



The Winter Park Sinkhole Then and Now

By S.E. "Jim" Jammal, PE and Jay W. Casper, PE, Nodarse and Associates Inc.

As we look back on the 28 years since the Winter Park Sinkhole, we can see significant gains in our understanding of sinkholes. However, in some areas the geotechnical engineering profession has not made significant progress and in fact may have stepped backward.

We now thoroughly understand the causes and mechanisms of sinkholes. We can also detect the possibility of sinkhole development with an increasing degree of certainty. However, still no sets of parameters can be considered reliable in prediction of when a sinkhole will form.

Considering everything we have learned, we have a reasonable and sufficient basis for most of the "W's," including the why, what, how and where, but the most important "W"—when—remains elusive. Unfortunately, we appear to have lost the momentum started when the Winter Park Sinkhole formed May 8-9, 1981.

THE SUPER SINKHOLE

The Winter Park Sinkhole opened just west of downtown Winter Park near the end of an extended drought that started in 1970. In two days, the Winter Park Sinkhole grew to 350 feet wide at the surface and 107 feet deep.

The event was unlike any geological happening ever in Central Florida. In the first few days of the event, the city of Winter Park had more tourists than Walt Disney World. The press coverage was as big as a Super Bowl or the opening of Disney World, with every major media outlet in the nation dispatched to Central Florida.

It was the "Super Sinkhole."

Following the event, the attention given to sinkholes intensified. Many long-held ideas about sinkholes were confirmed. It led to the creation of the Florida Sinkhole Research Institute, which provided valuable research and information for a decade. It also moved the state legislature to pass new laws requiring insurance companies to make available coverage for sinkhole losses.

However, in 1992, the City of Dunedin commissioned "The Dunedin Study" by the Research Institute, which focused on insurance claims. The study created split opinions among professionals and led to a cottage industry where the statutory definitions of sinkholes became too broad, enabling many to claim sinkhole damage simply because of minor subsidence or hairline cracks in the foundation. In addition, the state cut off funding for the Research Institute and slowed the research of sinkholes tremendously.

Let's take a look at three main areas of study in sinkholes and the growth of our knowledge of sinkholes from right before the Winter Park Sinkhole event until today.

CAUSES (WHAT, WHY AND HOW)

1981: Before the Winter Park Sinkhole, much of the study of sinkholes in Florida started just 20 years earlier through pioneers such as Dr. M.E. Ardaman, George F. Sowers of Georgia Tech and Dr. R.O. Vernon of the Florida Geological Survey. They had developed a sound understanding of the sinkholes throughout the state, but had only limited evidence to confirm their thoughts.

The Winter Park Sinkhole helped the profession confirm many of their ideas and provided modeling for all other future sinkhole events, including the following:

- It validated that the maximum size of a potential sinkhole can be predicted.
- It confirmed that a collapse is preceded by a cone of depression in the water table of the shallow aquifer.
- It demonstrated the mechanism of the cover-collapse type of sinkhole.
- It confirmed the requirements or pre-requisites that must exist within the subsoil for sinkholes to develop.
- It demonstrated that even large sinkholes can be self-healing or self-remediating as evidenced by the recovery of water levels to the shallow groundwater table.

2009: Today, we thoroughly understand the causes of the various types of sinkholes. While there has not been a complete consensus or uniformity in describing or classifying sinkholes, we are finally seeing some consistency. The four general classifications we recognize in Florida practice are:

- Limestone Solution.
- Limestone Collapse.
- Surface or Cover Subsidence.
- Cover Collapse.

We also know that sinkholes may be experienced to varying degrees of frequency or severity depending on the following factors:

- Extent of solutioning and the cavity system in the limestone.
- Depth from ground surface to the top of the limestone – the more shallow the limestone, the higher

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Early stages of Winter Park Sinkhole.

the frequency.

- Characteristics, condition and thickness of the unconsolidated sediments that overlie the limestone.
- Hydrogeology of the area, in particular the head difference between the water table of the surficial sand aquifer and the piezometric surface of the Floridan aquifer.
- Extent of recharge or circulation of groundwater within the unconsolidated sediments that overlie the limestone.

DETECTION (WHERE)

1981: Prior to the formation of the Winter Park Sinkhole, the practice relied widely on personal intuition as to whether the possibility of a sinkhole exists.

Until that point, there was a good deal of literature written on the subject, however very little of it dealt with Florida. Most of the literature concerned diamond mines in South



Today, Lake Rose in Winter Park Sinkhole.

Africa and collapses during highway construction in Alabama. While there are plenty of areas where Karst geology exists worldwide, the contributing causes of sinkholes in Florida were different than just about any other place on the globe.

We knew they happened in Florida but not much else. There were large sinkholes in Florida which had formed before the Winter Park event, but those were usually in the middle of nowhere and received little attention. The Winter Park Sinkhole brought exposure, media and new science to the study of sinkholes.

2009: Over the past 28 years, our industry has progressed significantly in detection of possible sinkholes. Thanks to the work of Richard C. Benson and other pioneers including Bill Wilson, William C. Sinclair, J. W. Stewart, A. E. Gilboy, J. W. Cooper, Sam Upchurch, John Garlanger, J.G. Newton, and P. E. LaMoreaux, the evolution and application of geophysical survey methods has made detection of sinkholes more accurate because we can base our assumptions on factors that were proven through the study of the Winter Park Sinkhole.

