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News Release

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Land Conservation Helps Preserve Water Quality at Walden Pond

Following in the tradition of Henry David Thoreau, the U.S. Geological Survey in Northborough, Mass., has contributed new knowledge to the Nation's understanding of Walden Pond in Concord, Massachusetts. The results of a three-year study of Walden Pond's ground-water aquifer and water clarity by USGS hydrologists John Colman and Paul Friesz are now available in a 61-page illustrated report, Water-Resources Investigations Report 01-4137, *Geohydrology and Limnology of Walden Pond, Concord, Massachusetts,* and a 56" by 38" map report, Water-Resources Investigations Report 01-4153, *Hydrology and Trophic Ecology of Walden Pond, Concord, Massachusetts*. These reports show that current land-conservation efforts and natural processes help maintain Walden's exceptional water clarity.

Walden Pond, which receives 55 percent of its water from ground water, has no surface-water inflows or outflows. Ground-water quality, therefore, may affect the ecology of Walden Pond. This factor, as well as Walden Pond's high visitor-use rate, historical significance, and land-use concerns, prompted this cooperative investigation between the Massachusetts Department of Environmental Management and the U.S. Geological Survey.

Colman and Friesz say that "the reports' results will help answer the public's concerns about whether or not Walden's urban/suburban setting has harmed or will harm the ecology of Walden Pond."

The investigation found that the area around Walden Pond that contributes ground water to the pond totals 153 acres. It extends only about 700 feet north and south of the lake, and does not include State Route 2, the Concord Municipal landfill, or a nearby trailer park. The contributing area extends east several thousand feet from the lake and includes a portion of land in a housing development. Water from the development, however, drains to Walden Pond only after passage through Goose Pond. Although 115 acres of the ground-water contributing area are protected by the Walden Pond State Reservation and municipal conservation land, the protected land does include the Reservation parking lot and the septic leachfield for the Reservation bathhouse.

Walden Pond's contributing aquifer underlies a thick, unsaturated zone of sand and gravel. In this zone, natural organic compounds, such as tannins, biodegrade, and phosphorus that seeps from the septic-system leachfield attaches to the sand. Removing dissolved organic material in the unsaturated zone helps preserve the clarity of water that will eventually discharge into the lake and maintains aerobic conditions in the aquifer, which further decreases transport of phosphorus. The low supply of phosphorus limits the growth of algae in Walden Pond, which would create murky water.

The authors add, however, that nitrogen, a second plant nutrient, does move from the septic system into the lake's water.

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"Interestingly, substantial amounts of nitrogen do move from the Reservation's septic system to Walden Pond, but rather than stimulate algal growth, already limited by phosphorus, the nitrogen may prevent the growth of cyanobacteria, surface-scum forming photosynthetic organisms that otherwise gain an advantage over algae by their ability to use nitrogen from the atmosphere."

Contemporary data were compared with data collected in the past to determine whether Walden's physical or chemical conditions have changed. The authors found that the current depth of Walden Pond is not significantly different than that measured by Thoreau in 1846 or by Yale University limnologist Edward Deevey in 1939. However, the investigation did find a third deep-zone, previously unmapped. Although less transparent than when Thoreau reported the lake bottom to be easily "discerned at the depth of twenty-five or thirty feet," Walden's present maximum transparency extends down to 23 feet. Historical water-quality data are sparse for Walden Pond, but Colman and Friesz found that depth profiles of dissolved oxygen collected by Deevey show less depletion of oxygen in deep water and less oxygen generated in the middle water than that reflected in present-day profiles.

The implication, the reports say, is that at present more plant nutrients enter the pond, causing more algal growth in the upper sunlit water. There is greater plant biomass settling and consequently greater oxygen use in the deep water at present than occurred in 1939. Naturally all lakes become more fertile and generate more plant life as nutrients wash into them from their drainages, but substantial plant-productivity changes that occur over 60 years, as compared to the thousands of years since glaciation, are likely of human origin.

