Engineering

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SUBSIDENCE ENGINEERING IN FLORIDIAN KARST TERRAIN

MEA was requested to perform a subsidence engineering study of a proposed large retail construction site in Florida. This site is underlain with a reef derived limestone formation which is known to have been solutioned (karst) and susceptible to result in dolines and sinkholes on the ground surface. However, performing a geotechnical investigation in karst terrain is one of the more difficult and yet important geologic environments to assess. This is because the geologic environment represents an erratic and essentially unpredictable ground conditions where stable ground is adjacent to unstable ground in what appears to be an arbitrary pattern. Therefore, the reliability of conventional surface geotechnical investigations alone are not very effective in quantifying the future risk of subsidence and the associated potential ground movements and damage.

Subsidence engineering investigation in karst terrain can be done in a 2 phased approach. The first phase is an assessment from all available site information. It also includes a site visit to inspect for any subsidence related surface features which would remain undetected from even higher resolution topographic data. This was the case on this project site where such features were detected. Figure 1 shows a doline which was found from the site inspection.

During the second phase of the subsidence investigation, subsurface exploration is included. MEA has used surface geophysics as a guide to assess the potentially more problematic areas because of the difficulty in assessing the subsidence potential of a project site in karst terrain. MEA has found from experience that the best means of identifying the location of critical karst related features in this Floridian environment was with the use of surface electric resistivity technology (ERT). Although we have found ERT not to be a full proof investigative tool, and it provides some practical estimation of the site's karst condition. Moreover this method among others are utilized by other investigators, although the traverses done are few and cursory in nature given when one considers the erratic condition of the karstified bedrock structure or system. Consequently, at the proposed large retail site at Florida, MEA performed closely spaced ERT traverses across the project area of concern. These resistivity transections are shown in Figure 1. This data was then used to create a map depicting anomalous areas identifying the areas of greatest concern. See Figure 2.

FIGURE 1 DOLINE DISCOVERED DURING SITE INSPECTION

MEA MARINO ENGINEERING ASSOCIATES, INC.
1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com

