West-Central Florida's Aquifers

Florida's Great Unseen Water Resources

The abundance of Florida's freshwater resources provides a great attraction for residents and tourists alike. The rivers, lakes and wetland areas found throughout the state serve as a water-lover's paradise for fishing, boating, hiking and many other recreational activities.

However, the majority of Florida's fresh water is inaccessible to the public for recreational purposes. In fact, most of the state's fresh water lies underground in Florida's aquifers.

While the groundwater within Florida's aquifers remains unseen, it still serves a vital role in maintaining the quality of life for all Floridians. The District is responsible for protecting this important resource.

A diver explores part of the Upper Floridan aquifer through a spring.

What Is an Aquifer?

An aquifer is a layer of underground rock or sand that stores water. The groundwater within an aquifer can fill the spaces between grains of sand and gravel, or it can fill the cracks and fissures in solid rock.

The water within an aquifer is constantly moving. How quickly the water moves depends on both the physical characteristics of the aquifer and the water-level gradient, or slope, in the aquifer. In aquifers with large caverns or many large fractures, water can travel very quickly. However, in aquifers where there is less space for water to move through, water travels much more slowly.

Southwest Florida
Water Management District

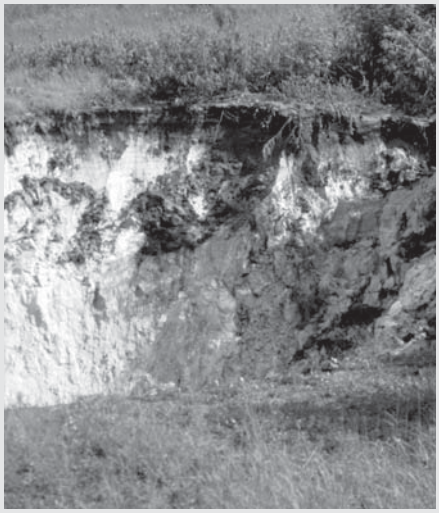
Confined and Unconfined Aquifers

An aquifer can be categorized as either confined or unconfined. An unconfined aquifer, also known as a water-table aquifer, is an aquifer that is often close to land surface. The water table in an unconfined aquifer is under atmospheric pressure and is replenished or recharged directly from water seeping downward from the land surface or upward from deeper in the aquifer. The water level in a well drilled into an unconfined aquifer indicates the position of the water table in the aquifer.

A confined aquifer is an aquifer that is bound above and below by relatively impermeable layers of rock or sediment, also known as confining units or layers. These confining units restrict the movement of groundwater. As a result, groundwater within a confined aquifer is typically under pressure. The water in a well that is drilled into a confined aquifer will rise above the top of the aquifer. In cases where the water level rises above the land surface, the well is called a flowing artesian well.

What Is Karst Terrain?

Karst terrain describes a type of landscape that has been formed by the dissolution of the underlying rock. The thick layers of limestone and dolomite rocks that underlie Florida are easily dissolved by weak acid that naturally occurs in rainfall. The water dissolves the rock to form openings through which water readily flows. As the rock dissolves, it can cause the surface area above it to collapse, creating a sinkhole. Karst areas are characterized by an abundance of sinkholes, springs and caverns.



An example of a sinkhole.

The Aquifers of West-Central Florida

Florida's aquifers contain about one-fifth the amount of water in all the Great Lakes, 100 times the amount in Lake Mead on the Colorado River and 30,000 times the daily amount flowing into the sea from Florida's 13 major coastal rivers. However, due to negative impacts that result from withdrawing too much of this water from the aquifers, only a fraction of this amount is available for our use.

In west-central Florida, the groundwater system is composed of three main units: the surficial aquifer, the intermediate aquifer system and the Floridan aquifer system.

