JULY 1989

FINAL

SURVEY-REVIEW REPORT

SUWANNEE RIVER
GEORGIA AND FLORIDA

US Army Corps
of Engineers
...nville District
Atlantic Division

SERIAL NO. 37

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SERIAL NO. 37

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

SUWANNEE RIVER

GEORGIA AND FLORIDA

JULY 1989

SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT

SYLLABUS

With a 9,950-square-mile basin, the Suwannee River is a major southeastern river of south Georgia and north Florida. Development is scattered and generally sparse, but at the study authorization in 1980, there was an expectation of pending rapid flood plain and river shore development. Local interests in Florida were formulating flood plain regulations and needed accurate flood plain information for regulatory purposes. With a maximum river stage variation of over 40 feet, large areas are subject to flooding. This study provided flood profile, flooded area, and floodway data to local interests at an opportune time, and included the basic data for nine flood insurance studies in Florida, which together have filled information needs for the present time.

An unusual flooding problem in karst topography at Live Oak, Florida, was also investigated in detail. A comprehensive flood removal plan, which also had the potential of reducing aquifer groundwater contamination due to storm drainage well use, did not prove to be economically feasible. A segmental flood reduction plan in Live Oak is considered appropriate for local implementation.

As a result of the study findings and conclusions, no further Federal action under the study authority is recommended at this time.

SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT

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SUWANNEE RIVER, GEORGIA AND FLORIDA

SURVEY-REVIEW REPORT

INTRODUCTION

1. Authority. A survey-review study was authorized by a Senate resolution adopted 5 December 1980. It was introduced by Senator Lawton Chiles on behalf of the State of Florida and the local sponsor, the Suwannee River Water Management District:

> "RESOLVED BY THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers for Rivers and Harbors is requested to review the report of the Chief of Engineers on Suwannee River, Georgia and Florida, published as House Document Numbered 467, Sixty-ninth Congress, First Session, and other pertinent reports, with a view to determining whether modifications in the recommendations are advisable for the conservation and management of the water and related land resources in the Suwannee River Basin to contribute to improvements in national economic development and environmental quality."

2. Study Purpose and Scope. As directed by the study authority, the study purpose was to consider all water resource problems and opportunities in the entire Suwannee Basin and make the most feasible recommendations, if any, that contribute to national economic development and environmental quality. A primary purpose was to consider the impacts and effects of an expected substantial increase in development along the Suwannee and its major tributaries, and of possible flood plain management. The need for flood plain data had been expressly stated by local interests. Another purpose was to investigate flood conditions at Live Oak, Florida, and other communities in the basin, to identify and develop a feasible and economical method of reducing flood damages. This report is the final response to the study authority.

3. Local Sponsor. The local sponsor for this study was a Florida State agency, the Suwannee River Water Management District in Live Oak, Florida.

4. Prior Studies.

a. This section lists identified reports pertinent to the authorized study. Table 1 lists prior Corps of Engineers reports conducted under congressional authority. Most reports listed were conducted in the interest of navigation. Several listed were interim and not final reports.

b. The basic document being reviewed in this study - H.D. 467, 69th Congress, 1st Session - was the last favorable report concerning the Suwannee River sent to Congress. It recommended the abandonment or curtailment of various river and harbor projects over the United States, including curtailment of the Suwannee River navigation project.

c. The January 1965 Survey - Review Report considered flood control as well as other water resource aspects. No further Federal action regarding the Suwannee River was recommended at that time. In view of the potential for future flood damages, the report recommended that local agencies investigate the possibility of instituting flood plain management.

d. A special flood hazard information report, Suwannee River Floods, Florida and Georgia, was published in December 1974 by the Corps, containing profiles and flooded area maps for floods of record. It was reprinted twice, the last time in February 1983 with profile revisions.

e. A Section 205 Reconnaissance Report (Small Flood Control Project Continuing Authority) was completed in June 1982. It analyzed flood conditions at Live Oak, Florida, and concluded that while a solution to flood problems appeared feasible, the magnitude of the problem and costs appeared to be beyond the scope of the Section 205 program. The report recommended that the flood problem be investigated under this current Suwannee River Survey-Review authority with consideration of a comprehensive flood reduction plan for Live Oak.

f. The initial reconnaissance report for this survey-review study was published in September 1983 and recommended that the Survey-Review study be continued.

g. Other Federal Reports:

(1) UNITED STATES STUDY COMMISSION, SOUTHEAST RIVER BASINS. A report of the United States Study Commission on the Suwannee River Basin was made in response to the provisions of Public Law 85-850 (72 Stat. 1090), dated 28 August 1958, which established the Commission. The report, completed in June 1963, summarizes the results of studies made in formulating a comprehensive plan for the conservation, utilization, and development of the land and water resources of the basin. Appendix 5 of the 13 appendixes covers the Suwannee River Basin.

(2) Suwannee River Wild and Scenic River study, pursuant to the Wild and Scenic Rivers Act, 1973, Bureau of Outdoor Recreation, U.S. Department of the Interior.

h. The Suwannee River Resource Planning and Management committee was appointed by the Governor of Florida in 1980 to make planning recommendations concerning the 100-year flood plain of the Suwannee River and its major tributaries. State and local government agencies represented by about 50 people were included on the committee. Its goal was "to develop and implement a resource management plan which will provide both for the present and the future protection for the land and water resources located within the identified study area of the Suwannee River Basin." The Suwannee River Management Plan was adopted November 6, 1981. The resulting report with 35 recommendations was published as appendix C in the initial reconnaissance report (September 1983) for this survey-review report.

TABLE 1

PRIOR REPORTS ON SUWANNEE RIVER
CORPS OF ENGINEERS

Subject	Date	Recommendation	House document			Notes
			No.	Congress	Session	
Survey Report, Suwannee River, Fla.	15 May 1841					
Withlacoochee River, Ga. mouth to Ocopilko CK. Prelim Exam	29 Jan 1875	Favorable	75	43	2	(1)
Exam of Suwannee River, Fla., Ellaville to mouth	26 Aug 1879	Favorable	82*	45	3	(2)
St. Marys River, Fla. to Gulf of Mexico; Canal	6 Apr 1880	Unfavorable	154*	46	2	(3)
Suwannee River, Fla., prelim exam, White Springs to Gulf of Mexico	7 May 1909	Unfavorable	427	61	2	
Suwannee River, Fla., prelim exam	3 Apr 1913	Unfavorable	108	63	1	
Suwannee River, Fla., prelim exam, Branford to Channel No. 4 in Gulf near Cedar Key	19 May 1924	Unfavorable	--Not printed--			(4)
Estimate of Exam. Costs Power Development	7 Apr 1926		308	69	1	
Partial Report regard to abandonment & curtailment of River & Harbor Projects	12 May 1926	Curtailment	467	69	1	

* House Executive Document 82; Senate Executive Document 154.

TABLE 1 - CONT'D.

PRIOR REPORTS ON SUWANNEE RIVER
CORPS OF ENGINEERS

Subject	Date	Recommendation	House document No.	Congress	Session	Notes
Canal via Lake Alto, Fla. (Santa Fe Basin)	16 Nov 1926	Unfavorable	--Not printed--			(4)
	22 Oct 1929	Unfavorable	--Not printed--			(4)
	26 Jun 1934	Unfavorable	--Not printed--			(4)
Suwannee River, Fla. & Ga. prelim exam	1 Sep 1930	Unfavorable	--Not printed--			(4),(5)
Suwannee River, Fla., prelim exam	8 Jul 1938	Unfavorable	--Not printed--			(4),(5)
Suwannee River, Fla., prelim. exam, Fla.-Ga. state line to Gulf of Mexico	10 Apr 1941	Unfavorable	--Not printed--			(4),(5)
Waldo, Fla. to Little Lake Santa Fe	22 Dec 1941	Unfavorable	--Not printed--			(4)
Suwannee River, Fla. & Ga., Survey Report	1 Jul 1947	Unfavorable	--Not printed--			(4),(5)
Santa Fe R. & Waterway from Kingsley L. to St. Johns R., Fla., prel. exam	17 Nov 1949	Unfavorable	--Not printed--			(4),(5)
Survey-Review, Satilla River, Ga., St. Marys & Suwannee Rivers, Ga & Fla	Jan 1965	Unfavorable	--Not printed--			(4),(5)
Alapaha R. & Trib., Ga.,	30 Nov 1972	Unfavorable	--Not printed--			(4),(5)
Santa Fe R., ltr. rpt.	21 May 1973	Unfavorable	--Not printed--			(4),(5)

NOTES: (1) Also Annual Report of Chief of Engineers for 1875, Part II, page 45.

(2) Also Annual Report of Chief of Engineers for 1879, page 857.

(3) Also Annual Report of Chief of Engineers for 1880, Part I, page 973.

(4) "Not printed" means not printed in a congressional document. A printed Corps report may exist.

(5) Report found in Jacksonville District files.

EXISTING CONDITIONS

5. Description of the Suwannee River Basin. The drainage area of Suwannee River includes about 9,950 square miles of the Coastal Plain, with about 5,720 square miles located in central-south Georgia and the remainder in central-north Florida. Principal tributaries of Suwannee River are the Withlacoochee and Alapaha Rivers, whose basins lie mostly in Georgia, and the Santa Fe River in Florida. The northernmost boundary of the basin is about 100 miles north of the Florida-Georgia State line. The Suwannee River flows into the Gulf of Mexico. All or part of 22 Georgia and 14 Florida counties are within the drainage basin. (See plate 1).

6. Description of Live Oak, Florida. The city of Live Oak is a typical small urbanized area with a centralized business district in the downtown area surrounded by residential development. Commercial development extends outward from the center of town along two major highways to the corporate limits. The business area includes many older buildings (20 to 30 years old) and more recent structures. The residential area is low density with predominantly single-family units. The land surrounding the city is predominantly devoted to farmland and pasture. (See plate 2).

7. Population. The population of the Georgia portion of the Suwannee River Basin has shown a general upward trend increasing in the 1950's, leveling in the 1960's and rising through 1980. It is projected that this rise will continue through 2020. (See table 2). However, a noticeable in-migration rate is not expected to occur since most of the area is expected to remain rural in the future. Valdosta, Georgia is the largest city in the entire basin with a population of 37,596 in 1980. However, the bulk of the population is situated in the northwestern section of the basin. In the Florida portion of the basin, the general trend in population is similar to Georgia with the exception that increases are greater. Although most counties along the Suwannee River declined in population between 1950-60, the 11-county area, as a unit, between 1950-80 saw a 91-percent increase in population reaching 300,301 people in 1980. Projections from 1990 through 2020 indicate a 25-percent increase, which is less than the 1950-80 period. (See table 3). The largest city in the Florida portion of the basin is Lake City with a 1980 population of 9,257. The city of Live Oak experienced a slight decline in population growth from 1970 to 1980. The 1980 census report showed a resident population of 6,732 which in a 10-year period declined about 1.4 percent from its 1970 total of 6,830. Recent population studies by the Suwannee River Water Management District (1988) for the Florida Surface Water Improvement and Management (SWIM) Plan indicate larger projected increases in population than those shown in table 3.

8. Income and Employment. The major portion of income earned in Florida comes from the service industries. The average Florida county in the basin had about a 27 percent increase in per capita personal income during

OKEFENOKEE SWAMP
MIZELL PRAIRIE

SUWANNEE RIVER BETWEEN
DOWLING PARK AND LURAVILLE

TABLE 2

GEORGIA POPULATION 1950 - 1980 PROJECTION TO 2020

	U.S. CENSUS				PROJECTIONS[1]			
COUNTY (2)	1950	1960	1970	1980	1990	2000	2010	2020
ATKINSON	6,050	6,188	5,879	6,141	6,871	7,447	7,904	8,823
BEN HILL	13,373	13,633	13,171	16,000	17,681	19,197	20,495	23,344
BERRIEN	11,809	12,038	11,556	13,525	14,328	15,139	15,843	17,601
BROOKS	15,001	15,292	13,743	15,255	16,213	17,221	18,084	19,953
CHARLTON	5,212	5,313	5,680	7,343	8,009	8,646	9,192	10,390
CLINCH	6,420	6,545	6,405	6,660	7,127	7,579	7,983	8,928
COFFEE	21,535	21,953	22,828	26,894	27,746	29,499	31,167	35,100
COLQUITT	33,399	34,048	32,298	35,376	37,568	40,322	42,848	48,479
COOK	11,597	11,822	12,129	13,490	14,196	15,032	15,806	17,577
CRISP	17,430	17,768	18,087	19,489	20,007	21,376	22,802	25,998
ECHOLS	1,840	1,876	1,924	2,297	2,349	2,456	2,553	2,782
IRWIN	9,036	9,211	8,036	8,988	9,636	10,278	10,824	11,996
LANIER	5,000	5,097	5,031	5,654	5,780	6,128	6,462	7,213
LOWNDES	48,331	49,270	55,112	67,972	72,807	78,478	83,702	95,360
TIFT	23,040	23,487	27,288	32,862	36,611	39,818	42,432	48,224
TURNER	8,278	8,439	8,790	9,510	10,030	10,680	11,275	12,621
WARE	33,567	34,219	33,525	37,180	39,339	42,444	45,371	51,859
WILCOX	7,754	7,905	6,998	7,682	7,946	8,470	8,970	10,072
WORTH	16,364	16,682	14,770	18,064	20,147	21,751	23,020	25,713
TOTALS	295,036	300,786	303,250	350,382	366,445	401,964	427,033	482,033

(1) Source: Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce, (OBERS) 1982

(2) Brantley, Dooly, and Thomas counties not included

TABLE 3

FLORIDA POPULATION 1950 - 1980 PROJECTIONS TO 2020

	U.S. CENSUS				PROJECTIONS (1)			
COUNTY (2)	1950	1960	1970	1980	1990	2000	2010	2020
ALACHUA	57,026	74,074	104,764	151,348	176,200	200,000	213,400	222,800
BRADFORD	11,457	12,446	14,625	20,023	22,400	24,800	26,500	27,700
COLUMBIA	18,216	20,077	25,250	35,399	39,900	44,400	47,300	49,400
DIXIE	3,928	4,479	5,480	7,751	9,300	10,500	11,200	11,700
GILCHRIST	3,499	2,868	3,551	5,767	7,600	8,900	9,500	10,000
HAMILTON	8,981	7,705	7,787	8,761	9,100	9,500	10,100	10,600
LaFAYETTE	3,440	2,889	2,892	4,035	4,700	5,400	5,800	6,000
LEVY	10,637	10,364	12,756	19,870	23,300	26,200	28,000	29,200
MADISON	14,197	14,154	13,481	14,894	15,400	15,800	16,800	17,600
SUWANNEE	16,986	14,961	15,559	22,287	26,300	29,500	31,500	32,900
UNION	8,906	6,043	8,112	10,166	10,500	10,600	11,300	11,800
TOTALS	157,273	170,060	214,257	300,301	344,700	385,600	411,400	429,700

(1) Source: University of Florida Bulletin No. 60, 1982

(2) Baker, Clay and Taylor counties not included

the 1977-82 period. For the State of Georgia, income by employment is more diversified and includes Government, manufacturing, wholesale and retail trade as well as the service industries. Within the basin, the major sources of income includes manufacturing, agriculture, services, and Government. Manufacturing, professional/related services, and retail trade are primary sources of income for residents in the city of Live Oak. Because Suwannee County is predominantly rural, agriculture accounts for a large source of employment and income in the areas of tobacco, timber, pecans, and watermelons. Another source of income is brought into the county by seasonal workers who rent living quarters at motels and in some residential homes during the harvest period of the agricultural crops.

9. Existing Water Projects. There is only one Corps of Engineers project in the Suwannee River Basin - a navigation channel project authorized in 1880 and 1890. The project had not been totally completed as originally authorized. The 12 May 1926 report, H.D. 467, 69th Congress, 1st Session, (table 1) recommended curtailment of the authorized project. The uncompleted portions, consisting of channel widening and dredging through rock shoals, were deauthorized on 5 August 1977 by Section 12 of Public Law 93-251. The current status of the project is one of a completed project. The completed channels are not currently maintained due to a lack of economic justification. The last examination survey was a centerline sounding survey up to Ellaville in 1986 and an additional entrance channel survey in January 1987. Local interests have provided aids to navigation and done some channel deepening at shoal areas in the various other Gulf of Mexico Suwannee River inlet passes. The last local work was done in 1986 by the Suwannee River Authority with State funding through the Suwannee River Water Management District.

There are only two significant impoundments on main river channels in the basin. One is a 4.5-mile-long low head dam across the main stem of the upper Suwannee River located upstream of Fargo, Georgia, in the Okefenokee Swamp. The "Suwannee River Sill" structure is located at the western edge of the Okefenokee National Wildlife Refuge and controls water levels in a portion of the swamp. It is operated and maintained by the Department of the Interior. The other structure is on the tributary Little River west of Adel, Georgia. The 375-acre recreational lake is in the Reed Bingham State Park which is operated by the Georgia Department of Natural Resources.

10. Regulatory Programs. Existing ongoing Federal, State, and local regulatory programs have significant impacts on resources and activities in the Suwannee Basin:

Federal permitting procedures relating to dredging, filling, and structures in waterways under Section 10 of the 1899 River and Harbor Act, and filling in wetlands under Section 404 of the 1972 Clean Water Act.

Related State or local permitting procedures.

State water quality monitoring, regulatory, and management programs.

Federal, State, and other land aquisition and management programs for preserves, parks, etc.

Local flood plain management regulations.

Federal flood insurance program.

State regulations governing land fills, dam safety, water-supply and sewage treatment facilities, health standards, etc.

The above and other programs have substantial effects on general environmental conditions, and control and stabilization of development changes in the basin, including those related to fish and wildlife and recreation resources as well as water quality.

PROBLEM IDENTIFICATION

11. Following are discussions of water and related land resource problems and needs in the study area, and specific opportunities that the survey review study might provide to seek solutions.

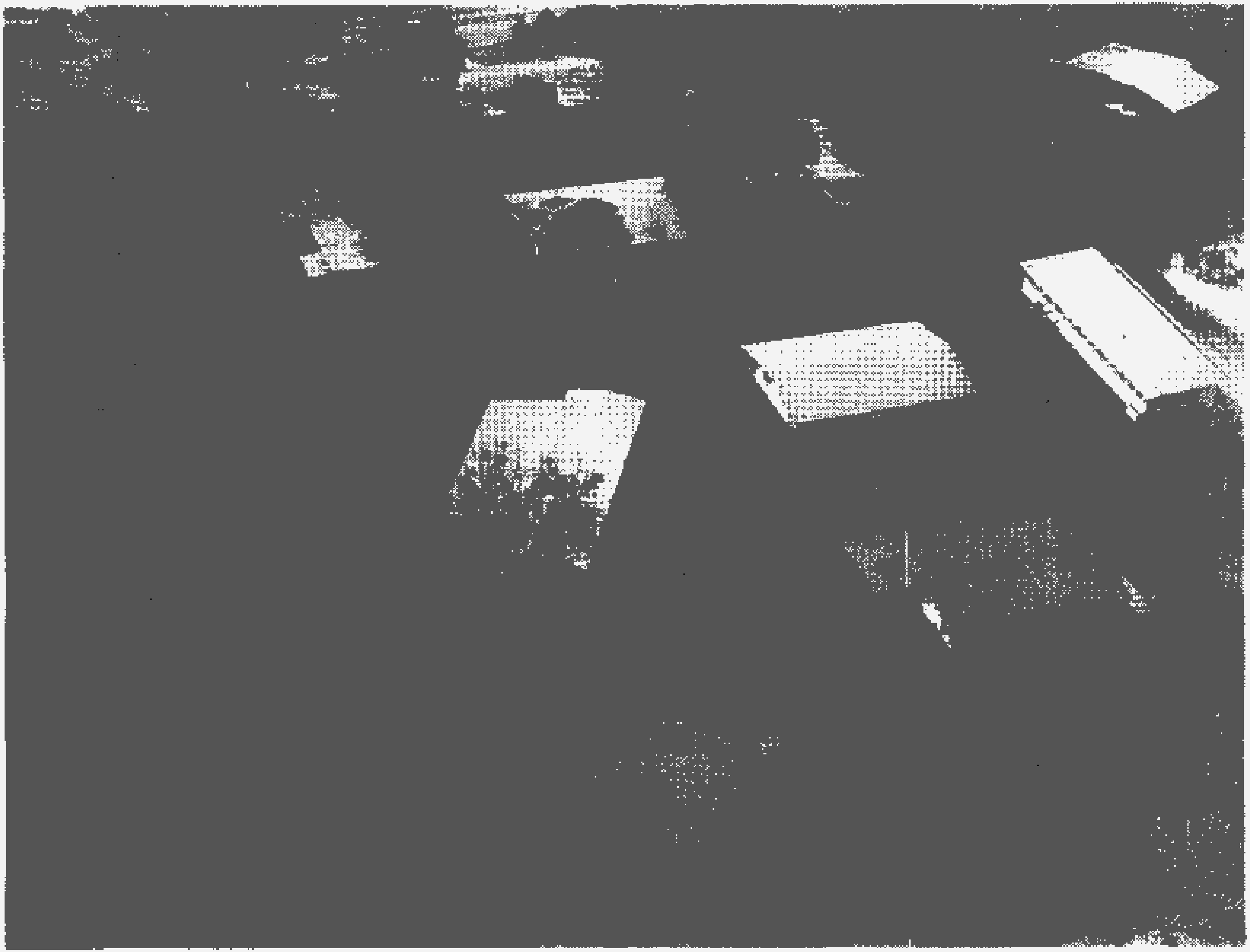
12. Flood damage is a major problem in the study area. The Suwannee River is a major river of the southeast and the second largest in Florida in terms of flood flow volumes. Due to tributary inflow of the Withlacoochee and Alapaha Rivers from south Georgia, the Suwannee River has its greatest stage variation in its middle reach near Suwannee Springs, Florida. The extreme high and low stages of record vary by more than 40 feet. This is more stage variation than occurs on any other river in Florida, or on coastal areas due to hurricane storm tides. Such a flood potential is difficult for many to comprehend or accept, and the general public is unaware of the magnitude of the flood threat.

13. There are about 1,000 homes, cottages, and other buildings scattered along the Suwannee River within its flood plain and subject to flood damage. Some agricultural areas and transportation facilities are also subject to flooding. Major floods of record occurred in 1948 and 1973. Average annual flood damages along the Suwannee River and its three major tributaries in Florida and Georgia are estimated at $810,000.

14. At the time of initiation of this study in 1982, substantial real estate development was occurring with little regulatory control. In 1984, the Suwannee River Water Management District estimated that about 37,300 lots subject to flooding had been platted along the Suwannee, Santa Fe, Withlacoochee, and Alapaha Rivers in Florida. Over 11,000 were estimated to be waterfront lots, which could represent 150 to 200 miles of potential waterfront development. Only a minor amount of similar development pressure is occurring at the present time along the Georgia portions of those streams.

SUWANNEE RIVER AT DOWLING PARK - 1948 FLOOD

SUWANNEE RIVER AT DOWLING PARK - 1973 FLOOD



15. In about 1983, the 11 Florida counties along the Suwannee River and its three major tributaries enacted and implemented flood plain regulations using the flood of record as a reference flood. That involved using the 1948, 1964, and 1973 floods which did not represent a uniform basin criterion. In line with its legislated responsibilities, in July 1986, the Suwannee River Water Management District (SRWMD) implemented its "surface water management and works of the district rules" that require the use of well-defined flood parameters. At the study initiation, Flood Insurance Studies were not available for the basin, except for portions of Brooks, Lowndes, and Tift counties in Georgia.

16. Due to the general karst topography of the Suwannee Basin, many areas, especially in the Florida portion, lack surface drainage. One such area which can suffer considerable flood damage during large floods is the city of Live Oak, Florida. This is not associated with any river and is caused by local rainfall and ponding. The flood of record occurred in September 1964 during Hurricane Dora. Flooding resulted in the death of one person and property damage in excess of $3 million (1964 dollars). The high school, 230 homes, and 132 small businesses had major damage from this storm. Minor damages were also done to 89 other homes and 69 small businesses. Other damages included roads, utilities, and other emergency costs. As a result of the flooding, the area was declared a natural disaster area. Currently, flood control is partially provided by drainage wells, which work reasonably well for ordinary rains. However, there is some concern in regard to groundwater quality resulting from their use and the Florida State Department of Environmental Regulation is reluctant to permit more drainage wells. There is a need to reduce flood damages and search for a method to reduce drainage well inflows.

17. *In summary, there is a significant need for flood plain information* in the basin to aid application of regulatory programs, a need to reduce present flood damage, and a need to prevent additional future flood damage. A survey-review study could provide such information and allow a search for an acceptable and feasible means for flood control in Live Oak, Florida, or other towns.

18. Water Supply. Table 4 indicates current water use in the Florida and Georgia portions of the basin. Those figures are based on 1980 county unit tabulations done by the U.S. Geological Survey and include some peripheral areas around the Suwannee River Basin. Most large water uses are associated with industrial or agricultural activities. Industrial use for phosphate mining is a major use in Florida. The largest municipal use in the basin is at Valdosta, Georgia, although agricultural use is the major use in the Georgia portion. Water use in the Suwannee Basin on both a county and a square mile basis is significantly less than both state average uses per county or per square mile. The Suwannee River Basin in both Florida and Georgia is sparsely populated and is expected to remain largely rural in the foreseeable future. Water supply problems do not appear to be major. Both the States of Georgia and Florida have ground and surface water withdrawal permitting responsibilities. They both also have concerns about the

LIVE OAK, FLORIDA - SEPTEMBER 1964 - HURRICANE DORA

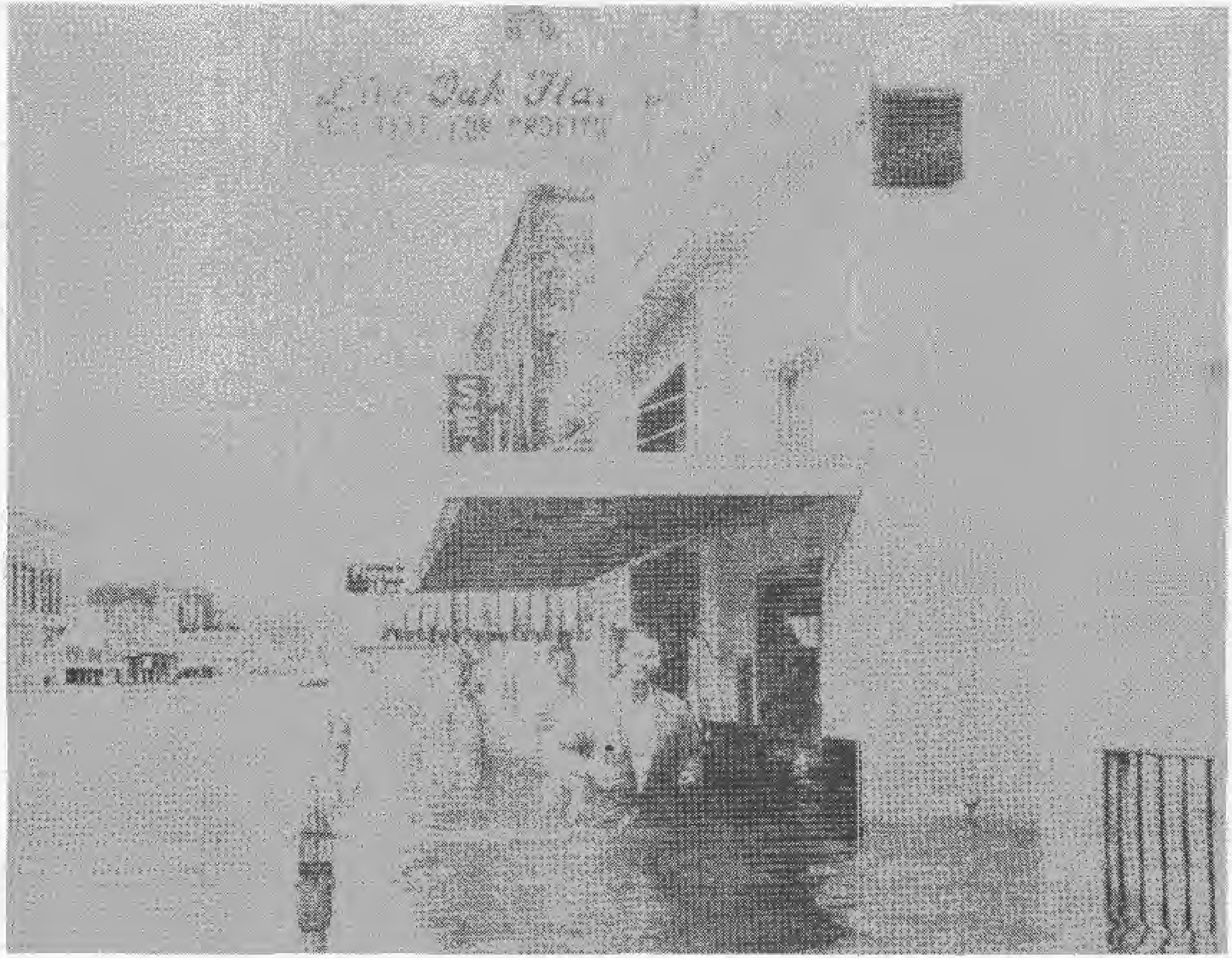


TABLE 4

1980 WATER USE - SUWANNEE RIVER AREA

MILLION GALLONS PER DAY VALUES

	Ground Water or Surface Water	Public Supply	Rural	Irrigation	Industrial	Sub Total	Thermo-Electric	Hydro-Electric (2)	Total All Uses
18-County Georgia Area	GW	35.59	15.26	44.92	21.22	116.99	0	0	116.99
	SW	.05	1.52	39.82	.08	41.47	2.2	0	43.67
TOTAL		35.64	16.78	84.74	21.30	158.46	2.2	0	160.66
Suwannee River Water Management District (Florida)	GW	11.05	18.49	18.12	94.18	141.84	.96	0	142.80
	SW	0	1.78	4.09	34.12	39.99	172.8	0	212.79
TOTAL		11.05	20.27	22.21	128.30	181.83	173.76	0	355.59
Georgia and Florida TOTAL		46.69	37.05	106.95	149.60	340.29	175.96	0	516.25

NOTE: (1) The above figures apply to county unit areas greater than the actual river basin in the respective states. Several Georgia counties with minor contributing areas are not included.
Source: U.S. Geological Survey

(2) In the Flint River Basin in Crisp County, just west of the Suwannee River Basin, there is a 1,790 MGD water use for hydroelectric power.

(3) All figures refer to quantities withdrawn which are subject to consumptive uses. Thermoelectric and hydroelectric uses are essentially nonconsumptive.

future availability of adequate supplies, but that concern is largely due to the unknown limitations of existing groundwater sources. Substantial groundwater withdrawals could cause a lowering of water surfaces of streams, springs, lakes, and wetlands. The SRWMD has a special concern for that potential adverse impact and its consequences. Neglecting run-of-the-river cooling water use, the major source is ground water from one aquifer. The major aquifer is the Floridan Aquifer which underlies all of Florida. It extends well up into Georgia and into parts of South Carolina and Alabama, where it is known as the Principal Artesian Aquifer. It is generally a prolific source. The use and protection of this aquifer are vital to the Suwannee River Basin.

There is concluded to be no immediate need for development of major regional water supply sources. There is a need for continued monitoring of water use, and for long-ranged groundwater studies that would quantify the limitations of available supplies and lead to a better understanding of surface water and groundwater interactions in the basin including the potential impacts of any proposed groundwater withdrawals in the areas that might be affected. Groundwater modeling efforts or other studies were not undertaken in the survey study as explained in paragraph 29.c.

19. Navigation. There is little commerce through the Suwannee River Inlet at the present time. No commerce or vessel trips are reported to the Corps of Engineers. Although the Federal entrance channels are not currently maintained, (see paragraph 9) local interests have from time to time improved channel depths in inlet passes. Information on controlling depths in entrance channels is given in the annual Department of Commerce publication "United States Coast Pilot 5, Atlantic Coast, Gulf of Mexico, Puerto Rico, and Virgin Islands".

There is a federally authorized 12-foot by 50-foot waterway along the Gulf Coast from St. Marks to Tampa Bay. It was authorized by the Act of 13 August 1968 and described in House Document 386, 90th Congress, 2nd Session. Construction was never started nor is any scheduled. Lacking any Federal funding and obligation of those funds prior to 31 December 1989, the entire waterway project will be automatically deauthorized on that date. There is substantial recreational navigation in the basin, including some commercial activity provided by outfitters. Most of the entire Suwannee River and considerable tributary areas are navigable for small boats during higher water levels. During low water, scattered shoals upstream of Branford to above White Springs, and on tributaries, limit through navigation. During drought periods, portions of the main river channel between White Springs, Florida, and Fargo, Georgia, can go dry. The Santa Fe River has a large 3-mile-long underground channel that prevents surface flows except during floods. The lower 18 miles of the Alapaha River has a surface and underground channels. Flow occurs in the surface channel about 50 percent of the time. The Withlacoochee and Little rivers also lose some low flows to ground water. The Suwannee River Sill or Mixons Ferry Dam (see paragraph 9) is the only existing manmade obstruction to small boat navigation on the main Suwannee River. However, that structure maintains sufficient water in parts of the Okefenokee Swamp to aid year-round boating. There is a need to provide and maintain suitable depths in the Suwannee River entrance channels to accommodate local traffic. Regulation and policing of recreational traffic is a reported problem in some areas. This includes the need to regulate use in some heavily used sensitive spring and spring run areas. However, these needs are not of a scope or type to warrant consideration of further Federal action.

20. Hydropower. Although the need exists for hydropower plants to provide peaking electric power capacity, there are no existing hydroelectric power plants in the study area. There is little prospect for hydropower due to the absence of existing structures and sufficient heads in the basin. In the 1981 National Hydroelectric Power Resources Study, no potentially feasible hydropower sites in the entire basin were identified.

21. Water Quality. The quality of surface and ground waters in the Suwannee Basin is generally rated as good to average, however there are specific existing pollution problems. Georgia and Florida have extensive programs and rules to monitor and protect both surface and ground waters. In Georgia, water quality standards and regulations are administered by the Environmental Protection Division of the Georgia Department of Natural Resources. In Florida, similar responsibilities are administered by the Department of Environmental Regulation. Both states delegate some duties to other State agencies. Several agency studies indicate trends of water quality deterioration. (FDER, 1985; USGS, 1985; SRWMD, 1988, 1989)

Florida has designated certain waters to receive special protection. It is State policy to afford a higher degree of protection to State waters designated as "Outstanding Florida Waters" as explained in Chapter 17-3 of Rules of the Department of Environmental Regulation. Following is a list of waters so designated in the Suwannee River Basin:

- Entire main Suwannee River in Florida
- Okefenokee National Wildlife Refuge (Florida portion)
- Ichetucknee Springs State Park
- Manatee Springs State Park
- O'Leno State Park
- Suwannee River State Park
- River Rise State Preserve
- San Felasco Hammock State Preserve
- Ocean Pond
- Tributaries of Suwannee:
  - Deep Creek, Robinson Creek, Falling Creek.
  - Santa Fe River System; - Santa Fe River, Lake Santa Fe, Little Lake Santa Fe, Santa Fe Swamp, Olustee Creek, and Ichetucknee River below U.S. 27, but excluding all other tributaries.

The 1987 Florida legislature adopted the Surface Water Improvement and Management (SWIM) Act that provides funding for the Department of Environmental Regulation and the Suwannee River Water Management District to develop an expanded water quality monitoring program and establish priorities to improve the quality of specific waterbodies.

There is a basin wide concern for water quality that presents two general problems: the definition and implementation of an appropriate and economical monitoring program; and implementation of programs to provide protection or improve degraded waters. This also applies to groundwater quality in the Principal Artesian or Floridan Aquifer. A specific aquifer problem exists in Live Oak, Florida, where about 50 wells are used to drain urban flood runoff directly into the underlying semi-confined aquifer. The Florida Department of Natural Resources, Bureau of Geology Map Series No. 94, "Potential Subsurface Zones for Liquid-Waste Storage in Florida" indicates that the Suwannee River Basin is one of the least suitable areas in Florida for waste injection. The Florida Sinkhole Research Institute has published a series of 10 maps covering the State of Florida entitled "Potential for Groundwater Pollution of the Floridan Aquifer, Based Upon Surficial Drainage, Karst Development, and Overburden Characteristics". The survey-review study did not undertake efforts toward water quality modeling as explained in paragraph 29.c. Study of the flood problem at Live Oak would allow a search for an alternative to drainage well use. Any flood plain information developed would aid the application of regulatory programs affecting water quality.

22. Fish and Wildlife. Because of generally low levels of population and development in the Suwannee Basin, a significant amount of wildlife habitat is available. A new National Wildlife Refuge is being formed on the lower Suwannee River and along its coastal estuarine areas. It will complement the existing Okefenokee National Wildlife Refuge at the other end of the river. Acquisition of wildlife corridors is also being pursued. The Suwannee River Water Management District has an active program of land acquisition along the Suwannee and tributary rivers in Florida. There are seven wildlife management areas substantially in the basin and one National Forest, the Osceola, in Florida. The Okefenokee Swamp and some natural spring areas are unique wildlife areas. The Suwannee River is host to the localized Suwannee bass and also the manatee, and Atlantic sturgeon. There are 24 wildlife animal species listed as endangered or threatened by the U.S. Government, or the States of Florida or Georgia. Information on Fish and Wildlife resources was published in the September 1983 Reconnassiance Report, (see paragraph 4f) including a Preliminary Resource Inventory by the U.S. Fish and Wildlife Service. Aside from a general population and development pressure and municipal wastewater discharges, the Fish and Wildlife Service listed the following as potential environmental hazards in the basin:

Industrial water pollution
Osceola National Forest mining
Increased boat traffic
Flood plain construction
Stream channelization
Non-point sources of pollution
Undesireable aquatic plants
Navigation projects
Water diversion

Additional concerns were presented by other Federal and State agencies in letters published in the Reconnaissance Report. The survey-review study would take steps to determine the impact on fish and wildlife resources of any proposed action. Any flood plain information developed, including any floodway delineation, would aid the application of regulatory programs that control flood plain construction and favorably impact fish and wildlife resources.

23. Recreation. Broadly speaking, recreation needs appear to be largely met by existing resources. While the Florida State Comprehensive Outdoor Recreation Plan (SCORP) does not indicate significant local need for recreational development, the unique attractions present in the project area are a partial cause of the discrepancy. A number of the natural spring areas are overused and some are misused due to lack of proper management. This abundant use of the existing facilities indicates a high demand and, consequently, a potential for additional park areas within the Suwannee River Basin. The major springs and their outlet spring runs probably have the highest unit value of all water related recreation resources in the basin. A valuable water and cultural resource that warrants protection from over utilization or accidental abuse, the Suwannee River and its tributaries provide an abundance of recreational opportunities for boating and canoeing along with fishing and swimming. Some of the runs, including the Ichetucknee River, are used extensively for tubing (floating) tours. The springs and limestone caverns are considered among the best freshwater scuba diving locations in the country. There are numerous woodland areas suitable for camping and picnicking with wilderness areas for hiking and biking trails and interpretive programs. The 1973 Wild and Scenic River Study (paragraph 4.g.(2)) recommended a State administered program. Although no official State program has ensued, the implementation of county flood plain regulations, and the Suwannee River Water Management District program of selected river shoreline and flood plain acquisition will provide substantial protection and enhancement of recreation resources and their use. In the Suwannee River Management Plan, adopted in November of 1981, the Suwannee River Resource Planning and Management Committee recommended the development of a recreational planning element for each local Government comprehensive plan. These elements would identify present and future recreational needs, goals and conflict resolution methods, preservation of significant archeological and historical resources, and a special zoning classification around springs to maintain their recreational benefits and protect the integrity of the springs and their runs. In a letter dated 22 April 1982, the Department of Natural Resources of the State of Florida indicated an interest in the Suwannee River and the adjacent springs because of their importance in providing recreational opportunities. Outdoor recreation is an important facet of this department's responsibilities and interests. These three are but a few of the sources that have indicated a vital interest in the recreation potential of the Suwannee River Basin. Implementation of these plans by State and local agencies is encouraged. Federal participation in recreational development on a 50/50 cost sharing basis with a non-Federal sponsor is permissible at Federal Water Resource Projects which indicate a favorable Federal interest for the basic project.

However, Federal participation will not be recommended by this report and further recreational planning and development by the U.S. Army Corps of Engineers is not contemplated. As indicated above, a high demand and potential for future development does exist and should be pursued by State and local agencies.

PLAN FORMULATION

This section provides a summary of the plan formulation effort for this study.

24. General Criteria. The purpose of plan formulation is to direct the course of decision making in order to define the best solution or plan to attain national objectives. Federal policy and procedures are set forth in the Water Resources Council's "Principles and Guidelines for Water and Related Land Resources Implementation Studies" dated March 10, 1983, as published in the Federal Register, Volume 47, No. 55, dated March 22, 1982. The goals of the principles and guidelines are to maximize National Economic Development while protecting or improving environmental quality and social well-being. It is intended that both structural and non-structural solutions be evaluated. While the study authority allows a broad scope and any plan can be considered or almost any study performed, implementation of Corps of Engineers projects for many purposes, such as water supply, water quality, recreation, and some others are generally prohibited unless there is a primary flood damage prevention, beach erosion, or nagivation project involved.

25. Public Involvement. The opportunity for input from all levels of Federal, State, and local agencies as well as the general public is essential to meet stated objectives. Primary coordination was maintained with the local sponsor - the Suwannee River Water Management District - through a substantial number of meetings, telephone conversations, and ongoing correspondence. Coordination was also maintained with the Environmental Protection Division of the Georgia Department of Natural Resources, although that agency did not act as a local sponsor. A substantial amount of public involvement was provided by the Suwannee River Resource Planning and Management Committee, that was formed in May 1980 before the authorization of this survey-review study (see paragraph 4h). At a public hearing sponsored by the Florida Department of Veteran and Community Affairs on November 6, 1981, the committee adopted two documents that were a consensus of its conclusions and opinions:

a. The Suwannee River Management Plan, with its 35 recommendations, was published as appendix C in the September 1983 Reconnaissance Report for this survey-review report.

b. A Model Flood Plain Ordinance that was intended as a guide for local county Governments.

A public workshop sponsored by the Suwannee River Water Management District was held on February 6, 1987, in Live Oak, Florida, to obtain input for the Live Oak Flood Study. Coordination with and assistance from private citizens and many other Federal, State, and local agencies also occurred. Some of the agencies are listed below:

U.S. Geological Survey
Federal Emergency Management Agency
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Florida Department of Transportation
Georgia Department of Transportation
Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Game and Fresh Water Fish Commission
Suwannee River Authority
City of Live Oak, Florida
Various private environmental organizations
U.S.D.A., Soil Conservation Service
Florida Regional Planning Councils
Georgia Regional Development Centers (formerly Planning and Development Commissions)

26. <u>Basin Planning</u>. As there was an indicated need for floodplain information, the general planning for the basin wide study was oriented in that direction. In 1982, the Water Management District contracted to have detailed mapping done for the main Suwannee River flood plain. Two-foot interval contour mapping was obtained. Cross sections at mile intervals were obtained and bench marks were established at about 2-mile intervals. County flood plain regulations were initially implemented about 1983 by the Florida counties bordering the Suwannee, Santa Fe, Withlacoochee, and Alapaha Rivers. At the time of this study authorization in December 1980, few flood insurance studies were available for the area. In May 1983, coordination between the Corps and the Federal Emergency Management Agency (FEMA) was initiated concerning the possibility of conducting flood insurance studies in conjunction with the survey-review study.

27. <u>Live Oak Flood Study Planning</u>. For the approach to this unusual flooding situation, consideration was given to all possible plans to determine feasible means of reducing flood damage. Another objective was to search for a cost effective method of eliminating the need for drainage wells, possibly in combination with flood control. The prior Section 205 report indicated that a comprehensive flood control plan might be feasible.

28. <u>Environmental Coordination</u>. Coordination with resource agencies has occurred during all phases of the study (refer to paragraphs 22 and 25). Earlier reports completed in 1982 and 1983 on the study were coordinated with the public, including the resource agencies. A 1988 scoping letter requested views and comments on the study of flood control needs in Live Oak, Florida. The State of Florida, Department of Community Affairs

expressed concern about sinkhole formations and contamination of ground water. Coordination with the Soil Conservation Service revealed many of the potential floodwater storage areas being studied consisted of agricultural lands.

a. The U.S. Fish and Wildlife Service (FWS) provided a Preliminary Resource Inventory (1983) which generally described valuable and sensitive resources within the basin. The FWS later provided a Planning Aid Letter (1988) which included a more detailed description of project area resources and projected impacts, based on an interagency field survey. The Planning Aid Letter recommended additional detailed studies on 3 of 13 flood storage sites due to potential degradation of high fish and wildlife values associated with these areas; however, additional studies were not warranted since the areas will not be affected by any Federal action.

b. The Florida State Historic Preservation Officer (SHPO) reviewed a large study area encompassing approximately 10 square miles, including the entire city of Live Oak. Six known archeological sites and three historic structures are located in this area (letter dated 22 July 1987). Additional cultural resources investigations and consultation with the SHPO would be required if a Federal project plan were pursued. Coordination for this report was conducted in compliance with the National Historic Preservation Act of 1966, as amended (PL 89-665); the Archeological and Historic Preservation Act, as amended (PL 91-293); and Executive Order 11593. (Protection and Enhancement of the Cultural Environment, 13 May 1971).

PRELIMINARY ALTERNATIVE PLANS

29. Suwannee River and Tributaries. Discussed below are preliminary alternatives to meet the national objectives in addressing the problems and needs found in the basin.

a. Non-Structural Solutions: Local interests had expressed a strong desire for a non-structural solution to flood problems. Flood plain information was urgently needed for regulatory functions that were in process of implementation. This course of action, providing useable flood plain information for local interests, was concluded to be the best solution.

b. Structural Solutions: Existing (1987) average annual flood damages along the Suwannee River and it major tributaries are estimated at $810,000. The figure is an updated value based on adjusted prior report estimates at November 1987 prices. A detailed analysis was not done. Included are portions of the tributaries extending into Georgia, including Little River. At current interest rates, (8 7/8 percent) that amount of damage would support a maximum project expenditure of 9 million dollars if all damage could be eliminated. Because of the areal extent of damages, and the large magnitudes of Suwannee Basin flood discharges and volumes, the obvious conclusion can be made that there is no possible structural solution that could approach being economically feasible.

c. Water Quantity and Quality Modeling: Aquifer water supply and surface and groundwater quality were definite interests of both Georgia and Florida agencies. Consideration was given to a modeling effort or support that would be useful. The U.S. Geological Survey has developed a Regional Aquifer System Model which covers the principal water supply aquifer within parts of South Carolina, Georgia, Florida, and Alabama. It has been used to analyze the hydrogeology and flow regimen of several general and specific areas in the region. Further development and refinement of the model will allow analysis of any other problem area and it will likely be a continuing tool for future groundwater analysis. All five Water Management Districts in Florida have indicated an intention to use the model in future groundwater analysis. The model has already been used in Georgia to analyze groundwater supply potentials at Brunswick and Savannah. It seemed proper that any regional effort should be directed toward the use of that model. Upon consideration of the size of the area, the cost to derive any meaningful results, and current water resources priorities, the decision was made not to undertake any water supply or quality modeling efforts.

d. No Action: This clearly was not an adequate solution. No further accurate information on flooding would leave a void that would have had to be met by local interests in some manner. Unavoidable further delays in the provision of adequate information would be costly in terms of regulatory problems for local interests. (See paragraph 15)

30. Live Oak. Following are preliminary alternative considerations of various potential plans to solve flood problems at Live Oak.

a. Surface Reservoir Flood Storage: Drainage areas in Live Oak are small and generally independent. There are essentially no streams flowing into or out of town. During larger floods, some areas do overflow to other areas. Review of the topography did not reveal any site where classic reservoir storage would be effective.

b. Excavated Flood Storage Areas: Due to the independent drainage areas and the ponding nature of flooding, an excavated volume below the flood elevation would reduce flood elevations. This is a method that has been used by local interests in Live Oak to provide some flood control. Since hurricane Dora flooding in September 1964 and by the end of 1988, about 25 flood storage pits have been excavated or enlarged. Preliminary cost comparisons indicated that this alternative deserved detailed analysis.

c. Pumping to a Distant Storage Site: As floodwater cannot flow out of Live Oak, except downward through infiltration or drainage wells, pumping floodwater out of town under a comprehensive plan is a possibility. An extensive and expensive gravity pipe system would be required to collect water from independent drainage areas, but a large pumping station could move water through a pressure conduit to a disposal site 2 to 5 miles away for gradual assimilation of floodwater by infiltration and evaporation. The 1982 Section 205 report (paragraph 4e) indicated such a plan may be feasible. Also, this is the only apparent general plan that would allow the use of the existing drainage wells in Live Oak to be discontinued.

d. Pumping to Suwannee River Drainage: The Suwannee River is 7 miles to the northeast from Live Oak. Floodwater could be pumped 3 miles to Workman Lake, where an outlet stream flows to within a mile of the Suwannee River before it goes underground. This plan is also a comprehensive plan similar to c. above but with an alternate disposal method. This alternative was rejected for two reasons: diversion of urban stormwater runoff of low quality to the Suwannee River would likely not be acceptable; and water disposed to ground water to the northeast of Live Oak might flow southwest with the general groundwater movement toward the Live Oak municipal supply wells which are on the northeast side of town.

e. Fill at Structure Replacements: On a long term basis, structures could be rebuilt on fill material to raise them above flood elevations. But as flooding is primarily a function of the flood volume, this procedure would be self-defeating and only transfer the flood elsewhere to a higher elevation. However, the raising of floor elevations without fill might be practical.

f. Evacuation of Flooded Areas: Since the record flood in 1964, this has occurred to some degree in parts of Live Oak. The concept of moving the town is not feasible, as most of the town area is flood free. Lacking a feasible structural solution, this option will be considered by individual property owners.

g. Additional Drainage Wells: Additional drainage wells would provide some flood reduction. The total capacity of the approximate 50 working wells in the city is perhaps no more than 100 cubic feet per second. This capacity is of definite value during marginally small floods. It is a very small capacity compared to peak surface inflow rates during major floods. The major value of the wells is the capacity to drain off flood waters to make storage available for the next storm rainfall. Aside from the above, additional drainage wells were not considered to be a feasible solution because of the improbability of their being permitted, due to the additional groundwater pollution potential.

h. Drain Fields: Horizontal drainage lines or drain fields could be a substitute for drainage wells. If placed in the surficial materials above the limestone aquifer, they could provide some filtration of stormwater runoff which would improve the quality of waters received by the aquifer; but there would be problems with implementation and operation. Substantial right-of-way would be required. Service life might be short due to the amount of sediment and debris involved. This is a significant problem with drainage wells. If covered for other uses, access would be difficult. Detailed analysis of flow potential was not undertaken. The alternative was not considered to be cost effective for flood removal capacity.

i. Forced Groundwater Injection: The addition of an injection pump to a gravity drainage well would increase its flow capacity. When a typical Live Oak drainage well inlet becomes submerged by about a foot or so, its flow control shifts from the casing pipe inlet to the aquifer. For ordinary conditions the aquifer water level can be 30 to 50 feet below the well inlet. Therefore, typical heads are 30 to 50 feet in order to produce the approximate 2-cubic-feet per second flow of a drainage well. Significant increases of head would be required to obtain meaningful flow increases. Forced injection at one well might result in a reduction of flow at another nearby well. In addition to the above questions, this alternative was not considered to be a feasible solution because of the improbability of its being permitted.

j. Flood Plain Regulations: To some extent, flood plain regulations are in effect in Live Oak. The city is in the flood insurance program. Onsite flood storage capacity is required for some commercial developments. The flood of record has had a regulatory effect. The fact that the September 1964 flood was such a large and rare event has left an impression of what can happen. Regulations relating to minimum floor elevations, etc., could be an effective means to reduce future additional flood damages, as regardless of whether or not any structural flood reduction measures are undertaken, the flood threat in lower areas of Live Oak cannot be entirely eliminated.

k. Flood Proofing: Flood proofing of individual buildings in Live Oak might be possible to reduce future damages. Technically, the exclusion of flood water from one building would increase flood stages elsewhere. However, such techniques may have net useful value when applied to individual properties.

l. Levees: In general, levees in the Live Oak area would be a self-defeating solution as the protection of any one area would adversely affect another area. No further consideration was given.

m. Gravity Outlet Channel: It would be conceivable to drain the Live Oak area with a gravity outlet canal to the Suwannee River, 7 miles away. However, excavation to impractical depths of 70 feet or so would be required and excavation costs would greatly exceed the potential benefits. The ground is flatter in the opposite direction toward the southwest, but excavation costs would quickly exceed potential benefits with no suitable receiving area nearby.

n. No Action: The recorded damage history indicated a need to make a thorough search for feasible means to reduce future damages. No action is a possible alternative if no economical solution were found. However, due to the potential damage that can occur, regulations or management to some extent in flood plain areas appear to be preferable to no action.

31. Other Flood Problems. There are other flood problems in scattered communities in the Suwannee basin. None of those areas identified appeared to warrant study under the survey review authority. During the survey study, two reconnaissance reports under the Section 205 Small Flood Control Project Continuing Authority were accomplished. One was for Sugar Creek at Valdosta, Georgia; the other for Bear Creek at Adel, Georgia. Both reports were negative.

ALTERNATIVES STUDIED IN FEASIBILITY PHASE

32. Flood Plain Information. This was concluded to be the only feasible alternative that would meet local basin needs. The early scope of information was intended to meet the specific needs of the Suwannee River Water Management District (SRWMD). As a result of consultations with the Federal Emergency Management Agency (FEMA), an agreement was made in 1983 to also provide and format data to allow completion of Flood Insurance Studies for nine Florida counties for portions bordering the Suwannee River and its three major tributaries.

a. Surveys: The SRWMD had funded and contracted for detailed mapping, cross-section and bridge data, and benchmark installation along the main Suwannee River to the state line. The Corps of Engineers contracted for cross-section, bridge data and benchmark installation on the tributary Santa Fe, Withlacoochee, and Alapaha Rivers in Florida; and on the Withlacoochee River in Georgia up to the mouth of Okapilco Creek. The portion of the Corps survey in Florida utilized aerial photography provided by the SRWMD under its survey.

b. Hydrologic Analyses: Discharge frequency relationships for the Suwannee River basin were determined by statistical analyses of historical discharge records in accordance with U.S. Department of Interior Guidelines for determining flood flow frequency. The hydrologic history for the Suwannee River dates back to about 1862 based on later recollections of settlers who moved into the area about that time. However, it was not until after the 1928 flood that a general gaging program was initiated along the Suwannee River and its tributaries. Discharge records through 1984 were analyzed for five locations on Suwannee River; three locations on Santa Fe River, two locations on Withlacoochee River and two locations on Alapaha River. Discharge frequencies for intermediate locations were obtained by interpolation.

c. Hydraulic Analyses: Analysis of the hydraulic characteristics of the Suwannee River and its major tributaries, the Withlacoochee, Alapaha, and Santa Fe Rivers, were carried out to provide estimates of the water surface elevations* of floods of the selected recurrence intervals. The 10-, 50-, 100-, and 500-year floods were investigated because of their significance to Flood Insurance Studies and flood plain management. These floods have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Cross section data were obtained by aerial survey methods from photography flown for the flood plain areas and by field measurements for the main channel and immediate overbanks. All bridges were field surveyed to obtain elevation data and structural geometry. Cross sections were located at close intervals upstream and downstream of bridges in order to compute hydraulic effects of these structures. These cross sections were the basis for the development of a

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* Unless otherwise indicated, all elevations in this report refer to the National Geodetic Vertical Datum (NGVD)(mean sea level datum of 1929)

hydraulic model to produce water surface elevations. Water surface elevations of floods of the selected recurrence intervals were computed through the use of the Corps of Engineers' HEC-2 Step Backwater Computer Program. Roughness coefficients (Mannings "n") used in the hydraulic computations were determined by analyzing known flood events. Calibration and verification of the computer model was based on the models' ability to reproduce the known flood elevations with an accuracy of 0.5 foot. Starting water surface elevations were based on the slope-area method. Floodways were produced for the purpose of flood plain management, with the 100-year flood being the base flood. A floodway is that part of the 100-year flood plain that will effectively pass the 100-year flood with no more than a 1-foot rise in water surface elevation. The floodway was computed on the basis of equal conveyance reduction from each side of the flood plain. Because of the coastal influence of the lower part of the Suwannee River, a different modeling procedure was used. A two-dimensional link node model was used here since HEC-2 was not appropriate because of varying directions of flow. A floodway was produced here but no profiles were derived. (Flood profiles for the lower Suwannee are shown in the previously completed flood insurance studies for Dixie and Levy Counties). Coastal storm surge was not factored into the model. Complete maps were prepared to show the study results. The maps included the frequency flood boundaries, the floodway boundary, cross section location, base flood elevations, and river miles.

d. <u>Analytical Results</u>: Due to urgent needs of the SRWMD, study results were provided as elements were completed. Information included plotted flood profiles and maps showing the 100-year and 500-year flood lines and designated floodway boundaries. Where available, the 2-foot contour maps obtained by the SRWMD were used. Elsewhere, U.S. Geological Survey quadrangle maps were used. The extent of basin work elements on 500 river miles is shown on plate 3. Flood insurance studies had been published by FEMA for the two lower counties on the Suwannee River -- Dixie and Levy Counties -- and a portion of Alachua County based on other contracted studies. This survey study provided formated data to FEMA to allow completion of flood insurance studies and maps for 9 counties in Florida covering the Suwannee River and three major tributaries including an Alachua County addition. Following are all 11 counties and the currently applicable report publication date:

Alachua	Mar	1984
Alachua	Nov	1988
Bradford	Nov	1989
Columbia	Jan	1988
Dixie	May	1983
Gilchrist	Aug	1988
Hamilton	Jun	1987
Lafayette	Jan	1987
Levy	Sep	1983
Madison	Jun	1987
Suwannee	Jan	1988
Union	Aug	1988

In addition to various towns in the basin, flood insurance studies are available for portions of the following Georgia counties:

Brooks	Sep	1981
Lowndes	Dec	1981
Tift	Dec	1981
Ware	Jun	1980

Profiles of the Suwannee River from the Flood Insurance Studies are shown on plates 7 through 16. The median stage and estimated low stage of record profiles have been added. The stream bottom thalweg profiles shown are from random cross sections. Generally, the river bottom is very irregular and controlling depths are much less than the bottom profiles indicate. Survey information was obtained for a portion of the Withlacoochee River in south Georgia up to Okapilco Creek. Flood plain informatin was not developed for this river segment. However, cross section data and benchmark locations and descriptions are available. Flood profiles were constructed for the Suwannee and Alapaha rivers in Georgia upstream of the Florida flood insurance report work as shown on plates 17 through 20. They are not based on backwater analysis. Frequency analyses of available gaging and field information were used. On the Alapaha River, some flood stages measured on March 20, 1984, were used together with bridge elevations provided by the Georgia Department of Transportation to aid profile construction. Accuracy away from gage locations is limited.

33. Live Oak, Florida - Flood Analysis. Two potential alternatives were assessed in detail to seek a feasible solution for reducing flood damage in Live Oak.

a. Surveys. Two-foot interval contour mapping from October 9, 1987, aerial photography was produced for the entire Live Oak corporate area at a scale of 1 inch equals 200 feet. In addition, building floor elevations were obtained by levels for several representative flood-prone areas. Field elevation measurements were also made for flood marks and drainage well information. Flow measurements were conducted by pumping into three drainage wells in order to help estimate head rating curves for existing wells.

b. Hydrologic and Hydraulic Analyses: The hydrology of flooding in the city of Live Oak involved a study of rainfall, losses, runoff, and ponding. Hydraulic analyses involved the flow-stage relationship of the city's drainage works, with special emphasis on the drainage wells. Drainage wells are shown on plate 4. Casing diameters vary from 4 inches to 16 inches. Above some level of flow into the well, the capacity becomes limited by the carrying capacity of the underground aquifer. The hydraulics of the wells were verified by the field pump tests. Computer models were developed to simulate drainage into each of the major sinkhole depressions in the city. Drainage areas are shown on plate 5. Hurricane Dora, a 250 year storm which struck Live Oak in 1964, was used to calibrate the model. Rainfall frequencies of 2 year to 100 year were put into the model to generate stage-frequency data for use in the economic analyses.

