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STATE BOARD OF CONSERVATION

DIVISION OF GEOLOGY
Robert O. Vernon, Director

REPORT OF INVESTIGATIONS NO. 48

ANALYSIS OF THE WATER-LEVEL FLUCTUATIONS OF LAKE JACKSON NEAR TALLAHASSEE, FLORIDA

By
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U. S. Geological Survey

Prepared by the
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LETTER OF TRANSMITTAL

Division of Geology

Tallahassee

June 15, 1967

Honorable Claude R. Kirk, Jr., *Chairman*
State Board of Conservation
Tallahassee, Florida

Dear Governor Kirk:

One of the most pressing problems relating to water resources management is that of flood plain control and zoning. A study of all of our flood plain problems is now being completed by the Corps of Engineers, personnel of the State Board of Conservation, and the U. S. Geological Survey.

A study on Lake Jackson has just been completed in which it was recorded that the 1966 high record level of water in the basin has established a base line for future planning. A report on the "Analysis of the Water-Level Fluctuations of Lake Jackson near Tallahassee, Florida," has been prepared by Gilbert H. Hughes of the U. S. Geological Survey and is being published as Report of Investigations No. 48. It is anticipated that the data presented in this report will be valuable to the planning departments of the City of Tallahassee and Leon County, and will serve as an example for State studies.

Respectfully yours,
Robert O. Vernon
Director and State Geologist

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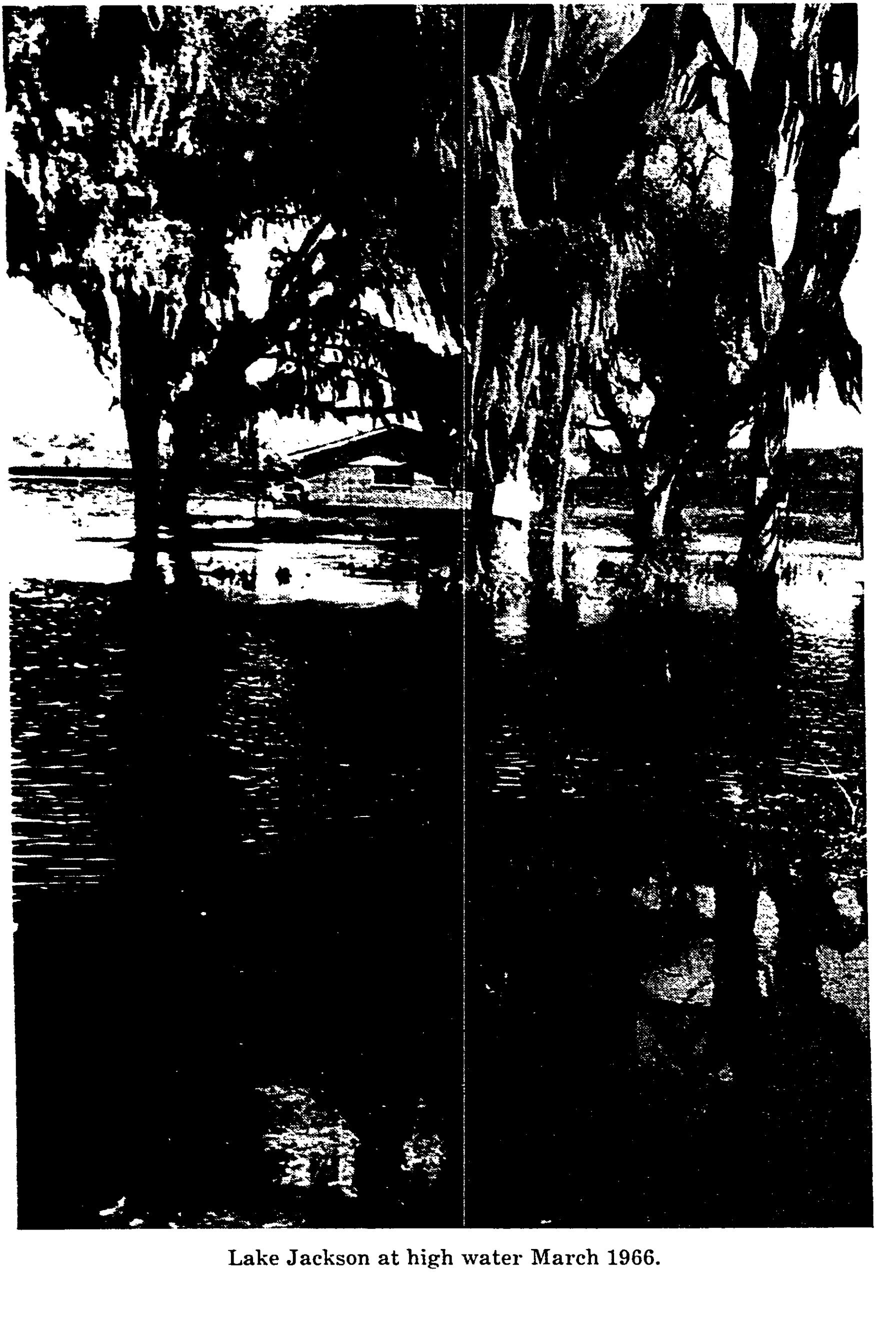

Lake Jackson at high water March 1966.

ANALYSIS OF THE WATER-LEVEL FLUCTUATIONS OF LAKE JACKSON NEAR TALLAHASSEE, FLORIDA

By
Gilbert H. Hughes

INTRODUCTION

Lake Jackson, near Tallahassee, currently (1966) is at a record-high level and is flooding parts of adjacent residential areas. The apparent disregard of the hazard of developing the adjacent flood plain areas is partly understandable as the lake was almost dry as recently as 1957.

The wide fluctuations of the lake level concern those who have an interest in the overall utility and scenic attractiveness of the lake as well as those whose property may be flooded. The purpose of this report is to summarize the hydrologic data that pertain to the fluctuations of the lake level so that the cause of the fluctuations can be more easily understood. Such understanding is required of those responsible for making decisions relative to lake control and land development.

Lake Jackson occupies a closed depression in an area of expanding population within the environs of Tallahassee, the State Capital. The lake is a valuable asset to the residents of the county and state, providing a convenient recreational area for boating, fishing, and bird hunting.

The approximate center of the somewhat irregularly shaped lake is about 7 miles north of the center of Tallahassee, figure 1. The altitude of the lowest point on the rim of the ridge that separates Lake Jackson drainage basin from the Ochlockonee River is about 115 feet. Lake Jackson recently rose to a maximum altitude of 96.5 feet. At altitude 90 feet, Lake Jackson covers about 9.8 square miles (6,300 acres) or about 23 per cent of its 43.2 square mile drainage area.

AVAILABLE DATA

LAKE LEVELS

The altitude of the water level of Lake Jackson has been measured by a continuous water-level recorder since March 1950 except at times when the water level dropped below the operating

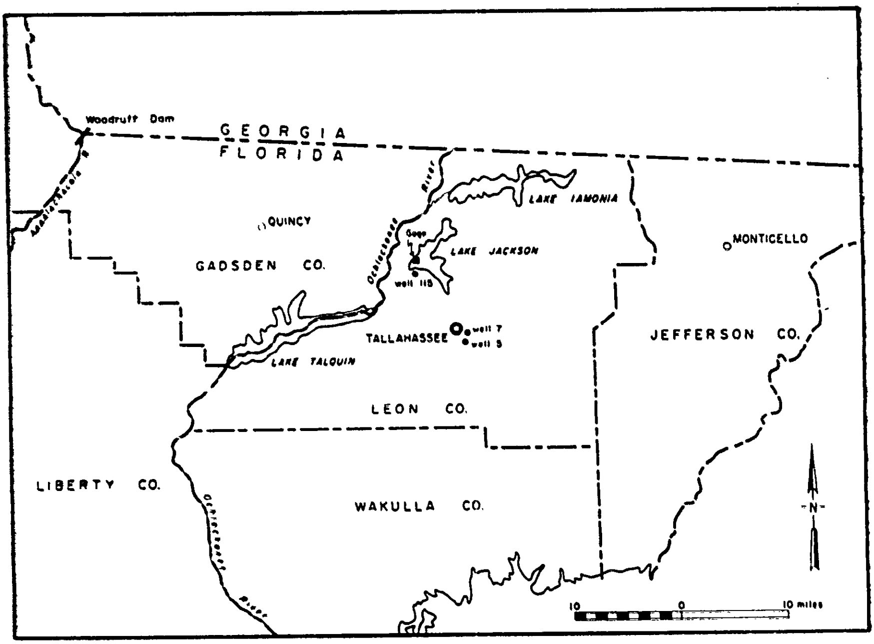

Figure 1.—Location of Lake Jackson.

limit of the gage. During these periods monthly measurements of the water level were obtained from an auxiliary staff gage. The monthly hydrograph for Lake Jackson is shown by figure 2. Figure 3 shows for the period of record the per cent of time that the lake was at or above a particular level.

