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SCIENTIFIC INVESTIGATIONS MAP 3037
Bathymetric contours of Manteno Park Pond,
Shelby County, Iowa—SHEET 4 of 7
Linhart, S.M., and Lund, K.D., 2008, Bathymetric Contour Maps of Lakes Surveyed in Iowa in 2005

Abstract

The U.S. Geological Survey, in cooperation with the Iowa Department of Natural Resources, conducted bathymetric surveys on seven lakes in Iowa during 2005 (Arrowhead Pond, Central Park Lake, Lake Keomah, Manteno Park Pond, Lake Miami, Springbrook Lake, and Yellow Smoke Lake). The surveys were conducted to provide the Iowa Department of Natural Resources with information for the development of total maximum daily load limits, particularly for estimating sediment load and deposition rates. The bathymetric surveys provide a baseline for future work on sediment loads and deposition rates for these lakes. All of the lakes surveyed in 2005 are man-made lakes with fixed spillways.

Bathymetric data were collected using boat-mounted, differential global positioning system, echo depth-sounding equipment, and computer software. Data were processed with commercial hydrographic software and exported into a geographic information system for mapping and calculating area and volume. Lake volume estimates ranged from 47,784,000 cubic feet (1,100 acre-feet) at Lake Miami to 2,595,000 cubic feet (60 acre-feet) at Manteno Park Pond. Surface area estimates ranged from 5,454,000 square feet (125 acres) at Lake Miami to 558,000 square feet (13 acres) at Springbrook Lake.

Introduction

Bathymetric mapping can provide useful information for water-quality managers to address a variety of issues on Iowa's lakes and reservoirs. The Iowa Water Science Center of the United States Geological Survey (USGS) began a lake bathymetric mapping program in June 2001 on Lake Delhi in east central Iowa resulting in a published bathymetric map and report (Schnoebelen and others, 2003). The USGS, in cooperation with the Iowa Department of Natural Resources (IDNR), conducted a bathymetric survey of Manteno Park Pond in 2005 to provide the IDNR with information for the development of total maximum daily load limits (TMDLs), particularly for estimating sediment load and deposition rates. The bathymetric contours also can provide a baseline for future work on sediment load and deposition rates for Manteno Park Pond.

Manteno Park Pond was constructed in the early 1960's, and is located in western Iowa about 15 miles (mi) northwest of Harlan in Shelby County in Manteno Park, and is used primarily for recreational activities. Manteno Park Pond receives flow from two intermittent unnamed creeks from the north and by an unnamed creek discharging through a culvert from a private pond to the east. Discharge from Manteno Park Pond is through a bottom outlet at the dam on the west end of the lake into Mill Creek.

Methods

Bathymetry data were collected on May 25, 2005. Bathymetric mapping was accomplished using boat-mounted global positioning system (GPS), echo depth-sounding equipment, and computer software. The GPS allowed for accuracies of about 3.28 feet (ft) (approximately 1 meter) in the horizontal direction. The echo sounder emits sound pulses that are reflected off the lake bottom and received by a transducer. The echo sounder transmitted at a frequency of 200 kilohertz; water depths were determined by the echo sounder based on the speed of sound in water compensated for temperature (Specialty Devices, Inc., 2003). In some areas of the lake, the depth limitations (less than 3.3 ft) of the echo-sounding equipment necessitated determining the depths manually at target points using a measuring device marked in 0.10-ft increments. Using the echo sounder, the bathymetry data were collected along planned transect lines spaced 50 ft apart. Individual data-collection locations along a transect line generally were 5 to 10 ft apart. The depth data later were converted to elevation, in the post-processing software (Coastal Oceanographics, Inc., 2002 and Specialty Devices, Inc., 2003), by subtracting the depths at each location from the reference surface elevation of the lake. The reference surface elevation was determined on the day of bathymetric data collection by measuring from a reference point of known elevation near the boat ramp. The elevation of the reference point was determined using a combination of GPS and standard surveying techniques. The bathymetry data then were filtered (fig.1) to reduce the density of data points and entered into geographic information system (GIS) software to produce a three-dimensional surface of the lake-bottom elevations. The three-dimensional surface was contoured, and the contours were adjusted manually to correct for interpretive errors. (See the Manteno Park Pond metadata at *http://water.usgs.gov/lookup/getgislist* for a more detailed explanation of methods used to collect and process the bathymetric data.)

