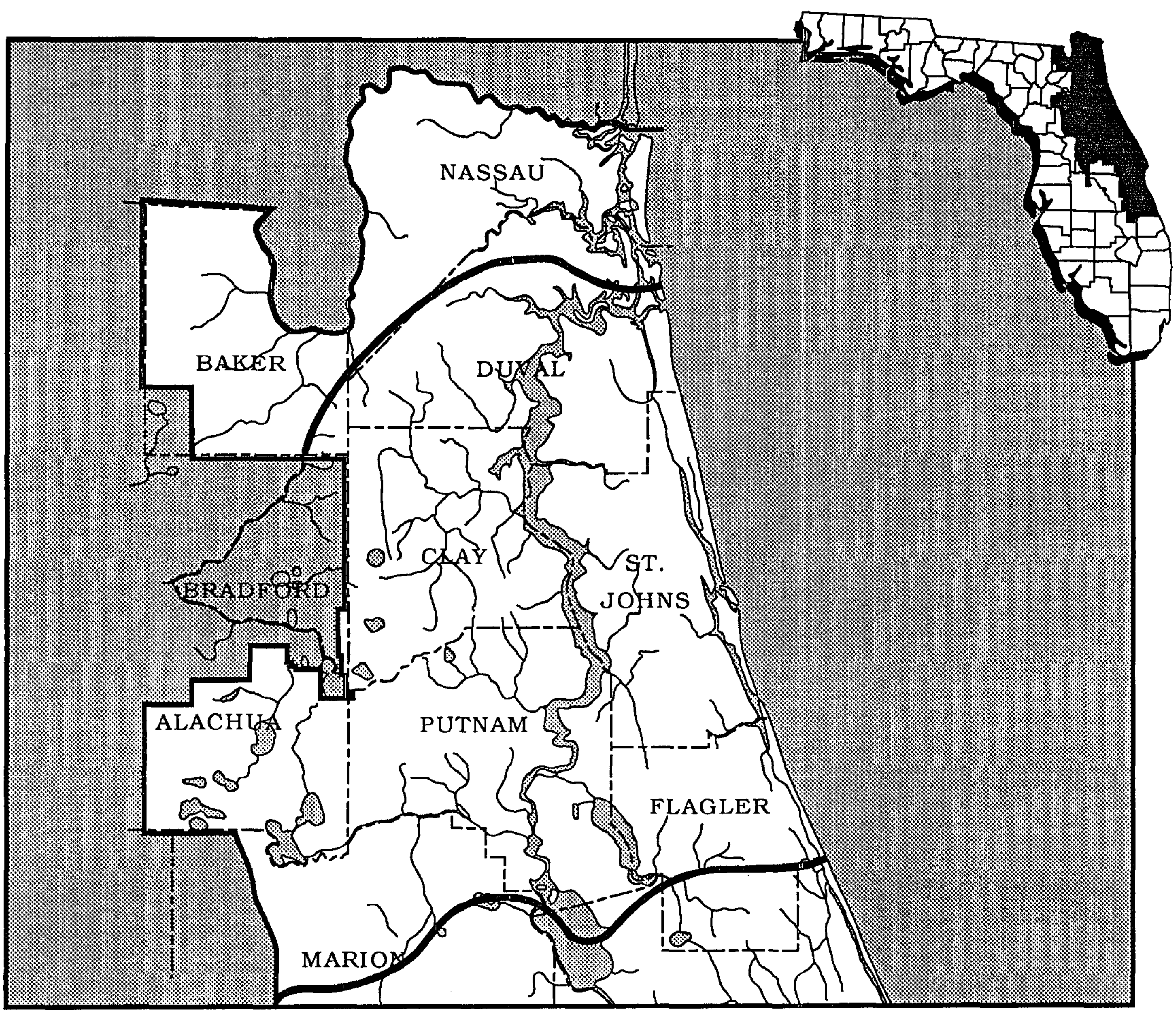
Technical Publication SJ 90-8

Lower St. Johns/St. Marys Ground Water Basin Resource Availability Inventory



St. Johns River Water Management District

Technical Publication SJ 90-8

LOWER ST. JOHNS AND ST. MARYS GROUND WATER BASINS RESOURCE AVAILABILITY INVENTORY

by

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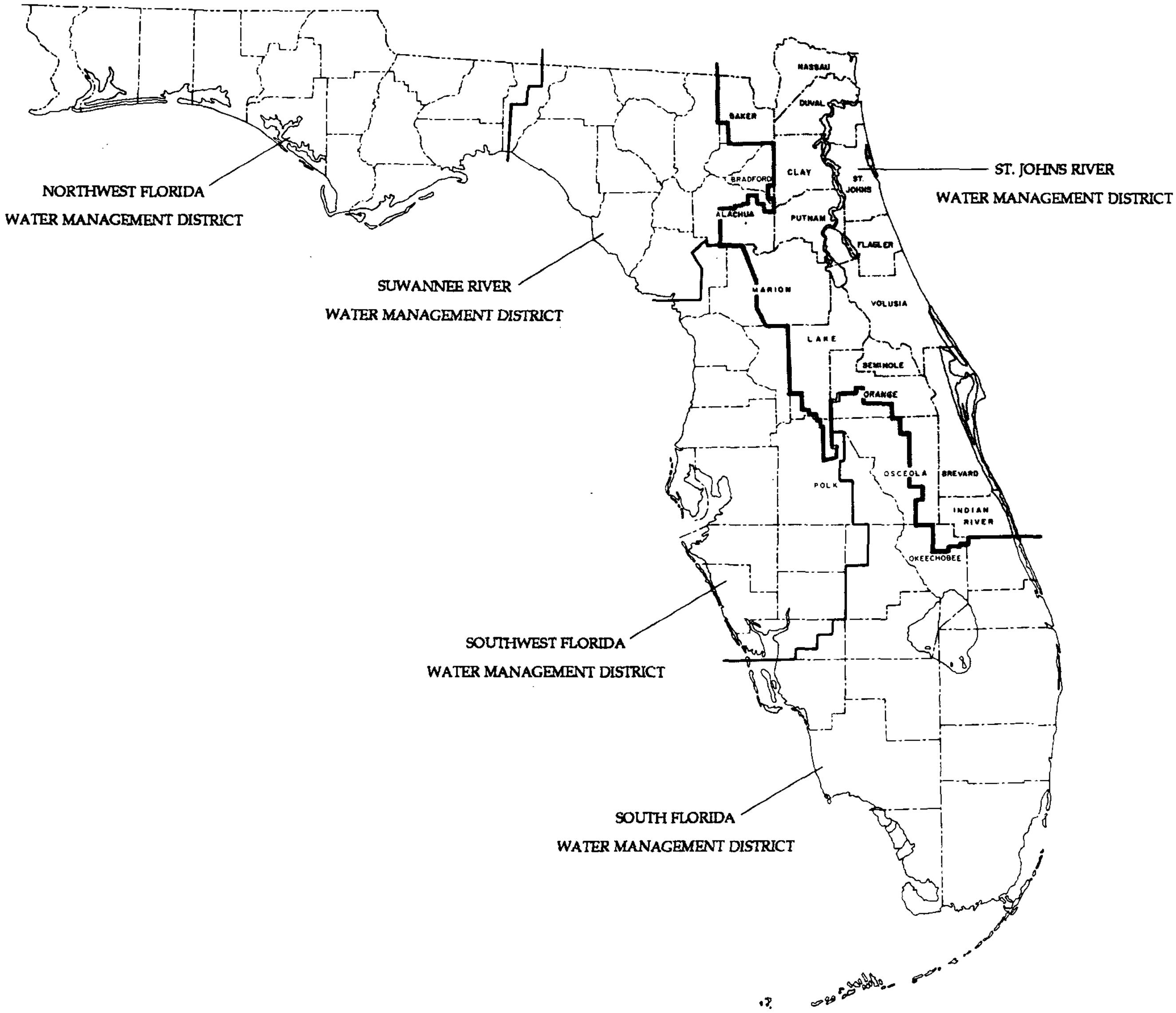
1990



THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or parts of nineteen counties in northeast Florida. The mission of SJRWMD is to manage water resources to insure their continued availability while maximizing environmental and economic benefits. It accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management. Technical reports are published to disseminate information collected by SJRWMD in pursuit of its mission.

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INTRODUCTION

Rapid population growth, urban sprawl, and increased agricultural and industrial activities in recent years have resulted in significantly increased stresses on the water resources throughout the state. In response to increased awareness of water resource issues, the Florida legislature has adopted legislation with the intent to improve water resource management and guide future growth through state, regional, and local planning programs.

This legislation has created a comprehensive planning process at the state, regional, and local levels of government. Local comprehensive plans address the elements set forth in the state comprehensive plan. One of these elements is conservation--which is concerned with the conservation, use, and protection of natural resources, including water and water recharge areas (Section 163.3177, Florida Statutes).

The legislature has directed the water management districts to develop a ground water basin resource availability inventory (GWBRAI) and to disseminate the inventory to local governments and regional agencies for use in the comprehensive planning process. (Section 373.0395, F.S., see Appendix A).

This report provides a general inventory of the ground water resources of the Lower St. Johns (LSJ) and St. Marys (SM) ground water basins including hydrogeologic features, recharge and discharge areas, ground water quality characteristics, present and projected water use, direct water reuse, and areas suitable for future water resource development. The LSJ and SM ground water basins are two of five ground water basins in the St. Johns River Water Management District (SJRWMD). A ground water basin is a particular ground water flow system that encompasses recharge areas and the associated discharge areas. The LSJ and SM ground water basins cover all, or part, of 10 counties--Nassau, Duval, Baker, Clay, Bradford, St. Johns, Alachua, Putnam, Marion, and Flagler counties--and extend to the west and north of the SJRWMD boundary into the Suwannee River Water Management District and into the State of Georgia (Figure 1).

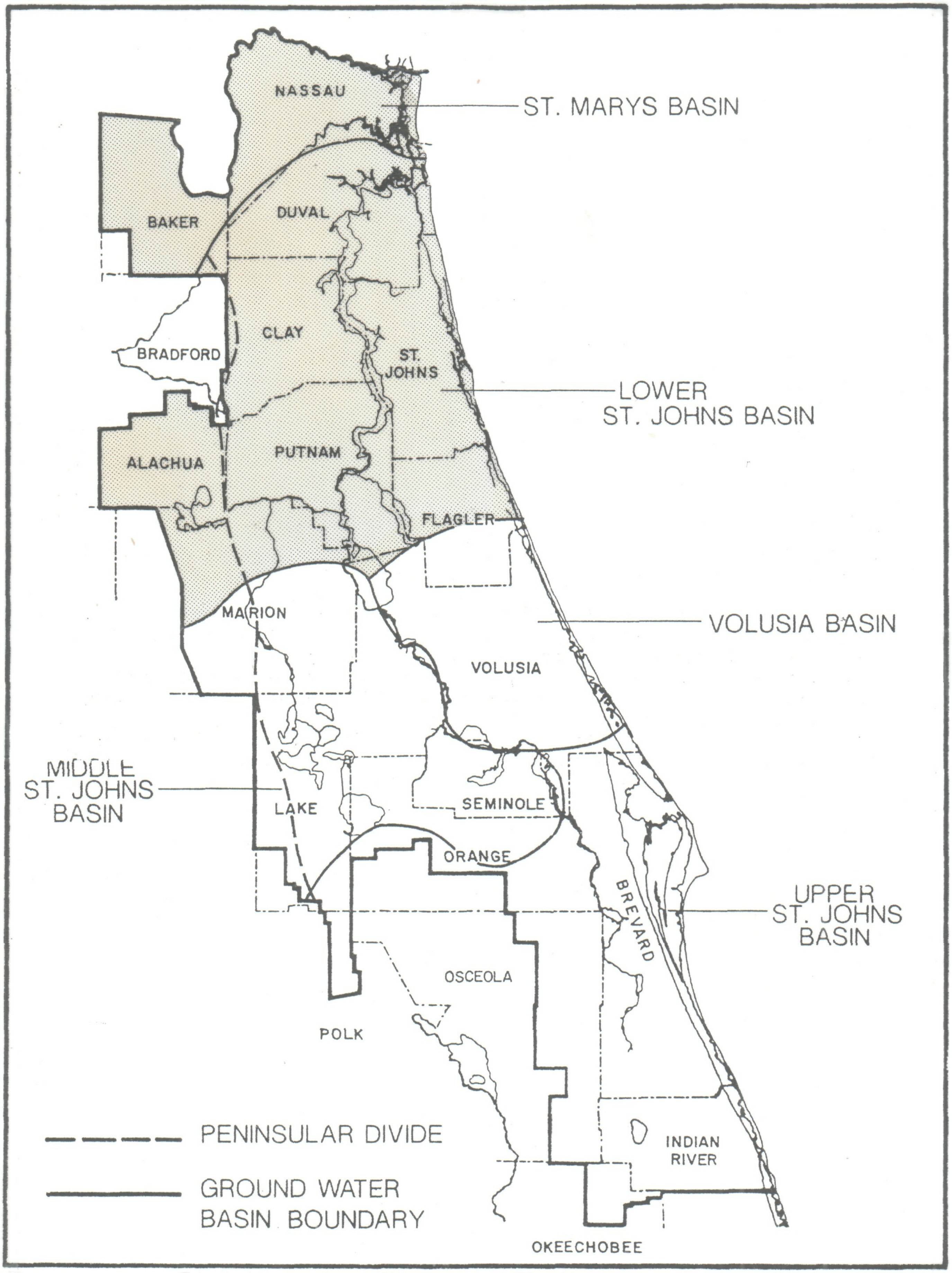

Figure 1. The St. Johns River Water Management District and ground water basins

PHYSIOGRAPHY AND TOPOGRAPHY

The major physiographic regions in the LSJ and SM ground water basins are the Atlantic Coastal Ridge, Center Park Ridge, Crescent City Ridge, Mount Dora Ridge, Trail Ridge, Eastern Valley, Duval Uplands, and Northern Highlands (Figure 2). These features are the result of primary deposition and subsequent erosion. Ridges are composed of sand that accumulated as beaches and offshore bars on the terraces of the Eastern Valley, and are characterized by thick sand sections at comparatively high land surface elevations. Ridges are important water resource features because of their ability to absorb and store significant quantities of rainfall. Terraces are features of low relief that mark the location of the ocean bottom at times when sea level stood higher than at present (Toth 1988). These areas, when covered with seawater, collected deposits of silts, muds, and organics. As the sea receded to its present level, these features were eroded and partially masked, leaving the topography and soil types present today. There are four major groups of soil types in the area (Fernald 1984):

- mostly Entisols--thick, well-drained sands
- mostly Spodosols--poorly drained sandy soils with dark, sandy subsoil layers
- mostly Histosols--minor amounts of organic soils (peat) underlain by marl and/or limestone
- miscellaneous beaches, dunes, tidal marshes, and tidal swamps of present and relict shorelines

Karst topography is typical of ridge areas throughout Florida and is evident in the LSJ and SM ground water basins in Marion, Alachua, southwestern Clay, northwestern and southeastern Putnam, and eastern Bradford counties. Poorly developed surface drainage is a clue in the identification of a karst terrain, as karst topography is a result of water passing through surficial sediments and percolating downward to dissolve the underlying carbonates (Casper 1981). This process typically results in topography characterized by an irregular, pitted surface of high relief, circular lakes, caves at land surface, and sinkholes (Figure 3). A significant triggering mechanism for sinkhole development is the lowering of the potentiometric surface, either naturally (drought) or artificially (increased pumpage). Karst processes contribute to loss of buoyant support for surface sediments,

