UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLORIDA DEPARTMENT OF NATURAL RESOURCES
published by BUREAU OF GEOLOGY

RUNOFF FROM HYDROLOGIC UNITS IN FLORIDA

By
G. H. Hughes

Prepared by
U.S. GEOLOGICAL SURVEY
in cooperation with the
BUREAU OF WATER RESOURCES MANAGEMENT
FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

INTRODUCTION

The accompanying map is one of a series of map reports designed to furnish generalized hydrologic information and to provide a general description of various aspects of the hydrologic cycle as it applies to Florida. The map shows the average annual runoff from hydrologic units in Florida. A hydrologic unit is a geographic area designated as a basis for cataloging and processing hydrologic data and other information compiled in the National Water Data network. Florida is within the South Atlantic–Gulf Region (Region 03) and encompasses part or all of 8 (Subregions 07-14) of the 18 Subregions included in that Region. The hydrologic units in Florida, previously compiled by Conover and Leach (1975), are listed in the accompanying table.

Runoff, that part of precipitation that appears in surface streams (Langbein and Iseri, 1960), includes water that flows directly into gullies, creeks, and rivers, and also includes water that infiltrates to ground-water bodies and subsequently emerges in surface streams within the area under consideration. The quantity of runoff from an area is commonly expressed in terms of inches of water uniformly distributed over the area that contributes the water. In other words, an inch of runoff represents a 1-inch layer of water covering the drainage basin that contributed the water.

FACTORS AFFECTING RUNOFF

Long-term streamflow records show that the annual runoff from Florida averages about 14 inches statewide, but locally it averages from less than 5 inches to more than 30 inches, and, of course, it also varies greatly from year to year. Areal variations in runoff are caused by several factors. Regional differences in rainfall are an important factor. For example, in northwest Florida the average annual rainfall is several inches greater than the statewide average of about 53 inches, as is apparent from the rainfall map just to the right. Hence, all other things being equal, the annual runoff in northwest Florida ought to be greater than the statewide average.

The annual runoff from an area is also influenced by the evaporation potential of the atmosphere and the extent to which water remains on or near the land surface to sustain evaporation from land and water surfaces and transpiration by plants. In short, any part of the rainfall that is taken up by evapotranspiration cannot produce runoff from the area.

The evaporation potential of the atmosphere, represented by the map of average annual lake evaporation in figure 2 (Visher and Hughes, 1969), is several inches greater in southern Florida than in northern Florida. Thus, on the basis of evaporation potential of the atmosphere, the annual runoff should be considerably greater in northern Florida than in southern Florida.

For water to be evaporated or transpired it must remain on the land surface or in the soil within the reach of plant roots. The extent to which this occurs is determined by the topographic and geologic characteristics of the area. For example, steep land slopes and relatively impermeable soils promote rapid runoff from the area, thereby reducing the opportunity for water to be evaporated or transpired. Flat land slopes and surface depressions promote the ponding of water which in turn promotes evapotranspiration. Permeable soils and substrata promote the rapid infiltration of water which greatly reduces the opportunity for water to be evaporated or transpired, especially if the water table is several feet below land surface. Of course, any water that enters the subsurface flow system may eventually emerge in surface streams where it again becomes available for evapotranspiration, but the wetted area in this instance is usually much smaller than the upland area where water first infiltrated the soil.

Man's activities also can affect runoff. The diversion of water from one basin to another reduces the natural runoff from the losing basin and increases the apparent runoff from the gaining basin. The storing of water in artificial surface reservoirs, or the spreading of water over the land surface—as in the irrigation of crops—increases evapotranspiration and thereby decreases runoff. Drainage canals tend to lower water levels in general and to remove water from an area more rapidly than would have occurred naturally, thereby reducing evapotranspiration and increasing runoff from the area. Urbanization also affects runoff. The creation of impervious areas tends to increase the overland flow from the urbanized area and decrease the recharge to the subsurface-flow system of the area. The more rapid removal of a greater part of the available water tends to decrease evapotranspiration and increase runoff from the area. The effects of man's activities are sometimes partly compensating. For example, areas that are drained by canals often are irrigated. Urbanization usually entails an increase in the consumptive use of water.

