SURFACE-WATER FEATURES IN OSCEOLA COUNTY AND ADJACENT AREAS, FLORIDA

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GENERAL DESCRIPTION

Osceola County in east-central Florida has numerous lakes, streams and marshes (see fig. 1). Lakes cover about 15 percent of the county. According to the Florida Board of Conservation (1969), Osceola County contains 878 named and unnamed lakes that have surface areas of 10 acres or more. Lake Kissimmee is the largest lake in the county; other large lakes are Lake Tohopekaliga, East Lake Tohopekaliga, Lake Hatchineha, Lake Marian, Cypress Lake, and Alligator Lake. Five other large lakes—Lake Marion, Lake Pierce, Lake Rosalie, Lake Weohyakapka, and Tiger Lake—are in adjacent Polk County but within about 10 mi of the western border of Osceola County. Table 1 lists the surface areas of some of the larger lakes in the area and their locations are shown on the map.

The objective of this report is to acquaint the reader with the principal surface water features of Osceola County and adjacent area, and to compile some of the pertinent hydrologic data available for the area. The report will provide a useful basis for future hydrologic studies of specific water problems in the area.

Osceola County is characterized by low undulating hills and wide, swampy valleys. Land surface is less than 15 ft above sea level near the northeast corner of the county and about 200 ft above sea level at the northwest corner where the county extends into the Lake Wales Ridge.

The western two-thirds of the county is drained by the Kissimmee River and its tributaries, some of which extend northward into Orange County and westward into Polk County. Streams in the eastern third of the county empty into St. Johns River or into flat, marshy areas that make up part of the headwaters of the St. Johns River.

The St. Johns River flows northward near and almost parallel to the eastern coast of Florida and empties into the Atlantic Ocean east of Jacksonville about 140 mi north of Osceola County. The Kissimmee River flows southward to Lake Okeechobee about 35 mi south of the county. The flow of the Kissimmee River is regulated by a control structure on the outlet of Lake Kissimmee (fig. 1) and by five additional control structures downstream in the extensively channelized reach between the lake and Lake Okeechobee. Outflow from Lake Kissimmee has been regulated in varying but increasing degree since 1962 by the improvement of canals and natural drains between lakes and by the construction of dams with gated controls on lakes and stream channels upstream from Lake Kissimmee.

HYDROLOGIC FEATURES

All the water stored in or passing through the lakes, streams, and marshes in and adjacent to the county is supplied by rainfall. Although in Osceola County, and in the upper Kissimmee River basin in general, the average yearly rainfall is about 52 in., the rainfall varies greatly from year to year, as shown in figure 2. At Kissimmee, for example, the yearly rainfall was 28.07 in. in 1961, and 80.38 in. in 1960. A frequency analysis of the rainfall data for Kissimmee (fig. 3) indicates that the occurrence of yearly rainfalls greater than 80 in. or less than 30 in. has a probability of about 1 percent, or, a likelihood of occurrence of 1 year in 100 years.

On the average, about 55 percent of the yearly rainfall occurs during the 4-month period June through September (fig. 4); however, the rainy season can begin as early as May or as late as July. September usually marks the end of the rainy season but heavy rainfalls occasionally occur in October. For example, at the town of Kissimmee the unusually severe drought of the mid-1950s ended with more than 17 in. of rain in October 1956. October rainfalls totalling more than 8 in. occur on the average of once in 10 years.

This marked seasonal variation in rainfall causes the flow of the unregulated streams of the area to fluctuate seasonally. The hydrographs of Catfish Creek near Lake Wales and Kissimmee River at S-65 near Lake Wales during 1951–60 (fig. 5) are characteristic of unregulated flow—the Kissimmee River was unregulated until 1964. Prior to October 1967 the gaging station "Kissimmee River at S-65 near Lake Wales" was cited in U.S. Geological Survey records as "Kissimmee River below Lake Kissimmee." Catfish Creek, the outlet of Lake Pierce, is a tributary to the Kissimmee River. Although areal differences in rainfall at times caused the flow patterns briefly to diverge from a common trend, the seasonal trends are basically the same for the two streams. In general, as figure 5 shows, streamflow increases steadily through the rainy season and crests in September or October shortly after the end of the rainy season. Streamflow gradually decreases during the remainder of the year, usually reaching a seasonal minimum in May or June just before the start of the next rainy season. The seasonal flow pattern is basically the same for all unregulated streams in the same general area.

