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INTERIM REPORT ON SURFACE WATER RESOURCES OF BAKER COUNTY, FLORIDA

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PREFACE

This report was prepared in the Ocala office of the U. S. Geological Survey under the supervision of A. O. Patterson, District Engineer, as part of a cooperative agreement with the Florida Geological Survey. Flood and basic streamflow data utilized in the study were collected under provisions of the same and other financial cooperative agreements. Climatological data and other information are from technical reports or publications of the U. S. Weather Bureau and the Florida Department of Agriculture.

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INTERIM REPORT ON SURFACE WATER RESOURCES OF BAKER COUNTY, FLORIDA

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ABSTRACT

The principal sources of surface-water supplies in Baker County are the St. Marys River and its tributaries. However, the flow of many of the small tributaries is intermittent, and without storage they are not dependable sources of supply during sustained periods of deficient rainfall.

Of the six stream-gaging stations in Baker County for which complete records are available, one has been in operation for 31 years and provides a long-term record upon which to base correlative estimates for extending the short-term records at the other stations. All available streamflow data to 1957 have been summarized in graphic or tabular form.

The hydrologic balance between minimum streamflows and increased evaporation losses afforded by potential shallow reservoirs provides design criteria for determining the maximum surface area of effective reservoir that can be created at a selected site within Baker County. This information has been presented in graphic and tabular form in the report.

INTRODUCTION

Purpose and Scope of Investigation

This report summarizes available data on the surface-water resources of Baker County and evaluates the present

and potential use of these resources. The county needs the hydrologic data for the design of shallow reservoirs on small streams to impound water for recreational uses. The report provides data which will be useful not only for the specific purpose of planning small artifical lakes but also for the formulation of plans for the future development and economic growth of the county.

Description of Area

Topography and Drainage

Baker County is in the Central Highlands topographic region in the northeastern part of Florida and extends about 25 miles southward from the Georgia-Florida line. The total area of the county is 585 square miles. The topography of the county is gently rolling, with the elevation of most of the area varying between 100 and 150 feet above mean sea level. The entire land surface of Baker County is covered with a mantle of loose gray sand ranging in thickness from a few feet to more than 50 feet.

The St. Marys River forms the northeastern boundary of Baker County and drains most of the county area. The drainage from small areas in the southern part of the county flows into tributaries of the Suwannee River. Pinhook Swamp in the northwestern part of the county is a continuation of the Okefenokee Swamp which occupies a large area in southern Georgia. The drainage from Pinhook Swamp is to the east into the St. Marys River basin and to the west into the Suwannee River basin. Because of the flat surface of the Pinhook Swamp area and absence of well defined ridge lines, the drainage divide between the St. Marys and the Suwannee River basins is indefinite. The drainage divide between the headwaters of several tributaries in the southwestern part of the county is also indefinite and, in places, the basins are interconnected. However, most of the drainage of the county follows the basin divides as shown in figure 1.

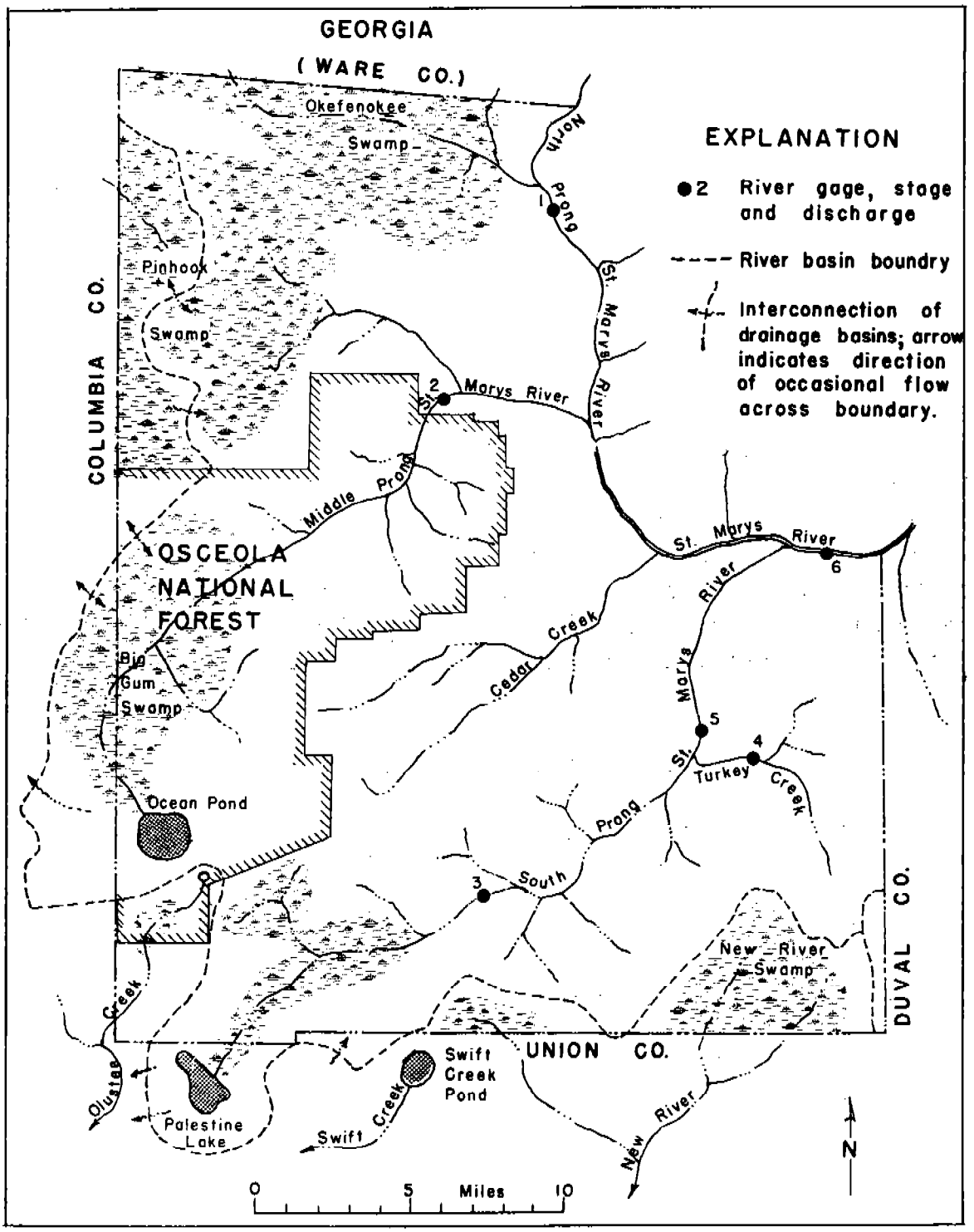

Figure 1. Map of Baker County, Florida, showing surface-water features and location of gaging stations.

Climate

The average temperature, based on 58 years of record at Glen St. Mary, is 68.6°, with an average high of 81.9° in July and an average low of 55.4° in December. The average annual rainfall at Glen St. Mary for a 61-year record since 1896 is 52.2 inches, with the heaviest rainfall in the months of June, July, August, and September. Figure 2 shows the variations in temperature and rainfall.

Industry

Baker County is primarily rural, with lumber, pulpwood, and naval stores operations representing a large portion of the revenue. Two of the largest nurseries in the State are located near Macclenny. In addition, small and diversified farming and the raising of poultry for the commercial market make up a considerable part of the local economy. About half of the Osceola National Forest is located in the western part of the county. The type of industry in the county at present does not require large quantities of water.

Definition of Terms

Some of the terms of streamflow and other hydrologic data, as used in this report, are defined as follows:

Precipitation. As used in meteorology includes all moisture that reaches the earth, whatever its form - rain, snow, sleet, hail, dew, or frost.

Evapotranspiration. The process whereby water leaves a drainage area as vapor, including transpiration from plants and evaporation from free surfaces.

Drainage area. The size of the area drained by a stream above a given location, usually expressed in square miles (sq mi).

Discharge. Rate of flow at a given instant in terms of volume per unit of time; usually expressed in cubic feet per second, gallons per minute, or millions of gallons per day.