Runoff varies greatly with time as well as with location. The annual runoff from a stream basin can vary several fold between extremely wet and dry years. For example, as shown in figure 3, runoff from the Santa Fe River basin in northeast Florida (Hydrologic Unit 110206) during the 44 years when data were available ranged from about 39 inches in 1948 to about 9 inches in 1956. Within each year the runoff rate varies widely, of course, because of the seasonal variation in rainfall.

COMPUTATION OF AVERAGE ANNUAL RUNOFF

Because of variations in the yearly runoff, comparisons of runoff from different areas are more meaningful if made for the same time span. For the accompanying map, runoff data for 1951–74 were used for all parts of the state except those drainage basins that lie south of Lake Okeechobee in Subregion 09, where data for 1965–74 were used. The results of various water-resources investigations in Florida were helpful in estimating the average annual runoff from some hydrologic units.

Runoff from the low coastal areas of Florida is usually not measured because the streams are affected by tides. Runoff from such areas is herein assumed to be the same as the gaged runoff from inland areas of the same hydrologic units. Some hydrologic units—such as units 140101, 140102, 100206, and others—include areas of saline water along the coast; these areas were not included in the computation of runoff values used in preparation of the accompanying map. For those hydrologic units in which the land area consists almost entirely of offshore sand bars and islands—such as units 130014 and 090203—runoff data do not exist. Because the surficial materials of the land areas in these units are relatively permeable, rainfall, after infiltrating the ground, could move to the shoreline without emerging in surface streams. Hence, the runoff from these areas was assumed to be minimal.

Runoff from each of the hydrologic units supposedly represents the surface outflow produced by rainfall on that particular unit. Thus, in places where surface streams pass through two units, the runoff of the downstream unit was determined as the difference between runoff from the upstream unit and the combined runoff from the two units. In some parts of Florida, water derived from rainfall on one hydrologic unit moves underground through an artesian aquifer to emerge in another unit downgradient in the subsurface-flow system. In such instances, the surface outflow from the upgradient unit represents the true runoff from that unit. However, the surface outflow from the downgradient unit is greater than the true runoff by the amount of the ground-water inflow from the up-gradient unit. For most hydrologic units in Florida, the ground-water inflow probably is not large enough in relation to the true runoff to seriously distort the areal runoff pattern. One known exception to this is the apparent high runoff to the Gulf of Mexico from hydrologic unit 100207 in west-central Florida which is caused by substantial ground-water inflow from hydrologic unit 100208 immediately to the east (Cherry and others, 1970, p. 62–76).

SELECTED REFERENCES

Cherry, R. N., Stewart, J. W., and Mann, J. A.
1970 General hydrology of the middle gulf area, Florida: Florida Dept. Nat. Resources, Bur. Geology Rept. Inv. 56, 96 p.

Clark, W. E., Musgrove, R. H., Menke, C. G., and Cagle, J. W., Jr.
1964 Water Resources of Alachua, Bradford, Clay, and Union Counties, Florida: Florida State Board of Conserv., Div. Geology, Rept. Inv. 35, 170 p.

Conover, C. S. and Leach, S. D.
1975 River basin and Hydrologic Unit map of Florida: Florida Dept. Nat. Resources, Bur. Geology, Map Ser. 72, 1 sheet.

Crain, L. J., Hughes, G. H., and Snell, L. J.
1975 Water resources of Indian River County: Florida Dept. Nat. Resources, Bur. Geology Rept. Inv. 80, 75 p.

Florida Department of Natural Resources
1974 Florida water and related land resources, Kissimmee-Everglades area, 180 p.

Kenner, W. E.
1966 Runoff in Florida: Florida Board Conserv., Div. Geology Map Ser. 22, 1 sheet.

Kohler, M. A., Nordenson, T. J., and Baker, D. R.
1959 Evaporation maps for the United States: U.S. Weather Bureau Tech. Paper 37, 13 p., 5 pl.

