

INTRODUCTION

Smithport Lake in northwestern Louisiana is a popular recreational lake used for water-based activities such as fishing, boating, and swimming. An understanding of current hydrologic conditions of Smithport Lake and other lakes and reservoirs in Louisiana is essential to the management and protection of these valuable natural resources. Water quality and quantity are important concerns to those who use these bodies of water for municipal, recreational, agricultural, or industrial purposes. Current and accurate information regarding the physical and chemical-related properties and conditions of freshwater lakes in Louisiana is fundamental to planners and managers for evaluating these resources. In October 1996, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development, began a study to conduct a bathymetric survey and determine the physical and chemical-related properties of Smithport Lake.

The purpose of this report is to present the results of the bathymetric survey and the results of vertical profiles of physical and chemical-related properties, including depth, water temperature, dissolved oxygen, specific conductance, and pH. Hydrographic surveying software was used for combining differential global positioning system (DGPS) information with digital survey fathometer data to accurately map the bathymetry of the lake. The bathymetric map was produced using geographic information systems (GIS), and lines of equal depth of water were reviewed and edited for accuracy and consistency. On-site physical and chemical-related properties were measured at three selected locations using a water-quality monitor. This report is one in a series of planned map reports describing current bathymetry and physical and chemical-related properties of lakes and reservoirs in Louisiana.

Description of Study Area

Smithport Lake (fig. 1) is located in eastern DeSoto Parish about 20 miles southeast of Shreveport, Louisiana. A 1997 census estimated a population of 25,406 for DeSoto Parish and 200,827 for Shreveport (University of Louisiana at Monroe, Uniform Resource Locator accessed December 1, 1998). This area has a subtropical transitional climate with a mean annual rainfall of 46.1 inches and a mean annual temperature of 54.2°F (degrees Fahrenheit) (Jay Grymes, Louisiana Office of State Climatology, written commun., 1998).

Smithport Lake has a drainage area of 205 square miles and primarily receives inflow from Clear Lake and Siphorien Bayou, which enter at the northern and western ends of the lake, respectively. An earthen dam built in 1953 has a top elevation of 142.0 feet above sea level and is 2,500 feet in length. Lake level is controlled by a 600-foot-long concrete spillway, at a crest elevation of 131.6 feet above sea level. The maximum design discharge for the spillway is 40,500 cubic feet per second (Ray Elfami, Louisiana Department of Transportation and Development, written commun., 1998).

Smithport Lake is very shallow and wide and is heavily forested. The shallower parts are extensively affected by submerged aquatic vegetation, impassable to motorized boats. This study was limited to the navigable areas of Smithport Lake. The entire lake is shown in the inset at the upper right in figure 1.

Acknowledgments

The author extends appreciation to Zahir "Bo" Bolourchi, Chief, Water Resources Section, Louisiana Department of Transportation and Development, for direction and assistance provided for this study.

BATHYMETRY

Bathymetric data for Smithport Lake were collected on July 8-9, 1997. Accurate position and depth data were obtained to comprehensively describe the bathymetry of the lake; 15,580 data points of latitude, longitude, and depth were recorded. The bathymetry of the lake is shown in figure 1; water depths are referenced to the water-surface elevation of 131.04 feet above sea level, which existed July 8-9, 1997.

Equipment used during the bathymetric survey included a Starlink DNAV-212 DGPS, an Odom digital survey fathometer, and HYPACK software. The DGPS measured spatial position in latitude and longitude with routine accuracy of 5 feet; horizontal control points were established at the beginning and rechecked at the end of each survey day to maintain that accuracy. The survey fathometer measured the depth with routine accuracy of 0.1 foot; the fathometer was calibrated at the start and verified at the end of each survey day to maintain that accuracy. The HYPACK software was used for survey planning, survey execution, and storage and editing of data. Data were exported to ARC/INFO for drawing lines of equal depth of water and subsequent reviewing and editing of the results.