Since 1964 when the control structure on the Kissimmee River at the outlet of Lake Kissimmee was completed the control of releases from Lake Kissimmee has greatly altered the pattern of flow downstream from the lake. The effect of control on Kissimmee River flow is shown by the hydrographs of the two stations, Catfish Creek near Lake Wales and Kissimmee River at S-65 for 1966–75 (fig. 6). During 1966–75 the flow variability of Catfish Creek was essentially the same as in 1951–60 although rainfall and discharge were considerably less (fig. 5); that is, its flow reflected the natural variations caused by the seasonal distribution of rainfall. The fluctuation in flow of the Kissimmee River, however, has been much more variable and erratic than it would have been without regulation. This greater seasonal fluctuation results from efforts to maintain the lake levels within a relatively small range. Controlling the flow below the outlet of the lake in this manner should not affect appreciably the average annual flow but it has decreased the magnitude of the low flows, increased the duration of flow in the intermediate range, and changed the timing of the high and low flows as compared to natural runoff.

The average yearly discharge of the Kissimmee River at S-65 near Lake Wales is 9.3 in., although Lichtler and others (1968, p. 45–53) show substantial differences in the unit runoff from areas in the upper part of the basin. Inasmuch as the stream discharge includes virtually all of the ground-water discharge in the area upstream from the gaging station, the difference between the stream discharge and the 52 in. average yearly rainfall, that is, 42.7 in., represents the quantity of water that returns to the atmosphere by evaporation from soil and water surfaces and transpiration by plants. This value, of course, applies to the western two-thirds of Osceola County that is drained by the Kissimmee River. The 42.7 in. estimate of evapotranspiration loss is virtually the same as that derived by Langbein (1955) for the entire Kissimmee River basin. Runoff from Jane Green Creek and Wolf Creek near Deer Park in the eastern part of the county averages 15 and 19 in., respectively. Given the same average annual rainfall (52 in.), this would indicate an evapotranspiration loss ranging from about 37 to 33 in. for some areas in the eastern part of the county that drain to the St. Johns River. Reasons for this difference are not definitely known, but the large wet and open water areas in the Kissimmee River basin as compared to the dry eastern part of the county are important factors. For Orange County, lake evaporation (considered to be comparable to evapotranspiration from an area with poor to moderate drainage and with abundant phreatophyte vegetation) is greatest in May–September, nearly coincident with the rainy season (see figs. 4 and 12) and is about 51 in. annually. For much of Osceola County, evapotranspiration would be significantly less, of course, to confirm the 42.7 in. estimate cited above.

Recorded maximum, minimum, and average annual discharges are shown in table 2 for some of the streams in Osceola County. The ratio of the instantaneous maximum to the average annual discharge provides an index of the relative capacity of the various stream basins to store water temporarily in lakes, swamps, and aquifers. The ratio is small for stream basins having a large storage capacity and large for those having a small storage capacity.

Levels of unregulated lakes reflect the seasonal distribution of rainfall in much the same way that streamflow does. The fluctuations for 1966–75 in the levels of two unregulated lakes, Weohyakapka and Marian, as represented by the graphs in figure 7 for 1966–75, have about the same characteristics and are basically in phase with the variations in flow of Catfish Creek (fig. 6). Table 3 shows the effect of regulating lake stage. For Alligator Lake, Cypress Lake, and Lakes Tohopekaliga and Kissimmee (whose levels have been regulated since 1964) the range in stage was from about 2.5 to 6 ft less during 1964–75 than it was during preceding years. For the unregulated lakes the range in stage was about the same for both periods. Inasmuch as the lake-level data for two of the unregulated lakes (Lakes Pierce and Rosalie) include all or most of the time covered by the data for the regulated lakes, the reduction in the range in stage of the regulated lakes cannot be attributed to differences in climatic conditions, and is therefore attributed to the effect of regulation. The effect of regulation is most noticeable in the levels of Lakes Tohopekaliga and Kissimmee (fig. 7). The control gates of these lakes usually are opened as inflow to the lakes increases during the rainy season, and later, at the end of the rainy season, are partly or completely closed. In 1971, levels of Lakes Tohopekaliga and Kissimmee were deliberately drawn down to an unusually low level as part of an experiment to improve the trophic condition of the lakes.

The effect of regulating Alligator Lake and Lake Kissimmee is shown on the stage-duration curves of figure 8. The most obvious difference is the flattening of the duration curves, directly translatable to a decrease in stage range.

Stage-duration curves for four unregulated lakes, Lakes Marian, Weohyakapka, Marion, and Rosalie, are shown in figure 9.

The evaporation loss from lake surfaces in Osceola County, on the basis of information applicable to Orange County (fig. 10), is greatest during April–September, that part of the year when temperatures are highest and nearly coincident with the rainy season. Average monthly open-water evaporation during the 6-month period is 5.6 in. and the average annual evaporation is 50.8 in. That the average annual open-water evaporation is higher than the computed basin evapotranspiration loss cited earlier is to be expected. For the land area of the basin, the actual evapotranspiration is much less than that of a free water surface as not all the areas have lush growths of phreatophytes that produce large transpiration rates.

