July 28, 2021

Mr. Christian Stark
LIV Development, LLC
2204 Lakeshore Drive, Suite 450
Birmingham, AL 35209

Reference: Report of Electrical Resistivity Survey
Springdale Road Development
2517 Springdale Road
Louisville, Kentucky
ECS Project Number: 26:2519-A

Dear Mr. Strak:

As authorized by your acceptance of our proposal, ECS Southeast, LLP (ECS) has completed an Electrical Resistivity (ER) Survey at the property located at 2517 Springdale Road in Louisville, Kentucky.

PROJECT INFORMATION

ECS understands that based on our review of geologic map information discussed in our original preliminary geotechnical investigation (ECS Report No. 61:2519) dated May 28, 2021, the aforementioned site falls in a moderate karst potential area. In order to further evaluate the site for karst potential, ECS has completed an Electrical Resistivity Survey study at the site.

ELECTRICAL RESISTIVITY SURVEY

To gain a better understanding of the subsurface conditions, an ER survey was performed at the project site. An ER survey is a non-invasive exploration method that can aid in the characterization of subsurface soil and rock conditions. During the subject ER survey, pins were driven into the ground, electrical current was applied to the ground at two locations, and a resulting voltage was recorded at two other locations. This allowed calculation of the apparent resistivity at a point centered between the four pins and at a depth related to the spacing of the pins. By moving the pins laterally, and by changing the spacing between the pins, a profile showing the apparent resistivity values at various depths along a line was produced. To aid in data collection, an array of multiple pins was laid out and connected to a single cable. This cable was then connected to an electrical resistivity meter which automatically selects various pin combinations to measure the apparent resistivity values across the line.

Once the apparent resistivity data were recorded, the data were modeled to estimate the electrical resistivity profile. This modeled resistivity profile was then correlated to soils, voids, fracture zones, rock surfaces, and other geologic features.

ECS conducted the ER survey utilizing a Syscal R1 24 probe automatic switching resistivity meter. Probe spacing was determined in the field and was designed to provide a maximum exploration depth of approximately 70 feet. A total of six (6) ER survey line were performed in the investigated areas. A site plan displaying the approximate location of the survey line is attached to this report.

ELECTRICAL RESISITIVITY SURVEY RESULTS

Data collected during this study were analyzed utilizing Resix 2DI, an electrical resistivity two-dimensional modeling program. The specific modeling method used was a smooth modeling inversion method, which uses a rapid least squares inversion of apparent resistivity values to develop a smooth model of the subsurface characteristics. The results of this study provide subsurface information to an approximate depth of 70 feet below the ground surface. Modeled resistivity values were compared within and between profiles to develop an indication of the subsurface conditions.

Additionally, the results of each ER survey line with the approximate estimated bedrock elevations and any obvious possible karst features noted. The lines included represent a 2-dimensional cut or slice at each line location shown on the Exploration Location Diagram included in the Appendix. These lines are oriented with the existing ground surface located at the top of the profile, and the resistivity readings with depth below. The graph is color coordinated based on the apparent resistivity vales generally ranging from values less than 25 ohm-feet to greater than 6,000 ohm-feet.

The table below generally describes what we can infer about the soil/rock properties based on the different color spectrums. It should be emphasized that we did not complete any subsurface boring with this investigation to ground-truth our resistivity lines, so some adjustments may need to be made if borings are completed.

Table 1 – Resistivity Values

Resistivity Values (Color Spectrum)	Description
<25 to 200 (Blue)	Areas that show up as blue in color are indicative of lower resistivity zones with the darker blue color indicating the lowest resistivity zone. Soils that are blue in color typically represent soils which are relatively high in moisture content. In general, as soils become more and more saturated they tend to become less stiff in consistency. Furthermore, when these softer soil zones extend deeper in the profiles, specifically below other nearby areas of interpreted bedrock, these areas can be indicative of potential slots/solution features in the existing bedrock profile.
200 to 750 (Green)	Areas that show up as green in color are typically indicative of relatively stiff soil zones.
750 to 1,500 (Yellow to Brown)	Areas that show up as yellow to brown in color are typically indicative of bedrock or chert laden soil zones. When yellow and/or brown resistivity zones are encountered in the upper portions of the resistivity profile and are surrounded by lower resistivity green or blue resistivity zones on all sides, this is typically indicative of soil zones with high chert contents or possibly floating boulders. These zones could also be indicative of buried construction debris or other highly resistive materials; however, based on our understanding that this site has not been previously developed, this is likely not the case for this site. If these yellow to brown zones are encountered directly above red to purple zones, this is typically indicative of the top of bedrock/weathered rock. Furthermore, reasonable depths of the yellow and brown zones (10+ feet) extend into the overall rock profile, these areas may be indicative of highly weathered or fractured bedrock.
1,500 to 6,000+ (Red to Purple)	Areas that show up as red to purple in color are typically indicative of competent bedrock zones. It is also possible for these zones to be encountered in the upper portions of the soil profile (similar to the yellow to brown zones) with can be indicative of floating boulders or very high chert contents. Also, isolated very high resistivity zones (typically dark purples) could be indicative of possible voids; however, with resistivity values alone, this is very difficult to determine.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the ER survey, we offer the following conclusions and recommendations to help guide you in further decisions.