Louisiana Department of Transportation and Development - U.S. Geological Survey Water Resources Cooperative Program



Figure 1. Bathymetry of Smithport Lake Reservoir, July 8-9, 1997

Surface area and volume spatial analyses also were performed within ARC/INFO. The navigable surveyed parts of the lake were extrapolated to the border to estimate the water surface and water volume of Smithport Lake. The depth-surface area, and depth-volume relations are shown in figure 2. The greatest depths are located in the center of the lake near the pipeline crossing where the maximum depth is 16.2 feet.

PHYSICAL AND CHEMICAL-RELATED PROPERTIES

Data on physical and chemical-related properties were collected on July 9, 1997, at selected sites in Smithport Lake. At these sites (1, 2, and 3 in fig. 1), multiple points along a vertical profile were sampled to establish the occurrence and depth of stratification. The HYDROLAB, a water-quality monitor, was calibrated at the beginning of the day prior to physical and chemical-related property data collection.

Data were collected along a vertical profile from above the lake bed to 1.6 feet below the water surface, with additional sampling points within the stratification zone. The deepest measurement at the three sampling sites was 12.5 feet, recorded at each of the three sites. Water temperature decreased slightly from approximately 84°F at the surface to 80°F at approximately 8 feet in depth, then decreased more rapidly with depth, with the deepest measurement of 71°F at 12.5 feet (fig. 3).

The DO profiles showed an immediate decrease in concentration occurring within shallow water in the lake. Concentrations of DO decreased markedly within the range from the surface to 8 feet. Shallow-water DO concentrations of 4.3 mg/L (milligrams per liter) decreased with depth to approximately 0.15 mg/L at 8 feet and deeper. Concentrations of DO vary considerably with depth, location, and season (Demas, 1985). The criterion for DO is 5 mg/L for freshwater aquatic life (Louisiana Department of Environmental Quality, 1998, p. 128; U.S. Environmental Protection Agency, 1976; 1986). Water visibility, measured with a Secchi disk, was 3.8 feet.

The specific conductance generally decreased with depth. The shallow-water concentrations varied between 141 and 151 $\mu\text{S}/\text{cm}$ (microsiemens per centimeter at 25 degrees Celsius), and bottom-water concentrations were about 138 $\mu\text{S}/\text{cm}$. The pH was about 6.3 (standard units) near the surface and decreased with depth. The deepest measurements ranged from 6.21 to 6.26 at 12.5 feet.

REFERENCES

Demas, C.R., 1985, A limnological study of Lake Bruin, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 38, 96 p.

Louisiana Department of Environmental Quality, 1998, Water quality regulations in Environmental Regulatory Code: Baton Rouge, Louisiana, Louisiana Administrative Code, title 33, part IX, p. 128.

University of Louisiana at Monroe, Center for Business and Economic Research, Louisiana parishes and municipalities July 1, 1997, population estimates published in January 1996: accessed December 1, 1998, at URL <http://leap.nlu.edu/POPHS/pop1997.txt>

U.S. Environmental Protection Agency, 1976, Quality criteria for water: Washington, D.C., U.S. Environmental Protection Agency, 256 p.

1986, Quality criteria for water: Washington, D.C., U.S. Environmental Protection Agency [variously paged].

