

INTRODUCTION

Lake Hancock is in west-central Polk County near the geographic center of peninsular Florida (fig. 1). The lake is part of the headwaters of the Peace River-Saddle Creek (fig. 2) flow through the lake and then joins the Peace River-Saddle Creek about 3 miles south of the lake to the Peace River. Lake Hancock, with a surface area of 4,540 acres, is the largest lake in the Peace River basin in Polk County.

Lake Hancock is the 10th in a series of lakes selected for study as part of a continuing investigation of the hydrologic conditions in the Southwest Florida Water Management District. The objective of the project is to document hydrologic conditions in the selected lake basins. To accomplish this objective, available data were evaluated to describe the hydrology of Lake Hancock and its environment. A map of the lake basin was prepared from bathymetric data collected as part of the study. Existing climatological and hydrologic data were used in water-budget analyses to determine the relation of the lake to ground-water and surface-water conditions. Water-quality data were collected and analyzed to document past and current water-quality conditions in the lake.

The hydrology and geology of the Lake Hancock area have been described in several publications by the U.S. Geological Survey. Heath (1961) reported on the surface-water resources of Polk County and included detailed estimates of stage for Lake Hancock and of discharges for Saddle Creek. A comprehensive description of the ground-water resources of Polk County was provided by Stewart (1966). Kaufman (1967) reported on the hydrologic effects of ground-water pumping in the Peace River basin. Robertson (1973) presented a brief description of stage fluctuations of Lake Hancock in his report on hydrologic conditions in the Lakeland Ridge area of Polk County. Hutchinson (1977) reported on shallow ground-water resources in the upper Peace River basin.

Several other reports and consultants have published reports on the Lake Hancock area. The Peace River Valley Water Conservation and Drainage District (1960) presented plans for improvement and development in the Peace River basin, including a recommendation for regulating the stage of Lake Hancock. Flood-plum information for Saddle Creek was published by the U.S. Army Corps of Engineers (1974). The Southwest Florida Water Management District (1976) estimated flood-stage frequency relations for several lakes in Polk County, including Lake Hancock, and in the same report presented wide-spread effects on Lake Hancock. Ardaman and Associates (1978) compiled locations of recorded rainfalls in Polk County.

Hydrologic data reports are published on a regular basis by the U.S. Geological Survey. Maps showing the potentiometric surface of the Floridan aquifer are published twice a year through cooperative programs with the Southwest Florida Water Management District. Water levels for Lake Hancock, discharges for Saddle Creek, and water-quality data are published annually in the series "Water Resources Data for Florida".

All elevations in this report are in NGVD 1929 (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 "mean sea level". NGVD of 1929 is referred to as sea level in this report.

AREA DESCRIPTION

Polk County is part of the highland area that trends along the north-south axis of peninsular Florida. Within the highland area, the Peace River and its tributaries are separated by relatively flat lowland areas. Lake Hancock is in the lowland area between the western and central ridges (fig. 1).

The climate of the Lake Hancock area is subtropical with humid, rainy summers and dry, mild winters. Average monthly temperatures range from 61°F in January to 82°F in July and August. About half the annual rainfall occurs during these three months. There has been an extended period of below-normal precipitation in the Lake Hancock area and in central Florida generally since 1960. Average annual precipitation for the National Weather Service station at Bartow, about 3 miles south of the Lake Hancock, is 53.85 inches, based on records from 1887 to 1977. Annual departures from average precipitation are shown in figure 3. Annual precipitation exceeded the average only twice from 1961 to 1977, resulting in a cumulative precipitation deficit of 78.25 inches.

Lake Hancock receives inflow from several streams. Saddle Creek originates east of Lakeland, flows generally south through a swampy area, and enters Lake Hancock about 1.2 miles southeast of State Road 540 (fig. 2). Lake Lena Run originates at the outlet of Lake Lena in Auburndale and enters Lake Hancock on the northeast side. Banana Lake, located about 1 mile northwest of Highland City, discharges into Banana Lake Overflow Canal that enters the west end of Lake Hancock. The shoreline of Lake Hancock has an elevation of slightly less than 100 feet above sea level. Within 1 mile of the shoreline, the lake is less than 100 feet above sea level. The lake, land-surface elevations exceed 100 feet above sea level. North and around the lake the land is relatively flat and swampy. Along the shoreline there is a strip of overland (fig. 2) generally less than 500 feet wide. At the lake outlet and on the southwest side, the swamp extends inland more than 1,000 feet. On the north end, where Saddle Creek enters the lake, swamps extend more than 0.5 mile inland.

Lake Hancock is in central Florida, the shoreline around Lake Hancock has not been developed into landward features. Along the eastern and southern shores of the lake there has been extensive strip-mining for phosphate. Pasture and citrus groves extend along the western shore. The public does not have ready access to the lake. Lake Hancock and the surrounding area are underlain by a layer of sand, clay, and limestone, ranging in thickness from about 100 feet to 400 feet. This surficial layer is underlain by several hundred feet of limestone and dolomite (Stewart, 1966). The formations can be divided into three hydrologic units: (1) the surficial aquifer, (2) secondary artesian aquifers and confining beds, and (3) the Floridan aquifer. Two generalized hydrologic sections are presented in figure 4. The sections are based on data from wells described by Stewart (1966) and on well logs from the Florida Bureau of Geology. Locations of the sections are shown in figure 1.

The surficial aquifer is composed of sand, sandy clay, and pebble phosphate deposits, which in Polk County have been used as a source of gravel. The thickness of the surficial aquifer ranges from about 20 feet near the shore of Lake Hancock to about 100 feet at the west end of section A-A' (fig. 4).

The secondary artesian aquifers and confining beds of Tertiary age are composed of clay, dolomite, and limestone of the Hawthorn Formation and the Tampa Limestone. The thickness of the secondary artesian aquifers and confining beds ranges from about 50 feet near Lake Hancock to about 150 feet at the west end of section A-A' (fig. 4).

Limestone and dolomite of the Hawthorn Limestone, Ocala Limestone, and Anson Park Limestone of Tertiary age make up the Floridan aquifer. Drilling logs described by Stewart (1966) indicate that zones within the limestone and dolomite contain numerous cavities and horizontal features. These result from dissolution of the carbonate rock by circulating ground water. Weaknesses in the geologic structures caused by dissolution are commonly responsible for sinkhole collapse. Ardaman and Associates (1978) reported that between 1966 and 1976 there were more than 20 sinkhole collapses within 5 miles of Lake Hancock.

According to Hutchinson (1977), ground water in the surficial and secondary artesian aquifers flows from the western and central ridges into the streams of the lowland areas. A depression in the potentiometric surface of the Floridan aquifer beneath the lake, however, shows the level of Lake Hancock is above the potentiometric surface of the secondary artesian and Floridan aquifers, at least in the past (Stewart, 1966, p. 88-87), there would be downward leakage from the lake into the underlying aquifer systems.

LAKE CHARACTERISTICS

The bottom of Lake Hancock was mapped in August 1978 using a sounding rod. Lake stage at the time of the soundings was 98.6 feet above sea level. Depth contours shown on the photograph have been, however, as referenced to the average stage for the period of record (1960-77), 97.68 feet above sea level.

The bottom slopes relatively steeply from the western shore to a 5-foot deep trough, which lies 600 to 1,000 feet from the western shore. This trough is probably the submerged stream channel of Saddle Creek. On the eastern and southern sides of Lake Hancock, a firm sand bottom slopes gradually from shoreline to a depth of about 3 feet, 1,000 to 1,500 feet from shore.

