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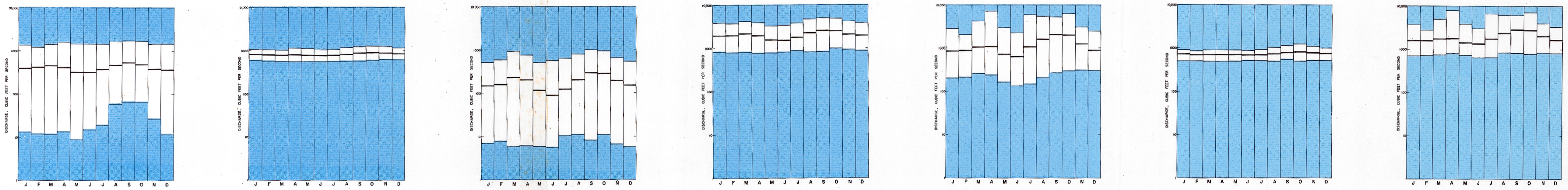
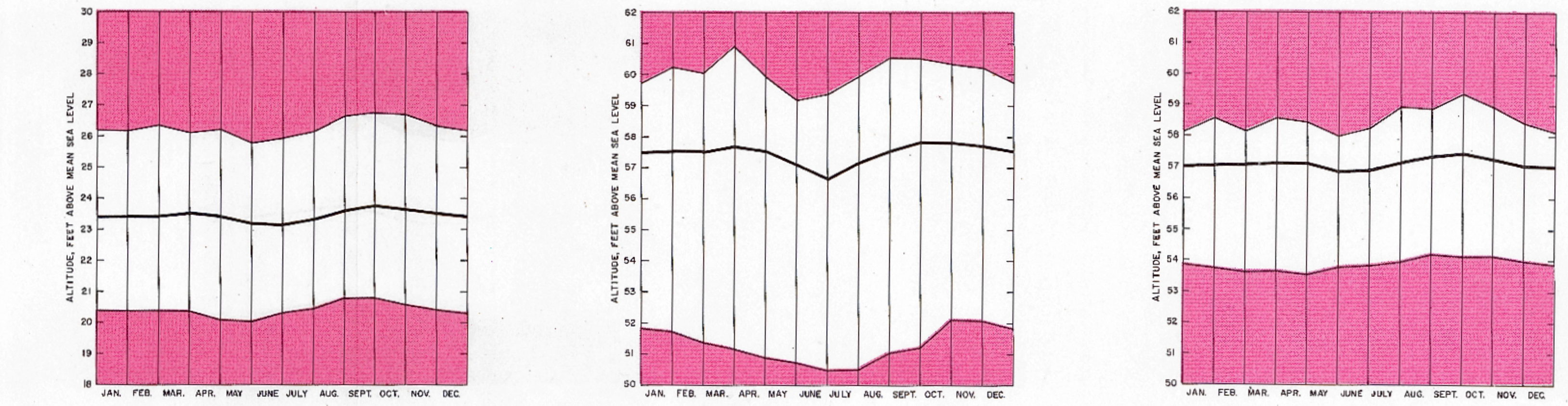


3 Oklawaha River near Ocala
4 Silver Springs near Ocala
6 Orange Creek near Orange Springs
1 Oklawaha River at Riverside Landing near Orange Springs
2 Withlacoochee River near Holder
5 Rainbow Springs near Dunnellon
7 Withlacoochee River at Dunnellon



3 Lake Kerr near Eureka
1 Orange Lake at Orange Lake
2 Lake Weir at Oklawaha

STREAM AND LAKE HYDROGRAPHS FOR SELECTED STATIONS IN MARION COUNTY AND VICINITY

Unshaded part of blue graphs shows maximum and minimum monthly mean discharge for the periods indicated.

Heavy black lines show the average monthly mean discharges for the periods indicated.

(See central map for location of station.)

Unshaded part of red graphs shows maximum and minimum month-end altitudes for the periods indicated.

Heavy black lines show the average month-end altitudes for the periods indicated.

(See central map for location of station.)