LIVE OAK - DRAINAGE WELL NO. 3

LIVE OAK, FLORIDA
PUMP TEST ON DRAINAGE WELL NO. 33

c. Economic Analysis. Analyses were made in accordance with the Principles and Guidelines. (see par. 24) Project life was 50 years with 1990 as the base year. The discount rate was 8 7/8 percent. Real estate appraisals of all pertinent flood prone properties were made. Assessments of flood damages were made for 47 separate and generally independent flooded sub-areas in Live Oak, which did not include all of the corporate limits. The 1964 flood of record was considered to be equivalent to a Standard Project Flood (SPF) and was plotted at a recurrence interval of 250 years. Table 5 shows existing condition without project flood damages to structures and contents for several sub-areas with the highest average annual values. Of 47 sub-areas, 14 had essentially zero computed average annual damages to structures and contents. Where necessary, other primary benefits were estimated and estimates of flood damages prevented by considered project elements were made as needed. A recurrence of the 1964 flood of record would cause an estimated damage of $4,657,000 to structures and contents only in all 47 sub-areas combined. Other damages would raise the total to about 6 million dollars.

TABLE 5

STRUCTURE AND CONTENT FLOOD DAMAGE
WITHOUT PROJECT CONDITION (IN DOLLARS)

Sub-Basin Number	Recurrence Interval-Years SPF	100	25	10	2	Average Annual
12	2,409,399	1,101,387	524,870	271,868	0	102,195
30	766,232	152,610	49,490	8,070	0	8,858
16	40,229	40,229	35,624	29,482	0	3,868
8-9	233,326	62,886	22,088	8,376	0	3,827
21	38,887	22,297	17,950	12,257	238	3,055
11	117,426	31,833	16,162	9,330	0	2,678

34. Comprehensive Live Oak Pump Alternative. This alternative pumping plan (paragraph 30.c.) could comprehensively solve many independent flood problems. The analysis was initiated by computing the total potential combined benefit. From the hydraulic analysis of existing conditions, average annual damages were computed for 47 individual sub-areas covering structure and content damage. Other potential benefit components were estimated to give a total potential benefit of a comprehensive plan. The values

are listed below for the total 47 sub-areas (an affluence factor is an allowance for future higher content value in given structures):

Existing Development Without Project

Structure and content flood damage	$137,221
Lawns, shrubs, pavements, streets (5%)	6,861
Affluence factor (5%)	6,861
Transportation delays and vehicle damage	14,000
Flood fighting	4,400
Reduced flood insurance administrative overhead cost ($77 (233 structures x 25%*))	4,485
Total potential benefit (Average annual equivalent)	$173,828

* Estimated percent of structures in the flood insurance program.

The 1982 Section 205 reconnaissance report gave preliminary costs for 400 cfs and 800 cfs pump systems. Initial costs for the 400 cfs system were:

Gravity collection system	$2,850,000
Pump system and 5-mile conduit	5,041,800
Contingencies, Eng. & Des., Sup & Adm.	2,000,600
Real Estate	75,000
Total	$9,967,400

The total average annual costs were $1,079,800 for the 400 cfs system and $1,275,500 for the 800 cfs system. Those costs have not been updated. The highest potential benefit-to-cost ratio of the smaller 400 cfs pump plan would be:

$$\frac{173,828}{1,079,800} = 0.16$$

The comprehensive pumping plan concept was concluded to be not feasible.

A study purpose was to investigate means to provide an alternative to the use of drainage wells at Live Oak, in the interest of groundwater quality. No attempt was made to evaluate groundwater quality benefits from replacing drainage wells with an alternative system. If a comprehensive pumping plan for flood control had been feasible (pararaph 34), the addition of 75 to 100 cfs (approximate total drainage well capacity) would possibly have had an initial cost of about $400,000 to $500,000. It would still be conceivable to replace the drainage wells with a similar pumping system; however, the single purpose cost would be substantially more. The provision of only 75 to 100 cfs capacity to only replace the wells, without any contribution from a flood control purpose, would probably cost at least $4 or $5 million for a similar comprehensive collection, pumping, and disposal system. The groundwater pollution potential is a continuing concern. If potential groundwater quality benefits would support an investment of that magnitude, a comprehensive pumping system to only replace drainage wells might be feasible. Given that, additional incremental removal capacity for flood control would show a more nearly marginal feasibility than indicated by the 0.16 benefit-to-cost ratio determined above. However, it is still doubtful that incremental flood control pumping capacity would be justified, except possibly for a few individual areas.

35. Live Oak Flood Storage Area Plan. This plan considered excavated flood storage capacity in each independent flooded area, which allows a separable potential solution applicable to any problem area (see paragraph 30.b.). A unit average annual cost for a minimum excavated storage capacity of 6.275 acre-feet was developed, which amounted to $5,333 with minimum real estate costs. The average annual cost value was compared to the existing average annual flood damage value determined for each of the 47 sub-areas. Stage reductions due to the addition of the unit storage capacity were determined for most sub-areas. Sub-areas showing marginal feasibility were analyzed in more detail with variable storage capacities.

A storage facility in only one sub-area proved feasible. Sub-area 12 is in a downtown commercial area of Live Oak. A storage area plan for 12.55 acre-feet of capacity is shown on plate 6. Preliminary initial costs are $421,800 and average annual costs are $38,000. Flood stages in sub-area 12 are as follows:

Flood	Elev. Ft. NGVD	
	Without Project	With Project
250-year	100.01	-
100-year	98.37	96.95
25-year	97.59	95.70
10-year	96.99	93.95
2-year	94.93	89.15

Existing average annual flood damages in sub-area 12 (structures and contents only without project) were computed to be $102,195. Average annual flood damages prevented (structures and contents) by 12.55 acre-feet of storage in sub-area 12 amount to $94,060. There would be some additional benefits. The total local drainage area involved is about 59 acres or almost one-tenth square mile. The protected area is limited to approximately 8 city blocks and considered local drainage. Information developed for this analysis has been provided to local interests for their use.

FINDINGS AND CONCLUSIONS

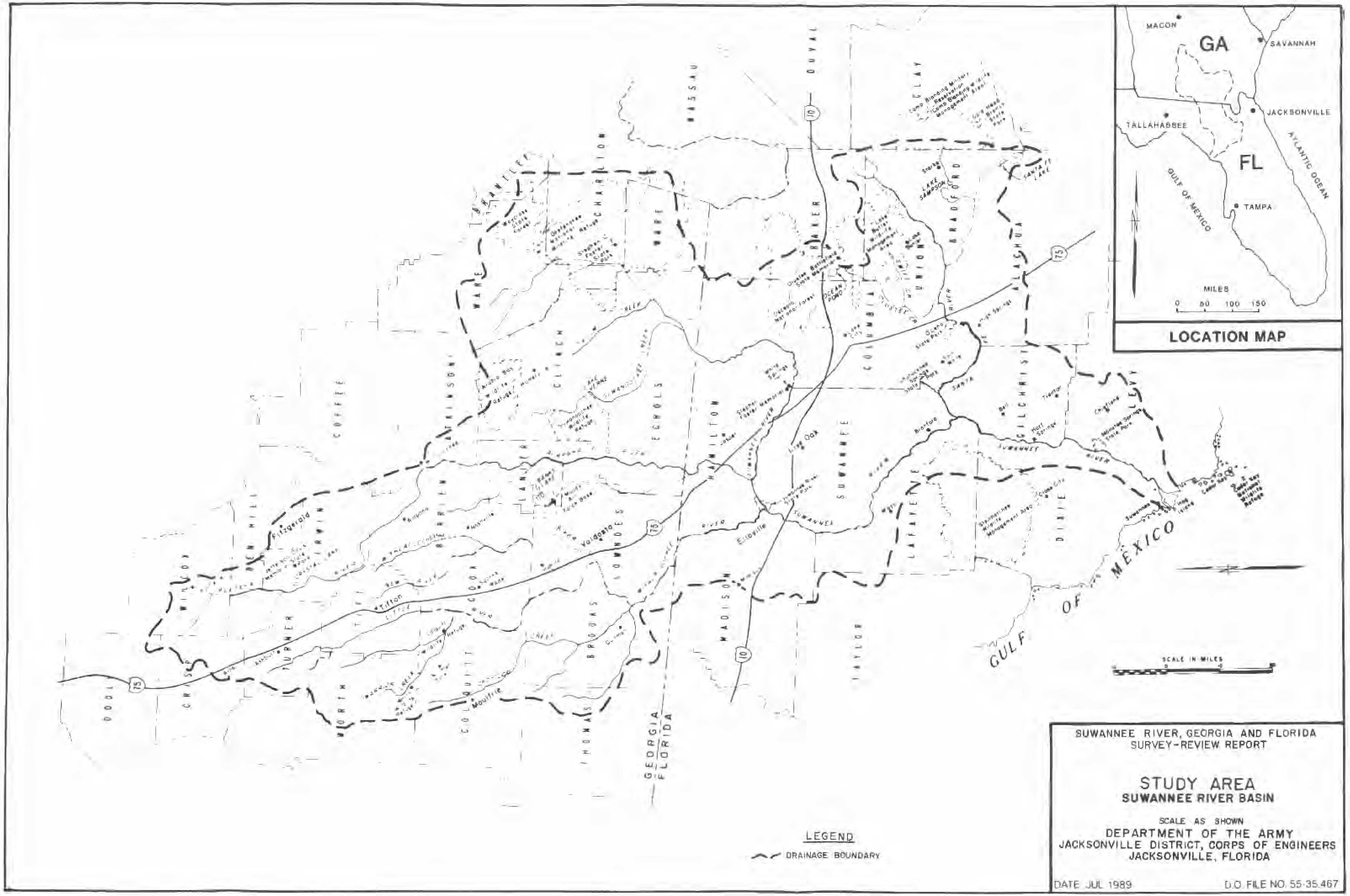
36. Suwannee Basin Study. Flood plain information was determined to be the major feasible basin need. Hydrologic and hydraulic information developed during the study was provided to the local sponsor at a very opportune and favorable time; and to the Federal Emergency Management Agency for a number of Flood Insurance Studies which have been completed. Information developed is available upon request and is concluded to satisfactorily meet present needs. Flood plain management should continue as a primary solution for the conservation and management of the water and related land resources in the Suwannee River basin.

37. Live Oak, Florida. Comprehensive plans to reduce flooding were not found to be economical. Although the study developed a feasible structural plan for flood reduction, it is very local in nature with limited drainage area size and number of beneficiaries. The project is considered as drainage and too localized to be included within the guidelines of a Federal project interest.

RECOMMENDATION

I have reviewed the reports pertinent to the Suwannee River basin, and based on the findings of this study, I recommend no modifications to the previous recommendations and that no Federal action be taken at this time.

Robert L. Herndon
Colonel, U.S. Army
District Engineer



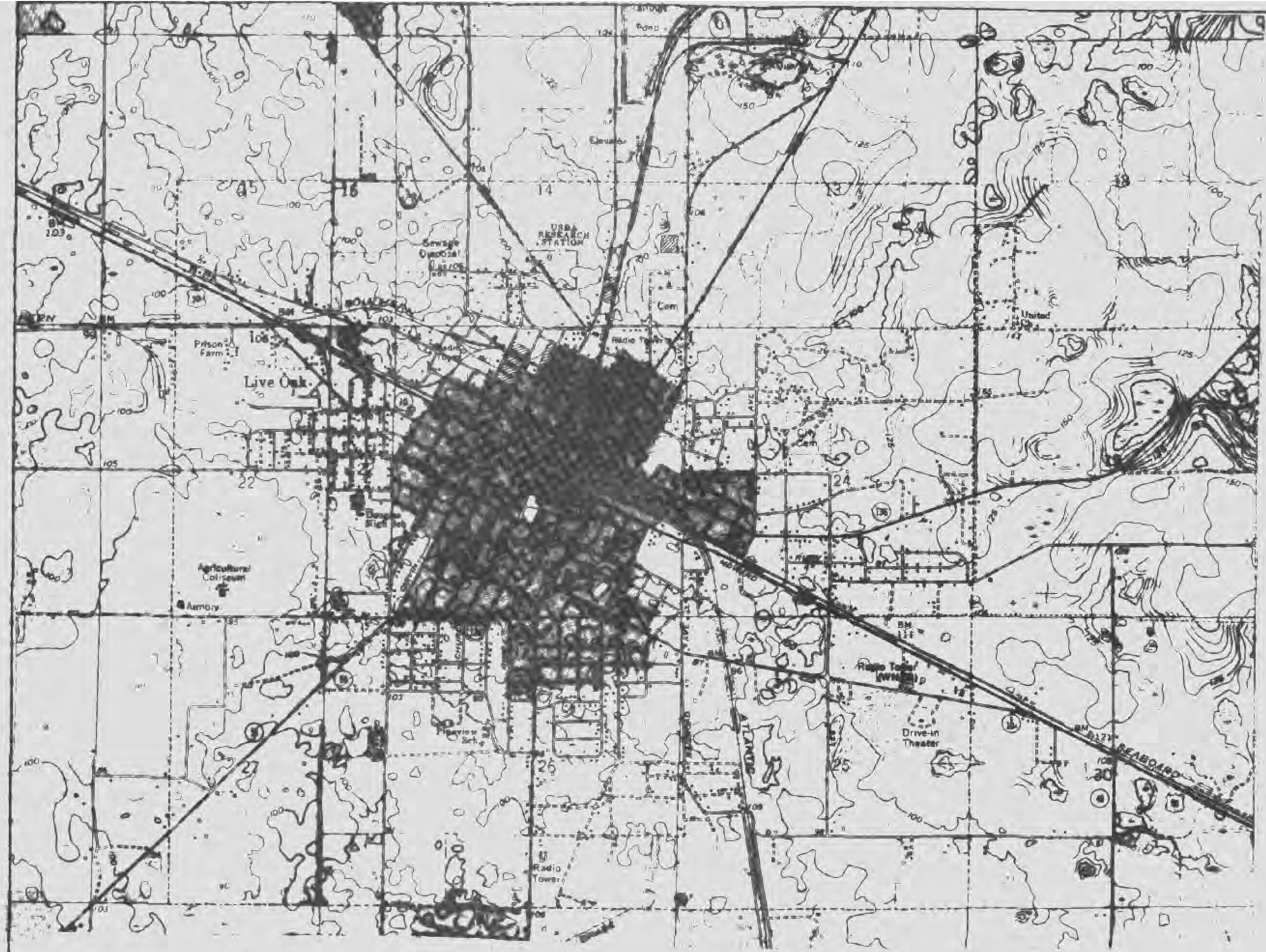
SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT

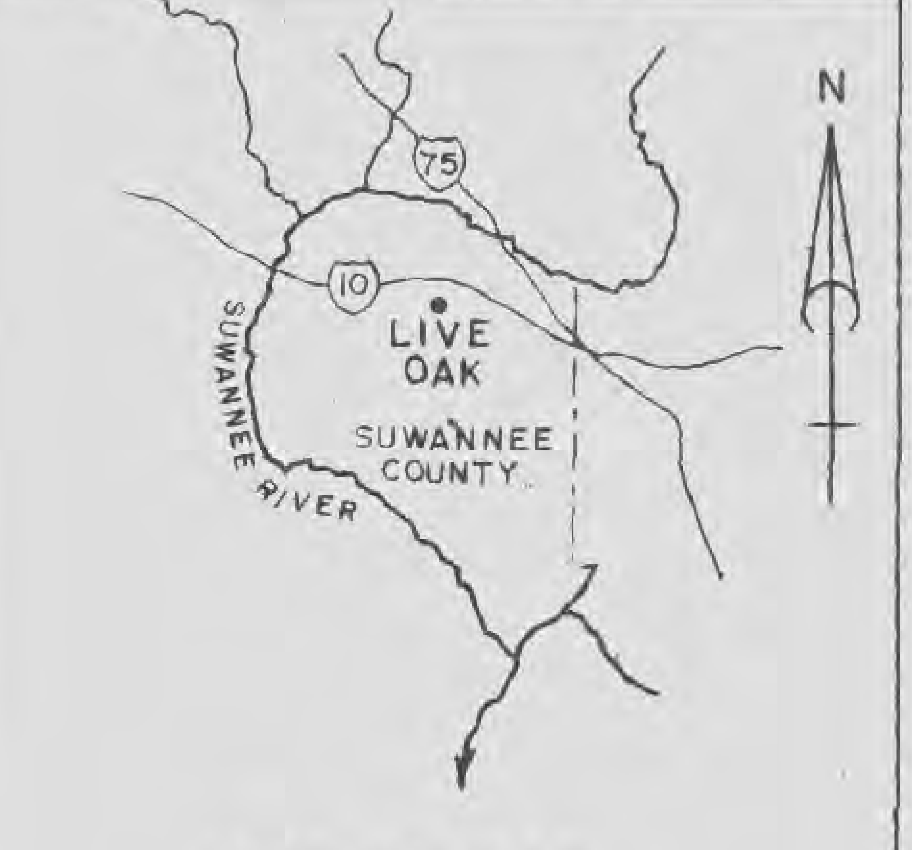
STUDY AREA
SUWANNEE RIVER BASIN

SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

DATE JUL 1989 D.O. FILE NO. 55-35,467

PLATE 1





LOCATION MAP

SCALE IN MILES

10 0 10 20

GRAPHIC SCALES

MILE 1 1/2 0

FEET 1000 0 1000 2000

LEGEND

---------- CITY BOUNDARY

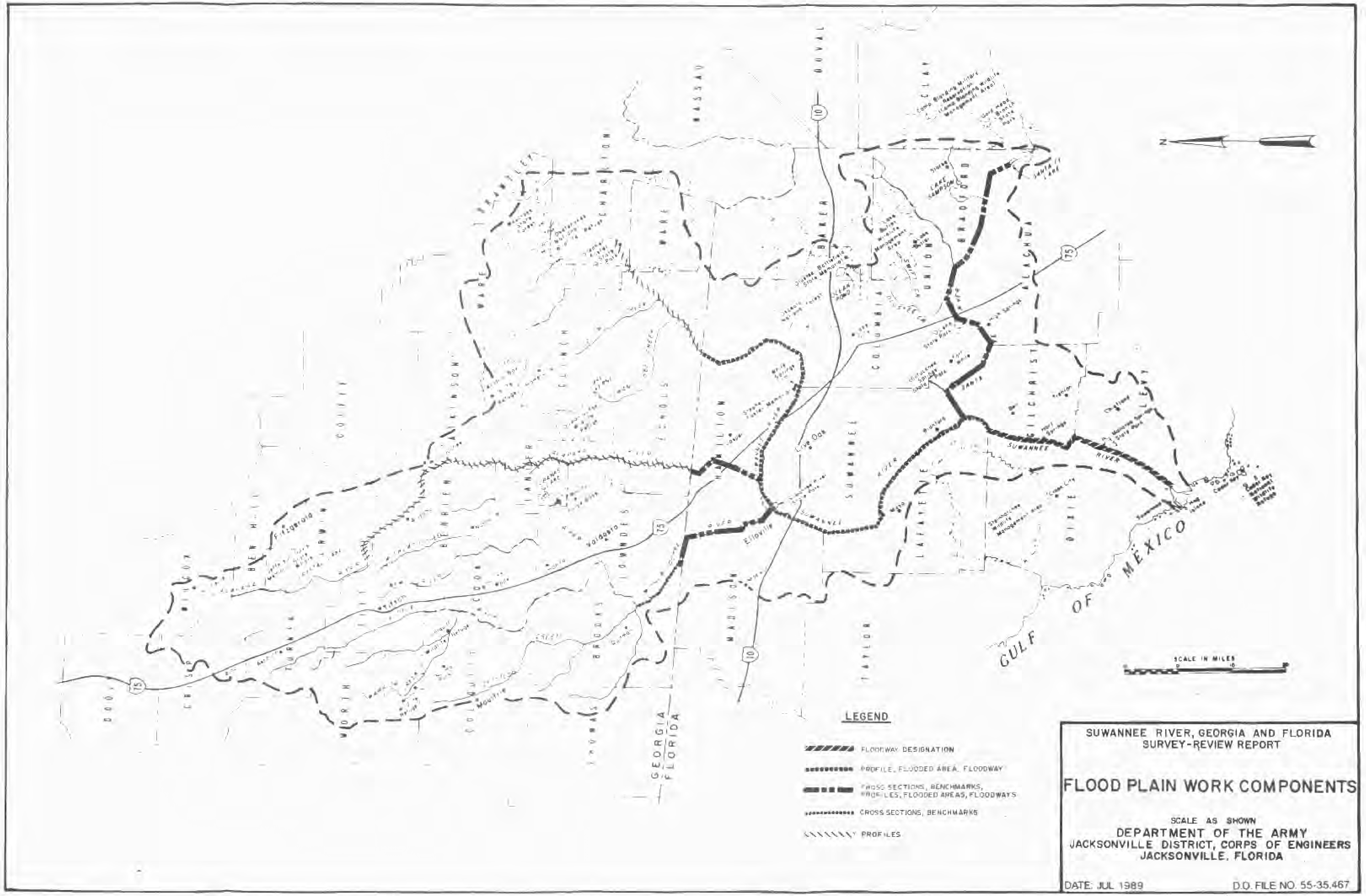
SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY- REVIEW REPORT

LIVE OAK, FLORIDA

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

DATE: JUL 1989 D.O FILE NO. 55-35,467

PLATE 2



SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT

FLOOD PLAIN WORK COMPONENTS

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

DATE: JUL 1989 D.O. FILE NO. 55-35,467

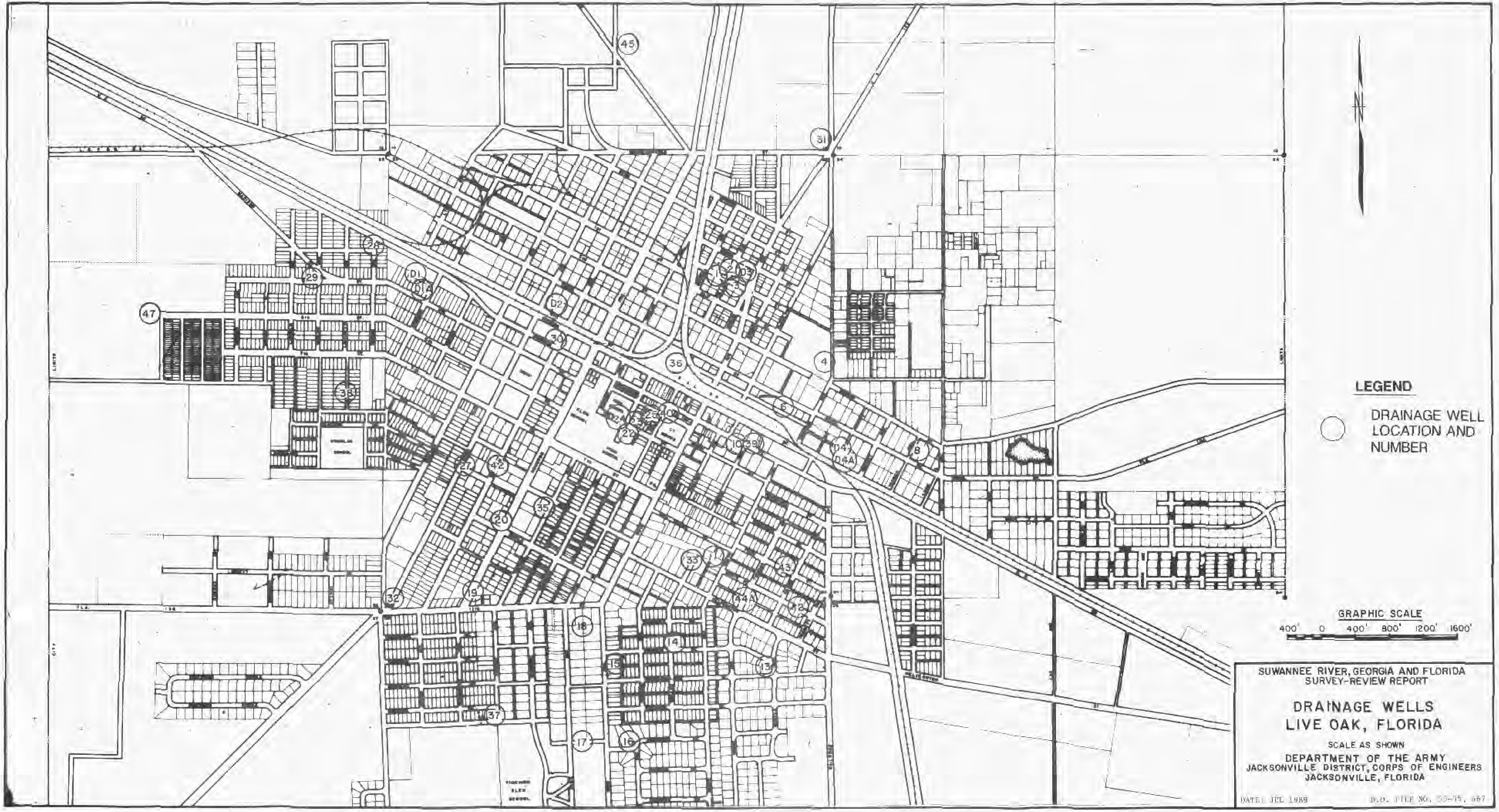
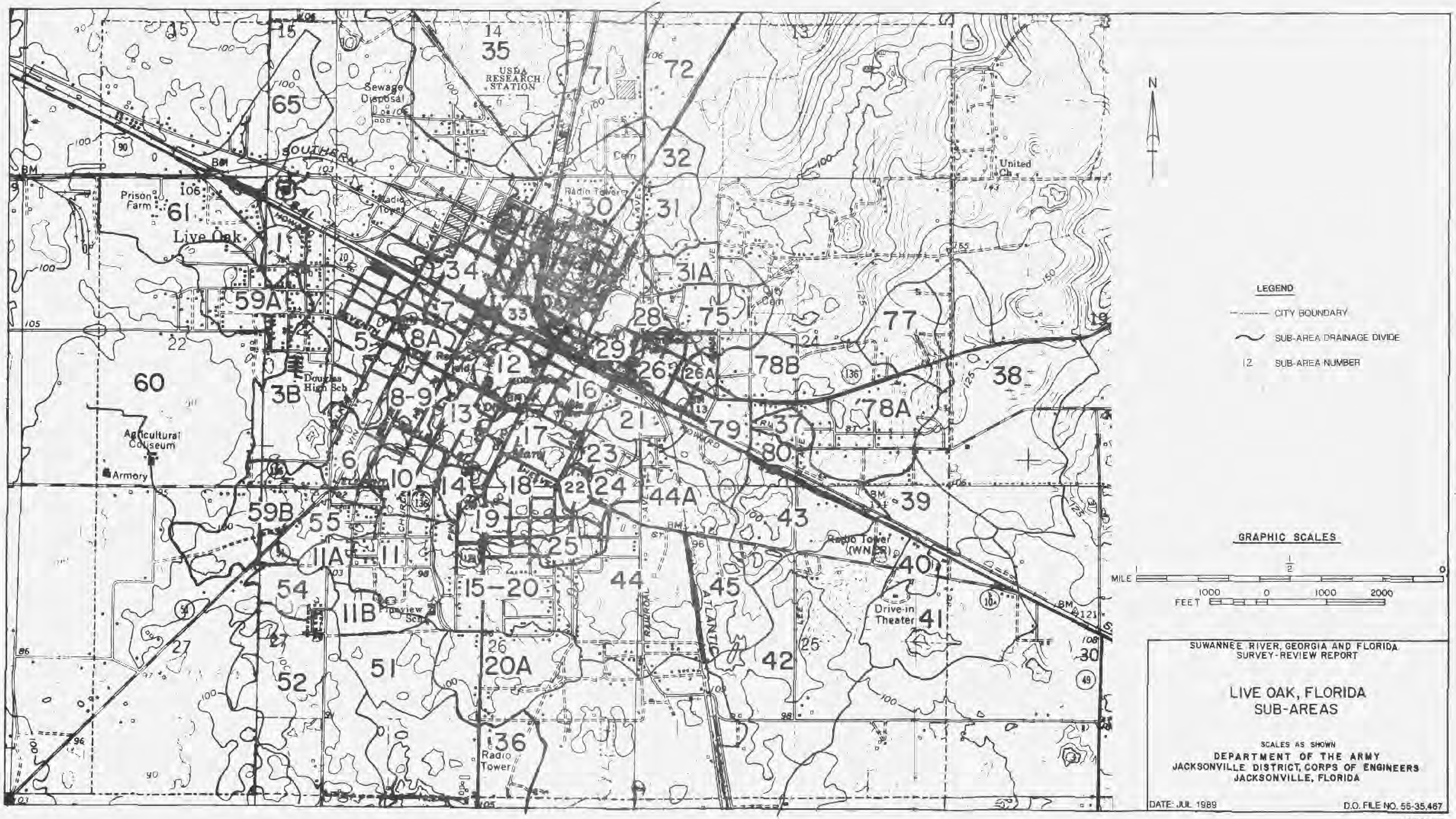
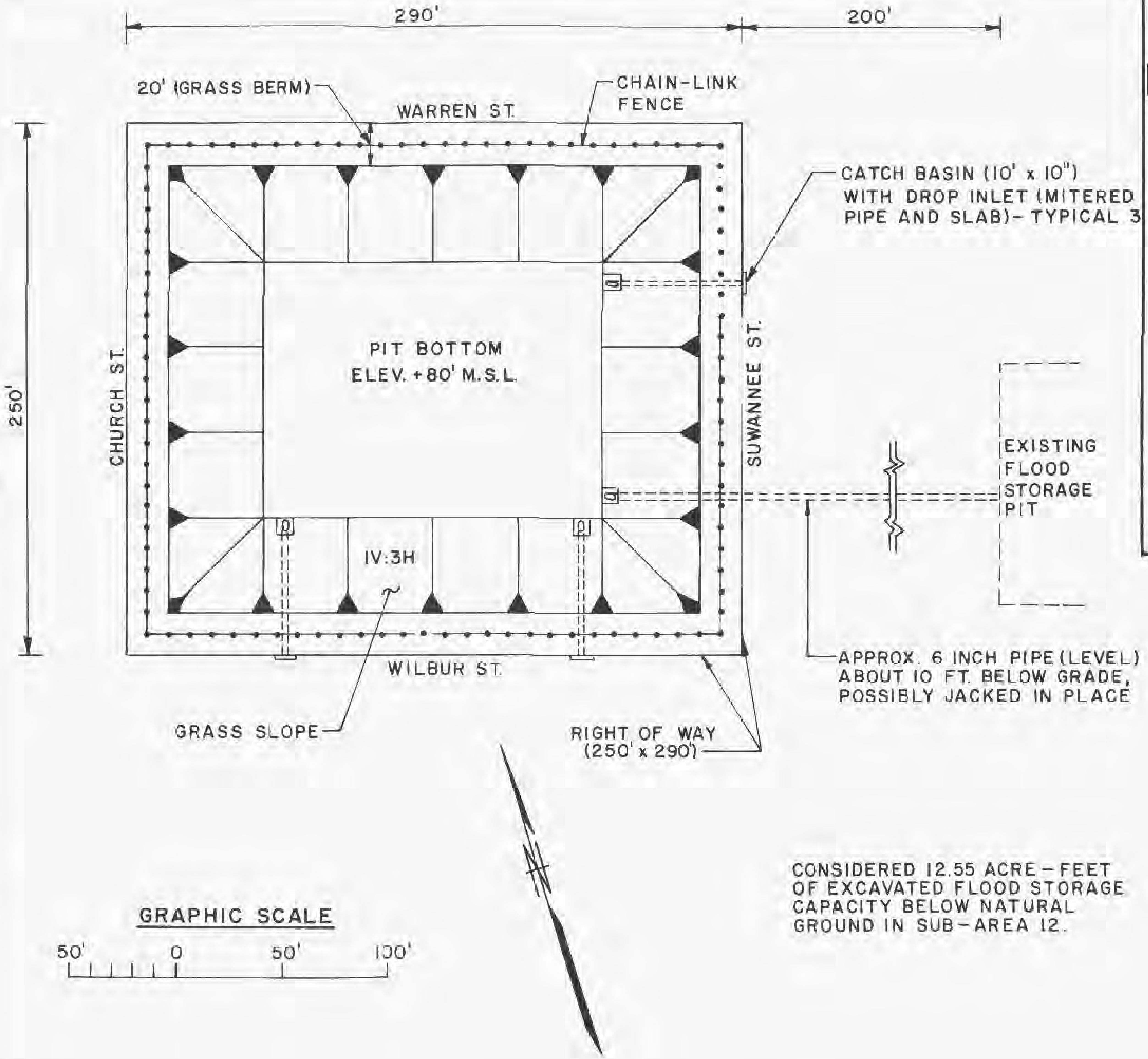
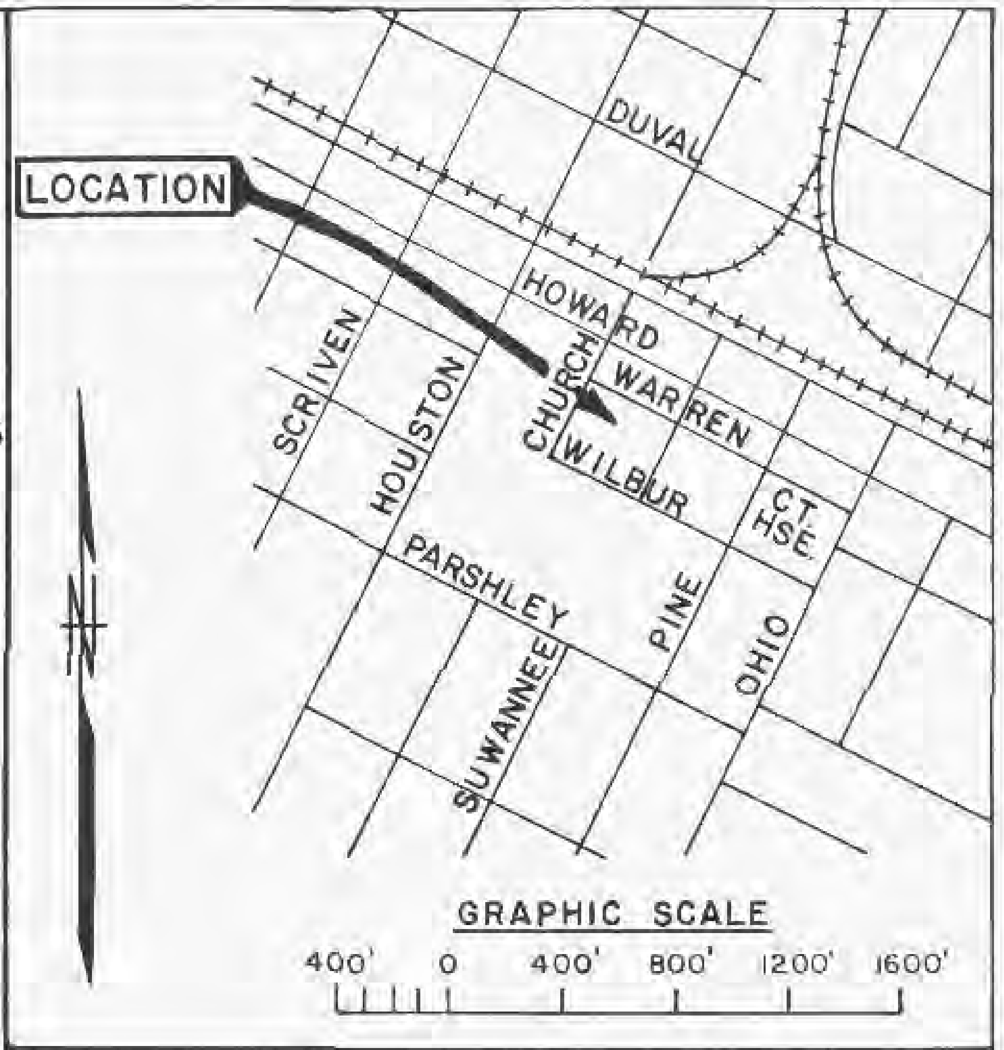

LEGEND
DRAINAGE WELL LOCATION AND NUMBER
GRAPHIC SCALE
400' 0 400' 800' 1200' 1600'
SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT
DRAINAGE WELLS
LIVE OAK, FLORIDA
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE: JUL 1989
D.O. FILE NO. 55-95, 467

PLATE 4



LEGEND
CITY BOUNDARY
SUB-AREA DRAINAGE DIVIDE
12 SUB-AREA NUMBER
GRAPHIC SCALES
MILE 1 ½ 0
FEET 1000 0 1000 2000
SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT
LIVE OAK, FLORIDA
SUB-AREAS
SCALES AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE: JUL 1989
D.O. FILE NO. 55-35,467
N
Live Oak
Prison Farm
Sewage Disposal
USDA RESEARCH STATION
Radio Tower
Cem
City Cem
United Ch
Douglas High Sch
Agricultural Coliseum
Armory
Drive-in Theater
Radio Tower (WNER)
Radio Tower
SOUTHERN
HOWARD
ATLANTIC
RAILROAD





CONSIDERED 12.55 ACRE-FEET OF EXCAVATED FLOOD STORAGE CAPACITY BELOW NATURAL GROUND IN SUB-AREA 12.

SUWANNEE RIVER, GEORGIA AND FLORIDA
SURVEY-REVIEW REPORT

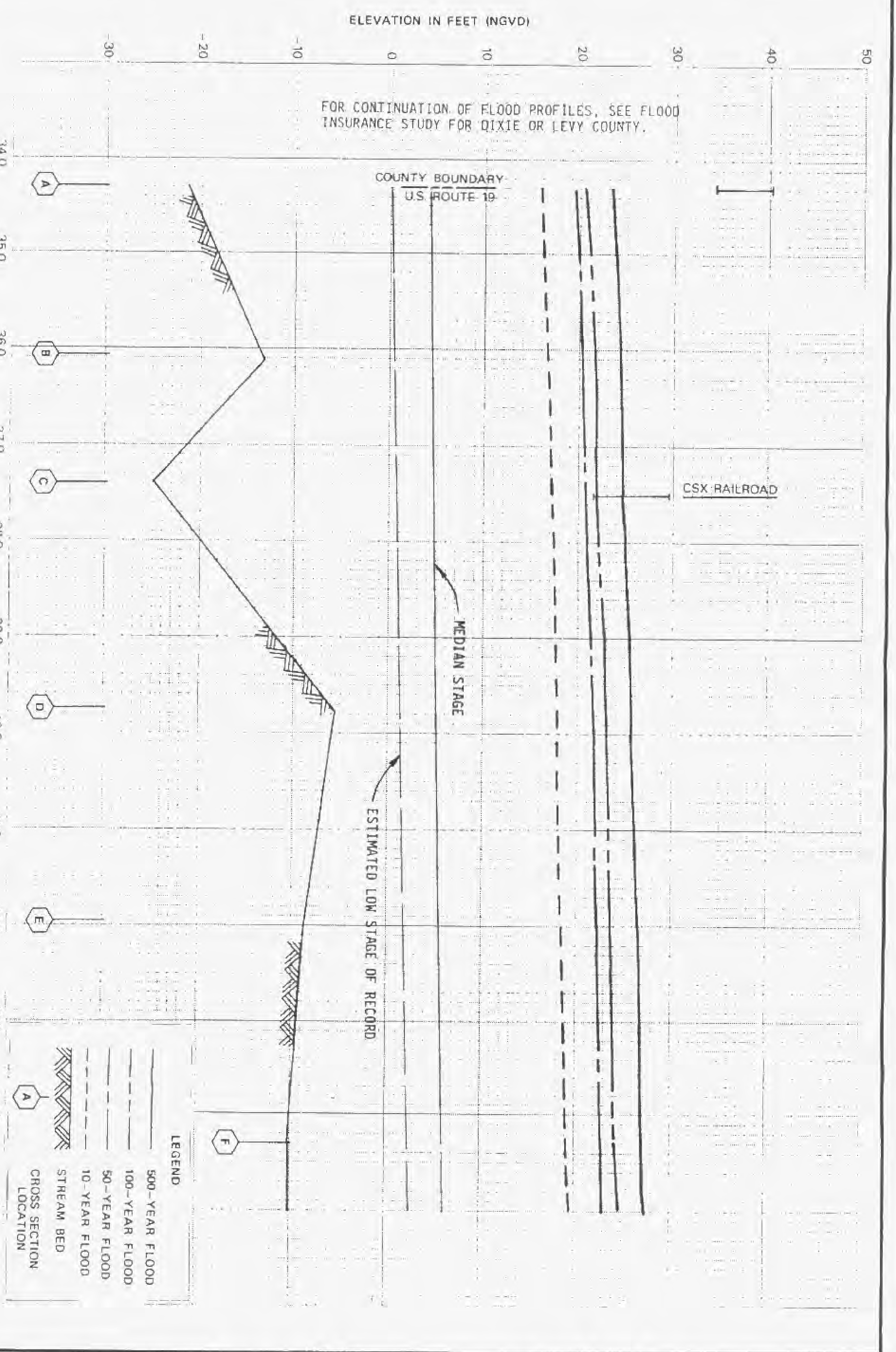
LIVE OAK FLOOD STORAGE FACILITY
PLAN VIEW

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

DATE: JUL 1989 D.O. FILE NO. 55-35,487

PLATE 6



FEDERAL EMERGENCY MANAGEMENT AGENCY

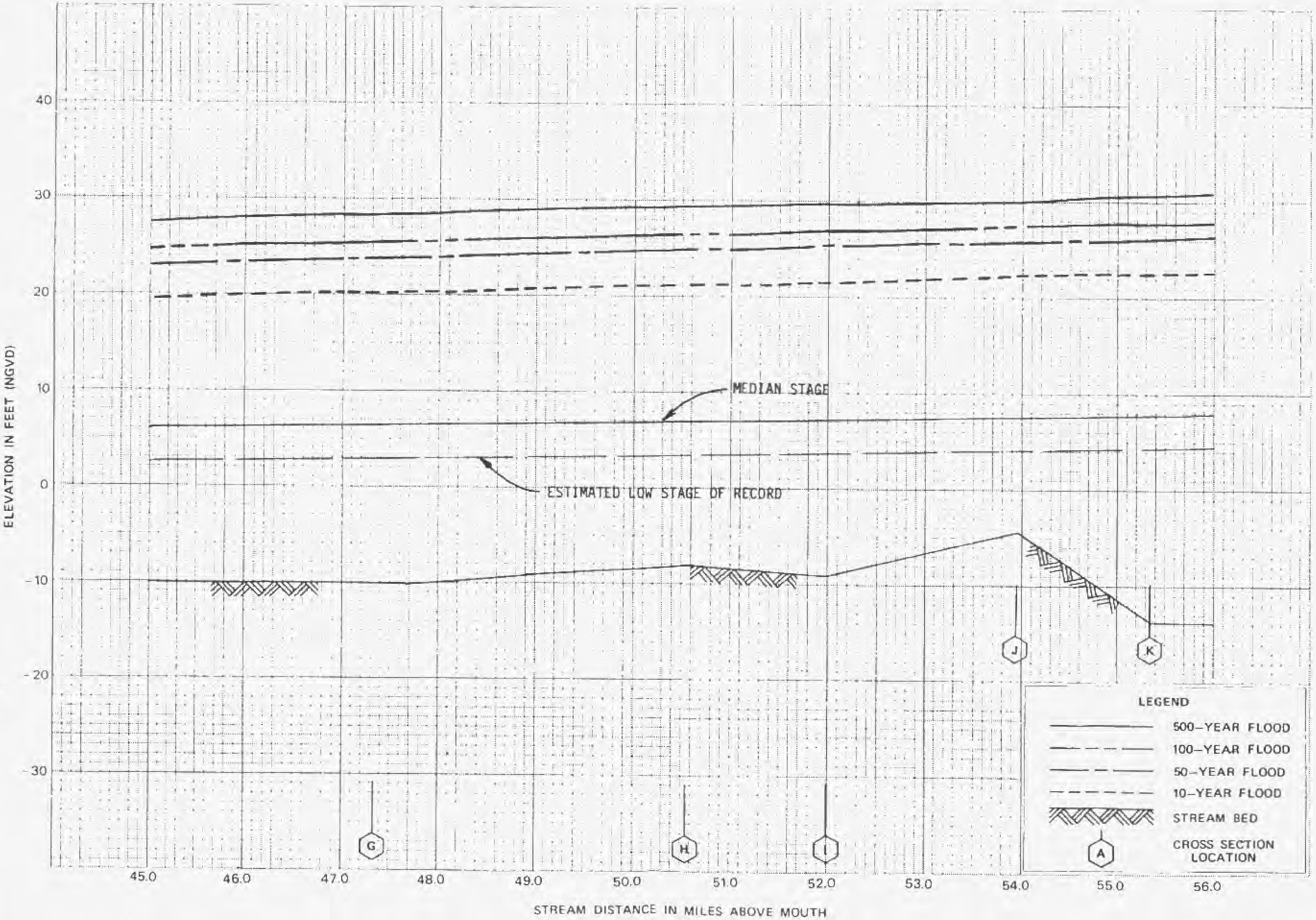
GILCHRIST COUNTY, FL AND INCORPORATED AREAS

FLOOD PROFILES

SUWANNEE RIVER

01P

PLATE 7



FLOOD PROFILES

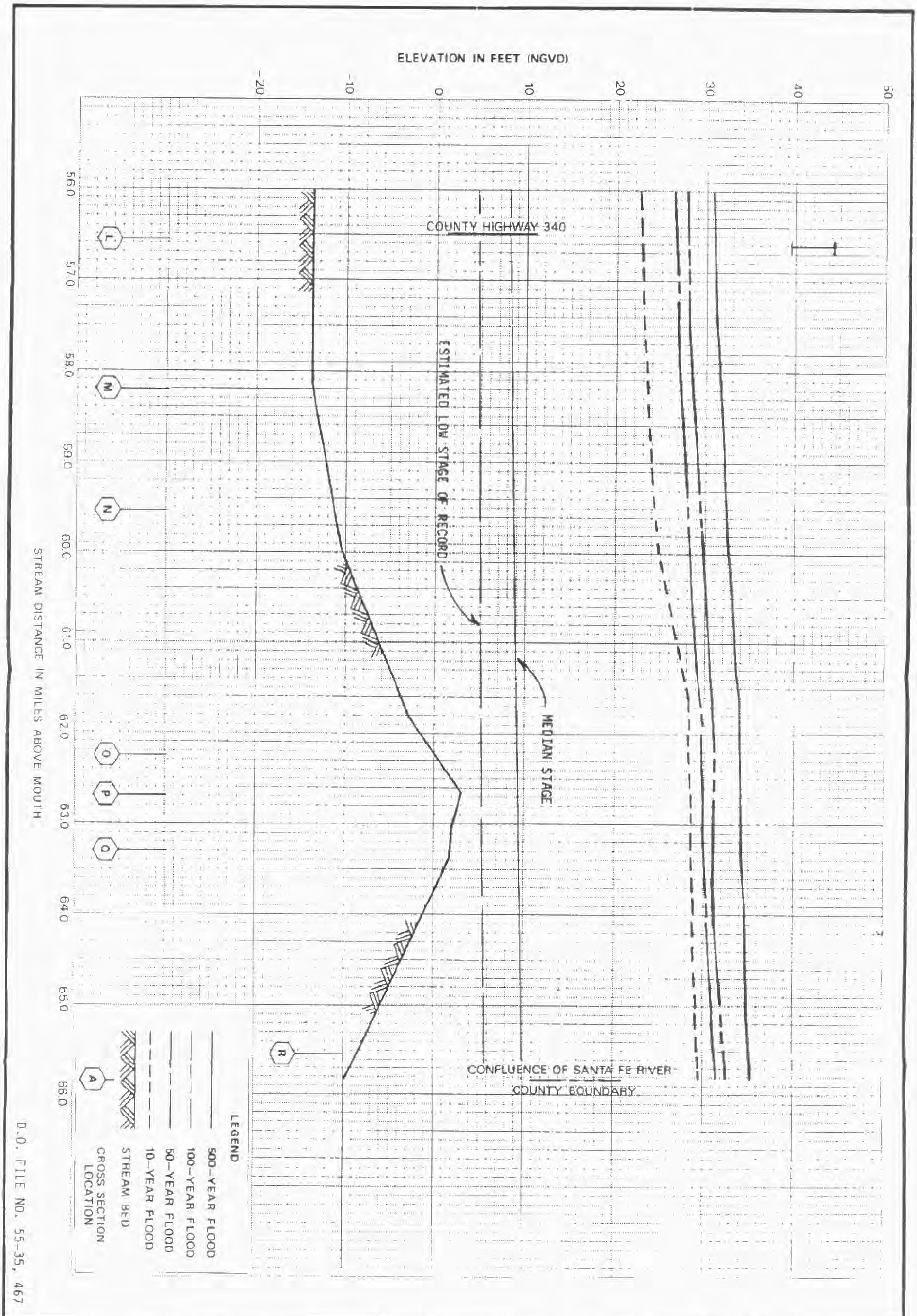
SUWANNEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

GILCHRIST COUNTY, FL AND INCORPORATED AREAS

D.O. FILE NO. 55-35, 467

02P



FEDERAL EMERGENCY MANAGEMENT AGENCY

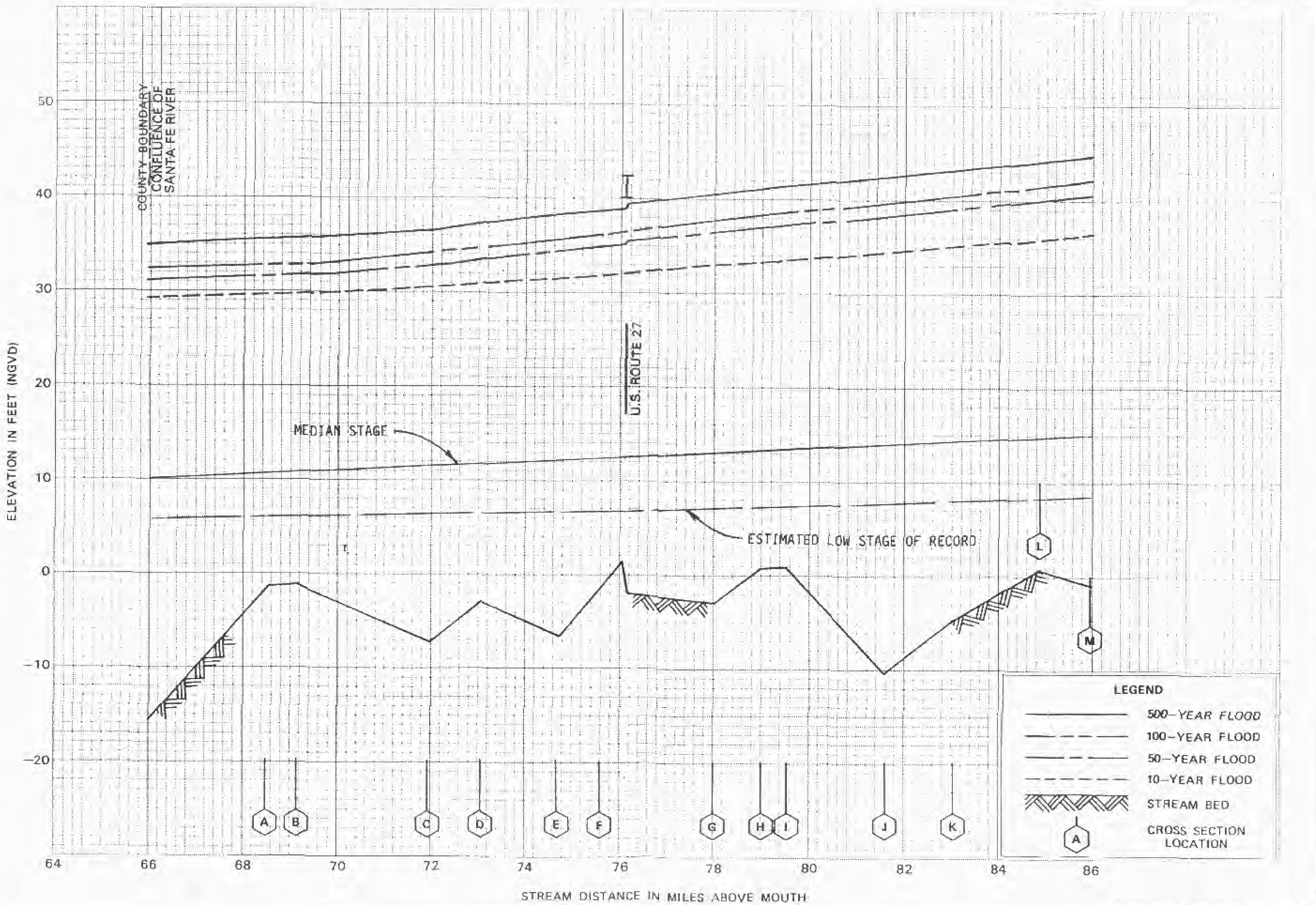
GILCHRIST COUNTY, FL AND INCORPORATED AREAS

FLOOD PROFILES

SUWANNEE RIVER

03P

PLATE 9



D.O. FILE NO. 55-35, 467

FLOOD PROFILES

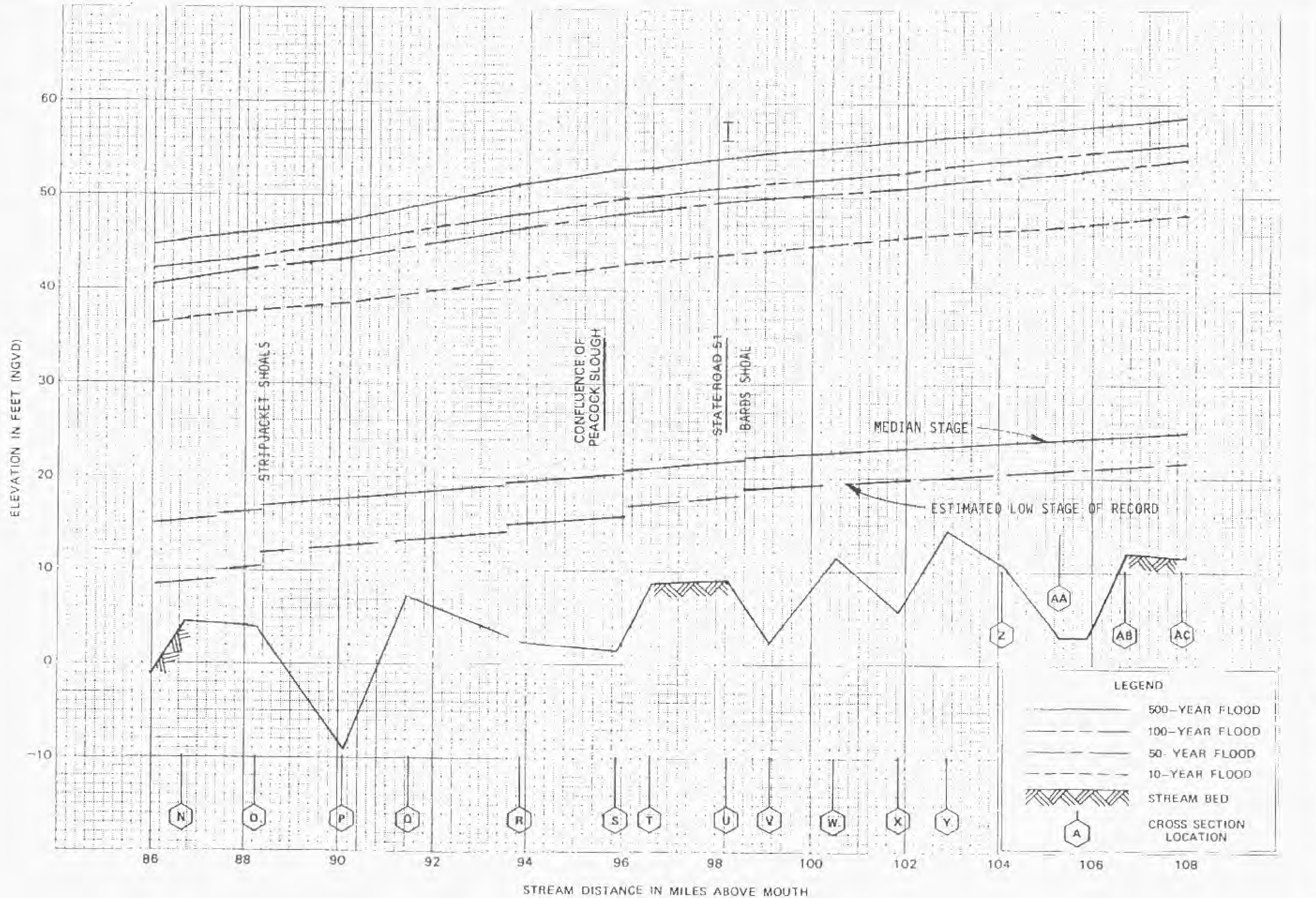
SUWANNEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SUWANNEE COUNTY, FL

(UNINCORPORATED AREAS)

01P



D.O. FILE NO. 55-35, 467

FLOOD PROFILES

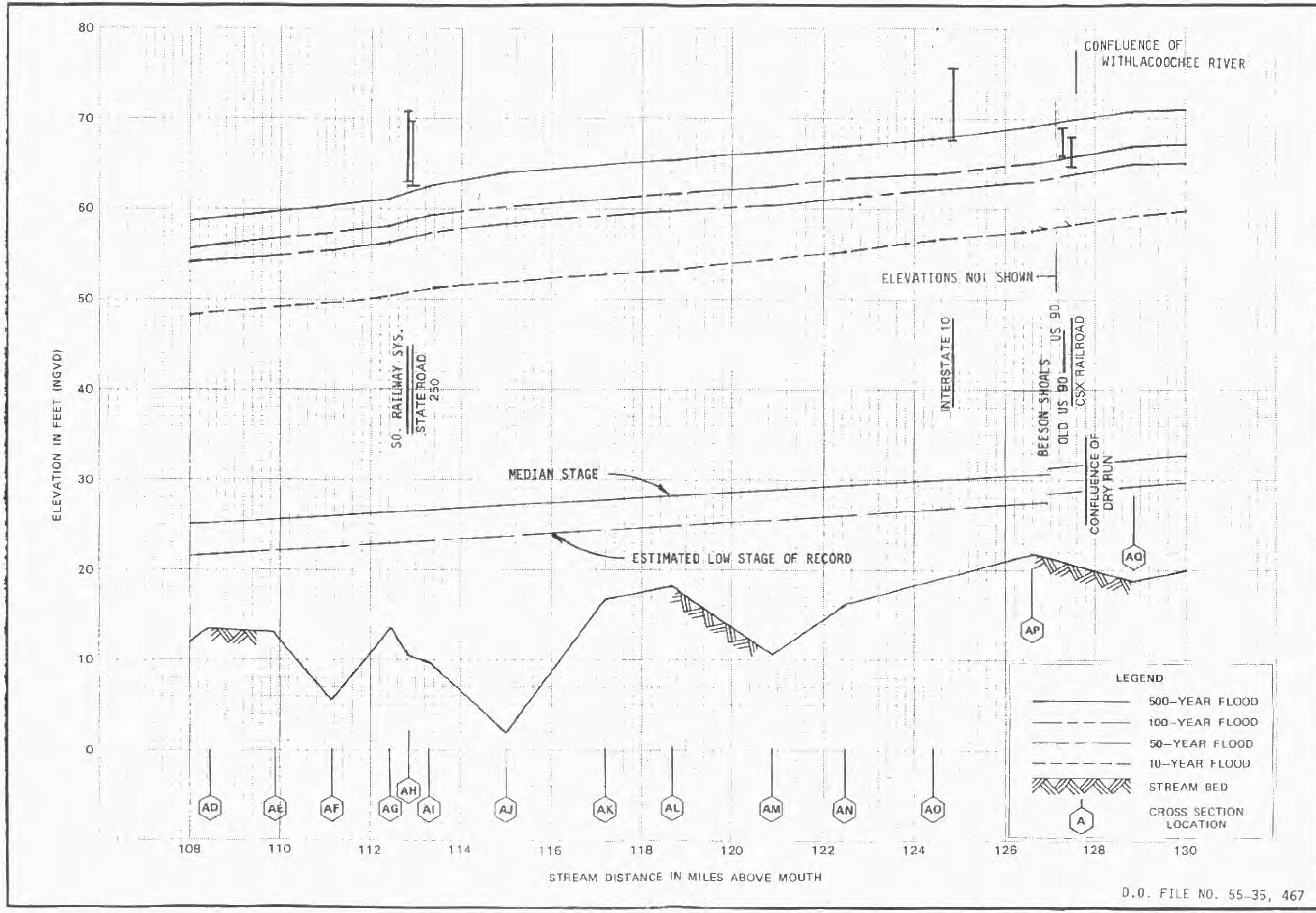
SUWANNEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SUWANNEE COUNTY, FL