The bottom of Lake Hancock is covered with a layer of organic material extending from the 5-foot depth contour on the east to the submerged stream channel on the west. Depth soundings for the lake were made in first recognizable bottom material. The material probably only reached the top of the organic layer. Kemmer (1964) presented bottom maps of 3 lakes in Polk County, all of which were at least 5 feet deep. It is probable that Lake Hancock has a morphology similar to that of the lake described by Kemmer. To the organic layer may be more than 5 feet thick near the center of the lake. Ardaman and Associates (1978) reported a sinkhole near the center of the lake. Soundings did not provide any evidence of a sinkhole.

Stage records of Lake Hancock have been collected by the U.S. Geological Survey since 1960. Average lake stage for 1960-77 was 97.68 feet above sea level. The maximum stage of record, 103.18 feet above sea level, occurred on September 16, 1965, as a result of Hurricane Donna. Minimum stage of record, 93.98 feet above sea level, occurred on May 23, 1968.

Maximum, minimum, and mean monthly stages of Lake Hancock are shown in figure 5. The mean monthly stage is lowest in May and highest in September. Maximum stages for six of the months occurred in 1960, four of which were related to extensive flooding in central Florida due to Hurricane Donna. Minimum monthly stages occurred mostly in 1968 and 1977 after long periods of deficient rainfall.

The volume of water in Lake Hancock varies with lake stage, as indicated by the stage-volume curve in figure 6. Because of the flatness of the lake bottom, a small increase in lake stage, about 0.5 feet above sea level, results in a relatively large increase in surface area and in the volume of water in the lake. At a stage of 97 feet above sea level, the lake contains about 10,000 acre-feet of water. At a stage of 98 feet above sea level, there is about 20,000 acre-feet of water in the lake.

Outflow from Lake Hancock is regulated by Structure P-11, operated under the jurisdiction of the Southwest Florida Water Management District. Structure P-11, completed in August 1960, replaced the previous control, a concrete and timber weir. It is composed of two 25-foot by 7-foot radial gates atop a concrete abutment. In August 1965, the Governing Board of the Southwest Florida Water Management District (Resolution Number 183) adopted 95.0 feet above sea level as minimum desirable stage and 98.0 feet above sea level as maximum desirable stage. Operation of the structure is generally dependent on lake stage and weather conditions. During periods of low stage, however, one gate may be opened slightly to provide water for livestock downstream.

The frequency distribution of annual maximum stages for Lake Hancock is shown in figure 7. Because of the short period of record, the stage-frequency curve for Lake Hancock was verified through two independent estimates. One estimate was computed based on the correlation of annual maximum stages of Lake Hancock with annual maximum stages at the streamflow station, Peace River at Bartow, about 4 miles downstream from Lake Hancock. The second independent estimate of peak-stage frequency was determined from step-backwater computations (Chow, 1959) on Saddle Creek discharge from Lake Hancock. Flood profiles for Saddle Creek and Lake Hancock were developed through backwater analysis, starting with stage and discharge from recurrence interval for Peace River at Bartow Murphy and others, 1978. Both estimates agree closely with the frequency distribution presented in figure 7.

The frequency curve (fig. 7) should not be used to estimate the probability of exceedance in any one year because annual maximum stages used in defining the curve are not independent. Annual maximum stages of Lake Hancock have been subject to effects of regulation in the past. The magnitude and frequency of flooding may be affected by regulation in the future. Stage-frequency data shown in figure 7 may not accurately reflect actual flood levels under an altered regulatory scheme. These stage-frequency curves for Lake Hancock are shown in figure 8. Curves for total days of record, for September days of record, and for May days of record are presented to show average, high, and low conditions, respectively. Figure 8 illustrates the narrow range of stage fluctuations of Lake Hancock. For total days of record, lake stage is within 0.5 feet of average stage 97.68 feet above sea level about 40 percent of the time. Lake stages for September and May are about 0.5 feet higher and lower, respectively, than stage for total days of record for the same probability of exceedance.

Records of daily discharges for Saddle Creek at Structure P-11 have been collected since 1964. Average daily discharge for October 1964 to September 1977 was 0.01 cubic feet per second. The maximum discharge of record, 516 cfs, occurred on August 13-14, 1965. There are many days of no flow in some years.

Maximum, minimum, and mean monthly discharges of Saddle Creek at Structure P-11 are shown in figure 9. The mean monthly discharge is lowest in May and highest in September. At the end of the wet summer season, the year of occurrence is shown on the curve in figure 9. Minimum discharge is zero for all months except September, which has a minimum discharge of 0.03 cfs.

Saddle Creek flow-duration curves for total days of record, September days of record, and May days of record are shown in figure 10. The September and May curves represent high and low conditions, respectively. A discharge of 0.01 cfs has been exceeded about 20 percent of the time in May, about 40 percent of the time during the period 1964-77, and about 65 percent of the time in September. Median discharges (50 percent exceedance) are about 0.01, 0.3, and 130 cfs for the May curve, total days curve, and September curve, respectively.

WATER BUDGET

The volume of water in Lake Hancock fluctuates in response to precipitation, evaporation, inflow, and outflow. This relationship can be expressed by water-budget equation.

Change volume	Precipitation	Evaporation	Surface inflow	Surface outflow	Net ground-water flow
Net ground-water flow	Ground-water inflow	Ground-water outflow			

The amount of water in each element of the water budget was evaluated by month, for the period 1964-77, to provide a basis for understanding the hydrology of the lake system. No other factors, such as diversions and consumption, are known to significantly affect Lake Hancock.

The volume of water in Lake Hancock is a function of lake stage as shown in figure 5. Monthly changes in volume were determined from lake-stage data (fig. 11) and the stage-volume relation.

Monthly precipitation data (fig. 11) used in the water-budget analysis were taken from National Weather Service records for Bartow. During the budget period, 1964-1977, annual precipitation exceeded the long-term average only once, in 1969. The cumulative precipitation deficit during the budget period was 74.73 inches, or an average of 0.34 inches per year.

Average monthly evaporation for Lake Hancock is estimated to range from about 2.5 inches in December to about 5.6 inches in July (fig. 12). Estimates were based on average annual evaporation of 36 inches from shallow lakes in central Florida (Kishler and others, 1969, p. 2) and on a comparison of average monthly evaporation with lake stage. Wet Palm (Linsley and Franzen, 1972). Although monthly evaporation varies from year to year, the variations are not considered critical. Average monthly evaporation of 36 inches, evaporation basins from Lake Hancock, exceeded total annual precipitation for 10 of the 14 years in the budget period.

Monthly mean surface-water outflow (fig. 11) was calculated from daily discharge records for Saddle Creek at Structure P-11. Monthly mean surface-water inflow (fig. 11) was estimated from about 25 miscellaneous measurements of Saddle Creek upstream from Lake Hancock. These measurements were made between 1965 and 1974. The measurements were correlated with measurements from the continuous record station, Peace Creek Drainage Canal near Altamira, about 5 miles southeast of Lake Hancock, and with measurements from Peace River at Bartow, a continuous record station about 4 miles downstream from Lake Hancock. The estimates of monthly inflow through Saddle Creek were generated from the two correlations. The arithmetic average of the two correlation estimates was adjusted by a drainage area ratio to account for additional surface-water inflow to Lake Hancock from Banana Lake Overflow, Lake Lena Run, and the adjacent swamps.

Net ground-water flow represents the difference between ground-water inflow and outflow. Ground-water inflow and outflow were not measured directly. The net exchange between Lake Hancock and ground-water system was, instead, estimated by solving the water-budget equation for net ground-water flow. Because it is computed as a residual, the accuracy of the net ground-water term is dependent upon the cumulative errors for net surface-water flow. Because it is computed as a residual, the accuracy of the net ground-water term is dependent upon the cumulative errors for net surface-water flow.

