HYDROLOGY OF LAKE PANASOFFKEE, SUMTER COUNTY, FLORIDA

By
G. F. Taylor

Prepared by the
U.S. GEOLOGICAL SURVEY
in cooperation with the
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

INTRODUCTION

Lake-front property is one of the prime locations for development in Florida because of its aesthetic and recreational value. Development around a lake without proper planning, however, may adversely affect the quality of the water in the lake and devalue the surrounding properties. Hydrologic background information about a lake is helpful in planning for future development. For that reason, the U.S. Geological Survey, in cooperation with the Southwest Florida Water Management District, made a hydrologic study of Lake Panasoffkee and its surrounding area from October 1974 to June 1975.

GEOGRAPHY

Lake Panasoffkee is in midwest Sumter County, in central Florida. The lake is in a predominantly rural area (fig. 1) west of the town of Coleman and Interstate Highway 75 and just north and east of the town of Lake Panasoffkee. The lake is about 2 mi east of the Withlacoochee River and the Sumter County line (fig. 2).

The lake is about 6 mi long, about 1.5 mi wide at its widest point, and has an area of 7.5 mi^2. Its average depth is 7 ft and its maximum depth is 10 ft when the lake level is 40.95 ft above mean sea level. The west shore of the lake is lined with residences and fish camps. The east shore is not developed and beyond the lake to the east are undeveloped marsh and wooded swamps of low relief.

The topographic drainage basin area for Lake Panasoffkee covers about 420 mi^2 and forms a large part of the Withlacoochee River basin east of the Withlacoochee River. The topographic basin, which is elongate north-south, includes much of Sumter and parts of Marion and Lake Counties.

The north part of the basin is sandy, well drained, and almost entirely in farms, ranches, and citrus groves. The south part of the basin is low and sandy and although it contains large marshy areas, it is also agricultural, with more citrus groves than in the north part.

HYDROLOGIC SETTING

Because of the karstic terrain of the topographic basin, only 60 mi^2 of basin actually contribute direct surface runoff to the lake (fig. 2).

Big Jones Creek and Little Jones Creek flow into Lake Panasoffkee from the north; Shady Brook flows into the lake from the south. The creeks are partly spring fed. Water discharges from the lake by way of the 2-mile long Outlet River to enter the Withlacoochee River, which flows into the Gulf of Mexico near Yankeetown. The lake outflow is controlled by small rock dams in Outlet River except during high stages of the Withlacoochee River when outflow is controlled by the backwater.

Two freshwater aquifers underlie the basin, a shallow water-table aquifer consisting mostly of sand and the Floridan aquifer consisting of porous limestone. Both aquifers apparently contribute water to Lake Panasoffkee. The contributing area of the shallow aquifer is essentially that of the contributing surface-water drainage shown in figure 2. The contributing area of the Floridan aquifer is south of an east-west line through the town of Wildwood. About 50 mi^2 of the total of 200 mi^2 in the ground-water basin lies outside the southern boundaries of the topographic basin (fig. 3).

Figure 4 shows the land profile along section A-A′, drillers' logs of four wells, and the potentiometric surface of the Floridan aquifer. Along this section, the top of the Floridan aquifer limestone ranges from 20 to 39 ft below land surface. For the topographic basin as a whole, the altitude of the top of the Floridan ranges from about 18 ft below to 100 ft above msl (mean sea level) (Faulkner, 1973).

The potentiometric surface (the height to which water will rise in wells cased into the aquifer) of the Floridan aquifer in May 1969 was about 40 ft above msl just west of the lake and 95 ft above msl in the south part of the basin (fig. 3). The level of the potentiometric surface of the Floridan is shown in reference to land surface in figure 1 and to sea level in figure 3. The potentiometric surface is higher than the lake surface most of the time. Ground-water movement is from the southeast to the northwest. Near the lake, the annual fluctuation of the potentiometric surface is less than 5 ft. At higher altitudes where seasonal fluctuations and pumping are greatest, it is as much as 10 ft.

The shallow aquifer consists of a surficial mantle of sand as much as 25 ft thick. The sand is underlain by a clay about 10 ft thick that acts as the confining layer for the artesian aquifer. Water levels in the shallow aquifer are at a depth of a few feet and follow the general configuration of the land surface.

