



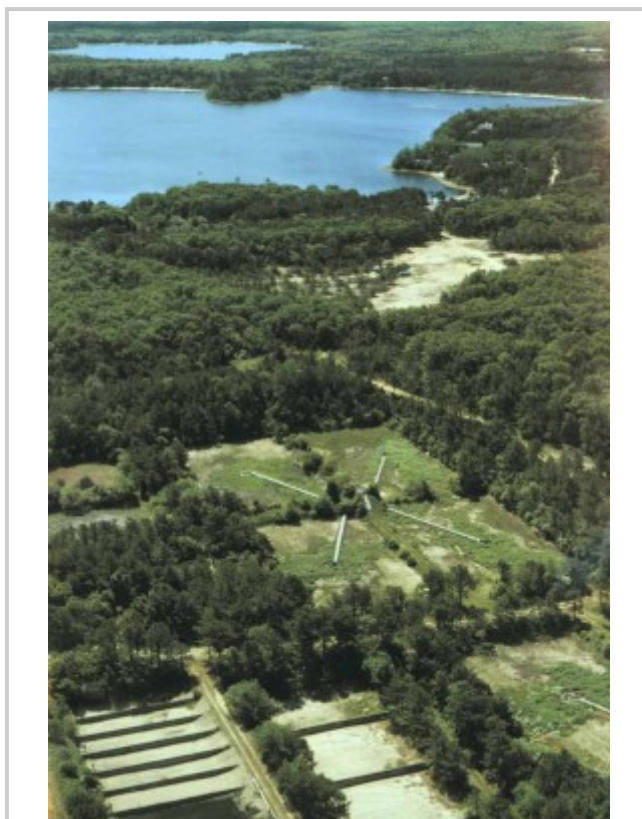
Environmental Health - Toxic Substances

Science Features

Phosphorus Doesn't Migrate in Ground Water? Better Think Again!



U.S. Geological Survey (USGS) scientists have been studying the long-term migration of phosphorus in a subsurface plume of treated sewage at the Toxic Substances Hydrology Program's research site located in [Cape Cod, Massachusetts](#). The ground-water contamination resulted from 60 years of disposal of treated sewage to infiltration ponds at the Massachusetts Military Reservation. Phosphorus is a common constituent of agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent. Excess phosphorus in lakes is a common cause of eutrophication. The observed extent of the phosphorus plume and the interaction of the plume with Ashumet Pond, a glacial kettle pond, has challenged scientists to re-evaluate their understanding of the mobility of phosphorus in ground water and of interactions between ground water and surface water.



Treated wastewater from Joint Base Cape Cod was discharged to rapid-infiltration disposal beds from 1936 to 1995. The disposal formed a groundwater contamination plume that extends more than 10 kilometers in the Cape Cod sand and gravel glacial outwash aquifer. Photo credit: Denis R. LeBlanc, USGS

- Phosphorus Mobility** - In the past, ground-water scientists thought that phosphorus in ground water migrated little and hence was of minimal ecological concern. Years of monitoring data on phosphorus concentrations in the plume of treated sewage on Cape Cod has shown that phosphorus does migrate in ground water, raising concerns that phosphorus-containing ground water discharging into Ashumet Pond may accelerate the eutrophication of the pond. USGS scientists are using their new understanding of the migration of phosphorus in ground water to predict the phosphorus load to Ashumet Pond from the sewage plume.

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The Massachusetts Department of Environmental Protection (DEP) is using these results to develop technical guidance concerning wastewater disposal to ground water. The DEP is concerned that land disposal of wastewater through infiltration basins and septic leaching fields can lead to discharge of phosphate-enriched ground water to sensitive lakes and streams. USGS scientists have assisted State resource managers in preparing guidelines for locating onsite wastewater disposal so that discharge of phosphorus into streams, ponds, and coastal waters will be minimized.

- **Ground Water and Lakes** - On the basis of past knowledge, scientists expected the phosphorus plume to discharge into the pond over a broad area in a cove on the western side of the pond. Monitoring data have shown that the phosphorus plume rises steeply upward and discharges to the pond in a narrow area within 100 feet of shore. This pattern of discharge, in which the greatest inflow is at the shoreline, has been reported in other lake studies by USGS scientists. Toxics Program scientists are working closely with the Air Force Center for Environmental Excellence and its contractors to design a remediation strategy that is based on a sound scientific understanding of phosphorus fate and transport. Actions to limit phosphorus discharge to the pond are now being focused on the small discharge area rather than on the much larger plume upgradient of the pond. Treating the discharge area is expected to be a more cost-effective approach that will provide the maximum benefit to the pond's ecosystem.

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More Information on the Cape Cod Sewage Plume

- [Phosphorus Plume Remediation](#), project description and information
- Sewage-Contaminated Ground Water -- [Cape Cod, Massachusetts](#)

USGS Information on Phosphorus and Other Nutrients

- [Stream Water Quality in the Conterminous United States -- Status and Trends of Selected Indicators During the 1980's](#), National Water Summary 1990-91 -- Stream Water Quality, U.S. Geological Survey Water-Supply Paper 2400
- National Water-Quality Assessment (NAWQA) Program, [National Nutrient Synthesis Project](#)

USGS Publications on Ground-Water/Surface-Water Interactions

[Ground Water and Surface Water A Single Resource](#), U.S. Geological Survey Circular 1139 (see figure 4).

Winter, T.C., 1999, [Relation of streams, lakes, and wetlands to groundwater flow systems](#): Hydrogeology Journal, v. 7, no. 1, p. 28-45.

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