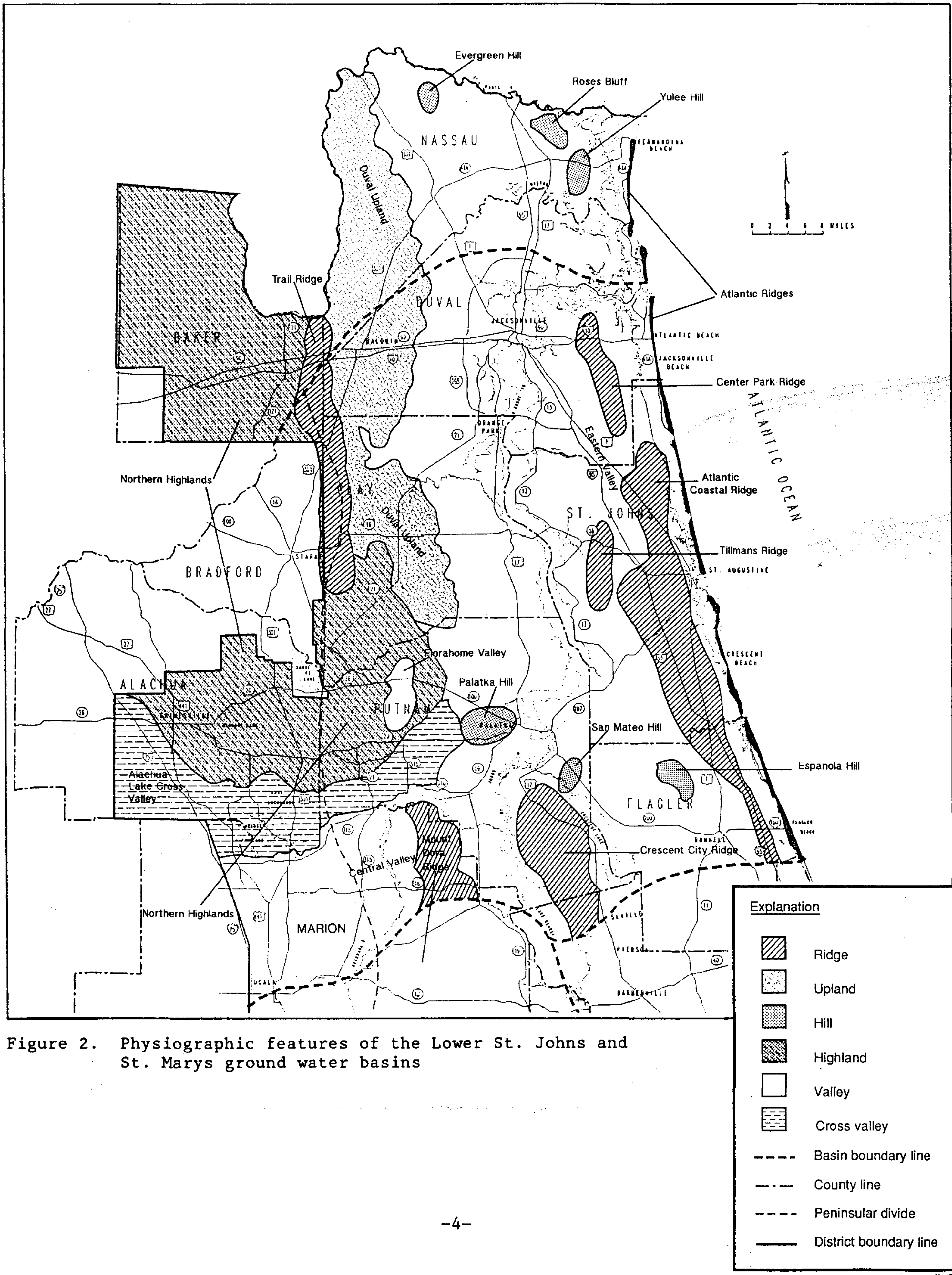

Figure 2. Physiographic features of the Lower St. Johns and St. Marys ground water basins

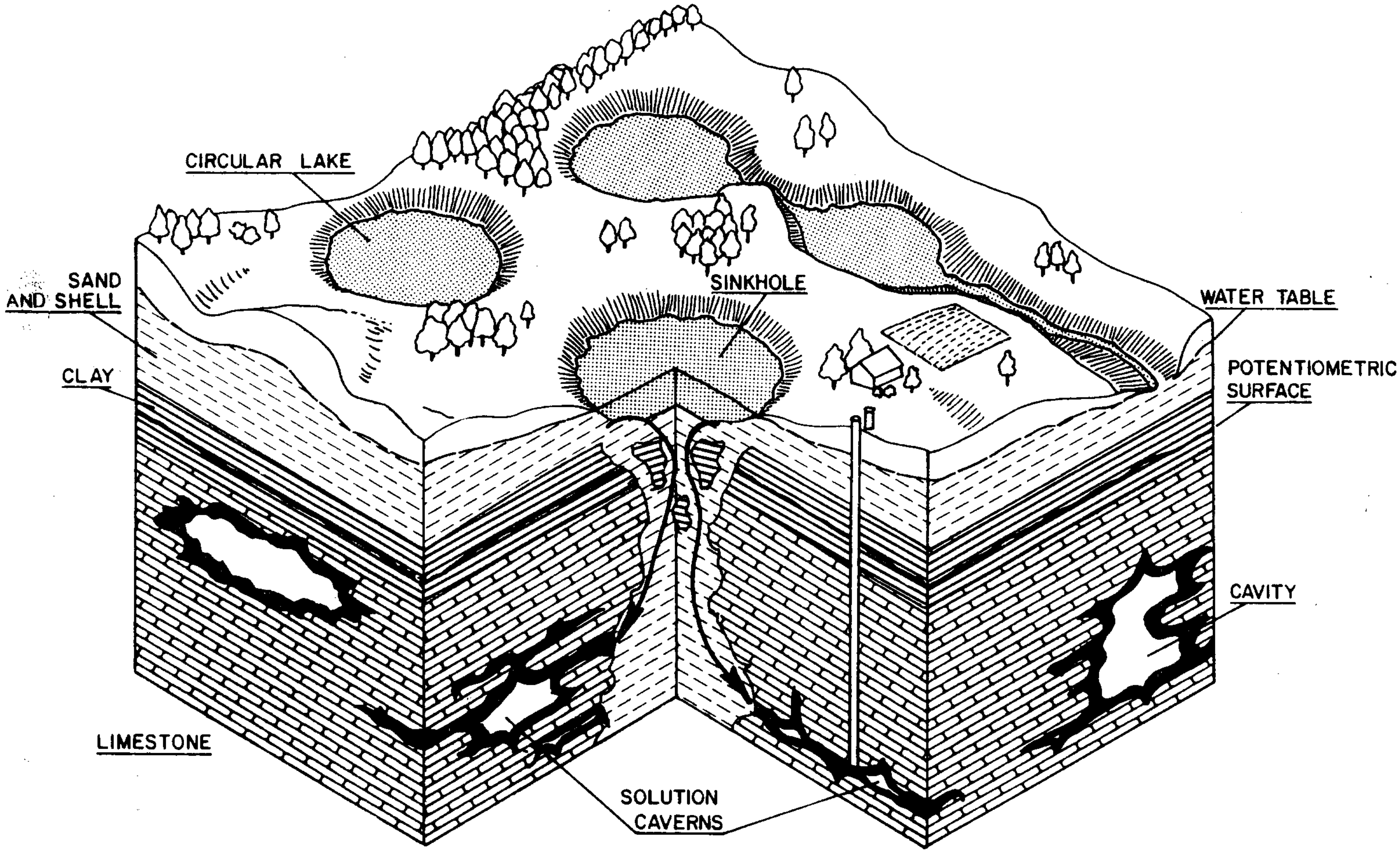

Figure 3. Generalized karst topography

increase in ground water velocity, and increased recharge to the Floridan aquifer, which increases dissolution of the limestone (Newton 1984). Recent sinkholes in the LSJ and SM ground water basins have occurred in the Crescent City/Georgetown area of southeastern Putnam County where several sinkholes formed in December 1989.

HYDROGEOLOGY

Ground water is the subsurface water in the zone in which all pore spaces are completely filled with water. All water from wells and springs is derived from ground water. The amount of precipitation that becomes ground water in a particular area depends on many factors such as rainfall amount and severity, runoff, vegetation, land use, evaporation, and seepage (Fernald 1984). Water supplies in the LSJ and SM ground water basins are obtained almost entirely from ground water sources (Leve 1965). These sources are the surficial, the intermediate, and the Floridan aquifer systems. Geologic cross-sections drawn from well log information show the relationships among, and the approximate depth of, the three aquifer systems in northeastern Florida (Figure 4).

THE SURFICIAL AQUIFER SYSTEM

The surficial aquifer system is composed of sand, shell, and some clay. The top of the aquifer is defined by the water table, which is free to rise and fall in response to atmospheric pressure. The water table marks the line below which all pore spaces are filled with water. Because there is no overlying confining unit, the aquifer is directly replenished by local rainfall and by percolation from surface water bodies (Snell and Anderson 1970). Flow in the surficial aquifer system usually follows the topography of the land surface and can discharge into streams, lakes, and rivers. Supplies of water from wells in the shallow aquifer are often limited by the seasonal fluctuations of the water table; however, shallow wells are a valuable source of water in the LSJ and SM ground water basins for domestic and livestock uses in areas where large quantities of water are not required and the depth to the Floridan aquifer, or where the quality of the water in the Floridan aquifer is not suitable for this use.

THE INTERMEDIATE AQUIFER SYSTEM

The intermediate aquifer system is found below the surficial aquifer system and includes the confining unit of the Floridan aquifer. It is composed of clays and thin, water-bearing zones of sand, shell, and limestone and contain ground water under confined

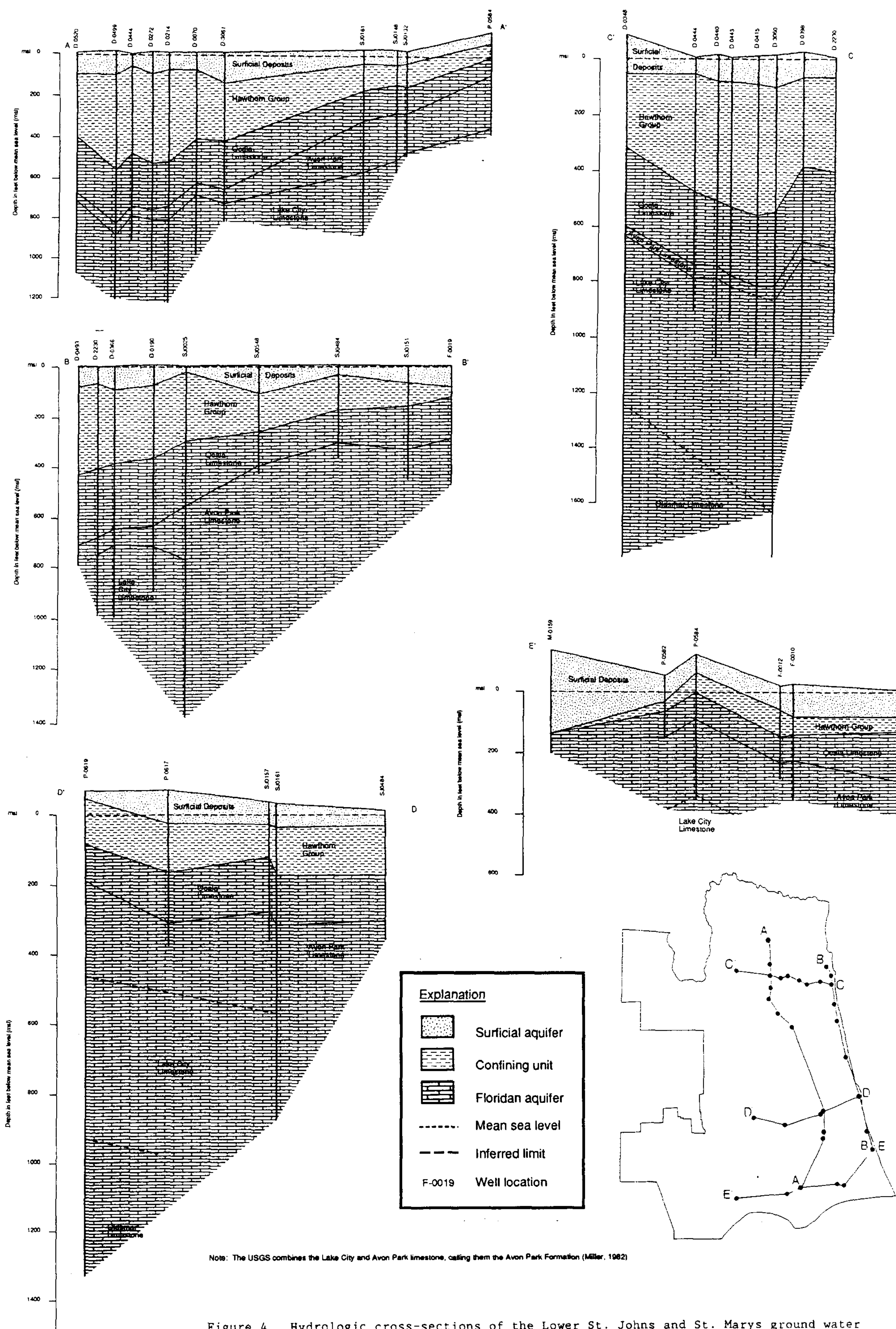

Figure 4. Hydrologic cross-sections of the Lower St. Johns and St. Marys ground water basins

(artesian) conditions. In the LSJ and SM ground water basins, the intermediate aquifers are used primarily in Clay County where these aquifers contain enough water of sufficient quality to use.

THE FLORIDAN AQUIFER

The Floridan aquifer, the primary water-producing aquifer in the LSJ and SM ground water basins, is an artesian aquifer composed of limestone and dolomite. In artesian aquifers the ground water is under pressure that is greater than atmospheric pressure. This pressure is demonstrated by the potentiometric surface, which is the level to which water will rise in tightly cased wells that penetrate the aquifer. When plotted on a map, this surface can be interpreted to show the direction of ground water flow (Figure 5).