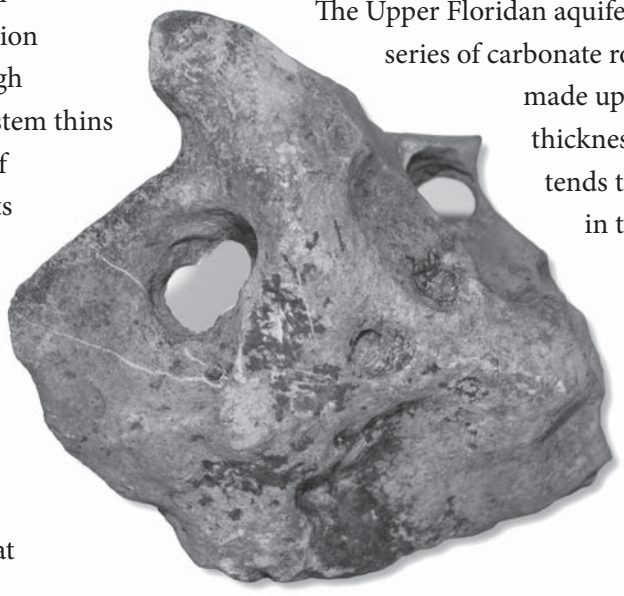
The Surficial Aquifer

The surficial aquifer is the uppermost unconfined aquifer. It is composed primarily of unconsolidated sand but may also contain clay and/or shell deposits. The surficial aquifer varies widely in thickness within the District, from completely absent in areas of the north to greater than 250 feet thick in the ridge areas of Polk and Highlands counties.

In the southern portion of the District, the surficial aquifer is underlain by a confining unit separating it from the underlying aquifer. However, in the northern portion of the District, this clay-confining unit is thin and discontinuous. As a result, the water table sometimes lies directly above and is often in direct connection with the underlying Upper Floridan aquifer.

The Intermediate Aquifer System

Below the surficial aquifer is the intermediate aquifer system, a confined system made up primarily of limestone, shell, sand and clay. In general, the thickness of the intermediate aquifer system decreases from south to north in the District, ranging from over 400 feet in Charlotte County to less than 50 feet in central Hillsborough County (see cross section below). North of central Hillsborough County, the intermediate aquifer system thins and becomes discontinuous north of central Pasco County. Where it exists in these areas, the system mostly acts as a confining unit separating the surficial and Upper Floridan aquifers.



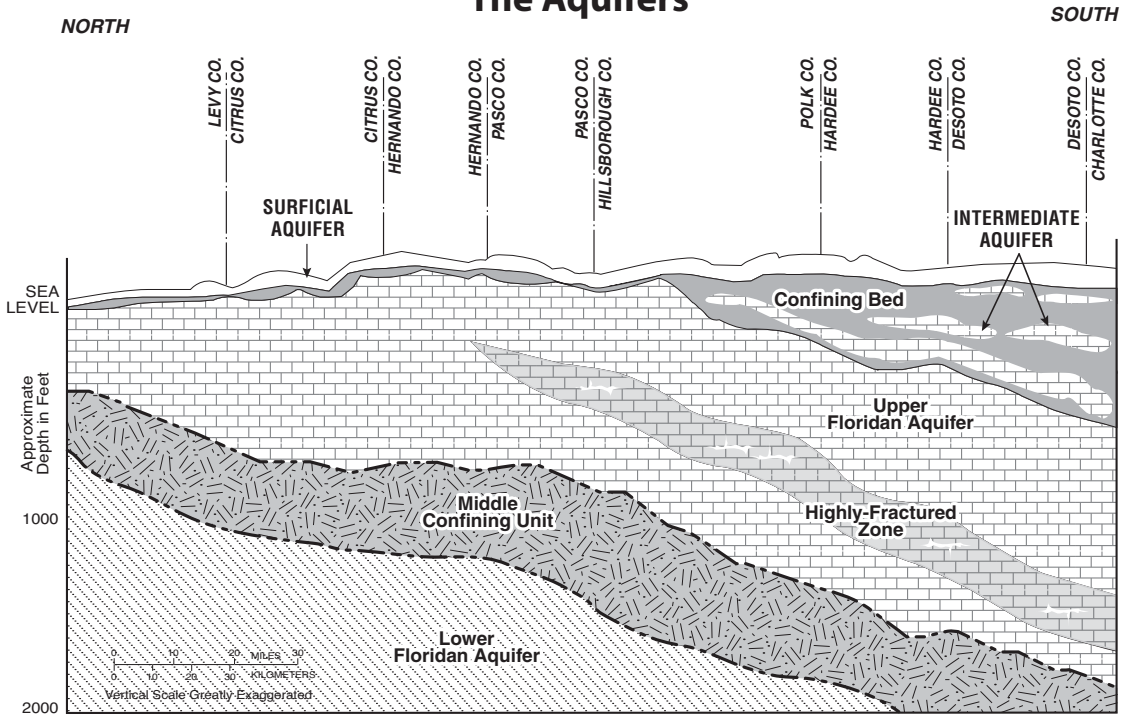
Porous limestone of the Upper Floridan aquifer