Results of water-budget calculations for three 9-month periods are listed below. September 1967 to May 1968 represents a period of declining lake levels. June 1968 to February 1969 represents a period of rising lake levels, and August 1971 to April 1972 represents a period during which the level of Lake Hancock stayed relatively constant. All values are in inches over the surface area of the lake, assumed constant at 4,540 acres.

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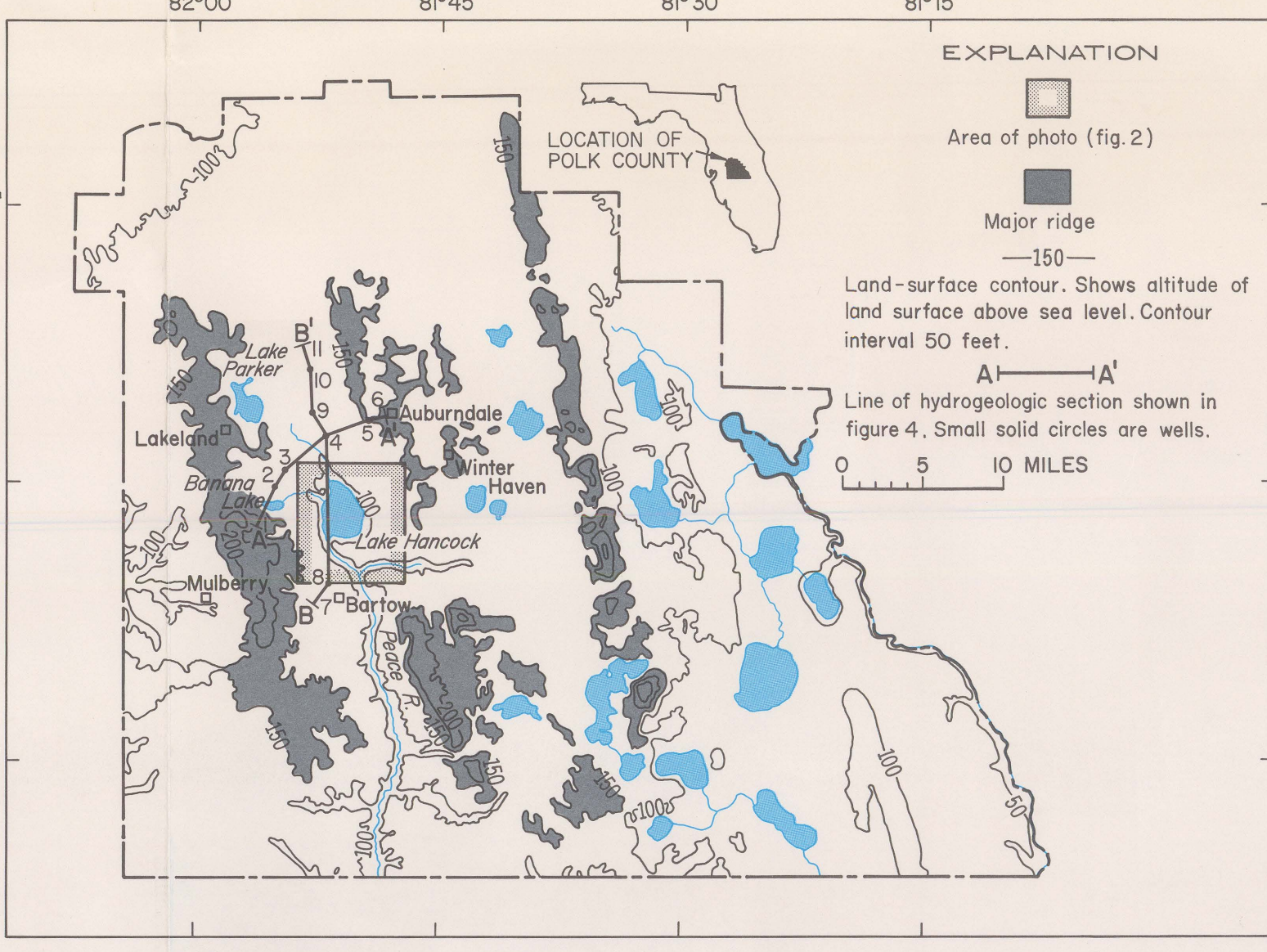


Figure 1.—Location of Lake Hancock and the three major ridges in Polk County.

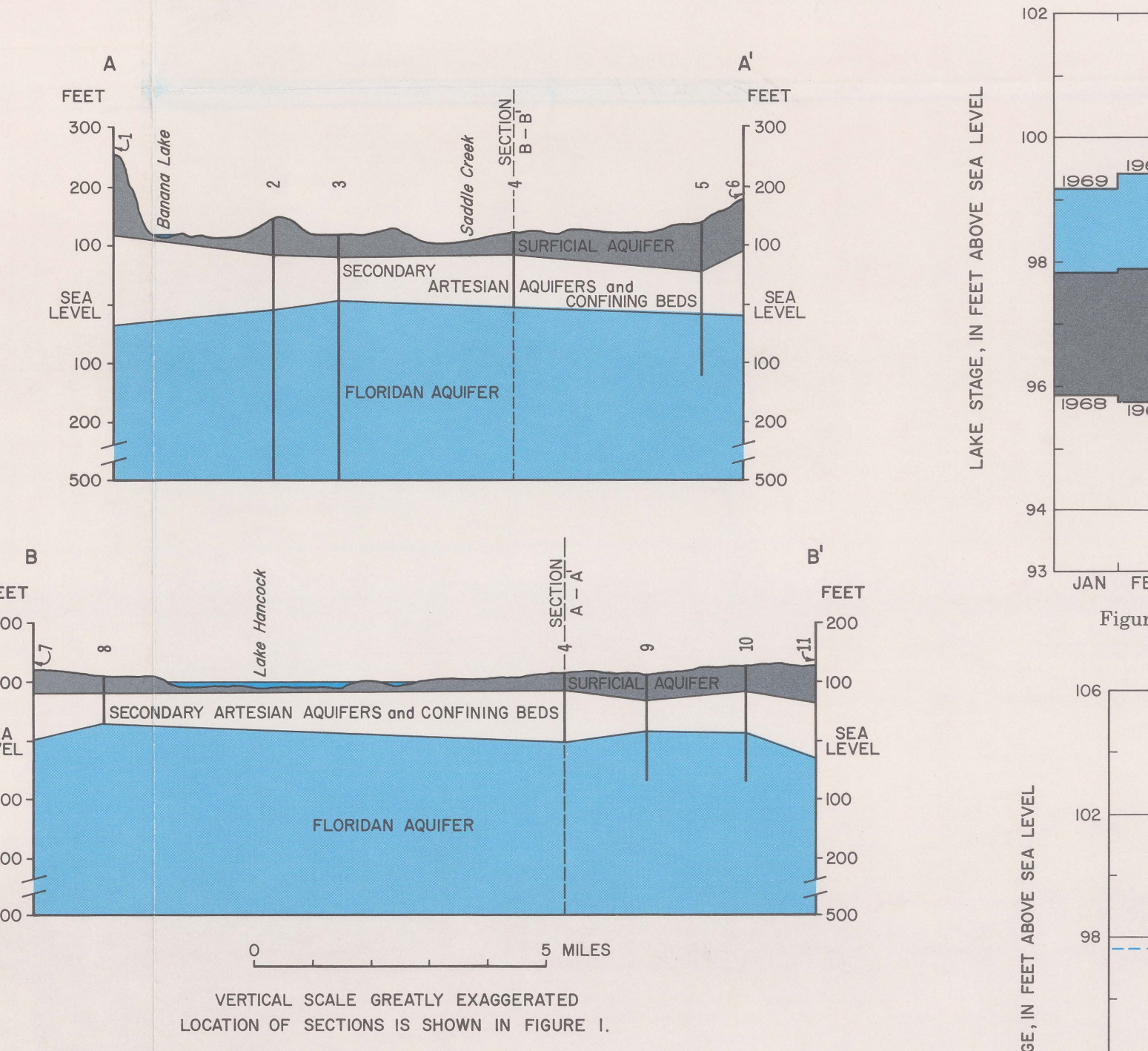


Figure 4.—Generalized hydrologic sections across the Lake Hancock area.

