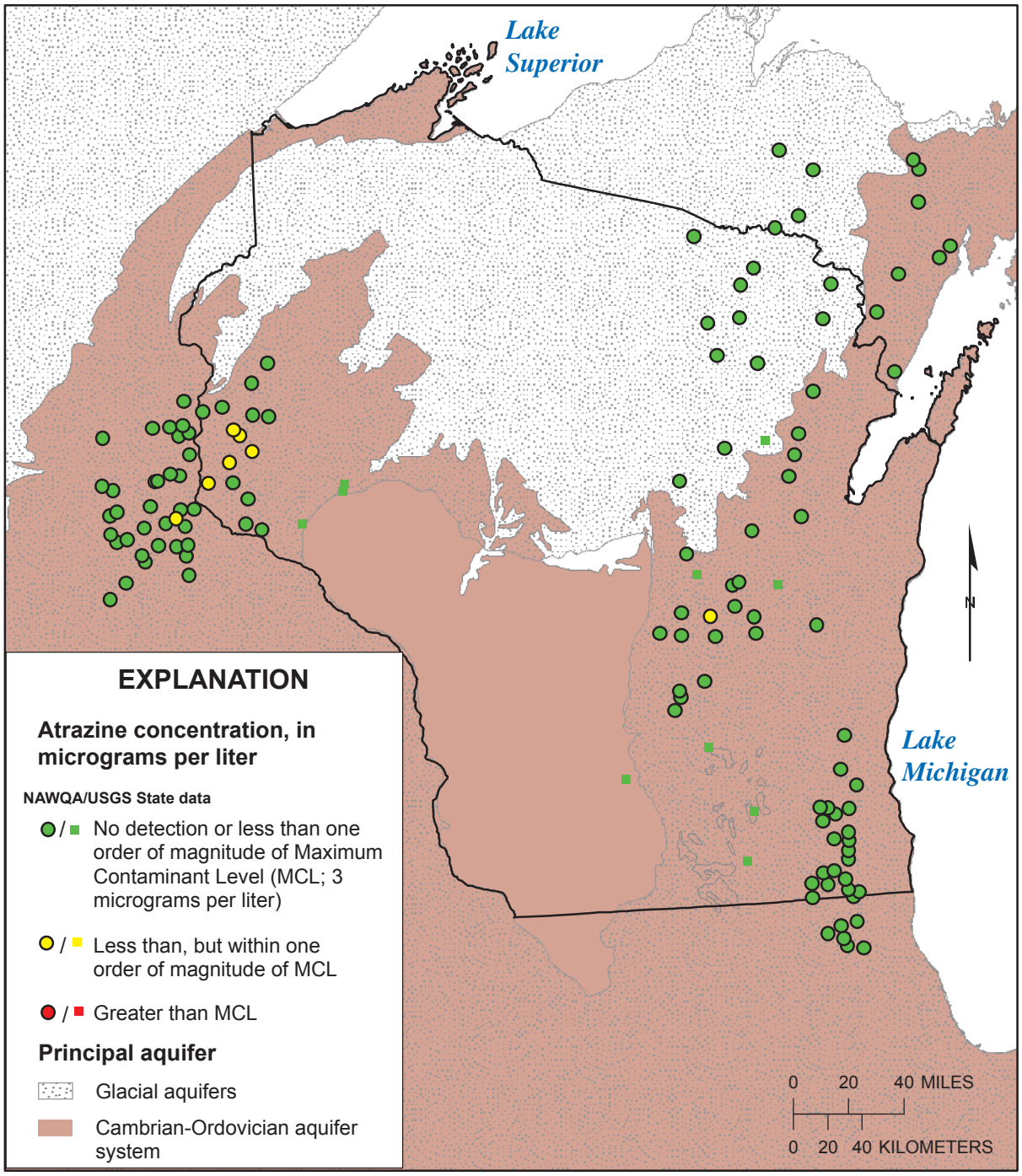
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

Figure WI6. Concentration of arsenic in samples from domestic wells in Wisconsin and nearby States (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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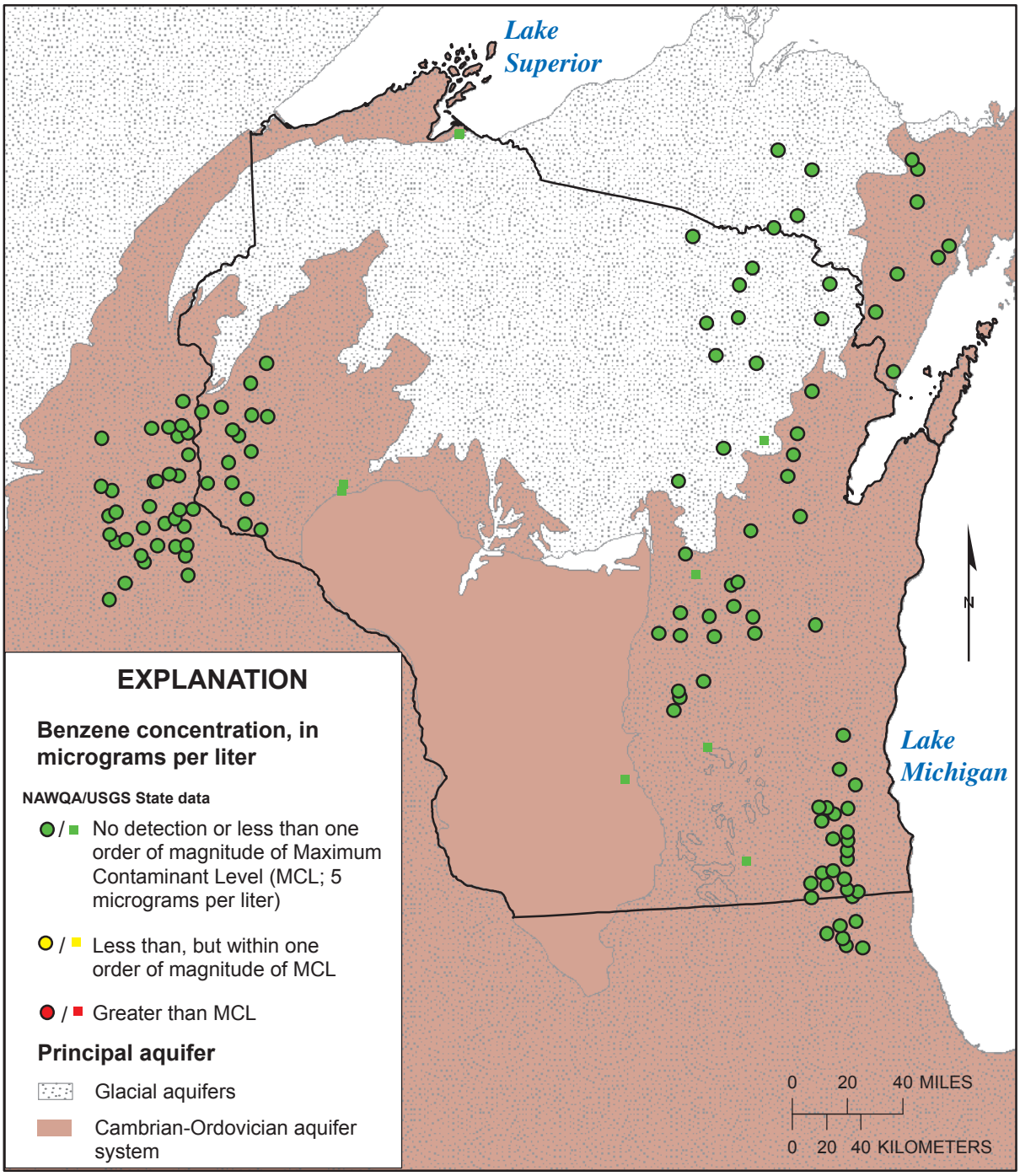