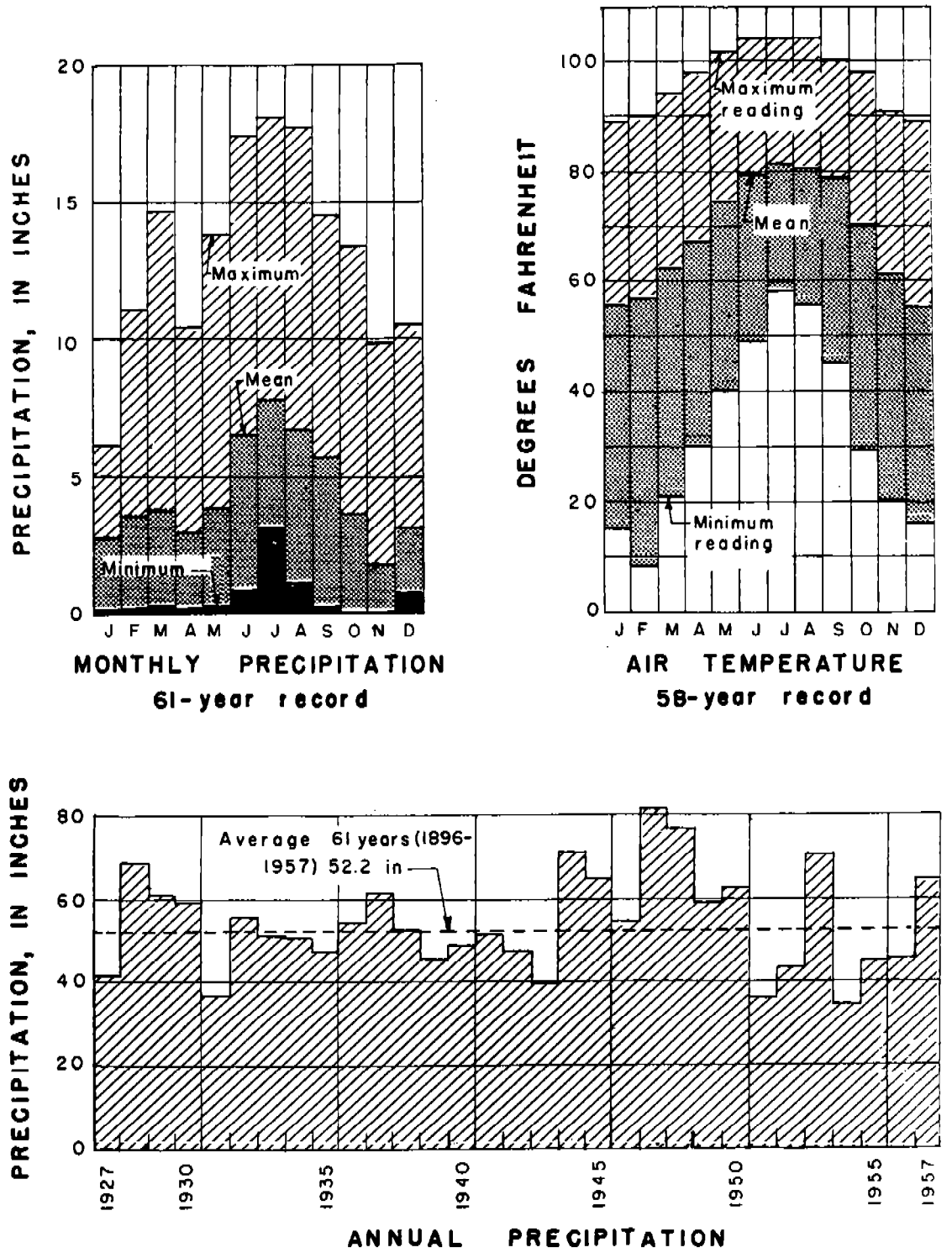

Figure 2. Climatological data for Glen St. Mary.

Cubic foot per second (cfs). The rate of discharge of a stream whose channel is one square foot in cross-sectional area and whose average velocity is one foot per second.

Cubic feet per second per square mile (cfsm). An average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Acre-foot. The quantity of water required to cover an acre to a depth of one foot and is equivalent to 43,560 cubic feet.

Runoff in inches. The depth to which an area would be covered if all the water draining from it in a given period were uniformly distributed on its surface. The term is used for comparing runoff with rainfall.

Water year. A 12-month period beginning October 1 and ending the following September 30. Designated as the year ending September 30.

OCCURRENCE OF SURFACE WATER

Sources of Water

Precipitation is the source of all of our water supplies. In the endless cycle of water from the clouds to the earth and back again, a part returns to the atmosphere through evaporation and transpiration and a part runs off the land into natural waterways and returns to the sea. The remainder seeps into the ground and eventually reaches the ground-water zone, from which it is discharged later by seepage into surface-water bodies or by evapotranspiration.

The amount of water following any of these paths depends on many factors. Much of the precipitation falling after long periods of dry weather will be absorbed by the soil. In areas covered by tight, impervious clay or underlain by impervious rocks, much of the precipitation will drain into the surface bodies of water, but on the other hand, in areas underlain by

porous material a higher percentage will percolate into the ground. In areas of rugged topography much of the precipitation will flow down the hillsides and enter the streams; much of the water that does enter the ground will soon discharge from the hillsides. In areas of relatively flat slopes where the drainage is poor, the opportunity for evaporation from surface pondage is increased. Thus, the amount of surface water available in an area depends upon the amount and the distribution of the precipitation, the topography, and the geology of the area.

Because of its flat topography, swamp area, and porous sandy soil, a rather low percentage of the precipitation in Baker County emerges as runoff in surface streams.

Areal Distribution of Surface Water

The principal source of surface water in Baker County is the St. Marys River system. The major branch of this river system is the North Prong which heads in the Okefenokee Swamp in southeastern Georgia and flows generally southward along the northeastern boundary of Baker County. The main St. Marys River is formed by the confluence of the North and Middle Prongs 10 miles south of the northern boundary of Baker County. From the confluence of these two streams the St. Marys River flows southeastward about six miles, thence eastward to a point just beyond the Baker County line. The river then flows northward for a distance of 30 miles, thence eastward again for 35 miles to the Atlantic Ocean. In the reach of the St. Marys River along the boundary of Baker County the larger tributaries enter from the Florida side. Cedar Creek and South Prong are two of the larger tributaries.

Other sources of surface water in Baker County are the headwaters of New River, Swift Creek, and Olustee Creek for small areas in the southern part of the county and drainage from Pinhook Swamp westward to the Suwannee River for a small area in the northwestern part of the county.

Ocean Pond, in the southwestern part of the county, is the only lake of appreciable size within the county. Palestine

Lake and Swift Creek Pond are just south of the Baker County line.

GAGING-STATION RECORDS

Records of stage and discharge for several gaging stations in the St. Marys River basin have been collected by the U. S. Geological Survey for periods of from seven to 31 years. The first of these gaging stations was established on North Prong St. Marys River between Baxter, Florida, and Moniac, Georgia, in January 1921. This gaging station is currently in operation but continuous records for the entire period have not been collected as the station has been discontinued and reestablished several times during the intervening period. The gaging station with the longest period of continuous record is on the St. Marys River near Macclenny. Records are available at this gaging site since October 1926. Records for South Prong St. Marys River at Glen St. Mary have been collected since January 1950. Other stations were established in September 1955 as data-collection points for this report.

No discharge records have been collected in Baker County for the headwaters of streams that are not in the St. Marys River basin. However, the areas drained by these small streams have hydrologic characteristics similar to those drained by the adjacent tributaries of the St. Marys River and similar runoff relations may be assumed.

A list of the gaging-station records and drainage areas at selected locations in Baker County are given in table 1. Location of the gaging stations is shown in figure 1.

FLOW CHARACTERISTICS

The variability of streamflow creates problems of too little water at times and too much water at other times. Thus, an analysis of streamflow characteristics logically falls into two parts - the analysis of low flows and the analysis of flood flows.