WATER QUALITY

The dissolved solids concentration in water from selected lakes and streams in Osceola County, on the basis of analyses of water samples collected from the lakes intermittently from 1960–75, ranged from about 25 to 240 mg/L. The range for individual lakes is much less, for example Alligator Lake (fig. 11), ranged from 25 to 65 mg/L. For most lakes and streams the fluctuation in concentration of dissolved solids is seasonal. The concentration is least when the lake or stream is being fed by surface runoff that consists largely of rainfall, and is greatest in lakes after evaporation has concentrated the mineral material in solution and in streams when flow is predominantly ground-water discharge.

Water from Osceola County is a calcium bicarbonate type because of the widespread occurrence of limestone. Color is high in some of the water; for example, a maximum of 400 units for Reedy Creek near Loughman. Color in a water generally is caused by the presence of humic acids, a group of chemicals whose occurrence is common in swamps where the soil is high in the organic compounds resulting from the decomposition of plant materials. The higher bicarbonate concentration of water in Shingle Creek and Lake Tohopekaliga probably reflects the addition of effluent from sewage treatment plants and irrigation water which includes water from the Floridan aquifer, a limestone aquifer.

Most of the water samples selected for analysis ranged in hydrogen-ion concentration from slightly acid (pH of 6) to slightly alkaline (pH of 8); only two exceeded a pH of 8. In general, ground water is slightly alkaline, and rainwater is slightly acid.

REFERENCES

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1965 Control of lake levels in Orange County, Florida: Florida State Board of Conservation, Division of Geology Information Circular 47, 15 p.

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1955 Hydrologic studies *in* Parker and others, Water resources of southeastern Florida: U.S. Geological Survey Water Supply Paper 1255, 965 p.

Lichtler, W.F., Anderson, Warren, and Joyner, B.F.
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For readers who may prefer to use metric units rather than inch-pound units, the conversion factors are listed below:

Multiply Inch-pound unit	By	To obtain metric (SI) unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
acre	0.4047	hectare (ha)
square mile (mi²)	2.590	square kilometer (km²)
cubic foot per second (ft³/s)	0.2832	cubic meter per second (m³/s)
mean sea level (msl)		National Geodetic Vertical Datum of 1929 (NGVD of 1929)

TABLE 1.—*Surface areas of selected lakes in Osceola County and adjacent areas.*

Lake	Surface area (acres)
Alligator	3,401
Conlin	6,281
Cypress	4,085
East Tohopekaliga	11,950
Hatchineha	6,336
Kissimmee	34,710
Marian	5,727
Marion	2,968
Pierce	3,736
Rosalie	4,592
Tiger	2,000
Tohopekaliga	18,790
Weohyakapka	7,555

Note: Surface areas are from U.S. Geological Survey published records.