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

Figure WI7. Concentration of atrazine in samples from domestic wells in Wisconsin and nearby States (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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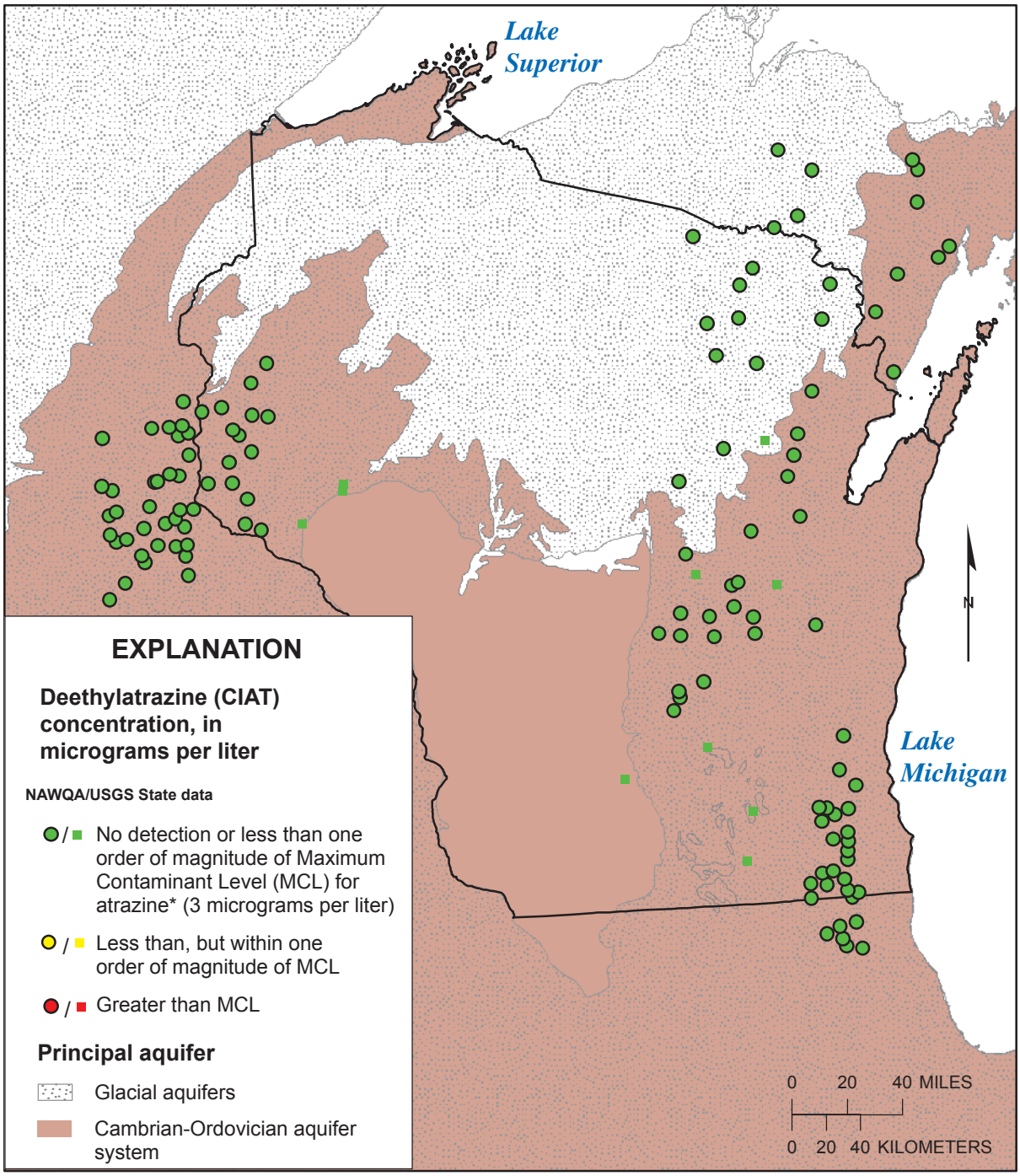
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