The authors suggest that some changes in plant growth in Walden Pond aren't necessarily a bad thing. A significant portion of Walden's current plant growth below depths of 19 to 41 feet is *Nitella,* a large alga often associated with clear-water lakes. To survive, this plant requires deep light penetration. By tying up nutrients at the sediment-water interface, along the pond's bottom, this plant keeps nutrients away from potential algal blooms at the surface.

One possible source of nutrients for Walden Pond and most other kettle-hole lakes in eastern Massachusetts is swimmers. If swimmers do constitute a significant source of nutrients to kettle-hole ponds, the means of delivery is through urine. Large numbers of swimmers, estimated at 220,000 per summer, are not a new circumstance for Walden Pond. In 1935, the *Concord Herald* reported that summer Sunday afternoon crowds reached 25,000, and that total summer attendance was 485,000. During his weekend measurements in 1939, Deevey counted "nearly 1,000 bathers."

A new technique would help track the effect of swimmers on water quality. Meanwhile, a continuation of current practices will help maintain Walden's water clarity.

New techniques that use stable isotopes of nitrogen to trace the effects of swimmers could be applied to kettle-hole lakes, such as Walden Pond. In the meantime, management of water quality at the Walden Pond State Reservation focuses upon maintaining the transparency of the surface water so that the deep-growing *Nitella* can continue its role in maintaining water clarity. The forested, protected land overlying the contributing aquifer helps greatly in this effort.

To obtain copies of these reports, contact the U.S. Geological Survey at 10 Bearfoot Road, Northborough, Mass., 01532, or phone them at 508-490-5000. Additional paper and microfiche copies may be purchased at cost from the U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225-0286; telephone (303) 234-7476. Order must include a check or money order payable to the U.S. Department of the Interior–U.S. Geological Survey. Specify report number WRIR 01-4137 or 01-4153.