RAINFALL

Rainfall has not been measured at Lake Jackson but rainfall at, or near, Tallahassee has been recorded since 1886. The average yearly rainfall for Tallahassee for all years of record through 1965 is 57.32 inches. The variation in annual rainfall at Tallahassee is shown by figure 4.

Rainfall at Quincy, Florida and Monticello, Florida (fig. 1) has been recorded since 1917 and 1906, respectively; however, the record for Monticello is incomplete for several years prior to 1920. The long-term average of yearly rainfall for all years of complete record through 1965 is 55.33 inches for Quincy and 56.82 inches for Monticello. Figure 5 compares the cumulative yearly rainfall at Tallahassee with that at both Quincy and Monticello. In each

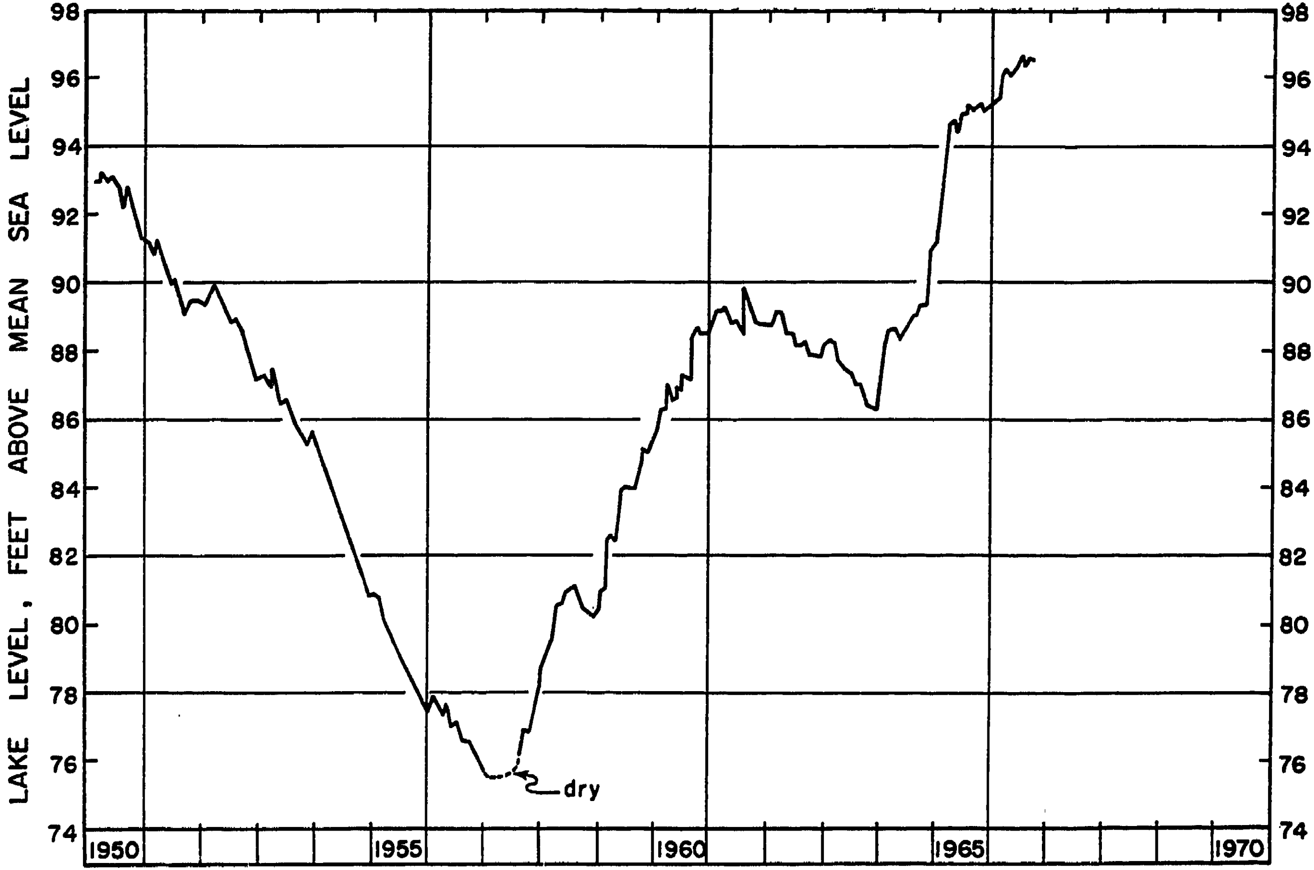

Figure 2.—Month-end water level of Lake Jackson.

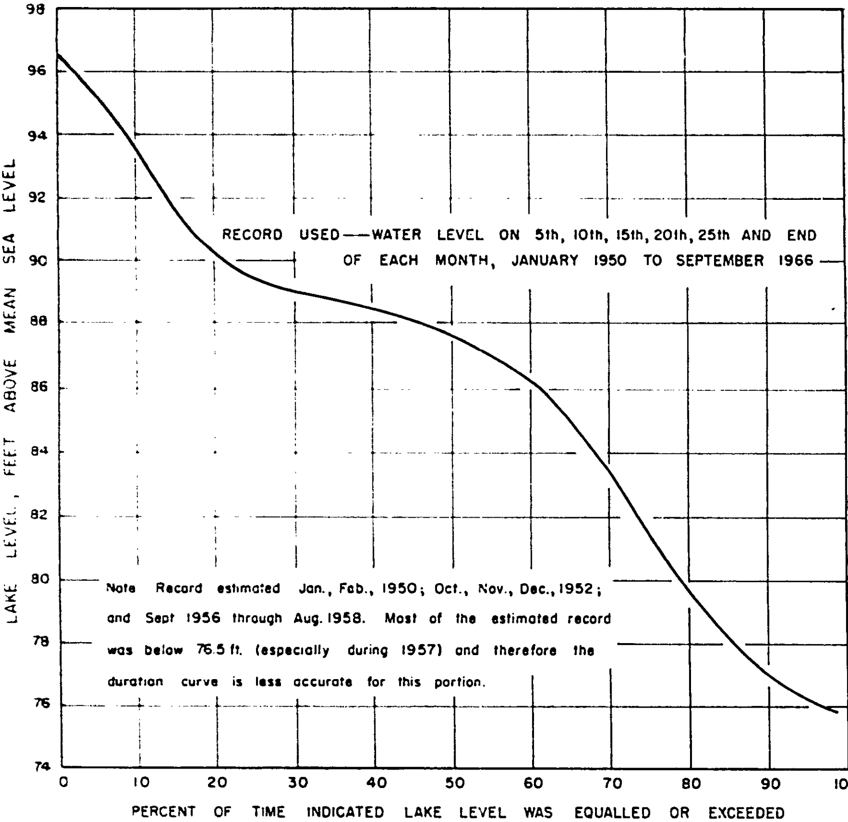

Figure 3.—Stage-duration curve for Lake Jackson.

case, only the data for complete years common to both of the involved stations were used.

The graph indicates that yearly precipitation at the three stations is almost equal and that there is no appreciable long-term deviation between the stations. Thus, the average of rainfall at these three stations should be reasonably representative of that falling at Lake Jackson.