LAKE STAGE AND RELATED FACTORS

The water level, or stage, of Lake Panasoffkee has been measured periodically since 1955 and continuously since December 17, 1962. The maximum stage of record was 44.28 ft above msl on April 15, 1960 and the minimum of record was 37.65 ft above msl on May 12, 1962. The stage of Lake Panasoffkee varies in response to rainfall, antecedent weather conditions and ground-water levels, evapotranspiration, infiltration capabilities of soils, and Withlacoochee River stages. The relation between lake stage, rainfall, and flow of Outlet River is shown in figure 5. Since 1964—construction of Wysong Dam was completed that year—variation in stage has been much less than before. This reduced fluctuation, as shown in figure 5, may be due in part to the operation of Wysong Dam and the lack of extreme wet or dry spells during this period.

The stage-duration curve for Lake Panasoffkee shown in figure 6 is based on data collected from 1966 through 1973, after installation of the Wysong Dam. This curve shows that 50 percent of the time during this 8-year period the lake stage has been higher than or equal to 40.95 ft.

The effect of seasonal imbalances between rainfall and evaporation on the lake stage is reflected in the graphs of figure 7. The increase in stage and also the excess of rainfall over evaporation are shown as positive; decreases in stage and evaporation in excess of rainfall are shown as negative. The average annual rainfall, according to the NOAA (National Oceanic and Atmospheric Administration) station at Bushnell, Florida, is 53 in and the average annual lake evaporation in the lake area is about 48 in (Kohler and others, 1959). Note that according to figure 7, the lake stage rises or falls as rainfall is greater than or less than evaporation; however, the balance between surface- and ground-water inflow and the continuous outflow through Outlet River also affects the stage.

GENERALIZED WATER BUDGET

The topographic basin includes 420 mi^2; however, because of land characteristics, most of the basin does not contribute surface-water runoff to the lake; the direct surface runoff area is only 60 mi^2 (fig. 2). On the basis of runoff of the Little Withlacoochee River at Rerdell and Jumper Creeks—both in similar drainage areas—the average surface runoff to the lake is 0.72 $(ft^3/s)/mi^2$ or 44 ft^3/s for the 60-mi^2 contributing area.

Inflow to the lake, in excess of the 44-ft^3/s runoff, must, therefore, be the ground-water contribution from the ground-water basin outlined in figure 3, and rainfall on the lake surface. The ground-water contributing area is about 200 mi^2, of which about 50 mi^2 lie outside the topographic basin.

The average outflow from Lake Panasoffkee by way of Outlet River over the 11-year period, 1963–73, is 207 ft^3/s. The estimate, summarized below, of the average daily water budget for Lake Panasoffkee indicates that about 160 ft^3/s or 103 Mgal/d of ground water enters the lake. This net ground-water inflow is from both the shallow aquifer and the Floridan aquifer, whose potentiometric surface is higher than the lake most of the time.

An estimate of the annual water budget for the lake is as follows:

	(ft^3/s)
INFLOW	
Rainfall directly on the lake surface	29
Surface inflow	44
Net inflow from the water-table and the Floridan aquifer	160
Total inflow	233
OUTFLOW	
Outlet River	207
Evaporation from the lake surface	26
Total outflow	233

WATER QUALITY

The quality of the water from Lake Panasoffkee has been generally good to the extent that concentrations of various constituents did not exceed recommended standards for public supplies (National Academy of Sciences and National Academy of Engineering, 1973). However, the water is moderately hard and slightly colored from tannins. The analyses listed in table 1 are typical for the water in Lake Panasoffkee. Dissolved solids is less than 200 mg/L, hardness less than 125 mg/L, and chloride 10 mg/L or less.

TABLE 1.—CHEMICAL ANALYSES OF WATER FROM LAKE PANASOFFKEE.
[Analyses by U.S. Geological Survey; values in milligrams per liter except where noted.]