Figure WI8. Concentration of benzene in samples from domestic wells in Wisconsin and nearby States (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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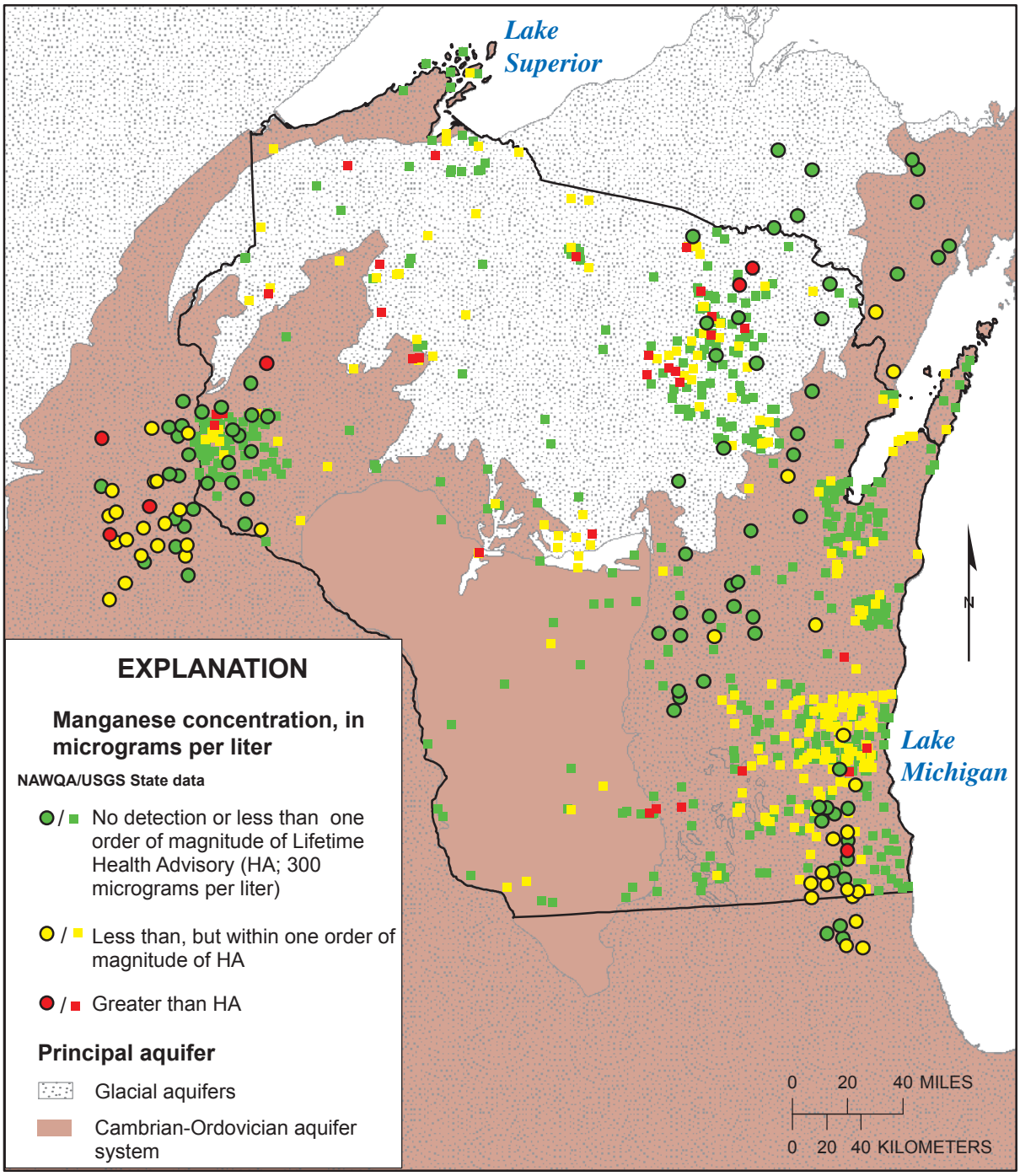
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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).

