State Summary for New Jersey

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 New Jersey is shown in figures NJ1–NJ16. The percentage of samples greater than U.S. Environmental Protection Agency (USEPA) human-health benchmarks for National Water-Quality Assessment (NAWQA) Program major-aquifer studies that included New Jersey and had at least 10 samples is given in table NJ1. The areal extent of some NAWQA major-aquifer studies goes beyond the State boundary (fig. NJ4). 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 New Jersey studies that are relevant to the 11 contaminants.

In New Jersey, the largest areas with the highest population density are located along the northeastern and southwestern parts of the State (fig. NJ1). About 40 percent of the domestic (private) and public drinking-water supply in New Jersey is obtained from ground water. The population (by census-block group for 1990) using a domestic-water supply from ground water was greatest in the northwestern and southeastern parts of the State (fig. NJ2). Although New Jersey is a heavily populated State, it also contains agricultural and forest lands. Most of the agricultural areas are located in the western part of New Jersey (fig. NJ3).

Seven major-aquifer studies were conducted in five principal aquifers (Northern Atlantic Coastal Plain aquifer system, Early Mesozoic basin aquifers, New York/New England crystalline-rock aquifers, Valley and Ridge aquifers, and glacial aquifers) in New Jersey (fig. NJ4). The Northern Atlantic Coastal Plain aquifer system is located in the southern and eastern part of New Jersey and consists of six regional aquifers in sedimentary deposits that extend from the coast of New Jersey south to the North Carolina-South Carolina State line (Trapp and Horn, 1997). The northern

Table NJ1. 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 New Jersey 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
delrsus3	Glacial aquifers	Radon	12	[1]100/0.0
delrsus1	Early Mesozoic basin aquifers	Radon	25	[1]100/8.0
delrsus2	Valley and Ridge aquifers	Radon	27	[1]89/14.8
linjsus1	New York/New England crystalline-rock aquifers	Radon	27	[1]85/18.5
podlsus2	Northern Atlantic Coastal Plain aquifer system	Radon	15	[1]13/0.0
linjsus3	Early Mesozoic basin aquifers	Arsenic	22	9.1
delrsus1	Early Mesozoic basin aquifers	Arsenic	25	8.0
linjsus1	New York/New England crystalline-rock aquifers	Arsenic	29	3.4
delrsus3	Glacial aquifers	Manganese	12	8.3
linjsus3	Early Mesozoic basin aquifers	Manganese	22	4.5
delrsus2	Valley and Ridge aquifers	Nitrite plus nitrate	27	7.4
linjsus2	Northern Atlantic Coastal Plain aquifer system	Nitrite plus nitrate	30	6.7
podlsus2	Northern Atlantic Coastal Plain aquifer system	Nitrite plus nitrate	16	6.3
linjsus3	Early Mesozoic basin aquifers	Trichloroethene (TCE)	22	4.5
linjsus1	New York/New England crystalline-rock aquifers	Uranium	29	3.4

[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).

part of the Northern Atlantic Coastal Plain aquifer system is underlain by a wedge-shaped mass of semi-consolidated to unconsolidated sediments that thickens toward the ocean and rests on crystalline rock. The thickness of the sediments at the New Jersey coastline is about 4,000 feet. Sand, gravel, and limestone compose aquifers of varying extent, some traceable over long distances, whereas others are local. The aquifers are separated by confining units of clay, silt, and silty or clayey sand, but some water can leak between units and therefore, some are hydraulically interconnected to some degree (Trapp and Horn, 1997).

The Early Mesozoic basin aquifers (known locally as Piedmont Mesozoic basin aquifers) consist of lowland areas underlain by carbonate rocks (limestone, dolomite, and marble) and by clastic sedimentary rocks and are located in the northeastern part of New Jersey. Locally, the Early Mesozoic basins aquifers contain bodies of igneous rocks, such as basalt flows and diabase dikes and sills (Trapp and Horn, 1997). The rocks include beds of sandstone, arkose, and conglomerate that originally had considerable effective porosity between grains, but after compaction and cementation, are now poorly interconnected so only a small amount of water moves between pores. Ground water moves primarily along joints, fractures, and bedding plains and is more or less continuous in each aquifer, but the hydraulic connection across confining units between individual aquifers is poor (Trapp and Horn, 1997).

New York/New England crystalline-rock aquifers in New Jersey consist mostly of metamorphic and intrusive igneous rocks; however, some undifferentiated sedimentary rock aquifers also occur and consist of tightly cemented clastic rocks that grade into metamorphic rocks. These aquifers extend from north-central New Jersey into the northern New England States. The regolith and fractures in the bedrock serve as the primary areas of storage and transmission of water, and ground-water movement generally is along short flow paths from inter-stream recharge areas to the nearest stream (Trapp and Horn, 1997).

The Valley and Ridge aquifers occur in the northwestern part of New Jersey and consist of permeable rocks of primarily sandstone, shale, and carbonates within a sequence of folded and faulted sedimentary formations of Paleozoic age (Trapp and Horn, 1997). A thick sequence of carbonate rocks contains the most productive aquifers with yields as much as 850 gallons per minute for some wells.

Several glacial aquifers are near the land surface in the northern part of New Jersey; these aquifers are contained in unconsolidated sand and gravel deposits of Quaternary age. Most of the individual aquifers that compose the system are not hydraulically connected, and were formed mostly from sediments deposited by continental glaciers or by meltwater from glaciers, or from alluvium in valleys of major streams (Trapp and Horn, 1997). Most of the productive aquifers contain water under mostly unconfined conditions; however, many places in New Jersey have fine-grained glacial-lake sediments that overlie coarse-grained sediments that create confined conditions. Well yields are quite variable in the glacial systems because of variable thicknesses, coarseness of material, and the extent of the deposits. The glacial aquifers in New Jersey consist of fill material in bedrock valleys, and yields in large diameter wells can range from 130 to 800 gallons per minute (Trapp and Horn, 1997).

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. NJ5) 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, manganese, nitrate, TCE, and uranium had concentrations greater than USEPA human-health benchmarks (table NJ1). 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). More than 85 percent of samples from four major-aquifer studies (glacial aquifers, Early Mesozoic basin aquifers, Valley and Ridge aquifers, and New York/New England crystalline-rock aquifers) had radon concentrations greater than 300 pCi/L (table NJ1), which is the proposed Maximum Contaminant Level (MCL) for radon. Median radon concentrations were largest in three major-aquifer studies (fig. NJ5; delrsus1, delrsus2, and linjsus1) in the Early Mesozoic basin aquifers, Valley and Ridge aquifers, and the New York/New England crystalline-rock aquifers; concentrations were greater than 4,000 pCi/L (alternative proposed MCL) in about 8, 15, and 19 percent of the samples from these three principal aquifers, respectively. The largest radon concentrations were in the northern part of New Jersey (fig. NJ13). NAWQA data showed radon concentrations to be greater than 300 pCi/L in most of the samples collected in all the principal aquifers except the Northern Atlantic Coastal Plain aquifer system (table NJ1, fig. NJ13); however, only minimal sampling was done in the Northern Atlantic Coastal Plain aquifer system. U.S. Geological Survey (USGS) State data showed a similar distribution of radon concentrations, and because a lot of additional sampling was done in the Northern Atlantic Coastal Plain aquifer system, additional concentrations greater than 300 pCi/L were detected in that aquifer system; however, median concentrations were still much lower than in the other principal aquifers in New Jersey (fig. NJ5). Radon-222 is a decay product of radium-226, and concentrations of radon greater than the human-health benchmark are widespread and can be attributed to natural sources in the soil and rock material in New Jersey.

Arsenic had the next largest potential concern to human health. Nearly 10 percent of the samples in two major-aquifer studies (linjsus3 and delrsus1) in the Early Mesozoic basin aquifers had concentrations greater than the human-health benchmark (MCL of 10 micrograms per liter (µg/L) (table NJ1). Median arsenic concentrations in the Early Mesozoic basin aquifers were greater than median arsenic concentrations in the other principal aquifers in New Jersey, with the exception of the New York/New England crystalline-rock aquifers (fig. NJ5). One sample (about 3 percent) from the linjsus1 major-aquifer study in the New York/New England crystalline-rock aquifers had an arsenic concentration greater than the human-health benchmark (table NJ1), but concentrations in most of the other samples from this principal aquifer were much smaller, which may indicate that this one value was a spurious data point (fig. NJ5). USGS State data also showed arsenic concentrations to be greater than the human-health benchmark in the same general areas (fig. NJ6). These concentrations of arsenic greater than the human-health benchmark appear coincident with agricultural land use, and many people could be using domestic-water supplies in this area on the basis of water-use data.

The manganese concentration in one sample (about 4 percent) from the linjsus3 major-aquifer study in the Early Mesozoic Basin aquifers was greater than the human-health benchmark (Lifetime Health Advisory (HA) of 300 µg/L) (table NJ1, fig. NJ10). The manganese concentration in one sample (about 8 percent) from the delrsus3 major-aquifer study in the glacial aquifers also was greater than the human-health benchmark, but this sample was located in Pennsylvania. USGS State data also showed manganese concentrations to be greater than the human-health benchmark in the same general area and in the western part of the Northern Atlantic Coastal Plain aquifer system (fig. NJ10).

Nitrate concentrations were greater than the human-health benchmark (MCL of 10 milligrams per liter (mg/L) as N) in more than 5 percent of the samples from the Valley and Ridge aquifers (delrsus2) and Northern Atlantic Coastal Plain aquifers (linjsus2 and podlsus2) (table NJ1). NAWQA data showed that most nitrate concentrations in the Northern Atlantic Coastal Plain aquifer system in southwestern New Jersey were greater than or within an order of magnitude of the human-health benchmark (fig. NJ11). USGS State data also showed this area in addition to an area in central New Jersey to have most nitrate concentrations greater than or within an order of magnitude of the human-health benchmark, but the geographic extent is better defined (fig. NJ11). The nitrate concentrations greater than the human-health benchmark appear coincident with agricultural land use where people tend to rely more on self-supplied domestic wells.

The TCE concentration in one sample (about 4 percent) from the linjsus3 major-aquifer study in the Early Mesozoic Basin aquifers was greater than the human-health benchmark, which is the MCL of 5 µg/L (table NJ1, fig. NJ15). USGS State data showed one TCE concentration to be greater than the human-health benchmark in the Northern Atlantic Coastal Plain aquifer system (fig. NJ15).

