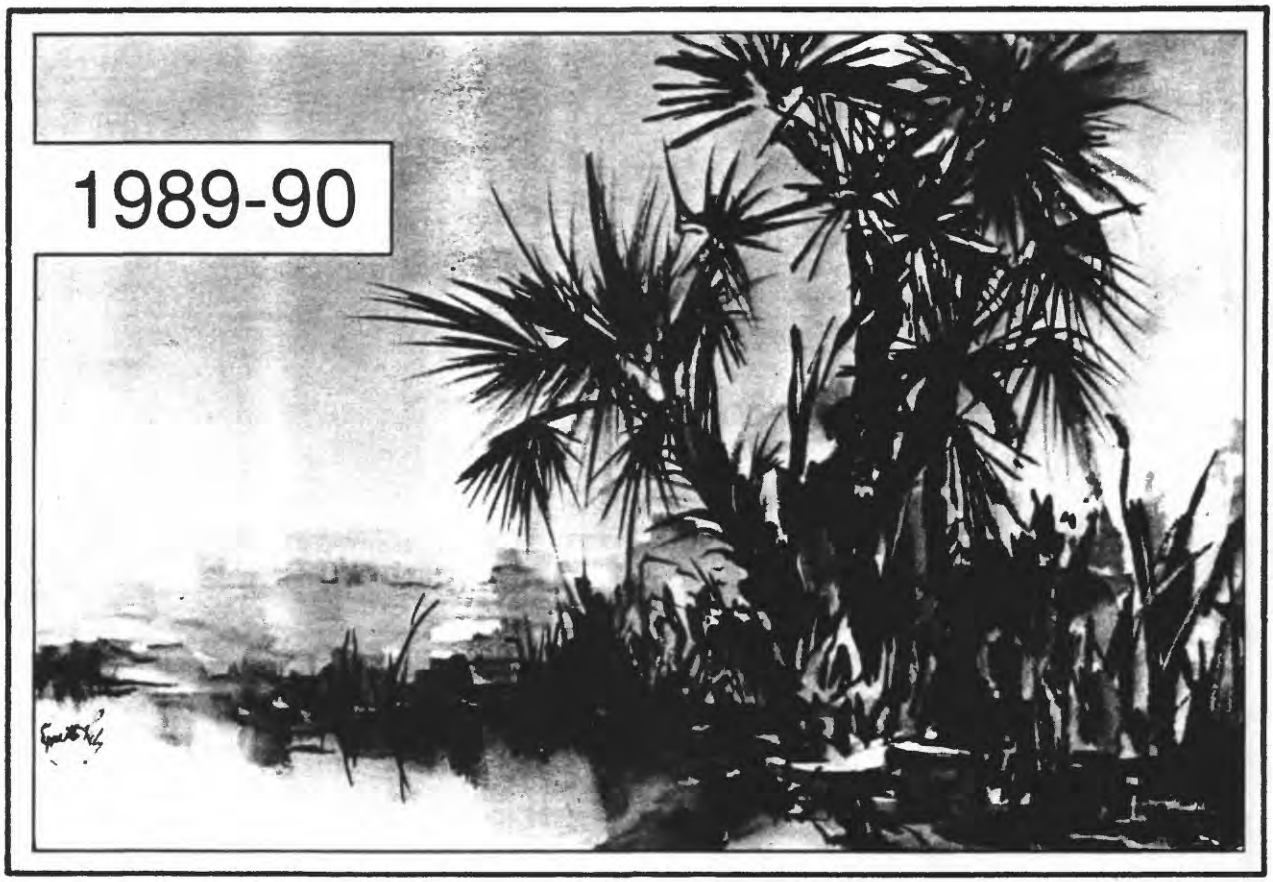
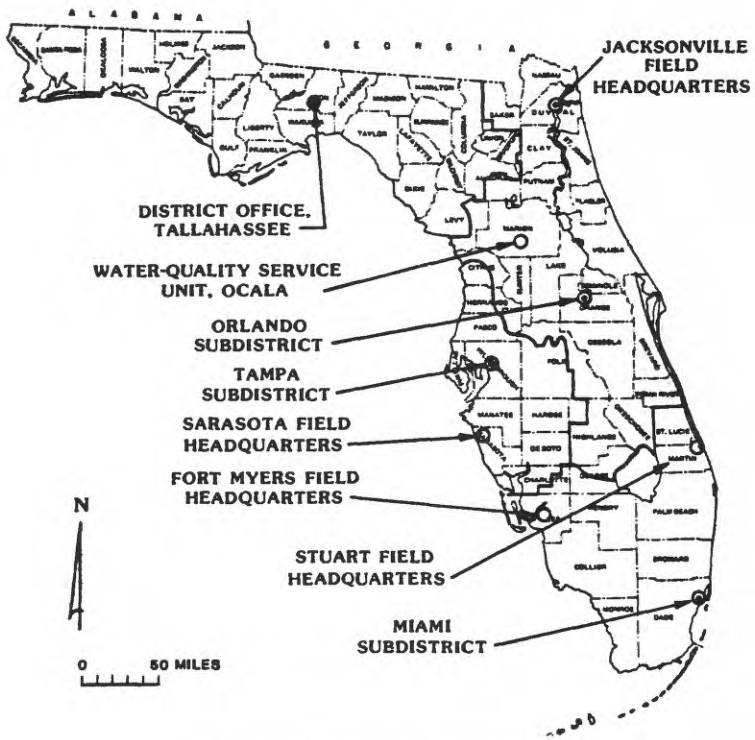
WATER RESOURCES ACTIVITIES IN FLORIDA



U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 90-169

Prepared in cooperation with STATE, FEDERAL, and LOCAL AGENCIES



District Office
Suite 3015
227 N. Bronough Street
Tallahassee, FL 32301
Telephone: (904) 681-7620

U.S. GEOLOGICAL SURVEY OFFICES IN FLORIDA

Miami Subdistrict Office
9100 N.W. 36th St., Suite 106-107
Miami, FL 33178
Telephone: (305) 594-0655

Orlando Subdistrict Office
224 West Center Street, Suite 1006
Altamonte Springs, FL 32714
Telephone: (407) 648-6191

Tampa Subdistrict Office
4710 Eisenhower Blvd., Suite B-5
Tampa, FL 33634
Telephone: (813) 228-2124

Ocala QW Service Unit
207 NW 2nd Street, Room 222
Ocala, FL 32670
Telephone: (904) 629-8931

Fort Myers Field Headquarters
3745 Broadway, Suite 301
Fort Myers, FL 33901
Telephone: (813) 334-7787

Jacksonville Field Headquarters
3728 Phillips Highway, Suite 222
Jacksonville, FL 32207
Telephone: (904) 398-2121

Sarasota Field Headquarters
243 Field End Road
Sarasota, FL 34240
Telephone: (813) 371-0821

Stuart Field Headquarters
6552 SE Federal Highway
Stuart, FL 33494
Telephone: (407) 286-6299

Cover: From original watercolor, 15" x 22" by Emeretta Rudy
Florida District Office, 1989.

WATER RESOURCES ACTIVITIES IN FLORIDA, 1989–90

Mildred E. Glenn, editor

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 90-169

IN COOPERATION WITH

Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Department of Transportation
Englewood Water District
Florida Game & Fresh Water Fish Commission
Florida Institute of Phosphate Research
Florida Keys Aqueduct Authority
Jacksonville Electric Authority
Metro-Dade Environmental Resources Management
Miami-Dade Water & Sewer Authority
Northwest Florida Water Management District
Palm Beach County Solid Waste Authority
Reedy Creek Improvement District
St. Johns River Water Management District
South Dade Soil & Conservation Water District
South Florida Water Management District
Southwest Florida Water Management District
Suwannee River Authority
Suwannee River Water Management District
Tampa Port Authority
West Coast Regional Water Supply Authority
Brevard County
Broward County
Broward County Environmental Quality Control Board
Collier County
Metro-Dade County
Hillsborough County
Lake County
Lee County
Leon County
Manatee County
Marion County
Palm Beach County
Pinellas County
Polk County
St. Johns County
Sarasota County
Volusia County
Walton County
City of Boca Raton
City of Bradenton
City of Cape Coral
City of Cocoa
City of Cottondale
City of Edgewater
City of Fort Lauderdale
City of Fort Walton Beach
City of Hallandale
City of Hollywood
City of Jacksonville
City of Lake Mary
City of Madison
City of Ocala
City of Perry
City of Pompano Beach
City of Quincy
City of St. Petersburg
City of Sanford
City of Sarasota
City of Stuart
City of Tallahassee Electric Department
City of Tallahassee Public Works Department
City of Tallahassee Streets & Drainage
City of Tallahassee Underground Utilities
City of Tallahassee Water Quality Laboratory
City of Tampa
City of Winter Park
Town of Highland Beach
University of Florida

Tallahassee, Florida

1990

DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey
Suite 3015
227 North Bronough Street
Tallahassee, Florida 32301

Copies of this report can be
purchased from:

U.S. Geological Survey
Books and Open-File Reports
Federal Center, Bldg. 810
Box 25425
Denver, Colorado 80225

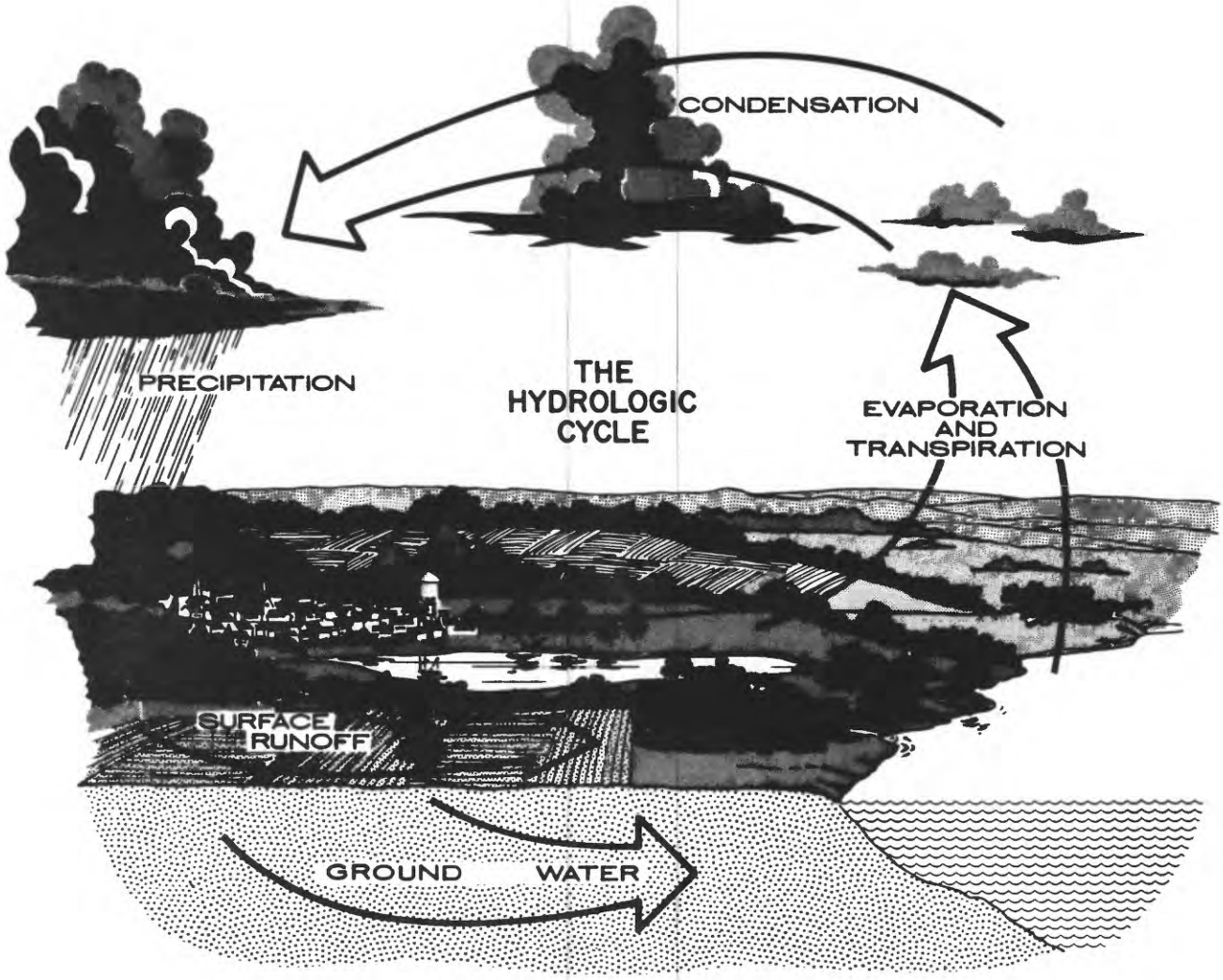
FOREWORD

The U.S. Geological Survey was created by an Act of Congress in 1879, as a bureau of the Department of the Interior, to classify public lands and to examine the geologic structure, mineral resources, and products of the national domain. Since then, the Survey's responsibilities have expanded to include topographic mapping, geochemical and geophysical studies, and the assessment of the quantity, quality, and distribution of water resources. Thus, during the past 100 years, the Survey has become the Nation's principal factfinding and research agency concerned with our physical resources. The mission of the Water Resources Division of the Survey is to provide hydrologic information needed for the development, management, and use of the Nation's water resources.

Although stream gaging began in 1884 as part of a study to identify irrigatable land, the water-resources program of the Survey began in 1894 when a small appropriation was obtained for the specific purpose of "gauging streams and determining the water supply of the United States." In the years following 1884, the need for water resources information grew rapidly but the Survey was unable to meet the demand because of restricted budgets. Many States initiated water resource programs to fill the deficiency and the Survey worked closely with the various State agencies. However, these efforts did not satisfy the need of the States and the Nation for a comprehensive water resources information program. Accordingly, in 1928 Congress established the cooperative matching program by which the Survey's water resources programs with State agencies may be funded on a 50/50 basis. This cooperative water resources program has grown over the years into the primary source of water information for the Nation. This is accomplished through cooperation with State and local governments and other Federal agencies by:

- Collecting data on a systematic basis to determine the quantity, quality, and use of surface and ground water.
- Conducting interpretive water-resource appraisals to describe the consequences of alternative plans for developing land and water resources.
- Conducting basic and problem-oriented research in hydraulics, hydrology, and related fields.
- Developing information on water-related natural hazards such as floods, landslides, volcanoes, mudflows, and land subsidence.
- Coordinating the activities of all Federal agencies in the acquisition of water data.
- Disseminating data and findings through reports, maps, and other forms of public release.
- Providing scientific and technical assistance in the hydrologic fields to other Federal agencies, to State and local agencies, and, on behalf of the U.S. Department of State, to international agencies.

Water Resources, National Mapping, and the Geologic Division are the three operating divisions of the Survey. General information pertaining to these divisions may be obtained from the Information Office, U.S. Geological Survey, 119 National Center, Reston, VA 22092. Circular 900, "*A Guide to Obtaining Information from the U.S. Geological Survey*" can be obtained free from the U.S. Geological Survey, Books and Open-File Reports, Federal Center, Box 25425, Denver, Colorado 80225.


CONDENSATION
PRECIPITATION
THE
HYDROLOGIC
CYCLE
EVAPORATION
AND
TRANSPIRATION
SURFACE
RUNOFF
GROUND WATER

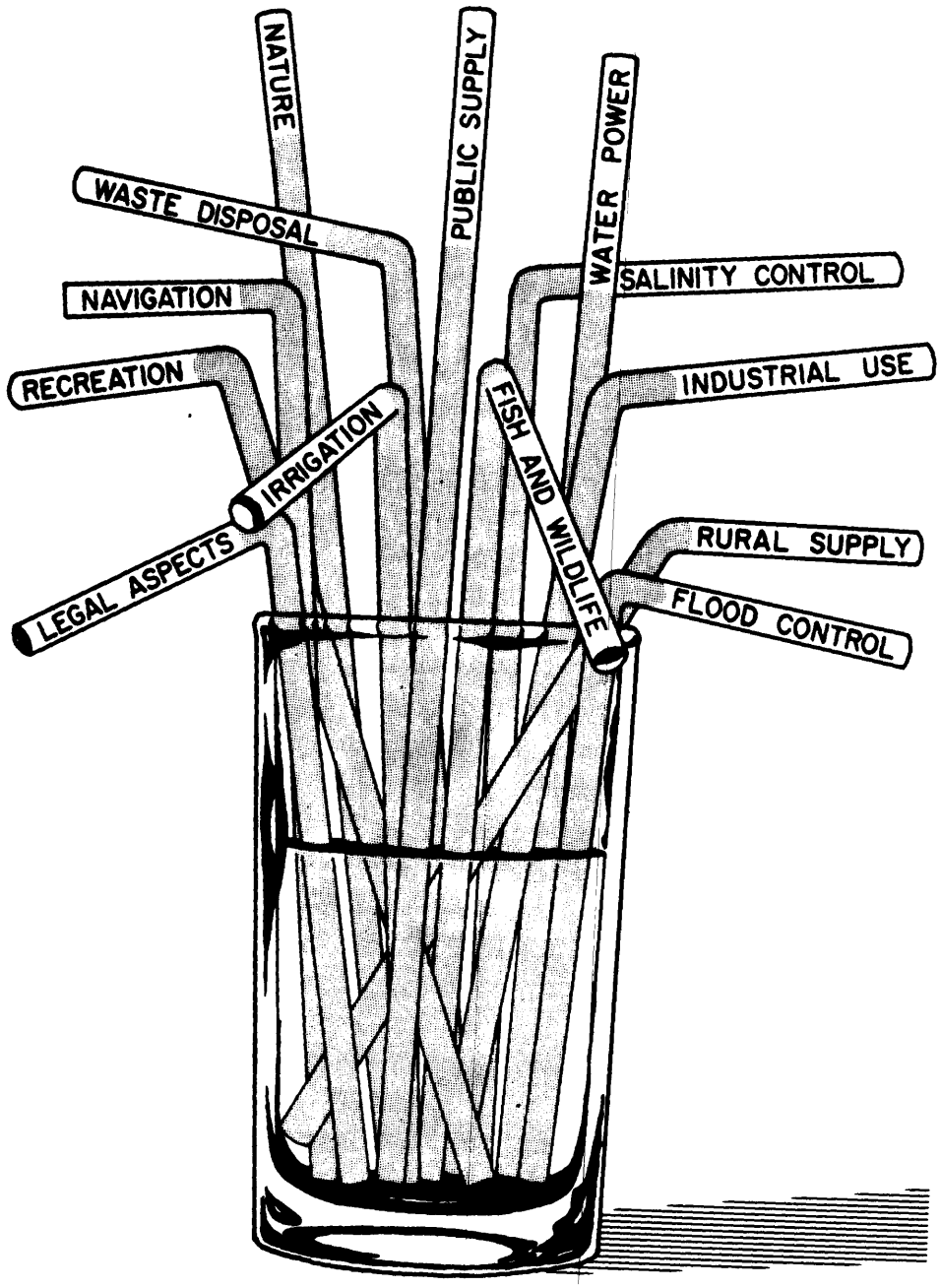
CONTENTS

CONTENTS--Continued

CONTENTS--Continued

ILLUSTRATIONS

COMPETITION FOR WATER



Competition for water is growing. Adequate information and analysis are keys to effective development, protection, and management of a common water resource.

WATER RESOURCES ACTIVITIES IN FLORIDA, 1989–90

By Mildred E. Glenn, *editor*

INTRODUCTION

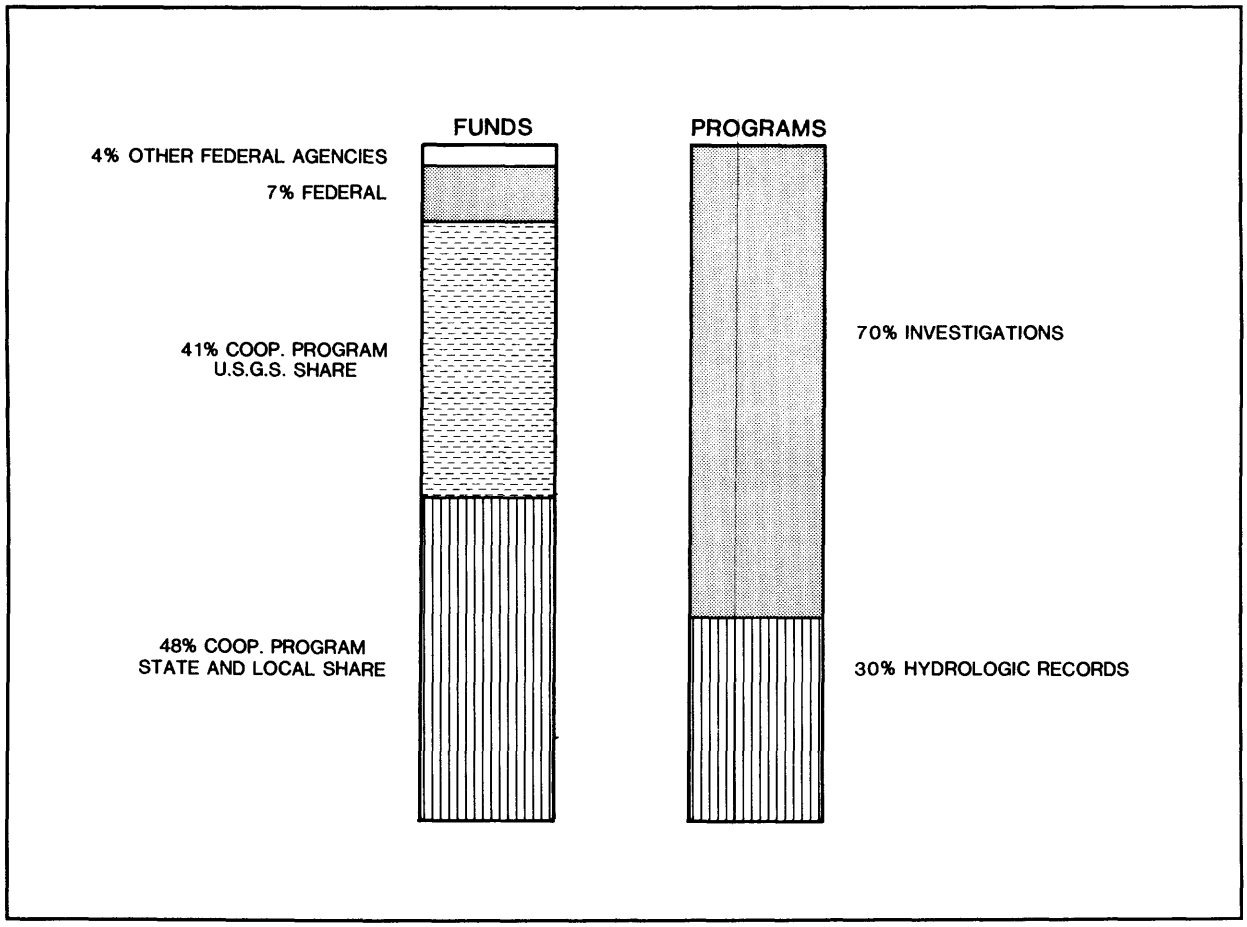
This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1989. These activities are part of the Federal program of appraising the Nation's water resources. Included are brief descriptions of the nature and scope of all active studies, summaries of significant results for 1989, and anticipated accomplishments during 1990.

Florida is a water-oriented State that, for many years, has experienced a mushrooming increase in population, attendant urban growth, and all the problems associated with such growth, particularly problems of protecting and preserving environmental quality. As the Florida environment is largely water sensitive, most environmental problems are water related. The Florida District of the U.S. Geological Survey has the principal responsibility at the Federal level for appraising water resources and for providing basic hydrologic data on both surface and ground water in the State.

Water resources appraisals in Florida are highly diversified, ranging from hydrologic records networks to interpretive appraisals of water resources and applied research to develop investigative techniques. Thus, water-resource investigations range from basic descriptive water-availability studies for areas of low-intensity water development and management to sophisticated cause and effect studies in areas of high-intensity water development and management. The interpretive reports and records that are products of the investigations are a principal hydrologic foundation upon which the plans for development, management, and protection of Florida's water resources may be based.

The need for water resources information is especially great in urbanized areas, where concern is being expressed that the "carrying" capacity of the land and water resources is being exceeded. Increasingly intensive and sophisticated water-management programs will have to be implemented in these urban areas to meet the increasing needs for water and to maintain good water quality. Water data and information required to implement sound water-management programs in highly urbanized areas relate to the quantity and quality of storm runoff, sources of aquifer contamination, injection of wastes into deep strata, underground storage of freshwater, artificial recharge of aquifers, environmental effects of reuse of water, and effects of land development on changes in ground- and surface-water quality. In some parts of the State broad areas are largely rural. Future growth is anticipated in many of these. However, recognition is given to the need for planned development tailored to the environment. The need for water information in these rural areas is related, to a large extent, to the need to provide for primary water development and to provide information on effects of development.

This report is intended to inform those agencies vitally interested in the water resources of Florida as to the current status and objectives of the U.S. Geological Survey cooperative program. The mission of this program is to collect, interpret, and publish information on water resources. Almost all of this work is done in cooperation with other public agencies.



Source of funds and makeup of program, Florida District, 1989–90.

WATER RESOURCES DIVISION PROGRAMS

Program development in the Water Resources Division is an evolving activity. Programs are reviewed regularly and future needs for water-data and hydrologic investigations are projected. Water problems and data needs brought out by State and local agencies and the public make up a major part of the planning process; thus, program development is a grassroots effort that is strongly influenced by changes in data needs and water problems.