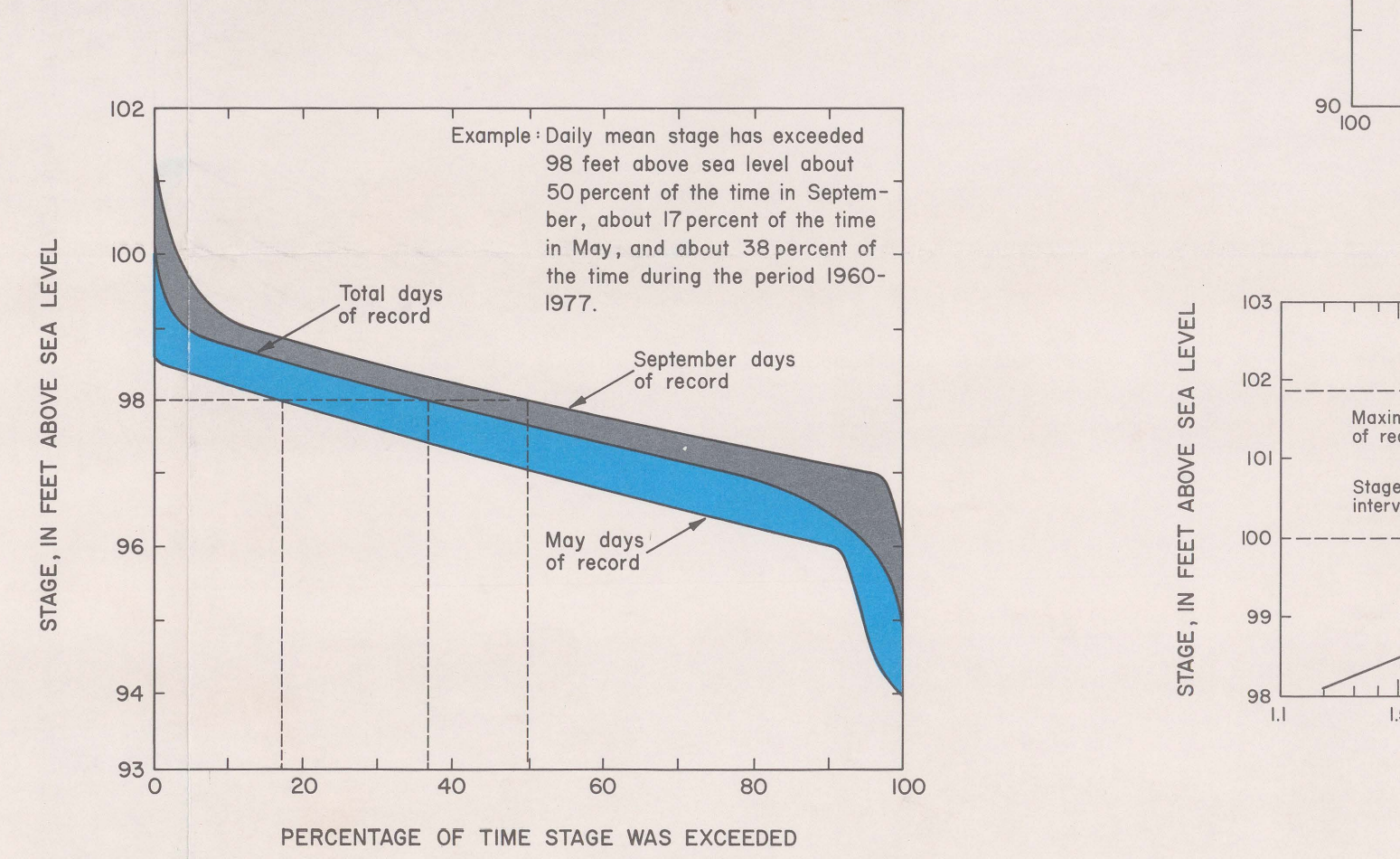


Figure 8.—Duration of daily mean stages, 1960-77, and for May and September.

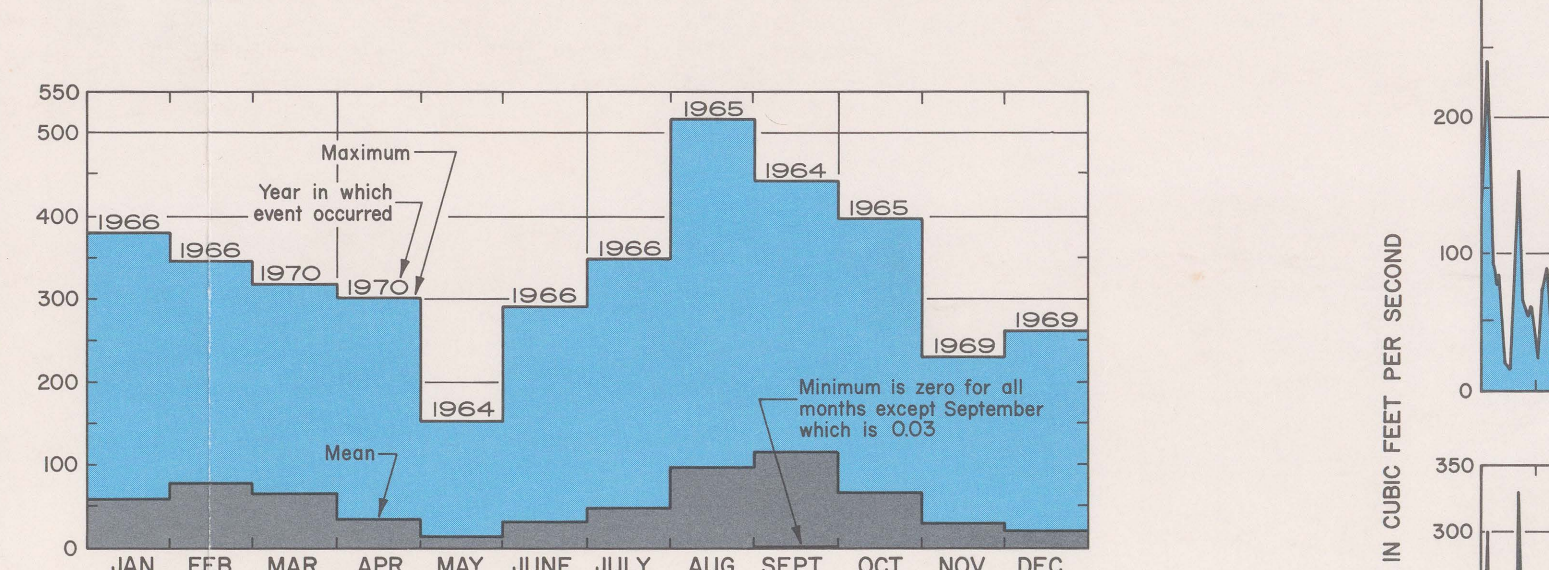


Figure 9.—Maximum, minimum, and mean monthly discharges of Saddle Creek at Structure P-11, 1964-77.