The uranium concentration in one sample (about 3 percent) collected from the linjsus1 major-aquifer study in the New York/New England crystalline-rock aquifers was greater than the human-health benchmark, which is the MCL of 30 µg/L (table NJ1, fig. NJ16). USGS State data also showed uranium concentrations less than but within an order of magnitude of the human-health benchmark in the same general area and in the southern part of the Early Mesozoic basin aquifers (fig. NJ16). These uranium concentrations of concern are coincident with aquifer rock type and probably are related to uranium-bearing minerals present in the bedrock.

NAWQA data did not show any PCE concentrations to be greater than the human-health benchmark (MCL of 5 µg/L); however, one sample from USGS State data set had a concentration greater than the human-health benchmark (fig. NJ12). No strontium concentrations in the NAWQA data set were greater than the human-health benchmark, but State data showed that 2 of the 451 samples had strontium concentrations greater than the human-health benchmark (HA of 4,000 µg/L) (fig. NJ14).

For the entire New Jersey data set, atrazine (fig. NJ7), benzene (fig. NJ8), and CIAT (fig. NJ9) 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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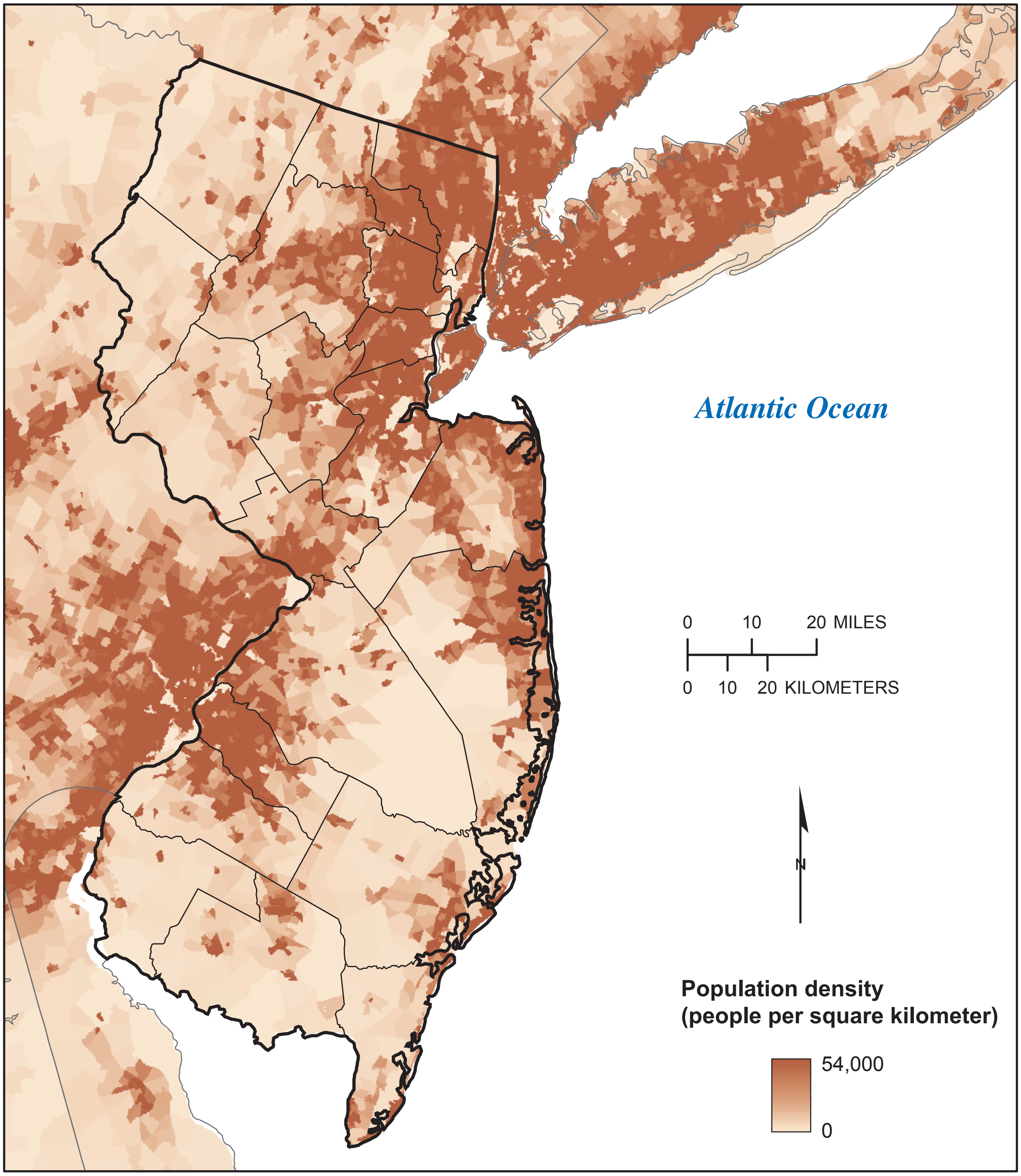

Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

Figure NJ1. Population density for New Jersey and nearby States. (Data from Hitt, 2003.)

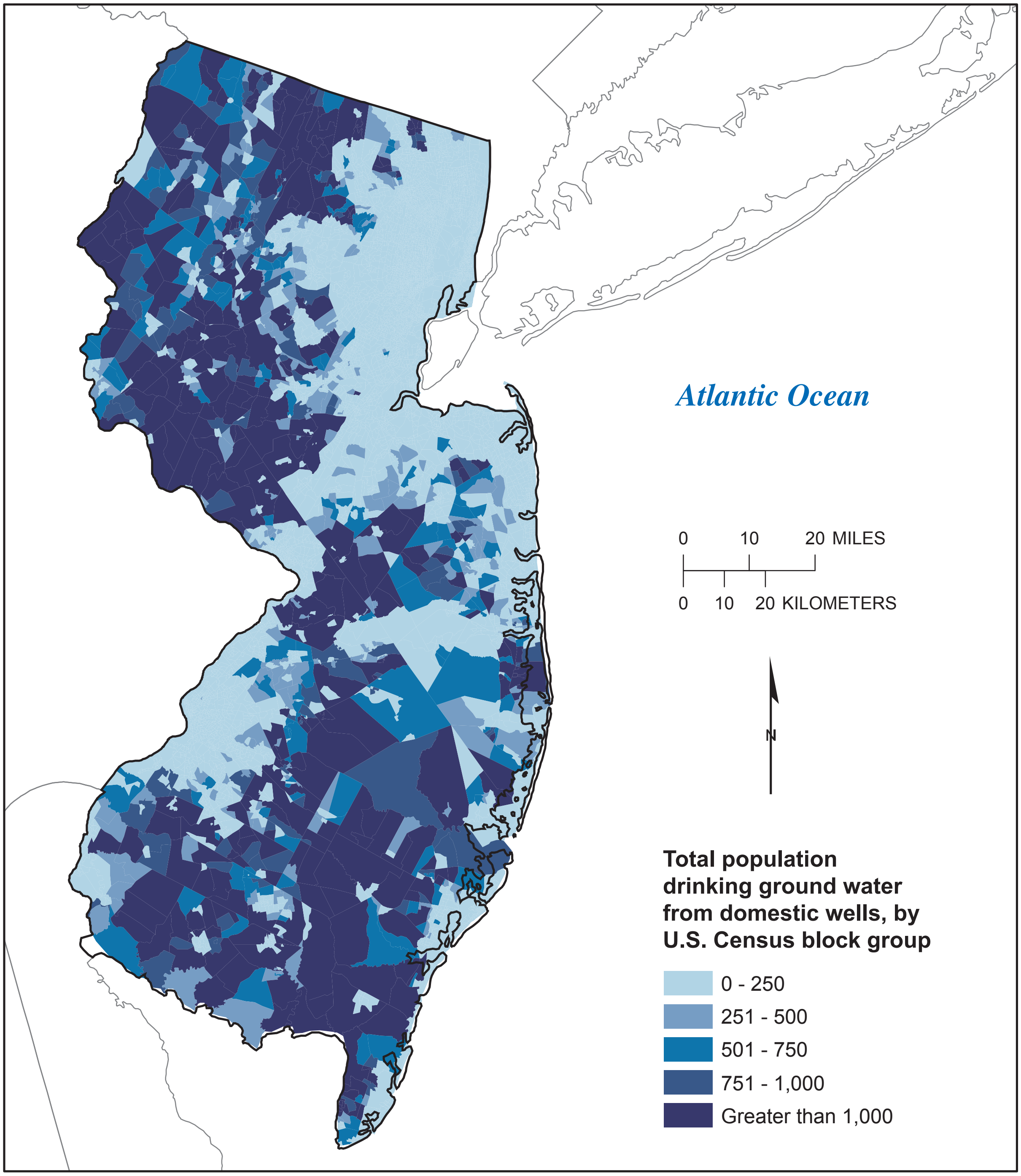

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Figure NJ2. Population using domestic-water supply (from ground water) for New Jersey. (Data from 1990 U.S. Census block group, Kerie Hitt, U.S. Geological Survey, written commun., 1997.)