Water Resources Division programs are of three major types: (a) data collection and dissemination, (b) problem-oriented water-resources appraisals, and (c) research. The programs are strongly interrelated; for example, theories arising from research are the foundation of data collection and problem-oriented water-resources appraisals, and data collection is a major component of all water-resources appraisals and most of the research studies.

The Division's activities may be described under three headings: long-term programs, technical-assistance programs, and topical programs.

Long-term programs include the Federal-State cooperative program; coordination of Federal water-data acquisition; assistance to other Federal agencies; the National Research Program; the National Water-Use Information Program; the hydrologic data-collection program, including the national stream quality accounting network and the national benchmark program; and the international hydrology program. These programs are fundamental to the Division's mission and they provide the data and research needed for the topical programs.

Topical programs are designed to provide critically needed information on issues of major and immediate concern to the Nation. These programs include hazardous waste hydrology, including high- and low-level nuclear and toxic-chemical wastes; coal and oil-shale hydrology; regional aquifer systems analysis; acid rain; volcano, subsidence, and flood hazards; and a nationwide water-quality assessment.

Technical-assistance programs include the instrumentation program, a central water-quality laboratory, and the national training center. These programs are internal to the Division but contribute significantly to the continuing development of hydrologic capabilities and thus to the success of the Division's mission.

NEW REPORTS FROM THE U.S. GEOLOGICAL SURVEY FLORIDA DISTRICT, 1989

The results of many of the water resources activities of the U.S. Geological Survey are released in reports for use by water agencies and the public. Most Survey reports on the water resources of Florida are available for inspection at the offices listed on the inside of the front cover, at the offices of the five water management districts, and at libraries of the State University system. Contact the Survey District Office in Tallahassee for information regarding the availability of these publications.

Aucott, W.R., 1988, Areal variation in recharge to and discharge from the Floridan aquifer system in Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4057, 1 sheet.

Barr, G.L., 1988, Potentiometric surface of the Upper Floridan aquifer in west-central Florida, September 1988: U.S. Geological Survey Open-File Report 88-730, 1 sheet.

Barr, G.L., 1989, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, May 1989: U.S. Geological Survey Open-File Report 89-393.

Barr, G.L., 1989, Potentiometric surface of the intermediate aquifer system in west-central Florida, September 1988: U.S. Geological Survey Open-File Report 89-36, 1 sheet.

Barr, G.L., 1989, Potentiometric surface of the intermediate aquifer system, west-central Florida, May 1989: U.S. Geological Survey Open-File Report 89-394, 1 sheet.

Bradner, L.A., 1988, Hydrology of the Floral City Pool of Tsala Apopka Lake, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4024, 44 p., and 1 sheet.

Franks, B.J., 1988, Creosote contamination of a surficial sand aquifer--a case study, *in* U.S. Geological Survey Yearbook, Fiscal Year 1987, p. 79-83.

Franks, B.J., 1988, Distribution and movement of wood-preserving compounds in a surficial aquifer, Pensacola, Florida, in National Water Summary 1986--Ground-Water Quality: Hydrologic Perspectives on Water Issues: U.S. Geological Survey Water-Supply Paper 2325, p. 93-98.

Fretwell, J.D., 1988, Water resources and effects of ground-water development in Pasco County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4188, 209 p.

Hampson, P.S., and Coffin J.E, 1989, Measurement of reaeration coefficients for selected Florida streams: U.S. Geological Survey Water-Resources Investigations Report 87-4020, 81 p.

Katz, B.G., 1988, Influence of mineral weathering reactions on the chemical composition of soil water, springs, and ground water, Catoctin Mountains, Maryland: Hydrological Processes, v. 3, p. 185-202.

Klein, Howard, and Ratzlaff, K.W., 1989, Changes in saltwater intrusion in the Biscayne aquifer, Hialeah-Miami Springs area, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4249, 1 sheet.

Laenen, Antonius, and Curtis, R.E., Jr., 1989, Accuracy of acoustic velocity metering systems for measurement of low velocity in open channels: U.S. Geological Survey Water-Resources Investigations Report 89-4090, 15 p.

Lewelling, B.R., 1986, Potentiometric surface of the Upper Floridan aquifer in west-central Florida, September 1986: U.S. Geological Survey Open-File Report 86-603, 1 sheet.

Lewelling, B.R., 1989, Potentiometric surface of the Intermediate aquifer in west-central Florida, May 1988: U.S. Geological Survey Open-File Report 88-721, 1 sheet.

Marella, R.L., 1988, Water withdrawals, use, and trends in Florida, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4103, 43 p.

Meyer, F.W., 1989, Subsurface Storage of liquids in the Floridan aquifer system in south Florida: U.S. Geological Survey Open-File Report 88-477, 25 p.

Peterson, C.J., 1988, Direct-current resistivity data from 94 sites in northeastern Palm Beach County, Florida: U.S. Geological Survey Open-File Report 88-464, 101 p.

Pruitt, J.B., Elder, J.F., and Johnson, I.K., 1988, Effects of treated municipal effluent irrigation on ground water beneath sprayfields, Tallahassee, Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4092, 35 p.

Rodis, H.G., 1989, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, September 1988: U.S. Geological Survey Open-File Report 89-65, 1 sheet.

Schiffer, D.M., 1989, Effects of three highway-runoff detention methods on water quality of the surficial aquifer system in Central Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4170, 79 p.

Schiffer, D.M., 1989, Effects of highway runoff on the quality of water and bed sediments of two wetlands in central Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4200, 63 p.

Schiner, G.R., 1989, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, May 1989: U.S. Geological Survey Open-File Report 89-417, 1 sheet.

Schiner, G.R., Laughlin, C.P., and Toth, D.J., 1988, Geohydrology of Indian River County, Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4073, 110 p.

Vecchioli, John, Hunn, J.D., and Aucott, W.R., 1989, Evaluation of methodology for delineation of protection zones around public-supply wells in west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4051, 36 p., and 1 sheet.

Wexler, Eliezer, J., 1989, Analytical solutions for one-, two-, and three-dimensional solute transport in ground-water systems with uniform flow: U.S. Geological Survey Water-Resources Investigations Report 89-56, 250 p.

Yobbi, D.K., 1989, Simulation of steady-state ground water and spring flow in the Upper Floridan aquifer of coastal Citrus and Hernando Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4036, 33 p.

HOW TO OBTAIN REPORTS PREPARED BY THE FLORIDA DISTRICT

The Florida District has been preparing reports on water resources for several decades. Titles of new reports prepared by the Florida District are included in the free catalog, *"New Publications of the U.S. Geological Survey."* To subscribe, write to:

"New Publications of the
Geological Survey"
582 National Center
Reston, VA 22092

For information on availability of Florida reports, please write to:

District Chief
U.S. Geological Survey,
Suite 3015,
227 N. Bronough Street,
Tallahassee, Florida 32301

PUBLICATION SERIES	CONTACT
OPEN-FILE REPORTS (Florida) WATER-RESOURCES INVESTIGATIONS (Florida)	U.S. Geological Survey 227 N. Bronough St., Suite 3015 Tallahassee, FL 32301
U.S. GEOLOGICAL SURVEY BOOKS Bulletins Circulars Professional Papers Water-Supply Papers	U.S. Geological Survey Books & Open-File Reports Box 25425, Federal Center, Bldg. 810 Denver, CO 80225 Phone (303) 236-7476
U.S. GEOLOGICAL SURVEY MAPS Hydrologic Investigations Atlases Hydrologic Unit Maps	U.S. Geological Survey Map Distribution Box 25286, Federal Center Denver, CO 80225 Phone: (303) 236-7477 (This office also handles topographic maps)
FLORIDA GEOLOGICAL SURVEY *(formerly Florida Bureau of Geology)* Bulletins Map Series Reports of Investigations Information Circulars	Florida Geological Survey 903 West Tennessee Street Tallahassee, FL 32304 Phone: (904) 488-9380

FLORIDA WATER RESOURCES RESEARCH CENTER

The Florida Water Resources Research Center, funded by the Department of the Interior, was established in 1964 as a result of the passage of Public Law 88-379, The Water Resources Research Act of 1964, "to stimulate, sponsor, provide for, and supplement present programs for conduct of research, investigation, experiments, and the training of scientists in the fields of water and of resources which affect water." Late in 1983, management of this program was transferred to the U.S. Geological Survey.

Under the administration of the Center, current water resources research pertaining to the achievement of adequate statewide water resource management, and water quality and quantity is being conducted by faculty at the University of Florida and at other universities in the State. For further information concerning the Center, contact Dr. James P. Heaney, Director, Florida Water Resources Research Center, 424 A.P. Black Hall, University of Florida, Gainesville, FL 32611 (904) 392-0840. A list of new publications resulting from the center projects is presented below:

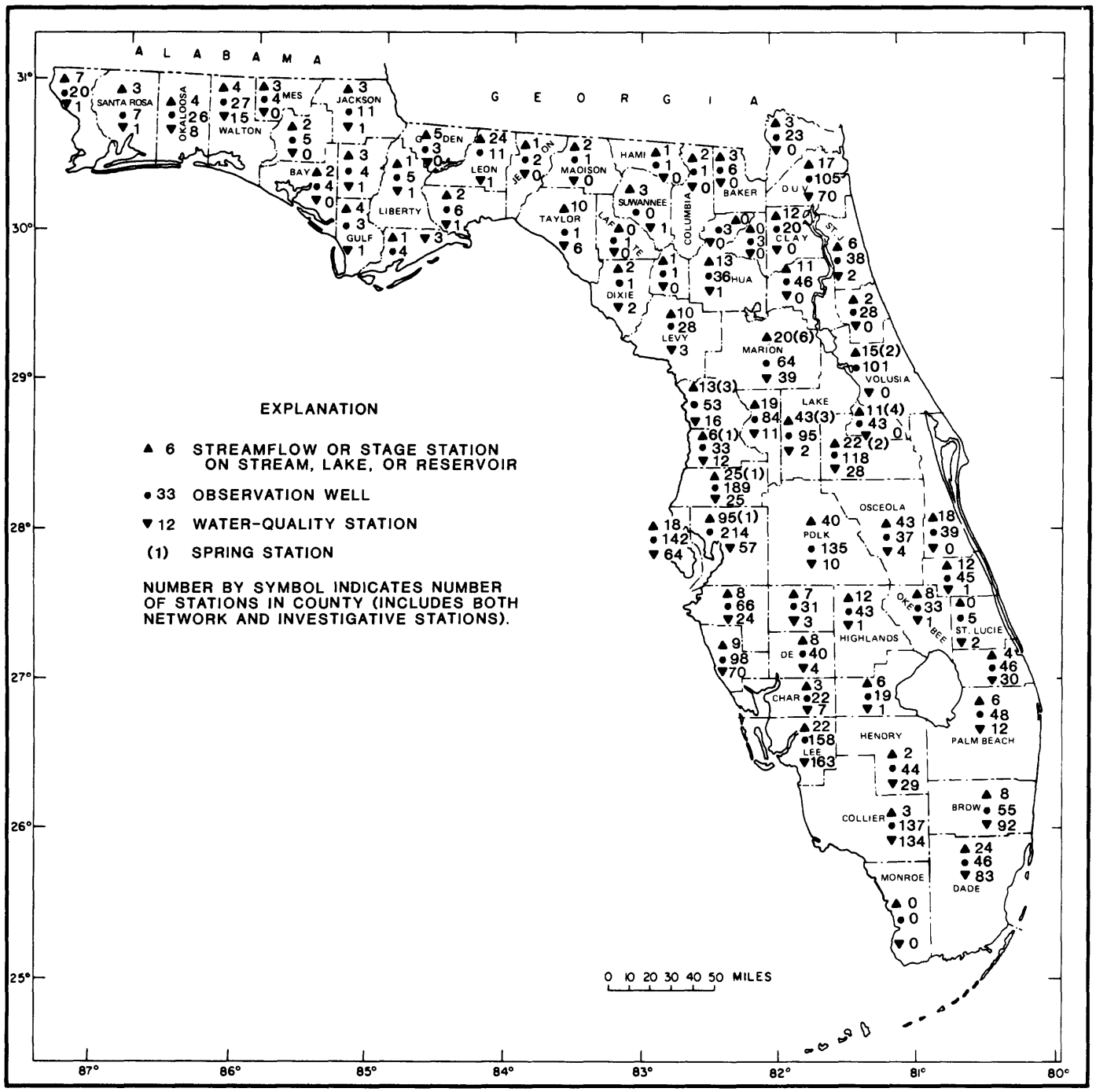
No. 107 USER'S MANUAL FOR A HEC-2 INPUT FILE PREPROCESSOR, by J.L. Fyfe and J.P. Heaney, 1989.

No. 108 WATER RESOURCES ANALYSIS OF A MULTIOBJECTIVE DRAINAGE NETWORK IN THE INDIAN RIVER LAGOON BASIN, by D.B. Bennett, 1989.

No. 109 MODEL OF POROSITY DEVELOPMENT IN A COASTAL AQUIFER SYSTEM, by A.F. Randazzo, 1989.

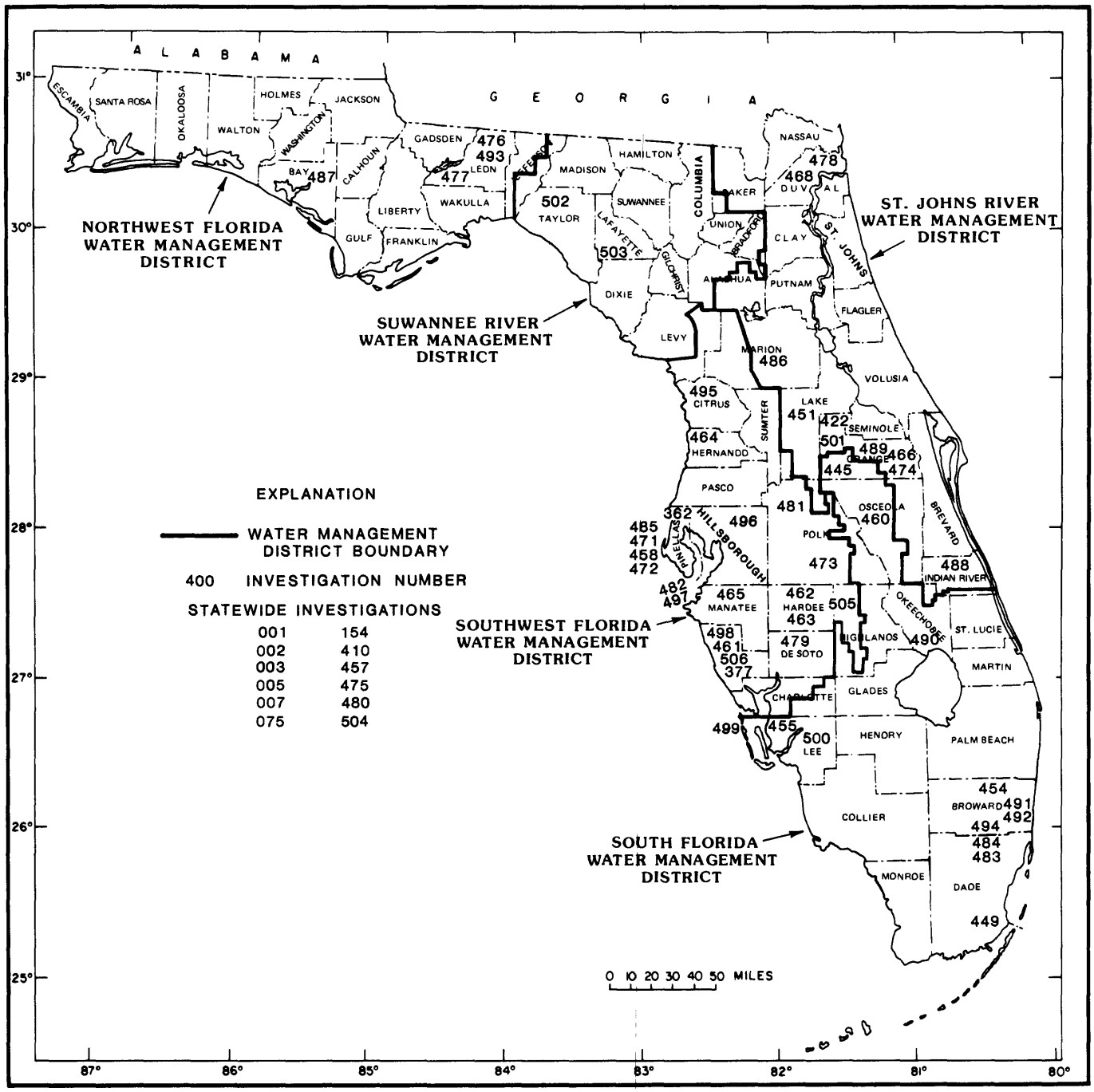
No. 110 DETERMINING SOIL-WATER SEASONAL MOVEMENT, by R.B. Brown, M.E. Collins, and G.J. Sawka, 1989.

No. 111 CONSERVATION OF WATER IN MINERAL PROCESSING OPERATION IN FLORIDA, by B.M. Moudgil, 1989.



Hydrologic data stations in Florida as of September 1989.

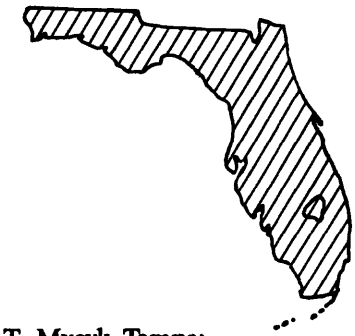
LOCATION OF AREAL INVESTIGATIONS AND THE FIVE WATER MANAGEMENT DISTRICTS



FLORIDA DISTRICT PROJECTS

A brief description of current District projects follows and includes the following information:

- Number
- Name
- Location
- Period of project
- Project Chief
- Cooperating agency(ies)
- Problem
- Objective(s)
- Approach
- Progress
- Plans for this year
- Reports in process
- Reports released



FL-001 SURFACE-WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1926

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: To obtain and document an unbiased inventory of streamflow, stream, and lake stage data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect stream discharge, stream, and lake stage data from a network of gaging stations that include daily discharge, periodic discharge, daily stage, and periodic stage stations to define streamflow and stage conditions within the State of Florida.

PROGRESS: Streamflow and stage data were collected from 713 network sites and prepared for publication. Streamflow and stage data currently are being obtained at the number of hydrologic data network stations given below.

PLANS FOR THIS YEAR: Continue operations as needs are defined.

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1989.

STATION CLASSIFICATION	NUMBER OF STATIONS
Stream stations	573
Continuous record:	
Discharge and stage	317
Stage only	80
Partial record:	
Peak (maximum) flow	63
Periodic streamflow	113
Lake and reservoir stations	140
Stage and contents	2
Stage only:	
Continuous	68
Periodic	70

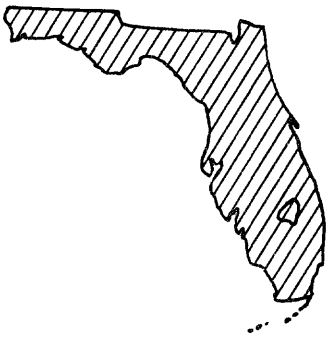
REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1988, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-88-1A, 440 p.

———1988, Water resources data, Florida, water year 1988, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-88-2A, 210 p.

———1988, Water resources data, Florida, water year 1988, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-88-3A, 290 p.

———1988, Water resources data, Florida, water year 1988, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-88-4, 264 p.



FL-002 GROUND-WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1930

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Long term water level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

OBJECTIVE: To obtain and document an unbiased inventory of water-level data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect water-level data for the various aquifers by a network of observation wells which includes 1,733 periodic observation sites and 501 sites where data are recorded continuously.

PROGRESS: Water-level data were collected and published as planned.

PLANS FOR THIS YEAR: Collection and publication of data will be continued.

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1989.

REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1988, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-88-1B, 396 p.

———1988, Water resources data, Florida, water year 1988, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-88-2B, 369 p.

———1988, Water resources data, Florida, water year 1988, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-88-3B, 311 p.

———1988, Water resources data, Florida, water year 1988, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-88-4, 264 p.

FL-003 QUALITY OF WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1939

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Water resource planning and water-quality assessment require a nationwide base level of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of surface and ground waters must be defined and monitored.

OBJECTIVE: To obtain and document unbiased inventory of water-quality data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect water-quality data from a network of daily, weekly, and periodic stations which include streams, lakes, springs, and wells to define water quality conditions within the State of Florida.

PROGRESS: Water-quality data are obtained at 137 surface-water network stations. These stations are used to monitor the quality of surface water in Florida. Some of these stations also are part of a U.S. Geological Survey nationwide network known as the National Stream Quality Accounting Network which is used to detect nationwide trends in water quality. The types of data determined at these sites are given below. Inasmuch as several types of data may be determined at a particular site and not all types of data are determined at each site, the number given below will not equal the total number of surface water sites.

DATA CLASSIFICATION	NUMBER OF SURFACE-WATER SITES
Physical data:	
Temperature, specific conductance, or pH	137
Sediment	26
Chemical data:	
Inorganic constituents	90
Organic constituents	48
Pesticides	17
Radiochemical data	5
Biological data	10

Water-quality data are obtained at network observation wells and springs. The types of data determined at these sites are listed below. Inasmuch as several types of data may be determined at a particular site, and not all types of data are determined at each site, the number given below will not equal the total number of ground-water sites.

DATA CLASSIFICATION	NUMBER OF WELLS	NUMBER OF SPRINGS
Physical data:		
Temperature, specific conductance, or pH	770	7
Chemical data:		
Inorganic constituents	92	5
Organic constituents	3	2
Biological data	13	1

PLANS FOR THIS YEAR: Collection and publication of data will be continued.

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1989.

REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1988, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-88-1A, 440 p.

———1988, Water resources data, Florida, water year 1988, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-88-1B, 396 p.

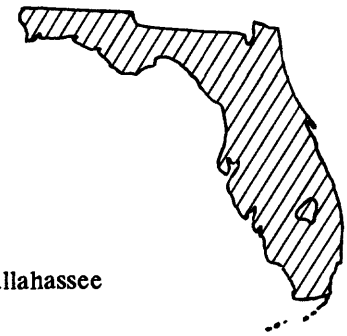
———1988, Water resources data, Florida, water year 1988, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-88-2A, 210 p.

———1988, Water resources data, Florida, water year 1988, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-88-2B, 369 p.

———1988, Water resources data, Florida, water year 1988, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-88-3A, 290 p.

———1988, Water resources data, Florida, water year 1988, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-88-3B, 311 p.

———1988, Water resources data, Florida, water year 1988, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-88-4, 264 p.



FL-005 QUALITY OF PRECIPITATION

DATE PROJECT BEGAN: July 1983

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATORS: Terrie M. Lee, Tampa, and George A. Irwin, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: The amount of substances dispersed in the atmosphere and deposited by precipitation is expected to continue to increase throughout North America. Thus, there is a need for reliable and long-term measurements of the chemical constituents in precipitation. Such measurements are essential for responsible management of the agricultural, forest, and aquatic ecosystems of the United States.

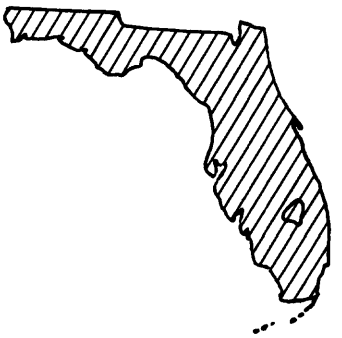
OBJECTIVE: The National Atmospheric Deposition Program (NADP) was created to conduct research on atmospheric deposition and its affect on surface waters and agricultural and forest lands in cooperation with Federal, State, and private research agencies. The U.S. Geological Survey (USGS) is participating in this program under the title of the National Trends Network (NTN) by establishing up to 40 stations nationwide with coordination and analytical services provided by NADP. These stations are established for the purpose of long-term coordinated data collection for use in local, regional and national studies.

APPROACH: Basic data on atmospheric deposition are collected at a NADP/NTN approved site at Verna Wellfield near Sarasota, Fla. Methods of data collection and instrumentation conform to NADP procedures and guidelines. Weekly precipitation samples are collected on a continuous basis, with additional samples collected for non-standard events. All samples are shipped to NADP Central Analytical Laboratory (CAL) which is operated by the Illinois State Water Survey.

PROGRESS: Weekly precipitation samples were collected at the Verna Wellfield site near Sarasota, Fla., according to NTN/NADP protocol. Water-chemistry data were reviewed as received from Illinois Central Analytical Laboratory (CAL).

PLANS FOR THIS YEAR: The data collection sites will be maintained and operated according to NADP/NTN standards and schedule. For 1990 only, data from the Verna NTN/NADP site near Sarasota, Fla., will be supplemented by data collected from additional precipitation samplers in the county for a study by the Branch of Quality Assurance.

REPORTS IN PROCESS: No reports planned for this project; data will be stored in WATSTORE data files.



FL-007 FLORIDA WATER-USE PROGRAM

DATE PROJECT BEGAN: July 1975

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: Richard L. Marella, Tallahassee

COOPERATING AGENCIES: Florida Department of Environmental Regulation
Northwest Florida Water Management District
St. Johns River Water Management District
South Florida Water Management District
Southwest Florida Water Management District
Suwannee River Water Management District

PROBLEM: Consistent and accurate statewide water use data are essential for the sound management of Florida's water resources. To date, periodic compilations of water-use data have been hampered by a lack of adequate long-term funding for water use in the cooperative program. The five water management districts are the primary collectors of water-use information. Consequently, within the State, there are five different levels of data collection, storage, compilation, and publication of water-use information.