(UNINCORPORATED AREAS)

02P



FLOOD PROFILES

SUWANNEE RIVER

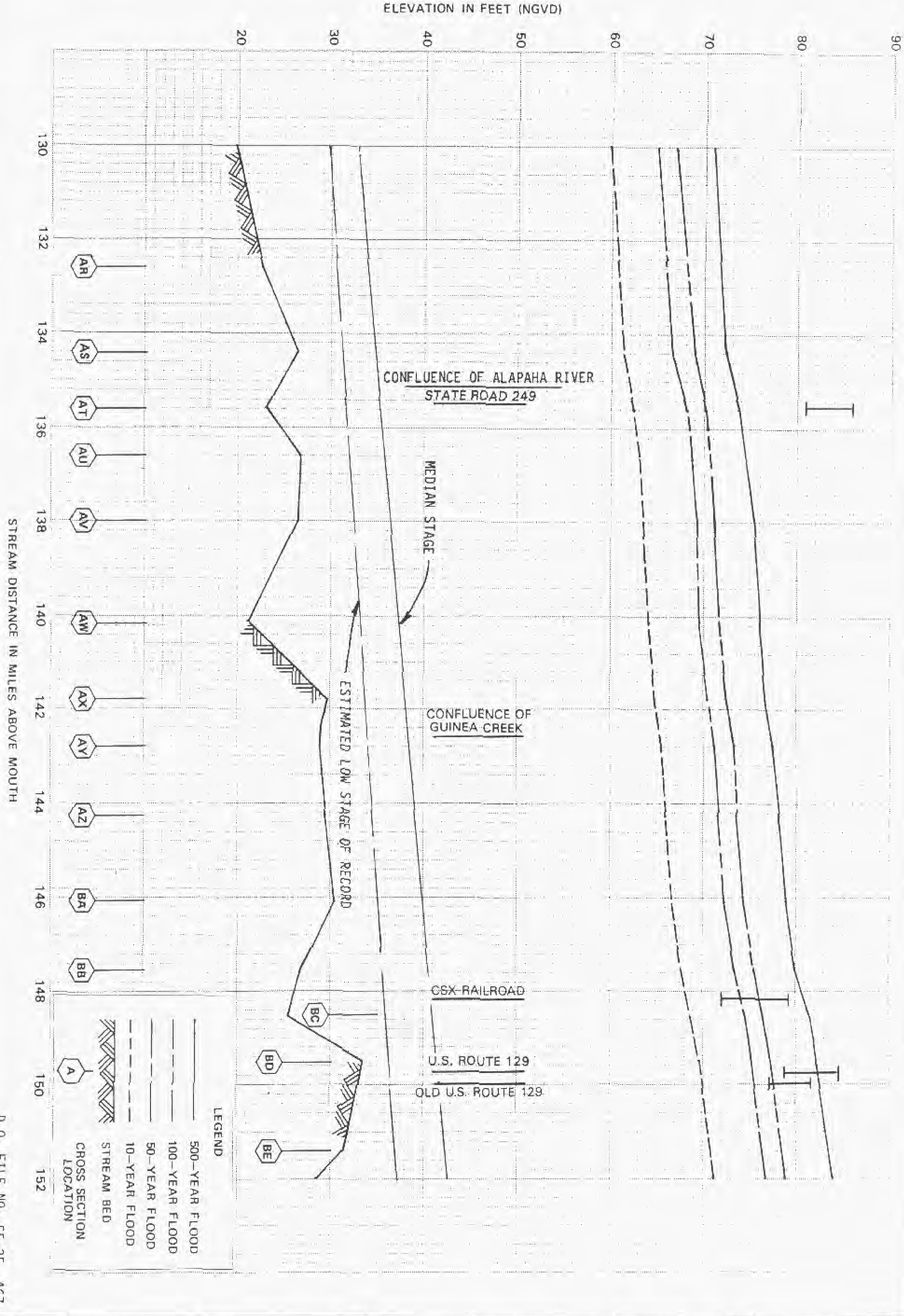
FEDERAL EMERGENCY MANAGEMENT AGENCY

SUWANNEE COUNTY, FL

(UNINCORPORATED AREAS)

03P

PLATE 12



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FEDERAL EMERGENCY MANAGEMENT AGENCY

SUWANNEE COUNTY, FL

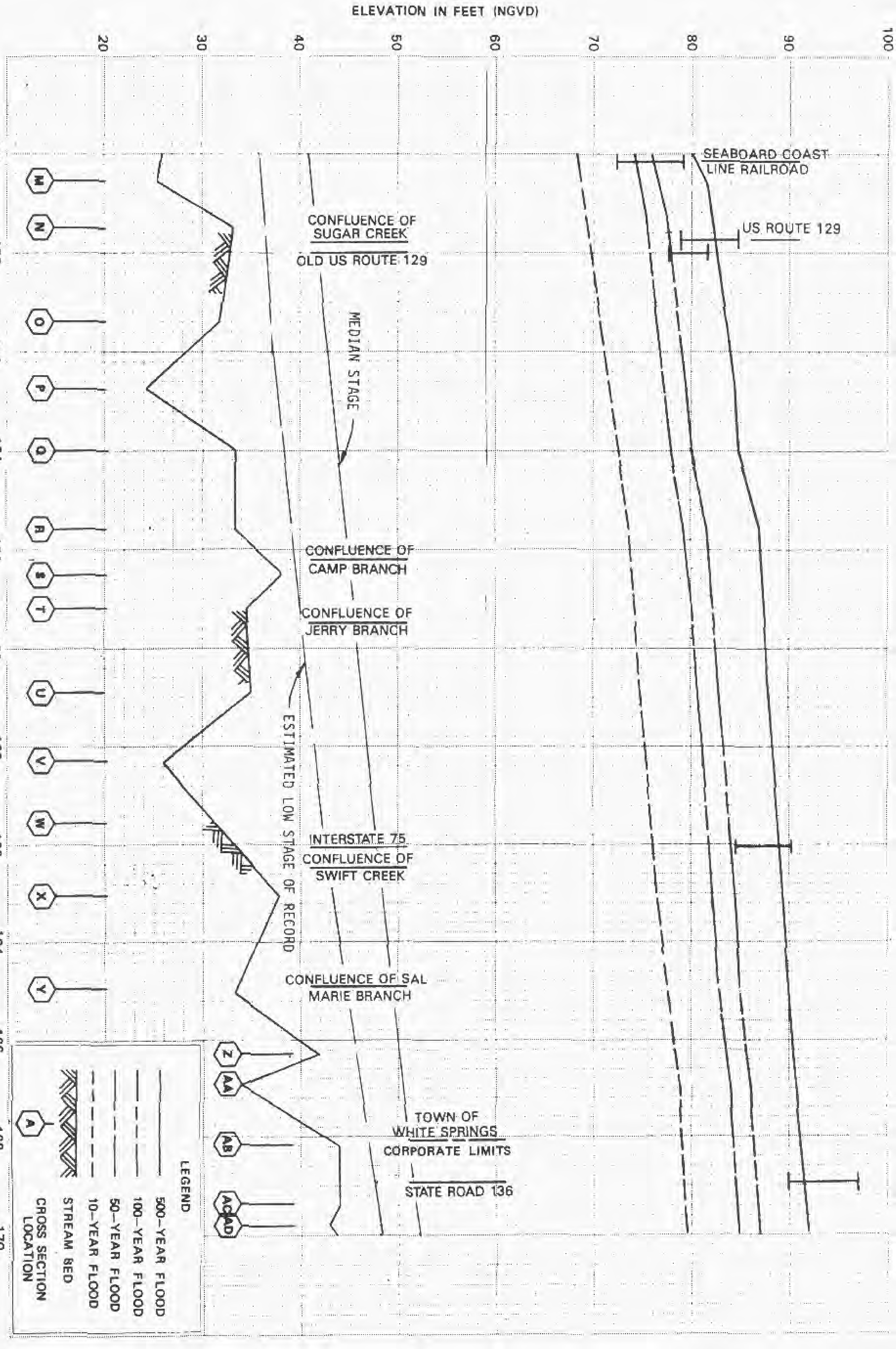
(UNINCORPORATED AREAS)

FLOOD PROFILES

SUWANNEE RIVER

04P

PLATE 13



D.O. FILE NO. 55-35, 467

FEDERAL EMERGENCY MANAGEMENT AGENCY

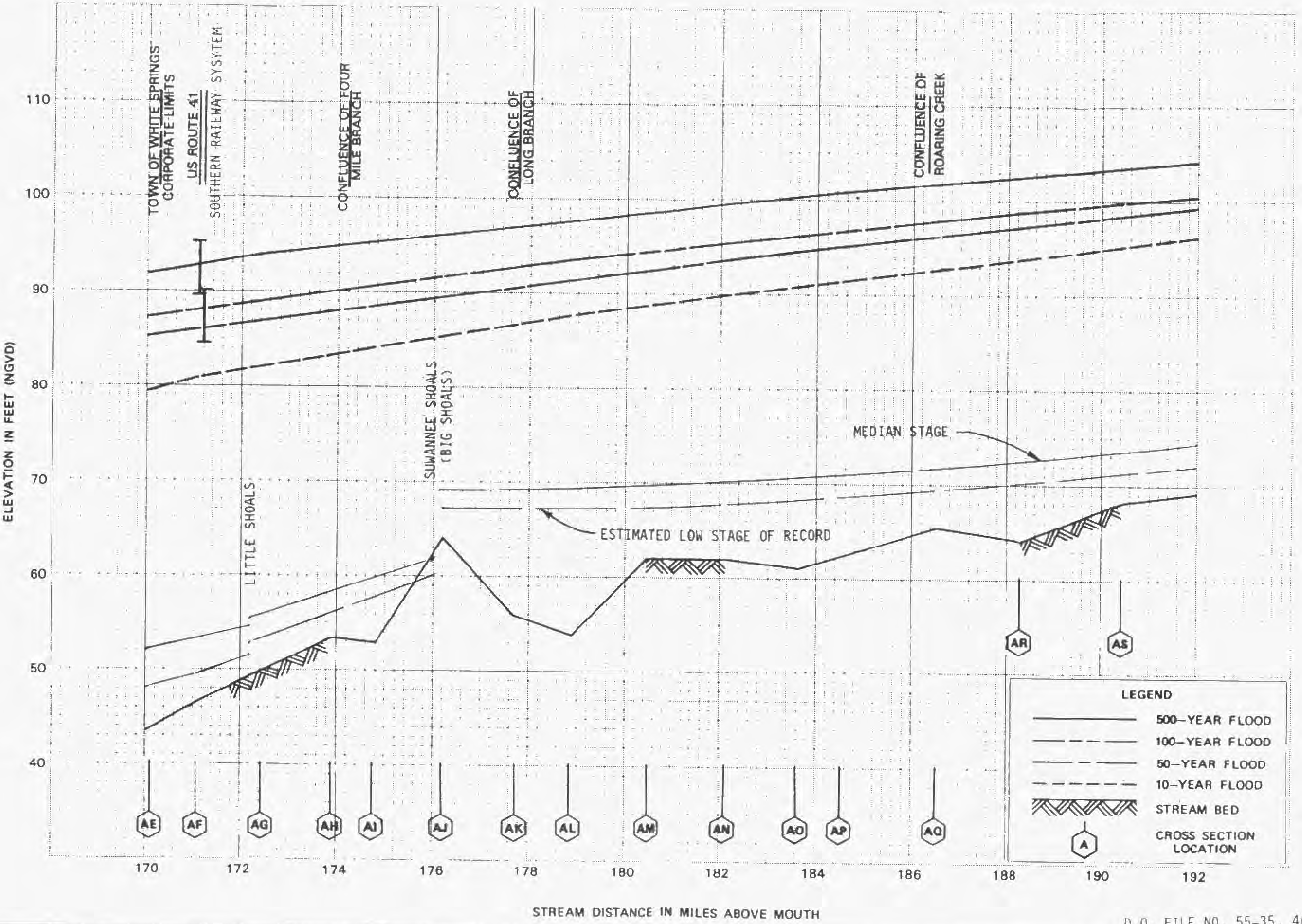
HAMILTON COUNTY, FL AND INCORPORATED AREAS

FLOOD PROFILES

SUWANNEE RIVER

02P

PLATE 14



D.O. FILE NO. 55-35, 467

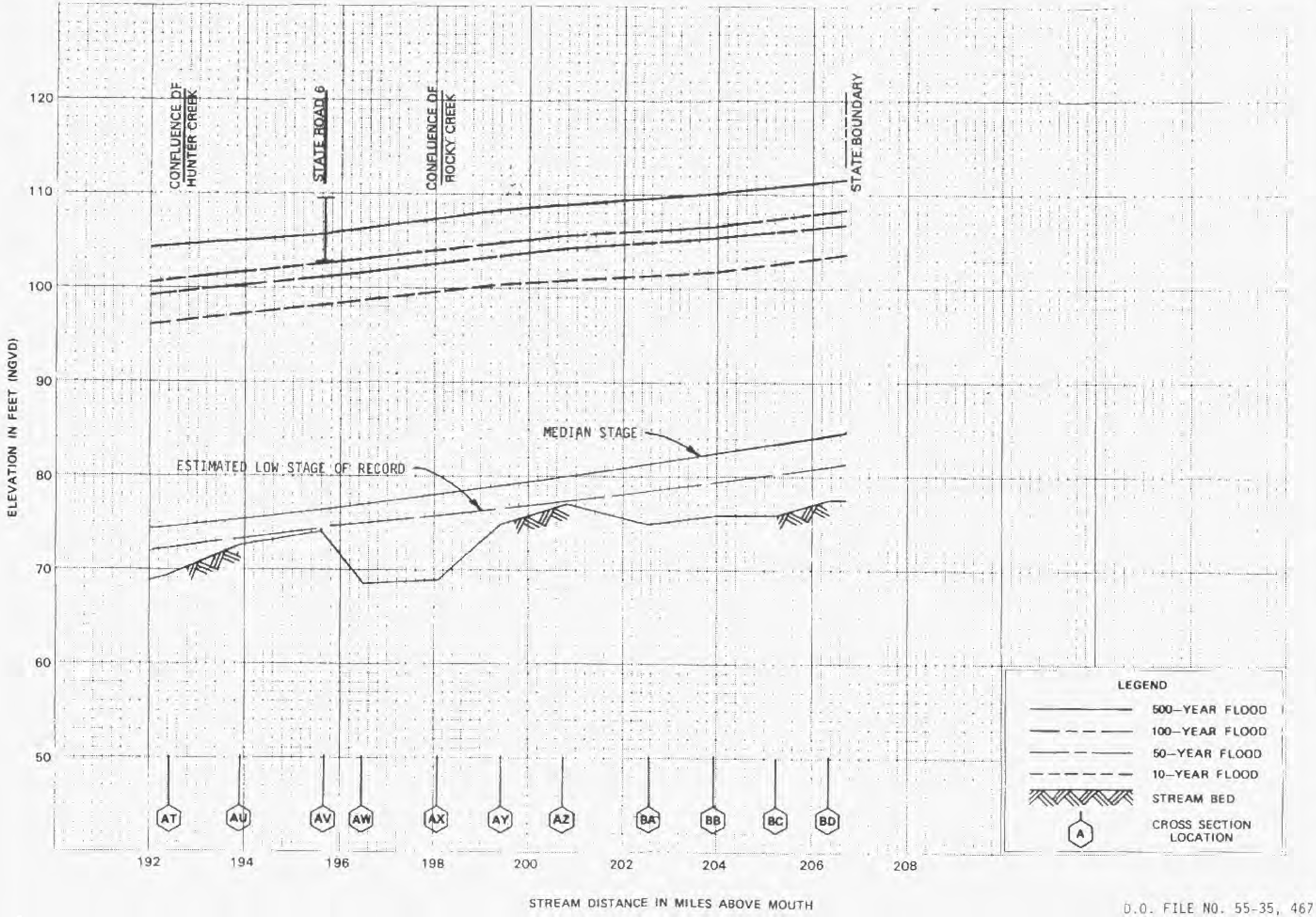
FLOOD PROFILES

SUWANNEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, FL AND INCORPORATED AREAS

03P



D.O. FILE NO. 55-35, 467

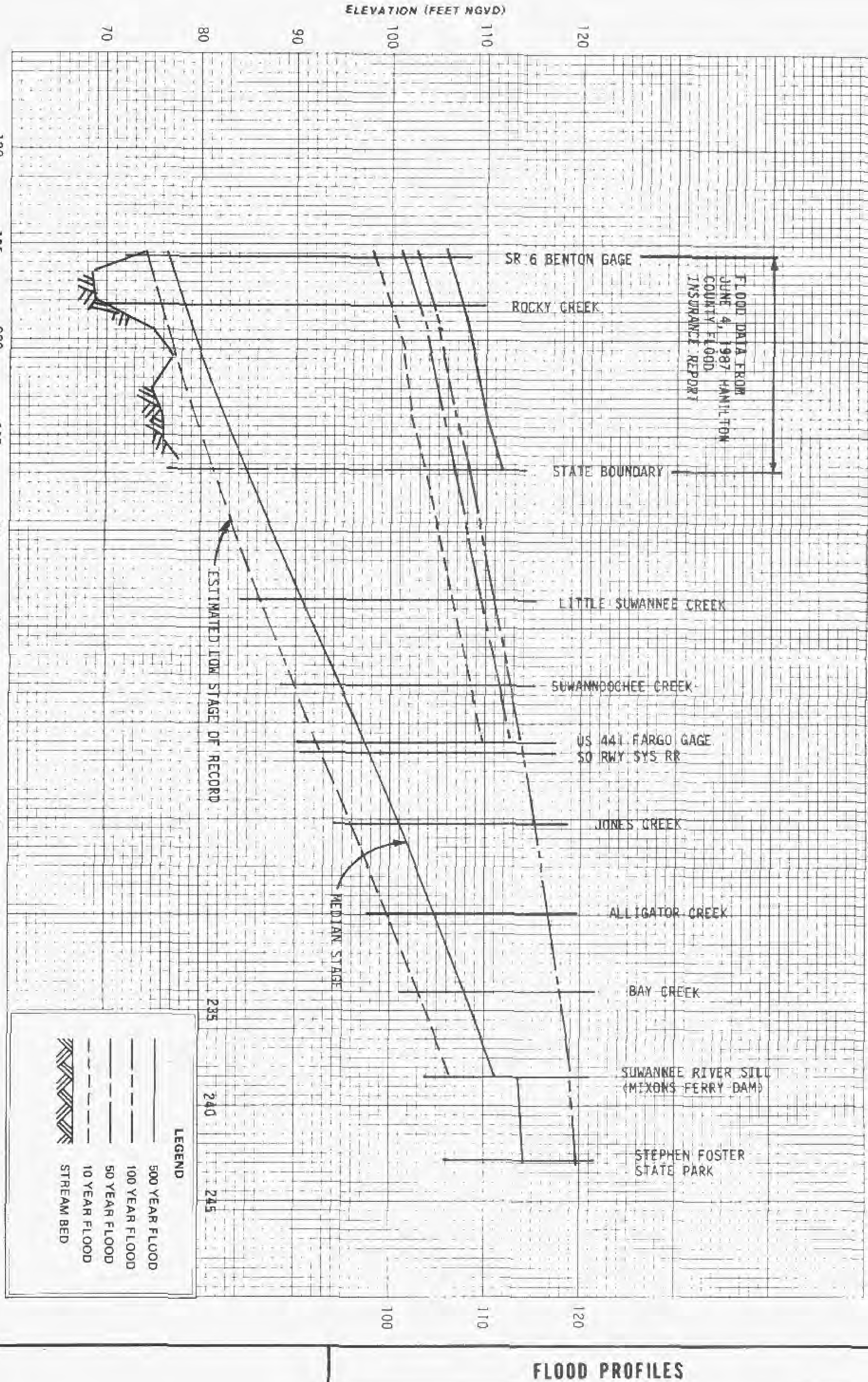
FLOOD PROFILES

SUWANNEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, FL AND INCORPORATED AREAS

04P

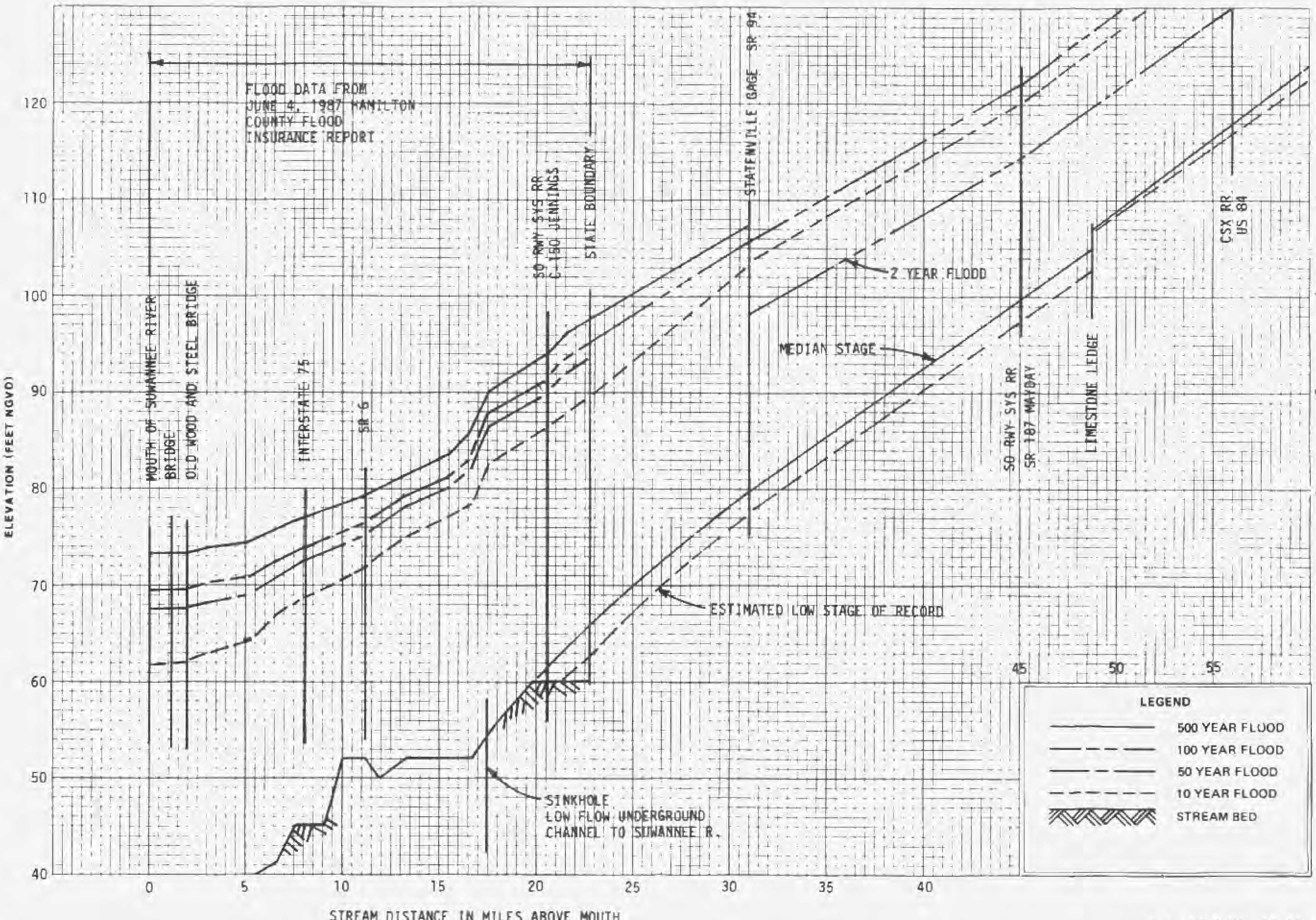


D.O. FILE NO. 55-35, 467

FLOOD PROFILES

SUWANNEE RIVER

PLATE 17



FLOOD PROFILES

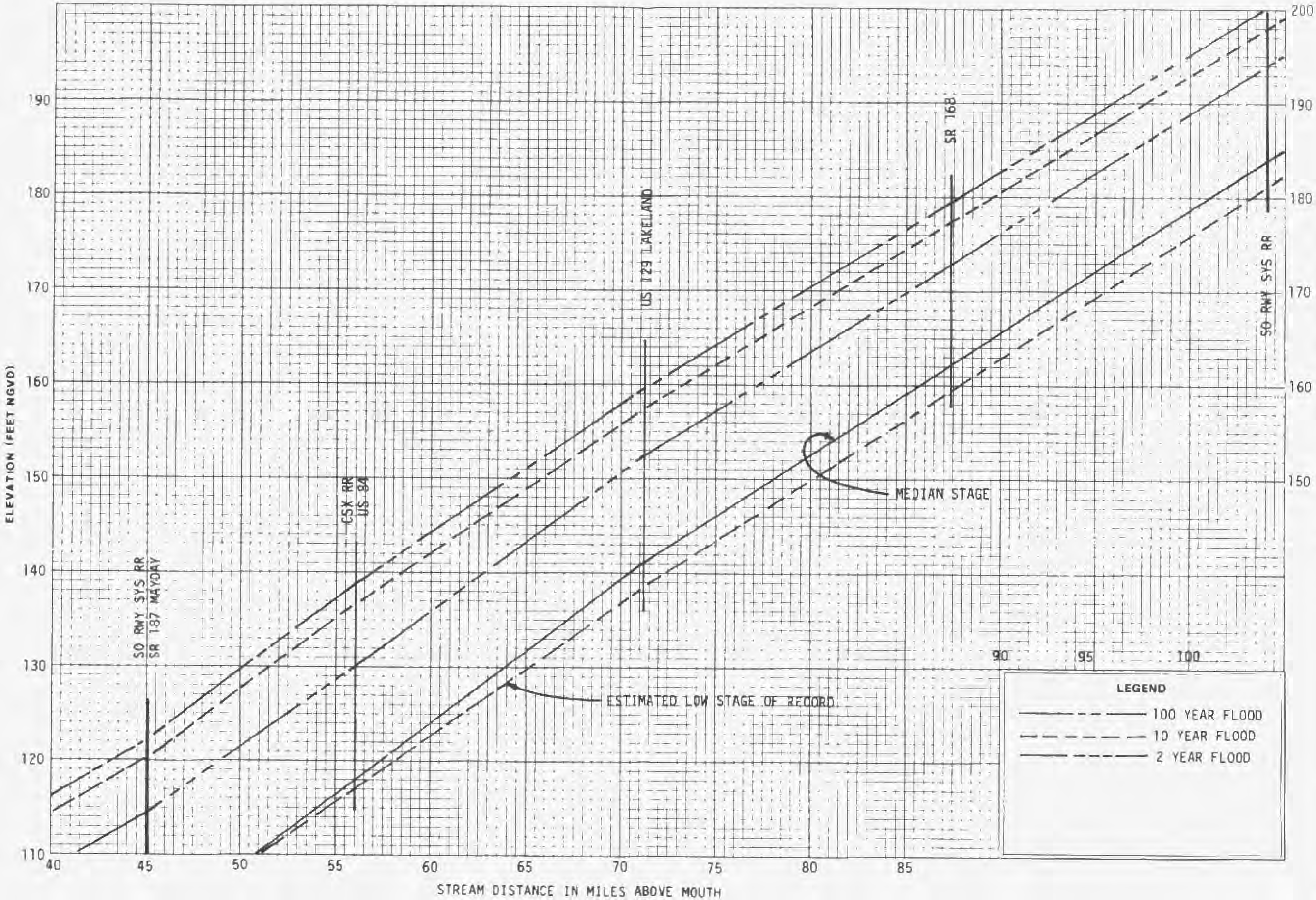
ALAPAHA RIVER

D.O. FILE NO. 55-35, 467

PLATE 18

ALAPAHA RIVER

FLOOD PROFILES



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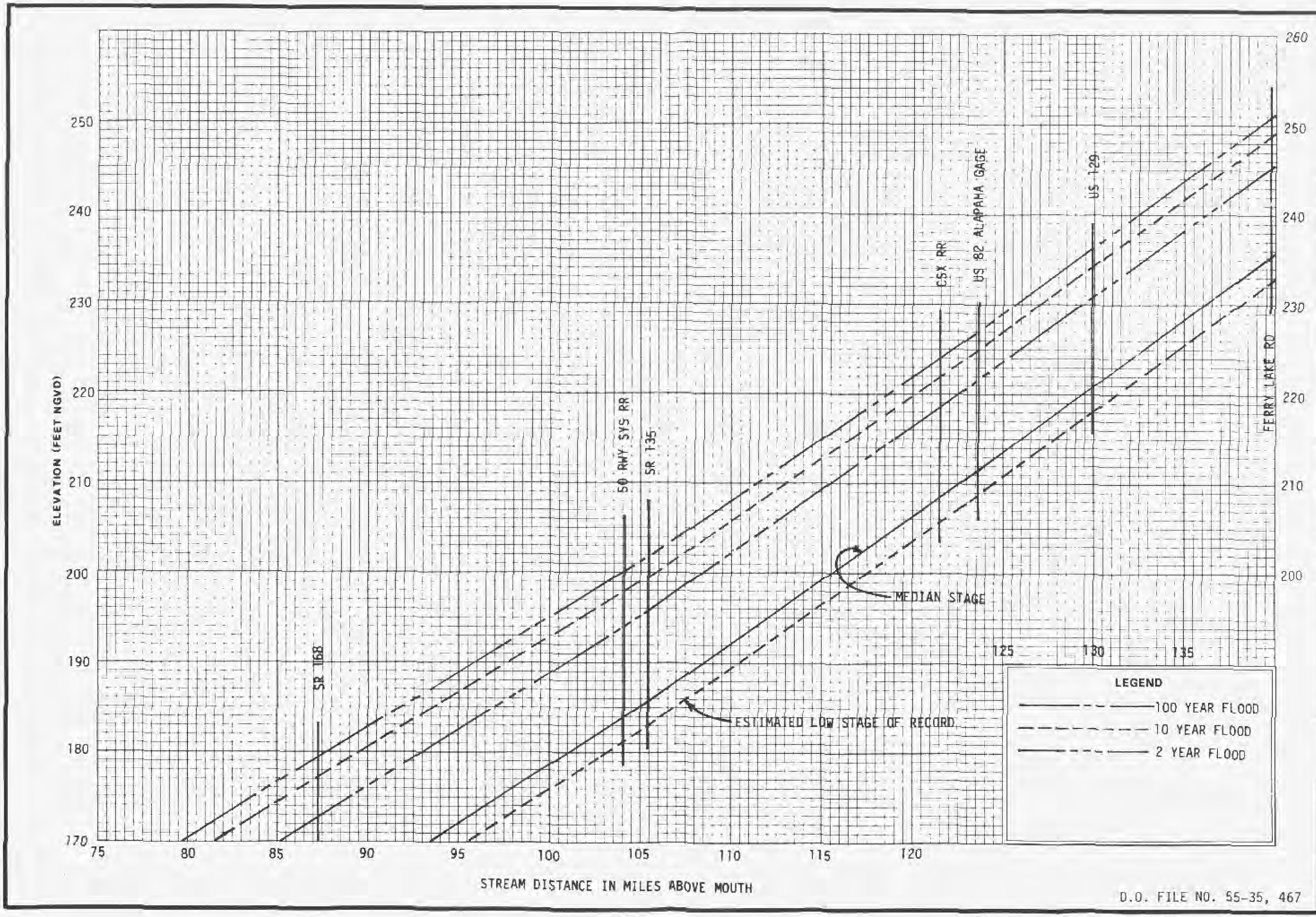


FLOOD PROFILES

ALAPAHA RIVER

APPENDIX

A

HYDROLOGY AND HYDRAULICS

APPENDIX A

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Appendix A

Hydrology and Hydraulics

1. General Basin Hydrology. The hydrology of the Suwannee River contains a rare interaction between surface water runoff and ground water storage as the river traverses the karst Florida portion of the basin. Limestone is at or near the ground surface over an area of 3,500 square miles extending northward from the lower 20 miles of the Santa Fe River to about the Florida-Georgia border on the Withlacoochee and Alapaha Rivers and to above White Springs on the Suwannee River. Normally, the river contains a typical amount of silt, sediment, and tannic acid color. However, during the dry summer months, surface water runoff diminishes and the river stage begins to fall. As the river recedes, the surcharge on the porous surficial aquifer adjacent to and under the river decreases and spring flow increases. The river water now begins to take on the crystal appearance associated with Florida springs. The interaction of river water and ground water is just the opposite at high stages. During floods, the surcharge on the springs causes flow to reverse. In addition, flood waters run out into the several miles wide floodplain and disappears into the porous underground aquifer through thousands of sink hole openings. Eventually, long after the flood has passed, much of the water will return to the river in the form of seepage and spring flow. This phenomenom has a tremendous effect on the hydraulics of the river. In almost all other rivers the peak flow rates increase downstream. However, in the Suwannee River basin, flow rates on the Withlacoochee, Alapaha, and Suwannee Rivers are about at their peak when they reach the surficial limerock outcroppings near the Florida-Georgia line. On the Suwannee it is a little above White Springs. Downstream, peak flow rates are less. In the case of most floods the volume is also less. This loss of flood water to the limestone aquifer beneath the river is difficult to estimate. The loss rate depends upon the ground water levels prior to the flood, the rate of rise of the flood, the peak stage, and the duration of the flood. Comparing the flows at Ellaville with the volume of flow at Branford, 50 miles downstream, gives some indication of the magnitude of this phenomenom. During the flood of 1973, when most of the rainfall was on the main stem Suwannee River area, and most of the flow was out of the Okefenokee and down the Suwannee, the difference between the flow at Ellaville and Branford was small. For the huge 1948 flood that came mostly from Georgia, gage records show that during the peak 2 months of the flood, 10 percent of the flow was lost. That represents a volume of 550,000 ac.-ft. which would fill a mile-wide corridor extending from Ellaville 50 miles to Branford to a depth of over 17 feet. Whether all this water was actually lost to the aquifer or permanently ponded in the floodplain or simply an error in the gaged data, is not known. Whatever the case, it makes flood routing on the Suwannee River with any of the standard methods extremely difficult. Figures A-1 and A-2 provide some insight into the attenuation of upstream tributary flow downstream to the Ellaville, Florida, gage.

2. Discharge Frequency Analyses. Tables A-1 through A-4 list the annual peak flood discharges at various locations in the Suwannee River basin. Gaging records recorded by the U.S. Geological Survey were the basis for the lists of data. However, some of the data was obtained by correlation analyses with other gages. In addition, previous estimates of the peak flows during the 1928 flood at Branford and Bell were adjusted. The extended data provides a more complete list of estimated annual peak flows. Except where noted, the flood events listed occurred in the water year listed. Note that the list selects a separate flood for each year and may not list the actual highest stage or discharge for every year. An annual peak stage or discharge occuring on the first or last day of the year could be caused by a flood which occurred primarily and peaked in an adjacent year. The data shown on tables A-1 through A-4 were used to compute peak discharges for floods of 2-year, 10-year, 50-year, 100-year, and 500-year frequencies for various locations in the Suwannee River basin. The computations were performed in accordance with the Hydrology Subcommittee's bulletin 17B, which describe the Federal guidelines for determining flood flow frequency analyses. In addition to this data, regional skew, historic floods, and base flows were considered. The results of the frequency analyses are shown in table A-5. Discharge frequency relations for sites where no historical flow records exist were obtained by engineering analyses and interpolations of drainage areas and river miles.

3. Suwannee River Sill. This 4.5-mile-long low earthen dam is on the border of Charlton and Ware Counties about 17 miles upstream of Fargo, Georgia. Also known as Mixons Ferry Dam, it regulates water levels in part of the Okefenokee National Wildlife Refuge. The structure was built after the severe droughts and fires in the middle 1950's. There are two spillway structures. The main one is at the Suwannee River channel and the other is a mile north. They were originally constructed as multi-bay stoplog structures with a bridge and bridge railings. During the April 1973 flood, the dam was apparently overtopped. An aerial photograph purported to be of the sill structure during the flood showed only the railings above water, with no evidence of significant head loss or severe erosive velocities. The dam embankment apparently suffered only minor damage. About July 1977, the main structure had a partial failure with some settlement apparently due to undermining. The structure was repaired and modified with the addition of taintor gates at four of the bays. The structure normally holds several feet of head. Although operation of the modified structure can affect ordinary flows downstream to Fargo, etc., it would probably have little effect on major flood conditions downstream. During severe flood conditions, tailwater elevations would likely be so high that even an embankment failure would probably have little downstream effect except in the immediate area.

4. Experimental Dam at Suwannee Springs. The 1961 Florida State Legislature authorized and funded the construction of a lowhead sheet pile dam with flashboards on the Suwannee River at Suwannee Springs. Its purpose was to determine if low water navigation by small boats could be improved in the upstream reach. The structure was built in December 1962 through January 1963. In February 1963, high water eroded the north abutment. Some

repairs were attempted, but erosion from high flows was a continuing problem. It was concluded that heads to improve navigation depths probably could be held. Some data was collected. Portions of the structure were reportedly removed about 1978 and the remnants were removed in the 1980's.

5. Live Oak, Florida, Drainage Areas. Due to the karst topography in Live Oak, local drainage areas tend to be small, independent, and closed, *especially for smaller rainfalls. As storm magnitudes increase, some areas* spill over into other areas. Some areas may combine with the same flood elevation. Table A-6 lists the individual areas defined for this study. The sub-areas are shown on plate 5 of the main report. There is a tendency for sinkhole formation in the area. The Florida Department of Natural Resources, Bureau of Geology Map Series No. 110, "Sinkhole Type, Development, and Distribution in Florida" provides information on the subject.

6. Hurricane Dora Floodmarks. During the course of the study, a number of interviews were conducted with local residents, public officials, and agencies to determine flood elevations for the September 1964 hurricane. This was greatly facilitated by the building floor elevation survey and contour mapping of Live Oak. On the basis of those investigations, the following peak flood elevations were estimated for that flood:

Drainage Area Number	General Street Location	September Peak Elevation Feet, NGVD
30	Ohio and Fir	94.0
12	Howard and Pine	100.36
5, 8-9, 13	Scriven and Ninth	101. *
17, 18	Helvenston and Weller	99.2
21, 26	Howard and Railroad	105.61
15-20, 20A	Ohio and Marymac	97.16
78A	Lake, South of Duval	105.61
78B	Lee, North of Duval	106.87

* Estimated from several conflicting reported floodmarks.

Since 1964, changes have occurred that would slightly change some peak elevations if that flood were to recur. Some drainage wells have been installed and some have become inoperative. Since the 1964 Dora flood event, about 25 flood storage areas have been either newly built or enlarged up through the year 1988. Additional paving and construction have occurred. Although the effect of these changes could be significant for smaller floods, the effect on a flood of the magnitude of Dora would generally not be great. Estimates of peak flood elevations in various areas due to a recurrence of the hurricane Dora flood on present conditions can be found on table A-18 under the 250-year recurrence interval.

7. Hurricane Dora Rainfall. The rain storm and flood of record for Live Oak, Florida, occurred in September 1964. The U.S. Weather Service published daily rainfall for the station Live Oak 2 ESE which is located in the southeastern portion of Live Oak at radio station WNER. The gage measurement is reportedly taken at 6:00 p.m. so the daily amount reported is actually for the period 6:00 p.m. to 6:00 p.m. Following are the published daily amounts for that storm, totaling 18.62 inches.

Tuesday	September 8, 1964	0
Wednesday	September 9, 1964	Trace
Thursday	September 10, 1964	2.37 inches
Friday	September 11, 1964	3.15 inches
Saturday	September 12, 1964	12.95 inches
Sunday	September 13, 1964	.15 inches
Monday	September 14, 1964	0
Tuesday	September 15, 1964	0

No hourly records are available. Interviews with local residents indicate that the most intense period of the September 12th rainfall occurred between about 2:30 a.m. and 5:00 a.m.

8. Drainage Wells. Well use for storm runoff in Live Oak dates back to before 1900. Plate 4 shows the location of most existing wells. Tables A-7 and A-8 list available information assembled for those wells and a few abandoned or poorly operating wells. For analytical purposes, it was necessary to document the changes in well use from the September 1964 flood of record and the present. That information is shown in tables A-9 and A-10.

9. Flood Storage Pits. Over the years, flood storage areas have been dug in Live Oak to increase the flood protection provided by natural low storage areas. Table A-11 lists some of this work, based on the recollections of the Live Oak Department of Public Works.

10. Drainage Well Flow Tests. Apparently, no actual flow measurements of Live Oak drainage well flows had ever been made. Estimates of well flows were calculated in 1966 (Smith and Gillespie Engineers, Incorporated) by calculating the volume and time of flood stage recession in drainage well pits. The conclusion was made that the average drainage well had a capacity of 1,000 gallons per minute. The well capacities calculated did not show any direct relationship to the diameter or depth of the wells.

With the cooperation and help of the City of Live Oak Public Works Department and the Suwannee River Water Management District, flow tests were conducted by the Jacksonville District on the following wells:

Well Number	Diameter	Date
33	8-inch	August 25, 1987
45	8-inch	September 2, 1987
11	10-inch	February 4, 1988

An 8-inch, tractor-pulled portable pump was used to pump water from a nearby pond into a manhole surrounding the well. Flows were measured with an ultrasonic flowmeter (Model DHT-P, Polysonic, Hydra, Houston, Texas). Sonic transducers are placed on the outside of the pipe leading to the well manhole. Flow velocity is measured through the Doppler Effect from sound waves reflected off particles in the flowing water. The water stage or head above the well pipe inlet was also measured for each flow reading.

Initial flow into a vertical drainage well is weir flow over the end of the pipe circumference. When the depth of the flow, or head, is about equal to the pipe diameter, the flow control switches over to orifice control, based on the end opening of the well pipe, if there is no restriction of flow by the receiving aquifer. In the case of the two 8-inch wells, the flow control quickly switched over to aquifer control. When that happens, the actual head on the aquifer can be 30 or 40 feet or more. Antecedent aquifer water levels can vary significantly and levels could rise significantly during floods. There are indications that during the 1964 flood of record, one or more wells may have supplied flood water for a time during the flood. That most likely would have occurred in sub-area 30 as its wellheads are the lowest in elevation.

Well 33 has a projecting pipe inlet. See figure A-3. Selected pump test data are shown on figure A-4 and an inflow rating curve is shown on figure A-5.

Well 45 was tested with a temporary manhole box around the well. The well inlet projects slightly above a small concrete base. A rating curve from test results is shown on figure A-6.

Tests of the 10-inch well were more inconclusive as the pump and 300 feet transmission line could not deliver enough water to reach the well capacity. Only about a 7-inch head could be developed, even though readings of over 1,000 g.p.m. were observed. Velocity readings may have been affected, as the pump was not adequately submerged and may have entrained air. Total pumping time on Well 11 was about 45 minutes (interrupted). During the Well 11 pumping, observations were made of the water level in Well 33 across Lake Mary about 280 feet away. The Well 33 level rose 2 or 3 inches from a level of 49 feet, 6 inches, below the manhole top (elevation 95.26 feet). The relationship of Wells 33 and 11 is shown on figure A-7. Shortly after the pumping at Well 11, it "spouted" water about 20 or 30 feet into the air. During initial weir flow over the end of a well pipe, before a drainage well becomes submerged, considerable air can be entrained into the flow and compressed into aquifer cavities under a head equal to the casing length when submerged. When flow and head are reduced at the well, or when other aquifer inflow occurs, compressed air can move back into the well casing. The rising and rapidly expanding air can blow a portion of the water column out of the well.

Based on the pump tests and all other available information, a set of generalized rating curves was developed for use in the flood analysis. The curves were extended upward with a straight line, based on the Darcy equation. It should not be expected that any one actual well would rate according to these curves, which are shown on figure A-8. The general well design, construction, and condition, in addition to its past history of sediment and trash intake, may have more bearing on its capacity than the well diameter.

11. Surface Storage Areas. Since storage capacity is an important flood parameter, surface land areas and volumes must be computed for any sub-area flood analysis. Tables A-12, A-13, and A-14 show the land surface areas that would be flooded for given flood elevations in most sub-areas. The assumed elevation of zero area and storage volume is also listed. Elevations, surface areas, and storage volumes for sub-areas 12 and 30 are shown in tables A-15 and A-16.

12. Live Oak Rainfall. Generalized estimates of rainfall frequency data for the Eastern United States are contained in U.S. Weather Service Technical Publication 40. Design rainfall in table A-17 was developed from point rainfall values contained in that report for the Live Oak, Florida, flood analysis. The hourly rainfall amounts are arranged in a design storm distribution.

13. Rainfall Losses. That portion of rainfall that does not runoff is called loss. Most losses result from infiltration, evaporation, and transpiration. However, in some basins, water storage and water use are also major factors. The U.S. Soil Conservation Service (SCS) has devised a method of estimating these losses based upon hydrologic soil classification, land use, and antecedent moisture conditions. Each type of soil is assigned a runoff classification of either (A), (B), (C), or (D) with classification (A) having the most losses (least runoff) and classification (D) having the least losses (most runoff). From previous SCS studies, each runoff soil group has been assigned a runoff curve value (0 to 100) representing approximately the percentage of water that will runoff from a given storm rainfall. If storm rainfall and peak flows or stages are known, curve numbers can be derived from observed data. Curve numbers used in the Live Oak analysis are shown on table A-6 for various drainage areas.

14. Flood Stages. An analysis of flooding in Live Oak was conducted as explained in paragraph 33.b of the main report. Table A-18 lists the estimated flood elevations that could occur for various frequency floods under existing conditions. Generally, the values for the 250-year flood, which is assumed to represent the September 1964 flood, are probably the most accurate as the procedure was calibrated to that flood. The Dora floodmark estimates in paragraph 6 only applied to a portion of the sub-areas analyzed. The curve numbers for most areas had to be estimated based on the curve numbers determined for sub-areas calibrated to the September 1964 flood.

TABLE A-1

ANNUAL PEAK FLOODS

	Suwannee R. at Wilcox, FL			Suwannee R. nr. Bell, FL			Suwannee R. at Branford, FL			Suwannee R. at Luraville, FL		
Drainage Area, Sq. Mi.	9,640			9,390			7,880			7,330		
River Mile	34			57			76			98		
Gage Datum Feet NGVD	0.00			3.60			4.81			16.49		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1927										29 Aug	5.8	6,090
1928		20.00	71,500 *	28 Aug	25.9	70,000(1)	28 Aug	32.0	65,000(2)	24 Aug	33.7	66,000
1929			31,000 *			30,700 *			27,000 *	15 Oct		27,000(3)
1930										7 Apr	21.6	25,900
1931	29 Feb	6.80	14,500			14,500 *			10,000 *	27 Jan	9.84	9,810
1932			12,500 *	1 Sep	9.8	12,600	30 Sep	16.66	14,800	29 Sep	13.80	14,800
1933			24,700 *	2 Mar	15.36	24,500	1 Mar	21.96	24,100	1 Mar	20.28	24,000
1934			14,700 *	21 Jun	11.30	14,800	20 Jun	12.76	8,350	17 Jun	6.67	6,560
1935			22,200 *	23 Sep	14.63	22,100	23 Sep	19.08	16,200	23 Sep	15.80	17,500
1936			16,200 *	1 Mar	12.10	16,200	29 Feb	17.39	14,200	1 Mar	13.10	13,900
1937			25,000 *	20 Apr	15.53	24,800	19 Apr	21.65	22,700	19 Apr	19.70	23,300
1938			7,930 *	14 Aug	11.98	8,130	12 Aug	15.01	5,450			
1939			13,500 *	15 Mar	10.28	13,600	14 Mar	14.48	13,300			
1940			11,600 *	29 Feb	8.88	11,700	29 Feb	12.08	8,900			
1941			8,900 *	1 Aug	7.14	9,110	1 Apr	8.86	5,790			
1942	28 Mar	12.96	29,200	28 Mar	17.28	30,000	28 Mar	23.70	24,900			
1943	18 Mar		8,000	17 Mar	6.37	8,270	16 Mar	9.200	6,730			
1944	13 Apr	10.96	22,300	12 Apr	15.26	24,000	10 Apr	21.42	21,700			
1945	2 Sep	11.40	24,300	30 Aug	15.98	25,300	30 Aug	22.44	22,500			
1946	19 Aug	9.27	18,600	18 Aug	13.59	18,800	13 Aug	17.77	14,700			
1947	1 May	8.96	17,900	28 Apr	13.33	18,100	28 Apr	18.20	16,500			
1948	14 Apr	22.32	84,700	13 Apr	27.43	82,300	11 Apr	34.07	83,900	Apr	37.0	83,600 *
1949	13 Sep	9.90	20,100	11 Sep	14.00	18,800	12 Apr	18.11	15,600			
1950	15 Sep		12,000	28 Oct	9.00	11,700(3)	6 Apr	9.41	6,900			
1951	28 Oct	6.40	12,400	12 Apr	9.56	11,300	11 Apr	12.19	9,480			
1952	11 Mar	8.43	16,700	11 Mar	12.25	15,900	9 Mar	16.40	13,700			
1953	13 Oct	9.87	20,000(3)	12 Oct	14.34	20,700(3)	10 Oct	18.96	16,700(3)			
1954	11 Jan		18,700	7 Jan		18,600	10 Jan		15,000			
1955	26 Apr	4.19	5,890	26 Apr	3.62	5,250	23 Sep	5.94	4,320			
1956	17 May	5.09	10,300	17 May	7.90	9,580	16 May	11.70	9,190			
1957	20 Jan	7.62	15,100			15,100 *	19 Jun	15.84	13,200			
1958	1 May	11.90	25,800			25,600 *	27 Apr	23.10	23,400			
1959	2 Apr	15.88	40,700			40,200 *	29 Mar	27.49	34,100			

TABLE A-1 - Continued

ANNUAL PEAK FLOODS

	Suwannee R. at Wilcox, FL			Suwannee R. nr. Bell, FL			Suwannee R. at Branford, FL			Suwannee R. at Luraville, FL		
Drainage Area, Sq. Mi.	9,640			9,390			7,880			7,330		
River Mile	34			57			76			98		
Gage Datum Feet NGVD	0.00			3.60			4.81			16.49		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1960	21 Apr	12.80	28,600			28,400*	19 Apr	24.45	25,400			
1961	3 May	10.35	21,300			21,200*	30 Apr	21.12	19,800			
1962	19 Apr	8.65	17,100			17,100*	16 Apr	18.98	16,800			
1963	12 Mar	7.39	14,700			14,700*	11 Mar	15.34	12,600			
1964	22 Sep	14.96	36,700			36,200*	16 Mar	25.36	28,700			
1965	19 Mar	14.09	32,500			32,100*	14 Mar	26.27	28,100			
1966	23 Mar	14.07	33,100			32,700*	20 Mar		29,100			
1967	25 Feb	9.88	20,200			20,100*	23 Feb		17,000			
1968	24 Mar		7,570			7,700*	23 Mar		3,560			
1969	30 Sep		11,700			11,800*	3 Apr		9,520			
1970	16 Apr	12.36	27,200			26,900*	14 Apr		24,300			
1971	10 Sep		15,100			15,100*	10 Sep		13,700			
1972	24 Feb		25,900			25,700*	20 Feb		22,500			
1973	21 Apr		55,100			54,200*	18 Apr		54,700			
1974	23 Sep		17,300			17,200*	21 Sep		12,500			
1975	1 May		27,500			27,200*	28 Apr		24,900			
1976	8 Jun		20,200			20,100*	5 Jun		17,800			
1977	21 Jan		25,300			25,100*	19 Jan		21,800			
1978	26 Mar		22,800			22,600*	24 Mar		18,600			
1979	11 Mar		18,800			18,700*	8 Mar		15,500			
1980	20 Apr		26,700			26,400*	17 Apr		23,300			
1981	7 Apr		11,300			11,400*	9 Apr		8,170			
1982	19 Apr		15,700			15,700*	26 Feb		10,200			
1983			31,300			30,900*			27,000			
1984			48,000			47,600*		28.89	42,200			
HISTORIC NOTE							The Flood of 1948 is reported to be the largest flood since 1862.					

NOTES: * Estimated
(1) Revised
(2) Daily Maximum
(3) For this flood event the year listed is the calendar year.

TABLE A-2

ANNUAL PEAK FLOODS

	Suwannee R. at Dowling Park, FL			Suwannee R. at Ellaville, FL			Suwannee R. at Suwannee Springs, FL			Suwannee R. at White Springs, FL		
Drainage Area, Sq. Mi.	7,190			6,970			2,630			2,430		
River Mile	113			127.5			150			170		
Gage Datum Feet NGVD				27.22			0.00			48.54		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1906										16 Jul	23.20	7,500
1907										24 Aug	11.40	3,220
1908										1 Jan	20.90	6,650
1927				28 Aug	6.0	5,900				27 Jul	9.8	2,610
1928				20 Aug	37.1	73,000				30 Apr	30.59	13,000
1929				12 Oct	26.9	34,000 (3)				1 Oct	33.90	20,600
1930				5 Apr		29,200				5 Oct	33.50	19,600
1931				25 Jan	10.70	9,730				24 Jan	15.00	4,280
1932				27 Sep	15.67	15,500				22 Sep	29.26	10,100
1933				25 Feb	24.02	26,400				17 Feb	28.97	10,200
1934				16 Jun	6.6	6,200				13 Aug	10.10	2,200
1935				18 Sep	18.35	18,200				22 Sep	21.07	6,330
1936				27 Feb	15.16	14,600				25 Feb	16.20	4,480
1937				17 Apr	23.66	25,200				17 Apr	29.54	11,100
1938				11 Aug		5,120				4 Oct	21.90	6,600
1939				12 Mar	15.10	14,500				23 Aug	19.01	5,640
1940				27 Feb	10.59	9,670				20 Feb	17.75	5,180
1941				29 Jul	6.24	5,710				27 Jul	13.52	3,550
1942				25 Mar	24.90	27,200				15 Jan	30.22	11,700
1943				13 Mar	7.43	6,790				3 Oct	7.54	866
1944				8 Apr	23.53	25,00				11 Aug	24.37	7,690
1945				28 Aug	24.26	26,200				25 Aug	33.20	16,500
1946				23 Mar	17.71	17,500				11 Aug	26.10	8,340
1947				26 Apr	17.57	17,500				29 Oct	35.47	23,700(3)
1948		60.1	90,630	7 Apr	40.88	95,300				5 Apr	36.65	28,500
1949				11 Sep	16.10	15,700				12 Sep	24.91	7,800
1950				7 Apr	6.8	6,480				8 Sep	11.20	2,740
1951				9 Apr	10.96	10,100				30 Oct	15.16	4,200
1952				7 Mar	14.76	14,300				5 Jan	19.34	5,780
1953				9 Oct	18.80	19,200 (3)				10 Sep		5,200
1954				1 Jan		15,400				8 Oct	28.36	10,100

TABLE A-2 - Continued

ANNUAL PEAK FLOODS

	Suwannee R. at Dowling Park, FL			Suwannee R. at Ellaville, FL			Suwannee R. at Suwannee Springs, FL			Suwannee R. at White Springs, FL		
Drainage Area, Sq. Mi.	7,190			6,970			2,630			2,430		
River Mile	113			127.5			150			170		
Gage Datum Feet NGVD				27.22			0.00			48.54		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1955				21 Sep	4.55	4,220				19 Sep	13.98	3,830
1956				14 May	11.80	11,700				11 May	8.17	1,760
1957				15 Jun	14.84	14,300				10 Jun	27.76	9,130
1958				24 Apr	25.29	27,700				11 Apr	26.29	8,420
1959				25 Mar	31.85	45,400				22 Mar	34.61	20,100
1960				15 Apr	27.80	31,700				19 Mar	22.07	6,810
1961				27 Apr	23.62	25,100				30 Apr	25.03	7,930
1962				13 Apr	20.41	21,100				10 Apr	28.65	9,850
1963				7 Mar	13.28	13,000				4 Mar	20.21	6,100
1964				11 May	29.67	33,800				17 Sep	35.82	23,300
1965				10 Mar	27.82	31,800				11 Mar	30.81	11,000
1966				17 Mar		33,400				20 Mar	30.79	12,600
1967				21 Feb		16,800(2)				21 Feb	22.19	6,900
1968				22 Mar		3,160				5 Jan	4.81	727
1969				30 Mar		11,200				27 Sep	16.42	4,940
1970				12 Apr		25,700				30 Aug	30.90	12,600
1971				8 Sep		14,100				6 Sep	24.92	8,610
1972				15 Feb		25,000				14 Feb	27.28	9,770
1973		58.9	67,900	13 Apr	37.75	77,100	12 Apr	78.91	30,100	10 Apr	40.02	38,100
1974				19 Sep		13,800	17 Sep	51.66	4,030	15 Sep	14.72	4,290
1975				23 Apr	26.83	29,100	26 Apr	65.57	10,300	24 Apr	28.77	10,800
1976				2 Jun	21.41	22,100	3 Jun	56.85	6,240	3 Jun	18.79	5,920
1977				14 Jan	22.47	23,400	20 Dec	63.77	10,100	20 Dec	28.47	10,600
1978				20 Mar	19.00	19,200	21 Mar	56.87	6,680	20 Mar	19.60	6,230
1979				6 Mar		18,600	17 May	50.68	4,160	17 May	14.73	4,280
1980				13 Apr		23,900	14 Mar		7,560	12 Mar	21.53	7,500
1981				6 Apr		8,040	12 Mar		3,860	7 Mar	13.00	4,000
1982				24 Feb		11,800			3,290	20 Mar		3,940
1983						27,300			9,810			9,570
1984		53.6	44,400	10 Apr	32.60	46,100	11 Apr	69.30	17,300	10 Apr	36.86	26,100

HISTORIC NOTES

Suwannee R. at Ellaville, FL: The flood of 1948 is reported to be the largest flood since 1862.

Suwannee R. at White Springs, FL: The flood of 1948 was reported to be the largest flood since 1862. (exceeded in 1973)

NOTES: (2) Daily Maximum
(3) For this flood event the year listed is the calendar year.