EVAPORATION

Evaporation from Lake Jackson has not been measured directly, but the yearly rate may be estimated with reasonable accuracy from measurements of evaporation from the United States Weather Bureau Class A Pan at Woodruff Dam (fig. 1). Records of pan evaporation for years 1959-65 are summarized in table 1.

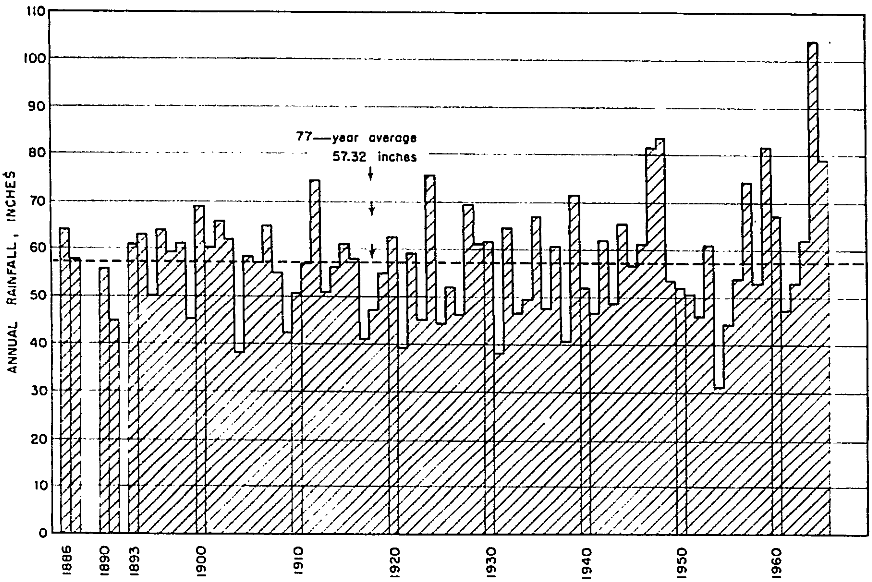

Figure 4.—Yearly rainfall at Tallahassee, Florida, from 1886 to 1965.

According to Kohler and others (1959, Plate 3), a yearly pan coefficient of 0.77 is applicable to Class A pan evaporation in the vicinity of Tallahassee. Thus, on the basis of this coefficient and records of pan evaporation in table 1, yearly lake evaporation averages about 50 inches or 4.2 feet per year.

SURFACE WATER

Most of the time there is little or no surface-water inflow to Lake Jackson; however, following periods of above average rainfall substantial inflow may occur from intense rainstorms. Small rivulets fed by ground water or by drainage from small ponds and lakes also contribute inflow to Lake Jackson during unusually wet periods, however, no measurements of surface-water inflow have been made.

There is no surface-water outflow from Lake Jackson. The lake can spill into the Ochlockonee River only when the lake level is above about 115 feet. This altitude is almost 19 feet above the present record-high level of the lake.

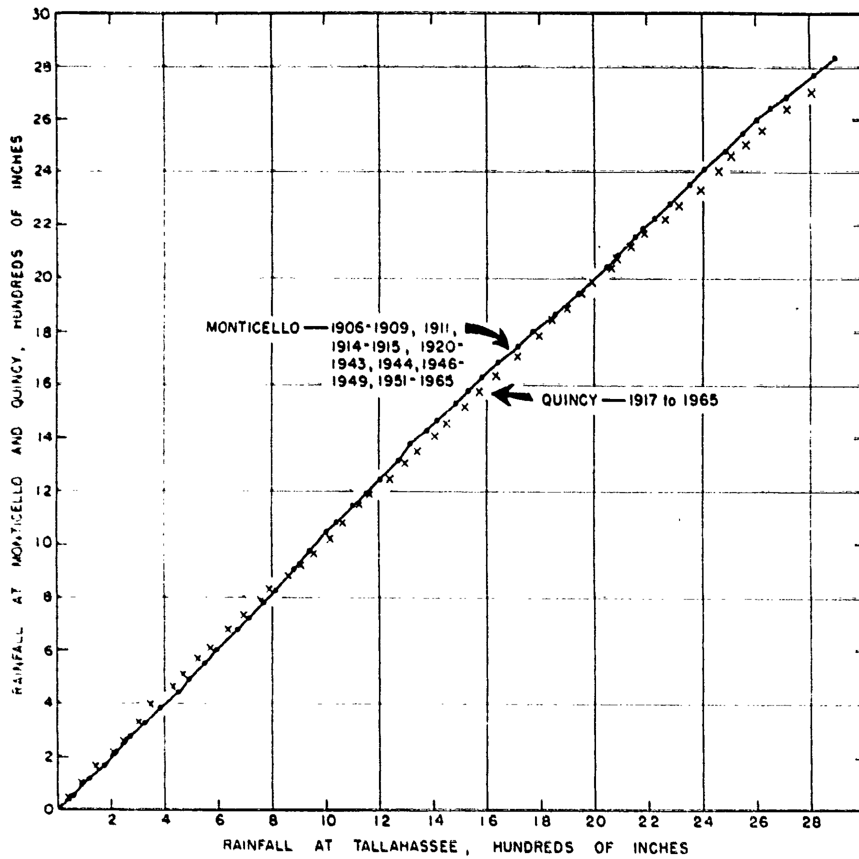

Figure 5.—Relation between cumulation rainfall at Tallahassee, and that at Monticello and Quincy.

GROUND-WATER LEVELS

Periodic measurements have been made of the water level in well Leon 115 since 1950. This well which is near the shoreline of Lake Jackson (fig. 1), is 194 feet in depth, and penetrates the artesian aquifer which underlies Florida and parts of Georgia and Alabama. Wells Leon 5 and Leon 7 (fig. 1), drilled as supply wells for the City of Tallahasse, penetrate the same artesian aquifer. The water level in well 5 was measured from 1932 to 1950, and that in well 7 has been measured from 1945 to present.

Hydrographs in figure 6 show that the level in well 115 differs in altitude from that in well 7, but the two fluctuate in the same

TABLE 1.—MONTHLY EVAPORATION FROM CLASS A PAN AT WOODRUFF DAM, 1959-65.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Maximum	3.09	3.80	5.66	7.28	9.11	8.84	7.85	7.77	7.53	6.28	3.74	3.04	69.17
Average	2.42	3.28	5.14	6.64	7.88	7.50	7.44	7.12	6.67	5.27	3.45	2.71	65.51
Minimum	2.00	2.69	4.09	5.28	7.33	6.47	6.71	6.43	5.58	3.31	3.26	2.35	57.47