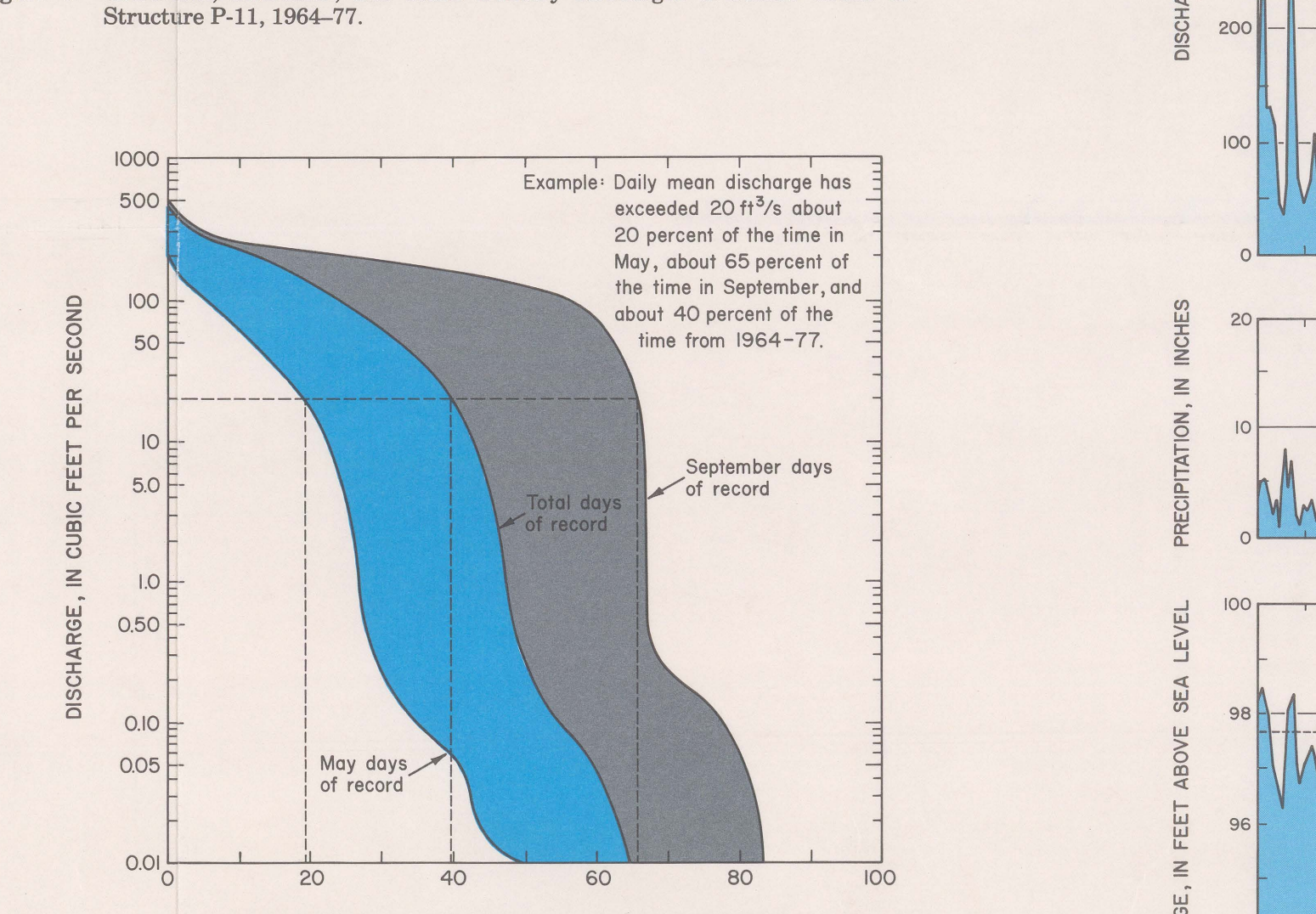


Figure 10.—Duration of daily mean discharges for Saddle Creek at Structure P-11, 1964-77, and for May and September.

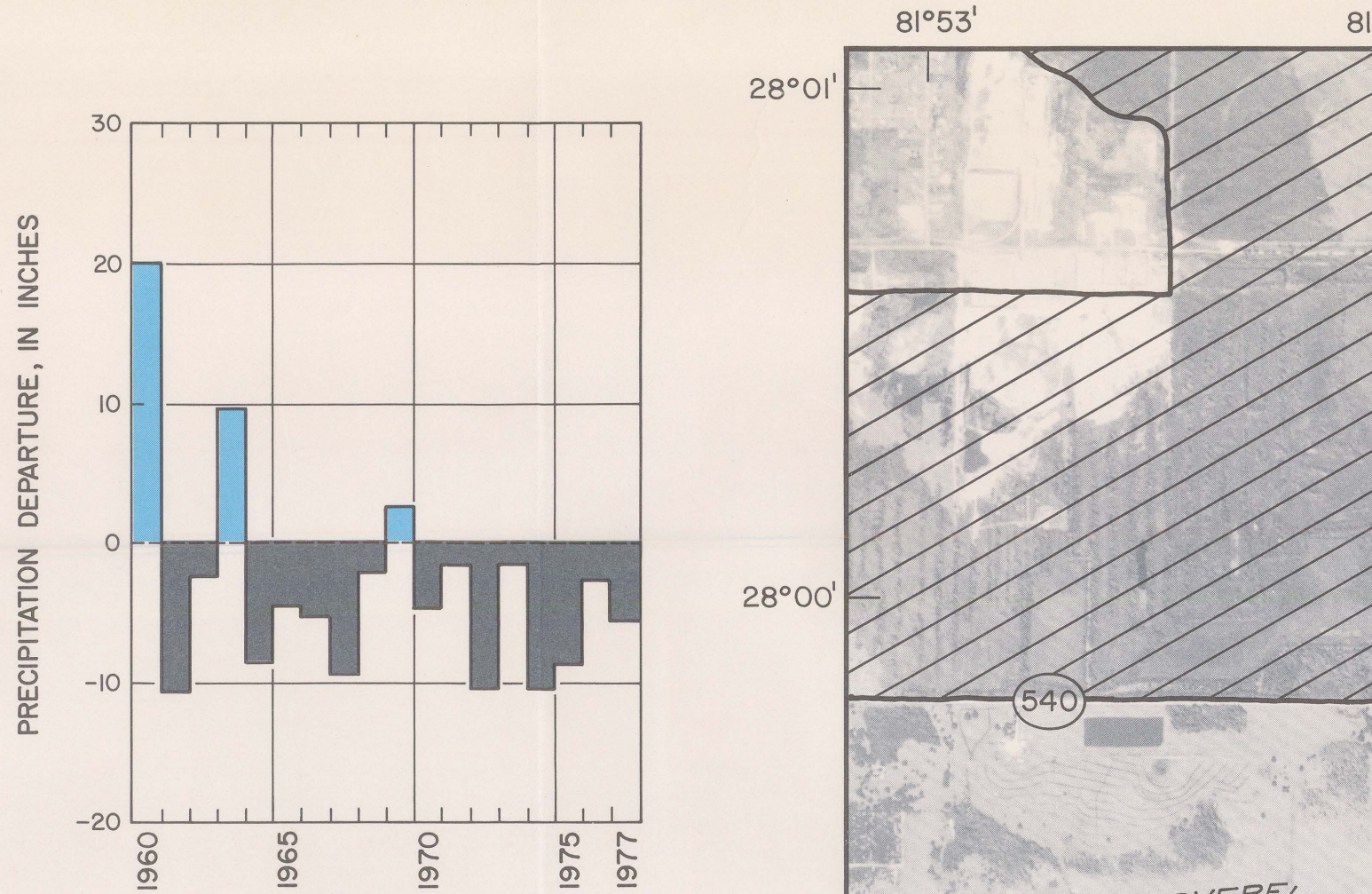


Figure 3.—Annual departures from long-term average precipitation (33.95 inches) at Bartow, 1960-77.