TABLE A-3

ANNUAL PEAK FLOODS

	Suwannee R. nr. Benton, FL			Suwannee R. at Fargo, GA.			Withlacoochee R. at Pinetta, FL			Alapaha R. nr. Jasper, FL		
Drainage Area, Sq. Mi.	2,090			1,260			2,120			1,720		
River Mile	196			221			22			11		
Gage Datum Feet NGVD	0.00			91.90			47.21			0.00		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1928				2 May	14.40	5,210	Aug	36.75	53,600			
1929				1 Oct	19.50	13,800	21 Mar		17,100 *			
1930				3 Oct	19.60	11,900	6 Oct		12,000 *			
1931				3 Oct	11.40	2,460	20 Aug		4,300 *			
1932	20 Feb	20.99	9,210			5,800 *	18 Jun	14.48	5,380			
1933	14 Feb	--	9,440			5,900 *	24 Feb	22.79	9,820			
1934						1,200 *	12 Jun	11.92	3,270			
1935						3,600 *	15 Sep	22.66	9,770			
1936						2,400 *	15 Feb	19.72	8,240			
1937						6,400 *	14 Apr	28.32	14,900			
1938				8 Oct	12.70	4,410	20 Nov	11.43	2,900			
1939				29 Aug	11.60	2,490	8 Mar	22.83	10,800			
1940				21 Feb	11.00	2,060	20 Feb	12.92	4,000			
1941				23 Sep	7.50	810	30 Mar	10.63	2,420			
1942				11 Jan	15.90	7,960	11 Jan	24.14	11,300			
1943				1 Oct	5.60	495	12 Mar	14.81	5,150			
1944				14 Aug	12.80	4,280	30 Mar	31.57	19,100			
1945				22 Aug	17.30	9,690	29 Jul	26.92	13,600			
1946				8 Aug	14.20	5,920	22 Mar	23.55	11,000			
1947				28 Oct	19.6	10,800(3)	24 Apr	22.82	10,300			
1948				5 Apr	17.3	9,300	5 Apr	38.64	79,400	6 Apr	76.19	24,600
1949				10 Sep	14.30	5,900	20 Apr	17.47	6,500			
1950				1 Oct	11.30	2,660	24 Mar	11.66	2,970			
1951				26 Oct	11.90	3,260	7 Apr	15.40	5,280			
1952				10 Nov	12.80	4,300	5 Mar	16.03	5,870			
1953				2 Sep	11.80	3,280	20 Apr	18.01	7,180			
1954				5 Oct	14.60	5,640	6 Oct	17.45	6,800			
1955				17 Sep	10.70	1,710	23 Apr	10.08	1,960			
1956				10 May	7.90	960	15 May	20.07	8,530			
1957				14 Jun	12.20	2,550	15 Jun	16.75	6,340			
1958				24 Apr	13.20	4,400	20 Apr	30.05	17,200			

TABLE A-3 - Continued

ANNUAL PEAK FLOODS

	Suwannee R. nr. Benton, FL			Suwannee R. at Fargo, GA.			Withlacoochee R. at Pinetta, FL			Alapaha R. nr. Jasper, FL		
Drainage Area, Sq. Mi.	2,090			1,260			2,120			1,720		
River Mile	196			221			22			11		
Gage Datum Feet NGVD	0.00			91.90			47.21			0.00		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1959				22 Mar	17.20	8,680	12 Mar	33.01	21,600			
1960				1 Aug	12.70	4,190	10 Apr	34.85	29,800			
1961				23 Apr	15.50	7,100	23 Apr	32.59	20,700			
1962				5 Apr	14.60	4,520	11 Apr	20.02	6,510			
1963				15 Mar	12.40	3,830	23 Mar	13.85	4,500			
1964				12 Sep	18.60	9,940	7 May	33.01	21,600			
1965				1 Oct	14.40	6,000	9 Dec	35.57	34,500			
1966				16 Mar	15.45	7,240	10 Mar	31.52	19,000	15 Mar	72.58	11,400
1967				17 Feb	12.49	3,540	14 Jan	19.69	8,330	5 Jan	68.20	6,460
1968				10 Sep	5.51	531	21 Mar	8.98	1,320			
1969				29 May	11.40	2,650	28 Mar	15.02	5,290	25 Sep	60.15	2,390
1970				18 Aug	15.42	5,870	4 Apr	22.25	9,880	14 Apr	69.58	7,700
1971				5 Sep	14.55	4,840	10 May	17.59	6,920	10 May	65.09	5,000
1972				26 Jan	14.36	5,910	13 Feb	25.53	12,400	17 Feb	68.55	6,730
1973	6 Apr		27,000	11 Apr	21.01	13,200	8 Apr	35.10	30,800	5 Apr	75.67	20,600
1974				19 Sep	11.20	2,480	18 Sep	18.68	7,610	17 Sep	66.07	5,040
1975				21 Apr		6,650	19 Apr	33.10	22,300			
1976	3 Jun		6,800	1 Jun		3,190	30 May	30.38	17,600			
1977	16 Dec		10,500	17 Dec		7,160	17 Mar	25.60	12,400			
1978	20 Mar		6,030	17 Mar		3,200	18 Mar	22.00	9,860			
1979				15 May		2,450	3 Mar	31.20	18,800			
1980	14 Mar		5,370	10 Apr		3,160	21 Mar		15,400			
1981	7 Mar		3,500	8 Mar		1,700	7 Apr		3,590			
1982			2,480	15 Apr		1,140			6,950			
1983			8,880	22 Mar		5,200	19 Mar		18,800			
1984				2 Apr		9,100	Mar	35.85	38,200			

NOTES: * Estimated

(3) For this flood event, the year listed is the calendar year. (For example: the 1947 Water Year is October 1, 1946, through September 30, 1947. The 10,800 cfs flood listed for Fargo, Georgia, occurred on October 28, 1947). See text par. A-2.

TABLE A-4

ANNUAL PEAK FLOODS

	Alapaha R. nr. Jennings, FL			Alapaha R. at Statenville, GA.			Santa Fe R. at Fort White, FL.		
Drainage Area, Sq. Mi.	1,680			1,400			1,017		
River Mile	20.5			31			11		
Gage Datum Feet NGVD	58.22			76.77			20.86		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1928	2 May		17,900	1 May	28.5	18,400	27 Aug	9.5	4,750
1929				22 Mar		14,200	9 Oct	8.4	4,530
1930				9 Oct		5,630	3 Oct	6.9	4,180
1931				19 May		3,370			
1932				30 Aug	11.6	2,740	20 Sep	1.96	1,740
1933				22 Feb	21.8	6,120	20 Apr	4.19	2,810
1934				4 Jun	10.8	2,420	20 Jun	11.04	11,400
1935				6 Sep	14.6	3,440	10 Sep	8.26	6,680
1936				19 Feb	18.5	4,900	14 Feb	2.50	2,140
1937				14 Apr	22.8	6,560	5 Sep	4.43	3,620
1938				30 Sep	6.4	1,130	7 Oct	6.00	4,730
1939				9 Mar	26.4	10,500	29 Oct	5.51	4,250
1940				28 Feb	11.7	2,630	28 Aug	2.16	2,000
1941				21 Mar	9.4	1,910	31 Jul	3.56	2,940
1942				23 Mar	22.3	6,370	26 Oct	8.14	7,410
1943				4 Apr	12.2	2,700	23 Aug	1.95	1,760
1944				27 Apr	26.8	11,100	13 Aug	4.17	3,330
1945				25 Aug	22.8	6,630	24 Oct	9.48	9,300
1946				30 Jan	17.2	4,160	6 Aug	4.79	3,820
1947				28 Apr	22.4	5,990	29 Sep	8.73	8,110
1948				6 Apr	29.8	27,300	14 Mar	13.70	12,300
1949				10 Dec		4,980	6 Sep	6.76	5,510
1950				5 Apr	8.7	1,740	11 Sep	8.00	7,350
1951				5 Apr	14.9	3,480	26 Oct	8.16	7,520
1952				13 Apr	14.5	3,360	4 Mar	2.29	2,020
1953				30 Sep	16.9	4,100	4 Sep		4,400
1954				9 Jan	16.6	4,010	31 Dec	5.85	5,080
1955				23 Apr	7.1	1,320	15 Feb	1.28	1,300
1956				8 May	19.7	4,450	18 Jul	1.17	1,050
1957				14 Jun	13.1	2,940	15 Jun	5.12	4,140
1958				22 Apr	25.2	7,950	15 Apr	3.80	2,450

TABLE A-4 - Continued

ANNUAL PEAK FLOODS

	Alapaha R. nr. Jennings, FL			Alapaha R. at Statenville, GA.			Santa Fe R. at Fort White, FL.		
Drainage Area, Sq. Mi.	1,680			1,400			1,017		
River Mile	20.5			31			11		
Gage Datum Feet NGVD	58.22			76.77			20.86		
Water Year	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS	Date	Gage Ht.-Ft.	Disch. CFS
1959				17 Mar	26.3	10,000	24 Mar	10.35	7,970
1960				11 Apr	27.8	15,000	23 Mar	7.52	6,290
1961				24 Apr	27.0	12,000	5 Sep	4.5	3,760
1962				11 Apr	15.9	3,790	11 Sep	1.68	1,280
1963				26 Feb	11.1	2,380	6 Mar	2.10	2,070
1964				9 Mar	26.4	10,200	16 Sep	15.34	17,000
1965				2 Mar	26.6	9,600	1 Jan	6.90	5,100
1966				14 Mar	27.1	12,300	6 Mar	7.87	5,850
1967				17 Jan	23.55	6,420	4 Oct	4.78	3,830
1968				20 Mar	5.86	1,000	5 Sep	7.24	6,540
1969				3 Sep	12.20	2,690	28 Mar	2.87	2,720
1970				13 Apr	25.10	7,800	3 Apr	9.29	7,980
1971				18 Mar	20.90	5,480			3,240
1972				15 Feb	22.96	6,190			4,470
1973				11 Apr	27.42	13,500			6,530
1974				11 Sep	18.63	4,670			2,840
1975				26 Apr		8,680			2,330
1976				2 Jun	23.60	6,440			2,270
1977	30 Nov	25.80	9,350	19 Mar		7,350			2,250
1978	9 Feb	30.80	14,000	9 Feb		6,600			4,130
1979	10 Mar	24.58	8,480	9 Mar	25.57	8,540			2,310
1980	24 Mar		9,400	22 Mar		9,480			4,730
1981	5 Mar		2,180	3 Apr		1,050			1,720
1982			5,020	23 Feb		4,460			3,220
1983				19 Mar		9,120			3,910
1984	Mar	31.32	17,200	10 Mar	27.75	13,100			5,050

TABLE A-5

PEAK FLOOD DISCHARGE FREQUENCY VALUES
CUBIC FEET PER SECOND

River and Station	Drainage Area Sq.Mi.	Recurrence Interval in Years				
		2	10	50	100	500
Suwannee River						
Fargo Gage	1,260	4,330	9,440	14,100	16,100	20,600
Above Suwanoochee Creek	1,290	4,400	9,600	14,400	16,600	21,300
Below Suwanoochee Creek	1,750	5,600	12,500	19,900	23,400	32,500
State Line	1,872	5,900	13,200	21,400	25,300	35,500
Above Rocky Creek	1,987	6,200	14,000	22,700	27,000	38,300
Benton Gage S.R. 6	2,090	6,400	14,600	24,000	28,500	40,800
Above Hunter Creek	2,102	6,500	14,700	24,100	28,700	41,100
Above Roaring Creek	2,153	6,600	15,000	24,700	29,500	42,400
Above Deep Creek	2,201	6,700	15,300	25,300	30,200	43,500
Above Robinson's Br.	2,318	7,000	16,000	26,700	31,900	46,400
Above Falling Creek	2,316	7,100	16,300	27,200	32,600	47,400
White Springs Gage U.S.41	2,430	7,300	16,700	28,000	33,600	49,100
White Springs S.R. 136		7,200	16,600	27,800	33,300	48,600
I-75		7,200	16,300	27,200	32,400	47,100
Suwannee Springs Gage	2,630	7,150	15,800	26,000	30,900	44,500
Above Alapaha River		7,050	15,300	24,700	29,100	41,400
Below Alapaha River		12,600	27,500	42,700	49,500	63,900
Above Withlacoochee River		12,200	26,200	40,500	46,700	63,100
Ellaville Gage	6,970	17,900	41,000	65,300	76,500	104,000
Branford Gage	7,880	16,300	34,800	54,000	62,900	85,300
Bell Gage	9,390	19,300	37,900	57,900	67,300	91,900
Wilcox Gage	9,640	19,400	38,100	58,000	67,400	91,900
Withlacoochee River						
So. Rwy. Sys. R.R.		9,790	26,600	47,600	58,400	87,400
Hwy. 31, 145		9,700	26,300	46,700	57,100	85,200
Pinetta Gage	2,120	9,630	25,600	45,100	54,900	81,400
S.R. 6		9,400	24,400	42,100	50,800	74,200
Bridge 2 Mi. Above Mouth		9,300	23,200	39,200	46,800	67,400
Mouth	2,360	9,200	22,900	38,600	46,000	65,900
Alapaha River						
Alapaha Gage	663	3,860	9,030	14,300	16,600	22,300
Statenville Gage	1,400	5,470	12,000	19,300	22,200	28,900
State Line		5,420	12,330	18,730	21,460	27,800
Above Alapahoochee River	1,430	5,410	12,270	18,610	21,300	27,500
Below Alapah. R. at CR 150	1,680	6,390	14,520	22,060	25,270	32,700
S.R. 6	1,720	6,080	13,640	20,560	23,460	30,200
I-75	1,800	5,880	13,070	19,595	22,290	28,500
Mouth	1,840	5,550	12,200	18,000	20,400	25,900

TABLE A-5 (Continued

PEAK FLOOD DISCHARGE FREQUENCY VALUES
CUBIC FEET PER SECOND

River and Station	Discharge Area Sq.Mi.	Recurrence Interval in Years 2	10	50	100	500
Santa Fe River						
U.S. 301			1,340	2,310	2,970	4,380
Graham Gage	95		1,340	2,310	2,970	4,380
Above L. Sampson Outlet			1,340	2,310	2,965	4,380
Below L. Sampson Outlet			2,690	3,880	4,670	6,830
Above New River	299		3,100	6,400	8,770	12,800
Below New River			12,820	20,750	25,200	36,500
Worthington Springs	575		12,820	20,750	25,200	36,500
Above Olustee Creek			12,270	19,400	23,800	35,500
Below Olustee Creek			17,100	26,900	32,800	46,500
Above Oleno Sink	820		17,000	26,650	32,600	46,300
Below Rise			9,710	16,800	20,900	32,000
High Springs U.S. 27	971		9,260	15,800	19,600	29,700
Ft. White Gage	1,017		9,190	13,800	16,700	22,200
Mouth	1,380		8,460	13,400	16,400	22,200

TABLE A-6

DRAINAGE AREAS - LIVE OAK, FLORIDA

Sub Area No.	Drainage Area Acres	Drainage Area Sq. Mi.	Selected SCS Curve No.	Drainage Wells (1)
1	13.40	0.02	80	29
3B	53.05	0.08	80	
5	65.99	0.10	65	27
6	25.52	0.04	75	
7	28.97	0.05	75	
8-9	34.16	0.05	65	20, 26, 42
8A	11.73	0.02	65	
10	30.01	0.05	75	19
11	49.35	0.08	75	37
11A	10.08	0.02	75	
11B	20.39	0.03	75	
12	43.72	0.07	84	22, 23, 24, 25, 40
13	33.66	0.05	65	35
14	10.70	0.02	76	18
15-20	82.94	0.13	20	16, 17
16	15.59	0.02	84	10, 39
17	46.56	0.07	58	11, 33
18	32.91	0.05	58	14
19	5.84	0.009	79	15
20A	76.49	0.12	69	
21	22.44	0.03	94	
22	6.60	0.01	75	44A
23	17.42	0.03	75	43
24	12.40	0.02	75	12
25	20.02	0.03	75	
26	30.36	0.05	88	D4, D4A
26A	4.39	0.007	88	8
28	8.52	0.01	70	4
29	11.75	0.02	81	5, 6
30	156.60	0.24	75	1, 2, 3, D3
31	26.68	0.04	75	
31A	26.64	0.04	75	
32	26.98	0.04	75	31
33	8.20	0.013	75	36
34	28.65	0.04		D2
36	29.57	0.05	50	44B
37	12.05	0.02	54	34
38	187.38	0.29	54	
39	34.60	0.05	54	

TABLE A-6 (Continued)

DRAINAGE AREAS - LIVE OAK, FLORIDA

Sub Area No.	Drainage Area		Selected SCS Curve No.	Drainage Wells (1)
	Acres	Sq. Mi.		
44	108.33	0.17	75	
44A	41.26	0.06	75	
55	26.92	0.04	75	
59A	55.52	0.09	80	
59B	65.09	0.10	80	
61	75.40	0.12	80	
65	61.25	0.09	80	
71	78.12	0.12	75	
72	69.58	0.11	80	
75	46.28	0.07	75	
77	42.73	0.07	54	
78A	70.99	0.11	54	
78B	56.91	0.09	54	
79	43.23	0.07	54	
80	23.62	0.04	54	

(1) Includes existing and former wells dating back through 1964.

TABLE A-7

LIVE OAK, FLORIDA, DRAINAGE WELL DATA

WELL NO.	SRWMD SITE I.D. NO.	LATITUDE (D - M - S)	LONGITUDE (D - M - S)	STREET LOCATION	CASING DIAM (INCHES)	REPORTED CONSTR DATE	LAND SURFACE ELEV.
DOT 1	021323015	30 18 01	82 59 43	Ammons & 5th St.	12	July 1963	
DOT 1A	0213230	30 18 00	82 59 41	Ammons & 5th St.	6		
DOT 2	021323016	30 17 57	82 59 23	Irvin & 4th St.	12	June 1963	
DOT 3	021323017	30 18 03	82 58 58	Fir & Ohio	12	1963	
DOT 4	021324006	30 17 42	82 58 46	Haines St. & Lisle Ave	8	1963	100
DOT 4A	021324007	30 17 42	82 58 45	Haines St. & Lisle Ave	4		100
16	021326010	30 17 09	82 59 14	Marymac & Darrow	6		
1	021323018	30 18 03	82 59 01	Fir & Hillman	12		80
2	021323019	30 18 03	82 59 00	Fir & Hillman	12		77
3	021323007	30 18 01	82 58 58	Fir & Ohio	12		75
4	021323020	30 17 52	82 58 47	Georgia & Bryson	4		
5				Duval & Waterworks	12		
6	021323004	30 17 47	82 58 52	Duval & Union	8	1898	105
7				Duval & Mussey	6		
8	021324008	30 17 43	82 58 35	Tedder & Duval	4	June 1962	107
9				Howard & Railroad			
10	021323021	30 17 40	82 59 00	Union & Howard	12		102
11	021323022	30 17 30	82 59 01	Van Buren & Lake Mary	10	1964	92
12	021326004	30 17 24	82 58 51	Nabor & Santa Fe	6	1962	92
13	021326002	30 17 19	82 58 54	Meadow & Myrtle	6	1962	93
14	021326009	30 17 21	82 59 07	Meadow & Weller	6		98
15	021326001	30 17 18	82 59 16	Meadow & Ohio	4	July 1942	97
17	021326003	30 17 09	82 59 21	Pine & Marymac	8	Sept. 1961	93
18	021326005	30 17 23	82 59 20	Pine & 11th St.	6	Dec. 1959	98
19	02113			Houston & 11th St.	6		
20	021323023	30 17 33	82 59 31	Houston & Maple	6	Oct. 1965	97
21				Suwannee & 7th St.	4		
22	021323024	30 17 14	82 59 13	Suwannee & Wilbur	4		
23	021323025	30 17 14	82 59 13	Suwannee & Wilbur	12		
24	021323026	30 17 15	82 59 14	Suwannee & Wilbur	10		94
25	021323009	30 17 45	82 57 12	Suwannee & Wilbur	12		94
26				Scriven & 9th St.	6		

TABLE A-7 - Continued

LIVE OAK, FLORIDA, DRAINAGE WELL DATA

WELL NO.	SRWMD SITE I.D. NO.	LATITUDE (D - M - S)	LONGITUDE (D - M - S)	STREET LOCATION	CASING DIAM INCHES)	REPORTED CONSTR DATE	LAND SURFACE ELEV.
27	021323027	30 17 41	82 59 36	Irvin & 8th St.	6		98
28	021322001	30 18 06	82 59 49	U.S. Hwy 90 & Woods	6	1959	95
29	021322003	30 18 00	82 59 57	5th St. & Taylor	6	Aug. 1962	106
30	021323033	30 17 56	82 59 24	Scriven & Howard	6		
31	021314003	30 18 18	82 58 47	Winderweedle & USHy129	12		102
32	021323006	30 17 26	82 59 45	Irvin & 11th St.	6		99
33	021323005	30 17 28	82 59 05	Weller & Lake Mary	8	March 1964	95
34	021324003	30 17 35	82 58 18	Ruby & Eva	6	June 1964	109
35	021323028	30 17 35	82 59 25	Church & John	10	June 1964	92
36	021323029	30 17 52	82 59 07	CSXRR & Suwannee	8		100
37	021326011	30 17 09	82 59 32	Hawkins & Church	8	July 1964	92
38	021322002	30 17 49	82 59 53	Lafayette & 8th St.	6	1964	110
39	021323030	30 17 40	82 58 59	Howard & Union	6		102
40	021323014	30 17 46	82 59 09	Pine & Warren	16	May 1965	94
42		30 17 39	82 59 32	Scriven & 9th St.	4		
43	021323031	30 17 28	82 58 52	Park & Thomas	6	Oct. 1966	95
44				Murphy Subdivision	6		
44A	021323032	30 17 25	82 58 57	Helvenston & Thomas	4		99
44B	021326006	30 16 38	82 59 09	Manor & Long	6		99
45	021314002	30 18 28	82 59 14	SR. 249 & Irvin	8		
47	021322	30 17 00	83 00 00	Johnson & 6th St.	4		

Notes:

This information is from various sources with some conflicts. Data are not necessarily verified.

Elevations are in feet, National Geodetic Vertical Datum (NGVD).

DOT is the Florida Department of Transportation. Well No. 16 is a DOT well.

TABLE A-8

LIVE OAK, FLORIDA, DRAINAGE WELL DATA

WELL NO.	TOP CASING OR BOX ELEV. (REPORTED)	DEPTH-MANHOLE OR GRATE TO WELL HEAD FEET-IN.	REPORTED CONSTR. DEPTH FEET		OBSERVED DEPTH USGS LOG	STUDY ASSUMPTIONS			REMARKS
			CASING	HOLE	FEET	WELLHEAD PIPE CASING ELEV.	MANHOLE COVER OR GRATE ELEV.	ZERO FLOW ELEV.	
DOT 1	90.0		142	271					
DOT 1A			80	112					
DOT 2	92.0		320	450				94.0e	
DOT 3	71.0		80	300				71.0e	
DOT 4	94.06		69	93		94.06		94.06	(1)
DOT 4A			40	54				94.1e	
16		3-8	138	200	74	83.52	87.19	83.52	
1			82	305	258			69.0e	
2			60	324	86			69.0e	
3	66.56		89	94	99			66.56e	
4	*100.*		42	54	54			100.0e	
5	91.23							105.e	Ab. 1968
6	91.22		520	655				91.22e	
7									Ab. before 1967
8			42	80				104.0e	
9									Ab.
10	99.39	3-1	84	318	315	99.39	102.47	99.39	
11	91.56		63	102	101	91.56	92.68	92.60	
12		7-5	110	195	168	86.0e	93.5e	86.0e	
13	93.13	6-0	80	260	79	87.13	93.13	87.13	
14	90.70	7-1	147	151	155	90.70	97.8e	90.7	
15	96.88	2-11	321	360.6	350	96.0e	99.0e	96.0e	
17	88.31	5-4	99	153	115	88.3	93.6	88.3	
18			80	179	96			99.0e	
19		5-0				93.0e	98.0e	93.0e	
20		4-	*97*	*267*	*80*	*92.0e*	95.96	94.0e	
21									Ab. before 1967
22				175			94.8e	91.8e	
23				285			94.6e	91.6e	

TABLE A-8 - Continued

LIVE OAK, FLORIDA, DRAINAGE WELL DATA

WELL NO.	TOP CASING OR BOX ELEV. (REPORTED)	DEPTH-MANHOLE OR GRATE TO WELL HEAD FEET-IN.	REPORTED CONSTR. DEPTH FEET		OBSERVED DEPTH USGS LOG	STUDY ASSUMPTIONS			
			CASING	HOLE	FEET	WELLHEAD PIPE CASING ELEV.	MANHOLE COVER OR GRATE ELEV.	ZERO FLOW ELEV.	REMARKS
24	94.71		94	185	127		94.71	91.7	
25		0-10	144	385	353	93.74	94.57	82.74	
26								94.e	Ab. after 1966
27		8-1	135	250		90.7e	98.8e	90.7e	
28			61	210					
29	99.08		103	177	116			99.08e	
30								96.0e	
31			102	426				97.0e	
32		5-3	54	73	74	94.05	99.3e	94.05e	
33	91.34		129	200	129	91.34	95.26	92.41	
34	103.88		65	165	94			102.0e	
35		5-3	63	200	88	90.55e	95.8e	90.55e	
36	93.94		142	194	147			93.94e	
37		4-10	85	153	88	87.8e	92.6e	88.2e	
38			91	175	131				
39		5-	102	385				99.0e	(1)
40		1-2	107	327	286	93.1e	94.2e	93.1e	
42		6-11	260	308	269	88.48	95.4	88.48	
43		6-1	95	95		89.6e	95.7e	89.6e	
44									
44A		5-4	282		282	91.7e	97.0e	91.7e	
44B			170	181	177			97.0e	
45									
47									

Notes:

This information is from various sources with some conflicts. Data are not necessarily verified.
Elevations are in feet, National Geodetic Vertical Datum (NGVD).
DOT is the Florida Department of Transportation. Well No. 16 is a DOT well.
e means estimated.
Ab. means abandoned - with date if known.
(1) means currently (1988) not working or working poorly.

TABLE A-9

DRAINAGE WELLS IN USE IN SEPTEMBER 1964, BUT NOT IN USE IN 1988

Sub-area No.	Well No.	Well Location	Well Dia-In.
8-9	26	Scriven & 9th St.	6
16	39	Howard & Union	6
26	DOT 4	Haines St. & Lisle Ave.	8
29	5	Duval & Water Works	12

Note: Well Nos. 7, 9, and 21 are assumed not to be in use in September 1964 or thereafter.

TABLE A-10

DRAINAGE WELLS IN USE IN 1988 BUT NOT IN USE IN SEPTEMBER 1964

Sub-area No.	Well No.	Well Location	Well Dia-In.
8-9	42	Scriven & 9th St.	4
8-9	20	Houston & Maple	6
12	40	Pine & Warren	16
23	43	Park & Thomas	6
26	DOT 4A	Haines St. & Lisle Ave.	4

TABLE A-11

FLOOD STORAGE PIT WORK AFTER SEPTEMBER 1964 THROUGH 1988

Sub-area	Description
30	2 pits dug 1978 - 79
5	2 pits dug
35	1 pit increased
71	2 small pits west of US 129
38	small increase since 1975
60	4 pits dug or enlarged
75	1 pit dug 1987
55	1 pit dug
11A	1 pit
20A	1 pit dug, 1 enlarged
52	2 pits, 1975 - 1986
36	1 pit about 1987
44	1 pit
41	1 pit
42	1 pit after 1967
8-9	2 pits dug 1988

TABLE A-12

ELEVATION - AREA DATA
SURFACE AREAS IN ACRES FLOODED AT GIVEN ELEVATIONS

Sub-Basin No.	Estimated Zero Storage Elevation (Feet NGVD)	ELEVATIONS - FEET (NGVD)											
		80	82	84	86	88	90	92	94	96	98	100	102
5	88.0					0	0.69	0.83	0.98	3.04	4.83	8.92	16.18
8-9	93.2								0.73	3.92	10.35	17.28	24.19
11	84.0			0	0.14	0.20	0.37	0.68	2.94	7.09	15.22		
12	78.0	0.13					0.26	0.32	0.36	4.34	9.35	14.61	20.41
13	87.70					0.06	0.36	0.47	0.58	0.76	1.64	4.20	10.97
15-20	87.19					0.27	0.60	1.22	5.10	24.90	44.28	55.97	
18	93.6								0.17	0.81	7.03	19.60	26.24
20A	89.3						1.44	2.61	4.67	14.92	28.61		
23	92.8								0.38	2.60	5.44	7.71	
24	91.0							0.45	1.69	4.95	9.08		
25	91.3							0.11	0.63	3.22	5.96		
44	78.0	0.64	0.70	0.91	1.25	2.19	4.19	9.81	30.43	43.96			
44A	80.1		0.43	1.69	3.07	4.29	5.85	7.61	10.69	14.75			
55	93.2								0.29	1.35	3.45	8.47	19.99
59B	89.0							0.50	1.60	7.47	17.55	32.63	52.36
65	84.5				0.23	0.41	1.06	2.13	3.67	5.52	11.47	19.34	32.76

TABLE A-13

ELEVATION - AREA DATA
SURFACE AREAS IN ACRES FLOODED AT GIVEN ELEVATIONS

Sub-Basin No.	Estimated Zero Storage Elevation (Feet NGVD)	ELEVATIONS - FEET (NGVD)									
		90	92	94	96	98	100	102	104	106	108
6	97.5					0.10	1.22	9.01	21.37		
11A	96.2					0.84	2.59	5.02			
19	97.0					0.39	1.91	4.04	4.63	5.23	
22	95.9				0.17	2.31	6.15				
26	94.1				0.47	0.61	0.91	1.95	5.39	12.61	
31	88.0	0.17	0.24	0.92	3.17	5.76	8.75	12.60	16.71	20.11	
31A	96.9					0.11	0.37	5.70	14.75		
34	91.6		0.39	0.48	0.57	0.67	0.93	2.02	5.56	9.16	
36	95.8				0.04	0.09	0.34	6.67	19.67		
59A	94.0			0	0.29	0.62	1.01	1.92	6.27	13.81	30.30
61	96.7					0.75	3.17	7.49	15.34	30.59	58.93
75	94.0			0	0.61	0.69	1.89	3.28	9.07	14.75	
78A-78B	94.7				0.83	5.61	9.74	20.01	34.41	54.83	76.15
80	97.4					0.35	1.01	2.30	4.78	9.67	14.65

TABLE A-14

ELEVATION - AREA DATA
SURFACE AREAS IN ACRES FLOODED AT GIVEN ELEVATIONS

Sub-Basin No.	Estimated Zero Storage Elevation (Feet NGVD)	ELEVATIONS - FEET (NGVD)								
		98	100	102	104	106	108	110	112	114
1	103.7				0.19	1.80	6.21	11.51		
7	98.6		3.07	9.42	16.23					
8A	99.6		0.77	1.89	4.48					
16	101.8			0.10	3.92	11.88				
21	101.02			0.99	7.85	14.93				
26A	107.4						0.41	1.96		
29	103.5				0.04	5.04	9.46			
32	100.6			1.18	2.62	4.70	7.83			
33	98.4		0.22	1.76	5.15	6.86				
37	100.9			1.26	3.26	7.15				
39	97.3	0.18	0.29	0.48	0.66	0.92	7.06			
72	100.6			0.25	2.19	5.44	11.86	17.98		
77	105.7					0.26	1.09	2.30	4.57	6.86

TABLE A-15

SUB-AREA 12

Elevation Feet, NGVD	Surface Area Acres	Volume Acre-Feet
78	0	0
84	0.13	
90	0.26	
91.6		2.3
92	0.32	2.42
94	0.36	3.10
96	4.34	7.14
98	9.35	20.62
100	14.61	44.97
102	20.41	84.75

TABLE A-16

SUB-AREA 30

Elevation Feet, NGVD	Surface Area Acres	Volume Acre-Feet
58.8	0	0
62	0.04	
62.4		0.05
68	0.31	
70.9		2.62
72	0.79	3.44
76	1.04	7.09
78	1.43	9.55
80	2.66	13.58
82	6.53	22.48
84	11.02	
86	15.76	
88	22.36	104.43
90	29.94	
92	38.97	227.40
94	48.07	315.31

TABLE A-17

ANNUAL SERIES POINT RAINFALL AT LIVE OAK, FLORIDA

IN INCHES

	Recurrence Interval in Years			
Hour	2	10	25	100
1	.02	.10	.08	.10
2	.02	.10	.08	.10
3	.02	.10	.08	.10
4	.03	.11	.08	.10
5	.04	.11	.08	.11
6	.05	.12	.09	.12
7	.05	.14	.17	.20
8	.05	.14	.18	.21
9	.08	.14	.18	.21
10	.10	.15	.19	.22
11	.10	.15	.19	.22
12	.10	.16	.20	.22
13	.15	.25	.39	.46
14	.15	.27	.40	.47
15	.35	.54	.71	1.03
16	1.89	2.93	3.30	3.92
17	.31	.45	.50	.55
18	.10	.23	.40	.46
19	.05	.14	.09	.10
20	.03	.11	.09	.10
21	.03	.11	.09	.10
22	.02	.10	.08	.10
23	.02	.09	.08	.10
24	.02	.09	.07	.10
Totals	3.78	6.83	7.80	9.40

TABLE A-18

FLOOD STAGES - LIVE OAK, FLORIDA
EXISTING CONDITIONS - FT. NGVD

Sub Area No.	Recurrence Interval 2 Yr	10 Yr	25 Yr	100 Yr	250 Yr
21	100.19	102.18	102.29	102.49	105.36
26A	108.00	108.76	108.90	108.90	108.90
26	100.13	102.36	102.69	103.34	105.08
16	102.62	103.98	104.02	104.05	104.05
12	94.93	96.99	97.59	98.37	100.01
71	99.09	100.01	100.03	100.07	100.10
32	102.16	102.85	103.09	103.52	103.52
75	100.55	102.03	102.06	102.14	102.22
31A	100.04	100.09	100.11	100.24	100.37
31	96.60	99.10	100.02	100.21	100.67
33	100.16	101.48	101.97	102.01	102.03
30	79.80	83.89	85.20	88.11	93.94
36	96.80	100.79	101.31	102.07	103.04
20A	92.79	95.22	95.52	95.54	95.63
14	102.39	103.80	104.00	104.02	104.02
19	98.19	99.10	99.94	100.74	102.15
15-20	83.53	83.54	90.55	94.02	97.21
17	92.80	96.04	96.45	97.22	99.24
18	92.80	96.04	96.45	97.22	99.24
77	108.14	110.03	110.07	110.19	110.19
38	105.22	108.02	108.14	108.33	109.14
39	105.22	108.02	108.14	108.33	109.14
79	96.82	99.75	100.69	102.15	106.22
37	96.82	99.75	100.69	102.15	106.22
80	96.82	99.75	100.69	102.15	106.22
8-9	93.71	96.91	97.62	98.45	100.99
8A	93.71	96.91	97.62	98.45	100.99
5	93.71	96.91	97.62	98.45	100.99
13	93.71	96.91	97.62	98.45	100.99
28	104.37	105.59	106.02	106.02	106.77
29	104.37	105.59	106.02	106.02	106.77
7	100.21	101.30	101.68	102.15	103.57
34	100.21	101.30	101.68	102.15	103.57
11A	98.67	100.13	100.37	100.79	103.11
11	93.46	95.97	96.32	96.88	99.55
23	94.78	96.50	96.85	97.43	99.07
25	94.25	96.10	96.39	96.89	98.90
22	96.24	97.21	97.60	98.07	98.66
24	92.51	94.21	94.47	94.92	96.28

TABLE A-18 (Continued)

FLOOD STAGES - LIVE OAK, FLORIDA
EXISTING CONDITIONS - FT. NGVD

Sub Area No.	Recurrence Interval 2 Yr	10 Yr	25 Yr	100 Yr	250 Yr
44	89.49	92.39	92.79	93.48	95.73
6	100.16	101.28	101.67	102.11	103.00
10	96.18	98.31	98.73	99.44	101.44
11B	95.32	99.16	100.03	100.3	101.99
55	96.69	98.40	98.71	99.25	100.94
44A	85.08	87.59	88.25	89.17	92.93
61	101.21	102.79	103.11	103.65	
59B	95.82	97.14	97.54	98.08	
59A (1)	102.79	104.79	105.21	105.93	
65	90.24	95.17	96.09	97.02	
3B (2)	95.02	97.39	98.04	98.77	
1	105.52	106.55	106.79	107.23	
72	106.14	107.98	108.34	108.93	
78A					105.61
78B					106.87
78A, 78B (3)	96.82	99.75	100.69	102.15	106.22

Notes: (1) These stages may be too high as some flood water may spill into Sub-area 61.

(2) These stages may be too high as some flood water may spill into Sub-area 59B.

(3) Stages shown are average stages for both subareas combined.

TABLE A-19

LIST OF BRIDGES

SUWANNEE RIVER, GA. AND FLA.

MILES ABOVE MOUTH	LOCATION	OWNER	TYPE	USE	APPROX. CLEARANCE HORZ. FEET	VERT. - FEET MEDIAN(1)	VERT. - FEET FLOOD(2)	ELEV.-FT.NGVD LOW CHORD	ELEV.-FT.NGVD TOP ROAD	DATE PERMIT	DATE COMP.	REMARKS
33.95	U.S. 19 SO., Old Town	FLA. D.O.T.	Fixed	Hwy.							-87	
33.96	U.S. 19 NO., Old Town	FLA. D.O.T.	Fixed	Hwy.	110	29.6	11.2	34.2	40.2	7-62	7-64	
37.30	Old Town	CSX Trans. (3)	Swing	R.R.	48	16.1	0	21.2		3-14	4-17	
56.86	S.R. 340	FLA. D.O.T.	Fixed	Hwy.	100	31.2	8.6	39.3	44.2	2-64	5-65	
76.10	U.S. 27, Branford	FLA. D.O.T.	Fixed	Hwy.	94	26.7	0.2	39.0		4-87		Under Constr.
89.58	East of Mayo	Florida Gas Transmission Co.(4)	Fixed	Pipe								
98.18	S.R. 51, Luraville	FLA. D.O.T.	Fixed	Hwy.	375	34.6	2.8	56.2	57.8	11-45	7-47	Suspension Br.
112.80	Dowling Park	Sou. Railway Sys.(5)	Fixed		63	36.5	1.4	62.9	70.5	10-55	12-56	Abandoned R.R.
112.90	S.R. 250, Dowling Park	FLA. D.O.T.	Fixed	Hwy.	38	35.8	0	62.3	69.7	9-54	9-55	
124.85	Interstate 10 - Twin	FLA. D.O.T.	Fixed	Hwy.	150	37.6	0.7	67.7	75.7	5-68	4-72	
127.28	U.S. 90, Ellaville	FLA. D.O.T.	Fixed	Hwy.								
127.30	Ellaville, (Old U.S. 90)	FLA. D.N.R.	Fixed		116	34.5	0	65.9	69.1	3-24	1-27	
127.46	Ellaville	CSX Transportation	Fixed	R.R.	67	33.4	0	64.8	68.0	7-52	12-53	
135.53	S.R. 249		Fixed	Hwy.								

TABLE A-19 (Continued)

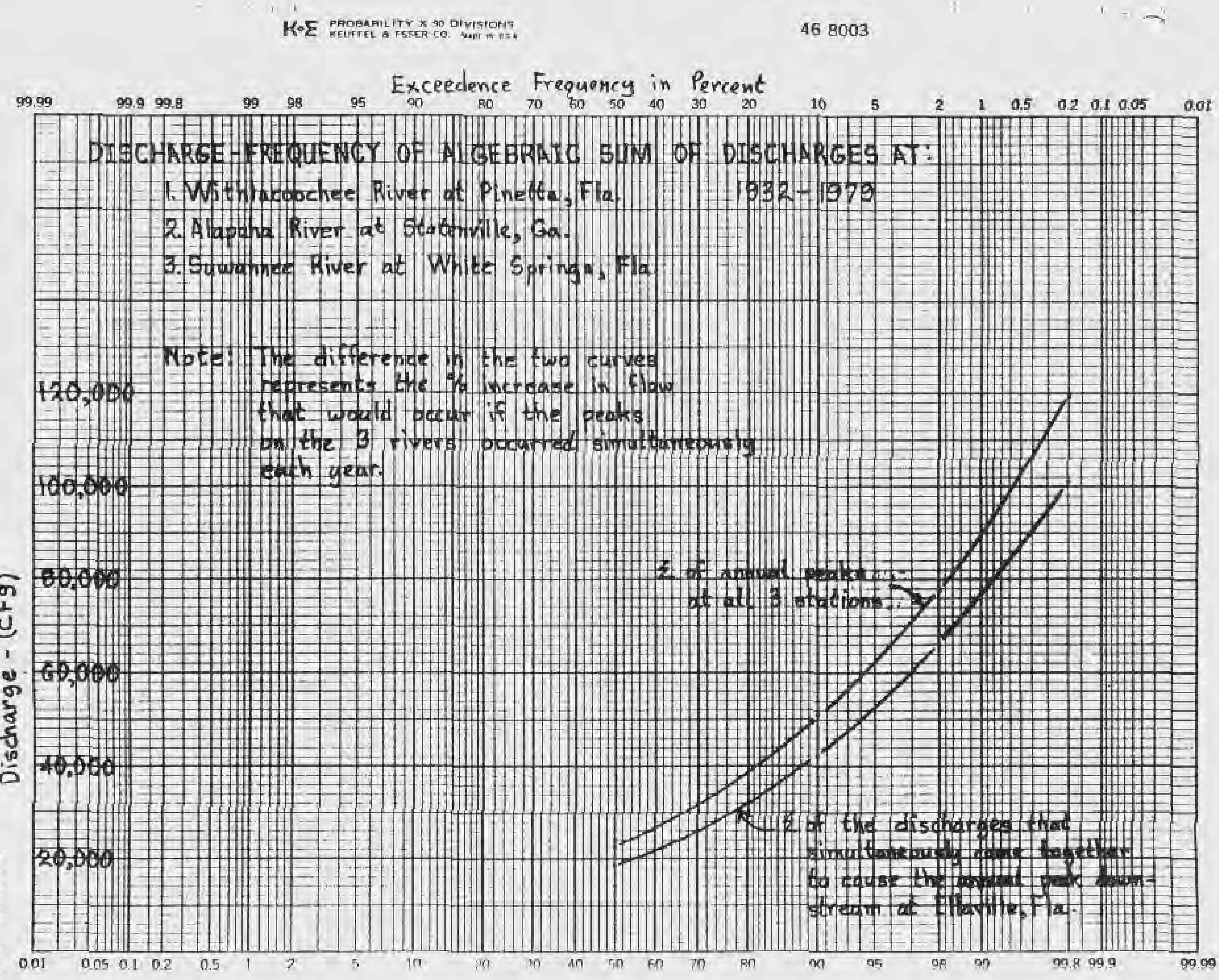
LIST OF BRIDGES

SUWANNEE RIVER, GA. AND FLA.

MILES ABOVE MOUTH	LOCATION	OWNER	TYPE	USE	APPROX. CLEARANCE HORZ. FEET	VERT. - FEET MEDIAN(1)	VERT. - FEET FLOOD(2)	ELEV.-FT.NGVD LOW CHORD	ELEV.-FT.NGVD TOP ROAD	DATE PERMIT/COMP.		REMARKS
148.18	Suwannee Springs	CSX Transportation	Fixed	R.R.	65	31.5	0	72.4	79.6	10-65	10-67	
149.76	U.S. 129, Suwannee Spr.	FLA. D.O.T.	Fixed	Hwy.	156	37.0	0.7	78.7	84.5	4-31	9-31	
149.98	Suwannee Spr. (Old U.S. 129)	Suwannee and Hamilton Counties	Fixed		125	35.4	0	77.2	81.3			Abandoned
162.05	Interstate 75 - Twin	FLA. D.O.T.	Fixed	Hwy.	86	37.0	0.3	84.7	90.2	2-60	8-62	
168.92	S.R. 136 White Springs	FLA. D.O.T.	Fixed	Hwy.	114	42.2	6.0	93.6	99.1	4-52	9-54	
171.10	U.S. 41	FLA. D.O.T.	Fixed	Hwy.	90	36.1	0.5	89.3	95.2	1-79	2-81	
171.18	Near White Springs	Sou. Railway Sys.	Fixed	R.R.	99	31.3	0	84.5	90.0		1885	
195.66	SR 6	FLA. D.O.T.	Fixed	Hwy.	119	28.0	1.5	104.6	109.5	6-50	5-51	
220.61	U.S. 441, Fargo, Ga.	GA. D.O.T.	Fixed	Hwy								
220.90	Near Fargo, GA.	Sou. Railway Sys.	Fixed	R.R.								
238.50	Suwannee R. Sill	U.S. Dept. of Inter.	Fixed	Ser. Rd.	(6)	(6)	(6)		117.7			Water Control Structure

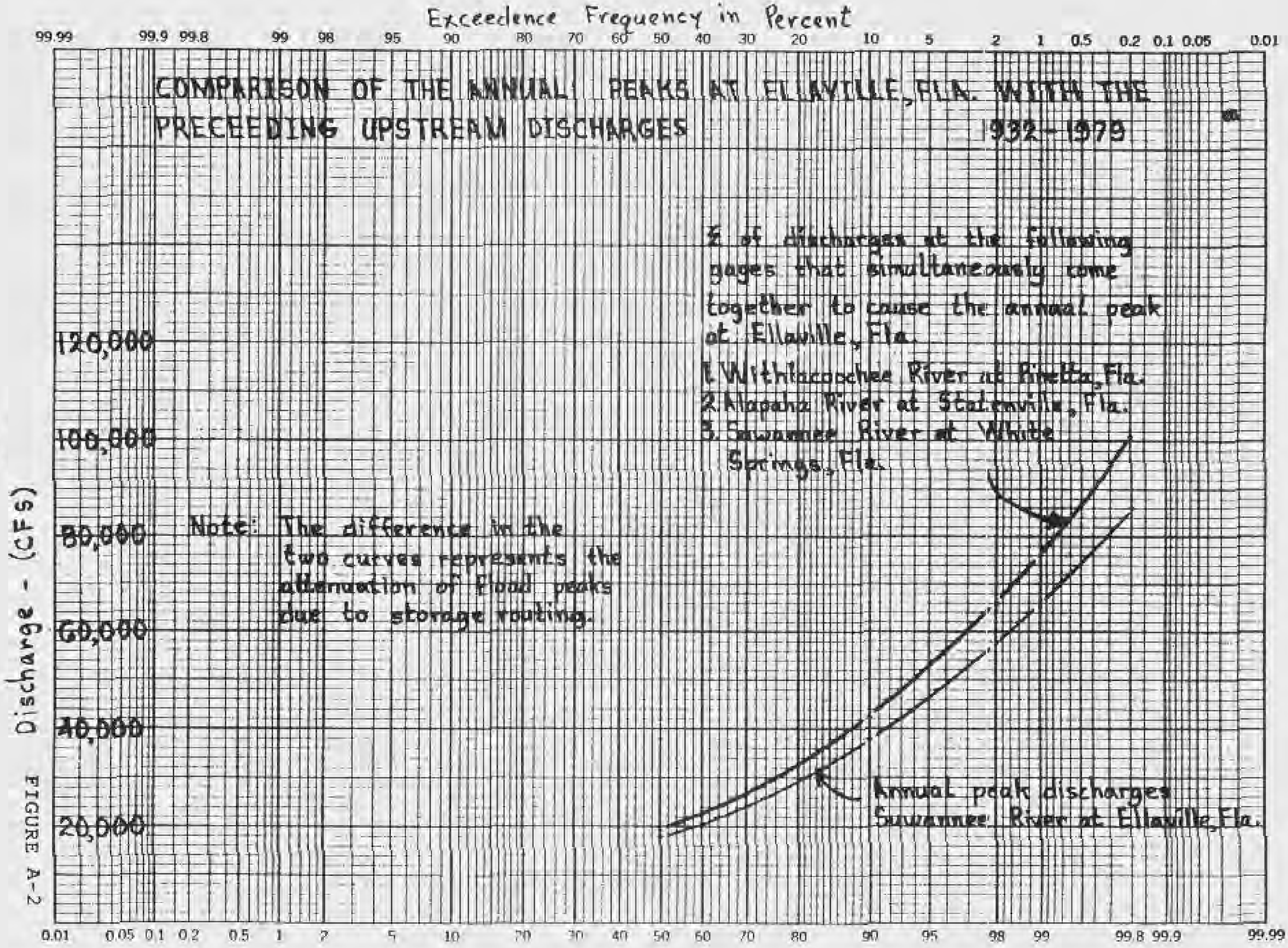
NOTES:

1. Main channel center clearance at the median or most typical river stage. The median stage is exceeded 50% of the time.
2. Main channel center clearance during flood of record peak.
3. CSX Transportation includes the former railroads: Seaboard System; Seaboard Coastline; Atlantic Coastline, and Seaboard Airline.
4. Suspension Bridge for 24-inch-diameter gas pipeline. There is also a 30-inch-diameter submarine gas pipeline about 100 feet downstream of suspension bridge.
5. Southern Railway System includes the former railroads: Live Oak, Perry, and Gulf; South Central of Georgia; Central of Georgia; Georgia Southern and Florida; Valdosta Southern; and Norfolk Southern.
6. Not passable by boats. Overtopped by record flood.



K+E PROBABILITY X 90 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8003
Exceedence Frequency in Percent
DISCHARGE-FREQUENCY OF ALGEBRAIC SUM OF DISCHARGES AT:
1. Withlacoochee River at Pinetta, Fla.
1932-1979
2. Alapaha River at Statenville, Ga.
3. Suwannee River at White Springs, Fla.
Note: The difference in the two curves represents the % increase in flow that would occur if the peaks on the 3 rivers occurred simultaneously each year.
Σ of annual peaks at all 3 stations
Σ of the discharges that simultaneously came together to cause the annual peak downstream at Ellaville, Fla.
Discharge - (CFS)
120,000
100,000
80,000
60,000
40,000
20,000

FIGURE A-1



Exceedence Frequency in Percent
COMPARISON OF THE ANNUAL PEAKS AT ELLAVILLE, FLA. WITH THE PRECEEDING UPSTREAM DISCHARGES
1932-1979
Σ of discharges at the following gages that simultaneously come together to cause the annual peak at Ellaville, Fla.
1. Withlacoochee River at Pinetta, Fla.
2. Alapaha River at Statenville, Fla.
3. Suwannee River at White Springs, Fla.
Note: The difference in the two curves represents the attenuation of flood peaks due to storage routing.
Annual peak discharges Suwannee River at Ellaville, Fla.
Discharge - (CFS)
120,000
100,000
80,000
60,000
40,000
20,000
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01

FIGURE A-2

DRAINAGE WELL #33

LIVE OAK, FL AT LAKE MARY

Measurements made 25 August 1987 by N. ENGE AND GLENN BEGUE for inflow rating pump test.

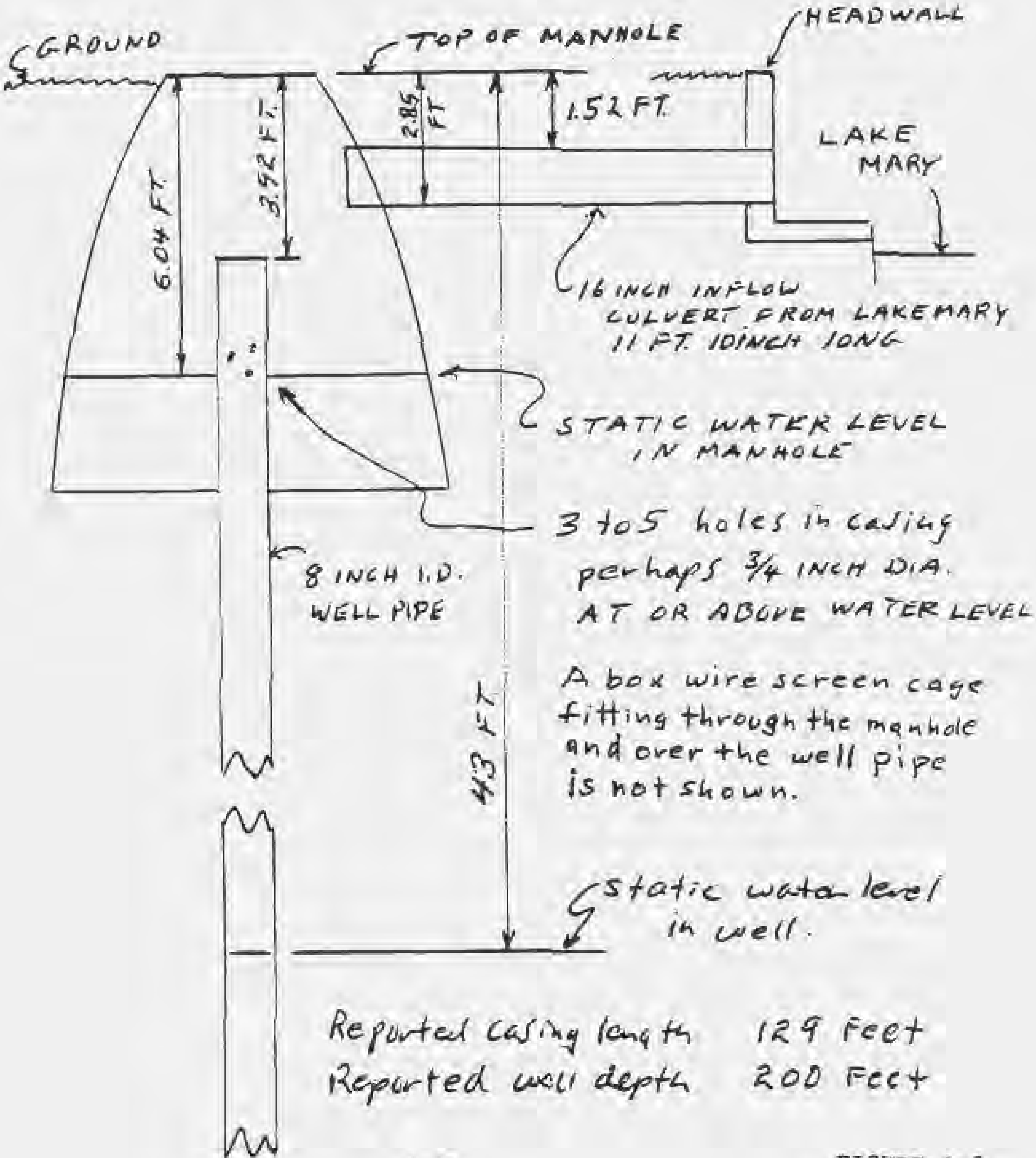


FIGURE A-3

PROJECT LIVE OAK FLOOD STUDY | Page __ of __ | COMPUTED BY | DATE

SUBJECT WELL 33 PUMP FLOW TEST AUG 25, 1987 | CHECKED BY | DATE

DRAINAGE WELL 33 AT LAKE MARY

A.M.

STAGE READING FEET	HEAD-FT. (3.92 − STAGE)	Q READING GPM	Est. LOSS (1) GPM	WELL Q GPM
3.70	0.22	156	0	156
3.60	0.32	257	0	257
3.55	0.37	350	0	350
1.35	2.57	562	40	522
1.25	2.67	765	75	690
1.60	2.32	546	36	510
1.65	2.27	507	27	480
1.68	2.24	468	28	440
1.00	2.92	800	150	650

PM

3.45	0.47	351	0	351
3.65	0.27	351	0	351
2.40	1.52	483	2	481
2.18	1.74	515	3	512
1.15	2.77	483	40	443
1.12	2.80	499	40	459
1.19	2.73	421	40	381
1.0	2.92	640	60	580
1.1	2.82	702	50	652
1.0	2.92	648	58	590

(1) Estimated loss through sandbagged 16 inch culvert from manhole to Lake Mary.