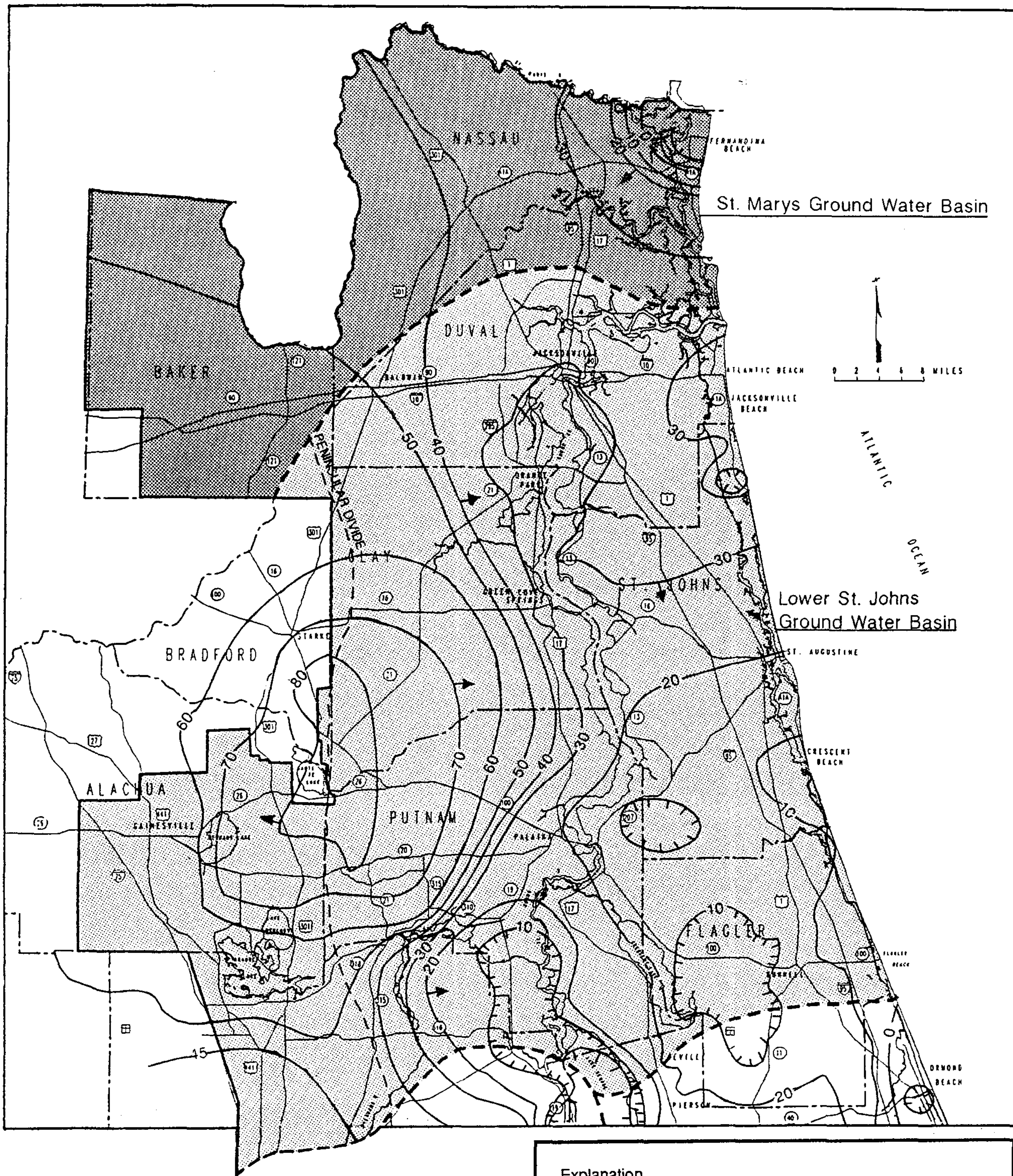

Figure 5. The potentiometric surface of the Floridan aquifer for May, 1987, in the Lower St. Johns and St. Marys ground water basins.

Explanation

- 50 — Potentiometric contour line (contour interval = 10 ft.)
- Direction of ground water flow in the Floridan aquifer
- Basin boundary line
- County line
- Peninsular divide
- District boundary line

RECHARGE AND DISCHARGE

SURFICIAL AQUIFER SYSTEM

Recharge to the surficial aquifer system is controlled by local rainfall, land use, vegetation, topography, and local soils. A generalized soils map for the LSJ and SM ground water basins provides one way to assess potential recharge to the surficial aquifer system. Areas of highly permeable, sandy soils are typically good recharge areas for the surficial aquifer system (Figure 6). These soils transmit fluids easily and can yield significant quantities of water. Areas characterized by impermeable soils are areas of little or no recharge to the surficial aquifers. The surficial aquifers can discharge into surface streams, lakes, and rivers or to lower aquifers.

FLORIDAN AQUIFER

The Floridan aquifer is recharged by the surficial aquifer system in areas where the water in the surficial aquifer system is higher than the potentiometric surface of the Floridan aquifer. Areas in the LSJ and SM ground water basins have been classified according to the potential recharge capability from the surficial aquifer system to the Floridan aquifer in four classes ranging from zero recharge to high recharge (Stewart 1980, Healy 1975). The areas of high potential recharge in the LSJ and SM ground water basins are in Marion, Alachua, southwestern Clay, and western and southeastern Putnam counties (Figure 7).

Discharge occurs where the potentiometric surface of the Floridan aquifer is higher than the elevation of the water table in the surficial aquifer system. In areas where the potentiometric surface is higher than land surface, wells penetrating the Floridan aquifer will flow at land surface. Where the overlying confining layer is thin or absent and the potentiometric surface is higher than land surface, naturally occurring springs will result. Springs are commonly found in discharge areas adjacent to rivers and streams. Major examples in the LSJ and SM ground water basins are Green Cove Springs in Clay County, Salt Springs in Marion County, and a large submarine spring offshore from Crescent Beach in St. Johns County.

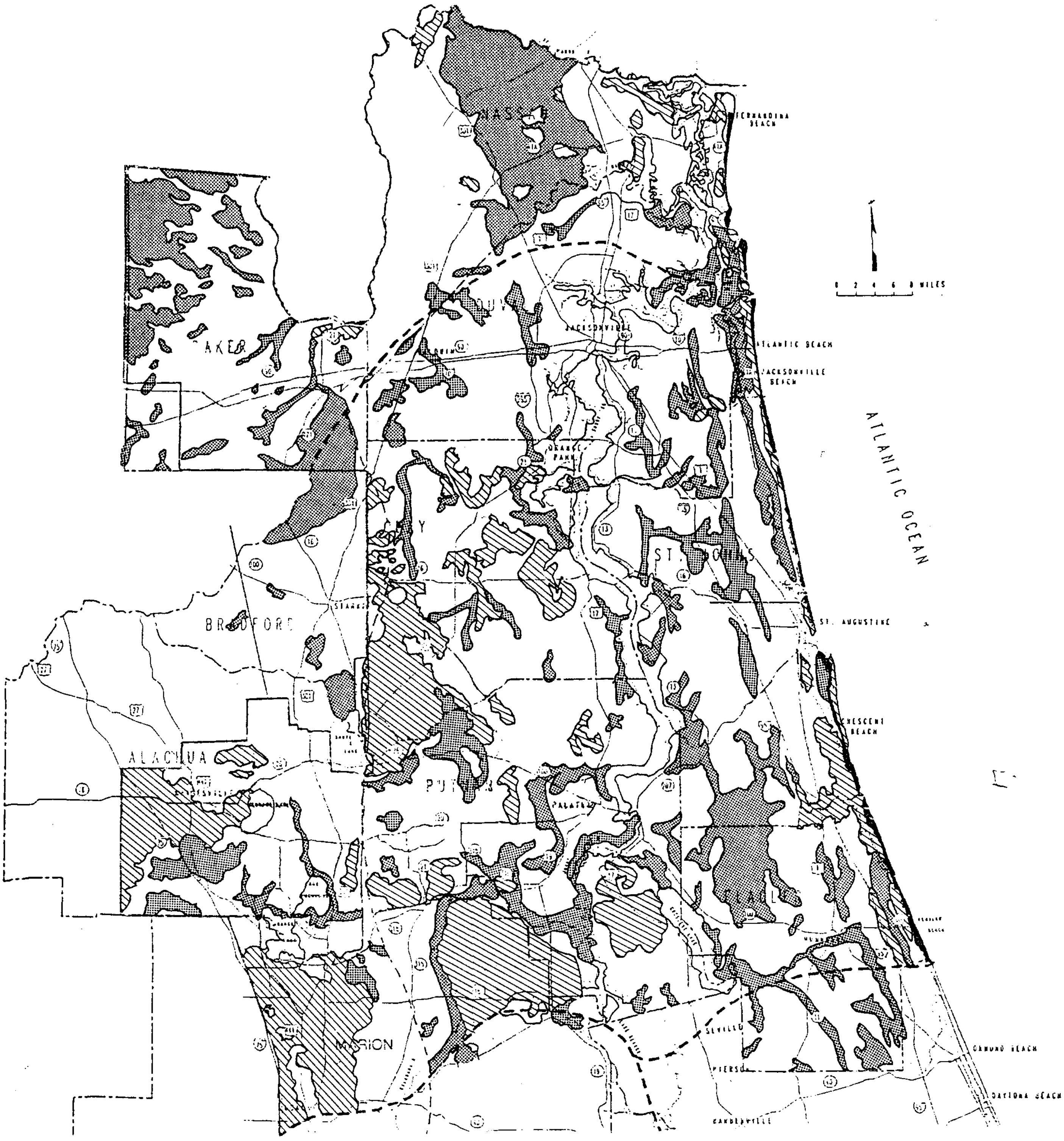

Figure 6. Generalized soils map for the Lower St. Johns and St. Marys ground water basins. Very permeable soils indicate areas of potential recharge for the surficial aquifer.

Explanation

- Areas dominated by sandy soils: very permeable
- Areas dominated by poorly-drained soils: very impermeable
- Basin boundary line
- County line
- Peninsular divide
- District boundary line

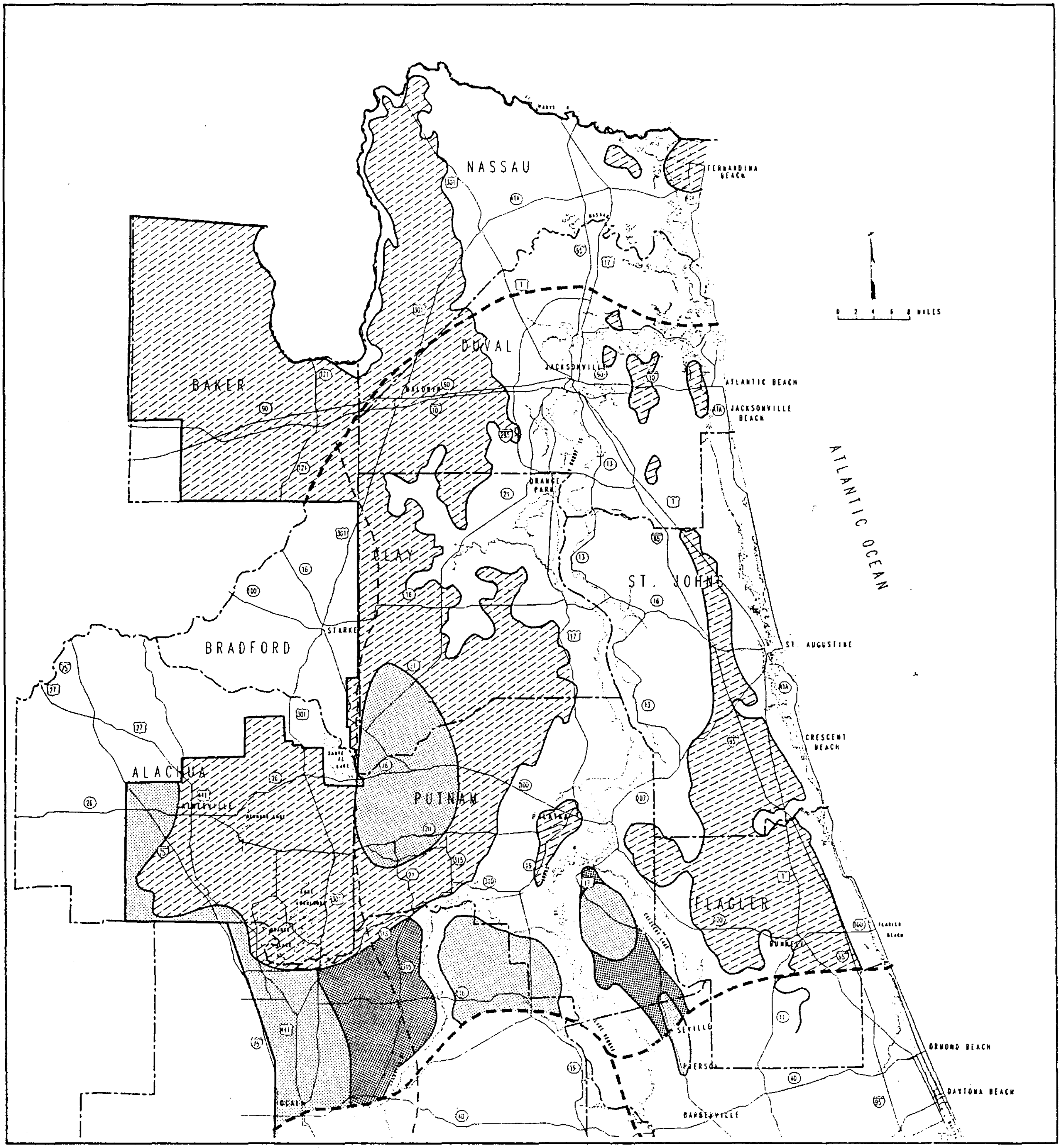

Figure 7. Approximate areas of natural recharge and discharge for the Floridan aquifer in the Lower St. Johns and St. Marys ground water basins

Explanation

- Areas of generally no recharge
- Areas of very low recharge
- Areas of low to moderate recharge
- Areas of high recharge
- Basin boundary line
- County line
- Peninsular divide
- District boundary line

PRIME GROUND WATER RECHARGE AREAS

Section 373.0395, F.S., provides that the GWBRAI should include the designation of prime ground water recharge areas for the Floridan aquifer. A pilot study to delineate areas of prime recharge to the Floridan aquifer has been performed by SJRWMD. The pilot study area is the Crescent City Ridge area of southeastern Putnam County. The methodology and knowledge gained from this pilot study will be used to delineate prime recharge areas in other areas of the district. Prime ground water recharge areas to the Floridan aquifer are currently scheduled to be delineated by July 1, 1991.

GROUND WATER QUALITY

The chemical characteristics and physical properties of ground water are affected by many factors, including the initial chemical composition of water entering the aquifer, the types of rocks with which it comes in contact, and the length of time it remains in contact with the rock. Generally, over the entire peninsular area of the State of Florida, waters at depth are more mineralized than shallower waters, which leads to a lens of buoyant, potable water underlain by denser, saline water. This lens of potable water is constantly changing in size and shape in response to changes in rates of recharge and discharge from the aquifer. Water quality is a composite of all producing zones penetrated (Toth 1990). Consequently, for long-term, desirable quality, wells should not be drilled any deeper than necessary.

Variations in water quality can be sufficiently described in the LSJ and SM ground water basins by two chemical constituents: chloride and sulfate. Increases in chloride concentration usually reflect seawater intrusion or a mixing with deeper, more saline water (Toth 1990). Figure 8 reflects chloride concentrations in the Floridan aquifer in the LSJ and SM ground water basins. The map of the Floridan aquifer was prepared using all available chloride information found in the SJRWMD database with additional data added to the coastal areas of Nassau, Duval, and St. Johns counties (Toth 1990). Chloride concentrations may vary from locale to locale as a result of the depth of the well sampled, the amount of withdrawal occurring in that area, and the time of the year. Sulfate concentrations in the LSJ and SM ground water basins, shown in Figure 9, also indicate water quality. The Environmental Protection Agency (EPA) and the State of Florida have adopted a drinking water standard of less than 250 milligrams/liter (mg/l) for chloride and sulfate and less than 500 mg/l of total dissolved solids (TDS). These are only some of the constituent concentrations that have been established for health standards and public acceptance for drinking water. Further guidelines may be obtained from local Health and Rehabilitative Service (HRS) or State of Florida Department of Environmental Regulation (DER) offices.