- Based on the results of the ER survey there appear to be two potential deep soft soil zones that may be indicative of a potential karst feature along ER Survey Lines 2 and 4; however, it may just be an isolated highly saturate soil zone. Please see the map in the appendix of this report with the approximate locations outlined.

  Based on this ECS recommends that when the final geotechnical investigation is completed, one boring should be completed at each of these locations and extended to the depth of auger refusal. If soft soil zones or reveling is encountered in either of these borings, ECS will provide additional remediation recommendations at that time. If there is not indications of obvious soil raveling or soft deep soil zones, these features may be indicative of an area where the weathering process to create a potential karst feature may be beginning; however, it would likely not develop into an active karst feature during the anticipated usable life expectancy of the proposed construction.

GENERAL COMMENTS AND CLOSURE

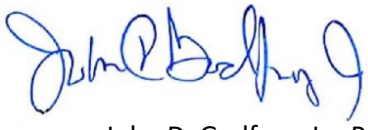
The conclusions and recommendations provided in this report are based upon the information provided to us at the time of the report, the results of the field reconnaissance at the time of the visit, and our experience with similar projects. If additional data becomes available or if varying conditions are encountered, ECS should be notified to review our recommendations and make revisions, as needed. Our scope did not include design of any repair.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the information presented in this report, or if we can be of further assistance, please contact us at 615-885-4983.

Respectfully,

ECS SOUTHEAST, LLP

Eric M. Gasiecki, P.E.
Geotechnical Department Manager



John D. Godfrey, Jr., P.E.
Principal Engineer

Attachments: ER Survey Location Diagram
ER Survey Lines 1 through Line 6
Important Information