In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

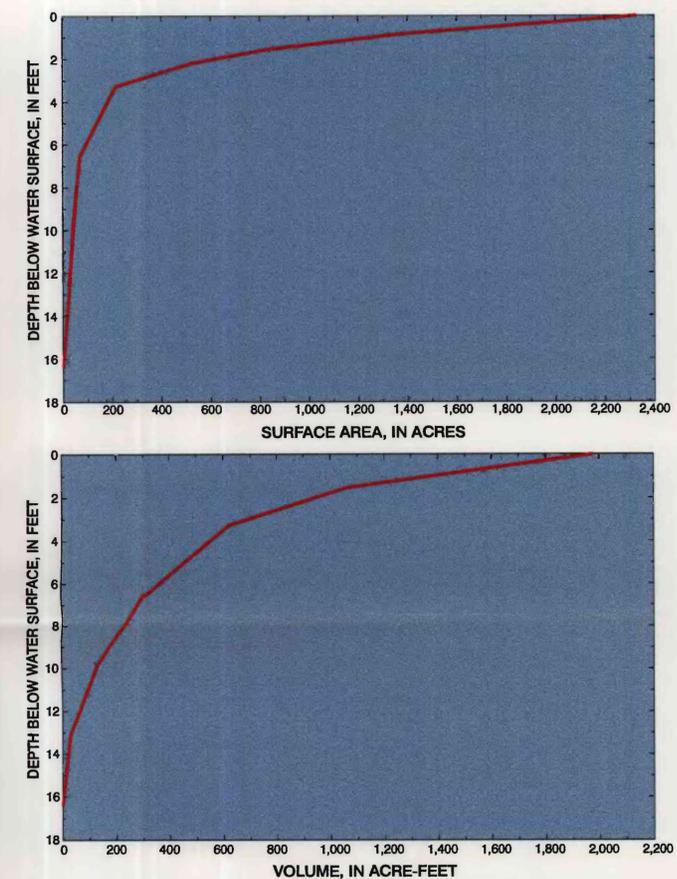


Figure 2. Depth-surface area and depth-volume relations for Smithport Lake. Water-surface elevation was 131.04 feet above sea level during the bathymetric survey, July 8-9, 1997.

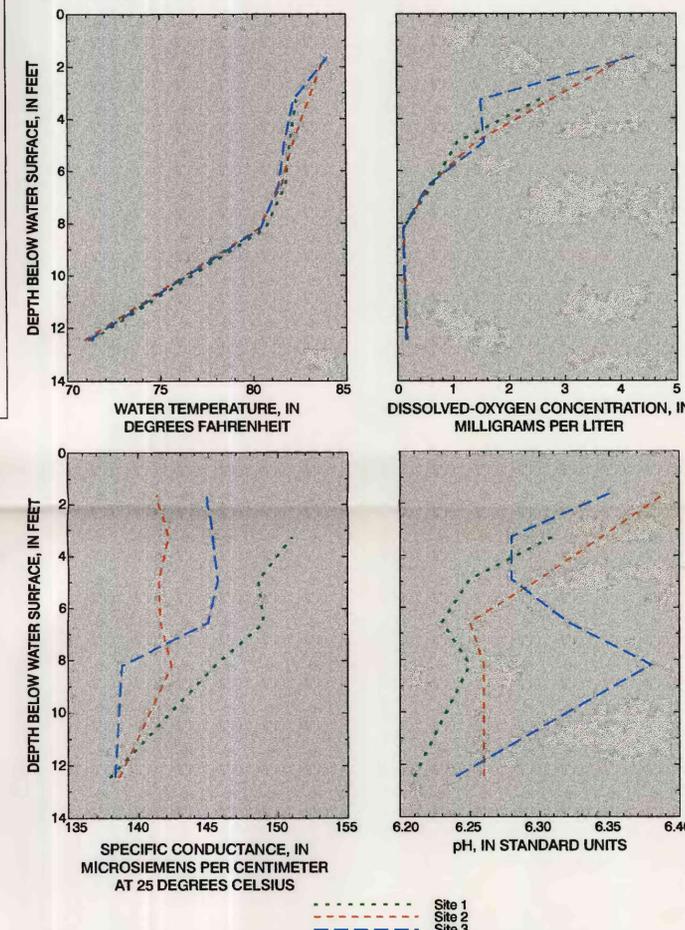


Figure 3. Variation of water temperature, dissolved-oxygen concentration, specific conductance, and pH at Smithport Lake, July 9, 1997.

For additional information, contact:

District Chief
U.S. Geological Survey
3535 S. Sherwood Forest Blvd., Suite 120
Baton Rouge, Louisiana 70816
E-mail: la@usgs.gov
Telephone: (225) 389-0281
Fax: (225) 389-0706

Copies of this report can be purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, Colorado 80225
Telephone (toll free): (888) ASK-USGS

Bathymetric Survey and Physical and Chemical-Related Properties of Smithport Lake, Louisiana, July 1997

By Paul A. Ensminger