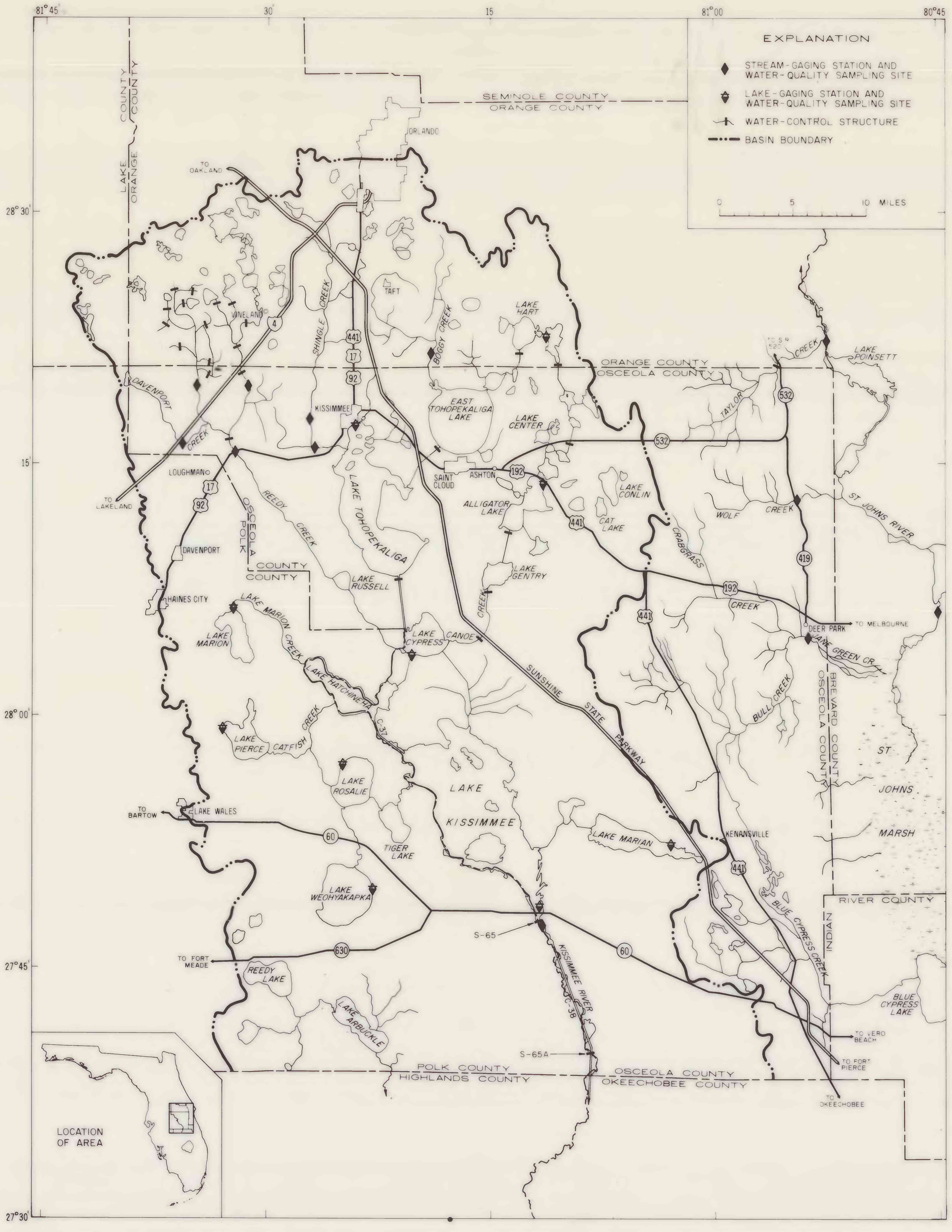

Figure 1—Surface-water features and selected hydrologic data sites in Osceola County and adjacent areas.

TABLE 2.—*Stream discharges at selected gaging stations in Osceola County and adjacent areas.*

Station	Drainage area (mi²)	Period of record	Average annual discharge (ft³/s)	Average annual discharge (in/yr)	Maximum discharge (ft³/s)	Minimum discharge (ft³/s)	Ratio of maximum to average annual discharge
Kissimmee River at S-65 near Lake Wales.	1,607	1933–75	1,100	9.3	8,970	0	8
Reedy Creek near Loughman.	110	1939–59, 1968–75	74.8	9.2	790	0	11
Jane Green Creek near Deer Park.	248	1953–75	275	15.0	18,400	0	67
Shingle Creek at Airport, near Kissimmee.	89.2	1958–75	64.2	9.8	3,320	0	52
Boggy Creek near Taft.	83.6	1959–75	50.5	8.2	3,680	1	73
Wolf Creek near Deer Park.	25.7	1956–75	36.2	19.1	7,700	0	212
Catfish Creek near Lake Wales.	58.9	1947–75	47.6	11.0	235	1.4	5

TABLE 3.—*Highest and lowest recorded stages in selected lakes in Osceola County and adjacent areas from beginning of record through 1963, and for 1964–75*

Lake	Record began	Stage, in feet: Through 1963 Maximum	Through 1963 Minimum	1964–75 Maximum	1964–75 Minimum	Range, in feet: Through 1963	1964–75	Change
Alligator Lake near Ashton[1]	November 1941	66.81	59.52	65.13	60.49	7.29	4.64	2.15
Lake Tohopekaliga at Kissimmee[1]	January 1942	59.40	48.93	56.09	48.62	10.47	7.47	3.0
Cypress Lake near St. Cloud[1]	January 1942	57.18	47.98	54.33	47.60	9.20	6.73	2.47
Lake Marion near Haines City[2]	February 1958	67.52	65.08	67.26	64.86	2.44	2.40	.04
Lake Pierce near Waverly[2]	December 1947	78.91	75.48	78.32	75.31	3.43	3.01	.42
Lake Weohyakapka at Indian Lake Estates[2]	February 1958	63.43	59.80	63.12	59.22	3.63	3.90	-.27
Lake Marian near Kenansville[2]	February 1958	61.63	58.14	61.22	57.42	3.49	3.80	-.31
Lake Kissimmee near Lake Wales[1]	August 1929	56.64	44.22	54.07	47.53	12.42	6.54	5.88
Lake Rosalie near Lake Wales[2]	December 1941	55.93	50.88	55.48	50.30	5.05	5.18	-.13