SAJ Form 1002
14 Mar 78

FIGURE A-4

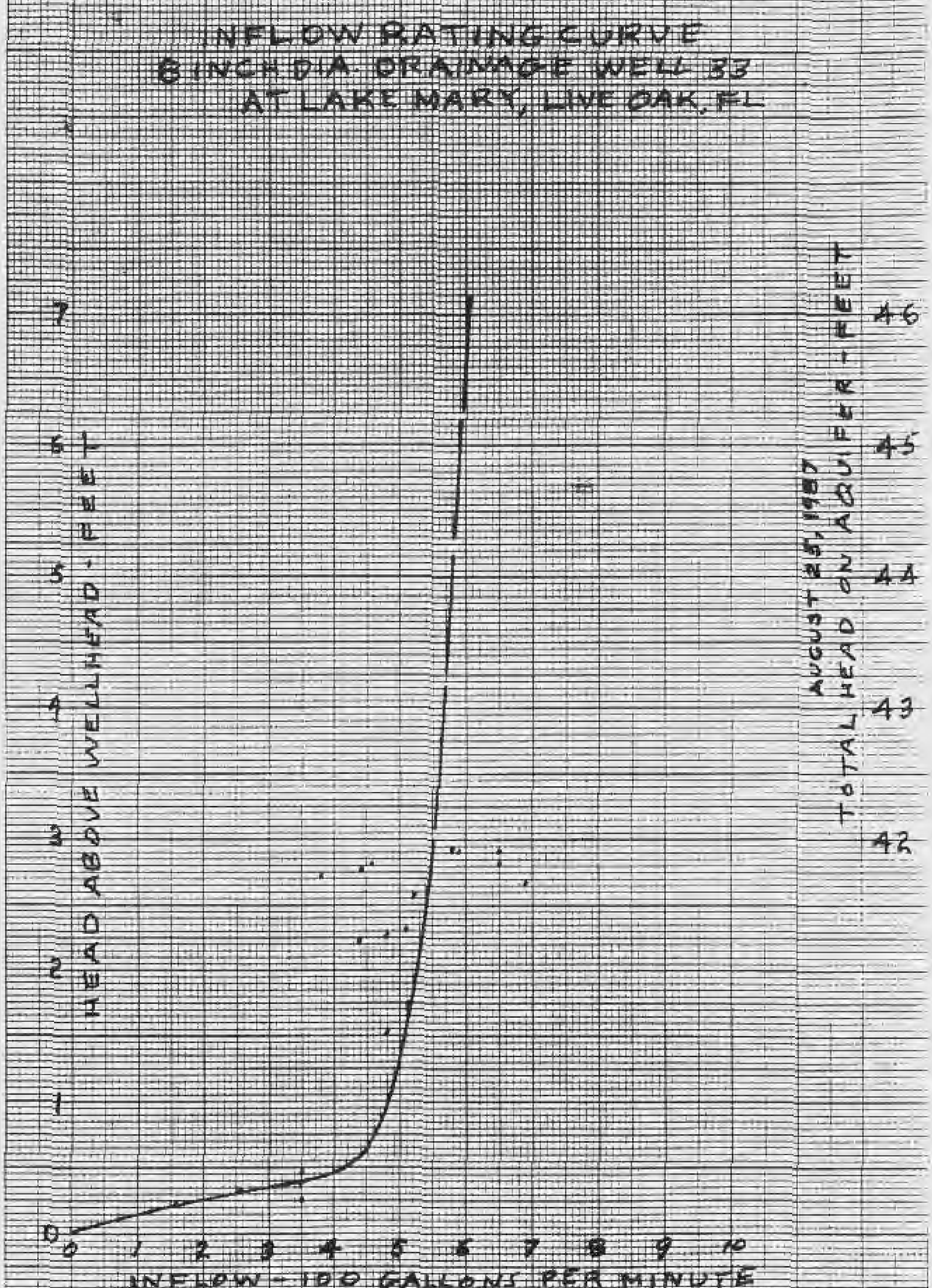

INFLOW RATING CURVE
6 INCH DIA. DRAINAGE WELL 33
AT LAKE MARY, LIVE OAK, FL
HEAD ABOVE WELLHEAD - FEET
0
1
2
3
4
5
6
7
INFLOW - 100 GALLONS PER MINUTE
0
1
2
3
4
5
6
7
8
9
10
AUGUST 25, 1987
TOTAL HEAD ON AQUIFER - FEET
42
43
44
45
46

FIGURE A-5

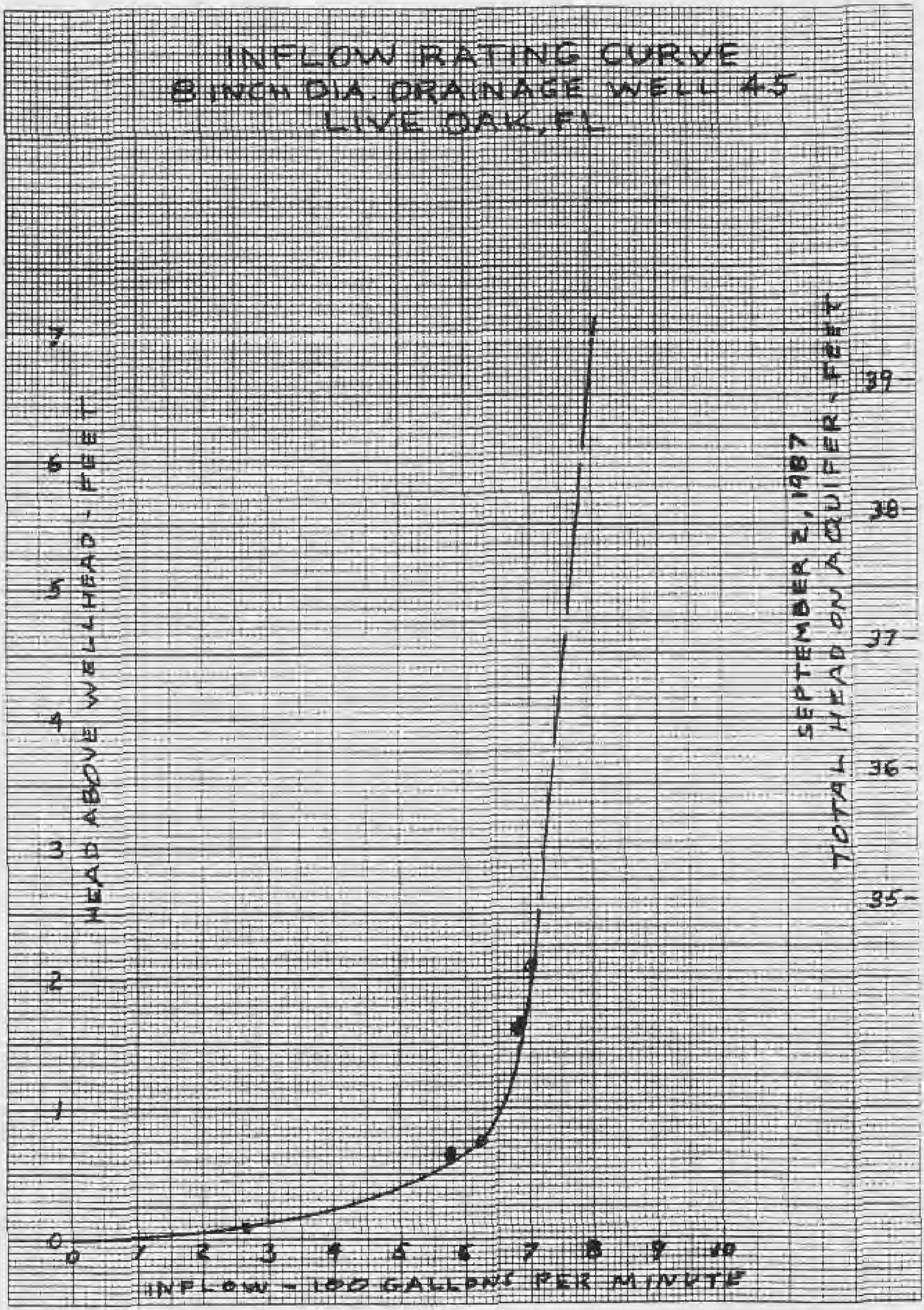
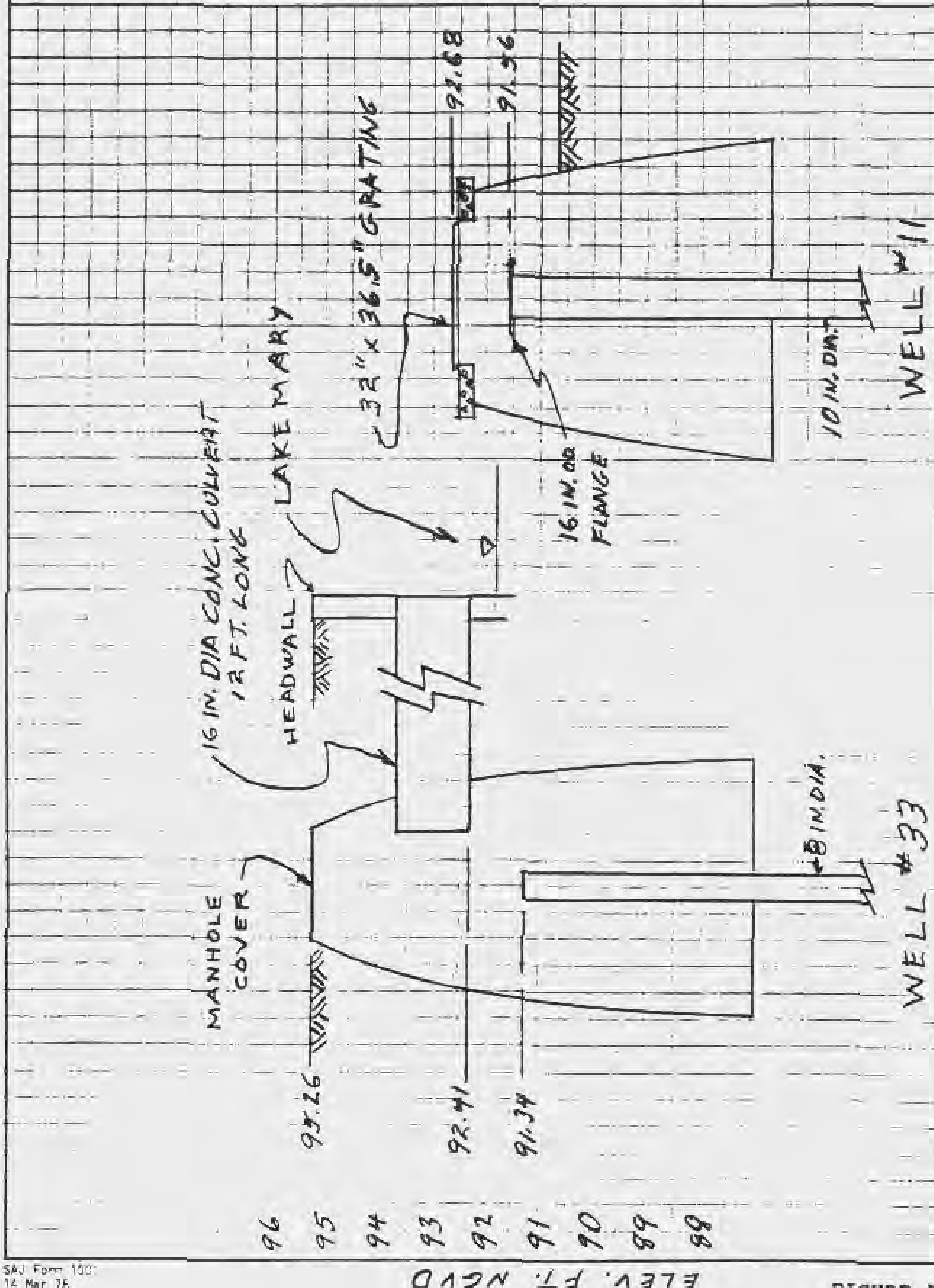

INFLOW RATING CURVE
8 INCH DIA. DRAINAGE WELL 45
LIVE OAK, FL
HEAD ABOVE WELLHEAD - FEET
0
1
2
3
4
5
6
7
INFLOW - 100 GALLONS PER MINUTE
0 1 2 3 4 5 6 7 8 9 10
SEPTEMBER 2, 1987
TOTAL HEAD ON AQUIFER - FEET
35
36
37
38
39

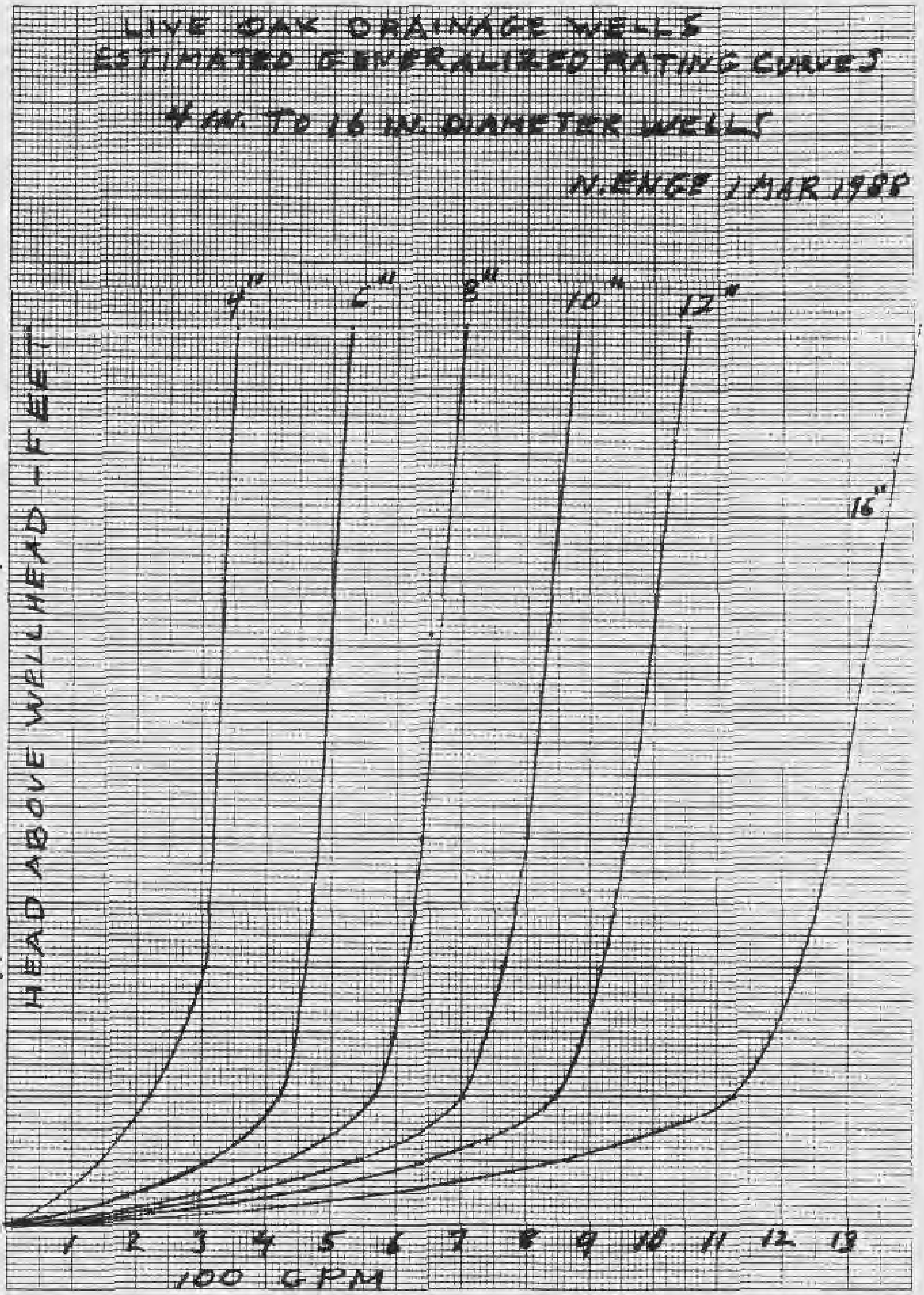
FIGURE A-6

PROJECT LIVE OAK, FL	Page — of —	COMPUTED BY AE	DATE MAR 1988
SUBJECT DRAINAGE WELLS AT LAKE MARY		CHECKED BY	DATE



SAJ Form 100
14 Mar 76

FIGURE A-7



LIVE OAK DRAINAGE WELLS
ESTIMATED GENERALIZED RATING CURVES
4 IN. TO 16 IN. DIAMETER WELLS
N. ENGE 1 MAR 1988
HEAD ABOVE WELLHEAD - FEET
100 GPM
4"
6"
8"
10"
12"
16"
0
1
2
3
4
5
6
7
8
9
10
11
12
13

FIGURE A-8

APPENDIX

E

ECONOMICS

APPENDIX B

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Appendix B
Economic Analysis

General Overview

1. Purpose and Objectives. The purpose of this appendix is to provide general demographic information for the Suwannee River Basin and to show the current flood damage potential to the municipality of Live Oak, Florida. Information provided in this appendix includes the following:

a. A general discussion of demographic conditions in the Suwannee River Basin.
b. A general discussion of demographic conditions in the Live Oak municipal area.
c. A description of the Live Oak study area.
d. The identification of the key economic activities in the Live Oak study area and the determination of the extent and location of present land use and resource development in the area.
e. The analysis of existing effects of the existing water control system.

2. General assumptions. The work was accomplished by developing an analysis rationale for the evaluation, generating a methodology for implementing the analysis, and performing the analysis. The general assumptions in this study are limited to the following:

a. During the project life there will be no major economic recessions which will seriously affect the long-term growth pattern of the Nation's economy.
b. The international political tensions will remain at approximately the present level and there will be no widespread outbreak of hostilities.

Suwannee River Basin Social and Economic Overview

3. Description of the Drainage Area. The drainage area of the Suwannee River includes about 9,950 square miles of the Coastal Plain, with about 5,720 square miles located in south-central Georgia and the remainder in north-central Florida. Principal tributaries of the Suwannee are the Withlacoochee and Alapaha Rivers, whose basins lie mostly in Georgia, and the Santa Fe River in Florida. The northernmost boundary of the basin is about 100 miles north of the Florida-Georgia State line. The Suwannee River flows into the Gulf of Mexico. All or part of 22 Georgia and 14 Florida counties are within the drainage basin.

4. Population in the Suwannee River Basin. The population of the Georgia portion of the Suwannee River Basin has shown a general upward trend

increasing in the 1950's leveling in the 1960's, and rising through 1980. It is projected that this rise will continue from 1990 through 2020 with a 32-percent increase. However, a noticeable in-migration rate is not expected to occur since most of the area is expected to remain rural in the future. Valdosta, Georgia, is the largest city in the entire basin with a population of 37,596 in 1980. However, the bulk of the population is situated in the northwestern section of the basin.

In the Florida portion of the basin, the trend in population is similar to Georgia's with the exception that increases are generally greater. Although most counties along the Suwannee River declined in population between 1950 and 1960, the 11 county area, as a unit, between 1950 and 1980 saw an increase in population reaching 300,301 people in 1980. Projections from 1990 through 2020 show a lower percentage change in population than the 1950 to 1980 period. Population is expected to increase by 25 percent in the period between 1990 and 2020. The largest city in the Florida portion of the basin is Lake City with a 1980 population of 9,257.

5. Income and Employment. The major portion of income earned in Florida comes from the service industries. The average Florida county in the basin had about a 27 percent increase in per capita personal income between 1977 and 1982. For the State of Georgia, income by employment is more diversified and includes government, manufacturing, wholesale, and retail trade as well as the service industries. Within the basin, the major sources of income include manufacturing, agriculture, services, and government.

County and City Social and Economic Overview

6. General. The basic units selected for the social and economic profile are for Suwannee County and the city of Live Oak. The information to be discussed will include population, education, households, labor force and employment, income, and the areas' financial resources.

7. County Overview. Suwannee County was established in 1858 and is located on the central ridge of the Atlantic Coastal Plain. The historic Suwannee River forms the north, west, and south borders of this north central county. The county is predominantly rural and bordered by Columbia, Hamilton, Madison, Lafayette, and Gilchrist Counties. The county area includes approximately 677 square miles of land and 10 square miles of water. The topography can be classified as gently rolling with land elevation varying between 10 and 190 feet above mean sea level (NGVD). The geology of the area generally consist of a sandy soil and various layers of limestone which are several thousand feet thick. The land, while being fairly rolling, has few significant surface drainage patterns even though the Suwannee River forms a semicircle around the western boundary of the county.

Suwannee County is not primarily a tourist oriented county. However, many visitors are attracted to the Stephen Foster Museum and Memorial facilities which are located in White Springs, Florida, on the banks of the Suwannee River. Timber, pecans, tobacco, and watermelons are the major agricultural crops of Suwannee County. Cotton is also grown in the county but the amount is insignificant and is not a major part of the agricultural setting.

8. City of Live Oak Overview. The city of Live Oak is a typical small urbanized area with a centralized business district in the downtown area surrounded by residential development. Commercial development extends outward from the center of town along two main highways, U.S. 90 and U.S. 129 to the corporate limits. The business area is a heterogeneous mix which includes many older buildings 20 to 30 years old along with more recent structures. The residential area is low density with predominantly single-family units. The structures' ages vary similarly to the business district with many older homes. The natural environment of Live Oak has been greatly altered by the development of the city. The natural vegetation within the city limits has generally been replaced by domestic shrubs and grasses with only the larger trees remaining. The land surrounding the city is predominantly devoted to farmland and pasture.

9. County Population. In 1984, the estimated permanent population for Suwannee County was 24,816. During the period 1970 to 1980, the county experienced an increase in population of 43.2 percent from 15,559 in 1970 to 22,287 in 1980. The growth of the county has increased at a moderate rate over the last 10 to 15 years and should continue to grow at a reduced rate to the year 2000. Historical population for selected years from 1970 to 1984 are displayed in table B-1 for Suwannee County and the city of Live Oak.

The 1980 census indicates that 33 percent (7,354) of Suwannee County's residents live in the incorporated areas and 67 percent (14,933) live in the unincorporated areas. Of the total, 99 percent are native to the United States and 1 percent is foreign born. Seventeen and six-tenths percent of the total population of the county are Black and 1.2 percent are of Spanish origin. Approximately 49 percent of the population in the county are male. Twenty-five percent of the 1984 estimated population in the county are 14 years of age and under and 17, 28, 22, and 16 percent are in the age groups 15-24, 25-44, 45-64, and 65 and over, respectively. The county's median age is 31.5.

10. City Population. The city of Live Oak experienced a slight decline in population growth from 1970 to 1980. The 1980 census showed a resident population of 6,732 which in a 10-year period declined about 1.5 percent from the 1970 total of 6,830. More than 99 percent are native to the United States. Thirty-five percent of the total population of Live Oak are Black

and 1.4 percent are of Spanish Origin. Approximately 47 percent of the population are male. Twenty-six percent of the total 1980 population in Live Oak are 14 years of age and under and 16, 23, 20, and 15 percent are in the age group 15-24, 25-44, 45-64, and 65 and over, respectively. The median age is 30.4.

11. County Education Patterns. For persons 25 years and older in 1980, the median number of school years completed was 12.1 (up from 10.2 years in 1970). Fifty-three percent of the group had completed high school (up from 34 percent in 1970), 14 percent had 1 to 3 years of college (up from 5.1 percent in 1970), and 6.5 percent had 4 years or more of college (up from 5.6 percent in 1970).

12. City Education Patterns. In 1980, of 3,867 Live Oak residents, 50.9 percent were high school graduates. Of those total residents, 10 percent had completed 1 to 3 years of college and 7 percent had completed 4 or more years of college.

13. County Housing Patterns. The total number of housing units available in Suwannee County in 1980 was 8,765. Of this total, 8,551 year-round units were available for use. Of the total year-round units, 5,996 were occupied by owners and 1,743 were occupied by renters with an average of 2.84 persons per household. Of the 5,996 owner occupied units, 795 were occupied by Blacks and of the 1,743 renters occupied units, 391 were occupied by Blacks. The mean house value in the county in 1980 was $24,000 and the mean contract rent was $101.00 per month. Mobile homes were the primary forms of construction in Suwannee County during the period 1970 to 1980 due to population increases primarily in the unincorporated areas. In 1970, there were 257 mobile homes which accounted for 10.1 percent of the total housing stock. In 1980, the number of mobile homes increased to 1,173 or approximately 75 percent of the total housing stock in the unincorporated area of the county. Single-family housing units and owner-occupied housing units have been the primary forms of construction in Suwannee County during the last decade.

14. City Housing Patterns. The total number of housing units in the city of Live Oak in 1980 was 2,659. Of this total, 2,646 were classified as year-round housing units. Of the total year-round housing units, 1,694 were occupied by owners and 695 were occupied by renters with 2.81 persons per household. Of the 1,694 owner occupied units, 467 were occupied by Blacks. Of the 695 renter occupied units, 256 were occupied by Blacks. The mean house value in 1980 in the city of Live Oak was $26,200 and the median contract rent was $100.00 per month.

15. Labor Force and Employment.

a. The total employed labor force in Suwannee County 16 years and over was 8,350 in 1980. Approximately 41.5 percent of the total employed were females 16 years and older. Government workers were 18 percent of the total employed. The total employed labor force for the city of Live Oak 16 years and over was 2,544 in 1980. Approximately 46.4 percent of the total employed were females 16 years and older. Government workers were 21.3 percent of the total employed.

b. The percentage of employment by type of industry in 1980 is displayed in table B-2 for Suwannee County and the city of Live Oak. These percentages indicate that manufacturing, professional and related services, and retail trade are primary sources of income for residents in Suwannee County and the city of Live Oak. The harvesting and processing of agricultural crops which include tobacco, timber, pecans, and watermelons also accounts for a large source of employment and income.

16. County Income Patterns.

a. Total personal income in Suwannee County in 1983 was approximately $176,400,000. Per capita personal income rose 7.4 percent on an average annual basis during a 10-year period, from $3,584 in 1973 to $7,330 in 1983, and wages and salaries accounted for 41 percent of total personal income. Total and per capita personal income for selected years in Suwannee County are displayed in table B-3.

b. The median income for a family of four in Suwannee County was $12,775 in 1979. There were 1,183 families below the U.S. established poverty level in 1979 of $7,412. The percentage of families earning less than poverty level income and below 125 percent of poverty level in Suwannee County in 1979 were 19 percent and 25.4 percent respectively.

c. According to statistics in the 1985 Florida Statistical Abstract, total quarterly pay-rolls subject to Florida's Unemployment Compensation Law were $18,175,000 in Suwannee County for the January-March period in 1984. Major sources of personal income in 1982 and 1983 for the county are shown in table B-4.

17. City Income Patterns. The median income for a family of four in the city of Live Oak was $12,760 per year in 1979. In 1979, there were 391 families below the U.S. established poverty level. The percentage of families earning less than poverty level income and below 125 percent of poverty level in the city of Live Oak were 22 percent and 48.9 percent respectively. Table B-5 displays the distribution of family and household income by income range for Suwannee County and the city of Live Oak.

18. Area Financial Resources. Total revenue collected in Suwannee County amounted to $8,671,000 in the 1984-85 fiscal year ending in September. Of this total 29 percent was revenue from taxes, 4 percent was charges for services, 37 percent was from miscellaneous and other financing sources, and 30 percent was from intergovernmental transfers.

Economic Evaluation

19. Suwannee Basin Study Area Existing Flood Damages. The major damages that occur along principal streams in the Suwannee River basin are to residential housing and other structures, agricultural activities, and transportation facilities and access. In recent years, until the institution of flood plain building restrictions, there had been a substantial increase in flood susceptible housing along basin streams, especially in Florida. Major arterial highway impacts have probably lessened. It was reported that for about 21 days during the 1948 flood all traffic between west and east Florida was routed through Georgia. Since that time, many bridges have been built or rebuilt at higher grade elevations. Even so, Interstate 75 traffic was interrupted for a short time during the 1973 flood. Damages due to restrictions of road access to houses and other development along non-arterial flood plain roads has increased because of additional development. Roads and access can be severely impacted where they cross low areas that can pond with flood waters, even though the terminal destination may be on higher ground. A damage frequency curve is shown on figure B-1. The 1987 development curve represents total existing damages with the range of flood frequencies at November 1987 prices. Only direct flood damages caused by main channel and overbank flooding along the Suwannee, Sante Fe, Withlacoochee, Little, and Alapaha Rivers are included. A detailed analysis was not made. Information from 10 river reaches in the 1965 Survey-Review Report (Appendix B) was updated with some corrections and adjustments for known changes including price levels. While the majority of damages occur in Florida, the 10 reaches covered extend up into Georgia, to near Tifton on the Little River, to Nashville on the Withlacoochee River, to near U.S. Highway 82 on the Alapaha River, and to the sill structure on the main Suwannee River in the Okefenokee Swamp. Average annual 1987 flood damages along the above-mentioned five rivers from figure B-1 are computed to be $810,000.

20. Live Oak Study Area.

a. The area under study is within the city limits of Live Oak in Suwannee County. The city of Live Oak includes approximately 6.9 square miles of incorporated area and is approximately 85 miles west of Jacksonville in north-central Florida. Live Oak is the County Seat and the largest city in the county.

b. The physical setting of Live Oak creates a rather unique flood problem. The absence of natural streams and the location of the city within a depression prevents normal surface drainage of rainfall. Once rain falls on the area, removal is slow by either evapotranspiration or gradual seepage through sinkholes. The city, in an effort to provide a means of drainage, has excavated surface storage areas and constructed numerous drainage wells around the town to permit rainfall runoff to pass through the less pervious surface layers and enter the caverns and solution channels of the lower limestone formations. The constructed wells, about 50 in all, vary in size from 4 to 16 inches in diameter and 54 to 655 feet in depth. Because of the limited storage and discharge capacity, significant rainfall produces more runoff than can be handled by the system. When this happens, rainwater begins to pond and cause flood problems.

21. Flood Protection Effects. The investigation consisted of an analysis of the various alternative impacts on land use development physically existing in the study area in the base year 1990. The physical flood damage effects included an analysis of the potential damage that would occur under different magnitude floods to the structures in the basin and to the value of the personal property in each structure, or content value. Additional physical damages which include damage to lawns, pavement, shrubs, and streets, and potential vehicle damage were also estimated. Income loss to the public and private sectors in Live Oak was estimated by calculating the costs of transportational delays after each flood. A potential benefit was computed for the avoidance of other costs which include emergency costs associated with flood fighting and the reduced flood insurance administrative overhead costs. The assumptions, methodology utilized, and calculations performed in each of these studies are discussed in the following paragraphs and in paragraphs 34 and 35 of the main report.

22. Assumptions. The assumptions utilized in the computation of flood damages include the following:

a. Base year: The base year or the beginning of the project life for the purpose of this report is the year 1990.

b. Project life: Physical depreciation of structures, obsolescence, and changing requirements for project services are a number of forces limiting the life of the project. The Economic and Environmental Principles and Guidelines for Water and Related Land Resources defines the project life as the period of time over which any alternative plan would have significant beneficial or adverse effects, not to exceed 100 years. An economic life of 50 years is selected for the project analysis.

Analysis Methodology

23. Inundation Damages to Existing Development.

a. This analysis includes the development of an existing land use pattern for the area under study. This was accomplished using aerial photographs, plat assessment maps, published data, and field surveys. In this study, aerial photographs and local tax assessor maps were utilized to locate every structure in the Live Oak study area. Structures in the study area were then located on aerial photo maps at a 1 inch equals 200 hundred feet scale and numbered for identification purposes.

b. Once the flood plain had been identified, the study area was sub-divided into 47 reaches. Damage reach delineation is primarily dependent upon hydrologic criteria. In this study, damage reaches have been delineated along sub-basin boundaries. This is possible since each sub-basin in the study area is generally hydraulically independent under all flood events except for large magnitude floods when it is possible that flood water may spill over a sub-basin divide. Therefore, the stage for a given magnitude flood in any sub-basin will be the same throughout the sub-basin and all land use in a given sub-basin is evaluated at the same stage for a given magnitude flood. The 47 sub-basins evaluated in the Live Oak study area are shown on plate 5.

c. The effects of this flooding on existing land use in the study area were then computed. The procedure included cataloguing the type of land use, topographic elevation, first floor elevation, and value for each structure and its personal property value. Land use types were initially determined using assessment information available from the tax assessors office in Live Oak. Structure type was later verified by the Real Estate Division of the Jacksonville District. The existing value of structures were estimated by the Real Estate Division of the Jacksonville District as replacement cost less depreciation. Residential development is the primary type of urban development. Types of residential development include single-family housing, multi-family housing, and mobile homes. Content values were estimated as a percent of structure value. Land use classifications and the number of structures analyzed in the study are shown in table B-6.

d. The elevation of structures was estimated from aerial photographs with 2 feet topographic contours. First floor elevations were estimated from topographic elevations and sample finished floor elevations provided by contract survey information. The sample finished floor elevations were primarily located in the downtown business district and adjacent residential communities where the most severe problem areas were located. First floor estimates were assigned to all other structures not included in the sample using the following procedure. First, the sample elevations were evaluated by subtracting topographic elevation to yield a true first floor height above ground. Second, a mean first floor height above ground and 90 percent confidence limit was computed for each of four sections where the sample data was located. It was noted that the confidence intervals in Sections 24 and 26 which are residential areas peripheral to the downtown district were reasonably narrow. Also, a comparison of mean differences in these two sections revealed that a significant difference in first floor height above ground existed between these two sections. Therefore, the average first floor height above ground in each section was used for all structures not included in the sample in each section. The average first floor height above ground computed in Section 23 exhibited too much variance to be useful in the analysis. This was expected since this section includes the downtown business district as well as adjacent residential development. The sample information in this section was separated into residential and non-residential development and means and confidence limits were again tested. Since the calculated means were significantly different for residential and non-residential development in this section, this was the criteria used to assign first floor heights above ground to non-sample information in Section 23. A general basin wide average was used to assign first floor heights above ground to all other structures in the flood plain.

e. Stage-damage relationships were prepared for each sub-basin for the without project condition. The specific type of land use inundated by each flood was then determined and the depth of water each type is exposed to was estimated. Damage to structure and contents is computed from depth-damage relationships prepared by the Jacksonville District on a per structure basis.

f. Damage estimates for the without project Standard Project Flood, 100-year, 25-year, 10-year and 2-year flood were then determined using the stage-damage relationships mentioned above. The probability of occurrence was then defined for these floods on the basis that the flood could be equaled or exceeded in a given year. Flood frequencies and damage estimates were then combined to produce a frequency-damage curve. The frequency-damage curve was integrated to produce average annual damages for the without project existing condition for each sub-basin.

24. Creation of Damage Relationships.

a. The single-family residential and mobile home damage relationships for structural damage and content damage were estimated using actual claims information from the Federal Emergency Management Agency (FEMA) for the State of Florida during the period 1978 to 1985. Since damage estimates for multi-family residential were not available from FEMA, relationships developed by the Jacksonville District were used. The initial work for the development of multi-family damage relationships was accomplished as a part of the initial National Flood Insurance Administration's efforts to develop damage relationships. The approach consisted of selecting an average design for a low, medium and high cost residence. The cost of each structure was estimated. With the aid of the architectural and estimating sections, a damage per 1 foot of flooding relationship was constructed for each component of the structure and its itemized contents. From this information depth-damage relationships were drawn for structures and contents. These data showed little variance in the damage relationships for structures of similar building material and design even though costs varied from low to medium to high valuation. Also, there was little variance in the relationship of the value of the contents of a residence when compared to the value of the structure. Because of this likeness, one depth-damage curve was selected for each multi-family structure design and one depth-damage curve was selected for the contents of each multi-family design.

b. Depth-damage relationships for all residential structures and contents have been expressed as a percentage of the value of the structure or content. Residential structure design in the study area is homogeneous; single-family homes are one story, and multi-family dwellings are generally two story. In this study, flood depths only effect the first floor of the structure.

c. Damage susceptible land use classifications other than residential encountered in the study would include commercial and institutional. Normally the damage to these establishments would have been analyzed by an evaluation of each activity. However, due to the number of structures involved with each activity, this was not possible. The depth-damage relationships utilized for commercial and institutional land use classifications were developed by the Galveston District. The relationships used in the study are as closely related as possible to the individual types of commercial and institutional land use types that are located in the basin.

d. A depth-damage relationship for the assessment of structural damage and a depth-damage relationship for the assessment of content damage was created for each of the 29 land use classifications used in the study. Selected depth-damage relationships are shown in figures B-2 through B-11. Depth is above the structure floor. The damage factors apply respectively to the individual structure values and individual structure content values. (First story portion)

25. <u>Without Project Condition - Structure and Content Damage</u>. The without project condition is defined as the hydrologic and economic conditions currently existing in the basin. The flood damage analysis has been performed using five different magnitude floods. Average annual damage for the existing land use pattern is estimated to be $137,221. Total urban damage in the basin is $4,656,851 for the SPF, $1,506,626 for the 100-year flood and $238 for the 2-year flood. Total flood damages for the without project condition is displayed in table B-7 for each of the 47 sub-basins in the study. The total number of affected structures for the without project condition is displayed in table B-8 for each of the 47 sub-basins in the study.

26. <u>Transportation Costs</u>. Damage frequency curves for vehicle flood damage and vehicle delay and operation cost damage are shown on figure B-12. Vehicle flood damage was based on observed flood damages. Vehicle delay and operation cost was based on an analysis of average daily traffic values, flood durations, and time and distance of alternative routes.

Table B-1

Population, Selected Years
Suwannee County and the City of Live Oak
1970-1984

	Suwannee County(1)	City of Live Oak(2)
1970	15,559	6,830
1972	15,894	7,024
1973	16,561	7,050
1974	17,645	7,155
1975	18,866	7,237
1976	18,918	7,304
1978	20,645	7,430
1979	20,879	7,463
1980	22,287	6,732
1982(Est.)	23,883	6,906
1983(Est.)	24,183	6,939
1984(Est.)	24,816	6,986

SOURCES: (1) Florida Statistical Abstract, 1971 - 1985

(2) Suwannee County Comprehensive Plan, February 1981

Table B-2

Percent of Industrial Employment by Industry Type, 1980
Suwannee County and the City of Live Oak

Industry Type	County	City
Agriculture, Forestry, Fishing, Mining	13.8	4.8
Construction	7.1	4.3
Manufacturing	19.3	24.3
Transportation	3.5	3.4
Communication, Public Utilities	5.4	8.1
Wholesale Trade	4.6	5.5
Retail Trade	14.8	14.7
Finance, Insurance, & Real Estate	5.1	7.7
Services	21.0	22.3
Public Administration	5.4	4.9
Total	100.0	100.0

Table B-3

Personal Income in Suwannee County
Selected Years

Year	Total Personal Income (In Millions $)	Per Capita (In $)
1973	63.4	3,584
1974	68.7	3,803
1975	78.8	4,049
1976	89.0	4,336
1977	90.6	4,207
1978	106.4	4,862
1979	115.3	5,139
1980	125.4	5,630
1981	153.2	6,614
1982	171.0	7,148
1983	176.4	7,330

SOURCE: Florida Statistical Abstract, 1985

Table B-4

Sources of Personal Income in Suwannee County, 1982 and 1983 ($1,000 of Dollars)

Source	1982	1983
Wage and Salary Disbursement	$ 72,802	$ 75,554
Other Labor Income	8,241	9,497
Proprietors Income	16,106	12,743
Farm	12,907	7,807
Ag Serv, Forestry, Fish & Other	(D)	(D)
Mining	(D)	(D)
Construction	3,737	4,338
Manufacturing	16,482	17,497
Trans. ,Public Utilities	11,060	12,184
Wholesale Trade	3,210	3,406
Retail Trade	13,893	14,393
Finance, Insur. & Real Estate	4,232	4,535
Services	11,341	12,698
Government	18,117	18,727
Total Income by Place of Work	97,149	97,794
(-) Social Insurance	4,951	5,257
Net Income Place of Work	92,198	92,537
(+) Residence Adjustment	-9,413	-10,542
Net Income by Place of Work	82,785	81,995
(+) Dividends,Interest,and Rent	30,416	31,146
(+) Transfer Payments	38,935	42,220
Personal Income by Place of Work	152,136	155,361

(D) Data withheld to avoid disclosure of information about individual companies

SOURCE: 1985 Florida Statistical Abstract

Table B-5

Percentage Distribution of Income

Income	Suwannee County (Families)	Live Oak (Households)
Less than $5,000	13.5	24.1
$5,000-$7,499	11.3	12.0
$7,500-$9,999	12.8	11.2
$10,000-$14,999	20.0	19.8
$15,000-$19,999	14.9	11.9
$20,000-$24,999	10.9	6.8
$25,000-34,999	10.9	8.7
$35,000-$49,999	4.8	3.6
$50,000 or more	0.9	1.9
Total	100.0	100.0

SOURCE: U.S. Department of Commerce, Bureau of Census, 1980 Census of Population, General Social and Economic Characteristics

Table B-6

Live Oak Study Area
Existing Land Use

Land Use	Number of Structures Analyzed
Single-Family Residential	929
Multi-family Residential	29
Mobile Homes	97
Warehouses	17
Restaurants	6
Stores	35
Repair Shops	7
Municipal and Commercial Offices	50
Schools	4
Churches	23
Shopping Centers	3
Financial Institutions	3
Newspaper Offices	2
Clubs, Lodges, Public Hall	7
Markets	3
Funeral Homes	2
Drug Stores	5
Mental Health Center	1
Night Clubs	5
Gas Station	17
Medical Centers	2
Manufacturing and Food Processing	6
Auto Dealer and Repair	11
Beauty or Barber Shops	6
Doctor's Offices	3
Florists	2
Grocery Stores	3
Libraries	1
Laundries	I
Total	1,280

Table B-7

Structure and Content Flood Damage Computation
Without Project Conditions (in $)

Sub-basin Number	SPF Frequency	100 year Frequency	25 year Frequency	10 year Frequency	2 year Frequency	Average Annual
1	0	0	0	0	0	0
05	42,824	0	0	0	0	280
06	62,263	22,115	0	0	0	571
07	156,924	27,469	10,364	1,095	0	1,747
08-09	233,326	62,886	22,088	8,376	0	3,827
08A	0	0	0	0	0	0
10	17,265	0	0	0	0	113
11	117,426	31,833	16,162	9,330	0	2,678
11A	19,095	6,123	4,858	4,386	0	1,376
12	2,409,399	1,101,387	524,870	271,868	0	102,195
13	4,745	0	0	0	0	31
15-20	108,997	0	0	0	0	713
16	40,229	40,229	35,624	29,482	0	3,868
17	110,717	12,443	8,133	0	0	1,189
18	29,385	0	0	0	0	192
19	26,493	0	0	0	0	173
20A	0	0	0	0	0	0
21	38,887	22,297	17,950	12,257	238	3,055
22	18,477	12,798	6,534	5,578	0	2,134
23	0	0	0	0	0	0
24	3,278	0	0	0	0	21
25	89,605	0	0	0	0	586
26	14,001	0	0	0	0	91
26A	0	0	0	0	0	0
29	4,498	0	0	0	0	29
30	766,232	152,610	49,490	8,070	0	8,858
31	0	0	0	0	0	0
31A	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	6,806	0	0	0	0	44
36	0	0	0	0	0	0
37	4,657	0	0	0	0	30
39	8,179	4,971	4,371	4,057	0	1,238
44	29,151	0	0	0	0	190
44A	0	0	0	0	0	0
55	88,902	0	0	0	0	582
59A	45,670	7,651	925	0	0	373
59B	11,651	0	0	0	0	76
61	266	0	0	0	0	2
65	23,947	1,814	0	0	0	150
72	22,688	0	0	0	0	149
75	0	0	0	0	0	0
77	0	0	0	0	0	0
78A	42,025	0	0	0	0	275
78B	58,843	0	0	0	0	385
80	0	0	0	0	0	0
Total	4,656,851	1,506,626	701,369	354,499	238	137,221

Table B-8

Number of affected structures
Without Project Conditions

Sub-basin Number	SPF Frequency	100 year Frequency	25 year Frequency	10 year Frequency	2 year Frequency
1	8	3	1	0	0
05	11	3	0	0	0
06	17	14	8	8	1
07	10	7	5	4	3
08-09	36	25	17	12	0
08A	0	0	0	0	0
10	6	2	1	1	0
11	16	8	7	7	1
11A	6	3	2	2	1
12	39	29	23	19	0
13	3	1	0	0	0
15-20	39	2	0	0	0
16	5	5	5	3	1
17	17	9	5	3	0
18	27	8	0	0	0
19	10	5	1	0	0
20A	0	0	0	0	0
21	4	4	4	3	2
22	11	6	3	3	1
23	4	0	0	0	0
24	5	1	1	1	0
25	16	9	9	6	0
26	6	3	1	1	0
26A	1	1	1	1	0
29	2	2	2	2	0
30	71	33	21	16	0
31	2	2	0	0	0
31A	1	1	1	1	1
32	0	0	0	0	0
33	2	2	2	2	0
34	10	6	1	1	0
36	3	2	0	0	0
37	7	0	0	0	0
39	2	2	1	1	1
44	21	4	1	0	0
44A	0	0	0	0	0
55	9	4	3	3	0
59A	34	10	7	7	0
59B	4	3	1	1	0
61	11	0	0	0	0
65	4	3	2	1	0
72	4	2	1	0	0
75	0	0	0	0	0
77	2	2	2	2	0
78A	19	6	1	0	0
78B	18	1	0	0	0
80	2	0	0	0	0
Total	525	233	140	111	12

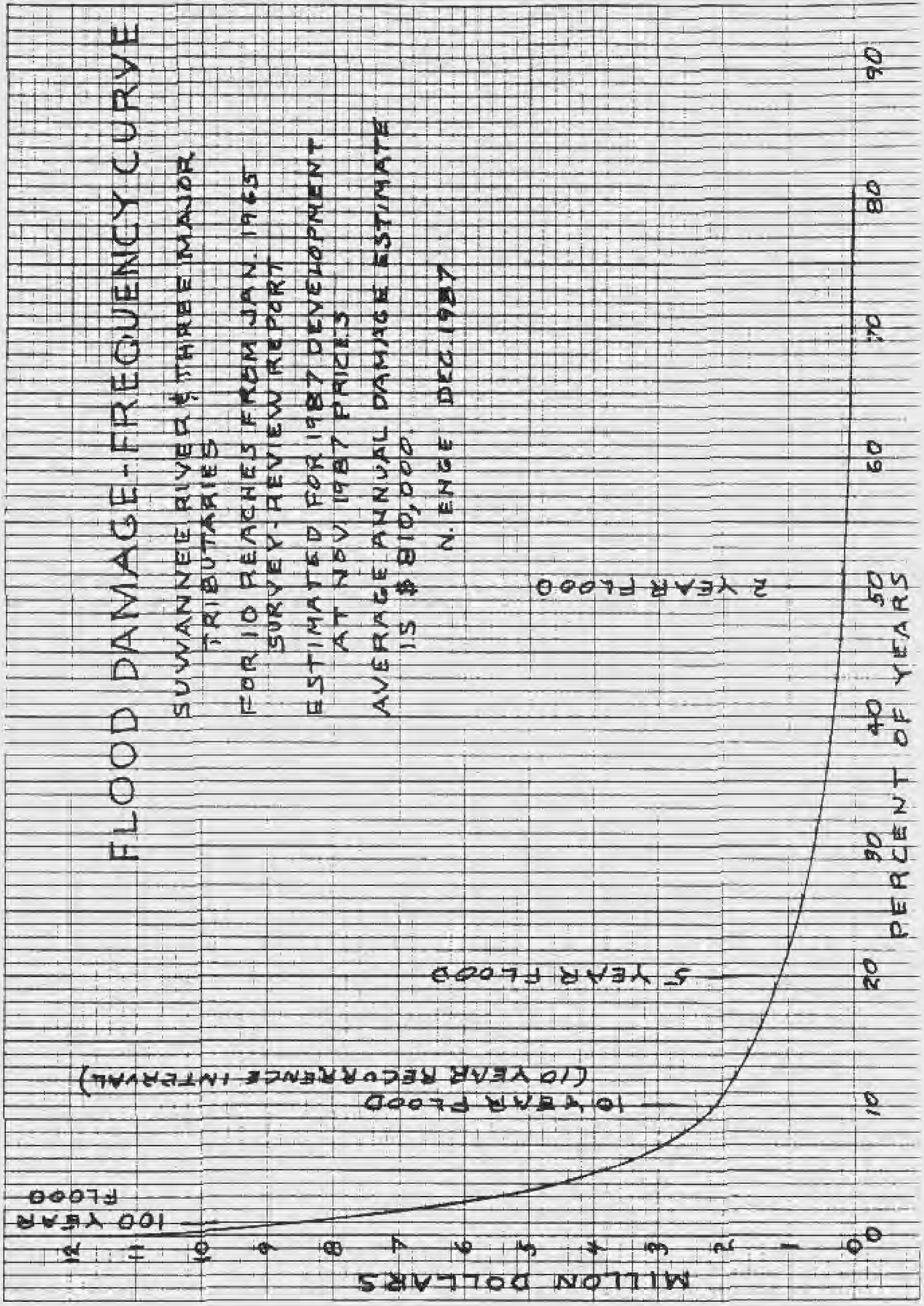

FLOOD DAMAGE-FREQUENCY CURVE
SUWANNEE RIVER & THREE MAJOR TRIBUTARIES
FOR 10 REACHES FROM JAN. 1965 SURVEY-REVIEW REPORT
ESTIMATED FOR 1987 DEVELOPMENT AT NOV. 1987 PRICES
AVERAGE ANNUAL DAMAGE ESTIMATE IS $810,000.
N. ENGE DEC. 1987
2 YEAR FLOOD
5 YEAR FLOOD
10 YEAR FLOOD
(10 YEAR RECURRENCE INTERVAL)
100 YEAR FLOOD
MILLION DOLLARS
0 1 2 3 4 5 6 7 8 9 10 11 12
PERCENT OF YEARS
0 10 20 30 40 50 60 70 80 90

FIGURE B-1

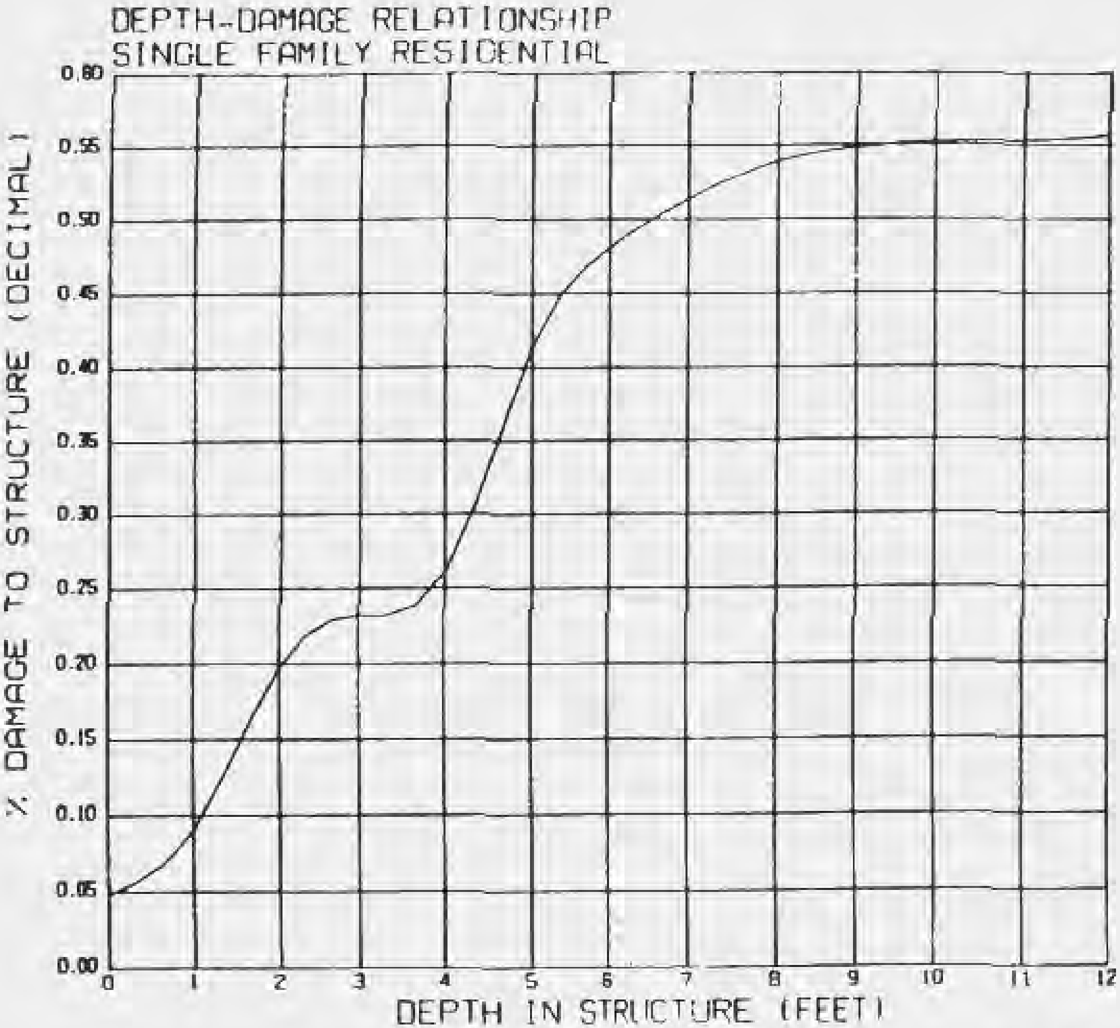

DEPTH-DAMAGE RELATIONSHIP
SINGLE FAMILY RESICENTIAL
% DAMAGE TO STRUCTURE (DECIMAL)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0 1 2 3 4 5 6 7 8 9 10 11 12
DEPTH IN STRUCTURE (FEET)

FIGURE B-2

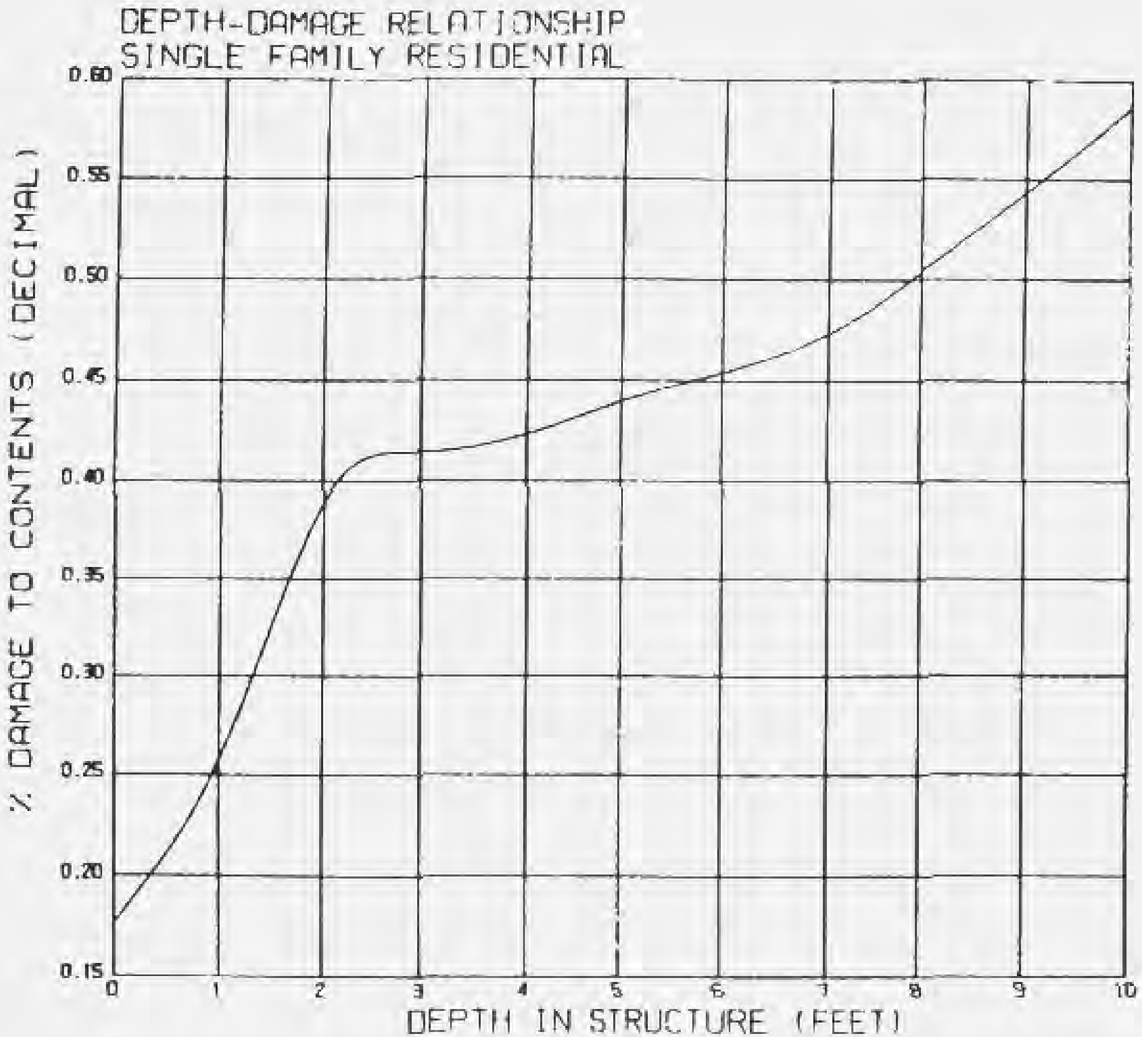

DEPTH-DAMAGE RELATIONSHIP
SINGLE FAMILY RESIDENTIAL
% DAMAGE TO CONTENTS (DECIMAL)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0 1 2 3 4 5 6 7 8 9 10
DEPTH IN STRUCTURE (FEET)

FIGURE B-3

DEPTH-DAMAGE RELATIONSHIP
MULTI-FAMILY RESIDENTIAL

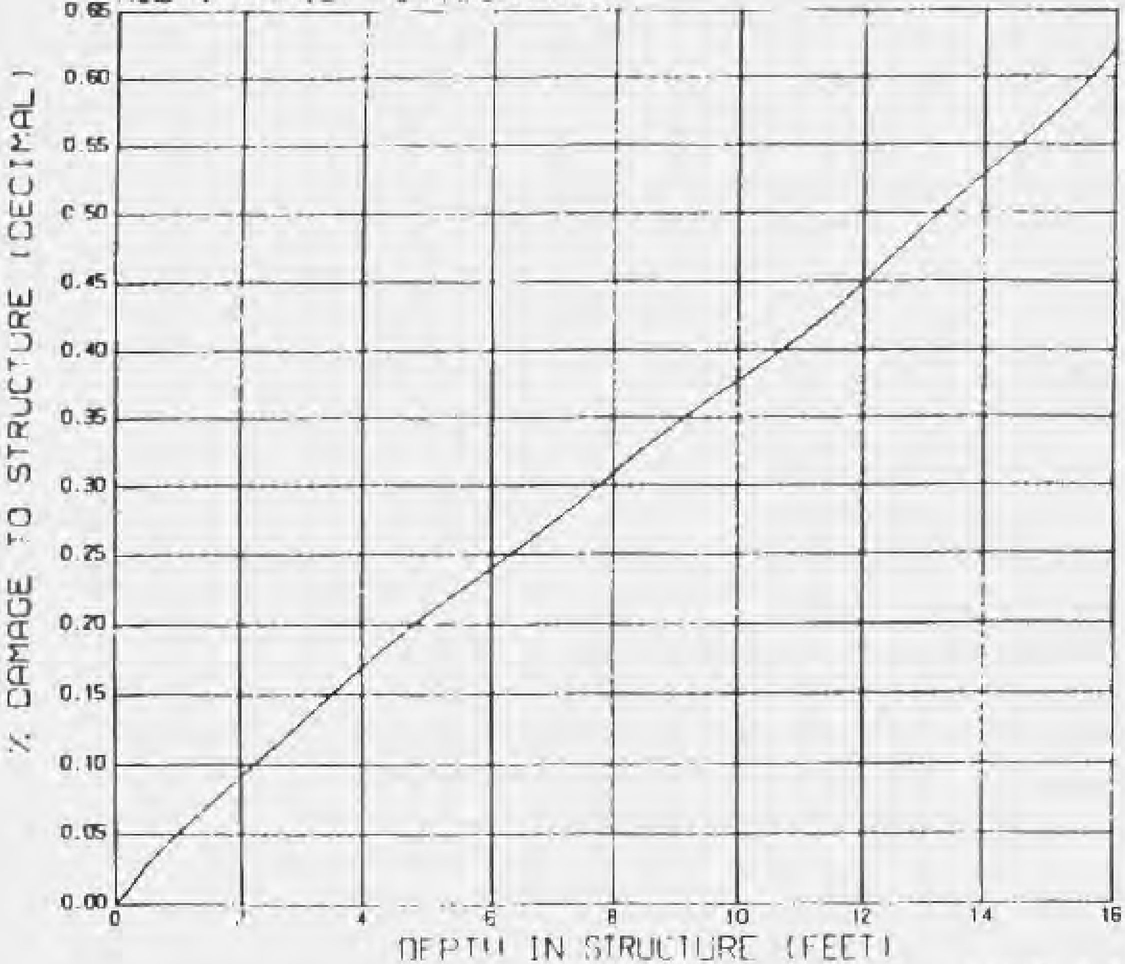


FIGURE B-4

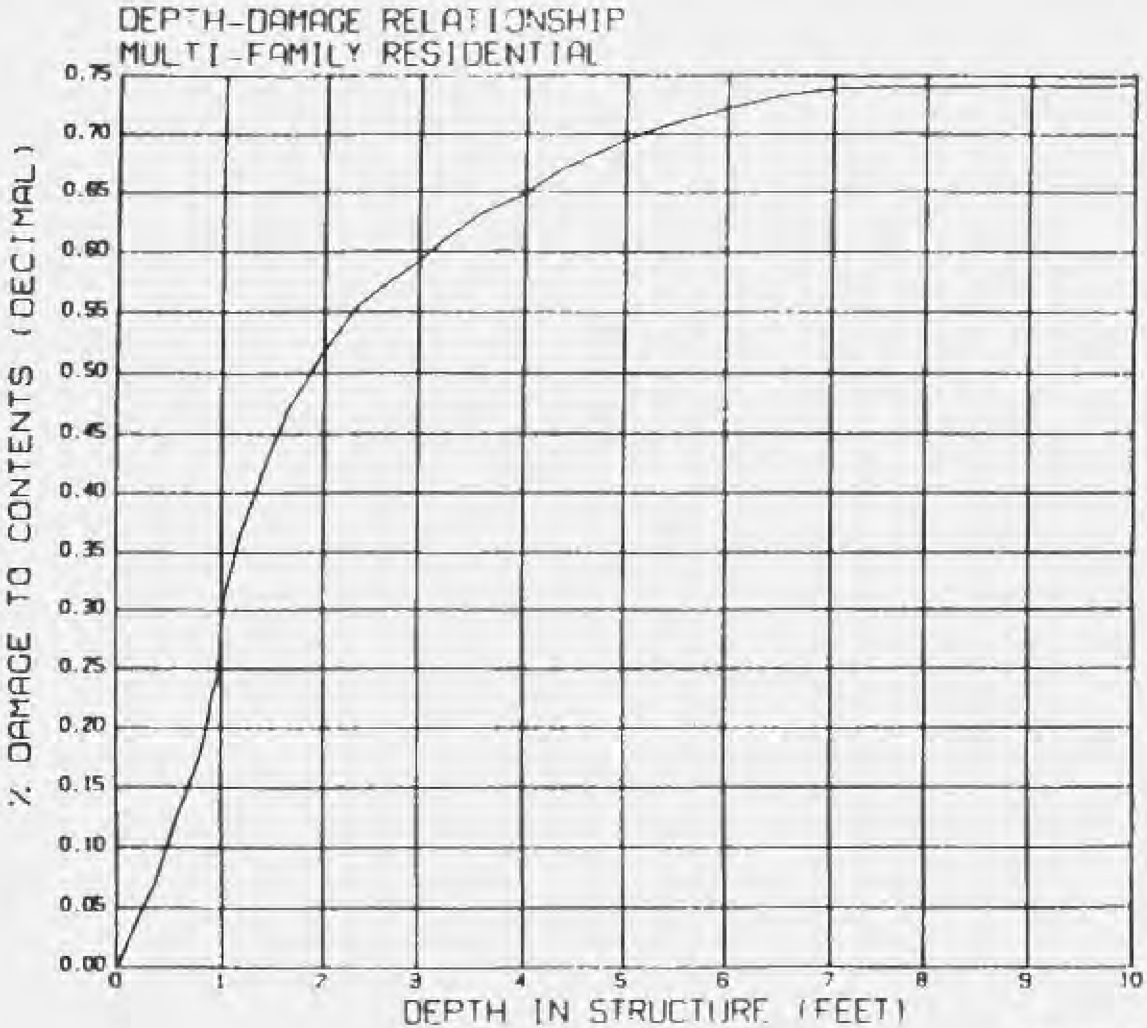

DEPTH-DAMAGE RELATIONSHIP
MULTI-FAMILY RESIDENTIAL
% DAMAGE TO CONTENTS (DECIMAL)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0 1 2 3 4 5 6 7 8 9 10
DEPTH IN STRUCTURE (FEET)