Water quality in the surficial aquifer is very sensitive to land use, and care must be taken not to contaminate this shallow zone. Water quality in the Floridan aquifer is less sensitive to surface contamination because of the aquifer depth and the percolation and filtering process.

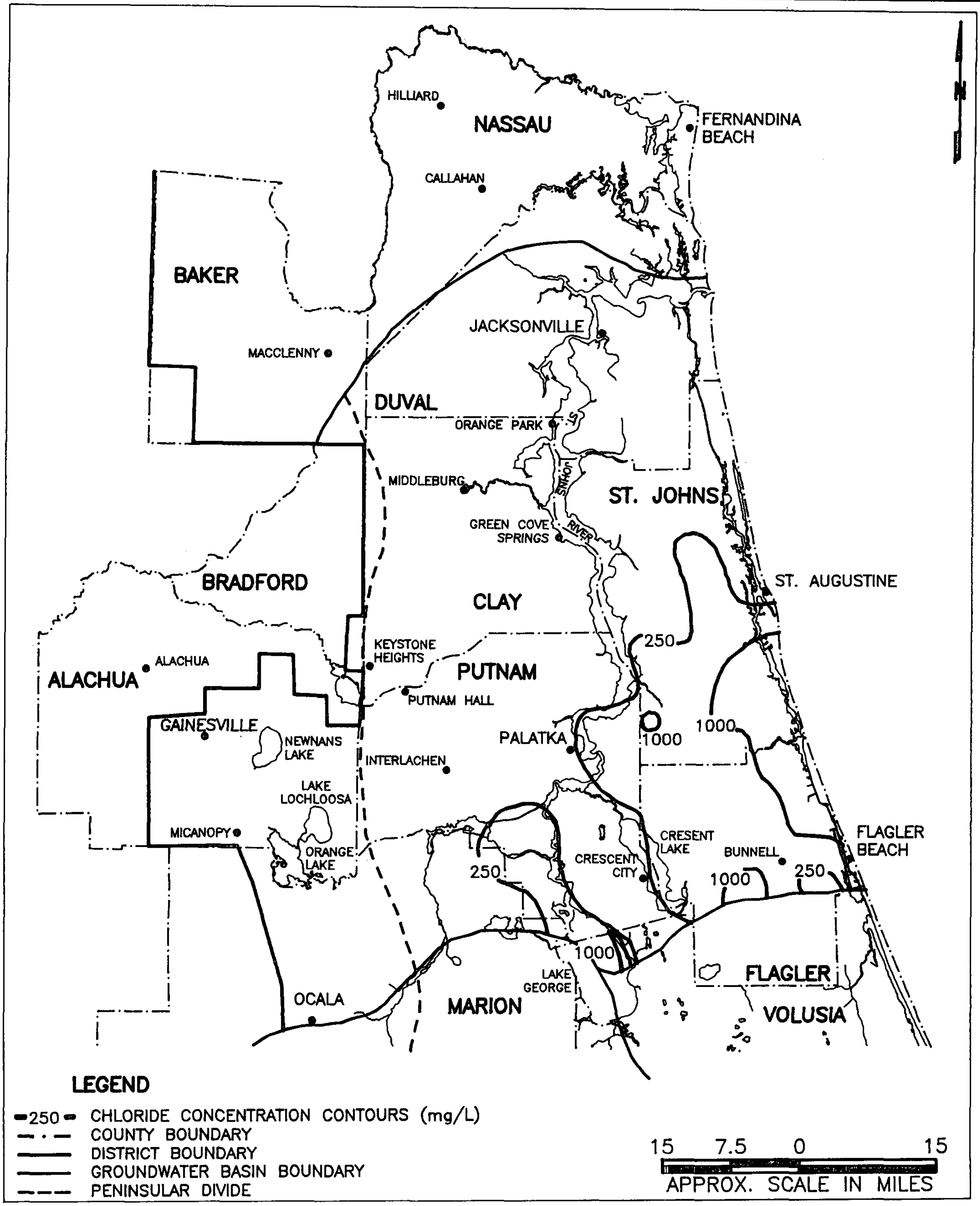

Figure 8 Revised

Floridan Aquifer Chloride Concentration for the Lower St. Johns and St. Marys Ground Water Basin Averaged Over the Years 1982 to 1988

Modified: Rutledge, 1985.

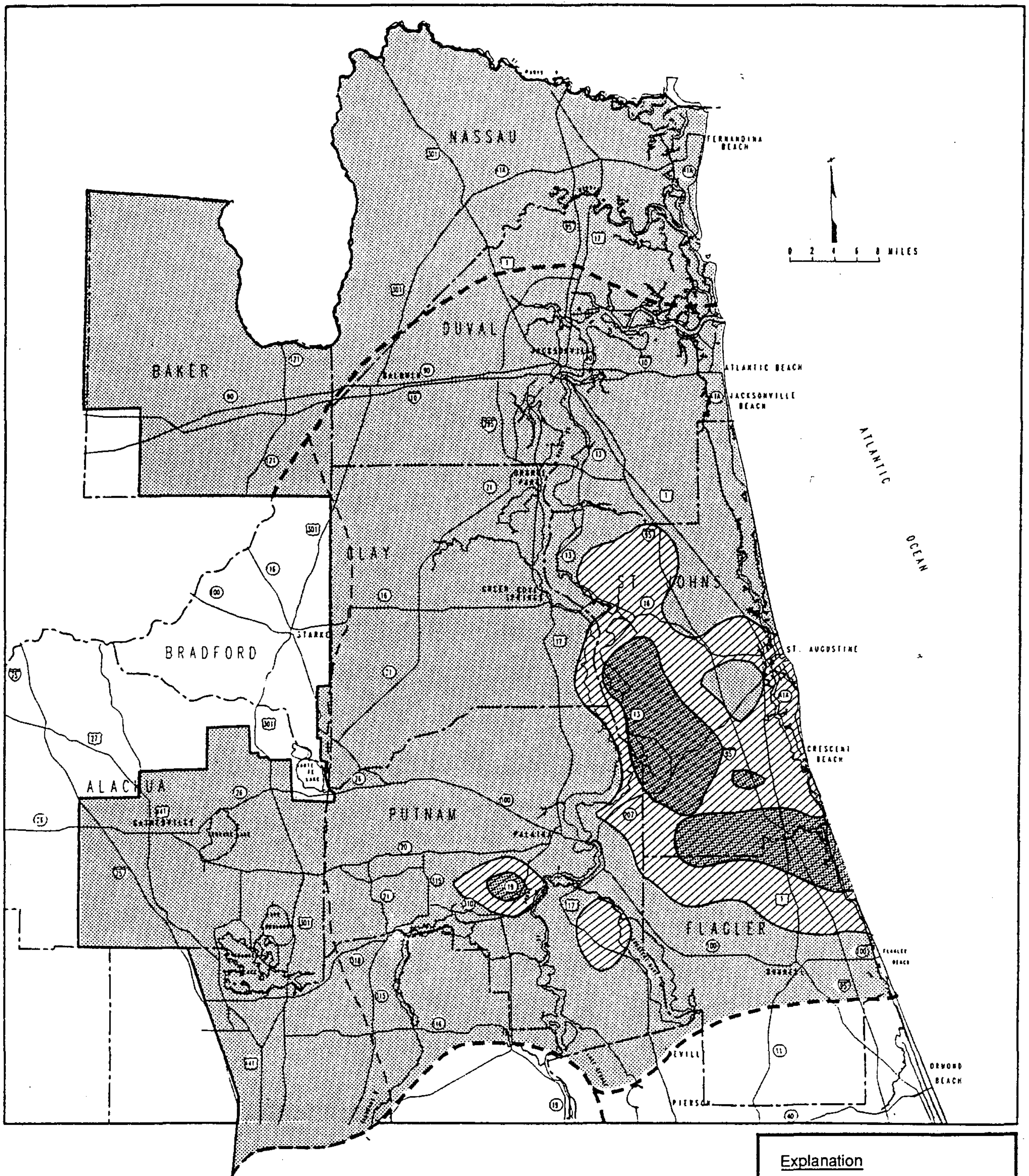

Figure 9. Sulfate concentration in the Floridan aquifer in the Lower St. Johns and St. Marys ground water basins

AREAS PRONE TO SALTWATER INTRUSION

The potential for saltwater intrusion exists in the LSJ and SM ground water basins. The sources for this potential intrusion are lateral and vertical saltwater migration.

Changes in the potentiometric surface result from changes in the magnitude of ground water withdrawals and climatic changes. As the potentiometric surface declines, the potential for the upward movement of saline water is increased (Figure 10). In parts of Duval and northern St. Johns counties high chloride/high sulfate waters occur along the coast, along portions of the St. Johns River, and in a line stretching from Fort George Island to the Ortega River in Jacksonville (Toth 1990).

In the agricultural areas of western St. Johns, eastern Putnam, and Flagler counties, ground water withdrawals for irrigation have lowered the potentiometric surface. High chloride/high sulfate waters occur in these areas as a result of upward movement of saline waters which exist at depth. These areas are prone to saltwater intrusion through improperly constructed wells. High chloride/high sulfate waters also occur near Lake George and the Oklawaha River in southeast Putnam County (Figure 8 and 9). This water is under higher artesian pressure than the water above it, thereby providing the potential for upward movement of saline water (Toth 1990).

The surficial aquifer system is most prone to saltwater intrusion along the coast where it is subject to tidal fluctuations and lateral saltwater movement. High chloride concentrations in the surficial aquifer system indicate areas where saltwater intrusion occurs (Figure 11). The surficial aquifer system in the coastal areas depends on local rainfall to maintain its freshwater supply. This aquifer is tapped by many small diameter wells for domestic supply and lawn irrigations.

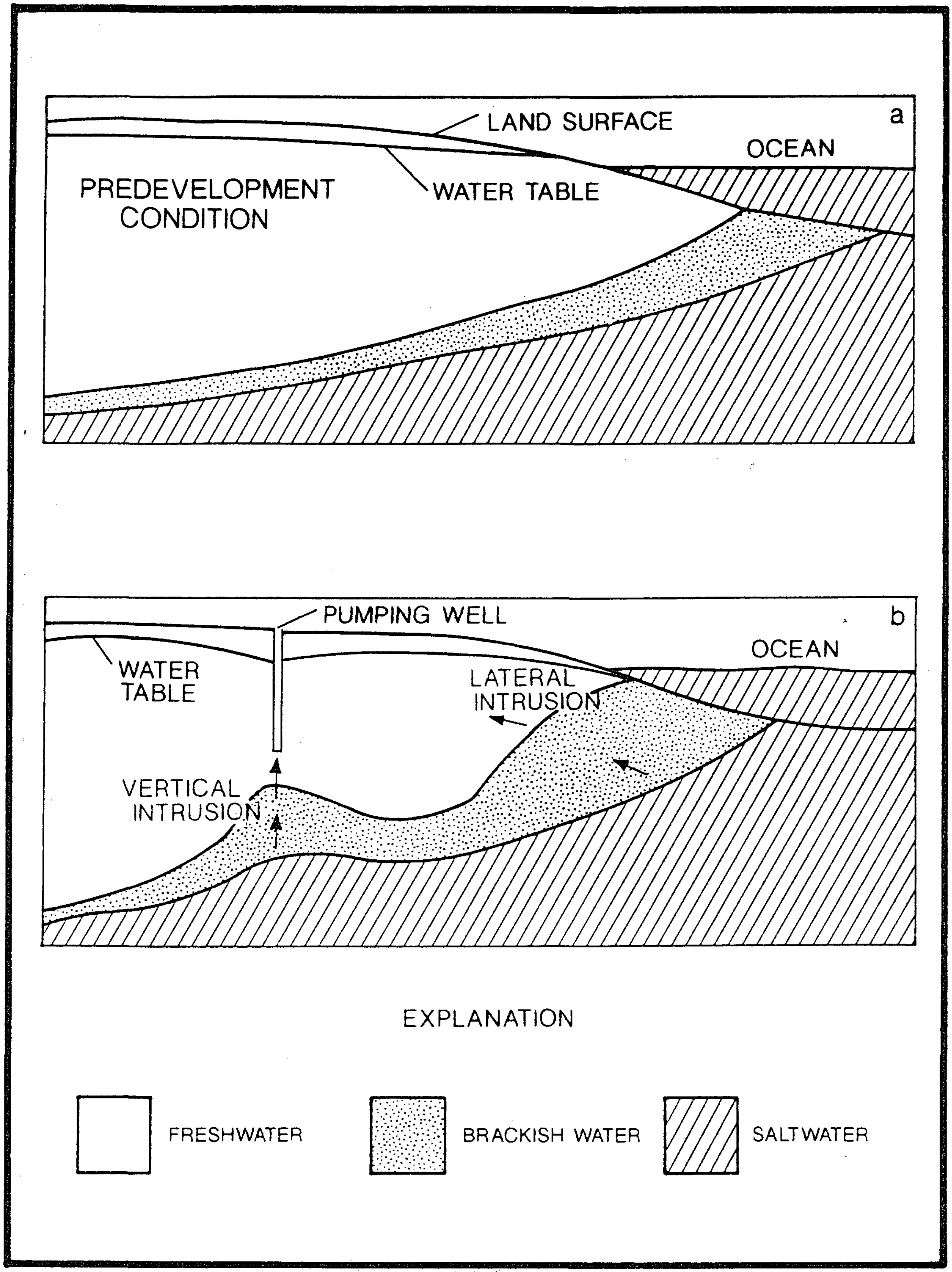

Figure 10. The movement of brackish water caused by pumping

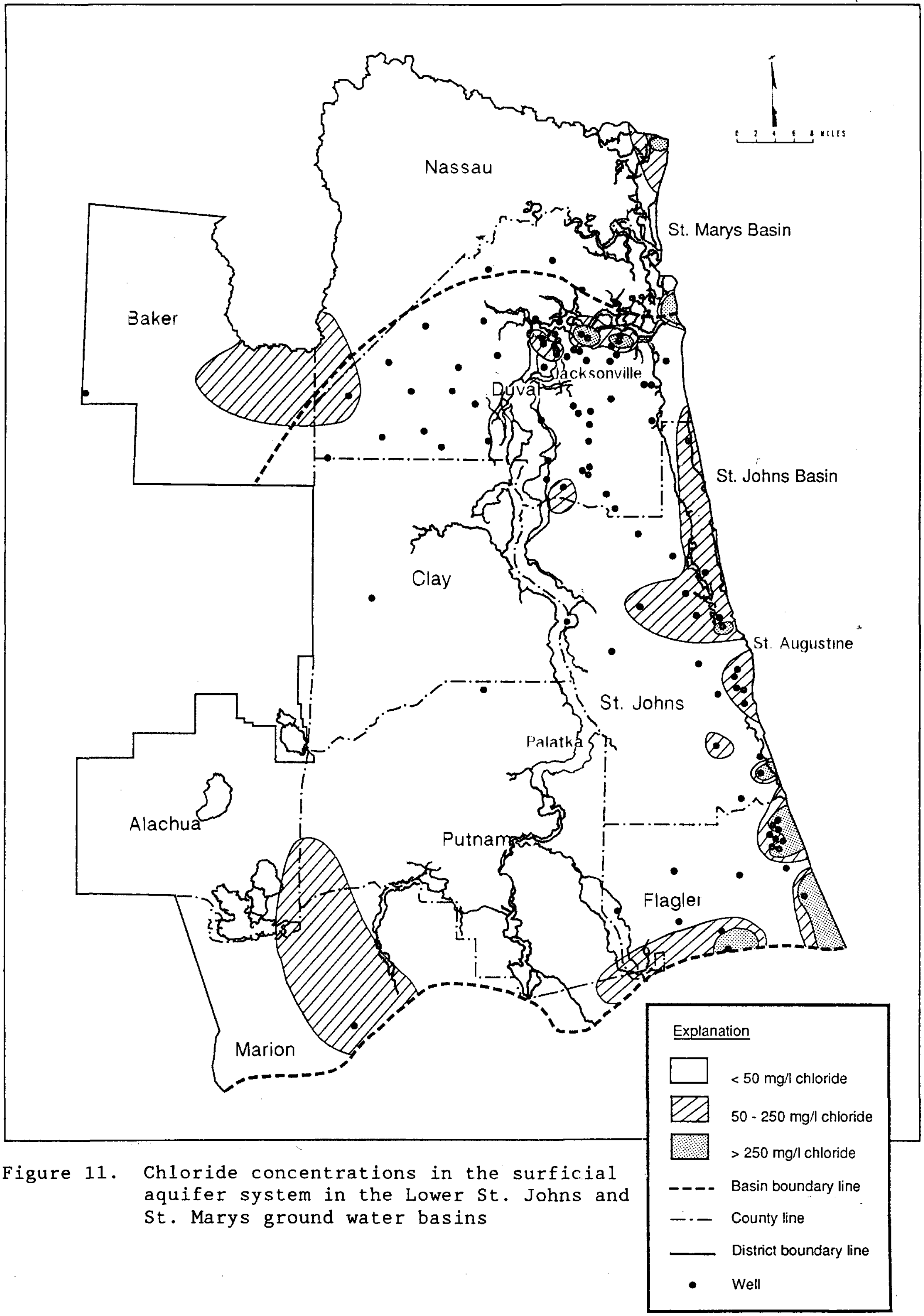

Figure 11. Chloride concentrations in the surficial aquifer system in the Lower St. Johns and St. Marys ground water basins