OBJECTIVE: The water-use program will ensure long-term continuity and technical coordination of water-use data in Florida. Specifically, the water-use program will include: (1) A liaison between the five water management districts, Florida Department of Environmental Regulation, and other State agencies regarding water-use data; (2) consultation and assistance with each water management district to locate, collect, tabulate, and interpret water-use data; and (3) collation, interpretation, and publication of statewide data at 5-year intervals starting in 1990.

APPROACH: The water-use program will compile data for 6 major categories of water use for all 67 counties and 5 water management districts on a monthly basis. Data will be collected for all sources of withdrawal including fresh and saline, ground and surface water. Other data collected will include acreage irrigated for specific crop types; wastewater discharge from public and industrial facilities; aquifer withdrawals; water reused for irrigation; water used for desalinization; and site-specific pumpage for commerical, industrial, and power generation facilities. Special projects to improve collection and accuracy of water-use data will be undertaken during time not devoted to the major assessment every 5 years. Additionally, periodic contact with key personnel at the five water management districts will be maintained.

PROGRESS: All of the 1985 data have been collected and tabulated for Florida by category and county. Three statewide reports have been generated from this 1985 data, a Water-Resources Investigations Report, a Water-Supply Paper, and a Florida Geological Survey Map Series. Additionally, water-use tables presenting 1985 data were published in the 1987 edition of the Florida Statistical Abstract. The 1985 data were also published by three water management districts (Northwest Florida Water Management District, St. Johns River Florida Water Management District, and Southwest Florida Water Management District) in their individual reports. The 1985 data for Florida were provided for the National Water-Use Information Program and used in the compilation of the National Water-Use Report (U.S. Geological Survey Circular 1004).

Public supply data were collected for 1987 by county, month, and source. Work has also been done on estimating future water demands for public supply (projections) for the years 2000, 2010, and 2020. These projections detail public supply water demands by county, and the social, economic, and demographic factors that affect that demand. Four of the five water management districts and key FDER personnel were visited to assist and promote the collection and analysis of water-use data at various levels.

PLANS FOR THIS YEAR: Will continue to work on public supply water demand projections. Will begin preliminary work on the 1990 national data collection effort. The first step will be to contact and visit all five water management districts to determine their status and plans for collecting the necessary 1990 data. The

second step will be to determine what data each water management district will collect and what data the Survey will need to collect. This will include evaluating and assisting each water management district in either data collection or locating data sources. The third step will be to locate data sources and contacts needed for obtaining necessary water-use information (for example, agricultural acreage, population figures, power generation values).

REPORTS IN PROCESS:

Marella, R.L., in press, Water supply and use, Florida, *in* National Water Summary 1987: U.S. Geological Survey Water-Supply Paper 2350.

REPORTS RELEASED:

Pride, R.W., 1973, Estimated use of water in Florida, 1970: Florida Bureau of Geology Information Circular 83, 31 p.

Healy, H.G., Public water supplies of selected municipalities in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 77-53 (PB-271 691/AS), 309 p.

Pride, R.W., 1975, Estimated water use in Florida, 1965 (2d ed.): Florida Bureau of Geology Map Series 36.

Leach, S.D., 1977, Water use inventory in Florida, 1975: U.S. Geological Survey Open-File Report 77-577, 57 p.

Leach, S.D., 1978, Source, use, and disposition of water in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 78-17, 90 p.

Leach, S.D., 1978, Freshwater use in Florida, 1975: Florida Bureau of Geology Map Series 87.

Leach, S.D., and Healy, H.G., 1980, Estimated water use in Florida, 1977: U.S. Geological Survey WaterResources Investigations 79-112, 76 p.

Duerr, A.D., and Trommer, J.T., 1981, Estimated water use in the Southwest Florida Water Management District and adjacent areas, 1979: U.S. Geological Survey Open-File Report 81-56, 58 p.

Duerr, A.D., and Trommer, J.T., 1981, Estimated water use in the Southwest Florida Water Management District and adjacent areas, 1980: U.S. Geological Survey Open-File Report 81-1060, 60 p.

Duerr, A.D., and Trommer, J.T., 1982, The benchmark farm program—a method for estimating irrigation water use in southwest Florida: U.S. Geological Survey Water-Resources Investigation 82-17, 49 p.

Leach, S.D., 1982, Estimated water use in Florida, 1980, Florida Bureau of Geology Map Series 103.

Duerr, A.D., and Sohm, J.E., 1983, Estimated water use in southwest Florida 1981, and summary of water use, 1970, 1975, and 1977-81: U.S. Geological Survey Open-File Report 83-45, 75 p.

Leach, S.D., 1983, Consumptive use of freshwater in Florida, 1980: Florida Bureau of Geology Map Series 105.

Leach, S.D., 1983, Source, use and disposition of water in Florida, 1980: U.S. Geological Survey Water-Resources Investigation 82-4090, 337 p.

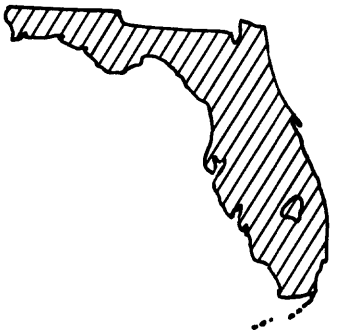
Spechler, R.M., 1983, Estimated irrigation water use in Florida, 1980: Florida Bureau of Geology Map Series 106.

Geiger, L.J., 1984, Water-use computer programs for Florida: U.S. Geological Survey Open-File Report 84-442, 91 p.

Leach, S.D. 1984, Projected public supply and rural (self-supplied) water use in Florida through year 2020: Florida Bureau of Geology Map Series 108.

Marella, R.L., 1988, Water withdrawals, use and trends in Florida, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4103, 43 p.

Marella, R.L., 1989, Freshwater withdrawals, water-use trend in Florida, 1985: Florida Geological Survey Map Series 123, 1 sheet.



FL-075 FLORIDA WATER ATLAS

DATE PROJECT BEGAN: September 1963

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: Walter R. Aucott, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Water-use planners have repeatedly expressed the need for maps that show the characteristics and availability of water in Florida or that show related information such as climate. Prior to the start of this project only a few maps had been published that give hydrologic data or other data closely related to hydrologic problems in Florida.

OBJECTIVE: This project seeks to make available the needed information in the form of a water atlas—a series of map reports designed to furnish to the user generalized hydrologic, geologic, and related information, portrayed graphically on a standard size map. These maps are most useful for broad planning to aid legislators, planners, industrialists, laymen, hydrologists, and others to provide readily available hydrogeologic information for decision making.

APPROACH: A total of 60 atlas series maps have been published to date. The Water Atlas program presently consists of three components, the first of which is the atlas program that has been ongoing since 1963. This consists of statewide map reports prepared using available information and knowledge from other studies. Many of these maps have been published by the Florida Geological Survey (FGS). Although money is no longer available for this program, some atlas type maps are still produced as parts of other projects.

The second part of the atlas program is the production of aquifer recharge maps. These will be produced using RASA modeling studies as well as existing soils, runoff, rainfall, potential evaporation, and topographic maps, and information on the base flow of streams.

The third part of the atlas program is a statewide series of maps of interest to planners and water managers that will depict factors that are of interest in locating potential sites for future public water supplies. These factors include recharge, which is already being mapped, aquifer transmissivity/well yields, water quality, and future water demand. The general approach will be to compile map reports for these factors for the Floridan aquifer system first, using existing data. Maps for the other aquifers will be completed later. Some of the maps for the other aquifers will require more than compilation of existing data.

PROGRESS: Seven map atlas reports have been initiated, approved or published during the past year. Work began on the first three future public water-supply reports: (1) "Transmissivity of the Floridan aquifer," and reports on (2) public supply water-use projections and the (3) hydrogeology of the Biscayne aquifer. Two reports are in press, "Water withdrawals, use, and trends in Florida, 1985" and "Ground-water sources and 1985 withdrawals in Florida." Additionally, two reports were published this past year, namely: "Areal variation in recharge to and discharge from the Floridan aquifer system in Florida," and "Runoff to streams in Florida." Considerable progress was made evaluating base-flow characteristics of streams that will be useful in upcoming bluebelt-related recharge determinations.

PLANS FOR THIS YEAR: Work will continue on all of the above listed report projects. Additionally, work will begin on at least one new atlas report.

REPORTS RELEASED:

Healy, H.G., 1961, Piezometric surface of the Floridan aquifer in Florida, July 6-17, 1961: Florida Geological Survey Map Series 1.

Healy, H.G., 1962, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6-17, 1961 (2d ed.): Florida Geological Survey Map Series 4.

Hoy, N.D., and Teel, J.R., 1963, Hydrologic features of the Floridan aquifer in Seminole County, Florida: Florida Division of Geology Map Series 5.

Hoy, N.D., 1964, Generalized water-table contours in southern Florida: Florida Division of Geology Map Series 7.

Shattles, D.E., 1965, Quality of water from the Floridan aquifer in Hillsborough County, Florida, 1963: Florida Division of Geology Map Series 9.

Toler, L.G., and Shampine, W.J., 1965, Quality of water from the Floridan aquifer in the Econfina Creek basin area, Florida, 1962: Florida Division of Geology Map Series 10.

Toler, L.G., 1965, Fluoride content of water from the Floridan aquifer of northwest Florida, 1963: Florida Division of Geology Map Series 11.

Shampine, W.J., 1965, Chloride concentration in water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 12.

Shampine, W.J., 1965, Hardness of water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 13.

Shampine, W.J., 1965, Dissolved solids in water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 14.

Shampine W.J., 1965, Sulfate concentration in water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 15.

Hyde, L.W., 1965, Principal aquifers in Florida (revised 1975): Florida Bureau of Geology Map Series 16.

Shampine, W.J., 1965, Quality of water from the Floridan aquifer in Brevard County, Florida, 1963: Florida Division of Geology Map Series 17.

Cherry, R.N., 1966, Chloride content of ground water in Pinellas County, Florida, 1950 and 1963: Florida Division of Geology Map Series 20.

Lichtler, W.F., and Joyner, B.F., 1966, Availability of ground water in Orange County, Florida: Florida Division of Geology Map Series 21.

Kenner, W.E., 1966, Runoff in Florida: Florida Division of Geology Map Series 22.

Toler, L.G., 1966, Fluoride content from water in the Floridan aquifer in northwestern Florida: Florida Division of Geology Map Series 23.

Anderson, Warren, and Joyner, B.F., 1966, Availability and quality of surface water in Orange County, Florida: Florida Division of Geology Map Series 24.

MacKichan, K.A., 1967, Temperature and chemical characteristics of the St. Johns River near Cocoa, Florida: Florida Division of Geology Map Series 25.

Barraclough, J.T., 1967, Ground-water features in Escambia and Santa Rosa Counties, Florida: Florida Division of Geology Map Series 26.

Kaufman, M.I., and Dion, N.P., 1967, Chemical character of water in the Floridan aquifer in southern Peace River basin, Florida: Florida Division of Geology Map Series 27.

Kenner, W.E., Pride, R.W., and Conover, C.S., 1967, Drainage basins in Florida: Florida Division of Geology Map Series 28.

McCoy, H.J., and Sherwood, C.B., 1968, Water in Broward County, Florida: Florida Division of Geology Map Series 29.

Knochenmus, D.D., 1968, Surface drainage characteristics in Volusia County, Florida: Florida Division of Geology Map Series 30.

Kenner, W.E., 1969, Seasonal variation of streamflow in Florida (revised 1975): Florida Bureau of Geology Map Series 31.

Visher, F.N., and Hughes, G.H., 1969, The difference between rainfall and potential evaporation in Florida (revised 1975): Florida Bureau of Geology Map Series 32.

Kaufman, M.I., 1969, Generalized distribution and concentration of orthophosphate in Florida streams (revised 1975): Florida Bureau of Geology Map Series 33.

Kenner, W.E., Hampton, E.R., and Conover, C.S., 1969, Average flow of major streams in Florida (revised 1975): Florida Bureau of Geology Map Series 34.

Kaufman, M.I., 1969, Color of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 35.

Pride, R.W., 1970, Estimated water use in Florida, 1965 (revised 1975): Florida Bureau of Geology Map Series 36.

Kaufman, M.I., 1970, The pH of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 37.

Hughes, G.H., 1970, Hydrologic setting of Deer Point Lake near Panama City, Florida: Florida Bureau of Geology Map Series 38.

Stewart, J.W., and Hanan, R.V., 1970, Hydrologic factors affecting the utilization of land for sanitary landfills in northern Hillsborough County, Florida: Florida Bureau of Geology Map Series 39.

Hughes, G.H., Hampton, E.R., and Tucker, D.F., 1971, Annual and seasonal rainfall in Florida: Florida Bureau of Geology Map Series 40.

Klein, Howard, 1971, Depth to base of potable water in the Floridan aquifer (revised 1975): Florida Bureau of Geology Map Series 42.

Anderson, Warren, 1971, Temperature of Florida streams (revised 1975): Florida Bureau of Geology Map Series 43.

Knochenmus, D.D., 1971, Ground water in Lake County, Florida: Florida Bureau of Geology Map Series 44.

Freiberger, H.J., 1972, Streamflow variation and distribution in the Big Cypress watershed during wet and dry periods: Florida Bureau of Geology Map Series 45.

Foster, J.B., 1972, Guide to users of ground water in Bay County, Florida: Florida Bureau of Geology Map Series 46.

Reichenbaugh, R.C., 1972, Sea-water intrusion in the upper part of the Floridan aquifer in coastal Pasco County, Florida, 1969: Florida Bureau of Geology Map Series 47.

Reichenbaugh, R.C., and Hunn, J.D., 1972, A hydrologic description of Lake Thonotosassa near Tampa, Florida: Florida Bureau of Geology Map Series 48.

Hunn, J.D., and Reichenbaugh, R.C., 1972, A hydrologic description of Lake Magdalene near Tampa, Florida: Florida Bureau of Geology Map Series 49.

Kaufman, M.I., 1972, The chemical type of water in Florida streams (revised 1975): Florida Bureau of Geology Map Series 51.

Klein, Howard, 1972, The shallow aquifer of southwest Florida: Florida Bureau of Geology Map Series 53.

Bush, P.W., 1972, A hydrologic description of Lake Minnehaha at Clermont, Florida: Florida Bureau of Geology Map Series 54.

Anderson, Warren, and Faulkner, G.L., Quantity and quality of surface water in Marion County, Florida: Florida Bureau of Geology Map Series 55.

Slack, L.J., and Kaufman, M.I., 1973, Specific conductance of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 58.

Rodis, H.G., 1973, Encroaching salt water in northeast Palm Beach County, Florida: Florida Bureau of Geology Map Series 59.

Hunn, J.D., 1974, Hydrology of Lake Tarpon near Tarpon Springs, Florida: Florida Bureau of Geology Map Series 60.

Coble, R.W., 1973, The Anclote and Pithlachascotee Rivers as water-supply sources: Florida Bureau of Geology Map Series 61.

Hughes, G.H., 1974, Water-level fluctuations of lakes in Florida: Florida Bureau of Geology Map Series 62.

Rosenau, J.C., and Faulkner, G.L., 1974, An index to springs of Florida (revised 1975): Florida Bureau of Geology Map Series 63.

Stone, R.B., 1974, Low streamflow in Florida—magnitude and frequency: Florida Bureau of Geology Map Series 64.

Healy, H.G., 1974, The observation-well network of the U.S. Geological Survey in Florida: Florida Bureau of Geology Map Series 65.

Snell, L.J., and Kenner, W.E., Surface water features of Florida: Florida Bureau of Geology Map Series 66.

Robertson, A.F., and Mills, L.R., 1974, Ground-water withdrawals in the upper Peace and upper Alafia River basins, Florida: Florida Bureau of Geology Map Series 67.

Tibbals, C.H., 1975, Recharge areas of the Floridan aquifer in Seminole County and vicinity, Florida: Florida Bureau of Geology Map Series 68.

Bush, P.W., 1974, Hydrology of the Oklawaha lakes area of Florida: Florida Bureau of Geology Map Series 69.

Pascale, C.A., 1975, Estimated yield of fresh-water wells in Florida: Florida Bureau of Geology Map Series 70.

Healy, H.G., 1975, Terraces and shorelines of Florida: Florida Bureau of Geology Map Series 71.

Conover, C.S., and Leach, S.D., 1975, River basin and hydrologic unit map of Florida: Florida Bureau of Geology Map Series 72.

Healy, H.G., 1975, Potentiometric surface and areas of artesian flow of the Floridan aquifer in Florida, May 1974: Florida Bureau of Geology Map Series 73.

Causey, L.V., and Leve, G.W., 1976, Thickness of the potable-water zone in the Floridan aquifer: Florida Bureau of Geology Map Series 74.

Slack, L.J., and Goolsby, D.A., 1976, Nitrogen loads and concentrations in Florida streams: Florida Bureau of Geology Map Series 75.

Slack, L.J., 1977, Program for monitoring surface-water quality in Florida: Florida Bureau of Geology Map Series 76.

Dysart, J.E., and Goolsby, D.A., 1977, Dissolved-solids concentrations and loads in Florida surface waters: Florida Bureau of Geology Map Series 77.

Dysart, J.E., 1978, Satellite image mosaic NASA ERTS-1 Imagery--1973: U.S. Geological Survey.

Hughes, G.H., 1978, Runoff from hydrologic units in Florida: Florida Bureau of Geology Map Series 81.

Phelps, G.G., 1978, Chemical quality of water used for municipal supply in Florida, 1975: Florida Bureau of Geology Map Series 82.

Phelps, G.G., 1978, Principal uses of freshwater in Florida, 1975: Florida Bureau of Geology Map Series 83.

Hull, R.W., and Irwin, G.A., 1979, Quality of untreated water for public supplies in Florida with reference to the National Primary Drinking Water Regulations: Florida Bureau of Geology Map Series 91.

Miller, R.A., Potential subsurface zones for liquid-waste storage in Florida: Florida Bureau of Geology Map Series 94.

Slack, L.J., and Rosenau, J.C., 1979, Water quality of Florida springs: Florida Bureau of Geology Map Series 96.

Stewart, J.W., 1980, Areas of natural recharge to the Floridan aquifer in Florida: Florida Bureau of Geology Map Series 98.

Healy, H.G., 1981, Estimated pumpage from ground-water sources for public supply and rural domestic use in Florida, 1977: Florida Bureau of Geology Map Series 102.

Leach, S.D., 1982, Estimated water use in Florida, 1980: Florida Bureau of Geology Map Series 103.

Healy, H.G., 1982, Potentiometric surface of the Floridan aquifer in Florida, May 1980: Florida Bureau of Geology Map Series 104.

Leach, S.D., 1982, Consumptive use of freshwater in Florida, 1980: Florida Bureau of Geology Map Series 105.

Spechler, R.M., 1983, Estimated irrigation water use in Florida, 1980: Florida Bureau of Geology Map Series 106.

Foose, D.W., and Sohm, J.E., 1983, Long-term streamflow stations in Florida, 1980: Florida Bureau of Geology Map Series 107.

Leach, S.D., 1984, Projected public supply and rural (self-supplied) water use in Florida through year 2020: Florida Bureau of Geology Map Series 108.

Hampson, P.S., 1984, Wetlands in Florida: Florida Bureau of Geology Map Series 109.

Sinclair, W.C., and Stewart J.W., 1985, Sinkhole type, development, and distribution in Florida: Florida Bureau of Geology Map Series 110.

Foose, D.W., 1987, Long-term stage records of lakes in Florida: Florida Geological Survey Map Series 118.

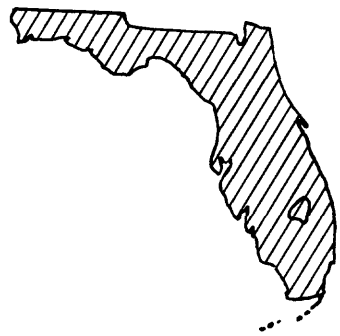
Barr, G.L., 1987, Potentiometric surface of the Upper Floridan aquifer in Florida, May 1985: Florida Geological Survey Map Series 119.

Aucott, W.R., 1988, Areal variation in recharge to and discharge from the Floridan aquifer system in Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4057.

Rumenik, R.P., 1988, Runoff to streams in Florida: Florida Geological Survey Map Series 122.

Marella, R.L., 1989, Freshwater withdrawals and water-use trends in Florida, 1985: Florida Geological Survey Map Series 123.

Conover, C.S., and Vecchioli, John, 1989, Ground-water sources and 1985 withdrawals in Florida: Florida Geological Survey Map Series 124.



FL-154 SUBSURFACE WASTE STORAGE, FLORIDA

DATE PROJECT BEGAN: October 1970

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: J.J. Hickey, Tampa

COOPERATING AGENCY: Federal Program

PROBLEM: Liquid wastes are now being injected into saline water in the deeper zones of the Floridan aquifer with indication of expanded use of the aquifer waste-storage capacity, especially in regard to storing and disposing of secondary treated sewage effluent. The hydrologic and geochemical characteristics needed to effectively evaluate the potential consequences of subsurface waste storage are not adequately known. Based on the present state of knowledge, reliable prediction of the movement, chemical interactions, and ultimate fate of liquid wastes underground is uncertain.

OBJECTIVE: To provide the needed scientific-information base and guidelines for a comprehensive evaluation of the lithology, hydrology and geochemistry of the deep saline parts of the aquifer systems, and for planning and management decisions among a multiplicity of possible uses of the saline aquifers, including subsurface liquid waste storage.

APPROACH: Assessment and synthesis of available hydrologic and geochemical data into a regional appraisal of the deep saline-water part of the aquifer system; inventory, assessment and evaluation of active and planned subsurface waste disposal systems in Florida, compilation of data, field investigations, and preparation of summary report including case studies, and establishment of a foundation for expanded effort in subsequent years through liaison with regulatory agencies, consultants, companies, the Florida Geological Survey and WRD research personnel.

PROGRESS: Two articles were published in national journals. One report and one abstract were approved for publication by the Director.

PLANS FOR THIS YEAR: Guide the generalized Ghyben-Herzberg article and the use of borehole television surveys report through the approval process. Continue work on study dealing with the physical factors that influence circular convection occurring subsurface injection.

REPORTS IN PROCESS:

Hickey, J.J., A generalized Ghyben-Gerzberg relation.

Salko, P., and Hickey, J.J., A preliminary approach to the use of borehole television surveys for characterizing secondary porosity in the Floridan aquifer system.

REPORTS RELEASED:

Goolsby, D.A., 1972, Geochemical effects and movement of injected industrial waste in limestone aquifer: American Association of Petroleum Geologists Memoir 18, p. 355-368.

Kaufman, M.I., 1973, Subsurface wastewater injection, Florida: American Society of Civil Engineers, Proceedings Paper 9598, v. 99, no. IRI, p. 53-70.

Kaufman, M.I., Goolsby, D.A., and Faulkner, G.L., 1973, Injection of acidic industrial waste into a saline carbonate aquifer: Geochemical aspects: American Association of Petroleum Geologists, Underground Waste Management and Artificial Recharge, v. 1, p. 526-551.

Puri, H.S., Faulkner, G.L., and Winston, G.O., 1973, Hydrogeology of subsurface liquid waste storage in Florida: American Association of Petroleum Geologists, Underground Waste Management and Artificial Recharge, v. 2, p. 825-850.

Wilson, W.E., Rosenshein, J.S., and Hunn, J.D., 1973, Hydrologic evaluation of industrial-waste injection at Mulberry, Florida: American Association of Petroleum Geologists, v. 1, p. 552-564.

Meyer, F.W., 1974, Evaluation of hydraulic characteristics of a deep artesian aquifer from natural water-level fluctuations, Miami, Florida: Florida Bureau of Geology Report of Investigations no. 75, 32 p.

Faulkner, G.L., and Pascale, C.A., 1975, Monitoring regional effects of pressure injection of wastewater in a limestone aquifer: Ground Water, v. 13, no. 2, p. 197-208.

Kaufman, M.I., and McKenzie, D.J., 1975, Upward migration of deep-well waste-injection fluids in Floridan aquifer, south Florida: U.S. Geological Survey Journal Research, v. 3, no. 3, 261-271.

McKenzie, D.J., 1976, Injection of acidic industrial waste into the Floridan aquifer near Belle Glade, Florida: Upward migration and geochemical interaction 1973-75: U.S. Geological Survey Open-File Report 76-626, 54 p.

Pascale, C.A., 1976, Construction and testing of two waste-injection monitor wells in northwest Florida: U.S. Geological Survey Open-File Report 76-1, 42 p.

Pitt, W.A.J., Jr., and Meyer, F.W., 1976, Ground-water quality at the site of a proposed deep-well injection system for treated waste-water, West Palm Beach, Florida: U.S. Geological Survey Open-File Report 76-91, 43 p.

Wilson, W.E., 1976, Hydrologic data for a subsurface waste-injection site at Mulberry, Florida 1972-75: U.S. Geological Survey Open-File Report 76-721, 24 p.

Pascale, C.A., and Martin, J.B., 1977, Hydrologic monitoring of a waste injection well near Milton, Florida: U.S. Geological Survey Open-File Report 77-368, 46 p.

Pitt, W.A.J., Jr.., Meyer, F.W., and Hull, J.E., 1977, Disposal of salt-water during well construction: Problems and solutions: Ground water, v. 15, no. 4, p. 276-283.

Wilson, W.E., 1977, Hydrologic data for a subsurface waste injection site, Mulberry, Florida, 1972-76: U.S. Geological Survey Open-File Report 77-511, 24 p.

Beaven, T.R., and Meyer, F.W., 1978, Well inventory and data summary for the Floridan aquifer system in Dade and Monroe Counties: U.S. Geological Survey Open-File Report 78-881, 26 p.

Pascale, C.A., and Martin, J.B., 1978, Hydrologic monitoring of a deep-well waste injection system near Pensacola, Florida, March 1970-March 1977: U.S. Geological Survey Water-Resources Investigations 78-27, 61 p.