[1] Stage regulated
[2] Stage unregulated as of 1975

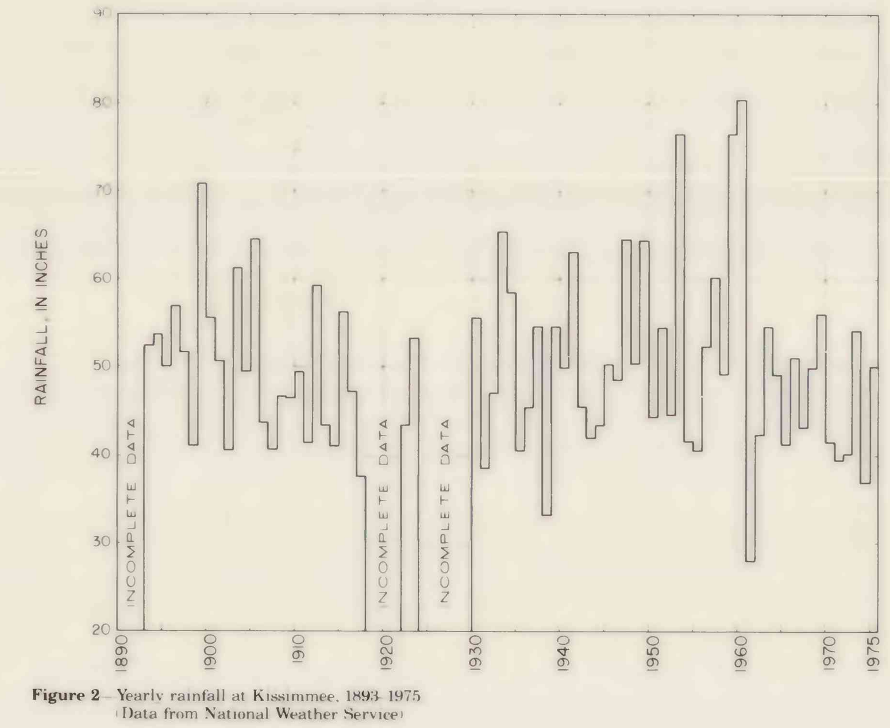

Figure 2—Yearly rainfall at Kissimmee, 1893–1975. (Data from National Weather Service)

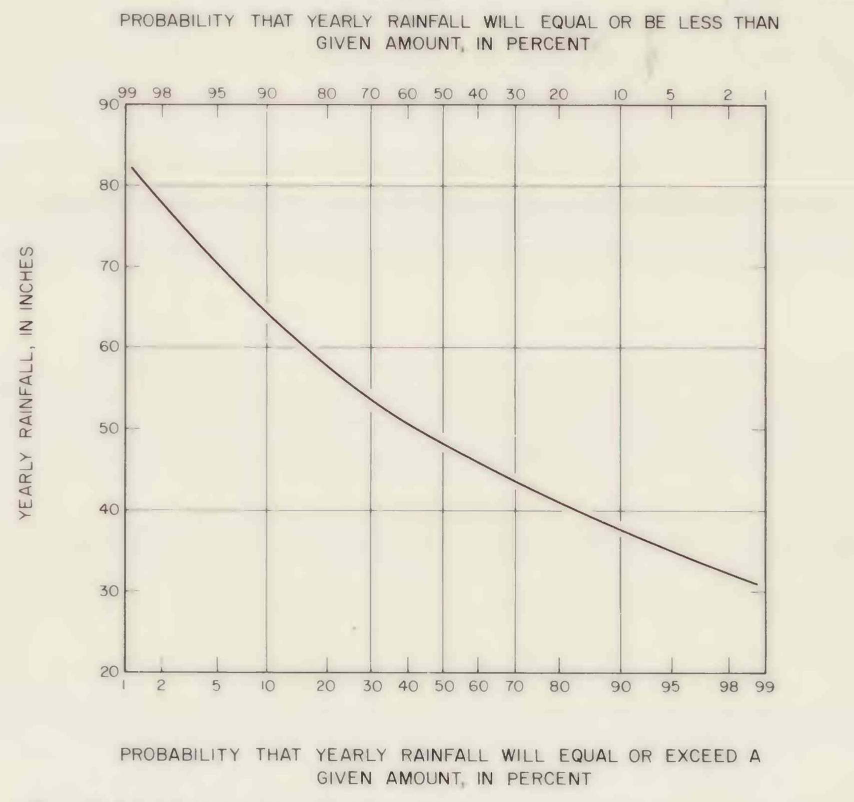

Figure 3—Probability curve for rainfall at Kissimmee.