Property	Date of sampling: May 1966	May 1967	May 1970	May 1973
Water temperature (°C)	—	28.9	27.0	28.0
Color	10	10	30	—
Conductance μmho/cm at 25°C.	280	210	240	212
Dissolved oxygen (DO)	—	11	9.0	7.9
Percent saturation	—	142	111	100
pH	7.4	7.9	7.5	—
Alkalinity	108	61	101	—
Bicarbonate (HCO_3)	132	74	123	—
Carbonate (CO_3)	—	0	.0	—
Phosphate (P)	—	—	0.10	—
Dissolved solids (residue at 180°C)	—	137	167	—
Orthophosphate, dissolved as P	0.026	.0	.006	.010
Hardness (Ca,Mg)	124	87	120	—
Noncarbonate hardness	16	26	19	—
Ammonia (NH_4) as N(nitrogen)	—	—	.03	—
Organic nitrogen	—	—	.59	.56
Calcium (Ca)	42	26	42	—
Magnesium (Mg)	4.6	5.2	3.5	—
Sodium (Na)	4.9	5.3	5.7	—
Potassium (K)	.2	.2	.2	—
Chloride (Cl)	9.0	10	8.8	—
Sulfate (SO_4)	17	20	11	—
Fluoride (F)	.3	.3	.4	—
Silica (Si)	8.1	3.2	4.5	3.4
Iron (Fe)	0	.01	—	—
Manganese (Mn)	—	.0	—	—
Strontium (Sr)	—	.37	—	—
Nitrate (NO_3) as N	.023	.0	.0	.0
Nitrite (NO_2) as N	—	—	.003	—

In April and May 1973, and in June 1974, minor fish kills may have been associated with algae blooms that were reported about the same time. Nonetheless, Lake Panasoffkee generally supports a favorably balanced fish population and a vast amount of aquatic vegetation of both surface and bottom types (Florida Game and Fresh Water Fish Commission, 1973). Floating hyacinths sometimes congest parts of the lake and Outlet River.

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Stewart, J. W., Mills, L. R., Knochenmus, D. D., and Faulkner, G. L.
1971 Potentiometric surface and areas of artesian flow, May 1969, and change of potentiometric surface 1964 to 1968, Floridan Aquifer, Southwest Florida Water Management District, Fla. U.S. Geol. Survey Hydrol. Atlas HA-440.

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in the report are listed below:

Multiply English unit	By	To obtain metric unit
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
foot (ft)	0.3048	meter (m)
inch (in)	25.4	millimeter (mm)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
million gal. per day (Mgal/d)	0.04381	cubic meters per second (m^3/s)
cubic feet per second per square mile $(ft^3/s)/mi^2$	0.01093	cubic meters per second per square kilometer $(m^3/s)/km^2$

