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Florida's Water: Supply, Use, and Public Policy[1]

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Abstract

This paper provides a capsule summary of information about the geohydrology of Florida, about patterns of water use, and about Florida's public institutions for water management. It is offered as a primer, as a starting point, for anyone wishing to participate in discussions and activities that bear upon the water resources of this state.

Florida's Water Resources

Florida receives an average of 55 inches of rainfall a year. This compares to an average of 30 inches for the nation as a whole, and only nine inches per year in Nevada, the driest state. Total annual rainfall for Florida typically varies (sometimes greatly) from one part of the state to another, from one season of the year to another, and from one year to the next. Such rainfall variations have direct impacts upon surface water and groundwater supplies. Lack of rainfall for a few weeks causes depletion of moisture in Florida's predominately sandy soils, along with reduction of stream flow and groundwater recharge.

There are significant differences in runoff and evapotranspiration between north Florida and south Florida. Evaporation from water bodies ranges from about 46 inches in the northern counties to about 54 inches in the southern portion of the state. Measured runoff averages only zero to 10 inches per year in much of extreme south Florida, but averages from 20 to 40 inches in parts of the northwest "panhandle." Differences in rainfall, topography, soil permeability, air temperature, humidity, wind speed, and vegetative ground cover account for the differences in runoff and evapotranspiration.

Of Florida's five largest rivers, four are in the drainage basins of northern Florida, with headwaters in Alabama or Georgia. The fifth largest river, the St. Johns River, flows northward beginning in Indian River County and ending at the Atlantic Ocean near Jacksonville. Southern Florida is dominated by the Kissimmee-Okeechobee-Everglades basin which extends from central Florida (Orlando area) to the southern tip of the peninsula. Many streams in south Florida have been altered by an extensive system of canals and levees that provide flood control, drainage, and water supply for agriculture near Lake Okeechobee and for cities on the lower east coast. Some portions of the original Everglades have been used as shallow water conservation areas during the past three decades. The remaining Everglades areas at the southern tip of the peninsula comprise the

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Everglades National Park, which receives water from this managed system.

The principal source of groundwater for most of Florida is the Floridan Aquifer. It is the source of municipal water supply for such cities as Tallahassee, Jacksonville, Gainesville, Orlando, Daytona Beach, Tampa, and St. Petersburg. It also yields water to thousands of domestic, industrial, and irrigation wells. The thick layers of porous limestone comprising the Floridan Aquifer underlie all of the state; however, in the southern portion of the state, the water it contains is too highly mineralized for domestic, industrial, or agriculture use. Water in the Floridan Aquifer is replenished by rainfall in central and northern Florida where the aquifer emerges at the surface, is covered by permeable materials, or where the confining material is breached by sinkholes. In some areas the aquifer is confined beneath impermeable layers with sufficient artesian pressure to produce free-flowing wells. Capping, plugging, and controlling abandoned free-flowing wells in these areas has become an important water management function.

The unconfined, surfacial Biscayne Aquifer underlies an area of about 3,000 square miles in Dade, Broward, and Palm Beach Counties. Water in the Biscayne Aquifer is derived mainly from local rainfall and, during dry periods, from canals ultimately linked to Lake Okeechobee. The Biscayne Aquifer is a major source of water supply for the lower east coast cities and for some agricultural users.

A non-artesian, sand-and-gravel aquifer is the major source of groundwater in the extreme western part of north Florida. Water in this aquifer is derived chiefly from local rainfall and furnishes most of the groundwater supplies used in Escambia and Santa Rosa Counties, and part of Okaloosa County.

Shallow aquifers are present over much of the state, but in most areas these are not major sources of groundwater.

Water Use in Florida

Whether water is scarce or abundant depends not only upon available supplies, but also upon patterns of water use and demand. The United States Geological Survey (USGS) has developed estimates of water withdrawals and water use by several water-use categories over the years. These estimates provide a perspective on patterns of water use by sector and over time.

In examining water use statistics, it is important to distinguish between water “withdrawal” and “consumptive use” of water. Water consumed is that which is withdrawn from a freshwater source and is not returned to the same source or another usable source, thus being unavailable for re-use except by way of the hydrologic cycle. For water management purposes, consumptive use may be considered all of the water withdrawn from an important, allocated source even though a portion may be returned to another usable body of water.

According to estimates compiled by the USGS, withdrawals of freshwater for all uses averaged 7.5 billion gallons per day in 1990, which is almost a 100 percent increase in the rate of withdrawals estimated for 1960, a 31 percent increase over the 1970 rate, and a 2.7 percent increase over the 1980 rate. The use of water treated through desalination to meet drinking water standards increased from 17 million gallons per day in 1985 to 48 million gallons per day in 1990. Dependence on groundwater as the principal source of freshwater has continued to increase. In 1950, 21 percent of freshwater withdrawals were from groundwater. By 1990, 62 percent were from groundwater. Nearly 10.0 million people in Florida served by public supply and all residents that use self-supplied domestic systems (1.71 million) depended on groundwater for their drinking water needs in 1990. Surface water withdrawals actually decreased by one percent between 1970 and 1990.