Quality Assurance

A bar check on the echo sounder was performed at the beginning of the day of data collection following established protocols (U.S. Army Corps of Engineers, 1994, Chapter 9). This was done to ensure that the echo sounder was calibrated correctly. The bar check involved suspending a 2-ft-diameter flat aluminum plate directly below the echo sounder. The suspension line was marked in 5-ft increments. An initial calibration was made at 5 ft by entering the speed of sound in water and adjusting the offset of the transducer in the computer software. The offset is the draft of the transducer below the lake surface. The aluminum plate was then lowered in 5-ft increments, depending on the range of depths expected to be encountered, and adjustments in the speed of sound were made until depth readings and the depth of the aluminum plate agreed to within approximately 0.1 ft.

A second independent bathymetry data set was collected for a smaller area of Manteno Park Pond. The control data set was used to estimate the precision (repeatability) of the sounding data collected with the echo sounder, to estimate the accuracy of the interpolation in the three-dimensional surface, and to estimate the accuracy of the contours (Wilson and Richards, 2006). Within 1.0 ft of each other there were 10 paired data and control points with a calculated Root Mean Square Error (RMSE) of 0.62 ft. At corresponding locations there were 532 paired three-dimensional surface elevations and control points with a calculated RMSE of 0.90 ft, and within 0.75 ft of each other there were 15 paired contours and control points with a calculated RMSE of 0.86 ft.

Bathymetric Contours

The water-surface elevation of Manteno Park Pond was 1,253.9 ft above North American Vertical Datum of 1988 (NAVD88) on May 25, 2005. Generally, water depth increases toward the dam (fig. 2). The deepest part of the lake is located approximately 200 ft east of the dam in the southwestern end of the lake, and the lowest elevation measured was 1,245.2 ft (8.7 ft deep). The average elevation of the lake bottom based on the three-dimensional surface was 1,249.4 ft (4.5 ft deep). The slope of the lake bottom generally is greatest along the eastern two-thirds of the south shoreline. Data from this survey indicate that the total surface area of Manteno Park Pond, at a water-surface elevation of 1,253.9 ft, is approximately 571,000 square feet (ft^2) (13 acres) and the total water volume of Manteno Park Pond is approximately 2,595,000 cubic feet (ft^3) (60 acre-ft).

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Manteno Park Pond in Shelby County, Iowa (photograph by Jon Nania, U.S. Geological Survey).

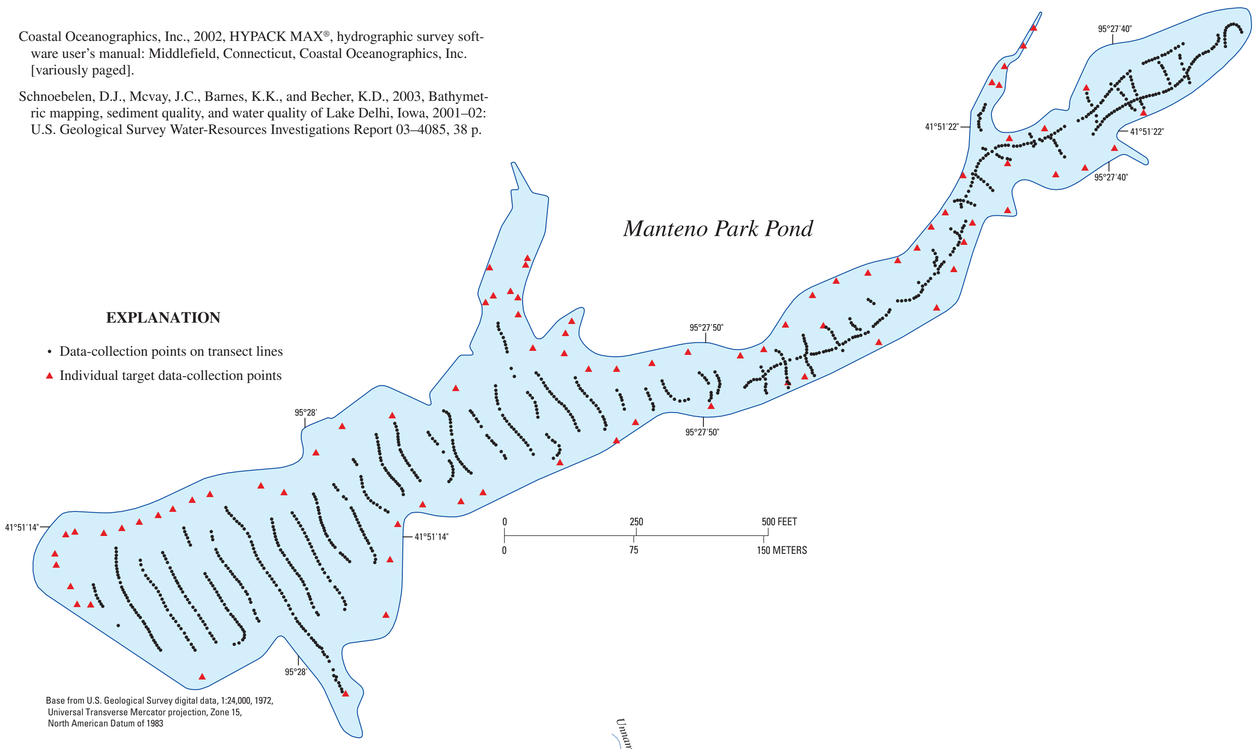

Figure 1. Data-collection points used to construct bathymetric contours.

