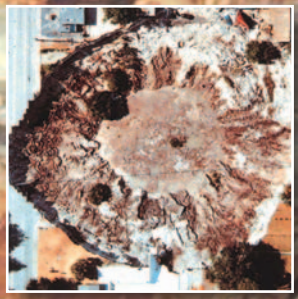
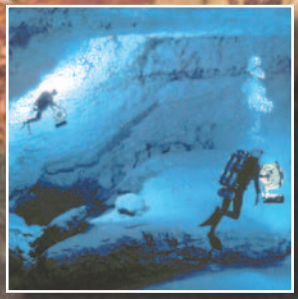
Southwest Florida Water Management District

Sinkholes





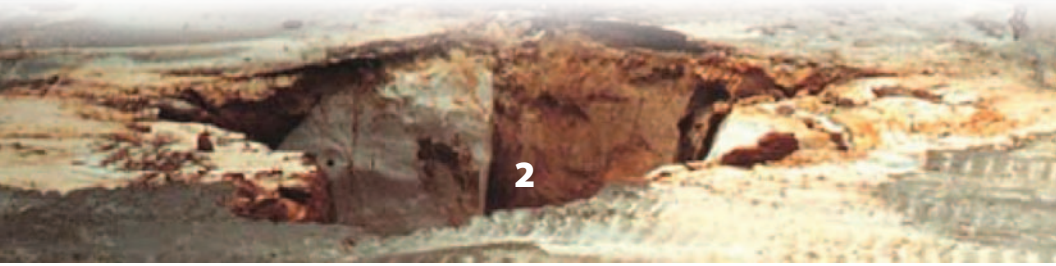
Florida — Land of sunshine, beautiful beaches and ... sinkholes!

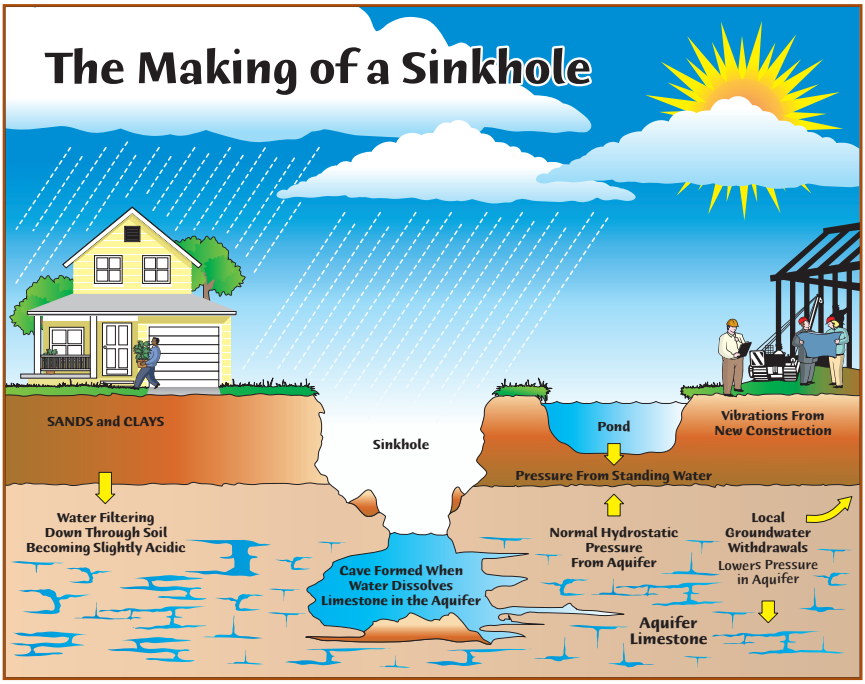
Sinkholes can be depressions or collapses in the land surface, or may be hidden from view below the surface. Sometimes referred to as "sinks," they are widely distributed in the northern and central counties of the Southwest Florida Water Management District (District) (see map on page 5). They can be shallow or deep, small or large, but all are a result of the same general geologic processes.

For more than 60 million years, ancient shallow seas covered what is now Florida. Factors relating to the chemistry of the water and the chemistry of the plants and animals that lived here resulted in limestone being deposited beneath these ancient seas. Eventually, the seas lowered to where they are today, leaving a base of predominantly limestone bedrock covered with sand and clay for us to live upon.