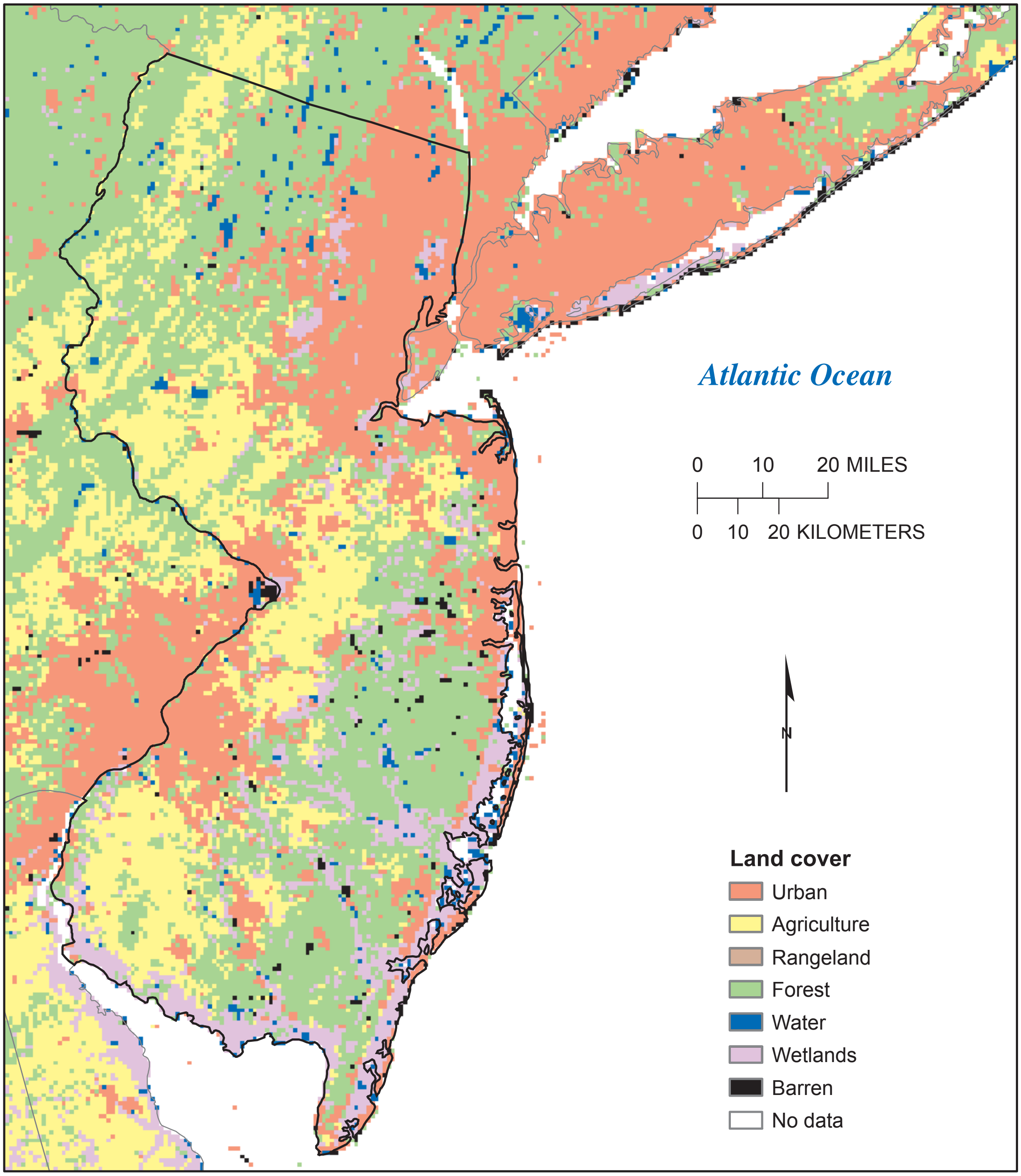

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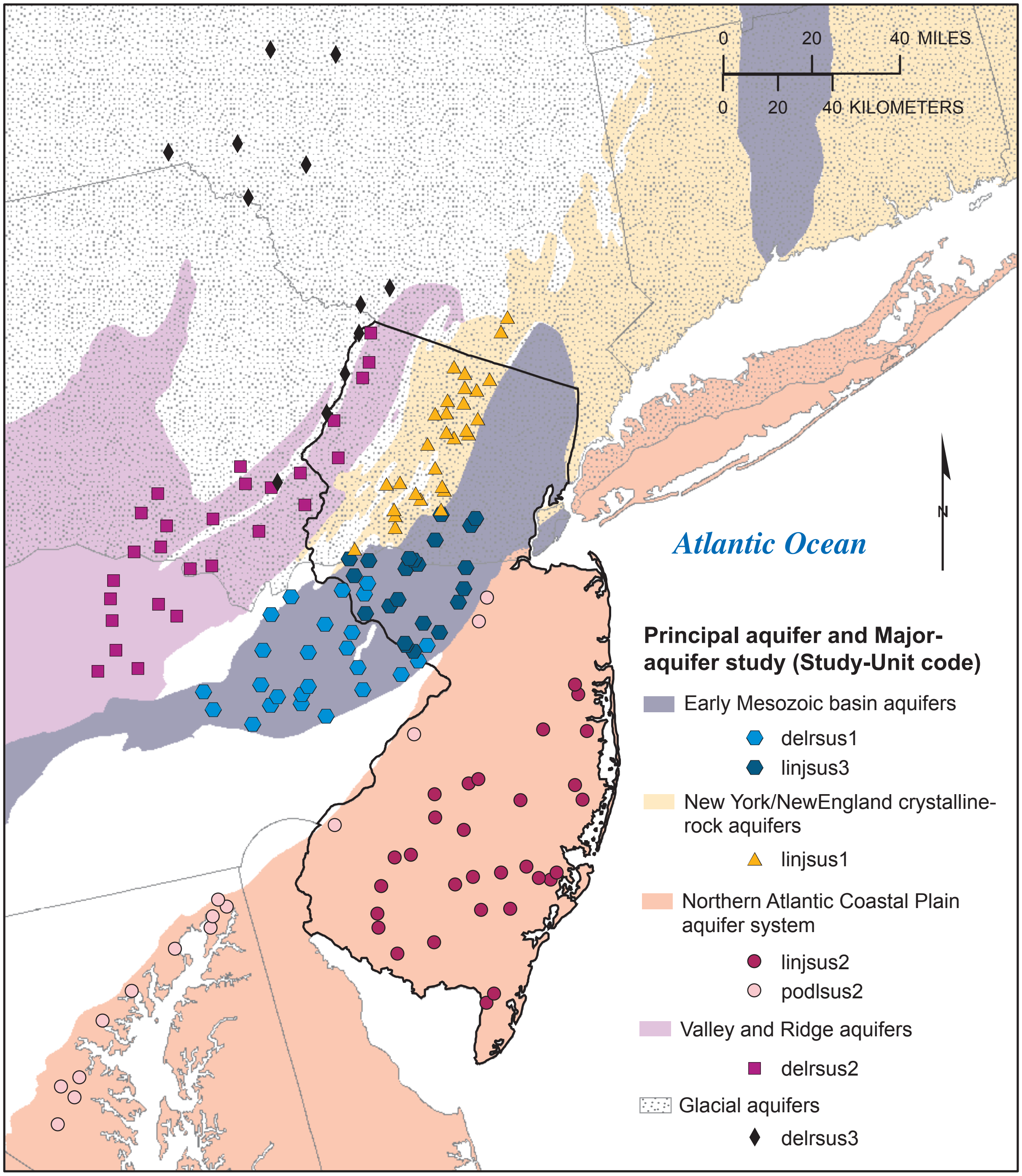
Figure NJ3. Land use/land cover for New Jersey and nearby States. (Data from Naomi Nakagaki, U.S. Geological Survey, written commun., 2005.)



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

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

Figure NJ4. Location of domestic wells sampled for National Water-Quality Assessment (NAWQA) major-aquifer studies that included New Jersey.

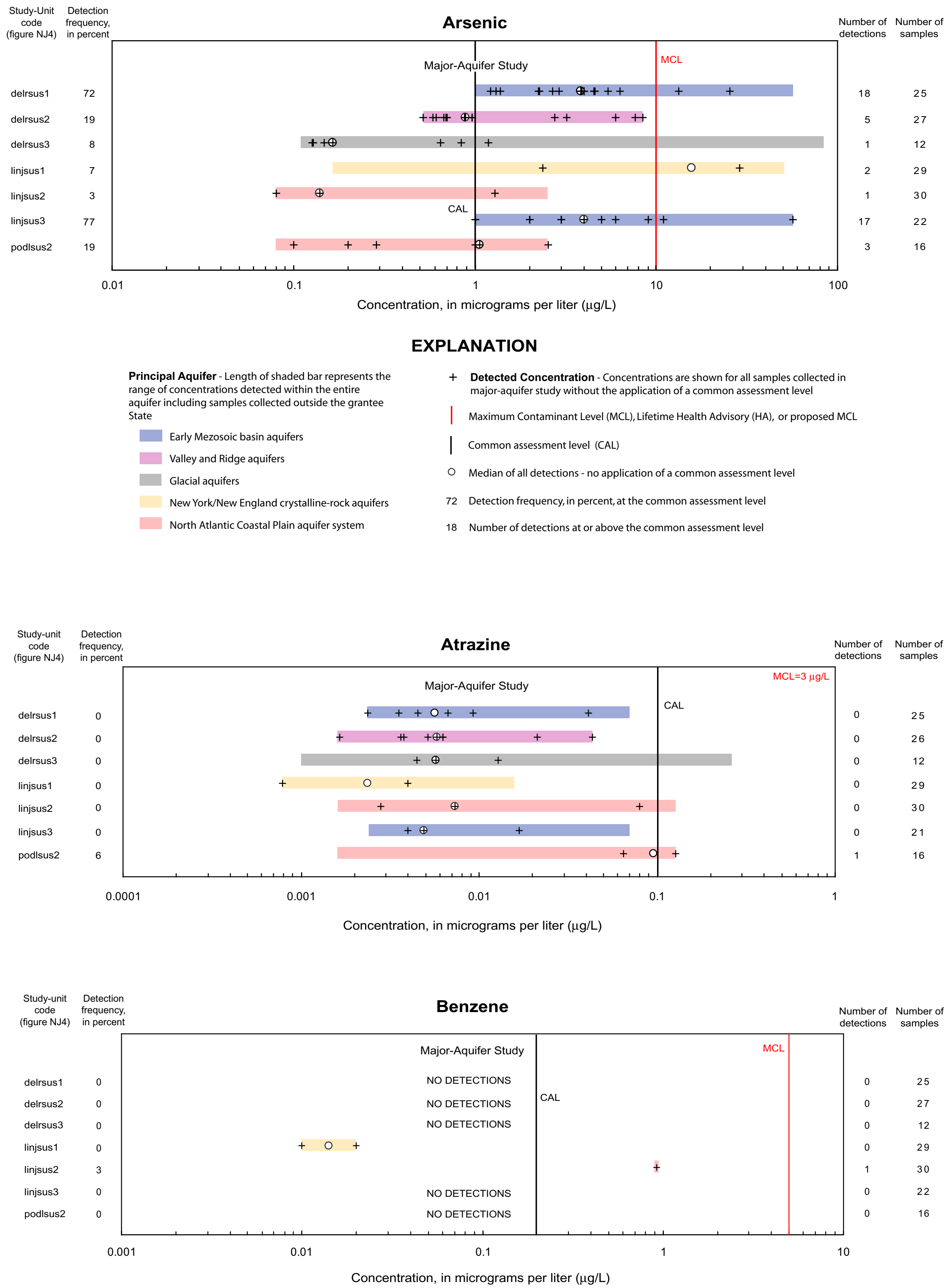
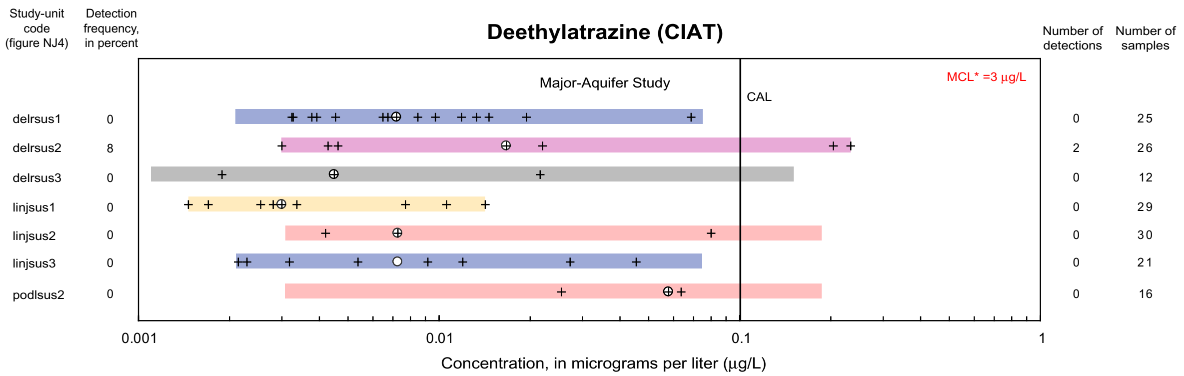
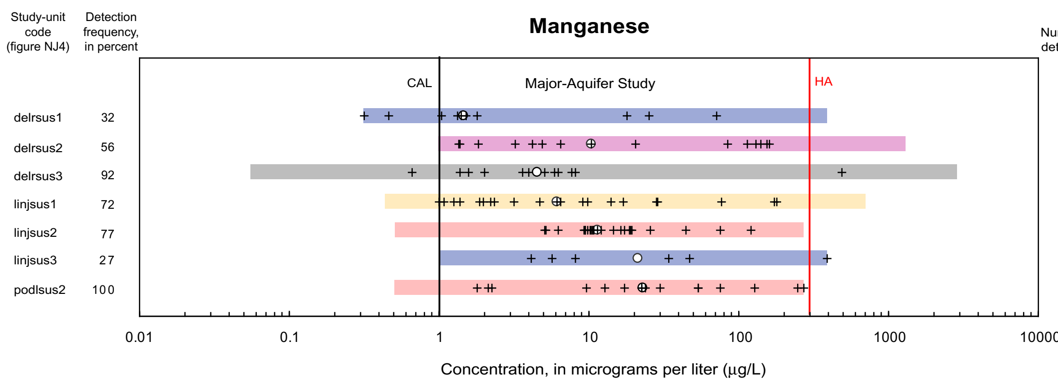
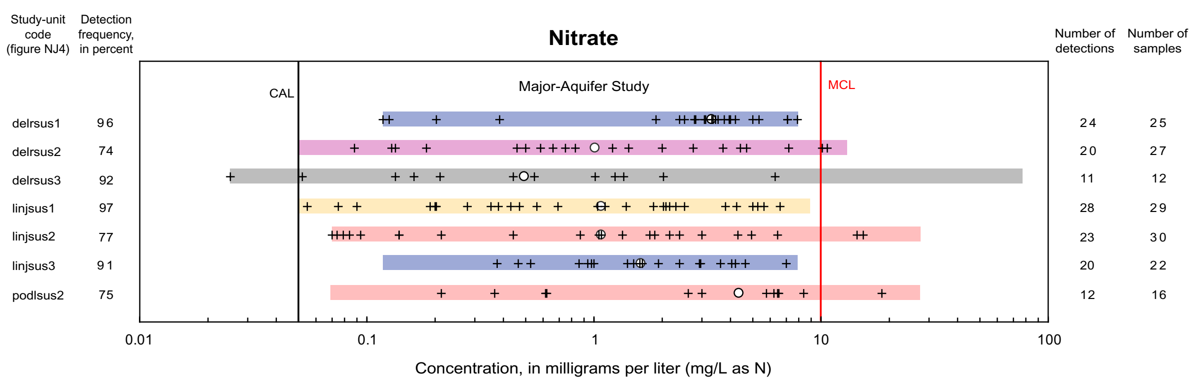