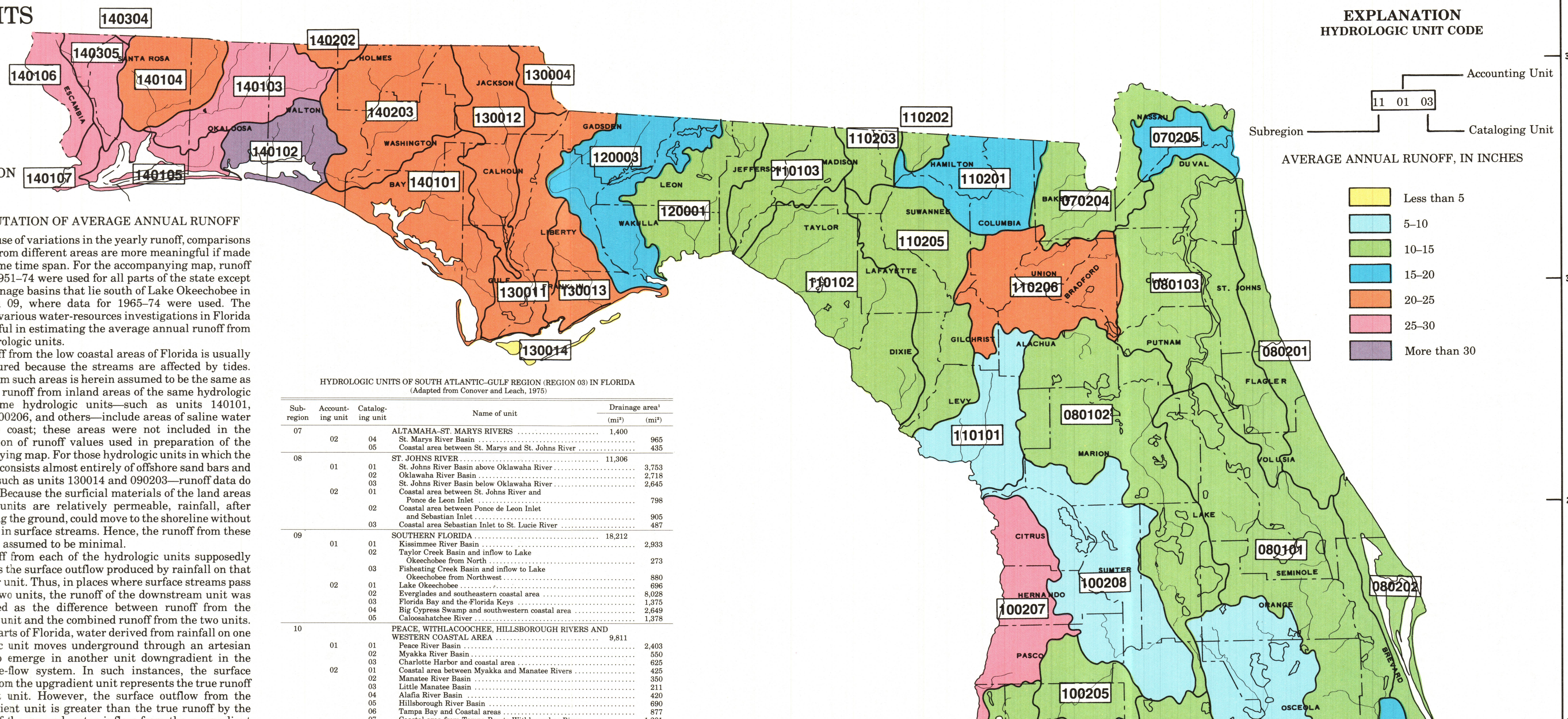
Langbein, W. B., and Iseri, K. T.
1960 General introduction and hydrologic definitions: U.S. Geol. Survey Water Supply Paper 1541-A, 29 p.

