# A systematic approach to understanding nutrients and pesticides — National water-quality priorities and concerns

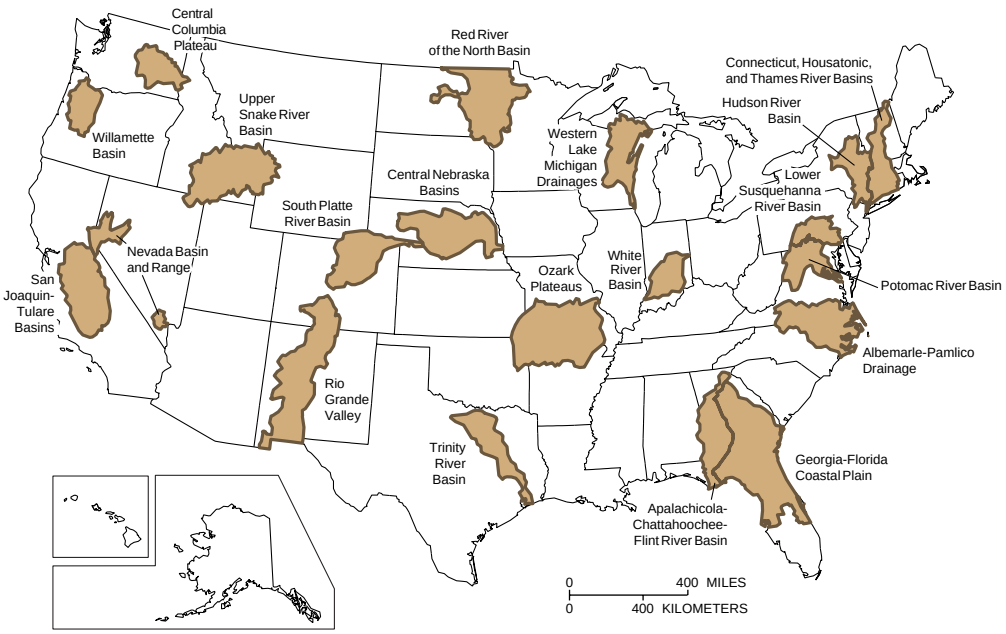
Societal concerns for the quality of our water resources continue, as many of the Nation's streams and coastal waters do not meet water-quality goals. States report that 40 percent of the waters they surveyed are too contaminated for basic uses, such as fishing and swimming. Some progress has been made since passage of the Clean Water Act in 1972. Since the early 1970s, private and public sectors have spent more than $500 billion on water-pollution control, much of which has been directed toward municipal and industrial point sources.[1] Although some violations still occur, this legislation has had a positive effect on limiting contaminants from point sources entering streams.

Progress in cleaning up contamination from point sources has not yet been matched by control of contaminated runoff from nonpoint sources, including fertilizers and pesticides applied in agricultural and urban areas, and nutrients from human and animal wastes. The challenges are great because nonpoint sources are ubiquitous yet highly variable causes of water-quality problems, making them difficult to evaluate and control.

Beginning in the early 1990s, widespread environmental and public-health concerns resulted in a Federal water-quality initiative to work with the Nation's farmers to protect surface water and ground water from nutrient and pesticide contamination. To address these national concerns, nutrients and pesticides were two of the first water-quality issues evaluated by the NAWQA Program. This report, which presents regional and national insights on these chemicals, is based on a compilation of findings from the first 20 NAWQA Study Units.

### Concerns about nutrients

Nitrogen and phosphorus are essential for healthy plant and animal populations; however, elevated concentrations of these nutrients can degrade water quality. Excessive nitrate in drinking water can result in "blue-baby syndrome," which causes oxygen levels in the blood of infants to be low, sometimes fatally. Elevated nitrogen and phosphorus concentrations in surface water can trigger eutrophication, resulting in excessive, often unsightly, growth of algae and other nuisance aquatic plants. These plants can clog water intake pipes and filters and can interfere with recreational activities, such as fishing, swimming, and boating. Subsequent decay of algae can result in foul odors, bad taste, and low dissolved oxygen in water (hypoxia). Excessive nutrient concentrations have been linked to hypoxic conditions, such as those found in the Gulf of Mexico, which can harm fish and shellfish that are economically and ecologically important to the Nation. High nutrient concentrations also are believed to be one cause for the growth of the dinoflagellate *Pfiesteria*, found in Atlantic coastal waters. This form of algae is potentially toxic to fish and other organisms, including humans.



One of the challenges and goals for NAWQA in the first 20 Study Units was to explain where nutrients and pesticides (which include herbicides, insecticides, and other classes of pesticides) commonly occur, and why some land-use and environmental settings are more vulnerable to contamination than others, particularly during certain times of the year. Stream quality was monitored seasonally and during high-flow events, such as storms and periods of peak irrigation, as well as over several years, to better understand when changes occur. By NAWQA design, an initial 3 to 4 years of intensive study are followed by 6 to 7 years of low-level monitoring, at which time intensive study resumes to assess water-quality changes.

Streams and shallow ground water in agricultural, urban, and some undeveloped (mostly forested) settings were studied in the first 20 Study Units. The agricultural areas are diverse in climate and geography, and they span coastal, desert, and temperate environmental settings. They include areas of corn and soybean production in the Midwest; areas of production of wheat and other grains in the Great Plains; areas of mixed row crop and poultry production in the East; rangeland grazing and cattle feeding operations in the arid Southwest; and areas of intensive production of grain, fruits and nuts, vegetables, and specialty crops in California and the Pacific Northwest.

Sampling of streams and shallow ground water in urban areas represented primarily residential land use, typically with low to medium population densities.[2] In general, the urban assessments focused on nonpoint sources of contaminants, although some sampling of rivers was done downstream from major metropolitan areas (such as Atlanta and Denver, which have point discharges from municipal wastewater treatment plants).

Nutrients and pesticides also were assessed in major rivers and in aquifers commonly used for drinking water. These resources represent integrated water-quality effects from multiple land uses and environmental settings that occur within relatively large contributing areas.

### Concerns about pesticides

Pesticides, used to control weeds, insects, and other pests, receive widespread public attention because of potential impacts on humans and the environment. Depending on the chemical, possible health effects from overexposure to pesticides include cancer, reproductive or nervous-system disorders, and acute toxicity. Similar effects are possible in the aquatic environment. Recent studies suggest that some pesticides can disrupt endocrine systems and affect reproduction by interfering with natural hormones.

The NAWQA Program was not intended to assess the quality of the Nation's drinking water, such as by monitoring water from taps. Rather, NAWQA assessments focus on the quality of the resource itself, thereby complementing many ongoing Federal, State, and local drinking-water monitoring programs. Comparisons made in this report to drinking-water standards and guidelines are made only in the context of the available untreated resource.

**NAWQA findings address these key questions about nutrients and pesticides…**

- Which nutrients and pesticides are found in streams and ground water across the Nation? At what concentrations?
- Are elevated concentrations more prevalent in certain geographic regions and environmental settings?
- How do differences in land use, chemical use, land-management practices, and natural processes help explain differences in vulnerability to contamination of streams and ground water?
- Are nutrient and pesticide concentrations elevated only at certain times of the year? Are concentrations changing over time?
- What are the implications to human health and the environment?
- How is this information useful for guiding future research, monitoring, and water-management and protection strategies related to nutrients and pesticides?