This limestone is thousands of feet thick and underlies the entire state and portions of the Atlantic Ocean and the Gulf of Mexico. When the limestone was originally deposited, it was laid down in layers or beds. These layers have slight differences in chemical composition, hardness and thickness. Earth processes are in constant motion. As a result, the limestone cracks, breaks and develops fractures, and weak layers slowly dissolve.

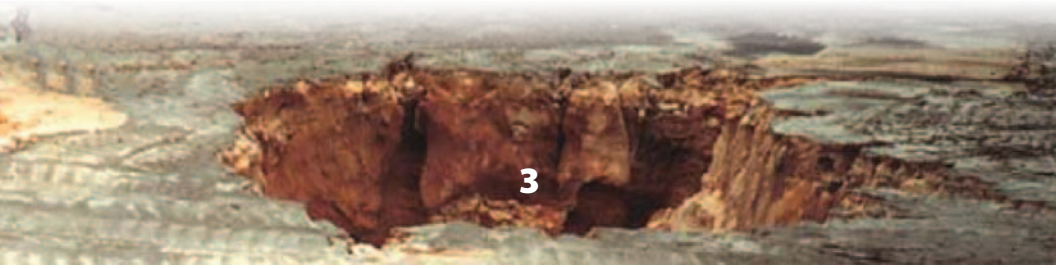
The essential factor of all sinkhole development is the dissolving of the underlying limestone by slightly acidic water. As rain falls through the atmosphere, it absorbs carbon dioxide and forms a weak carbonic acid. As this water moves through the soil zone, it reacts with living and decaying plant matter and becomes more acidic. The acidic water slowly dissolves limestone, especially along the fractures and weak layers. This chemical erosion eventually causes voids or cavities into which overlying sediments may collapse or subside. The result of chemical erosion of limestone, followed by physical collapse or subsidence, is a sinkhole.





Much of Florida's landscape is composed of many kinds of "karst" landforms. A karst terrain is a land surface produced by water dissolving the bedrock and is characterized by sinkholes, cavern systems and disappearing streams and springs.

The buried karst of the southern half of the District receives much less infiltration of rainwater and is much more stable than the northern half. The reason is that the ground water in the southern part of the District is well confined due to thick sediment formations. These formations contain beds of sand, large amounts of clay, and limestone. The thickness and the type of materials that overlie the limestone determine the type of sinkhole that may form.

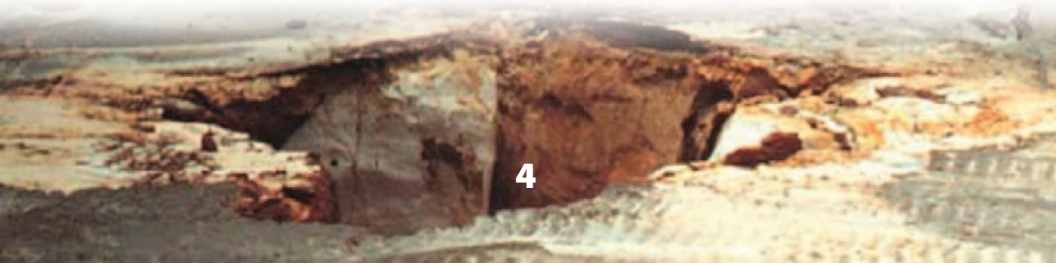


Natural or Induced?

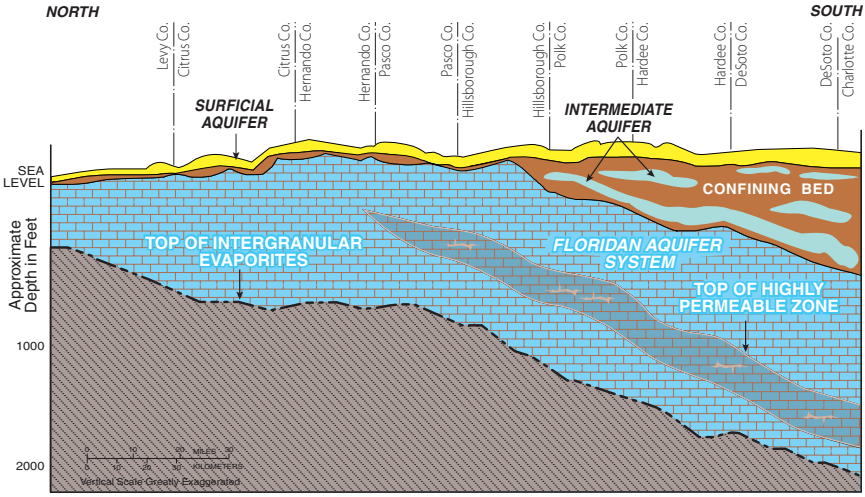
Sinkholes occur as part of a natural process of erosion of the limestone by water. Ancient cavities dissolved in the limestone require a triggering mechanism to cause the collapse. In predevelopment times, sinkholes were usually triggered by heavy rains or a flood, which made the soil "roof" over the cavity very heavy so that it eventually collapsed into a preexisting cavity below. Droughts can also lower the groundwater levels, reducing the buoyant support of a cavity roof and prompting a collapse. The combination of droughts or low water levels followed by excessive rainfall can accelerate sinkhole development. Natural sinkhole development still occurs in Florida.