Legend

ER Lines

Further Investigation Areas

Springdale Road
Louisville, Kentucky
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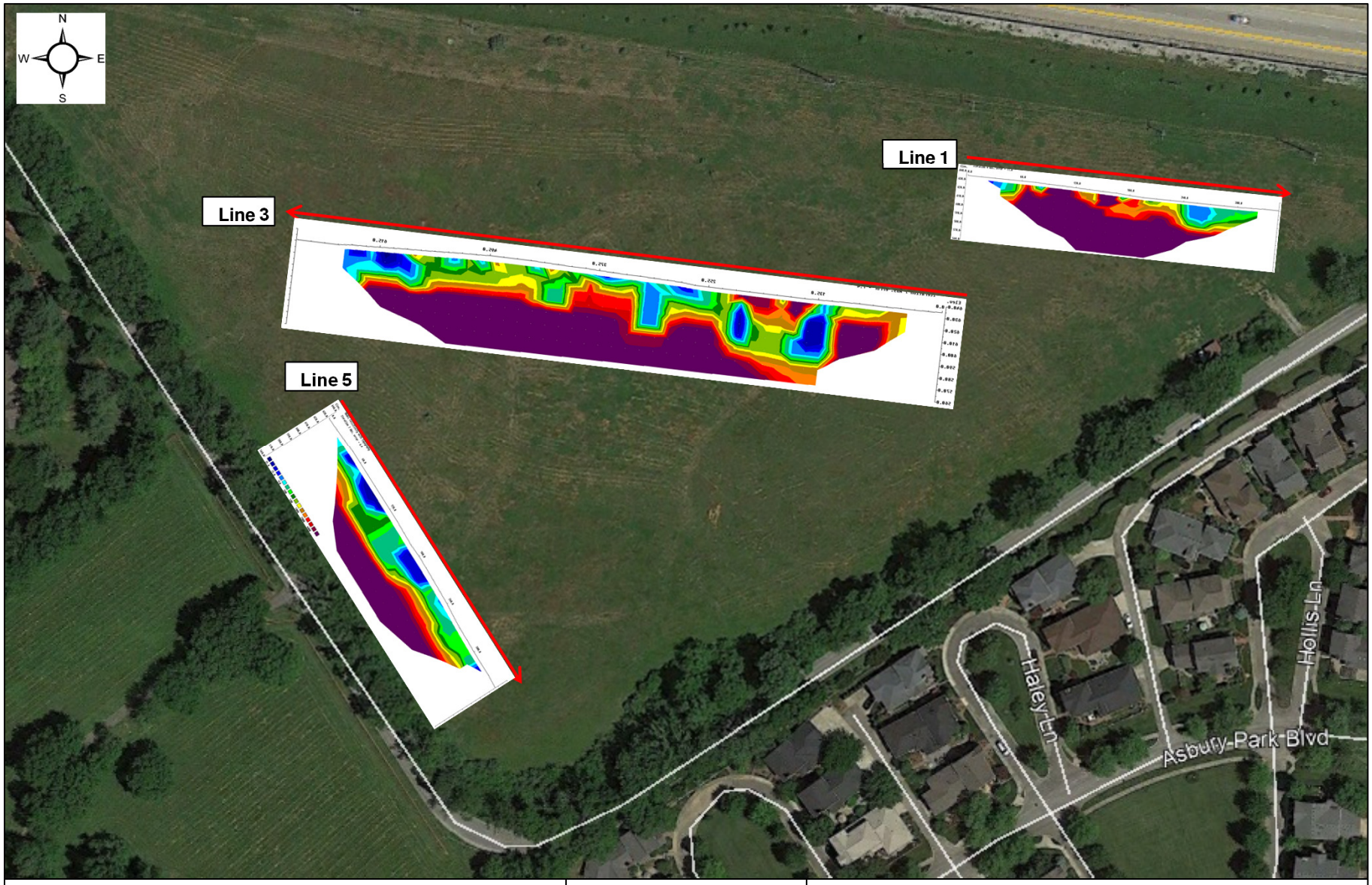