Ehrlich, G.G., Godsy, E.M., Pascale, C.A., and Vecchioli, John, 1979, Chemical changes in an industrial waste liquid during post-injection movement in a limestone aquifer: Pensacola, Florida, Ground Water, v. 17, no. 6, p. 562-573.

Miller, J.A., 1979, Potential subsurface zones for liquid-waste storage in Florida: Florida Bureau of Geology Map Series 94, 1 sheet.

Vecchioli, John, 1979, Monitoring of subsurface injection of wastes, Florida: Ground Water, v. 17, no. 3, p. 244-249.

Hickey, J.J., 1981, Hydrogeology, estimated impact, and regional well monitoring of effects of subsurface wastewater injection, Tampa Bay area, Florida: U.S. Geological Survey Water-Resources Investigations 80-118, 40 p.

Vecchioli, John, 1981, Subsurface injection of liquid waste in Florida, United States of America, *in* The Science of the Total Environment: Amsterdam, Elsevier Scientific Publishing Company, p. 127-136.

Hickey, J.J., 1982, Hydrogeology and results of injection tests at waste-injection test sites in Pinellas County, Florida: U.S. Geological Survey Water-Supply Paper 2183, 42 p.

Hickey, J.J., and Wilson, W.E., 1982, Results of deep-well injection testing at Mulberry, Florida: U.S. Geological Survey Water-Resources Investigations 81-75, 15 p.

Hull, R.W., and Martin, J.B., 1982, Data on subsurface storage of liquid waste near Pensacola, Florida, 1963–1980: U.S. Geological Survey Open-File Report 82-689, 179 p.

Schiner, G. R., and German, E.R., 1983, Effects of drainage well recharge on quality of water of the Floridan aquifer in the Orlando area, central Florida: U.S. Geological Survey Water-Resources Investigations Report 82-4094, 124 p.

Hickey, J.J., 1984, Field testing the hypothesis of Darcian flow through a carbonate aquifer: Ground Water, v. 22, no 5, p. 544-547.

Hickey, J.J., 1984, Subsurface injection of treated sewage into a saline-water aquifer at St. Petersburg, Florida—aquifer pressure buildup: Ground Water, v. 22, no. 1, p. 48-55.

Hickey, J.J., and Ehrlich, G.G., 1984, Subsurface injection of treated sewage into a saline-water aquifer—water quality changes and potential for recovery of injected sewage: Ground Water, v. 22, no. 4, p. 397-405.

Kimrey, J.O., and Fayard, L.D., 1984, Geohydrologic reconnaissance of drainage wells in Florida—an interim report: U.S. Geological Survey Water-Resources Investigations Report 84-4021, 67 p.

McKenzie, D.J., and Irwin, G.A., 1984, Quality of water recovered from a municipal effluent injection well in the Floridan aquifer system, Pompano Beach, Florida: U.S. Geological Survey Water-Resources Investigations Report 84-4100, 23 p.

Merritt, M.L., 1984, Digital simulation of the regional effects of subsurface injection of liquid waste near Pensacola, Florida: U.S. Geological Survey Water-Resources Investigations Report 84-4042, 73 p.

Meyer, F.W., 1984, Disposal of liquid wastes in cavernous dolostones beneath southeastern Florida, *in* Hydrology of Karstic Terrains: International Association of Hydrogeologists, v. 1, p. 211-216.

Vecchioli, John, Ehrlich, G.G., Godsy, E.M., and Pascale, C.A., 1984, Alterations in the chemistry of an industrial waste liquid injected into limestone near Pensacola, Florida, *in* Hydrology of karstic terrains: International Association of Hydrogeologists, v. 1, p. 217-221.

Hickey, J.J. and Vecchioli, J., 1986, Subsurface injection of liquid waste with emphasis on injection practices in Florida, U.S. Geological Survey Water Supply Paper 2281, 25 p.

Hickey, J.J., 1987, Convective circulation during subsurface injection of liquid waste: Proceedings of the International Symposium on Subsurface Injection of Oil Field Brines sponsored by the Underground Injection Practices Council and U.S. Environmental Protection Agency, New Orleans, Louisiana, May 4-6, p. 318-341.

Hickey, J.J., 1989, An approach to the field study of hydraulic gradients in variable salinity ground water: Ground Water, v. 27, no. 4, p. 531-539.

Hickey, J.J., 1989, Circular convection during subsurface injection of liquid waste, St. Petersburg, Florida: Water Resources Research, v. 25, no. 7, p. 1481-1494.

FL-362 EVALUATION OF STORMWATER DETENTION BASINS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1980

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: William M. Woodham, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Pinellas County is one of the most densely populated counties in Florida, and serious water-quality problems in the Gulf of Mexico and Tampa Bay are caused by the increase in urban runoff. There is a need for data to evaluate the cost-effectiveness of the pollution control measures being planned to satisfy receiving water quality standards.

OBJECTIVE: To determine the effectiveness of runoff detention ponds in reducing suspended solids, nutrients, metals, coliform, and BOD loading entering receiving waters from urban areas in Pinellas County.

APPROACH: Runoff quantity and quality of an urban watershed will be monitored for a year before the construction of a stormwater detention pond just upstream from the monitoring station. This will provide background information to compare with data after the completion of the pond in the second year. After completion of the pond, an additional monitoring station will be operated at the inflow. Loads entering and leaving the pond will be compared. An interpretive report will be written in the third year after at least one complete year of inflow and outflow data have been analyzed.

PROGRESS: Daily discharge and rainfall were recorded at the outflow of Detention Basin No. 3 on St. Joes Creek at Pinellas Park. Samples of storm runoff water quality were collected and analyzed for chloride, copper, chromium, lead, zinc, total solids, and nutrients. Samples of base flow were collected and analyzed quarterly for these same constituents. Construction on the detention basin was completed late in the fiscal year. A daily discharge and rainfall site was installed at the inflow to the detention basin in September 1989.

PLANS FOR THIS YEAR: Continue the collection of daily discharge and rainfall at the inflow and outflow of Detention Basin No. 3. Quarterly base flow and storm runoff water quality samples for four storms will be collected and analyzed at both inflow and outflow stations. Constituent loads of chloride, copper, chromium, lead, zinc, nitrogen, phosporus, BOD, and total solids will be computed for each storm.

FL-377 ENVIRONMENTAL ASSESSMENT STUDY OF THE CHARLOTTE HARBOR ESTUARINE SYSTEM AND SURROUNDING AREA SOUTHWEST FLORIDA

DATE PROJECT BEGAN: July 1982

DATE PROJECT ENDS: June 1989

PRINCIPAL INVESTIGATOR: B.F. McPherson, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The area surrounding the Charlotte Harbor estuarine system is undergoing rapid development and population growth. As development occurs, surface-drainage features will be modified, and area water resources will undergo increased stress from water-supply withdrawals and waste disposal. Consequently, the magnitude of freshwater inflow to the estuarine system will be reduced and the inflow patterns altered. Saltwater may move upstream on principal tributaries and into surficial and intermediate aquifer systems, and salinity in the estuarine system may increase. Altered inflow patterns and increased chemical constituent loads will affect physical, chemical, and biological processes in the estuarine system.

OBJECTIVE: To determine existing conditions and evaluate the effect of future development on water-related resources of the Charlotte Harbor estuary. Specific objectives are to evaluate: (1) Freshwater runoff in the major tributaries and salinity distribution in the estuary. (2) Land and water use in the basin. (3) Material transport and water-quality characteristics in the major tributaries. (4) Circulation, flushing, and transport characteristics of the estuarine system. (5) Water-quality characteristics of the estuarine system, including physical, optical, chemical, radiochemical, and biological properties. (6) Relations among freshwater runoff, nutrient loading, and water-quality characteristics in the estuarine system.

APPROACH: Information will be gathered from the existing literature and from field data collected to define and describe the estuarine system so as to meet the objectives listed above. Available information includes (1) numerous scientific and technical reports, and maps; and (2) rainfall, temperature, streamflow, water-quality, stream channel cross-sections, tide stage and velocity, water-use, land-use, and topographic data. However, much additional biologic and hydrologic data will be required to meet study objectives. Evaluation will require application of various engineering and hydrologic methods including digital models that simulate hydraulic and water-quality conditions in streams and estuaries.

PROGRESS: Work continued on analysis of hydrodynamic data. Calibration of a 2-dimensional circulation model of the estuary was completed. Work continued on analysis and interpretation of salinity data and on the preparation of reports on salinity, circulation and flushing, residence times, nutrients, and biological productivity. Three reports are in preparation, four reports are in review, and three reports are awaiting publication.

PLANS FOR THIS YEAR: Prepare reports for publication.

REPORTS IN PROCESS:

McPherson, B.F., and others, Phytoplankton productivity and biomass in the Charlotte Harbor estuarine system, Florida.

McPherson, B.F., and Miller, R.L., Nutrient distribution and variability in the Charlotte Harbor estuarine system, Florida.

Miller, R.L., and McPherson, B.F., Estuarine flushing and residence times in Charlotte Harbor, Florida, using salt balance and a mixing model.

Miller, R.L., McPherson, B.F., and Kraemer, T.F., Radium and radon in the Charlotte Harbor estuary.

Stoker, Y.E., Distribution and abundance patterns of phytoplankton in the Charlotte Harbor estuarine system, southwestern Florida

REPORTS RELEASED:

Stoker, Y. E. and Karavitis, G. A., 1983, Literature assessment of the Charlotte Harbor Estuarine System and surrounding area, southwest Florida: U.S. Geological Survey Open-File Report 83-127, 143 p.

Estevez, E.D., 1985, Infaunal macroinvertebrates of the Charlotte Harbor estuarine system and surrounding inshore waters, Florida: Water-Resources Investigation Report 85-4260.

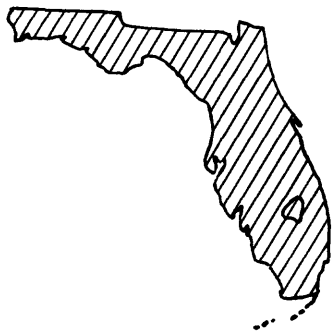
Stoker, Y. E., 1985, Water quality of the Charlotte Harbor estuarine system, Florida, November 1982 through October 1984, U.S. Geological Survey Open-File Report 85-563, 213 p.

Fraser, T.H., 1986, Long-term water-quality characteristics of Charlotte Harbor, Florida: Water-Resources Investigations Report 86-4180, 43 p.

McPherson, B.F., and Miller, R.L., 1987, The vertical attenuation of light in Charlotte Harbor, a shallow, subtropical estuary, southwestern Florida: Estuarine, Coastal and Shelf Science, v. 25, p. 721-737.

Hammett, K.M., 1988, Land use, water use, streamflow and water quality characteristics of the Charlotte Harbor inflow area, Florida: U.S. Geological Survey Open-File Report 87-472, 104 p.

Stoker, Y.E., Henderson, S.E., and McPherson, B.F., 1989, Hydraulic and salinity characteristics of the tidal Peace River, southwestern Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4162..



FL-410 ADAPTATION OF FLORIDAN AQUIFER SYSTEM RASA MODELS FOR WATER-MANAGEMENT NEEDS, FLORIDA

DATE PROJECT BEGAN: October 1983

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: C.H. Tibbals, Orlando

COOPERATING AGENCIES: South Florida Water Management District,
Southwest Florida Water Management District,
St. Johns River Water Management District, and
Suwannee River Water Management, District

PROBLEM: From 1950 to 1980, the population of Florida grew from about 2.8 million to about 9.8 million, an increase of 350 percent. By 2000, the population is expected to grow to about 17 million. Population growth, plus that of industry and the increased use of ground water for crop irrigation has placed great demand on the ground-water resource. The principal source of fresh ground water is the Floridan aquifer system that underlies all of Florida and parts of Alabama, Georgia, and South Carolina. The effects of increased pumping of ground water have been responsible, in part, for lower pressure heads in the Floridan which, in turn, are responsible for intrusion of salty water along both the east and west coasts of peninsular Florida and along the Gulf coast of north-central Florida; lower lake levels; lower water levels in the surficial aquifer; reduced streamflow; and, to some degree, increased potential for sinkhole activity.

OBJECTIVE: The overall objective is to provide the basis for long-term liaison and, thus, coordination between the U.S. Geological Survey (USGS) and the five State Water Management Districts as regards refinement and uses of the regional and subregional Floridan aquifer computer models constructed during the now-completed Floridan Regional Aquifer Systems Analysis (RASA) projects; to provide information on new modeling techniques; and to provide, on an as-needed basis, general guidance and advice on matters that relate to ground-water modeling in general and ground-water hydraulics. Other, more specific, objectives are: (1) Identify data and investigate needs on an areal basis; (2) Suggest and help implement changes to existing models; (3) Help provide results of specific-purpose modeling runs done in cooperation with the Southeastern Region staff that maintains the regional model; (4) Participate in the development of a high resolution (small grid block), multi-District ground-water model data base; (5) Develop techniques to access that data base at any location so as to provide "movable models," small models for any area that are, for the most part, already calibrated and that can be quickly constructed.

APPROACH: Liaison and coordination will be accomplished by means of both formal and informal meetings and discussions between the USGS District project leader, the Water Management District staffs, and the USGS Southeast Regional staff. Data and investigative needs will be assessed on a continuing basis by the USGS and the Water Management District staffs as the Districts implement their respective water-management plans. Some of these needs will be identified as the USGS regional RASA model is called upon to furnish results of specific purpose modeling runs to determine various stress-effect relations. The high-resolution data base will be constructed by adapting and incorporating the data bases generated for the regional and subregional models. The USGS Trescott-Larson three-dimensional source code will be the first to be modified to access the data base. Later, the USGS McDonald-Harbaugh three-dimensional modular model will be modified. Programs will be written in Fortran 77 to be executed in interactive mode.

PROGRESS: The "Movable Model" is operational for use with either the McDonald-Harbaugh or the Trescott-Larson ground-water flow models. Interactive modules have been developed for both models. PC versions of both models have also been developed. A preprocessor program was developed for input of pumping/recharging well data. Digitize/discretize programs for large-scale arrays remain under development for input of thematic map data. Color 3D graphics interface has been refined and improved. The "Movable Model" is available for use by WRD personnel via netlink.

PLANS FOR THIS YEAR: Continue to develop and refine the Movable Model. Complete digitize/discretize programs. Input historical statewide potentiometric maps to master data base. Continue to develop preprocessor programs.

REPORTS RELEASED:

Rutledge, A.T., 1989, A program for converting rectangular coordinates to latitude-longitude coordinates: U.S. Geological Survey Water-Resources Investigations 89-4070.

FL-422 IMPACTS OF SELECTED DEVELOPMENTAL ACTIVITIES ON THE QUALITY OF GROUND WATER, CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1984

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Edward R. German, Orlando

COOPERATING AGENCY: Federal Program

PROBLEM: There is a need to appraise the quality of ground water in relation to major developmental activities prevalent in recharge areas of the Floridan aquifer system. Many studies have dealt with ground-water quality, although most have not emphasized organic chemicals or trace metals. The three developmental activities of concern are: (1) use of drainage wells for stormwater disposal in urban areas, (2) use of pesticides and fertilizers in citrus groves, and (3) use of various chemicals in processing of phosphate ore and use of interconnector wells for drainage in phosphate mining areas.

OBJECTIVES: Determine the effect of citrus growing, phosphate mining, and urban storm water disposal on ground-water quality. Test the transferability of findings to other areas of similar land use and hydrology. Determine surface loadings of potential contaminants and evaluate contaminant potentials based on chemical properties and transport models. Determine vertical patterns of flow and quality in the surficial aquifer underlying the citrus area.

APPROACH: Design and install a network of wells representative of the land-use types. Sample the wells for selected constituents with a ground water contamination potential. Compile data on pesticide usage, including type and application quantities. Evaluate pesticide contamination potential based on chemical properties and transport, using simple unsaturated-zone flow models. Install and sample nests of wells in a typical cross-section of the citrus area to determine vertical patterns of flow and quality. Statistically examine data for evidence of ground water contamination and for factors affecting ground-water quality in each land-use type. Test conclusions by sampling in different areas of similar land use.

PROGRESS: Two areas were selected for sampling to confirm conclusions regarding effect of land use on water quality. The citrus land-use area selected is in Polk County where 12 wells were sampled. The urban land-use area is in Ocala, Fla., where 11 wells were sampled. Analyses were for selected pesticides, metals, organics, major constituents, and nutrients. An abstract for a paper describing effect of land use on ground-water quality was prepared and was accepted for presentation at the National Water Quality Symposium in November 1989. Work was begun on a detailed outline of the final project report.

PLANS FOR THIS YEAR: A paper describing nonpoint source contamination of ground water in central Florida from urban runoff, citrus cultivation, and phosphate mining will be presented at the National Symposium on Water Quality in November. The final report of the project will be completed.

REPORTS RELEASED:

Rutledge, A.T., 1986, Effects of land use on ground-water quality in central Florida—preliminary results: U.S. Geological Survey Water-Resources Investigations Report 86-4163, 49 p.

German, E.R., 1989, Assessment of potential for contamination of the Upper Floridan aquifer from drainage-well recharge in the Orlando area, central Florida, *in* Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigtions Report 88-4220, 63 p.

FL-445 ASSESSMENT OF WATER-QUALITY PROCESSES AFFECTING NUTRIENTS IN WETLANDS STREAM

DATE PROJECT BEGAN: October 1985

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Paul S. Hampson, Orlando

COOPERATING AGENCY: Reedy Creek Improvement District

PROBLEM: Phosphorus concentrations in Reedy Creek which receives treated-sewage discharges are relatively high downstream from Walt Disney World. Dissolved oxygen concentrations are at times much lower than allowed by state regulations. The low DO may be due largely to natural runoff from swampy areas, or it may be related to nitrogen-conversion processes related to the wastewater effluent. Little is known about how Reedy Creek assimilates and cycles nutrients. A better understanding of the efficiency of wetlands streams in nutrient assimilation and the effect of nutrient enrichment on such streams is required.

OBJECTIVES: Define the hydrologic environment of the Reedy Creek wetlands system in terms of water storage capacity, mean depth, stage duration, and water residence time. Evaluate role of wetlands in nutrient cycling and DO variation. Determine loads and speciation of nitrogen and phosphorus at selected points in the basin. Measure the nutrient-retention capacity of the RCID wetlands, and the effect of the wetlands on downstream water quality.

APPROACH: The methods used to accomplish the objectives will require six different types of data collection. These are: sampling of soil cores and sediments from the wetlands; *in situ* experiments to measure sediment oxygen demand and mechanism of nutrient cycling; aerial and field surveys for determination of flooded area and water depth; operation of continuous DO monitors and streamflow stations; sampling of nutrients at selected load stations under a range of discharge conditions; and collection of samples along Reedy Creek to establish profiles of water quality.

PROGRESS: Continuous monitoring of temperature, DO, and conductance has continued at 4 stations along Reedy Creek. Water-quality samples have been collected monthly and three reaeration coefficient-time of travel measurements have been completed. Preliminary data analysis shows that sewage outfall is the major source of phosphorus to the Reedy Creek wetland area. Analysis of background data from undeveloped Big Creek indicates that low DO concentrations are natural in many central Florida wetland streams. Two papers, "Input and output of dissolved solids, nitrogen, and phosphorus to an underdeveloped wetland area, central Florida," by E.R. German, and "Dissolved oxygen concentrations in a central Florida wetlands stream," by P.S. Hampson, were published in the proceedings of the AWRA symposium on wetlands, September 1989, in Tampa.

PLANS FOR THIS YEAR: Continue minimonitor operation and water-quality sample collection. Complete reaeration coefficient and time of travel measurements. Complete data analysis with respect to processes affecting dissolved oxygen concentrations and prepare a final report.

FL-449 SIMULATION OF A SALTWATER PLUME FROM A FLOWING WELL IN A SURFICIAL AQUIFER, DADE COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Michael L. Merritt, Miami

COOPERATING AGENCY: Metro-Dade Environmental Resources Management (DERM)

PROBLEM: Water supply in highly populated southeastern peninsular Florida is obtained almost entirely from the surficial aquifer. The presence of a chloride plume in the aquifer was established in 1979 and traced to a flowing well in Chekika State Park that was constructed in 1944. It was plugged in March 1985. Dade County plans to develop a new wellfield to the northeast of the plume, and concerns exist about possible well field contamination and about the future movement and rate of dilution of the plume.

OBJECTIVES: The objectives are to obtain information about the hydrologic regime in the surficial aquifer of south central Dade County and about the local movement and dispersal of pollutants, and to use this information to assess the future migration and attenuation of the chloride plume and the possibility of contamination of water withdrawn from the proposed new well field.

APPROACH: Digital models will be constructed to represent flow and transport in the area containing the chloride plume. Information used to design the models will include descriptions of rock samples and cores and the results of hydraulic testing now taking place as part of a separate study. Information used to calibrate the model will include the results of a synoptic QW reconnaissance by the USGS in 1979, a time series of QW data collected by DERM at various sites since 1981, and surface resistivity surveys in 1979 and 1986. The hydraulic regime will be simulated first, to be followed by chloride transport calculations and analyses to predict future plume movement and assess possible wellfield contamination.

PROGRESS: Continued the verification of the flow model and began model documentation. Continued small-scale simulation of chloride transport and began final report.

PLANS FOR THE YEAR: Prepare final report for publication.

FL-451 NUTRIENT LOADS IN THE APOPKA-BEAUCLAIR CANAL, UPPER OKLAWAHA BASIN, CENTRAL FLORIDA

DATE PROJECT BEGAN: May 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Donna M. Schiffer, Orlando

COOPERATING AGENCIES: St. Johns River Water Management District and Lake County

PROBLEM: The water entering Lake Beauclair is thought to have high nutrient concentrations. Presently, two sources of nutrient are suspect— Lake Apopka and the muck-farming operations adjacent to the Apopka-Beauclair Canal. The problem is to determine the relative contribution of nutrients from each source.

OBJECTIVES: Collect discharge data and nutrient data for the Apopka-Beauclair Canal in order to determine the nutrient loads leaving Lake Apopka and those entering Lake Beauclair. The difference between the input and output loads of the canal will be considered as the load entering from the muck farms along the canal.

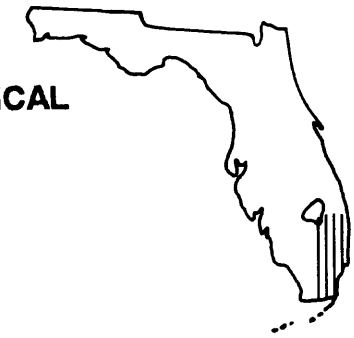
APPROACH: The geographic scope of the study will be the uppermost lakes of the upper Oklawaha basin, with the main emphasis on the northern outlet of Lake Apopka and the Apopka-Beauclair Canal. Data were collected for 2 years; during the second year, a constriction was built in the canal one-half mile downstream from Lake Apopka to facilitate discharge monitoring, and the project was extended to include data collection for an additional 2 years. The last year of the study will be devoted to writing and processing the report.

Instrumentation will include an electro-magnetic current meter for gaging purposes at the upstream site, and monitoring equipment at the lock and dam site to record gate openings and stages for computation of discharge at that site. At both sites, a microprocessor-controlled water-quality monitoring system will be installed, which includes continuous monitoring of temperature, specific conductance, and dissolved oxygen.

Discharge monitoring will be conducted on a continuous basis, limited only by equipment failure and maintenance problems. Routine monthly to bi-weekly sampling will be carried out, and supplemented by additional sampling during storms. Analysis of the field-collected data will begin by calculating canal discharge and having nutrient concentrations analyzed in the laboratory.

PROGRESS: Data were collected for the entire year at the two study sites. Data collected on a continuous basis at each site include stage, temperature, conductance and dissolved oxygen. At the lock-and-dam site, continuous data were also collected for rainfall and the operation of the two radial-arm gates. Water-quality samples were taken at each site on a monthly to biweekly basis. Discharge measurements were made at the constriction site and a rating was developed for computation of discharge based on a point velocity. Water quality and bed sediment samples were collected for sites between Lake Apopka and Lake Beauclair during the dry season.

PLANS FOR THIS YEAR: Routine data collection will be continued at the two data-collection sites and bed sediment samples will be collected once at selected sites in the study area. Data analysis will continue and the discharge at the constriction will be measured frequently to verify the established relation between the point velocity being recorded at the station and discharge.



FL-454 WASTE CONTAMINATION USING A GEOGRAPHICAL INFORMATION SYSTEM

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Roy Sonenshein, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: The southeast coast of Florida stretches from Palm Beach County on the north to Dade County on the south and has a population that is projected to increase from 3 to 5.5 million people in the next 15 years. This projected growth in population will increase the demand for drainage and water supply, thereby placing a greater stress on the water resources of the area and requiring more intense water management. Presently, more than 90 percent of the nearly 1 billion gallons per day of water used on the southeast coast comes from ground-water sources, primarily from the Biscayne aquifer. County agencies are formulating county-wide well-field protection ordinances and are in need of a means to assess risk of ground-water contamination within the cones of influence. At present, there is no method to correlate probable contamination versus land use within these cones of influence.

OBJECTIVES: Develop a procedure to assess the probability of contamination, based on land-use information, flow direction, hydrogeologic characteristics, time-of-travel models, water use, and known contaminant sources, in the cone of influence of wells using a Geographic Information System (GIS) as a data-base management tool.

APPROACH: Existing data bases would be analyzed to determine how to best enter these data to maintain both accuracy and spatial integrity. Most data bases (coverages) will be digitized, and information tables formatted. Some of the data are already in a digital format, and the spatial coverages and information tables can be processed without digitizing and hand entering data. These data can then be combined to produce various coverages with accompanying information tables for evaluation of waste hazard potential near well fields.