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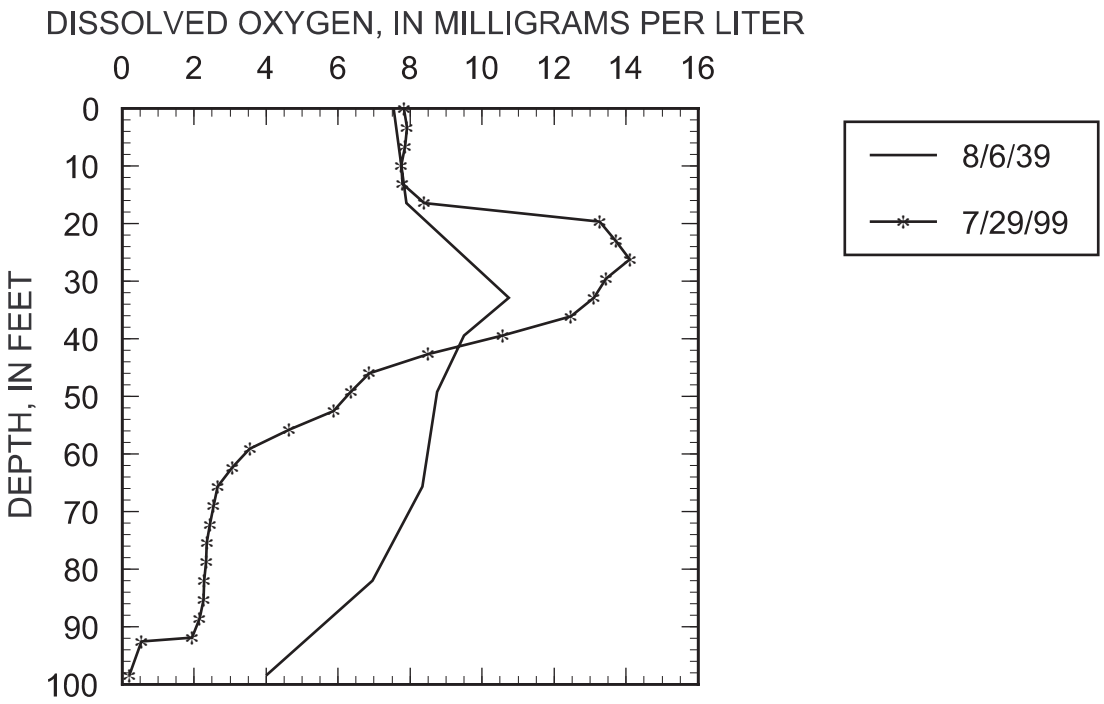
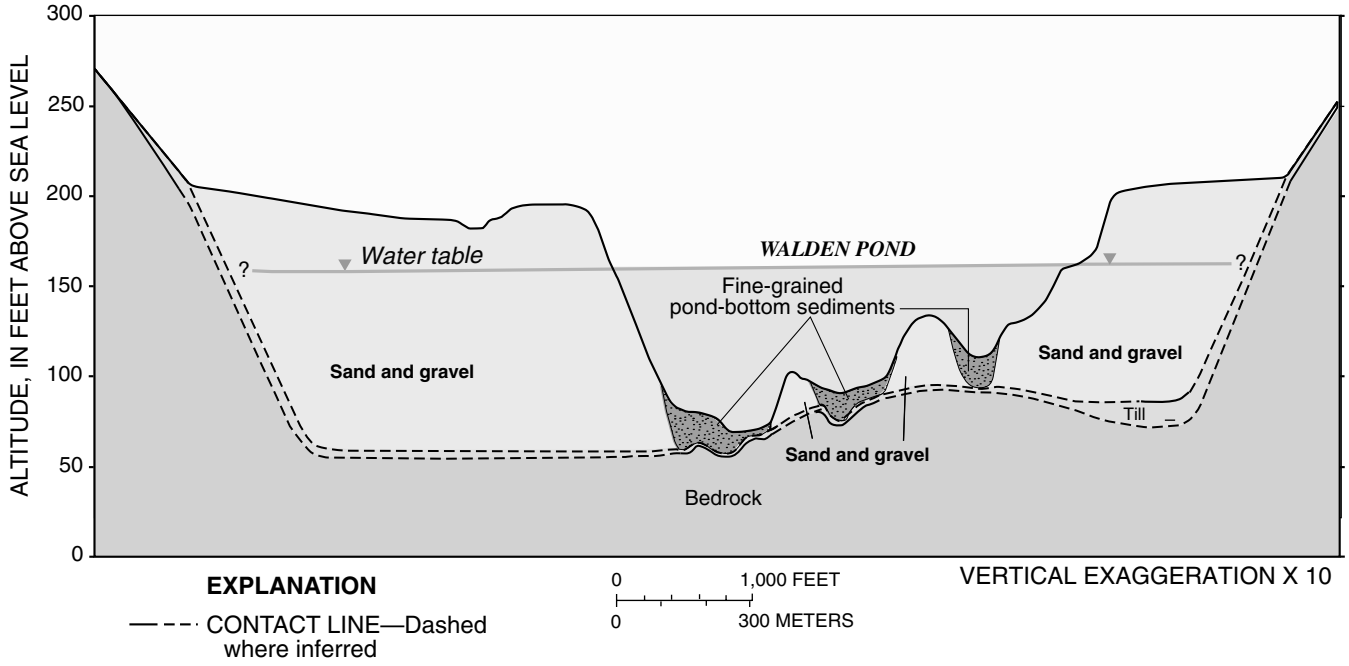


Comparison of data from Deevey's 1939 investigation to data obtained from Colman and Friesz's investigation show that less oxygen was depleted in deep water and less oxygen was generated in middle-depth water at the time of Deevey's study than at present.



As ground water seeps into the permeable glacial outwash deposits that surround Walden Pond, the thick unsaturated zone above the aquifer helps preserve water clarity by allowing degradation of natural organic compounds and tying up phosphorus before it reaches the water table.