FIGURE B-5

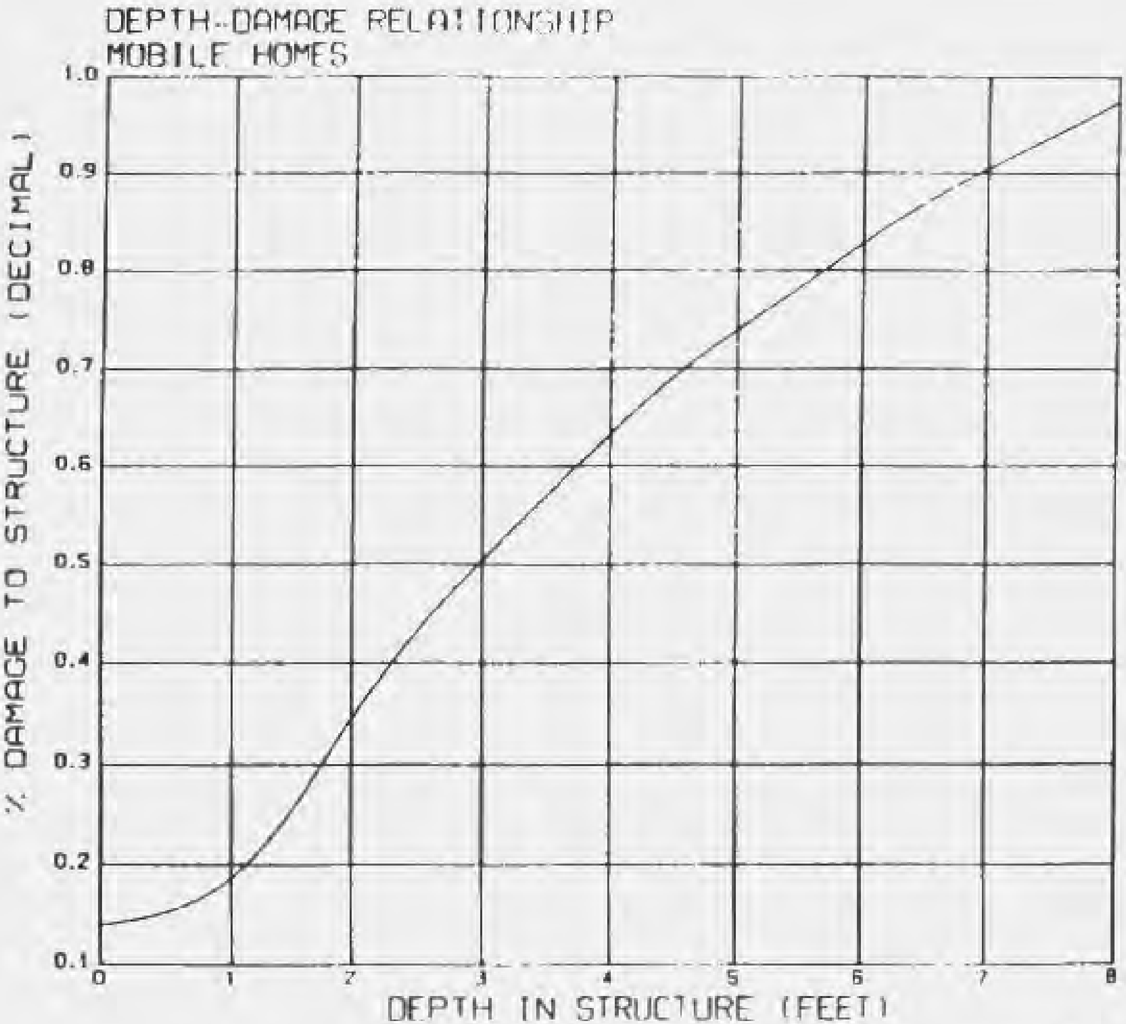

DEPTH-DAMAGE RELATIONSHIP
MOBILE HOMES
% DAMAGE TO STRUCTURE (DECIMAL)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
DEPTH IN STRUCTURE (FEET)

FIGURE B-6

DEPTH-DAMAGE RELATIONSHIP
MOBILE HOMES

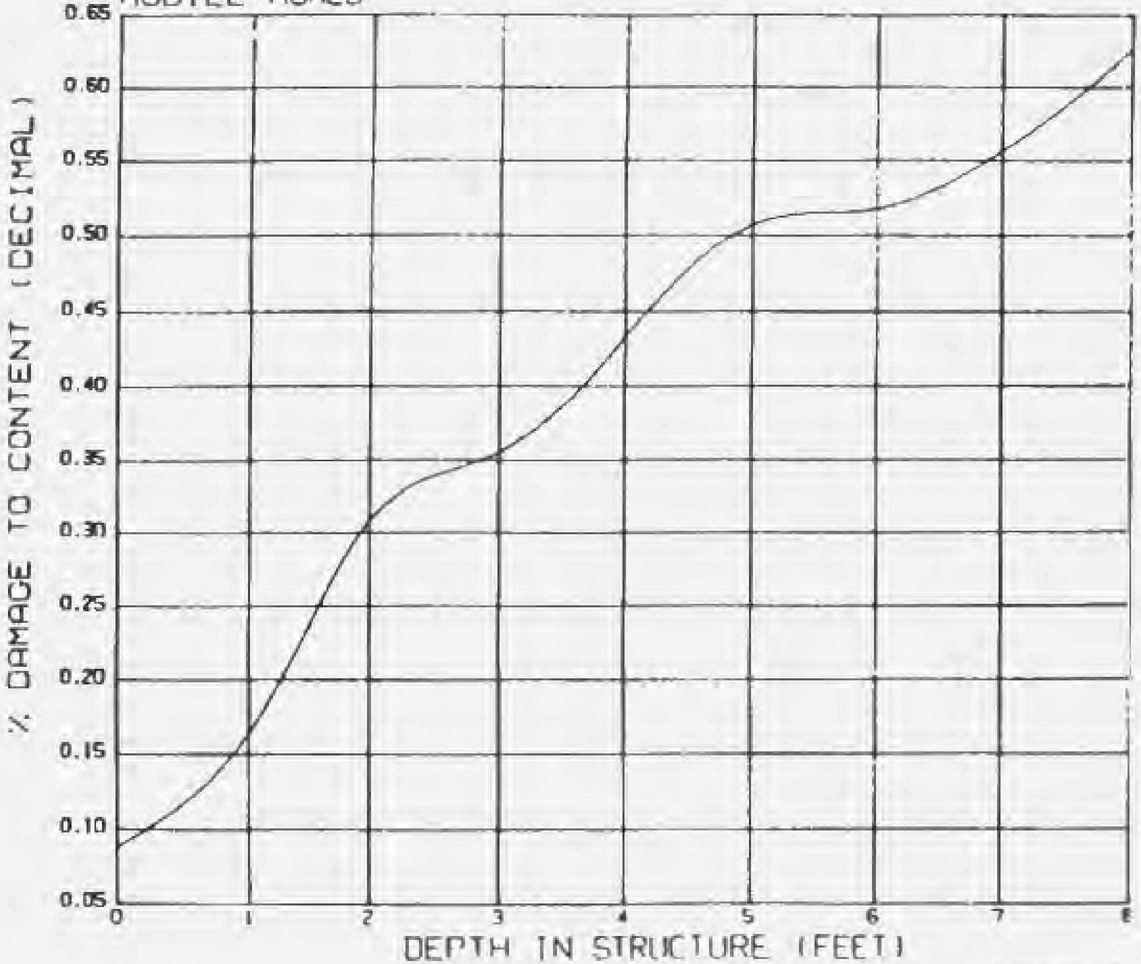
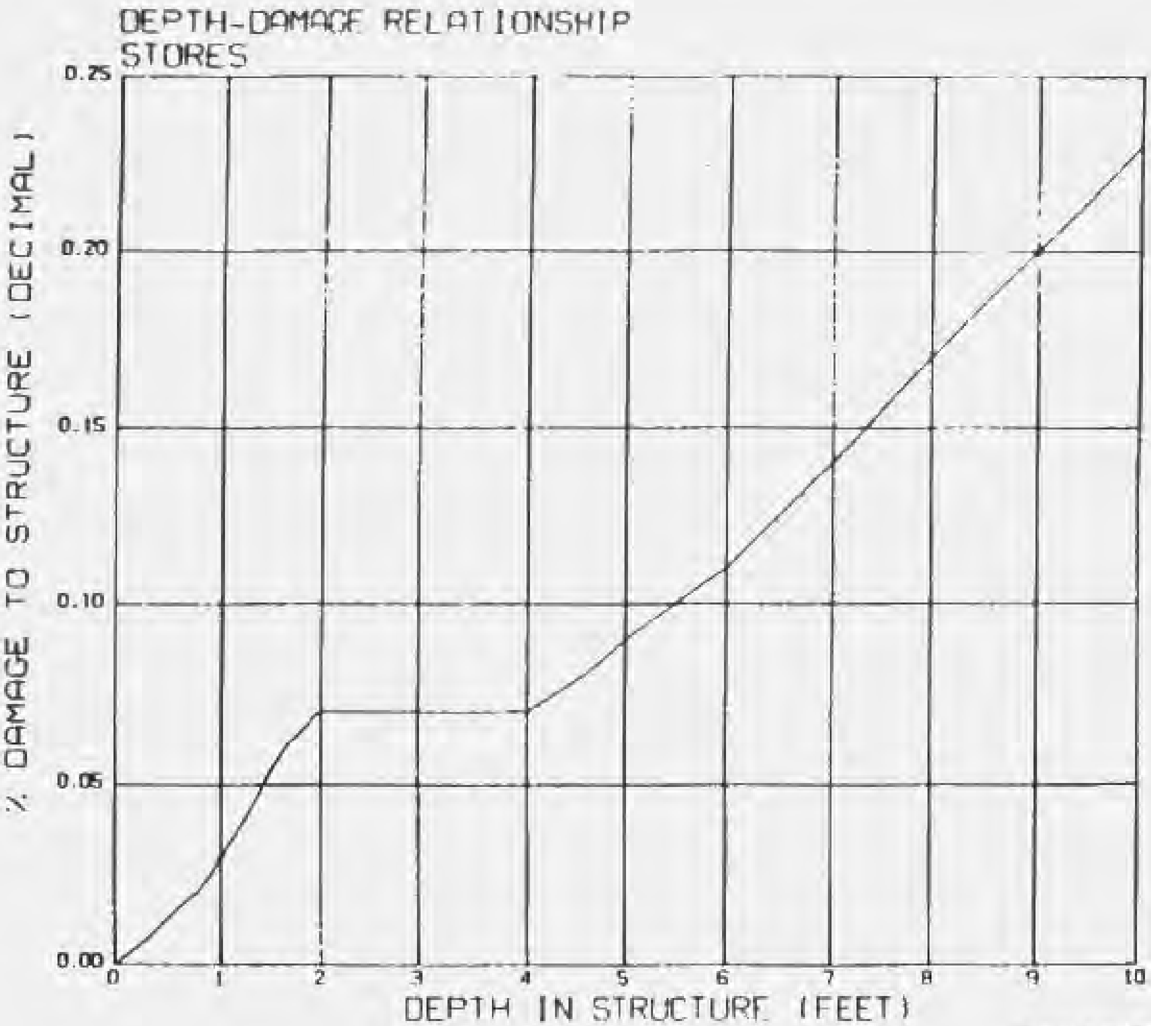


FIGURE B-7



DEPTH-DAMAGE RELATIONSHIP
STORES
% DAMAGE TO STRUCTURE (DECIMAL)
0.25
0.20
0.15
0.10
0.05
0.00
0
1
2
3
4
5
6
7
8
9
10
DEPTH IN STRUCTURE (FEET)

FIGURE B-8

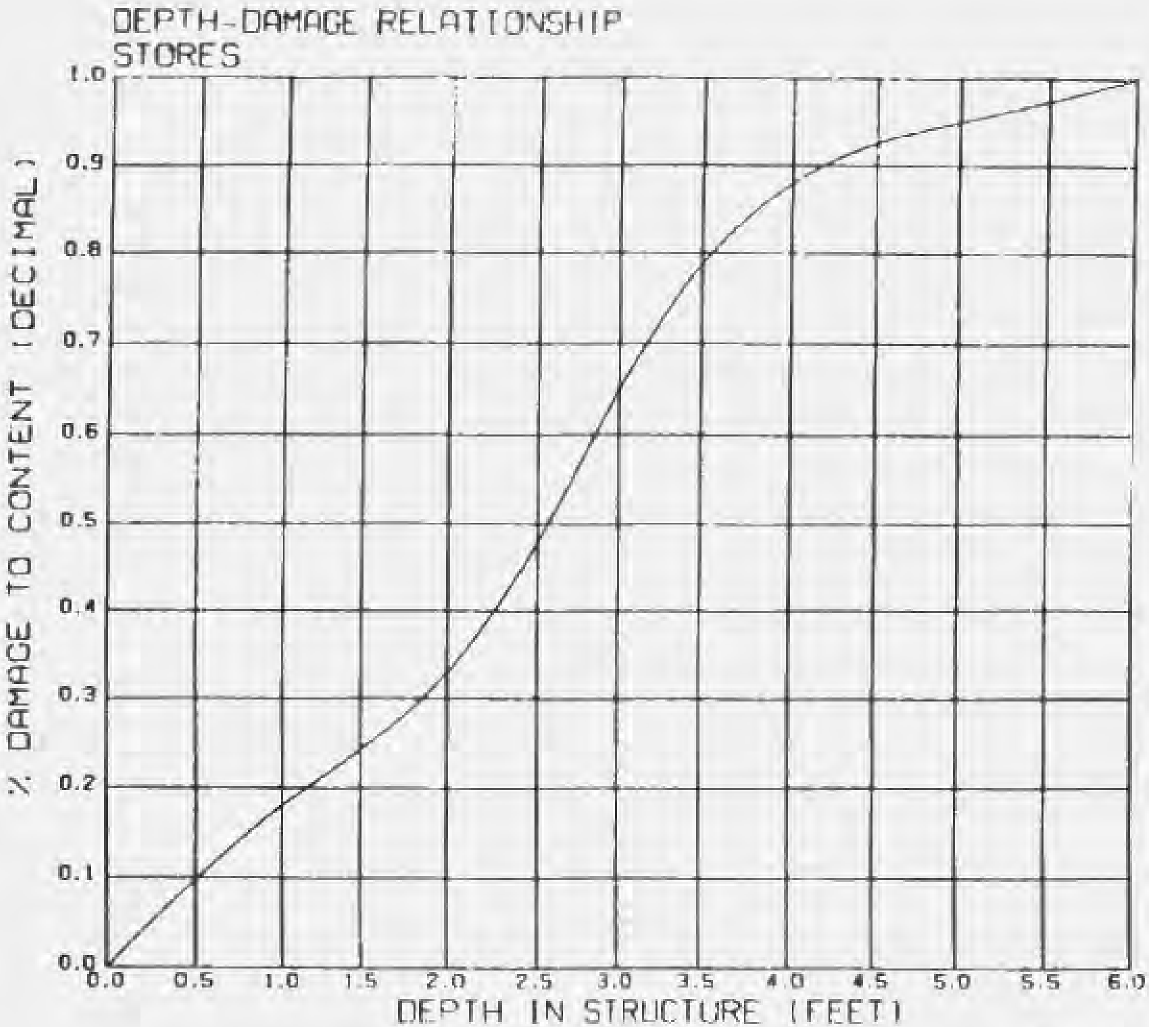

DEPTH-DAMAGE RELATIONSHIP
STORES
% DAMAGE TO CONTENT (DECIMAL)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
DEPTH IN STRUCTURE (FEET)

FIGURE B-9

DEPTH DAMAGE RELATIONSHIP
MUNICIPAL AND COMMERCIAL OFFICES

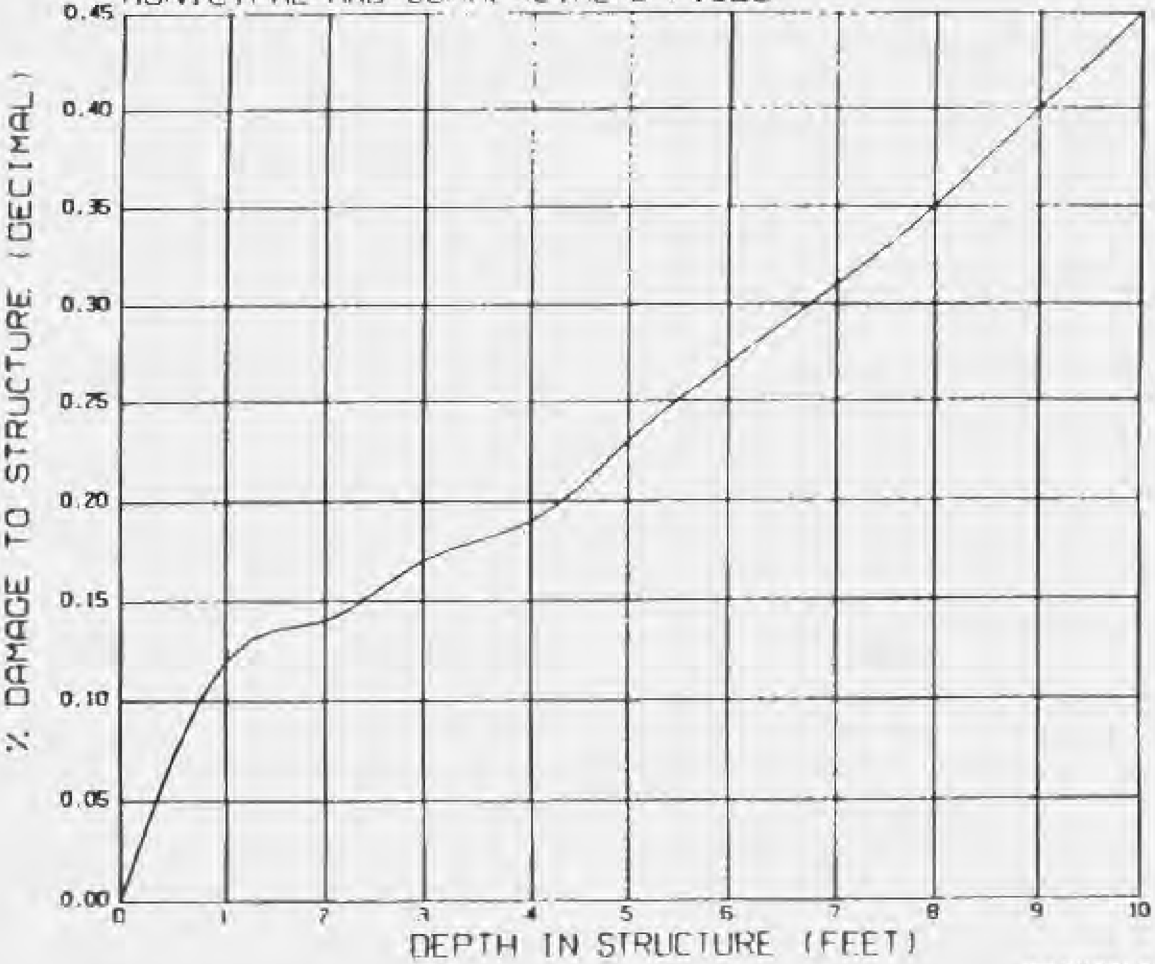
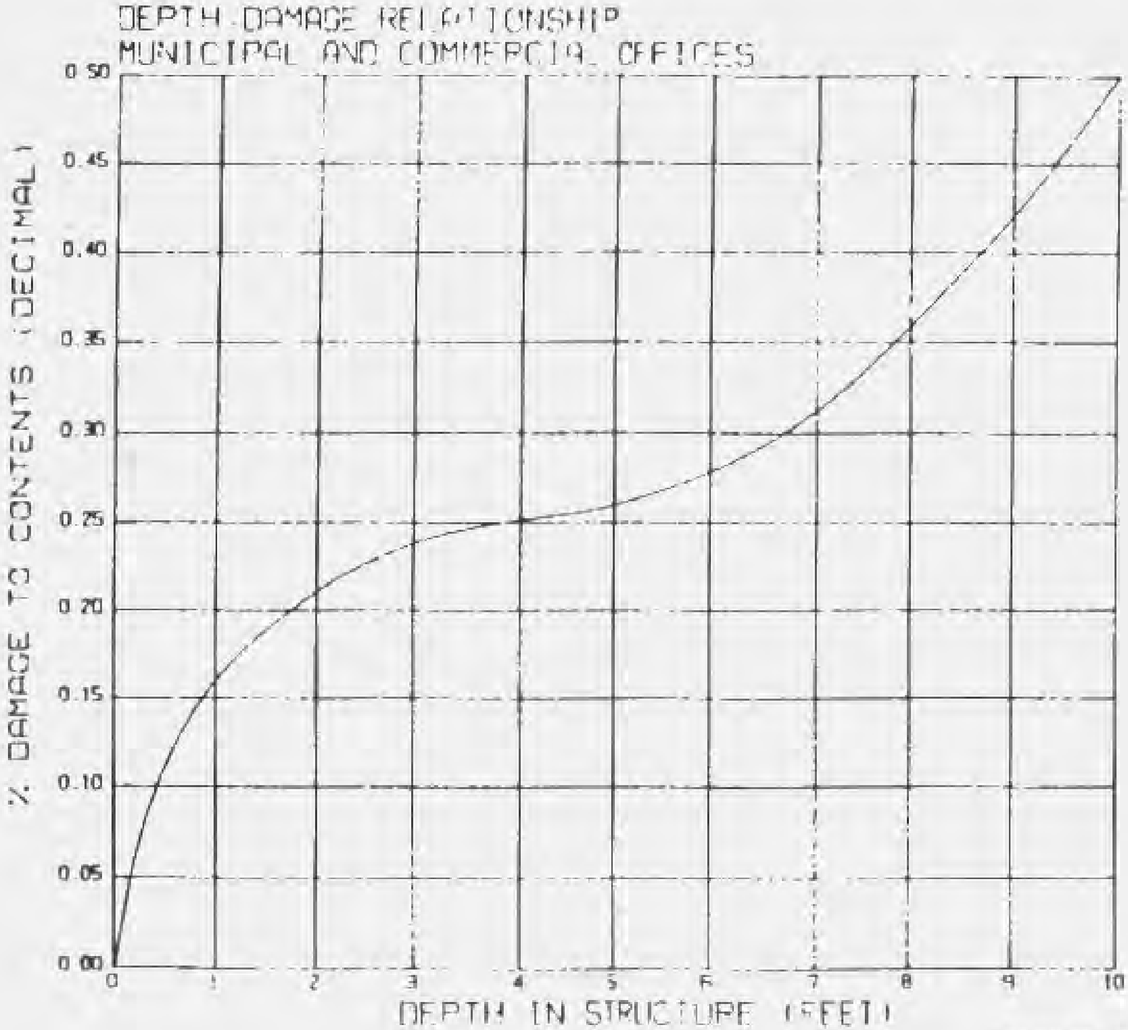


FIGURE B-10



DEPTH-DAMAGE RELATIONSHIP
MUNICIPAL AND COMMERCIAL OFFICES
% DAMAGE TO CONTENTS (DECIMAL)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0 1 2 3 4 5 6 7 8 9 10
DEPTH IN STRUCTURE (FEET)

FIGURE B-11

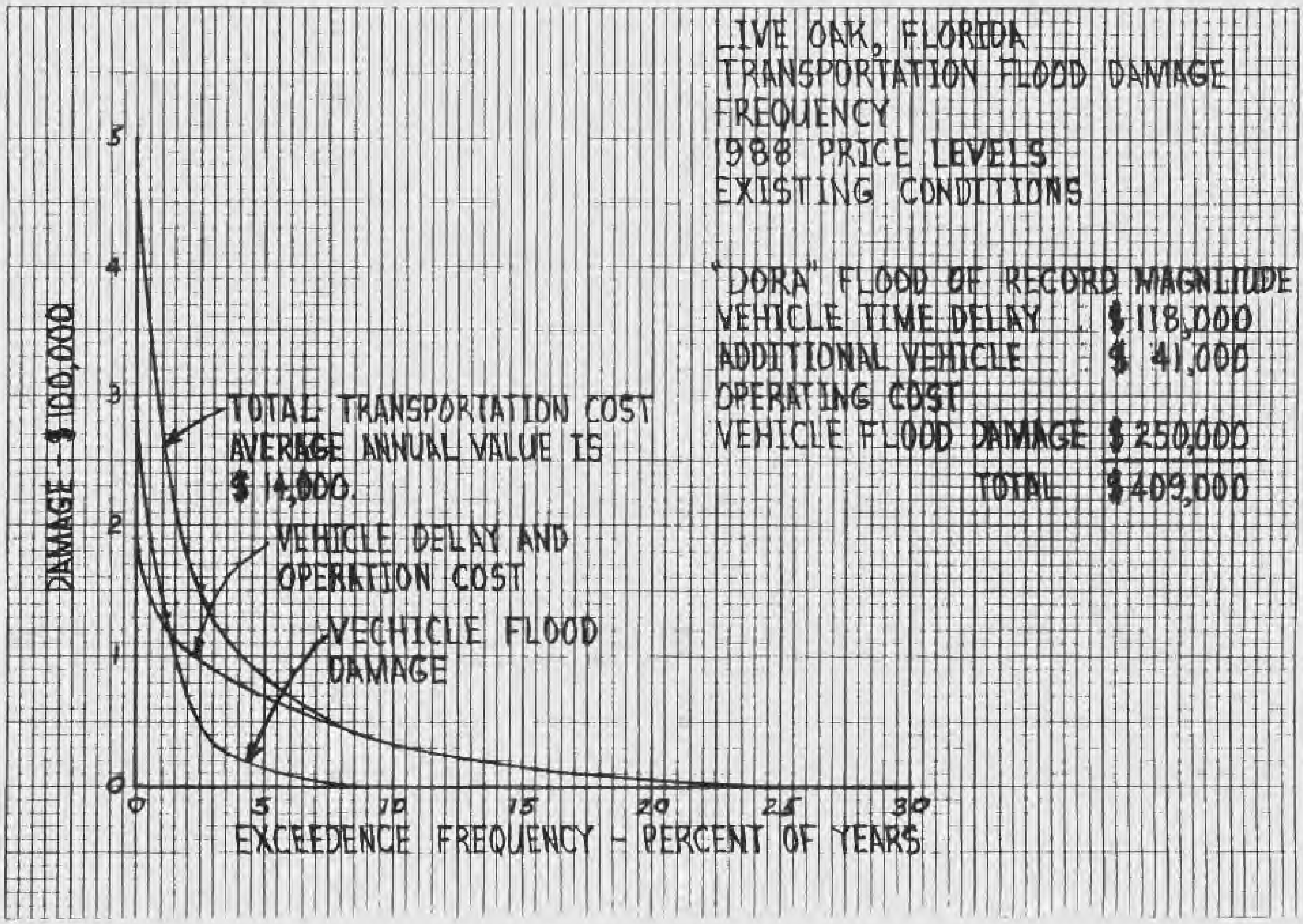

LIVE OAK, FLORIDA
TRANSPORTATION FLOOD DAMAGE
FREQUENCY
1988 PRICE LEVELS
EXISTING CONDITIONS
"DORA" FLOOD OF RECORD MAGNITUDE
VEHICLE TIME DELAY $118,000
ADDITIONAL VEHICLE OPERATING COST $ 41,000
VEHICLE FLOOD DAMAGE $250,000
TOTAL $409,000
TOTAL TRANSPORTATION COST AVERAGE ANNUAL VALUE IS $14,000.
VEHICLE DELAY AND OPERATION COST
VECHICLE FLOOD DAMAGE
DAMAGE - $100,000
0
1
2
3
4
5
0
5
10
15
20
25
30
EXCEEDENCE FREQUENCY - PERCENT OF YEARS

FIGURE B-12

APPENDIX

E

DESIGNS AND COSTS

Appendix C

Designs and Costs

1. Flood Storage Area Plan. Plate 6 in the main report shows a flood storage area plan for sub-area 12. This is only a preliminary design with a cost estimate shown on figure C-1. A final design should reconsider some factors. A larger pipe connection between a new and the existing storage area and optimization of its elevation should be investigated. Consideration should also be given to interception of existing flow going into Well no. 24 in Wilbur Street so that flow into the well would only occur if the stage in the storage area rises to the well pipe inlet. Flow could also be intercepted from the storm drain system that starts near the west end of Wilbur Street, west of Church Street. Steeper side slopes could be considered. A reduction in the right-of-way required would allow space for parking or other uses. Sinkhole activity has been observed at this site.

Optimization of Storage Capacity. The storage area plan shown on plate 6 has a storage capacity of 12.55 acre-feet. An economic analysis of the optimization of storage capacity was made. See figure C-2. Federal analytical procedure calls for storage capacity optimization at a point where the excess of annual benefits less annual costs is a maximum. Stages and annual damages prevented for various storage capacities were computed. From figure C-2, the optimized storage is indicated to be about 13 acre-feet. However, a storage capacity as small as 8 or 9 acre-feet would still provide substantial benefits.

U.S. ARMY ENGINEER DISTRICT, JACKSONVILLE
CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

PRELIMINARY COST ESTIMATE | DATE PREPARED 2-1-85 | SHEET 1 OF 1

PROJECT: FLOOD STORAGE AREA, SUWANNEE RIVER SURVEY-REVIEW REPORT

LOCATION: LIVE OAK, FL.

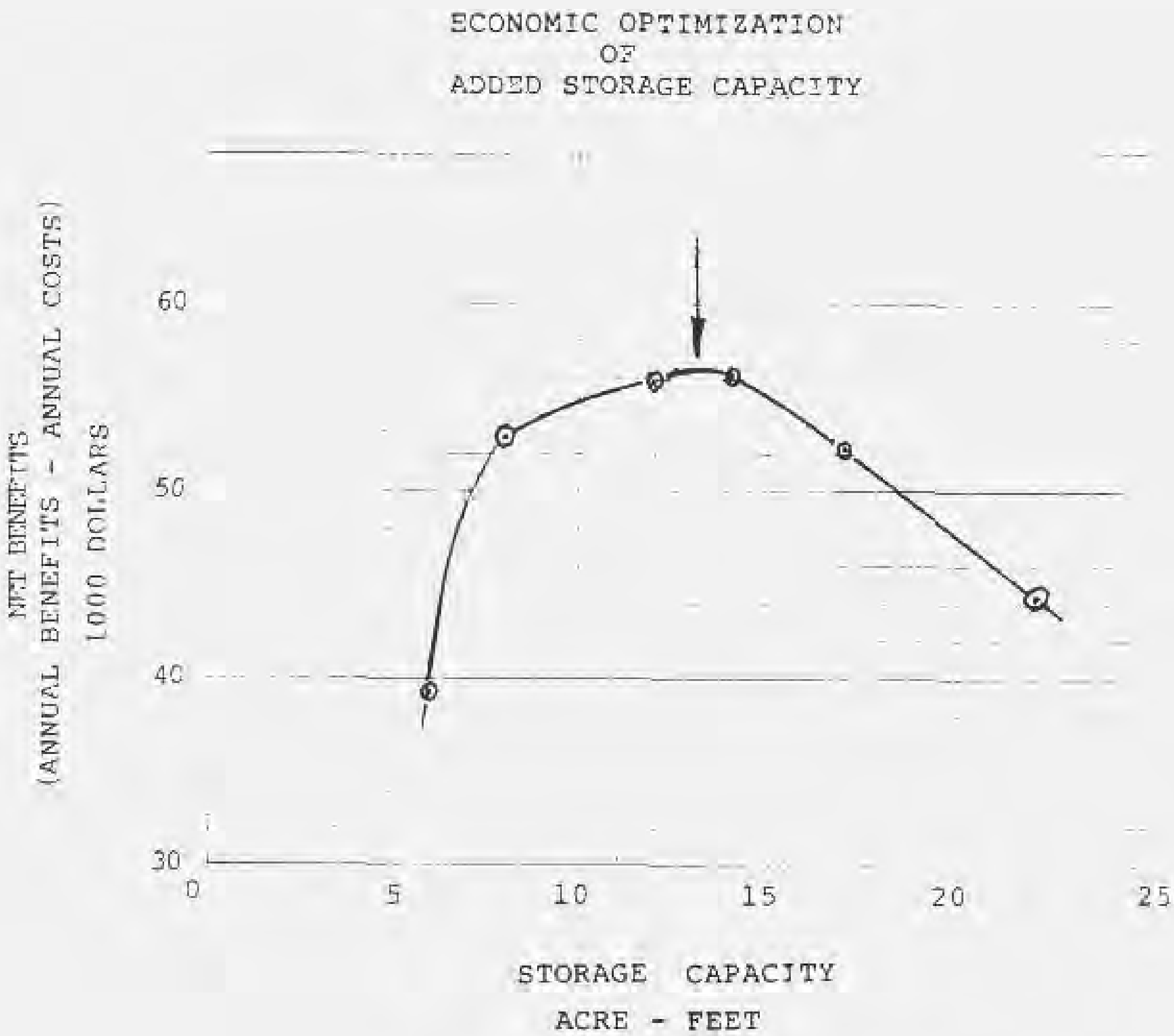
ARCHITECT ENGINEER: JAX, D.O. | CWE | PROGRAMMED

LINE ITEM NO OR CAT. CODE NO. | ESTIMATOR GT | CHECKED BY JFW | APPVD BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1	MOB & PREPWORK	1	JOB	LS	5,000 –
2	DEMOLITION OF SCHOOL BLDG	17,000	SF	2.00	34,000 –
3	DEMO OF SUPPORT BLDG	3,500	SF	2.00	7,000 –
4	PIT EXCAVATION (16' DEEP) (15 MILE HAUL)	28,000	CY	3.40	95,200 –
5	FENCE W/GATE (CHAIN LINK 6' HIGH)	1040	LF	9.00	9,400 –
6	6" PIPE (6' DEEP) (JACKING)	200	LF	12.00	2,400 –
7	CULV INLETS W/RIPRAP (57' of 36" CMP)	3	EA	3000	9,000 –
8	GRASSING (BAHIA)	0.46	ACRE	3000	1,400 –
9	CORE BORINGS	2	EA	2500	5,000
10	RIGHT OF WAY (1.7 ACRE)	1	JOB	LS	125,000
					293,400
		CONTINGENCIES @ 25%			73,400
					366,800
		E&D and S&A @ 15%			55,000
					$421,800
		ANNUAL COST @ 8 7/8% (.09003)			$38,000

SAJ FORM 430
19 OCT 60

FIGURE C-1



FOR SUBAREA 12 STORAGE PLAN

FIGURE C-2

APPENDIX

D

ENVIRONMENTAL COORDINATION

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019
April 26, 1988

Planning Division
Environmental Resources Branch

To Addresses on Attached List:

The Jacksonville District Corps of Engineers is conducting a study of flood control needs in Live Oak, Suwannee County, Florida. A survey report for Live Oak is being prepared as part of the Suwannee River Survey - Review Study.

The Corps is requesting your views and comments to assist our study and report preparation. Alternative methods of storing stormwaters are being studied. One alternative involves a pumping station and pipeline to (a) storage site(s). At present, thirteen possible flood storage sites have been identified for consideration. Of these, two or three will be selected for more detailed study. Refer to the attached map. A storm drainage pipeline system would be required to move stormwater to the pumping station(s).

Other alternative plans being studied are stormwater storage pits in downtown Live Oak. The city currently uses pits and wells to move floodwaters away from problem areas. Additional storage pits within the city limits are being considered. A disposal site(s) for the excavated material has not been identified.

Environmental consequences to be studied will include impact on wetlands, water quality, fish and wildlife habitat, and aquifer recharge. The project would not affect known archeological or historical sites identified by correspondence with the State Historic Preservation Officer.

Please provide your comments, where applicable, in conformance with the following acts: Clean Water Act, Fish and Wildlife Coordination Act, National Environmental Policy Act, and National Historic Preservation Act. Letters should be sent to the letterhead address within 30 days.

Sincerely,

A. J. Salem
Chief, Planning Division

Attachments

FLORIDA

Florida Audubon Society
1101 Audubon Way
Maitland, Florida 32751-5451

Mr. John Rains, Jr.
Isaak Walton League of America, Inc.
5314 Bay State Road
Palmetto, Florida 33561-9712

Field Supervisor
U.S. Fish and Wildlife Service
Federal Building
Room 334
Brunswick, Georgia 31520

State Clearinghouse
Office of Planning & Budgeting
Executive Office of the Governor
The Capitol
Tallahassee, Florida 32301-8074

Florida Wildlife Federation
4080 North Haverhill Road
West Palm Beach, Florida 33407-3402

The Nature Conservancy
Florida State Office
1331 Palmetto Ave., No. 205
Winter Park, Florida 32789-4969

National Audubon Society
Southeast Regional Office
P.O. Box 1268
Charleston, South Carolina 29402-1268

Environmental Information Center
of the Florida Conservation
Foundation, Inc.
1203 Orange Avenue
Winter Park, Florida 32789-4968

Special Programs
Center for Environmental Health
Shambee 27
Centers for Disease Control
Atlanta, Georgia 30333

Seventh Coast Guard District
51 SW 1st Avenue
Miami, Florida 33130

Mr. Sheppard N. Moore
Environmental Review Section
EPA, Region IV
345 Courtland Street NE
Atlanta, Georgia 30365-2401

Regional Director
Insurance & Mitigation Division
FEMA
1371 Peachtree Street NE
Atlanta, Georgia 30309-3102

Chief, Bureau of Laboratories
and Special Programs
Department of Environmental
Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-8241

State Director
ASCS
U.S. Department of Agriculture
P.O. Drawer 670
Gainesville, Florida 32602-0670

Southern Region Forester
U.S. Forest Service
Department of Agriculture
1720 Peachtree Road NW
Atlanta, Georgia 30309-2405

National Marine Fisheries Service
Environmental Assessment Branch
3500 Delwood Beach Road
Panama City, Florida 32407-7499

National Marine Fisheries Service
Office of the Regional Director
9450 Koger Boulevard
St. Petersburg, Florida 33702-2496

FLORIDA (Continued)

Northeast Regional Planning Council
8649 Baypine Road
Suite 10
Jacksonville, Florida 32216-7513

Regional Environmental Officer
Housing & Urban Development
Room 600-C
75 Spring Street, SW
Atlanta, Georgia 30303-3309

Division Engineer
Federal Highway Administration
P.O. Box 1079
Tallahassee, Florida 32302-1079

Suwannee River Water Management District
Route 3 Box 64
Live Oak, Florida 32060

City Administrator
City Hall
Live Oak, FL 32060

National Marine Fisheries Service
Chief, Protected Species
Management Branch
9450 Koger Boulevard
St. Petersburg, Florida 33702-2496

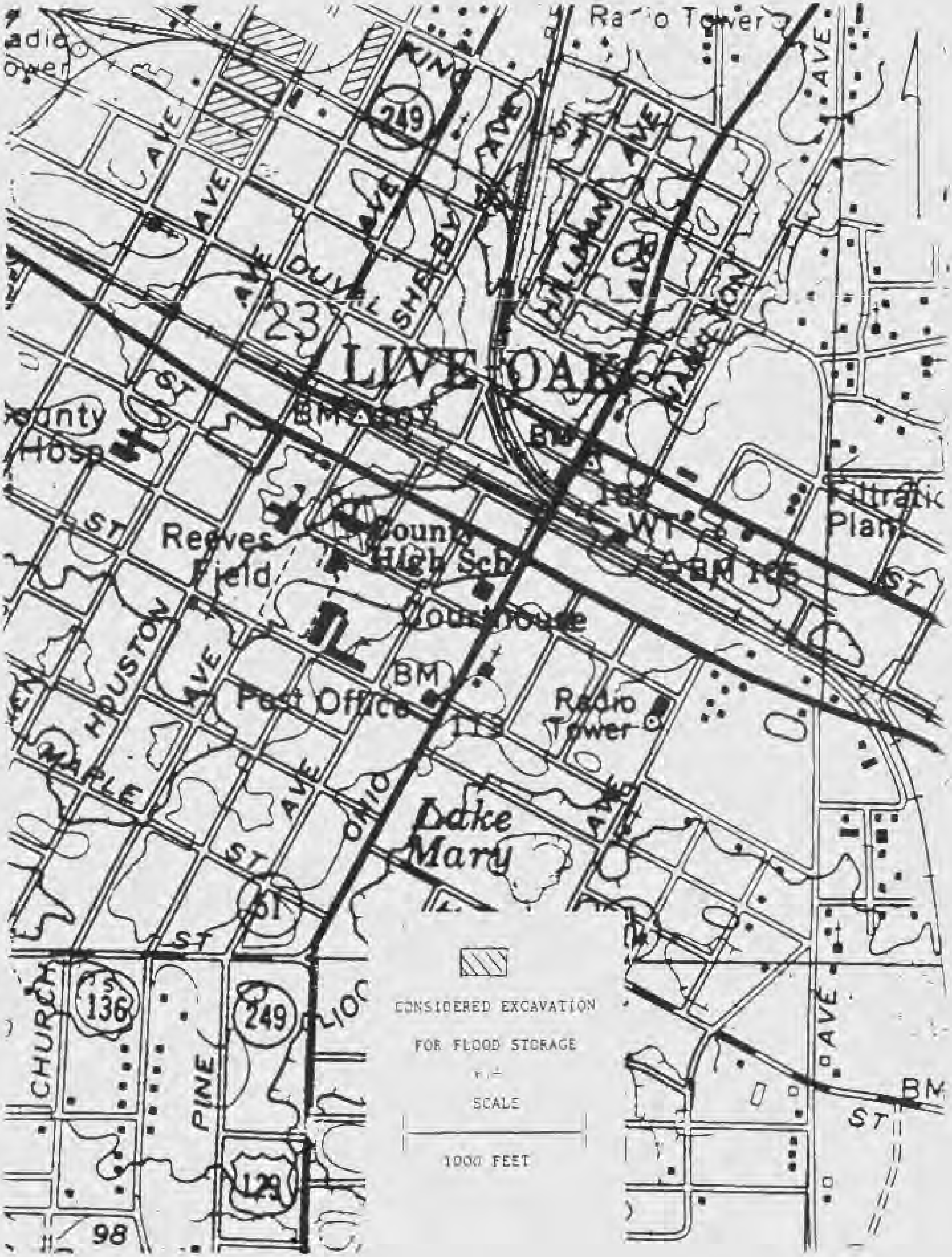
Regional Director
U.S. Fish and Wildlife Service
75 Spring Street, SW
Atlanta, Georgia 30303-3309

Mr. David J. Wesley
Fish and Wildlife Service
3100 University Boulevard, South
Suite 120
Jacksonville, Florida 32216-2732

State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
401 First Avenue, Southeast
Gainesville, FL 32601-6816

Mr Perry Jenks
SCS
Rt 4 Box 10
Live Oak, Fl 32060


R 12 E
CO
R 13 E
R 14 E
Suwannee
HAMILTON
COUNTY
River
LIVE
OAK
13
12
10
5
1
2
CONSIDERED FLOOD STORAGE AREAS
There is no site no. 5
Scale
One Mile


LIVE OAK
Radio Tower
County Hosp
Reeves Field
County High Sch
Courthouse
Post Office
Radio Tower
Lake Mary
Filtration Plant
DUVAL
SHELBY
KING
HOUSTON
MAPLE
OHIO
CHURCH
PINE
AVE
ST
BM
249
136
129
51
90
98
CONSIDERED EXCAVATION
FOR FLOOD STORAGE
SCALE
1000 FEET

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399

BOB MARTINEZ
Governor

THOMAS G. PELHAM
Secretary

May 18, 1988

Mr. A. J. Salem, Chief
Department of the Army
Jacksonville District
Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

The Department of Community Affairs, Division of Emergency Management, wishes to present its assessment and concerns for the planned floodwater storage alternatives for the City of Live Oak, Suwannee County, Florida.

The Corps addresses two alternative flood control methods currently under consideration for containment and disposal of floodwaters. The first being the construction of a number of surface floodwater storage ponds in locations surrounding the city; and the second, the expanded use of pits and wells to divert floodwater underground.

Large volumes of water injected into the underlying limestone bedrock could flush out existing cavities and speed up solution activity creating conditions for a potential geologic hazard that could result in the formation of sinkholes. Sinkhole formation is a natural process that is common in karst areas such as Suwannee County.

According to Mr. Bill Wilson of the University of Central Florida, Sinkhole Research Institute, there have been twenty-six major sinkhole formations within Suwannee County in the past five years. It is his opinion that because of the county's rural nature, this figure is an underestimate. He estimated the figure should be ten new sinkholes on the average per year, having an average width of five to ten feet. The underground injection of large volumes of water could speed up natural sinkhole formation within the City of Live Oak. With the continual expansion by solution and flushing of subsurface cavities, there is the real possibility that the bedrock could fail. Collapse of cavernous passages and voids is generally abrupt and, within a populated city center could be catastrophic. It is the recommendation of this Division that this alternative not be expanded within the city limits.

Surface water storage ponds should also be evaluated for possible future sinkhole development. An evaluation of the subsurface bedrock formation should be conducted using ground penetrating radar to identify major solution cavities. Ponds should be constructed with protective clay linings to prevent migration of surface water to the groundwater aquifer, and only in areas deemed safe so that the additional weight of water on the surface is not cause for subterranean collapse.

Possible contamination of the groundwater aquifer is another concern that this Division requests the Corps address in its study. The infusions of surface contaminants into the groundwater aquifer supply could severely reduce its present quality and create hardship and additional cost to people dependent on clean water.

Thank you for this opportunity to comment on this proposed project. If you have any further questions, please contact Frank Votra at (904) 487-4915.

Sincerely,

Gordon L. Guthrie
Director

GLG:gm

United States Department of Agriculture

Soil Conservation Service

Route 4, Box 10
Live Oak, Fl 32060

June 8, 1988

Liz Rhodes
Department of Army
Jacksonvile Department, Corps of Engineer
P. O. Box 4970
Jacksonville, Fl 32232-0019

Dear Liz:

I was glad to meet with you and Noble Enge of the Corps of Engineer, and Don Palmer and Mike Bentzien of the U.S. Fish and Wildlife Service on June 6, 1988.

I hope our discussion assisted you in your task. I know your objective is important to those of us that live in Live Oak.

If I can be of further assistance, please contact me.

Sincerely,

Perry Jenks,
District Conservationist
Live Oak, Florida

PJ/tmo

cc: Frank Ellis, Area Conservationist

United States Department of the Interior
FISH AND WILDLIFE SERVICE
3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

September 19, 1988

Colonel Robert L. Herndon
District Engineer
Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Planning Division

Dear Colonel Herndon:

This letter represents the Fish and Wildlife Service's (Service) Reconnaissance Planning Aid Letter for the Live Oak Flood Control Project in the town of Live Oak, Suwannee County, Florida. This report does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act, or fulfill the requirement of Section 7 of the Endangered Species Act of 1973, as amended. This letter was coordinated with the Florida Game and Fresh Water Fish Commission.

The study presented in this report was conducted under the authority of a Senate resolution adopted December 5, 1980. A Reconnaissance Report was prepared as a result of this resolution in September 1983, in which the Service provided a Preliminary Resource Inventory of the Suwannee River Basin. Prior to completing the Reconnaissance Report, the town of Live Oak and the Suwannee River Water Management District requested the Corps, pursuant to Section 205 of the Flood Control Act of 1948, as amended, to identify the problems and needs related to flooding in the urbanized areas of Live Oak. The Section 205 Reconnaissance Report was prepared in June 1982. The recommendation of the District Engineer was that the flood problems at Live Oak be investigated under the Suwannee River Basin Study, and that no further investigations be conducted under Section 205 authority. The Service entered into an agreement with the Corps on May 6, 1988, to investigate a number of sites around Live Oak for water retention basins.

Live Oak is located in north central Florida, about 80 miles west of Jacksonville. It is the County Seat of Suwannee County, and the largest town in the County. Suwannee County is located on the Central Ridge of the Atlantic Coastal Plain, and the topography is gently rolling with land elevations 55 to 175 feet above mean sea level. Significant drainage patterns are lacking even though the Suwannee River forms a semicircle around the western boundary of the County. A more detailed description of the area, including climatic conditions, geology, soils and demography, is found in the Section 205 Reconnaissance Report.

The physical setting of Live Oak creates a unique flood problem. The absence of natural streams and the location of the town within a complex of low-lying basins prevent normal surface drainage. The town, in an effort to improve this situation, has constructed numerous pits and discharge wells to channel the runoff through the underground Hawthorne Formation into caverns and solution channels of the lower formations. Significant rainfall produces more runoff than currently can be handled by the well injection system.

The diversity and density of wildlife in the Live Oak area is typical of north Florida. Upland areas support large mammals such as white-tailed deer, hogs, and black bears, and small mammals such as gray squirrels, raccoons, otters, armadillos, voles, shrews, and mice. Wetland habitats in the area are occupied by a variety of wading birds, such as herons and egrets, and possibly federally endangered woodstorks. Upland birds include turkeys, a wide variety of passerine birds, and woodpeckers. There is a possibility of nesting bald eagles, a federally listed species. The federally listed Florida panther may be in the area, but it would be extremely rare. However, there are plans to release panthers in Osceola National Forest within the near future.

Without the considered project, most sites would probably remain in current land use. Growth potential in the area is low, and there would be little pressure to convert the sites to other uses.

Alternatives explored in the Section 205 Reconnaissance Report included no action, flood plain zoning, flood warning system, evacuation of flood plain, floodproofing, levees, detention reservoirs, channel modification, additional drainage wells, and major drainage outlets. A series of major drainage outlets was selected as the most feasible alternative. This alternative involves a collection facility to convey flood waters to a central area within the town limits, a pumping facility to lift waters out of the collection facility, and a force main pipeline away from the town to a discharge area for natural percolation. Under the current Suwannee River Survey Review Study, the Corps identified 13 possible sites for a flood storage area outside the city of Live Oak. Other flood control alternatives, including flood storage areas within the city limits are being analyzed.

On June 6 and 7, 1988, two biologists from the Jacksonville Field Station, accompanied by two representatives from the Jacksonville District, inspected Live Oak and the 13 potential sites. The survey of the sites was cursory; a brief description of each site is presented in Table 1, and the sites are shown on the attached maps. Only three sites, 4, 5, and 12, were considered to have high quality wildlife or fishery habitats. Site 4 includes mesic hammock and forested wetlands. Site 12 consists of mixed deciduous woods. In north Florida, these habitats provide feeding, shelter, and breeding areas for mammals, resident and migratory birds, reptiles, and amphibians, and a countless variety of plants and invertebrates. Vertebrates typical of such areas were discussed above. Site 5 is part of the Florida Game and Freshwater Fish Commission's Suwannee Lake Water Management Area. The impounded lake is well vegetated in pond cypress and provides good habitat for recreational fish, such as large mouth bass and sunfish. The area is used by recreational fisherman and has one boat ramp. The recreational value of this site is considered high. The remaining sites, were either in improved pasture, agricultural land, or had low wildlife value. Should any site, but these three be selected, the Fish and Wildlife Service will not object.

If sites 4, 5, or 12, are selected as the preferred sites to construct the drainage basins, the wildlife and fish values associated with these areas will be severely degraded. The vegetation will be impacted by prolonged inundation, and urban waters and wildlife will be displaced.

Attached is a Scope of Work to determine the importance of sites 4, 5, and 12, to fish and wildlife resources. The Service has no interest in the remaining sites.

The Service believes that, based on our review of the information, there would be less impact to agricultural lands and fish and wildlife resources if flood control measures were centered in the town. Because of the potential for acquifer contamination, the use of sinkholes for flood water retention may be inappropriate. The Corps should investigate the feasibility of excavating additional water retention basins in town.

Sincerely yours,

David J. Wesley
Field Supervisor

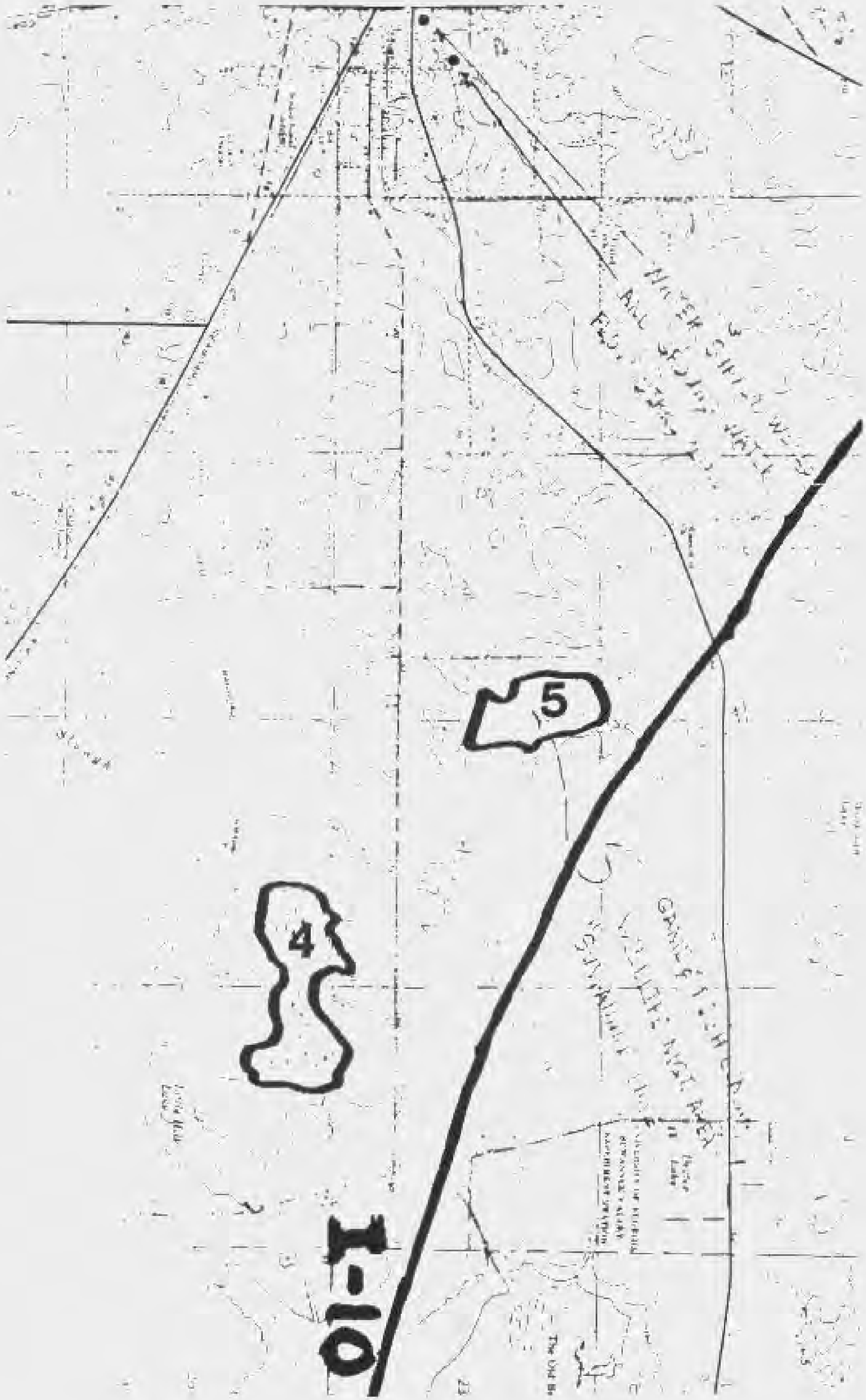
Attachments

Table 1

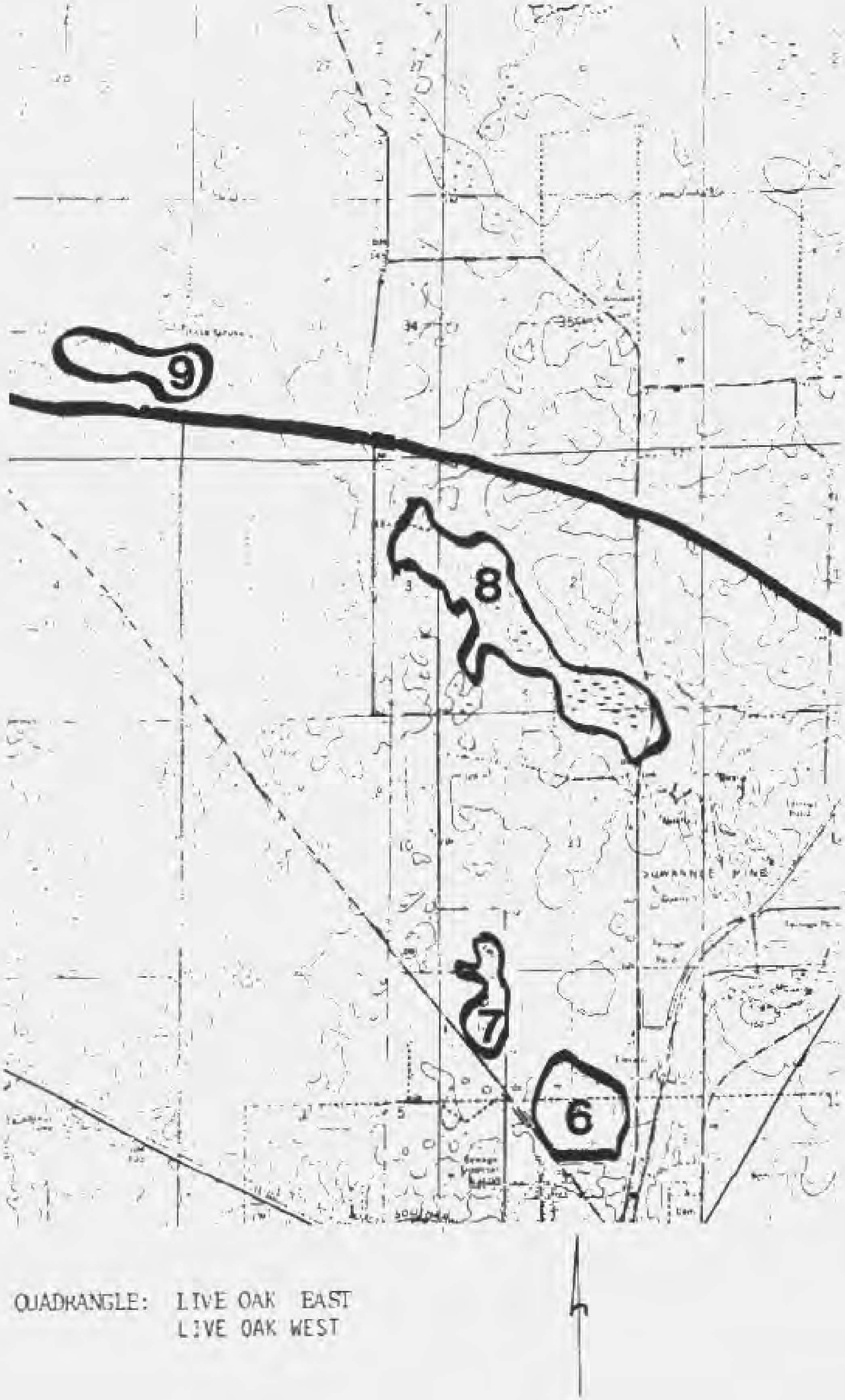
SITES CONSIDERED FOR THE DRAINAGE BASINS –
LIVE OAK FLOOD CONTROL PROJECT

SITE	ACREAGE	DESCRIPTION
1	53	Site is in a sinkhole adjacent to an open field and is surrounded by homes.
2	56	Site is in a low-lying area vegetated with live oaks. There is standing water on much of the site. Water marks about 6-7 feet up on the live oaks indicate that this area floods.
3	24	Site is located in an improved pasture; there is a sinkhole on the property
4	110	Site lies adjacent to a power line cut and consists of mesic hammock and wetland. The site has a stream running through it, draining from north to south. Other than the right-of-way, the wetland appeared to be intact.
5	76	Site is within the Florida Game and Fresh Water Fish Commission's Suwannee Lake Wildlife Management Area.
6	62	Site is within an open field.
7	32	Site is within an open field with a small pond.
8	125	Site is a mined area with numerous deep quarries.
9	90	Site is an agricultural land; during the inspection, the crop was tobacco.
10	20	A portion of this site has recently been filled. Remaining habitat is well vegetated with an apparent sinkhole in the center.
11	41	Site was inspected from a distance. It was pasture containing live oaks and pines, and had some cattle grazing.
12	100	Site appeared to be primarily upland, and supported a mixed deciduous forest.
13	25	Site contains improved pasture and a sinkhole vegetated with live oaks. A house is located just to the west.