The Floridan Aquifer System

The Floridan aquifer system is a highly productive aquifer system that covers all of Florida and areas of Alabama, Georgia and South Carolina. The Floridan aquifer system is further subdivided into the Upper Floridan aquifer and the Lower Floridan aquifer. In west-central Florida, the Upper Floridan aquifer generally contains good water quality and is the principal source of water for much of the District. Underlying the Upper Floridan aquifer is a sequence of relatively impermeable rocks, which serve as a confining unit separating the fresher water of the Upper Floridan aquifer from the primarily saline water found in the Lower Floridan aquifer in the west-central Florida area.

The Upper Floridan aquifer consists of a thick continuous series of carbonate rocks, hundreds of feet thick, made up of limestone and dolomite. The thickness of the Upper Floridan aquifer tends to increase from north to south in the District, ranging from several hundred feet in the north to over 1,400 feet in portions of Manatee and Sarasota counties. In general, the Upper Floridan aquifer is confined over most of the central and southern portions of the District. However, the relatively thin and discontinuous clay confining units in the northern portion of the District result in the Upper Floridan aquifer becoming unconfined in nature over large areas.

The Aquifers



Aquifer Recharge and Discharge

Water continually moves into and out of most aquifers. These two processes, called recharge and discharge, are important in regulating the amount of groundwater found in any particular aquifer.

Aquifer recharge occurs when water percolates down through the soil and into the aquifer to replenish its water supply. Rainfall that soaks into the ground serves as the source of most of the groundwater within an aquifer.

However, the majority of the rain that falls does not find its way into aquifers. Most rainfall returns to the atmosphere through evaporation and transpiration, or runs off across the land into surface water bodies. A variety of factors, including the thickness of confining units, determines how much rainfall actually recharges aquifers.

Chassahowitzka Springs is an example of groundwater discharging to surface water.

Within the District, the amount of rainwater that enters the Upper Floridan aquifer ranges from 2 percent to 38 percent of the total rainfall. Generally, recharge is greatest in the northern areas of the District where the Upper Floridan aquifer is close to the land surface and the confining units are thin and discontinuous.

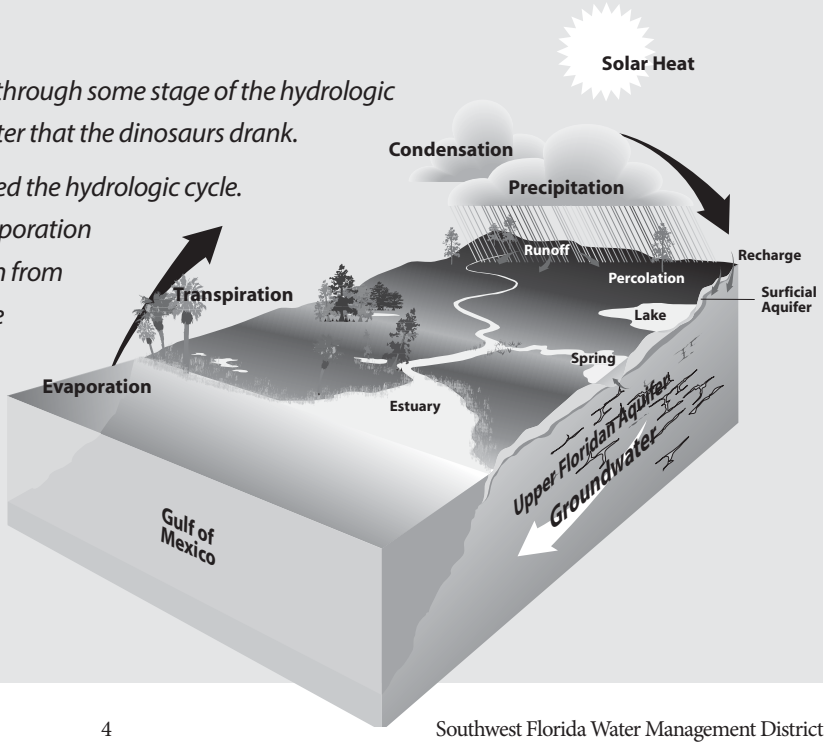
Aquifer discharge occurs when groundwater flows out of the aquifer, either toward the land surface or into an overlying aquifer. Discharge typically occurs in low-lying coastal areas and in surface water bodies such as wetlands, lakes, rivers and springs. Aquifer discharge can also occur as pumping from wells. Within the District, the major portion of groundwater typically leaves the aquifer along the coast.