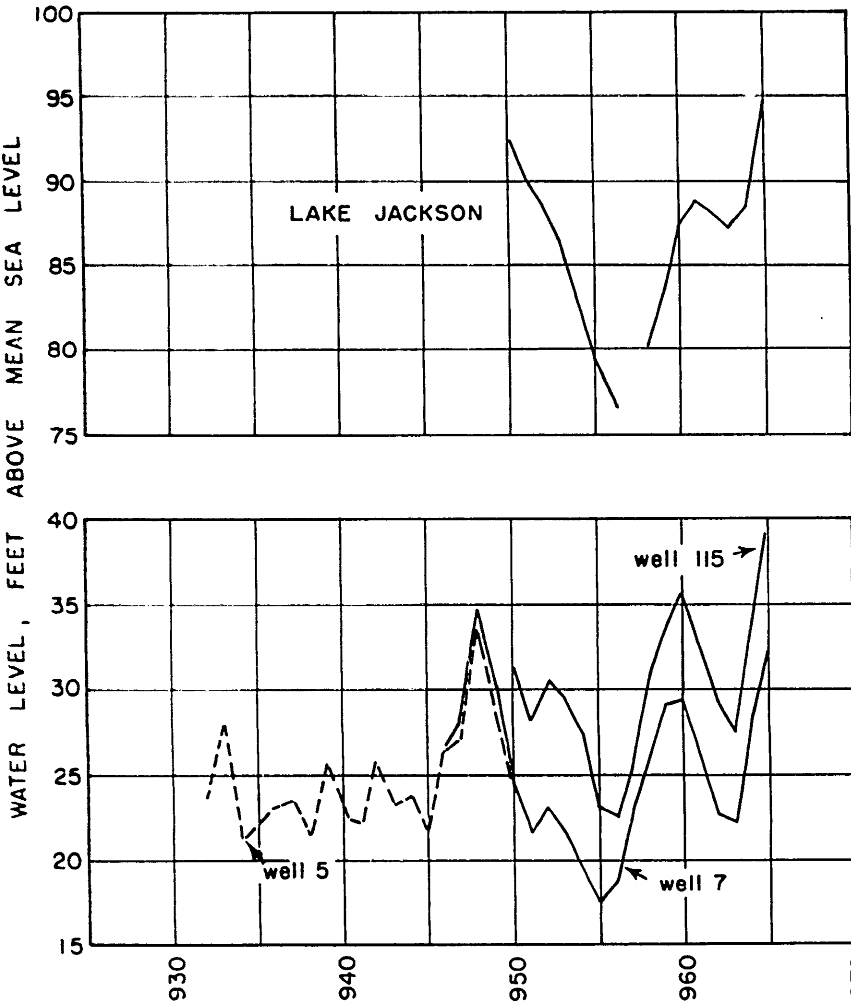

Figure 6.—Yearly average water level of Lake Jackson and selected wells.

general manner. The hydrographs for wells 5 and 7 are basically the same during the period of concurrent record, as might be expected from their proximity to each other.

GROUND-WATER MOVEMENT

The rate of ground-water movement into, or out of, Lake Jackson has not been determined. The level of Lake Jackson consistently is about 50 to 55 feet above the level of the piezometric surface in the underlying limestone aquifer. Active sinkholes have existed in the lake bottom (Sellards, 1914 p. 128) and, with the lake at a low level, the downward movement of lake water has been visible. Thus, some water probably always moves from the lake to the limestone aquifer system through sinkholes. A sink-hole depression, exposed when the lake was dry in 1932, is shown in figure 7.

In addition to the limestone aquifer there is a surficial, sandy-clay aquifer with a water table that probably approximates the lake level in areas adjacent to the lake. During years of greater-than-average rainfall the surficial aquifer probably contributes significantly to the lake, but during dry periods its contribution to the lake is probably small.

Net ground-water movement to or from the lake may vary depending on the relative amounts contributed by the surficial aquifer and lost to the limestone aquifer. Evidence developed later in this report indicates that net ground-water movement is into the lake during most years having greater-than-average rainfall and out of the lake during most years having less-than-average rainfall.

ANALYSIS OF DATA

RAINFALL VERSUS RISE OF LAKE LEVEL

Much of the rainfall at Lake Jackson is from thunderstorms that are intense but of brief duration. The rise of the lake level due to such storms is illustrated by graphs in figure 8. During these brief periods of rise, loss of water by evaporation or ground-water outflow is small. Thus, the rise of the lake level should be at least as great as the rainfall; any inflow from the tributary area during the storm adds to the lake-level rise.

The over-all effect of inflow from the tributary area can be evaluated by comparing the lake-level rise to the rainfall. Rainfall was not recorded at Lake Jackson and thunderstorm intensities vary greatly over wide areas, therefore, such a comparison cannot be made on a daily basis. However, the variability of rainfall at different points in the area tends to decrease as the measurement period is increased.

Thus, to evaluate the effect of inflow to Lake Jackson from its tributary area, the rise of the lake level was determined for all detectable storm periods. All rises whether abrupt or gradual were included, but only the months for which the recorder record was

Figure 7.—A sink hole depression in Lake Jackson when dry in 1932.

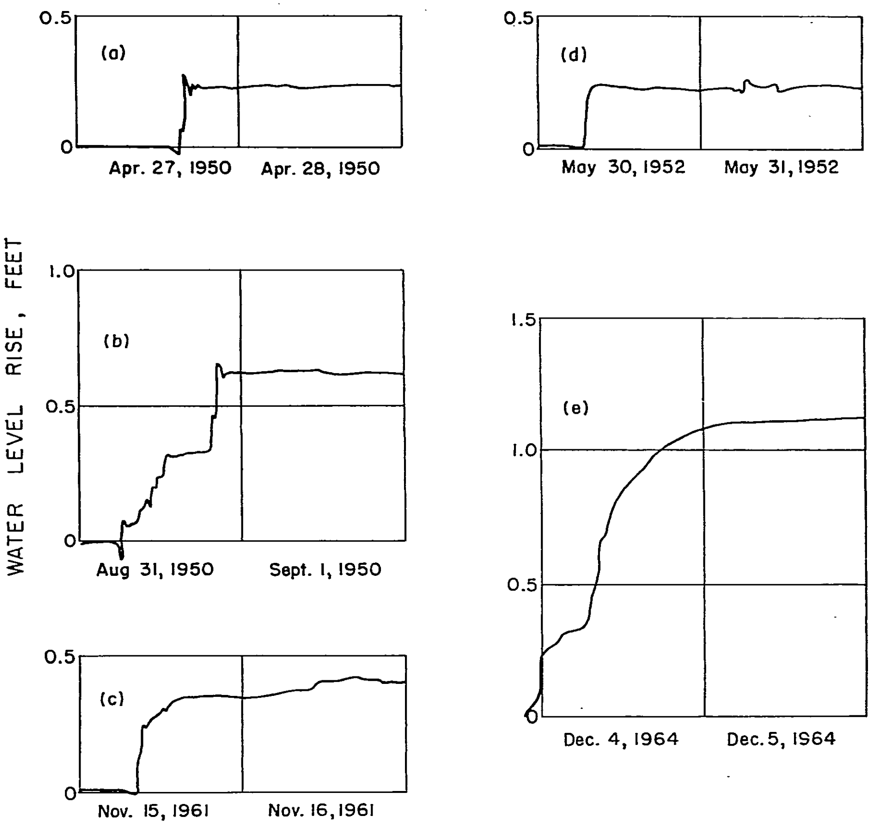

Figure 8.—Water-level rise of Lake Jackson during selected storm periods.

complete and accurate were included. These months are identified by bar graphs in figure 9.

Figures 10 and 11 show the accumulation of all individual rises during a month compared to the average of monthly rainfall at Quincy, Monticello, and Tallahassee.

The plot of points in figure 10 indicates that for monthly rainfall of less than about 0.6 foot the rise of the lake level is less than the rainfall while with greater rainfall the rise of the lake level exceeds the rainfall. Part of the scatter of the plot can be attributed to the fact that the measured rainfall was not always representative of rainfall on Lake Jackson. Scatter due to this cause, however, should tend to be centered about the equal-value line.

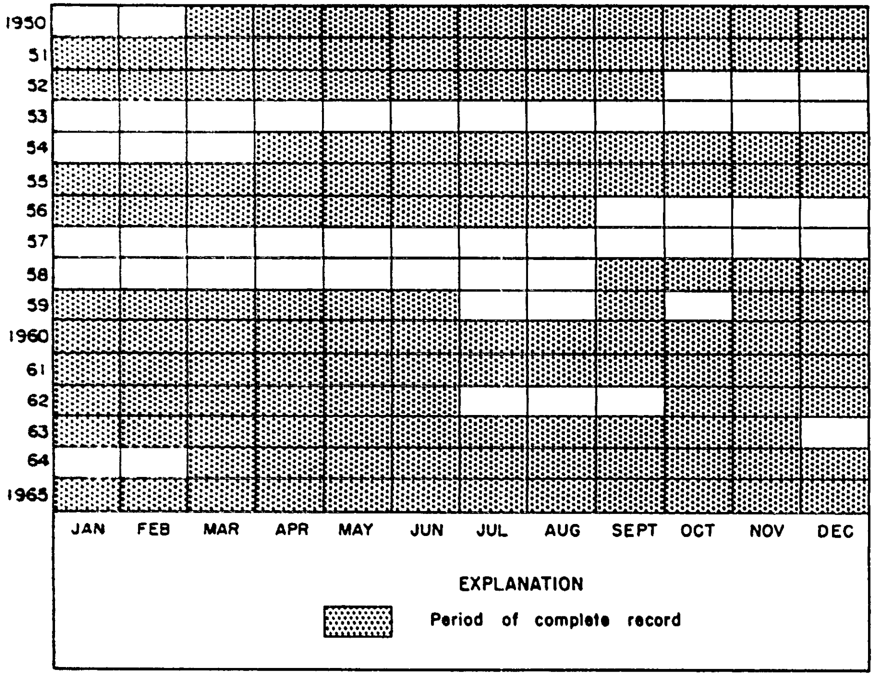

Figure 9.—Months for which water-level recorder chart record for Lake Jackson was complete.