About 60 percent of the total groundwater withdrawn in Florida in 1990 was obtained from the Floridan Aquifer. Polk, Orange, Hillsborough, and Duval Counties were the largest users of water from the Floridan Aquifer in 1990. About 18 percent of the state's groundwater withdrawals were obtained from the Biscayne Aquifer. Dade and Broward Counties withdrew all of their groundwater from the Biscayne Aquifer, and Palm Beach County withdrew some water from this aquifer.

Since 1950, all categories of freshwater withdrawals in Florida have increased. Between 1970 and 1990, however, freshwater withdrawals for public-supply, self-supplied domestic use, and agricultural irrigation have increased and withdrawals for self-supplied commercial-industrial use and thermoelectric power generation have decreased.

Agriculture accounted for the largest use of freshwater in Florida in 1990 (followed by public supply, self-supplied commercial-industrial, domestic and thermoelectric power generation). Withdrawals of freshwater for agricultural use constituted 50 percent of total water withdrawals for the state in 1990. Agricultural water withdrawals totaled 3,805 million gallons per day of fresh water, of which 47 percent was surface water. In addition, 170 million gallons per day of reclaimed wastewater was used for irrigation purposes. Estimated consumptive water use in agricultural irrigation was 2,561 million gallons per day, or 67 percent of water withdrawn for agricultural use. The Floridan Aquifer system supplied 1,249 gallons per day (62 percent) of the groundwater withdrawn for agricultural irrigation in 1990. Surface-water canals, mostly from Lake Okeechobee, supplied large amounts of water for agricultural use in South Florida. Withdrawals for agricultural irrigation in 1990 varied seasonally and were lowest in December and highest in May. USGS attributed seasonal fluctuations to intense crop production and the dry conditions during the early spring. More than 32 percent of the water used for irrigation was withdrawn during the months of March, April, and May, and less that 20 percent was withdrawn during the months of October, November, and December. Irrigation of citrus crops accounted for the largest amount of water withdrawn (33 percent), followed by sugar-cane (22 percent), sod (five percent), and turfgrass/golf courses (five percent).

A total of 2.15 million acres were irrigated in Florida in 1990. Palm Beach, Hendry, Dade, Polk, and Brevard Counties each had more than 100,000 acres irrigated in 1990. Irrigated acreage increased in the state between 1980 and 1990, despite a reduction in citrus acreage.

Water withdrawn for public supply in Florida totaled 1,925 million gallons per day in 1990. Groundwater was the source of more than 88 percent of the water withdrawn for public supply, serving about 10.0 million people. The Floridan Aquifer supplied about 852 million gallons per day (50 percent) of the water withdrawn for public supply. The Biscayne Aquifer delivered another 573 million gallons per day. Public-supply withdrawals were lowest in January and highest in May during 1990. Water withdrawals for public supply in Florida have increased rapidly, from 170 million gallons per day in 1950 to 1,925 in 1990. The population served by public-supply systems increased from 5.42 million in 1970 to 11.23 million in 1990. In 1990, 87 percent of the population was served by public-supply systems.

Self-supplied commercial use includes water withdrawn at government and military facilities, schools, prisons, hospitals, recreational facilities, and nonmanufacturing establishments. Self-supplied industrial use includes water withdrawn at mining, processing, and manufacturing facilities. In 1990, there were 174 self-supplied commercial users inventoried and 278 self-supplied industrial users inventoried. Total water withdrawn by self-supplied commercial-industrial systems was 826 million gallons per day, of which 93 percent was freshwater. Withdrawals by industrial facilities accounted for 92 percent of the freshwater withdrawals, and commercial facilities accounted for the remaining eight percent. The largest single use of freshwater within the self-supplied category in 1990 was for mining, with total withdrawals of 315 million gallons per day, followed by pulp and paper industry with withdrawals of 189 million gallons per day. Mining tends to be concentrated in the central part of the state, while pulp and paper operations are located in the forested areas of northern and western Florida. Freshwater withdrawn for self-supplied commercial-industrial use in Florida decreased between 1970 and 1990 (partly due to water conservation practices), but has not changed much since 1980. However, deliveries to commercial and industrial users from public-supply systems increased nearly 300 million gallons per day during this period.

