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BATHYMETRIC SURVEY AND PHYSICAL AND CHEMICAL-RELATED PROPERTIES OF LAKE BRUIN

INTRODUCTION

Lake Bruin, an oxbow lake formed from a cutoff of the Mississippi River in northeastern Louisiana, is a popular recreational lake widely used for water-based activities such as water skiing, fishing, boating, and swimming. Lake Bruin is a source of drinking water for several small communities surrounding the lake. The following amounts of water were withdrawn from the lake during 1994: the Newellton Water System, 0.25 Mgal/d (million gallons per day); the Lake Bruin Water System, 0.038 Mgal/d; and the Tensas Water Distribution Association, 0.281 Mgal/d (P.M. Johnson-Thibaut, U.S. Geological Survey, written commun., 1998). An understanding of current hydrologic conditions of Lake Bruin 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 the lakes 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 Lake Bruin.

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, which were measured at three sites on the lake. 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 contour lines were reviewed and edited for accuracy and consistency. On-site physical and chemical-related properties were measured at the three strategic locations using a water-quality sampler. 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

Lake Bruin (fig. 1) is located in Tensas Parish about 4 miles north of the town of St. Joseph, Louisiana. This area has a subtropical transitional climate with a mean annual rainfall of 54.7 inches, and a mean annual temperature of 65°F (degrees Fahrenheit) (Bette Wall, Louisiana Office of State Climatology, written commun., 1997).

Lake Bruin has a drainage area of 21.4 square miles, and receives some inflow from a canal that drains Big Pond and from Bayou Bruin, both entering at the western end of the lake at the shallow slough Brushy Lake. The lake level is controlled by a structure on Routh Ditch at U.S. Highway 65; the crest elevation is 61.00 feet above sea level. Neither the Mississippi River nor ground water appear to be a source of water to the lake, and fluctuations in lake level are closely associated with rainfall and runoff (Demas, 1985, p. 6, 9). Camping and boat access is available at the Lake Bruin State Park, with other boat ramps available at Shilo and Cypress Landing.

Acknowledgments

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BATHYMETRY

Bathymetric data for Lake Bruin were collected during February 4-6, 1997. Accurate position and depth data were obtained to comprehensively describe the lake bathymetry; 26,719 data points of latitude, longitude, and depth were recorded. The bathymetry of Lake Bruin is shown in figure 1; water depths are referenced to the water-surface elevation of 59.72 feet above sea level, which existed throughout the bathymetric survey.

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 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 contouring, and subsequent reviewing and editing of contouring results.

Surface area and volume spatial analyses also were performed within ARC/INFO. The water-surface area of Lake Bruin was 2,824 acres, and the water volume was 63,400 acre-feet. The depth-surface area and depth-volume relations are shown in figure 2. Lake Bruin is a relatively deep lake compared to other Louisiana lakes, with a depth of 22.9 feet or greater over more than 50 percent of the lake surface area. Greatest depths are in the northeastern part of the lake area near the Shilo boat ramp, and depths decrease progressively in either direction. An island exists along the northwestern inner bank of the lake.

Aerial photomap by U.S. Geological Survey.
Aerial photograph provided by National Aeronautics and Space Administration, January 1995

Figure 1. Bathymetry of Lake Bruin, February 4-6, 1997.

PHYSICAL AND CHEMICAL-RELATED PROPERTIES

Data on physical and chemical-related properties were collected on September 24, 1997, at selected sites on Lake Bruin. At these sites (1, 2, and 3 in fig. 1), multiple points along a vertical profile were measured to establish the occurrence and depth of stratification. The HYDROLAB, a water-quality measuring device, 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 total depths at the three sampling sites were as follows: site 1, 31.5 feet; site 2, 32.81 feet; and site 3, 34.45 feet. Water temperature remained constant at approximately 82°F from the surface to approximately 20 feet in depth, then decreased linearly at approximately 1°F per foot to the deepest measurement (fig. 3).