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1973

QUANTITY AND QUALITY OF SURFACE WATER IN MARION COUNTY, FLORIDA

By
Warren Anderson and Glen L. Faulkner

Surface water is abundant around much of the periphery of Marion County and along the Oklawaha River, which flows from south to north through the east central part of the county (see central map). Surface water is sparse elsewhere in the county because, with a few exceptions, rainfall infiltrates the sandy soils too rapidly to run off or accumulate in depressions. Thus, only about 25 percent of Marion County is subject to direct surface drainage and the remainder is drained through the subsurface. Most of the water that infiltrates the ground enters the principal aquifer, which in Marion County is the Floridan aquifer. The Floridan aquifer stores the water while transporting it to two major discharge points, Silver Springs and Rainbow Springs, and several lesser discharge points within the county. Nearly all the spring flow leaves Marion County by way of the Oklawaha River, Blue Run, Juniper Creek, and Salt Springs Run.

The annual rainfall on Marion County averages 53.2 inches, an average of about 4.1 bgd (billion gallons per day). About 240 mgd (million gallons per day) enter the county from the south in the Oklawaha River and a net input of about 440 mgd flows into the county in the Floridan aquifer. Thus, Marion County receives an average of 4.8 billion gallons of water per day. An average of about 3.1 bgd returns to the atmosphere by evaporation and transpiration leaving an average of about 1.7 bgd to replenish the aquifers, lakes, and streams in the county. The fact that the part of the rainfall that returns to the atmosphere within the county is termed "water loss" does not preclude its use during the period it remains on or beneath the land surface. However, little can be done to prevent its eventual loss.

In addition to this huge quantity of water, on the average, about 760 mgd passes along the southwestern county line in the Withlacoochee River and about 2,300 mgd enters Lake George, which abuts the eastern county line. Thus, the total quantity of water entering the county or flowing along the county line is nearly 4.8 bgd on the average, more than a tenth of the total surface water runoff from the state of Florida.

Important functions of streams other than as sources of water are removal of excess water and conveyance and dilution of wastes. In the 25 percent of the county subject to direct surface drainage, this function is performed with varying degrees of efficiency. Flat swampy areas drain more slowly than areas of greater relief. However, except for the contribution from springs, flow from these areas becomes negligible during dry periods. In the other 75 percent of the county, excess water is removed from the surface with great efficiency by infiltration. Of course, dissolved pollutants contained in the water also infiltrate the ground.

Fortunately, much of the pollution is eliminated by the natural purifying action of the soil. However, the capacity of the soil to purify is limited, thus every effort should be made to manage urban, industrial and agricultural development so as to avoid introduction of wastes of a kind and volume that cannot be naturally degraded in areas internally drained.

Lakes in or abutting Marion County range in size from water-filled sink holes of less than an acre to Lake George which covers about 46,000 acres. Lake altitudes range from about 1 foot for Lake George to more than 190 feet above mean sea level for several lakes in the vicinity of Irvine. Many of the lakes along the Oklawaha River are at altitudes of 50 to 60 feet whereas those near the eastern county line are at 20 to 30 feet. The lakes in the vicinity of Irvine rest on a thick layer of relatively impermeable deposits which overlie the more permeable limestones of the Floridan aquifer. These lakes drain to sinks which bottom at altitudes about 100 feet lower than the lakes. These sinks are points of relatively large amounts of recharge to the Floridan aquifer. Among the more significant benefits of lakes in Marion County is their value for recreation, homesites, and scenic beauty.

Problems with surface water almost always result from its variability, whether in amount or in quality. The alternate conditions of surplus and deficiency in the surface-water supply of Marion County results from imbalance between the rate and chronological distribution of the input (rainfall and inflow) and the output (evapotranspiration, runoff, and infiltration). The accompanying illustrations show how this hydrologic imbalance affects selected streams and lakes in and near Marion County.

Variability of streamflow in Marion County is illustrated by the three small maps beneath the large central map. Although the variation in flow is shown to be large, the amount of variation in the flow of streams in Marion County, except Orange Creek and the Oklawaha River upstream from Silver River, is much less than that in the flow of most other streams in Florida because of the high base flows supplied by the large springs in the county. Maximum flows, which are usually the result of a severe storm following an extended period of above normal rainfall, are several times the average flows. Average flows are generally less than three times the minimum flows.