PROGRESS: Completed analysis of Broward County test areas. Finish planned reports. Assisted County and State agencies to develop ground-water monitoring networks and well-field protection strategies based on the data-base management system developed.

PLANS FOR THIS YEAR: Prepare final report for publication.

REPORTS IN PROCESS:

Waller, B.G., Ground-water protection strategies developed from real estate tax based data using a grographic information system (Conference Paper).

Waller, B.G., and Higer, A.L., Design of a GIS data base management system to develop a ground-water quality management model in Broward County, Florida (Conference Paper).

FL-455 FEASIBILITY OF STORING FRESHWATER IN SUBSURFACE FORMATIONS, CAPE CORAL, LEE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: E.J. Wexler, Miami

COOPERATING AGENCIES: South Florida Water Management District and City of Cape Coral

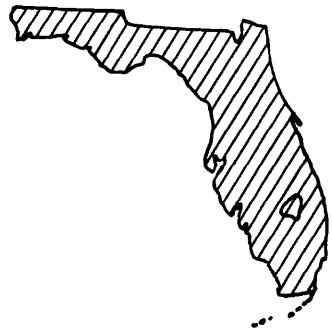
PROBLEM: Cape Coral is a southwest Florida coastal city, whose fresh ground-water resources are heavily stressed. The city has an 8.8 MGD reverse-osmosis plant that utilizes saline ground water, but the current growth rate of 29 percent will soon stress this resource also. The city has about 300 miles of freshwater canals. It has been proposed that excess runoff during the rainy season should be stored in deep saline aquifers as an additional source of supply during the high-demand dry season. First, the excess freshwater canal runoff must be quantified and an appropriate ground-water aquifer storage site needs to be investigated. Next, digital modelings need to be developed for the Cape Coral area to test the various methods of storage/retrieval and recharge schemes.

OBJECTIVES: To define the runoff pattern of the freshwater canal system, assess quantities of excess runoff occurring during the wet season, and assess the feasibility of conserving this freshwater in Cape Coral by artificial recharge or subsurface storage. Secondarily, to develop a multivariate relation among recovery efficiency, aquifer permeability, and cost, constrained by maximum permitted injection pressure and selected values for native aquifer water salinity.

APPROACH: Excess runoff and pattern of runoff will be determined from surface-water records from selected freshwater canal sites. Geohydrological data will be used as a basis for construction of digital flow and transport models. Digital modeling will be used to evaluate proposed injection, storage, and recovery efficiency after multiple cycles. Digital modeling will also be used to determine the optimum relations among aquifer transmissivity, recovery efficiency, and cost of pumping for various values of native water salinity.

PROGRESS: Continued work on development and calibration of models. Prepared first draft of final report.

PLANS FOR THIS YEAR: Prepare final report for publication.



FL-457 LOW-FLOW CHARACTERISTICS OF FLORIDA STREAMS

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Roger P. Rumenik, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: A rapid growth in State population and the increased demand for environmental protection has emphasized a need for information on low stream flows. Low-flow frequency information is needed to assess water-supply potential and waste-load assimilation capacity of streams in Florida.

OBJECTIVES: (1) Develop a centralized computer-storage data base for existing miscellaneous measurements. (2) Determine low-flow frequencies (7- and 30-day 2-year, and 7- and 30-day 10-year low-flow) for daily-record stations, and for partial-record stations where data can be correlated with long-term index stations. (3) Prepare a report that describes the data base useage, and presents low-flow data and frequency information.

APPROACH: Enter all miscellaneous streamflow-measurement data in the MEAS/INSP file of the WRD ADAPS (System), selected as the project's data base. Test and select distributions that best define low-flow frequencies for daily-record stations. Evaluate the adequacy of correlation between partial-record stations and daily-record index stations using statistical programs on the computer, and determine low-flow frequencies when correlations exist. Prepare final report that describes the data base usages, and presents low-flow data and frequency information in text and map format.

PROGRESS: Efforts were completed for entering all miscellaneous streamflow measurement data in the USGS Automatic Data Processing System on the Prime minicomputers located in Tallahassee, Tampa, Orlando, and Miami. These computers are electronically linked to all USGS Florida offices. Low-flow frequency data were determined for approximately 100 daily-record stations in northern (Northwest Florida Water Management District and Suwannee River Water Management District) and northeastern (lower St. Johns River Water Management District) Florida. Recommended correlation techniques under Survey guidelines were automated for use on the Prime computer. Low-flow frequency data were determined at approximately 90 of 500 partial-record stations in northern Florida where sufficient data were available and applicable for use in analytical or graphical correlation techniques. Efforts have begun on illustrations and tables for presenting low-flow data in a final report (water-resources investigations report).

PLANS FOR THIS YEAR: Complete estimates for the magnitude and frequency of low flows for all daily-record stations; and determine low-flow frequencies for partial-record sites where data can be correlated with long-term index stations. Complete final report.

FL-458 SALTWATER-FRESHWATER INTERFACE IN THE COASTAL AREA OF SOUTHWEST FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: John T. Trommer, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District and West Coast Regional Water Supply Authority

PROBLEM: Increased ground-water development associated with a rapidly growing population along the southwest coast of Florida poses a threat of contamination to major freshwater supplies through the introduction of saltwater into the upper Floridan and intermediate aquifers. To predict and prevent this occurrence, it is necessary to define the present location of the saltwater-freshwater transition zone in the major ground-water production zones along the southwest Florida coast.

OBJECTIVES: (1) To select and monitor 50 to 75 primary wells and up to 250 secondary wells in and near the transition zone in the major ground-water producing areas of the coastal area of southwest Florida, (2) to describe each monitor well by defining the hydrogeologic setting, (3) to recommend frequency of sampling, sampling protocol, and chemical analyses, (4) to describe short- and long-term changes in chloride concentration and specific conductance with time at selected wells, and (5) to use the data collected to define the location of the saltwater-freshwater transition zone.

APPROACH: (1) Compile available data including water-level, water-quality, well-construction and geophysical data. (2) Collect new data as necessary to supplement and update existing data which will include: (a) surface-DC resistivity and/or EM induction surveys; (b) borehole geophysical logging; (c) water-quality analysis for chloride, sulfate, specific conductance, density and temperature, and (d) continuous specific conductance and water-level monitoring at selected sites.

PROGRESS: Comprehensive data on existing and potential transition-zone monitor wells have been updated as new information has become available. Geophysical logging of four additional wells has been completed this year. Logs were run to determine well construction and hydrogeology at the site. Three long-term and three short-term sites have provided continuous water-level and specific conductance data and several have provided temperature data. These monitors provide information on short-term changes in water-quality in a well. Water-quality samples have been collected from approximately 200 wells in May and September (dry and wet seasons). Specific conductance, chloride, sulfate, and temperature analyses have been made on most samples and additional characteristics of calcium, magnesium, potassium, sodium, fluoride, silica, pH, and alkalinity at selected sites. Water levels also were measured when samples were collected.

The project was expanded to include additional borehole logging, water-quality sampling, and installation of minimonitors and water-level recorders at three sites having differing hydrogeologic settings. Data from this activity will be used to test the validity of various sampling techniques. Tests at two of the sites have been completed.

A first-draft of preliminary sections of the report has been completed.

PLANS FOR THIS YEAR: Wells selected for the chloride-monitor network will be tied to sea level. Temporary mini-monitors will continue to be rotated as necessary. Permanent mini-monitors will continue to be monitored. Water-quality sampling will continue through May 1990. Surface geophysics work will be done in areas where needed to interpolate water-quality between wells. The final test under the project expansion will be completed. The water-quality network will be adjusted as necessary based on new data. Data collected will continue to be processed, stored, analyzed, and interpreted. Manuscript preparation will continue.

FL-460 GROUND-WATER HYDROLOGY OF THE SURFICIAL AND FLORIDAN AQUIFER SYSTEMS IN OSCEOLA COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: George R. Schiner, Orlando

COOPERATING AGENCIES: South Florida Water Management District and St. Johns River Water Management District

PROBLEM: Osceola County is undergoing a rapid growth in population, more than doubling in the last 5 years. With this growth, the need for additional water supplies is becoming more acute. Evaluation of water use and water supply potential is particularly needed for the rural areas that have been incorporated or taken over by cities. More than 90 percent of all water used by domestic, municipal, and agriculture water users is obtained from the Floridan aquifer system, the rest is supplied by the overlying surficial aquifer system. Overdraft could result in water-quality degradation from saltwater intrusion.

OBJECTIVES: (1) To determine the relations between rainfall and water levels in aquifers, (2) to describe the hydrologic and water-quality characteristics of the aquifers and their individual and collective response to changes in recharge, and to pumping, (3) to delineate areas where water quality or quantity is or may become a problem, (4) to establish a network of hydrologic stations to monitor water level changes in the major aquifers, and changes in water quality in ground waters and (5) to prepare an interpretative report.

APPROACH: (1) Prepare a page size base map showing major drainage, cultural, and political features. (2) Collect and synthesize historical water-resources information from published and unpublished reports. (3) Inventory existing wells. (4) Run geophysical logs and sample wells for water-quality. (5) Drill 5-12 test observations wells and collect information on water levels, lithology, and water quality. (6) Conduct specific capacity, or short-term aquifer tests. Conduct longer-term aquifer tests on selected wells. (7) Establish a hydrologic network and install instruments.

PROGRESS: Data collection completed and report started. Tables and illustrations of report have been completed.

PLANS FOR THIS YEAR: Prepare report for publication.

FL-461 EVAPOTRANSPIRATION FROM AREAS OF NATIVE VEGETATION IN CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: William A. Bidlake, Tampa

COOPERATING AGENCIES: Sarasota County, Southwest Florida Water Management District, and West Coast Regional Water Supply Authority

PROBLEM: Water availability is becoming a critical issue even in humid, subtropical climates. By understanding and quantifying the components of the water budget in such areas, unique solutions may be developed to manage water resources. Although evapotranspiration is by far the major component of the water budget in humid, subtropical climates, very little has been done to obtain reliable estimates of evapotranspiration (ET). Accurate estimates of ET of four common, major native vegetation types in central Florida will be determined by selected energy budget techniques. The results of this investigation will provide a significant new knowledge by developing more accurate ET values for extensive and ecologically important wetland areas.

OBJECTIVES: The objectives of the study are: (1) to develop accurate estimates of evapotranspiration from palmetto prairie, pine flatwoods, grass ponds, and cypress heads in the Ringling-MacArthur Reserve (RMR) and the Cypress Creek and Big Cypress swamp area, (2) to estimate total ET from RMR, and (3) to analyze for error in the estimated ET.

APPROACH: The approach to this study will include delineating areas of native vegetation in the study area; and evaluating the use of energy budget techniques, e.g., Penman, Bowen ratio and eddy correlation using 2 years of field data and estimate ET for the study area using the best applicable techniques. Vegetative cover will be delineated with detailed aerial color photography. Field data collection sites will be selected, assuring that sites are representative for each vegetative type. Periods of monitoring for each site will be (a) permanent-continuous for parameters used in calculating ET by the Penman method and (b) portable short-term for parameters used in energy budget techniques, generally monthly to bimonthly for 24 to 48 hour periods.

PROGRESS: An additional instrument tower was erected to permit collection of Penman evapotranspiration data, and Bowen ratio and eddy correlation data from a dense stand of pine on Ringling-MacArthur Reserve. Short-term measurements of ET by Bowen ratio and eddy correlation methods were conducted for palmetto prairie, grassy pond, pine flat, and cypress dome sites. Penman potential ET data were collected for palmetto prairie and cypress dome sites. Data were sorted and plotted.

PLANS FOR THIS YEAR: ET data will be collected from all established sites through March. Data from continuous Penman potential ET measurements will be calibrated with direct ET measurements to produce time series of ET from vegetation types at RMR and from the cypress domes. Report preparation will continue.

FL-462 POTENTIOMETRIC MAPS OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SUMMARY OF HYDROLOGIC CONDITIONS FOR HIGH AND LOW WATER

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: G. Lynn Barr, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: In west-central Florida, the intermediate aquifer system occurs in parts of eight counties. The aquifer is an important source of water in three of these counties because water in the deeper Floridan aquifer has a high mineral content near the Gulf coast. Rapid growth has taken place here the past 5 years, and in 1985, this was one of the leading growth areas of the State. Associated with this growth is an increased demand on water for public supply, industrial and agricultural uses. Extremes in water-level fluctuation need to be known to better manage the resources.

OBJECTIVES: A potentiometric surface map of the intermediate aquifer will be produced in May and September. A list of water level data will be prepared from the potentiometric surface maps. Hydrographs will be prepared for selected wells to show continuous water-level data. A brief text summarizing water-level conditions during the high- and low-water conditions will be prepared.

APPROACH: The water level monitoring network established for the "Hydrogeology of the intermediate aquifer system" project (FL-411) will be expanded and revised for this project for making semiannual water level measurements and producing a potentiometric map.

PROGRESS: The May 1988, September 1988, and May 1989 potentiometric surface map reports were published. Water-level data for the September 1989 high water-level conditions were collected.

PLANS FOR THIS YEAR: Prepare the September 1989 map for review and publish report.

REPORTS RELEASED (1988-89 only):

Barr, G.L., 1988, Potentiometric surface of the intermediate aquifer system, west-central Florida, September 1988: U.S. Geological Surfey Open-File Report 88-730, 1 sheet.

Barr, G.L., 1989, Potentiometric surface of the intermediate aquifer system, west-central Florida, May 1989: U.S. Geological Survey Open-File Report 89-394, 1 sheet.

Lewelling, B.R., 1989, Potentiometric surface of the intermediate aquifer system, west-central Florida, May 1988: U.S. Geological Survey Open-File Report 88-721, 1 sheet.

FL-463 HYDROLOGY AND WATER QUALITY OF THE INTERMEDIATE AND UPPER FLORIDAN AQUIFERS, HARDEE AND DE SOTO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: A.D. Duerr, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Hardee and De Soto Counties are experiencing increases in population and expansion of industry and citrus groves. Because of the increase in population and water use, there is concern about the long-term effects of increased withdrawals from the intermediate and upper Floridan aquifers. There is a potential for degrading the quality of water in the upper aquifers due to improper well construction, such as open hole in multiple zones containing water of varying quality.

OBJECTIVES: The purpose of the study is to identify the major aquifers, define their lateral extent, identify areas where they are interconnected, and describe the hydraulic and water-quality characteristics of each aquifer.

APPROACH: Field data collection will include an inventory of existing wells, collection of geologic and water-quality samples during drilling of new wells, collection of geophysical data, aquifer tests, and collection of water-quality samples and water-level data from existing wells. Maps will be prepared showing the thickness and lateral extent of the intermediate and upper Floridan aquifers. Potentiometric surface maps will be drawn and the lateral and vertical variations of selected water-quality parameters will be mapped. Seepage runs will be conducted on the Peace River to study the relation between ground and surface water and to identify areas of recharge and discharge.

PROGRESS: The reconnaissance of wells needed for collecting water-quality and lithologic data was completed. Water samples were collected from 22 wells and were analyzed for dissolved solids, hardness, chloride, sulfate, fluoride, iron, specific conductance, silica, boron, and nitrate. All data were processed, tabulated, and stored. Data for two aquifer tests of the intermediate aquifer system were analyzed. An observation well was deepened and flowmeter logs were run at the Regional Observation and Monitor Well Program (ROMP) 31 site in preparation for a second aquifer test. A first draft of the project report was completed. The report includes sections on geohydrologic framework and hydraulic properties, potentiometric surface, Peace River seepage, water quality, and water withdrawal.

PLANS FOR THIS YEAR: The ROMP 17 aquifer test analysis will be reviewed and revised as needed. A second aquifer test will be conducted at ROMP 31 and the analysis of that test will be submitted for review. The project report will be completed and approved for publication.

REPORTS IN PROCESS:

Duerr, A.D., and Enos, G.M., Hydrology and water quality of the Intermediate and Upper Floridan aquifers, Hardee and De Soto Counties, Florida (in review).

FL-464 SALTWATER INTRUSION IN SPRINGS ALONG THE COASTAL MARGIN OF CITRUS AND HERNANDO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: D.K. Yobbi, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Because of the potential for increased saltwater intrusion due to expanding use of groundwater, it is important to develop a better understanding of coastal springs and their role and relationship to the hydrology of the area. Insufficient data exist for evaluating the dynamics associated with seawater and the level and quantity of freshwater in coastal springs. Such data collection and development of hydrologic relations are needed to understand coastal spring hydrology and requirements to maintain healthy estuaries.

OBJECTIVES: To collect and analyze data to define movement of saltwater in springs along the coastal margin of Citrus and Hernando Counties.

APPROACH: Water quality and streamflow measurements will be made over a range of hydrologic conditions. Continuous recording streamflow, tide-stage, and water quality monitoring stations will be established on selected springs. Near major springs, recording water-level and water-quality stations will be established on selected wells. A well inventory and test-drilling program will be conducted. Ground-water levels will be measured and potentiometric maps prepared. Surface-geophysical techniques will be applied over a range of hydrologic conditions.

PROGRESS: Water-quality measurements were made at 2 surface-water sites in the Gulf of Mexico, 1 well, and 24 springs. Flow measurements also were made at the springs. Short-term, continuous tidal stage and water-quality instruments were rotated among 21 spring sites. Surface geophysical data were collected at selected sites along three west-to-east transects located north of the Weeki Wachee River, south of the Chassahowitzka River, and north of the Homosassa River. Data-collection instruments were removed from sites and processing of daily conductivities, stage, and discharge was completed. Preliminary data analysis and interpretation was completed and a draft copy of the final report was prepared.

PLANS FOR THIS YEAR: The project report will be reviewed and submitted for Director's approval.

REPORTS IN PROGRESS:

Yobbi, D.K., Water quality, discharge, and salinity characteristics of coastal springs in Citrus and Hernando Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report.

FL-465 POTENTIAL FOR CONTAMINATION OF THE FLORIDAN AQUIFER SYSTEM, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Craig B. Hutchinson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District (SWFWMD)

PROBLEM: West-central Florida is undergoing rapid growth and in some areas water is already in short supply. The Floridan aquifer system supplies more than 90 percent of the freshwater used in west-central Florida. Areas that are particularly vulnerable to contamination occur where the Floridan aquifer system is near land surface or where recharge to the aquifer is rapid. Recently, the pesticide EDB, used only for the past 30 years, has been detected in water from the Floridan aquifer system. In order to safeguard the water supply, the potential for water quality degradation in the Floridan aquifer system must be assessed.

OBJECTIVES: Map hydrogeologic conditions suspected to rapidly convey recharge to the upper Floridan aquifer. Develop data base of existing radiochemical and stable isotopes in the SWFWMD. Evaluate chemical, radiochemical, and stable isotope methods used to indicate relatively recent recharge water. Supplement data base of radiochemical and stable isotopes in the SWFWMD. Use hydrogeologic and chemical data to map qualitatively the potential for contamination of the Floridan aquifer system.

APPROACH: Make a qualitative assessment of susceptibility based on available hydrogeologic information and prepare a preliminary map of pollution potential. Field test geochemical ground-water age dating methods, such as tritium, deuterium, oxygen-18, partial pressure of CO_2, redox potential, saturation indices and the presence of compounds such as EDB, 24-D, and alkyl benzene sulfanate. About 30 wells will be sampled to validate these methods. About 90 additional wells will be sampled throughout SWFWMD in order to identify relatively recent recharge areas. The existing geochemical data base and preliminary pollution potential map will be updated and an interpretive report will be written.

PROGRESS: Thirty wells that tap the upper part of the Floridan aquifer system were inventoried and sampled for chemical characteristics. All wells were sampled for field pH, alkalinity, specific conductance, dissolved oxygen, temperature, and Eh. Samples were sent to the Survey laboratories for analyses of major ions, and environmental deuterium, oxygen-18/oxygen-16, and tritium. Eight wells in a vertical profile at Starkey well field also were sampled for tritium. Water quality data from 120 wells were compiled and analyzed using standard geochemical and statiscal methods. A preliminary map of pollution potential to the Floridan aquifer system was prepared. The map indicates that the highest potential occurs in the area where the aquifer system is unconfined and overlain by permeable sand units which provide temporary storage for recharging water. A data release was prepared for the cooperator describing progress during the third year of the study. Work began on the final report.

PLANS FOR THIS YEAR: During FY 90, the final report summarizing the results of the study will be completed.

FL-466 FLORIDAN AQUIFER SYSTEM WATER QUALITY IN AN AREA OF DRAINAGE-WELL INFLOW

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: L. Anne Bradner, Orlando

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The Floridan aquifer system serves as the principal source of drinking water for the metropolitan Orlando area. Because of the dual usage of the Floridan aquifer system, there is a potential for contamination of the area's drinking-water supply by drainage-wells. Studies aimed at investigating the effect of drainage-well inflow on water quality in the Floridan aquifer system have not revealed any widespread water-quality problems. There was no evidence of a direct link between supply water quality and drainage-well proximity. Study of areas downgradient of drainage wells having large inflows is needed to determine if contamination of the aquifer system is occurring.

OBJECTIVE: To determine the effect of drainage-well inflow on the quality of water in the Floridan aquifer in the vicinity of drainage wells.

APPROACH: Inventory and evaluate potential sites. Select 2 to 3 sites for intensive investigation. Drill additional wells at the selected sites as necessary. Use geophysical logging to determine characteristics of the drainage wells and the depth. Install and operate a water level, specific conductance, and temperature recorder on one of the monitor wells at each study site. Sample wells near end of dry season, several weeks after onset of wet season, and after wet season has ended.

PROGRESS: Water-quality sampling was completed. Analyses of long-term and areal sampling data were completed. Report in review.

PLANS FOR THIS YEAR: Prepare report for publication.

FL-468 WATER RESOURCES OF DUVAL COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Eugene C. Hayes, Orlando

COOPERATING AGENCY: City of Jacksonville

PROBLEM: Jacksonville is rapidly increasing in population and expanding commercially and industrially. As a result, areas that were once rural are now becoming urbanized and stresses are being placed on the physical environment including the quality and quantity of water supplies. A large amount of hydrologic data has been obtained and many technical reports have been prepared as a result of 27 years of investigations. Most of the reports are moderately to highly technical and were prepared mainly for the scientist, engineer, and professional water manager. A nontechnical report is needed, prepared from historical data, to help educate the public on vital aspects of the water resources of Duval County. Proper management of the system cannot occur without the cooperation of an informed public.

OBJECTIVE: The principal objectives of this investigation and resulting report are to summarize and interpret some of the major results of the 27-year program of investigation of the water resources of Duval County and northeast Florida in a manner that will be useful to local citizens as well as to scientists and professional water managers. Specifically, the report will be prepared using STOP FORMAT and present (1) the source, occurrence, and movement of water in Duval County (natural hydrologic system, and (2) the effects of man's activities on the system.

APPROACH: (1) Collect, synthesize, and interpret historical information from published and unpublished reports and maps and from records of the U.S. Geological Survey and from other sources as available and necessary; (2) prepare the resulting Water Atlas report using STOP FORMAT. Where possible maps for illustrations will be generated from the GIS ARC-INFO data base. New layers of information will also be generated and stored in a Duval County data base accessible to the cooperator.

PROGRESS: All historical information available from U.S. Geological Survey and the City of Jacksonville files have been collected. Approximately 75 percent of the illustrations have been completed.

PLANS FOR THIS YEAR: Complete the first draft, process and publish report.

FL-471 GROUND-WATER QUALITY IN THE VICINITY OF STORMWATER PONDS, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Mario Fernandez, Jr., Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: During the wet season, stormwater-detention ponds excavated into the water table aquifer recharge the aquifer with stormwater runoff. This runoff has been shown to contain organic chemicals that could potentially contaminate the ground water in the shallow aquifer.

OBJECTIVE: To investigate inorganic and organic contaminants in ground water near stormwater ponds and bottom deposits in ponds receiving runoff from residential and commercial/urbanized areas; to evaluate the effects of the ponds on the ground water at each site; and attempt to determine the direction of migration of leachate from the ponds.

APPROACH: Surveys will be conducted to describe pond sediments. Wells completed in the water-table aquifer will be sampled for water-quality analyses and the levels will be measured. Direction of ground-water flow will be established. Ground- and surface-water samples and pond sediments will be collected for analysis of inorganic and organic constituents.

PROGRESS: The investigation of the three stormwater retention ponds has been completed. The final report has been drafted.

PLANS FOR THIS YEAR: Final report will be reviewed and submitted for publication.

FL-472 HYDROGEOLOGICAL ASSESSMENT OF SPRAY EFFLUENT AND SLUDGE DISPOSAL BASINS AT A DISPOSAL SITE, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: John T. Trommer, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Results of previous water-quality monitoring at the Northwest Pinellas County sewage treatment plant effluent and sludge disposal sites and private wells, have indicated increasing concentrations of some chemical constituents. The treatment plant is located in an area of rapid urban development, and water from a private well to the south is beginning to show changes in water quality. Because the general direction of ground-water movement is toward the west, privately owned wells in that direction also may begin to show water-quality changes. The overall effects of the disposal system on the surrounding environment has not been evaluated.

OBJECTIVE: To determine if land application of effluents and fertilizers at a nearby resort to the east is migrating through the groundwater into the site; to determine the extent that effluent and sludge disposal operations have affected ground-water quality at the disposal site and in areas downgradient from the site; to conduct a reconnaissance of downgradient private wells to determine whether they have been, or will be affected by the disposal operations.