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ER Lines

Springdale Road
Louisville, Kentucky
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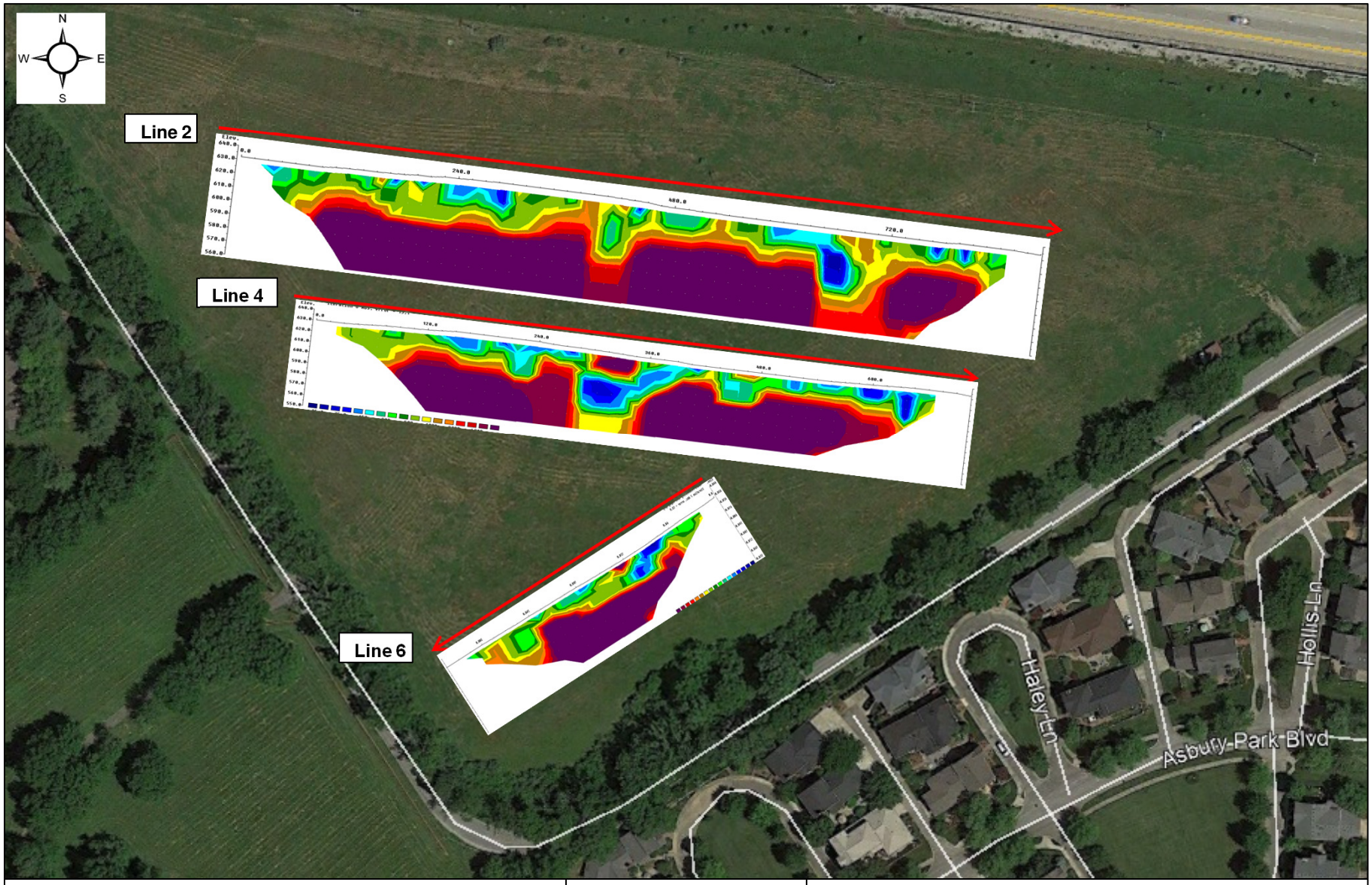