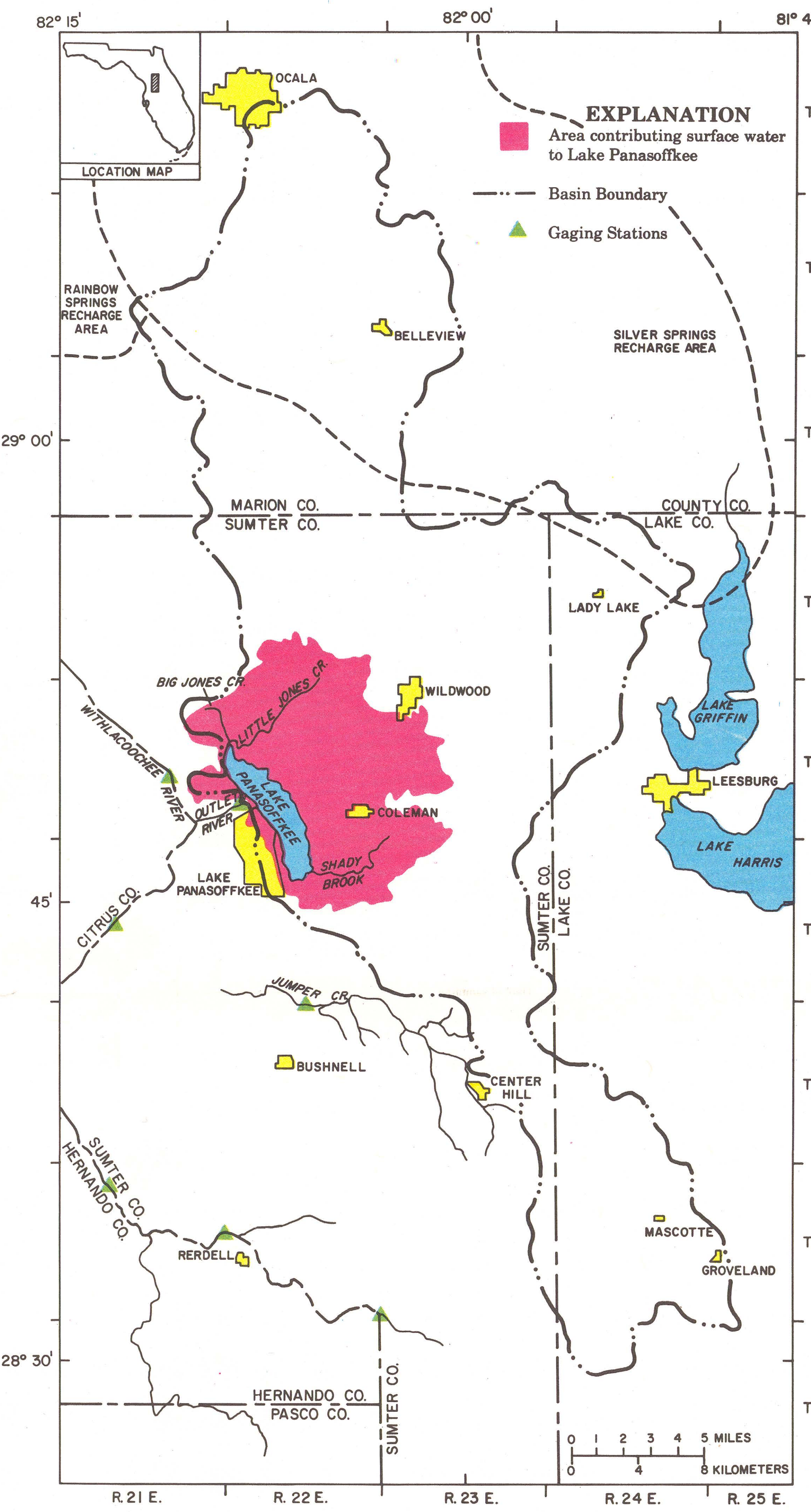

Figure 2 — Map of Lake Panasoffkee drainage basin showing surface-water contributing area.