APPROACH: All existing water-quality and hydrologic data will be evaluated. A surface geophysical survey will be conducted using resistivity and electromagnetic methods to locate and delineate any plumes. About 20 additional wells will be drilled to monitor water quality and water levels. In addition, three 4-inch wells will be installed in order to determine aquifer characteristics and rate of ground-water movement. Samples will be collected and analyzed for nutrients, metals, herbicides, pesticides, volatile organic compounds, and priority pollutants; standard complete Flame Ionization Detection (FID), gas chromatography and standard lab analyses will be used.

PROGRESS: Water levels were measured periodically and water-quality samples were collected from all wells and from five surface-water sites, including the effluent-holding pond during February, March, and April 1989. Samples were analyzed for standard chemical constituents, nutieints, methylene-blue-active substance and nitrogen isotopes. Water table, potentiometric surface, and water-quality maps were prepared from these data. Ground-penetrating radar (GPR) was used along the western boundary of the study area to locate possible conduits and further define the karst geology in the vicinity of Wall Spring. Geologic cross sections have been prepared based on GPR records and previously collected drilling data. Additional samples were collected using a stainless-steel drive-point sampler in the vicinity of a well containing an extremely high nitrate concentration. Samples were measured for conductivity in order to delineate a contaminant plume. Report preparation continued throughout the year.

PLANS FOR THIS YEAR: Manuscript preparation will be completed and submitted for approval and publication.

FL-473 HYDROLOGIC IMPACTS OF PHOSPHATE MINING ON SMALL BASINS, CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1987

DATE PROJECT ENDS: March 1992

PRINCIPAL INVESTIGATOR: Billy R. Lewelling, Tampa

COOPERATING AGENCY: Florida Institute of Phosphate Research

PROBLEM: The hydrologic characteristics of small basins in central Florida are poorly defined. Permits for mined-land reclamation require that runoff from reclaimed land not exceed pre-mining conditions and there be no degradation of water quality of the receiving stream. There are no data on the hydrologic characteristics of reclaimed land forms.

OBJECTIVE: (1) Define the hydrology and water quality of undistributed small basins in the phosphate mining area of central Florida; (2) define the hydrology and water-quality characteristics of the four most common reclaimed land forms: a clay settling area, land and lakes (graded overburden) area, in sand-clay mix settling area, and an overburden capped sandtailings fill area; (3) compare results from 1 and 2 above.

APPROACH: Collect hydrologic data from small undisturbed basins and from four nearby basins representing the common reclaimed land forms to define streamflow and aquifer characteristics. Collect ground-water samples during high and low water table conditions to define ground-water quality. Collect streamflow samples during baseflow and during related storm runoff to define water quality of streamflow. Compare and describe statistical differences between unmined and reclaimed basin pairs and among various reclamation types.

PROGRESS: Data-collection installations were completed at the five reclaimed-mined drainage basins and the three nearby unmined basins. Each drainage basin has a monitoring network that includes: a continuous streamflow station, 1 or 2 rainfall gages, 10 to 13 periodic small-diameter surficial aquifer observation wells and 2 large-diameter continuous recording wells to monitor the surficial and intermediate aquifers. Slug tests were conducted and analyzed at three observation wells in each of the basins to determine the hydraulic conductivity of the surficial aquifer using the Bouwer-Rice method. An aquifer test to evaluate the transmissivity and the storage coefficient of the unconfined surficial aquifer was completed at a well selected in a graded-overburden reclamation site. Water-quality samples of the surficial aquifer and base streamflow (if present) were collected in each basin and analyzed for field parameters, metals, and radiochemicals. Additional samples of streamflow, surficial, and intermediate aquifer water were analyzed monthly for field parameters.

PLANS FOR THIS YEAR: Data collection and processing will continue for the network of eight small-drainage basins. Each basin will be scheduled for water-quality sampling of high flow runoff for field parameters, metals, and radiochemicals. Monthly sampling for field parameters of streamflow, surficial and intermediate aquifer wells will continue. Water-table contour maps of each basin will be generated. Streamflow-duration curves will be developed for each basin.

FL-474 EFFECTS OF STRUCTURAL CHANGES ON THE WATER-QUALITY EFFICIENCY OF STORMWATER DETENTION POND

DATE PROJECT BEGAN: January 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: W. Scott Gain, Orlando

COOPERATING AGENCY: Florida Department of Transportation

PROBLEM: The velocity of water entering a detention pond is dramatically decreased immediately inside the pond. If the travel time of the water within the pond is significantly lengthened, then an increased particulate load should settle to the bottom of the detention pond. Existing detention ponds may be modified to lengthen the flow path of water by placing a wall in the middle of the pond. This structural change could increase the water-quality treatment ability of this detention facility.

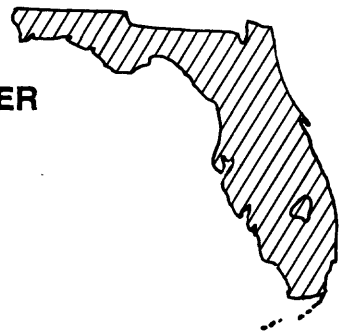
OBJECTIVE: The primary objective of this investigation is to determine the effectiveness of selected structural changes to detention facilities for improving water-quality treatment. Secondary objectives are to: determine and analyze the increased residence time, or detention time, due to the structural changes; and determine if the hydraulic conditions caused by the structural changes can be modeled, either with an existing model or one that is easily modified.

APPROACH: The first task is to perform a hydraulic study of the presently structured pond. Samples will be collected at nine sampling points within the pond. Separate tracer studies will be run at three different steady-state discharges. Analyses of these data will permit the calculation of the pond's hydraulic residence time(s), probably as a function of live storage or discharge.

Once the pond is restructured, about 10 to 15 storms will be gaged and sampled. The last task is to perform a hydraulic analysis of the restructured pond, analogous to the study completed in the first task.

PROGRESS: Dye studies were run at high and medium discharges. Residence times of dye have been analyzed. Paper containing dye-study results was prepared and presented to Engineering Foundation Conference. Structural changes of the pond were started. Trees and brush were cleared, sand-cement bags were placed on pond embankment to increase storage capacity, curtain wall through the center of the pond was installed, and storm sampling has begun.

PLANS FOR NEXT YEAR: Dye studies for post-structural changes will be run. Storm discharge and quality data collection will continue.



FL-475 EVALUATION OF THE DESIGN OF GROUND-WATER QUALITY MONITORING NETWORKS IN FLORIDA

DATE PROJECT BEGAN: March 1987

DATE PROJECT ENDS: March 1990

PRINCIPAL INVESTIGATOR: Brian G. Katz, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: A greatly increased level of interest and funding in national and regional ground-water quality monitoring has occurred in the past few years. For example, a large data base has been developed in Florida to determine the extent of EDB (pesticide) contamination of ground water. Little detailed work has been done in terms of evaluating different network design strategies, applied to an existing data base, for characterizing the areal and vertical distribution of a contaminant in ground water.

OBJECTIVES: (1) To describe the regional distribution of EDB in ground water in Polk and Highlands Counties spatially and in association with various key factors such as hydrogeology and soil characteristics and (2) To evaluate the influence of key factors affecting the occurrence of EDB in ground water at local and regional scales.

APPROACH: The EDB data base will be evaluated using statistical and spatial (GIS) techniques to determine the areal, vertical and temporal distribution of EDB in ground water. Mass balance geochemical modeling and statistical modeling will be used to assess the influence of factors related to the distribution of EDB. Results from local- and regional-scale analyses will be compared to assess implications for designing monitoring networks.

PROGRESS: Ancillary data, including information on well construction, EDB application in citrus areas, soil characteristics, antecedant precipitation and soil/air temperature, and hydrogeology, have been compiled in a computer data base. Maps depicting the areal and vertical distribution of wells sampled for EDB were completed. Grid sampling was used to select subsets of wells from the EDB network in Polk, Highlands, and Jackson Counties to assess the effectiveness of grid-based designs. Statistical and geochemical analyses were initiated for regional-, intermediate-, and local-scale study areas in Polk and Highlands Counties. Trend analyses were performed for selected wells where multiple ground-water samples had been collected.

PLANS FOR THIS YEAR: Complete the mass balance geochemical modeling and statistical analyses in selected study areas and finalize report.

REPORTS IN PROCESS:

Choquette, A.F., Katz, B.G., Pendexter, W.S., Orona, M.A., in press, Delineation of factors related to the occurrence of 1,2-dibromoethane in ground water, central Florida: U.S. Geological Survey National Symposium on Water Quality, Conference Proceedings, November 1989, Orlando, Fla. (abstract)

Katz, B.G., Choquette, A.F., Pendexter, W.S., Orona, M.A., in press, Relations between the occurrence of 1,2-dibromoethane in ground water and selected hydrogeologic, climatic, and land use factors, central Florida: American Water Resources Association, Conference Proceedings, September 1989, Tampa, Fla. (abstract).

REPORTS RELEASED:

Katz, B.G., and Choquette, A.F., 1988, An interim assessment of regional and local factors affecting the occurrence, movement, and fate of 1,2-dibromoethane in the subsurface, central Florida, *in* Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program--Proceedings, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 637. (abstract)

Choquette, A.F., and Katz, B.G., 1989, Grid-based groundwater sampling: lessons from an extensive regional network for 1,2-dibromoethane (EDB) in Florida: Stephen Ragone, ed., International Association of Hydrological Science, Proceedings, IAHS Publication No. 182, p. 79-86.

FL-476 IMPORTANCE OF HYDROLOGIC AND VEGETATIVE FACTORS TO FISH ECOLOGY IN A SEASONALLY INUNDATED FLOOD-PLAIN FOREST

DATE PROJECT BEGAN: July 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Helen M. Leitman, Tallahassee

COOPERATING AGENCY: Florida Game and Fresh Water Fish Commission

PROBLEM: River flood-plain forests are a valuable and productive national resource under considerable development pressure from agricultural interest. Ecological linkages between biotic and abiotic factors operating in river wetlands must be established if this important natural resource is to be properly managed. Habitat characteristics of the flood plain that are important to fish populations will be evaluated in an interdisciplinary study of an alluvial river in north Florida.

OBJECTIVE: Relate hydrologic conditions and vegetative communities to fish diversity and abundance in a seasonally inundated river flood-plain forest.

APPROACH: The 3-year study will require data collection and analyses by an interdisciplinary interagency team comprised of hydrologists, botanists, and fisheries biologists. USGS will quantify hydrologic fluctuations and characterize plant communities, and sample fish in cooperation with fishery biologists from the Florida Game and Fresh Water Fish Commission.

PROGRESS: Data collection is completed. Data analysis and report writing are in progress.

PLANS FOR THIS YEAR: Analyze hydrology, fish, and vegetation data collected over the first 2 years. Prepare water- resources investigations report describing fish populations that use the forested flood plain and how they are affected by changing hydrologic conditions.

FL-477 AN EVALUATION OF VARIOUS PHYSICAL AND BIOLOGICAL INDICATORS USED TO DELINEATE WETLAND BOUNDARIES ON BLACKWATER STREAM SYSTEMS IN FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Helen M. Leitman, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Protection of Florida's wetlands is entrusted primarily to the Florida Department of Environmental Regulation (FDER). River wetlands are of particular importance to the State because inflow of nutrients from freshwater river wetland systems are largely responsible for high productivity in estuaries. The proposed study will provide the data necessary for improved management and regulation of blackwater stream wetlands by evaluating the various indicators used by FDER to delineate wetland boundaries on those systems.

OBJECTIVE: To quantitatively describe the occurrence of wetland plants, hydric soils, and other wetland indicators in flood-plain sites along several north Florida blackwater streams, and relate these indicators to duration of inundation.

APPROACH: The 3-year study will require data collection and analyses by an interdisciplinary interagency team comprised of hydrologists, botanists, and soil scientists. USGS will describe depth and duration of flooding at each site based on a long period of gage record. USGS and DER will work together to describe plant communities, soil types, and other hydrologic indicators at the sites. USGS will relate the various indicators to the long-term hydrologic conditions at each site.

PROGRESS: Data-collection phase is nearing completion. Data analysis is underway.

PLANS FOR THIS YEAR: Complete data analysis and prepare a report describing interrelations among hydrologic conditions, vegetation, and soil types.

FL-478 OCCURRENCE AND SIGNIFICANCE OF SALINE WATER IN THE FLORIDAN AQUIFER, NORTHEAST FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Rick Spechler, Orlando

COOPERATING AGENCIES: City of Jacksonville and the St. Johns River Water Management District

PROBLEM: Increased ground-water withdrawals from the Floridan aquifer have lowered water levels 0.5 to 2.0 feet per year in parts of northeast Florida. Associated with the decline in water levels has been an increased potential for saltwater intrusion into the freshwater zones of the Floridan aquifer along the coast. Gradual but continual increases in salinity of the water from the aquifer have been observed in several areas along the coast in Nassau, Duval, and St. Johns Counties. Further intrusion of saltwater into the aquifer could seriously affect water supplies.

OBJECTIVE: (1) Provide a refined conceptual model of the hydrogeologic framework of the Floridan aquifer system in northeast Florida, and (2) delineate areas where saline water occurs in the various water-bearing zones of the Floridan aquifer system and possibly deeper zones.

APPROACH: Compile all existing geologic, geophysical and chemical data to help determine the lateral and vertical distributions of saltwater in the Floridan aquifer. Collect new data to supplement and update the existing data base which will include: (a) water-quality analysis for major ions, density, specific conductance and temperature, (b) borehole geophysical logging to determine flow zones and water-quality changes with depth, (c) marine seismic reflection surveys, and (d) maps showing the thickness and lateral extent of various hydrogeologic units.

PROGRESS: A marine seismic reflection survey was completed on a 25-mile section of the St. Johns River in Duval County. The purpose of the survey was to locate geologic structures such as solution features or faults that might be present under the river. Water samples from about 120 wells were analyzed for major chemical constituents. Water from 80 additional wells were analyzed for chloride, sulfate, specific conductance, and temperature. Data collected have been processed and stored and some have been analyzed.

PLANS FOR THIS YEAR: Geophysical logging of selected wells will continue. Sampling of wells for major chemical constituents will be completed. Data collected will continue to be processed, stored, analyzed, and interpreted. Manuscript preparation will continue.

FL-479 IMPACTS OF A MIGRATING CITRUS INDUSTRY ON THE WATER RESOURCES OF HARDEE AND DE SOTO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPLE INVESTIGATOR: James L. Kiesler, Jr., Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Citrus growers began to migrate southward after freezes in northern and central Florida devastated the citrus industry during the early 1980's. As growers moved south the need for water to irrigate citrus increased. Irrigated citrus acreage in Hardee and De Soto Counties, Florida, increased from 59,000 acres in 1980 to 82,000 in 1986. How has the hydrology of Hardee and DeSoto Counties, and southwest Florida, been affected by the increased irrigation? As additional growers move into this area what effect will the irrigation of their groves have on the hydrology? What are the long-term effects of citrus irrigation on the hydrology of this area?

OBJECTIVES: (1) Evaluate the present and long-term effects of the current citrus industry on the hydrology of Hardee and De Soto Counties. (2) Develop a technique using GIS and mathematical models that will allow resource managers to evaluate the probable hydrologic effects of future citrus expansion.

APPROACH: Existing continuous and periodic water-level data from the two-county area will be examined. The nonparametric Seasonal Kendall test will be used to test for monotonic trends in ground-water levels. Tests will be made for the period of record, period prior to 1981, and period after 1981. The nonparametric Mann-Whitney-Wilcoxon test will be used to test for step trends in water levels for the pre- and post-1981 periods. Monthly precipitation totals for Arcadia, Fla., will be tested for precipitation trends that may mask trends in ground-water levels.

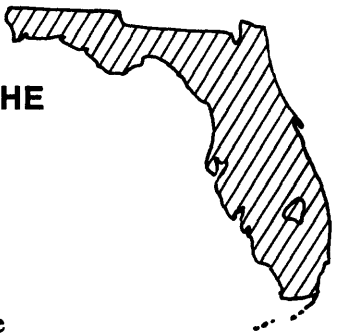
Model simulations, using the McDonald-Harbaugh Finite-Difference model will be used to determine the effects of increased irrigation on the ground-water resources. The model will be calibrated and verified under steady-state and transient conditions. The ground-water model will be developed to simulate historical and current water-level conditions. Future changes in water levels will be simulated using projected trends in pumpage data. The data required to run the model will be loaded into a GIS data base. The GIS will then be used to create the model input and to display the model output. Existing RASA models will be used as the starting point for model calibration.

PROGRESS: Construction of the GIS and hydrologic data bases continued. Emphasis was placed on loading data for the hydrologic analysis and model. A project base map showing the political boundaries and selected municipal areas was created. Elevations of the tops and bottoms of the Floridan and Intermediate aquifers, the hydrologic characteristics of these aquifers, consumptive use data from SWFWMD, and selected potentiometric surface maps were loaded into the GIS. Coverages of soil and land use will be loaded during the upcoming year.

Computer software linking the ground-water model to the GIS was completed. Software to construct a model grid as part of the GIS, to populate the model grid, to construct model input data sets, and to read model output data sets back into the GIS were developed, tested, and implemented. The steady-state model was calibrated and verified and calibration of the transient ground-water model began. An outline and first draft of the introduction for the modeling report were completed.

Statistical analyses of existing ground-water and precipitation data were completed. Analyses of these data indicate that a decreasing trend exists in ground-water levels and that this trend was interrupted between 1975 and 1980 by an increasing trend. An annotated outline and first draft of the report on this statistical analysis was completed.

PLANS FOR THIS YEAR: The third and final year of the project will be spent completing model calibration and verification, data analysis, report writing, and completion of the GIS data base. Calibration and verification of the transient ground-water model will be completed. Simulation runs to show changes in water levels will be generated and analyzed. Reports describing the ground-water models, the analysis of the simulated data, and analysis of existing data will be completed. The GIS data base will be completed.



FL-480 CHARACTERIZATION OF WATER QUALITY FOR THE MAJOR AQUIFER SYSTEMS IN FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATORS: Brian G. Katz and Anne Choquette, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Assessment of water-quality degradation due to human effects required information on background (baseline) water-quality characteristics. A statewide sampling network has been established to determine background water-quality conditions of principal aquifers in Florida. The data from the network need to be evaluated to determine if the sampling network is adequate for meeting program objectives and to outline long-term sampling needs.

OBJECTIVE: (1) To delineate hydrochemical zones that define areas of similar background water quality in Florida's aquifers on the basis of data from the statewide sampling network and other sources. (2) To evaluate the design of the statewide sampling network for long-term monitoring of background water quality of principal aquifers in Florida.

APPROACH: Geochemical and statistical methods will be used to characterize background water quality based on data from the sampling network. Zones of similar background hydrochemistry will be delineated based on spatial differences in the distribution and relative abundance of major ions and selected trace constituents. The sampling network design will be evaluated using geostatistical techniques and existing information on geochemical and hydraulic properties of principal aquifers.

PROGRESS: The statewide background water-quality data base has been updated and the data have been verified by the Florida Department of Environmental Regulation and the water management districts for the major aquifer systems. Additional screening of analytical data for chemical logic and internal consistency was performed for four of the five major aquifer systems. Geochemical and statistical analyses have been performed on water-quality data from the sand-and-gravel aquifer. The results have been presented at two scientific meetings and in a report to be published as a journal article.

PLANS FOR THIS YEAR: Delineate hydrochemical facies for each major aquifer system. Statistically summarize selected water-quality data for each aquifer system spatially and vertically. Relate the background water quality to hydrogeologic factors where possible (such as distance along ground-water flow paths, aquifer mineralogy, recharge-discharge areas). Evaluate the design of the monitoring network for each aquifer system. Summarize these findings in a final report.

REPORTS IN PROCESS:

Katz, B.G., Geochemical characterization of the sand-and-gravel aquifer in northwest Florida.

FL-481 THE RELATIVE IMPORTANCE OF GROUND WATER TO THE CHEMICAL BUDGET OF SEEPAGE LAKES

DATE PROJECT BEGAN: June 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Terrie M. Lee, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: In order to predict long-term trends in lake pH there is a need to understand the relative quantitative importance of individual hydrologic and chemical factors regulating acid neutralizing capacity (ANC) in lakes. This is particularly true of Florida's numerous acidic seepage lakes which have hydrologic budgets dominated by precipitation. Even small amounts of ground-water inflow, and certain in-lake processes, contribute ANC to lakes and may play important roles in the chemical budget of acidic, seepage lakes.

OBJECTIVES: The objectives of this study are: (1) to understand the factors that regulate ANC in seepage lakes, particularly the relative importance of ground-water contributions of ANC to seepage lakes; (2) to improve our conceptual and physical models of the hydrologic and chemical processes affecting the chemistry of seepage lakes; and (3) to use these models to predict the vulnerability of seepage lakes to changes in acidic deposition or alterations in ground-water flow.

APPROACH: The approach of the study is to compare and contrast the hydrologic and chemical budgets of two seepage lakes with different acid-neutralizing capacities; acidic Lake Barco in Putnam County and circumneutral Lake Lucerne in Polk County, Florida. The hydrologic budget of each lake will include evaporation losses quantified by the energy budget evaporation method, and ground-water inflows and outflows calculated by flow-net analysis and numerical modeling studies. The evaluation of the geologic setting of each lake will be a central part of the investigation of lake/ground-water interactions. Lake chemical budgets will be derived from lake, precipitation, and ground-water chemical data, and an evaluation of in-lake solute fluxes at the sediment-water interface. An input-output chemical model will be used to simulate trends in lake ANC.

PROGRESS: Lake Barco and its surrounding basin have been instrumented to collect hydrologic and chemical data. The hydrologic monitoring network includes 38 monitoring wells within the Lake Barco basin and 6 wells jetted into the lake bottom, a recording gage at Lake Barco, and staff gages at 3 adjacent lakes. At Lake Lucerne, lake stage, precipitation volume, and water levels in the wells are being routinely monitored. Land and raft climate stations were installed at Lake Barco, and evaporation data are being collected on a continuous basis. A bathymetric map of Lake Barco has been completed, and a marine seismic reflection survey is currently being interpreted. The local geologic setting of Lake Barco has been defined and summarized. Lake and ground-water sampling has started on a 6-week interval at Lakes Barco and Lake Lucerne; a total of six sampling trips have been conducted to date. Wet and dry deposition are being collected weekly at Lake Barco, and peepers have been installed in the lake sediment to collect pore-water chemistry. Lake and precipitation chemistry collected at Lucerne between 1984 and 1988 has been reviewed and summarized.

PLANS FOR THIS YEAR: Plans for FY 90 include continued monitoring of hydrologic and chemical variables at Lake Barco and Lake Lucerne. This will consist of measuring climatic variables, lake stage, and ground-water head distribution in the two lake basins. Ground water and lake chemistry will be monitored at the two lakes, and collection of precipitation chemistry at Lake Barco will continue. Pore-water chemistry will be sampled on a quarterly basis at the two lakes using peepers. Evaluation and preliminary interpretation of hydrologic and chemical data will be made. Ground-water modeling simulations of the Lake Barco basin will begin. Other plans are the collection of sediment cores from Lake Barco and the mineralogical analysis of well cuttings.

FL-482 FINE SEDIMENT RESUSPENSION PROCESSES AND LIGHT ATTENUATION IN SHALLOW ESTUARINE ENVIRONMENTS

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: David H. Schoellhamer, Tampa

COOPERATING AGENCIES: City of St. Petersburg, Hillsborough County Environmental Protection Commission, Pinellas County, Southwest Florida Water Management District, Tampa Port Authority

PROBLEM: Fine sediment plays an important role in the overall health of shallow estuaries, such as Tampa Bay, in at least two ways. Elevated concentrations of fine sediment in the water column reduce the depths to which sunlight can support photosynthesis. This could be at least partly why Tampa Bay has lost over 80 percent of its seagrass beds over the last 100 years. Fine sediment also adsorbs a wide range of toxic organic and inorganic chemicals whose distribution and availability to various biological communities are then primarily governed by fine sediment transport processes. These processes, particularly the mechanisms of resuspension from the bay bottom, are poorly understood and can presently contribute little toward proper management of Tampa Bay.

OBJECTIVE: The objectives of the project are to both determine the mechanisms that cause resuspension of fine sediments from the bottom of Tampa Bay and to determine the effect of these resuspended materials on light attenuation.

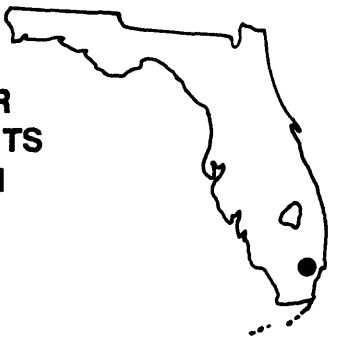
APPROACH: To accomplish the first of these objectives, one site in Hillsborough Bay and one site in Old Tampa Bay will be established to continuously measure the vertical structure of both velocity and suspended sediment. The sites will be chosen to be representative of fine sediment deposits known to exist in Hillsborough Bay and to be determined in Old Tampa Bay. Data from instruments at these sites will be analyzed to detect resuspension events and relate them to velocity variations and bottom shear stress caused by tidal currents, storms, ship wakes, and other disturbances.

To relate the resuspension information to light attenuation and to detect possible interferences from nonresuspension processes (such as phytoplankton blooms, river discharges, and stormwater runoff), a wide range of supplemental weekly and monthly data will be collected at the two primary sites as well as nearby companion sites having sandy bottoms. Constituents and properties to be monitored will include suspended solids, suspended organic carbon, color, chlorophyll, light intensity, specific conductance, temperature, and turbidity. Horizontal gradients of suspended solids in the vicinity of the primary sites will be measured by towing of optically sensitive meters. The ability of benthic organisms to inhibit resuspension by effectively armoring the bay bottom will be documented by periodic bottom samples.