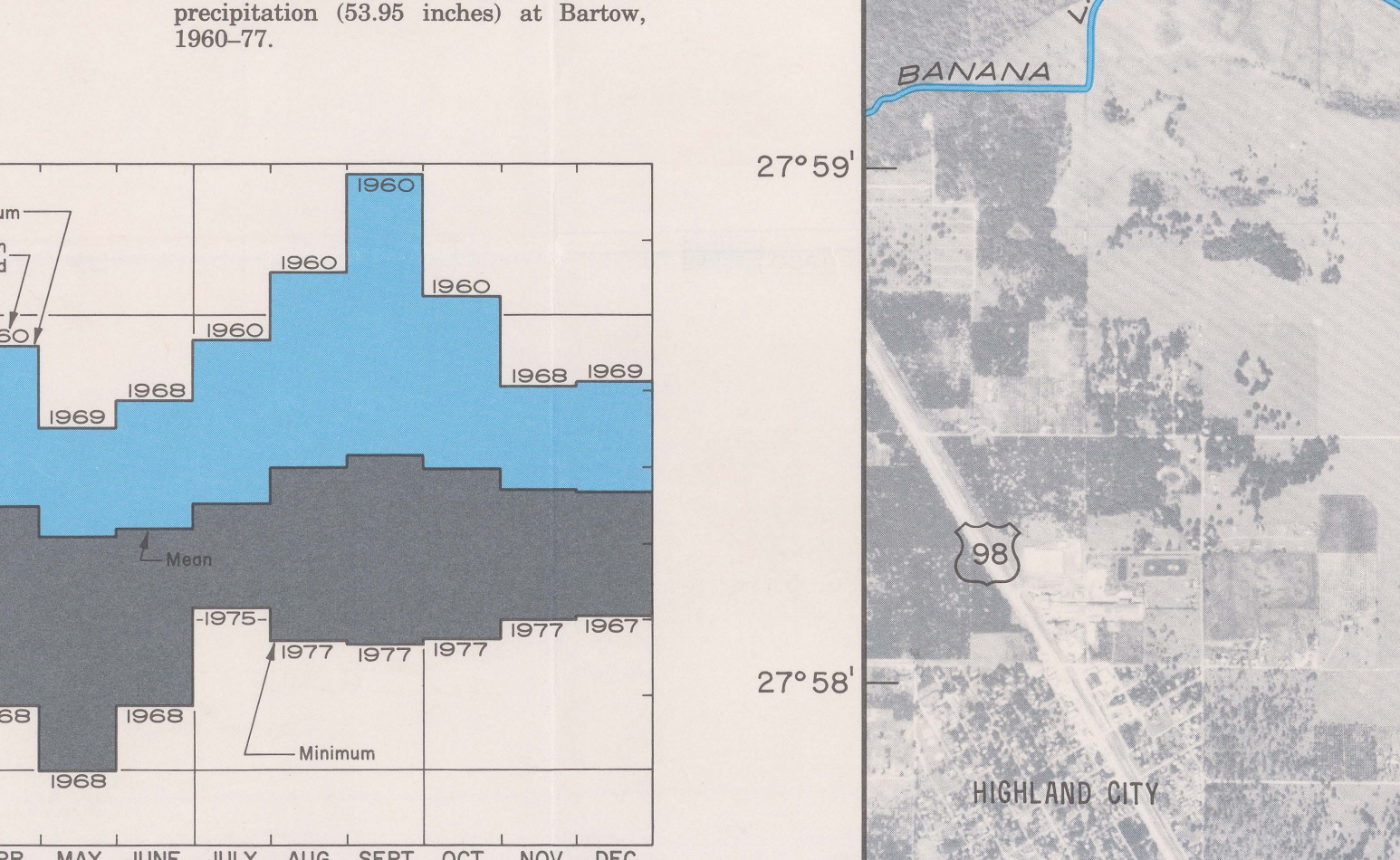


Figure 5.—Maximum, minimum, and mean monthly stages, 1960-77.

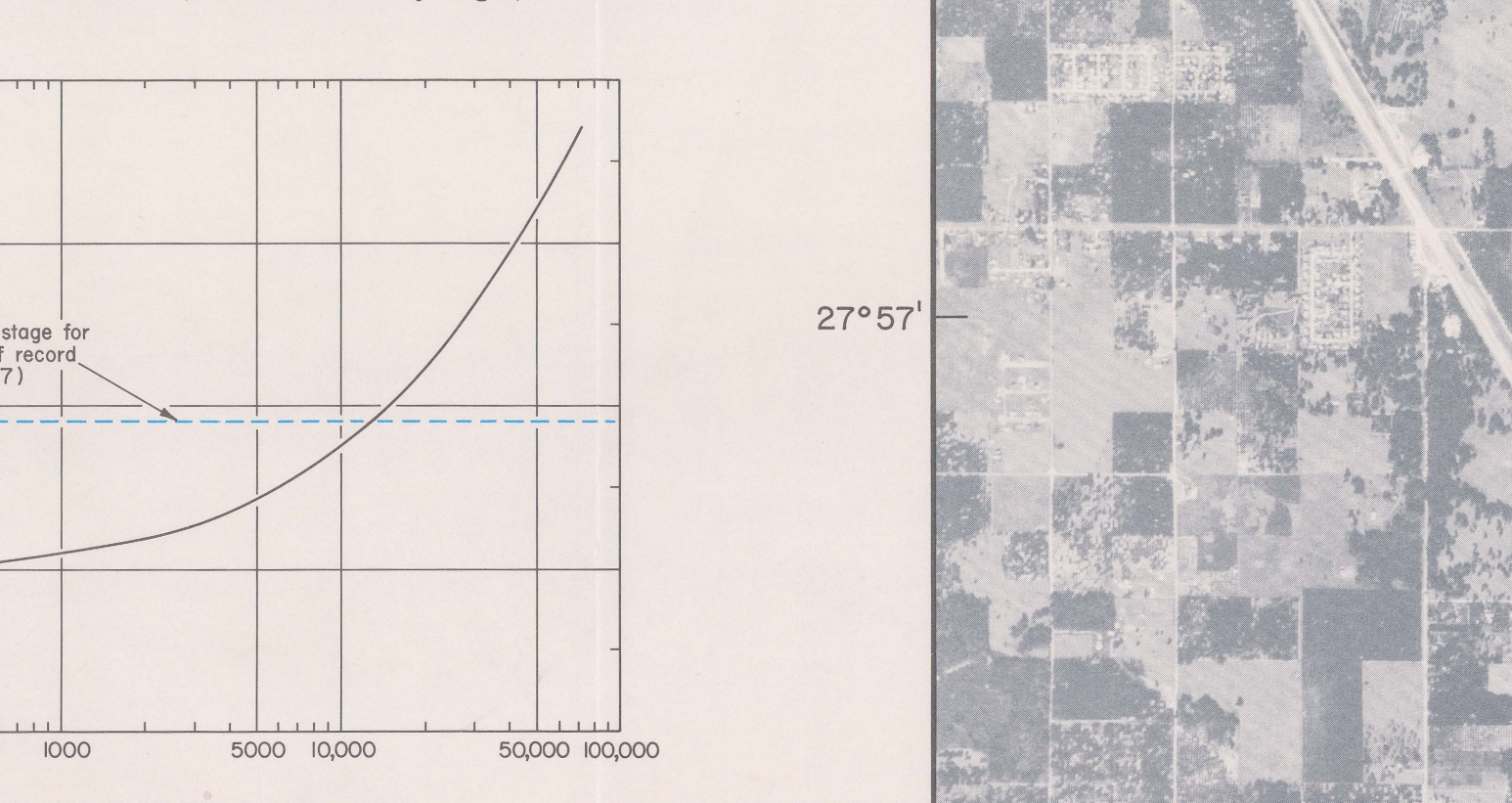


Figure 6.—Stage-volume relation.