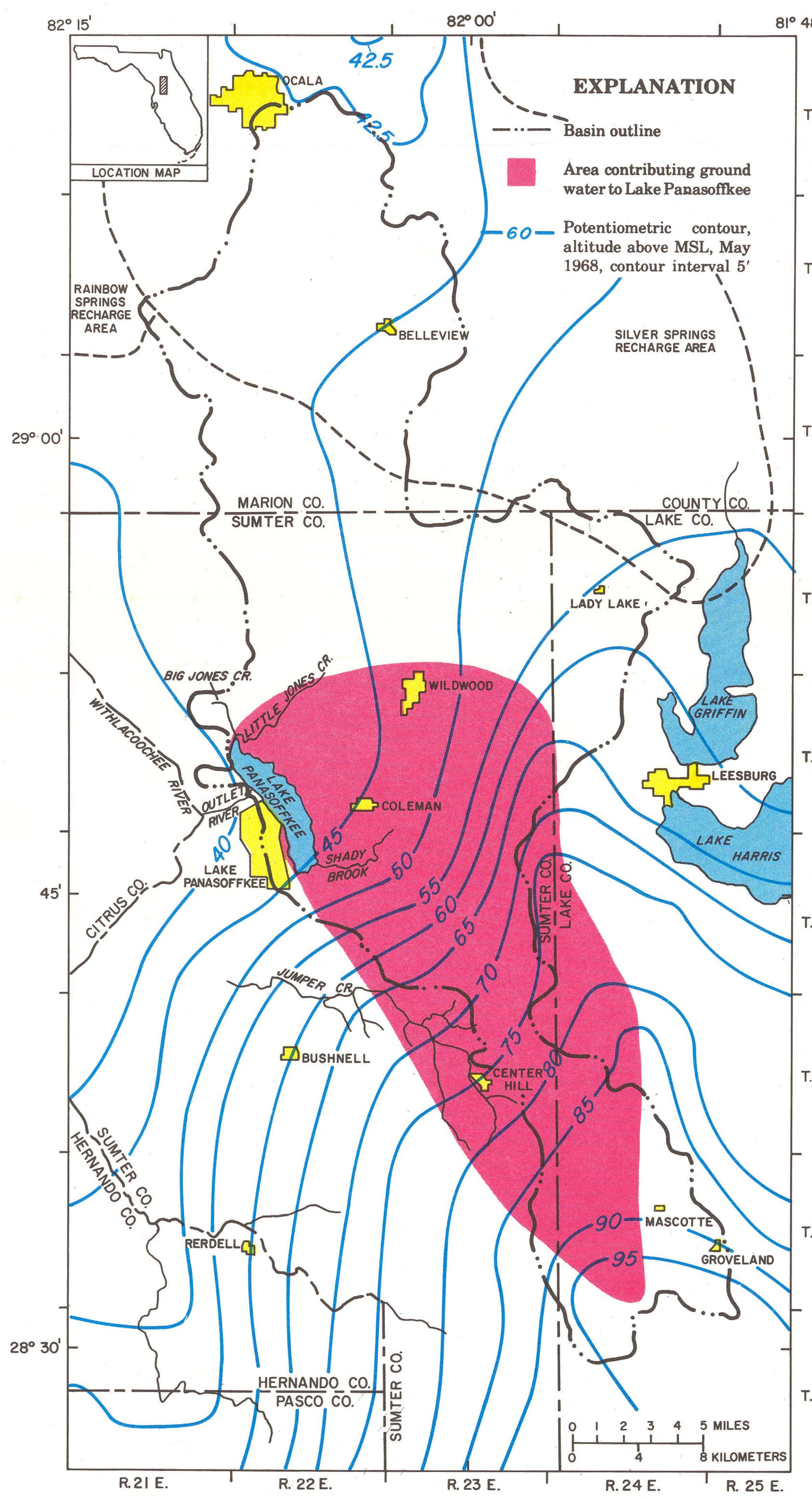

Figure 3 — Potentiometric surface of Floridan aquifer, May 1968 in the Lake Panasoffkee drainage basin and the area contributing ground water to the lake.