The tendency for the lake-level rise to be smaller than monthly rainfall for amounts less than about 0.6 foot may be due partly to evaporation and ground-water outflow and partly to mechanical lag of the water-level recorder. If the recorder is following a downward trend, the water level must rise about 0.01 foot before a trace of the rise is recorded. This effect is a cumulative one if only the rises are considered as has been done on this analysis. The total effect is appreciable for months having several rises.

The tendency of the lake-level rise to exceed rainfall when monthly rainfall is greater than about 0.6 foot is probably due to surface-water inflow from the more intense storms during the month.

The data shown in figure 10 are plotted on a cumulative basis in figure 11. Monthly values of each parameter were summed in chronological order for months when the data were complete. (See fig. 9).

The over-all slope of the graph in figure 11 shows that measured rainfall generally exceeded the recorded rise of the lake level. As

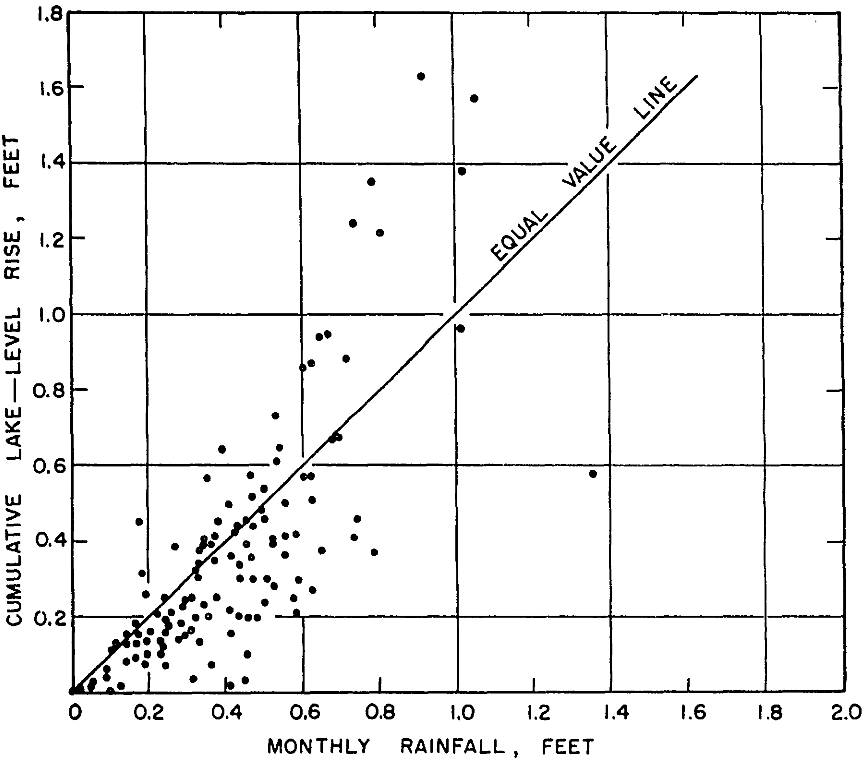

Figure 10.—Plot of monthly rainfall estimated for Lake Jackson versus the cumulation of all rises of the lake level during the month.

mentioned above, this tendency may be due to the use of nonrepresentative rainfall data, mechanical lag of the recorder, loss of water from the lake by evaporation, or by ground-water outflow during storm periods.

The breaks in the slope of the graph are generally related to rising and declining trends of the lake level. Periods of increasing slope, which correspond to rising trends of the lake level, indicate that surface-water inflow probably contributed appreciably to the lake-level rise during these periods. This interpretation is consistent with the fact that rising trends of the lake level are related to periods of greater-than-average rainfall when maximum surface runoff occurs.

Urbanization alters the pattern of runoff from an area and may alter the total yield of the area. The effect of progressive urbanization would be manifested in a cumulative relation involving

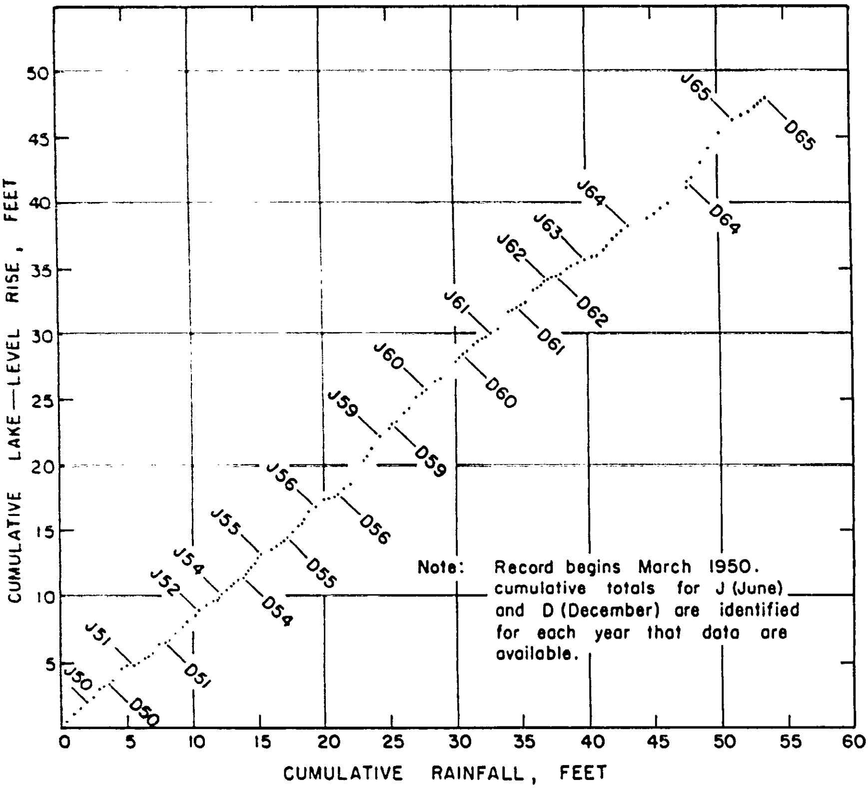

Figure 11.—Double mass relation between estimated rainfall at Lake Jackson and the resulting rise of the lake level.

runoff, and by a tendency for the relation line, as shown in figure 11, to drift persistently in one direction. In figure 11, however, the relation line shows no such tendency, indicating that to date the total runoff from the lake basin has not been altered appreciably by urbanization.

LONG-TERM FLUCTUATIONS OF LAKE LEVEL

The hydrologic significance of the recent water-level fluctuations of Lake Jackson may be appraised by considering past fluctuations. Unfortunately, systematic observations of the water level of Lake Jackson, or of any comparable lake, were not made prior to 1950. Other hydrologic parameters, such as rainfall and ground-water levels, have been observed for longer periods of time. Thus, if similarities can be established between lake-level fluctuations and variations of other hydrologic parameters, the probable range of the past lake-level fluctuations may be inferred.

COMPARISON OF LAKE LEVEL AND GROUND-WATER LEVEL

Although lakes and ground-water bodies differ in many ways, the two have at least one important factor in common. Both derive their water from rainfall. Thus, if the recharge area for the ground-water body is in the general area of the lake, the fluctuations of the two must follow the same long-term trend.