Table 1. Gaging-Station Records and Drainage Areas at Selected Locations in Baker County

No. on map	Stream and location	Drainage area in square miles	Records available to September 30, 1957 (Gage heights and daily discharges)
1	North Prong St. Marys River at State Highway 94, at Moniac, Georgia	160	January 1921 to December 1923, January 1927 to June 1930, July 1932 to June 1934, October 1950 to date
2	Middle Prong St. Marys River at State Highway 125, at Taylor, Florida	127	September 1955 to date
	Middle Prong St. Marys River at mouth	221	
	Cedar Creek at State Highway 125, near Glen St. Mary, Florida	61	
	Cedar Creek at mouth	71	
3	South Prong St. Marys River at State Highway 229, near Sanderson, Florida	58	September 1955 to date
4	Turkey Creek at State Highway 23, at Macclenny, Florida	20.9	September 1955 to date
	Turkey Creek at mouth	26.4	
5	South Prong St. Marys River at U.S. Highway 90, at Glen St. Mary, Florida	150	January 1950 to date
6	St. Marys River near Macclenny, Florida	720	October 1926 to date

GAGING-STATION RECORDS

St. Marys River Basin

(1) North Prong St. Marys River at Moniac, Georgia

Location. Lat. 30°31', long. 82°14', in sec. 8, T. 1 N., R. 21 E., near right bank at upstream side of bridge on State Highway 94, 950 feet upstream from Georgia Southern & Florida Railway bridge, 0.5 mile west of Moniac, Charlton County, and 1.0 mile downstream from Moccasin Creek.

Drainage area. About 160 sq mi, includes part of watershed in Okefenokee Swamp which is indeterminate.

Gage. Water-stage recorder. Datum of gage is 89.40 feet above mean sea level, datum of 1929. January 1921 to June 1934, staff gage at site 800 feet downstream at datum 3.22 feet higher. October 1 to December 13, 1950, wire-weight gage at present site and datum.

Average discharge. 12 years (1921-23, 1927-29, 1932-33, 1950-57), 134 cfs.

Extremes. 1921-23, 1927-30, 1932-34, 1950-57: Maximum discharge, about 6,060 cfs, probably September 19, 1928 (gage height, 19.9 feet, present datum, at site then in use), from rating curve extended above 2,000 cfs; no flow at times.

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1921	---	---	---	---	108	45.9	11.0	5.62	0.29	277	461	12.2	---
1922	0.04	0.60	16.0	37.7	118	137	15.9	7.51	63.3	23.8	169	96.3	56.8
1923	218	92.4	44.9	252	85.1	91.2	97.1	146	341	331	172	82.4	164
1924	40.5	15.0	8.83	---	---	---	---	---	---	---	---	---	---
1927	---	---	---	---	80.9	108	26.0	1.34	69.3	330	249	39.9	---
1928	5.45	0.052	4.34	5.41	31.8	297	701	214	107	802	266	1,590	334
1929	491	58.2	48.7	305	512	455	154	307	151	413	403	491	315
1930	627	55.9	188	427	299	679	417	32.6	133	---	---	---	---
1932	---	---	---	---	---	---	---	---	---	---	323	557	---
1933	218	199	62.2	157	642	242	486	51.4	21.3	41.1	39.2	205	193
1934	1.10	1.02	.477	.187	.214	1.19	.203	1.01	141	---	---	---	---
1951	914	136	55.2	37.3	30.6	32.9	30.5	1.24	1.36	1.44	7.82	20.3	107
1952	56.7	132	179	129	270	448	72.1	13.3	1.38	.10	22.7	36.9	113
1953	16.9	3.03	1.45	5.56	17.0	9.37	135	13.6	0.55	29.3	127	510	71.9
1954	662	58.0	291	247	52.9	33.3	13.0	1.86	0.04	0	.01	.02	115
1955	.003	0	.13	.73	2.26	.40	.82	.23	.05	2.39	70.9	118	16.3
1956	17.1	11.4	2.90	14.2	52.6	28.9	4.14	57.9	11.2	19.2	1.15	1.69	18.5
1957	79.1	18.3	2.00	.62	.59	25.2	71.7	23.8	775	78.5	65.7	51.9	98.8

GAGING-STATION RECORDS

St. Marys River Basin

(2) Middle Prong St. Marys River at Taylor, Florida

Location. Lat. 30°26', long. 82°17', on line between secs. 2 and 3, T. 1 S., R. 20 E., near center of span on upstream side of bridge on State Highway 215, 0.5 mile southeast of Taylor, Baker County, and three-quarters of a mile upstream from Little River.

Drainage area. 127 sq mi, approximately.

Gage. Water-stage recorder. Datum of gage is 89.4 feet above mean sea level, datum of 1929 (from elevation of centerline of bridge, furnished by Florida State Road Department.

Extremes. 1955-57: Maximum discharge 1,040 cfs June 11, 1957 (gage height, 10.51 feet); minimum daily, 0.1 cfs August 24-31, September 12-18, 23, 1956.

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1956	1.21	0.95	0.66	0.92	1.64	1.80	1.12	2.72	1.42	1.83	0.50	0.81	1.30
1957	124	64.2	6.49	1.88	1.32	7.10	14.7	13.3	361	36.9	321	100	87.9

GAGING-STATION RECORDS

St. Marys River Basin

(3) South Prong St. Marys River near Sanderson, Florida

Location. Lat. 30°12', long. 82°16', in NW¼ sec. 25, T. 3 S., R. 20 E., near left bank five feet downstream from bridge on State Highway 229, one mile upstream from small tributary, and 3½ miles south of Sanderson, Baker County.

Drainage area. 58 sq mi, approximately.

Gage. Staff gage read twice daily. Datum of gage is 112.67 feet above mean sea level, datum of 1929 (Florida State Road Department benchmark).

Extremes. 1955-57: Maximum discharge, 1,060 cfs June 10, 1957 (gage height, 6.16 feet); no flow at times.

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1956	0.99	0.31	0.12	0.76	8.11	1.85	0.04	2.15	0.87	6.20	0.03	0.08	1.77
1957	34.6	8.59	.31	.06	.03	2.89	13.3	24.6	201	12.4	58.5	22.4	31.5

GAGING-STATIONS RECORDS

St. Marys River Basin

(4) Turkey Creek at Macclenny, Florida

Location. Lat. 30°16'05", long. 82°07'20", in NE¼ sec. 5, T. 3 S., R. 22 E., near left bank at downstream side of bridge on State Highway 23, 0.9 mile south of Macclenny, Baker County, and 1.8 miles upstream from mouth.

Drainage area. 20.9 sq mi.

Gage. Staff gage and crest-stage indicator; gage read twice daily. Datum of gage is 102.27 feet above mean sea level, datum of 1929 (Florida State Road Department benchmark).

Extremes. 1955-57: Maximum discharge, 1,130 cfs October 17, 1957 (gage height, 6.90 feet); minimum, 0.2 cfs April 21-24, 1956 (gage height, 1.24 feet).

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1956	2.75	1.72	0.96	2.16	6.28	1.33	0.70	76.1	4.49	18.0	1.68	4.39	10.1
1957	68.9	5.05	2.05	1.77	2.30	8.54	8.18	6.13	81.0	10.2	94.9	22.2	26.1

GAGING-STATIONS RECORDS

St. Marys River Basin

(5) South Prong St. Marys River at Glen St. Mary, Florida

Location. Lat. 30°16'40", long. 82°08'40", in sec. 31, T. 2 S., R. 22 E., on right bank 65 feet upstream from bridge on U.S. Highway 90 and 1.0 mile east of Glen St. Mary, Baker County.

Drainage area. 150 sq mi, approximately.

Gage. Water-stage recorder. Datum of gage is 77.13 feet above mean sea level, datum of 1929.

Average discharge. 7 years, 81.2 cfs.

Extremes. 1950-57: Maximum discharge, 6,200 cfs September 7, 1950 (gage height, 12.71 feet); minimum, 0.4 cfs May 23, 1950 (gage height, 1.52 feet).

Flood in September 1947 reached a stage of 13.0 feet, from information furnished by Florida State Road Department (discharge, 6,700 cfs).