Instrumentation at the two primary sites will include five electro-magnetic velocity meters, five optical backscatterance meters, an electronic data logger, and equipment to transmit data directly to the U.S. Geological Survey computer. This will all be mounted on pile-supported platforms for necessary stability and servicing requirements and operated for one year at each site. Prior to deployment in the bay, the instruments and data transmission equipment will be tested at a site in Bayboro Harbor at St. Petersburg.

PROGRESS: During FY 89, the instrumentation on the scientific instrument platform in Old Tampa Bay was operated until December 1988. Data from the platform and from concurrent weekly light and water-quality sampling trips provided information on the hydrodynamics, suspended sediment, and light environment. The platform and sampling procedures were modified to improve the data collection and the instruments were redeployed in September 1989. An additional instrument package for deployment at the shallow, sandy bottom site in Old Tampa Bay was completed and tested. Monthly light and water-quality sampling trips were continued in Hillsborough Bay and in Old Tampa Bay when the instruments were not operating.

PLANS FOR THIS YEAR: Data from the Old Tampa Bay platform will continue to be collected and analyzed and data from the shallow water site will be collected and analyzed. A platform in Hillsborough Bay will be constructed and the instruments will be redeployed during the summer of 1990. Light measurements and water-quality sampling will continue. Reports on bottom sediment distribution and on sedimentation in the port of St. Petersburg will be prepared.



FL-483 APPLICATION OF ACOUSTICAL-VELOCITY METER (AVM) SYSTEMS TO DISCHARGE MEASUREMENTS IN LOW-VELOCITY FLOW CONDITIONS OF SOUTH FLORIDA CANALS

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Eduardo Patino, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Velocities of 0.2 foot per second or less are common in south Florida canals, and conventional discharge-measuring techniques are not accurate for such low velocities. There is a need to develop a velocity-measuring device and companion field techniques that would allow for more reliable discharge measurements in these canals.

OBJECTIVES: (1) Acquire an off-the-shelf AVM that has been adapted to read only velocity, uses battery power, and is portable; (2) develop field techniques for using a portable AVM to make instantaneous measurements of discharge; and (3) test the AVM device and field techniques at an existing surface-water gaging station where low-velocity conditions exist.

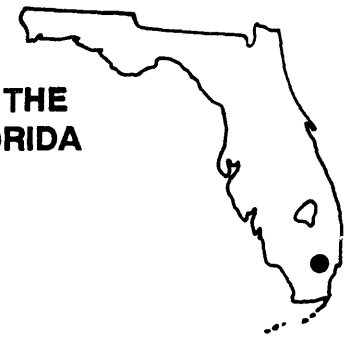
APPROACH: The gaging station used will be 02289500 Tamiami Canal near Coral Gables, which has been rated in the range of 35 to 200 cubic feet per second by the a stationary AVM calibrated using the Price AA current meter. A new unit being tested can be modified to accept battery power and read only velocity. The specifications will be drawn up and a solicitation for bids prepared. It is anticipated that a cross-patch adaption will be necessary at the selected site and a transducer frequency of 200 kilohertz used. Four posts will be erected in the channel at the prescribed spacing and fitted with vertically adjustable brackets that will hold the transducers.

PROGRESS: Continued to collect measurements during the first half of the year and began planned water-resources investigations report, documenting the results of the field activities.

PLANS FOR THIS YEAR: Prepare report for publication.

REPORTS PUBLISHED:

Laenen, Antonius, and Curtis, R.E., 1989, Evaluating the capability of acoustic velocity meters for making discharge measurements in low velocity canals: U.S. Geological Survey Water-Resources Investigations Report 89-4090, 15 p.



FL-484 STUDY OF CANAL-AQUIFER RELATIONSHIPS IN THE SURFICIAL AQUIFER SYSTEM, SOUTHEAST FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: David Chin, Miami

COOPERATING AGENCIES: South Florida Water Management District and
Metro-Dade Environmental Resources Management

PROBLEM: The surface of the surficial aquifer system has been cut by an extensive canal network. Because of the high hydraulic conductivity in the upper part of the system (Biscayne and surficial aquifers), there is an exchange of water between the canal and the aquifers. Water managers have long recognized the fact that canals recharge the aquifers. Studies have been conducted to evaluate the infiltration from the Miami Canal into the Biscayne aquifer in the vicinity of the Miami Springs-Hialeah well field. Attempts to determine the hydraulic relations between the canal and the aquifer in other areas have not been as successful.

OBJECTIVES: (1) Develop methods for quantifying water exchange between canal and aquifer; and (2) determine effect of the canal on the ground-water flow system.

APPROACH: The approach is to calculate losses from a canal using an AVM and to calculate the effect of bottom material on leakage to the aquifer. Also, using the MODFLO or a finite-element model, the ground-water flow adjacent to the canal will be defined.

PROGRESS: Continued data collection using the AVM, collected water-level data, and continued to develop the canal-aquifer model.

PLANS FOR THIS YEAR: Prepare report for publication.

FL-485 SALINE GROUND-WATER RESOURCES IN THE UPPERMOST PART OF THE FLORIDAN AQUIFER SYSTEM, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1988

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: T.H. Thompson, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Ground water in Pinellas County has chloride and total dissolved solids concentrations that exceed drinking water standards. Water must be imported from other counties. Two agencies are considering use of reverse osmosis to replace part or all of the imported water. The uppermost part of the Floridan aquifer system, with TDS less than 10,000 mg/L, needs to be more precisely defined in order to evaluate the saline ground-water resources. A solute-transport model is needed to estimate changes in salinity that may occur at these sites under various rates of pumping.

OBJECTIVES: Describe and map the hydrogeologic units above and in the uppermost part of the Floridan aquifer system in and adjacent to Pinellas County. Describe and map the regional distribution of the saline water and freshwater. Identify sites that may be suitable for development of the saline-water resources. Select and develop a solute-transport model for two or three of the most suitable sites for well-field development and siting of water-treatment plants. Using the model, estimate long-term changes in the salinity at the well-field sites under various pumping scenarios.

APPROACH: Prepare planning document, conduct literature and file search on the hydrogeologic character and water quality of the study area. Prepare maps and sections showing the top and thickness of the hydrogeologic units, the potentiometric surface, and salinity distribution. Tables will be prepared showing values of transmissivity, storage coefficients, and leakance or hydraulic conductivity. The HST3D solute-transport model with R-Z radial discretization will be used to simulate upconing of saltwater and changes in salinity of the pumped water with time at two or three sites. Model sensitivity analysis will be used to guide additional data collection.

PROGRESS: Maps were completed showing top and thickness of the hydrogeologic units, areas of potential for downward leakance, and salinity distribution. Tables were completed listing the plausible range of hydraulic parameter values for model input. Simulation modeling was completed. Scenarios included using various pumping rates, well penetrations, and time-dependent pumping/recovery schemes. Figures were prepared to exhibit sensitivity analysis results. The first draft of the report was completed.

PLANS FOR THIS YEAR: Revise report in response to review comments. Complete review and submit for approval by Director, and prepare report for publication.

REPORTS IN PROCESS:

Knochenmus, L.A., and Thompson, T.H., Saline ground-water resources in the uppermost part of the Floridan aquifer system, Pinellas County, Florida: Water-Resources Investigations Report, in review.

FL-486 HYDROGEOLOGY AND EFFECTS OF SELECTED DRAINAGE WELLS AND IMPROVED SINKHOLES ON WATER QUALITY IN THE UPPER FLORIDAN AQUIFER, SILVER SPRINGS BASIN, MARION COUNTY, FLORIDA

DATE PROJECT BEGAN: July 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: G.G. Phelps, Orlando

COOPERATING AGENCIES: City of Ocala, Marion County, and St. Johns River Water Management District

PROBLEM: Because of the highly karstic character of the hydrogeologic system, the potential exists for significant contamination of the Upper Floridan aquifer in the Silver Springs basin either from direct emplacement of surface waters into the aquifer, or from an accidental spill. Because the aquifer is the principal source of water supply in the basin, a need exists for documentation of any major potential sources of contamination, and a better understanding of the geohydrologic system.

OBJECTIVES: (1) Develop a better understanding of the geohydrology of the Silver Springs basin; (2) Document locations of concentrated points of recharge entering the Upper Floridan aquifer and major potential sources of contamination; (3) Evaluate the potential movement and effects of contaminants introduced into the aquifer at a few selected sites.

APPROACH: Inventory existing wells, sinkholes and other points of recharge and potential contamination. Update and analyze existing geologic and hydrologic data. Select several sites for detailed study. At those sites, collect samples of recharge water and water from existing wells; run geophysical logs of selected wells; and perform dye-trace studies to determine local flow systems. Analyze existing tritium data to help determine flow paths. If contaminated sites are found, drill monitor wells to supplement existing wells. Run geophysical logs and collect water samples from new monitor wells.

PROGRESS: Inventory of existing drainage wells and other potential sources of contamination complete. Sampling of recharge water begun. Background sampling of wells begun. Surface geophysics begun at selected sites. Inventory of existing cave systems begun.

PLANS FOR THIS YEAR: Complete surface geophysics. Drill test wells to supplement existing data-collection sites and supplement surface-geophysics data. Run geophysical logs of test wells. Begin work on a simple particle-tracking model to evaluate the effectiveness of a proposed protection zone around the Ocala municipal well field.

FL-487 WATER BUDGET OF A SOFTWATER SEEPAGE LAKE IN THE FLORIDA PANHANDLE

DATE PROJECT BEGAN: June 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATORS: Anne F. Choquette and Walter R. Aucott, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Acidification of lakes over much of eastern Canada and the northeastern United States has become a serious problem in recent years. Although it has not been demonstrated that Florida lakes have shown a clear trend towards acidity, some of Florida's lakes are acidic. Many lakes may be naturally acidic but an assessment of the contribution of acidic precipitation to lake acidification has not been made. Softwater seepage lakes having low conductance and low alkalinity may be the most susceptible to further acidification from acid deposition and it is important to establish the relative quantitative importance of hydrologic and chemical parameters on the acid neutralization capacity (ANC) of softwater seepage lakes. An accurate hydrologic budget is essential in assessing the effects of acid precipitation on the ANC of a given lake because ground water may have a significant effect on the degree of ANC.

OBJECTIVES: The primary objectives of this study are to establish a complete hydrologic budget for lake Five-0 and to collect samples of precipitation, ground water, and lake water for chemical analysis.

APPROACH: The approach to the establishment of the hydrologic budget is to make accurate and independent calculations of each component of the hydrologic budget including ground water, evaporation, and precipitation. A network of monitoring wells and piezometer nests distributed vertically within the ground-water flow system will be used to establish detailed water-level maps and determine horizontal and vertical hydraulic head gradients. Piezometers will be placed in the lake bed. Using these data, ground-water inflows and outflows will be determined by flow-net analysis and numerical modeling studies. Evaporation losses will be determined by the energy budget method. This requires detailed measurements of various parameters such as wind speed and direction, relative humidity, air and water temperature, and incoming solar radiation. Lake volume will be monitored throughout the study using lake bathymetry data and lake stage. Precipitation in the lake basin will be measured directly using two different types of rain gages.

PROGRESS: Fifty-three monitoring wells were installed and developed. Geologic logs were made and formation samples and cores were collected. Geophysical logs were made at the deepest boring. The wells were leveled in and monthly synoptic water-level measurements have been made since October. Land and raft climate stations were established and data collection is continuing. Bathymetric and marine seismic surveys were completed. Lake thermal surveys and lake and ground-water quality sampling have continued on a routine basis. Slug tests were performed where possible.

PLANS FOR THIS YEAR: Routine data collection will continue for ground-water and lake levels, water quality, land and raft climate stations, and thermal surveys. An interim map report will be submitted for review. Work will begin on the evaporation analysis and ground-water flow model.

FL-488 FRESHWATER INFLOW TO INDIAN RIVER LAGOON, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Larry D. Fayard, Orlando

COOPERATING AGENCY: St. Johns River Water Management District

PROBLEM: Estuarine-dependent fish are adversely affected by the lower salinities that are caused by excessive freshwater inflows to the Indian River Lagoon. Data are needed to quantify the natural inflows so that controlled flows can be more effectively managed.

OBJECTIVE: Define the runoff of freshwater from natural basins by: (1) operating gaging stations, or simulating discharges using a computer model; and (2) using inference techniques.

APPROACH: Traditional gaging will be used on some of the sites. Flow in tide affected areas will be defined using the 1-D BRANCH model. Discharge on some of the smaller streams will be defined by using regionalization, rainfall-runoff, or other inference techniques.

PROGRESS: Established five gaging stations, seven rainfall stations, and one crest-stage station. Areal reconnaissance of entire study area was performed in July.

PLANS FOR THIS YEAR: Establish three more rainfall stations and one or two more gaging stations. Install ultrasonic velocity meters on one or two stations. Acquire and process land-use data for use in rainfall-runoff models. Apply storm events to models as they occur. Measure discharge at all model sites during two full tide cycles. Redefine cross section if needed.

FL-489 WATER QUALITY IN THE WINTER PARK CHAIN OF LAKES, AND IMPACT OF DEVELOPMENT, CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: E.R. German, Orlando

COOPERATING AGENCIES: City of Winter Park and the St. Johns Water Management District

PROBLEM: Although data are sparse, there are indications that the lakes are eutrophic and are receiving phosphorus loading in excess amounts. Lake water clarity may be decreasing and inflow of vegetative and other debris with stormwater runoff may be contributing to excessive sediment buildup in the lakes. Because of the lack of knowledge of the relative inputs from the various nutrient sources, a practical water-quality management strategy is not possible.

OBJECTIVE: Establish a systematic program of data collection to determine rainfall quantity, lake level and water quality, and surface inflow quality and quantity. Investigate composition of lake sediments and rate of sediment buildup. Estimate loads of nutrients and bacteria to the lakes from atmospheric deposition, storm runoff, and ground-water seepage. Determine contribution of coarse, fine, very fine, and dissolved material in the total stormwater loading to the lakes, for nutrients and oxygen demand.

APPROACH: Install and operate discharge stations on the three major surface-inflow canals, and the outflow canal. Install and operate lake-level recorder and rain gage. Begin a bimonthly schedule of sampling for nutrients, major ions, chlorophyll, and field determinations at nine locations. Sample bottom sediments to determine if chemical composition may indicate source of materials: stormwater or decaying in-lake vegetation. Conduct bathymetric surveys with sound reflection and ground-penetrating radar to determine sediment thickness and rate of buildup. Determine major source of nutrient inflow by sampling stormwater inflow, surface inflow from upstream lakes, and ground water. Select two stormwater inflow sites for collection of composite samples of runoff. Determine loading of oxygen demand and nutrient inflow due to coarse, fine, very fine, and dissolved materials in the runoff.

PROGRESS: Three gaging stations to record inflow to the lakes were installed. Two stormwater-sampling stations and a recording rain gage were installed. Operation of the rain gage was begun. A procedure for separating stormwater samples into aliquots containing selected particulate sizes was developed and sent to colleagues for review and comment.

PLANS FOR THIS YEAR: Begin operation of the three inflow-gaging stations, and sample five storms each at the two stormwater-sampling stations and at the inflow-gaging stations and the outflow station. Sample the lakes bimonthly. Conduct bathymetric survey of the lakes using sound reflection and ground-penetrating radar.

FL-490 GROUND-WATER RESOURCES OF OKEECHOBEE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Anne Bradner, Orlando

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: A countywide ground-water resource study of Okeechobee County has never been done. Data needed to assess and interpret the occurrence and quality of water in the surficial, intermediate, and Floridan aquifer systems in Okeechobee County are lacking. In some areas, ground water is too highly mineralized even for irrigation use. A description of the county's ground-water resources is needed for orderly planning, management, and the best use of the resource. Evaluation of water use and water supply potential is particularly needed for additional municipal supply and for expanding irrigation use.

OBJECTIVES: The primary objective of the investigation is to supply the framework of water-resources data needed to conserve and manage the ground-water resources of Okeechobee County. Elements involved in the primary objective are: (1) an evaluation of ground-water use, water-level trends, and availability of water from the major aquifers; (2) a description of selected water-quality characteristics of the major aquifers, such as chloride and iron concentrations, and their individual and collective response to changes in water levels and to pumping; (3) reconnaissance appraisal of priority-type pollutants in the surficial aquifer system; (4) delineation of areas where nonpotable saline ground water is or may become a problem; and (5) a description of the water-bearing characteristics of the geologic formations.

APPROACH: Collect and analyze historical water-resources information from published and unpublished reports and from records of the South Florida Water Management District, and the St. Johns River Water Management District, municipalities and their consulting firms, and from local well drillers. Inventory existing wells by interviewing well owners to obtain information on water levels, well yields, and water quality. Sample for major constituents (including chloride and nitrate) and priority pollutants at selected sites to assess water quality of the major aquifers. Use surface and subsurface geophysics to aid in evaluation of geology and water quality. Drill 5 to 12 test-observation wells to collect information on water levels, lithology, and water quality. Make specific capacity and longer-term aquifer tests on selected wells as necessary to determine hydraulic characteristics of aquifers. Establish a hydrologic network and install instruments where necessary to collect continuous and periodic data. Collect and compile data on amounts and sources of water used by municipalities and other public suppliers, industry, agriculture, and private owners.

PROGRESS: Existing data were collated. Base map was compiled. Wells in selected areas were inventoried.

PLANS FOR THIS YEAR: Complete inventory of wells. Complete most water-quality sampling. Continue geophysical studies. Drill at least five test-observation wells. Make aquifer tests. Install monitoring equipment.

FL-491 ASSESSMENT OF SALTWATER INTRUSION IN COASTAL BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Michael Merritt, Miami

COOPERATING AGENCIES: Broward County and the South Florida Water Management District

PROBLEM: Water management needs simulation modeling techniques to reduce the cost of data collection in assessing the degree of saltwater intrusion and to permit assessments of scenarios for amelioration.

OBJECTIVES: The objectives of the study are to collect more data describing the degree of saltwater intrusion and to develop, evaluate, and apply digital simulation methodology for representing the saltwater intrusion process and for predicting future changes under hypothetical scenarios.

APPROACH: Approximately 10 additional pairs of sampling wells will be added to the current observation network. These wells are intended to locate the position of saltwater intrusion where it is not presently known. In addition, geologic test wells and hydraulic test wells will be installed which will provide data to be used for hydrologic models. Simulation will provide data to be used for hydrologic models. Simulation efforts using a cross-sectional model will be conducted at a selected well field located near the saltwater interface. When the vertical layering is adequately simplified, the model will be extended into three dimensions which will include additional well fields, canals, and other local features for more realistic and precise simulations.

PROGRESS: The main effort this past year was to advertise and award a drilling contract for the test wells and monitoring network. Also, data collection, especially water-quality and hydraulic characteristics data, was a major task during this period.

PLANS FOR THIS YEAR: Chloride observation wells in southeast Broward County will be drilled. Sensitivity analyses will be made with a cross-sectional solute transport model to determine significant aspects of the intrusion process. A draft of these findings will be prepared. An areal flow model will be adapted from a regional flow model produced as part of a concurrent project.

FL-492 DEVELOPMENT OF AN ARTIFICIAL INTELLIGENCE ROUTINE IN BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Roy Sonenshein, Miami

COOPERATING AGENCIES: Broward County and the South Florida Water Management District

PROBLEM: The Florida Department of Environmental Regulation requires each of the five water-management districts within the State to design and implement a monitoring network that will be utilized to determine the effects of land use on ground-water quality. However, a cost-effective method to design a monitoring network that describes land-use effects has not been technically defined.

OBJECTIVES: (1) Develop a routine within the framework of an existing artificial intelligence (AI) software package that will analyze hydrogeologic and anthropogenic information, and (2) develop the computer program for interfacing ground-water flow model results and Geographic Information System (GIS) information with AI.

APPROACH: The first phase of the development of the AI software will be accomplished using the commercial AI program "Insight." It will house the decision tree elements, and a search aspect will be developed using a FORTRAN routine that would interface initially with GIS programs. The second phase will be using an operational AI that interfaces with a number of data bases from ground-water model output.

PROGRESS: The data format for AI using the output from the current Geographic Information System (GIS) Project was developed. Also developed were the types of scenarios that would be answered by AI, such as direction of contaminant movement and the location of potential areas (polygons) or supply wells with minimum contaminant risk. Software for searching the polygons and using the decision trees was developed.

PLANS FOR THIS YEAR: A particle tracking program (OFR 89-381) will be interfaced with the GIS system. Additional software will be developed to interface the NWIS with the GIS. Work will continue on developing the data files necessary to test the software programs being developed.

FL-493 HYDROGEOLOGY AND THE EFFECTS OF DEGRADATION OF THE AIRPORT LANDFILL MATERIALS ON GEOCHEMISTRY OF GROUND WATER SOUTHWEST OF TALLAHASSEE, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Marian P. Berndt, Tallahassee

COOPERATING AGENCY: City of Tallahassee, Department of Public Works

PROBLEM: Ground-water samples from wells located around the perimeter of a landfill, in operation from approximately 1959-76, show local contamination of ground water. Sulfate, tetrachloroethene, nitrate sodium and manganese concentrations have been detected in concentrations above their maximum contaminant levels (MCLs) in ground-water samples. The seven wells at the site are not adequate to provide the information necessary to characterize the hydrogeology, determine the direction of ground-water flow and determine the processes of degradation of the landfill materials.

OBJECTIVE: (1) Characterize the geology and hydrogeology of the site; (2) determine the areal and vertical extent of contamination; and (3) determine the processes of degradation of landfill materials.

APPROACH: Electromagnetic terrain conductivity measurements will be used as a reconnaissance tool to determine the approximate extent of contamination. Public and private wells in the area will be sampled and additional wells will be drilled so the hydrogeology of the site can be described, water levels measured and water samples can be collected to determine the extent of contamination. Both the oxidized and reduced species of compounds containing organic carbon, oxygen, sulfur and nitrogen will be analyzed to determine the types of reactions and processes controlling degradation of landfill materials.

PROGRESS: Electromagnetic terrain conductivity was done and indicated several possible areas of contamination. Thirteen additional wells were installed. Potentiometric surface shows flow is toward the southwest and west. Quarterly sampling of new wells shows little additional contamination. Slug tests were done on several of the newly installed wells to determine hydraulic conductivity of the surficial aquifer and the Upper Floridan aquifer.

PLANS FOR THIS YEAR: Prepare an interim report describing the preliminary findings. Continue with quarterly sampling of all the wells at the site. Evaluate the analytical data from FY 88 and determine if additional wells need to be installed at greater depths or at greater distances from the landfill.

FL-494 ASSESSMENT OF CANAL-AQUIFER INTERACTION IN THE SURFICIAL AQUIFER SYSTEM USING A COUPLED SURFACE-WATER AND GROUND-WATER FLOW MODEL, BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: E.J. Wexler, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Simulation techniques for surface-water/ground-water flow modeling need improvement to better analyze canal-aquifer interaction on a regional scale. Several ground-water flow models have been developed by the U.S. Geological Survey and others which incorporate surface-water routing models. These models are generally developed for two-dimensional ground-water flow and would be inadequate for simulating flow in the multilayer or multiple aquifer systems of south Florida.

OBJECTIVES: The objective of this study is to develop a hybrid ground-water surface-water flow model by modifying the U.S. Geological Survey modular three-dimensional finite-difference ground-water flow (MODFLO) model to incorporate the flow routing techniques of the U.S. Geological Survey surface-water flow (BRANCH) model to better simulate canal-aquifer interaction. After testing and verification, the model will be used to simulate regional ground-water flow and canal flow in Broward County, Florida.

APPROACH: The MODFLO ground-water flow model will be modified to include the BRANCH model as a replacement for the RIVER module. An iteractive procedure will be designed within the main program to solve the resulting nonlinear system of equations. The modified model will be extensively tested to verify that no coding or computational errors have been introduced. Documentation of changes made to the two computer codes will be provided to the South Florida Water Management District along with a user's guide describing additional input data requirements for the modified MODFLO model. Once the modified MODFLO model has been tested and verified as computationally correct, data collected in this investigation will be used to simulate coupled ground-water and surface-water flow in the area. The results of these simulations will be compared to those obtained using the original MODFLO model to demonstrate the improvement in simulation capabilities and the model's effectiveness as a management tool.

PROGRESS: During the first year, available hydrogeologic data was compiled and interpreted to develop a preliminary model of Broward County. Published interpretive reports describing the geology, hydrologic characteristics, and water-quality data were used in designing the framework of the model.

PLANS FOR THIS YEAR: Aquifer testing at new well sites is being planned. Data on aquifer geometry and properties will continue to be updated and field verified. Data on canals will be assembled to aid in selecting a canal system to be analyzed with the USGS BRANCH model.

FL-495 WATER MOTION AND RETENTION TIMES IN KINGS BAY, FLORIDA

DATE PROJECT BEGAN: January 1989

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: G. Larry Sanders, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Kings Bay is presently producing large standing crops of nuisance algae, hydrilla and lyngbya that are having a negative effect on the use of the resource by fish, wildlife, and the many residents and visitors to the area. The water-resource management problem in Kings Bay, as in most water bodies with similar conditions, is the identification of the primary causes and contributors to the algal blooms. The specific aspect of the management problem addressed in this proposal is the lack of information on the movement, mixing, and retention time of water and an evaluation of how these physical elements may influence the distribution of nutrients in Kings Bay.

OBJECTIVES: The purpose of this study is to determine the dynamics of water motion in Kings Bay (including velocity, mixing, and retention time) and to evaluate the effect of such water motion on the distribution of nutrients and salinity. The study will include development of a two-dimensional, hydrodynamic simulation model and collection of tidal stage, tidal velocity, tidal discharge, and bathymetry data.