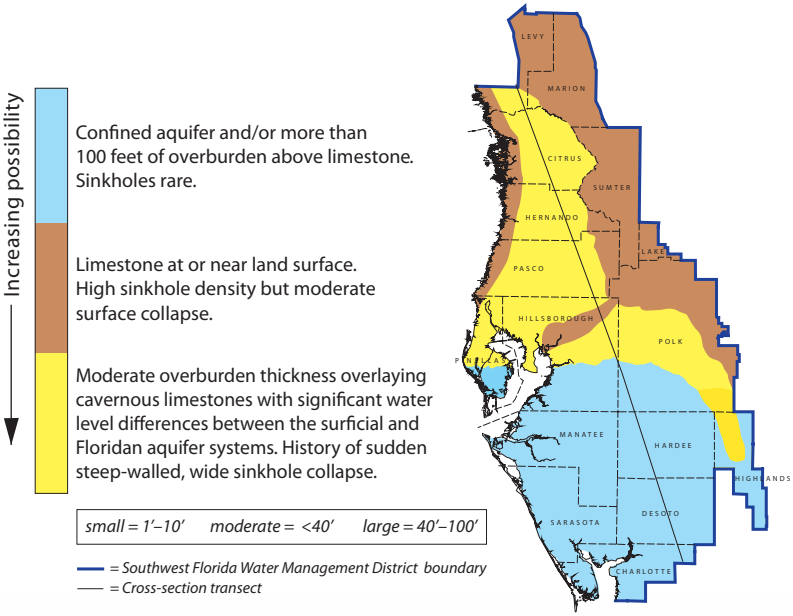
Increased numbers of sinkholes can generally be attributed to changing or loading of the earth's surface with development such as retention ponds, buildings, changes in drainage patterns, heavy traffic, drilling vibrations or a sudden or gradual decline in groundwater levels. In urban areas, all these impacts may occur at the same time, accelerating any sinkhole tendencies. Urban construction, coupled with limestone depths of less than 200 feet, contributes to many of the modern sinkholes. For example, the lack of sinkholes in areas south of Hillsborough County can be attributed to the depth to limestone, which is generally greater than 100 feet. The thick sequence of sand and clay, identified as a confining bed above the limestone (shown in the cross section on page 5), seems to support this observation.

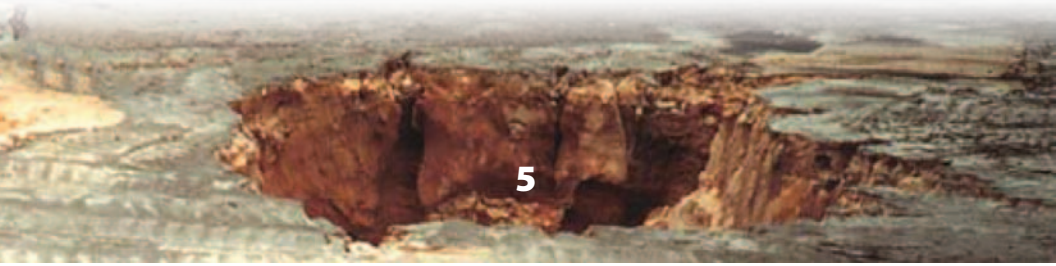
Whether natural or induced, there are several types of sinkholes. The majority occurring in southwest Florida are limestone solution sinkholes, cover-subsidence sinkholes and cover-collapse sinkholes.