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1950	---	---	---	8.88	11.7	31.6	10.5	2.95	6.19	237	18.0	805	---
1951	870	97.6	36.5	27.3	22.4	20.5	13.8	3.99	2.50	2.65	3.93	5.84	93.5
1952	4.10	10.6	17.8	16.7	107	81.9	29.6	12.8	14.3	14.4	20.7	100	35.4
1953	57.1	6.34	5.76	28.4	62.1	37.5	319	12.1	8.86	17.4	418	496	122
1954	598	48.9	560	245	45.0	28.8	23.8	5.15	3.27	3.38	4.60	9.95	133
1955	8.64	3.35	7.54	18.7	36.8	7.51	6.47	3.02	2.18	119	16.5	77.4	25.6
1956	11.6	9.20	6.64	10.6	35.6	16.6	4.04	110	17.3	58.3	6.14	8.03	24.6
1957	213	39.5	8.86	7.99	8.96	33.0	53.4	138	611	32.3	323	138	134

GAGING-STATION RECORDS

St. Marys River Basin

(6) St. Marys River near Macclenny, Florida

Location. Lat. 30°21'35", long. 82°04'55", in sec. 2, T. 2 S., R. 22 E., on right bank 200 feet downstream from site of former Stokes Bridge, one mile downstream from South Prong, and six miles northeast of Macclenny, Baker County.

Drainage area. 720 sq mi, approximately, includes part of watershed in Okefenokee Swamp which is indeterminate.

Gage. Water-stage recorder. Datum of gage is 40.00 feet above mean sea level (levels by Mees and Mees). Prior to February 21, 1939, staff gage, and February 21, 1939 to August 15, 1948 water-stage recorder, at site of former bridge 200 feet upstream at same datum.

Average discharge. 31 years, 632 cfs.

Extremes. 1926-57: Maximum discharge, 28,100 cfs September 25, 1947 (gage height, 22.29 feet); minimum observed, 12 cfs May 22, 1932; minimum gage height observed 0.04 feet June 4, 5, 1927.

Monthly and Yearly Mean Discharge, in Cubic Feet Per Second

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1927	383	632	238	131	465	746	117	26.5	105	707	1,810	321	475
1928	54.5	27.3	37.4	38.7	104	770	2,750	1,140	523	2,180	1,150	5,370	1,173
1929	2,110	231	172	1,010	1,290	1,530	794	774	673	1,600	1,520	2,200	1,160
1930	2,860	170	422	1,290	1,310	3,760	1,630	161	1,190	753	211	162	1,160
1931	179	265	416	1,420	672	778	932	633	71.3	92.9	76.9	93.1	469
1932	22.7	15.9	18.0	21.7	20.6	44.7	27.7	20.4	640	245	1,140	1,720	326
1933	489	535	260	448	1,650	1,120	2,160	240	180	624	312	1,480	781
1934	53.6	22.3	20.5	22.9	20.2	45.0	26.0	31.9	2,290	438	691	193	320
1935	145	35.7	37.5	77.7	79.9	61.1	25.7	22.5	18.8	390	830	2,931	386
1936	403	61.3	46.6	134	884	640	408	48.6	128	147	175	53.0	259
1937	410	67.5	197	206	1,252	599	1,045	262	68.8	291	785	2,044	595
1938	2,374	376	256	600	664	151	58.3	32.9	135	721	2,180	172	648
1939	1,228	593	103	113	205	262	199	121	423	1,712	1,700	539	605
1940	192	101	101	250	794	289	283	48.5	105	669	666	131	302
1941	30.1	23.3	191	257	410	321	176	30.6	81.6	974	374	384	271
1942	307	625	1,512	2,404	2,390	2,906	327	51.1	348	608	368	606	1,033
1943	74.3	31.6	39.5	50.7	44.9	76.8	30.8	31.0	92.2	165	607	180	120
1944	36.3	26.6	31.4	87.2	82.0	581	1,034	209	221	1,930	2,545	1,326	679
1945	3,149	583	367	1,332	573	165	56.8	49.0	62.6	2,135	3,296	1,291	1,099
1946	222	98.7	515	1,230	464	550	305	948	649	1,622	2,275	1,621	880

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GAGING-STATION RECORDS

St. Marys River Basin

(6) St. Marys River near Macclenny, Florida (continued)

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1947	1,142	182	98.5	83.1	378	1,223	1,359	332	243	523	538	4,467	877
1948	6,240	4,155	2,470	1,198	1,309	3,913	4,883	70.6	32.3	525	2,133	446	2,285
1949	1,644	155	317	343	2,390	247	427	108	74.9	328	650	1,391	661
1950	235	231	109	69.1	51.8	237	102	40.6	31.6	887	87.6	4,115	514
1951	4,347	661	220	156	134	116	101	35.5	27.3	36.6	55.3	83.1	504
1952	141	286	296	261	768	861	212	73.2	59.3	52.5	62.8	158	268
1953	117	40.9	36.1	78.0	127	85.8	728	78.3	43.7	114	1,294	2,301	419
1954	3,416	312	1,803	1,268	258	165	112	45.7	28.4	31.3	24.9	64.3	636
1955	61.1	32.5	47.0	75.0	146	46.3	38.6	25.3	20.8	164	126	306	90.1
1956	82.8	51.1	37.9	65.7	177	94.7	38.2	343	80.7	245	54.2	81.5	113
1957	827	231	59.7	44.5	37.8	136	261	260	2,642	287	1,285	666	561

Low Flows

During the period since October 1926, when streamflow records were started for St. Marys River near Macclenny, there have been outstanding droughts as well as major floods. Particularly outstanding periods of low runoff are those of 1927-28, 1931-32, 1934-35, 1943, 1951-52, and 1954-56. From the standpoint of the collection of information on low-flow conditions, it is fortunate that this project investigation of streamflows in Baker County was conducted during part of the period covered by the most recent drought.

Streamflow conditions of North Prong St. Marys River are influenced by the amount of water stored in Okefenokee Swamp. During prolonged periods of deficient rainfall the water levels in the Swamp are lowered by evapotranspiration losses and runoff in surface streams ceases. At the gaging station at the state line between Baxter, Florida, and Moniac, Georgia, there was no flow for the period June 7 to December 1954, except for ten intermittent days in which an average daily discharge of 0.1 cubic foot per second occurred.

Middle Prong St. Marys River is also largely swamp drainage and its runoff characteristics are somewhat similar to those for North Prong. However, flows are better sustained during low-water periods and at the gaging station at Taylor the stream has not ceased to flow during the two-year period of record. The minimum daily discharge that has occurred during the period of record at this station was 0.1 cubic foot per second August 24-31 and September 12-18, 23, 1956. During longer drought periods, such as the latter six months of 1954 (prior to the establishment of the station), the flow at this station probably ceased.

No streamflow data have been collected for Cedar Creek except a measurement of 2.7 cfs at State Highway 125 on April 18, 1956. Records for gaged streams in Baker County indicate that streamflow was not extremely low at that time, and that the flow of Cedar Creek at State Highway 125 would drop to about one cfs during periods of drought.

The flow of South Prong St. Marys River has been

determined at two gaging stations. At the station in the upper part of the basin at State Highway 229 south of Sanderson, the flow has ceased for long periods several times during the two-year period of record. At the lower station on the South Prong at U. S. Highway 90 at Glen St. Mary the flows have diminished sharply during drought periods but were better sustained than those at the upper station or those for North and Middle Prongs. At the station on U. S. Highway 90 the minimum daily discharges were 0. 9 and 0. 8 cubic foot per second for May 17 and May 23, 1950, respectively, which are the only times during the 8-year period of record that the flow has dropped below one cubic foot per second.

One of the major tributaries of the South Prong St. Marys River is Turkey Creek which flows into the South Prong about one mile upstream from the gaging station at U. S. Highway 90. The flow of Turkey Creek has been determined since September 1955 at a gaging station at State Highway 23, 0. 9 mile south of Macclenny. The minimum flow during the period of record was 0. 2 cubic foot per second on April 21-24, 1956. The low-water base flow for this stream is sustained by flow from ground storage which is probably enough to prevent the streamflow from ceasing during moderate drought conditions.

The gaging station on the main St. Marys River is located one mile downstream from South Prong, near the eastern boundary of Baker County, and is called St. Marys River near Macclenny. The discharge of the river at this gaging station includes practically all of the surface runoff from Baker County as well as that from about 200 square miles in Georgia. The total drainage area of the stream above the station is approximately 720 square miles. Minimum discharge since October 1926 was 12 cubic feet per second (0. 0167 cfs per square mile) which occurred May 22, 1932.