AREAS SUITABLE FOR FUTURE WATER RESOURCE DEVELOPMENT

Water resource development is affected by such factors as the cost of developing and transporting potable water and/or the cost of treating water to an acceptable level. In addition, other factors influencing the suitability of an area for water resource development are:

- water quality
- the thickness of potable water within a given aquifer
- whether confining units above aquifer zones of supply provide protection against contamination
- whether unique geologic conditions may cause sinkholes or land subsidence, and
- the magnitude of withdrawals associated with existing consumptive use permits.

Each of these factors must be considered specifically for any given site in the ground water basin.

Pursuant to the requirements of Section 373.0391(2)(e), F.S., by July 1, 1991, the district is required to prepare an assessment of the regional water resource needs and sources for the next 20 years. This assessment should provide more information concerning the suitability of water resource development in the LSJ and SM ground water basins.

MINIMUM GROUND WATER LEVELS

The state legislature has mandated that the water management districts establish minimum flows and levels for surface water and ground water (Section 373.042, F. S.). SJRWMD is developing a technique for establishing these levels. These levels, when proposed, must be adopted through the public hearing process, which will provide an opportunity for public input. Information relating to minimum ground water levels is scheduled to be provided to local governments by July 1, 1991.

POPULATION PROJECTIONS AND WATER USE

The LSJ ground water basin includes six entire counties--Clay, Duval, Flagler, Nassau, Putnam, and St. Johns--and parts of two other counties--Alachua and Baker. Water use data are collected and tabulated by county and the projections presented here are also by county. In 1987, the eight counties in this ground water basin used 383.93 million gallons of water a day (mgd), 36 percent of the total water used in SJRWMD. Duval County used the most water in the LSJ and SM ground water basins (Figure 12).

The following graphs present actual water use through 1988 and projections for 1995 and 2000 for each county (Figures 13a-h).

The projections are based on the assumption that increases in water use will be proportional to increases in population. Population projections were taken from the medium estimates given by the Bureau of Economic and Business Research of the University of Florida (Smith and Bayya 1990). For Alachua and Baker counties, the county population included in the district was assumed to be 69 percent of the total county population for Alachua County and 95 percent of the total for Baker.

Estimates for total water use were obtained by multiplying per capita water use by the population projections for 1995 and 2000 from Smith and Bayya (1990). Per capita water use was assumed to be the same as in the most recent (1987) published data (Marella 1990).

Water use projections for 1995 and 2000 were made using two assumptions. First, based on 1987 data (Marella 1990), agricultural and industrial/power generation water use in each county were defined as percentages of the total water use by individual households (the sum of public supply and domestic self supply). Second, it was assumed that the percentages of agricultural and industrial/power generation water use in relation to the total water use by individual households would remain the same in the 1995 and 2000 projections as in the 1987 data.

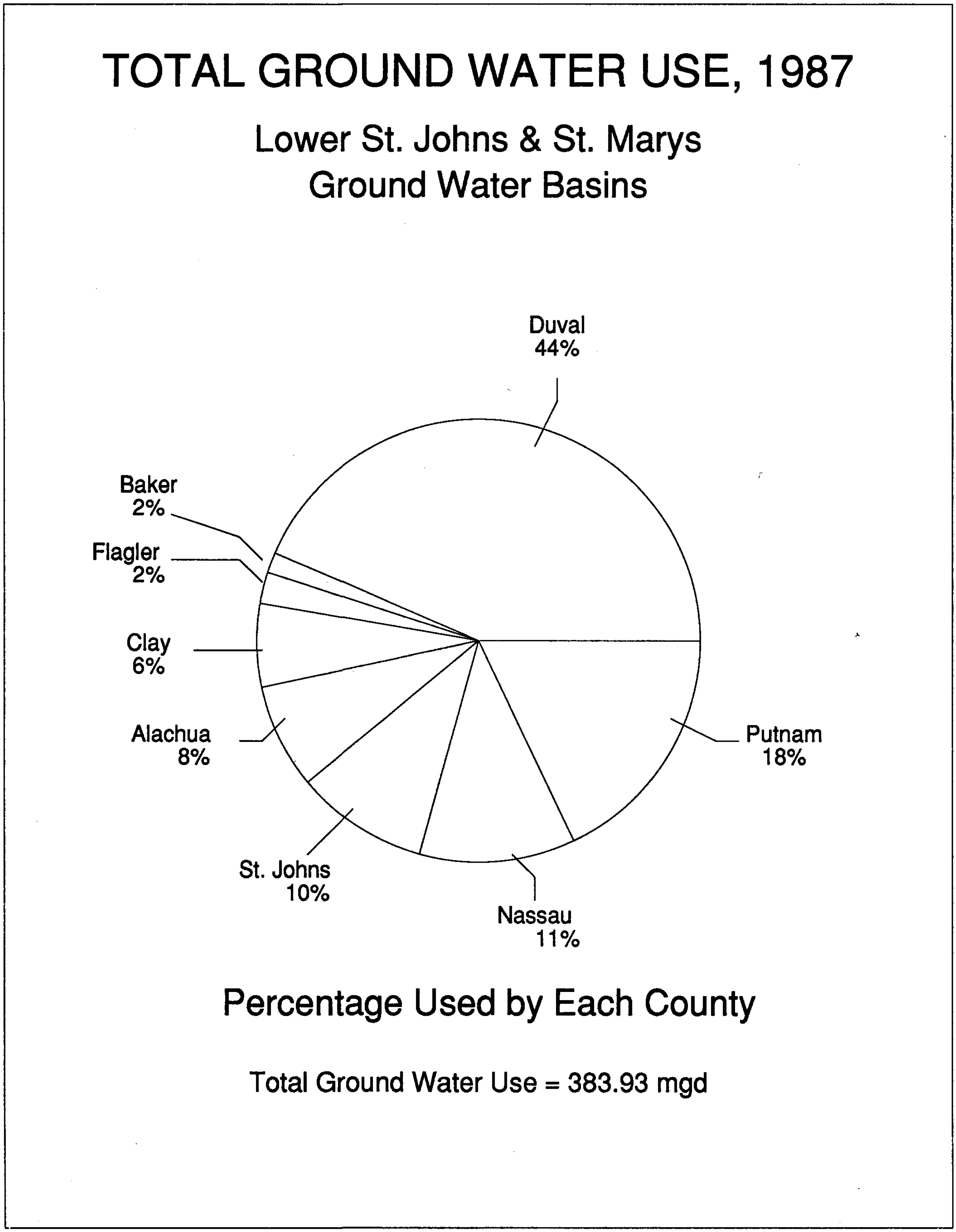

Figure 12. Percentages of the total ground water use in the Lower St. Johns and St. Marys ground water basin used by each county