The Hydrologic Cycle

Water is recycled over and over again, always passing through some stage of the hydrologic cycle. In fact, the water you drink today is the same water that the dinosaurs drank.

Water on earth moves through a continuous cycle called the hydrologic cycle. The sun's energy moves water into the sky through evaporation from soil and surface waters and through transpiration from plants. The water then falls back to the earth where the cycle begins again.

Aquifers play an important role in the hydrologic cycle by storing and moving water that seeps deep into the ground. Though it may take hundreds or thousands of years, groundwater eventually reaches the surface through discharge to begin the cycle again.



The Importance of Aquifers

The aquifers serve important functions that benefit not only our community but also the environment. The aquifers that provide water for our taps also play an important role in maintaining the ecological health of our area's springs, lakes, rivers, wetlands and estuaries.

Water Supply

Aquifers provide a significant source of water for all public, agricultural and industrial uses. In fact, groundwater withdrawn from aquifers constitutes about 80 percent of the water used within the District. Each of our aquifers is used in some capacity for water supply.

The surficial aquifer supplies only limited amounts of water for use within the District. In eastern portions of Polk and Highlands counties, where the aquifer is thickest, the surficial aquifer is often used for agricultural irrigation. In the southern coastal areas of the District — where the water quality of the intermediate and Upper Floridan aquifers is poor — there are zones within the surficial aquifer that are used for agricultural irrigation and for some household uses.

The Weeki Wachee River is an example of a spring-fed river.

In the southern portion of the District, the intermediate aquifers serve as an important source of water supply. Polk, Sarasota, Highlands, Hardee, DeSoto and Charlotte counties rely on the intermediate aquifers for public supply, agricultural irrigation and household uses.

The Upper Floridan aquifer serves as the principal water source for public supply, agriculture and industry in the District. It supplies more than 10 times the amount of water pumped from either the surficial or intermediate aquifers. In 2010, approximately 1 billion gallons of water were withdrawn each day from the Upper Floridan aquifer, primarily for agricultural irrigation and public supply. In the southwestern portion of the District, the Upper Floridan is very deep and has poor water quality, limiting most uses unless it is treated.

Surface Water Interactions

At first glance, it may seem that groundwater from aquifers and water from surface water bodies are separate. However, groundwater and surface water are interrelated.

In some cases, surface water bodies provide a method of direct recharge to, and/or discharge from, the aquifer. A spring-fed river is an example of a discharge area for an aquifer. Depending on the location and hydrologic conditions, rivers and streams can serve as both recharge and discharge areas. For example, when water levels in a lake or stream are higher than the surrounding groundwater, then the lake may provide recharge to the aquifer. Conversely, when water levels in the aquifer are higher than the adjacent surface water bodies, then the surface water may receive groundwater discharge. The level of interaction between surface water bodies and the aquifer also depends on the nature of the confining unit separating them.

Because of these complex interconnections, aquifers play an important role in a variety of surface water body conditions. These impacts can affect springflow or streamflow, water levels in lakes and wetlands, saltwater intrusion and overall biological health.

West-Central Florida's Aquifers at Risk

Groundwater provides a reliable, year-round source of water for the District. Therefore, it is important that this valuable natural resource be protected and responsibly managed. The two main issues that put west-central Florida's aquifers at risk are overdraft and contamination.

Overdraft

In Florida, the aquifers are constantly being recharged by rainfall. At the same time, water is being discharged or flows out of the aquifer to the coast or other surface water bodies. Overdraft occurs when the amount of groundwater withdrawn for our use exceeds the amount of water that naturally recharges the aquifer. When this occurs over an extended period of time, long-term declines in groundwater levels can occur. As population and development increase within the District, the demand for groundwater will also increase; in some areas, the District has experienced overdraft.

Florida's aquifers are generally surrounded by salt water. Overdraft may cause the salt water to move into the aquifers, making the groundwater unsuitable for use without extensive and costly treatment. This is called saltwater intrusion. Coastal and southern areas within the District are especially susceptible to saltwater intrusion.