Total water withdrawals for the 52 self-supplied thermoelectric powerplants in Florida amounted to 11,042 million gallons per day, but only about seven percent of that amount (732 million gallons per day) was freshwater. Of the total freshwater withdrawn, 97 percent (709 million gallons per day) was surface water. Almost all of the water used for thermoelectric power generation in 1990 was for cooling purposes. Much of the water used was for once-through cooling although some systems recirculated water several times before it was returned to its surface source. Because most of the water used for cooling is returned to its source, actual consumptive use of water for thermoelectric power generation is quite low.

Self-supplied domestic water is provided by individual domestic wells or by small utility companies. In 1990, an estimated 1.71 million people in Florida used self-supplied water systems and withdrew about 199 million gallons per day, almost entirely groundwater.

Public Policy and Water in Florida

Water Allocation Policy

The early history of water policy in Florida dealt mostly with drainage and flood control, especially in central and southern Florida. Special acts of the legislature created special drainage districts which, in more recent years, provide water storage and conservation as well as drainage and flood control. The United States Army Corps of Engineers, with federal government funding, built the Central and Southern Florida Flood Control project between 1949 and 1965.

Otherwise, Florida's water law was based in common law, which, through case law and long established practices, provided a basis for water use rights. When the state's population began to grow rapidly in the 1950s, policymakers and water managers began to argue for a more effective institutional basis for water management. The Florida Water Resources Act of 1972 (Chapter 373, Florida Statutes) established a form of administrative water law that brought all waters of the state under regulatory control. Five water management districts were formed, encompassing the entire state. Each district covers one or more important water basins. The five districts are the South Florida Water Management District, the Southwest Florida Water Management District, the St. John's River Water management District, the Suwannee River Water Management District, and the Northwest Florida Water Management District. Each district is controlled by a governing board of nine members who reside within the district, except the Southwest district, which has 11 board members. The members are appointed by the governor and confirmed by the Florida Senate to serve four-year terms.

The districts are required to implement regulatory programs for well construction, consumptive water use, and for alterations to the hydrologic regime (management and storage of surface water). In addition to permitting authority, the districts have broad powers with respect to maintaining, regulating, altering, or constructing waterways and appurtenant facilities. An important source of funding for the districts is the ad valorem tax. A constitutional amendment, passed by statewide referendum in 1976, granted ad valorem taxing power to the water management districts.

Statewide authority for water resource management was vested in the Department of Environmental Regulation [which has since merged with the Department of Natural Resources by an act of the 1993 Florida Legislature to become the Department of Environmental Protection (DEP)]. The state agency was directed to develop, with the five water management districts, a State Water Use Plan and to delegate water management authority to the districts "to the greatest extent practicable." Legislative intent was to provide for continuity of water management policy, statewide, with regional implementation taking into account the variability of water resources over the state.

Water Quality Policy

The Air and Water Pollution Control Act as amended (Chapter 403, Florida Statutes), along with several other pieces of legislation, provides the statutory basis for regulation of most aspects of water quality in Florida. It provides the Department of Environmental Protection with broad powers and duties to accomplish the statutory goal of protecting

and improving water quality throughout the state. These include the power to classify surface and groundwater bodies according to their most beneficial uses; establish ambient water quality criteria within each classification for various parameters of water quality; develop standards of quality for wastewater discharges; and implement a permit system for the "operation, construction, or expansion of any installation that may be a source of. . . water pollution" and require posting bond to operate any such installation.

The Environmental Regulation Commission (ERC), established by the Florida Environmental Reorganization Act of 1975, is empowered to act as an adjudicatory body for final actions taken by the Department of Environmental Protection and is the exclusive standard-setting authority of the Department.

Other State Programs

Other programs have been created by state legislation which are motivated, at least in part, by water quality protection or restoration goals.

- The Florida Safe Drinking Water Act of 1977 provided for the adoption and enforcement of state primary and secondary drinking water regulations and standards.
- The Water Quality Assurance Act of 1983 was divided into 12 separate parts, each of which addressed a distinct groundwater or hazardous waste problem. The Act addressed the need to compile data relating to water resources; prevent contamination of potable water supplies; plug abandoned artesian wells; control siting of septic tanks; clean up existing contamination sites; prevent pollution from leaking underground fuel storage tanks; and require the proper treatment, storage, and/or disposal of all hazardous wastes.
- The State Underground Petroleum Environmental Response Act of 1986 further addressed the need to prevent pollution from leaking underground storage tanks and to fund the cleanup of existing pollution sites.
- The Warren S. Henderson Wetlands Protection Act of 1984 augmented the role of the Department of Environmental Regulation in the regulation of upland wetlands and assigned responsibility for regulation of agricultural impacts on wetlands to the state's five water management districts.
- The Surface Water Improvement and Management Act of 1987 (SWIM) promised state funding to water management districts for remedial measures to restore water quality in surface water bodies that had been contaminated in the past.
- The Marjory Stoneman Douglas Everglades Protection Act of 1991 was a combination of provisions for taxes, land acquisition, and regulation designed to resolve a complex and controversial lawsuit concerning water quality impacts of irrigation drainage on the Everglades marsh ecosystem in south Florida.
- The Florida Cooperative Extension Service and the University of Florida's Institute of Food and Agricultural Sciences conduct research, education, and demonstration projects specifically directed at minimizing water quality impacts of agricultural operations, and these projects often involve cooperation with the Department of Environmental Protection, water management districts, or with the Natural Resource Conservation Service of the U.S. Department of Agriculture.
- Both the Department of Environmental Protection and the USDA have provided cost-share assistance and technical assistance to farmers to help reduce both point-source and nonpoint-source pollution from agriculture operations, especially from dairies.
- The Department of Agriculture and Consumer Services administers a pesticide review and registration program to assure that pesticides labeled for use in Florida have been tested under Florida conditions and will not pose an unreasonable threat to water quality.