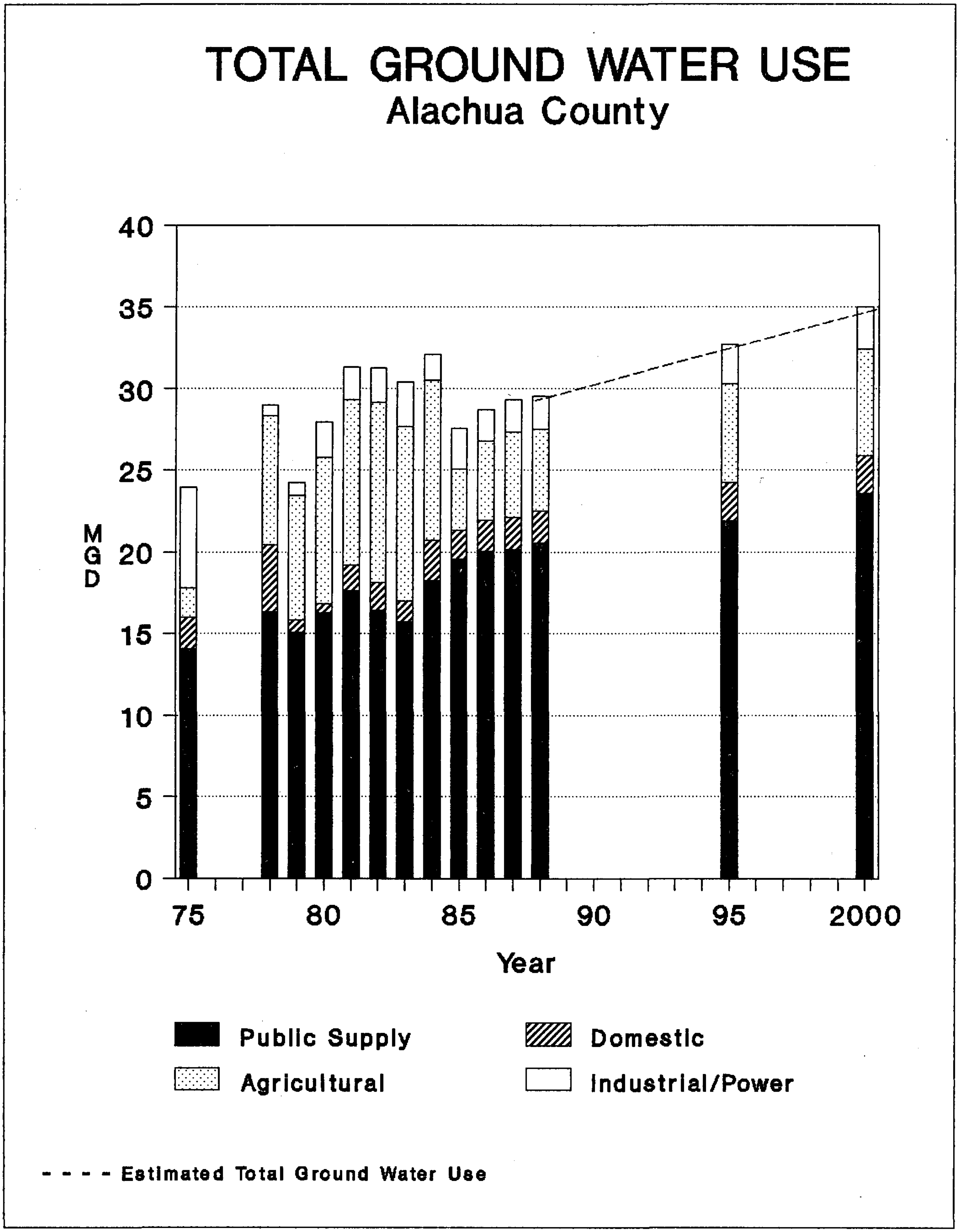

Figure 13a. Actual and projected ground water use for Alachua County

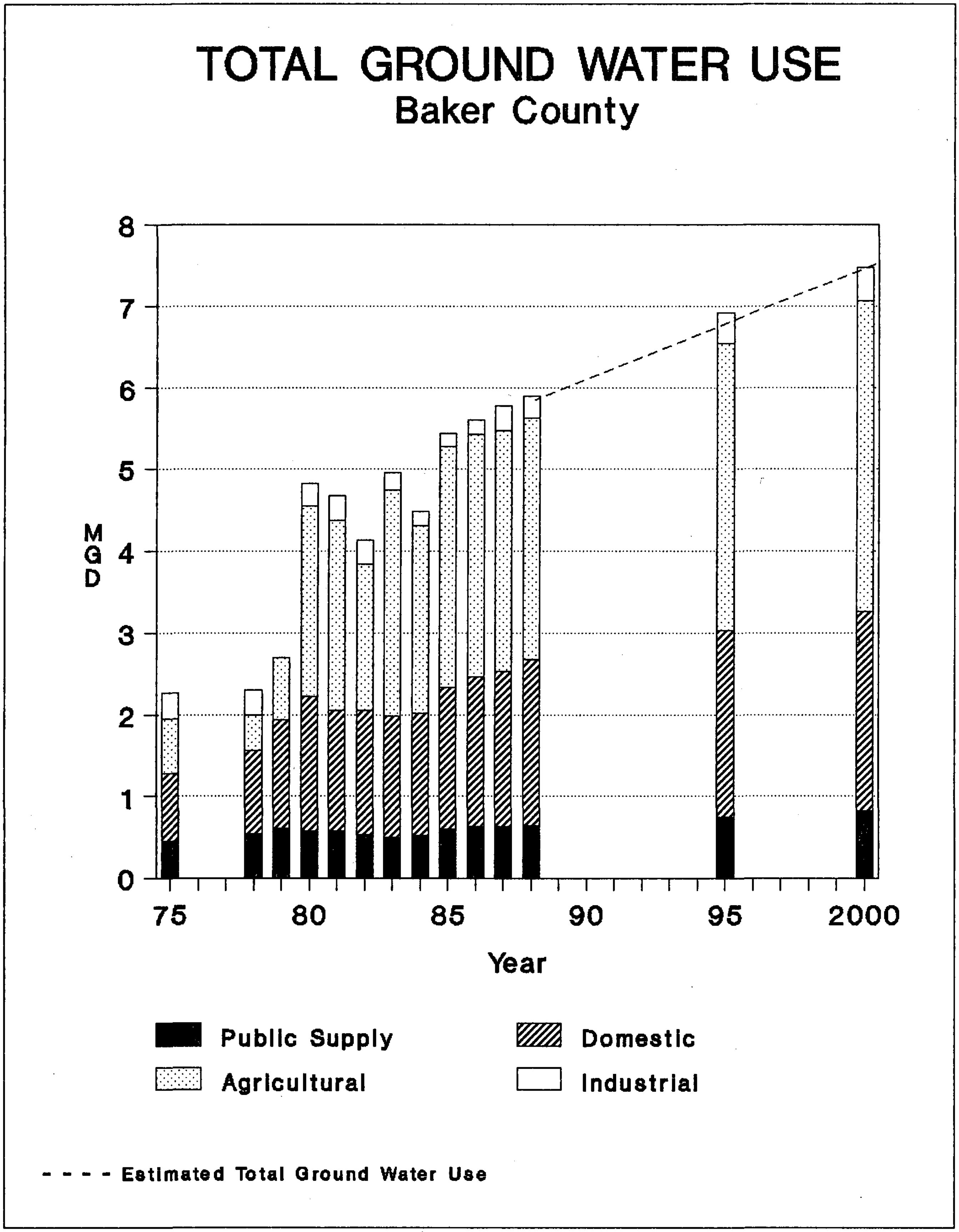

Figure 13b. Actual and projected ground water use for Baker County

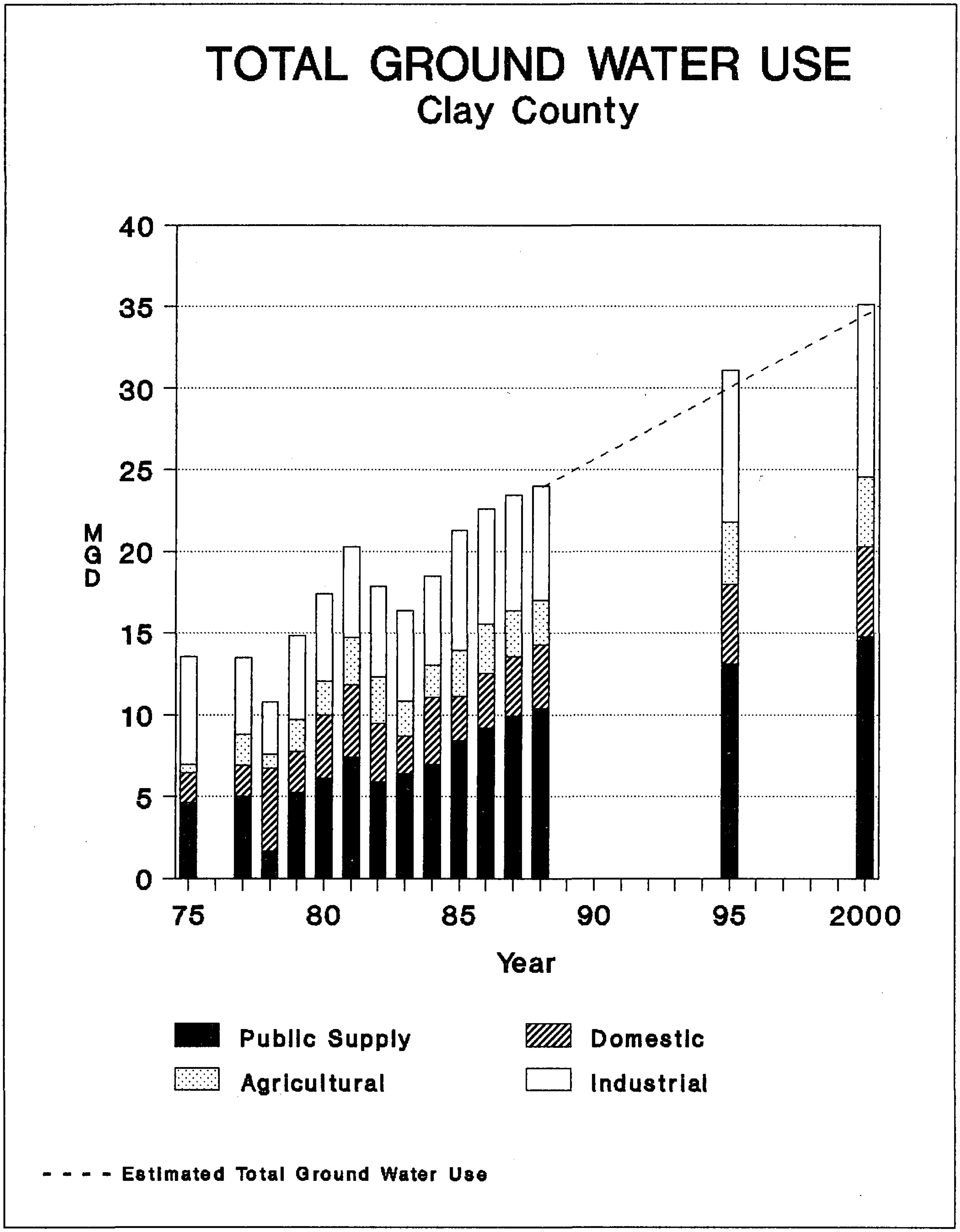

Figure 13c. Actual and projected ground water use for Clay County

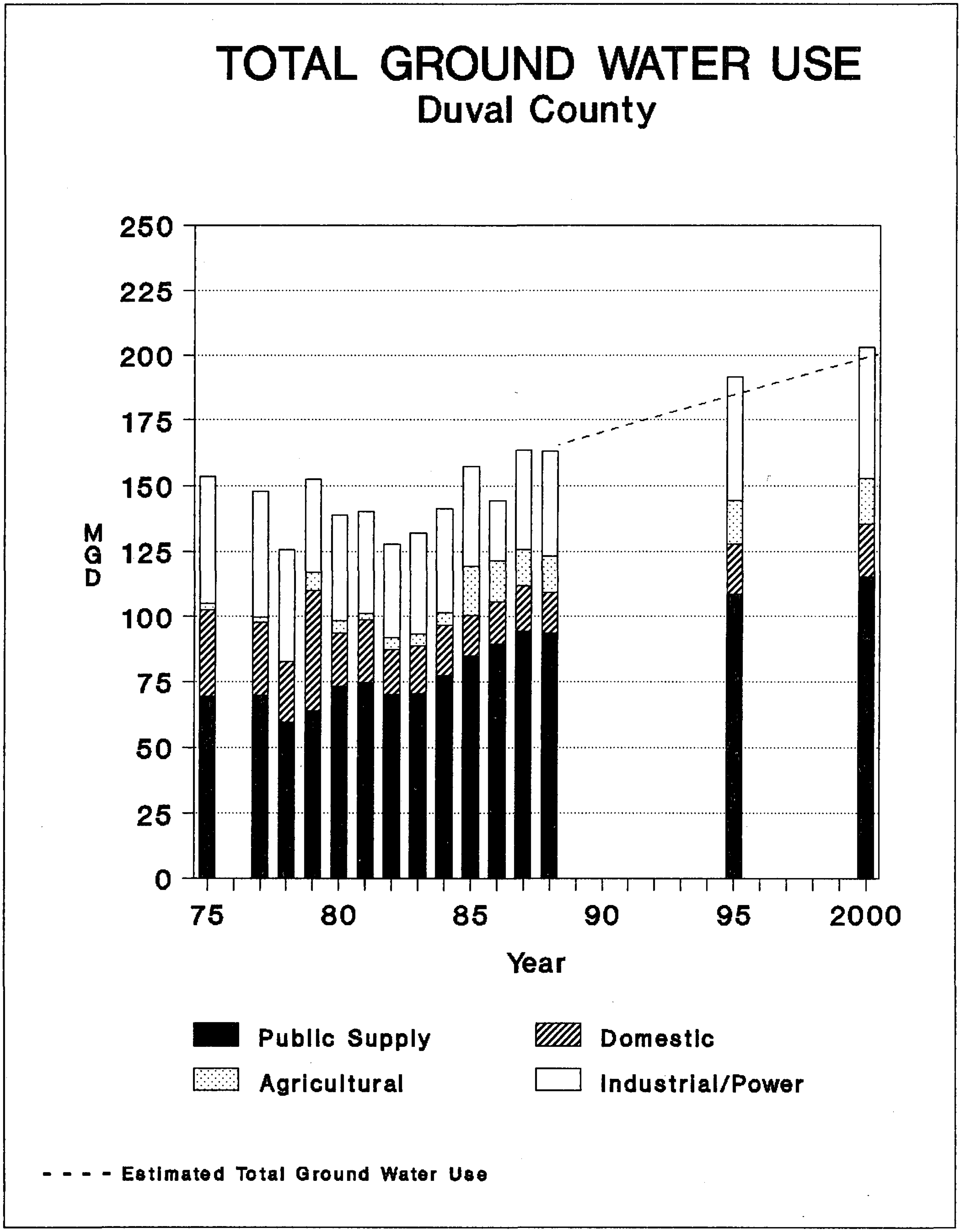

Figure 13d. Actual and projected ground water use for Duval County

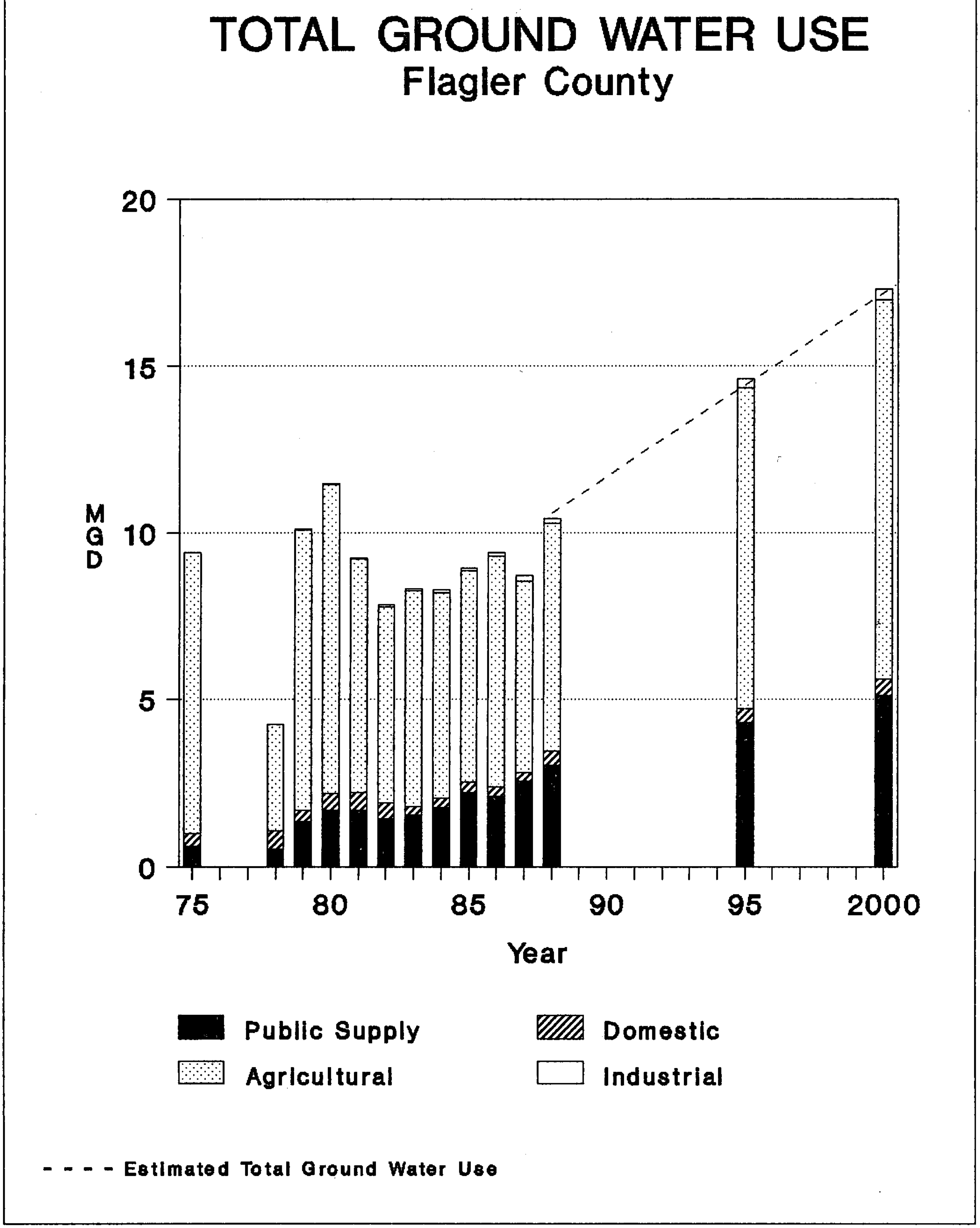

Figure 13e. Actual and projected ground water use for Flagler County

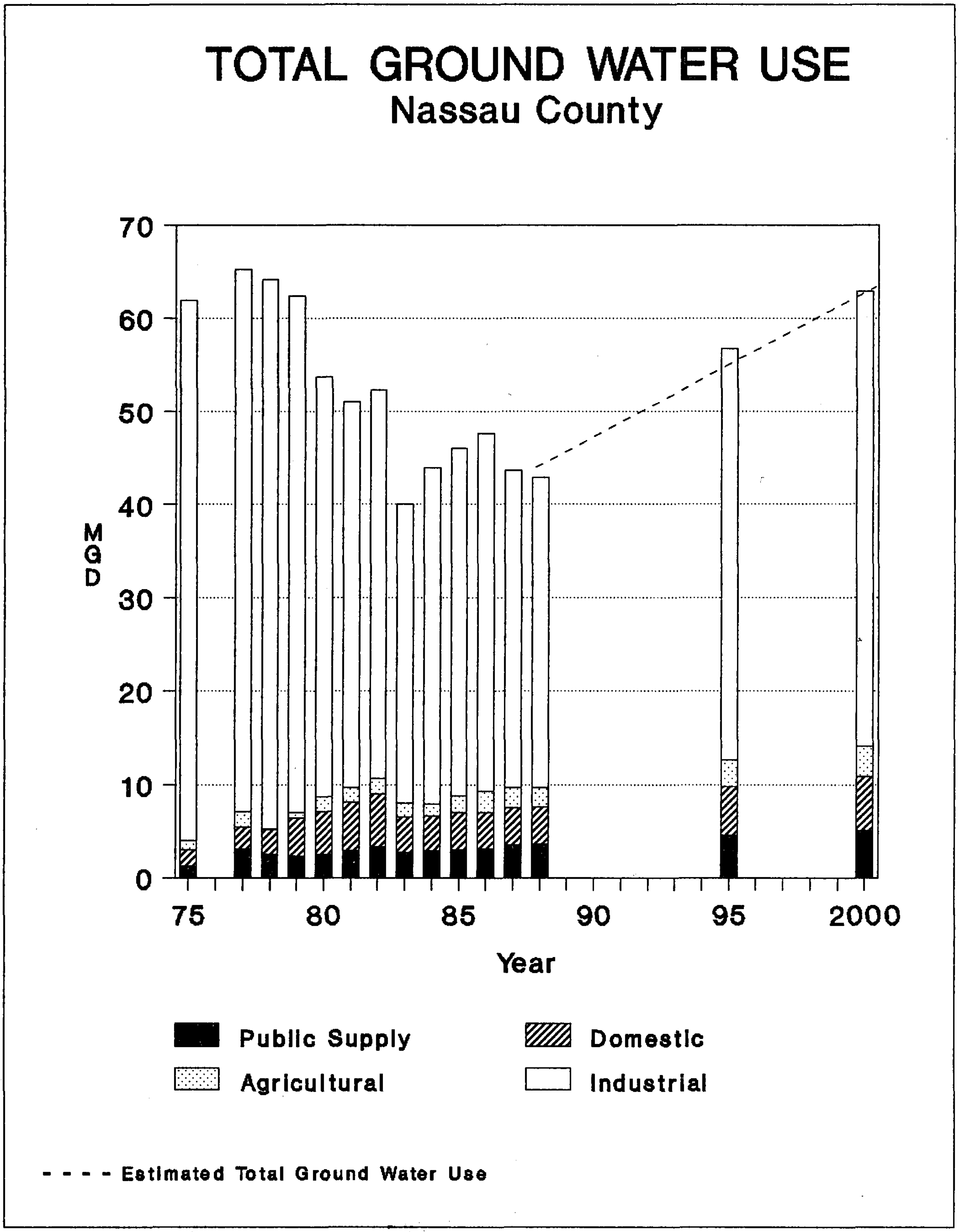

Figure 13f. Actual and projected ground water use for Nassau County

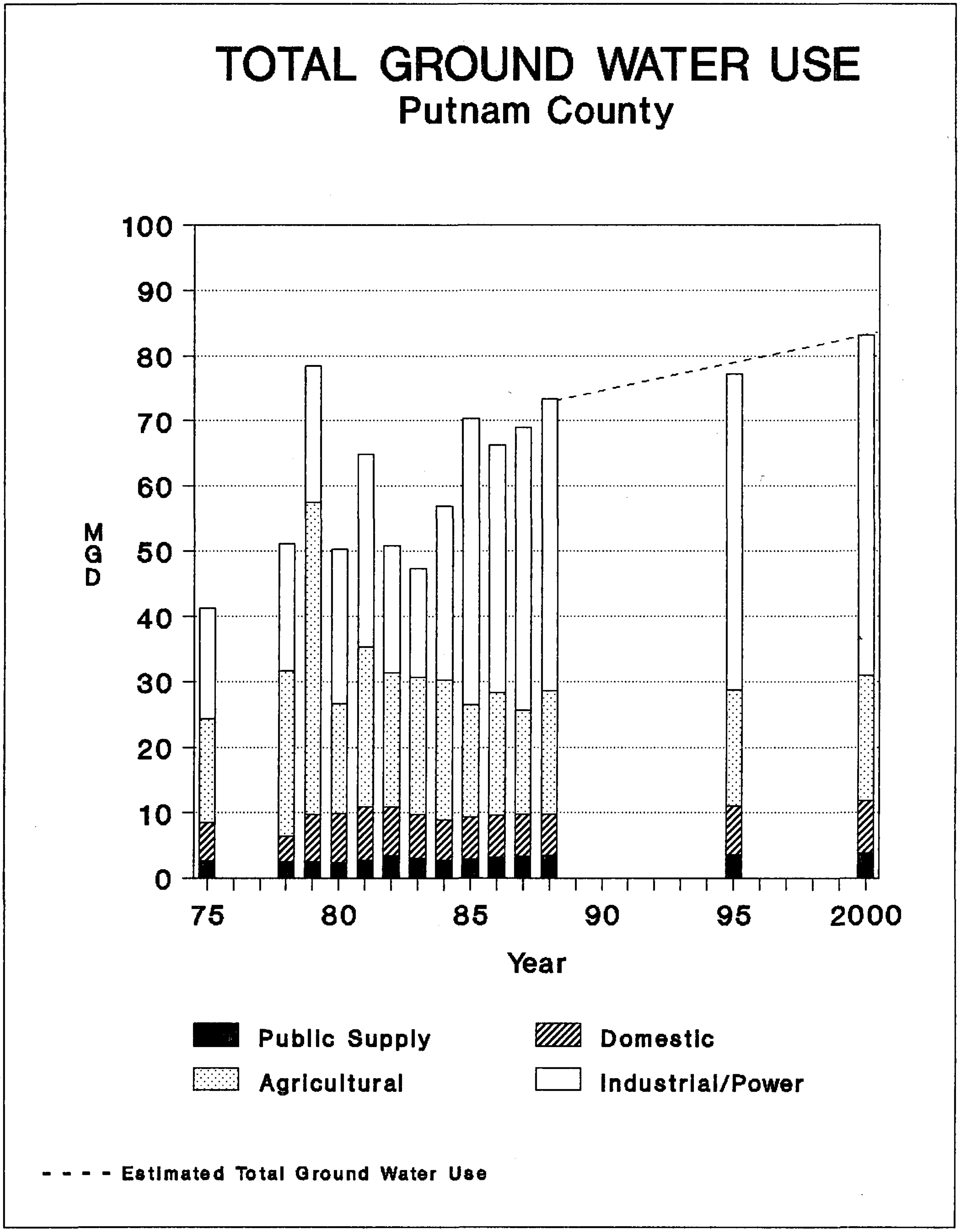

Figure 13g. Actual and projected ground water use for Putnam County

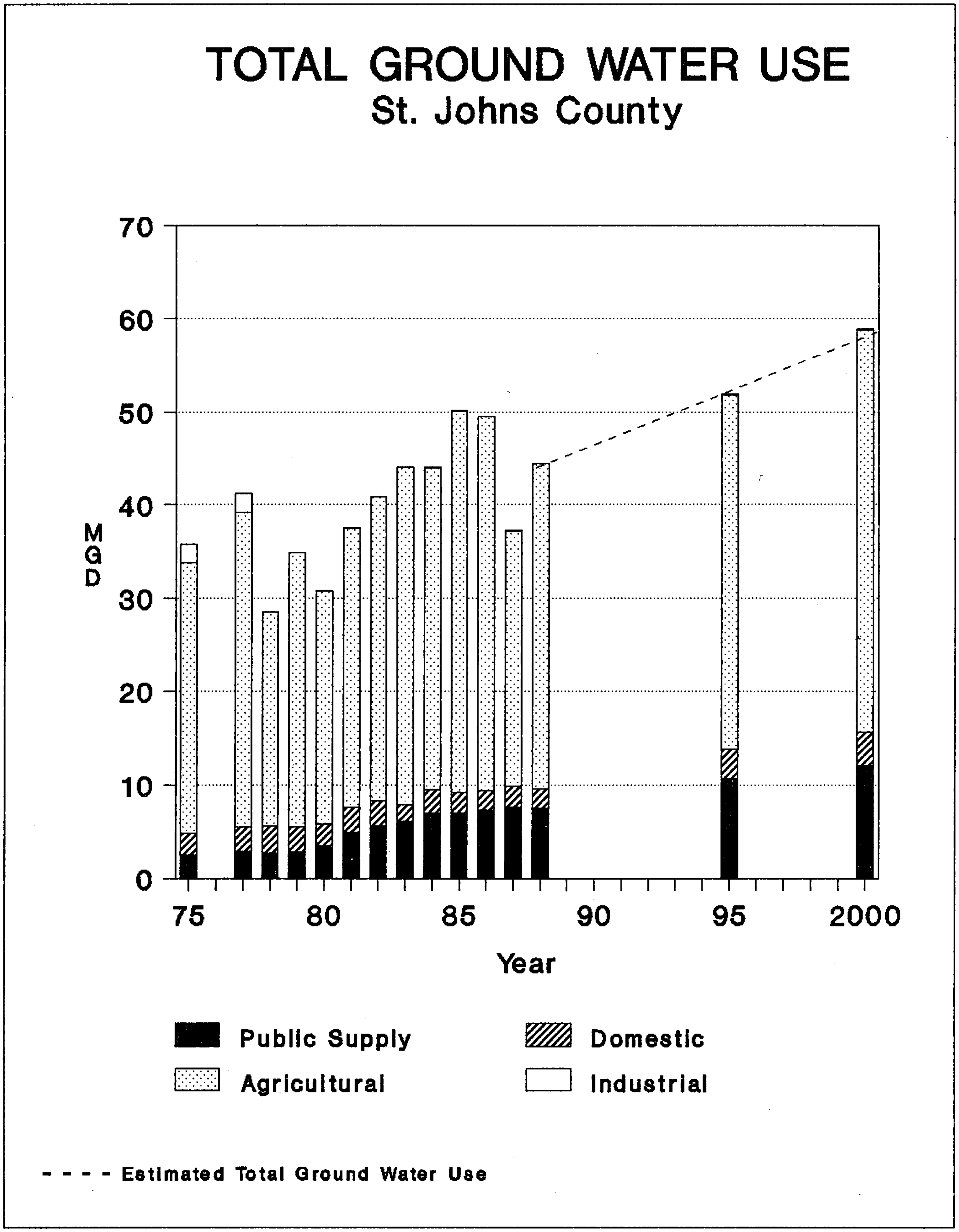

Figure 13h. Actual and projected ground water use for St. Johns County

DIRECT WATER REUSE

Effluent from a wastewater treatment plant (WWTP) can be treated to a specified level and then reapplied to land (i.e., lawns, golf courses, landscapes, and agricultural areas) or used in some industrial processes. In areas of increasing water demand or areas of limited water resources, reuse could provide an important conservation measure. Agricultural irrigation, sewage treatment, and industrial processes often generate water that could be used again if treated to an environmentally acceptable level. Non-potable water supplies can be used for the following (DER 1989): agricultural irrigation, landscape irrigation, ground water recharge, industrial uses, aesthetic uses, fire protection, construction dust control, toilet flush, and wetlands restoration.

Proximity of WWTPs to golf courses, landscaped areas, agricultural areas, and industry are some of the important concerns which should be considered when assessing the potential for implementing a reuse program. A WWTP must have a design capacity of 1.0 mgd for land application of waste water to be considered cost effective (Steward 1985). Environmental factors such as soil characteristics, depth to the water table, and the proximity of the application site to surface waters also need to be considered.

In the LSJ and SM ground water basins, only three counties--Duval, Nassau, and St. Johns--have reuse programs in place. In 1988, 3.16 mgd of treated sewage effluent was being reused in these three counties for golf course irrigation: Nassau (.47 mgd), St. Johns (.32 mgd), and Duval (2.37 mgd).