The stage- and flow-duration curves show the percentage of time during the periods of record that specific stages or discharges were equaled or exceeded. For example, on 50 percent of the days of record, the stage of Lake Weir (curve 2) was 57.2 feet or more above mean sea level and the discharge of Orange Creek at Orange Springs (curve 6) was 100 cubic feet per second or more. The stage-duration curves show that the range in stage of the gaged lakes in Marion County is generally about 7 feet. However, the ranges of some other lakes in the county may be appreciably greater or less than this amount.

The hydrographs show the similarity in the pattern of the seasonal variation in the average conditions of streams and lakes. The seasonal changes in streamflow and lake stages result from differences in the seasonal amounts of rainfall and evaporation shown by the graphs of average monthly rainfall and evapotranspiration. The effect of imbalances between rainfall and evaporation on lake stages is illustrated by the graphs that show a comparison of the differences between average monthly rainfall and evaporation totals with the average monthly change in the stage of Lake Weir. The hydrographs for Silver Springs and Rainbow Springs show that the seasonal variation in the average monthly mean flows and the range in monthly mean flows is very small. This is due to the very large storage capacity of the Floridan aquifer from which the springflow emerges. The hydrographs for Oklawaha River near Ocala, Withlacoochee River near Holder, and Orange Creek at Orange Springs show the seasonal variation in the flow of these streams to be greater than that of the springs and the extremes in monthly mean flows to be considerably more. The variation in average monthly mean flow of the Oklawaha River near Ocala is shown to be less than that of the Withlacoochee River near Holder and that of Orange Creek at Orange Springs. This is because the flow of the Oklawaha is regulated at Moss Bluff to more evenly distribute the flow throughout the year. The extremes in monthly mean flow of the Oklawaha River at Ocala are, however, shown to vary more than those of the Withlacoochee River near Holder and, except for the summer months, to vary as much as those of Orange Creek at Orange Springs. The seasonal variation in the average monthly mean flows of the Oklawaha River at Riverside Landing is shown to be about the same as that of the river near Ocala but the extremes in monthly mean flow are shown to be far less. The more stable flow at Riverside Landing is attributable to the inflow between the two points from Silver Springs. The mineral (dissolved solids) content, color, and pH of water in streams and lakes in Marion County are indicated by the graph under the text. Rainwater usually contains a very small amount of dissolved minerals when it reaches the land surface. The dissolved solids content of a natural surface water is mostly a measure of the minerals dissolved by the water as it moves over the land surface or through the soil or rock to a stream or lake. Most water in streams in Marion County, and to a lesser degree in lakes, is of the calcium and magnesium bicarbonate type, meaning that the principal dissolved solids in the water come from the limestone and dolomite present in many places near the land surface and which make up the Floridan aquifer. Because calcium and magnesium bicarbonate cause hardness in water, a high mineral content in water in Marion County usually means that the water is hard. The mineral content of streams in Marion County ranges from 20 mg/l (milligrams per liter), soft, to more than 400 mg/l, very hard.

The mineral content of Orange Creek varies much less than that of other streams in the county because nearly all its flow is derived from Orange Lake, direct surface runoff, or seepage from the water-table aquifer, which consists mostly of sand. The mineral content of water from all these sources is low. The mineral content of the other streams varies more than that of Orange Creek because most of their base flow comes from the Floridan aquifer when the weather is dry, whereas most of their flood flow is from direct runoff or rainfall. Water from the Floridan aquifer contains more dissolved minerals than water from the other sources contains. The minimum mineral content of Oklawaha River at Moss Bluff probably results from local runoff of rain water between Moss Bluff and Lake Griffin. The higher content is typical of that for water in Lake Griffin. The generally lower mineral content of water in the Oklawaha River near Ocala than at Moss Bluff is probably due to surface inflow and to seepage from the water-table aquifer between these sites. The main reason for the much higher mineral content of the Oklawaha River at Riverside Landing near Orange Springs than at the upstream sites is inflow from Silver Springs and saline ground water that enters the river downstream from Silver Springs. The relatively high minimum mineral content at Riverside Landing reflects the influence of discharge from Silver Springs and other ground-water sources which make up a relatively large part of the flow here even during floods. Spring flow is a relatively small part of the flood flow of the Withlacoochee River near Holder but it is a relatively large part of its base flow. Consequently, the mineral content of the river is low at high discharge and high at low discharge. The mineral content of Silver Springs is much more than that of Rainbow Springs, indicating that either the water from Silver Springs remains in contact with the limestone aquifer longer than that from Rainbow Springs or the limestones of the aquifer feeding Silver Springs are more soluble than those feeding Rainbow Springs. The mineral content of all lakes in Marion County is low.