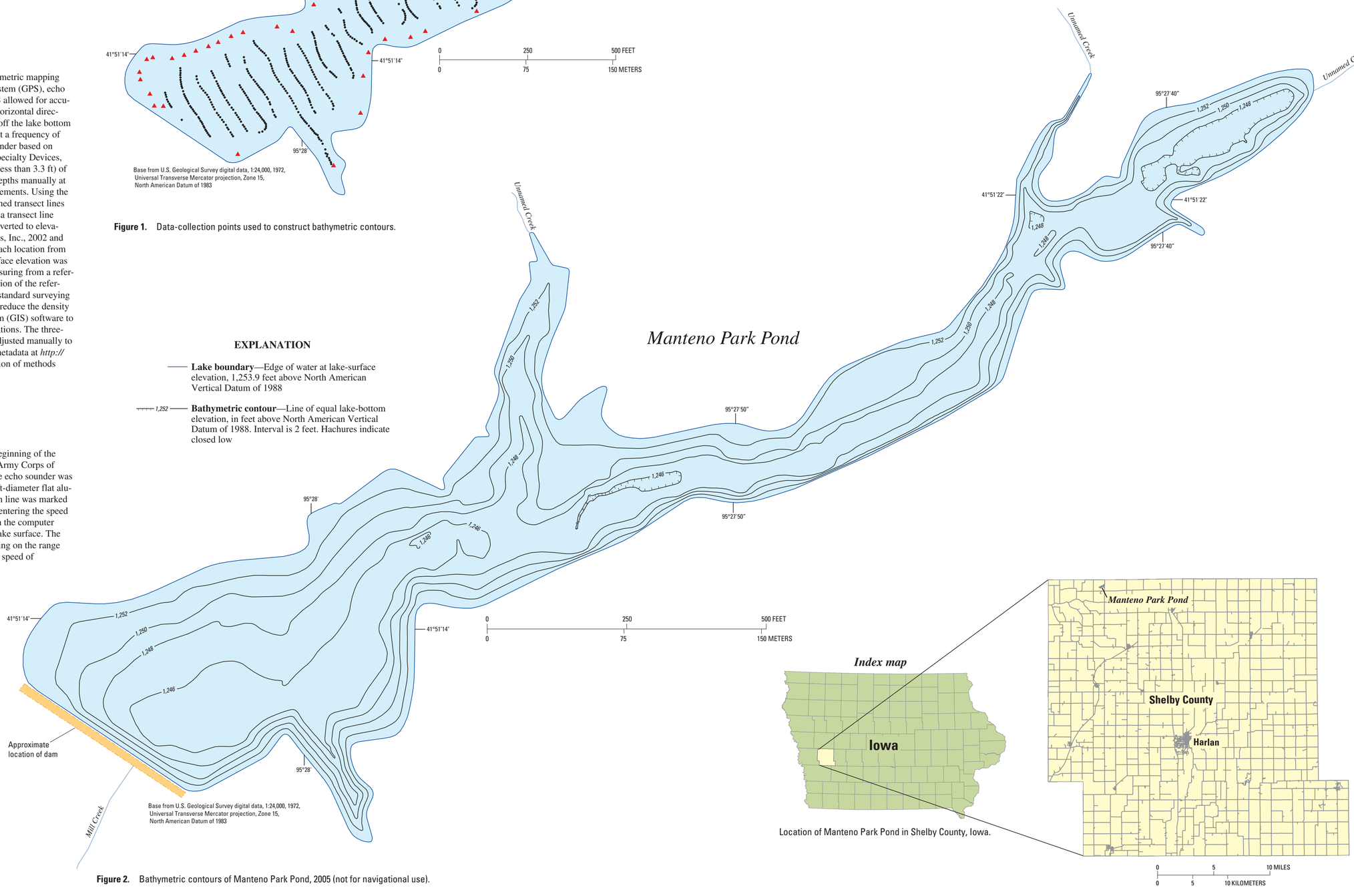

Figure 2. Bathymetric contours of Manteno Park Pond, 2005 (not for navigational use).

Bathymetric Contours for Manteno Park Pond, Shelby County, Iowa

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