The primary potential source of reclaimed water is treated sewage effluent. In 1990, it is estimated there will be 127.36 mgd gallons of treated sewage effluent available from WWTPs with a design capacity of 1 mgd or greater (pers. comm. V. A. Seibold 1990) in the LSJ and SM ground water basins (Table 1). This water is potentially available for use as reclaimed water. The amount of treated effluent potentially available in each county in 1990 is compared to the amount of reuse in 1988 in Figure 14.

Further, reuse in the counties in these ground water basins could reduce potable water demands, help conserve water, solve problems with waste water disposal, and help lessen the impact of ground water withdrawals. However, reuse can increase the cost of wastewater disposal by requiring improvements to existing wastewater treatment plants to meet higher standards of treatment. Both economic and environmental factors need to be thoroughly considered when implementing a reuse program.

Table 1. Total available treated waste water in 1990

County	Waste water (mgd)	WWTPs
Alachua	16.48 mgd	3
Baker	0 mgd	0
Clay	8.16 mgd	5
Duval	90.08 mgd	13
Flagler	2.08 mgd	2
Nassau	1.36 mgd	1
Putnam	2.40 mgd	1
St. Johns	6.80 mgd	3

Source: pers. comm., V. A. Seibold, DER, 1990

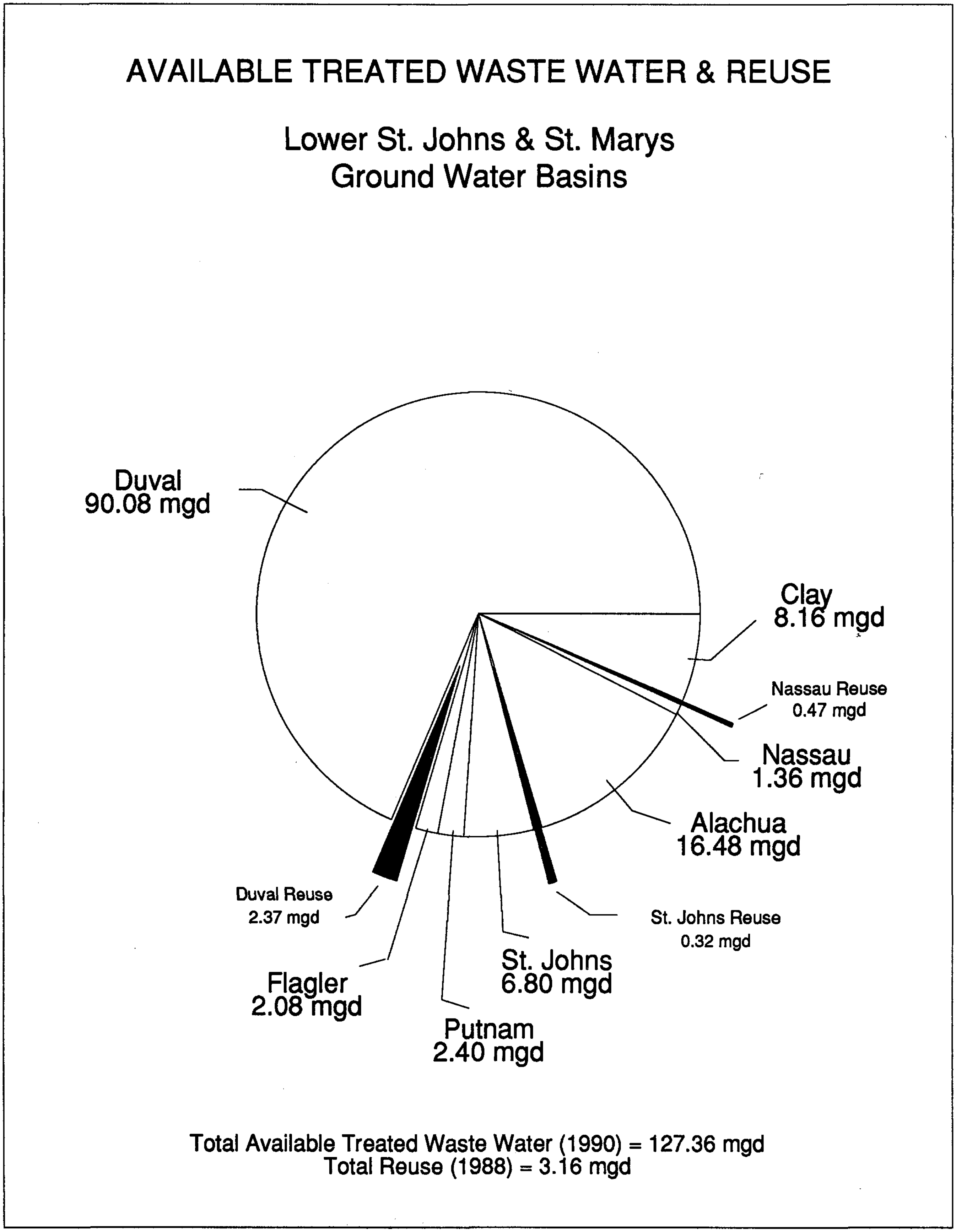

Figure 14. Potential effluent available for reuse and actual reuse in the counties in the Lower St. Johns and St. Marys ground water basins

INTEGRATION OF COASTAL WELLFIELDS

One means of meeting increasing water demands for public supply is to integrate wellfields. Wellfields could be interconnected through inter-local agreements or the creation of a regional water supply authority to distribute withdrawals among wellfields to provide for more flexible water management.

Decisions concerning integration of wellfields should be made based on hydrologic and economic considerations. Inadequate information is currently available to propose specific integration strategies.

ADDITIONAL INFORMATION

Additional information on the subjects contained in this report can be obtained by contacting the St. Johns River Water Management District. These references, providing some sources of further information, are available in major libraries in the state and in the SJRWMD library.