APPROACH: The first year of the study will include compilation of existing data and collection of new data for development of a preliminary two-dimensional hydrodynamic model of Kings Bay. This will include boundary condition information for bathymetry, tidal stage, and the quantity and distribution of spring discharge within the study area. Results from initial data collection and preliminary model results will be used to help plan data-collection efforts during the second year. The second year will include continued collection of tidal-stage data and intensive tidal-cycle velocity measurements at the bay mouth and throughout the bay. These data will be collected in conjunction with tidal-cycle, water-quality sampling by the cooperating agency. This concurrent stage, discharge, velocity, and water-quality information will be used to calibrate and verify the model. The model will then be applied to determine water motion and constituent retention times in Kings Bay.

PROGRESS: In the first nine months of 1989, significant progress has been made in establishing data-collection sites and locating existing information. Two stage-recorder sites have been installed. Approximately six culverts, which will be upstream boundary conditions, have been identified and preliminary measurements made. Many of the major springs in the bay have been located, several of which have been mapped and measured for discharge. Two sources of bathymetry data have been found.

PLANS FOR THIS YEAR: Data collection and preparations for the preliminary model will be completed. The inventory of the significant spring discharges will be started. The collection of tidal-cycle measurements is planned for the spring dry season to minimize the influence of stormwater discharge.

FL-496 TRACER TESTS OF GROUND-WATER FLOW IN A KARST AQUIFER IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Craig B. Hutchinson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The rationale for delineating protection zones, which considers the Upper Floridan aquifer a homogeneous medium, probably is not valid for west-central Florida. If the aquifer cannot be treated as a homogeneous, porous medium, which appears to be the case, there is the need to reconsider the guidelines for establishing protection zones.

OBJECTIVES: The study will provide information and hydrogeologic data needed to evaluate ground-water flow near pumping wells in a karst aquifer system and apply this knowledge to well-head protection strategies for west-central Florida. Specific objectives are: (1) estimate the extent of fracture systems/solution cavities within a selected well-head protection zone, (2) define the hydraulic properties of the aquifer system in the protection zone, (3) measure movement of tracers in the protection zone, (4) simulate the measured tracer movement and quantify transport properties of the karst aquifer within the protection zone, and (5) propose guidelines to assist in evaluation the adequacy of present well-head protection strategies for west-central Florida.

APPROACH: The study will consist of four main phases: (1) geophysical studies will be conducted at a suitable test site with well-developed karst features; (2) aquifer tests will be conducted to define hydraulic properties that control flow to a production well and observations wells for tracer injection and monitoring; (3) tracer tests will be conducted over large and small depth intervals of the aquifer with monitoring of tracer movement for up to 6 months; and (4) the USGS modular ground-water flow model with a recently developed particle tracking model or another existing analytical method will be used to simulate tracer movement and to test the validity of relations among aquifer heterogeneity, hydrodynamic dispersion, and porosity.

PROGRESS: New project.

PLANS FOR THIS YEAR: Conduct static and pumping flowmeter surveys on one 400-foot deep well to detect zones that produce water. Obtain estimates for installing a powerline and purchasing a 20 HP submersible pump. Make arrangements for photolinear and geophysical studies in conjunction with the University of South Florida.

FL-497 LIGHT ATTENUATION IN THE ESTUARINE AND COASTAL WATERS OF SOUTHWEST FLORIDA—CAUSE AND IMPLICATIONS

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Benjamin F. McPherson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The amount of photosynthetically active radiation (PAR) in estuarine and coastal waters is of fundamental importance in determining growth and vigor of aquatic plants. The availability of PAR in these waters may be severely limited by dissolved (color) and suspended material so that plants compete. In deep-water environments, phytoplankton have an advantage over benthic plants and may flourish in the upper sunlit waters and thereby shade benthic algae, periphyton, and seagrasses. In shallow water, drift algae and periphyton may cover seagrasses and reduce light available to the seagrasses. Cultural enrichment of estuarine waters favors the growth of phytoplankton, drift algae, and periphyton, and that growth may greatly reduce light penetration and light available to seagrasses.

Reduced light availability has been implicated in the decline of seagrasses and other submerged aquatic vegetation in the estuarine environment. Recent studies have documented large declines in seagrass meadows in two of Florida's largest estuaries—Charlotte Harbor and Tampa Bay. In both estuaries, seagrass losses have been greatest in deeper water, indicating that reduced light availability may be involved.

OBJECTIVES: The overall objective of this study is to provide information to help guide management strategies in the estuarine and coastal waters of southwestern Florida by determining the causes of light attenuation. The causes of light attenuation include both the identification of the material (i.e., dissolved organic material, suspended sediment, phytoplankton, periphyton, drift algae) and the processes that contribute to its presence in the water column or on seagrasses (i.e., wind, tide, water depth, type of shoreline, benthic plants and animals, bottom and suspended sediment characteristics, freshwater inflow, nutrient concentrations and loads, etc.). The study area will include Tampa Bay, Charlotte Harbor, and nearshore waters of the Gulf of Mexico. The study will include 6 months of method development and testing, and approximately 2 years of data collection and analysis, including two summers of intensive sampling.

APPROACH: Ten study areas in Tampa Bay and Charlotte Harbor that represent different regional environments and different levels of basin development are proposed for this study. Within each of these areas, several stations will be established to characterize the light-attenuating properties of different benthic and shoreline environments. If seagrasses occur in the study area, a station will be established within the seagrass meadow and another will be established beyond the meadow in deeper water.

The study areas will be sampled approximately 20 times over 2 years. The most intensive sampling will be during May through September. The 2-year span provides the minimum time needed for an annual comparison. Measurements will be made of light attenuation (PAR) in the water column and in seagrass and drift algal communities. Physical, chemical, and biological data that may affect light attenuation will also be collected.

PROGRESS: New project.

PLANS FOR THIS YEAR: Literature on light attenuation in estuarine waters will be reviewed. Methods will be developed for measuring light attenuation and its causes. Reconnaissance surveys in Tampa Bay and Charlotte Harbor will be made. Stations will be established and light attenuation and water-quality data collected and processed.

FL-498 CIRCULATION AND CONSTITUENT TRANSPORT IN SARASOTA BAY, FLORIDA

DATE PROJECT BEGAN: January 1990

DATE PROJECT ENDS: April 1993

PRINCIPAL INVESTIGATOR: Kathleen M. Hammett, Tampa

COOPERATING AGENCY: National Estuary Program and Southwest Florida Water Management District

PROBLEM: Sarasota Bay, a coastal lagoon in southwest Florida, is 1 of 12 estuaries selected by the Environmental Protection Agency for inclusion in the National Estuary Program (NEP). The NEP Sarasota Bay study area, bounded by Tampa Bay on the north and Venice Inlet on the south, is being subjected to environmental stress as a result of rapid urban development. Water quality in much of the study area is relatively good, but in some parts of the bay, water clarity and quality have decreased and seagrass communities have declined.

As part of the NEP, a comprehensive management plan will be developed for Sarasota Bay. The plan will include strategies for preserving, restoring, and enhancing the bay and will serve as a national model for marine and estuarine management. To preserve, restore, or enhance an estuary, it is necessary to describe and quantify the circulation and constituent transport that are characteristic of the system. A hydrodynamic model provides a tool for evaluating these characteristics in the existing system and for estimating the potential effects of physical changes that may be proposed as part of restoration or enhancement. The description and eventual simulation of water clarity response to both natural causes and proposed management alternatives is also dependent upon the availability of a satisfactory hydrodynamic model. A hydrodynamic model serves as a starting point to which other physical, chemical and biological processes that influence water clarity can be added. No hydrodynamic model presently exists for the whole Sarasota Bay study area.

OBJECTIVES: The primary objective of this investigation is to develop a calibrated and verified hydrodynamic model of water circulation and constituent transport in the Sarasota Bay study area. The model will closely simulate the existing system and will be used to evaluate the changes in circulation and constituent transport characteristics due to natural and proposed manmade physical changes in the system. A related objective is to develop the hydrodynamic model so that physical, chemical, and biological processes that affect water clarity can eventually be linked into the model.

APPROACH: This will be a joint effort between the U.S. Geological Survey and the University of Florida (UF) Coastal and Oceanographic Engineering Department. The experience, expertise, and equipment of both groups will allow separate activities to occur in parallel and thus meet the established time requirements. A work plan will be developed during the first quarter of the investigation and will include an assessment of available data and existing circulation models. As a result of this assessment, the most appropriate circulation and transport model and an optimized data-collection program will be defined. The work plan will also recommend a sequence of simulations that can be run using the calibrated and verified model that will demonstrate the circulation and constituent transport characteristics of Sarasota Bay under existing and altered conditions.

Collection of preliminary tide and bathymetric data will begin concurrently with development of the work plan. This will allow construction of a coarse-grid preliminary model that can be used to evaluate and revise the schematization of the study area, sensitivity of boundary conditions, and provide feedback to optimize the data-collection effort. It is estimated that the final data network will include six to eight shore-based recording stations and up to four in-bay platforms to measure tidal stage and current and salinity. In addition, submersible meters will be used at various locations for *in situ* measurements. The preliminary model will be modified to more accurately reflect field conditions as reliable data becomes available. Model calibration will focus on matching stage, salinity, discharge, and current data from the first of two intensive data-collection efforts. The data used for model calibration and the calibration results will be documented as interim products of this investigation. Measurements from the second of two intensive data-collection efforts will be used in the

calibrated model to establish its degree of verification. Following calibration and verification, application runs will be made that show the response of Sarasota Bay to selected modifications or various management alternatives.

PROGRESS: Several planning and coordination meetings have been held between the USGS and UF in preparation for development of the work plan. Both USGS and UF have also been coordinating activities with technical and advisory committees of the NEP.

PLANS FOR THIS YEAR: Prepare the detailed work plan and submit it to NEP for approval. Begin data-collection efforts and construct a preliminary model.

FL-499 HYDRAULIC AND SALINITY CHARACTERISTICS OF MATLACHA PASS ESTUARY, LEE COUNTY, FLORIDA

DATE PROJECT BEGAN: July 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Gary Russell, Stuart

COOPERATING AGENCY: Florida Department of Environmental Regulation, Lee County, and the City of Cape Coral

PROBLEM: The western spreader canal system in Cape Coral, has altered the sheetflow patterns of freshwater runoff into Matlacha Pass. The Florida Department of Natural Resources has expressed concern that altering the freshwater runoff patterns into the pass may have a detrimental effect on salinity distribution which, in turn, may affect the aquatic system of the pass. Adequate data are not available to evaluate the effects of redistribution of freshwater inflow, its movement, and mixing. This proposed study will help identify the hydrodynamic aspects for managing the estuary.

OBJECTIVES: The objectives of the study are to determine the hydrodynamics of tidal-flow freshwater inflow and water circulation in Matlacha Pass estuary and to evaluate the effects that water circulation may have on the distribution of selected physical and chemical characteristics of the pass. The study will provide baseline information on bathymetry, salinity, and selected water-quality data. The main focus of the study will include development of a two-dimensional hydrodynamic simulation model of Matlacha Pass. The model will be calibrated by the use of bathymetry, tidal stage, tidal velocity, tidal discharge, freshwater inflow, and selected water-quality data.

APPROACH: (1) A preliminary two-dimensional flow and circulation model will be simulated by use of an existing two-dimensional model of the Charlotte Harbor estuary; (2) continuous collection of calibration data in the estuary will be compared with data generated from the initial model, and concurrent water-quality information will be used in conjunction with stage and velocity measurements to calibrate and verify the model; and (3) documentation of the model will be prepared.

PROGRESS: New project.

PLANS FOR THIS YEAR: A bathymetric profile of the estuary is planned and initial model runs are planned using collected data and a modification of the Charlotte Harbor estuary model.

FL-500 DELINEATION OF GROUND-WATER RECHARGE AREAS OF THE SURFICIAL AQUIFER IN SOUTH FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Richard K. Krulikas, Fort Myers

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Information on ground-water recharge in Florida is of vital importance to studies involved with quantification of the effects of ground-water development. Presently, recharge has been evaluated only with respect to the Upper Floridan aquifer and for the Floridan RASA study on small scales. Delineation of recharge rates at a larger scale is required for detailed comprehensive assessments of the effects of ground-water development on a subregional to local basis. Moreover, delineation of high-rate ground-water recharge areas at a large scale is needed by the State regulatory agencies for implementation of the "Blue Belt" constitutional amendment. This amendment authorizes a tax break to owners of land that remains in an undeveloped state and which provides a high rate of recharge to Florida's ground water.

OBJECTIVES: The objective of the study is to evaluate feasibility, cost, and time for large-scale mapping of high- and low-rate recharge areas to the surficial aquifer where it is unconfined.

APPROACH: Spring discharge and stream base-flow data will be used as indirect measurements of ground-water recharge to the respective drainage basins where definable. This recharge total will then be distributed across the area, taking into account as appropriate: (1) topographic features, (2) soils, (3) surficial deposits, (4) intermediate confining unit thickness and characteristics, and (5) potentiometric surface of the surficial aquifer in relation to land surface and the water table. Available model-derived recharge distribution to the surficial aquifer will be used to guide the analysis, although at a lesser scale. Hydrogeologic judgment will be applied in assessing the net effect of the above factors on rate of recharge and on the extrapolation of discharge data into areas devoid of measurements but similar hydrogeologically to areas having measurements.

PROGRESS: New project.

PLANS FOR THIS YEAR: The report for this phase I project will consist of a primer describing methods of delineating ground water recharge areas within south Florida, using Lee and Palm Beach Counties as a sample study. The report will also contain a glossary of hydrologic terms pertaining to ground-water recharge. The publication is anticipated to be released as a U.S. Geological Survey Circular.

FL-501 AVAILABILITY OF GROUND WATER IN THE ORLANDO METROPOLITAN AREA, EAST-CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1990

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: Louis Murray, Orlando

COOPERATING AGENCY: St. Johns River Water Management District and South Florida Water Management District

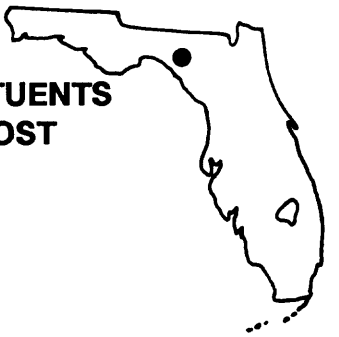
PROBLEM: Growth in the Orlando metropolitan area is expected to cause ever-increasing demands on the ground-water resources. Available well-field locations are constrained by the occurrence of salty water, other polluted ground water, zones of low aquifer transmissivity, and by the proximity of existing well fields. At present, there is insufficient interpretive information to assess what long-term effect land-use changes and increasing water use will have on the ground-water resources.

OBJECTIVES: To assess the potential for developing additional large ground-water supplies in the Orlando metropolitan area, to identify favorable locations for well fields, and to develop a strategy for monitoring changes in the geohydrology.

APPROACH: (1) Assimilate all ground-water and geologic information from published and unpublished reports; (2) Use existing current and historical ground-water quality data to prepare interpretive thematic maps of the areal and depth distribution of selected water-quality constituents; (3) Construct and calibrate a high-resolution, 3-D finite-difference ground-water flow model, a particle-tracking model, and an optimizing model for locating potential well fields; (4) Outline a strategic ground-water monitoring network to observe changes in ground-water quality and quantity.

PROGRESS: New project.

PLANS FOR THIS YEAR: Compile data on amounts, sources, and locations of water used by municipalities and other public suppliers, industry, agriculture, and private owners. Run geophysical logs and sample water quality at selected wells and artesian springs. Store water-resources data collected in computer and hard-copy files.



FL-502 TRANSPORT OF SELECTED CHEMICAL CONSTITUENTS IN FIELDS AMENDED WITH CRAB-SCRAP COMPOST

DATE PROJECT BEGAN: January 1990

DATE PROJECT ENDS: October 1991

PRINCIPAL INVESTIGATOR: Hilda H. Hatzell, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation,
Florida Sea Grant Program, University of Florida, and
Institute of Food and Agricultural Sciences, University of Florida

PROBLEM: Composting of crab scrap with wood products provides a possible solution for two situations. The first is the need to reduce the amount of materials entering landfills. Wastes from crab-processing operations may consume as much as 20 percent of the landfill space in several Florida counties. The second is the need to increase the agricultural productivity of acid-sand soils in a way that is compatible with the environment. An organic amendment, such as compost, can increase water infiltration, levels of soil moisture, and cation-exchange capacity. Although the use of compost may provide beneficial soil effects, the crab compost may also impact the quality of ground water.

OBJECTIVES: The potential impacts of crab compost on ground water will be evaluated to (1) determine if crab scrap compost retards the movement of a field-applied pesticide to the water table, and (2) evaluate the leaching of selected organic compounds and trace metal ions released during decomposition of field-applied crab compost.

APPROACH: Field plots containing a selected crop will be located at the IFAS Experiment Station at Live Oak. Each plot will receive the same amount of pesticide and one of three levels of compost. The leaching of selected organic compounds, metal ions, and the pesticide will be monitored with lysimeters and wells located in the plots. Sampling events will be timed to account for cropping practices.

PROGRESS: New project.

PLANS FOR THIS YEAR: The pesticide to be applied as well as which organic compounds and metal ions involved in monitoring will be selected. The plots will be established and monitoring of the lysimeters and wells will begin.

FL-503 EFFECTS OF DAIRY FEEDLOTS ON GROUND- AND SURFACE-WATER QUALITY IN NORTH FLORIDA

DATE PROJECT BEGAN: November 1989

DATE PROJECT ENDS: October 1991

PRINCIPAL INVESTIGATOR: William Andrews, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: In the past few years, an increasing number of dairies have been located near the Suwannee River in Lafayette and Suwannee Counties. Dairy cows deposit approximately 75 kilograms of nitrogen per year per animal as manure, much of which can be converted to nitrate which is highly soluble and mobile in ground-water systems and can cause human health problems. The area where the dairies have been located is highly susceptible to ground-water contamination because the principal source aquifer in the area, the Upper Floridan aquifer, consisting of the Suwannee and Ocala Limestones, is unconfined, near the land surface, and in many places is directly connected to the land surface by karstic drainage features. The Suwannee River, designated as an Outstanding Florida Water requiring the highest priority of protection, is directly connected to the Upper Floridan aquifer in the area through numerous springs which flow from the aquifer into the river. Elevated nutrient concentrations in surface waters can cause undesirable eutrophication of those waters.

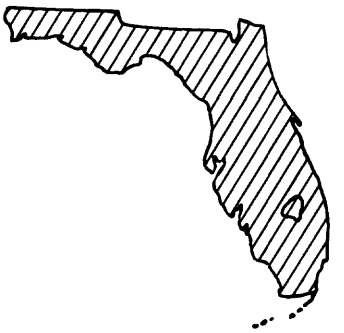
State regulatory agencies require more detailed information on the effects that these dairy operations are having on water quality in north Florida in order to identify waste-management practices that minimize ground- and surface-water contamination from these operations.

OBJECTIVE: To determine the extent of contamination of ground water beneath and surface water flowing from dairy operations and how the contamination relates to varying waste-management practices and hydrogeological conditions in LaFayette and Suwannee Counties.

APPROACH: Five to ten dairy operations with differing waste-disposal practices will have several wells installed into the top of the phreatic zones and surface-water sampling sites will be established. Wells will be located within or downgradient from the sites of waste deposition. Water samples will be collected and analyzed quarterly from each well or collection site, with selected sites being sampled in the intervening months in order to monitor seasonal variations in water quality. Dissolved constituents analyzed will include those considered to be waste tracers and the results will be statistically analyzed to examine relationships between dissolved nitrogen species, other waste tracers, waste-disposal practices, and hydrogeological factors.

PROGRESS: New project.

PLANS FOR THIS YEAR: The study site farms will be selected and well drilling will be completed. Sampling will occur upon completion of drilling and will continue through the remainder of the year.



FL-504 RECHARGE MAPPING PILOT STUDY

DATE PROJECT BEGAN: November 1989

DATE PROJECT ENDS: November 1990

PRINCIPAL INVESTIGATOR: John Vecchioli, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

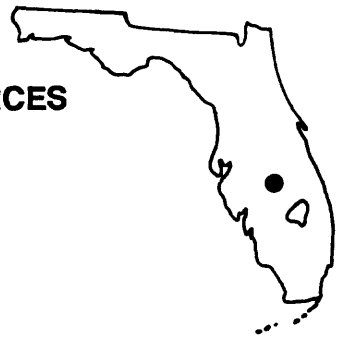
PROBLEM: Delineation of high-rate ground-water recharge areas at a large scale is needed by the State for implementation of the "Blue-Belt" Amendment.

OBJECTIVE: To evaluate feasibility of mapping high- and low-rate recharge areas to the water table and to the Upper Floridan aquifer where it is confined.

APPROACH: Spring discharge and stream baseflow data will be used as indirect measurements of ground-water recharge to the respective drainage basins. This recharge total will then be distributed across the drainage basin taking into account as appropriate: (1) topographic features, (2) soils, (3) surficial deposits, (4) intermediate confining unit thickness and characteristics, and (5) potentiometric surface of the Upper Floridan aquifer in relation to land surface and the water table. Available model-derived recharge distribution to the Upper Floridan aquifer, although at a lesser scale, will be used to guide the analysis. Hydrogeologic judgement will be applied in assessing the net effect of the above factors on rate of recharge and on the extrapolation of discharge data into areas devoid of measurements but similar hydrogeologically to areas having measurements.

PROGRESS: New project.

PLANS FOR THIS YEAR: Recharge determinations will be made for three pilot areas—parts of Okaloosa, Pasco, and Volusia Counties.



FL-505 HYDROLOGY AND EFFECTS OF WATER-RESOURCES DEVELOPMENT IN THE HIGHLANDS RIDGE OF WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: July 1989

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: D.K. Yobbi, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The Highlands Ridge, which occupies 700 square miles in central Polk and Highland Counties, is an uplands recharge area along the axis of the Floridan Peninsula. Many large sinkhole lakes occur along the crest of the ridge. Since the early 1960's, significant declines in lake levels have occurred in this important citrus-producing area. The problem of declining lake levels may be related to several factors, including below normal rainfall, increased ground-water pumpage for agricultural and industrial use, reduced recharge and drainage related to the channelization of the Kissimmee River, and agricultural drainage practices. In order to maintain the lake environment, it is important to understand and quantify the flow to, from, and within the ground-water system.

OBJECTIVE: To develop an understanding of the hydrogeologic regime and impacts of water-resources development in a regional lake environment that is strongly affected by pumping. A numerical model of ground-water flow will be used to simulate the response of the water table and lake levels to hydrologic stress.

APPROACH: Literature and file searches will be made and existing data will be compiled and geologic maps and cross sections will be prepared. The hydrogeologic system in the Highlands Ridge will be simulated using the USGS finite-difference modular computer code. Existing coarsely-gridded models will be divided into 1-square mile or 1-minute (latitude and longitude) grid blocks. Starting heads, recharge, evapotranspiration, streamflow, pumping, and aquifer hydraulic properties will be estimated using the best available information. The initial steady-state calibration will be based on September 1989 hydrologic conditions. A transient model calibration will be made for the time period September 1989–September 1990. A sensitivity analysis of the model-input parameters will be performed following the steady-state and transient calibrations. Simulation runs will be made to demonstrate how the model can be used to assess regional impacts of water-resources development.

PROGRESS: New project.

PLANS FOR THIS YEAR: Extract a submodel of the Highlands Ridge from the U.S. Geological Survey RASA movable model. Collect and analyze hydrologic data for input to Highlands Ridge model. Begin steady-state calibration and sensitivity analysis.

FL-506 HYDROLOGIC RESPONSE OF WETLANDS TO CLIMATE CHANGE

DATE PROJECT BEGAN: March 1990

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: William R. Bidlake, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District and Sarasota County

PROBLEM: The possibility of global climate change threatens to compound water supply and wild-land management problems. Specific concerns in west-central Florida arise from the possible effects of regional warming on wetland ecosystems. Climate warming will likely induce changes in the water balance of wetland ecosystems by altering the magnitude and seasonal timing of precipitation, ground-water recharge, and evapotranspiration (ET). It is crucial that water and wild-land managers be given tools to assess possible effects of climate change on these sensitive and vitally important ecosystems.

OBJECTIVES: The overall objective of the study is to develop a better understanding of the effects of climate change on wetland ecosystems, and to develop predictive tools useful to managers. Specific objectives are: (1) Describe and model the ground-water system of the Ringling-MacArthur Reserve (RMR), a wetlands area located in west-central Florida, (2) Link the ground-water flow model with a process-oriented ET model, (3) Develop estimates of leaf area index (LAI) and rooting depth by vegetation type, (4) Calibrate the composite model for historical conditions, (5) Generate a range of possible future climate scenarios based on output from general circulation or other climate models, and (6) Assess hydrologic response of wetlands in RMR to the range of future climate scenarios.

APPROACH: A modular ground-water flow model for RMR will be available from Sarasota County. This model will be linked with a process-oriented ET model which simulates unsaturated zone flow and storage, ET, and rainfall interception. The model will be operated using hydrologic and micrometeorologic data collected from the study area. Climate scenarios will be developed from the results of climate modeling research. The scenarios will be used to drive the wetland water balance model to assess possible future impacts of climate change.

PROGRESS: New project.

PLANS FOR THIS YEAR: The on-site data collection network will be reviewed and augmented as necessary in order to permit routine collection of seasonal ground-water and surface-water levels and micrometeorologic variables. The existing data-collection network will be operated during revision. Existing geohydrologic data will be compiled and inventoried to facilitate use of these data in modeling work.

☆U.S. GOVERNMENT PRINTING OFFICE: 1990-731-097/00019