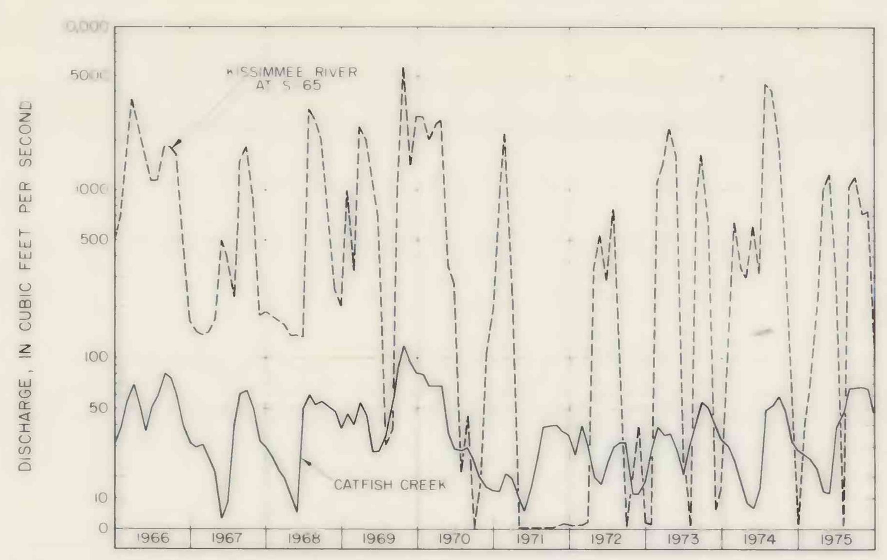

Figure 5—Hydrographs of Kissimmee River at S-65 near Lake Wales and Catfish Creek near Lake Wales, 1951–60.

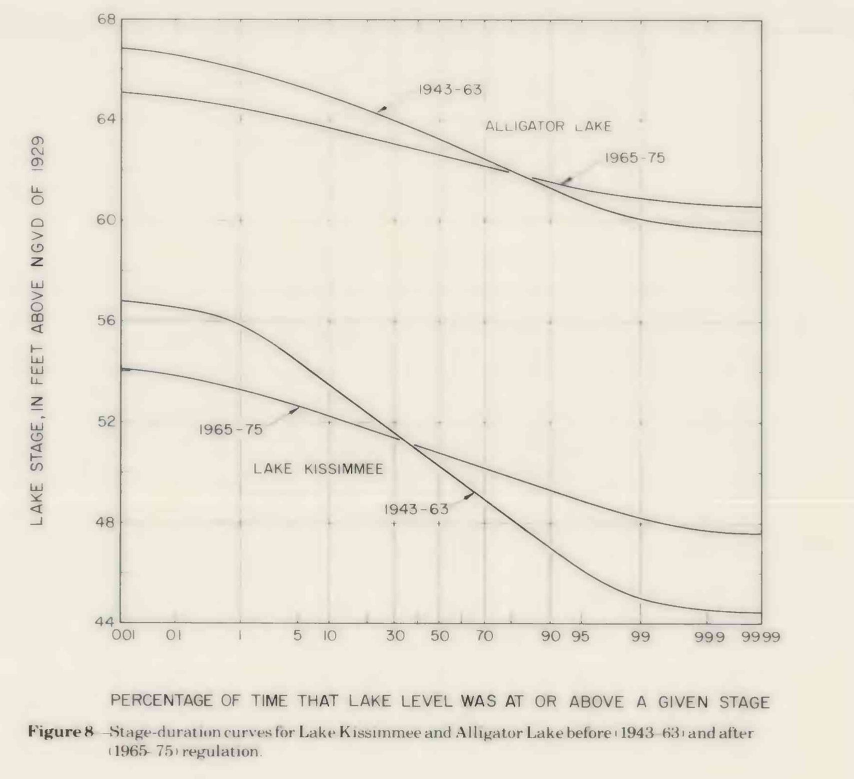

Figure 8—Stage-duration curves for Lake Kissimmee and Alligator Lake before (1943–63) and after (1965–75) regulation.