The maximum period of deficient discharge during the period of record at the station on St. Marys River near Macclenny is shown by curves in figure 3. One curve shows the maximum period of consecutive days during which the flow was less than a given amount, and the other shows the lowest average discharge for periods ranging from one day to

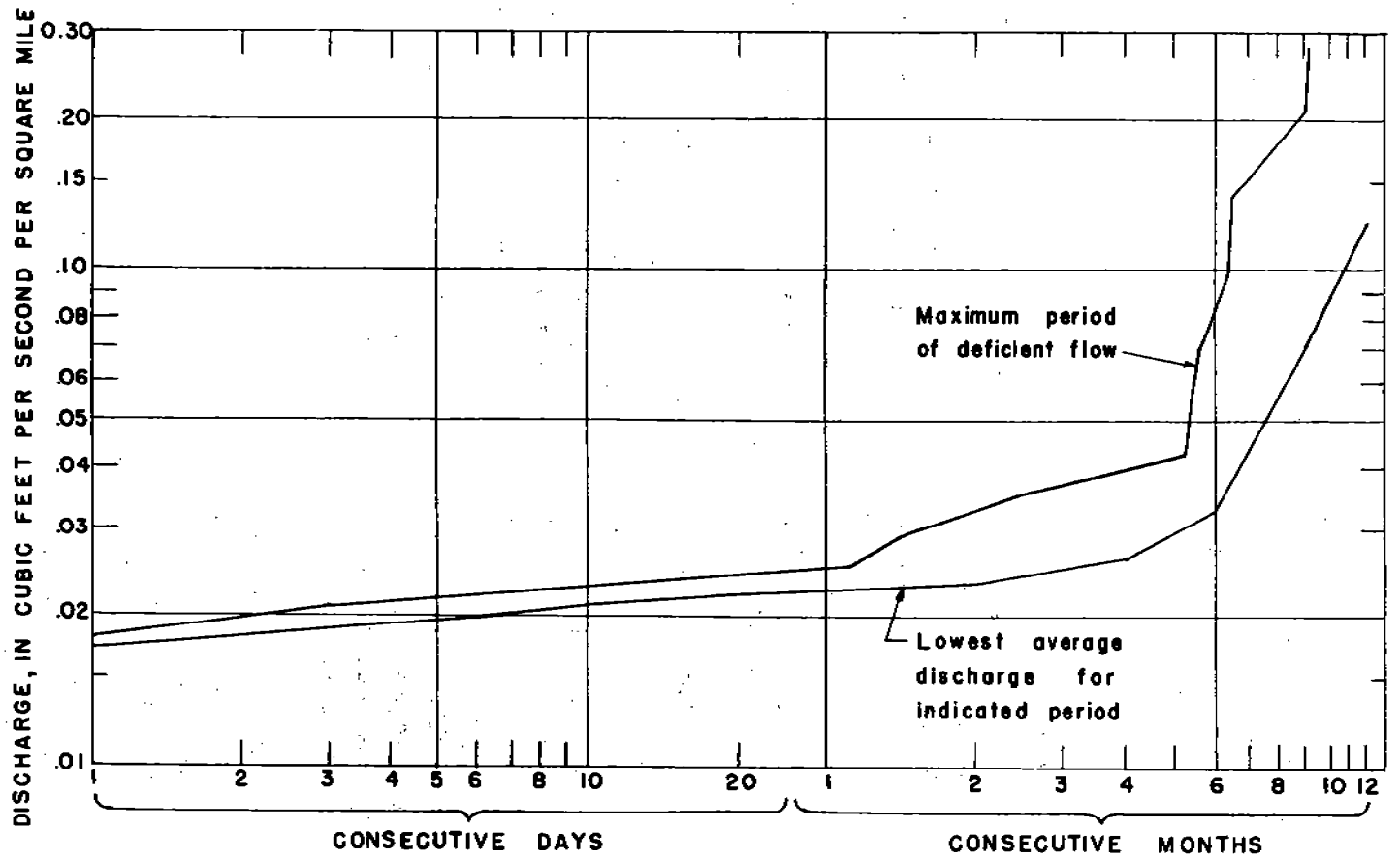

Figure 3. Discharge available without storage, St. Marys River near Macclenny, 1926-57.

twelve months.

As an example, during the period 1926-57, 33 days was the longest consecutive period that the daily runoff at this station remained below 0.025 cubic foot per second per square mile (18 cfs). The longest period during which the runoff averaged as low as 0.025 cubic foot per second per square mile was 100 days.

Flow-Duration Curves

The flow-duration curve shows the percentage of time that a specified discharge was equaled or exceeded during a given period. In a strict sense the flow-duration curve applies only to the period for which data were used to develop the curve. However, if the period on which the flow-duration curve is based represents long-term flow of the stream, the curve may be considered a probability curve and used to estimate the percent of time a specified discharge will be equaled or exceeded in the future.

The duration curves of daily flow for six gaging stations in Baker County are shown in figure 4. Records for only one station, St. Marys River near Macclenny, are continuous for the 31-year period, 1926-57. The curves for the other five stations in the report area have been adjusted from their individual short-term records to the 31-year base period. The relationship of the duration of flows at the six stations in the St. Marys River basin shown in figure 4 is for the common 31-year base period. In order to compare the duration curves for each station, discharge is expressed as cubic feet per second per square mile.

The difference in the low-flow characteristics of each tributary is apparent from the curves shown in figure 4. As an example, at the Turkey Creek station (drainage area, 20.9 square miles) the flow equaled or exceeded 0.025 cfs per square mile for 90 percent of the time. However, at the station on Middle Prong at Taylor (drainage area, 127 square miles) for the same duration period the flow was only 0.0021 cfs per square mile. Low flow at the Turkey Creek

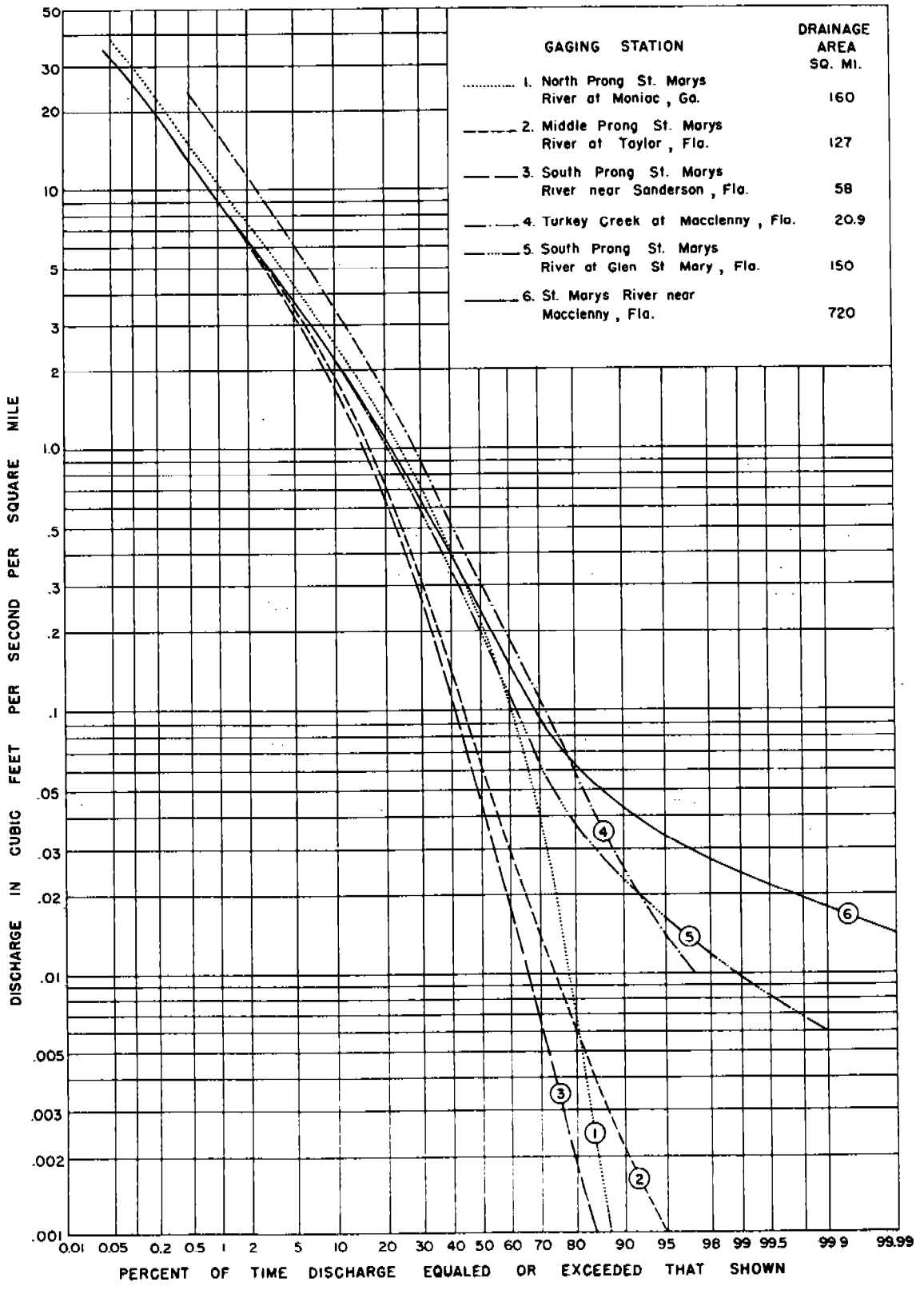

Figure 4. Flow-duration curves for gaged streams in Baker County for the 31-year period, 1926-57.

station is fairly well sustained by ground-water inflow while that at the Middle Prong station is poorly sustained and flow ceases during extended periods of deficient rainfall.