Figure NJ5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for New Jersey (includes studies for which at least 10 analyses were available).



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





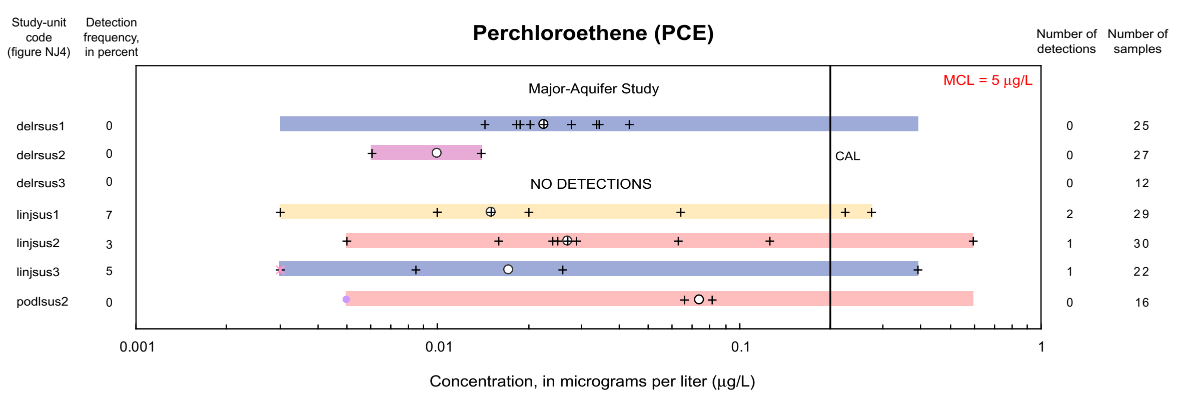


Figure NJ5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for New Jersey (includes studies for which at least 10 analyses were available). —Continued

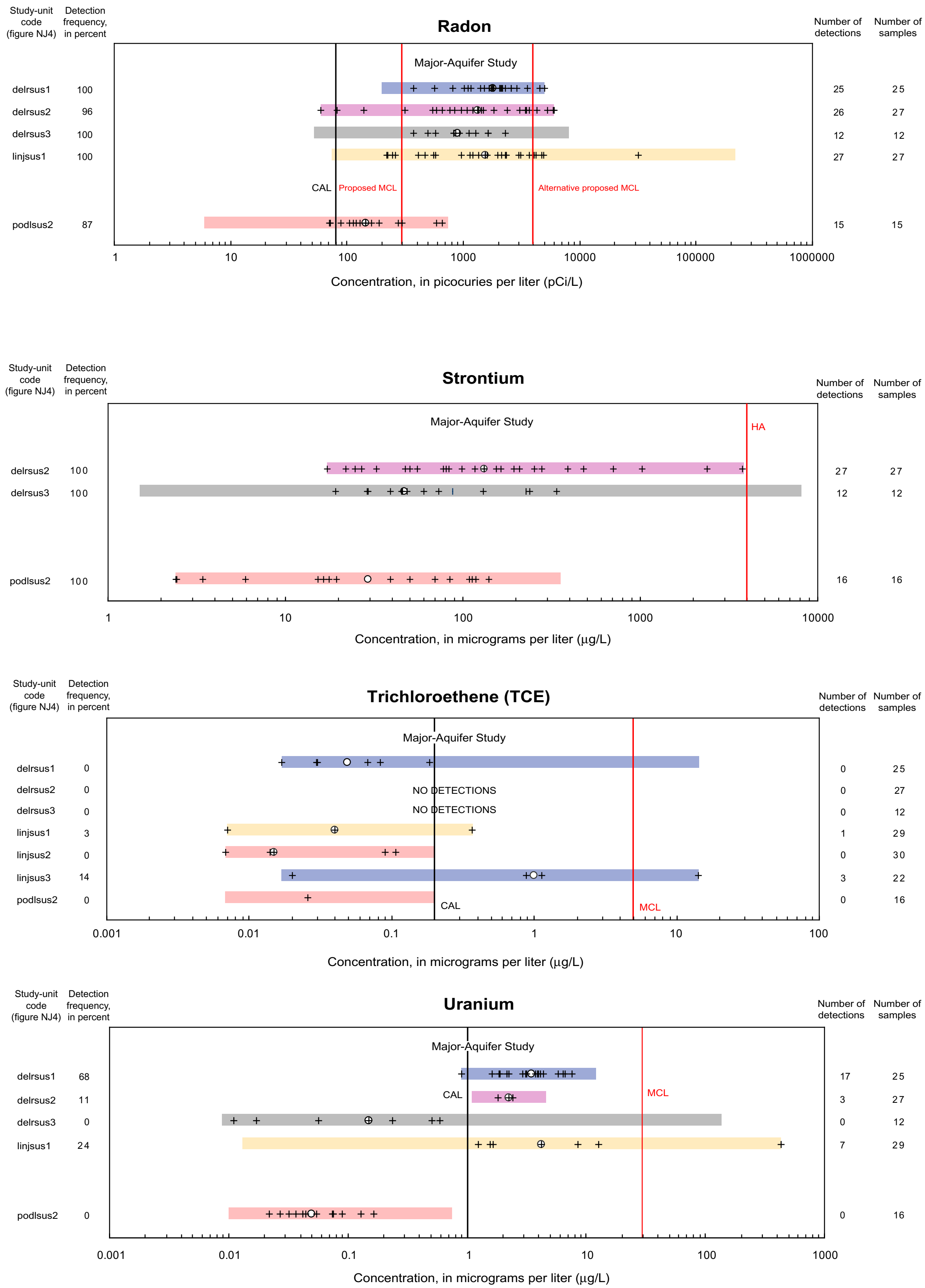
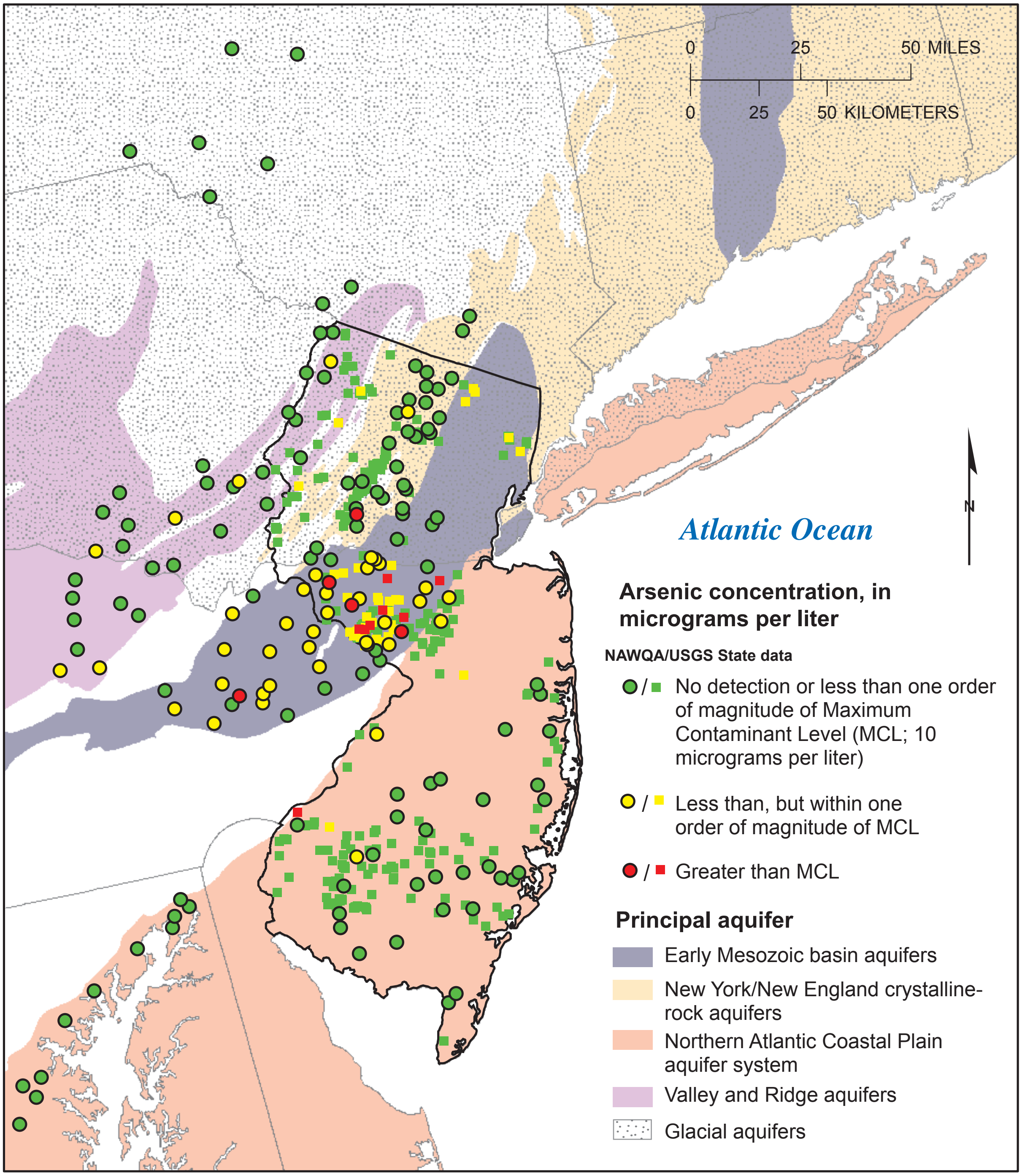