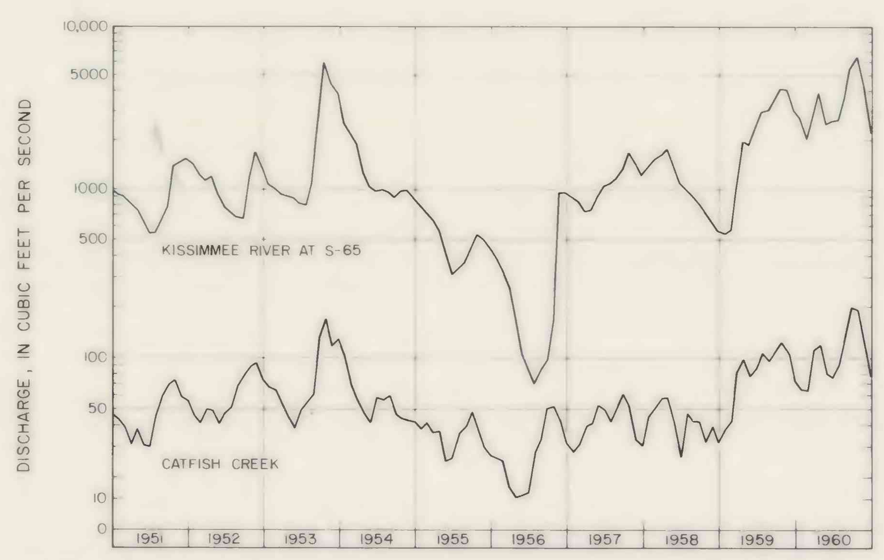

Figure 6—Hydrographs of Kissimmee River at S-65 near Lake Wales and Catfish Creek near Lake Wales, 1966–75.

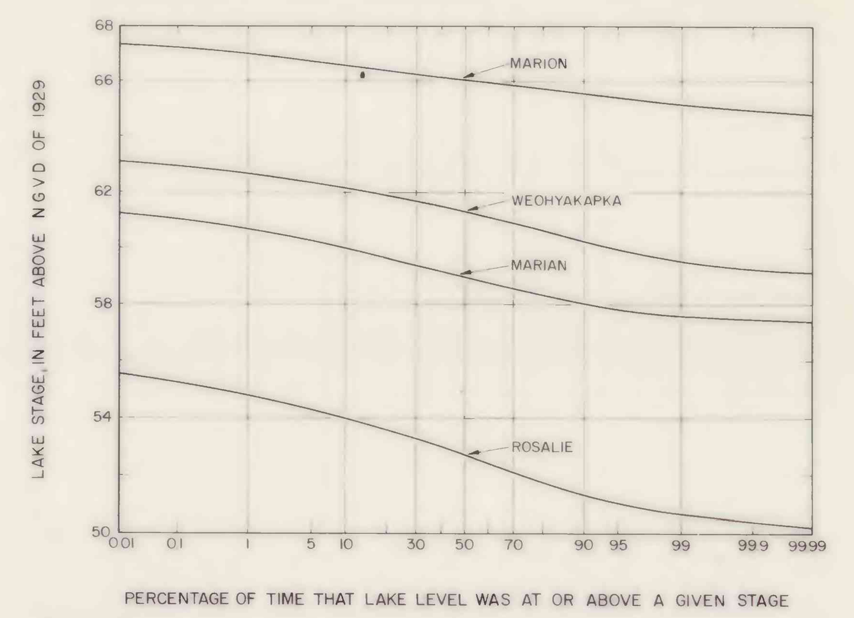

Figure 9—Stage-duration curves for selected lakes in Osceola County and adjacent area, 1965–75.