Flood Flows

The knowledge of flood-flow characteristics of the streams in an area is required information in the economic design of bridges, roadfills, spillways, detention dams, and other structures placed in, across, or adjacent to flood plains.

From a study of the magnitude and pattern of recurrence of past floods a means of estimating with fair dependability the expectancy of floods in the future has been developed. Such a study of floods in Florida has been made and presented in an earlier report.[1] Parts of the earlier report that are applicable to Baker County have been abstracted and presented here.

Flood-Frequency Relations

This abstract summarizes and explains the use of regional flood-frequency relations for streams in Baker County.

Among the many physical characteristics of drainage basins that affect runoff, those most applicable in Florida are size of drainage area of the basin; amount of storage capacity in stream channels, swamps, and lakes; shape of basin; land and stream slopes; porosity of soil; type of vegetal cover; and land use.

From the earlier report it was determined that the size of drainage area is the dominant factor influencing the

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[1] Pride, R.W., Flood Frequency Relations for Florida: U.S. Geol. Survey open-file report, extracted from an unpublished report, Floods in Florida, Magnitude and Frequency, 1957.

magnitude of floods on streams in Baker County. Figure 5, which was prepared from flood relations in the earlier report, shows the variation of flood discharge with drainage area for streams in Baker County.

Flood data for only two gaging stations in this report area (North Prong St. Marys River at Moniac and St. Marys River at Macclenny) were available for a long enough period to be used in the development of the flood-frequency relation shown in figure 5. However, the data were analyzed and results summarized on a regional basis using flood data from other long-term stations in Florida as well as southern Georgia and Alabama. Baker County is part of a much larger geographical area for which flood characteristics are similar. Therefore it can be assumed that the relations as shown in figure 5 may be applied with a fair degree of assurance in estimating the magnitude of floods of various recurrence intervals up to 50 years.

STORAGE CONSIDERATIONS

The primary purpose of this report of the surface-water resources of Baker County is to furnish data for the planning of water-impoundment reservoirs for recreational uses. At this time other water uses or benefits that would result from the creation of impoundment reservoirs are secondary in importance to the recreational requirement. There are several hydrologic factors that must be considered in the design of reservoirs.

Evaporation from Water Surfaces

The evaporation losses from large multipurpose reservoirs, such as those required for flood control, navigation, water-power development, and water conservation, are usually of minor importance compared to the inflows, outflows, and volume of storage. However, in the design of small recreational reservoirs, such as those being considered by Baker County on streams with poorly sustained low flows, the evaporation losses have an appreciable effect.

By the construction of a reservoir an enlarged area of water surface is exposed and the evaporation opportunity is increased. Total evaporation losses from a reservoir are proportional to the area of the water surface. Thus, the losses from a shallow, wide reservoir are considerably higher, percentagewise, than those from a deep, narrow reservoir.

Most investigations of evaporation have been confined to measurements from small areas, such as the Class A evaporation pans used by the U. S. Weather Bureau. The yearly evaporation from pans is greater than from natural water bodies. The ratio of evaporation from a pan to that from a large body of water is known as the "pan coefficient." The results of experiments to determine the pan coefficient indicate seasonal as well as geographical variations in the

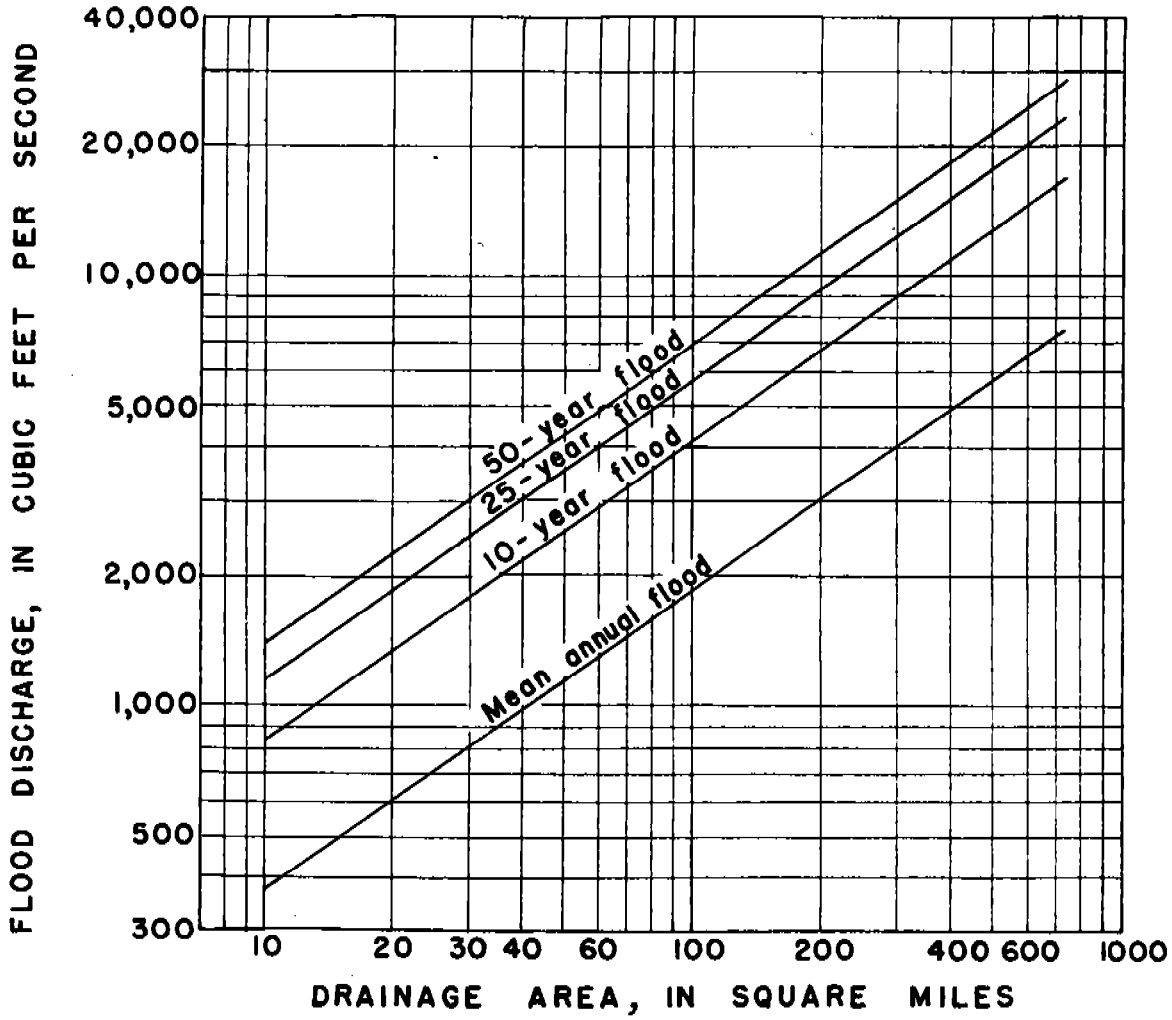


Figure 5. Variation of flood discharge with drainage area for streams in Baker County.

coefficients. Monthly pan-to-lake coefficients have been computed from records collected at Lake Okeechobee, Florida, for the period 1940-46. These coefficients range from 0.96 for February to 0.91 for July and August.