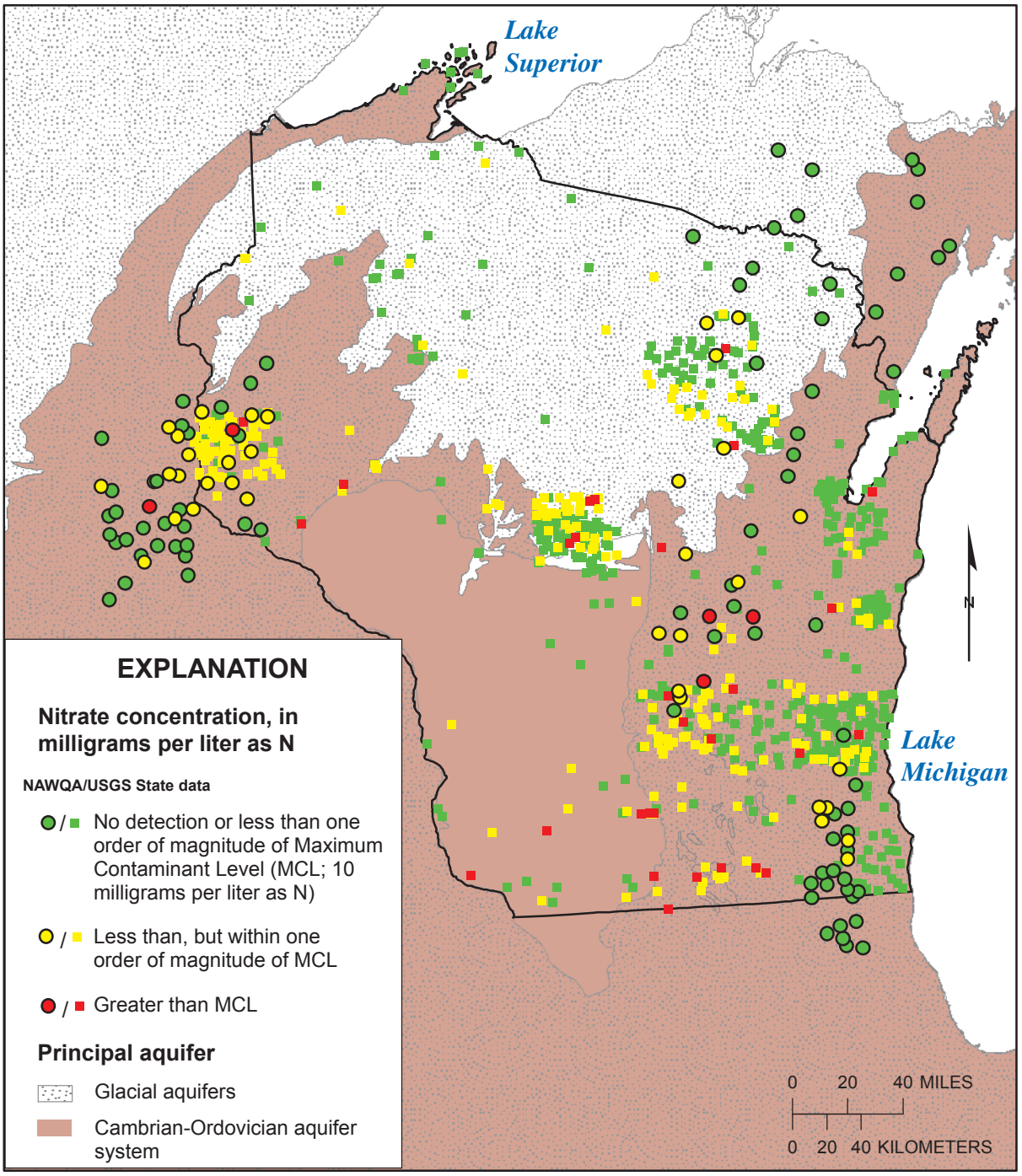
Figure WI9. Concentration of deethylatrazine (CIAT) in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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 WI10. Concentration of manganese in samples from domestic wells in Wisconsin