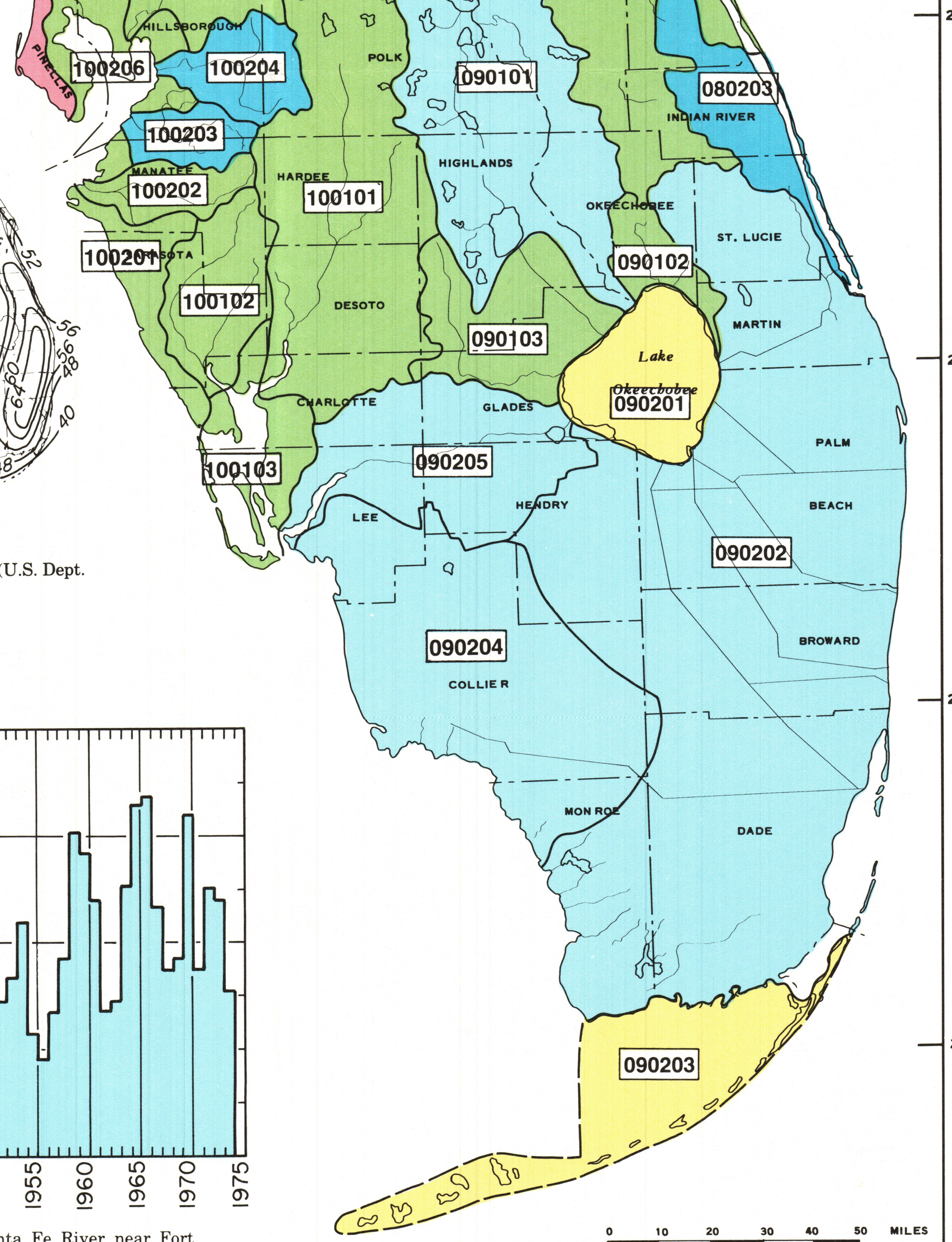
Musgrove, R. H., Foster, J. B., and Toler, L. G.
1965a Water resources of the Econfina Creek basin area in northwestern Florida: Florida State Board Conserv., Div. Geology Rept. Inv. 41, 51 p.

Musgrove, R. H., Barraclough, J. T., and Grantham, R. G.
1965b Water resources of Escambia and Santa Rosa Counties, Florida: Florida State Board Conserv., Div. Geology Rept. Inv. 40, 102 p.

U.S. Dept. Commerce
1972 Climate of the states, Florida: Climatography of the United States No. 60-8, Natl. Oceanic and Atmospheric Adm. Environmental Data Service, 31 p.

Visher, F. N. and Hughes, G. H.
1969 The difference between rainfall and potential evaporation in Florida: Florida Dept. Nat. Resources, Bur. Geol. Map Ser. 32, 1 sheet.