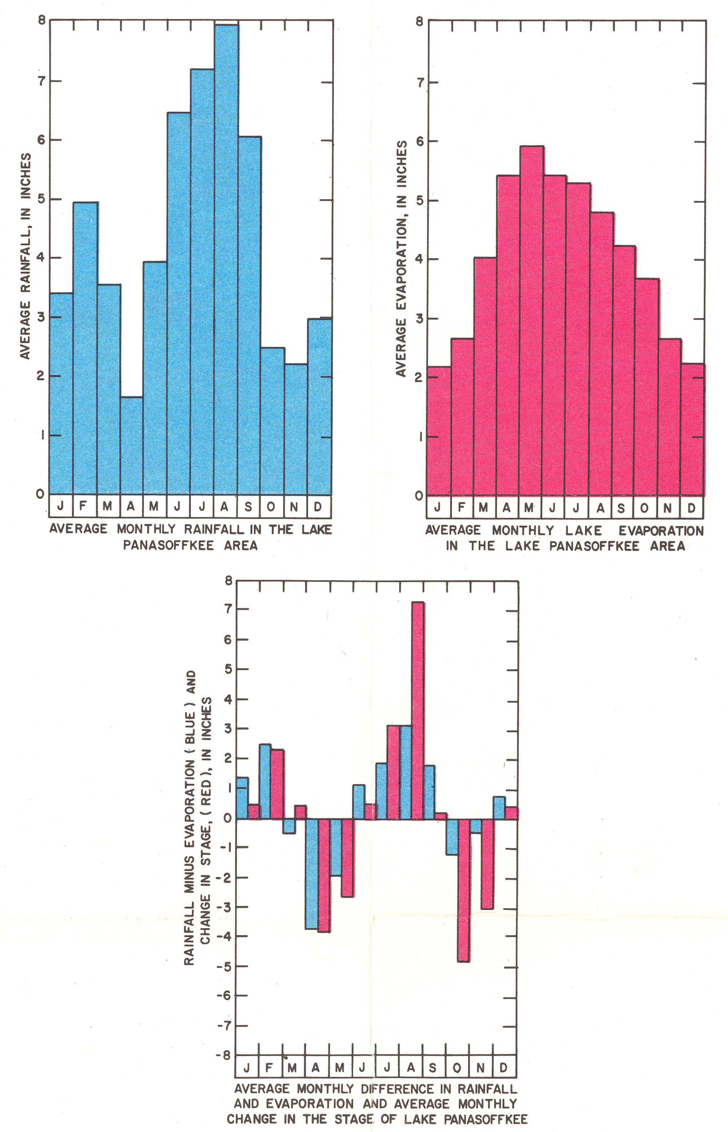

Figure 7 — Comparison of average monthly rainfall, evaporation, and change in lake stage 1963–73. Rainfall data from National Oceanic and Atmospheric Administration (NOAA). Evaporation data are from pan evaporation values from NOAA adjusted to lake evaporation.

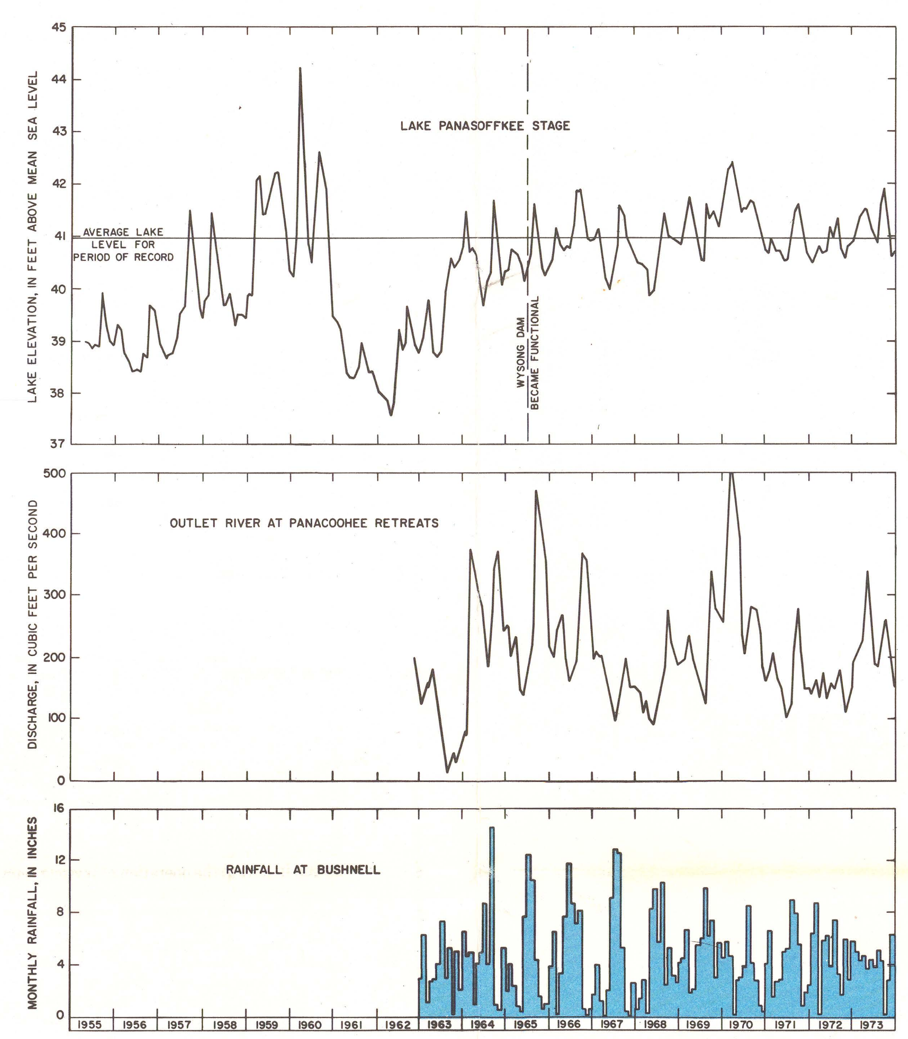

Figure 5 — Month-end stage of Lake Panasoffkee, 1955–73, monthly discharge of Outlet River, and monthly rainfall at Bushnell, 1963–73.