Dissolved-oxygen (DO) concentration profiles showed stratification occurring at a depth between 16 and 23 feet, similar to the water temperature profiles. Within this interval, DO concentrations decreased markedly, with shallow-water DO concentrations varying between 3 and 4.5 mg/L (milligrams per liter), and bottom-water DO concentrations of approximately 0.18 mg/L. DO concentrations vary considerably with depth, location, and season, and it was observed that Lake Bruin overturns in October (Demas, 1985). The U.S. Environmental Protection Agency's criterion for dissolved oxygen is 5 mg/L for freshwater aquatic life (U.S. Environmental Protection Agency, 1976; 1986). Water visibility, measured with a Secchi disk, was 3.6 feet.

Specific conductance profiles showed stratification beginning at a depth of 16 feet, similar to the temperature and DO profiles. The specific conductance remained constant at 180 µS/cm (microsiemens per centimeter at 25 degrees Celsius) from the surface to about 18 feet, then increased with depth; the bottom measurements ranged from 259 to 355 µS/cm. The pH was about 7.2 (standard units) near the surface and generally decreased with depth.

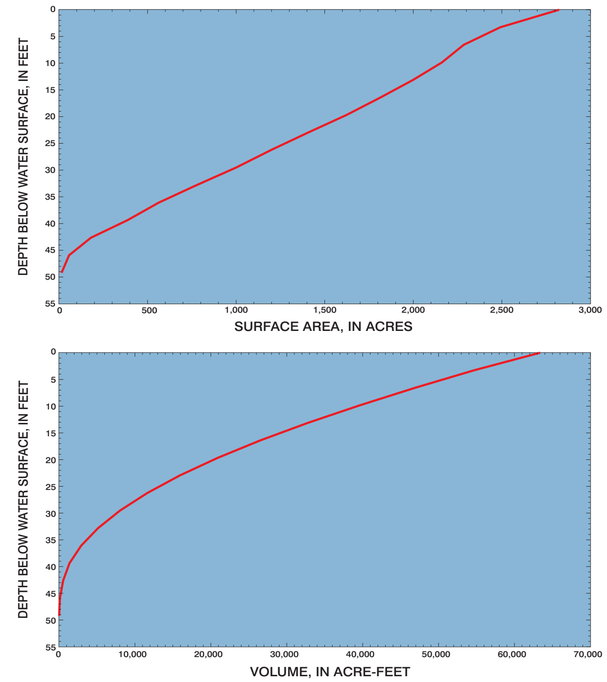

Figure 2. Depth-surface area and depth-volume relations for Lake Bruin. Water-surface elevation was 59.72 feet above sea level during the bathymetric survey February 4-6, 1997.

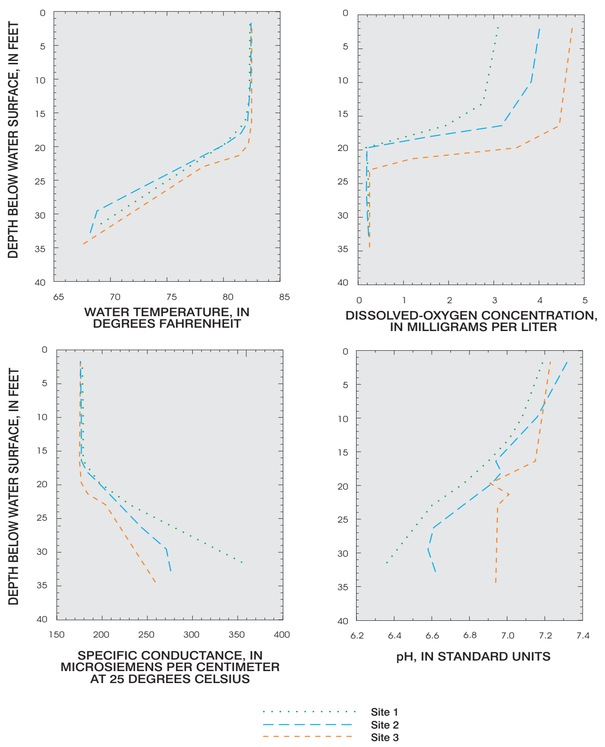

Figure 3. Variation of water temperature, dissolved-oxygen concentration, specific conductance, and pH at Lake Bruin, September 24, 1997.

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.

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.

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

Bathymetric Survey and Physical and Chemical-Related Properties of Lake Bruin, Louisiana, February and September 1997

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