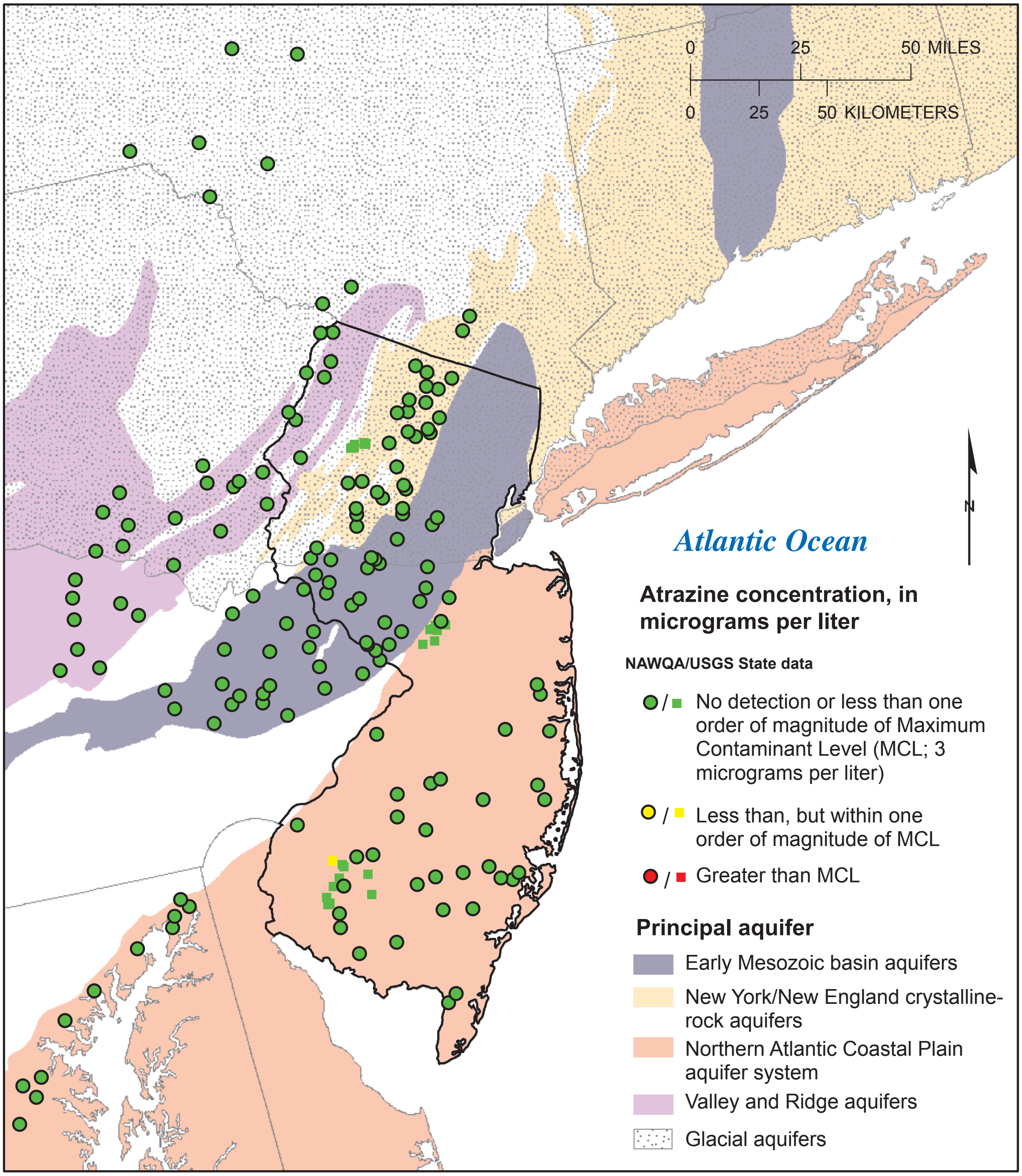
Figure NJ5. Statistical summary for 11 selected contaminants by major-aquifer study using domestic-well data from National Water-Quality Assessment (NAWQA) studies for New Jersey (includes studies for which at least 10 analyses were available). —Continued



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 NJ6. Concentration of arsenic in samples from domestic wells in New Jersey 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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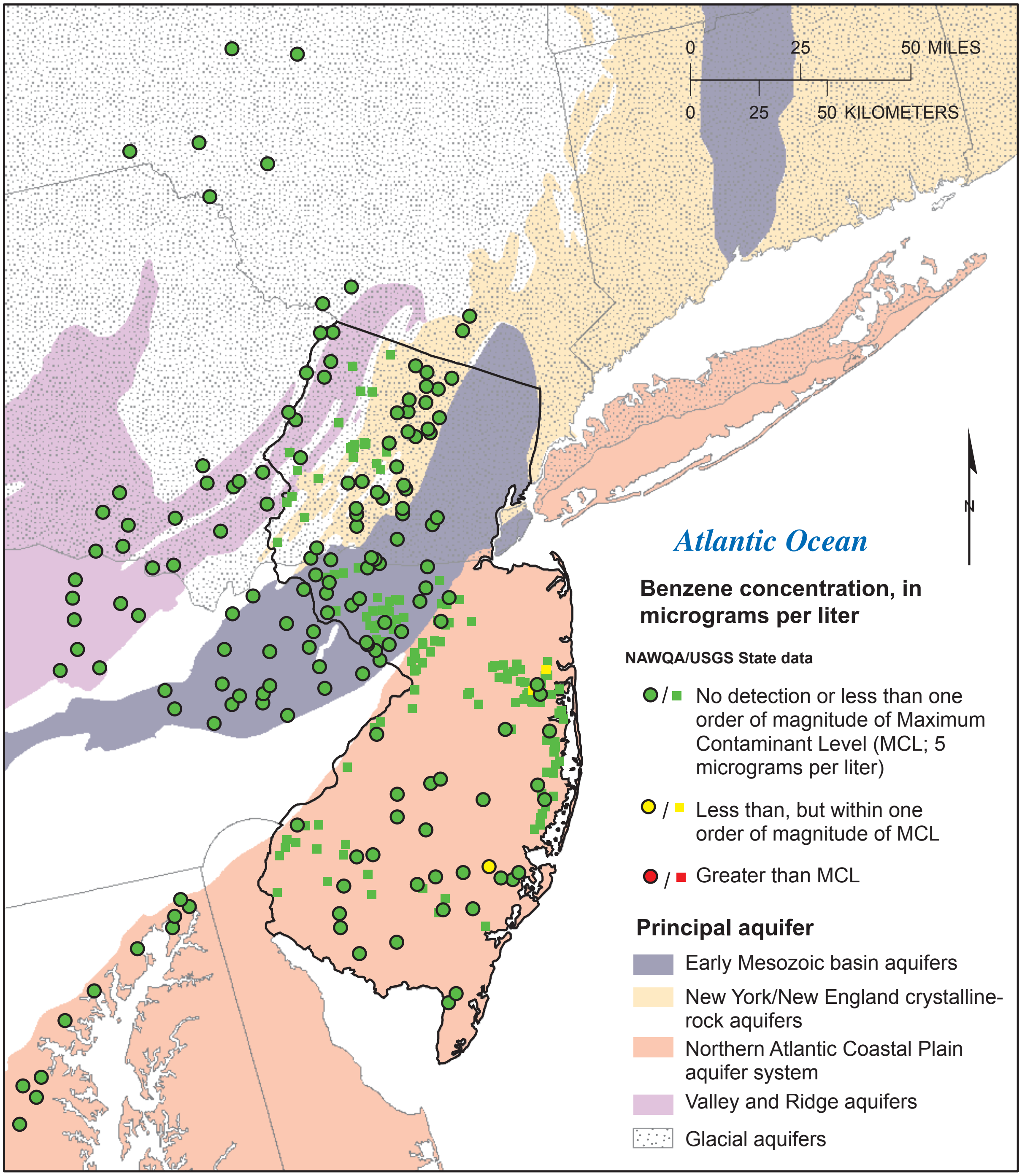
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