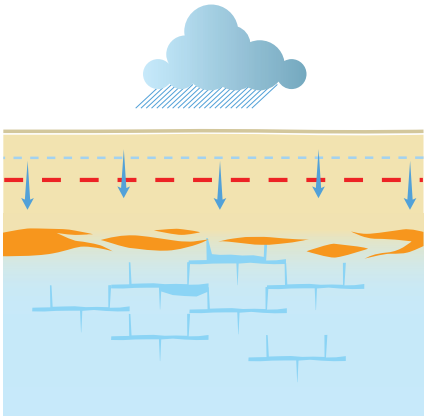
General Hydrogeologic Cross Section of the Region



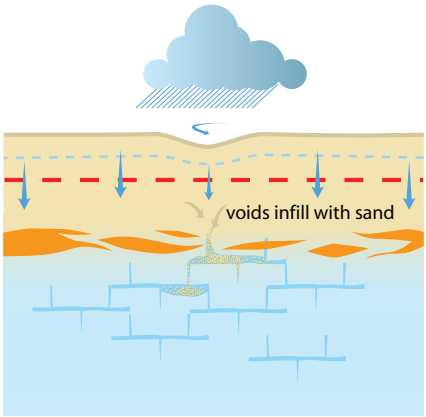




Stages of a Cover-Subsidence Sinkhole Development



Rainwater percolates through incohesive geologic deposits to the underlying limestone. Highly transmissive voids, cavities or joints in the limestone dissolve faster than others.



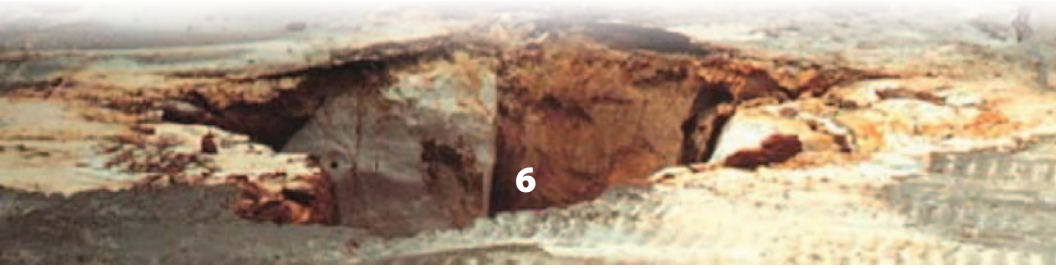
Differential solution of limestone bedrock is expressed by a depression at land surface that funnels water to the enlarged joints.

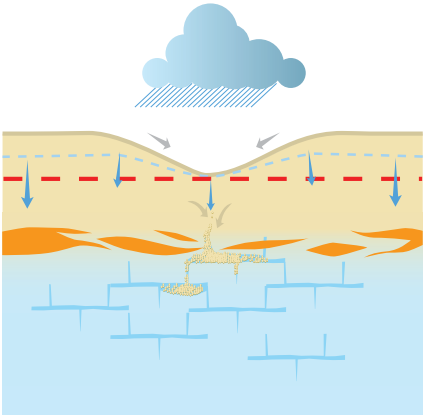
Limestone Solution Sinkholes

In parts of Pasco, Hernando, Marion, Citrus and Levy counties, limestone is exposed at the surface or is covered by a thin layer of soil. The limestone is subject to both physical and chemical processes that break down the rock. When this breakdown occurs, it usually forms a cavity or void. Due to the natural dissolving of limestone, these sinkholes develop continuously, but slowly.

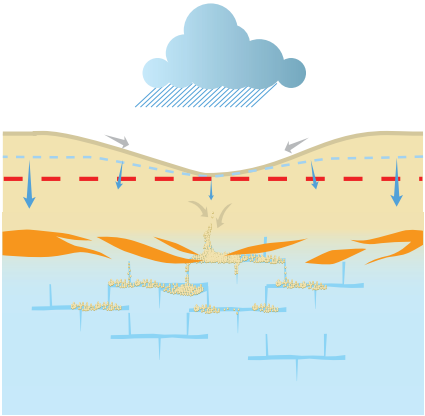
Cover-Subsidence Sinkholes

Where the sand layer may be as thick as 50 to 100 feet, with very little clay below it, the dissolving limestone is replaced by granules of sand that cascade down to fill the void. This type of sinkhole is referred to as a cover-subsidence sinkhole. These sinkholes are only a few feet in diameter and depth. Their small size is due to the fact that the cavities in the limestone cannot develop to appreciable size before they are infilled with sand.