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Appendix A

LEGISLATION

LEGISLATION

373.0395, F. S., ground water basin resource availability inventory.

Each water management district shall develop a ground water basin resource availability inventory covering those areas deemed appropriate by the governing board. This inventory shall include, but not be limited to, the following:

(1) A hydrogeologic study to define the ground water basin and its associated recharge areas.

(2) Site specific areas in the basin deemed prone to contamination or overdraft resulting from current or projected development.

(3) Prime ground water recharge areas.

(4) Criteria to establish minimum seasonal surface and ground water levels.

(5) Areas suitable for future water resource development within the ground water basin.

(6) Existing sources of waste water discharge suitable for reuse as well as the feasibility of integrating coastal wellfields.

(7) Potential quantities of water available for consumptive uses.

Upon completion, a copy of the ground water basin availability inventory shall be submitted to each affected municipality, county, and regional planning agency. This inventory shall be reviewed by the affected municipalities, counties, and regional planning agencies for consistency with the local government comprehensive plan and shall be considered in future revisions of such plans. It is the intent of the legislature that future growth and development planning reflect the limitations of the available ground water or other available water supplies.

Appendix B

POPULATION AND WATER USE PROJECTIONS

POPULATION

	1975	1980	1987	Projections 1995	Projections 2000
Alachua	65,000	151,000	180,000	210,000	225,000
Baker	12,000	15,000	18,000	22,000	24,000
Clay	48,000	67,000	95,000	126,000	143,000
Duval	578,000	571,000	664,000	760,000	806,000
Flagler	4,000	6,000	19,000	32,000	38,000
Nassau	29,000	33,000	44,000	57,000	64,000
Putnam	44,000	51,000	62,000	71,000	76,000
St. Johns	40,000	51,000	75,000	105,000	119,000
	867,000	1,006,000	1,157,000	1,383,000	1,495,000

Source: Smith and Bayya 1990

GROUND WATER USE*

	1975	1980	1987	Projections 1995	Projections 2000
Alachua (69%)**	23.1	27.9	29.2	32.7	34.0
Baker (95%)**	3.1	4.8	5.8	6.9	7.5
Clay	18.3	17.4	23.4	31.1	35.1
Duval	154.0	141.6	167.0	191.4	203.0
Flagler	9.1	11.5	8.7	14.6	17.3
Nassau	63.1	53.7	43.6	56.7	62.9
Putnam	61.7	50.1	68.8	77.2	83.2
St. Johns	35.9	30.8	37.2	51.9	58.9

* Data do not include miscellaneous water uses or free-flowing wells
** Percentage of the county population and water use included in SJRWMD

Source: Marella 1987, 1988, 1990

Appendix C

PUBLIC SUPPLY WITHDRAWALS BY UTILITY IN THE LOWER ST. JOHNS/ST. MARYS GROUND WATER BASIN FOR 1987

Table C. Public supply withdrawals by utility in the Lower St. Johns and St. Marys ground water basins for 1987

LOWER ST. JOHNS GROUND WATER BASIN

			Water Source		1987 Data (a)		
(b)	Utility/Owner	County	Primary	Secondary	mgd	Population	Comments
	Arredondo Village/Estates	Alachua	Floridan		0.07	1,180	
1	Gainesville Regional Ut.	Alachua	Floridan		19.69	116,650	
	Hawthorne - City of	Alachua	Floridan		0.22	1,279	
	Kincaid Hills S/D	Alachua	Floridan		0.11	1,000	
	Micanopy - Town of	Alachua	Floridan		0.07	782	
	Southern States Utilities	Bradford	Floridan		0.04	340	
2	Clay Utility Co.	Clay	Floridan		0.70	6,500	
	Duval Utility Co.	Clay	Floridan		0.04	250	
3	Green Cove Springs - City of	Clay	Floridan		0.71	4,432	
4	Keystone Heights - City of	Clay	Floridan		0.39	2,640	
5	Kingsley Service Co.	Clay	Floridan		6.23	42,644	
	Lake Asbury Utilities	Clay	Floridan		0.15	1,566	
	Magnolia Springs Utilities	Clay	Floridan		0.08	800	
6	Orange Park - Town of	Clay	Floridan		1.47	9,685	
	Penny Retirement com.	Clay	Floridan		0.04	220	
	Penny Farms - Town of	Clay	Floridan		0.09	450	
	The Ravines Village & Resort	Clay	Floridan		0.03	500	
7	Atlantic Beach - City of	Duval	Floridan		2.64	12,695	
8	Beauclerc Utilities	Duval	Floridan		0.69	6,670	
	Baldwin - City of	Duval	Floridan		0.23	1,766	
9	Canal Utilities	Duval	Floridan		1.67	6,800	
	Colony MHP	Duval	Floridan		0.10	962	
	Commercial Utilities	Duval	Floridan		0.11	1,200	
	Dulay Utilities (Argyle F.)	Duval	Floridan		0.35	3,065	Now owned by Jacksonville
10	Duval Utility Co.	Duval	Floridan		0.36	1,900	
	Harbor View S/D	Duval	Floridan		0.19	2,100	
11	Jacksonville Beach - City of	Duval	Floridan		3.63	18,849	

(a) Withdrawal and population data taken from Marella 1990.
(b) Number refers to location of utility/facility on following map.
Only utilities that withdrew more than 0.25 mgd in 1987 are plotted on the map.

mgd = million gallons per day.

Table C. Public supply withdrawals by utility in the Lower St. Johns and St. Marys ground water basins for 1987

LOWER ST. JOHNS GROUND WATER BASIN

			Water Source		1987 Data (a)		
(b)	Utility/Owner	County	Primary	Secondary	mgd	Population	Comments
12	Jacksonville-City of	Duval	Floridan		61.24	355,080	
12	Jacksonville-City (Mandarin)	Duval	Floridan		4.99	33,862	Formerly Mandarin Utilities
13	Jacksonville Suburban Ut.s	Duval	Floridan		10.46	73,872	
	Lamplighter MHP	Duval	Floridan		0.13	735	
	Londontowne Apartments	Duval	Floridan		0.16	1,125	
	Mayport Water Plant	Duval	Floridan		0.08	400	
	Neighborhood Utilities	Duval	Floridan		0.04	543	
14	Neptune Beach - City of	Duval	Floridan		1.24	6,425	
	Normandy Estates MHP	Duval	Floridan		0.10	500	
15	Normandy Village Utilities	Duval	Floridan		0.40	2,912	
16	Ortega Utilities	Duval	Floridan		0.90	4,423	
17	Regency Utilities	Duval	Floridan		0.75	4,900	
	Shadowrock Utilities	Duval	Floridan		0.22	1,250	
18	Southern Gulf Utilities	Duval	Floridan		0.44	2,896	
19	Southern State Utilities	Duval	Floridan		1.90	9,000	
20	Southside Utilities	Duval	Floridan		1.11	6,640	
	Wonderwood MHP	Duval	Floridan		0.13	775	
	Beverly Beach Utility	Flagler	Floridan		0.03	411	
21	Bunnell - City of	Flagler	Floridan		0.29	2,104	
22	Flagler Beach - City of	Flagler	Floridan		0.46	3,246	
23	Palm Coast Utilities	Flagler	Surficial		1.74	11,500	
	Plantation Bay	Flagler	Floridan		0.04	241	
24	Crescent - City of	Putnam	Floridan		0.30	2,295	
	Interlachen - Town of	Putnam	Floridan		0.12	1,054	
	Lake Como Water Association	Putnam	Floridan		0.02	310	
	Melrose Water Association	Putnam	Floridan		0.07	705	
25	Palatka - City of	Putnam	Floridan		2.57	13,872	
	Southern States Utilities	Putnam	Floridan		0.20	2,595	

(a) Withdrawal and population data taken from Marella 1990.
(b) Number refers to location of utility/facility on following map.
Only utilities that withdrew more than 0.25 mgd in 1987 are plotted on the map.

mgd = million gallons per day.

Table C. Public supply withdrawals by utility in the Lower St. Johns and St. Marys ground water basins for 1987

LOWER ST. JOHNS GROUND WATER BASIN

(b)	Utility/Owner	County	Water Source Primary	Water Source Secondary	1987 Data (a) mgd	1987 Data (a) Population	Comments
26	Anastasia/Mainland Water Sys.	St.Johns	Surficial	Floridan	2.10	16,350	
	Fountain Condominiums	St.Johns	Floridan		0.04	392	
	Fruit Cove Oaks S/D	St.Johns	Floridan		0.07	450	
	GDU - Julington Creek S/D	St.Johns	Floridan		0.02	110	
	Hastings - City of	St.Johns	Surficial	Floridan	0.08	595	
27	Intercoastal Utilities	St.Johns	Floridan		0.48	2,995	
	North Beach Water System	St.Johns	Floridan		0.16	876	
	Ponce DeLeon Ut. -Goodwin Beach	St.Johns	Floridan		0.02	400	
28	Ponte Vedra Utilities	St.Johns	Floridan		0.94	5,600	
	S. Ponte Vedra Beach Utilities	St.Johns	Floridan		0.10	700	
29	St. Augustine - City of	St.Johns	Surficial	Floridan	1.81	15,757	
30	St. Augustine Shores Utilities	St.Johns	Surficial		0.50	5,452	
	St.Johns North Utility	St.Johns	Floridan		0.06	315	
31	St.Johns Service Co.	St.Johns	Floridan		1.11	7,500	
	Wesley Manor Water System	St.Johns	Floridan		0.07	400	
	Totals	Alachua (c)			20.16	120,891	
		Bradford (c)			0.04	340	
		Clay			9.92	69,687	
		Duval			94.28	561,345	
		Flagler			2.56	17,502	
		Putnam			3.28	20,831	
		St.Johns			7.56	58,132	
					137.80	848,728	

(a) Withdrawal and population data taken from Marella 1990.
(b) Number refers to location of utility/facility on following map.
Only utilities that withdrew more than 0.25 mgd in 1987 are plotted on the map.
(c) Totals represent only those utilities located in the St.Johns River Water Management District.

mgd = million gallons per day.

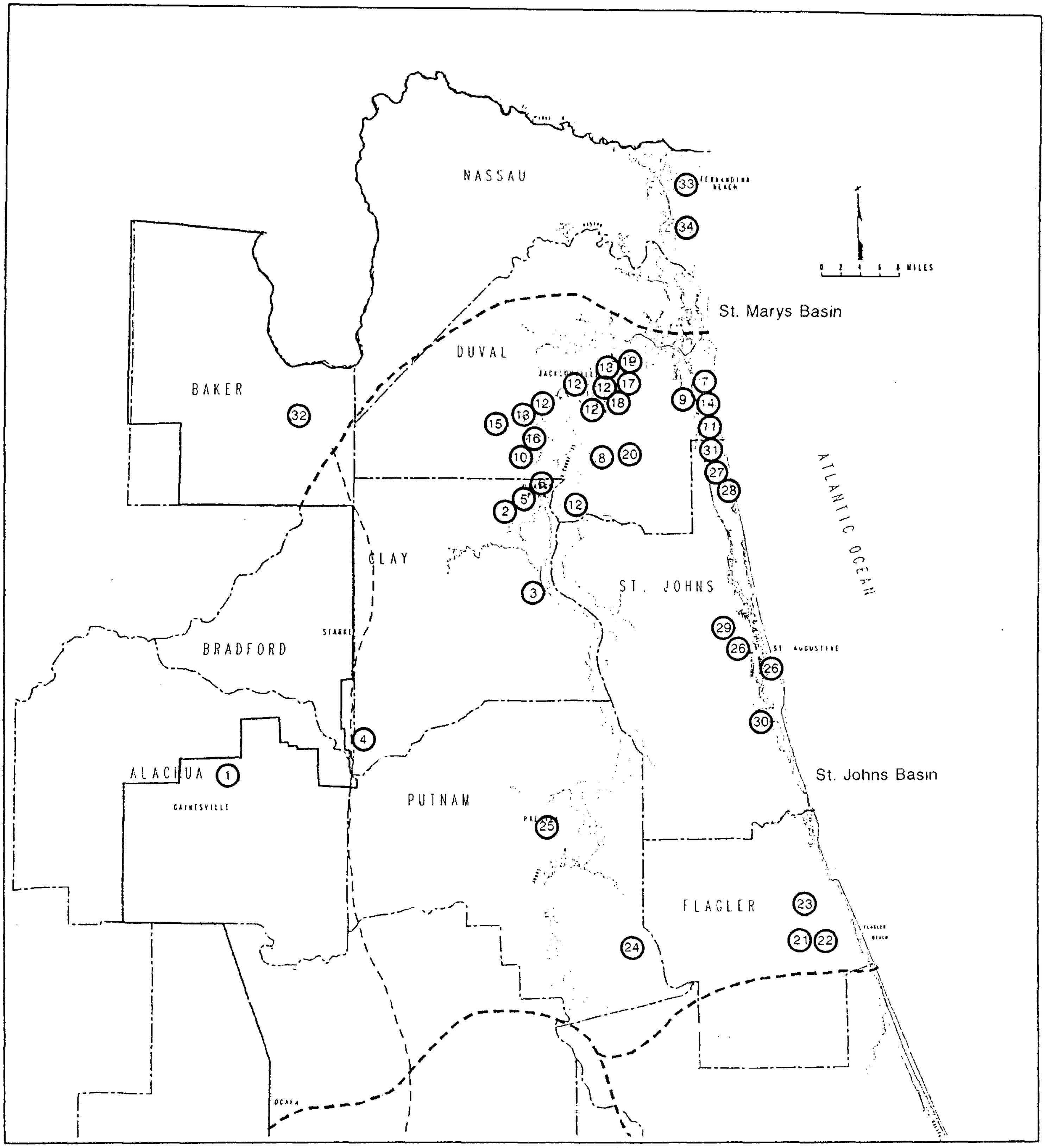
Table C. Public supply withdrawals by utility in the Lower St. Johns and St. Marys ground water basins for 1987

ST. MARYS GROUND WATER BASIN

(b)	Utility/Owner	County	Water Source: Primary	Water Source: Secondary	1987 Data (a): mgd	1987 Data (a): Population	Comments
32	MacClenny - City of	Baker	Floridan		0.61	4,185	
	MacClenny S/D	Baker	Floridan		0.02	130	
	Callahan - Town of	Nassau	Floridan		0.18	1,136	
	Eastwood Oaks	Nassau	Floridan		0.05	365	
33	Fla. Public Ut-Fernandina Bch.	Nassau	Floridan		2.57	11,928	
	Hilliard - Town of	Nassau	Floridan		0.18	2,175	
	Marsh Cove Apartments	Nassau	Floridan		0.03	200	
34	Southern States Ut (Amelia Is)	Nassau	Floridan		0.52	4,931	
	Totals	Baker (c)			0.63	4,315	
		Nassau			3.54	20,735	
					4.17	25,050	

(a) Withdrawal and population data taken from Marella 1990.
(b) Number refers to location of utility/facility on following map.
Only utilities that withdrew more than 0.25 mgd in 1987 are plotted on the map.
(c) Totals represent only those utilities located in the St.Johns River Water Management District.

mgd = million gallons per day.



Appendix C. Public supply wellfields and areas of service in the Lower St. Johns and St. Marys ground water basins. Numbers refer to Table C.

Explanation

- Location of utility
- Basin boundary line
- County line
- Peninsular divide
- District boundary line

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