The recharge area for the limestone aquifer underlying Lake Jackson though not precisely delineated is known to be widespread. As indicated by rainfall records for Quincy, Monticello, and Tallahassee, the variations in rainfall at Lake Jackson would apply to a broad area. Therefore, the long-term water-level fluctuations of Lake Jackson should be similar to those of wells 7 and 115. Although the hydrograph for Lake Jackson shown in figure 6 is not entirely similar to those shown for wells 7 and 115, the graphs do follow the same over-all trends.

The fluctuations of the ground-water levels between 1933 and 1947 are smaller than those for subsequent years (fig. 6). Thus, though records of lake-level fluctuations prior to 1950 are lacking, the graphs of ground-water levels suggest that the fluctuations of Lake Jackson between 1933 and 1947 were much less pronounced than those for subsequent years. A longer period of record is needed for comparison, in order to establish which set of fluctuations might be considered the more unusual.

COMPARISON OF LAKE LEVELS AND RAINFALL

Extreme levels of natural water bodies normally result from successive years of greater-than-average or less-than-average rainfall rather than from a gross excess or deficiency of rainfall in any one year. The cumulative effect of two or more years of rainfall can be appraised by use of a moving average of rainfall.

The moving average is computed by averaging rainfall data for a specified number of consecutive years, progressively discarding data for the first year of the period as data for each successive year is included. Thus, in a sense, the period represented by the average moves through the entire period of record. Figure 12 shows the moving average of rainfall at Tallahassee for 3-year

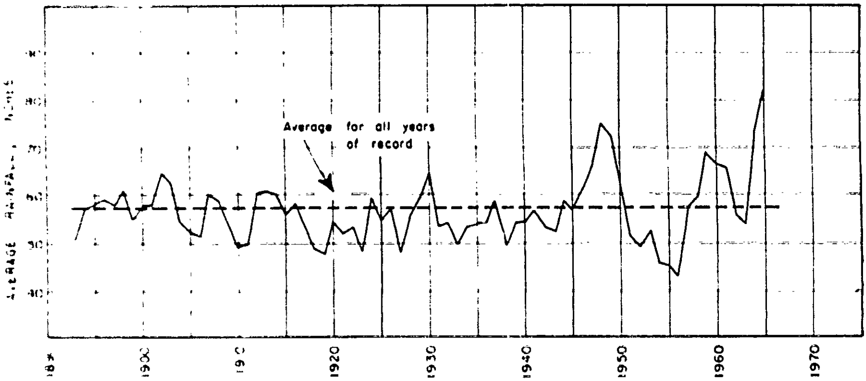

Figure 12.—Three-year moving average of rainfall at Tallahassee, Florida.

periods, the average being plotted at the end of the last year of the period represented.

Although the rainfall graph (fig. 12) and the water-level graphs for Lake Jackson and wells 5 and 7 (fig. 6) differ in detail, in a gross sense the graphs are similar. The rainfall record for Tallahassee was used to compute the moving average because the period of continuous record for this station was appreciably longer than that for either Quincy or Monticello.

The rainfall graph suggests that the 3-year periods preceding 1948, 1956, and 1965 were periods of hydrologic signifiance. The graph further suggests that the level of Lake Jackson was higher in 1965 than at any time during the preceding 75 years. The same conclusion is indicated by moving average graphs for 4- and 10-year periods. The graph for 5-year periods shows the average for the period ending 1948 to be slightly higher than that for 1965.

Lake Jackson was dry during the early part of 1957, coincident with the low shown on the graph of rainfall. The lake is quite shallow, however, and leakage through its bottom may vary. Thus, the lake could have been dry during less severe drought periods than 1954-56. Sellards (1914, p. 129) reported the lake to be "dry, or nearly so, in the early spring of 1907." He also mentioned the existence of two active sinks in the lake bottom. Local residents report that the lake was dry in 1932, 1935, and 1936. Thus, interpreted in light of this information, the rainfall graph indicates that the lake may have been dry a number of times.

ANALYSIS OF THE YEARLY CHANGE OF THE LAKE LEVEL

The level of Lake Jackson declines because of evaporation from the water surface, transpiration by aquatic vegetation, and ground-water outflow. The lake level rises because of precipitation on the water surface and inflow from the tributary area. Whether there is a net decline or a net rise for a given period depends on the degree of balance between these different factors. Separate analysis of years of net decline and of years of net rise provides a broader basis for understanding the behavior of the lake.

During years 1950-56, 1962-63, the lake level declined an average of 2.2 feet per year (table 2). Evaporation from the water surface as computed from table 1 was 4.2 feet per year, and it is arbitrarily assumed that any transpiration by aquatic vegetation was the same. Yearly rainfall at Lake Jackson may be assumed equal to the average of rainfall at Quincy, Monticello, and Tallahassee, which during these particular years (table 2) was 4 feet per year. Thus, the net decline that may be attributed to the difference between precipitation and evaporation was only 0.2 foot. The remaining 2.0 feet of the decline represents ground-water

TABLE 2.—NET YEARLY CHANGE IN WATER LEVEL OF LAKE JACKSON, 1950-65

[Minus (−) indicates decline; plus (+) indicates rise]

Year	Average lake level, in feet	Net yearly change, in feet	Estimated rainfall*, in inches
1950	92.5	−1.7	45.1
1951	90.2	−1.9	54.1
1952	88.8	−2.3	46.1
1953	86.4	−1.4	60.9
1954	83.0	−5.0	30.4
1955	79.1	−3.2	41.8
1956	76.9	−1.8	51.7
1957	......	+2.2	66.3
1958	80.2	+2.4	52.9
1959	83.4	+5.0	73.7
1960	87.2	+3.2	64.8
1961	89.1	+0.2	51.8
1962	88.4	−1.0	47.9
1963	87.3	−1.6	51.3
1964	88.8	+4.7	92.0
1965	94.2	+3.9	73.4

*Average of rainfall at Quincy, Monticello, and Tallahassee.

outflow in excess of ground-water and surface-water inflow from the tributary area. If such inflow were zero—and it probably was minimal during these relatively dry years—the decline of 2.0 feet per year would be a measure of the ground-water outflow.

During years 1957-61, 1964-65, the lake rose an average of 3.1 feet per year. Precipitation at Quincy, Monticello, and Tallahassee during these years averaged 5.6 feet. Evaporation and transpiration again may be assumed to be 4.2 feet per year. Thus, only 1.4 feet of the 3.1 feet average yearly rise may be attributed to the difference between precipitation and evaporation. The remaining 1.7 feet of the rise represents the difference between gound-water and surface-water inflow from the tributary area and ground-water outflow. In other words, inflow from the tributary area apparently was greater than ground-water outflow through the lake bottom by an amount equivalent to 1.7 feet per year.

The relative distribution of inflow from the tributary area between surface-water inflow and ground-water inflow cannot be determined. The small lakes and ponds within the tributary area are influenced by the same factors that cause Lake Jackson to fluctuate, and they contribute inflow to Lake Jackson only at the height of unusually wet periods. In addition their combined surface area is small relative to that of Lake Jackson. Therefore, the drainage of surface water from lakes and ponds would not be likely to noticeably affect the average yearly rise of Lake Jackson.

The preceding analysis of the lake-level rise due to rainfall shows that at times during and immediately after storms, surface-water runoff contributed substantially to the water-level rise of Lake Jackson. This effect does not appear to have exceeded from 1 to 1.5 feet per year during the wettest years (fig. 11). Thus, during wet years ground-water inflow may have exceeded ground-water outflow.

Ground-water outflow during dry years was equivalelnt to a lake-level decline averaging at least 2 feet per year, and it could be about the same during wet years. If so, ground-water inflow contributed substantially to the over-all lake-level rise during the wet years.

The years of net rise all occurred after the lake was almost dry in 1957, when one active sink reportedly was filled with dirt. Therefore, ground-water outflow during years after 1957 may have been less than indicated by data for preceding years.