Color in the streams is caused mostly by organic matter that reaches the stream in direct runoff during rainy periods. Thus, color is low during low flow and high during high flow. In general, the springs are almost colorless but some lakes, for example Orange Lake, exhibit color caused by large amounts of surface inflow during wet weather.

The pH of a water indicates whether the water is acidic or alkaline. If its pH is 7.0 the water is neutral. If its pH is less than 7.0 it is acidic and if greater than 7.0 it is alkaline. Most natural waters tend to be either slightly acidic or slightly alkaline. For instance, rainwater usually has a pH of about 5.5, whereas the pH of Silver Springs water usually ranges between 7.5 and 8.0. The pH of lake water in Marion County is lower, as a rule, than that of streams. The higher pH of the streams reflects the larger proportion of the more alkaline flow derived from the limestone of the Floridan aquifer.

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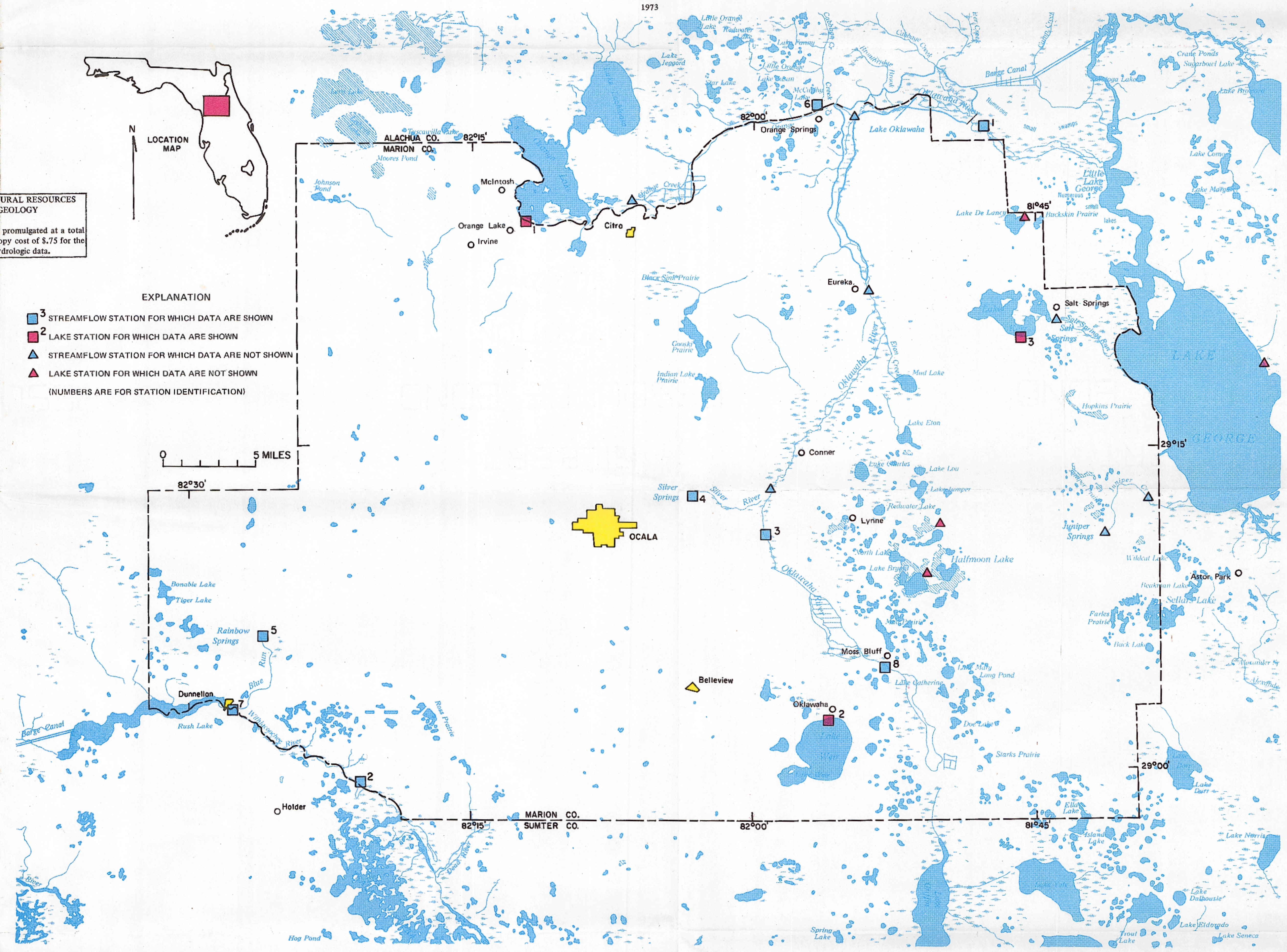
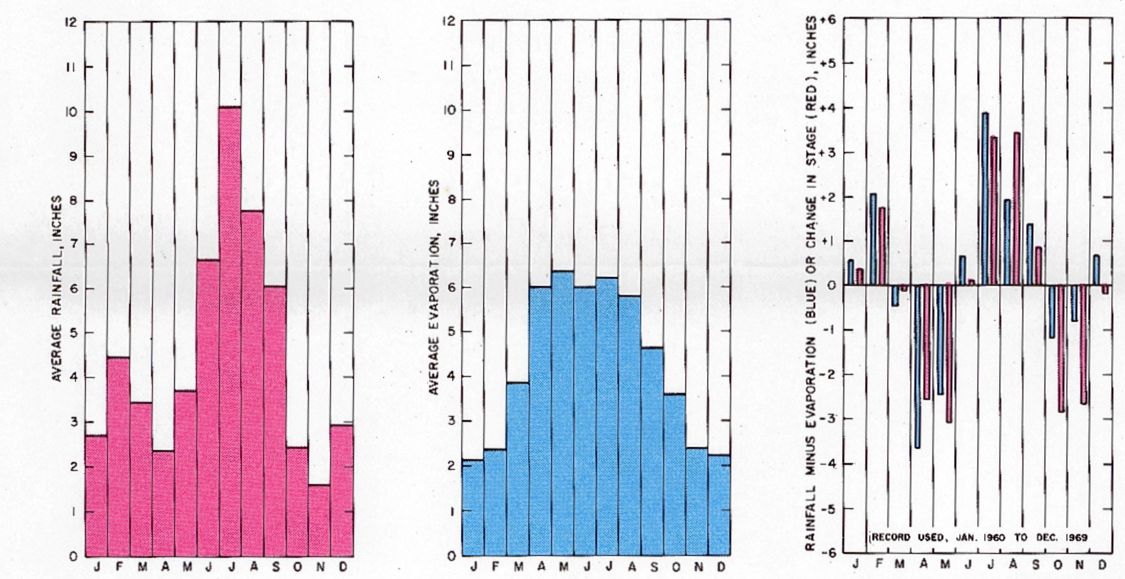
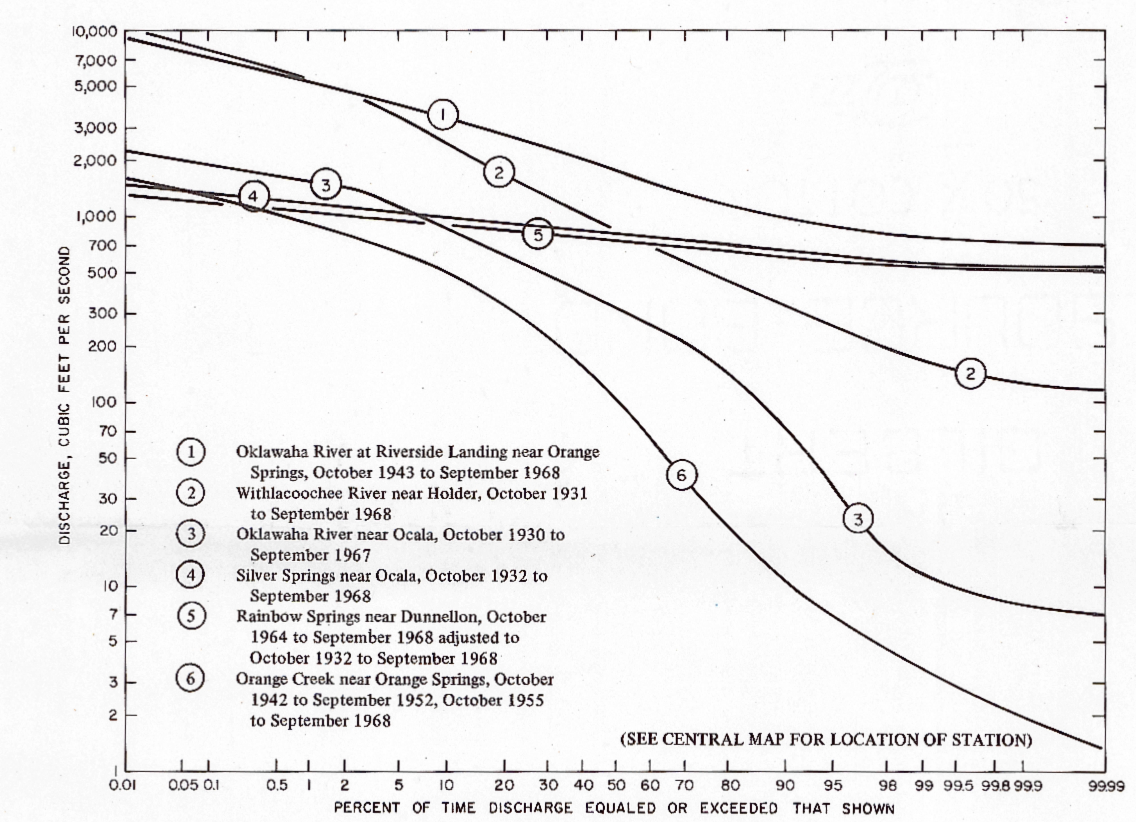