HYDROLOGIC UNITS OF SOUTH ATLANTIC–GULF REGION (REGION 03) IN FLORIDA
(Adapted from Conover and Leach, 1975)

Sub-region	Accounting unit	Cataloging unit	Name of unit	Drainage area[1] (mi²)	(mi²)
07			ALTAMAHA–ST. MARYS RIVERS	1,400	
	02	04	St. Marys River Basin		965
		05	Coastal area between St. Marys and St. Johns River		435
08			ST. JOHNS RIVER	11,306	
	01	01	St. Johns River Basin above Oklawaha River		3,753
		02	Oklawaha River Basin		2,718
		03	St. Johns River Basin below Oklawaha River		2,645
	02	01	Coastal area between St. Johns River and Ponce de Leon Inlet		798
		02	Coastal area between Ponce de Leon Inlet and Sebastian Inlet		905
		03	Coastal area Sebastian Inlet to St. Lucie River		487
09			SOUTHERN FLORIDA	18,212	
	01	01	Kissimmee River Basin		2,933
		02	Taylor Creek Basin and inflow to Lake Okeechobee from North		273
		03	Fisheating Creek Basin and inflow to Lake Okeechobee from Northwest		880
	02	01	Lake Okeechobee		696
		02	Everglades and southeastern coastal area		8,028
		03	Florida Bay and the Florida Keys		1,375
		04	Big Cypress Swamp and southwestern coastal area		2,649
		05	Caloosahatchee River		1,378
10			PEACE, WITHLACOOCHEE, HILLSBOROUGH RIVERS AND WESTERN COASTAL AREA	9,811	
	01	01	Peace River Basin		2,403
		02	Myakka River Basin		550
		03	Charlotte Harbor and coastal area		625
	02	01	Coastal area between Myakka and Manatee Rivers		425
		02	Manatee River Basin		350
		03	Little Manatee Basin		211
		04	Alafia River Basin		420
		05	Hillsborough River Basin		690
		06	Tampa Bay and Coastal areas		877
		07	Coastal area from Tampa Bay to Withlacoochee River		1,201
		08	Withlacoochee River Basin		2,059
11			SUWANNEE AND AUCILLA RIVERS	7,832	
	01	01	Waccasassa River and coastal area between Withlacoochee and Suwannee Rivers		924
		02	Coastal area between Suwannee and Aucilla Rivers		1,892
		03	Aucilla River Basin		756
	02	01	Suwannee River above Withlacoochee River excluding Alapaha River Basin		912
		02	Alapaha River Basin		112
		03	Withlacoochee River Basin		275
		05	Suwannee River Basin below Withlacoochee River excluding Santa Fe River Basin		1,577
		06	Santa Fe River Basin		1,384
12			OCHLOCKONEE RIVER	2,324	
	00	01	St. Marks and Wakulla Rivers and coastal area between Aucilla and Ochlockonee Rivers		1,047
		03	Ochlockonee River Basin		1,277
13			APALACHICOLA, CHATTAHOOCHEE, AND FLINT RIVERS	3,081	
	00	04	Lower Chattahoochee		191
		11	Apalachicola River Basin		1,061
		12	Chipola River Basin		1,020
		13	Coastal area between Ochlockonee and Apalachicola Rivers		557
		14	Apalachicola Bay coastal area and offshore islands		252
14			CHOCTAWHATCHEE, YELLOW, AND ESCAMBIA RIVERS	6,491	
	01	01	St. Andrew Bay, inflow and coastal area		1,351
		02	Choctawhatchee Bay, inflow and coastal area		692
		03	Yellow River Basin		858
		04	Blackwater River Basin		700
		05	Escambia Bay, inflow and coastal area		542
		06	Perdido River Basin		252
		07	Perdido Bay, inflow and coastal area		133
	02	02	Pea River		108
		03	Choctawhatchee River below Pea River		1,430
	03	04	Lower Conecuh River Basin		8
		05	Escambia River Basin		417

[1]For units which extend into adjoining states, includes area in Florida only.