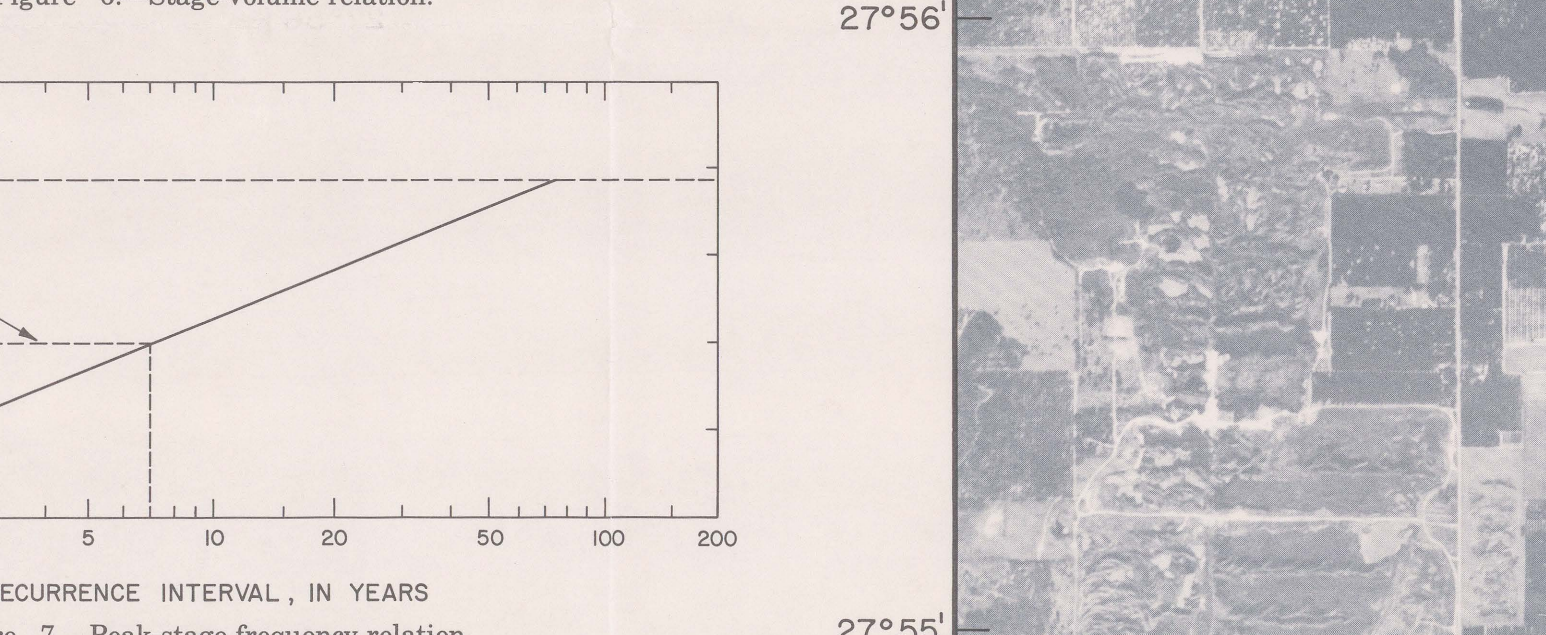


Figure 7.—Peak-stage frequency relation.

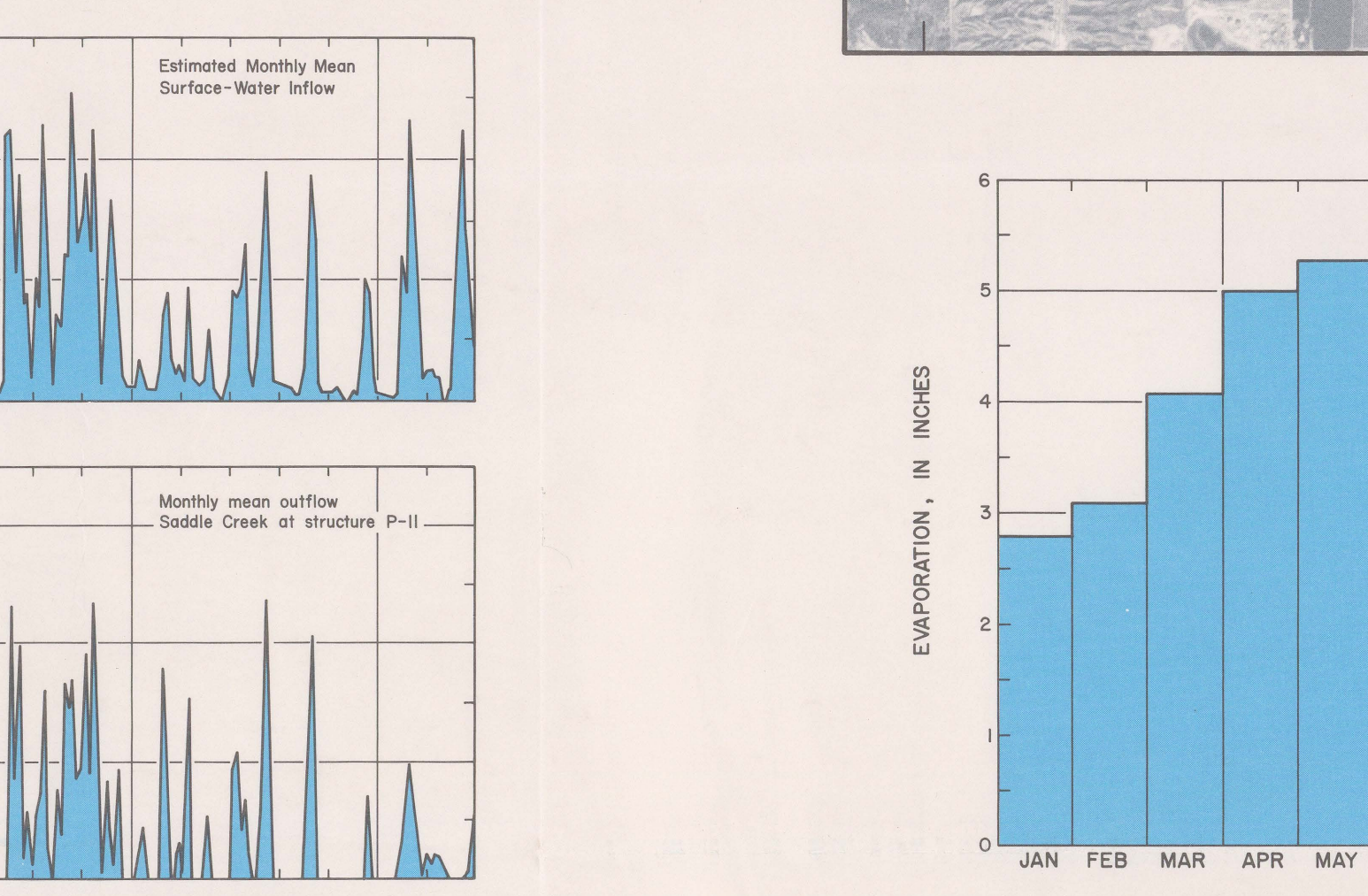


Figure 11.—End-of-month stages of Lake Hancock, monthly precipitation at Bartow, monthly mean outflow through Saddle Creek at Structure P-11, and estimated monthly mean surface-water inflow, 1964-77.