Records of evaporation from a Class A pan at Gainesville, Florida, are available for the years 1954-57. These evaporation records have been used with the pan coefficients, derived from the Lake Okeechobee investigation, to compute the approximate evaporation loss that would be expected from small reservoirs in Baker County.

Rainfall is probably more variable seasonally and geographically in Florida than evaporation. Fortunately, a 61-year rainfall record at Glen St. Mary is available. The average monthly rainfall based on this 61-year record has been used to indicate the rainfall that would occur on the lake surface.

The net water losses resulting from evaporation are shown for each month in table 2.

Seepage and Transpiration

As previously discussed under OCCURRENCE OF SURFACE WATER, part of the water falling as precipitation seeps into the ground and part is used in transpiration by plant life. In considering the availability of surface supplies the amounts of water removed by these processes are considered to be losses.

In Baker County the seepage losses probably would be increased to some extent by impoundment of water in shallow reservoirs. On the other hand, in some areas in the eastern part of the county there is some indication of upward leakage or flow from ground storage to the surface by artesian pressure. The evaluation of seepage losses or gains is beyond the scope of this investigation. The additional seepage that would result from the construction of a small low-head reservoir has been assumed to be negligible.

Transpiration losses also would be increased by the

Table 2. Summary of Monthly Average Evaporation and Rainfall in Baker County

Month	Evaporation (inches)			Rainfall[3] (inches)	Net evaporation loss from lake (inches)
	Class A Pan[1]	Pan Coefficient[2]	Lake		
January	3.38	0.77	2.60	2.73	---
February	4.24	.69	2.92	3.53	---
March	5.96	.73	4.35	3.81	0.54
April	6.70	.84	5.63	2.97	2.66
May	8.21	.82	6.74	3.79	2.95
June	8.37	.85	7.11	6.55	.56
July	7.67	.91	6.98	7.83	---
August	7.71	.91	7.01	6.71	.30
September	5.72	.85	4.85	5.68	---
October	4.93	.76	3.75	3.61	.14
November	3.92	.71	2.78	1.81	.97
December	3.13	.83	2.60	3.14	---

[1]Monthly average of records for 1954-57 from U.S. Weather Bureau evaporation station at Gainesville, Florida.

[2]Computed evaporation data for Lake Okeechobee, Florida. Kohler, M.A., 1954, Lake and pan evaporation, in Water-loss investigations - Lake Hefner studies, technical report: U.S. Geol. Survey Prof. Paper 269, p. 128, based on a study by Langbein, W.B., "Research on Evaporation from Lakes and Reservoirs," Paper presented at Brussels Assembly, 1951, and U.S. Weather Bureau records.

[3]Monthly average of records for 1896-1957 from U.S. Weather Bureau rainfall station at Glen St. Mary, Florida.

construction of a shallow reservoir if vegetation around the edges of the pool was permitted to flourish. The possible small losses from this cause have likewise been considered as negligible in the computations that follow.

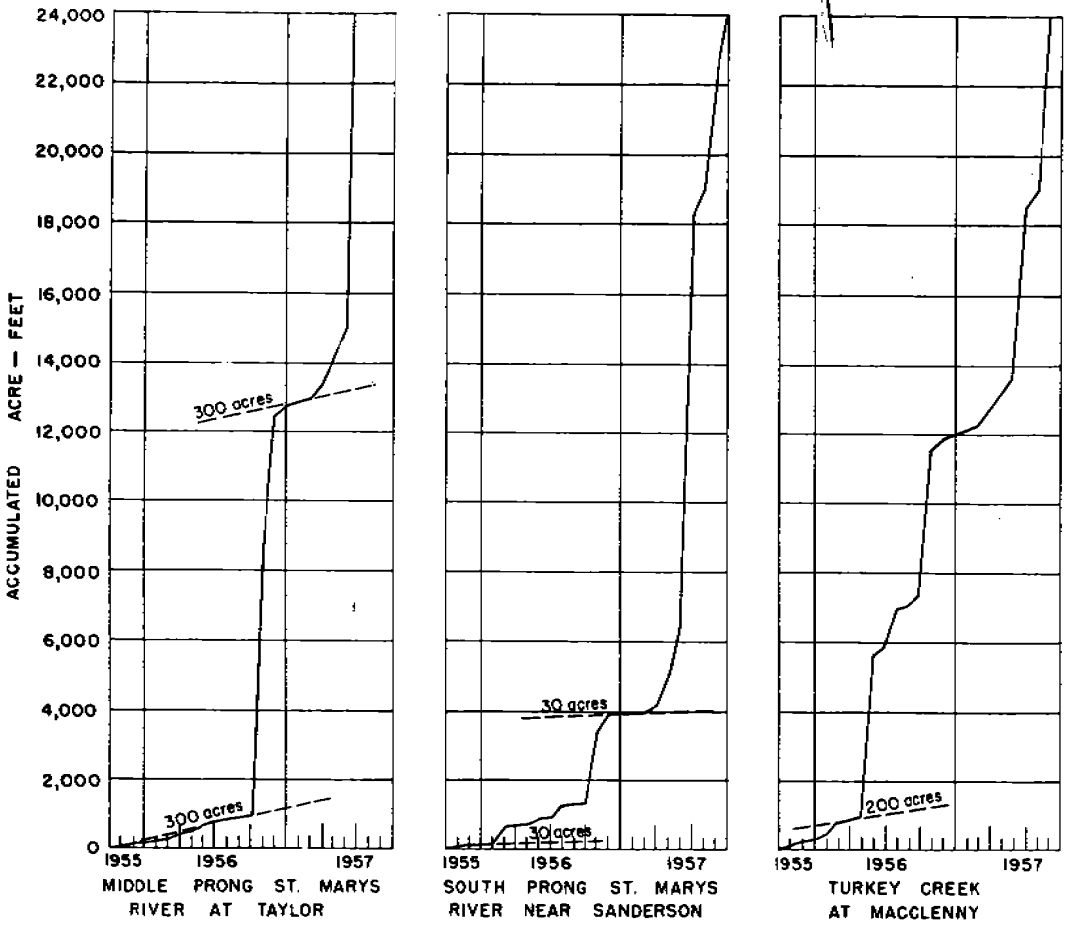
Potential Reservoir Sizes

The relatively flat topography and shallow stream valleys indicate that the only feasible type of surface reservoir for Baker County is one with low-head dam and shallow pool.

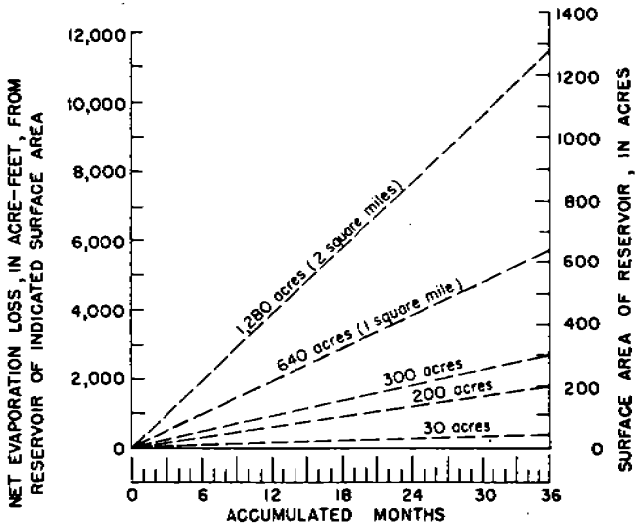
The flow records at gaging stations in Baker County indicate that the minimum flows during droughts would not equal the increased evaporation losses that would result from the additional surface of shallow reservoirs of large areal extent. This would result in a decrease in the water level in the reservoir from evaporation losses alone. However, the minimum flows would be sufficient to balance the evaporation losses from small reservoirs. An analysis of the flow records was made to determine the surface area of the largest reservoir that could be created in the basin of each of the gaged tributaries in Baker County to balance evaporation losses against minimum inflow so as to maintain a full reservoir.

Mass curves were plotted as shown in figures 6 and 7, using discharge records from four of the gaging stations at sites of potential small reservoirs. The slope of the mass curve is a measure of the rate of flow of the stream. The minimum slope occurs when the monthly flow is small and is the critical condition of inflow for design of recreation reservoirs.