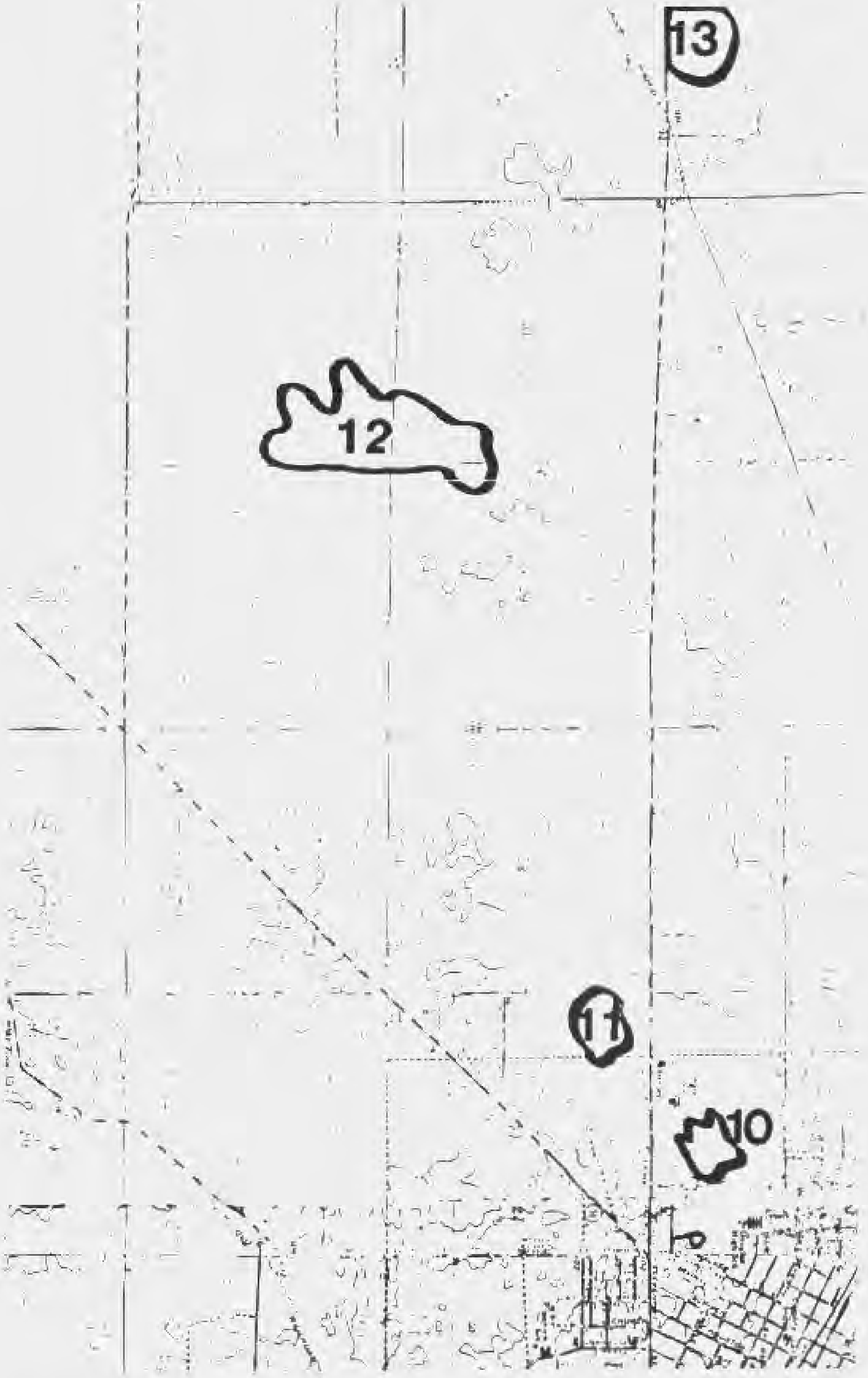
QUADRANGLE: LIVE OAK EAST
MCALPIN



QUADRANGLE: LIVE OAK EAST



QUADRANGLE: LIVE OAK EAST
LIVE OAK WEST



QUADRANGLE: LIVE OAK WEST
LIVE OAK EAST

APPENDIX

E

CORRESPONDENCE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232

December 6, 1983

Reply to
Attention of

Planning Division
Flood Control and Flood
Plain Management Branch

TO ADDRESSEES ON ATTACHED LIST

Attached is a reconnaissance report for the Suwannee River, Georgia and Florida Survey - Review Study authorized by Congress. It outlines the planned course of investigations. Public comment is invited, and may be sent to:

Commander
U.S. Army Corps of Engineers District
ATTN: Flood Control and Flood Plain
Management Branch, Planning Division
P. O. Box 4970
Jacksonville, Florida 32232

Should you have any questions, you may contact Mr. Noble Enge, telephone 904/791-1108.

Sincerely,

Richard E. Bonner
for A. J. SALEM
Chief, Planning Division

Enclosures

SUWANNEE RIVER, GEORGIA AND FLORIDA

Honorable Lawton M. Chiles
U.S. Senator
Federal Building
Lakeland, Florida 33801

Honorable Paula Hawkins
U.S. Senator
Post Office Box 2000
Winter Park, Florida 32790

Honorable Sam Nunn
U.S. Senator
126 Bull Street, Federal Bldg.
Savannah, Georgia 31402

Honorable Mack Mattingly
U.S. Senator
Suite 195, 380 Interstate North
Atlanta, Georgia 30339

Honorable Don Fuqua
Representative in Congress
227 North Bronough Street
Tallahassee, Florida 32301

Honorable Charles Hatcher
Representative in Congress
225 Pine Avenue, Room 202
Box 1932
Albany, Georgia 31701

Honorable Kenneth (Buddy) Mackay
Representative in Congress
Post Office Box 160
Ocala, Florida 32678

Honorable J. Roy Rowland
Representative in Congress
Room 207, Federal Building
Waycross, Georgia 31501

Honorable Lindsay Thomas
Federal Building
Brunswick, Georgia 31520

Field Supervisor
U.S. Fish & Wildlife Service
1612 June Avenue
Panama City, Florida 32401

District Chief
U.S. Geological Survey
6481 Peachtree Industrial Blvd.
Doraville, Georgia 30360

U.S. Geological Survey (2)
325 John Knox Road
Suite F 240
Tallahassee, Florida 32303

State Conservationist, S.C.S.
U.S. Department of Agriculture
Post Office Box 832
Athens, Georgia 30613

State Conservationist, S.C.S.
U.S. Department of Agriculture
Post Office Box 1208
Gainesville, Florida 32601

U.S. Department of Agriculture
Forest Service, Southern Region
1720 Peachtree Road Northwest
Atlanta, Georgia 30309

Honorable William Grant
State Senator
878 East Baya Avenue
Lake City, Florida 32055

Honorable George Kirkpatrick
State Senator
1338 Northwest 13th Street
Gainesville, Florida 32601

Honorable Gene Hodges
State Representative
Post Office Box 339
Cedar Key, Florida 32625

Honorable Wayne Hollingsworth
State Representative
Route 7, Box 120
Lake City, Florida 32055

Honorable Alfred Lawson, Jr.
State Representative
311 House Office Building
Tallahassee, Florida 32301

Honorable Jon Mills
State Representative
Post Office Box 12607
Gainesville, Florida 32604

Mr. Charles E. Badder
State Clearinghouse Adm.
Office of Planning & Budget
270 Washington Street, NE.
Atlanta, Georgia 30334

Georgia Department of Natural Resources (8)
Environmental Protection Division
270 Washington Street Southwest
Atlanta, Georgia 30334

Florida Intergov. Coor. (6)
Office of Planning & Bud.
The Capitol
Tallahassee, Florida 32301

Florida Department of Environmental Regulation (10)
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Florida Department of Natural Resources
Director, Division of Resource Management
3900 Commonwealth Boulevard
Tallahassee, Florida 32303

Department of Veteran and Community Affairs
Division of Land and Water Management
2571 Executive Center Circle, E.
Tallahassee, Florida 32301

Executive Director
Suwannee River Water Management District (10)
Route 3, Box 64
Live Oak, Florida 32060

Florida Game & Fresh Water Fish Commission
Office of Environmental Service
Bryant Building
Tallahassee, Florida 32301

Jerry Krummrich
Florida Game & Fresh Water Fish Commission
Northeast Region
Route 7, Box 102
Lake City, Florida 32055

Mr. Leon Kirkland, Director
Game and Fish Division
Department of Natural Resources
270 Washington Street, Southwest
Atlanta, Georgia 30334

North Central Florida Regional Planning Council
2002 Northwest 13th Street
Suite 202
Gainesville, Florida 32601

Withlacoochee Regional Planning Council
1241 Southwest Ten Street
Ocala, Florida 32670

South Georgia Area Planning Development Commission (5)
Box 1223
327 West Savannah Avenue
Valdosta, Georgia 31601

Heart of Georgia APDC
501 Oak Street
Post Office Box 667
Eastman, Georgia 31023

Middle Flint APDC
Post Office Box 6
Ellaville, Georgia 31806

Southeast Georgia APDC
Post Office Box 1276
Waycross, Georgia 31501

Southwest Georgia APDC
Cox Building
Post Office Box 346
Camilla, Georgia 31730

Suwannee County
Board of County Commissioners
200 South Ohio Avenue
Live Oak, Florida 32060

Bradford County
Board of County Commissioners
Post Office Drawer 8
Starke, Florida 32091

Madison County
Board of County Commissioners
P. O. Box 237
Madison, Florida 32340

Columbia County
Board of County Commissioners
Post Office Box 1529
Lake City, Florida 32055

Mayor of Live Oak
Post Office Drawer 1506
Live Oak, Florida 32060

Lafayette County
Board of County Commissioners
Post Office Box 88
Mayo, Florida 32066

Levy County
Board of County Commissioners
Post Office Drawer 306
Bronson, Florida 32621

Dixie County
Board of County Commissioners
Post Office Drawer 4-J
Cross City, Florida 32628

Gilchrist County
Board of County Commissioners
Post Office Box 37
Trenton, Florida 32693

Frank C. Davis
Suwannee County Coordinator
224 Pine Avenue
Live Oak, Florida 32060

Board of County Commissioners
Hamilton County Courthouse
Jasper, Florida 32052

Alachua County
Board of County Commissioners
Post Office Drawer CC
Gainesville, Florida 32602

Union County
Board of County Commissioners
County Courthouse - 103
Lake Butler, Florida 32054

Suwannee River Coalition
626 North Main Street
Gainesville, Florida 32601

Florida Phosphate Council
Post Office Box 5530
Lakeland, Florida 33803

Occidental Chemical Company
Post Office Box 300
White Springs, Florida 32096

Four Rivers Audubon Society
Post Office Box 596
Lake City, Florida 32055

Frank Sedmera
Route 1, Box 367
Lake City, Florida 32055

Florida Audubon Society
ATTN: Bill Peters
328 East St. Johns Street
Lake City, Florida 32055

Suwannee River Citizens Assoc.
Route 2, Box 486
Bell, Florida 32619

Florida Audubon Society
ATTN: Marvin Cook, Jr.
Post Office Box 1635
Tallahassee, Florida 32302

Florida Audubon Society
ATTN: Paul E. Moler
Post Office Box 185
Gainesville, Florida 32601

Florida Audubon Society
1101 Audubon Way
Maitland, Florida 32751

Florida Defenders of the Environment
622 North Main Street
Gainesville, Florida 32601

APPENDIX

5

SURVEY DATA

Appendix F

Survey Data

1. Cross Sections - Suwannee River. Cross sections and bridge data and 2-foot contour mapping used to display study information along the main Suwannee River in Florida were obtained from the Suwannee River Water Management District.

2. Cross Sections - Tributaries in Florida. Cross sections, bridge data, and establishment of bench marks for the three major tributaries were accomplished by Corps of Engineers contract for use in hydraulic computations, etc. Bound copies of benchmark lists, benchmark descriptions, and benchmark location maps were provided to the Suwannee River Water Management District.

3. Survey Data - Georgia. Cross sections of the Withlacoochee in Georgia and establishment of associated benchmarks up to the mouth of Okapilco Creek were also accomplished under the above-mentioned contract. Cross section data for 17 Cross sections (SW-26 through SW-40) are shown on figures F-1 through F-15. Elevations are in feet NGVD and station distances start at an arbitrary 10,000 feet on the left bank facing downstream. Location of cross sections are shown on USGS quandrangle maps on figures F-16 through F-20. Lists of benchmarks on the entire Withlacoochee River are shown on figures F-21 through F-24. Benchmark descriptions for six monuments established along the Withlacoochee River in Brooks County, Georgia, are shown on figures F-25 through F-30. Benchmark locations are shown on USGS quadrangle maps on figures F-31 and F-32.

4. Live Oak, Florida, Contour Mapping. Two-foot interval contour mapping of the city of Live Oak, Florida, at a scale of 1 inch equals 200 feet was accomplished under a Corps of Engineers contract. First floor building elevations in selected areas were also obtained. Copies were provided to the Suwannee River Water Management District and to the city of Live Oak.

5. Suwannee River Examination Survey. The latest to date sounding surveys of Federal navigation project channels were conducted in 1986 and 1987. The following two letters and their enclosures provide summaries of those surveys.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

December 17, 1986

Construction-Operations Division
Navigation Section

Mr. Slaughter, Chairman
Suwannee River Authority
P.O. Box 906
Live Oak, Florida 32060-0906

Dear Mr. Slaughter

Enclosed for your information are half-sized prints (D.O. File No. 55-34,838 - 17 sheets) and a Condition of Channels Report of our latest examination survey of Suwannee River, Florida (Gulf of Mexico to Ellaville).

There are no plans to perform maintenance dredging during Fiscal Year 1987.

Sincerely,

Gail G. Gren

Gail G. Gren
Chief, Construction-Operations Division

Enclosures

Copies Furnished (w/enclosures):

Suwannee River Authority, Suwannee River, FL
Group St. Petersburg, St. Petersburg, FL
Bureau of Coastal Engineering, Tallahassee, FL
U.S. Fish and Wildlife Service, Panama City, FL
Mid-Continent Mapping Ctr, Rolla, MO
Commander, Seventh Coast Guard District, Miami, FL (trip)
Commander, USACE, WRSC-D, Ft. Belvoir, VA
National Ocean Service, Rockville, MD (dup encl 1)
Commander, U.S. Army Corps of Engineers (DAEN-CWO-M)
Commander, South Atlantic Division (SADCO-O)

BCF (w/encls):
SAJEN (w/encl 1 only)
SAJTA

REPORT OF CHANNEL CONDITIONS
(100 TO 400 FEET WIDE)

D.O. File No. 55-34,838 - 17 sheets (Exam)   December 1986

Suwannee River HARBOR, Florida (State)

Name of Channel	Date survey	Project			Minimum depths in channel entering from seaward Suwannee River Navigation Datum		
		Feet width	Miles length	Feet depth	Left outside quarter feet	Mid-channel for half project width feet	Right outside quarter feet
NORTHWEST PASS Suwannee Channel: From DBN-1 (Jct. Lower Suwannee River Channel, Vic. of Little Bradford Island) to DBN-29 (Town of Suwannee)	8 May 2 July 1986	**	2.1	**	*	3.0**	*
LOWER SUWANNEE RIVER CHANNEL From: DBN-1 (Gulf of Mexico) to Jct. with East Pass	" 1986	**	2.8	**	*	3.1**	*
DERRICK ISLAND GAP From: DBN-2, Cut-5, Gulf of Mexico (Southerly Limit of Federal Project) to Entrance to Shoals South of East Pass (MI-10 to -2)	" 1986	70	8.0	6	*	3.2(1)	*
From: Entrance to Shoals South of East Pass to South Entrance to East Pass Cut-20 (MI-2 to 0.0)	" 1986	150	2.0	5	*	0.8(2)	*
EAST PASS From: South Entrance to East Pass, Cut 20 to North End East Pass, Jct. with Lower Suwannee River Channel (MI 0.0 to MI 3.4)	" 1986	150	3.4	5	*	3.3(3)	*

REPORT OF CHANNEL CONDITIONS
(100 TO 400 FEET WIDE)

D.O. File No. 55-34,838 - 17 sheets (Exam) December 1986

Suwannee River ~~HARBOR~~ Florida (State)

Minimum depths in channel entering from seaward
Suwannee River Navigation Datum

Name of Channel	Date survey	Project Feet width	Project Miles length	Project Feet depth	Left outside quarter feet	Mid-channel for half project width feet	Right outside quarter feet
SUWANNEE RIVER CHANNEL From: North End of East Pass to Vista (MI 3.4 to 12.3)	8 May 2 July 1986	150	8.9	5	*	3.8(4)	*
From: Vista to Fanning Springs, US #19 and 98 Bridge (MI 12.3 to 32.9)	"	150	20.6	5	*	3.4(5)	*
From: Fanning Springs, US #19 and 98 Bridge to SCL Railroad Bridge near Old Town (MI 32.9 to 36.4)	"	150	3.5	5	*	5	*
From: SCL Railroad Bridge near Old Town to Branford, formerly Rolands Bluff (MI 36.4 to 76.0)	"	150	39.6	5	*	4.1(6)	*
From: Branford to SR #51 Hwy Bridge near Luraville (MI 76.0 to 97.5)	"	60	21.5	4	*	4	*
From: SR #51 Hwy Bridge near Luraville to Ellaville, Dry Run Springs (MI 97.5 to 127.0)	"	60	29.5	4	*	3.4(7)	*

Suwannee River, FL
D.O. File No. 55-34,838 - 17 sheets (Exam)
Page 3 of 3
December 1986

NOTES

(A) Elevations shown are based on the Suwannee River navigation datum water level stage at the time of the field survey effort. Actual water depths may vary from depths 4 feet deeper in the lower coastline channels and depths 3 feet lesser in the mid to upper channel area at the time of the 1986 survey.

(B) See sheet No. 17 for the navigation water planes showing relationship between mean sea level, NGVD of 1929 and median water level established for use as the Suwannee River navigation datum.

(1) Shoaling along major portion of this reach with elevations ranging between 3.2' to 6.0' with a controlling elevation of 3.2' located opposite DBN-8.

(2) Major shoaling along this reach with elevations ranging between 0.8' to 5.0' with a controlling elevation of 0.8' located between SP 6 and SP 7. Vessels should use extreme caution while navigating through the Suwannee Sound approach shoals into East Pass.

(3) Least depth occurs at entrance into East Pass.

(4) Least depth occurs just downstream of Vista.

(5) Least depth occurs 1 mile downstream from Jack Landing.

(6) Least depth occurs approximately 3,000' downstream from McCrabb Landing

(7) Least depth occurs in area of Dempsey Lake.

*Centerline survey obtained utilizing limited horizontal control, aids to navigation, and prominent land features taken from NOAA Coast Chart No. 11408 and numerous USGS quadrangle maps. Shoal areas not developed by cross section this survey.

**The Suwannee River westerly approach channels through the Northwest Pass and including Suwannee Channel upstream to the junction of Suwannee River East Pass is not an authorized Federal navigation project. These channels are controlled by natural water depths and aids to navigation are privately maintained.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE FLORIDA 32232-0019

May 27, 1987

Construction-Operations Division
Navigation Section

Mr. Slaughter, Chairman
Suwannee River Authority
P.O. Box 906
Live Oak, Florida 32060-0906

Dear Mr. Slaughter:

Enclosed for your information are half-sized prints (D.O. File No. 55-34,900 - five sheets) and a Condition of Channels Report of our latest reconnaissance and shoal investigation survey of Suwannee River, Florida (East Pass, connector channels, and West Pass).

There are no plans to perform maintenance dredging during Fiscal Year 1987.

Sincerely,

Gail G. Gren

Gail G. Gren
Chief, Construction-Operations Division

Enclosures:

Copies Furnished (w/enclosures):

Suwannee River Authority, Suwannee River, FL
Group St. Petersburg, St.Petersburg, FL
Bureau of Coastal Engineering, Tallahassee, FL
U.S. Fish and Wildlife Service, Panama City, FL
Mid-Continent Mapping Ctr, Rolla, MO
Commander, USACE, WRSC-D, Fort Belvoir, VA
National Ocean Service, Rockville, MD (dup encl 1)
Commander, U.S. Army Corps of Engineers (DAEN-CWO-M)
Commander, South Atlantic Division (SADCO-O)
Commander, Seventh Coast District, Miami, FL
Gerald M. Ward Assoc., Riviera Beach, FL

BCF (w/encls):
SAJEN (w/encl 1 only)
SAJTA

REPORT OF CHANNEL CONDITIONS
(100 TO 400 FEET WIDE)

D.O. File No. 55-34,900 - 5 sheets (Exam) Apr 1987

Suwannee River ~~HARBOR~~, Florida (State)

Name of Channel	Date survey	Project			Minimum depths in channel entering from seaward MLW Datum		
		Feet width	Miles length	Feet depth	Left outside quarter feet	Mid-channel for half project width feet	Right outside quarter feet
Derrick Island Gap from: entrance to shoals south of East Pass to south entrance to East Pass, Cut-20 (MI 1.5 - 0.0).	8-26 Jan 87	70	1.5	5	0.0 (1)	0.2 (1)	0.8 (1)
Connector Channel from: East Pass, Cut-11, to Alligator Pass (DBN-15)	"	*	2.2	*	**	0.5 (2)	**
Connector Channel from: East Pass (Cut-11) to Alligator Pass (DBN-11)	"	*	2.1	*	**	0.3 (3)	**
West Pass from: DBN-15 to DBN-29	"	*	2.5	*	**	1.5 (4)	**

ENG Form 4021-R
1 Jul 59

Replaces SAD Form 1623 which is obsolete

Suwannee River, Florida
D.O. File No. 55-34,903 - 5 sheets
Sheet 2 of 2
April 1987

Notes

1. Major shoaling along this reach with elevations ranging between 0.0 feet to 5.0 feet with a controlling elevation of 0.2 feet located between SP 6 and SP 7. Vessels should use extreme caution while navigating through the Suwannee Sound approach shoals into East Pass.

2. Least depth occurs approximately 800 feet easterly of DBN-15.

3. Least depth occurs approximately 500 feet north of DBN-15.

*The connector channels and West Pass are controlled by natural water depths and are not part of the authorized Federal navigation project.

**Centerline survey obtained utilizing limited horizontal control, aids to navigation, and prominent land features taken from NOAA Coast Chart No. 11408 and several USGS quadrangle maps. Shoal areas not developed by cross section.

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk# 83-241.1 SUWANNEE RIVER WT
SW-26 file 55 # points 51 length 5862.00 min Z 58.30 max Z 100.00 Z range 41.70

#	DIST	ELEV	CODES	#	DIST	ELEV	CODES
1	10000.000	100.000	0	51	15862.000	100.000	0
2	10206.240	82.800	0				
3	10329.960	79.300	0				
4	10421.450	75.900	0				
5	10498.760	79.300	0				
6	10552.370	81.100	0				
7	10652.800	78.600	0				
8	10777.920	80.000	CL 0				
9	10903.090	84.800	0				
10	11038.170	84.600	0				
11	11180.120	83.700	0				
12	11256.510	80.700	0				
13	11363.190	85.000	0				
14	11430.650	85.400	0				
15	11556.400	83.500	0				
16	11649.930	77.700	0				
17	11784.400	79.100	0				
18	11795.570	61.300	0				
19	11920.620	79.800	0				
20	11963.590	[illegible]	CL 0				
21	12156.620	87.400	0				
22	12200.470	83.500	CL 0				
23	12277.570	74.400	0				
24	12317.240	58.300	UP 0				
25	12459.180	58.300	UP 0				
26	12508.100	77.400	0				
27	12574.630	79.300	0				
28	12667.400	87.600	0				
29	12875.240	68.900	0				
30	13057.030	83.200	0				
31	13271.140	83.900	0				
32	13420.470	66.200	0				
33	13564.860	87.300	0				
34	13667.740	90.200	0				
35	13744.800	92.100	0				
36	13873.270	91.800	0				
37	14057.950	92.400	0				
38	14206.870	89.600	0				
39	14342.320	89.600	0				
40	14493.360	89.400	0				
41	14636.920	91.600	0				
42	14757.480	93.000	0				
43	14946.030	91.900	0				
44	15071.450	92.600	0				
45	15182.890	92.800	0				
46	15270.820	93.300	0				
47	15415.430	93.500	CL 0				
48	15539.020	96.500	0				
49	15647.840	97.600	0				
50	15764.040	97.800	0				

NOTE: The number designation for this cross section is SW-26, with the location shown on figure F-16.

FIGURE F-1

83-241 TRIE SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER [illegible]
[illegible] file 56 # points 43 length 5650.03 min Z 59.40 max Z 100.00 Z range 40.60

#	DIST	ELEV	CODES
1	10000.000	100.000	0
2	10075.300	99.300	0
3	10320.560	95.800	0
4	10447.440	92.500	0
5	10623.240	86.300	0
6	10760.630	85.600	0
7	10850.320	67.700	0
8	10881.500	66.500	CL 0
9	10946.330	88.700	0
10	11032.150	68.200	0
11	11366.730	87.400	0
12	11519.490	82.300	0
13	11674.630	81.100	0
14	11804.440	79.800	0
15	11961.060	[illegible]	0
16	12106.320	[illegible]	[illegible]
17	12222.0[illegible]	[illegible]	0
18	12293.[illegible]	76.500	CL 0
19	12367.[illegible]	[illegible]	0
20	12547.520	80.300	0
21	12627.840	80.170	0
22	12689.420	71.800	0
23	12706.080	59.400	WE 0
24	12835.690	59.400	WE 0
25	12875.[illegible]	[illegible]	0
26	13046.[illegible]	[illegible]	CL 0
27	13159.480	[illegible]	0
28	13498.[illegible]	[illegible]	0
29	13588.150	80.630	0
30	13733.[illegible]	[illegible]	0
31	13845.[illegible]	80.170	0
32	13958.930	[illegible]	0
33	14079.[illegible]	[illegible]	0
34	14198.[illegible]	82.400	0
35	14604.[illegible]	57.800	0
36	14522.270	95.600	0
37	14735.320	94.000	0
38	14850.560	91.000	0
39	15119.967	91.000	0
40	15273.340	93.300	0
41	15402.939	95.100	0
42	15522.440	98.000	0
43	15650.030	100.000	0

FIGURE F-2

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANNEE RIVER WS
SU-168F file 45 # points 13 length 229.00 min Z 52.10 max Z 73.40 Z range 21.30

#	DIST	ELEV	CODES
1	10000.000	73.400	LB 0
2	10007.000	69.480	0 1
3	10025.000	64.470	0 1
4	10047.000	60.500	WS 0
5	10055.000	53.640	0 1
6	10086.000	59.500	0
7	10110.000	53.800	0 1
8	10125.000	53.800	0 1
9	10175.000	53.100	0
10	10187.000	52.100	0 1
11	10207.000	60.500	WS 0 1
12	10204.000	63.040	0 1
13	10229.000	67.300	TS 0

FIGURE F-3

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SW-28 file 57 # points 40 length 6365.21 min Z 66.10 max Z 100.00 Z range 33.90

#	DIST	ELEV	CODES
1	10000.000	100.000	0 1
2	10072.800	98.800	0
3	10236.210	96.000	0 1
4	10349.520	95.000	0 1
5	10446.020	92.800	0 1
6	10562.670	88.400	0 1
7	10650.150	81.200	0 1
8	10738.240	86.200	0 1
9	10863.960	85.800	0 1
10	11043.780	86.900	0
11	11276.530	84.700	0 1
12	11460.430	79.300	0 1
13	11699.910	74.200	0 1
14	11752.840	66.100	WS 0 1
15	11869.900	66.100	WS 0
16	11906.430	76.200	0 1
17	11986.900	78.700	CL 0
18	12156.240	77.400	0
19	12342.550	76.300	0 1
20	12553.590	75.210	0
21	12769.810	83.000	0 1
22	12934.420	82.100	0 1
23	13022.240	83.1[illegible]	[illegible]
24	13272.860	84.300	0
25	13506.730	81.000	0 1
26	13856.240	78.300	0
27	14059.300	77.7[illegible]	0 1
28	14280.480	85.200	0 1
29	14429.310	82.200	CL 0
30	14626.410	86.700	0 1
31	14811.410	88.900	0 1
32	15056.450	87.400	0
33	15319.160	90.100	0 1
34	15540.210	91.000	0 1
35	15715.380	96.800	0 1
36	15855.930	97.100	0 1
37	16035.990	92.300	0 1
38	16152.080	94.400	0 1
39	16232.520	96.600	CL 0
40	16365.210	100.000	0

FIGURE F-4

83-241 TREE SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SW-29 file 56 # points 38 length 6556.29 min Z 65.20 max Z 100.60 Z range 35.40

#	DIST	ELEV	CODES
1	10000.000	100.600	0
2	10062.140	99.800	0
3	10262.500	81.300	0
4	10488.630	79.100	0
5	10772.190	80.500	0
6	10976.900	78.500	0
7	11469.460	76.900	0
8	11630.070	67.900	0
9	11756.290	80.300	0
10	11833.990	81.600	0
11	12443.470	79.200	0
12	12654.290	79.100	0
13	13157.080	77.500	0
14	13289.380	77.500	0
15	13375.570	83.500	CL 0
16	13408.620	8[illegible].600	0
17	13506.120	8[illegible]	0
18	13586.750	83.[illegible]	0
19	13666.560	8[illegible]	0
20	13996.740	83.400	0
21	14110.680	85.000	0
22	14200.900	82.500	0
23	14345.000	79.500	0
24	14485.740	78.300	0
25	1457[illegible].860	[illegible].500	0
26	14628.440	81.500	CL 0
27	14677.450	77.900	TE 0
28	14720.870	65.200	WA 0
29	14770.550	66.200	WR 0
30	14857.590	79.[illegible]	TE 0
31	1497[illegible]	81.500	CL 0
32	15099.450	88.500	0
33	15600.550	84.300	CL 0
34	15756.010	85.300	CL 0
35	16226.150	86.300	0
36	16405.760	94.400	0
37	16467.160	97.200	0
38	16556.290	100.400	0

FIGURE F-5

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER UI
SW-30 file 59 # points 32 length 7323.99 min Z 65.20 max Z 102.10 Z range 36.90

#	DIST	ELEV	CODES
1	10000.000	100.400	CL 0 1
2	10133.930	100.000	CL 0 1
3	10281.780	99.900	0 1
4	10436.300	97.700	0
5	10514.760	97.000	0 1
6	10730.810	96.400	0 1
7	10918.300	89.400	0 1
8	11117.300	90.100	0 1
9	11197.160	88.200	0 1
10	11411.530	85.500	0 1
11	11947.680	84.600	0 1
12	12057.650	83.600	0 1
13	12182.890	82.300	0 1
14	12753.970	82.400	0 1
15	12863.640	79.900	0 1
16	13950.670	81.700	0 1
17	14650.840	80.500	CL 0 1
18	14730.960	78.900	TB 0
19	14793.050	65.200	WF 0 1
20	14864.430	65.200	WF 0
21	14957.500	77.500	TB 0 1
22	15121.110	76.500	0 1
23	15167.500	78.500	CL 0 1
24	15152.250	76.000	0 1
25	15617.870	92.700	0
26	15704.390	93.800	0 1
27	15819.030	96.900	0 1
28	15901.720	97.300	0 1
29	16027.260	97.700	0 1
30	16110.200	97.300	0 1
31	16229.070	96.500	0
32	17323.990	102.100	0 1

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER UI
SW-17AF file 45 # points 13 length 166.00 min Z 57.12 max Z 83.24 Z range 26.12

#	DIST	ELEV	CODES
1	10000.000	77.470	TB 0 1
2	10015.000	67.620	WA 0 1
3	10020.000	63.620	0 1
4	10035.000	58.420	0 1
5	10060.000	57.620	0 1
6	10085.000	57.120	0 1
7	10100.000	60.620	0 1
8	10125.000	58.820	0 1
9	10142.000	59.820	0 1
10	10152.000	64.620	0 1
11	10157.000	67.620	WA 0 1
12	20158.000	65.820	TB 0 1
13	10166.000	83.240	TB 0 1

FIGURE F-6

93-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9016 disk: 93-241.1 SUWANNEE RIVER at

SU-31 file 60 # points 67 length 8331.29 min Z 60.50 max Z 100.00 Z range 39.50

#	DIST	ELEV	CODES	#	DIST	ELEV	CODES
1	10000.000	100.000	0	51	16115.830	82.900	0
2	10137.190	93.100	0	52	16221.400	86.200	0
3	10273.700	89.800	0	53	16381.350	87.200	0
4	10386.460	83.900	0	54	16531.860	89.100	0
5	10516.990	85.700	0	55	16753.640	90.000	0
6	10652.470	82.600	0	56	16887.150	91.900	0
7	10771.230	79.300	0	57	17009.150	93.000	0
8	10950.250	79.200	0	58	17156.650	91.300	0
9	11102.020	74.600	0	59	17318.920	90.400	0
10	11216.510	72.400	0	60	17464.440	90.500	0
11	11397.770	73.700	0	61	17614.220	86.500	0
12	11548.530	75.300	0	62	17722.970	88.200	0
13	11711.750	73.700	0	63	17872.960	89.400	0
14	11890.810	75.600	0	64	17964.240	91.300	0
15	12048.320	75.000	0	65	18118.730	90.800	0
16	12136.080	77.600	0	66	18229.280	90.600	0
17	12255.080	69.400	CL 0	67	18331.290	92.200	0
18	12304.830	77.700	0				
19	12341.090	65.200	WA 0				
20	12421.090	65.200	WP 0				
21	12461.600	84.900	0				
22	12489.650	86.200	CL 0				
23	12528.850	68.100	0				
24	12732.360	85.600	0				
25	12934.330	85.500	0				
26	13106.850	74.600	0				
27	13306.150	82.600	0				
28	13460.550	81.000	0				
29	13625.670	79.700	0				
30	13816.450	72.600	0				
31	13998.200	79.600	0				
32	14165.710	81.000	0				
33	14285.470	81.400	0				
34	14407.950	83.500	0				
35	14574.450	84.100	0				
36	14723.990	68.100	0				
37	14866.750	83.900	0				
38	14982.510	83.500	0				
39	15156.020	79.900	0				
40	15310.540	77.400	0				
41	15464.050	81.500	0				
42	15560.550	82.600	0				
43	15634.560	78.700	0				
44	15752.060	88.700	0				
45	15834.820	91.300	0				
46	15895.820	87.900	CL 0				
47	15902.430	87.900	CL 0				
48	15987.170	84.200	0				
49	16027.090	61.200	0				
50	16070.830	60.500	0				

FIGURE F-7

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SW-32 file E: # points 72 length 7823.04 min Z 68.90 max Z 101.40 Z range 32.50

#	DIST	ELEV	CODES	#	DIST	ELEV	CODES
1	10000.000	101.400	0	51	15862.910	89.600	0
2	10039.430	99.100	0	52	15908.410	90.200	CL 0
3	10343.320	98.000	0	53	15985.170	91.800	0
4	10456.510	97.200	0	54	16070.960	94.300	0
5	10549.270	91.400	CL 0	55	16122.450	94.800	0
6	10658.310	82.700	0	56	16271.690	90.300	0
7	10797.530	76.300	0	57	16455.700	88.500	0
8	10937.110	79.500	0	58	16559.210	89.600	0
9	11059.800	82.800	0	59	16650.480	92.400	0
10	11225.065	83.100	0	60	16772.470	91.400	0
11	11464.830	83.800	0	61	16849.220	91.800	0
12	11605.090	87.600	0	62	16894.330	94.400	0
13	11845.110	87.300	0	63	16970.980	96.700	0
14	11998.120	82.700	0	64	17059.740	98.200	0
15	12166.870	82.600	0	65	17140.500	99.200	0
16	12292.130	85.300	0	66	17217.500	100.500	0
17	12491.400	81.700	0	67	17356.030	99.800	0
18	12764.660	76.400	0	68	17478.520	97.200	CL 0
19	12978.420	75.500	0	69	[illegible]	95.700	0
20	13120.960	94.500	0	70	[illegible]	98.200	0
21	13221.200	81.100	0	71	17790.630	[illegible]	0
22	13269.460	68.900	WF 0	72	[illegible]	[illegible]	CL 0
23	13325.910	68.900	WS 0				
24	13369.720	86.100	0				
25	13419.470	86.600	[illegible] 0				
26	13476.470	87.900	0				
27	13519.730	86.900	CL 0				
28	13562.240	87.700	0				
29	13657.240	84.200	CL 0				
30	13719.730	86.800	0				
31	13818.010	88.000	0				
32	13897.740	88.100	0				
33	13974.260	79.800	0				
34	14078.020	86.600	0				
35	14172.520	93.000	0				
36	14275.770	95.000	CL 0				
37	14406.300	94.100	0				
38	14526.800	87.300	0				
39	14684.550	81.500	0				
40	14761.060	81.200	0				
41	14865.000	89.700	CL 0				
42	14915.630	82.900	0				
43	15075.850	87.600	0				
44	15190.350	88.900	0				
45	15285.870	88.500	CL 0				
46	15344.350	89.300	0				
47	15452.380	87.000	CL 0				
48	15595.140	86.500	0				
49	15638.400	91.100	0				
50	15687.310	89.300	0				

FIGURE F-8

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SU-33 file 62 # points 30 length 4894.09 min Z 74.90 max Z 100.00 Z range 25.10

#	DIST	ELEV	CODES
1	10000.000	100.000	0 1
2	10138.450	94.700	0 1
3	10296.360	95.400	0 1
4	10511.530	83.800	0 1
5	10633.280	91.200	0 1
6	10865.650	91.900	CL 0 1
7	10954.440	94.300	0 1
8	11564.180	95.300	0 1
9	11736.510	90.600	0 1
10	11932.980	87.600	0
11	12096.440	87.200	0 1
12	12319.790	87.500	0 1
13	12439.280	88.100	CL 0 1
14	12553.340	82.100	0 1
15	12592.820	74.900	WA 0 1
16	12661.500	74.900	WA 0 1
17	12728.140	80.800	0 1
18	12904.520	85.300	0 1
19	13049.300	91.700	0
20	13243.260	93.800	0 1
21	13480.840	91.800	0 1
22	13709.190	91.800	0
23	13822.470	90.100	CL 0 1
24	13965.270	90.200	0 1
25	14191.570	89.330	0 1
26	14363.970	89.100	0 1
27	14556.370	92.200	0 1
28	14781.940	90.500	0 1
29	14862.610	97.400	CL 0 1
30	14894.090	100.000	0 1

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SU-34 file 63 # points 15 length 6122.93 min Z 68.30 max Z 100.00 Z range 31.70

#	DIST	ELEV	CODES
1	10000.000	100.000	0 1
2	10813.810	95.800	CL 0 1
3	12296.690	90.400	0 1
4	12399.190	89.300	0 1
5	12632.440	90.200	0 1
6	13096.420	85.600	CL 0 1
7	13266.940	89.800	0 1
8	13477.950	88.300	0 1
9	13605.340	87.000	0 1
10	13798.820	87.400	0 1
11	13904.740	87.800	0 1
12	15360.510	68.300	WA 0 1
13	15505.550	68.300	WA 0 1
14	16082.820	97.700	0 1
15	16122.930	100.000	0 1

FIGURE F-9

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WS
SW-35 file 64 # points 32 length 6037.64 min Z 76.10 max Z 110.00 Z range 33.90

#	DIST	ELEV	CODES
1	10000.060	110.000	0 1
2	10159.430	96.900	0 1
3	10391.740	100.900	0 1
4	10594.110	103.400	0 1
5	10848.710	99.000	0 1
6	11067.300	86.900	0 1
7	11299.040	82.600	0 1
8	11530.060	78.700	0 1
9	11791.870	88.500	0 1
10	12026.350	97.800	0 1
11	12303.420	93.500	0 1
12	12601.160	94.500	0 1
13	12806.400	96.900	CL 0 1
14	12920.960	97.600	0 1
15	13239.780	95.100	0
16	13495.070	96.500	0 1
17	13726.080	89.300	0
18	13874.850	87.000	0
19	14033.355	84.600	0 1
20	14597.200	84.900	LB 0
21	14674.585	76.100	WL 0 1
22	14694.470	76.100	WR 0
23	14918.750	85.700	0 1
24	14939.010	89.500	0 1
25	15018.510	91.600	0 1
26	15140.020	94.900	0 1
27	15311.730	92.900	0 1
28	15457.780	97.500	0 1
29	15716.[illegible]	91.700	0 1
30	15842.910	93.350	0 1
31	15939.100	105.400	0 1
32	16037.640	110.200	0 1

FIGURE F-10

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SU-36 file 65 # points 43 length 6832.20 min Z 73.70 max Z 120.00 Z range 46.30

#	DIST	ELEV	CODES
1	10000.000	100.000	0
2	10231.050	107.300	0
3	10397.290	105.600	0
4	10625.930	98.300	0
5	10860.870	96.100	0
6	11107.090	94.300	0
7	11472.650	93.400	0
8	11812.360	93.400	0
9	12040.890	93.900	0
10	12220.150	95.400	0
11	12343.170	91.600	0
12	12522.920	93.300	0
13	12708.430	88.600	0
14	12862.940	92.900	0
15	13055.200	91.500	CL 0
16	13225.210	93.300	0
17	13456.460	89.600	0
18	13547.490	91.600	0
19	13802.750	84.900	0
20	14016.770	86.100	0
21	14224.280	68.900	0
22	14465.800	87.100	0
23	14711.620	91.500	CL 0
24	14880.330	93.300	0
25	14956.340	93.700	CL 0
26	15308.100	90.600	0
27	15495.120	91.600	CL 0
28	15558.120	85.400	0
29	15623.670	61.100	0
30	15754.630	76.700	0
31	15793.380	73.700	WF 0
32	15837.890	73.700	WF 0
33	15852.390	76.200	0
34	15885.140	74.600	0
35	15898.140	73.700	WA 0
36	15946.890	73.700	WF 0
37	15985.900	74.700	0
38	16177.660	84.300	0
39	16363.680	84.100	0
40	16540.160	87.600	0
41	16640.650	96.500	0
42	16767.200	114.800	0
43	16832.200	120.000	0

FIGURE F-11

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANNEE RIVER WI
SW-37 file 66 # points 43 length 6913.37 min Z 73.90 max Z 162.60 Z range 88.70

#	DIST	ELEV	CODES
1	10000.000	96.000	0 1
2	10231.540	95.300	0 1
3	10495.590	93.300	0 1
4	10798.980	95.400	0 1
5	11017.170	92.900	0 1
6	11267.940	87.700	0 1
7	11565.780	87.600	0 1
8	11844.940	90.300	0 1
9	12084.370	93.400	0 1
10	12334.660	93.700	0 1
11	12591.040	94.200	0 1
12	12812.950	92.400	0 1
13	12980.200	88.500	0 1
14	13170.560	87.500	0 1
15	13396.110	85.000	0 1
16	13576.350	84.800	0 1
17	13662.350	83.300	0
18	13724.360	85.300	0 1
19	13766.120	87.200	0 1
20	13879.640	89.100	0
21	140[illegible].400	86.800	CL 0 1
22	14043.210	93.400	0
23	14208.240	91.900	0 1
24	14323.670	89.400	0
25	14479.210	83.200	0 1
26	14681.560	78.300	0
27	14896.550	75.900	0 1
28	15065.830	76.700	0
29	15135.830	74.200	0 1
30	15255.850	74.900	WA 0
31	15504.030	73.900	WA 0 1
32	15545.170	73.300	0
33	15687.670	77.400	TB 0 1
34	15776.750	78.900	0
35	15959.220	83.300	0 1
36	16106.560	82.700	0
37	16232.240	80.300	0 1
38	16375.530	79.700	0
39	16458.090	76.900	0 1
40	16577.310	133.600	0 1
41	16657.100	148.200	0 1
42	16767.620	154.300	0
43	16913.370	162.600	0 1

FIGURE F-12

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 desk: 83-241.1 SUWANEE RIVER W.
SW-21 file 67 # points 48 length 4932.19 min Z 76.70 max Z 155.20 Z range 78.50

#	DIST	ELEV	CODES
1	10000.000	103.600	0 1
2	10171.600	102.600	0 1
3	10338.320	102.300	0
4	10520.060	102.200	0 1
5	10698.360	102.200	0 1
6	10856.640	102.300	0
7	10952.690	103.600	0 1
8	11128.750	102.600	0 1
9	11281.240	100.900	0 1
10	11436.040	98.600	0 1
11	11567.530	95.000	0 1
12	11722.840	92.900	0 1
13	11881.580	91.600	0 1
14	12035.670	92.000	0 1
15	12174.690	88.500	0
16	12324.360	86.000	0 1
17	12490.420	84.100	0 1
18	12617.430	81.800	0
19	12683.560	80.100	0
20	12776.340	76.720	WF 0 1
21	12843.740	76.700	WF 0 1
22	12862.510	96.700	TB 0
23	12906.540	97.560	0
24	12943.360	95.000	0 1
25	12979.930	93.900	0 1
26	13000.300	93.300	0
27	13055.050	95.000	0
28	13152.610	95.930	0 1
9	13266.850	97.000	0 1
0	13265.610	96.150	EP 0
1	13293.270	96.150	EP 0 1
2	13325.900	97.400	0
3	13429.630	95.700	0 1
	13521.810	95.200	0 1
	13589.660	95.700	0
	13609.260	95.200	EP 0 1
	13622.490	95.300	EL 0 1
	13638.240	95.200	EP 0 1
	13650.950	95.700	0 1
	13691.950	95.400	0 1
	13813.000	95.400	0 1
	13949.750	95.600	0 1
	14139.020	96.600	0 1
	14310.300	98.500	0 1
	14462.560	112.900	0 1
	14607.840	130.100	0 1
	14779.900	148.300	0 1
	14932.190	155.200	0 1

FIGURE F-13

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WS
SW-39 file 68 # points 40 length 7749.77 min Z 78.00 max Z 144.60 Z range 66.60

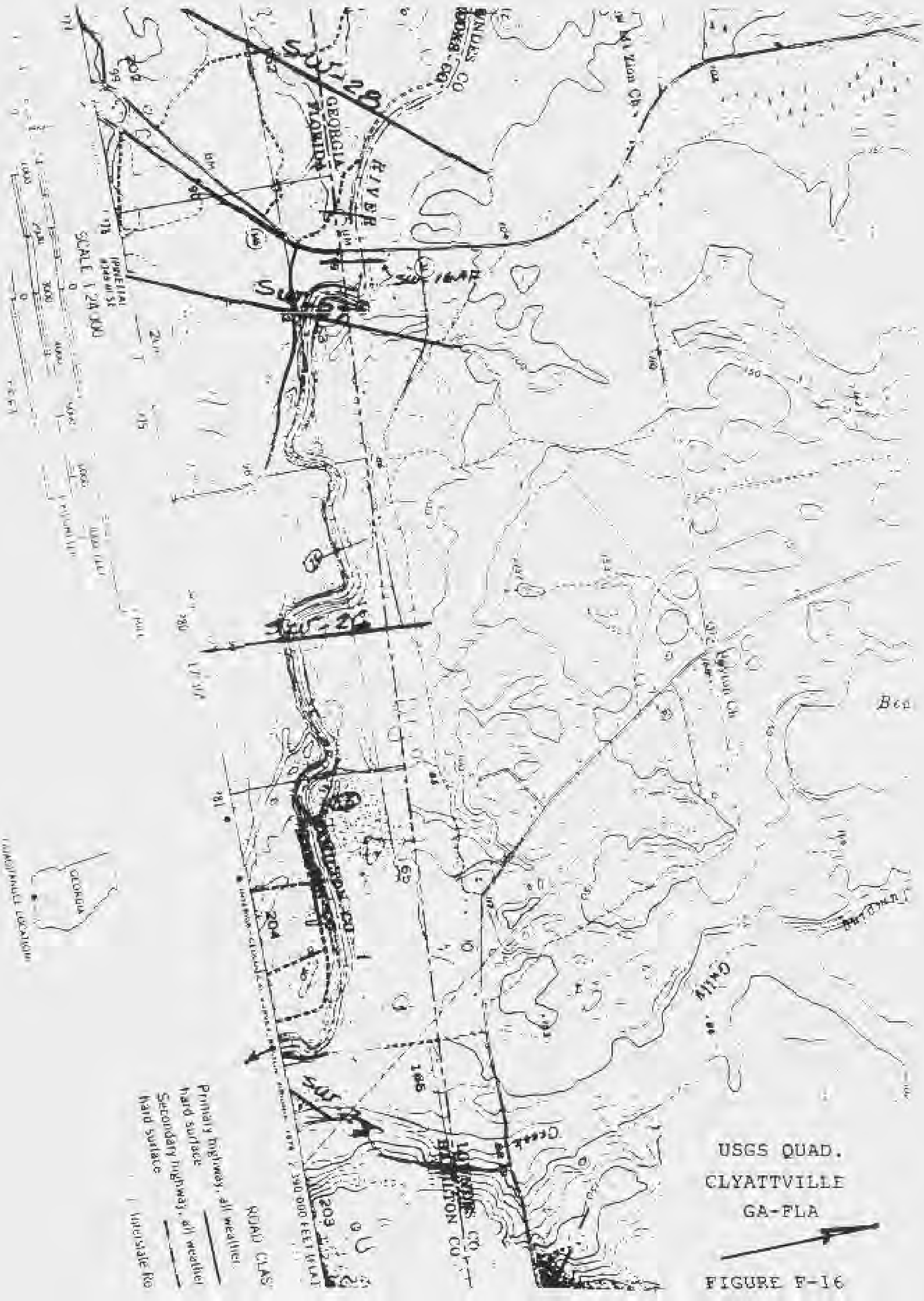
#	DIST	ELEV	CODES
1	10000.000	97.800	0 1
2	10281.570	94.700	0 1
3	10596.750	91.200	0 1
4	10932.090	92.400	0 1
5	11208.660	93.700	0 1
6	11360.660	93.700	0 1
7	11455.700	96.400	0 1
8	11579.520	96.400	0 1
9	11703.060	96.300	0
10	11910.380	94.500	0 1
11	12093.520	93.700	0 1
12	12196.960	95.900	0
13	12352.490	94.400	0 1
14	12515.050	92.000	0 1
15	12747.080	95.100	0 1
16	12837.070	94.000	0 1
17	12948.160	94.400	0 1
18	13089.140	92.200	0 1
19	13261.460	92.030	0 1
20	13511.390	93.900	0 1
21	13722.840	94.200	0 1
22	13961.090	94.300	0 1
23	14180.550	95.900	0 1
24	14394.150	95.700	0 1
25	14607.760	95.300	0 1
26	14737.060	91.500	0 1
27	[illegible]	83.700	BE 0
28	[illegible]	78.000	WS 0 1
29	15188.730	78.300	WE 0
30	15232.360	66.100	TB 0 1
31	15361.500	93.400	0
32	15626.070	94.900	0 1
33	15990.680	95.700	0 1
34	16261.110	95.400	0 1
35	16703.510	98.300	0 1
36	17034.450	99.900	0 1
37	17257.390	112.100	0 1
38	17421.220	131.100	0 1
39	17592.020	144.600	0 1
40	17749.770	143.100	0 1

FIGURE F-14

83-241 TRIB SUWANNEE - WITHLACOOCHEE 04/30/85 9816 disk: 83-241.1 SUWANEE RIVER WI
SW-40 file 69 # points 45 length 6751.40 min Z 80.40 max Z 150.20 Z range 69.80

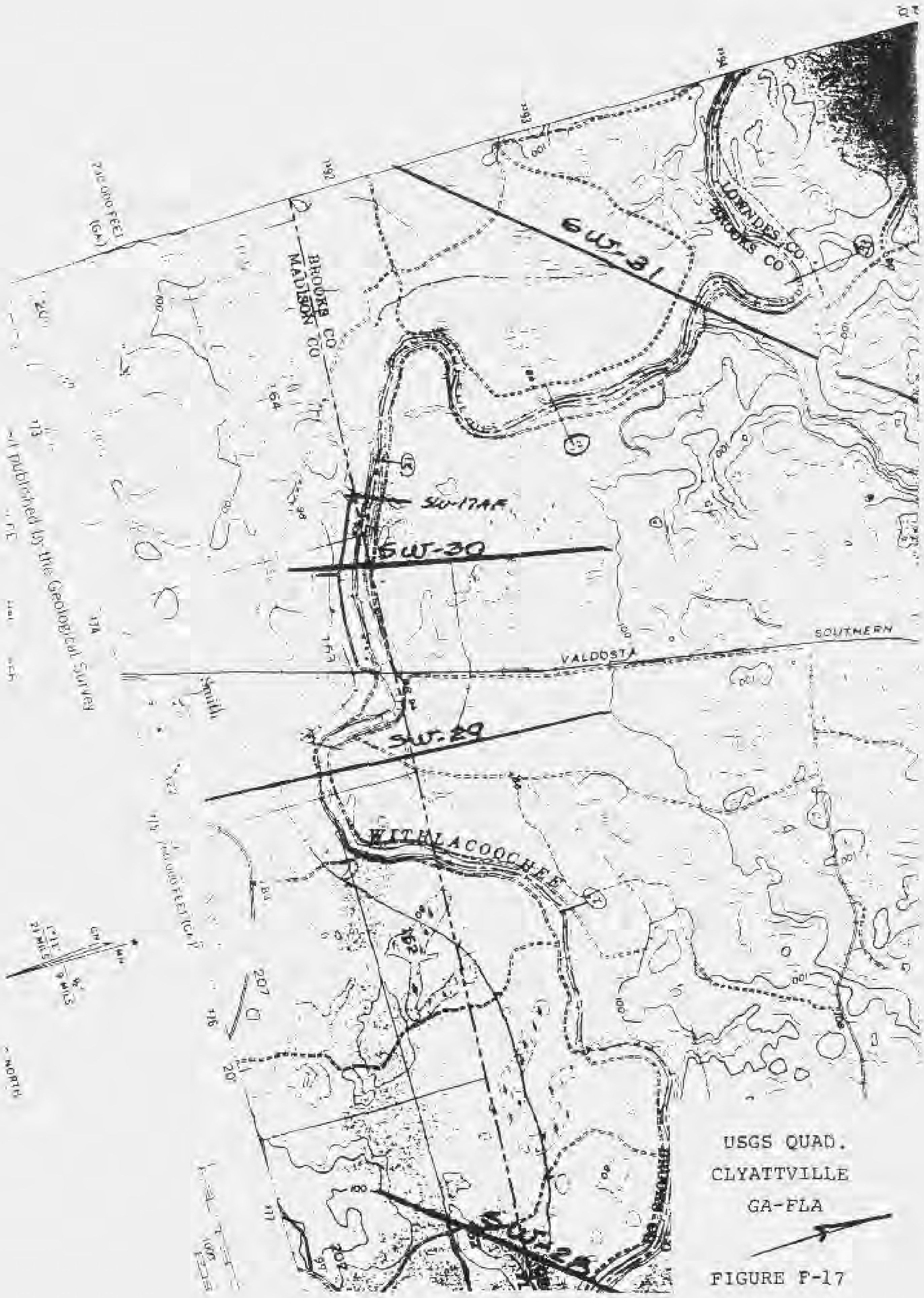
#	DIST	ELEV	CODES
1	10000.000	100.600	0 1
2	10110.710	97.100	0 1
3	10180.080	97.400	0 1
4	10294.950	100.200	0 1
5	10429.007	101.600	0 1
6	10539.480	101.900	0 1
7	10669.500	101.900	0 1
8	10854.030	102.100	0 1
9	11065.835	99.600	0 1
10	11249.030	99.900	0 1
11	11374.850	101.600	0 1
12	11478.870	101.700	0 1
13	11602.880	99.000	0 1
14	11726.150	98.900	0 1
15	11894.180	98.800	0 1
16	12039.200	100.000	0 1
17	12201.220	100.200	0 1
18	12375.007	99.200	0 1
19	12514.270	100.500	0 1
20	12692.050	101.400	0 1
21	12871.620	100.200	0 1
22	13059.310	99.900	0 1
23	13322.690	95.900	0 1
24	13535.420	93.000	0 1
25	13772.200	90.400	0 1
26	13894.470	86.700	0 1
27	13987.490	84.700	0 1
28	14034.490	80.400	WA 0 1
29	14176.010	80.400	WA 0 1
30	14223.270	88.400	0 1
31	14264.020	95.400	0 1
32	14460.060	96.200	0 1
33	14783.850	97.300	0 1
34	14909.630	98.900	0 1
35	15080.660	98.200	0 1
36	15225.420	99.200	0 1
37	15375.650	98.500	0 1
38	15522.710	98.400	0 1
39	15668.490	100.400	0 1
40	15871.770	102.200	0 1
41	16150.550	102.900	0 1
42	16261.080	105.400	0 1
43	16417.050	112.200	0 1
44	16591.620	113.700	0 1
45	16751.400	150.200	0 1