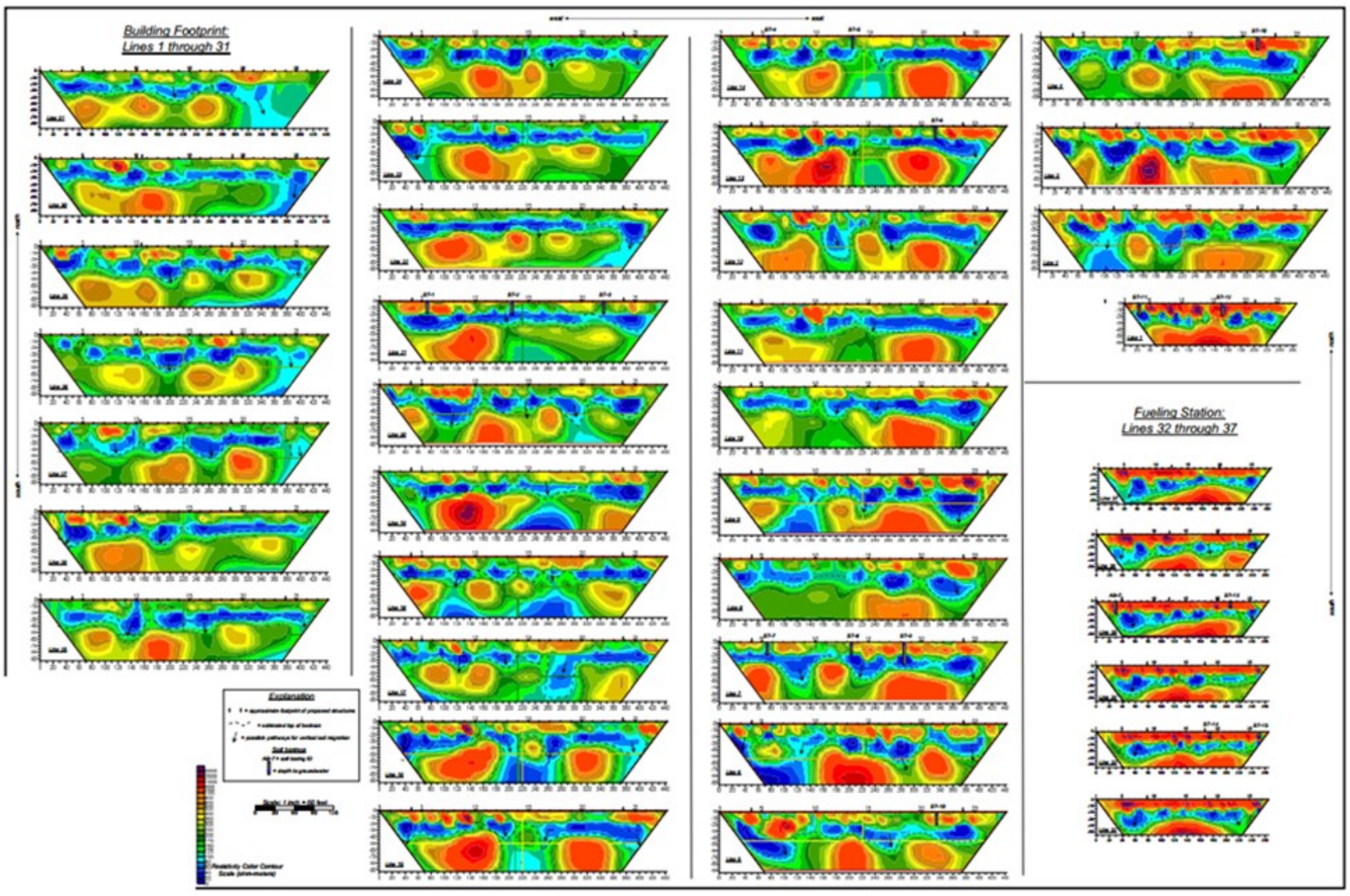

FIGURE 2—MEASURED ELECTRIC RESISTIVITY ZONES WITH DEPTH ALONG DIFFERENT TRAVERSES

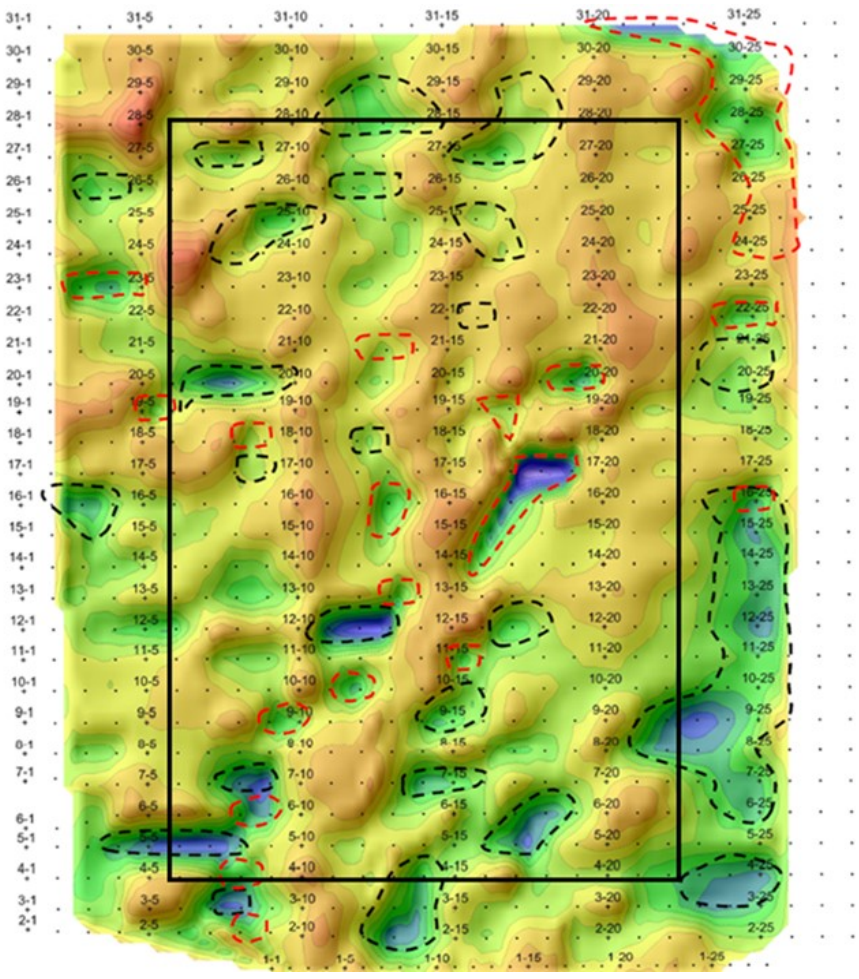

FIGURE 3 MAP OF AREAS INDICATING SIGNIFICANT AREAS OF POTENTIAL KARSTIFICATION

These areas of greatest concern were drilled and sampled with about 50% of these areas representing false positive indications. Significant karst features from drilling were found in the remainder of these identified areas. To mitigate the potential surface subsidence in these verified karstified areas upstage low mobility grouting was specified and monitored by MEA. Figure 3 depicts the low mobility grouting being performed in one of these karstified areas of greatest concern.

CONCLUSION:

It is impossible to identify all the significant subsurface karst feature across an area of a project construction with exploratory drilling given the erratic nature of this geologic environment. Once subsidence and significant damage are predicted, the most thorough mitigation approach would entail both structural and foundation measures to the building to bridge the potential subsidence and void fill and compaction grouting with closely spaced injection holes. Where more risk is tolerated, identified target areas from extensive ERT mapping can be stabilized via down hole grout injection.

Other MEA Publications that may be of Interest:

What is Karst Subsidence?
https://meacorporation.com/what-is-karst-subsidence/
Risk Investigation of Karst on Sinkhole/Subsidence Prone Lands
https://meacorporation.com/wp-content/uploads/Update34web.pdf
Property Management System for Geotechnical Risks
http://www.meacorporation.com/wp-content/uploads/Update-44.pdf

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 30 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact MEA at the address listed below.

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PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com