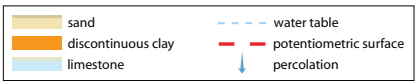




Sinkhole intersects the water table. Rate of dissolution is reduced because there is less head difference between the water table and potentiometric surface and, thus, less percolation.



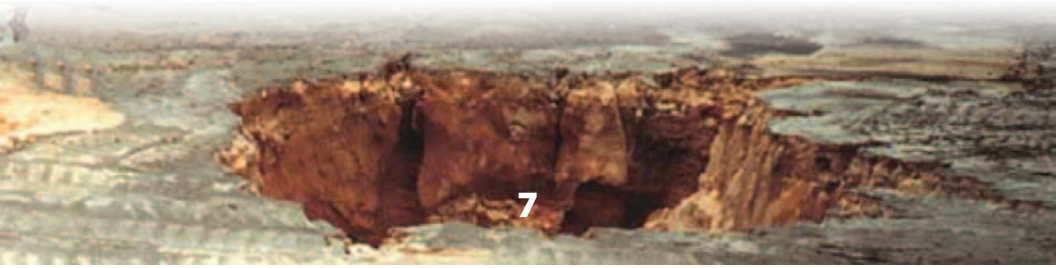
Sinkhole spreads laterally faster than it subsides.



Cover-Collapse Sinkholes

Generally, the deeper the sediment, the more clayey the soils tend to become. This clay provides some cohesiveness to the soil material above it, allowing it to bridge any existing cavity in the limestone. If this "bridge" collapses, it results in what is called a cover-collapse sinkhole.

The size of the sinkhole depends upon the size of the cavity. Cover-collapse sinkholes form the same way as cover-subsidence sinkholes but differ mainly in the bearing strength of the soil above the cavity and whether the sinkhole subsides slowly or collapses abruptly.



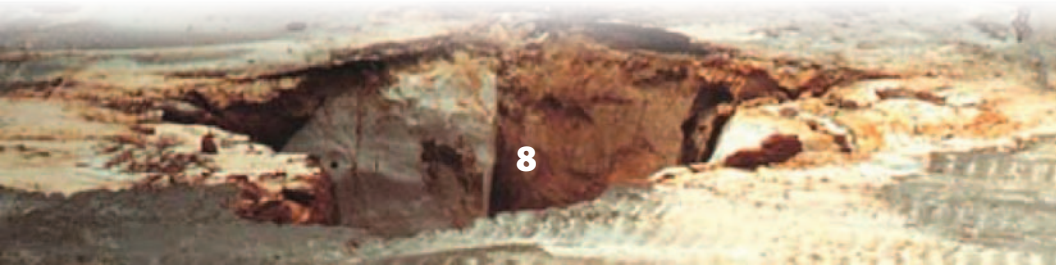
Flow in the upper Peace River entering a sinkhole in the riverbed.

Water and Its Role in Sinkhole Development

Water not only contributes to the chemical dissolving of the limestone but it also contributes to the support (or lack of support) it provides to the geologic formation material when it is lowered or raised. The water provides hydrostatic pressure, which is exerted on the clay layers that separate the shallow surficial aquifer from the deeper Floridan aquifer (drinking water) below.

Fluctuations in this hydrostatic force have a weakening effect on a limestone roof or a clay layer spanning a cavity. Oftentimes the water level will reduce the hydrostatic support to the clay "bridge" and increase the downward gradient of the overlying surficial aquifer, allowing movement of sediment and resulting in a sinkhole collapse.

Although the sinkhole may have occurred eventually, the lowering of the water level accelerates the sinkhole collapse, acting as a catalyst or triggering mechanism.