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ER Lines

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Louisville, Kentucky
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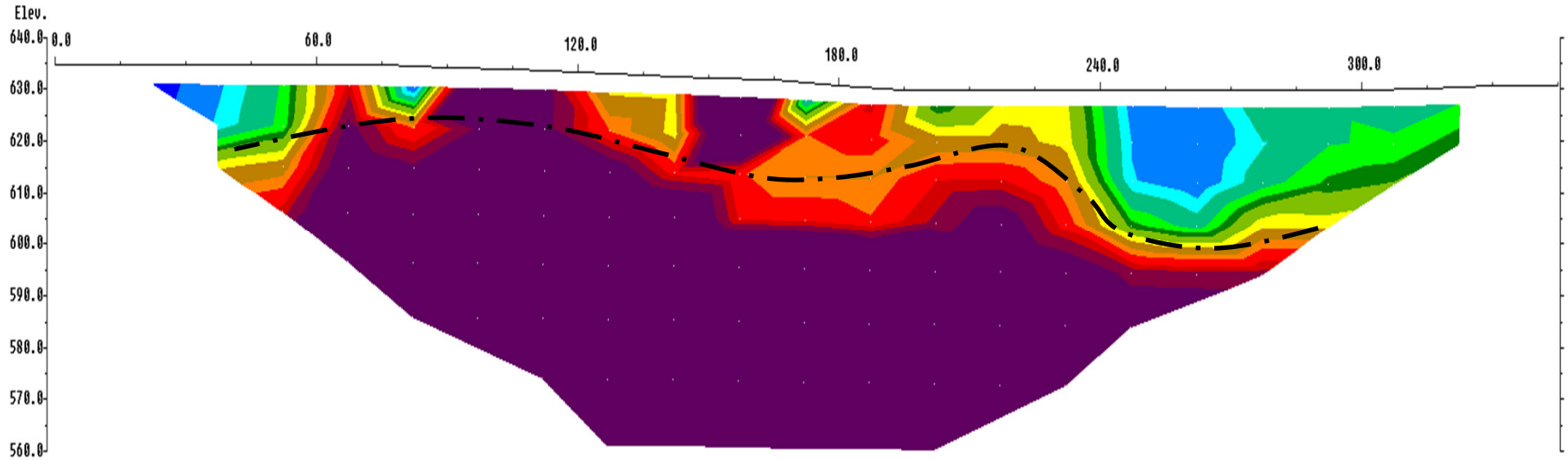
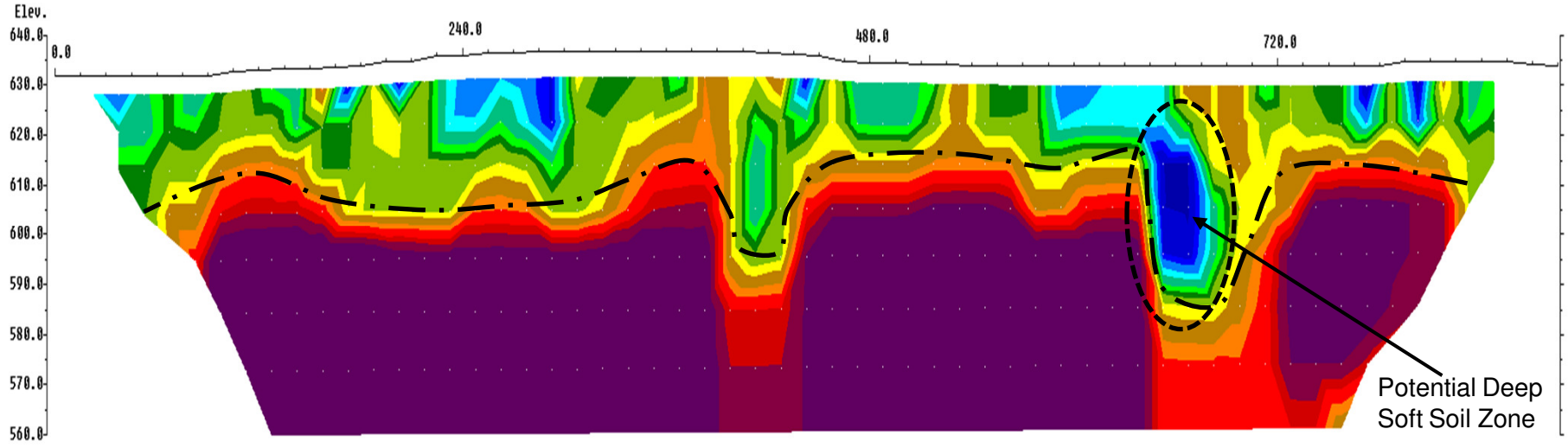
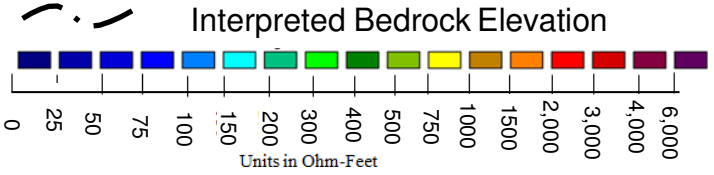


Line 1 ER Survey Results (East is to the Left)



Line 2 ER Survey Results (West is to the Left)



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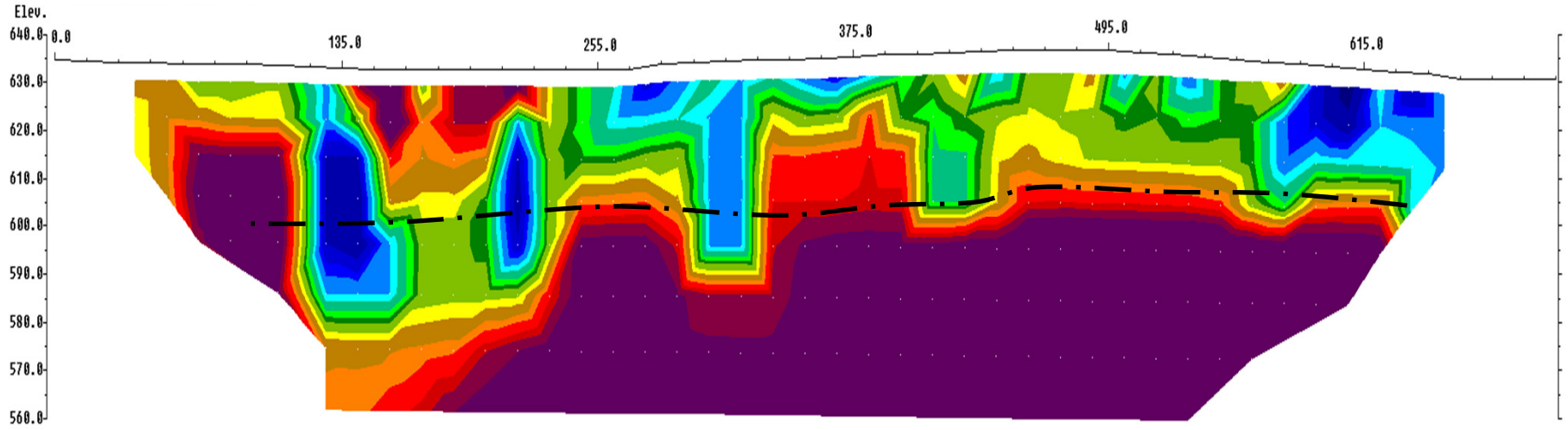