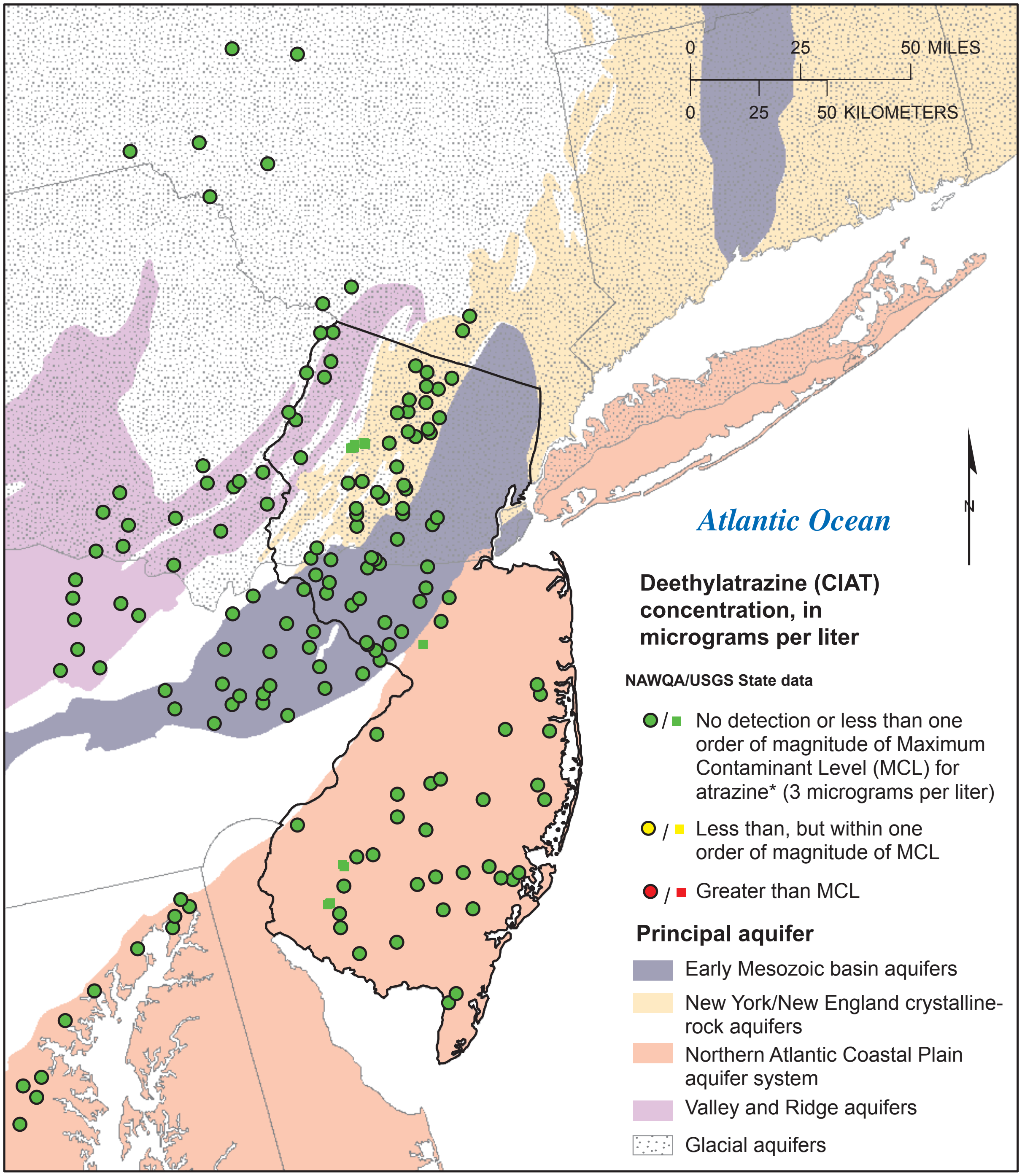
Figure NJ7. Concentration of atrazine in samples from domestic wells in New Jersey and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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 NJ8. Concentration of benzene in samples from domestic wells in New Jersey 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)).

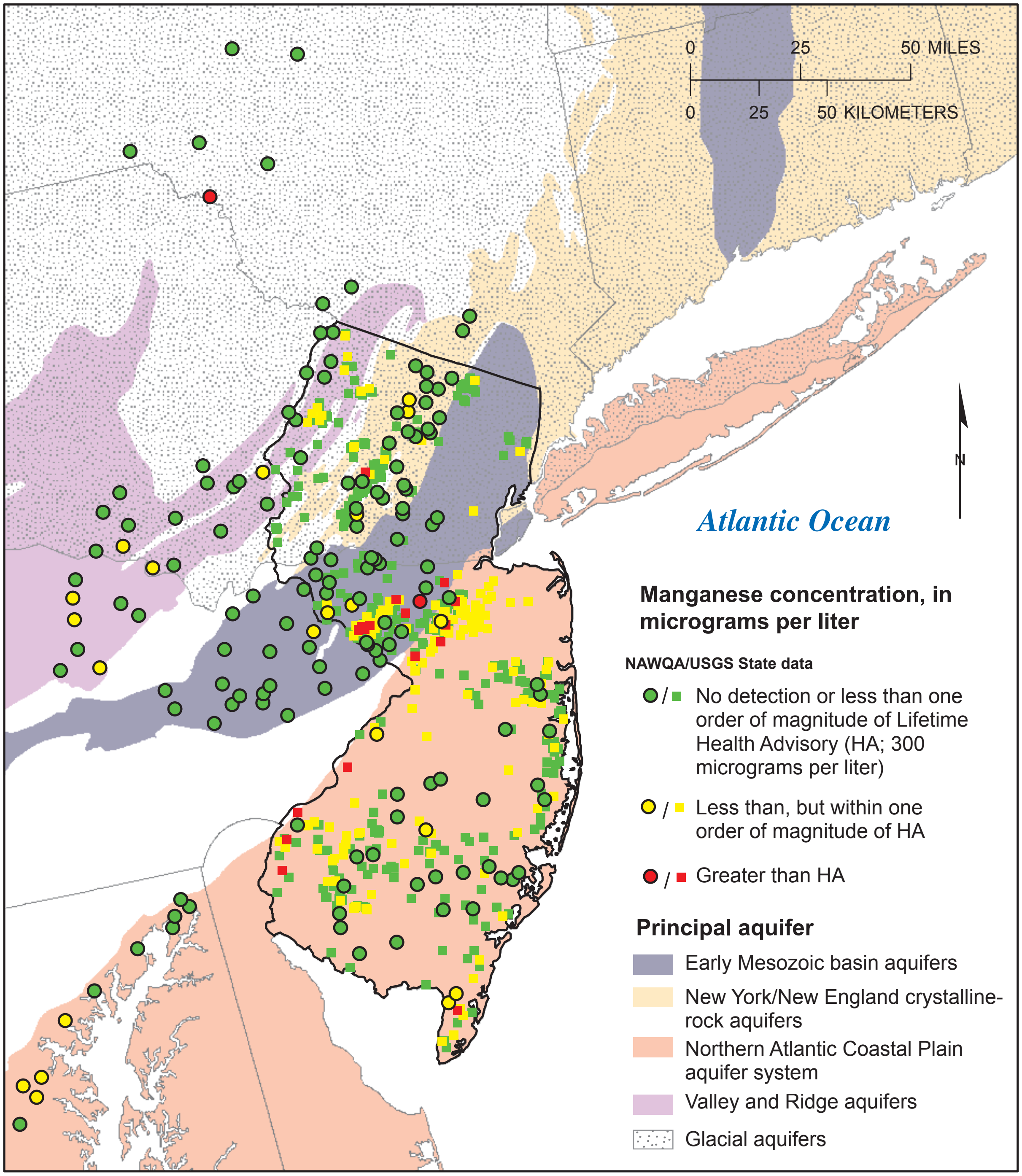


Base information from U.S. Geological Survey digital data, 1:2,000,000
Albers Equal-Area projection
Standard Parallels 29º30' and 45º30', central meridian -96º

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 NJ9. Concentration of deethylatrazine (CIAT) in samples from domestic wells in New Jersey 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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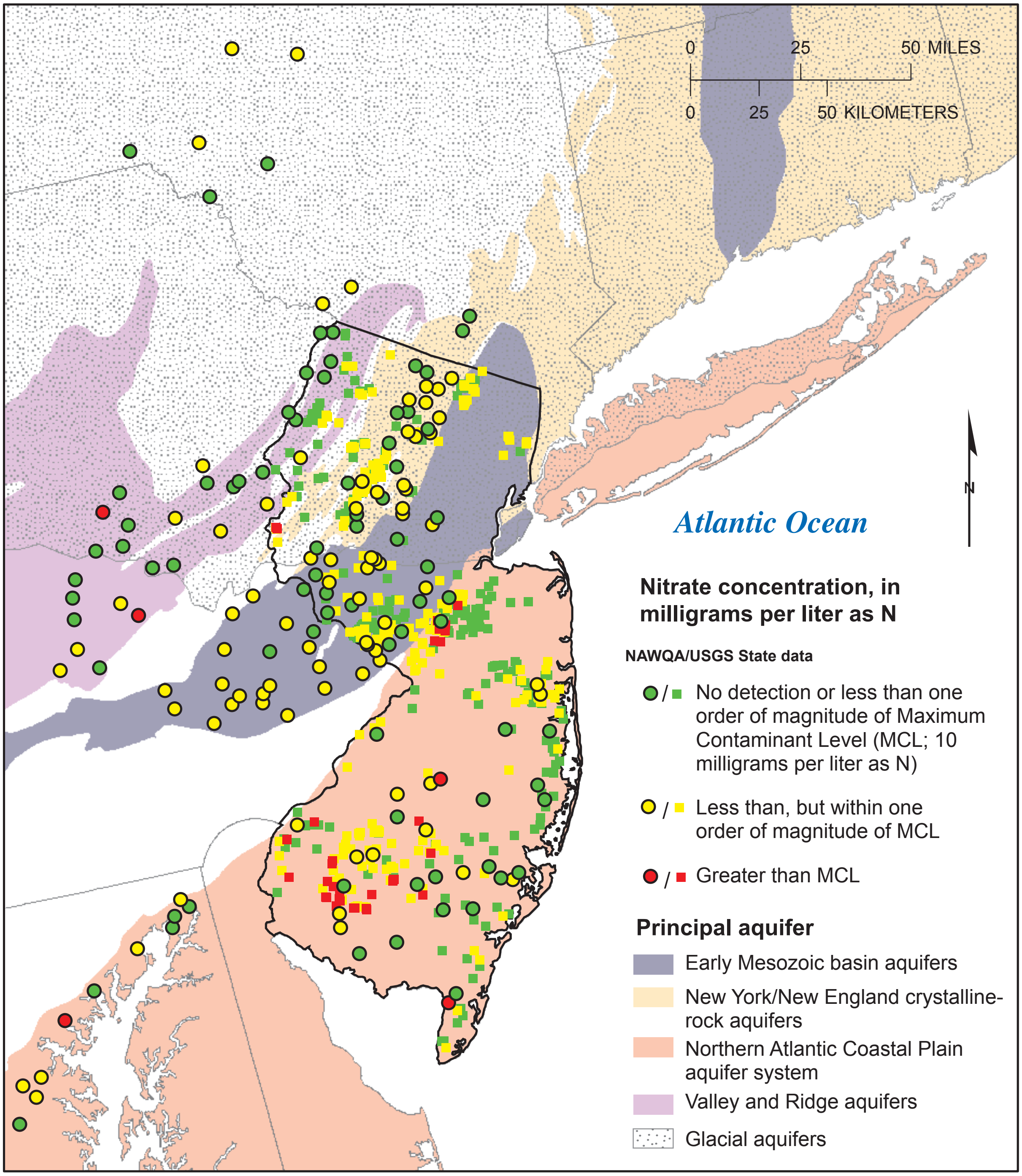
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