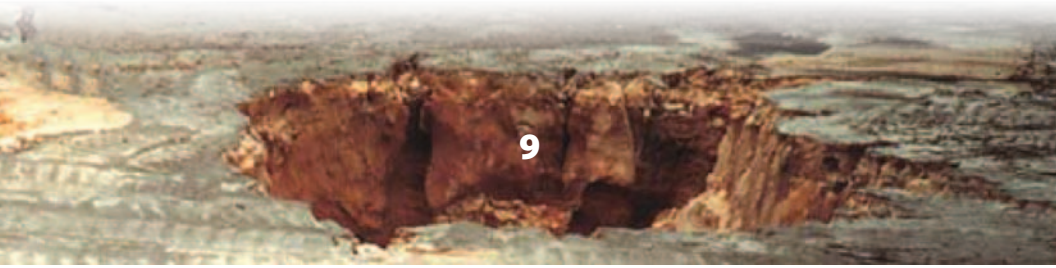
Sinkhole Misconceptions

When a sinkhole develops, anything on the land surface or in the soil below has the potential to end up in the aquifer. The same fascinating hydrogeologic system that allows dissolved rock to carry tremendous amounts of clean water for our use also allows surface water to carry contaminants through the sinkhole into the drinking water.

Many people see sinkholes as drainpipes, calling them "go-away holes." They think that out-of-sight is out-of-mind when, in actuality, the drain may go directly into their well or drinking water!

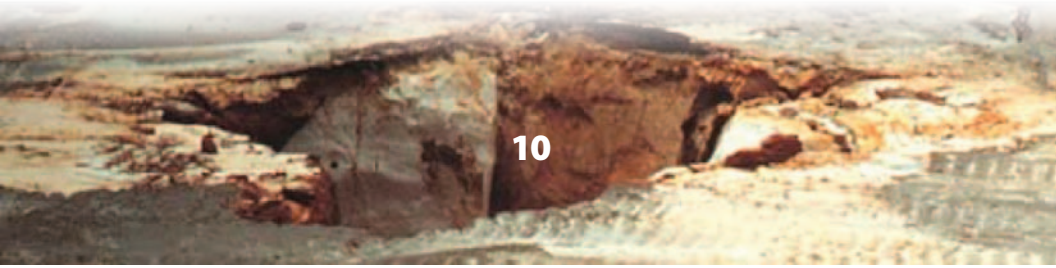
The area around a sinkhole should be kept free of garbage and wastes. Don't use it as a garbage dump or compost pit.

Make sure that fertilizers, chemicals, motor oils, animal wastes or pesticides are not allowed to drain into a sinkhole from the surrounding area.



Sinkhole Warning Signs

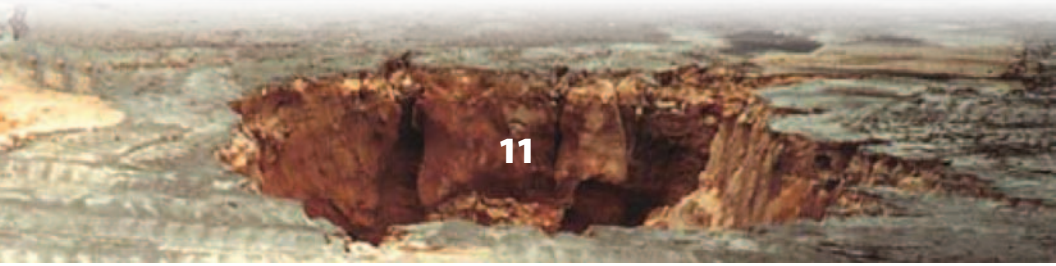
- Fresh exposures on fence posts, foundations and trees that result when the ground sinks
- Slumping, sagging or slanting fence posts, trees or other objects; doors and windows that fail to close properly
- Ponding — small ponds of rainfall forming where water has not collected before
- Wilting of small, circular areas of vegetation because the moisture that normally supports vegetation in the area is draining into the sinkhole that is developing below the surface
- Turbidity in water in nearby wells during early stages of sinkhole development
- Structural cracks in walls, floors and pavement; cracks in the ground surface