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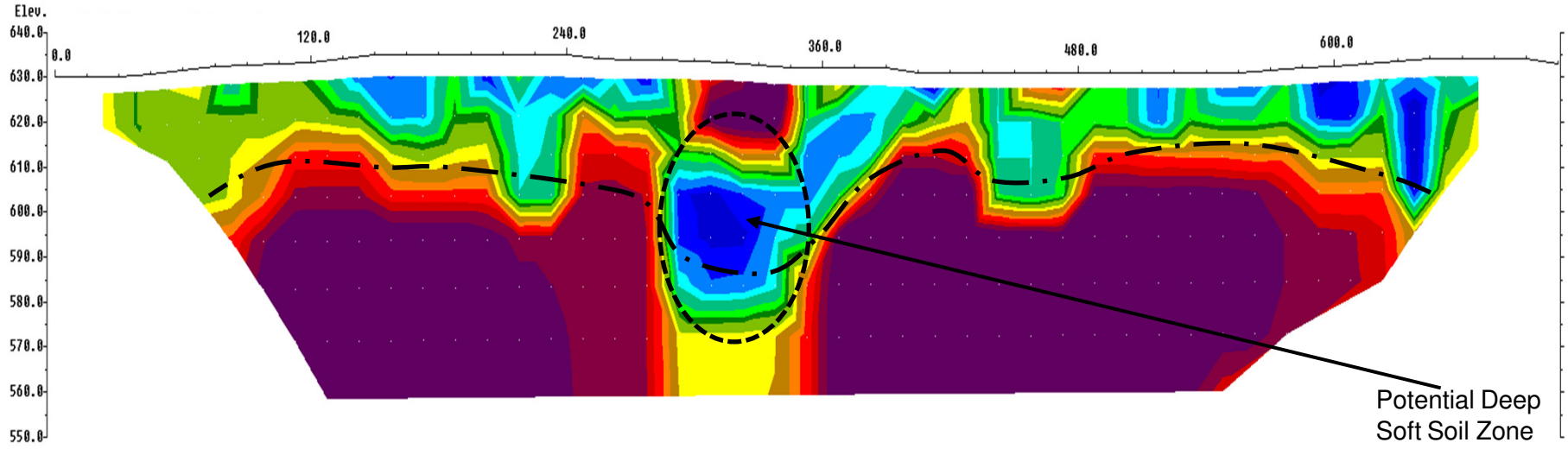
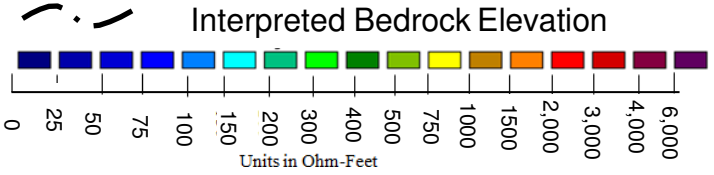


Line 4 ER Survey Results (West is to the Left)