Figure NJ10. Concentration of manganese in samples from domestic wells in New Jersey 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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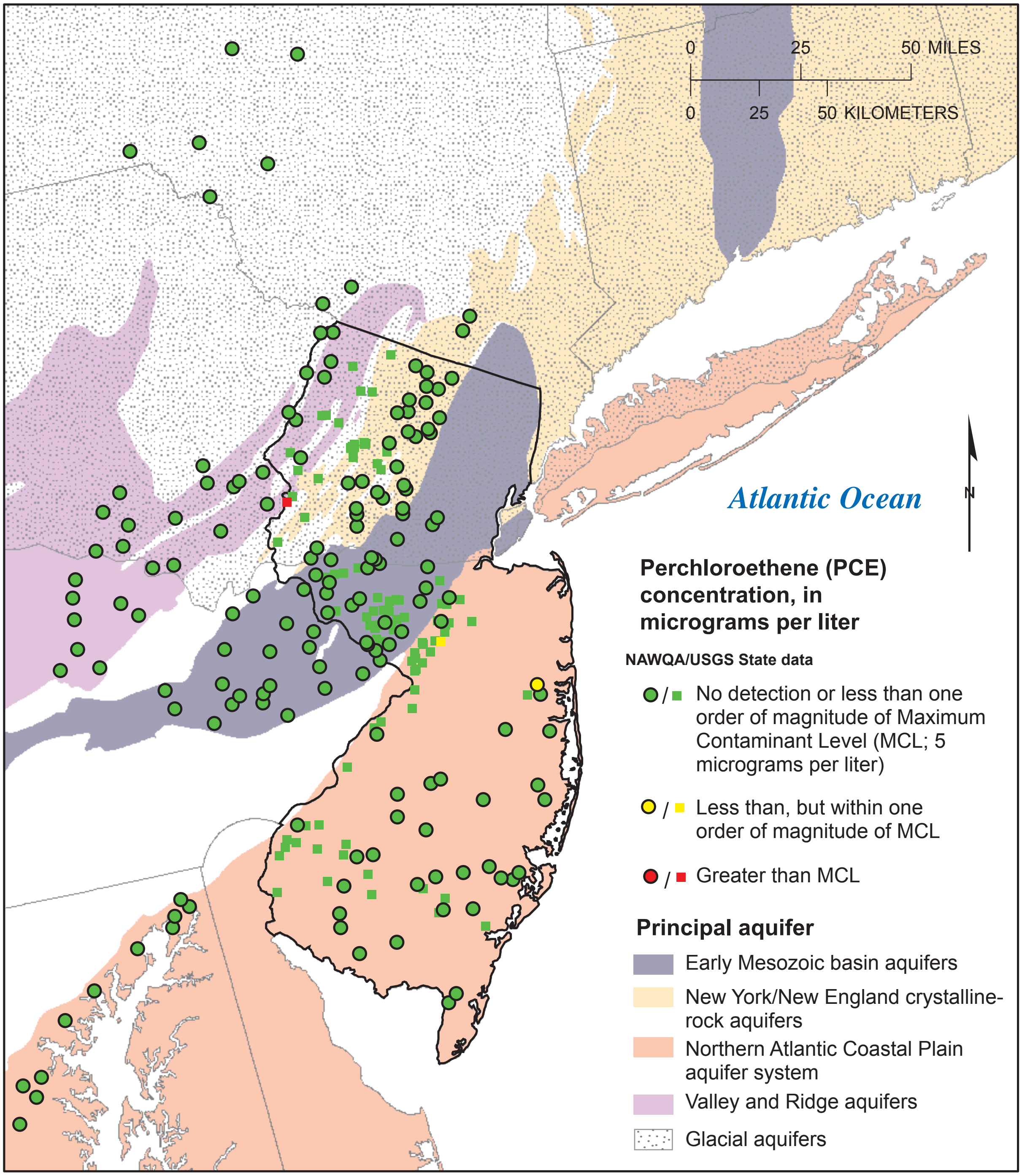
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian -96°

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

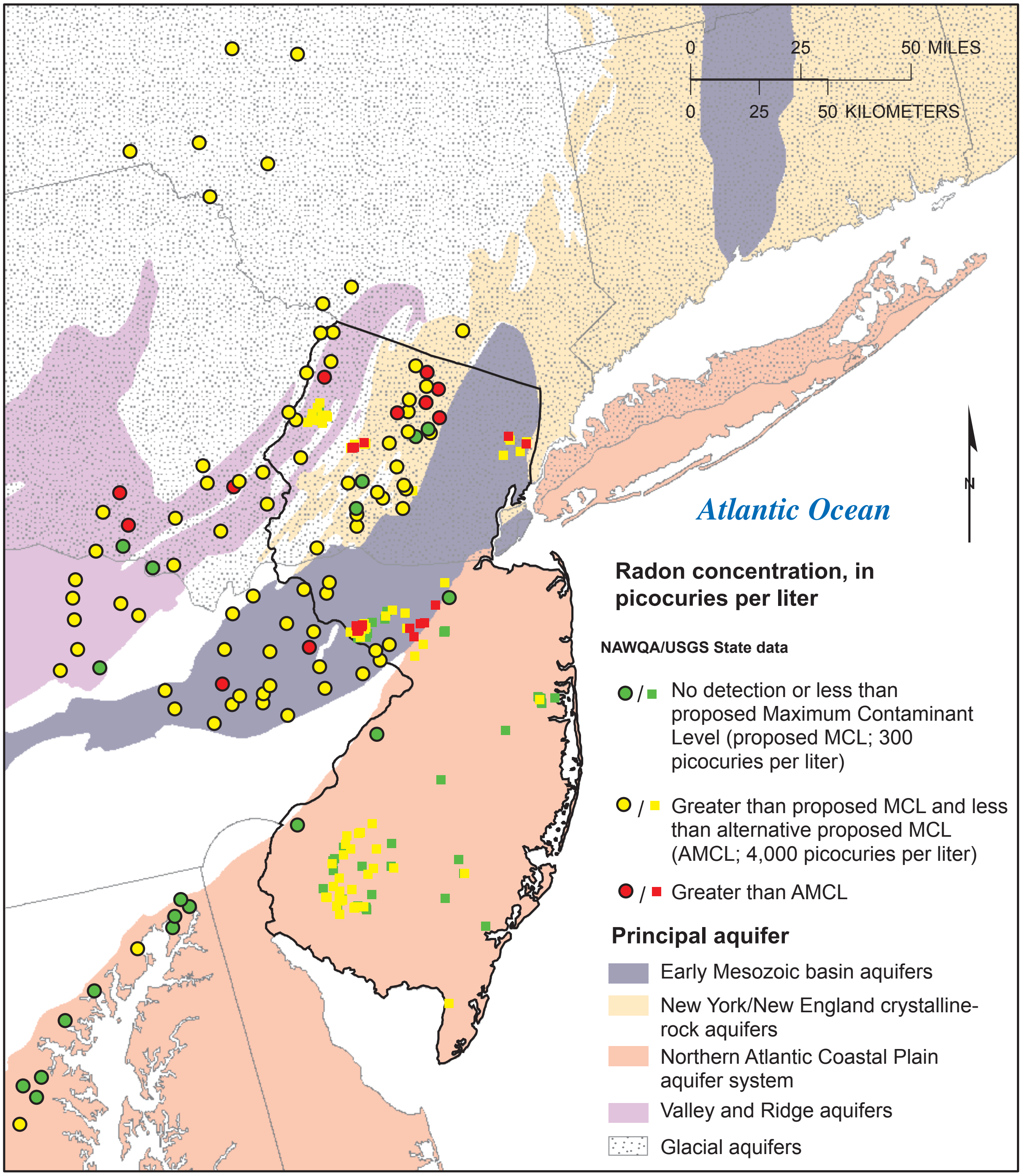
Figure NJ11. Concentration of nitrate in samples from domestic wells in New Jersey and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