In addition, overdraft may decrease aquifer discharge into surface water bodies. This results in the lowering of water levels and flows in surface water bodies. Lake levels may lower, river currents may slow and wetlands may decrease in size. These changes in water levels can cause loss of important plant and animal habitats and threaten the state's ecology.

Contamination

A variety of sources may contribute to contaminating the groundwater within west-central Florida's aquifers. Potential sources include excessive and improper use of fertilizer and pesticides, excessive pet and livestock waste in areas near water bodies, leaky underground storage tanks and septic tanks, landfills, industrial waste sites, chemical spills, injection and drainage wells, and improperly abandoned wells.

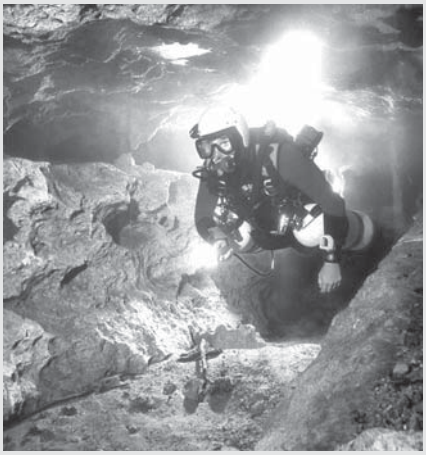
In areas of high aquifer recharge, contaminants may directly enter the aquifer. Contaminants that enter surface water bodies may also find their way into groundwater through aquifer recharge. The Upper Floridan aquifer in the northern portion of the District and the surficial aquifer throughout the District are especially vulnerable to contamination.

Increased contamination may eventually make groundwater unsuitable for use without expensive treatment. In addition, contaminated groundwater may discharge into surface water bodies, causing environmental damage and endangering wildlife.

Window Into the Aquifer

Springs provide a useful "window" into the Upper Floridan aquifer. Most springs are a result of water from the Upper Floridan aquifer rushing to the surface. By testing spring water, scientists can determine the quality of water within the Upper Floridan aquifer.

Most springs within the District are in good condition, but some show signs of stress. Contaminants from fertilizers and human and animal waste have steadily increased in some springs since the 1950s and 1960s. This raises concerns about the future of spring health and groundwater quality.



A diver enters an aquifer through a spring.

Protecting the Aquifers

A few simple actions can make a huge difference in protecting the aquifers within the District. These include proper use of pesticides and fertilizers, regularly inspecting septic systems for leaks, conserving water, and never dumping toxins and garbage into surface water or sinkholes. In addition, it is important to properly dispose of or recycle motor oil and antifreeze rather than pouring it on the ground.

Alternative Sources

The District actively encourages the development of alternative nongroundwater sources to help reduce the need to pump water from the aquifers. The District provides funding and technical assistance for alternative sources including surface water, seawater desalination, reclaimed water and conservation initiatives.

Education and Outreach

The District provides a variety of educational resources about the importance of protecting groundwater in the aquifers. These are available to the general public, teachers, parents, students and other government agencies. Resources include the District website, free print materials and grant opportunities.

Also, the District has started various programs to protect and improve groundwater within west-central Florida's aquifers. The District, along with federal, state and local governments, will continue its efforts to further improve the region's groundwater conditions.

Minimum Groundwater Levels

The District establishes minimum groundwater levels to determine how much water can be safely withdrawn from the aquifer. To date, minimum groundwater levels have been set only in areas where aquifer water quality affected by saltwater intrusion is a concern. Identifying and maintaining minimum levels within the aquifer can help slow saltwater intrusion.

Protecting Aquifer Recharge Areas

The responsibility of protecting aquifer recharge areas is shared by the District, the Florida Department of Environmental Protection, local governments and other organizations. District contributions include mapping recharge areas, providing technical assistance to local governments, providing funding for protection programs, and permitting to regulate the impacts of development.

Water Use Caution Areas

Areas where water withdrawals are causing or may cause negative impacts to the water, related land resources or the public interest may be designated by the District as water use caution areas (WUCAs). The majority of the southern portion of the District, starting from Pasco County, has been designated a WUCA.

As part of a WUCA, groundwater resources are comprehensively managed to make sure there are sufficient and sustainable water supplies for current and future users. These management activities range from funding projects for the development of alternative water supplies and resource recovery to implementation of additional regulatory requirements and restrictions.