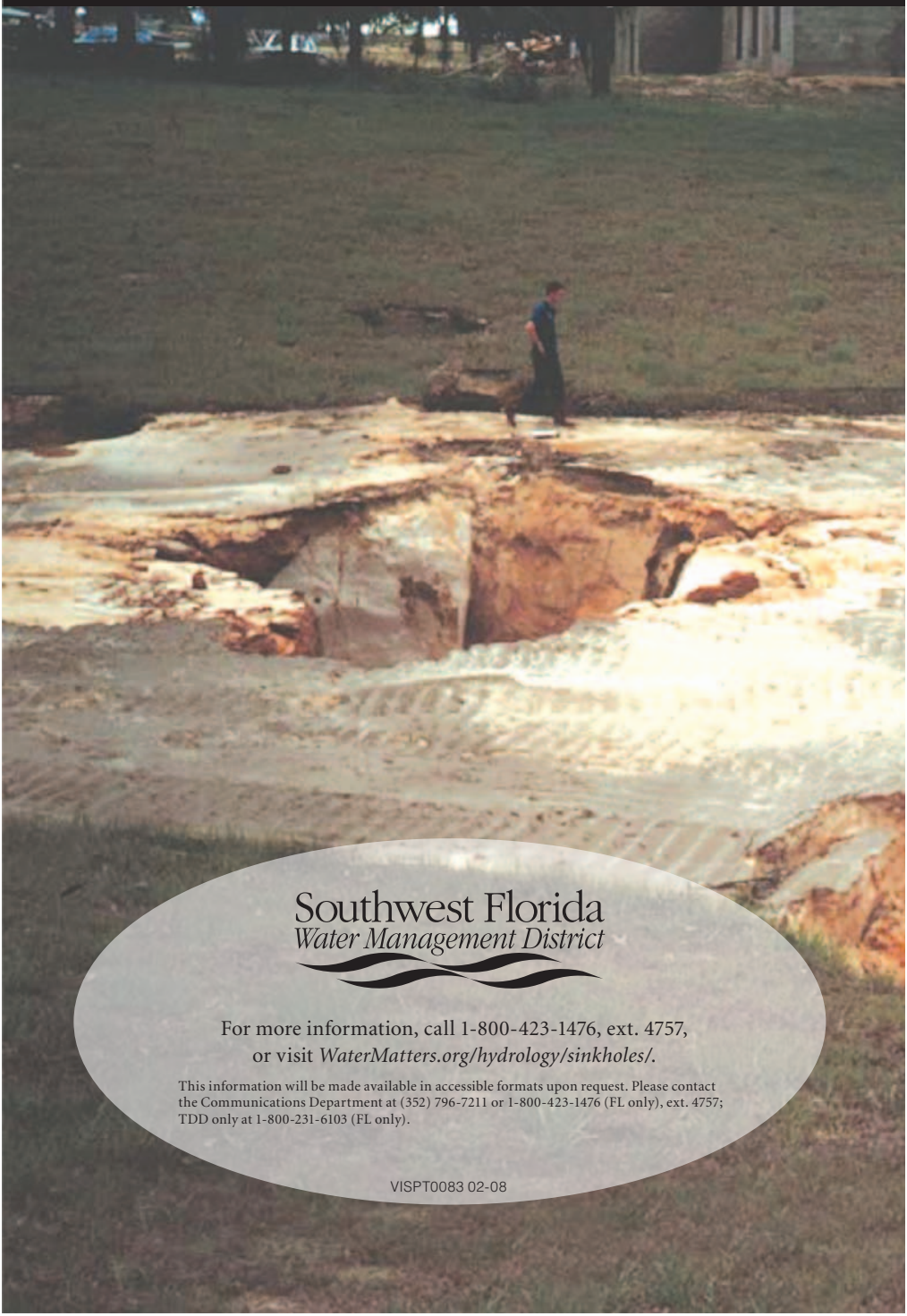
If a sinkhole has appeared on your property or a portion of your home has shifted or sunk, take these steps immediately:

- ☑ Provide for the personal safety of your family. Evacuate if necessary.
- ☑ Secure or move your valuable possessions if you can do so safely.
- ☑ Notify your insurance company or agent.
- ☑ Notify your city or county building inspection department.
- ☑ Mark the sinkhole or property with fencing, rope or tape to warn others of the danger. You could be held liable if someone is injured in the sinkhole.

If you have questions that your insurance agent can't answer, call the Florida Department of Financial Services' Consumer Helpline at 1-877-693-5236 or find state consumer information on the web at *MyFloridaCFO.com/consumers/Guides/Property/*.



Balancing Water Needs ... Protecting Water Resources



Southwest Florida
Water Management District

For more information, call 1-800-423-1476, ext. 4757,
or visit *WaterMatters.org/hydrology/sinkholes/*.

This information will be made available in accessible formats upon request. Please contact the Communications Department at (352) 796-7211 or 1-800-423-1476 (FL only), ext. 4757; TDD only at 1-800-231-6103 (FL only).

VISPT0083 02-08