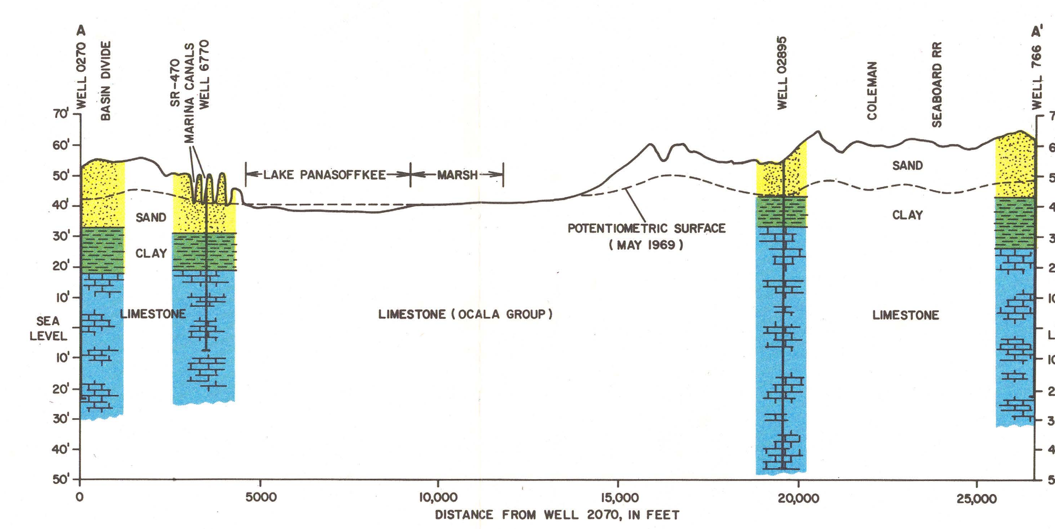

Figure 4 — Land-surface Profile, Geologic cross-section, and profile of Potentiometric Surface of Floridan aquifer Along Section A-A′ (Well and Section Locations Shown on Figure 1)