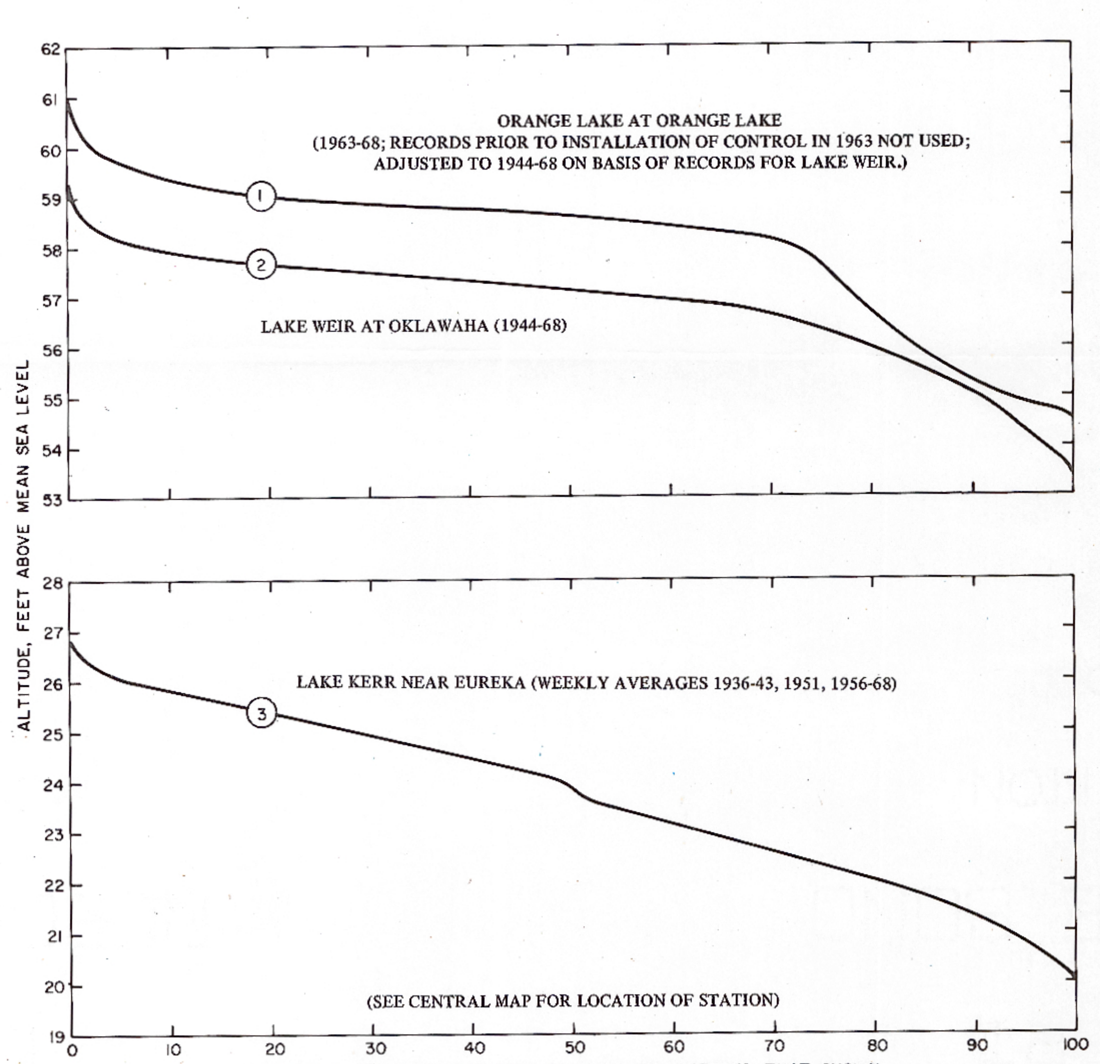
Average monthly rainfall in Marion County.