This possibility is partly substantiated by data given in table 2. During years 1952-53 and 1962-63 the lake was declining from about the same level. The over-all decline was 3.7 feet in 1952-53 compared to only 2.6 feet in 1962-63; yet, rainfall at Quincy, Monticello, and Tallahassee was 0.7 feet greater in 1952-53. No conclusion regarding ground-water outflow can be made based on this evidence, however, because rainfall at Quincy, Monticello, and Tallahassee is not necessarily always truly representative of rainfall at Lake Jackson. Future observations during a prolonged drought period may indicate whether ground-water outflow has changed appreciably, but such observations likewise may not be conclusive because sinkholes may develop at any time.

Figures 10 and 11 show that the rise of the lake level is closely related to areal rainfall. Thus, if yearly evaporation and seepage are virtually constant, the yearly net lake-level change should be directly related to yearly rainfall. Data given in table 2 suggest that such a relation exists but the plot of these data in figure 13 does not expressly define the relation.

The scatter of the data in figure 13 is not unusual for hydrologic correlations of this type but part of the data appear to be grouped in a way that is not independent from the sequence of years. This type of grouping suggests that the required underlying assumptions may not have applied uniformly during the entire period under consideration. For example, such an effect might result from a pronounced change in seepage.

In figure 14 similar data are plotted separately for the individual rainfall stations involved. The scatter of these plots more nearly conforms to that which might be due primarily to the nonrepresentativeness of the rainfall data with respect to Lake Jackson. Thus, the apparent grouping that results when these data are averaged may be only coincidental.

A more adequate measurement of rainfall at Lake Jackson would be required to evaluate the inconsistencies which abound in figures 13 and 14. Some scatter still would persist, however, because the effects of variations in the seasonal distribution of rainfall are not entirely compensating within the period of a year.

If, tentatively, the relation between yearly rainfall and net yearly lake-level change shown in figure 13 can be presumed to be defined, further speculations can be made regarding the relative frequency of a given yearly lake-level change. The relative frequency of areal rainfall, as represented by the average of rainfall at Quincy, Monticello, and Tallahassee, is shown on a cumulative basis by the graph in figure 15. By means of the relation between

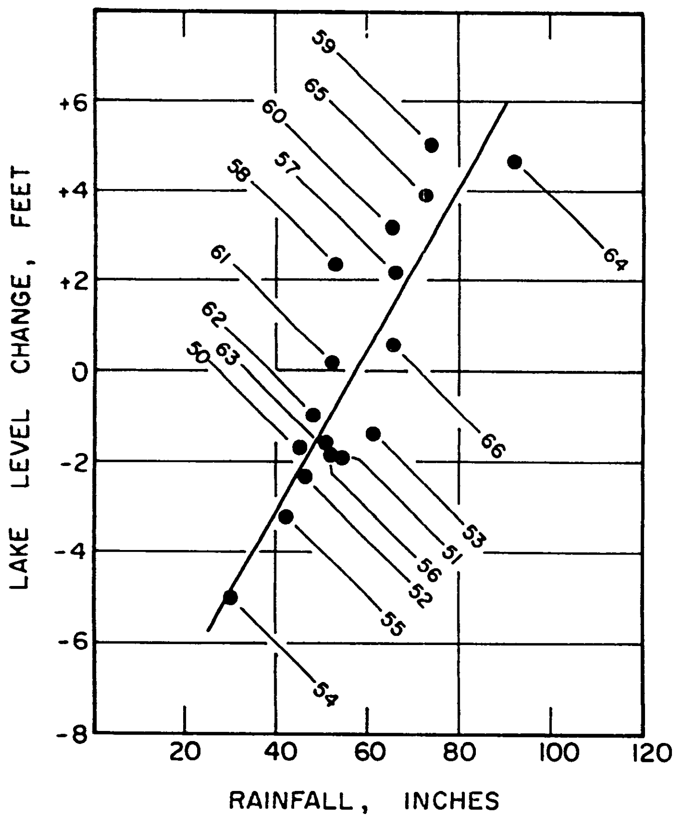

Figure 13.—Relation between the average of yearly rainfall at Quincy, Monticello and Tallahassee, and the net yearly change of the level of Lake Jackson.

rainfall and lake-level change given in figure 13, the rainfall frequency curve can be converted into a frequency curve for lake-level change as shown in figure 16.

Figure 16 can be used to approximate the probability of occurrence of a yearly lake-level change of a specified magnitude. The reality of the approximation rests on the validity of three assumptions: (1) that yearly rainfall is a random event; (2) that the relative frequency of rainfall has been established by records of past rainfall; (3) that the relation between rainfall and lake-level changes shown in figure 13 adequately represents the true relation.

If the factors controlling the lake level are in basic equilibrium, the frequency curve in figure 16 should be symmetrical about the line of zero change. As drawn, the frequency curve suggests a

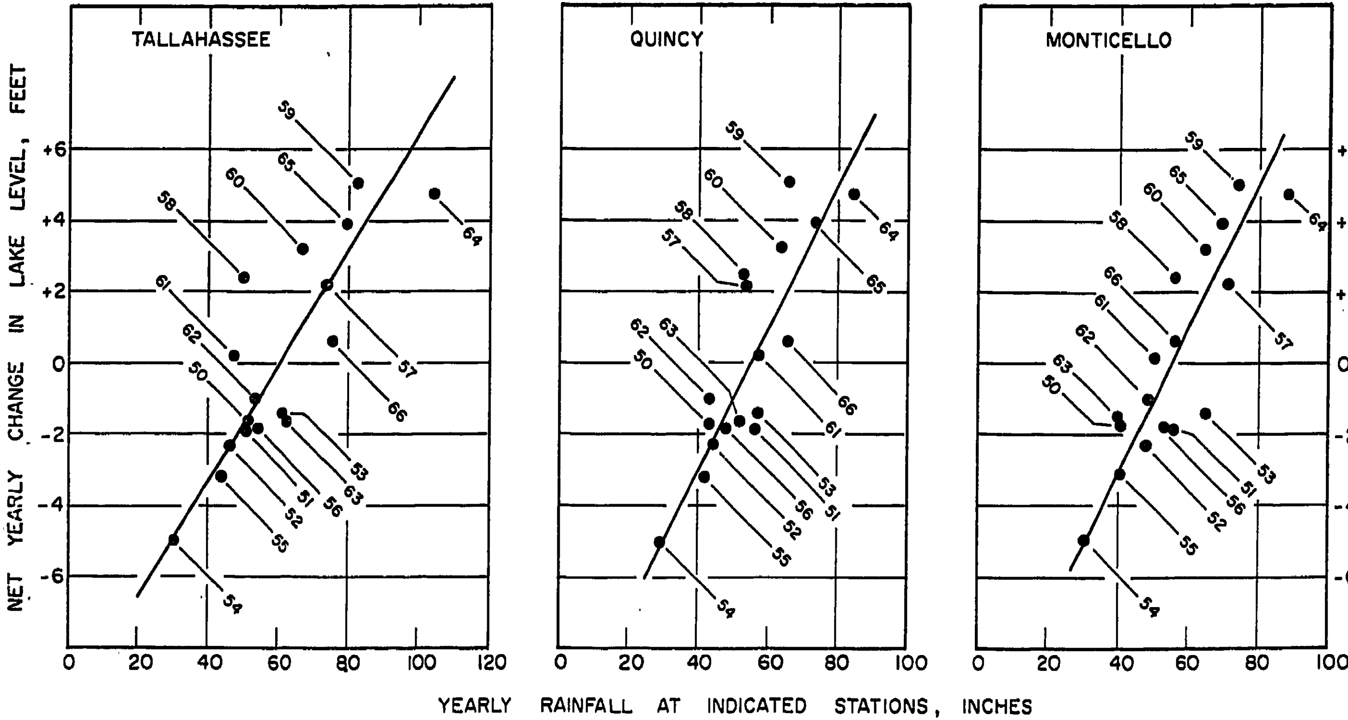

Figure 14.—Relations between the net yearly lake-level change and yearly rainfall at Quincy, Monticello, and Tallahassee.