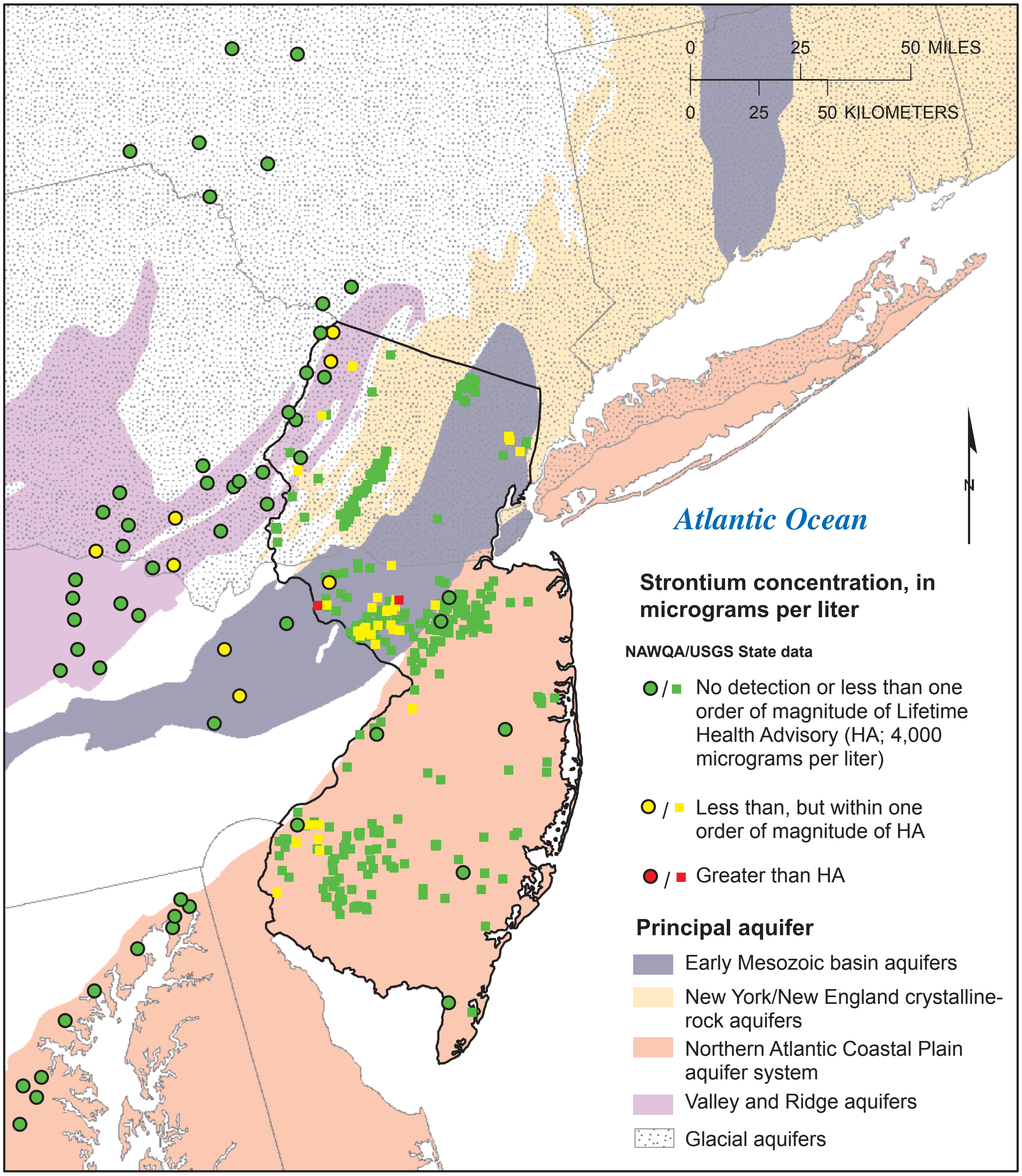
Figure NJ12. Concentration of perchloroethene (PCE) in samples from domestic wells in New Jersey and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

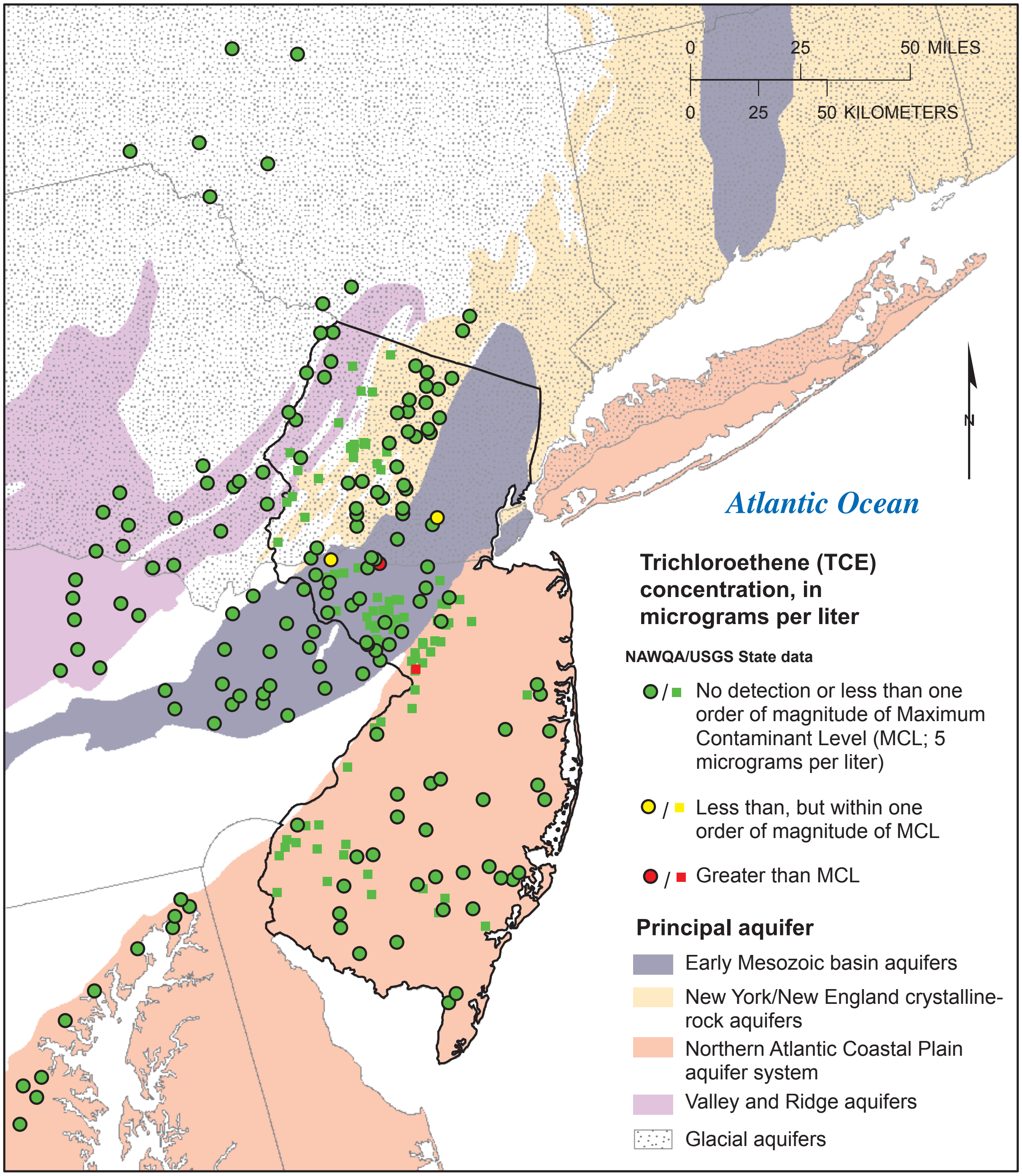
Figure NJ13. Concentration of radon in samples from domestic wells in New Jersey and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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

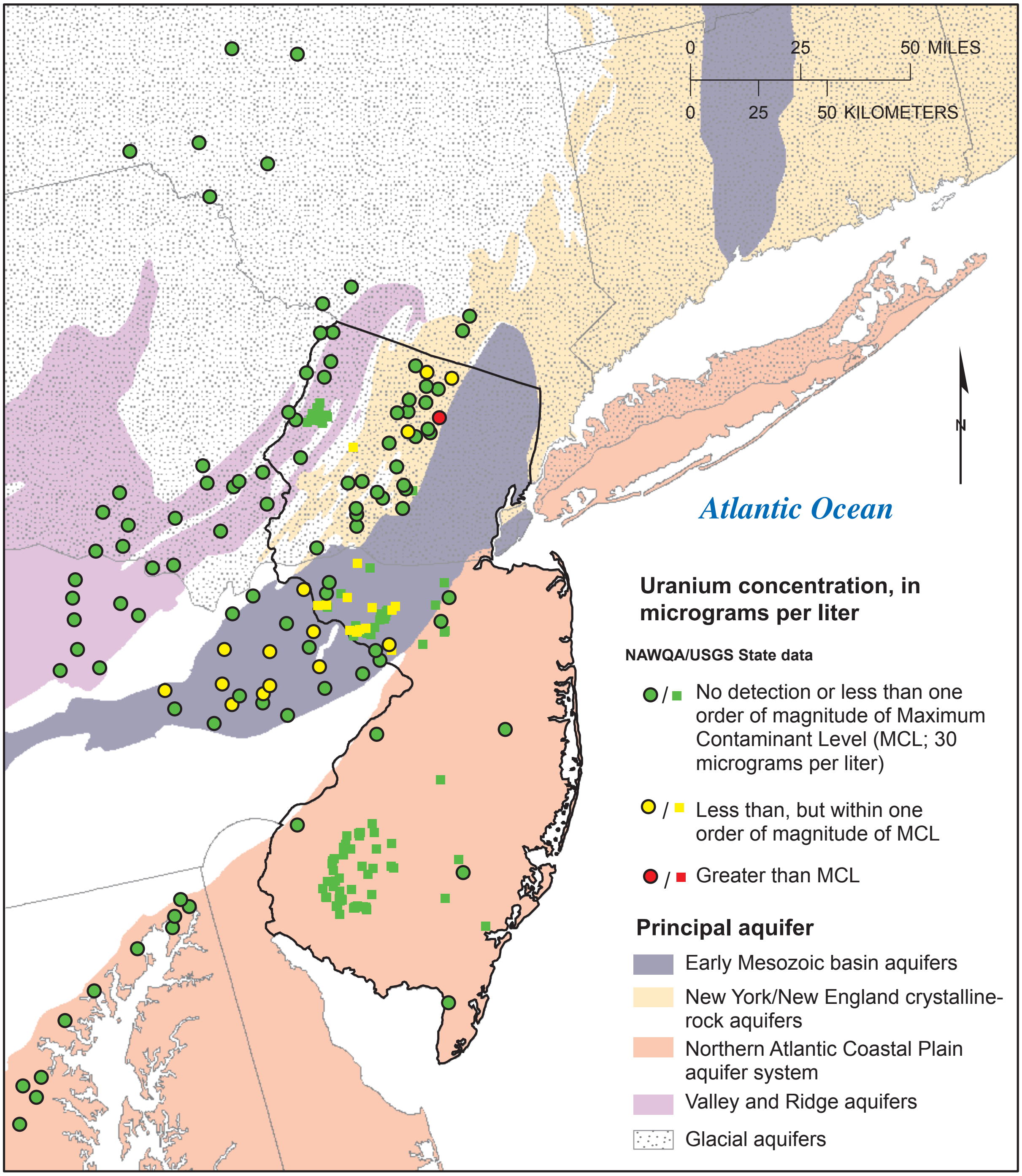
Figure NJ14. Concentration of strontium in samples from domestic wells in New Jersey and nearby States (from National Water-Quality Assessment (NAWQA) studies and U.S. Geological Survey (USGS) State data in the National Water Information System (NWIS)).



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 NJ15. Concentration of trichloroethene (TCE) in samples from domestic wells in New Jersey 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 NJ16. Concentration of uranium in samples from domestic wells in New Jersey 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)).