Average monthly lake evaporation in Marion County.

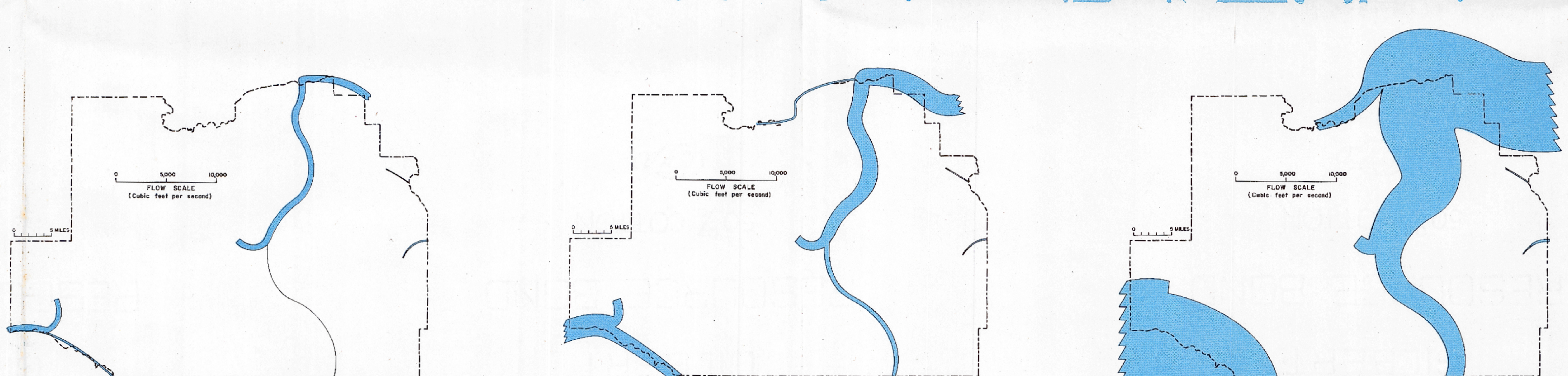
Average monthly difference in rainfall and evaporation and average monthly change in the stage of Lake Weir.



Flow-duration curves for selected streamflow sites in and near Marion County.