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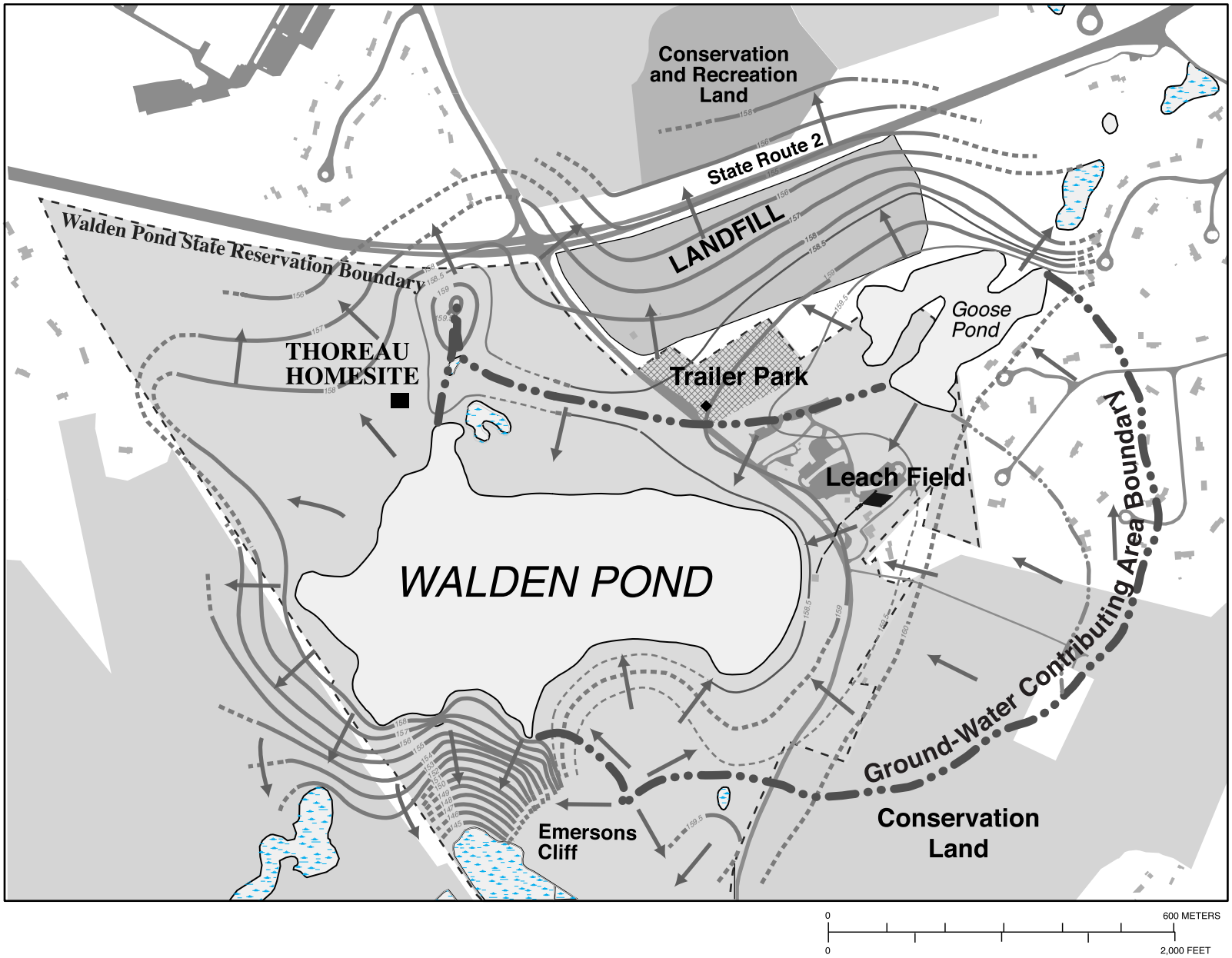

The 153 acres of ground-water contributing area to Walden Pond extend only about 700 feet north and south of the lake, and do not include State Route 2, the Concord Municipal landfill, or a nearby trailer park. The contributing area extends east several thousand feet from the lake and includes a portion of land in a housing development. Water from the development passes through Goose Pond before draining to Walden Pond.