When looking at detecting sinkhole activity, we examine the site and area above ground and the subsoil conditions.

In site conditions, we look for the following factors, among others:

- Rolling upland with closed depressions.
- Stressed vegetation.
- Primary drainage through infiltration, not streams.
- An area with a history of sinkholes.

In many cases, particularly in areas believed to present low sinkhole risk, these factors alone may provide a level of assessment sufficient to show there is only a minimal risk of sinkholes.

However, the Winter Park Sinkhole enabled us to develop a significant amount of new technology and heightened the awareness of the affect of subsoil conditions; we look for the following additional factors:

- Stratification not uniform.
- Highly variable penetration test “N” values.
- Varying texture within the Hawthorn clays (confining layer for the aquifer).
- Depressed non-artesian water table.

Today, we realize that the more prerequisites and indications are found, the more likely a sinkhole is to occur in a given area.

PREDICTION (WHEN)

1981: When the sinkhole opened, we had little to reference on predicting when a sinkhole would open in Florida. Again, much had been researched on sinkholes in other areas of the world, but Florida’s geology provides different geological circumstances.

2009: Today, the science of predicting sinkholes has progressed little. Unlike detection, there are no commonly held factors to determine when a sinkhole will open.

Many of us can try to predict, even though there are no written or verbalized set of criteria. The graphs



Winter Park sinkhole reaches community pool.



Pool fails after undermining by several feet.



Sinkhole still growing and swallowing a house and large trees virtually intact.

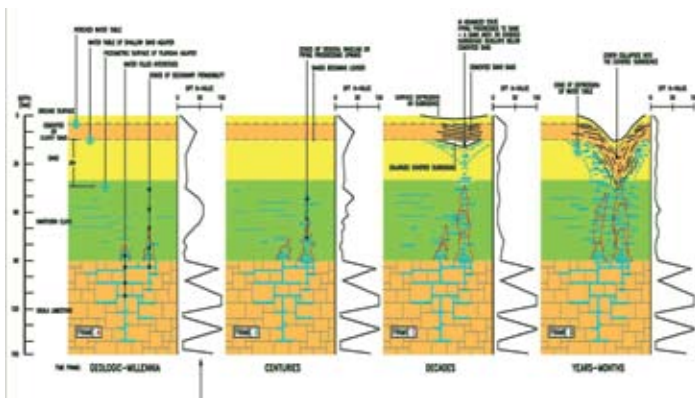


Figure 1. Sinkhole Development Timetable.

in Figure 1 represent a situation similar to piping in an earth dam, turned on a 90 degree angle. The closer the raveled zone is closer to the surface, the closer the timetable on a sinkhole.

However, the comparison to piping is not an official manner of prediction, only a tool some in the field employ.

WHERE DO WE GO FROM HERE?

As we look to the future of sinkhole research in our industry, it is critical to move our profession away from relying solely on state statutes when dealing with insurance and return to science to develop credible prediction tools.

After the Winter Park Sinkhole, legislation was passed to include sinkhole coverage for insurance. For the first 10 years, an engineer was required to see a hole in the ground for a sinkhole to be declared.

After the Dunedin Study, simple subsidence of the ground was added as a basis for an insurance claim. Under that assumption, we will almost always find a sinkhole probability, but it's not based on sound science and from an engineering point of view, there would not be the same level of concern. This led to widespread declarations of sinkholes, including many subsidence cases which were probably not sinkhole-related, and a spike in insurance claims.

Recently, the state passed new laws when dealing with insurance claims and sinkholes. The new statute, 627.706, passed in 2007 breaks the designation of sinkholes for insurance purposes into "catastrophic ground cover collapse" and "sinkhole loss." It will be interesting to see how the definition of each will lead to new claims or a reduction of claims. However, we should consider establishing a crack-size threshold as a basis for treatment of claims to help define the new legislation. Such a threshold is practiced in the United Kingdom for shrink-swell clays.

Now, the geotechnical profession should look at where it has been, where we are and how best we should move forward. The detection and prediction of sinkholes should not be a statutory approach. It should be based on science.

We have not performed or encouraged enough research to establish those scientific factors. Much like what happened after the Winter Park Sinkhole, we need to put an emphasis on research to establish guidelines or basis for prediction. ■

About the Authors:



S. E. "Jim" Jammal, PE, with 48 years of dedication to geotechnical engineering excellence is recognized as one of Florida's most respected geotechnical engineers and the leading authority on Florida's Karst sinkhole subsidence. He is frequently consulted by owners, developers, the media, and government regarding the sinkhole phenomena and is considered a pioneer in raising the consciousness of the geotechnical engineering profession in Florida.



Jay W. Casper, PE has over 28 years of geotechnical experience and has directed over 2,000 geotechnical projects throughout Central Florida. He has worked on almost every imaginable type of residential or commercial development, stormwater, high-rise office, hotel or government buildings, major industrial projects, roadways and bridges. He has had a special interest in sinkholes since his first degree in geology, through ME degree research on sinkholes, and from almost 25 years of working with Engineer Jammal.

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