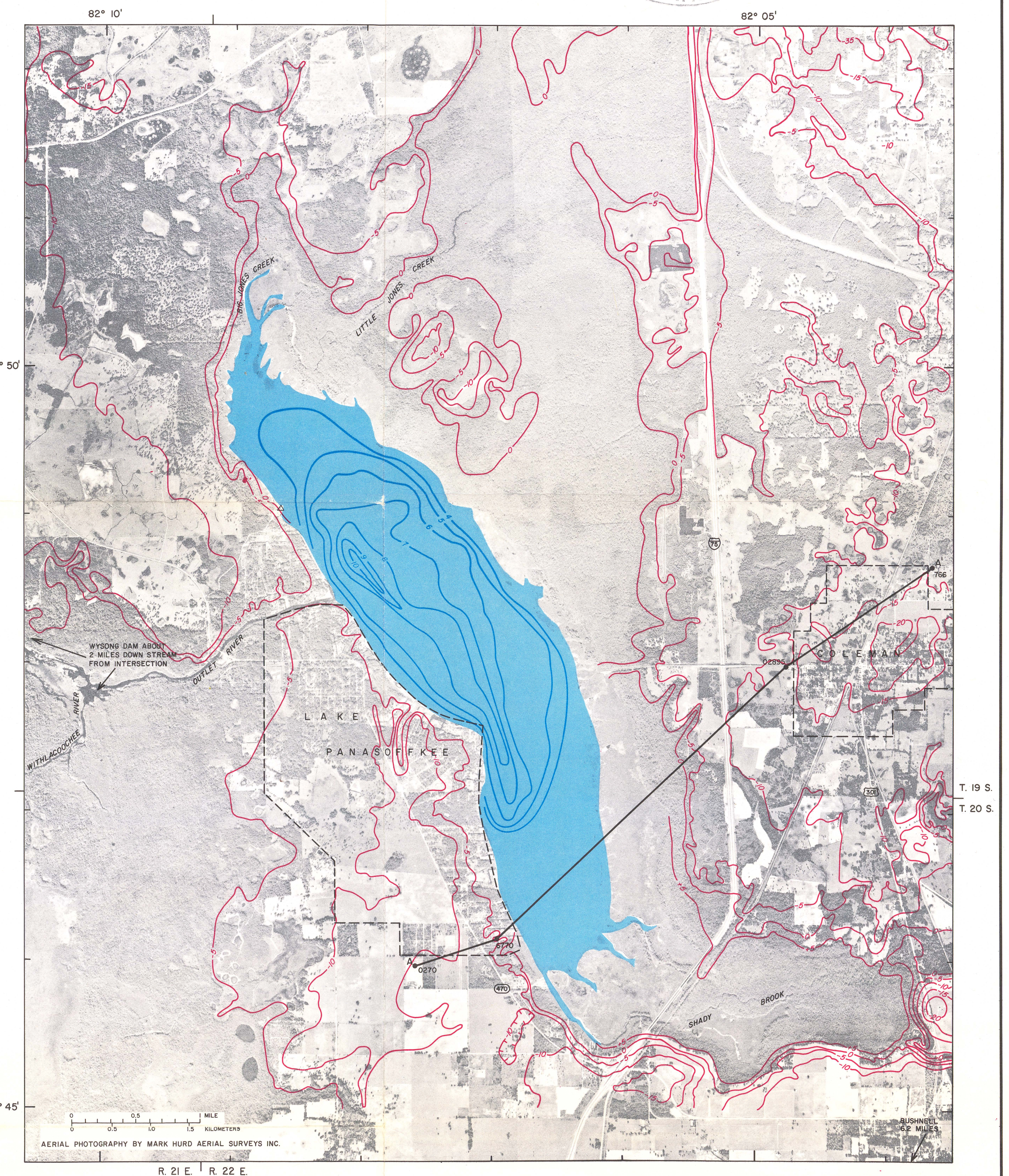

FIGURE I. -- AERIAL PHOTO MAP OF LAKE PANASOFFKEE AREA SHOWING LAKE DEPTH, GEOHYDROLOGIC SECTION, GEOLOGIC SECTION AND WELL LOCATIONS.

EXPLANATION

A-A′ LINE OF GEOLOGIC SECTION

0270 WELL, NUMERAL IS PERMIT NUMBER ASSIGNED BY SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

5 LINE OF EQUAL DEPTH TO POTENTIOMETRIC SURFACE OF FLORIDAN AQUIFER, MAY 1968—Interval 5 feet. Datum is land surface (red).

7 LINE OF EQUAL DEPTH TO LAKE BOTTOM—Interval 1 foot (From Florida Game and Fresh Water Fish Commission). Datum is mean lake surface at 41.0 feet MSL.

△ GAGING STATION (U.S. Geological Survey). Downstream order number is 02312698.

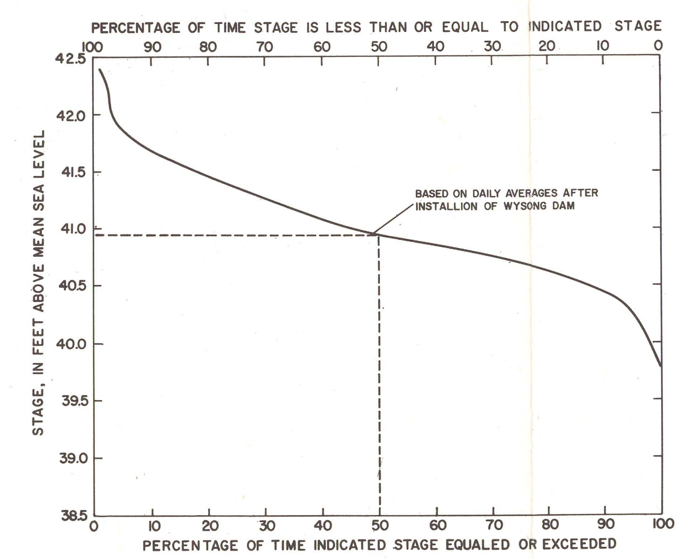

Figure 6 — Stage-duration curve for Lake Panasoffkee, 1966–73.

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