Conceptually, state policymakers have a menu of policy tools with which to implement water quality goals. In generic terms, these tools include regulations, taxes and monetary incentives, acquisition, and research and education, not to mention recourse to the common law approach to dispute settlement through litigation. In the main, Florida's approach to water pollution control is built on a framework of comprehensive regulation. Florida has made significant use of public acquisition and management of land for water management purposes. Research, education, and technical assistance has been used in supplemental ways, often incidental to regulatory approaches. Taxes and other monetary incentives, as a mechanism to influence behavior, have not been widely used.

Water Issues

Several broad issues exist against this backdrop of information about Florida's water resources. These may be grouped into allocation issues, quality issues, and institutional issues.

Allocation Issues

The Southwest Florida Water Management District has designated a multi-county area south of Tampa as a Water Use Caution Area. District hydrologists have become convinced that withdrawals from the aquifer in that area have exceeded recharge for many years with the result that the salt water interface from the Gulf of Mexico has moved upward and inland, threatening long-term availability of freshwater from the aquifer. To address the problem, the District has imposed a moratorium on new consumptive use permits in the area, and is considering non-renewal of expiring permits in the future. Much of agriculture in the area depends upon groundwater for irrigation.

In the South Florida Water Management District, a major allocation issue revolves around concerns that remaining portions of the original Everglades marsh ecosystem are declining because of long-term alteration of the hydro period in the region as a result of flood control works built by the Corps of Engineers and managed by the District. Conservationists argue that restoration of the ecosystem will require redesign of the flood control system and cessation of agricultural production in what is now known as the Everglades Agricultural Area. These arguments are controversial because the stakes are high for all parties to the dispute.

Interjurisdictional transfers of water from one county to another or from one water management district to another are the subject of dispute in some parts of the state. Because population demographics shape patterns of water use, and since populations centers tend to be located where water resources are least abundant, the fear or the reality of water transfers from sparsely populated areas to heavily populated areas are likely to continue into the future.

Water Quality Issues

In the South Florida Water Management District, the effects of nutrients in drainage water from the Everglades Agricultural Area on the remaining Everglades marsh ecosystem has been the focus of a major lawsuit and of much political controversy. The dispute has pitted conservationists against agriculturalists in the area.

Issues concerning the siting of new dairies in north central Florida is an out-growth of quality problems from dairies north of Lake Okeechobee. Some citizen groups have opposed the siting of new dairies in Levy and Gilchrist Counties because of concerns over impacts on water quality in the area.

Groundwater quality problems persist in the kharst region in Jackson County, and have been an issue in the fern production region of Volusia County. The Department of Environmental Protection is investigating the possibility of nitrate contamination of groundwater in the ridge citrus production area.

Saltwater intrusion is a part of the water allocation issue in the Southwest Water Management District's Water Use Caution Area, and is a constant water management concern in many parts of Florida because of the state's situation as a peninsula between large bodies of salt water.

Institutional Issues

Much is made in some circles over the fact that Florida's water management districts have ad valorem taxing authority, but the district boards are not elected. This gives rise to the argument that the districts are engaging in "taxation without representation." Some argue that the boards should be elected, while others argue that the district's taxing authority should be revoked or that the existing system is appropriate.

Regulation, in general, frequently draws charges of unconstitutional "taking" of private property without compensation as property owners discover that their opportunities to profit from land ownership are sometimes seriously constrained by environmental regulations. The property rights issues and the issues of "regulatory takings" will likely be aired in the future.

As population pressures continue to grow, there is concern that Florida's case-by-case regulatory approach to consumptive use regulation is grossly inefficient in terms of bureaucratic process and in terms of water allocation decision-making. Some argue that market-like processes for allocating and re-allocating available water supplies may need to be implemented in order to assure orderly water management decision-making in the future.

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