FIGURE F-15



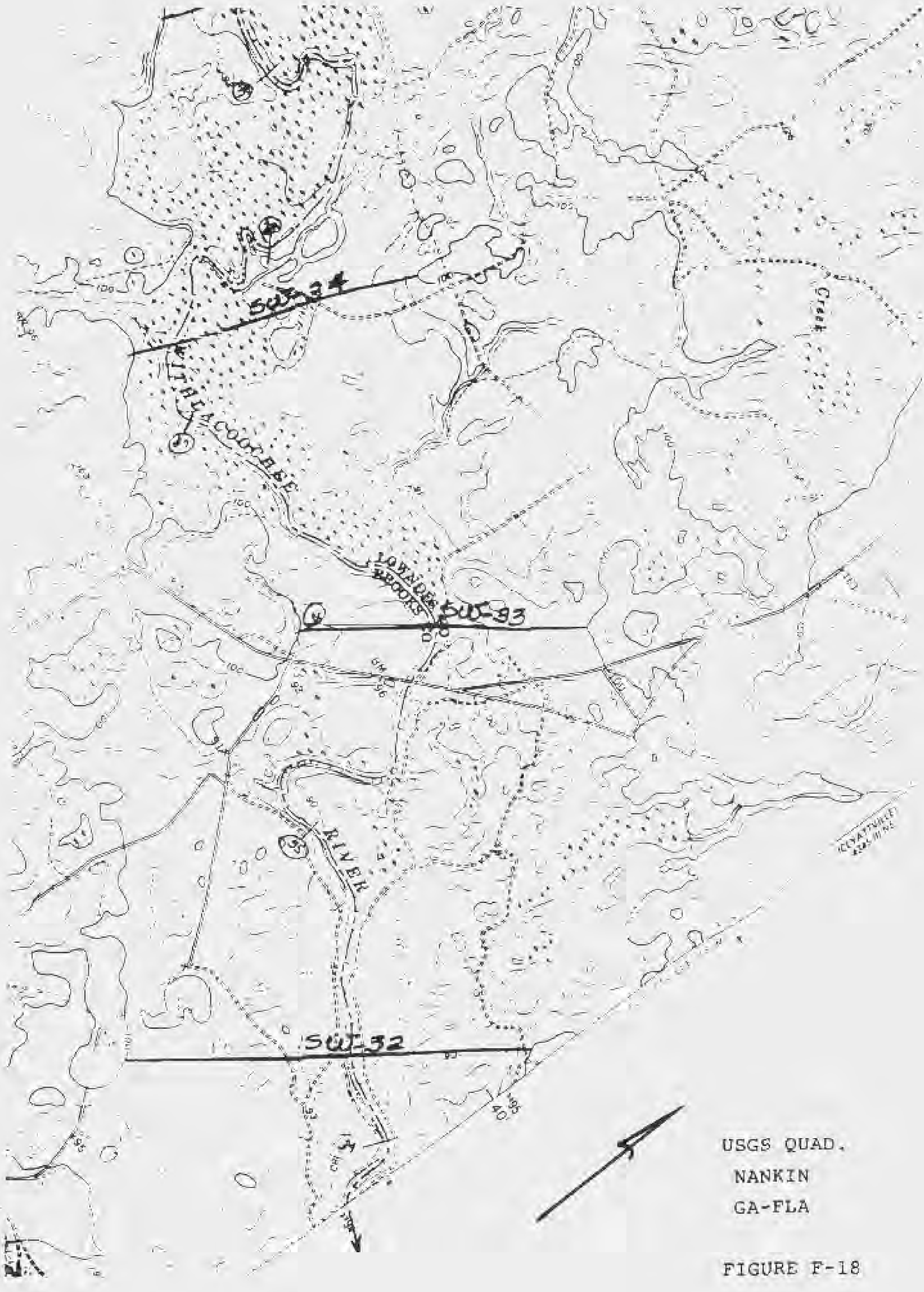
USGS QUAD.
CLYATTVILLE
GA-FLA

FIGURE F-16



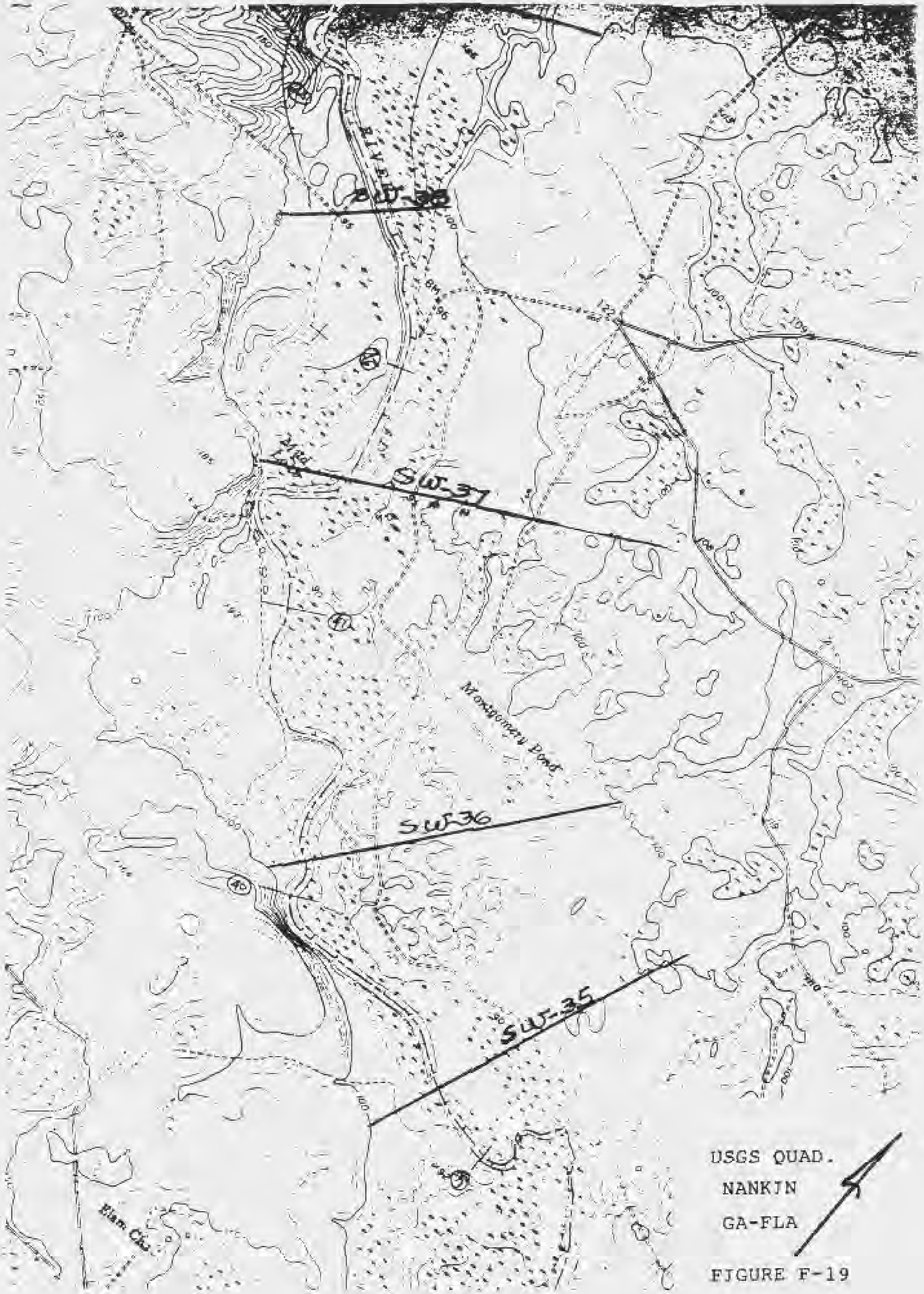
USGS QUAD.
CLYATTVILLE
GA-FLA

FIGURE F-17



USGS QUAD.
NANKIN
GA-FLA

FIGURE F-18



USGS QUAD.
NANKIN
GA-FLA

FIGURE F-19

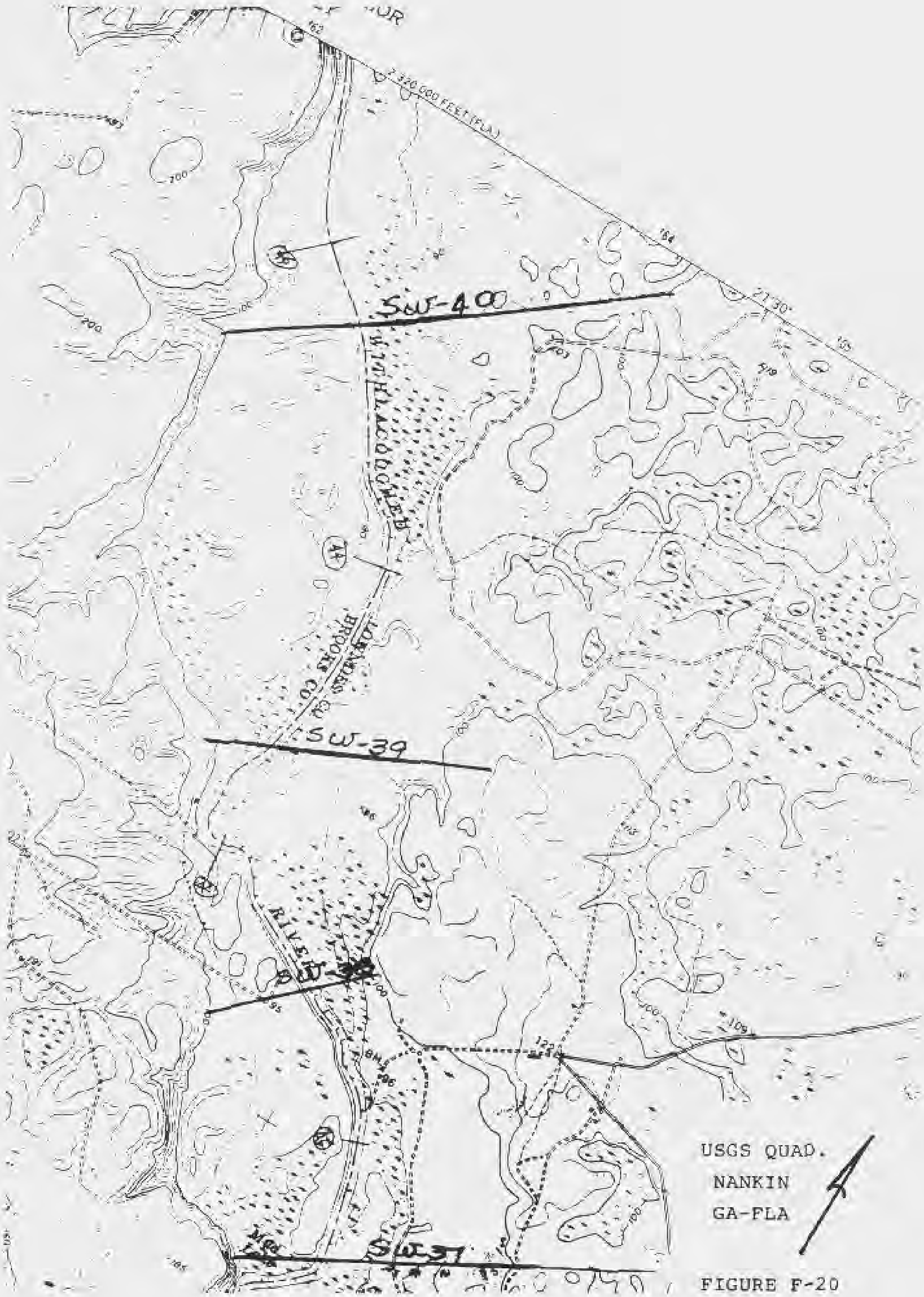

SW-40
SW-39
SW-37
WITHLACOOCHEE
BROOKS CO
LOWNDES CO
RIVER
2 320 000 FEET (FLA.)
USGS QUAD.
NANKIN
GA-FLA

FIGURE F-20

WITHLACOOCHEE RIVER

Tabulation of Benchmarks

Name	Type Marker	Vol./Page	Elevation
DR-2	Disk in Concrete	Vol. 2/P. 11	81.11
DR-2-B	Disk in Concrete	Vol. 2/P. 23	74.59
DR-6	Disk in Concrete	Vol. 2/P. 19	113.45
DR-9	Disk in Concrete	Vol. 2/P. 33	78.05
DR-10	Disk in Concrete	Vol. 2/P. 34	80.23
DR-12	Disk in Concrete	Vol. 2/P. 36	76.04
DR-13	Disk in Concrete	Vol. 2/P. 41	84.54
DR-13-C	Concrete Post	Vol. 2/P. 67	79.09
DR-13-D	Concrete Post	Vol. 2/P. 62	92.25
DR-14	Disk in Concrete	Vol. 2/P. 42	128.07
DR-15	Disk in Concrete	Vol. [illegible]/P. 46	81.80
DR-16	Disk in Concrete	Vol. 2/P. 47	80.0[illegible]
DR-17	Disk in Concrete	Vol. 2/P. 48	92.04
DR-18	Disk in Concrete	Vol. 2/P. 49	95.37
DR-19	Disk in Concrete	Vol. 2/P. 49	94.56
DR-20	Disk in Concrete	Vol. 2/P. 48	[illegible]
DR-21	Disk in Concrete	Vol. 2/P. 67	83.86
DR-22	Disk in Concrete	Vol. 2/P. 73	100.07
DR-23	Disk in Concrete	Vol. 2/P. 73	92.92
DR-24	Disk in Concrete	Vol. 2/P. 74	[illegible]
DR-25	Disk in Concrete	Vol. 2/P. 74	175.65
DR-26	Disk in Concrete	Vol. 2/P. 72	96.52
DR-27	Disk in Concrete	Vol. 2/P. 75	221.78
Cor. Sec. 4 & 9	Disk in Concrete	Vol. 2/P. 7	63.94
PRM-75	Disk in Concrete	Vol. 2/P. 3	83.23
PRM-2940	Concrete Post	Vol. 7/P. 70	69.54
PRM-1824-1	Concrete Post	Vol. 2/P. 53	67.57
PRM-1824-2	Concrete Post	Vol. 4/P. 8	67.83

WITHLACOOCHEE RIVER

Tabulation of Temporary Benchmarks

Name	Type Marker	Vol.-Page	Elevation
TDBM- 1	Nail	Vol. 4/P. 2	64.69
TDBM- 1-A	R.R. Spike	Vol. 7/P. 71	67.24
TDBM- 2	R.R. Tie	Vol. 5/P. 5	109.23
TDBM-27	Nail	Vol. 2/P. 57	112.57
TDBM-28	Nail	Vol. [illegible]/P. 37	118.75
TDBM-34	Nail	Vol. 4/P. 43	125.80
TDBM-45	R.R. Spike	Vol. 7/P. 3	106.74
TDBM-46	R.R. Spike	Vol. 7/P. 5	104.63
TDBM-50	R.R. Spike	Vol. 7/P. 23	160.69
TDBM-51	R.R. Spike	Vol. 7/P. 24	[illegible]
TDBM-52	R.R. Spike	Vol. 7/P. 26	92.56
TDBM-54	R.R. Spike	Vol. 7/P. 32	[illegible]
TDBM-55	R.R. Spike	Vol. 7/P. 33	122.90
TDBM-57	R.R. Spike	Vol. 7/P. 36	156.95
TDBM-58	R.R. Spike	Vol. 7/P. 37	[illegible]
TDBM-59	R.R. Spike	Vol. 7/P. 38	155.39
TDBM-60	R.R. Spike	Vol. 7/P. 53	[illegible]
TDBM-61	R.R. Spike	Vol. 7/P. 54	[illegible]
TDBM-62	R.R. Spike	Vol. 7/P. 69	64.40
TDBM-63	R.R. Spike	Vol. 7/P. 70	72.57
TDBM-64	R.R. Spike	Vol. 7/P. 72	54.20
TDBM-65	R.R. Spike	Vol. 7/P. 74	64.72
TDBM-66	R.R. Spike	Vol. 7/P. 75	94.15
TDBM-68	R.R. Spike	Vol. 6/P. 7	123.56
TDBM-69	R.R. Spike	Vol. 6/P. 9	100.19
TDBM-71	R.R. Spike	Vol. 6/P. 16	[illegible]

FIGURE 3-22

Name	Type Marker	Vol. Page	Elevation
TDBM-72	R.R. Spike	Vol. 6/P. 17	108.686
TDBM-73	R.R. Spike	Vol. 6/P. 18	99.758
TDBM-74	R.R. Spike	Vol. 6/P. 18	106.416
TDBM-75	R.R. Spike	Vol. 6/P. 23	94.54
TDBM-76	R.R. Spike	Vol. 6/P. 23	98.63
TDBM-77	R.R. Spike	Vol. 6/P. 26	101.57
TDBM-78	R.R. Spike	Vol. 6/P. 27	93.54
TDBM-79	R.R. Spike	Vol. 6/P. 27	93.82
TDBM-80	Ch. X	Vol. 6/P. 28	101.34
TDBM-81	R.R. Spike	Vol. 6/P. 46	160.87
TDBM-82	R.R. Spike	Vol. 6/P. 47	107.25
TDBM-83	R.R. Spike	Vol. 6/P. 49	153.54
TDBM-84	R.R. Spike	Vol. 6/P. 50	174.66
TDBM-85	R.R. Spike	Vol. 6/P. 51	206.42
TDBM-86	R.R. Spike	Vol. 6/P. [illegible]	208.66
TDBM-87	R.R. Spike	Vol. 6/P. 53	196.45
TDBM-88	R.R. Spike	Vol. 6/P. 53	193.35
TDBM-90	R.R. Spike	Vol. 6/P. 55	187.05
TBM DR-1	Conc. Post	Vol. 2/P. 2	75.05
TBM DR-2-A	R.R. Spike	Vol. 2/P. 24	61.63
TBM DR-3	Ch. X	Vol. 2/P. 14	72.47
TBM DR-4	Disc	Vol. 2/P. 15	74.43
TBM DR-7	R.R. Spike	Vol. 2/P. 26	72.40
TBM DR-8	R.R. Spike	Vol. 2/P. 29	82.96
TBM DR-9	¢ Corn. Conc.	Vol. 2/P. 33	76.05
TBM DR-10	Sec. Line Conc.	Vol. 8/P. 34	80.22

FIGURE F-23

Withlacoochee River
Page 3

Name	Type Marker	Vol./Page	Elevation
TBM DR-11	R.R. Spike	Vol. 2/P. 33	[illegible].54
TBM DR-13-A	R.R. Spike	Vol. 2/P. 43	98.16
TBM DR-13-E	R.R. Spike	Vol. 2/P. 63	97.17
TBM DR-28	R.R. Spike	Vol. 2/P. 56A	156.05
TBM DR-29	R.R. Spike	Vol. 2/P. 7[illegible]	[illegible]
TBM DR-30	Ch. Sq.	Vol. 2/P. 72	82.66
TBM DR-97	R.R. Spike	Vol. 23/P. 5	59.13
TBM DR-98	R.R. Spike	Vol. 23/P. 6	61.57

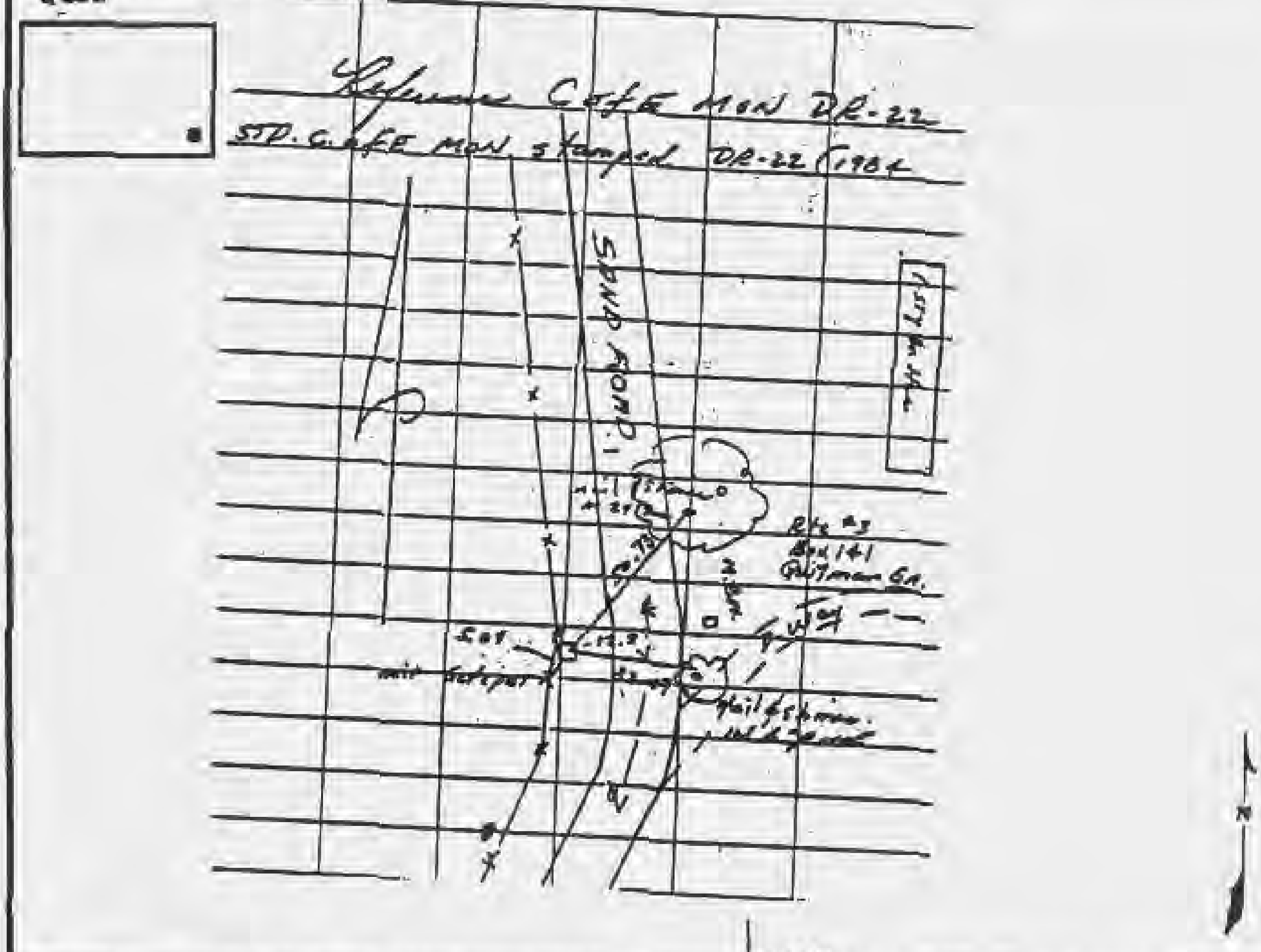
COUNTRY	TYPE OF MARK	STATION	
Georgia, USA	Disk in concrete	DR-22	
LOCALITY	STAMPING ON MARK	AGENCY (CAST IN MARKS)	ELEVATION (FT)
Brooks County	DR-22 1984	Corps of Engrs.	100.07
LATITUDE	LONGITUDE	DATUM	DATUM
			NGV 1929
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	ESTABLISHED BY (AGENCY)
			SRMC
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	DATE: 1984 / ORDER: 3rd

TO OBTAIN GRID AZIMUTH, ADD TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID) (MAGNETIC)	BACK AZIMUTH	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)

Nankin, Georgia
Quad



SKETCH

DA FORM 1 OCT 64 1959 REPLACES DA FORMS 1958 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATION
For use of this form, see TM 5-237; the proponent agency is TRADOC.

FIGURE F-25

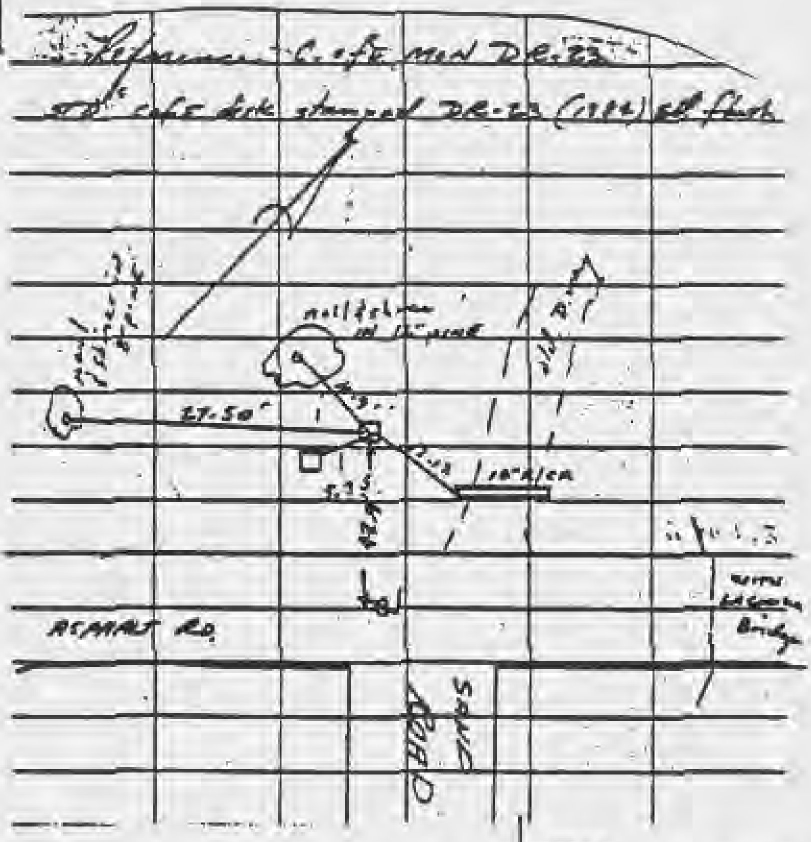
COUNTRY	TYPE OF MARK	STATION	
Georgia, USA	Disk in concrete	DR-23	
LOCALITY	STAMPING ON MARK	AGENCY (CAST IN MARKS)	ELEVATION (FT)
Brooks County	DR-23 1984	Corps of Engrs.	92.92
LATITUDE	LONGITUDE	DATUM	DATUM
			NGV 1929
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	ESTABLISHED BY (AGENCY)
			SRMC
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	DATE 1984 / ORDER 3rd

TO OBTAIN GRID AZIMUTH, ADD ° ' " TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) ° ' " TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID) (MAGNETIC)	BACK AZIMUTH	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)
	° ' "	° ' "		

Nankin, Georgia-
Florida Quad



SKETCH

DA FORM 1 OCT 64 1959 REPLACES DA FORMS 1959 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATION
For use of this form, see TM 5-237; the proponent agency is TRADOC.

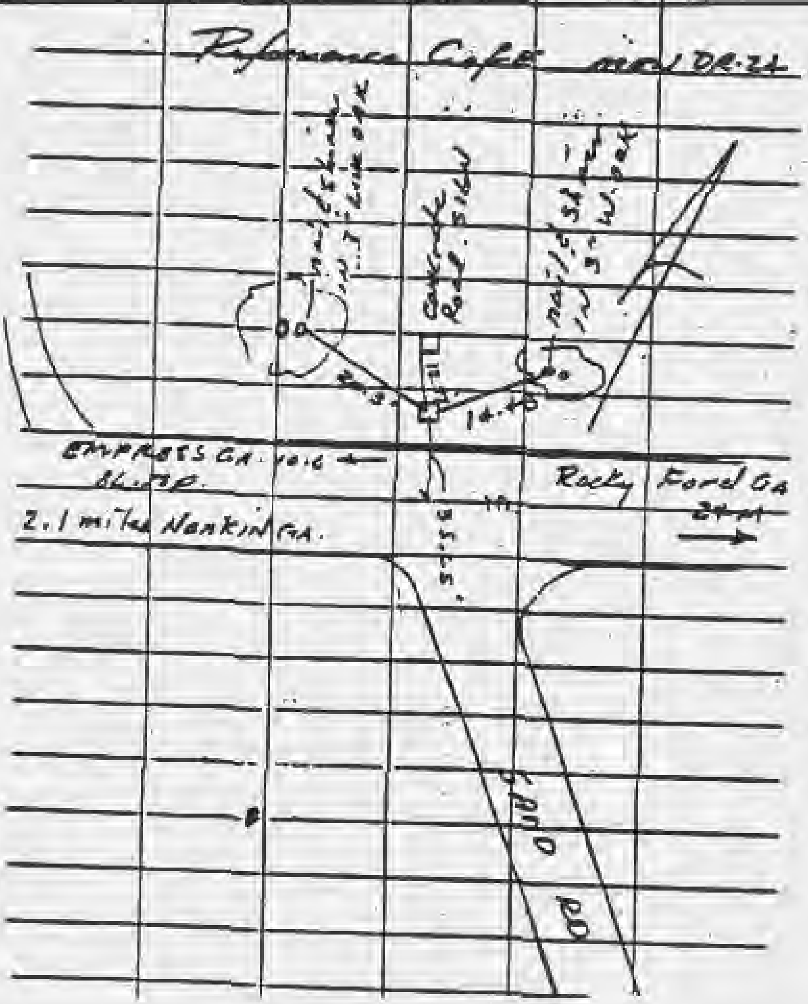
FIGURE F-26

COUNTRY	TYPE OF MARK	STATION	
Georgia, USA	Disk in concrete	DR-24	
LOCALITY: Brookes County	STAMPING ON MARK: DR-24 1984	AGENCY (CAST IN MARKS): Corps of Engrs.	ELEVATION (FT): 180.50 XX
LATITUDE	LONGITUDE	DATUM	DATUM: NGV 1929
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	ESTABLISHED BY (AGENCY): SRMC
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	DATE: 1984 — ORDER: 3rd

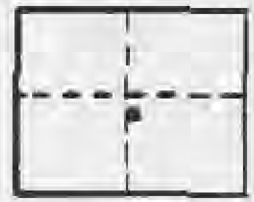
TO OBTAIN GRID AZIMUTH, ADD ° TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) ° TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID) (MAGNETIC)	BACK AZIMUTH	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)
	° ' "	° ' "		



Nankin, Georgia Quad



SKETCH

DA FORM 1959, 1 OCT 64 — REPLACES DA FORMS 1959 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATION
For use of this form, see TM 5-237; the proponent agency is TRADOC.

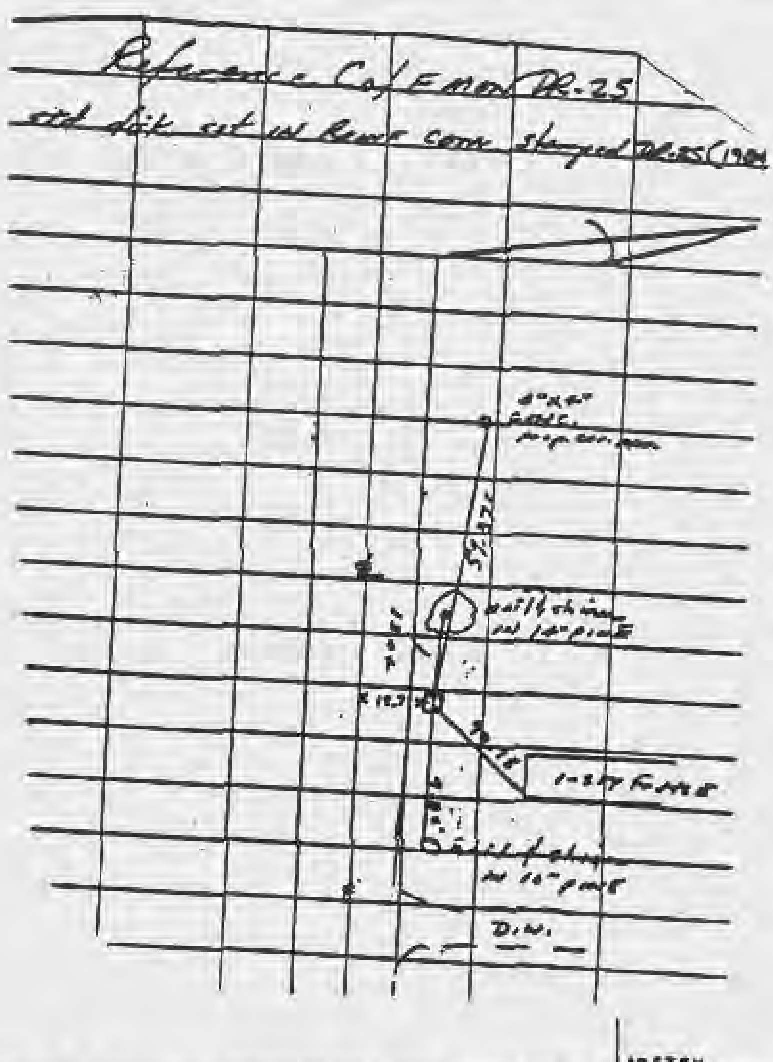
FIGURE F-27

COUNTRY: Georgia, USA	TYPE OF MARK: Disk in concrete	STATION: DR-25	
LOCALITY: Brookes County	STAMPING ON MARK: DR-25 1984	AGENCY (CAST IN MARKS): Corps of Engrs.	ELEVATION (FT) (M): 179.65
LATITUDE:	LONGITUDE:	DATUM:	DATUM: NGV 1929
(NORTHING)(EASTING) (FT) (M):	(EASTING)(NORTHING) (FT) (M):	GRID AND ZONE:	ESTABLISHED BY (AGENCY): SRMC
(NORTHING)(EASTING) (FT) (M):	(EASTING)(NORTHING) (FT) (M):	GRID AND ZONE:	DATE: 1984 ORDER: 3rd

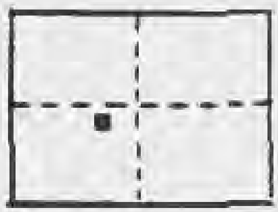
TO OBTAIN GRID AZIMUTH, ADD ° TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) ° TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID)(MAGNETIC) ° ' "	BACK AZIMUTH ° ' "	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)



Nankin, Georgia Quad



SKETCH

DA FORM 1959, 1 OCT 66. REPLACES DA FORMS 1959 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATIO

For use of this form, see TM 5-237; the proponent agency is TRADOC.

FIGURE F-28

COUNTRY	TYPE OF MARK	STATION	
Georgia, USA	Disk in concrete	DR-26	
LOCALITY: Brookes County	STAMPING ON MARK: DR-26	AGENCY (CAST IN MARKS): Corps of Engrs.	ELEVATION (FT) (M): 98.56 (FT)
LATITUDE	LONGITUDE	DATUM	DATUM: NGV 1929
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	ESTABLISHED BY (AGENCY): SRMC
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	DATE: 1984 — ORDER: 3rd

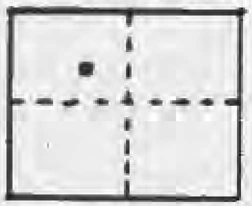
TO OBTAIN GRID AZIMUTH, ADD ° ' " TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) ° ' " TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID) (MAGNETIC)	BACK AZIMUTH	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)
	° ' "	° ' "		

NOTE: BM DR-26 is 0.4 miles WNW of USGS BM 21GAF

Nankin, Georgia Quad



SKETCH

DA FORM 1 OCT 64 1959 REPLACES DA FORMS 1959 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATION

For use of this form, see TM 5-237; the proponent agency is TRADOC.

COUNTRY	TYPE OF MARK	STATION	
Georgia, USA	Disk in concrete	DR-27	
LOCALITY	STAMPING ON MARK	AGENCY (CAST IN MARKS)	ELEVATION (FT.)
Brookes County	DR-27 1984	Corps of Engrs.	201.78 xxx
LATITUDE	LONGITUDE	DATUM	DATUM
			NGV 1929
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	ESTABLISHED BY (AGENCY)
			SRMC
(NORTHING)(EASTING) (FT) (M)	(EASTING)(NORTHING) (FT) (M)	GRID AND ZONE	DATE / ORDER
			1984 / 3rd

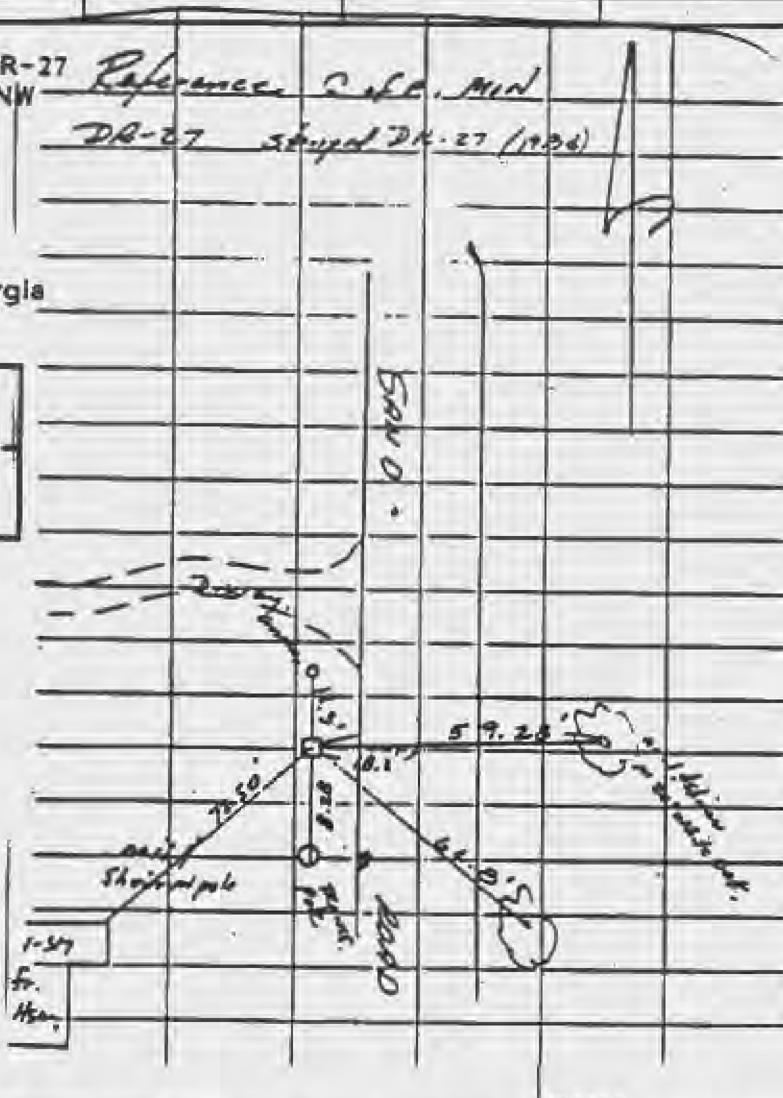
TO OBTAIN GRID AZIMUTH, ADD ° TO THE GEODETIC AZIMUTH

TO OBTAIN GRID AZ. (ADD)(SUB.) ° TO THE GEODETIC AZIMUTH

OBJECT	AZIMUTH OR DIRECTION (GEODETIC)(GRID) (MAGNETIC) ° ' "	BACK AZIMUTH ° ' "	GEOD. DISTANCE (METERS) (FEET)	GRID DISTANCE (METERS) (FEET)

NOTE: BM DR-27 is 0.6 miles NW of USGS BM 18GAF

Nankin, Georgia Quad



SKETCH

DA FORM 1 OCT 64 1959 REPLACES DA FORMS 1959 AND 1960, 1 FEB 57, WHICH ARE OBSOLETE.

DESCRIPTION OR RECOVERY OF HORIZONTAL CONTROL STATION
For use of this form, see TM 5-237; the proponent agency is TRADOC.

FIGURE F-30

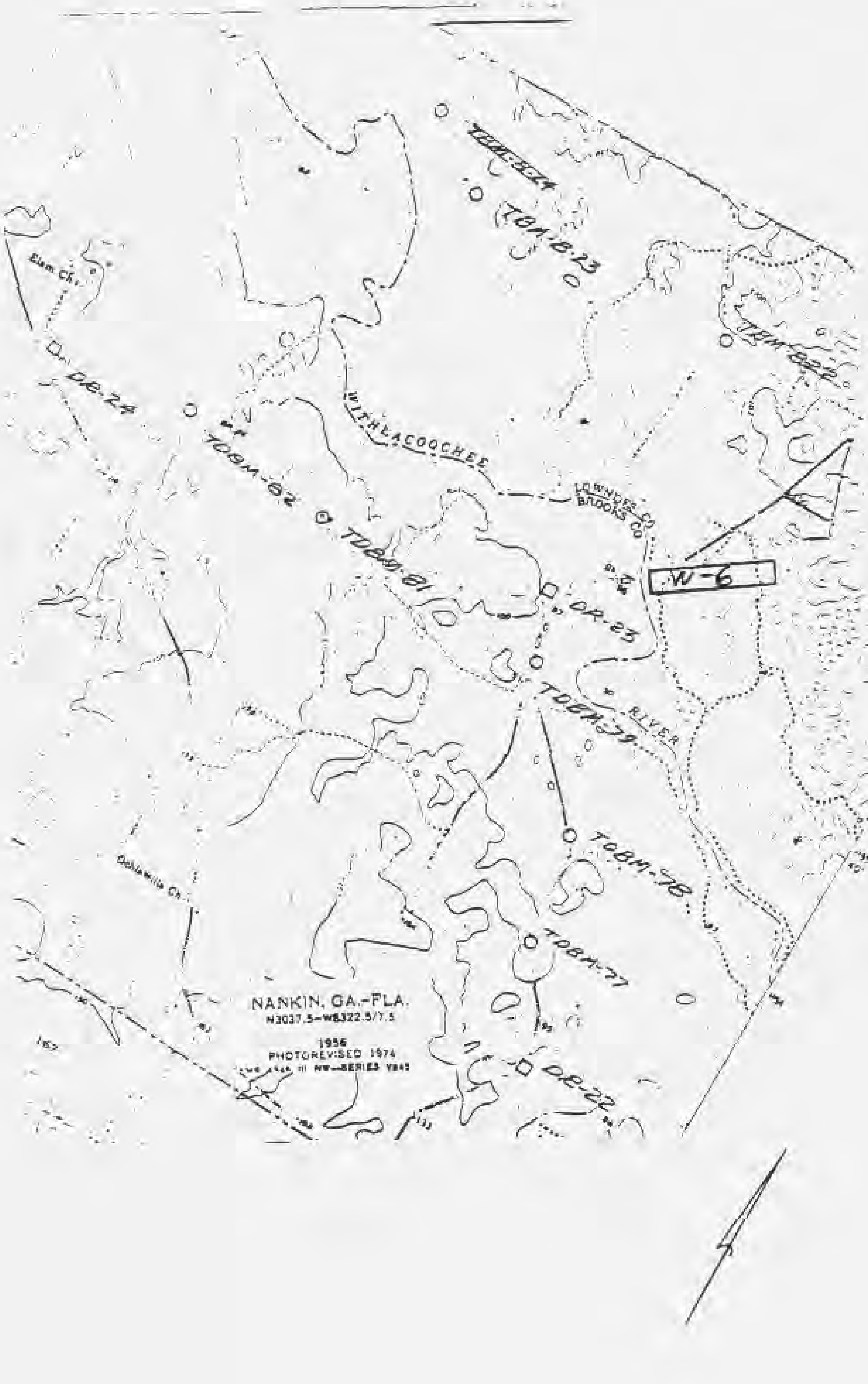

TBM-B-24
TBM-B-23
TBM-B-22
Elam Ch.
DR-24
TDBM-82
WITHLACOOCHEE
LOWNDES CO
BROOKS CO
TDBM-81
W-6
DR-23
TDBM-79
RIVER
TDBM-78
Okhlawilla Ch.
TDBM-77
NANKIN, GA.-FLA.
N3037.5—W8322.5/7.5
1956
PHOTOREVISED 1974
DR-22

FIGURE F-31

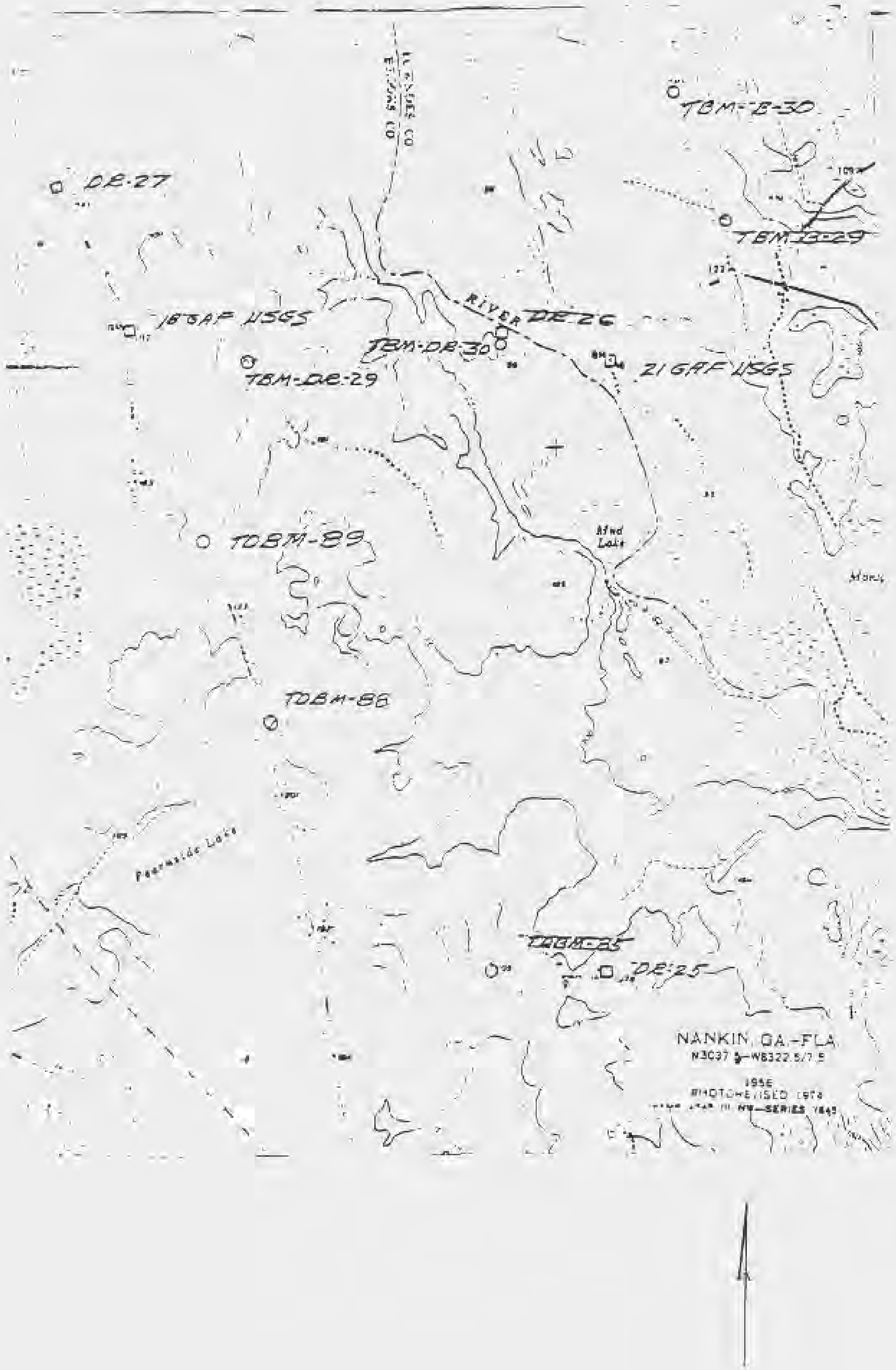

TBM-B-30
DR-27
TBM-B-29
RIVER
DR-26
18 GAF USGS
TBM-DR-30
TBM-DR-29
21 GAF USGS
TDBM-89
TDBM-86
Pearmaide Lake
TDBM-85
DR-25
NANKIN, GA.-FLA.

FIGURE F-32

APPENDIX

G

REPORT OF 1948 FLOOD

Appendix G
Report of 1948 Flood

The following Corps of Engineers report is printed verbatim for its historical value. Data presented were preliminary, with some stages, discharges, etc. being revised later. Additional information about the 1948 and 1973 floods of record on the Suwannee River is found in the Special Flood Hazard Report listed in paragraph 4.d. of the main report.

14 July 1948

REPORT OF APRIL - MAY 1948 FLOOD, SUWANNEE RIVER, FLORIDA AND GEORGIA

General.--Flooding in the Suwannee River basin in March, April, and May 1948 was caused by a long period of heavy rainfall in southern Georgia and northern Florida. The eleven counties most seriously affected by the flood waters were:

Georgia	Florida
Lowndes	Madison Gilchrist
Clinch	Hamilton Dixie
Brooks	Suwannee Levy
Echols	Lafayette

The total population of these counties is 133,000.

Damages caused by the flood all into two separate categories:

(1) Damages to the area that borders the flood plain of the river.

(2) Damages by flood waters from the river.

The area that borders the flood plain of the river is relatively high and hilly with sparce vegetation which consists principally of slash pine, scrub oak, and wire grass. The soil is a sandy loam underlain by limestone and is subject to erosion. The area is characterized by many depressioons and sink holes. Some of the depressions have areas of hundreds of acres and have no means of drainage except through seepage. These areas are normally dry and are farmed; some have highways and railroads across them. The greatest loss during the flood of March and April was to this area by:

Erosion, washing away the fertilizer that had been applied to the young crops.

Inundation of farms, highways, and railroads in the depressions.

Damages by flood waters from the river were caused by the strong current washing out highway and railroad fills, bridges, and culverts, by the water overflowing farms, farm houses, and drowning livestock, and by sand washing from the bordering area over the more fertile land in the flood plain, and by floodwaters preventing, or delaying, crop planting. The area involved along the flood plain of the river is a more fertile and more stable soil than that which borders it and, unlike the hilly area, there is very little if any permanent damage done to the soil by floods. The principal vegetation is pine, oak, gum, cypress, and many kinds of swamp growths, and is a good winter range for cattle. It is not as highly developed as the bordering area due to flood hazards.

Meteorology.--Conditions leading up to the flood on Suwannee River were caused by heavy rainfall in north Florida and south Georgia during March and April which raised the ground-water table, thus saturating the ground and greatly restricting the discharge of water by seepage through the limerock formation that underlies the area. Rainfall records for the months of March and April for stations in the Suwannee River basin are as follows:

Rainfall Records in the Suwannee River Basin for March and April 1948

Station	March	April
Georgia:		
Moultrie	12.66	12.03
Tifton	9.96	9.26
Valdosta	15.94	4.60
Alapaha	11.55	10.70
Fitzgerald	11.01	6.87
Quitman	14.78	8.60
Florida:		
Madison	20.37	2.89
Lake City	12.61	4.52
Cross City	10.06	3.04
Perry	10.74	4.06

The biggest rainstorms occurred on March 31, April 1, and April 2. The precipitation recorded on those days is as follows:

	March 31	April 1	April 2
Georgia:			
Moultrie	1.20	9.00	0.02
Tifton	0.52	5.17	2.10
Valdosta	3.71	1.78	T
Alapaha	1.17	8.35	0.00
Fitzgerald	1.86	4.44	0.42
Quitman	0.85	4.40	1.90
Florida:			
Madison	8.93	0.03	1.77
Lake City	1.58	1.32	2.50
Cross City	0.04	2.59	0.20
Perry	0.00	0.00	3.40

Hydrology.--The flood of 1948 was the greatest of record in the Suwannee River basin. The Suwannee River was out of its banks from north of the Georgia-Florida line to the Gulf of Mexico. It varied in width from 1/2 to 6 miles. The maximum stages and discharges, as recorded by the U.S. Geological Survey and the places and dates they occurred for the 1948 flood, and the maximum discharges and dates of the 1928 flood, the highest previous flood of record, are as follows:

	Flood of 1948			Flood of 1928		
Station	Date	Elev. in ft. above m.s.l.	Discharge in sec. ft.	Date	Elev. in ft. above m.s.l.	Discharge in sec. ft.
White Springs	Apr. 5	85.19	29,000	Sept. 30 Oct. 1	-	20,600
Ellaville	Apr. 7 or 8	68.70	95,700	Aug. 20	-	73,000
Branford	Apr. 11	38.82	82,500	Aug. 26	-	65,000
Bell	Apr. 13	30.20	82,500	Aug. 28	-	70,000
Wilcox	Apr. 14	21.94	85,500	-	-	-

Emergency Work.--Emergency work to restore to use those county roads which school buses and R.F.D. mail carriers traveled over and to provide access to isolated areas to permit travel by physicians and health authorities in Madison, Lafayette, Hamilton, and Suwannee Counties was initiated by the Third Army, through the Florida Military District, under the Army emergency plan for assistance to civil authorities. The number of personnel and a list of equipment furnished under the plan were as follows:

Personnel	Equipment	
4 Officers	3 Draglines	3 1-ton trailers
100 Enlisted Men	11 Motor graders	12 20-ton trailers
	18 Dump trucks	1 750-gal. gas truck
	6 Bulldozers	1 10-ton wrecker
	4 Personnel carriers	1 10-ton ammunition carrier
	7 Prime movers	4 Jeeps

The equipment was used by the counties for about 3 weeks and accomplished the following work:

Graded 280 miles of county roads.
Restored 120 miles of county road ditches.
Excavated for fills 27,000 cubic yards of material.

Flood losses.--General. - Water was 8 feet deep in Ellaville, Dowling Park, and Oldtown, and 2 to 4 feet deep in Branford, Suwannee Springs, and Luraville. Branford, with a population of 882, is the only one of the above-named towns which is incorporated. Approximately 15,000 acres of farm land and 75,000 acres of pasture land were covered by backwater from the

Suwannee River and its tributaries. Many thousand additional acres were inundated in depressions and by lakes without outlets. Also much damage was done by erosion due to rain storms and sink holes overflowing.

The flood waters remained over the low lands for a period of 30 days and in depressions much longer. All highway and rail traffic between west Florida and east and south Florida was detoured through Georgia for about 21 days. The Live Oak, Perry, and Gulf Railroad was out of service from March 16th until May 2nd. For 12 days the main line of the Seaboard Railway between Jacksonville and New Orleans, which normally runs four scheduled passenger trains and 12 to 18 freight trains a day, was routed through Georgia, adding 100 miles distance between those two cities. The Georgia Southern & Florida Railroad, the Atlantic Coast Line Railroad, the Georgia & Florida Railroad, and the South Georgia Railroad also had their schedules temporarily interrupted. Red Cross and State health agents were sent to the area to care for the most needy and to prevent the spread of any disease that might treaten as a result of unsanitary conditions.

Flood damages.--Estimates of damage have been prepared on a basis of an inspection of the area and in cooperation with county agricultural agents and officials of the counties and railroads involved. In estimating losses, care was exercised to exclude damages other than those caused by the overflow from the Suwannee River and its tributaties.

Agriculture.--Losses to agriculture were not as great as they would have been if the flood had occurred later in the season. The water receded in time to plant late crops on most of the farm land. However, considerable difficulty was experienced by some farmers to get financial backing to start another crop, after losing the cost of labor, fertilizer, and seed for starting the first crop. The losses to agriculture are estimated as follows:

Loss of fertilizer:	
600 acres of tobacco	$30,000
15,000 acres of other crops	$45,000
Crop land held out of production:	
1,000 acres	20,000
Depreciation on farm machinery	5,000
Damage to farm residences and buildings:	
25 at average damage of $500 ea.	12,500
Total	112,500

It is doubtful if dealers in farm equipment and supplies were benefited by additional sales, due to the loss of accounts as a result of farmers being unable to pay after large flood losses.

Livestock.--A considerable number of livestock, especially hogs, were lost by drowning. Stock usually feed in the low lands along the river in the winter and early spring of the year. Due to the moderately rapid rise of the river and its strong current, many cattle and hogs were unable to get to higher ground. Since the grazing land was inundated for a comparatively short time and it being the season when new grass is growing, it is not believed that the flood waters materially affected the livestock that survived.

Losses to livestock are estimated as follows:

Cattle by drowning:	
800 head at $45 a head-------------	$36,000
By forced sales:	
3,000 head at $10 a head-----------	30,000
Hogs by drowning:	
1,000 head at $12.50 a head--------	12,500
By forced sales:	
2,000 head at $3 a head------------	6,000
Total----------------------	84,500

Urban.--White Springs. - The principal damage in White Springs was to the resort springs. The bath houses were flooded for about 3 weeks; only minor damages were caused to residences and other commercial establishments.

Suwannee Springs. - The water was several feet deep in Suwannee Springs. One well-built residence, a small tourist camp, and several summer residences were flooded. The business loss was small.

Ellaville. - One business establishment and two residences were flooded at Ellaville. The water was about 6 feet deep in the residences and 2 1/2 feet deep in the business establishment which is a combination service-station, restaurant, dance hall, and grocery store.

Dowling Park. - The water was standing about 6 feet deep in three small general stores in Dowling Park, and varied from a few inches to 8 feet deep in about eight residences, including a home for aged men. One small residence was washed in a slough and completely destroyed.

Branford. - In Branford several residences in the edge of town were flooded and shrubbery was killed around several houses. A recently completed quick-freezing plant was flooded about 4 feet deep, constituting the greatest loss in that town. Very little merchandise was lost, the main part of town was not flooded. There was only minor damage to streets.

Oldtown.--The settlement of Oldtown is along Federal Highway No. 19 where it crosses the Suwannee River. It consists mostly of tourist camps and fishing camps. The water was about 5 feet deep in about 20 tourist cottages and one combination restaurant, gasoline station, and grocery store. Some of the tourist cottages were modern, having tile baths and other modern conveniences. Trade to these tourist camps and fishing camps was at a standstill for about 1 month.

Urban losses

Place	Commercial	Business	Residences
White Springs	$ 2,000	$ 2,000	-
Suwannee Springs	1,000	-	$ 5,000
Ellaville	2,000	3,000	3,000
Dowling Park	4,000	3,000	6,000
Branford	10,000	4,000	6,000
Oldtown	8,000	4,000	2,000
Total	$27,000	$16,000	$22,000

The losses to restaurants, taxis, service stations, and other business enterprises due to lack of travel in the flooded area are included in the business losses. The total urban loss is estimated at $65,000.

Timber and timber products.--Sawmill and cross-tie operators were forced to confine their operations to high ground; some operators in low places were forced to suspend operations for several weeks. Also turpentine-still operators were restricted to the high areas and some gum was lost by water rising over the cups, washing the gum out. Total loss to timber and timber products is estimated at $20,000.

Railroads.--One of the greatest losses was to transportation facilities. The Live Oak, Perry & Gulf Railroad is believed to have suffered the greatest loss. Service on this railroad was suspended for about 6 weeks. About 50 feet of the north end of the bridge across Suwannee River at Dowling Park and about 60,000 cubic yards of earth fill had to be replaced. The total loss to this railroad was estimated at $75,000 by Mr. J.H. Kansinger, its President and General Manager. Estimates of losses on the Seaboard Railway, the Atlantic Coast Line, the Georgia Southern & Florida, the Georgia & Florida and the South Georgia Railroads are not available at present. Representatives of the Seaboard Railway and Atlantic Coast Line Railroads said their losses were large, but that estimates of damages have not been completed. It is estimated that the damages to the Live Oak, Perry & Gulf Railroad would about equal the combined damages to the other railroads, thus making a total loss of $150,000 to railroads.

Buses and motor cars.--Buses and motor cars were forced to detour up to 150 miles in traveling from south and east Florida to points west of the

Suwannee River, for a period of 21 days. It is estimated that buses and cars traveled an additional 100,000 miles at an average cost of 6 cents per mile, making a loss to buses and automobiles of $6,000.

Damage to Federal highways.--No. 84 had a 300-foot section of fill washed out near Quitman, Georgia, where it crosses the Withlacoochee River. No. 41 near White Springs, Florida, where it crosses Suwannee River, had a 50-foot section of fill and the abutment of a bridge washed out. On No. 90 near Ellaville two large culverts were washed out. Nos. 129 and 19 were covered by flood waters about 3 weeks but only minor damage was caused to the highway. Damage to Federal highways is estimated at $30,000.

Damage to State highways.--No. 15 near Luraville had one culvert washed out and about 2 miles of fill and surfacing was badly eroded and had to be replaced. No. 49 was covered by floodwaters in several places but only minor damage was caused. Damage to State highways is estimated at $8,000.

Damage to County roads.--County roads lying along the Suwannee River and its tributaries were badly damaged, many bridges and culverts were washed out. All of these roads have not yet been restored to use. Most of the roads were of graded dirt construction, so that repair was reasonably low except where bridges and culverts had to be replaced. It is estimated that damages to County roads was $40,000.

Summary of damages.

Agriculture	$112,500
Livestock	94,500
Urban	65,000
Timber and timber products	20,000
Railroads	150,000
Buses and motor cars	6,000
Federal highways	30,000
State highways	8,000
County roads	40,000
Total	$516,000

While the 1948 flood was the greatest of record in the Suwannee River basin, and the damages appear quite large, they are distributed over a large area extending from southern Georgia to the south of the Suwannee River near Cedar Keys, Florida, a distance of about 220 river miles. A re-evaluation of the economic data shown in the survey report entitled "Survey Report Suwannee River, Florida and Georgia," dated 1 July 1947, is considered unnecessary since, in arriving at damage-frequency data for purposes of the report, the resulting curves were extrapolated to include a condition similar to that recently experienced. An economic analysis specifically including the effects of the 1948 flood produces no appreciable economic change from that shown in the report of 1 July 1947.

APPENDIX

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Appendix H

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