Stage-duration curves for selected lakes in and near Marion County.

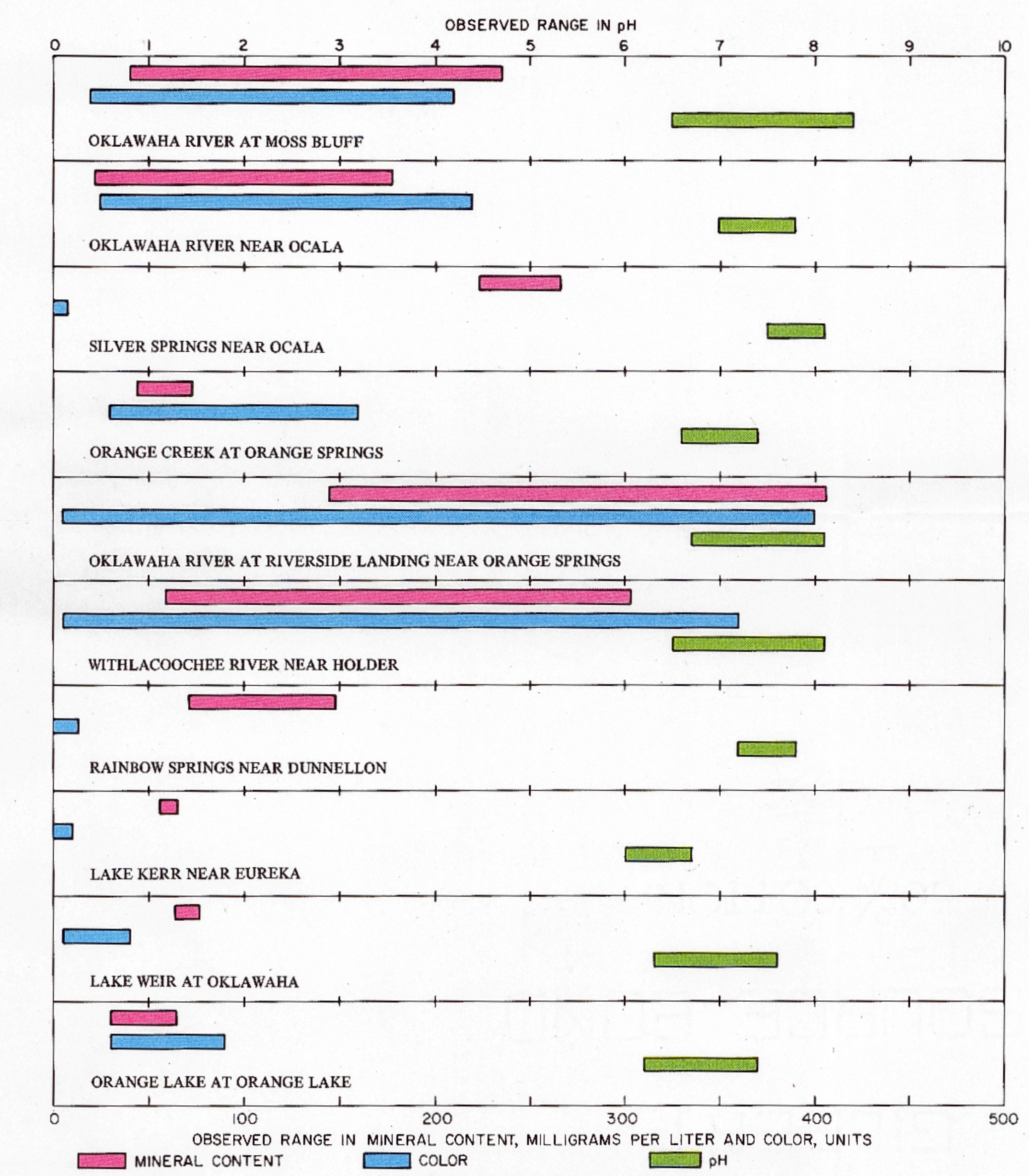


Minimum flow

Average flow

Maximum flow

COMPARATIVE FLOW CONDITIONS FOR STREAMS IN MARION COUNTY



Quality of water from selected surface sources in and near Marion County