and nearby States (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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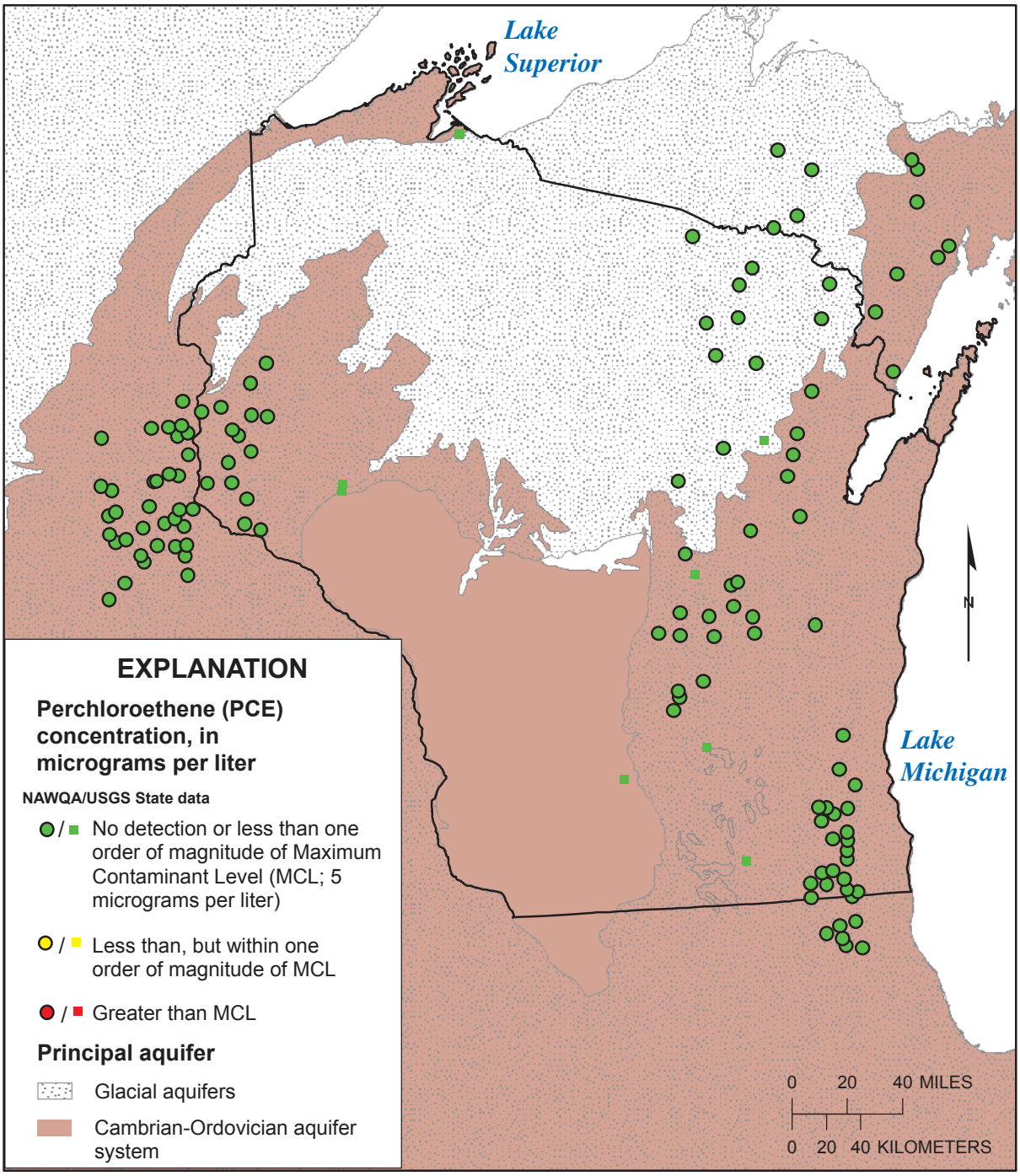
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

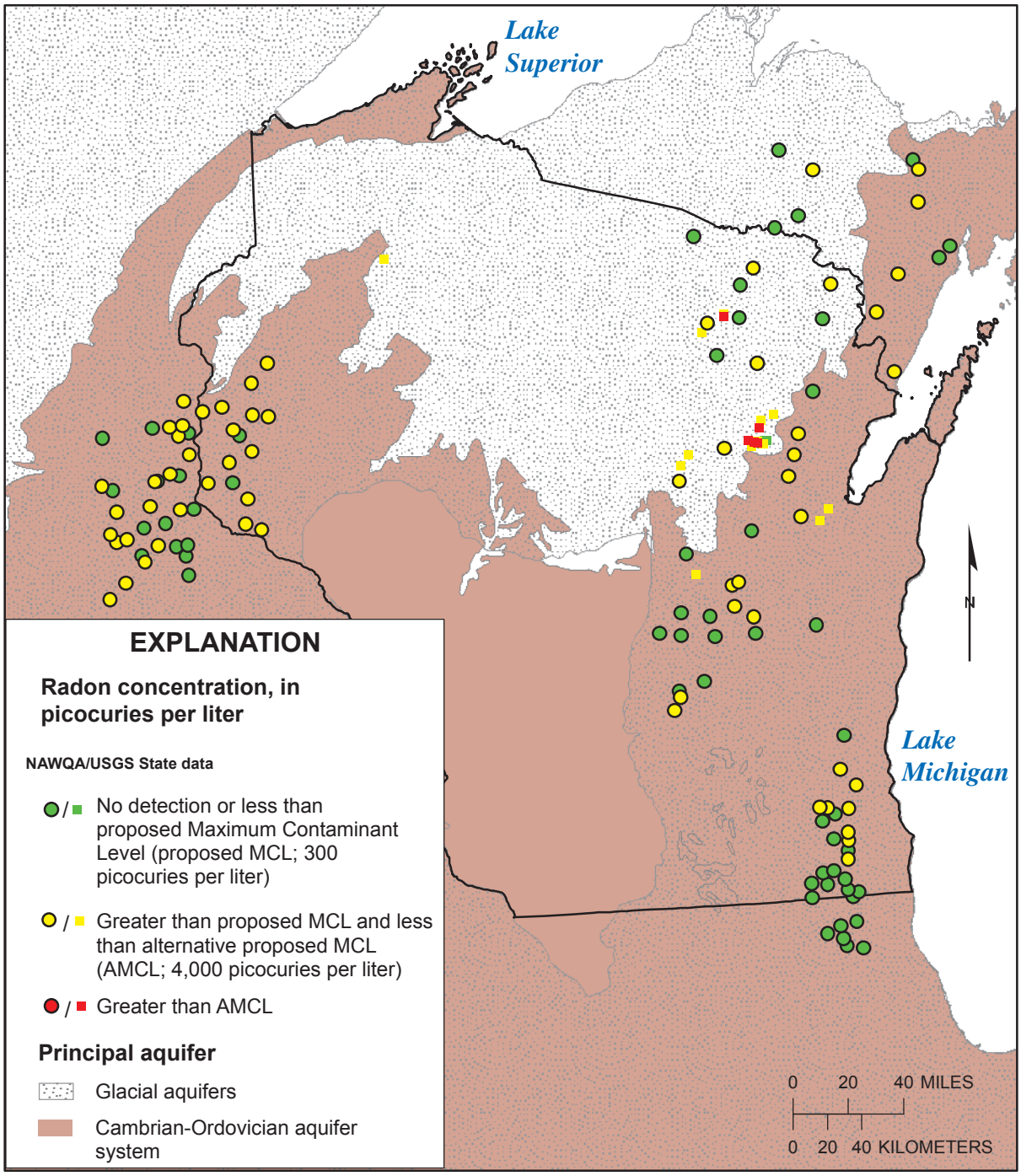