Watershed Management Program

Under the District's Watershed Management Program, watershed management plans have been developed for all areas of the District. The plans identify top priorities and strategies for improving groundwater supply, other water supply sources, water quality, flood protection and natural systems.

The District works with other government agencies to implement these strategies. Many of the projects in the plans will be funded and completed through the combined efforts of federal, state, regional and local governments, as well as those of industry and private partners.

Glossary

Aquifer: *a layer of underground rock or sand that stores water*

Confined Aquifer: *an aquifer that is overlain by a confining unit and in which water levels in a well that is open to the aquifer rise above the top of that aquifer*

Confining Unit: *a layer of impermeable material that slows or prevents groundwater flow*

Discharge: *water that moves out of an aquifer*

Groundwater: *water found underground*

Hydrologic Cycle: *the continuous process of water moving from the earth's surface into the atmosphere and then back down to the surface*

Intermediate Aquifer System: *aquifers that are between the surficial and Upper Floridan aquifers in the southern portions of the District*

Karst Terrain: *a type of landscape that has been formed by the dissolution of the underlying rock*

Overdraft: *a condition that occurs when groundwater withdrawals consistently exceed aquifer recharge, resulting in a decline in groundwater levels*

Recharge: *water that moves into an aquifer*

Saltwater Intrusion: *the movement of salt water into aquifers*

Surface Water: *water found aboveground*

Surficial Aquifer: *an aquifer that is present near land surface*

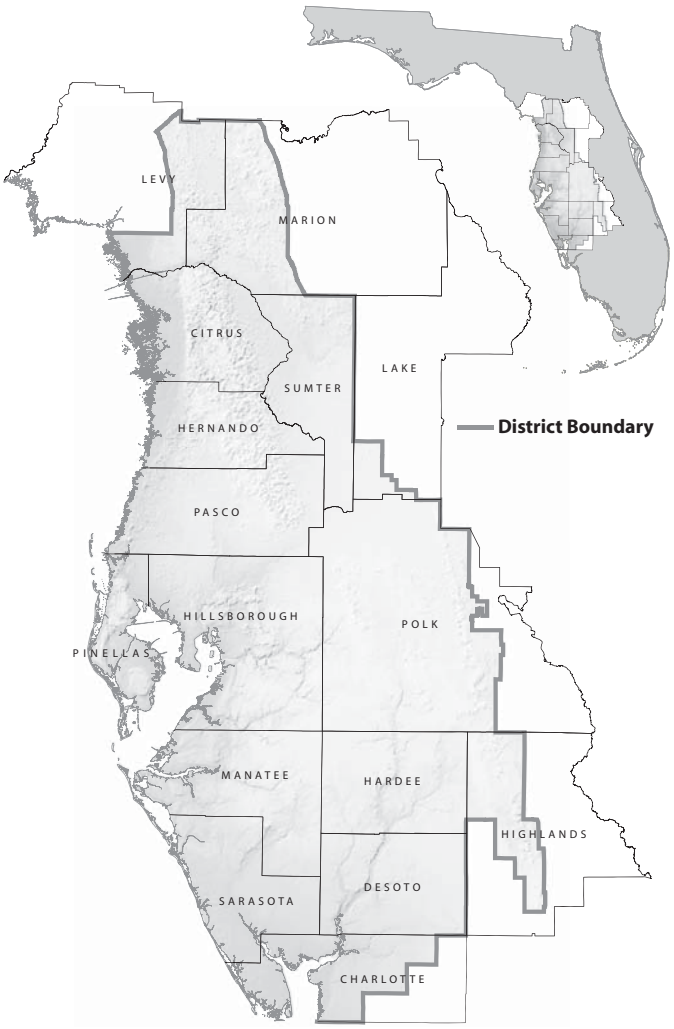
Transpiration: *process in plants by which water is taken up by the roots and released as water vapor by the leaves*

Unconfined Aquifer: *an aquifer that is not overlain by a confining unit*

Upper Floridan Aquifer: *the largest, highly productive aquifer in Florida and the major source of water within the state*

Water Table: *the water level of an unconfined aquifer*

The District manages the water resources for west-central Florida as directed by state law. The District encompasses roughly 10,000 square miles in all or part of 16 counties, extending north to Levy County, south to Charlotte County and inland to Polk and Highlands counties, serving a population of more than 5 million people.



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