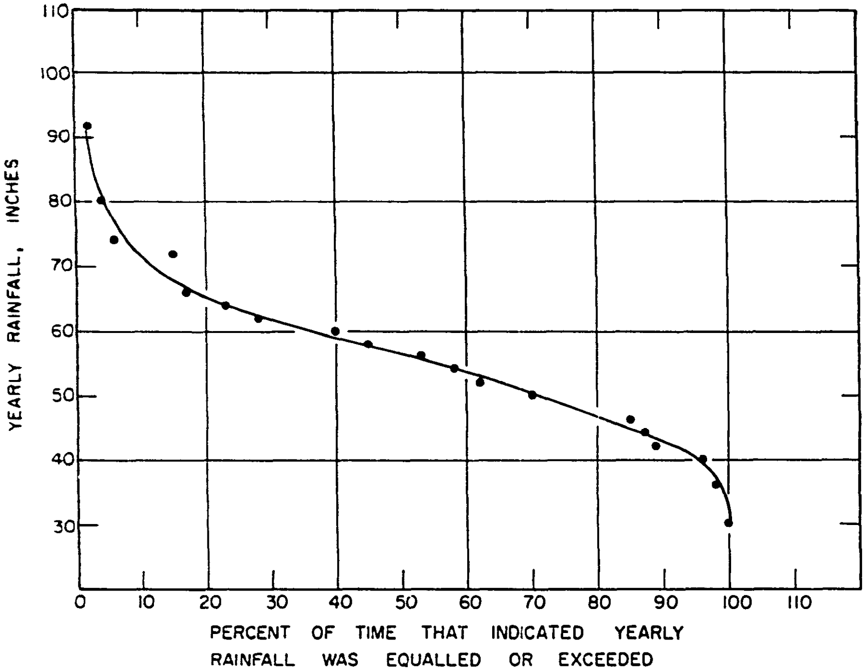

Figure 15.—Cumulative frequency curve for average of rainfall at Quincy, Monticello, and Tallahassee, Fla.

slight tendency for the lake to dry up. This tendency probably is real, as the lake has been dry several times, but the tendency may be greater or less than indicated because part of the basis for the frequency curve was not explicitly defined.

The foregoing analyses may be affected by variations in evaporation during wet and dry years. The pan evaporation record at Woodruff dam was available only for the years 1959-65. However, yearly pan evaporation for 1962-63, which were relatively dry years, averaged only 0.6 inch more than that for 1964-65, which were relatively wet years. Thus, it is doubtful that variations in annual evaporation are an important factor.

CONTROL OF THE LAKE LEVEL

Lake Jackson is currently flooding adjacent residential areas which, as lakeshore properties, offer scenic and recreational advantages. Although to date the behavior of the lake apparently has

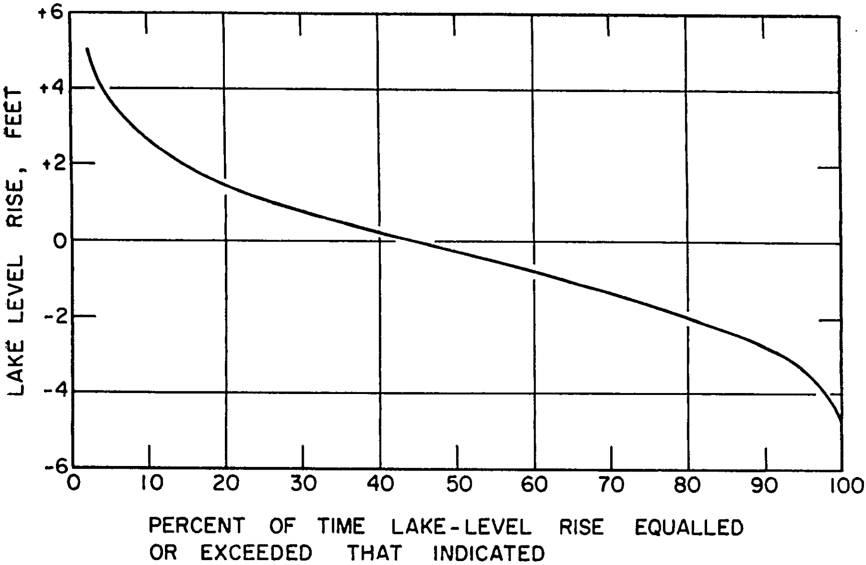

Figure 16.—Cumulative frequency curve for net yearly lake-level change of Lake Jackson.

not been affected by urbanization within its tributary area, continued urbanization may increase the total inflow to the lake. The threat of increased damage by future floodings leads to the consideration of methods of maintaining the lake below a given maximum level. However, the diversion of water from the lake to control high levels during wet periods will tend to decrease the utility of the lake during dry periods. Thus, methods of maintaining the lake level above a given minimum level during dry periods also may be considered.

RISING LAKE LEVEL

The design of an outflow system to maintain the lake level below a given maximum level should be based on data representative of the maximum rise that probably will occur. The outstanding rise of Lake Jackson, within the period of record, occurred from December 1, 1964 to April 30, 1965, when the net rise was 1.6 feet for the month of December alone and 5.2 feet for the 5-month period. Preventing any appreciable cumulative rise of the lake level during this prolonged and unusually wet period would have required the removal of a volume of water each month equivalent to a rise of about 1 foot. Some fluctuation of the lake level would result, of course, because inflow does not occur at a uniform rate. Most of the net rise of the lake for December 1964, for example, was due to a rise of 1.1 feet within a 24-hour period (figure 8, graph (e)).

The volume of water equivalent to a 1-foot rise of the lake level depends on the surface area of the lake which, in turn, varies with the lake level. The higher the lake level, the greater the surface area and the greater the volume of water corresponding to a given rise.

The level of the lake prior to the outstanding rise beginning in December 1964 was slightly below the altitude of 90 feet. At this level the surface area of the lake is about 6,300 acres. The volume of water corresponding to a 1-foot rise at this level is about 6,300 acre-feet. Removal of this volume of water within a period of 30 days would require an average outflow of 106 cfs (cubic feet per second) or 48,000 gpm (gallons per minute).

Flow by gravity past the controlling feature of the outflow system would vary with the height of the water above the level of the controlling feature. Thus, flow would not occur at an average rate but, rather, would be greater than average part of the time and less than average part of the time. To accomplish an average flow of 106 cfs, therefore, the controlling feature of the outflow system must be designed to pass a maximum flow substantially greater than the average. A lower rate of outflow could be used if more time were allowed to lower the lake to the desired level. In this case, however, the cumulative lake rise would be greater, thus requiring a greater allowance for the zone subject to flooding.

DECLINING LAKE LEVEL

During years having less-than-average rainfall the level of Lake Jackson usually declines. If the decline could be decreased by adding water to the lake during dry years, the utility of the lake for some purposes would be increased.

The decline of the lake level averaged 2.2 feet per year for the 9 years of net decline since 1950 (table 2). The required inflow to offset such a decline with the lake level at an altitude of 90 feet, for example, would be equivalent to a continuous inflow of about 20 cfs or 9,000 gpm. As a matter of comparison, this amount is about 50 per cent greater than the pumpage for the City of Tallahassee, which during 1965 averaged about 6,200 gpm.

SUMMARY

The present high level of Lake Jackson is due to the occurrence of an unusual number of successive years of greater-than-average rainfall. Total rainfall at Tallahassee during the 3-year period 1963-65 exceeded that for any 3-year period since at least 1885. By way of contrast, the drought at Tallahassee during 1954-56 was the most extreme that has occurred since at least 1885. Oddly enough, this severe drought occurred within the decade (1956-65) having the highest average rainfall since at least 1885.

Rainfall on the lake and surface-water inflow to the lake during and immediately after storms basically are the only factors causing the lake level to rise, rainfall being the predominant factor. Ground-water inflow apparently contributes appreciable water to the lake during years of greater-than-average rainfall. Ground-water inflow contributes to the over-all rise of the lake by retarding the lake-level decline due to evaporation and ground-water outflow during the interval between storms.

The level of Lake Jackson can be stabilized within reasonable limits. However, facilities for doing so must be designed to remove large amounts of water from the lake during years of unusually great rainfall and to return large amounts of water to the lake during most years of less-than-average rainfall.

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