Figure WI11. Concentration of nitrate in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

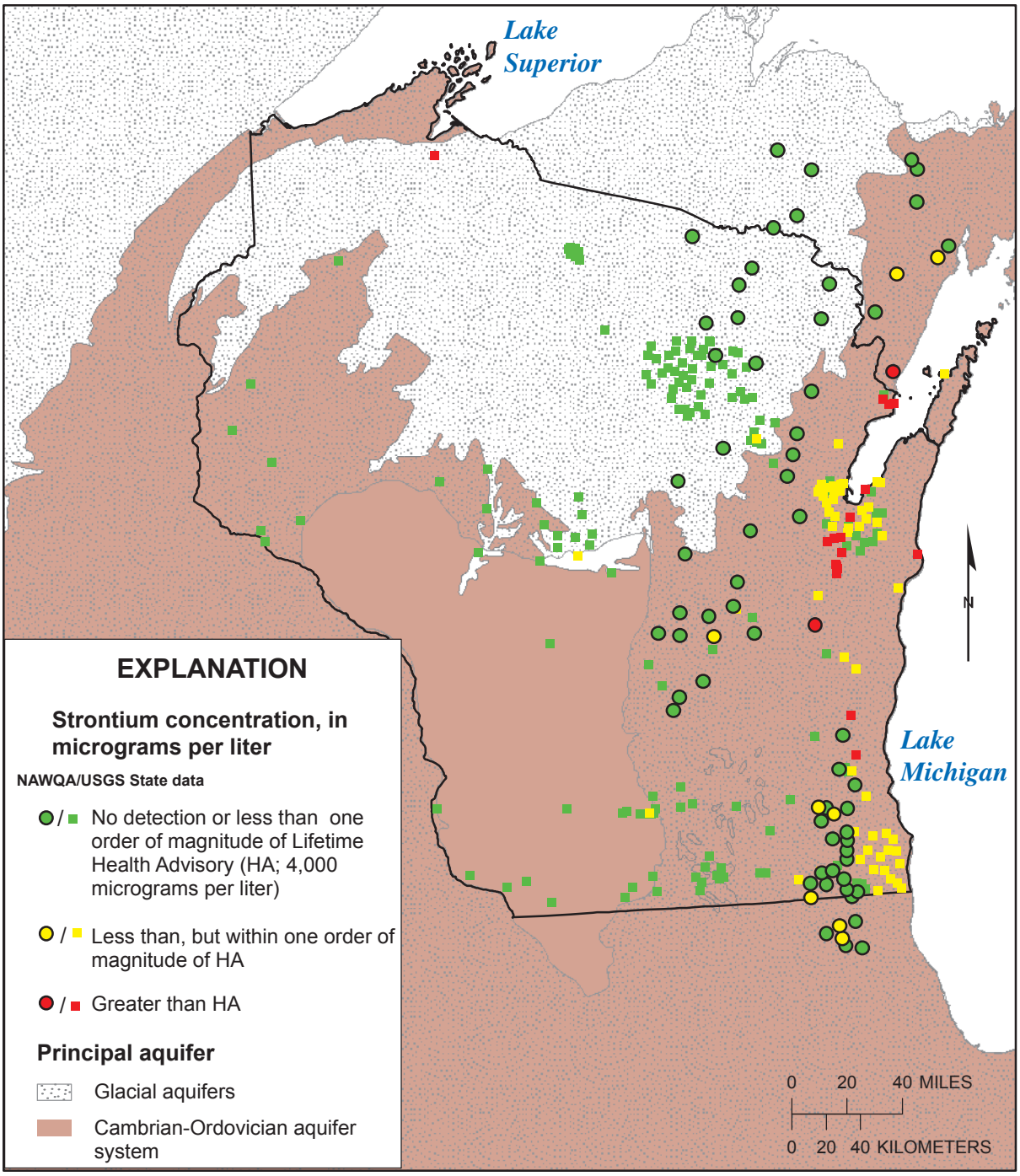
Figure WI12. Concentration of perchloroethene (PCE) in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

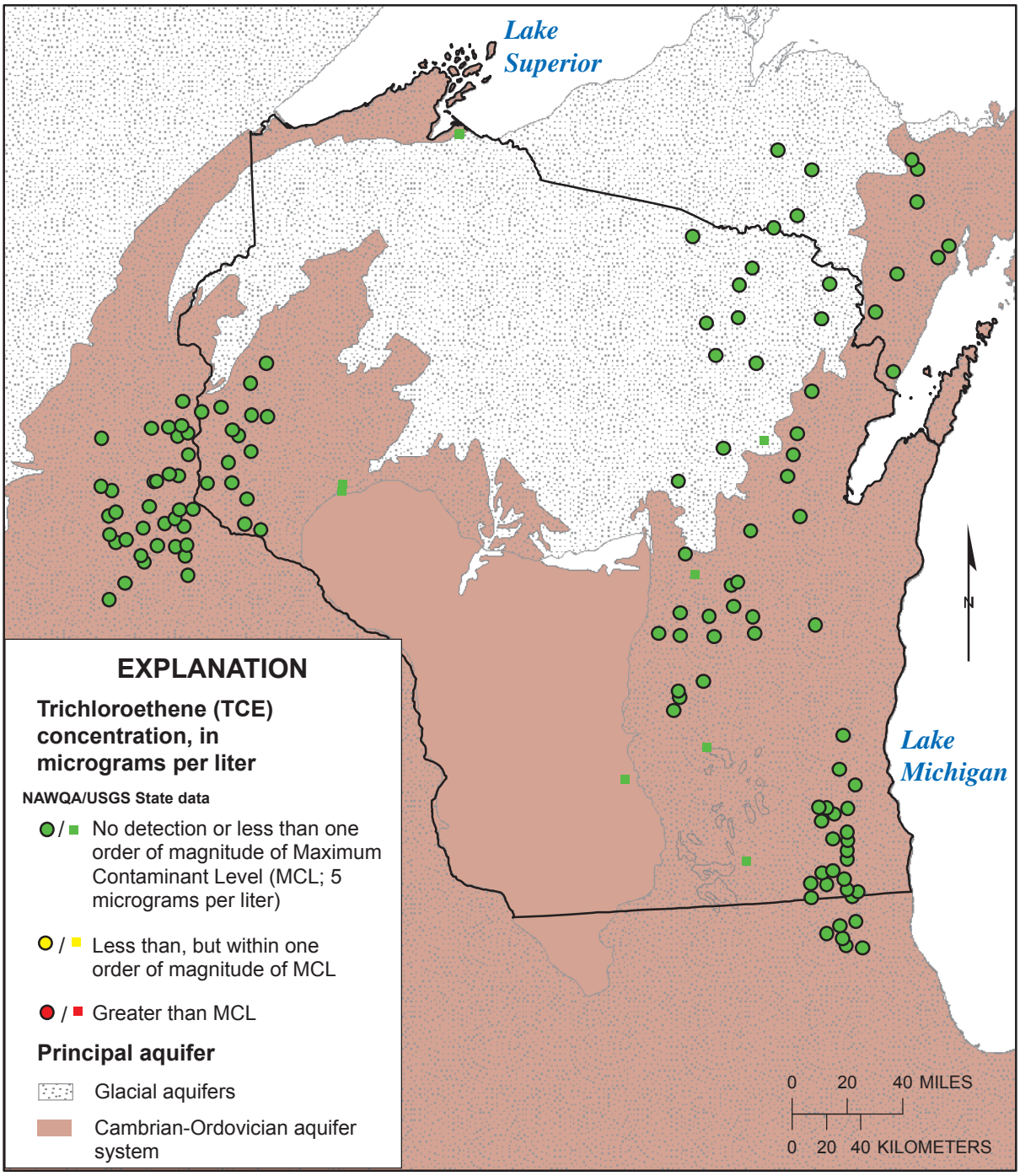