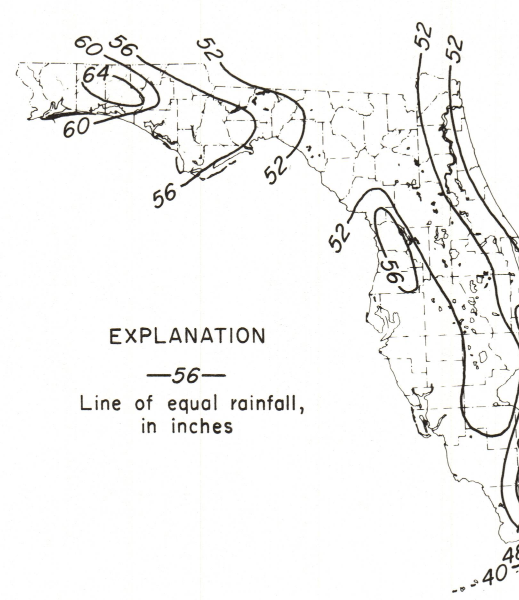


Figure 1.—Average annual rainfall in Florida (U.S. Dept. Commerce, 1972).

DEPARTMENT OF NATURAL RESOURCES
BUREAU OF GEOLOGY

This public document was promulgated at a total cost of $764.00 or a per copy cost of $.38 for the purpose of disseminating hydrologic data.

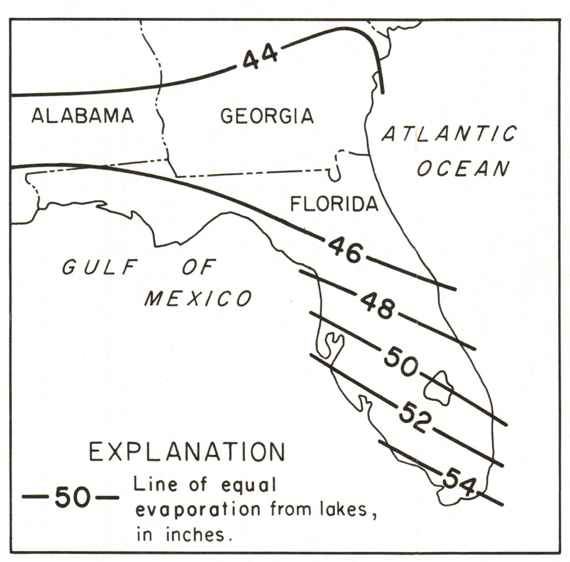


Figure 2.—Average annual lake evaporation in Florida. (From Kohler and others, 1959.)

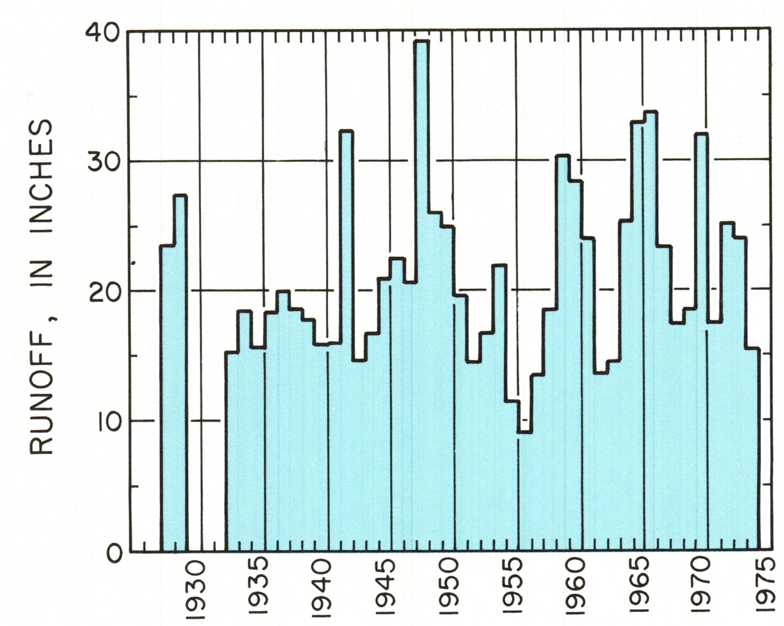


Figure 3.—Annual runoff of Santa Fe River near Fort White (in Hydrologic Unit 110206).