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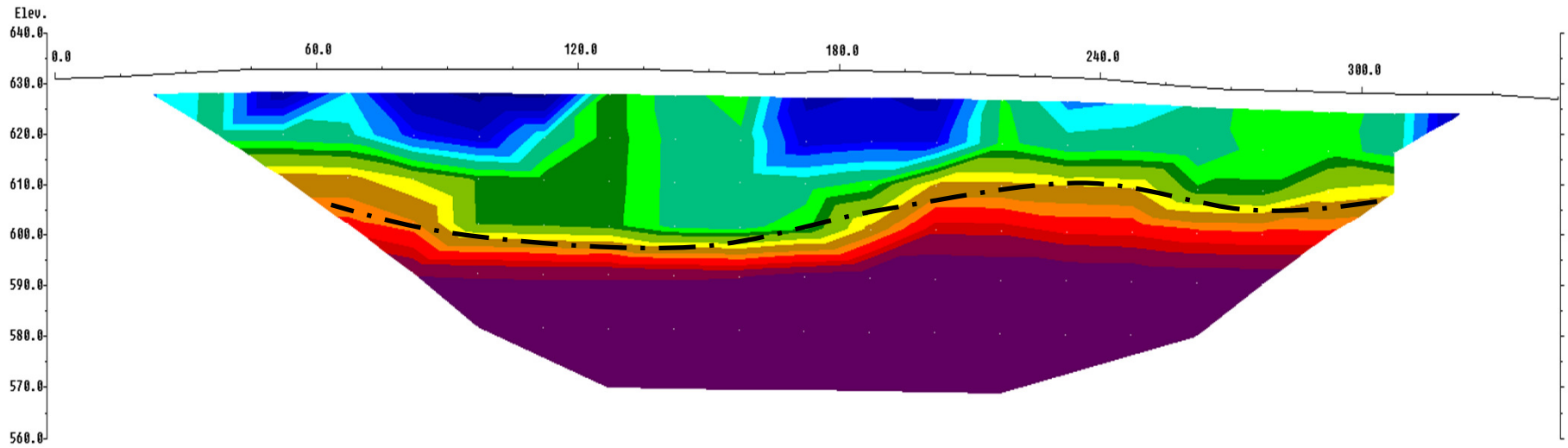
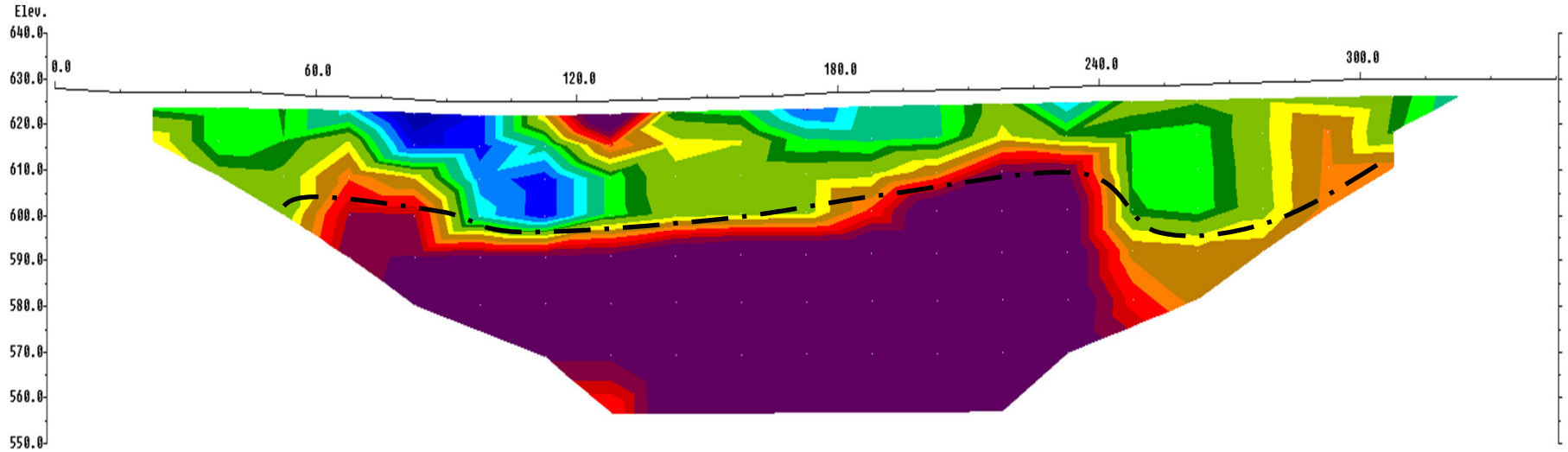
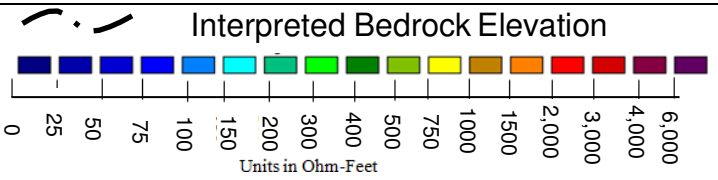


Line 5 ER Survey Results (Northwest is to the Left)



Line 6 ER Survey Results (Northeast is to the Left)



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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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