Figure WI13. Concentration of radon in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

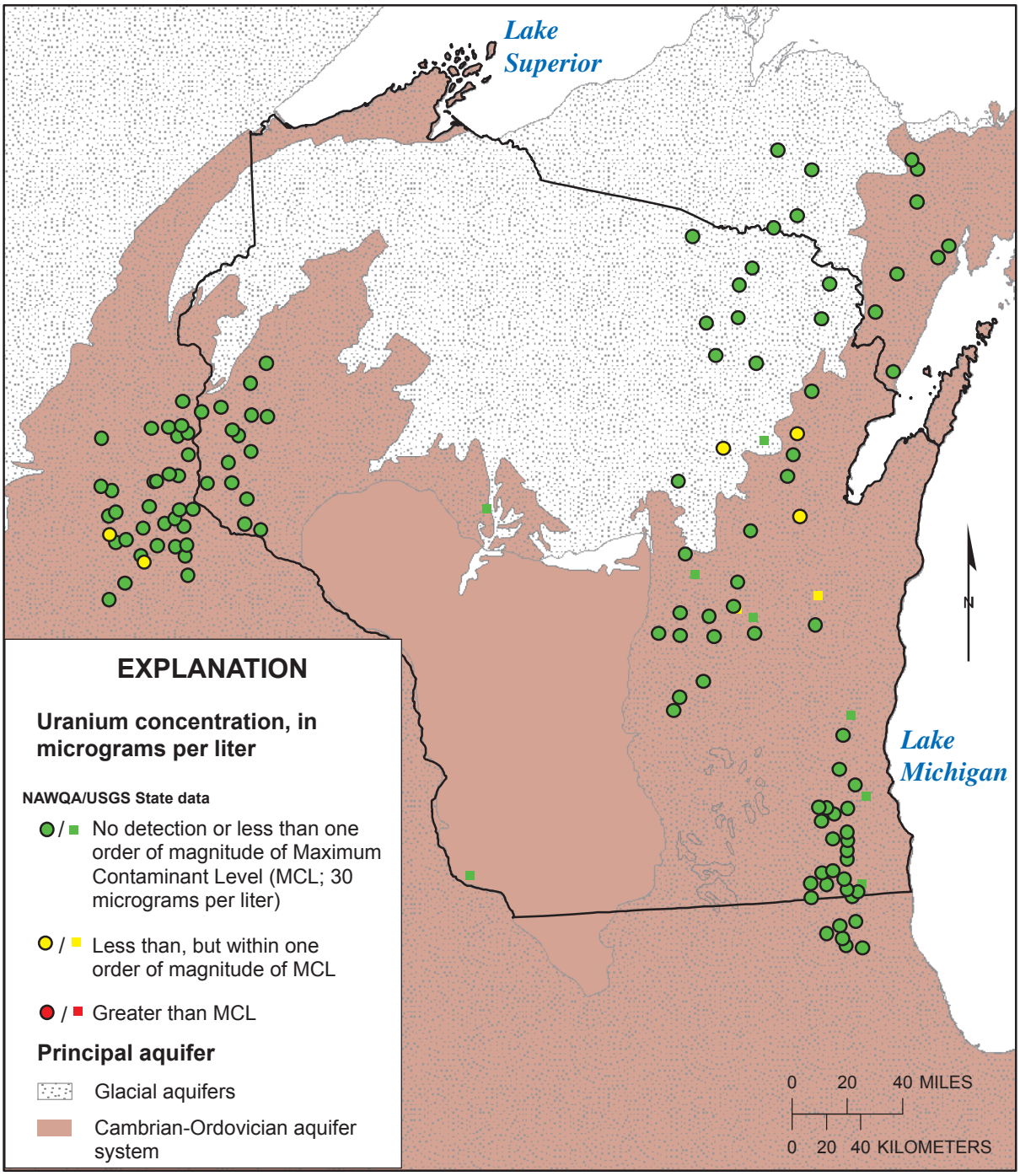
Figure WI14. Concentration of strontium in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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 WI15. Concentration of trichloroethene (TCE) in samples from domestic wells in Wisconsin and nearby States (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 WI16. Concentration of uranium in samples from domestic wells in Wisconsin and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).