The maximum rate of net evaporation loss is represented by the right-hand curves in figures 6 and 7. Table 2 shows the monthly evaporation losses in inches from a free water surface, based on average conditions of pan evaporation and rainfall. The maximum amount was 2.95 inches, or 0.25 foot, for May. For months when the rainfall on the reservoir pool occurred at less than average amounts, the net evaporation loss would be correspondingly higher. Greater than



NOTE.—FOR PERIODS OF MINIMUM FLOW SHOWN ABOVE, EVAPORATION LOSSES FROM A RESERVOIR OF INDICATED SURFACE AREA WOULD HAVE EQUALED THE INFLOW TO THE RESERVOIR.



NOTE.- SLOPE OF LINE REPRESENTS MAXIMUM MONTHLY AVERAGE RATE OF NET EVAPORATION LOSS IN ACRE-FEET FOR VARIOUS RESERVOIR AREAS. NET EVAPORATION LOSS BASED ON NET RATE OF 0.25 FT PER MONTH FOR 36-MONTH PERIOD. NO ALLOWANCE MADE FOR TRANSPIRATION AND SEEPAGE LOSSES.

Figure 6. Mass curves for flow at three gaging stations in Baker County and diagram showing rate of evaporation loss from various reservoir areas.

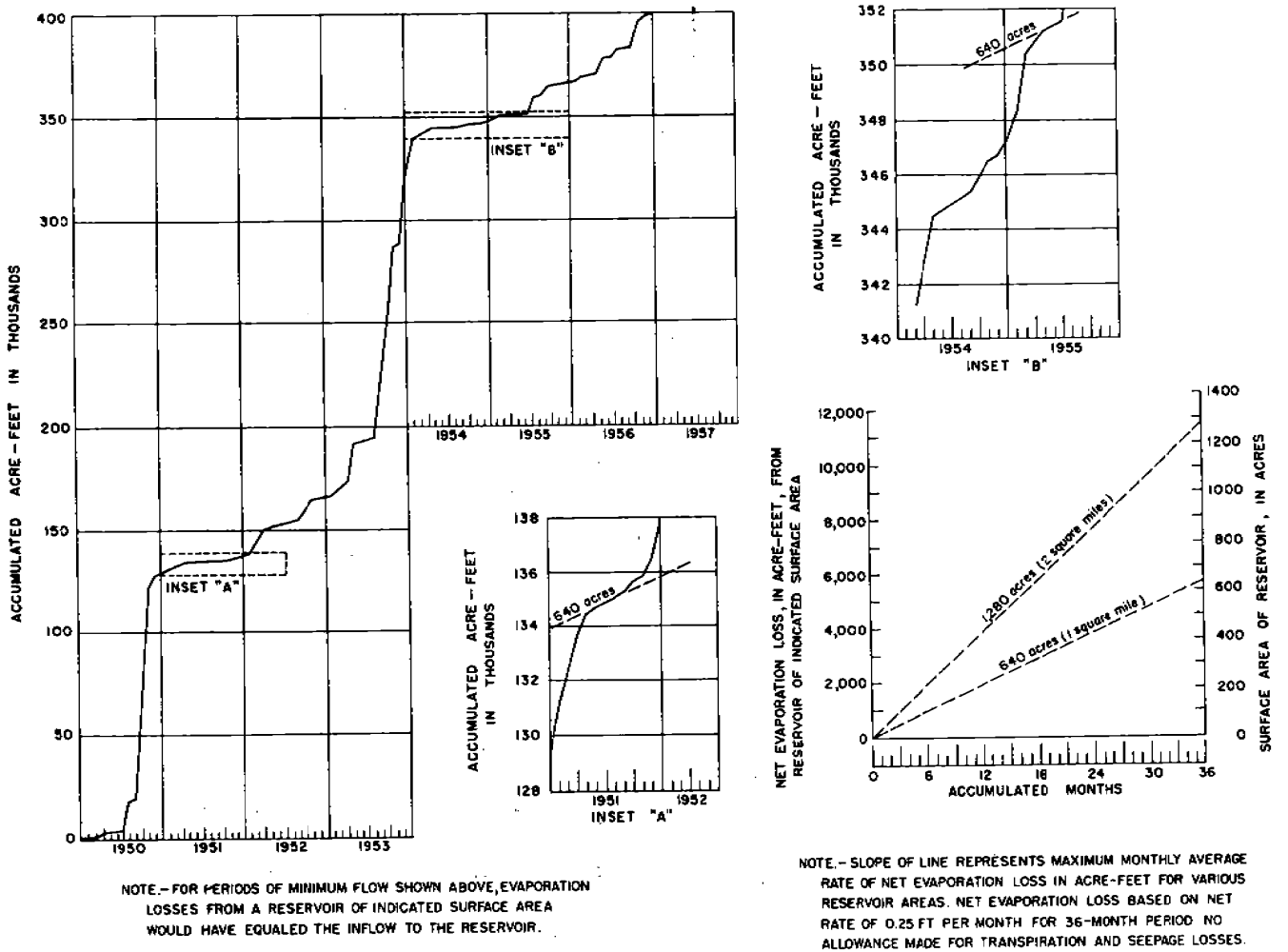


Figure 7. Mass curve for flow of South Prong St. Marys River at Glen St. Mary and diagram showing rate of evaporation loss from various reservoir areas.

average rates of rainfall would result in more discharge over the spillway.

Using 0.25 foot per month as a design rate of evaporation, the volumes of water loss in acre-feet per month were computed for selected pool areas in constructing figures 6 and 7. The minimum slope of the mass curve for each station was transferred to the evaporation loss diagram. The size of surface area of the reservoir thus obtained represents the maximum for which inflow would have balanced evaporation losses, during the dry months in 1955-57, assuming no other draft or consumptive use of the impounded water and assuming that the reservoir was full at the beginning of that drought. If a larger reservoir should be created, the gap between the supply and loss curves would represent the amount of water in acre-feet that would be lost for evaporation in excess of the replacement by inflow. In such a case, this would result in a reservoir less than full for a time, depending on the size of the reservoir.

The surface areas of the largest reservoirs that could be kept filled by the base flows at each of the four stations shown below were determined from figures 6 and 7, which were based on a monthly net evaporation rate of 0.25 foot (from table 2) and on streamflow experience during the period of record at each station. The areas are shown in the following table.

Gaging station	Drainage area, in square miles	Surface area of reservoir, in acres
Middle Prong St. Marys River at Taylor	127	300
South Prong St. Marys River near Sanderson	58	30
South Prong St. Marys River at Glen St. Mary	150	640
Turkey Creek at Macclenny	20.9	200

Although there are longer periods of streamflow records for North Prong St. Marys River at Moniac and St. Marys

River near Macclenny, the sizes of potential reservoirs at these gaging stations have not been determined as these streams border Baker County and only part of their drainage area is within the county.

CONCLUSIONS

Surface-water supplies in Baker County vary seasonally as well as geographically. The highest runoff usually occurs during the summer and early fall and the lowest during the winter and early spring, corresponding to the same rainfall distribution pattern.

Streamflows of the St. Marys River basin are influenced by the large swampland areas in Baker County and southern Georgia. During prolonged periods of deficient rainfall, much of the surface water stored in the swamps is lost by evaporation and transpiration and the surface streams draining from these swamps cease to flow. Long periods of little or no flow have occurred at points on North Prong, Middle Prong, and the upper reaches of South Prong of the St. Marys River. Low flows in Turkey Creek and in the lower reach of South Prong St. Marys River are fairly well sustained by ground-water inflow.

During periods of drought, the yield of the streams in Baker County varies from less than 0.001 to 0.01 cfs per square mile, depending on the location. The median runoff varies from 0.045 to 0.3 cfs per square mile. The mean annual peak flow varies from 38 cfs per square mile from a drainage area of 10 square miles to 10.4 cfs per square mile from 720 square miles. The ratios of the 10-, 25-, and 50-year flood to the mean annual floods are 2.22, 3.05, and 3.72, respectively.

Evaporation from the water surface would account for most of the natural water losses from proposed recreation reservoirs in Baker County; however, streamflow even in dry periods would sustain reservoirs in sizes of from 30 to 640 acres in certain stream basins. Larger reservoirs could be built at the risk of having them less than full during periods of drought.