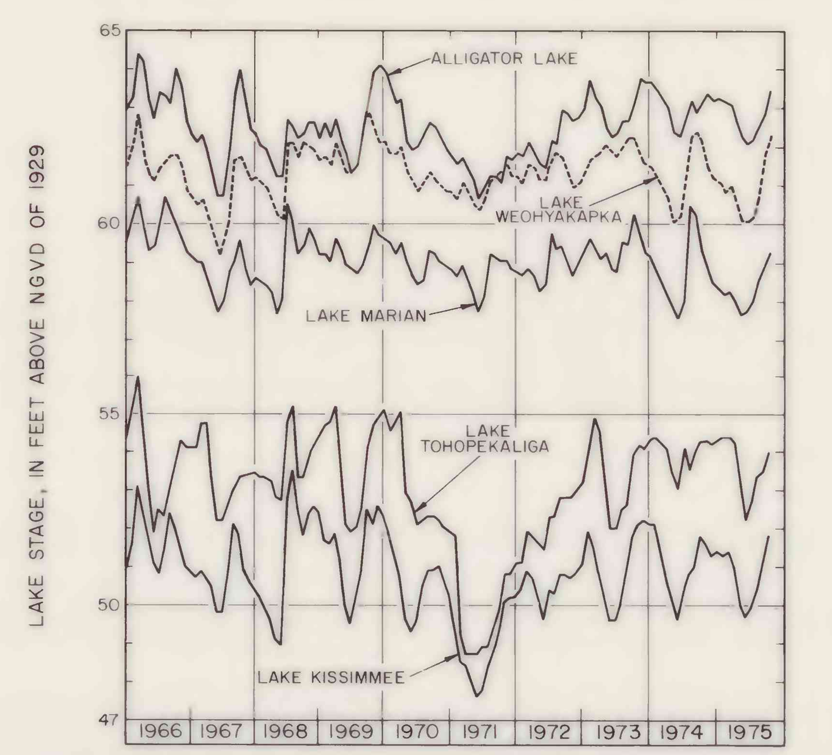

Figure 7—Hydrographs for five selected lakes in Osceola County, 1966–75.

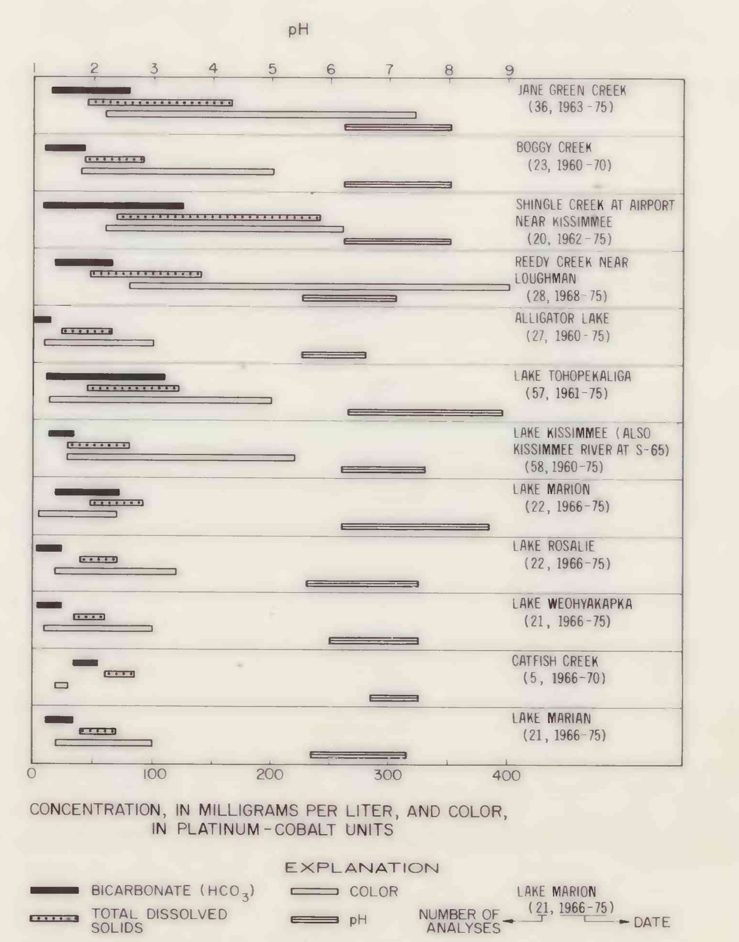

Figure 11—Observed range in concentration of chemical constituents and color of water from selected streams and lakes in Osceola County and adjacent area.

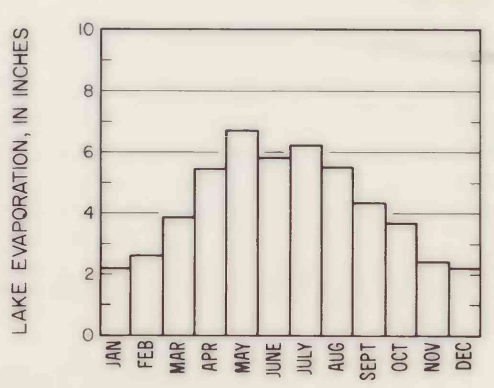

Figure 4—Monthly rainfall at Kissimmee. (Data from National Weather Service)

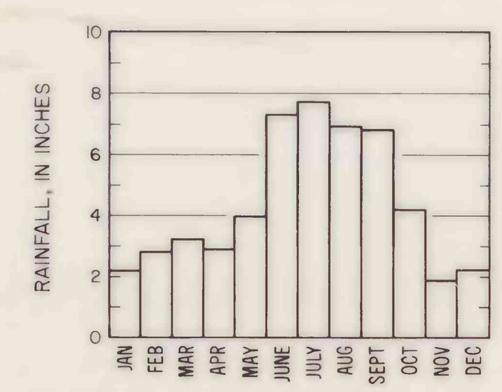

Figure 10—Average monthly lake evaporation in Orange County (From Anderson and others, 1965)

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