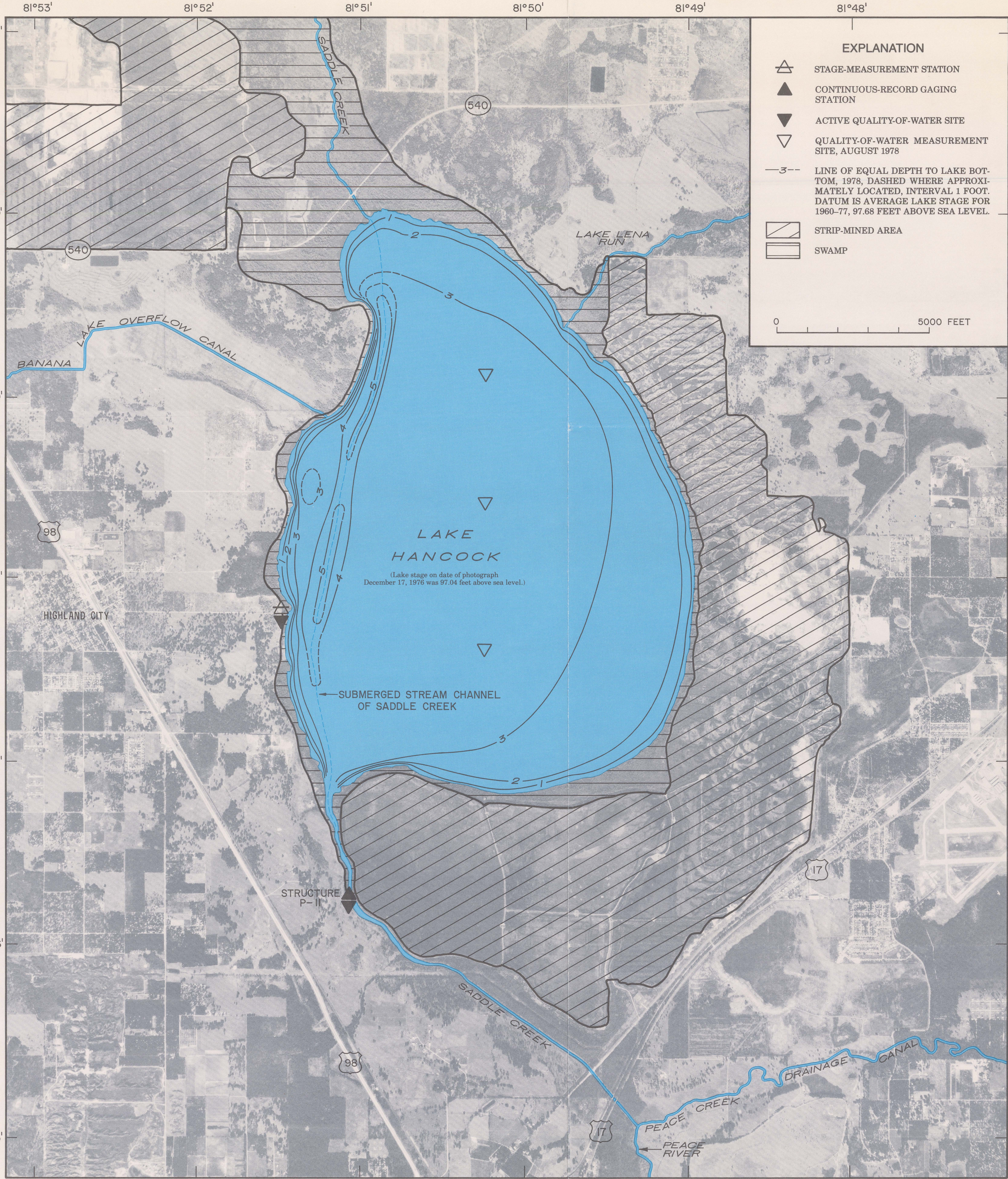


Figure 2.—Lake Hancock bottom contours, data collection sites, and adjacent land use.

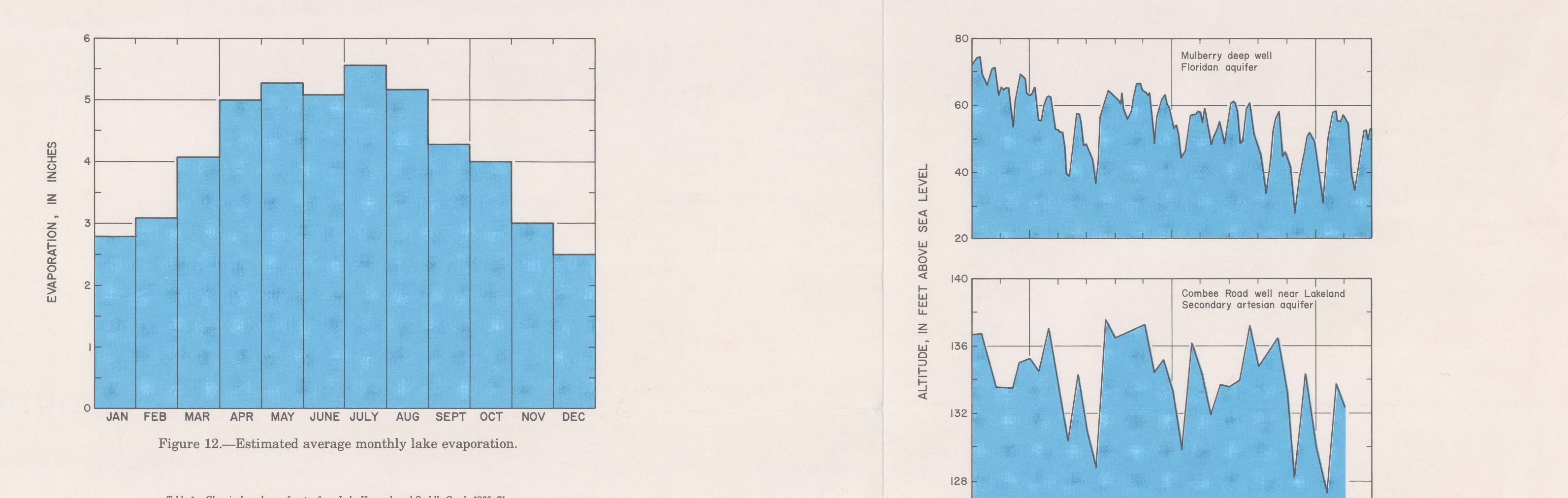


Figure 12.—Estimated average monthly lake evaporation.

Figure 13.—Water levels in Mulberry deep well and Combee Road well, 1964-77.

Table 2.—Analysis of water from Lake Hancock, August 1979 (In milligrams per liter, except as noted)	Station	Date	Time	Chemical analysis (mg/L)	pH	Temperature (°C)	Dissolved oxygen (DO)	Phytoplankton (10 ⁶ cells/L)	Total	Return flow (g/L)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Date	Time	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)	Ammonia (NH ₄)	Phosphate (PO ₄)	Silica (SiO ₂)	Iron (mg/L)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO ₄)	Potassium (K)	Boron (B)	Aluminum (Al)	Nitrate (NO ₃)	Nitrite (NO ₂)